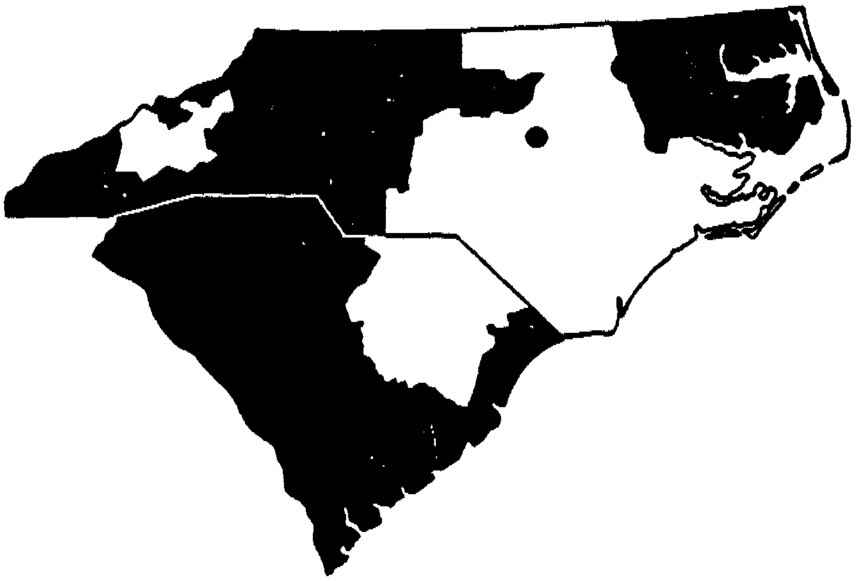
COPY NO: 3

ASSIGNED TO: C. S. Bohanan

Vol. 1

Shearon Harris Nuclear Power Plant Units 1, 2, 3 & 4



Environmental Report Operating License Stage

Carolina Power & Light Company

DOCUMENT AMENDMENT RECORD SHEET

Keep this page in the General Information Section in Volume 1 of the ER. Record the entry of amendments on this sheet as they are inserted. This will then serve as a record of the completeness of this ER.

Amendment No./Date Issued	Date Amendment Entered	Initials
No. 1 / January 29, 1982	2/12/82	SB
No. 2 / March 31, 1982	5/18/82	PK
No. 3 / June 30, 1982	7/29/82	PK
No. 4 / October 15, 1982	11/11/82	PK
No. 5 / December 15, 1982	12/21/82	PK
No. 6		
No. 7		
No. 8		
No. 9		
No. 10		
No. 11		
No. 12		
No. 13		
No. 14		
No. 15		
No. 16		
No. 17		
No. 18		
No. 19		
No. 20		

CP&L
Carolina Power & Light Company

January 29, 1982

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

SHEARON HARRIS NUCLEAR POWER PLANT
UNIT NOS. 1 AND 2
DOCKET NOS. 50-400 AND 50-401
<u>ENVIRONMENTAL REPORT AMENDMENT NO. 1</u>

Dear Mr. Denton:

Carolina Power & Light Company (CP&L) hereby transmits three (3) originals and forty-one (41) copies of Amendment No. 1 to the Shearon Harris Nuclear Power Plant Environmental Report (ER). Amendment No. 1 consists of new or revised technical information and editorial changes. Each page which has been revised bears the amendment number. Changes in technical material only have been indicated by placement of a vertical bar in the margin of the affected page adjacent to the change. Instructions for entering the revised pages in the ER are included in this Amendment.

As required by Commission Regulations, this Amendment is signed under oath by a duly authorized officer of CP&L.

Yours very truly,

P. W. Howe

P. W. Howe
Vice President
Technical Services

ONH/lr (0570)

Attachment

cc: Mr. E. A. Licitra (w/o att.)
Mr. J. P. O'Reilly (w/o att.)

Sworn to and subscribed before me this 29th day of January, 1982

Franklin Murray
Notary Public

My commission expires: Oct. 4, 1986

FRANKLIN MURRAY

411 Fayetteville Street • P. O. Box 1551 • Raleigh, N. C. 27602

SHEARON HARRIS NUCLEAR POWER PLANT

UNIT NOS. 1 & 2

ENVIRONMENTAL REPORT

AMENDMENT NO. 1

JANUARY 29, 1982

CAROLINA POWER & LIGHT COMPANY
SHEARON HARRIS NUCLEAR POWER PLANT
DOCKET NOS. 50-400 AND 50-401
ENVIRONMENTAL REPORT
INSTRUCTION SHEET

This amendment contains additional or revised technical information and editorial changes in the form of replacement pages for the SHNPP ER. Each revised page bears the notation "Amendment No. 1" at the page bottom. Vertical bars with the number "1" beside them have been placed in the margins of revised pages to indicate the location of technical revisions on the page. Minor editorial changes to the page which do not alter technical content have not been marked by amendment bars in most cases.

Since many SHNPP ER pages are printed double-sided, the replacement pages in this amendment will occasionally consist of original information on one side of the page and revised information on the other side. Reference to the amendment identification number in the lower right corner of the page will enable the user to determine the amendment status of the page (whether it is original or revised material). Unchanged material located on the reverse side of a revised page will not contain an amendment identification number or amendment bars.

The following page removals and insertions should be made to incorporate Amendment No. 1 into the ER:

REMOVE EXISTING PAGES	INSERT REPLACEMENT PAGES
CHAPTER 2	CHAPTER 2
2.1.1-1 / 2.1.1-2	2.1.1-1 / 2.1.1-2
2.1.2-1 / 2.1.2-2	2.1.2-1 / 2.1.2-2
2.1.2-3	2.1.2-3
2.1.2-4	2.1.2-4
2.1.2-5	2.1.2-5
2.1.2-6	2.1.2-6
2.1.2-7	2.1.2-7
-	2.1.2-8
-	2.1.2-9
-	2.1.2-10
-	2.1.2-11
-	2.1.2-12
-	2.1.2-13
-	2.1.2-14
-	2.1.2-15
-	2.1.2-16
-	2.1.2-17
-	2.1.2-18
-	2.1.2-19
-	2.1.2-20

REMOVE EXISTING PAGES	INSERT REPLACEMENT PAGES
-	2.1.2-21
-	2.1.2-22
-	2.1.2-23
-	2.1.2-24
-	2.1.2-25
2.1.3-1 / 2.1.3-2	2.1.3-1 / 2.1.3-2
2.1.3-3	2.1.3-3
2.1.3-5	2.1.3-5
2.1.3-6	2.1.3-6
2.1.3-7	2.1.3-7
-	2.1.3-8
-	2.1.3-9
-	2.1.3-10
-	2.1.3-11
-	2.1.3-12
-	2.1.3-13
-	2.1.3-14
-	2.1.3-15
-	2.1.3-16 do not have
-	2.1.3-17
-	2.1.3-18
-	2.1.3-19
-	2.1.3-20
-	2.1.3-21
-	2.1.3-22
REFERENCES SECTION 2.1	REFERENCES SECTION 2.1
Page Containing References:	Page Containing References:
2.1.2-1 through 2.1.3-5	2.1.2-1 through 2.1.3-5
2.2.0-1	2.2.0-1
2.2.1-1 / 2.2.1-2	2.2.1-1 / 2.2.1-2
2.2.1-3 / 2.2.1-4	2.2.1-3 / 2.2.1-4
-	2.2.1-5
2.2.2-1 / 2.2.2-2	2.2.2-1 / 2.2.2-2
2.2.2-3 / 2.2.2-4	2.2.2-3 / 2.2.2-4
2.2.2-5 / 2.2.2-6	2.2.2-5 / 2.2.2-6
2.2.2-7	2.2.2-7
2.2.2-9	2.2.2-9
2.2.2-10	2.2.2-10
2.2.2-11	2.2.2-11
2.2.3-1 / 2.2.3-2	2.2.3-1 / 2.2.3-2
REFERENCES SECTION 2.2	REFERENCES SECTION 2.2
Page Containing References:	Page Containing References:
2.2.0-1 through 2.2.0-12	2.2.0-1 through 2.2.0-13

REMOVE EXISTING PAGES	INSERT REPLACEMENT PAGES
REFERENCES SECTION 2.2 Page Containing References: 2.2.0-13 through 2.2.3-5	REFERENCES SECTION 2.2 Page Containing References: 2.2.3-1 through 2.2.3-5
2.4.2-36	2.4.2-36
2.4.2-37	2.4.2-37
2.4.2-38	2.4.2-38
2.4.2-39	2.4.2-39 — do not have
2.4.2-40	2.4.2-40
2.4.2-41	2.4.2-41
2.4.2-42	2.4.2-42
2.4.2-43	2.4.2-43
2.4.2-44	2.4.2-44
2.4.2-45	2.4.2-45
2.6-1	2.6-1
REFERENCES SECTION 2.6 Page Containing References: 2.6-1 through 2.6-7	REFERENCES SECTION 2.6 Page Containing References: 2.6-1 through 2.6-7
CHAPTER 4	CHAPTER 4
4.1-1 / 4.1-2	4.1-1 / 4.1-2
4.1-3 / 4.1.4	4.1-3 / 4.1-4
4.1-8	4.1-8
4.3-1	4.3-1
CHAPTER 5	CHAPTER 5
5.1.3-1 / 5.1.3-2	5.1.3-1 / 5.1-3-2
5.1.3-6	5.1.3-6
5.1.3-7	5.1.3-7
REFERENCES SECTION 5.1 Page Including References: 5.1.2-1 through 5.1.3-8	REFERENCES SECTION 5.1 Page Including References: 5.1.2-1 through 5.1.3-8
5.3-1 / 5.3-2	5.3-1 / 5.3-2
- - -	REFERENCES SECTION 5.3 Page Containing References: 5.3.3-1 through 5.3.3-3

REMOVE EXISTING PAGES	INSERT REPLACEMENT PAGES
CHAPTER 6	CHAPTER 6
6.1.4-3	6.1.4-3
REFERENCES SECTION 6.1 Page Containing References: 6.1.1-1 through 6.1.4-1	REFERENCES SECTION 6.1 Page Containing References: 6.1.1-1 through 6.1.4-1
REFERENCES SECTION 6.1 Page Containing References: 6.1.4-2 through 6.1.5-5	REFERENCES SECTION 6.1 Page Containing References: 6.1.4-2 through 6.1.5-4
REFERENCES SECTION 6.1 Page Containing References: 6.1.5-6 through 6.1.5-9	REFERENCES SECTION 6.1 Page Containing References: 6.1.5-5 through 6.1.5-9
6.3-1	6.3-1
REFERENCES SECTION 6.3 Page Containing References: 6.3-1 through 6.3-4	REFERENCES 6.3 Page Containing References: 6.3-1 through 6.3-4
CHAPTER 8	CHAPTER 8
8.2.2-1 / 8.2.2-2 8.2.2-5 / 8.2.2-6	8.2.2-1 / 8.2.2-2 8.2.2-5 / 8.2.2-6

CP&L
Carolina Power & Light Company

June 30, 1982

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

SHEARON HARRIS NUCLEAR POWER PLANT
UNIT NOS. 1 AND 2
DOCKET NOS. 50-400 AND 50-401
ENVIRONMENTAL REPORT AMENDMENT NO. 3

Dear Mr. Denton:

Carolina Power & Light Company (CP&L) hereby transmits three (3) originals and forty-one (41) copies of Amendment No. 3 to the Shearon Harris Nuclear Power Plant Environmental Report (ER). Amendment No. 3 revises technical information to reflect the cancellation of SHNPP Units 3 and 4 including the cancellation of all 500 kV transmission lines at SHNPP. Editorial changes have also been made. All pages revised by Amendment No. 3 bear the amendment number at the bottom of the page. Only technical changes are marked by vertical bars in the margin of the page. Instructions for entering the revised pages in the ER are included.

As required by Commission Regulations, this Amendment is signed under oath by a duly authorized officer of CP&L.

Yours very truly,

for M. A. McDuffie
Senior Vice President
Engineering & Construction

LJW/cr (108C5T2)
Attachments

cc: Messrs: D. G. Ward (w/o att.)
J. P. O'Reilly (NRC-RII) (w/o att.)

Sworn to and subscribed before me this 30th day of June, 1982.

Franklin Murray
Notary (Seal)

My commission expires: October 4, 1986

FRANKLIN MURRAY
NOTARY PUBLIC
WAKE COUNTY, N. C.

411 Fayetteville Street • P. O. Box 1551 • Raleigh, N. C. 27602

SHEARON HARRIS NUCLEAR POWER PLANT

UNIT NOS. 1 & 2

ENVIRONMENTAL REPORT

AMENDMENT NO. 3

JUNE 30, 1982

REMOVE EXISTING PAGES	INSERT REPLACEMENT PAGES
CHAPTER 1	CHAPTER 1
1-i	1-i / 1-ii
1-ii	1-iii
1-iii	-
1.1-3 / 1.1-4	1.1-3 / 1.1-4
1.1-5 / 1.1-6	1.1-5 / 1.1-6
1.1-8	1.1-8
1.1-10	1.1-10
1.1-11	1.1-11
1.1-12	1.1-12
1.1-14	1.1-14
1.1-16	1.1-16
CHAPTER 2	CHAPTER 2
2-v	2-v
2.1.2-1 / 2.1.2-2	2.1.2-1 / 2.1.2-2
2.6-1	2.6-1
REFERENCES SECTION 2.6	REFERENCES SECTION 2.6
Page Containing References:	Page Containing References:
2.6-1 through 2.6-7	2.6-1 through 2.6-3
CHAPTER 3	CHAPTER 3
3-vi	3-vi
3-vii	3-vii
3-xi	3-xi
3-xiv	3-xiv
3.9-1 / 3.9-2	3.9-1 / 3.9-2
-	3.9-3
Figure 3.9.0-1	Figure 3.9.0-1
-	through
-	Figure 3.9.0-4
Figure 3.9.1-1	-
Figure 3.9.2-1	-
CHAPTER 4	CHAPTER 4
4-i	4-i
4-ii	4-ii
4.2-1 / 4.2-2	4.2-1
4.2-3 / 4.2-4	-
-	Appendix 4.2A Tab (inserted directly after 4.2 References)

REMOVE EXISTING PAGES	INSERT REPLACEMENT PAGES
CHAPTER 5	CHAPTER 5
5-ii	5-ii
5-iii	5-iii
5.5-1	5.5-1
CHAPTER 6	CHAPTER 6
6.1.3-5 / 6.1.3-6	6.1.3-5 / 6.1.3-6
CHAPTER 10	CHAPTER 10
10-i	10-i
10-ii	10-ii
10.9-1 / 10.9-2	10.9-1 / 10.9-2
10.9-3	-
REFERENCES SECTION 10.9 Page Containing Reference: 10.9.3-1	-
Figure 10.9.2-1	-
CHAPTER 12	CHAPTER 12
12.0-1 / 12.0-2	12.0-1 / 12.0-2
12.0-8	12.0-8
12.0-9	12.0-9
APPENDIX C	APPENDIX C
Cover Sheet Appendix B Environmental Technical Specifications (Nonradiological)	Cover Sheet Appendix B Environmental Technical Specifications (Nonradiological)
C-i	C-i
C-1	C-1

CP&L

Carolina Power & Light Company

October 15, 1982

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

SHEARON HARRIS NUCLEAR POWER PLANT
UNIT NOS. 1 AND 2
DOCKET NOS. 50-400 AND 50-401
ENVIRONMENTAL REPORT AMENDMENT NO. 4

Dear Mr. Denton:

Carolina Power & Light Company (CP&L) hereby transmits three (3) originals and forty-one (41) copies of Amendment No. 4 to the Shearon Harris Nuclear Power Plant Environmental Report (ER). Amendment No. 4 consists of new or revised technical information and editorial changes. A summary of the changes included in this amendment is provided in Attachment 1. Each page which has been revised bears the amendment number. Changes in technical material only have been indicated by placement of a vertical bar in the margin of the affected page adjacent to the change. Instructions for entering the revised pages in the ER are included in this Amendment.

As required by Commission Regulations, this Amendment is signed under oath by a duly authorized officer of CP&L.

Yours very truly,

M. A. McDuffie

M. A. McDuffie
Senior Vice President
Engineering & Construction

LJW/lr (5520C4T4)
Attachment

cc: Mr. Prasad Kadambi (NRC)
Mr. G. F. Maxwell (NRC-SHNPP)
Mr. J. P. O'Reilly (NRC-RII)
Mr. Daniel F. Read (CHANGE/ELP)
Mr. Travis Payne (KUDZU)

Sworn to and subscribed before me this 15th day of [illegible]

Notary (Seal)

My commission expires: My Commission Expires 6-8-86

411 Fayetteville Street • P. O. Box 1551 • Raleigh, N. C. 27602

CAROLINA POWER & LIGHT COMPANY
SHEARON HARRIS NUCLEAR POWER PLANT
DOCKET NOS. 50-400 AND 50-401
ENVIRONMENTAL REPORT - AMENDMENT NO. 4
INSTRUCTION SHEET

This amendment contains additional or revised technical information and editorial changes in the form of replacement pages for the SHNPP ER. Each revised page bears the notation "Amendment No. 4" at the page bottom. Vertical bars with the number "4" beside them have been placed in the margins of revised pages to indicate the location of technical revisions on the page. Minor editorial changes to the page which do not alter technical content have not been marked by amendment bars in most cases.

Since many SHNPP ER pages are printed double-sided, the replacement pages in this amendment will occasionally consist of original information on one side of the page and revised information on the other side. Reference to the amendment identification number in the lower right corner of the page will enable the user to determine the amendment status of the page (whether it is original or revised material). Unchanged material located on the reverse side of a revised page will not contain an amendment identification number or amendment bars unless it was revised in an earlier amendment.

The following page removals and insertions should be made to incorporate Amendment No. 4 into the ER:

REMOVE EXISTING PAGES	INSERT REPLACEMENT PAGES
VOLUME 1	VOLUME 1
General Table of Contents	General Table of Contents
i / ii ✓	i / ii
List of Tables	List of Tables
xiii / xiv	xiii / xiv
xv / xvi	xv / xvi
xvii / xviii	xvii / xviii
xix / xx	xix / xx
xxi / xxii	xxi / xxii
xxiii / xxiv	xxiii / xxiv
xxv / xxvi	xxv / xxvi
xxvii/ xxviii	xxvii / xxviii
xxix / xxx	xxix / xxx
List of Figures	List of Figures
xxxi / xxxii	xxxi / xxxii
xxxiii / xxxiv	xxxiii / xxxiv
xxxv / xxxvi	xxxv / xxxvi

REMOVE EXISTING PAGES	INSERT REPLACEMENT PAGES
xxxvii / xxxviii	xxxvii / xxxviii
xxxix / xl	xxxix / xl
xli / xlii	xli
-	xlii / xliii
CHAPTER 1	CHAPTER 1
1-i / 1-ii	1-i / 1-ii
1-iii	1-iii
1.1-1 / 1.1-2 THROUGH 1.1-39	1.1-1 / 1.1-2
FIGURE 1.1.1-1 THROUGH FIGURE 1.1.2-3	1.1-3

DO NOT REMOVE FIGURE 1.1-1

TAB - 1.1A COVER SHEET FOR APPENDIX 1.1A 1.1A-1 / 1.1A-2 1.1A-3 / 1.1A-4	1.1-4
CHAPTER 2	CHAPTER 2
2-ii	2-ii
2-iii	2-iii
2-iv	2-iv
2-v	2-v
2-vi ✓	2-vi ✓
2-xi	2-xi
2-xii	2-xii
2-xiii	2-xiii
2-xiv	2-xiv
2-xv	2-xv
2-xvi	2-xvi
2-xvii	2-xvii
-	2-xviii
-	2-xix
2.1.2-1 / 2.1.2-2	2.1.2-1 / 2.1.2-2
-	2.1.2-2a
2.1.2-20	2.1.2-20
-	2.1.2-26

REMOVE EXISTING PAGES	INSERT REPLACEMENT PAGES
2.1.3-1 / 2.1.3-2	2.1.3-1 / 2.1.3-2
2.1.3-3	2.1.3-3
2.1.3-4	2.1.3-4
-	2.1.3-23
-	2.1.3-24
REFERENCES SECTION 2.1 Page Containing References: 2.1.2-1 through 2.1.3-5	REFERENCES SECTION 2.1 Page Containing References: 2.1.2-1 through 2.1.3-8
-	REFERENCES SECTION 2.1 Page Containing References: 2.1.3-9 through 2.1.3-10
2.2.0-1	2.2.0-1
2.2.3-1 / 2.2.3-2	2.2.3-1 / 2.2.3-2
2.4.1-1	2.4.1-1
2.4.1-2	2.4.1-2
2.4.2-1 / 2.4.2-2	2.4.2-1 / 2.4.2-2
2.4.2-3 / 2.4.2-4	2.4.2-3 / 2.4.2-4
2.4.2-5 / 2.4.2-6	2.4.2-5 / 2.4.2-6
2.4.2-7 / 2.4.2-8	2.4.2-7 / 2.4.2-8
2.4.2-9 / 2.4.2-10	2.4.2-9 / 2.4.2-10
2.4.2-11 / 2.4.2-12	2.4.2-11 / 2.4.2-12
2.4.2-13 / 2.4.2-14	2.4.2-13 / 2.4.2-14
2.4.2-15 / 2.4.2-16	2.4.2-15 / 2.4.2-16
2.4.2-17 / 2.4.2-18	2.4.2-17 / 2.4.2-18
2.4.2-19	2.4.2-19 / 2.4.2-19a
-	2.4.2-19b / 2.4.2-19c
-	2.4.2-19d / 2.4.2-19e
-	2.4.2-19f / 2.4.2-19g
-	2.4.2-19h
2.4.2-21	2.4.2-21
2.4.2-22	2.4.2-22
2.4.2-24	2.4.2-24
2.4.2-27	2.4.2-27
2.4.2-28	2.4.2-28
2.4.2-29	2.4.2-29
2.4.2-30	2.4.2-30
2.4.2-31	2.4.2-31
2.4.2-49	2.4.2-49
-	2.4.2-49a
2.4.2-51	2.4.2-51
2.4.2-59	2.4.2-59
2.4.2-60	2.4.2-60

REMOVE EXISTING PAGES	INSERT REPLACEMENT PAGES
-	2.4.2-61
-	2.4.2-62
-	2.4.2-63
-	2.4.2-64
-	2.4.2-65
-	2.4.2-66
2.4.3-1 / 2.4.3-2	2.4.3-1 / 2.4.3-2
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2.4.3-8	2.4.3-8
2.4.3-9	2.4.3-9
2.4.3-10	2.4.3-10
2.4.3-12	2.4.3-12
2.4.4-1	2.4.4-1 / 2.4.4-1a
2.4.5-1	2.4.5-1 / 2.4.5-1a
REFERENCES SECTION 2.4 Page Containing References: 2.4.2-1 through 2.4.2-13	REFERENCES SECTION 2.4 Page Containing References: 2.4.2-1 through 2.4.2-13
REFERENCES SECTION 2.4 Page Containing References: 2.4.3-1 through 2.4.3-6	REFERENCES SECTION 2.4 Page Containing References: 2.4.2-14 through 2.4.4-2
FIGURE 2.4.1-1	FIGURE 2.4.1-1
FIGURE 2.4.1-5	FIGURE 2.4.1-5
FIGURE 2.4.2-9	FIGURE 2.4.2-9
-	FIGURE 2.4.2-9a
-	FIGURE 2.4.2-9b
-	FIGURE 2.4.2-10a
-	FIGURE 2.4.2-10b
-	FIGURE 2.4.2-10c
-	FIGURE 2.4.2-11a
-	FIGURE 2.4.2-11b
-	FIGURE 2.4.2-12a
-	FIGURE 2.4.2-13a
-	FIGURE 2.4.2-14a
FIGURE 2.4.2-15	FIGURE 2.4.2-15
FIGURE 2.4.2-38	FIGURE 2.4.2-38
-	FIGURE 2.4.2-39
-	FIGURE 2.4.2-40
-	FIGURE 2.4.2-41
-	FIGURE 2.4.2-42

REMOVE EXISTING PAGES	INSERT REPLACEMENT PAGES
FIGURE 2.4.3-4	FIGURE 2.4.3-4
-	FIGURE 2.4.3-7
-	FIGURE 2.4.3-8
-	FIGURE 2.4.3-9
-	FIGURE 2.4.3-10
-	FIGURE 2.4.3-11
CHAPTER 3	CHAPTER 3
3-viii	3-viii
3-xii	3-xii
3.2-2	3.2-2
3.3-1 / 3.3-2	3.3-1 / 3.3-2
3.3-3 / 3.3-4	3.3-3
-	3.3-4
3.3-5	3.3-5
3.3-6	-
3.3-7	-
3.4.2-1 / 3.4.2-2	3.4.2-1 / 3.4.2-2
3.4.2-3 / 3.4.2-4	3.4.2-3 / 3.4.2-4
-	3.4.2-4a
3.4.2-5 / 3.4.2-6	3.4.2-5 / 3.4.2-6
3.4.2-7 / 3.4.2-8	3.4.2-7 / 3.4.2-8
3.4.2-9 / 3.4.2-10	3.4.2-9 / 3.4.2-10
3.4.2-12	3.4.2-12
3.4.2-13	3.4.2-13
-	3.4.2-14
3.4.3-1 / 3.4.3-2	3.4.3-1 / 3.4.3-2
3.4.4-1	3.4.4-1
3.4.5-1	3.4.5-1
FIGURE 3.4.2-3	FIGURE 3.4.2-3
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CP&L

Carolina Power & Light Company

December 15, 1982

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

SHEARON HARRIS NUCLEAR POWER PLANT
UNIT NOS. 1 AND 2
DOCKET NOS. 50-400 AND 50-401
ENVIRONMENTAL REPORT AMENDMENT NO. 5

Dear Mr. Denton:

Carolina Power & Light Company (CP&L) hereby transmits three (3) originals and forty-one (41) copies of Amendment No. 5 to the Shearon Harris Nuclear Power Plant Environmental Report (ER). Amendment No. 5 consists of new or revised technical information and editorial changes. A summary is included as Attachment 1. Each revised page bears the amendment number. Changes in technical material have been indicated by placement of a vertical bar in the margin of the affected page adjacent to the change. Instructions for entering the revised pages in the ER are included.

As required by Commission Regulations, this Amendment is signed under oath by a duly authorized officer of CP&L.

Yours very truly,

M. A. McDuffie
Senior Vice President
Engineering & Construction

LJW/pgp (5520P1T2)
Attachment

cc: Mr. N. Prasad Kadambi (NRC)
Mr. G. F. Maxwell (NRC-SHNPP)
Mr. J. P. O'Reilly (NRC-RII)
Mr. Daniel F. Read (CHANGE/ELP)
Mr. Travis Payne (KUDZU)
Chapel Hill Public Library
Wake County Public Library
Mr. Wells Eddleman (w/o attachment)
Dr. Phyllis Lotchin (w/o attachment)
Ms. Patricia T. Newman (w/o attachment)
Mr. John D. Runkle (w/o attachment)
Dr. Richard D. Wilson (w/o attachment)

Sworn to and subscribed before me this 15th day of December, 1982

Franklin Murray
Notary (Seal)

My commission expires: OCT 04 1986

FRANKLIN MURRAY

ATTACHMENT 1

SUMMARY OF MAJOR REVISIONS IN AMENDMENT NO 5

1.	Chapter 2	Typographic errors. Editorial changes to clarify meaning. Addition of information on sedimentation in Main Reservoir due to Cape Fear River makeup.
2.	Chapter 3 and Appendix A	Deletion of redundant design information on radwaste systems. This information is already provided in detail in SHNPP FSAR. Appropriate references to the SHNPP FSAR have been included. Minor revisions in technical content as indicated.
3.	Chapters 8, 9, and 11	Revisions to cost/benefit analysis. New analysis addresses operating cost and benefits of SHNPP only. These changes are in response to the Commission's amendments to 10 CFR Part 51, effective April 26, 1982, which provided that "need for power" and "alternative energy sources" need not be considered in operating license proceedings for nuclear power plants. 47 Fed. Reg. 12940 (March 26, 1982). Revisions incorporate commitments discussed in "Applicants Response to Supplement to Petition to Intervene by Wells Eddleman," June 15, 1982.
	Appendix B	Final NPDES Permit

Other revisions include corrections of typographical errors and minor technical or editorial changes as indicated.

(5867C5T1)

SHEARON HARRIS NUCLEAR POWER PLANT

UNIT NOS. 1 & 2

ENVIRONMENTAL REPORT

AMENDMENT NO. 5

DECEMBER 15, 1982

CAROLINA POWER & LIGHT COMPANY
SHEARON HARRIS NUCLEAR POWER PLANT
DOCKET NOS. 50-400 AND 50-401
ENVIRONMENTAL REPORT - AMENDMENT NO. 5
INSTRUCTION SHEET

This amendment contains additional or revised technical information and editorial changes in the form of replacement pages for the SHNPP ER. Each revised page bears the notation "Amendment No. 5" at the page bottom. Vertical bars with the number "5" beside them have been placed in the margins of revised pages to indicate the location of technical revisions on the page. Minor editorial changes to the page which do not alter technical content have not been marked by amendment bars in most cases.

Since many SHNPP ER pages are printed double-sided, the replacement pages in this amendment will occasionally consist of original information on one side of the page and revised information on the other side. Reference to the amendment identification number in the lower right corner of the page will enable the user to determine the amendment status of the page (whether it is original or revised material). Unchanged material located on the reverse side of a revised page will not contain an amendment identification number or amendment bars unless it was revised in an earlier amendment.

The following page removals and insertions should be made to incorporate Amendment No. 5 into the ER:

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CAROLINA POWER AND LIGHT COMPANY
SHEARON HARRIS NUCLEAR POWER PLANT
UNITS 1 AND 2

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ENVIRONMENTAL REPORT - OPERATING LICENSE STAGE
LIST OF ABBREVIATIONS

ac.	acre
acs.	acres
Btu	British thermal unit
C	concentration
cfm	cubic feet per minute
cfs	cubic feet per second
db	decibel
dbT	dry bulb Temperature
F	degrees Fahrenheit
fps	feet per second
ft.	feet
gal.	gallon
gpd	gallons per day
gpm	gallons per minute
gpy	gallons per year
hr.	hour
in.	inches
Kg	kilogram
Kw-Hr	kilowatt-hour
kW	kilowatt
m	meter
m3	cubic meter
mbar	barometric pressure
MGD	million gallons per day
MGM	million gallons per month
mi.	mile
MPC	Maximum Permissable Concentration
MWe	Megawatt (electric)
MwH	megawatt hour
MWt	Megawatt (thermal)
ppm	parts per million
psi	pounds per square inch
psia	pounds per square inch (absolute)
psig	pounds per square inch (gage)
rpm	revolutions per minute
yd.3	cubic yard

ENVIRONMENTAL REPORT - OPERATING LICENSE STAGE
LIST OF ABBREVIATIONS

AEC	Atomic Energy Commission
BOD	Biological Oxygen Demand
CCWS	Component Cooling Water System
CNR	Composite Noise Rating
CP&L	Carolina Power & Light Company
CPER	Construction Permit Environmental Report
CPLF	coincident peak load factors
CST	condensate storage tank
CVCS	Chemical & Volume Control System
CWS	Circulating Water System
DEM	N. C. Division of Environmental Management
DOT	Department of Transportation
EMC	N. C. Environmental Management Commission
EPA	Environmental Protection Agency
ER	Environmental Report
ESWS	Emergency Service Water System
FAA	Federal Aviation Administration
FDS	Floor Drain System
FERC	Federal Energy Regulatory Commission
FPC	Federal Power Commission
GMT	Greenwich Meridian Time
HUD	Housing & Urban Development
HVAC	heating, ventilating, and air conditioning
HX	Heat Exchangers
LLD	Lower Limits of Detection
MCNR	Modified Composite Noise Rating
MDC	minimum detectable concentration
msl	mean sea level
NCAC	N. C. Administrative Code
NCDNRCD	N. C. Department of Natural Resources & Community Development
NPDES	National Pollutant Discharge Elimination System
NPSH	net positive suction head
NRC	Nuclear Regulatory Commission
NSSS	Nuclear Steam Supply System
ODCM	Offsite Dose Calculation Manual
PMF	probable maximum flood
PMH	probable maximum hurricane
PMP	probable maximum precipitation
RHR	residual heat removal
RL	Research Laboratories
RMS	Radiological Monitoring System
RMWS	reactor makeup water storage
SEPA	Southeastern Power Administration
SERC	Southeastern Electric Reliability Council
SHNPP	Shearon Harris Nuclear Power Plant
ST	Southern Testing
SWS	Service Water System
TLD	thermoluminescent dosimeter
USDA	United States Department of Agriculture
USGS	United States Geological Survey
VACAR	Virginia-Carolinas Subregion
WPB	Waste Processing Building

CHAPTER 1
PURPOSE OF THE PROPOSED FACILITY AND ASSOCIATED TRANSMISSION

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CAROLINA POWER & LIGHT COMPANY
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CAROLINA POWER AND LIGHT COMPANY
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1.0 PURPOSE OF THE PROPOSED FACILITY AND ASSOCIATED TRANSMISSION

1.1 SYSTEM DEMAND AND RELIABILITY

Carolina Power & Light Company (CP&L) is an investor-owned utility serving portions of North and South Carolina. Carolina Power & Light Company provides electric service for a 30,000 square mile area and for approximately 758,000 customers as of December, 1981. A general map of the service area is shown in Figure 1.1-1.

In the 1969-1970 time period, CP&L's peak demand forecasts indicated a need for additional capacity of about 800 MW per year for the years 1977 and 1978 to meet projected peaks and to provide an adequate generating reserve. In December of 1970, CP&L's Board of Directors approved construction of the Shearon Harris Nuclear Power Plant (SHNPP) (initially called White Oak) to be placed in service in 1977 and 1978. Subsequently, the plans for SHNPP were revised to include the construction of four units. Due to lower load growth projections, financial considerations, changing regulatory requirements, and an intensified load management and conservation program, Units 3 and 4 have been cancelled.

In January 1974, CP&L was granted an exemption to do certain site preparation and related activities prior to the issuance of a construction permit. The purpose of SHNPP and associated transmission system including the need for power generated by SHNPP was considered at the construction permit stage. After consideration of pertinent factors, the NRC granted CP&L a construction permit for SHNPP in January, 1978.

The Commission has since amended its regulations in Title 10 of the Code of Federal Regulations, Part 51.21, to provide that, for NEPA purposes, "need for power" issues need not be readdressed in the licensing permit stage and, therefore, need not be addressed in the Environmental Report - Operating License Stage. Chapter 1 of the SHNPP ER-OL is hereby amended to delete these discussions. 4

CHAPTER 1

PAGES 1.1-2 THROUGH 1.1-39
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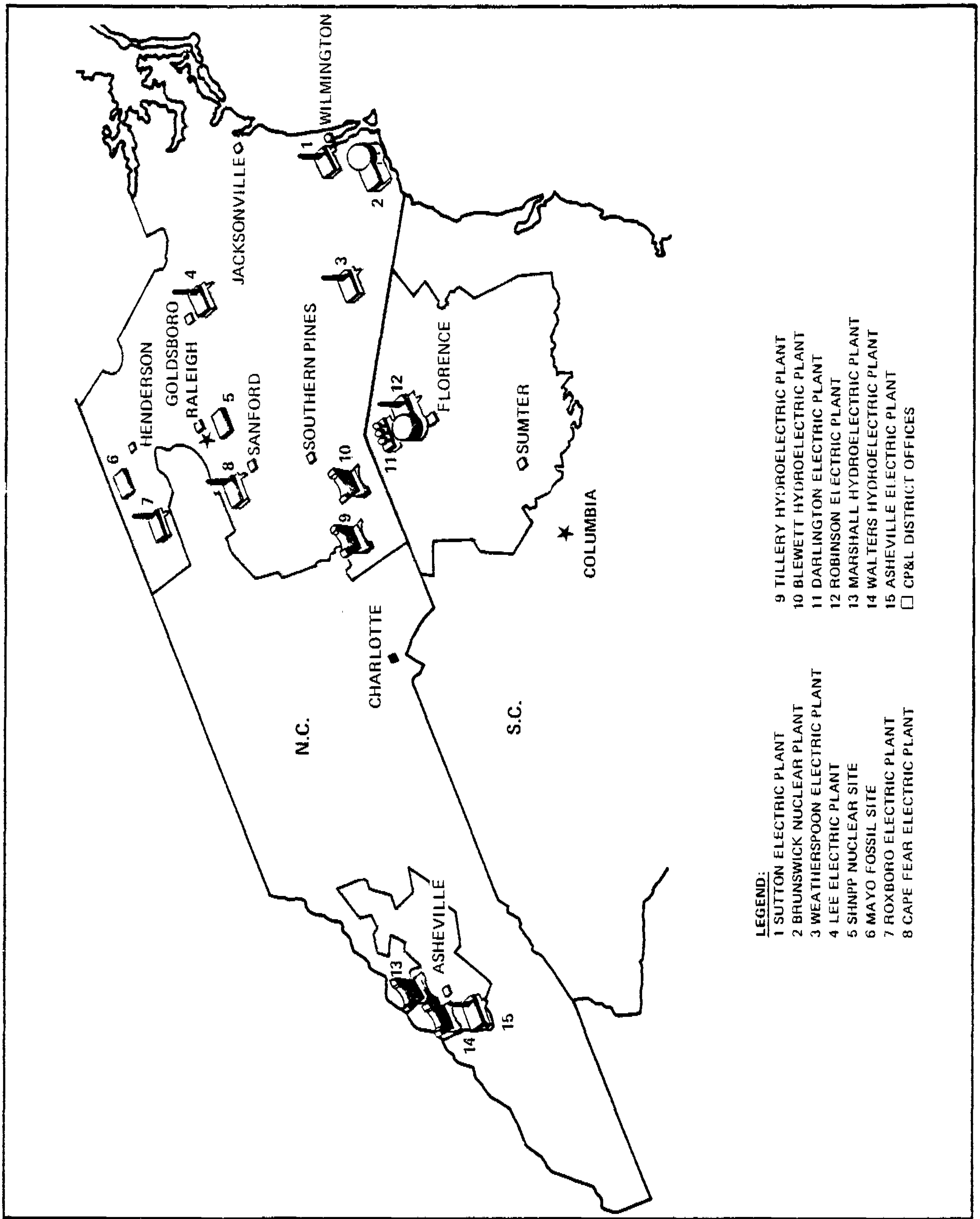

LEGEND:

1 SUTTON ELECTRIC PLANT
2 BRUNSWICK NUCLEAR PLANT
3 WEATHERSPOON ELECTRIC PLANT
4 LEE ELECTRIC PLANT
5 SHNPP NUCLEAR SITE
6 MAYO FOSSIL SITE
7 ROXBORO ELECTRIC PLANT
8 CAPE FEAR ELECTRIC PLANT
9 TILLERY HYDROELECTRIC PLANT
10 BLEWETT HYDROELECTRIC PLANT
11 DARLINGTON ELECTRIC PLANT
12 ROBINSON ELECTRIC PLANT
13 MARSHALL HYDROELECTRIC PLANT
14 WALTERS HYDROELECTRIC PLANT
15 ASHEVILLE ELECTRIC PLANT
☐ CP&L DISTRICT OFFICES

SHEARON HARRIS NUCLEAR POWER PLANT Carolina Power & Light Company ENVIRONMENTAL REPORT	CP&L SERVICE AREA	FIGURE 1.1-1

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FIGURES 1.1.1-1 THROUGH 1.1.2-3
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APPENDIX 1.1A, SECTION 1.2 AND SECTION 1.3
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1.2 OTHER OBJECTIVES

The objective of the SHNPP is to help assure CP&L's ability to provide an adequate and economical supply of electric energy to meet the needs of its customers. There are no other objectives.

1.3 CONSEQUENCES OF DELAY

The impact of delays in the operation of the SHNPP units beyond the current schedule would be serious to CP&L and its customers. The impact would be significant economic penalties and reduced reliability. Tables 1.3-1 and 1.3-2 show reserve margins for the CP&L system and the VACAR Subregion with delays of one, two, and three years of the SHNPP units, and for postponing the project indefinitely. 2

As indicated in Section 1.1.3, delay of the project will place CP&L in a position where reserves will be inadequate for reliable service in several years. This is of particular significance because CP&L and neighboring utilities with which CP&L is interconnected are in similar situations with respect to the prospects of importing large quantities of power. Each utility is confronted with long lead times for construction of generating facilities and the uncertainties of maintaining construction schedules. None of these other companies are installing extra generating capacity in quantities required to allow the selling of power to CP&L on a firm basis in the amounts required if the SHNPP units are not brought into operation in the years 1985-1989 as scheduled. Sufficient transmission interconnection capacity for 2
interchanges of large blocks of power between CP&L and its neighbors is planned under the VACAR agreement for the primary purpose of providing emergency assistance in the event of equipment failure.

TABLE 1.3-1

CP&L RESOURCES LOAD & RESERVES

Delay 1 year both SHNPP units:

Year	Total Power Resouces	Load	Reserves	% Reserves	W/O IC* % Reserves
1985	8883	7363	1520	20.6	6.0
1986	8883	7536	1347	17.9	3.6
1987	9783	7674	2109	27.5	13.4
1988	9783	7863	1920	24.4	10.7
1989	9783	8046	1737	21.6	8.2
1990	10683	8228	2455	29.8	16.7

Delay 2 years both SHNPP units:

Year	Total Power Resources	Load	Reserves	% Reserves	W/O IC* % Reserves
1985	8883	7363	1520	20.6	6.0
1986	8883	7536	1347	17.9	3.6
1987	8883	7674	1209	15.8	1.7
1988	9783	7863	1920	24.4	10.7
1989	9783	8046	1737	21.6	8.2
1990	9783	8228	1555	18.9	5.8
1991	11403	8426	2977	35.3	22.5

2

*IC turbines rated at 1078 MW

TABLE 1.3-1 (CONT'D)

Delay 3 years both SHNPP units:

Year	Total Power Resources	Load	Reserves	% Reserves	W/O IC* % Reserves
1985	8883	7363	1520	20.6	6.0
1986	8883	7536	1347	17.9	3.6
1987	8883	7674	1209	15.8	1.7
1988	8883	7863	1020	13.0	-0.7
1989	9783	8046	1737	21.6	8.2
1990	9783	8228	1555	18.9	5.8
1991	10503	8426	2077	24.6	11.9
1992	11403	8633	2770	32.1	19.6

2

Indefinitely Postpone both SHNPP units:

Year	Total Power Resources	Load	Reserves	% Reserves	W/O IC* % Reserves
1985	8883	7363	1520	20.6	6.0
1986	8883	7536	1347	17.9	3.6
1987	8883	7674	1209	15.8	1.7
1988	8883	7863	1020	13.0	-0.7
1989	8883	8046	837	10.4	-3.0
1990	8883	8228	655	8.0	-5.1
1991	9603	8426	1177	14.0	1.2
1992	9603	8633	970	11.2	-1.3
1993	9603	8837	766	8.7	-3.5

2

IC turbines rated at 1078 MW

TABLE 1.3-2

VACAR RESOURCES LOAD & RESERVES

Delay 1 year both SHNPP units:

Year	Total Power Resources	Load	Reserves	% Reserves
1985	41198	33464	7734	23.1
1986	44743	34407	10336	30.0
1987	45343	35564	9779	27.5
1988	45793	36834	8959	24.3
1989	46343	38138	8205	21.5
1990	48650	39471	9179	23.3

Delay 2 years both SHNPP units:

Year	Total Power Resources	Load	Reserves	% Reserves
1985	41198	33464	7734	23.1
1986	43843	34407	9436	27.4
1987	45343	35564	9779	27.5
1988	45793	36834	8959	24.3
1989	46343	38138	8205	21.5
1990	47750	39471	8279	21.0
1991	50870	40731	10139	24.9

2

Note: As of 1980, approximately 19% of VACAR resources were composed of oil-fired capacity.

TABLE 1.3-2 (CONT'D)

Delay 3 years both SHNPP units:

Year	Total Power Resources	Load	Reserves	% Reserves
1985	41198	33464	7734	23.1
1986	43843	34407	9436	27.4
1987	44443	35564	8879	25.0
1988	45793	36834	8959	24.3
1989	46343	38138	8205	21.5
1990	47750	39471	8279	21.0
1991	49970	40731	9239	22.7
1992	51096	42575	8521	20.0

2

Indefinitely Postpone both SHNPP units:

Year	Total Power Resources	Load	Reserves	% Reserves
1985	41198	33464	7734	23.1
1986	43843	34407	9436	27.4
1987	44443	35564	8879	25.0
1988	44893	36834	8059	21.9
1989	45443	38138	7305	19.2

CHAPTER 2
THE SITE AND ENVIRONMENTAL INTERFACES

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ENVIRONMENTAL REPORT - OPERATING LICENSE STAGE

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ENVIRONMENTAL REPORT - OPERATING LICENSE STAGE

CHAPTER 2 LIST OF FIGURES (Cont'd)

ENVIRONMENTAL REPORT - OPERATING LICENSE STAGE

CHAPTER 2 LIST OF FIGURES (Cont'd)

FIGURE TITLE

ENVIRONMENTAL REPORT - OPERATING LICENSE STAGE

CHAPTER 2 LIST OF FIGURES (Cont'd)

ENVIRONMENTAL REPORT - OPERATING LICENSE STAGE

CHAPTER 2 LIST OF FIGURES (Cont'd)

2.0 THE SITE AND ENVIRONMENTAL INTERFACES

2.1 GEOGRAPHY AND DEMOGRAPHY

2.1.1 SITE LOCATION AND DESCRIPTION

2.1.1.1 Specification of Location

The SHNPP site is located in the extreme southwest corner of Wake County, North Carolina, and the southeast corner of Chatham County, North Carolina. The City of Raleigh, North Carolina, is approximately 16 mi. northeast and the City of Sanford is about 15 mi. southwest.

Carolina Power & Light Company has constructed a dam on Buckhorn Creek about 2.5 mi. north of its confluence with the Cape Fear River. This dam has created an approximately 4000-acre reservoir which will be used for cooling tower makeup requirements. The power block structures are located on the northwest shore of the Main Reservoir about 4.5 mi. north of the Main Dam. Coordinates of the reactors are:

		Unit No. 1	Unit No. 2
Latitude	(North)	35° 38' 00"	35° 38' 03"
Longitude	(West)	78° 57' 22"	78° 57' 24"
North Carolina	(North)	685,444.524	685,716.417
Plane Coordinates	(East)	2,013,001.262	2,012,874.476
Universal Transverse	(North)	3,945,013.683	3,945,095.767
Mercator Coordinates	(East)	685,064.389	685,024.074

2

The universal transverse Mercator zone number for the SHNPP is 17.

2.1.1.2 Site Area

A site area map is included as Figure 2.1.1-1 and indicates the site boundary line (which is the same as the station property boundary), the exclusion boundary, and principal transportation routes. Figure 2.1.1-2 details the exclusion area boundary and identifies principal station structures. There are no industrial, recreational, or residential structures on CP&L property. However, as discussed in Section 2.1.3, CP&L will cooperate with appropriate State agencies to provide public access for boating, fishing, hunting, and other recreational uses which are not inconsistent with the primary purpose of the lands and waters. As such, some recreational facilities such as boat ramps and access areas may be located on station property for public use.

Carolina Power & Light Company's Harris Energy & Environmental Center, as discussed in Sections 2.1.2.3 and 2.1.3, is located approximately 2.1 mi. ENE of the plant.

2.1.1.3 Boundaries for Establishing Effluent Release Limits

The exclusion area includes approximately 3534 acres (Figure 2.1.1-2). The boundary of this area is used to determine effluent release limits. All effluent release limits meet requirements as specified in 10CFR Part 20.

Airborne effluent release points for each of the units are indicated in Figure 3.1-5. The liquid effluent release point for the plant (via the cooling tower blowdown discharge line) is identified in Figure 2.4.1-1. Minimum distance from the center point of the plant to the exclusion boundary is 7000 ft. in all directions, with the exceptions of the N (6980 ft.), NW (6660 ft.), NNW (6640 ft.), and S (7200 ft.). 2

2.1.2 POPULATION DISTRIBUTION

Estimates of existing population distribution are based on 1980 census data and were derived by using methods described in the Electric Power Research Institute's Guidelines for Estimating Present and Forecasting Future Population Distributions Surrounding Reactor Sites (Draft of a Standard) (Reference 2.1.2-1). As a general procedure, calculations of population were made using the smallest geographic unit used by the U. S. Bureau of the Census. Where a Census Bureau geographical unit did not fall entirely into a "standard nuclear site display geographical unit," population of such census unit was distributed proportionately to the standard display units.

2.1.2.1 Population Within Ten Miles

Population distribution within a 10-mile radial area of the plant is for the most part considered rural. The exception to this is in Apex, North Carolina (8 mi. NE) where the 1980 population was 2847.

A map showing the 10-mile radial area of the site is presented in Figure 2.1.2-1. Concentric circles have been drawn at distances of 1, 2, 3, 4, 5, and 10 miles using the center line of the originally planned four reactors as center point. The circles have been divided into 22-1/2-degree segments with each segment centered on one of the 16 compass points. The 1980 estimates of residential population within each of these areas are presented in Table 2.1.2-1. Also presented are population projections for 1985 (the expected first year of plant operation), for each census decade through the projected plant life, and for the year 2027. | 3

Population projections have been based on population growth patterns and projections as described in Update North Carolina Population Projections (Reference 2.1.2-2). County growth patterns have been assumed to apply evenly throughout each county area.

Age distribution projections for the midpoint of the station life (2006) are presented in Table 2.1.2-2. Projections are based on population estimates and projections prepared by the U.S. Bureau of the Census (Reference 2.1.2-3).

2.1.2.2 Population Between Zero and Fifty Miles

The population within a 50-mile radius of the plant site is marked by concentrations of people in and around Raleigh (16 mi. NE), Durham (19 mi. N), and Fayetteville (37 mi. S), each having populations greater than 50,000. Six other smaller cities and towns have populations greater than 10,000. Away from these population concentrations, there is a rural type population distribution with small towns interspersed through the area. A map showing the 50-mile radial area and identifying major cities and towns is presented as Figure 2.1.2-2. Concentric circles have been drawn at distances of 10, 20, 30, 40, and 50 miles, using the center line of the originally planned four reactors as center point. The circles have been divided into 22-1/2-degree segments with each segment centered on one of the 16 compass points. The 1980 estimates of residential population within each of these areas are presented in Table 2.1.2-3. Also presented are population projections for 1985 (the expected first year of plant operation), for each census decade through the projected plant life, and for the year 2027. Cumulative totals of population estimates and projections are included in | 3

Table 2.1.2-4. Projected age distributions for the midpoint of the station life (2006) are presented in Table 2.1.2-5.

Methods used for determining population, population projections and age distributions were similar to those described in Section 2.1.2.1.

Information gathered during periodic security patrols will be used to develop and maintain a feel for the general land use in the exclusion area. A prompt notification system will alert the people in the area within fifteen minutes.

2.1.2.3 Transient Population

Recreational land uses which would attract transient concentrations of people within the 50-mile radius of the site are not extensive and are limited to Umstead State Park (20 mi. NE), Raven Rock State Park (13 mi. SSE), Eno River State Park (30 mi. N), and when completed, the New Hope Project renamed the B. Everett Jordan Reservoir (3 mi. NNW), and the Falls of the Neuse Project (22 mi. NNE). Although the Falls of the Neuse Project has not been completed, it was originally estimated that the project will have an annual attendance of 2,431,000 in 2000 (Reference 2.1.2-4). Figure 2.1.2-3 includes locations of principal recreation areas. 4

On occasions, there are high concentrations of people at sporting events and at functions at the various universities in the area. The North Carolina State Fair, held during October of each year in Raleigh, attracted 110,925 people during a one-day period in 1981.

Daily transient population concentrations in and around the major industrial areas of the region are a result of commuting patterns of workers. Approximately 20 mi. NNE of the site, the Research Triangle Park attracts about 12,000 workers daily. In Moncure (7 mi. WSW) approximately 969 workers are employed; and in Apex (8 mi. NE) industries employ approximately 1900 people. Additionally, the Harris Energy and Environmental Center, located 2.1 mi. ENE of the plant site, employs approximately 125 people and may attract up to 200 additional people for training sessions.

Land use and land use compatibility are discussed in Section 2.1.3 and in Sections 2.1.4 and 3.1 (respectively) of the SHNPP Construction Permit Environmental Report.

Approximately 3 percent of the B. Everett Jordan Reservoir lies within five miles of the SHNPP. Total acreage varies based on lake elevation. At 216 ft. MSL (top of reservoir), there are about 330 acres within 5 miles; at 240 ft. MSL (top of flood control pool), there are about 1,100 acres within 5 miles. During the first three years of public use of the reservoir, approximately 58,000 individuals will annually use those areas of the lake.

4 Part or all of the areas of four proposed public use sites lie within five miles of SHNPP (as shown in Table 2.1.2-6). The U. S. Army Corps of Engineers has not projected dates for their development. Present use is restricted to hunting and sightseeing. The "optimum carrying capacity" is approximately 25,000 individuals per year. The "optimum carrying capacity" represents the maximum number of individuals who can utilize an area and still receive the recreational benefits for which their trip was designed. Since optimum use is

not expected each day, an annual average use would be considerably lower than 25,000 individuals. Estimates of annual average use are not available.

During a "normal summer Sunday in July", 500 individuals are estimated to use the B. Everett Jordan Reservoir area which lies within five miles of the SHNPP. The "optimum daily carrying capacity" of proposed public use sites with all or part of their areas within five miles of the site is 140 individuals. No peak daily attendance estimates are available. However, peak numbers would be somewhat greater than the "normal summer Sunday in July" or the "optimum daily carrying capacity". 4

TABLE 2.1.2-1

POPULATION ESTIMATES FOR 1980 AND POPULATION PROJECTIONS FOR THE YEARS 1985 TO 2027 BETWEEN ZERO AND TEN MILES OF THE SHNPP

0 TO 1 MILES

DIRECTION	1980	1985	1990	2000	2010	2020	2027
N	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	0
NE	0	0	0	0	0	0	0
ENE	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	0
SSE	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0
SSW	0	0	0	0	0	0	0
SW	0	0	0	0	0	0	0
WSW	0	0	0	0	0	0	0
W	0	0	0	0	0	0	0
WNW	0	0	0	0	0	0	0
NW	0	0	0	0	0	0	0
NNW	0	0	0	0	0	0	0
TOTAL	0	0	0	0	0	0	0

2

TABLE 2.1.2-1 (continued)

POPULATION ESTIMATES FOR 1980 AND POPULATION PROJECTIONS FOR THE YEARS 1985 TO 2027 BETWEEN ZERO AND TEN MILES OF THE SHNPP

1 TO 2 MILES

DIRECTION	1980	1985	1990	2000	2010	2020	2027
N	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	0
NE	0	0	0	0	0	0	0
ENE	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	0
SSE	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0
SSW	0	0	0	0	0	0	0
SW	0	0	0	0	0	0	0
WSW	0	0	0	0	0	0	0
W	0	0	0	0	0	0	0
WNW	0	0	0	0	0	0	0
NW	0	0	0	0	0	0	0
NNW	25	28	32	40	48	56	62
TOTAL	25	28	32	40	48	56	62

2

TABLE 2.1.2-1 (continued)

POPULATION ESTIMATES FOR 1980 AND POPULATION PROJECTIONS FOR THE YEARS 1985 TO 2027 BETWEEN ZERO AND TEN MILES OF THE SHNPP

2 TO 3 MILES

DIRECTION	1980	1985	1990	2000	2010	2020	2027
N	30	34	38	47	56	66	73
NNE	39	44	50	62	74	87	96
NE	47	53	60	74	89	104	114
ENE	3	3	4	5	6	7	8
E	8	9	10	12	14	16	18
ESE	17	19	22	27	32	37	41
SE	0	0	0	0	0	0	0
SSE	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0
SSW	0	0	0	0	0	0	0
SW	5	5	6	7	8	9	10
WSW	0	0	0	0	0	0	0
W	15	16	17	19	21	23	24
WNW	17	18	19	21	23	25	26
NW	20	21	22	24	26	28	30
NNW	95	105	114	134	155	176	191
TOTAL	296	327	362	432	504	578	631

2

TABLE 2.1.2-1 (continued)

POPULATION ESTIMATES FOR 1980 AND POPULATION PROJECTIONS FOR THE YEARS 1985 TO 2027 BETWEEN ZERO AND TEN MILES OF THE SHNPP

3 TO 4 MILES

DIRECTION	1980	1985	1990	2000	2010	2020	2027
N	38	42	47	57	67	78	86
NNE	43	49	55	68	82	96	106
NE	43	49	55	68	82	96	106
ENE	72	82	92	114	137	160	176
E	62	70	80	99	118	138	152
ESE	69	78	89	110	132	154	169
SE	56	63	71	88	105	123	136
SSE	53	60	68	84	100	117	129
S	28	30	32	36	40	44	47
SSW	26	27	29	32	35	38	40
SW	26	27	29	32	35	38	40
WSW	26	27	29	32	35	38	40
W	26	27	29	32	35	38	40
WNW	26	27	29	32	35	38	40
NW	26	27	29	32	35	38	40
NNW	26	27	29	32	35	38	40
TOTAL	646	712	792	948	1108	1272	1387

2

TABLE 2.1.2-1 (continued)

POPULATION ESTIMATES FOR 1980 AND POPULATION PROJECTIONS FOR THE YEARS 1985 TO 2027 BETWEEN ZERO AND TEN MILES OF THE SHNPP

4 TO 5 MILES

DIRECTION	1980	1985	1990	2000	2010	2020	2027
N	45	50	55	66	77	88	95
NNE	55	62	71	88	106	124	136
NE	55	62	71	88	106	124	136
ENE	76	86	98	122	146	171	188
E	97	110	124	154	185	216	238
ESE	97	110	124	154	185	216	238
SE	91	102	115	141	168	195	214
SSE	48	51	56	64	72	80	86
S	34	36	38	42	46	50	53
SSW	34	36	38	42	46	50	53
SW	34	36	38	42	46	50	53
WSW	34	36	38	42	46	50	53
W	34	36	38	42	46	50	53
WNW	34	36	38	42	46	50	53
NW	34	36	38	42	46	50	53
NNW	34	36	38	42	46	50	53
TOTAL	836	921	1018	1213	1413	1614	1755

2

TABLE 2.1.2-1 (continued)

POPULATION ESTIMATES FOR 1980 AND POPULATION PROJECTIONS FOR THE YEARS 1985 TO 2027 BETWEEN ZERO AND TEN MILES OF THE SHNPP

5 TO 10 MILES

DIRECTION	1980	1985	1990	2000	2010	2020	2027
N	439	477	519	603	689	776	836
NNE	863	978	1110	1370	1650	1930	2120
NE	3760	4250	4820	5970	7160	8380	9220
ENE	871	987	1120	1390	1660	1950	2140
E	1490	1690	1920	2380	2850	3330	3670
ESE	2550	2890	3280	4060	4870	5700	6270
SE	764	846	939	1130	1320	1510	1640
SSE	575	623	675	777	881	985	1060
S	515	556	601	690	779	869	932
SSW	449	487	529	613	699	786	846
SW	600	653	710	827	946	1070	1150
WSW	690	750	816	948	1080	1220	1320
W	607	646	687	770	853	937	996
WNW	539	570	603	668	733	798	842
NW	368	390	411	455	499	543	574
NNW	340	360	380	421	462	503	532
TOTAL	15420	17153	19120	23072	27131	31287	34148

2

TABLE 2.1.2-2

AGE DISTRIBUTION FOR THE YEAR 2006 FOR THE AREA BETWEEN ZERO AND TEN MILES OF THE SHNPP

2

0 TO 1 MILES

DIRECTION	AGE 0-13	AGE 14-18	AGE OVER 18
N	0	0	0
NNE	0	0	0
NE	0	0	0
ENE	0	0	0
E	0	0	0
ESE	0	0	0
SE	0	0	0
SSE	0	0	0
S	0	0	0
SSW	0	0	0
SW	0	0	0
WSW	0	0	0
W	0	0	0
WNW	0	0	0
NW	0	0	0
NNW	0	0	0
TOTAL	0	0	0

TABLE 2.1.2-2 (continued)

AGE DISTRIBUTION FOR THE YEAR 2006 FOR THE AREA BETWEEN ZERO AND TEN MILES OF THE SHNPP

2

1 TO 2 MILES

DIRECTION	AGE 0-13	AGE 14-18	AGE OVER 18
N	0	0	0
NNE	0	0	0
NE	0	0	0
ENE	0	0	0
E	0	0	0
ESE	0	0	0
SE	0	0	0
SSE	0	0	0
S	0	0	0
SSW	0	0	0
SW	0	0	0
WSW	0	0	0
W	0	0	0
WNW	0	0	0
NW	0	0	0
NNW	11	3	32
TOTAL	11	3	32

TABLE 2.1.2-2 (continued)

AGE DISTRIBUTION FOR THE YEAR 2006 FOR THE AREA BETWEEN ZERO AND TEN MILES OF THE SHNPP

2 TO 3 MILES

DIRECTION	AGE 0-13	AGE 14-18	AGE OVER 18
N	12	3	36
NNE	16	4	48
NE	20	5	58
ENE	1	0	4
E	3	1	9
ESE	7	2	21
SE	0	0	0
SSE	0	0	0
S	0	0	0
SSW	0	0	0
SW	2	0	5
WSW	0	0	0
W	5	1	14
WNW	5	1	15
NW	6	2	18
NNW	34	9	102
TOTAL	111	28	330

2

TABLE 2.1.2-2 (continued)

AGE DISTRIBUTION FOR THE YEAR 2006 FOR THE AREA BETWEEN ZERO AND TEN MILES OF THE SHNPP

3 TO 4 MILES

DIRECTION	AGE 0-13	AGE 14-18	AGE OVER 18
N	15	4	44
NNE	18	5	53
NE	18	5	53
ENE	30	8	89
E	25	7	77
ESE	29	8	86
SE	23	6	69
SSE	22	6	65
S	9	2	27
SSW	8	2	24
SW	8	2	24
WSW	8	2	24
W	8	2	24
WNW	8	2	24
NW	8	2	24
NNW	8	2	24
TOTAL	246	65	731

2

TABLE 2.1.2-2 (continued)

AGE DISTRIBUTION FOR THE YEAR 2006 FOR THE AREA BETWEEN ZERO AND TEN MILES OF THE SHNPP

4 TO 5 MILES

DIRECTION	AGE 0-13	AGE 14-18	AGE OVER 18
N	17	5	50
NNE	23	6	69
NE	23	6	69
ENE	32	9	95
E	41	11	121
ESE	41	11	121
SE	37	10	109
SSE	16	4	48
S	10	3	31
SSW	10	3	31
SW	10	3	31
WSW	10	3	31
W	10	3	31
WNW	10	3	31
NW	10	3	31
NNW	10	3	31
TOTAL	310	86	930

2

TABLE 2.1.2-2 (continued)

AGE DISTRIBUTION FOR THE YEAR 2006 FOR THE AREA BETWEEN ZERO AND TEN MILES OF THE SHNPP

5 TO 10 MILES

DIRECTION	AGE 0-13	AGE 14-18	AGE OVER 18
N	154	41	458
NNE	362	97	1070
NE	1570	420	4670
ENE	365	97	1080
E	625	167	1860
ESE	1070	285	3180
SE	292	78	866
SSE	198	53	587
S	175	47	520
SSW	156	42	465
SW	212	57	629
WSW	242	65	720
W	193	52	574
WNW	167	45	496
NW	114	30	337
NNW	105	28	312
TOTAL	6000	1604	17824

2

TABLE 2.1.2-3

POPULATION ESTIMATES FOR 1980 AND POPULATION PROJECTIONS FOR THE YEARS 1985 TO 2027 BETWEEN ZERO AND FIFTY MILES OF THE SHNPP

0 TO 10 MILES

DIRECTION	1980	1985	1990	2000	2010	2020	2027
N	552	603	659	773	889	1010	1090
NNE	1000	1130	1280	1590	1910	2240	2460
NE	3900	4420	5000	6200	7440	8710	9580
ENE	1020	1160	1310	1630	1950	2280	2510
E	1660	1880	2130	2640	3170	3700	4080
ESE	2740	3100	3510	4350	5220	6110	6720
SE	911	1010	1130	1350	1590	1830	1990
SSE	676	734	799	925	1050	1180	1270
S	577	622	671	768	865	963	1030
SSW	509	550	596	687	780	874	939
SW	665	721	783	908	1040	1160	1250
WSW	750	813	883	1020	1170	1310	1410
W	682	725	771	863	955	1050	1110
WNW	616	651	689	763	837	911	961
NW	448	474	500	553	606	659	697
NNW	520	556	593	669	746	823	878
TOTAL	17226	19149	21304	25689	30218	34810	37975

2

TABLE 2.1.2-3 (continued)

POPULATION ESTIMATES FOR 1980 AND
POPULATION PROJECTIONS FOR THE YEARS
1985 TO 2027 BETWEEN ZERO AND FIFTY MILES OF THE SHNPP

10 TO 20 MILES

DIRECTION	1980	1985	1990	2000	2010	2020	2027
N	17100	18600	20100	23100	26100	29200	31300
NNE	5520	6030	6590	7700	8850	10000	10800
NE	50100	56800	64300	79600	95600	112000	123000
ENE	43400	49200	55700	69100	82900	97000	107000
E	8430	9550	10800	13400	16100	18800	20700
ESE	6950	7790	8750	10700	12700	14800	16200
SE	5710	6190	6720	7750	8790	9840	10600
SSE	5260	5700	6180	7120	8070	9030	9690
S	2970	3220	3490	4020	4560	5100	5470
SSW	5090	5550	6040	7050	8080	9120	9840
SW	18500	20200	22100	25800	29600	33500	36200
WSW	4060	4410	4790	5550	6340	7140	7690
W	1990	2100	2220	2460	2700	2940	3110
WNW	3640	3850	4070	4510	4950	5400	5700
NW	2950	3120	3300	3660	4020	4380	4640
NNW	26500	29600	33200	40200	47200	54300	59200
TOTAL	208170	231910	258350	311720	366560	422550	461140

2

TABLE 2.1.2-3 (continued)

POPULATION ESTIMATES FOR 1980 AND
POPULATION PROJECTIONS FOR THE YEARS
1985 TO 2027 BETWEEN ZERO AND FIFTY MILES OF THE SHNPP

20 TO 30 MILES

DIRECTION	1980	1985	1990	2000	2010	2020	2027
N	92500	99000	106000	120000	133000	147000	156000
NNE	42000	44800	47800	53600	59500	65400	69500
NE	57600	65300	73900	91600	110000	129000	142000
ENE	79900	90600	103000	127000	153000	178000	196000
E	14700	16000	17500	20400	23400	26400	28600
ESE	5810	6170	6550	7300	8050	8810	9330
SE	23300	25200	27200	31200	35200	39300	42100
SSE	9370	10100	10800	12300	13700	15100	16100
S	8950	9670	10400	11900	13500	15000	16000
SSW	4780	5200	5670	6610	7570	8530	9200
SW	5680	6290	6980	8390	9850	11300	12400
WSW	3120	3380	3680	4280	4890	5520	5950
W	4700	4970	5250	5820	6390	6960	7350
WNW	3440	3620	3810	4200	4580	4960	5230
NW	5100	5300	5530	5930	6330	6720	6990
NNW	17000	19100	21500	26200	30900	35600	38900
TOTAL	377950	414700	455570	536730	619860	703600	761650

2

TABLE 2.1.2-3 (continued)

POPULATION ESTIMATES FOR 1980 AND POPULATION PROJECTIONS FOR THE YEARS 1985 TO 2027 BETWEEN ZERO AND FIFTY MILES OF THE SHNPP

30 TO 40 MILES

DIRECTION	1980	1985	1990	2000	2010	2020	2027
N	16900	18200	19700	22500	25400	28200	30200
NNE	14500	15000	15600	16600	17600	18600	19300
NE	13700	15300	17100	20700	24400	28200	30900
ENE	18700	21100	23800	29300	35000	40900	44900
E	11400	12100	12900	14300	15800	17300	18300
ESE	19000	20200	21500	23900	26400	28800	30600
SE	12300	13200	14100	15900	17800	19600	20900
SSE	14900	15800	16800	18500	20200	21900	23000
S	114000	121000	128000	141000	154000	166000	175000
SSW	3860	4230	4650	5490	6350	7220	7820
SW	12800	14500	16500	20600	24900	29300	32400
WSW	7090	8020	9060	11200	13500	15800	17500
W	8830	9480	10200	11500	12900	14300	15300
WNW	11000	11700	12400	13900	15400	16800	17900
NW	34100	34200	34300	34100	33800	33400	33000
NNW	21800	23400	25100	28500	31800	35100	37400
TOTAL	334880	357430	381710	427990	475250	521420	554420

2

TABLE 2.1.2-3 (continued)

POPULATION ESTIMATES FOR 1980 AND POPULATION PROJECTIONS FOR THE YEARS 1985 TO 2027 BETWEEN ZERO AND FIFTY MILES OF THE SHNPP

40 TO 50 MILES

DIRECTION	1980	1985	1990	2000	2010	2020	2027
N	8410	8910	9440	10500	11500	12600	13300
NNE	8070	8190	8310	8490	8660	8810	8910
NE	13900	14700	15400	16900	18400	19900	20900
ENE	10000	10600	11300	12600	13900	15200	16100
E	14200	15100	15900	17600	19300	21000	22100
ESE	10200	10800	11500	12800	14000	15300	16200
SE	7070	7410	7760	8460	9170	9870	10400
SSE	12500	13200	13900	15300	16600	17900	18800
S	101000	108000	114000	126000	138000	149000	157000
SSW	12700	14100	15500	18600	21800	25000	27200
SW	20400	23200	26300	32800	39600	46600	51500
WSW	8770	9740	10800	13100	15400	17800	19500
W	34400	37400	40600	47000	53600	60200	64700
WNW	24200	25800	27500	30800	34100	37500	39800
NW	64300	64900	65600	66200	66600	66800	66900
NNW	9380	9650	9950	10500	11000	11500	11800
TOTAL	359500	381700	403760	447650	491630	534980	565110

2

TABLE 2.1.2-4

CUMULATIVE POPULATION ESTIMATES AND PROJECTIONS BETWEEN ZERO AND FIFTY MILES OF THE SHNPP

YEAR	0-1	0-2	0-3	0-4	0-5	0-10	0-20	0-30	0-40	0-50
1980	0	25	321	967	1800	17200	225000	603000	938000	1300000
1985	0	28	355	1070	1990	19200	251000	666000	1020000	1400000
1990	0	32	394	1190	2210	21300	280000	735000	1120000	1520000
2000	0	40	472	1420	2630	25700	337000	873000	1300000	1750000
2010	0	48	552	1660	3070	30200	397000	1020000	1500000	1990000
2020	0	56	634	1910	3520	34800	457000	1160000	1680000	2210000
2027	0	62	693	2080	3840	38000	499000	1260000	1810000	2370000

4

TABLE 2.1.2-5

AGE DISTRIBUTION FOR THE YEAR 2006 FOR THE AREA BETWEEN ZERO AND FIFTY MILES OF THE SHNPP

0 TO 10 MILES

DIRECTION	AGE 0-13	AGE 14-18	AGE OVER 18
N	198	53	588
NNE	419	112	1240
NE	1630	436	4850
ENE	428	114	1270
E	695	186	2070
ESE	1150	306	3400
SE	352	94	1040
SSE	236	63	700
S	194	52	578
SSW	174	47	520
SW	232	62	689
WSW	260	70	775
W	216	58	643
WNW	190	51	566
NW	138	37	410
NNW	168	45	501
TOTAL	6680	1786	19840

2

TABLE 2.1.2-5 (continued)

AGE DISTRIBUTION FOR THE YEAR 2006 FOR THE AREA BETWEEN ZERO AND FIFTY MILES OF THE SHNPP

10 TO 20 MILES

DIRECTION	AGE 0-13	AGE 14-18	AGE OVER 18
N	5870	1570	17400
NNE	1970	527	5870
NE	21000	5600	62300
ENE	18200	4850	54000
E	3530	941	10500
ESE	2800	748	8320
SE	1970	526	5860
SSE	1810	484	5380
S	1020	273	3040
SSW	1810	482	5360
SW	6620	1770	19700
WSW	1420	379	4220
W	614	164	1820
WNW	1130	301	3340
NW	914	244	2720
NNW	10400	2790	31000
TOTAL	81078	21649	240830

2

TABLE 2.1.2-5 (continued)

AGE DISTRIBUTION FOR THE YEAR 2006 FOR THE AREA BETWEEN ZERO AND FIFTY MILES OF THE SHNPP

20 TO 30 MILES

DIRECTION	AGE 0-13	AGE 14-18	AGE OVER 18
N	30100	8030	89400
NNE	13500	3600	40000
NE	24100	6440	71600
ENE	33500	8930	99400
E	5230	1400	15500
ESE	1830	488	5430
SE	7920	2110	23500
SSE	3090	825	9180
S	3030	809	9000
SSW	1690	451	5020
SW	2180	582	6480
WSW	1090	292	3250
W	1450	387	4310
WNW	1040	279	3100
NW	1460	388	4320
NNW	6820	1820	20300
TOTAL	138030	36831	409790

2

TABLE 2.1.2-5 (continued)

AGE DISTRIBUTION FOR THE YEAR 2006 FOR THE AREA BETWEEN ZERO AND FIFTY MILES OF THE SHNPP

30 TO 40 MILES

DIRECTION	AGE 0-13	AGE 14-18	AGE OVER 18
N	5710	1520	17000
NNE	4060	1080	12100
NE	5390	1440	16000
ENE	7690	2050	22900
E	3590	958	10700
ESE	5980	1600	17800
SE	4020	1070	11900
SSE	4610	1230	13700
S	35100	9380	104000
SSW	1410	377	4200
SW	5450	1460	16200
WSW	2960	791	8800
W	2920	778	8660
WNW	3480	929	10300
NW	8010	2140	23800
NNW	7170	1910	21300
TOTAL	107550	28713	319360

2

TABLE 2.1.2-5 (continued)

AGE DISTRIBUTION FOR THE YEAR 2006 FOR THE AREA BETWEEN ZERO AND FIFTY MILES OF THE SHNPP

40 TO 50 MILES

DIRECTION	AGE 0-13	AGE 14-18	AGE OVER 18
N	2620	700	7790
NNE	2030	541	6020
NE	4200	1120	12500
ENE	3150	842	9370
E	4390	1170	13000
ESE	3190	852	9480
SE	2100	559	6220
SSE	3790	1010	11200
S	31400	8370	93200
SSW	4820	1290	14300
SW	8670	2310	25700
WSW	3410	909	10100
W	12000	3200	35700
WNW	7730	2060	23000
NW	15700	4190	46600
NNW	2540	679	7560
TOTAL	111740	29802	331740

2

TABLE 2.1.2-6

PROPOSED JORDAN RESERVOIR PUBLIC USE SITES WITHIN 5 MILES OF SHNPP

Name	Area (ac)	Distance (mi)*	Use Present/Future
Bonsal Point Recreation Area	520	3.9	hunting - interim wildlife management/ day use - overnight camping
Beaver Point Recreation Area	630	4.3	hunting - interim wildlife management/ day use - overnight camping
Weaver Creek Wildlife Area	770	2.9	wildlife area/ wildlife area
Little Beaver Creek Wildlife Area	870	2.5	wildlife area/ wildlife area

4

*Distance given from SHNPP

2.1.3 USES OF ADJACENT LANDS AND WATERS

Figure 2.1.3-1 includes land contours, site boundary, exclusion boundary, CP&L property, area properties, water bodies, and transportation links. There are no settlements, commercial areas, industrial plants, dedicated areas, or valued historic, scenic, cultural, or natural areas on CP&L property.

Total land area owned by CP&L in the plant vicinity is approximately 22,850 ac. Total required site area (station property) is approximately 10,800 ac. Approximately 4000 ac. are utilized by the Main Reservoir, and about 1217 ac. are used for plant related activities.

The Harris Energy & Environmental Center is located approximately 2.1 miles ENE of the plant. The facility houses various CP&L environmental testing and training laboratories and includes a visitors' center. A Boy Scout camping area is located approximately 3.7 mi. SSE of the site, and a private nursing home is located approximately 2.2 mi. NE.

Table 2.1.3-1 indicates the distances from the center line of the first operational nuclear unit to the nearest milk cow, milk goat, residence, site boundary, vegetable garden and meat animal. Distances are indicated for each of the 16 sectors as described in Section 2.1.2 to a radial distance of 5 mi.

The majority of the land within the five-mile radial area is wooded, with a scattering of fields and residential properties (Figure 2.1.3-2). Much of the land is used for timber and pulpwood production. Agricultural development exists on a limited basis, and three dairy farms are in operation. Major commercial and expanded residential development is not expected to occur due to the poor percolation characteristics of the soils and the lack of adequate sewage and water systems. 2

Due to CP&L's land and reservoir use policy, there will be some recreational usage of CP&L's property. It is the policy of CP&L to make available for the enjoyment of the general public the lands and waters of the SHNPP and reservoir consistent with their primary purpose -- the generation of electric power. Property in the flood control strip around the reservoir and plant will not be sold or leased by CP&L for private development. Private construction of piers, docks, moors, boat houses, or similar facilities in or adjacent to the reservoir will not be permitted.

To permit the greatest use by the greatest number of people, the Company will cooperate with appropriate State agencies to provide public access for boating, fishing, hunting, and other uses which are not inconsistent with the primary purpose of the lands and waters. It is the desire of CP&L that the public benefits of the SHNPP reservoir and property shall contribute to the quality of life in the area, in addition to meeting the power needs of all its customers.

Consistent with the provisions of the SHNPP land policy, CP&L will permit the appropriate State agencies to establish wildlife refuge areas adjacent to the reservoir and a wildlife management program for the Company-owned lands. The development of a favorable sport fishery in the Main Reservoir is expected to result from existing Whiteoak and Buckhorn creek populations with some seeding from Cape Fear River makeup water. Operational monitoring programs (Section 6.2) will be conducted.

A majority of the land within a 50-mile radial area of the plant is devoted to some form of agricultural activity. Major crops include tobacco, soybeans, corn for grain and sweet potatoes. Secondary crops include corn for silage, other grain crops and hay. Livestock production includes hog, beef, poultry, and dairy products. Data on annual agricultural, livestock, and poultry production within a 50-mile radius of the plant for sectors as described in Section 2.1.2 are presented in Tables 2.1.3-2, 2.1.3-3, and 2.1.3-5 (References 2.1.3-1 and 2.1.3-7). According to the North Carolina Crop and Livestock Reporting Service, the grazing season for the four counties surrounding the site (Wake, Chatham, Harnett, and Lee Counties) is March to November (Reference 2.1.3-6).

Commercial fish and shellfish catch is negligible from waters within 50 mi. of the station discharge. A small number of American shad, striped bass and blueback herring are harvested seasonally (spring) from the Cape Fear River below Lillington. This number is considered insignificant as compared to North Carolina's commercial fishing harvest. Commercial fishing in the Cape Fear River is generally restricted to the area from Lock No. 1 to the river mouth. The nearest commercial fishery port is Wilmington, North Carolina, approximately 150 river miles downstream of the site. Commercial catches reported for Wilmington are principally salt water species harvested from the lower Cape Fear River estuary and from the Atlantic Ocean.

The N. C. Division of Marine Fisheries has made available preliminary estimates of commercial fish and shellfish catches in the Cape Fear for 1980 and 1981. The commercial catch for these years was 604,900 kg in 1980 and 592,800 kg in 1981. The commercial catch includes sedentary shellfish (oysters, clams), resident fishes (catfish, bullheads), and migratory species (shrimp, shad, trout, spot, croaker, bluefish, mullet, striped bass). The presence, and thus the catch, of the latter group of species varies according to their movement patterns in and out of the river system.

Recreational fishing catch within the 50-mile radial area is dominated by sunfish species, largemouth bass, and catfish (Reference 2.1.3-2). The limited number of lakes within the area and the fact that there are not estuarine or salt water bodies principally confines sport fishing to private ponds, impounded areas, and bridge crossings on rivers and streams. The recreational fish catch from the SHNPP Main Reservoir after its completion is estimated to be 22,200 kg/yr. The estimated recreational fish catch from the Cape Fear River to a distance of 80 km below SHNPP is 500 kg/yr and to a distance of 176 km is 7000 kg/yr as shown on Table 2.1.3-6 (References 2.1.3-8, 2.1.3-9, and 2.1.3-10). However, the small catch which is associated with this fishing would probably not be a principal food source for residents within the 50-mile area.

The overall potential harvest in the Main Reservoir and Cape Fear River is
5 | approximately 622,500 kg/yr, of which about 95 percent is the commercial catch
in the lower river (over 175 km downstream).

In addition to the SHNPP reservoir, the development of the Falls of the Neuse Project and the B. Everett Jordan Reservoir (New Hope Project) will create two large reservoirs within 30 mi. of the SHNPP site. Fish species similar to those discussed in Section 5.1.3 are expected to develop in the reservoirs. Each reservoir will provide significant recreational fishing opportunities, thus increasing the region's recreational fishery harvest. 4

The cooling tower blowdown pipeline discharges into the Main Reservoir just north of the Main Dam. Discharges will enter the reservoir via a submerged discharge outfall, and the public will have access to the discharge area. Although a reasonable sport fishery is expected to develop in the reservoir, limited fishing success in the area affected by plant discharges is expected.

As discussed in Sections 5.1.3 and 5.3, the thermal and chemical effects of the cooling tower blowdown are expected to be minimal and to be restricted to a small mixing zone (ranging from 20 to 120 acres). Fishing success in the mixing zone area, which represents less than 3 percent of the reservoir's surface area, is not expected to be as good as in other parts of the reservoir. For the most part, the anticipated lower fishing success in the mixing zone area will result from the lack of favorable habitat for the expected important species--largemouth bass and sunfish species. The mixing zone area will be relatively deep (40-50 feet) with steep shorelines and limited shallow areas. 4

While there are several bait farms, a number of fishing ponds, and a State fish hatchery near Raeford, North Carolina (48 mi. SSW) there are no known fish farms within the 50-mile radial area of the plant that utilize water that reasonably may be affected by plant discharges.

Hunting occurs within a 50-mile radial area of the site. Predominant game species harvested include deer, waterfowl, mourning dove, and wild turkey. Estimates of annual harvests (excluding dove) are indicated in Table 2.1.3-4. These estimates were calculated using data presented in References 2.1.3-3, 2.1.3-4, and 2.1.3-5.

There are no public access areas for swimming on the Cape Fear River downstream of SHNPP. Some swimming occurs incidental to boating activities but in general, the Cape Fear River is not used for swimming. 4

The location, nature, and amounts of present and projected surface and groundwater use that may be contaminated by station effluents are described in Section 2.4.

Table 2.1.3-1 DISTANCE WITHIN FIVE MILES OF CENTERLINE OF FIRST OPERATIONAL UNIT TO NEAREST STATION PROPERTY BOUNDARY, RESIDENCE, GARDEN, MILK COW, MILK GOAT, AND MEAT ANIMAL.

	Distance (miles)						
	Station Property Boundary	Residence	Garden	Milk Cow	Milk Goat	Meat Animal	
N	1.3	2.2	2.2	1.8	-	1.8	
NNE	1.3	1.7	1.8	4.3	-	3.1	
NE	1.3	2.2	2.2	-	-	2.2	
ENE	1.3	2.0	1.9	-	-	1.9	4
E	1.4	1.8	2.1	4.4	-	4.4	
ESE	1.3	2.7	2.7	-	-	2.8	
SE	1.3	4.2	4.2	-	-	4.2	
SSE	2.0	-	-	-	-	-	
S	2.2	-	-	-	-	-	
SSW	1.5	4.0	4.0	-	-	4.3	
SW	1.5	2.8	2.8	-	-	2.8	
WSW	1.3	4.3	4.3	-	-	4.3	
W	1.3	2.8	2.8	-	-	3.0	
WNW	1.4	2.1	2.1	-	-	2.0	4
NW	1.3	1.8	1.9	-	-	1.7	
NNW	1.3	1.5	1.4	-	4.6	1.7	

As of May 12, 1982. 4

TABLE 2.1.3-2

1980 AGRICULTURAL PRODUCTION OF MAJOR CROPS BETWEEN ZERO AND FIFTY MILES OF THE SHNPP

0 TO 10 MILES

DIRECTION	SOYBEANS	TOBACCO	SWEET POTATOES	CORN FOR GRAIN
N	134000	130000	28600	316000
NNE	288000	321000	82800	316000
NE	288000	321000	82800	316000
ENE	288000	321000	82800	316000
E	288000	321000	82800	316000
ESE	288000	321000	82800	316000
SE	486000	351000	182000	767000
SSE	574000	339000	230000	1020000
S	388000	232000	144000	746000
SSW	181000	145000	24100	287000
SW	180000	139000	21600	284000
WSW	195000	156000	26200	276000
W	90100	64700	8220	310000
WNW	66500	45200	4720	317000
NW	66500	45200	4720	317000
NNW	80900	61300	8870	332000
TOTAL	3882000	3313400	1097030	6552000

2

All data reported in kilograms
Basis: Reference 2.1.3-1

TABLE 2.1.3-2 (continued)

1980 AGRICULTURAL PRODUCTION OF MAJOR CROPS BETWEEN ZERO AND FIFTY MILES OF THE SHNPP

10 TO 20 MILES

DIRECTION	SOYBEANS	TOBACCO	SWEET POTATOES	CORN FOR GRAIN
N	273000	241000	24800	758000
NNE	686000	765000	182000	771000
NE	837000	933000	241000	918000
ENE	795000	885000	228000	871000
E	917000	1020000	274000	1010000
ESE	1220000	1080000	1290000	2030000
SE	2060000	1130000	856000	3710000
SSE	2140000	1160000	890000	3860000
S	2150000	1160000	892000	3870000
SSW	1240000	784000	371000	1850000
SW	770000	595000	93000	790000
WSW	592000	447000	66300	849000
W	173000	102000	4440	956000
WNW	175000	103000	4500	969000
NW	172000	101000	4590	937000
NNW	316000	181000	14400	1200000
TOTAL	14516000	10687000	5436030	25349000

All data reported in kilograms
Basis: Reference 2.1.3-1

TABLE 2.1.3-2 (continued)

1980 AGRICULTURAL PRODUCTION OF MAJOR CROPS BETWEEN ZERO AND FIFTY MILES OF THE SHNPP

20 TO 30 MILES

DIRECTION	SOYBEANS	TOBACCO	SWEET POTATOES	CORN FOR GRAIN
N	636000	537000	56300	1360000
NNE	654000	730000	115000	806000
NE	1420000	1580000	408000	1560000
ENE	1440000	1610000	415000	1580000
E	2740000	2090000	5110000	5800000
ESE	3460000	2380000	7570000	8060000
SE	3560000	2000000	2310000	6670000
SSE	3280000	1650000	1280000	5840000
S	3530000	1850000	1420000	6330000
SSW	2900000	1650000	1120000	5050000
SW	823000	731000	103000	1120000
WSW	540000	487000	59900	1230000
W	319000	187000	8170	1760000
WNW	332000	198000	8430	1720000
NW	873000	537000	27300	3100000
NNW	894000	507000	49100	2670000
TOTAL	27401000	18724000	20060200	54656000

All data reported in kilograms
Basis: Reference 2.1.3-1

TABLE 2.1.3-2 (continued)

1980 AGRICULTURAL PRODUCTION OF MAJOR CROPS BETWEEN ZERO AND FIFTY MILES OF THE SHNPP

30 TO 40 MILES

DIRECTION	SOYBEANS	TOBACCO	SWEET POTATOES	CORN FOR GRAIN
N	1000000	768000	79200	2380000
NNE	1190000	1600000	129000	1750000
NE	2060000	2150000	463000	2420000
ENE	2380000	2390000	1720000	3300000
E	4720000	3250000	10400000	11000000
ESE	4670000	3220000	10300000	10900000
SE	4930000	2570000	6210000	13900000
SSE	4250000	951000	1220000	8120000
S	4130000	788000	805000	6710000
SSW	3660000	750000	249000	3430000
SW	490000	651000	70600	1300000
WSW	506000	607000	63900	1540000
W	817000	273000	9750	4550000
WNW	925000	471000	16900	4430000
NW	1390000	889000	33700	5010000
NNW	1320000	777000	60100	4200000
TOTAL	38438000	22105000	31830150	84940000

All data reported in kilograms
Basis: Reference 2.1.3-1

TABLE 2.1.3-2 (continued)

1980 AGRICULTURAL PRODUCTION OF MAJOR CROPS BETWEEN ZERO AND FIFTY MILES OF THE SHNPP

40 TO 50 MILES

DIRECTION	SOYBEANS	TOBACCO	SWEET POTATOES	CORN FOR GRAIN
N	499000	2280000	31100	4410000
NNE	1450000	2230000	26500	2840000
NE	3100000	2670000	449000	4860000
ENE	3230000	3030000	3220000	6090000
E	5420000	4890000	10400000	18100000
ESE	7400000	4140000	9870000	22000000
SE	6210000	2360000	5200000	22900000
SSE	6030000	1740000	3280000	16600000
S	5970000	1050000	865000	8940000
SSW	7730000	740000	99600	5190000
SW	642000	795000	87400	1650000
WSW	607000	674000	77400	1780000
W	1210000	353000	12200	6750000
WNW	1120000	758000	21700	5980000
NW	1390000	1270000	40500	5620000
NNW	1160000	1600000	43800	4510000
TOTAL	53168000	30580000	33724200	138220000

2

All data reported in kilograms
Basis: Reference 2.1.3-1

TABLE 2.1.3-2 (continued)

1980 AGRICULTURAL PRODUCTION OF MAJOR CROPS BETWEEN ZERO AND FIFTY MILES OF THE SHNPP

CUMULATIVE TOTALS

SECTOR	SOYBEANS	TOBACCO	SWEET POTATOES	CORN FOR GRAIN
00 TO 10	3882000	3313400	1097030	6552000
00 TO 20	18398000	14000400	6533060	31901000
00 TO 30	45799000	32724400	26593260	86557000
00 TO 40	84237000	54829400	58423410	171497000
00 TO 50	137405000	85409400	92146710	309717000

2

All data reported in kilograms
Basis: Reference 2.1.3-1

TABLE 2.1.3-3

1980 LIVESTOCK STATISTICS BETWEEN ZERO AND FIFTY MILES OF THE SHNPP

0 TO 10 MILES

DIRECTION	MILK COWS	BEEF COWS	HOGS	CHICKENS
N	93	242	649	11800
NNE	101	108	618	5030
NE	101	108	618	5030
ENE	101	108	618	5030
E	101	108	618	5030
ESE	101	108	618	5030
SE	72	123	801	3140
SSE	54	152	909	3100
S	62	205	808	6700
SSW	51	230	613	6420
SW	47	234	611	6140
WSW	44	214	592	4950
W	80	288	652	13000
WNW	89	302	663	14800
NW	89	302	663	14800
NNW	94	307	694	15100
TOTAL	1280	3139	10745	125100

1

Milk cows defined as milk cows and heifers that have calved.

Beef cows defined as beef cows and heifers that have calved.

Basis: Reference 2.1.3-1

TABLE 2.1.3-3 (continued)

1980 LIVESTOCK STATISTICS BETWEEN ZERO AND FIFTY MILES OF THE SHNPP

10 TO 20 MILES

DIRECTION	MILK COWS	BEEF COWS	HOGS	CHICKENS
N	219	730	1200	29600
NNE	231	377	1370	14500
NE	292	312	1790	14600
ENE	277	296	1700	13900
E	318	342	1970	15900
ESE	232	408	3420	13800
SE	117	409	2940	3030
SSE	118	422	3040	2940
S	118	423	3050	2950
SSW	71	516	2170	1400
SW	47	582	1750	582
WSW	116	698	1840	14700
W	268	937	2010	46000
WNW	271	949	2030	46600
NW	265	909	1940	44500
NNW	453	852	1670	35900
TOTAL	3413	9162	33890	300902

1

Milk cows defined as milk cows and heifers that have calved.

Beef cows defined as beef cows and heifers that have calved.

Basis: Reference 2.1.3-1

TABLE 2.1.3-3 (continued)

1980 LIVESTOCK STATISTICS BETWEEN ZERO AND FIFTY MILES OF THE SHNPP

20 TO 30 MILES

DIRECTION	MILK COWS	BEEF COWS	HOGS	CHICKENS
N	515	985	1090	27800
NNE	187	813	933	23500
NE	496	530	3040	24800
ENE	504	539	3090	25200
E	231	911	10100	23100
ESE	101	1120	13900	22600
SE	184	761	6270	7300
SSE	175	640	4500	6600
S	191	693	4940	5970
SSW	160	752	4520	4680
SW	46	818	2970	5910
WSW	169	1030	3120	30200
W	493	1720	3700	84700
WNW	499	1590	3250	73700
NW	1160	1700	1860	32800
NNW	1240	1280	2100	38300
TOTAL	6351	15882	69383	437160

1

Milk cows defined as milk cows and heifers that have calved.

Beef cows defined as beef cows and heifers that have calved.

Basis: Reference 2.1.3-1

TABLE 2.1.3-3 (continued)

1980 LIVESTOCK STATISTICS BETWEEN ZERO AND FIFTY MILES OF THE SHNPP

30 TO 40 MILES

DIRECTION	MILK COWS	BEEF COWS	HOGS	CHICKENS
N	976	1520	1890	43600
NNE	404	1240	2560	49200
NE	500	991	6660	58600
ENE	625	877	6450	38200
E	138	1530	19000	31000
ESE	136	1520	18800	30700
SE	179	1090	21100	44000
SSE	170	752	7060	33300
S	167	748	4170	28800
SSW	53	652	4560	8490
SW	19	934	4280	15600
WSW	102	1030	4360	25900
W	900	1730	5410	117000
WNW	1100	1970	4230	87900
NW	1800	2620	1960	28000
NNW	1790	2080	2720	47400
TOTAL	9059	21284	115210	687690

1

Milk cows defined as milk cows and heifers that have calved.

Beef cows defined as beef cows and heifers that have calved.

Basis: Reference 2.1.3-1

TABLE 2.1.3-3 (continued)

1980 LIVESTOCK STATISTICS BETWEEN ZERO AND FIFTY MILES OF THE SHNPP

40 TO 50 MILES

DIRECTION	MILK COWS	BEEF COWS	HOGS	CHICKENS
N	471	1810	4540	36800
NNE	506	1700	3600	73900
NE	173	1640	14500	124000
ENE	146	1320	14600	159000
E	132	1510	22600	79100
ESE	173	1710	26700	95300
SE	207	916	34900	89600
SSE	223	976	21700	66100
S	182	890	5930	31000
SSW	46	507	5950	1230
SW	30	1170	5500	20200
WSW	79	1190	6610	26400
W	1240	1880	7090	148000
WNW	1180	1990	4890	99000
NW	1690	2760	2100	29800
NNW	1450	2540	2880	29800
TOTAL	7928	24509	184090	1109230

1

Milk cows defined as milk cows and heifers that have calved.

Beef cows defined as beef cows and heifers that have calved.

Basis: Reference 2.1.3-1

TABLE 2.1.3-3 (continued)

1980 LIVESTOCK STATISTICS BETWEEN ZERO AND FIFTY MILES OF THE SHNPP

CUMULATIVE TOTALS

SECTOR	MILK COWS	BEEF COWS	HOGS	CHICKENS
00 TO 10	1280	3139	10745	125100
00 TO 20	4693	12301	44635	426002
00 TO 30	11044	28183	114018	863162
00 TO 40	20103	49467	229228	1550852
00 TO 50	28031	73976	413318	2660082

1

Milk cows defined as milk cows and heifers that have calved.

Beef cows defined as beef cows and heifers that have calved.

Basis: Reference 2.1.3-1

TABLE 2.1.3-4

ANNUAL GAME SPECIES HARVEST
BETWEEN ZERO AND FIFTY MILES OF THE SHNPP

0 TO 10 MILES

DIRECTION	WATERFOWL	WHITETAIL DEER	WILD TURKEY
N	28	3	0
NNE	69	1	0
NE	69	1	0
ENE	69	1	0
E	69	1	0
ESE	69	1	0
SE	50	1	0
SSE	34	1	0
S	22	2	0
SSW	9	2	0
SW	5	2	0
WSW	8	2	0
W	9	4	0
WNW	10	4	0
NW	10	4	0
NNW	13	4	0
TOTAL	543	34	0

1

Basis: References 2.1.3-3, 2.1.3-4, and 2.1.3-5

TABLE 2.1.3-4 (continued)

ANNUAL GAME SPECIES HARVEST
BETWEEN ZERO AND FIFTY MILES OF THE SHNPP

10 TO 20 MILES

DIRECTION	WATERFOWL	WHITETAIL DEER	WILD TURKEY
N	15	16	1
NNE	142	8	0
NE	199	4	0
ENE	189	4	0
E	217	4	0
ESE	167	5	0
SE	87	2	0
SSE	88	2	0
S	88	2	0
SSW	31	3	0
SW	0	3	0
WSW	7	6	0
W	22	13	1
WNW	23	13	1
NW	22	13	1
NNW	13	18	1
TOTAL	1310	116	5

1

Basis: References 2.1.3-3, 2.1.3-4, and 2.1.3-5

TABLE 2.1.3-4 (continued)

ANNUAL GAME SPECIES HARVEST
BETWEEN ZERO AND FIFTY MILES OF THE SHNPP

20 TO 30 MILES

DIRECTION	WATERFOWL	WHITETAIL DEER	WILD TURKEY
N	3	32	1
NNE	55	25	0
NE	337	6	0
ENE	343	6	0
E	198	14	0
ESE	131	18	0
SE	144	5	0
SSE	152	12	0
S	154	8	0
SSW	112	4	0
SW	24	8	0
WSW	34	13	1
W	41	24	2
WNW	44	21	2
NW	93	25	4
NNW	0	42	2
TOTAL	1865	263	12

Basis: References 2.1.3-3, 2.1.3-4, and 2.1.3-5

TABLE 2.1.3-4 (continued)

ANNUAL GAME SPECIES HARVEST BETWEEN ZERO AND FIFTY MILES OF THE SHNPP

30 TO 40 MILES

DIRECTION	WATERFOWL	WHITETAIL DEER	WILD TURKEY
N	4	50	1
NNE	117	59	0
NE	295	35	0
ENE	432	14	0
E	178	24	0
ESE	176	24	0
SE	148	39	0
SSE	336	99	0
S	370	105	0
SSW	261	23	0
SW	70	14	1
WSW	65	16	1
W	19	34	2
WNW	91	30	3
NW	200	27	8
NNW	57	51	4
TOTAL	2819	644	20

1

Basis: References 2.1.3-3, 2.1.3-4, and 2.1.3-5

TABLE 2.1.3-4 (continued)

ANNUAL GAME SPECIES HARVEST BETWEEN ZERO AND FIFTY MILES OF THE SHNPP

40 TO 50 MILES

DIRECTION	WATERFOWL	WHITETAIL DEER	WILD TURKEY
N	165	84	13
NNE	92	99	1
NE	54	91	1
ENE	56	65	0
E	246	26	0
ESE	187	25	0
SE	114	76	0
SSE	309	114	0
W	510	118	0
SSW	531	30	0
SW	94	32	1
WSW	103	125	2
W	7	50	1
WNW	225	28	1
NW	416	20	5
NNW	115	97	22
TOTAL	3224	1080	47

1

Basis: References 2.1.3-3, 2.1.3-4, and 2.1.3-5

TABLE 2.1.3-4 (continued)

ANNUAL GAME SPECIES HARVEST BETWEEN ZERO AND FIFTY MILES OF THE SHNPP

CUMULATIVE TOTALS

SECTOR	WATERFOWL	WHITETAIL DEER	WILD TURKEY
00 TO 10	543	34	0
00 TO 20	1853	150	5
00 TO 30	3718	413	17
00 TO 40	6537	1057	37
00 TO 50	9761	2137	84

1

Basis: References 2.1.3-3, 2.1.3-4, and 2.1.3-5

TABLE 2.1.3-5

1980 MILK AND MEAT PRODUCTION

A. Breakdown of Milk & Meat Production

Sector	Milk[a]	Beef[b,c]	Hogs[c]	Chickens[e]	
(Miles)	(kg/yr)	(kg/yr)	(kg/yr)	Broilers (kg/yr)	Eggs (#/yr.)
0 to 10	7,067,000	1,388,000	1,092,000	13,284,000	30,024,000
0 to 20	25,911,000	5,440,000	4,535,000	43,052,000	102,240,000
0 to 30	60,975,000	12,464,000	11,585,000	82,034,000	207,159,000
0 to 40	110,991,000	21,877,000	23,291,000	135,660,000	372,204,000
0 to 50	154,763,000	32,716,000	41,995,000	193,366,000	638,420,000

4

B. Total Meat Production

Sector (miles)	Meat Production (kg/yr)[d,e]
0 to 10	15,764,000
0 to 20	53,027,000
0 to 30	106,083,000
0 to 40	180,828,000
0 to 50	268,077,000

[a] Based on milk cows and heifers that have calved.
[b] Based on beef cows and heifers that have calved.
[c] Assumes that all animals are slaughtered.
[d] Includes beef cows, heifers that have calved, hogs, and chickens. For cattle and hogs, it is assumed that all animals are slaughtered.
[e] The number of chickens given on page 2.1.3-16 of Table 2.1.3-3 is based on layers; however, meat production is based on broilers.
(References 2.3.1-1 and 2.3.1-7.)

TABLE 2.1.3-6

ESTIMATED POTENTIAL FISH HARVESTS FROM THE HARRIS RESERVOIR AND FOR THE CAPE FEAR RIVER TO A DISTANCE OF 176 KILOMETERS DOWNSTREAM OF SHNPP.

Source	Harvest (Kg/ha/yr)	Comments
Jenkins and Morais 1971	16.4	Mean of 103 U.S. reservoirs
Degan, Harrell, and Johnson (in prep.)	35.4	L. Wylie, NC/SC
	5.3	L. Norman, NC
	10.2	L. Badin, NC
	8.2	L. Hartwell, SC
	1.5	L. Keowee, SC
	18.7	L. Murray, SC
	13.7	SHNPP Main Reservoir: Based on mean harvest at 13.7 kg/ha/yr and a reservoir area of 1620 ha (4000 ac), the estimated total harvest will be about 22,200 kg/yr.
Fish 1968; Jenkins & Morais 1971	0.9	Cape Fear River (SHNPP to U. S.-301 bridge): Based on 225 g/fish average weight for sunfish and crappie, 5.4 fish/hour (from Fish 1968), 76.1 hours/ha (from Jenkins and Morais 1971 for reservoirs), 541 ha area of Cape Fear River (from Fish 1968), and 1% of this stretch of river being accessible to anglers, the estimated total harvest will be 500 kg/year.
	9.2	Cape Fear River (US-301 bridge to Corps of Engineers Lock #1): Based on the same assumptions as stated for the Cape Fear River above, except 757 ha and 10% accessibility, the estimated harvest will be 7000 kg/year.

(References 2.1.3-8, 2.1.3-9, and 2.1.3-10.)

5

REFERENCES: SECTION 2.1

2.1.2-1 Electric Power Research Institute prepared by Sigma Research, Inc. Guidelines for Estimating Present and Forecasting Future Population Distributions Surrounding Power Reactor Sites. Special Report EPRI EA-427-SR. 1976. 7 p.

2.1.2-2 State of North Carolina. Office of State Budget and Management. Update North Carolina Population Projections. Raleigh, North Carolina. July 1981.

2.1.2-3 U. S. Bureau of the Census. Projections of the Population of the United States: 1970 to 2050. Current Population Reports, Series P-25, No. 704. U. S. Government Printing Office. Washington, D. C. 1977.

2.1.2-4 U.S. Army Corps of Engineers. Final Environmental Statement (revised) Falls Lake Neuse River Basin North Carolina. Wilmington, N. C. March, 1974.

2.1.3-1 North Carolina Crop and Livestock Reporting Service. Agricultural Statistics. No. 144. Raleigh, North Carolina. September, 1981.

2.1.3-2 Fish, Frederic F. The Sport Fishery Statistics from the Inland Fishing Waters of North Carolina, 1970-1971. North Carolina Wildlife Resources Commission. Raleigh, North Carolina. November, 1974.

2.1.3-3 North Carolina Wildlife Resources Commission. "Big Game Tag Report Number 5." Wildlife in North Carolina 45:7. Raleigh, North Carolina. July, 1981.

2.1.3-4 Carney, Samuel M., Michael F. Sorensen, and Elwood M. Martin. Average Harvest of Each Duck Species in States and Counties During 1966-75 Hunting Seasons. U. S. Fish and Wildlife Service Office of Migratory Bird Management Administrative Report. Laurel, Maryland. October, 1978.

2.1.3-5 Carney, Samuel M., Michael F. Sorensen, and Elwood M. Martin. Distribution in States and Counties of Waterfowl Species Harvested During 1961-1970 Hunting Season. U. S. Fish and Wildlife Service Special Scientific Report - Wildlife No. 187. U. S. Government Printing Office. Washington, D.C. 1975.

2.1.3-6 Griffith, Robert L., North Carolina Crop and Livestock Reporting Service (telephone conversation with Carolyn W. Anderson, CP&L) May 19, 1982

2.1.3-7 North Carolina Crop and Livestock Reporting Service. Farm Income No. 147. Raleigh, North Carolina. February, 1982.

2.1.3-8 Jenkins, R. M. and D. I. Morais. "Reservoir Sport Fishing Effort and Harvest in Relation to Environmental Variables" in Reservoir Fisheries and Limnology. G.E. Hall, ed. American Fisheries Society. Washington, D.C. 1971. 4

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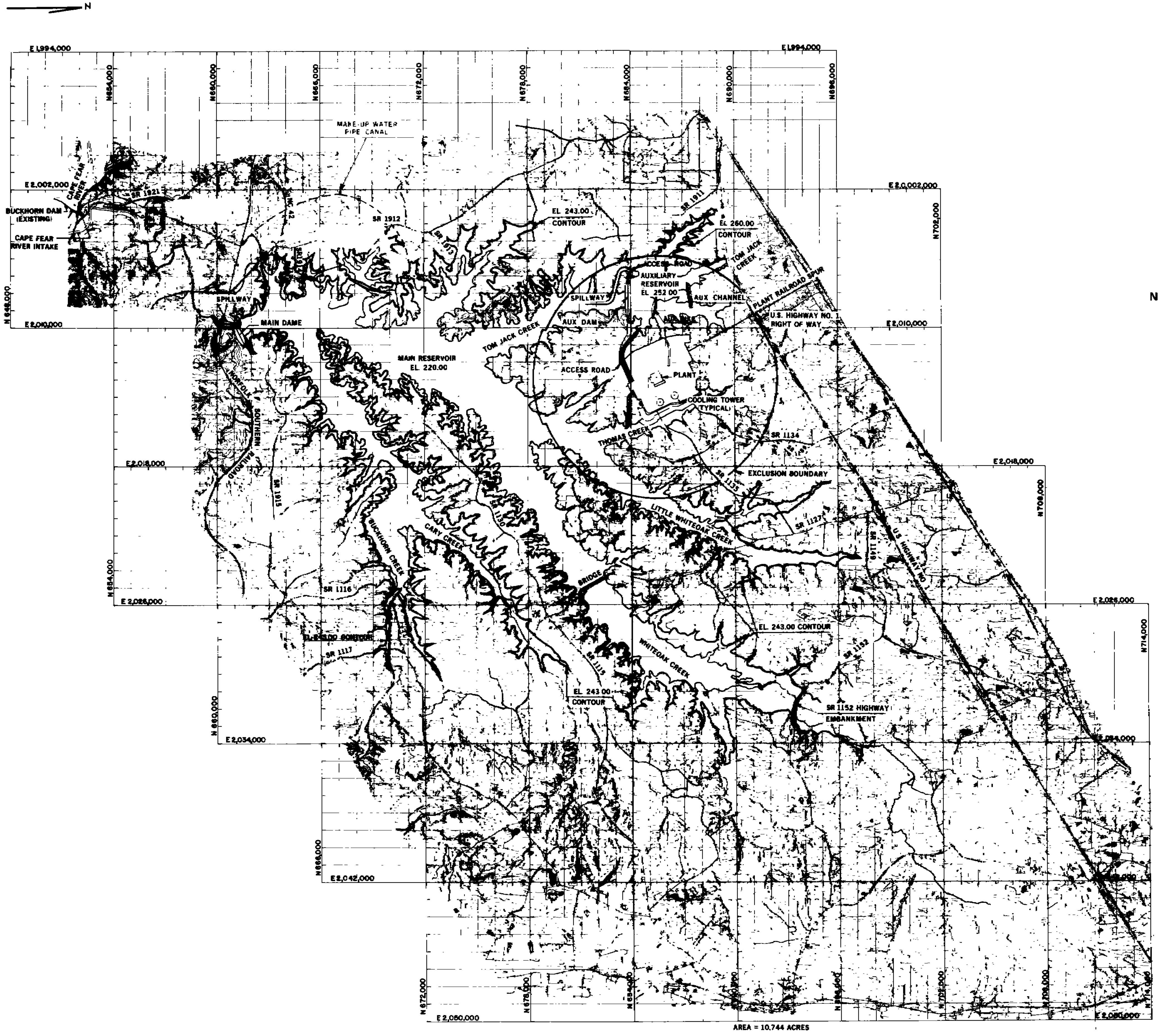
2.1.3-9 Fish, F. F. A Catalog of the Inland Fishing Waters in North Carolina. North Carolina Wildlife Resources Commission. Raleigh, North Carolina. 1968

2.1.3-10 Degan, D., R. D. Harrell and S. Johnson. 1979-80 Creel Survey of Lake Wylie, North Carolina/South Carolina. Duke Power Company Environmental Services Section. Huntersville, North Carolina (in preparation). 4



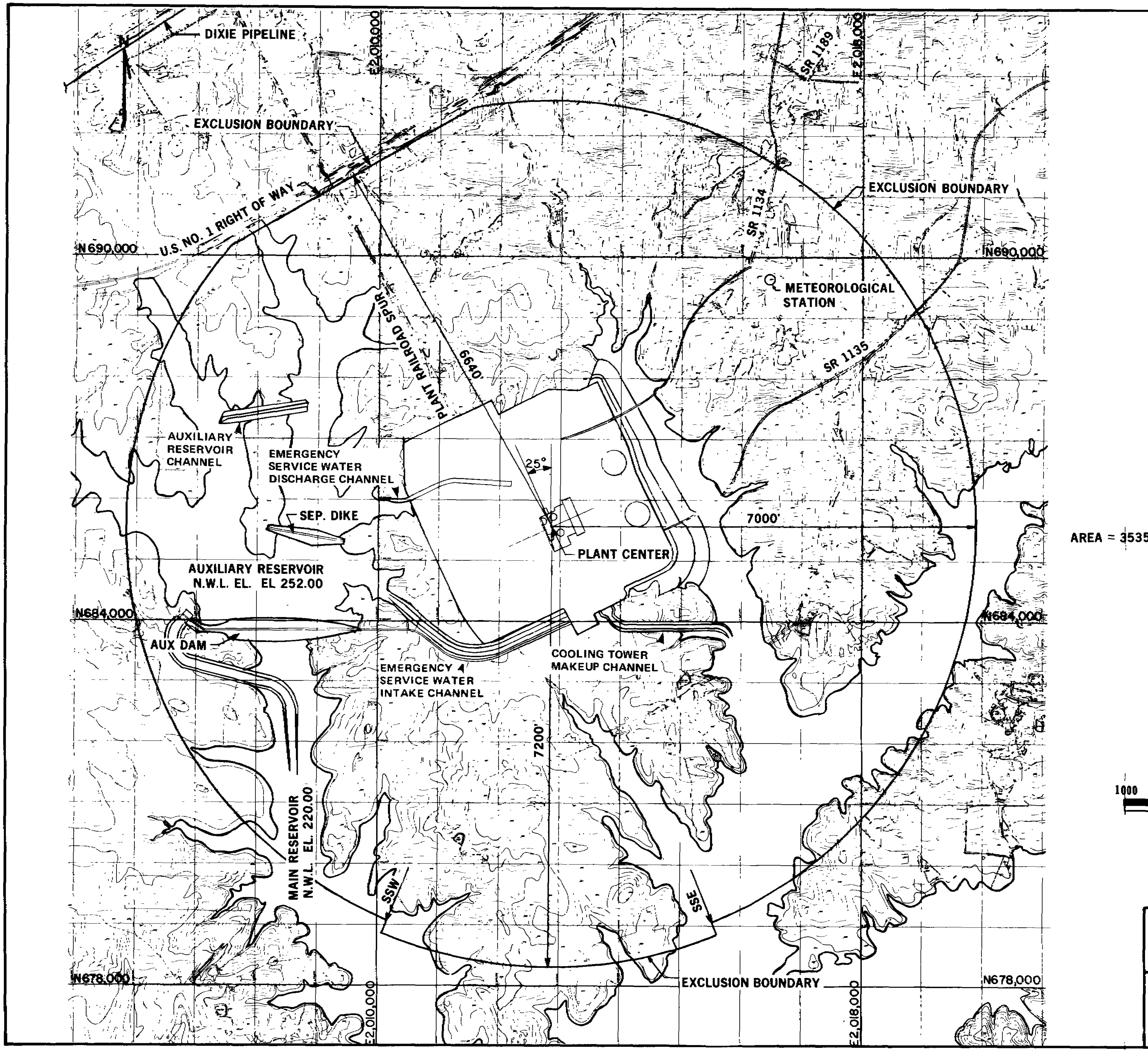
NOTE: SITE BOUNDARY IS ENCLOSED BY THE EXCLUSION BOUNDARY, THE EL 243 CONTOUR OF THE MAIN RESERVOIR, AND THE EL 260 CONTOUR OF THE AUXILIARY RESERVOIR.

AMENDMENT NO. 5, (12/82)

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
ENVIRONMENTAL REPORT

MAP OF SITE EXCLUSION BOUNDARY AND SITE BOUNDARY

FIGURE 2.1.1-1

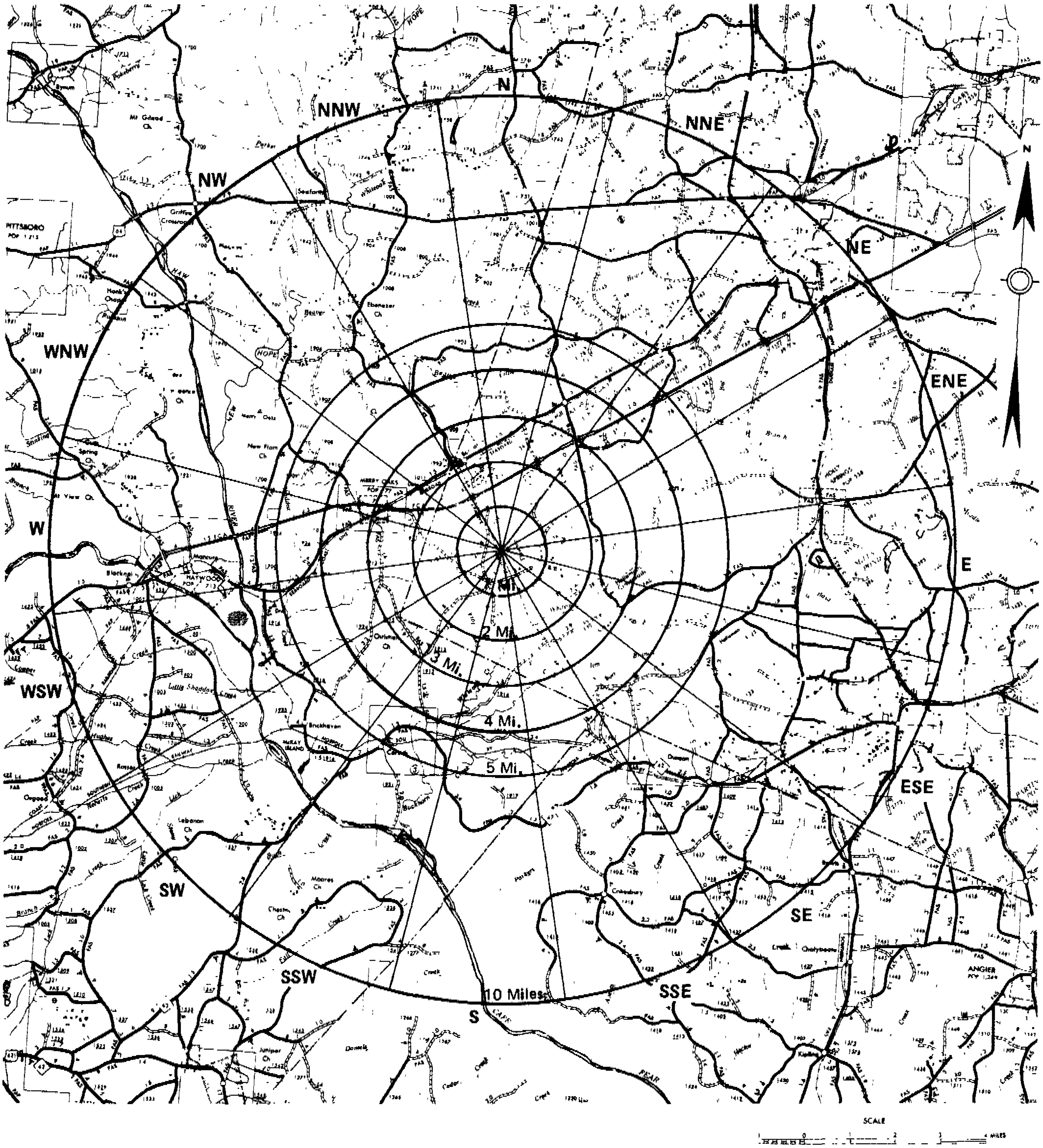


Amendment No. 5

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
ENVIRONMENTAL REPORT

SHNPP EXCLUSION BOUNDARY PLAN

FIGURE 2.1.1-2

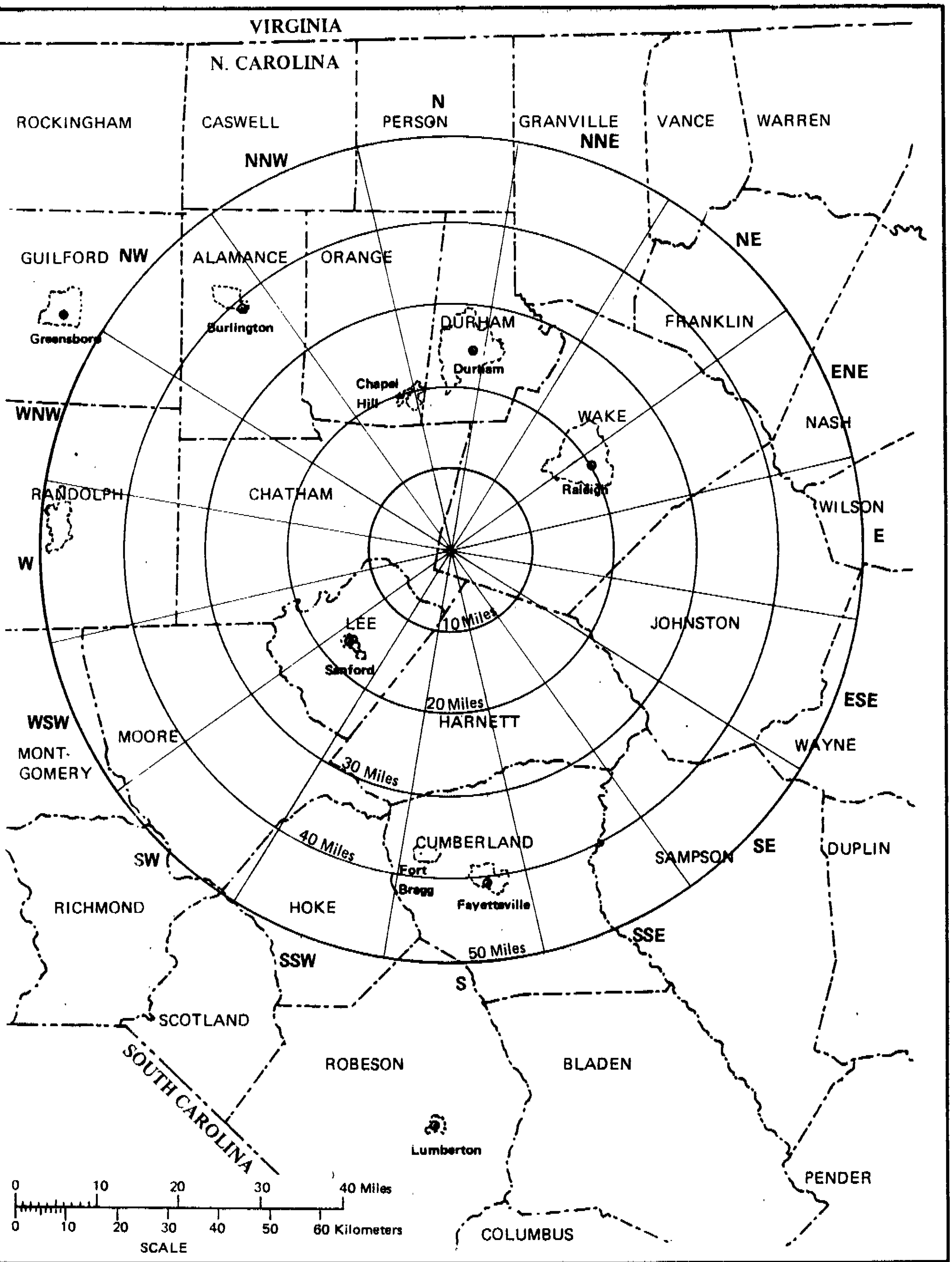


SHEARON HARRIS
NUCLEAR POWER PLANT
Carolina
Power & Light Company
ENVIRONMENTAL REPORT

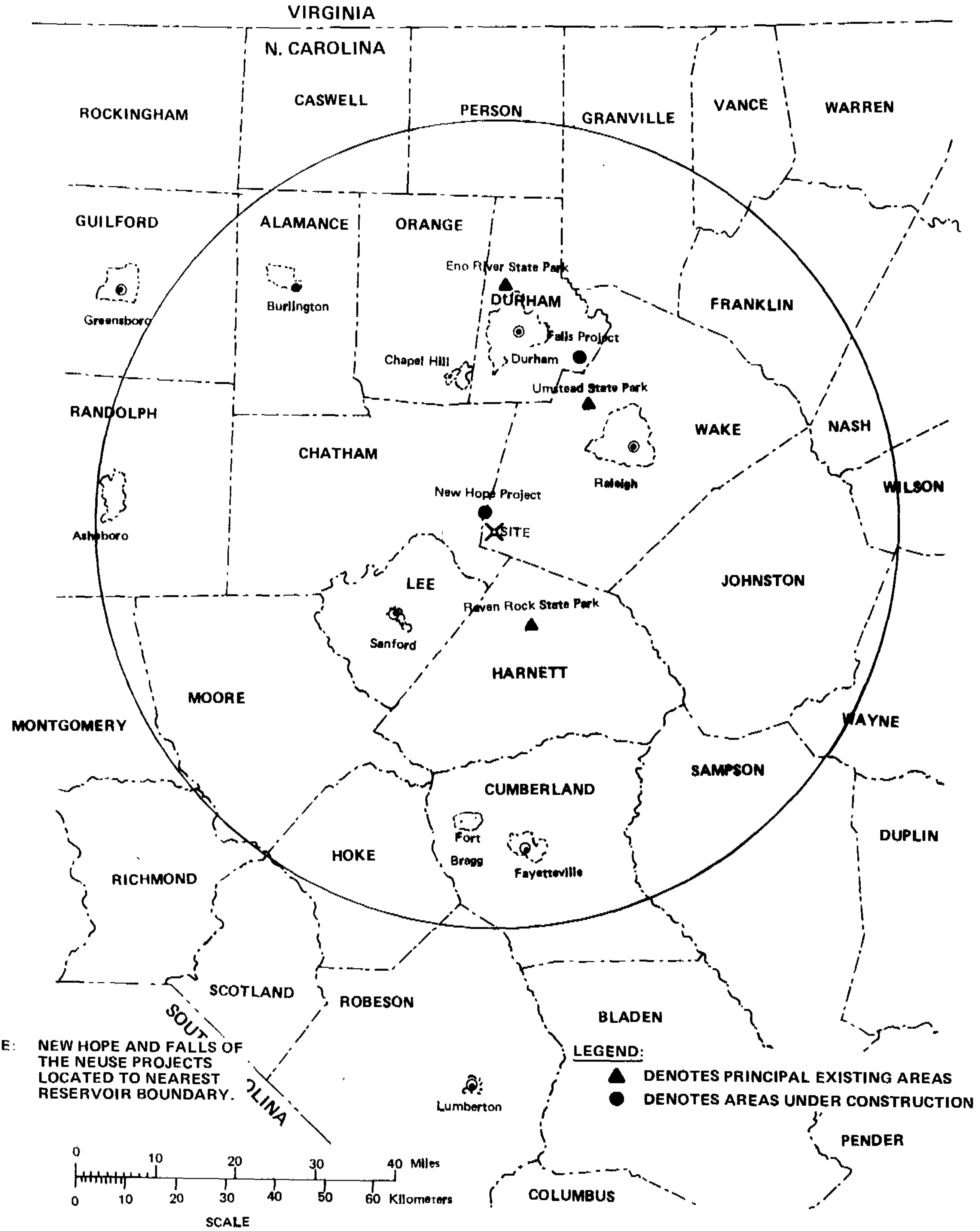
TEN MILE RADIAL AREA SURROUNDING THE SHEARON HARRIS NUCLEAR POWER PLANT

FIGURE

2.1.2-1



SHEARON HARRIS NUCLEAR POWER PLANT Carolina Power & Light Company ENVIRONMENTAL REPORT	FIFTY MILE RADIAL AREA SURROUNDING THE SHEARON HARRIS NUCLEAR POWER PLANT	FIGURE 2.1.2-2



NOTE: NEW HOPE AND FALLS OF THE NEUSE PROJECTS LOCATED TO NEAREST RESERVOIR BOUNDARY.

LEGEND:

▲ DENOTES PRINCIPAL EXISTING AREAS

● DENOTES AREAS UNDER CONSTRUCTION

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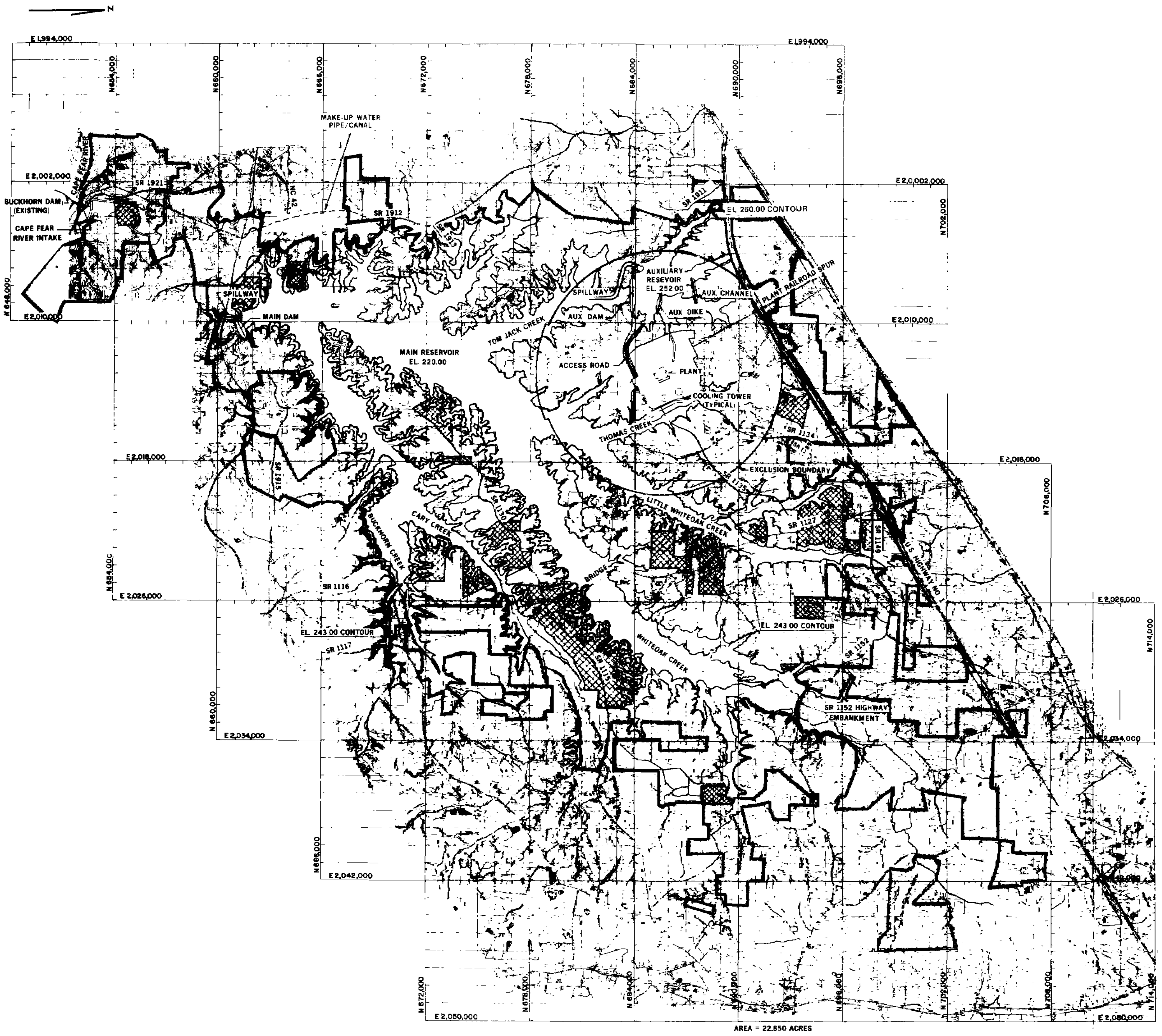
PRINCIPAL RECREATIONAL AREAS
WITHIN 50 MILES OF THE SHNPP

FIGURE

2.1.2-3



LEGEND:

▬ INDICATES CP&L PROPERTY BOUNDARY, EXCLUSION BOUNDARY AND SITE BOUNDARY

▨ INDICATES AREAS WITHIN ABOVE BOUNDARIES WHICH ARE NOT OWNED BY CP&L.

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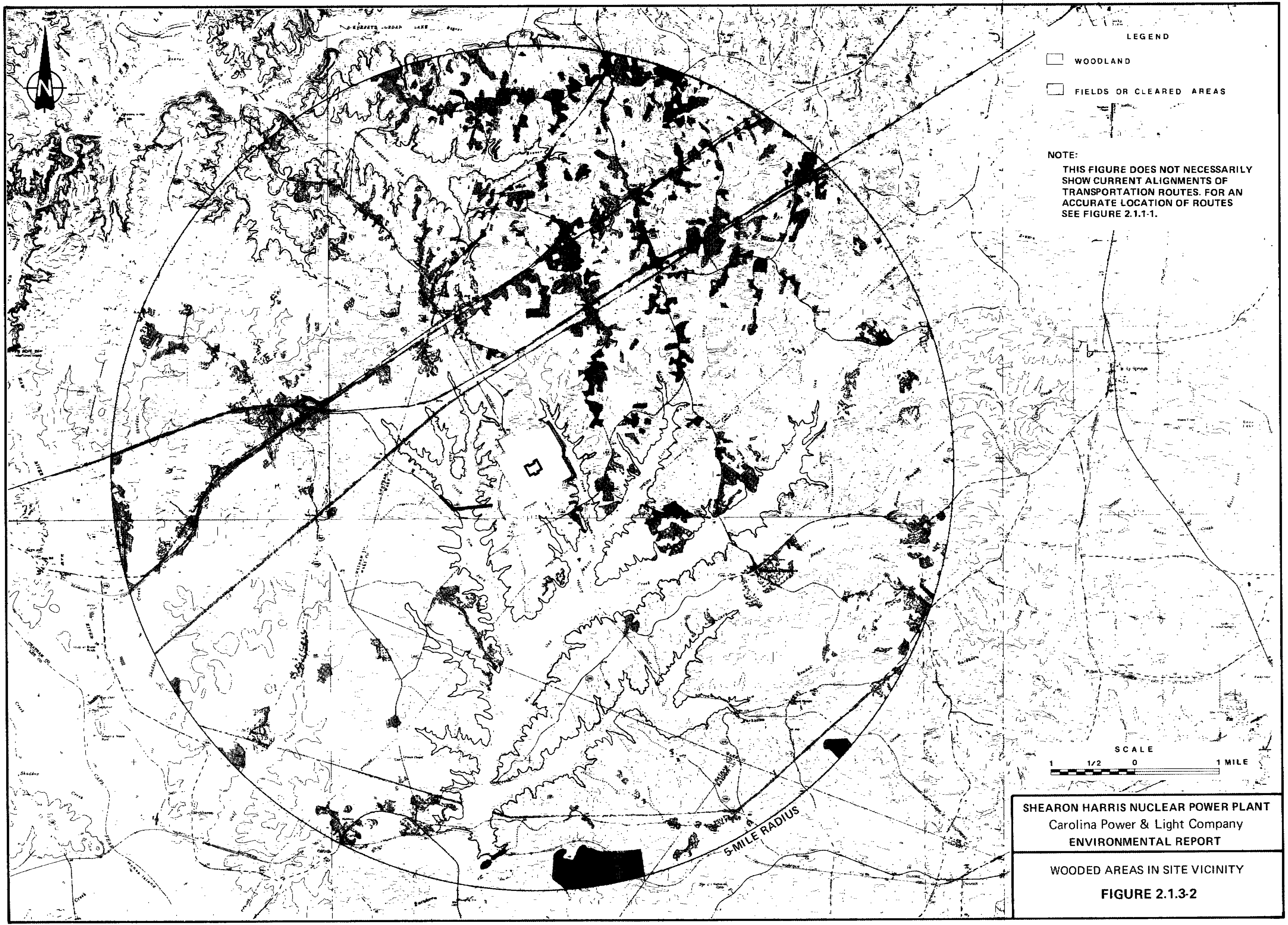
MAP OF EXCLUSION AREA, SITE AREA AND CP&L PROPERTY

FIGURE 2.1.3-1


LEGEND
☐ WOODLAND
☐ FIELDS OR CLEARED AREAS
NOTE:
THIS FIGURE DOES NOT NECESSARILY SHOW CURRENT ALIGNMENTS OF TRANSPORTATION ROUTES. FOR AN ACCURATE LOCATION OF ROUTES SEE FIGURE 2.1.1-1.
SCALE
1
1/2
0
1 MILE
5-MILE RADIUS
N

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WOODED AREAS IN SITE VICINITY

FIGURE 2.1.3-2

2.2.0 ECOLOGY

The SHNPP site is on the eastern edge of the Piedmont Plateau near the fall-line which separates the Piedmont and Coastal Plain physiographic provinces of North Carolina. The topography of the region is generally characterized by a gently rolling terrain dissected by small streams which are part of the Cape Fear River system. The streams in this system generally have distinct riffle and pool areas, with a gravel, rubble substrate in the riffles and with sandy, silty bottoms in the pools. Flows are moderate to low with extreme seasonal fluctuations.

Baseline ecology studies were initiated in April 1972 at the SHNPP site for CP&L by Aquatic Control, Inc., an ecological consulting company. The results of Aquatic Control's ecology studies through May 1974 were published in reports submitted to CP&L entitled "Baseline Biota of the Shearon Harris Nuclear Power Plant Study Area, North Carolina" (Reference 2.2.0-1) and "Baseline Biota of the Shearon Harris Nuclear Power Plant Study Area, June 1973 - May 1974" (Reference 2.2.0-2). After June 1974, the responsibility for terrestrial ecology studies was assumed by CP&L biologists. Aquatic Control, Inc. continued the aquatic ecology studies through March 1975, when CP&L biologists assumed that responsibility. The results of the aquatic biology studies performed by Aquatic Control, Inc. during that period were included in a report entitled "Aquatic Baseline Biota of the Shearon Harris Power Plant Study Area, North Carolina, 1974 - 1975" (Reference 2.2.0-3).

In October 1975, an NRC approved interim preconstruction monitoring program was substituted for the original baseline design. The interim program remained in effect until January 27, 1978, when the construction permit for the project was issued by the NRC. At that time, the program returned to the design as described for preoperational monitoring in the AEC's Revised Final Environmental Statement (Reference 2.2.0-4). The results of CP&L's preconstruction programs were presented in reports entitled "Shearon Harris Nuclear Power Plant, Pre-Construction Monitoring Report, Terrestrial Biology June 1974 - January 1978, Water Chemistry 1972-1977," (Reference 2.2.0-5) and "Annual Report: Shearon Harris Nuclear Power Plant, Baseline Monitoring Program, Aquatic Biology Unit, 1976 and 1977" (Reference 2.2.0-6). The results of CP&L's first year of monitoring after receipt of the construction permit were included in a report entitled "Shearon Harris Nuclear Power Plant, Annual Environmental Monitoring Report, Water Chemistry, Aquatic Biology, Terrestrial Biology, 1978" (Reference 2.2.0-7). The results of the second year of construction phase monitoring were included in a report entitled "Shearon Harris Nuclear Power Plant, Annual Environmental Monitoring Report for 1979" (Reference 2.2.0-8). 4

Additional ecological studies in the immediate site area were conducted by the North Carolina Wildlife Resources Commission (Reference 2.2.0-9) and the U. S. Bureau of Sport Fisheries and Wildlife (Reference 2.2.0-10). Fisheries studies of the general area have been conducted by the North Carolina Wildlife Resources Commission (Reference 2.2.0-11) and CP&L (Reference 2.2.0-12).

2.2.1 SITE TERRESTRIAL ECOLOGY

2.2.1.1 Site Terrestrial Flora

The SHNPP site occupies approximately 10,800 acres of land within the Buckhorn-Whiteoak Creek watershed, a tributary system of the Cape Fear River. Because the agricultural history of the Buckhorn-Whiteoak basin generally follows that of the Piedmont province, the entire project area is an aggregate of farmland, abandoned fields, and forests of various ages. While farming was once a major occupation on the SHNPP site, the primary land use at the time CP&L acquired the project land was the production of pulpwood and other wood products. The existing vegetation characteristics of the site were the outcome of disturbance through clearing, farming, and logging followed by the natural process of secondary succession. To identify the vegetation characteristics of the SHNPP site, baseline botanical investigations were designed to include qualitative and quantitative determinations of species and community types. Qualitatively, 452 species of vascular plants (Table 2 in Reference 2.2.0-5) were identified within seven generalized vegetative communities (Table 2.14 in Reference 2.2.0-4). These plants and communities were identified during field sampling throughout the project area with special emphasis within four terrestrial sample areas (Figure 2 in Reference 2.2.0-5). Quantitative botanical evaluations included vegetation cover mapping of the project area (Figures 3.6-1 through 3.6-6 in SHNPP Construction Permit Environmental Report) with the resulting acreage estimates (Table 2.14 in Reference 2.2.0-4) and quarter method analyses of the two wooded sample areas.

Estimates based on the 1972 vegetation cover map indicated that 8% of the SHNPP project area was in field and 14% was cutover woodlands. The remaining 78% was covered by forests of various types.

Results of botanical studies of four terrestrial sample areas indicated that the vegetation of the SHNPP project area was typical of the eastern portion of the Piedmont province of North Carolina. The fields and cleared areas were undergoing changes described as secondary or "old field" succession. The areas covered with forests were also undergoing successional changes, although these changes were not as easily detectable.

The two old field sample areas were representative of the majority of the fields throughout the project area. In 1972, these areas were dominated by various herbaceous plants such as grasses (Poaceae), asters (Asteraceae), and other forbs. By 1978, the areas were being invaded by woody species including pines (Pinus spp.), river birch (Betula nigra), black willow (Salix nigra), and oaks (Quercus spp). These changes in species dominance were expected and predictable, and if allowed to continue, would reflect the development of these areas into hardwood forests. |2

The two wooded transects were representative of the majority of the vegetation of the SHNPP project area. This included forests in various stages of succession, from young pine stands to fairly mature hardwood stands. These forests represented the later stages of secondary succession, and reflected the ultimate fate of the abandoned fields and cutover areas. Eventually, if not disturbed, the majority of the project area would become a forest

dominated by various species of oaks, hickories (*Carya* spp.), sourwood
2 (*Oxydendrum arboreum*), pines, and red maple (*Acer rubrum*) (Table 2.15 in
Reference 2.2.0-4). Some variation in species composition would occur in
areas along stream bottoms, where more water tolerant species such as river
birch, sycamore (*Platanus occidentalis*), and yellow poplar (*Liriodendron
tulipifera*) would predominate.

Because the creeks within the SHNPP site were generally well shaded and highly variable in flow, few aquatic macrophytes existed there. However, aquatic vegetation was prevalent along the banks of the Cape Fear River, and growths were readily visible among the exposed rocks and islands, especially during low flow conditions. The emergent water willow (*Justica americana*) was a macrophyte found in and along the river. Elodea (*Elodea canadensis*), filamentous algae (probably *Cladophora* sp.) and riverweed (*Podostemum ceratophyllum*) comprised a major portion of the aquatic river vegetation.

The results of construction phase monitoring at SHNPP are presented in the annual reports for 1978 and 1979 (References 2.2.0-7 and 2.2.0-8). Construction effects are discussed in Section 4.1.3 of the document.

2.2.1.2 Site Terrestrial Fauna

The available wildlife habitat in the Buckhorn-Whiteoak watershed, although diverse, generally was conceded to be of below average quality. That evaluation was initially based on a U. S. Bureau of Sport Fisheries and Wildlife survey of the Buckhorn-Whiteoak basin conducted in the fall of 1969 (Table 2.16 in Reference 2.2.0-4).

Generally, the wildlife habitat and the wildlife populations identified at the SHNPP site were characteristic of the Piedmont province of North Carolina. More specifically, the habitat and associated wildlife were typical of a highly exploited, but relatively uninhabited area of the Piedmont. A variety of non-game wildlife species was observed in the various habitats of the project area. Although small game species were common in appropriate habitats, big game species were nearly non-existent.

The baseline inventory study of the amphibians and reptiles inhabiting the SHNPP site was conducted by recording observations during all phases of terrestrial vertebrate field studies. The primary source of data regarding bird species inhabiting the SHNPP site was periodic roadside surveys. In addition to the quantitative data provided by the roadside surveys, qualitative information was obtained by recording observations by species throughout the project area with emphasis on the four terrestrial sample areas. Information concerning the game bird populations was obtained by conducting call count surveys along the avifauna routes during the spring and summer of 1976 and 1977. The mammal investigations of the SHNPP site consisted of small mammal trapping at the terrestrial sample areas supplemented by observations of mammals or mammal sign throughout the project area. A leafnest survey of the site was conducted in mid-winter of four consecutive years to assess the gray squirrel populations in various habitat types. The locations of terrestrial sample areas and survey routes are presented in Figures 2 and 3 of CP&L's 1978 terrestrial biology report (Reference 2.2.0-5).

Throughout the entire baseline study of the SHNPP site terrestrial fauna, 22 amphibian, 27 reptilian, 154 avian, and 28 mammalian species were observed (Tables 5, 6, 11, and 15 in Reference 2.2.0-5). Records of the terrestrial vertebrate species which were observed at the four terrestrial sample areas during the June 1974 through January 1978 period are given in Tables 9, 10, 13, and 16 (Reference 2.2.0-5). These data provide an indication of the more common vertebrate species comprising the faunal component of the communities represented by the sample areas.

The principal game birds at the SHNPP site included bobwhite (Colinus virginianus), mourning dove (Zenaidura macroura), wild turkey (Meleagris gallopavo), American woodcock (Philohela minor), and waterfowl (12 species). The relative values of these birds as recreational resources at the site ranged from quite high for bobwhite to very low for woodcock and wild turkey. Bobwhite appeared to be quite common and well distributed throughout the project area. Based on the results of the roadside game bird call count surveys (Table 14 in Reference 2.2.0-5), the breeding population of bobwhite at the SHNPP site was relatively stable between the 1976 and 1977 breeding seasons.

Mourning doves also were quite numerous and widely distributed within the project area. Information obtained for mourning doves during the game bird call counts (Table 14 in Reference 2.2.0-5) indicated a stable breeding population along the Holleman's Crossroads to Buckhorn Dam route, but suggested a declining breeding population along the Merry Oaks to Buckhorn Dam route. The reason for this apparent decline along the one route was not determined, but weather conditions during the specific surveys or subtle changes in habitat or food supply along that route may have been contributing factors.

Field observations indicated that a very small but possibly increasing population of wild turkey existed at the SHNPP site. These birds probably repopulated the Buckhorn-Whiteoak Creek drainage from remnant or reintroduced populations along the Cape Fear River. Only one survey during the two years of game bird call count surveys yielded information concerning wild turkey (Table 14 in Reference 2.2.0-5). On that occasion, a hen and a gobbler were heard calling along the Holleman's Crossroads to Buckhorn Dam route.

During the baseline study of the SHNPP site, 12 species of waterfowl (Table 11 in Reference 2.2.0-5) were observed on or near project land. The proximity of the site to the Cape Fear River contributed to the number of waterfowl species present. The low numbers of waterfowl observed are indicative of the deficiency of quality habitat available at the site.

Although observed on several occasions, American woodcock was not considered an important game species at the SHNPP site. These birds probably inhabited the moist stream banks and pond margins throughout the project area in small numbers during the winter months, with some nesting there during the breeding season.

The small mammal component of the four terrestrial sample areas at the SHNPP site was assessed by means of a trapping program. The results of the trapping effort (Tables 4.4-3, 4.4-4, 4.4-6, and 4.4-7 in Reference 2.2.0-1; Table 4.4-4 in Reference 2.2.0-2; Tables 18 - 21 in Reference 2.2.0-5) indicated that the more common species on the sample areas were shorttail shrew (Blarina spp.), hispid cotton rat (Sigmodon hispidus), and white-footed mouse (Permoycus leucopus).

The most common game mammal present on the SHNPP site was the gray squirrel Sciurus carolinensis). To evaluate the relative abundance of this animal within the various community types at the site, a leafnest survey was conducted during December of each year from 1974 through 1977. The results of these surveys (Table 22 and Figures 5 and 6 in Reference 2.2.0-5) indicated a continuous decline in numbers of leafnests per acre over the years surveyed in bottomland hardwood communities. In all other community types except cutover pines, the number of leafnests per acre fluctuated over the years with 1977 having the lowest counts. Although there were fluctuations over the years, the overall trend seemed to be downward in the number of leafnests per acre. Fluctuations in squirrel populations are commonly related to mast production which is affected by severe weather conditions such as summer drought or unusually long winters. After a good mast crop, the squirrel populations generally respond with high production of young in the next breeding season. Natural mortality including disease and predation are also contributing factors to population fluctuations.

No specific study was conducted to determine the status of cottontail rabbit (Sylvilagus floridanus) populations at the SHNPP site. But, based on the low numbers of observations recorded during the entire study, cottontail rabbits probably were not very numerous on the site.

The whitetail deer (Odocoileus virginianus) population at the SHNPP site was quite small but seemed to be increasing. Few actual deer sightings were made during the study, but the number, distribution, and frequency of deer track observations increased as the field study progressed.

Foxes were common throughout the project area. The gray fox (Urocyon cineroargenteus) was more numerous than the red fox (Vulpes vulpes). Bobcat (Lynx rufus) was uncommon within the project area, but at least one restricted area of the site supported a small population. In addition to fox and bobcat, other furbearing species found at or near the SHNPP site were opossum (Didelphis marsupialis), beaver (Castor canadensis), muskrat (Ondatra zibethica), raccoon (Procyon lotor), long-tail weasel (Mustela frenata), and skunk (Mephitis mephitis). Of these species, only the opossum was very common. The population levels of all the others appeared to be quite low. The limited wetlands at the site was the most likely reason for the low populations of these species.

The presence of feral dogs in relatively high numbers was evident during CP&L field investigations. The uninhabited nature of the site, while being quite close to the highly populated areas of Raleigh and its suburbs, made the site a favorable location for disposing of unwanted family pets. As a result, the sighting of packs of dogs or their tracks was a frequent occurrence during the field work at the site. These animals posed a significant threat to the native wildlife of the area.

The results of construction phase monitoring are presented in the annual reports for 1978 and 1979 (References 2.2.0-7 and 2.2.0-8). Construction effects are discussed in Section 4.1.3 of this document. 1

2.2.2 SITE AQUATIC ECOLOGY

2.2.2.1 Periphyton and Plankton

During 1972-1973, quarterly plankton samples were collected from two river and seven stream stations in the study area. Sampling locations and methodology are presented in Figure 2.2-1 in the Aquatic Control, Inc. report of 1974 (Reference 2.2.0-1). Common algal species were mainly benthic with the diatoms predominating. Chlorophytes (green algae) and cyanophytes (blue-green algae) dominated the phytoplankton population at the stream stations in April and were also present in the two river stations (Figures 3.1-1 and 3.1-3 in Reference 2.2.0-1). Chrysophytes (yellow-green or yellow-brown algae) dominated the river stations throughout the year and the streams during July, October, and January, while chlorophytes and cyanophytes were present in moderately dense populations (Figure 3.1-2 in Reference 2.2.0-1). Changes in numerical abundance of phytoplankters occurred at the different stations during the year (Table 3.1-2 in Reference 2.2.0-1).

Biological studies were conducted monthly from June 1973 through May 1974, at four river transects (Transects A, B, C, and D). Station locations and methods are presented in the Aquatic Control, Inc., report of 1975 (Reference 2.2.0-2). Algal communities in the river were dominated by members of the Bacillariophyceae (diatoms).

Members of the Chlorophyta (green algae) and Cyanophyta (blue-green algae) exhibited peaks from July to September and in April and May (Figures 3.1-1, 3.1-3, 3.1-7, and 3.1-8 in Reference 2.2.0-2). River transects located below Buckhorn Dam were dominated throughout the sampling period by periphytic and benthic diatoms, while the upstream transect supported a truly planktonic algal population. No major differences of the attached algal community in numerical abundance or species composition were detected between stations on the same transect. However, significant differences were noted in the phytoplankton communities among the various stations in the SHNPP study area. Seasonal variations and community organization followed similar trends at Transects A and D, while inverse trends were observed at Transects B and C.

The algal sampling program was continued from June 1974 through March 1975. The Aquatic Control, Inc. report of 1976 (Reference 2.2.0-3) presents methodology and station location. The four river transects (A, B, C, and D) were sampled in addition to two creek stations. Seasonal variation was demonstrated among the Bacillariophyceae and Chlorophyta. Green algae became co-dominant during the summer months. The diatoms predominated throughout the year and exhibited population maxima in July, February, and March (Figure 3.1-1 in Reference 2.2.0-3). The Chlorophyta and Bacillariophyceae comprised 85 percent of the phytoplankton numbers. There were significant transect differences in numbers among all the major groups of phytoplankton and total phytoplankton.

Buckhorn Creek supported fewer total numbers and kinds of algae than the Cape Fear River (Figure 3.1-4 in Reference 2.2.0-3). Thomas Creek had lower numbers and diversity of phytoplankton than any other station (Figure 3.1-5 in Reference 2.2.0-3). The river transects exhibited high levels of community organization (species composition and abundance). Buckhorn Creek diversity values were lower than those observed in the river but still were comparable to river transects. Thomas Creek reflected low levels of community organization. Species composition, abundance, and distribution of periphyton collected from the Cape Fear River and associated creeks during 1974-1975 were comparable to that of the 1973-1974 sampling period.

During April, 1975, CP&L initiated an interim algal monitoring program. Algae were sampled periodically at two more selected creek stations in addition to the previously sampled river and stream stations. Station locations, sampling data, and methods are presented in CP&L's aquatic biology report of 1978 (Reference 2.2.0-6). A total of 175 species of diatoms and 67 non-diatom algal species (Table 27 in Reference 2.2.0-6) were recorded from samples during 1975 and 1976. Similar major taxonomic groups of diatoms were collected at the river and creek stations. These included representatives of 14 families of the Bacillariophyceae.

Numerically dominant diatoms collected in 1975 and 1976 downstream of Buckhorn Dam included representatives of the family Achnanthaceae (Table 19, 20, and 21 in Reference 2.2.0-6), while upstream of the dam, the flora consisted of the families Coscinodiscaceae and Naviculaceae (Table 22 in Reference 2.2.0-6). Diatoms collected from the stream stations were dominated by members of the Achnanthaceae, Gomphonemaceae, Naviculaceae, and Tabellariaceae. Diatom flora collected from Thomas Creek were collected in extremely low numbers (Tables 23-26 in Reference 2.2.0-6).

The interim semiannual biological sampling program initiated by CP&L in 1975 was continued during 1977 with methods and collection locations referenced in the CP&L aquatic biology report of 1978 (Reference 2.2.0-6). During this sampling period, 185 species of diatoms and 67 species of non-diatom algae were collected. The data indicated that no major changes in algal abundance or composition had occurred from 1976 to 1977. The numerically dominant diatoms collected downstream of Buckhorn Dam included representatives of the families Achnanthaceae, Fragilariaceae, and Gomphonemaceae. The flora sampled upstream of the dam included the above mentioned families in addition to members of the Coscinodiscaceae, Naviculaceae, Nitzchiaceae, and Surirellaceae. Diatoms present in the creeks during 1977 were represented by all the above families and also the Eunotiaceae (Table 2.1 - 2.4 in Reference 2.2.0-6). These similar major taxonomic groups of diatoms were collected at the river and creek stations during 1976. In 1977, the numerical abundance of diatoms in the Cape Fear River and tributaries were found to be comparable to the numerical abundance observed in the 1976 sampling period.

1 The results of construction phase monitoring of periphyton populations on the SHNPP site are presented in the 1978 and 1979 annual reports (References 2.2.0-7 and 2.2.0-8). Construction effects on the aquatic communities are discussed in Section 4.1.4 of this document.

2.2.2.2 Benthic Macroinvertebrates

An eleven-month quarterly field sampling program, initiated in April 1972, provided baseline biological monitoring information on the benthic macroinvertebrates collected at selected stations located in the major streams of the area and in the Cape Fear River. Sampling station locations and methodology are presented in the Aquatic Control, Inc. report of 1974

(Reference 2.2.0-1). An overview of the species composition and relative abundance of benthic macroinvertebrates indicated aquatic insects (mostly larvae and nymphs) accounted for a great percentage of the total number of benthic organisms collected at selected stream and river stations during April 1972 through January 1973 (Reference 2.2.0-1). In addition, data presented in the Aquatic Control, Inc., report of 1974 (Reference 2.2.0-1), indicates some benthic groups such as the Hydropsychidae (Trichoptera) were generally more abundant in the river than in the streams. Mollusks were also more numerous in the river; however, several genera were common at both river and stream stations.

The biological monitoring of aquatic macroinvertebrates collected from the Cape Fear River was continued from June 1973 through May 1974. The Aquatic Control, Inc. report of 1975 (Reference 2.2.0-2), presents sampling station locations and methodology. A brief assessment of the benthic macroinvertebrate communities collected in the SHNPP study area is presented in the Aquatic Control, Inc. report of 1975 (Reference 2.2.0-2). Information contained in this reference indicates that "the benthic organisms of the study area show a wide variety of forms and fairly high number of individuals reflecting varied habitat types and generally favorable environmental conditions." The data also indicate that Ephemeroptera (mayflies) and Trichoptera (caddisflies), dominated by the Heptageniidae and Hydropsychidae, respectively, were the most numerous insect forms present below Buckhorn Dam. The Diptera (true flies) were also abundant, being represented by the Chironomidae (midges) downstream of the dam and the Chironomidae and Chaoboridae upstream of the dam. The Oligochaeta (segmented worms) were also numerous, represented mainly by the Tubificidae upstream of the dam and the Naididae at the downstream transects.

The biological monitoring of aquatic macroinvertebrates conducted monthly from June 1974 to March 1975 is presented in the Aquatic Control, Inc. report of 1976 (Reference 2.2.0-3). This reference presents sampling station locations and methodology. The composition, abundance, and distribution of benthic organisms collected from the Cape Fear River during June 1974 to March 1975 was similar to the composition, abundance, and distribution observed during the June 1973 through May 1974 sampling. In addition, Oligochaeta (Naididae) and chironomids (Orthocladiinae) were the dominant forms collected from the sandy substrate of Buckhorn Creek, while tubificid Oligochaetes dominated the benthic fauna of Thomas Creek where the bottom was composed of silt during most of the 1974-75 sampling period.

During April 1975, CP&L initiated an interim benthic biology monitoring program. Station locations, sampling dates, and methods are presented in the CP&L aquatic biology report of 1978 (Reference 2.2.0-6). Benthic macroinvertebrates were periodically sampled from April 1975 to June 1976 at four transects in the Cape Fear River and four selected tributary stations. During the sampling, 153 taxa were collected. These included representatives of Insecta, Mollusca, Turbellaria, Hirudinea, Oligochaeta, Polychaeta, Nematoda, Amphipoda, Coelenterata, and Decapoda. The numerically dominant organisms collected downstream of Buckhorn Dam included representatives of the Plecoptera (stone flies), Ephmeroptera, Diptera, and Trichoptera. Upstream of the dam, the benthic fauna was dominated by Diptera and Oligochaeta. Similar taxonomic groups of benthic organisms were collected at some stream stations with the numerically dominant organisms representing taxa of Trichoptera, Ephemeroptera, and Diptera. The benthic fauna at the Thomas Creek station was dominated by Diptera and Oligochaeta, while Plecoptera, Ephemeroptera and Trichoptera either were collected in low numbers or were absent from samples.

The interim benthic biology monitoring program mentioned above was continued during 1977, with station locations and methods presented in the CP&L aquatic biology report of 1978 (Reference 2.2.0-6). This data indicated that no major changes in benthic composition or abundance had occurred from 1976 through the 1977 sampling period. The numerical abundance of dominant organisms collected from both Cape Fear River and stream stations during 1976 was similar to the numerical abundance observed during the 1977 sampling period.

1 The results of construction phase monitoring of benthic macroinvertebrates are presented in the 1978 and 1979 annual reports (References 2.2.0-7 and 2.2.0-8). Construction effects on these organisms are discussed in Section 4.1.4 of this document.

2.2.2.3 Fisheries

2.2.2.3.1 Fish Communities

The Aquatic Control, Inc. and CP&L studies have identified a total of 51 species of fishes from the Cape Fear River within the site area (Table 2.2.2-1). A total of 69 species have been identified from both the Cape Fear River and the stream stations within the site area (Table 2.2.2-2) with 54 species occurring at the stream stations (Table 2.2.2-3). This high number of species reflects the location of the site area in the fall zone, the major transition area between the Piedmont and Coastal Plain provinces. The ichthyofauna of the fall zone typically is species rich and includes species common to both upland habitats and coastal plain habitats. The presence of Buckhorn Dam (Figure 1 in Reference 2.2.0-6, Part A) provides for a semi-lentic habitat immediately upstream of the dam in contrast to the typically lotic stream habitat below the dam. This diversity in habitat resulting from the presence of the dam and the location of the site area in the fall zone contributed to the high number of species in the area.

The presence of several dams on the Cape Fear River downstream of Buckhorn Dam has placed limitations on the number of migratory fishes that can move upstream into the site area. Migratory fishes can move into the area only during periods of very high water. This is necessary to enable them to travel over the low-level dams on the river. Few fishes, other than local migratory fishes [i.e., suckers (Catostomids) and gars (Lepisosteids)], move up the river. The only truly migratory fish collected has been the American shad (Alosa sapidissima). This fish has been collected on rare occasions and in small numbers (Table 2.2.2-1 and References 2.2.0-1 and 2.2.0-2). Further migrations up the Buckhorn Creek system is inhibited by the existence of an old dam for an out-of-service hydroelectric plant in the lower reach of the stream. These factors make the migration of fishes into the area to be impounded by this project possible only during extremely high water levels for sustained periods of time. It is unlikely that any area normally utilized by migratory species was impounded by the SHNPP Main Dam or that any migratory species was trapped in the resulting flooded area.

Although the total number of species collected has varied from year to year (Tables 2.2.2-1 and 2.2.2-3), the major components (species) of community structures have not varied significantly over the years (Reference 2.2.0-6). Three fairly distinct communities exist in the area. Upstream of Buckhorn Dam, a lake-type community exists - dominated (numerically) by sunfish. Below the dam, a riverine community exists - dominated numerically by cyprinids, ictalurids and sunfish. On the reservoir site, stream communities existed in the creeks - dominated by cyprinids (numerically). The habitat differences account for the community differences existing in the area. The variation in the number of species collected from year to year is mainly a function of the number of samples collected and the season during which the sampling was conducted. Basically, the abundances of organisms collected have been stable throughout the sampling (Reference 2.2.0-6). The species not collected over the entire time period have normally been few in number and weight; the low numbers render the variance in abundance and biomass as insignificant to the community structures. Also, in river or stream habitats minor changes (major over longtime periods) are not uncommon due to the changing or unstable environment, which differs considerably from a more static lake environment.

Information collected on fisheries during construction phase monitoring is
presented in the 1978 and 1979 annual reports (References 2.2.0-7 and 2.2.0- 1
8). Construction effects on the fisheries of the site are discussed in
Section 4.1.4 of this document.

2.2.2.3.2 Important Fish Species: Recreational and Commercial Species

The U. S. Bureau of Sport Fisheries and Wildlife conducted an evaluation of
Whiteoak Creek during 1969 (Reference 2.2.0-10). They found that there were 1
negligible sport and commercial fisheries in the area. The only substantial
fisheries existing in the area are on the Cape Fear River. Below Buckhorn
Dam, the fisheries are limited, except during the early spring when sucker
fishermen are active during spawning runs. Above Buckhorn Dam, the more
lake-like habitat encourages a sport fishery for sunfish and catfish
throughout the year and a limited commercial fishery for catfish. The
negligible sport and commercial fisheries of the Buckhorn-Whiteoak Creek
System will develop into a viable sport fishery after impoundment. This
fishery probably will be similar in composition to the fishery existing above
Buckhorn Dam on the Cape Fear River (Reference 2.2.0-6 and 2.2.0-12). 1

The following list includes those species in the area that might contribute to the sport fishery of the SHNPP reservoir:

a) Gizzard shad (*Dorosoma salmoides*) - This filter feeder is a very
common forage fish and is possibly a major component of the prey utilized by
predators in the study area (Reference 2.2.0-6). Because they are open-water
spawners and are numerous above Buckhorn Dam (Reference 2.2.0-12), a 1
significant population should develop in the SHNPP reservoir.

b) Largemouth bass (*Micropterus salmoides*) This predator probably is the
top predator of the study area above Buckhorn Dam (References 2.2.0-6 and
2.2.0-12). It is fished quite frequently in this area and seems to maintain a 1
healthy population, as indicated by age-growth comparisons (Table 1.15 in

Reference 2.2.0-6). Because they spawn in nests built in the shallows, the SHNPP reservoir should offer ample breeding grounds.

c) Bluegill (Lepomis macrochirus) - This sunfish is a very common panfish in the study area. It is actively fished in the Cape Fear River and comprises a major portion of the sunfish community (References 2.2.0-6 and 2.2.0-12). Age-growth of bluegill in the study area compares well with the regional age-growth values (Table 1.15 in Reference 2.2.0-6). They, like most sunfish, spawn in nests in shallows, which should be adequately available in the SHNPP reservoir.

d) Redear sunfish (Lepomis microlophus) - Although this sunfish exists above Buckhorn Dam (References 2.2.0-6 and 2.2.0-12), it does not have a large population in the study area. In other areas of this region, it is an abundant and desirable gamefish. This species may become an important component of the fish community in the SHNPP reservoir due to more favorable habitat.

e) Black and white crappie (Pomoxis nigromaculatus and P. annularis) - These sunfish are efficient predators and desirable sport fish. They, especially black crappie, are fairly common in certain areas above Buckhorn Dam (Reference 2.2.0-12). These species build nests in shallows and require more vegetation and cover than most of the other sunfish. If there is adequate cover in the SHNPP reservoir, the crappies could become a significant component of the sport fishery.

f) White catfish (Ictalurus catus) - This catfish is common in the study area above Buckhorn Dam (References 2.2.0-6 and 2.2.0-12), where it is commonly fished with set lines and by angling. This common fish should be present in the SHNPP reservoir.

g) Channel catfish (Ictalurus punctatus) - This catfish is abundant in the study area (References 2.2.0-6 and 2.2.0-12). Similar to the white catfish, it is actively fished and should establish itself in the SHNPP reservoir.

h) Snail bullhead (Ictalurus brunneus) - The snail bullhead is a little known ictalurid of the region. It is actively fished in other areas, but is common only below Buckhorn Dam in the study area (References 2.2.0-6 and 2.2.0-12). Some age-growth comparisons have been conducted (Table 1.15 in Reference 2.2.0-6), but there is little data on the habits or requirements for this species. The development of a population of this species in the SHNPP reservoir is uncertain.

TABLE 2.2.2-1

COMPARISONS OF FISH COLLECTIONS MADE FROM 1972 TO 1977 IN THE CAPE FEAR RIVER

	Species	1972-1973*	1973-1974*	1974-1975*	1976	1977	
1.	*Lepisosteus osseus*	X	X	X	X	X	
2.	*Amia calva*	X	X	X	X	-	
3.	*Anguilla rostrata*	X	X	X	X	X	
4.	*Alosa sapidissima*	X	X	-	-	-	
5.	*Dorosoma cepedianum*	X	X	X	X	X	
6.	*Esox a. americanus*	X	-	-	-	-	
7.	*E. niger*	-	-	X	-	-	
8.	*Cyprinus carpio*	X	X	X	X	X	
9.	*Hybognathus nuchalis*	-	-	-	-	X	
10.	*Nocomis leptocephalus*	-	X	-	-	-	
11.	*Notemigonus crysoleucas*	-	X	X	X	X	
12.	*Notropis albeolus*	-	X	-	-	-	
13.	*N. alborus*	-	-	-	X	-	
14.	*N. altipinnis*	-	X	-	-	X	
15.	*N. amoenus*	X	X	X	X	-	
16.	*N. analostanus*	X	X	X	X	X	
17.	*N. hudsonius*	X	X	X	X	X	| 1
18.	*N. mekistocholas*	-	-	X	-	-	
19.	*N. niveus*	-	X	X	X	X	
20.	*N. petersoni*	-	-	X	-	-	
21.	*N. procne*	-	-	X	X	X	
22.	*N. scepticus*	X	X	X	X	X	
23.	*N. volucellus*	-	-	X	-	X	
24.	*Carpiodes velifer*	-	X	-	X	-	
25.	*Moxostoma anisurum*	X	X	X	X	X	
26.	*M. macrolepidotum*	X	X	X	X	X	
27.	*M. robustum*	X	-	-	-	-	
28.	*Minytrema melanops*	-	-	-	X	X	
29.	*Ictalurus brunneus*	-	X	X	X	X	
30.	*I. catus*	-	X	X	X	X	
31.	*I. melas*	-	-	-	X	-	
32.	*I. natalis*	-	-	-	X	-	
33.	*I. nebulosus*	-	X	X	X	X	
34.	*I. platycephalus*	X	-	-	-	X	
35.	*I. punctatus*	X	X	X	X	X	
36.	*Pylodictis olivaris*	-	-	-	X	X	
37.	*Noturus insignis*	X	X	X	X	X	
38.	*Gambusia affinis*	-	X	X	X	-	
39.	*Enneacanthus gloriosus*	-	-	-	X	-	
40.	*Lepomis auritus*	X	X	X	X	X	
41.	*L. cyanellus*	-	-	-	X	X	
42.	*L. gibbosus*	X	X	X	X	X	

*From Aquatic Control, Inc. (References 2.2.0-1, 2, 3)

TABLE 2.2.2-1 (Continued)

	Species	1972-1973*	1973-1974*	1974-1975*	1976	1977
43.	*L. gulosus*	-	X	-	X	-
44.	*L. macrochirus*	X	X	X	X	X
45.	*L. marginatus*	-	X	-	-	-
46.	*L. microlophus*	-	X	X	X	X
47.	*Micropterus salmoides*	X	X	X	X	X
48.	*Pomoxis annularis*	-	X	-	X	-
49.	*P. nigromaculatus*	-	X	X	X	X
50.	*Etheostoma olmstedi*	-	X	-	X	X
51.	*Percina crassa*	X	X	X	X	X
	Total	22	35	31	38	32

*From Aquatic Control, Inc. (References 2.2.0-1, 2, 3)

TABLE 2.2.2-2

COMMON AND SCIENTIFIC NAMES OF FISHES COLLECTED FROM THE CAPE FEAR RIVER AND SHNPP SITE

Common Name	Scientific Name	
Lepisosteidae		
1. Longnose gar	*Lepisosteus osseus*	
Amiidae		
2. Bowfin	*Amia calva*	
Anguillidae		
3. American eel	*Anguilla rostrata*	
Clupeidae		
4. American shad	*Alosa sapidissima*	
5. Gizzard shad	*Dorosoma cepedianum*	
Escocidae		
6. Chain pickerel	*Esox niger*	
7. Redfin pickerel	*E. americanus americanus*	
Cyprinidae		
8. Rosyside dace	*Clinostomus funduloides*	
9. Carp	*Cyprinus carpio*	
10. Silvery minnow	*Hybognathus nuchalis*	
11. Bluehead chub	*Nocomis leptocephalus*	
12. Golden shiner	*Notemigonous crysoleucas*	
13. White shiner	*Notropis albeolus*	
14. Whitemouth shiner	*N. alborus*	
15. Highfin shiner	*N. altipinnis*	
16. Comely shiner	*N. amoenus*	
17. Satinfin shiner	*N. analostanus*	
18. Crescent shiner	*N. cerasinus*	
19. Dusky shiner	*N. cummingsae*	
20. Spottail shiner	*N. hudsonius*	
21. Whitetail shiner	*N. galacturus*	
22. Yellowfin shiner	*N. lutipinnis*	
23. Cape Fean shiner	*N. mekistocholas*	
24. Whitefin shiner	*N. niveus*	
25. Coastal shiner	*N. petersoni*	
26. Swallowtail shiner	*N. procne*	
27. Sandbar shiner	*N. scepticus*	
28. Mimic shiner	*N. volucellus*	
29. Creek chub	*Semotilus atromaculatus*	
Catostomidae		
30. Highfin carpsucker	*Carpiodes verifer*	
31. Northern hogsucker	*Hypentelium nigricans*	1
32. Creek chubsucker	*Erimyzon oblongus*	
33. Spotted sucker	*Minytrema melanops*	
34. Silver redhorse	*Moxostoma anisurum*	
35. Shorthead redhorse	*M. macrolepidotum*	
36. Suckermouth redhorse	*M. papillosum*	
37. Smallfin redhorse	*M. robustum*	
38. Striped jumprock	*M. rupiscartes*	

TABLE 2.2.2-2 (Continued)

Common Name	Scientific Name	
Ictaluridae		
39. Snail bullhead	*Ictalurus brunneus*	
40. White catfish	*I. catus*	
41. Black bullhead	*I. melas*	
42. Yellow bullhead	*I. natalis*	
43. Brown bullhead	*I. nebulosus*	
44. Channel catfish	*I. punctatus*	
45. Flat bullhead	*I. platycephalus*	
46. Flathead catfish	*Pylodictis olivaris*	
47. Tadpole madtom	*Noturus gyrinus*	
48. Margined madtom	*N. insignis*	
Aphredoderidae		
49. Pirate perch	*Aphredoderus sayanus*	
Cyprinodontidae		
50. Northern studfish	*Fundulus catenatus*	
51. Speckled killifish	*F. rathbuni*	
Poeciliidae		
52. Mosquitofish	*Gambusia affinis*	
Centrarchidae		
53. Mud sunfish	*Acantharchus pomotis*	
54. Flier	*Centrarchus macropterus*	
55. Bluespotted sunfish	*Enneacanthus gloriosus*	
56. Redbreast sunfish	*Lepomis auritus*	
57. Green sunfish	*L. cyanellus*	
58. Pumpkinseed	*L. gibbosus*	
59. Warmouth	*L. gulosus*	
60. Bluegill	*L. macochirus*	
61. Dollar sunfish	*L. marginatus*	
62. Redear sunfish	*L. microlophus*	
63. Largemouth bass	*Micropterus salmoides*	
64. White crappie	*Pomoxis annularis*	
65. Black crappie	*P. nigromaculatus*	
Percidae		
66. Swamp darter	*Etheostoma fusiforme*	
67. Tessellated darter	*E. olmstedi*	1
68. Sawcheek darter	*E. serriferum*	
69. Piedmont darter	*Percina crassa*	

TABLE 2.2.2-3

COMPARISONS OF FISH SPECIES COLLECTED FROM 1972 TO 1977 IN THE SHNPP SITE CREEKS

Species	1972-1973*	1973-1974*	1974-1975*	1976	1977	
1. *Anguilla rostrata*	X		X	X	X	
2. *Dorosoma cepedianum*	-		-	-	-	
3. *Esox a. americanus*	X		X	X	X	
4. *E. niger*	X		-	X	-	
5. *Clinostomus funduloides*	X		-	X	-	
6. *Nocomis leptocephalus*	X		X	X	X	
7. *Notemigonus crysoleucas*	X		X	X	X	
8. *Notropis albeolus*	X		-	X	X	
9. *N. alborus*	X		X	X	X	
10. *N. altipinnis*	-		-	X	X	
11. *N. amoenus*	-		X	X	X	
12. *N. analostanus*	-		X	X	X	
13. *N. cerasinus*	-		-	X	X	
14. *N. cummingsae*	X		-	X	X	
15. *N. hudsonius*	X		-	-	X	
16. *N. galacturus*	-		-	X	-	
17. *N. lutipinnis*	-		-	X	-	
18. *N. mekistocholas*	X		-	-	-	
19. *N. niveus*	X		-	X	-	
20. *N. petersoni*	X		X	X	-	
21. *N. procne*	X		X	X	X	
22. *N. scepticus*	X		X	X	X	
23. *Semotilus atromaculatus*	X		-	X	-	
24. *Hypentelium nigricans*	-		-	X	-	1
25. *Erimyzon oblongus*	X		X	X	X	
26. *Moxostoma anisurum*	-		-	X	X	
27. *M. pappillosum*	X		-	-	-	
28. *M. robustum*	X		-	-	-	
29. *M. rupiscartes*	-		-	X	X	
30. *Ictalurus brunneus*	-		X	X	X	
31. *I. catus*	-		-	X	-	
32. *I. natalis*	-		X	X	-	
33. *I. nebulosus*	-		-	X	-	
34. *I. platycephalus*	X		-	X	-	
35. *Noturus gyrinus*	-		X	X	-	
36. *N. insignus*	X		-	X	X	
37. *Aphredoderus sayanus*	X		X	X	X	
38. *Fundulus catenatus*	-		-	X	-	
39. *F. rathuni*	X		X	X	X	
40. *Gambusia affinis*	X		X	X	-	
41. *Acantharchus pomotis*	X		-	X	-	
42. *Centrarchus macropterus*	-		X	-	-	1

*From Aquatic Control, Inc. (References 2.2.0-1, 2, 3)

TABLE 2.2.2-3 (Continued)

Species	1972-1973*	1973-1974*	1974-1975*	1976	1977
43. *Enneacenthus gloriosus*	-		-	-	X
44. *Lepomis auritus*	X		X	X	X
45. *L. cyanellus*	X		X	X	X
46. *L. gibbosus*	X		X	X	X
47. *L. gulosus*	X		X	X	X
48. *L. macrochirus*	X		X	X	X
49. *L. microlophus*	-		-	-	X
50. *Micropterus salmoides*	X		X	X	X
51. *Etheostoma fusiforme*	-		-	-	X
52. *E. olmstedi*	X		X	X	X
53. *E. serriferum*	X		X	-	-
54. *Percina crassa*	X		X	X	X
Total	34	-	27	44	32

*From Aquatic Control, Inc. (References 2.2.0-1, 2, 3)

2.2.3 SPECIES OF SPECIAL INTEREST

2.2.3.1 United States and North Carolina Endangered Species Legislation

All plant and animal species identified on or near the SHNPP site were reviewed for endangered or threatened status as afforded by the United States Endangered Species Act or applicable North Carolina regulations. The source list for federally endangered and threatened species was the list of "Endangered and Threatened Wildlife and Plants: Republication" (Reference 2.2.3-1) and subsequent *Federal Register* notices. North Carolina regulations (Reference 2.2.3-2) provided duplicative state protection for those federally listed species found in North Carolina.

Only two species found in the area, the bald eagle (*Haliaeetus leucocephalus*) and the red-cockaded woodpecker (*Picoides borealis*), are protected by federal or state endangered species legislation. Both species are listed as endangered.

The biological field data revealed records of six separate sightings of individual bald eagles. Those records were dated August 1973, April 1974, July 1974, April 1981, August 1981, and August, 1982. Of the six eagles sighted since 1972, four were observed near the Cape Fear River and two were observed at the newly created SHNPP reservoir. Spring and summer observations of bald eagles in the Raleigh-Durham area are not rare occurrences, particularly with the development of several large impoundments such as the SHNPP Main Reservoir, the B. Everett Jordan Reservoir, and the Falls of the Neuse Reservoir. It is expected that the creation of the SHNPP Main Reservoir will result in more eagle sightings since the reservoir will provide an attractive feeding and resting area for migrant or wandering bald eagles.

A single red-cockaded woodpecked observation was made in October, 1972. One inactive red-cockaded woodpecker cavity tree was located in New Hill, North Carolina, along SR 1411 (within five miles of the plant) in March 4
1979. The location of this tree was reported to biologists at North Carolina State University who are undertaking a statewide survey of red-cockaded woodpecker occurrence. This locality has been logged by the private landowner and the tree is no longer standing. The NCSU biologists reported two additional sightings. An individual woodpecker had been sighted during the winter of 1979 near the Chatham-Harnett county line (approximately five miles from the SHNPP) and an active cavity start was reported in January 1981. This tree was apparently still being worked by the birds, although a true cavity had not yet been constructed. This tree, located 1 mile south of the New Hill exit on the west side of U.S. 1, was examined during the summer of 1982 by CP&L biologists. At that time a second tree was being excavated and the cavity in the first was apparently complete. This additional information indicates that red-cockaded woodpeckers occur, and did occur, in areas surrounding the SHNPP. However, since only marginally suitable habitat for this woodpecker species existed before project construction, it is concluded that the SHNPP project does not represent a threat to the status of the red-cockaded woodpecker species.

2.2.3.2 North Carolina Endangered Species Symposium Status

Four species of plants which were identified on or near the SHNPP site are listed as endangered or threatened by a North Carolina endangered species symposium proceedings published in *Endangered and Threatened Plants and Animals of North Carolina* (Reference 2.2.3-3). The four species [*Tradescantia hirsuticaulis*, largetooth aspen (*Populus grandidentata*), avens (*Geum vernum*) and ginseng (*Panax quinquefolium*)] are neither cited in the federal listing of "Endangered and Threatened Wildlife and Plants" (Reference 2.2.3-1) nor in the federal proposed list of endangered plants entitled "Endangered and Threatened Species: Plants" (Reference 2.2.3-4). Although avens, largetooth aspen and ginseng were reported from the SHNPP site, their presence and specific location cannot be confirmed. These species were reported during early studies, but voucher specimens were not collected. The geographic distribution of largetooth aspen and avens probably excludes their presence from the site, and their inclusion in the site species list is probably due to misidentification. *Tradescantia hirsuticaulis* was collected at the site, but its known distribution is limited to an area that will not be disturbed by the SHNPP project.

Another plant species, harbinger-of-spring (*Erigenia bulbosa*) appeared on the list of species collected at the SHNPP site between May 1973 and April 1974. Because this species previously had never been collected in North Carolina, CP&L biologists made intensive field searches in the spring of 1975 and 1976 at the reported place of collection. The plant was not located and, therefore, its presence or absence cannot be confirmed. The species was reportedly located on the site where the habitat would not be disturbed in any way, so there would be no danger of eliminating the plant should it occur there.

Thirty-nine species of terrestrial vertebrates observed on or near the SHNPP site during the preconstruction study period (1972 - January 1978) were of various concern to the participants of the North Carolina symposium. These species are shown in Table 23 in Reference 2.2.0-5. The bald eagle and red-cockaded woodpecker were listed as endangered. Seven species [turkey vulture (*Cathartes aura*), black vulture (*Coragyps atratus*), sharp-shinned hawk (*Accipiter striatus*), Cooper's hawk (*Accipiter cooperii*), red-shouldered hawk (*Buteo lineatus*), warbling vireo (*Vireo gilvus*), and brown creeper (*Certhia familiaris*)] were considered threatened. The remaining species had lesser or "undetermined" status. Discussions of the concerns for these species in North Carolina are contained in Reference 2.2.3-3.

One fish species found near the SHNPP site, the Cape Fear shiner (*Notropis mekistocholas*), was identified in Reference 2.2.3-3 as being of "special concern" in the Cape Fear River drainage. The Cape Fear shiner is endemic to several tributaries of the Haw, Deep, and Cape Fear rivers near the site area. However, only one specimen of this species was found in the area under study (Reference 2.2.0-6), and that specimen was not found in the area to be impounded. This indicates that no habitat being used by this unique species will be removed from its range. For a further discussion, see References 2.2.0-11 and 2.2.3-5.

None of the invertebrate fauna found on or near the SHNPP site were identified as endangered, threatened and/or of "special concern" in Reference 2.2.3-3.

Information collected during the construction phase monitoring program is presented in the 1978 and 1979 annual reports (References 2.2.0-7 and 2.2.0-8). Construction effects are discussed in Sections 4.1.3 and 4.1.4 of this document.

2.2.3 SPECIES OF SPECIAL INTEREST

2.2.3.1 United States and North Carolina Endangered Species Legislation

All plant and animal species identified on or near the SHNPP site were reviewed for endangered or threatened status as afforded by the United States Endangered Species Act or applicable North Carolina regulations. The source list for federally endangered and threatened species was the list of "Endangered and Threatened Wildlife and Plants: Republication" (Reference 2.2.3-1) and subsequent *Federal Register* notices. North Carolina regulations (Reference 2.2.3-2) provided duplicative state protection for those federally listed species found in North Carolina.

Only two species found in the area, the bald eagle (*Haliaeetus leucocephalus*) |1
and the red-cockaded woodpecker (*Picoides borealis*), are protected by federal or state endangered species legislation. Both species are listed as endangered.

The biological field data revealed records of three separate sightings of individual bald eagles. Those records were dated August 1973, April 1974, and July 1974. Because these birds were observed along the Cape Fear River and not actually within the project boundaries and because no sightings have been made for nearly six years, the SHNPP development cannot realistically be considered a threat to any local or regional bald eagle populations.

A single red-cockaded woodpecker observation was made in October 1972. No other observations of this species occurred after that date throughout many years of additional field studies. No characteristic red-cockaded woodpecker cavity trees were found on the site. Further, the site did not support mature, open pine forest which is the preferred nesting habitat of the species. For these reasons, the SHNPP project does not represent a threat to the status of the red-cockaded woodpecker species.

2.2.3.2 North Carolina Endangered Species Symposium Status

Four species of plants which were identified on or near the SHNPP site are listed as endangered or threatened by a North Carolina endangered species symposium proceedings published in *Endangered and Threatened Plants and Animals of North Carolina* (Reference 2.2.3-3). The four species [*Tradescantia hirsuticaulis*, largetooth aspen (*Populus grandidentata*), avens (*Geum vernum*) and ginseng (*Panax quinquefolium*)] are neither cited in the federal listing of "Endangered and Threatened Wildlife and Plants" (Reference 2.2.3-1) nor in the federal proposed list of endangered plants entitled "Endangered and Threatened Species: Plants" (Reference 2.2.3-4). Although avens, largetooth aspen and ginseng were reported from the SHNPP site, their presence and specific location cannot be confirmed. These species were reported during early studies, but voucher specimens were not collected. The geographic distribution of largetooth aspen and avens probably excludes their presence from the site, and their inclusion in the site species list is probably due to misidentification. *Tradescantia hirsuticaulis* was collected at the site, but its known distribution is limited to an area that will not be disturbed by the SHNPP project.

Another plant species, harbinger-of-spring (*Erigenia bulbosa*) appeared on the list of species collected at the SHNPP site between May 1973 and April 1974.

Because this species previously had never been collected in North Carolina, CP&L biologists made intensive field searches in the spring of 1975 and 1976 at the reported place of collection. The plant was not located and, therefore, its presence or absence cannot be confirmed. The species was reportedly located on the site where the habitat would not be disturbed in any way, so there would be no danger of eliminating the plant should it occur there.

Thirty-nine species of terrestrial vertebrates observed on or near the SHNPP site during the preconstruction study period (1972 - January 1978) were of various concern to the participants of the North Carolina symposium. These species are shown in Table 23 in Reference 2.2.0-5. The bald eagle and red-cockaded woodpecker were listed as endangered. Seven species [turkey vulture (Cathartes aura), black vulture (Coragyps atratus), sharp-shinned hawk (Accipiter striatus), Cooper's hawk (Accipiter cooperii), red-shouldered hawk (Buteo lineatus), warbling vireo (Vireo gilvus), and brown creeper (Certhia familiaris)] were considered threatened. The remaining species had lesser or "undetermined" status. Discussions of the concerns for these species in North Carolina are contained in Reference 2.2.3-3.

One fish species found near the SHNPP site, the Cape Fear shiner (Notropis mekistocholas), was identified in Reference 2.2.3-3 as being of "special concern" in the Cape Fear River drainage. The Cape Fear shiner is endemic to several tributaries of the Haw, Deep, and Cape Fear rivers near the site area. However, only one specimen of this species was found in the area under study (Reference 2.2.0-6), and that specimen was not found in the area to be impounded. This indicates that no habitat being used by this unique species will be removed from its range. For a further discussion, see References 2.2.0-11 and 2.2.3-5. 1

None of the invertebrate fauna found on or near the SHNPP site were identified as endangered, threatened and/or of "special concern" in Reference 2.2.3-3.

1 Information collected during the construction phase monitoring program is presented in the 1978 and 1979 annual reports (References 2.2.0-7 and 2.2.0-8). Construction effects are discussed in Sections 4.1.3 and 4.1.4 of this document.

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2.3 METEOROLOGY

2.3.1 REGIONAL CLIMATOLOGY

The SHNPP site lies in the transition zone delineating the Coastal Plain Region and the Piedmont Region of North Carolina. Climatology of North Carolina largely depends on elevation above sea level and distance from the Atlantic Ocean. At an elevation of about 260 ft. MSL and 115 mi. from the nearest Atlantic coastline, the site area has a temperate climatic regime. | 2 Stations representing the regional climatology, their locations with respect to the site area, and their elevations are presented in Table 2.3.1-1.

The summer months of June, July, and August are characterized by a southwesterly air flow resulting from the extension of the Azores-Bermuda high pressure system. This Gulf of Mexico and occasionally Atlantic moisture laden air produces the bulk of precipitation for these months in the form of afternoon and evening thundershowers. During this three-month period, an average of 39 days reach 90F or above as reported by the Raleigh-Durham Weather Service, the nearest first-order reporting station to the site area. July is the hottest month at all stations within the site area. These months can be quite oppressive with dewpoints averaging between 66 and 67F (Reference 2.3.1-1).

The autumn months of September, October, and November show a gradual decrease of average temperature of about 10F per month. The combination of residual summer moisture and increased radiational cooling due to longer nights makes this the season of highest fog frequency. Although precipitation is distributed rather uniformly on an annual basis, the autumn months tend to be the driest. Daytime heating is not sufficiently intense to produce significant convective activity, and the general north-south temperature | 2 gradient does not substantially materialize to generate strong frontal precipitation. Winds tend to the northeast during the autumn reflecting a change in the pressure distribution. The summer wind flow configuration of a high pressure system offshore, and a lower pressure system over the continent is replaced by the northerly wind flow configuration of a continental high pressure system with a lower pressure system centered offshore. The land-sea temperature contrast favors higher pressure over the ocean in spring and summer with higher pressure over the continent in autumn and winter, thus providing the seasonal reversal of wind directions. The higher autumnal northeastern frequency when compared to the winter frequency is the result of slower moving autumnal synoptic systems.

The winter months of December, January, and February show a shift of the wind direction frequency into the westerly quadrants from the northeasterly fall season distribution responding to a strengthened westerly component added to the predominant southwest-northeast bimodal distribution. January is the coldest month, averaging 18 days with a minimum temperature below 32F at the Raleigh-Durham Weather Service (Reference 2.3.1-1). Cold air outbreaks are either blocked or significantly modified by the Appalachian Mountain chain located some 150 miles to the west and northwest of the site. Most sustained winter precipitation is the result of two storm tracks. One track originates in the warm waters of the western Gulf of Mexico, then crosses Florida skirting the Atlantic Coast northward. The second track is called the "Cape

Hatteras Low", so named because the temperature contrast of the off-shore gulf stream and shape of the coastline just south of Cape Hatteras, N. C. provide excellent breeding conditions for cyclonic circulations. These two storm tracks are responsible for virtually all of the snowfall in the site area, January accumulating the greatest average snowfall totals.

The spring months of March, April, and May are characterized by consistently rising temperatures on the order of 9F per month. Precipitation occurs in a mixed mode of frontal and convective forms. This transitional season generally possesses more winter than summer characteristics. The mean date of the last 32F temperature for the area is around the first week in April (Reference 2.3.1-1). Maximum average wind speeds are generally observed in this season due to the intensity of the general north-south temperature gradient.

2.3.2 ATMOSPHERIC CONDITIONS

The extent of vertical mixing is a major factor in determining atmospheric diffusion characteristics. As a rule, mixing depths are characterized by a diurnal cycle of a nighttime minimum and a daytime maximum. The nighttime minimum is the result of surface radiational cooling producing stable conditions, frequently coupled with a low level inversion or isothermal layer.

The mid-afternoon maximum is attributable to surface heating producing instability and convective overturning through a larger portion of the atmosphere. Mean mixing depths also show a seasonal cycle of a winter season minimum and a summer season maximum. Holzworth (Reference 2.3.2-1) has shown this by listing monthly mean maximum mixing depths. Table 2.3.2-1 lists these results for Greensboro (nearest data point to plant site). The lowest mean maximum mixing depth occurs in January (390m), and the greatest mean maximum depth in June (1790m).

Low level inversions inhibit vertical mixing of the atmosphere. Hosler (Reference 2.3.2-2) has compiled frequencies based on the percent of total hours of occurrence of an inversion or isothermal layer based below 500 ft. The frequency of those low level inversions for Greensboro are presented in Table 2.3.2-2. The summer season averages inversions about 33 percent of all hours. Comparatively, inversions exist during approximately 43 percent of all hours during the winter season.

Cases of high air pollution potential occur during periods of stagnating anticyclones which exhibit low surface winds, no precipitation, and a shallow mixing depth resulting from a subsidence inversion. These conditions occur most frequently at the plant site during the fall months, particularly October. According to Korshover (Reference 2.3.2-3) about 32 cases of autumnal atmospheric stagnation, lasting four days or more, occurred during the period 1936-1970. A total of four cases lasting seven days or more were recorded during the same 35-year period.

2.3.3 TEMPERATURE

Monthly and annual summaries of climatological normal maximum, minimum, and average temperatures for Raleigh-Durham (Reference 2.3.3-1), Greensboro (Reference 2.3.3-2), Charlotte (Reference 2.3.3-3), Moncure (Reference

2.3.3-4), Pinehurst (Reference 2.3.3-4), and Asheboro (Reference 2.3.3-4) are given in Table 2.3.3-1. Monthly and annual onsite mean temperature data for January 1976 through December 1978 is presented in Table 2.3.3-2. The mean maximum and minimum temperature data from the onsite meteorological station is shown in Table 2.3.3-3. The site area diurnal temperature range spans from about 20F in the winter and summer seasons to around 25F in the transitional autumn and spring months (Reference 2.3.1-1). Measured maximum and minimum temperature extremes for the offsite stations are summarized in Table 2.3.3-4. The lowest temperature recorded was a -7F in January of 1940 in Greensboro, the highest recorded temperature being a 107F reading at Moncure in July of 1952 (References 2.3.3-1, 2.3.3-2, 2.3.3-3, 2.3.3-4).

2.3.4 WATER VAPOR

Mean monthly and annual dewpoint temperatures and corresponding absolute humidity values for Raleigh-Durham, Charlotte, and Greensboro are given in Table 2.3.4-1 (Reference 2.3.1-1). Monthly and annual onsite dewpoint temperatures for the period January 1976 through December 1978 are given in Table 2.3.4-2. The onsite average dewpoint temperature of 47.4F compares very well to the 48F average dewpoint temperature observed at Raleigh-Durham, although winter dewpoint temperatures tend to be lower at the site and summer values a little higher.

A maximum persisting 12-hour surface dewpoint temperature of record for the site area is approximately 77F and would be expected to occur during a period of extended air flow trajectories from the Gulf of Mexico (Reference 2.3.1-1).

Diurnal variations of relative humidity for Charlotte, Greensboro, and Raleigh-Durham are given in Table 2.3.4-3 for the local standard times of 1:00 a.m., 7:00 a.m., 1:00 p.m., and 7:00 p.m. (Reference 2.3.3-1, 2.3.3-2, 2.3.3-3). The 7:00 a.m. and 1:00 p.m. times correspond to the general maximum and minimum respective values of the diurnal relative humidity cycle, with 1:00 a.m. and 7:00 p.m. providing approximate midrange values. The late summer to early fall maximum of early morning (7:00 a.m.) relative humidity values results in a maximum of radiational fog frequency occurring at this time of year. See Section 5.1.4 for fogging and icing potentials.

2.3.5 PRECIPITATION

Precipitation is rather uniformly distributed on an annual basis in the site region. Table 2.3.3-1 gives climatological normal monthly and annual precipitation amounts for nearby recording stations (Reference 2.3.3-1, 2.3.3-2, 2.3.3-3). Onsite precipitation totals are summarized in Table 2.3.5-1. Climatologically, July has a tendency to be the wettest month, October the driest; but, the variance is small such that the region does not possess a "wet" and "dry" season. Extreme precipitation amounts for nearby recording stations are listed in Table 2.3.3-4 (Reference 2.3.3-1, 2.3.3-2, 2.3.3-3). The extreme rainfall rates summary for the onsite facility for the January 1976 through December 1978 period is shown in Table 2.3.5-2. The onsite extreme rainfall rates for all time periods included by the table occurred on the same date, March 21, 1976, with a maximum 24-hour precipitation total of 4.41 in.

On an average the site area receives precipitation one day in three. Table 2.3.5-3 displays precipitation statistics for the stations of Raleigh-Durham, Greensboro, and Charlotte (Reference 2.3.5-1). These statistics are presented for the months of January, April, June, and October which are considered representative of the four seasons. Table 2.3.5-3e indicates that precipitation intensities during July are about double those of January. Table 2.3.5-3f further characterizes the higher intensity, shorter duration July precipitation versus lower intensity, longer duration January precipitation. Generally, winter precipitation duration is about twice as long as that of July. However, daily rain totals are generally smaller. The transitional April and October months seem to fit the winter precipitation regime better, partly due to slower moving rain systems in the transitional seasons than in mid-winter. Onsite data showing the number of hours with measurable precipitation by month and year including the overall average for the January 1976 through December 1978 period is depicted in Table 2.3.5-4.

2 Seasonal and annual precipitation wind roses for Raleigh-Durham (Reference 2.3.5-2) are illustrated by Figures 2.3.5-1 and 2.3.5-2. The Onsite precipitation wind rose for the period January 1976 through December 1978 is presented in Figure 2.3.5-3. A northeast-southwest wind frequency distribution is the dominate flow regime during precipitation periods for both stations. Extreme precipitation totals for representative offsite stations are shown by Table 2.3.3-4 along with measured extreme snowfall totals (References 2.3.3-1, 2.3.3-2, 2.3.3-3, and 2.3.3-4).

2.3.6 WIND DISTRIBUTIONS

2 Wind direction and speed distributions are essential parameters for determining site characteristic diffusion climatology. Onsite joint frequency distributions of direction and speed by stability class and a summary of all winds as outlined by Regulatory Guide 1.23 (Reference 2.3.6-1) for the period January 1976 through December 1978 are given by Tables 2.3.6-1A through 2.3.6-1P. Annual and seasonal wind roses for Raleigh (Reference 2.3.5-2), Greensboro (Reference 2.3.6-2), and Charlotte (Reference 2.3.6-3) are illustrated by Figures 2.3.6-1 through 2.3.6-6.

The Raleigh (1955-1964) joint frequency distribution of wind direction and speed by Pasquill stability classes is given in Tables 2.3.6-2A through 2.3.6-2G. Pasquill stability classes were determined by the STAR method (Reference 2.3.5-2). Stability classes F and G were combined into F stability.

Despite differing techniques used to determine atmospheric stability (delta temperature method for onsite data and the STAR method for Raleigh data), the onsite joint wind frequencies of Table 2.3.6-1 compare favorably to those compiled for Raleigh. Neutral (D) and slightly stable (E) stability classes occur most frequently at both stations. However, Stable (F) and extremely stable (G) stability classes are more frequent at the onsite meteorological station. This is due in part to some nighttime cold air drainage into the broad, shallow basin in which the site is located (See Section 2.3.8).

The characteristic northeast-southwest bimodal frequency distribution is evident at all locations and is depicted by the onsite wind rose given in

Figure 2.3.6-7. Average annual wind speeds from the area offsite stations are 2
rather uniform, ranging from 6.9 mph at Charlotte to 7.9 mph at Raleigh-
Durham.

The onsite lower level (12.5m) mean wind speed based on 1976-1978 data is 4.6 mph. The onsite value is about 35 percent lower than the 7.1 mph value observed at the Raleigh-Durham Weather Service. Differing time periods, averaging methods, and instrumentation account, in part, for the lower average onsite wind speed value.

It is believed that topography probably is the single most influential factor resulting in the lower average onsite wind speed. The SHNPP site lies in a broad, shallow 200 ft. deep basin extending about ten miles in directions west through south of the site (see Section 2.3.8). Cold air drainage into a basin during the night is a common occurrence in some areas. This phenomena tends to reduce the vertical momentum flux having a discoupling effect on the wind flow in the site area and thereby contributing to light surface winds. This colder air is denser than the surrounding environment, and therefore, difficult to displace and, in fact, quite often remains until dissipated soon after sunrise by the influx of solar radiation. Although unconfirmed, this phenomena is believed to be the major factor resulting in lower onsite wind speeds compared to those observed at the Raleigh-Durham Weather Service.

From the seasonal wind roses, the southwesterly component is most evident in
the spring, summer, and winter seasons. The higher frequency of northeast
wind directions in the fall is the result of a trend toward continental high 2
pressure systems introducing a northerly wind flow and the slower movement of
synoptic systems due to weak upper level steering currents prevailing at this
time of year. Winds from the southeastern quadrant are rare and for the most
part preceed warm frontal passages.

Wind direction persistence for the on-site data is defined as the number of
consecutive hours during which the wind direction was from the same
22.5 degree direction sector. Tables 2.3.6-3A through 2.3.6-3P show the
number of hours of persisting wind directions by stability class as recorded
at the 12.5m and 61.4m onsite levels of operation for the SHNPP. The maximum 2
period of persistent wind direction for the 60 meter level was from the
south-southwest and lasted 37 hours. The same synoptic pattern produced the
maximum period of persistent wind direction at the 125 meter level which
lasted 30 hours. Maximum persisting winds at both levels were out of the
south-southwest direciton and ended at the same time. Figure 2.3.6-8 presents
a graph of the number of persisting wind direction probability of one-sector
wind direction persistence occurrence. An estimate of the percent of the
total time a given number of wind persistence hours occurs can be taken
directly from Figure 2.3.6-8. For example, a 10-hour wind direction
persistence from any one of the 16 compass directions occurred about 2 percent
of the total hours.

Sustained winds greater than 50 knots have occurred only twice in the past 24 years as recorded by the Raleigh-Durham Weather Service. A one-minute average 69 mph wind from the southwest was recorded during a thunderstorm on July 21, 1962. A maximum site area one-minute average wind of 73 mph from the west-northwest was recorded during Hurricane Hazel on October 15, 1954.

(Reference 2.3.3-1). A complete list of hurricanes affecting the site area, the amount of precipitation, and fastest-mile wind associated with each is given by Table 2.3.6-4. The intensities of wind and precipitation produced by hurricanes at the plant site are generally no greater than those produced by severe thunderstorms.

2.3.7 ATMOSPHERIC TRANSPORT PROCESSES TO 50 MILES

Meteorological data and analysis of the preceding sections have included onsite and representative offsite stations both within and outside a 50-mile radius of the plant. Because of the homogeneous nature of the topography and climatology of the parameters that govern atmospheric transport processes, the analysis presented in the preceding sections is also sufficient to characterize transport processes to within a 50-mile radius.

2.3.8 TOPOGRAPHIC FEATURES

The SHNPP site lies within a very shallow basin as depicted by Figures 2.3.8-1 through 2.3.8-4 which gives plots of elevation versus distance from the plant center by direction sectors. Generally, within 10 miles of the site, the elevation above mean sea level gradually increases from the plant grade level of 260 ft. to around 400 ft. in all but the west-southwest, southwest and north-northwest sectors.

Topographic features within a 5-mile radius as modified by the plant are shown in Figure 2.3.8-5. Filling of the main reservoir south and southeast of the plant will add an additional heat and moisture source to the area. As a result, a slight increase of wind speed is expected with possible changes in wind direction frequencies. Additionally, the reservoirs are expected to reduce the intensity of the nighttime surface inversion thereby reducing the frequency of Pasquill class G stability.

Topographic features within a 50-mile radius are shown in Figure 2.3.8-6. In general, the terrain slopes upward northwest of the site area averaging about 10 ft. per mile to reach an elevation of about 800 ft. at 50 miles from the plant site. The terrain from the north through the west sectors is gently rolling, ranging only from about 100 ft. to 500 ft. above mean sea level.

TABLE 2.3.1-1

STATIONS REFERENCED FOR REGIONAL CLIMATOLOGY AND LOCAL METEOROLOGY

Station	Elevation (ft. msl)	Distance from Plant Site (mi.)	Direction from Plant Site	Climatological Region of North Carolina
Raleigh-Durham	434	19	NNE	Central Piedmont
Moncure	202	7	W	Central Piedmont
Pinehurst	548	44	SW	Southern Piedmont
Asheboro	870	54	W	Central Piedmont
Greensboro	886	69	WNW	Northern Piedmont
Charlotte	736	117	WSW	Southern Piedmont

TABLE 2.3.2-1

MEAN MONTHLY MAXIMUM MIXING DEPTHS (METERS ABOVE SURFACE)

Greensboro

Month	Depth (m)
January	390
February	650
March	1130
April	1180
May	1530
June	1790
July	1490
August	1420
September	1370
October	1020
November	840
December	580

TABLE 2.3.2-2

FREQUENCY OF INVERSIONS BASED BELOW 500 FEET

Percent Frequency of Inversion Occurrence at
Specific Times and All Times

Season	0300 GMT	1500 GMT	0000 GMT	1200 GMT	All Hours
Winter	73	15	58	72	43
Spring	70	3	13	66	32
Summer	78	1	11	6	33
Fall	74	4	52	74	40

NOTE: 1. 0300 and 1500 GMT observations for the period 6/55 - 5/57.

2. 0000 and 1200 GMT observations for the period 6/57 - 5/59.

TABLE 2.3.3-1A

RALEIGH-DURHAM NORMAL PRECIPITATION (in.) AND TEMPERATURE (F)

	TEMPERATURE (F)			PRECIPITATION (in.)
Month	Maximum	Minimum	Average	Average
January	51.0	30.0	40.5	3.22
February	53.2	31.1	42.2	3.32
March	61.0	37.4	49.2	3.44
April	72.2	46.7	59.5	3.07
May	79.4	55.4	67.4	3.32
June	85.6	63.1	74.4	3.67
July	87.7	67.2	77.5	5.08
August	86.8	66.2	76.5	4.93
September	81.5	59.7	70.6	3.78
October	72.4	48.0	60.2	2.81
November	62.1	37.8	50.0	2.82
December	51.9	30.5	41.2	3.08
Average	70.4	47.8	59.1	42.54

Period: 1941--1970

TABLE 2.3.3-1B

GREENSBORO NORMAL PRECIPITATION (in.) AND TEMPERATURE (F)

	TEMPERATURE (F)			PRECIPITATION (in.)
Month	Maximum	Minimum	Average	Average
January	48.8	28.5	38.7	3.22
February	51.4	29.7	40.6	3.37
March	59.4	36.1	47.8	3.72
April	70.9	46.2	58.6	3.15
May	78.9	55.3	67.1	3.04
June	85.4	63.3	74.4	3.91
July	87.5	66.9	77.2	4.39
August	86.2	65.8	76.0	4.30
September	80.5	58.8	69.7	3.55
October	71.2	47.2	59.2	2.94
November	60.1	36.5	51.3	2.62
December	49.9	29.2	39.6	3.15
Average	69.2	47.0	58.1	41.36

Period: 1941--1970

TABLE 2.3.3-1C

CHARLOTTE NORMAL PRECIPITATION (in.) AND TEMPERATURE (F)

	TEMPERATURE (F)			PRECIPITATION (in.)
Month	Maximum	Minimum	Average	Average
January	52.1	32.1	42.1	3.51
February	54.9	33.1	44.0	3.83
March	62.2	39.0	50.6	4.52
April	72.7	48.9	60.8	3.40
May	80.2	57.4	68.8	2.90
June	86.4	65.3	75.9	3.70
July	88.3	68.7	78.5	4.57
August	87.4	67.9	77.7	3.96
September	82.0	61.9	72.0	3.46
October	73.1	50.3	61.7	2.69
November	62.4	39.6	51.0	2.74
December	52.5	32.4	42.5	3.44
Average	71.2	49.7	60.5	42.72

Period: 1941--1970

TABLE 2.3.3-1D

MONCURE NORMAL PRECIPITATION (in.) AND TEMPERATURE (F)

	TEMPERATURE (F)			PRECIPITATION (in.)
Month	Maximum^{0}	Minimum^{0}	Average^{0}	Average*
January	51.7	25.0	38.4	3.46
February	54.0	26.9	40.5	3.71
March	61.7	34.3	48.0	4.03
April	73.2	43.6	58.4	3.53
May	80.7	52.4	66.6	3.88
June	86.9	60.4	73.7	3.89
July	90.1	65.0	77.6	6.73
August	88.7	64.4	76.6	5.48
September	83.4	57.3	70.4	4.43
October	73.7	44.7	59.2	3.21
November	64.0	33.6	48.8	3.15
December	54.2	26.8	40.5	3.40
Average	71.9	44.5	58.2	48.90

* = 1941-70
0 - 1951-73

TABLE 2.3.3-1E

ASHEBORO NORMAL PRECIPITATION (in.) AND TEMPERATURE (F)

	TEMPERATURE (F)			PRECIPITATION (in.)
Month	Maximum[0]	Minimum[0]	Average[0]	Average[*]
January	50.9	30.7	40.8	3.41
February	54.0	32.3	43.1	3.64
March	61.8	38.8	50.3	3.90
April	72.8	48.4	60.6	3.44
May	79.4	55.8	67.6	3.53
June	85.5	63.0	74.3	3.74
July	88.4	66.8	77.7	5.58
August	87.3	66.1	76.8	4.88
September	82.0	60.1	71.1	3.84
October	72.2	49.1	60.7	3.05
November	62.3	40.0	51.2	2.75
December	53.0	33.2	43.1	3.20
Average	70.8	48.7	59.8	44.87

0 = 1951-73
* = 1941-70

TABLE 2.3.3-1F

PINEHURST NORMAL PRECIPITATION (in.) AND TEMPERATURE (F)

	TEMPERATURE (F)			PRECIPITATION (in.)
Month	Maximum[0]	Minimum[0]	Average[0]	Average[*]
January	52.3	31.2	41.8	3.44
February	55.5	32.8	44.1	4.00
March	63.3	39.2	51.3	4.21
April	74.9	48.6	61.8	3.67
May	82.0	56.4	69.2	3.60
June	87.7	63.7	75.7	4.80
July	90.2	67.4	78.8	6.85
August	89.2	66.7	78.0	5.60
September	83.9	60.5	72.2	4.10
October	74.0	49.5	61.8	3.33
November	63.3	39.9	51.6	3.02
December	54.3	33.3	43.8	3.32
Average	72.6	49.1	60.8	49.94

* = 1941-70
0 = 1951-73

TABLE 2.3.3-2

SHNPP ONSITE DATA
MEAN TEMPERATURE (JANUARY 1976 - DECEMBER 1978)

Month	1976	1977	1978	Avg.
January	40.1*	29.3	34.3	34.6
February	51.2	41.7	33.8	42.2
March	55.7	55.5	48.0	53.1
April	59.0	63.0	59.4	60.5
May	66.5	68.4	65.2	66.7
June	73.1	73.7	73.7	73.5
July	77.9	81.3	76.2	78.5
August	75.5	77.6	77.3	76.8
September	69.9	72.4	72.1	71.5
October	55.2	56.6	57.2	56.3
November	43.5	52.7	54.0	50.1
December	39.6	41.1	43.8	41.5
Annual	58.9	59.4	57.9	58.7

*Data collection began on January 14th.

TABLE 2.3.3-3

SHNPP ONSITE DATA
MAXIMUM-MINIMUM TEMPERATURES (JANUARY 1976 - DECEMBER 1978)

	1976		1977		1978		Average	
Month	Max	Min	Max	Min	Max	Min	Max	Min
January	52.0*	27.8*	38.6	19.6	44.7	25.3	45.1	24.2
February	65.0	36.7	54.5	28.2	43.8	24.4	54.3	29.8
March	68.5	42.3	67.0	43.6	58.5	37.5	64.7	41.1
April	74.0	43.2	76.0	49.1	71.6	47.0	73.9	46.4
May	78.8	54.5	80.8	56.8	76.0	53.6	78.5	55.0
June	83.6	63.9	84.7	59.7	84.5	63.4	84.3	62.3
July	89.6	67.1	93.0	69.6	86.8	66.3	89.8	67.7
August	86.3	64.4	91.0	68.5	87.8	69.0	88.4	67.3
September	82.2	57.9	83.4	62.9	83.2	62.9	82.9	61.2
October	67.6	43.2	67.7	45.8	71.0	44.2	68.8	44.4
November	56.5	30.8	62.7	42.9	63.6	44.8	60.9	39.5
December	50.4	28.1	50.7	31.1	55.6	31.6	52.2	30.3
Annual	71.2	46.7	70.8	48.2	68.9	47.5	70.3	47.5

*Data collection began January 14th.

TABLE 2.3.3-4

SITE REGION METEOROLOGICAL EXTREMES
(month/year of occurrence) [Data period]

	Charlotte	Greensboro	Raleigh-Durham	Pinehurst	Asheboro	Moncure
Maximum Monthly Precipitation (water equivalent)	12.48 in (5/75) [1940-77]	13.26 in (9/47) [1929-77]	12.94 in (9/45) [1945-77]	13.88 in (7/59) [1951-73]	13.79 in (7/65) [1951-73]	12.55 in (7/73) [1951-73]
Maximum 24-hour Precipitation (water equivalent)	5.34 in (10/76) [1940-77]	7.49 in (9/47) [1929-77]	5.20 in (8/55) [1945-77]	7.11 in (10/54) [1951-73]	8.96 in (8/66) [1951-73]	5.14 in (8/67) (1951-73]
Minimum Monthly Precipitation (water equivalent)	Trace (10/53) [1940-77]	.13 in (9/39) [1929-77]	.23 in (4/76) [1945-77]	----	----	----
Maximum Monthly Snowfall (inches)	19.3 in (3/60) [1940-77]	22.9 in (1/66) [1929-70]	14.4 in (1/55) [1945-77]	16.0 in (12/58) [1951-73]	18.5 in (3/60) [1951-73]	14.0 in (3/60) [1951-73]
Maximum 24-hour Snowfall (inches)	12.0 in (2/69) [1940-77]	14.3 in (12/30) [1929-70]	9.3 in (3/69) [1945-77]	----	----	----
Maximum Temperature (°F)	104°F (9/54) [1940-77]	102°F (7/77) [1929-70]	105°F (7/52) [1945-77]	106°F (8/54) [1951-73]	103°F* (7/52) [1951-73]	107°F* (7/52) [1951-73]
Minimum Temperature (°F)	-3°F (1/40) [1940-77]	-7°F (1/40) [1929-70]	-1°F (1/77) [1945-77]	+3°F (12/62) [1951-73]	+2°F (12/62) [1951-73]	-4°F (1/66) [1951-73]

*On earlier dates

TABLE 2.3.4-1

DEWPOINT TEMPERATURES (°F) AND ABSOLUTE HUMIDITY (g/m^3)*

	RALEIGH-DURHAM		CHARLOTTE		GREENSBORO	
Month	Dewpoint	Absolute Humidity	Dewpoint	Absolute Humidity	Dewpoint	Absolute Humidity
January	32	4.85	32	4.85	29	4.25
February	31	6.64	32	4.85	29	4.25
March	35	5.43	36	5.64	34	5.23
April	45	7.86	46	8.27	44	7.58
May	56	11.58	56	11.58	55	11.18
June	64	15.16	64	15.16	63	14.66
July	68	17.28	67	16.73	67	16.73
August	67	16.73	67	16.73	66	16.18
September	61	13.71	61	13.71	60	13.26
October	50	9.40	50	9.40	48	8.75
November	38	6.08	39	6.31	37	5.86
December	30	4.44	32	4.85	29	4.25
Annual	48	8.75	49	9.07	47	8.45

* 1946-1965 period

TABLE 2.3.4-2

SHNPP ONSITE DATA
DEWPOINT TEMPERATURE (10 METER LEVEL)

Month	1976	1977	1978	Average
January	*25.6	18.8	21.7	22.0
February	32.4	25.6	21.0	26.3
March	40.5	41.2	34.2	38.6
April	39.2	50.0	43.2	44.1
May	53.6	58.5	55.7	55.9
June	65.1	64.5	63.7	64.4
July	67.2	69.0	66.6	67.6
August	65.5	72.2	68.6	68.8
September	60.7	65.5	64.0	63.4
October	46.8	48.8	46.4	47.3
November	32.2	41.3	45.5	39.7
December	30.0	30.9	30.7	30.5
Annual	46.6	48.9	46.8	47.4

*Data collection began on January 14th.

TABLE 2.3.4-3A

CHARLOTTE RELATIVE HUMIDITY (%)

Month	1:00 a.m.	7:00 a.m.	1:00 p.m.	7:00 p.m.
January	72	78	57	62
February	67	75	51	54
March	69	79	50	52
April	68	79	47	49
May	78	84	53	59
June	81	86	57	63
July	83	88	58	67
August	84	89	59	67
September	84	90	57	68
October	80	88	53	66
November	75	83	52	62
December	74	80	57	63
Annual	76	83	54	61

TABLE 2.3.4-3B

RALEIGH-DURHAM RELATIVE HUMIDITY (%)

Month	1:00 a.m.	7:00 a.m.	1:00 p.m.	7:00 p.m.
January	72	78	55	63
February	67	74	48	55
March	70	79	48	55
April	73	80	44	53
May	85	87	55	67
June	87	88	57	69
July	88	90	59	72
August	90	93	61	76
September	88	93	59	78
October	85	90	54	76
November	77	83	49	65
December	75	80	56	68
Annual	80	84	54	66

TABLE 2.3.4-3C

GREENSBORO RELATIVE HUMIDITY (%)

Month	1:00 a.m.	7:00 a.m.	1:00 p.m.	7:00 p.m.
January	76	81	58	65
February	70	77	51	57
March	71	80	51	55
April	72	79	48	52
May	83	85	56	63
June	87	87	57	67
July	89	90	60	70
August	91	92	61	73
September	88	91	59	72
October	85	89	55	73
November	77	82	51	65
December	78	81	58	68
Annual	81	84	55	65

TABLE 2.3.5-1

SHNPP ONSITE DATA
PRECIPITATION (in.) (JANUARY 1976 - DECEMBER 1978)

Month	1976	1977	1978	Average
January	1.29*	2.65	7.42	3.79
February	1.15	1.57	1.74	1.49
March	4.69	6.18	3.85	4.91
April	0.43	2.17	4.36	2.32
May	2.72	1.87	3.59	2.73
June	2.74	0.77	5.08	2.86
July	1.66	1.92	4.63	2.74
August	1.76	3.78	3.47	3.00
September	2.87	6.16	2.72	3.92
October	1.26	4.17	0.91	2.11
November	1.14	2.35	3.57	2.35
December	3.66	3.08	2.85	3.20
Annual	25.37	36.67	44.19	35.41

*Data collection began on January 14th.

TABLE 2.3.5-2

SHNPP ONSITE EXTREME RAINFALL RATES

Hours	Amount (in.)	Date
1	1.92	3/21/76
2	3.69	3/21/76
3	4.00	3/21/76
6	4.41	3/21/76
12	4.41	3/21/76
24	4.41	3/21/76

TABLE 2.3.5-3

PRECIPITATION FREQUENCIES AND AMOUNTS (1951-1960: January, April, July, October)

	(a) Percent of Days with Measurable Precipitation, ≥0.01 in.				(b) Average No. of Hourly Reports per Month with ≥0.01 in. in Preceding Hour				(c) Percent of the Hourly Reports with Precipitation in the Preceding Hour which were only Trace, ≤0.005 in.			
Station	J	A	J	O	J	A	J	O	J	A	J	O
Raleigh	29	31	35	22	53	50	37	41	52	46	52	57
Greensboro	32	35	37	26	59	54	33	44	52	48	54	59
Charlotte	29	34	37	23	59	51	34	39	46	43	52	55

	(d) Average Precipitation (in.) during Days Having ≥0.01 in.				(e) Average (in.) during Hours Having ≤0.01 in.				(f) Ratio of (b) to No. of Rainy (≥0.01 in.) Days per Month			
	J	A	J	O	J	A	J	O	J	A	J	O
Raleigh	.38	.42	.49	.42	.06	.08	.15	.07	5.9	5.4	3.4	6.3
Greensboro	.35	.38	.37	.39	.06	.07	.13	.07	5.8	5.2	2.9	5.6
Charlotte	.38	.40	.33	.33	.06	.08	.11	.06	6.6	5.0	2.9	5.4

TABLE 2.3.5-4

SHNPP HOURLY PRECIPITATION OCCURRENCE

Month	1976	1977	1978	1976-1978	Mean
January	10*	44	89	143	48
February	2	17	50	69	23
March	11	71	60	142	47
April	2	28	55	85	28
May	32	37	35	104	35
June	38	20	40	98	33
July	24	8	35	67	22
August	24	30	41	95	32
September	30	30	18	78	26
October	27	61	12	100	33
November	30	39	63	132	44
December	93	59	41	193	64
TOTAL	323	444	539	1306	435

*Data period began January 14th.

NOTE: Precipitation instrument resolution is 0.01 in.

TABLE 2.3.6-1A

JOINT PERCENTAGE FREQUENCIES OF WIND DIRECTION AND SPEED
FOR THE PERIOD 4:00 PM 1/14/76 TO 11:00 PM 12/31/78
UPPER WIND LEVEL
STABILITY CLASS A
STABILITY CALCULATED FROM DIFF. TEMPERATURE

HARRIS ON-SITE METEOROLOGICAL FACILITY

UPPER WIND DIRECTION		SPEED CLASS(MPH)							
	CALM	0.75 - 3.5	3.5 - 7.5	7.5 - 12.5	12.5 - 18.5	18.5 - 25.0	GREATER THAN 25.0	TOTAL	AVG. WIND SPEED
N	0.0	0.1215E-01	0.1539E+00	0.3280E+00	0.8908E-01	0.4049E-02	0.0	0.5871E+00	0.9463E+01
NNE	0.0	0.1215E-01	0.1701E+00	0.2956E+00	0.1255E+00	0.0	0.0	0.6033E+00	0.9484E+01
NE	0.0	0.8098E-02	0.9717E-01	0.2348E+00	0.7288E-01	0.1620E-01	0.0	0.4292E+00	0.1010E+02
ENE	0.0	0.1215E-01	0.6073E-01	0.8503E-01	0.1215E-01	0.0	0.0	0.1701E+00	0.8139E+01
E	0.0	0.1215E-01	0.8098E-01	0.3239E-01	0.4049E-01	0.0	0.0	0.1296E+00	0.6341E+01
ESE	0.0	0.1620E-01	0.1053E+00	0.1620E-01	0.4049E-02	0.0	0.0	0.1417E+00	0.5741E+01
SE	0.0	0.8098E-02	0.4859E-01	0.4049E-02	0.0	0.0	0.0	0.6073E-01	0.5209E+01
SSE	0.0	0.8098E-02	0.7288E-01	0.2834E-01	0.4049E-02	0.0	0.0	0.1134E+00	0.6835E+01
S	0.0	0.1620E-01	0.9312E-01	0.7693E-01	0.1215E-01	0.4049E-02	0.4049E-02	0.2065E+00	0.8127E+01
SSW	0.0	0.4049E-02	0.1053E+00	0.2672E+00	0.1862E+00	0.2834E-01	0.0	0.5911E+00	0.1111E+02
SW	0.0	0.2834E-01	0.1862E+00	0.3280E+00	0.2510E+00	0.8908E-01	0.1620E-01	0.8949E+00	0.1171E+02
WSW	0.0	0.2429E-01	0.1377E+00	0.2672E+00	0.1336E+00	0.4454E-01	0.2024E-01	0.6236E+00	0.1125E+02
W	0.0	0.1215E-01	0.1174E+00	0.1093E+00	0.8503E-01	0.2024E-01	0.8098E-02	0.3523E+00	0.1052E+02
WNW	0.0	0.1620E-01	0.9717E-01	0.2591E+00	0.2429E+00	0.4454E-01	0.1215E-01	0.6721E+00	0.1212E+02
NW	0.0	0.8098E-02	0.1098E+00	0.2308E+00	0.1255E+00	0.2834E-01	0.0021E+00	0.5021E+00	0.1077E+02
NNW	0.0	0.1215E-01	0.1093E+00	0.2794E+00	0.1215E+00	0.8098E-02	0.0	0.5304E+00	0.1024E+02
TOTAL	0.0	0.2105E+00	0.1745E+01	0.2842E+01	0.1470E+01	0.2875E+00	0.6073E-01	0.6608E+01	0.9197E+01

NUMBER OF CALMS - 0
NUMBER OF BAD HOURS - 566

TABLE 2.3.6-18

JOINT PERCENTAGE FREQUENCIES OF WIND DIRECTION AND SPEED
FOR THE PERIOD 4:00 PM 1/14/76 TO 11:00 PM 12/31/78
UPPER WIND LEVEL
STABILITY CLASS B
STABILITY CALCULATED FROM DIFF. TEMPERATURE

HARRIS ON-SITE METEOROLOGICAL FACILITY

UPPER WIND DIRECTION	CALM	SPEED CLASS(MPH) 0.75 - 3.5	3.5 - 7.5	7.5 - 12.5	12.5 - 18.5	18.5 - 25.0	GREATER THAN 25.0	TOTAL	AVG. WIND SPEED
N	0.0	0.1215E-01	0.1417E+00	0.1336E+00	0.4049E-01	0.4049E-02	0.0	0.3320E+00	0.8641E+01
NNE	0.0	0.4049E-10	0.1134E+00	0.1458E+00	0.5668E-01	0.0	0.0	0.3199E+00	0.9048E+01
NE	0.0	0.8098E-02	0.9717E-01	0.1498E+00	0.4454E-01	0.4049E-02	0.0	0.3037E+00	0.8897E+01
ENE	0.0	0.8098E-02	0.8908E-01	0.4859E-01	0.8098E-02	0.0	0.0	0.1539E+00	0.7095E+01
E	0.0	0.8098E-02	0.9717E-01	0.40493-01	0.0	0.0	0.0	0.1458E+00	0.6635E+01
ESE	0.0	0.1620E-01	0.8908E-01	0.2429E-01	0.0	0.0	0.0	0.1296E+00	0.6073E+01
SE	0.0	0.8098E-02	0.2834E-01	0.1620E-01	0.0	0.0	0.0	0.5264E-01	0.6199E+01
SSE	0.0	0.1620E-01	0.5668E-01	0.3644E-01	0.0	0.0	0.0	0.1093E+00	0.6463E+01
S	0.0	0.0	0.5264E-01	0.1012E+00	0.3239E-01	0.0	0.0	0.1862E+00	0.9677E+01
SSW	0.0	0.1215E-01	0.1012E+00	0.1660E+00	0.5668E-01	0.2024E-01	0.0	0.3563E+00	0.9864E+01
SW	0.0	0.2024E-01	0.1417E+00	0.1943E+00	0.1053E+00	0.2429E-01	0.4049E-02	0.4899E+00	0.1009E+02
WSW	0.0	0.2834E-01	0.9312E-01	0.1741E+00	0.1174E+00	0.1215E-01	0.2024E-01	0.4454E+00	0.1110E+02
W	0.0	0.4049E-02	0.6883E-01	0.5264E-01	0.4859E-01	0.2024E-01	0.8098E-02	0.2024E+00	0.1117E+02
WNW	0.0	0.1620E-01	0.1012E+00	0.17015+00	0.1377E+00	0.4049E-01	0.8098E-02	0.4737E+00	0.1157E+02
NW	0.0	0.8098E-02	0.1134E+00	0.1579E+00	0.1134E+00	0.1215E-01	0.0	0.4049E+00	0.1026E+02
NNW	0.0	0.4049E-02	0.7693E-01	0.1174E+00	0.3644E-01	0.4049E-02	0.0	0.2389E+00	0.9290E+01
TOTAL	0.0	0.1741E+00	0.1462E+01	0.1729E+01	0.7976E+00	0.1417E+00	0.4049E-01	0.4344E+01	0.8879E+01

NUMBER OF CALMS - 0
NUMBER OF BAD HOURS - 13

TABLE 2.3.6-1C

JOINT PERCENTAGE FREQUENCIES OF WIND DIRECTION AND SPEED
FOR THE PERIOD 4:00 PM 1/14/76 TO 11:00 PM 12/31/78
UPPER WIND LEVEL
STABILITY CLASS C
STABILITY CALCULATED FROM DIFF. TEMPERATURE

HARRIS ON-SITE METEOROLOGICAL FACILITY

UPPER WIND DIRECTION	CALM	SPEED CLASS(MPH) 0.75 - 3.5	3.5 - 7.5	7.5 - 12.5	12,5 - 18.5	18.5 - 25.0	GREATER THAN 25.0	TOTAL	AVG. WIND SPEED
N	0.0	0.2834E-01	0.1741E+00	0.1620E+00	0.7288E-01	0.0	0.0	0.4373E+00	0.8576E+01
NNE	0.0	0.8098E-02	0.1498E+00	0.1255E+00	0.4454E-01	0.8098E-02	0.0	0.3361E+00	0.8566E+01
NE	0.0	0.4049E-02	0.1215E+00	0.1053E+00	0.2429E-01	0.4049E-02	0.0	0.2591E+00	0.8125E+01
ENE	0.0	0.1215E-01	0.1215E+00	0.7693E-01	0.1215E-01	0.0	0.4049E-02	0.2267E+00	0.7937E+01
E	0.0	0.1215E-01	0.1053E+00	0.5668E-01	0.0	0.0	0.0	0.1741E+00	0.6577E+01
ESE	0.0	0.2024E-01	0.1012E+00	0.8098E-02	0.0	0.0	0.0	0.1296E+00	0.5289E+01
SE	0.0	0.8098E-02	0.8098E-01	0.2024E-01	0.0	0.0	0.0	0.1093E+00	0.6033E+01
SSE	0.0	0.2834E-01	0.6883E-01	0.8908E-01	0.1215E-01	0.0	0.0	0.1984E+00	0.7448E+01
S	0.0	0.1620E-01	0.1417E+00	0.1255E+00	0.1620E-01	0.1215E-01	0.0	0.3118E+00	0.8057E+01
SSW	0.0	0.4049E-01	0.1215E+00	0.2065E+00	0.1093E+00	0.2834E-01	0.4049E-02	0.5102E+00	0.1006E+02
SW	0.0	0.3239E-01	0.1701E+00	0.1903E+00	0.1255E+00	0.3644E-01	0.1215E-01	0.5668E+00	0.1046E+02
WSW	0.0	0.3644E-01	0.1822E+00	0.2470E+00	0.1012E+00	0.3239E-01	0.1215E-01	0.6114E+00	0.9767E+01
W	0.0	0.2429E-01	0.1336E+00	0.1174E+00	0.5264E-01	0.2834E-01	0.0	0.3563E+00	0.9294E+01
WNW	0.0	0.1215E-01	0.9717E-01	0.1296E+00	0.1093E+00	0.4859E-01	0.4049E-02	0.4008E+00	0.1162E+02
NW	0.0	0.2834E-01	0.1296E+00	0.1417E+00	0.9312E-01	0.2024E-01	0.0	0.4130E+00	0.9501E+01
NNW	0.0	0.1620E-01	0.1336E+00	0.1660E+00	0.8098E-01	0.1215E-01	0.0	0.4089E+00	0.9367E+01
TOTAL	0.0	0.3280E+00	0.2033E+01	0.1968E+01	0.8543E+00	0.2308E+00	0.3644E-01	0.5450E+01	0.8542E+01

NUMBER OF CALMS - 0
NUMBER OF BAD HOURS - 18

TABLE 2.3.6-1D

JOINT PERCENTAGE FREQUENCIES OF WIND DIRECTION AND SPEED
FOR THE PERIOD 4:00 PM 1/14/76 TO 11:00 PM 12/31/78
UPPER WIND LEVEL
STABILITY CLASS D
STABILITY CALCULATED FROM DIFF. TEMPERATURE

HARRIS ON-SITE METEOROLOGICAL FACILITY

UPPER WIND DIRECTION		SPEED CLASS(MPH)							
	CALM	0.75 - 3.5	3.5 - 7.5	7.5 - 12.5	12.5 - 18.5	18.5 - 25.0	GREATER THAN 25.0	TOTAL	AVG. WIND SPEED
N	0.0	0.1498E+00	0.8057E+00	0.1008E+01	0.3442E+00	0.3239E-01	0.0	0.2340E+01	0.8760E+01
NNE	0.0	0.1579E+00	0.8584E+00	0.1247E+01	0.3158E+00	0.2024E-01	0.0	0.2599E+01	0.8614E+01
NE	0.0	0.1579E+00	0.6357E+00	0.7855E+00	0.2753E+00	0.4049E-02	0.0	0.1858E+01	0.8447E+01
ENE	0.4049E-02	0.1701E+00	0.5992E+00	0.5061E+00	0.1134E+00	0.4049E-02	0.0	0.1397E+01	0.7298E+01
E	0.4049E-02	0.1620E+00	0.5183E+00	0.3239E+00	0.1215E-01	0.0	0.0	0.1020E+01	0.6452E+01
ESE	0.0	0.1255E+00	0.4656E+00	0.2591E+00	0.4454E-01	0.0	0.0	0.8948E+00	0.6576E+01
SE	0.0	0.1255E+00	0.4494E+00	0.2632E+00	0.6478E-01	0.8098E-02	0.0	0.9110E+00	0.7123E+01
SSE	0.0	0.1255E+00	0.5223E+00	0.4778E+00	0.2186E+00	0.1215E-01	0.1620E-01	0.1373E+01	0.8624E+01
S	0.0	0.1579E+00	0.5264E+00	0.5790E+00	0.1782E+00	0.3644E-01	0.4049E-02	0.1482E+01	0.8446E+01
SSW	0.4049E-02	0.1822E+00	0.6316E+00	0.6802E+00	0.5021E+00	0.2105E+00	0.3239E-01	0.2243E+01	0.10548+02
SW	0.4049E-02	0.1782E+00	0.8867E+00	0.8543E+00	0.4940E+00	0.1458E+00	0.5668E-01	0.2620E+01	0.9951E+01
WSW	0.0	0.1336E+00	0.6964E+00	0.8260E+00	0.3199E+00	0.5264E-01	0.4454E-01	0.2073E+01	0.9489E+01
W	0.0	0.1255E+00	0.4373E+00	0.4494E+00	0.2105E+00	0.6883E-01	0.8098E-02	0.1300E+01	0.9100E+01
WNW	0.0	0.1093E+00	0.3401E+00	0.4859E+00	0.3077E+00	0.1296E+00	0.1215E-01	0.1385E+01	0.1055E+02
NW	0.0	0.1134E+00	0.4373E+00	0.5304E+00	0.4008E+00	0.6883E-01	0.4049E-02	0.1555E+01	0.9999E+01
NNW	0.0	0.1255E+00	0.5790E+00	0.7248E+00	0.2591E+00	0.2429E-01	0.0	0.1713E+01	0.8725E+01
TOTAL	0.1620E-01	0.2300E+01	0.9389E+01	0.1000E+02	0.4061E+01	0.8179E+00	0.1782E+00	0.2676E+02	0.8668E+01

NUMBER OF CALMS - 4
NUMBER OF BAD HOURS - 266

TABLE 2.3.6-1E

JOINT PERCENTAGE FREQUENCIES OF WIND DIRECTION AND SPEED
FOR THE PERIOD 4:00 PM 1/14/76 TO 11:00 PM 12/31/78
UPPER WIND LEVEL
STABILITY CLASS E
STABILITY CALCULATED FROM DIFF. TEMPERATURE

HARRIS ON-SITE METEOROLOGICAL FACILITY

UPPER WIND DIRECTION	CALM	SPEED CLASS(MPH) 0.75 - 3.5	3.5 - 7.5	7.5 - 12.5	12.5 - 18.5	18.5 - 25.0	GREATER THAN 25.0	TOTAL	AVG. WIND SPEED
N	0.0	0.5668E-01	0.3077E+00	0.8584E+00	0.2510E+00	0.4454E-01	0.0	0.1518E+01	0.9900E+01
NNE	0.0	0.5264E-01	0.3280E+00	0.1000E+01	0.2389E+00	0.0	0.0	0.1620E+01	0.9596E+01
NE	0.0	0.8503E-01	0.3927E+00	0.9474E+00	0.2348E+00	0.0	0.0	0.1660E+01	0.9101E+01
ENE	0.0	0.5668E-01	0.3401E+00	0.4859E+00	0.1053E+00	0.1620E-01	0.0	0.1004E+01	0.8678E+01
E	0.0	0.6478E-01	0.3927E+00	0.4778E+00	0.8503E-01	0.0	0.0	0.1020E+01	0.8049E+01
ESE	0.0	0.4454E-01	0.4049E+00	0.3604E+00	0.3644E-01	0.0	0.0	0.8462E+00	0.7695E+01
SE	0.0	0.6883E-01	0.3077E+00	0.3280E+00	0.2024E-01	0.0	0.0	0.7248E+00	0.7458E+01
SSE	0.0	0.5668E-01	0.4656E+00	0.8422E+00	0.1498E+00	0.1620E-01	0.2024E-01	0.1551E+01	0.9027E+01
S	0.0	0.7288E-01	0.5749E+00	0.1413E+01	0.5102E+00	0.4049E-01	0.4049E-02	0.2616E+01	0.9863E+01
SSW	0.0	0.7288E-01	0.5830E+00	0.1931E+01	0.8098E+00	0.7288E-01	0.4049E-02	0.3474E+01	0.1041E+02
SW	0.0	0.6478E-01	0.5547E+00	0.9070E+00	0.4859E+00	0.8503E-01	0.1215E-01	0.2109E+01	0.1023E+02
WSW	0.4049E-02	0.1174E+00	0.4616E+00	0.6397E+00	0.2308E+00	0.4454E-01	0.0	0.1498E+01	0.9003E+01
W	0.0	0.7693E-01	0.2389E+00	0.4697E+00	0.1579E+00	0.8098E-02	0.0	0.9515E+00	0.9055E+01
WNW	0.0	0.4859E-01	0.2632E+00	0.5466E+00	0.1943E+00	0.8098E-02	0.0	0.1061E+00	0.9499E+01
NW	0.0	0.6883E-01	0.2389E+00	0.7652E+00	0.1782E+00	0.8098E-02	0.4049E-02	0.1263E+01	0.9386E+01
NNW	0.4049E-02	0.9717E-01	0.3442E+00	0.6154E+00	0.1741E+00	0.2834E-01	0.0	0.1263E+01	0.9052E+01
TOTAL	0.8098E-02	0.1105E+01	0.6199E+01	0.1259E+02	0.3863E+01	0.3725E+00	0.4454E-01	0.24180+02	0.9126E+01

NUMBER OF CALMS - 2
NUMBER OF BAD HOURS - 200

TABLE 2.3.6-1F

JOINT PERCENTAGE FREQUENCIES OF WIND DIRECTION AND SPEED
FOR THE PERIOD 4:00 PM 1/14/76 TO 11:00 PM 12/31/78
UPPER WIND LEVEL
STABILITY CLASS F
STABILITY CALCULATED FROM DIFF. TEMPERATURE

HARRIS ON-SITE METEOROLOGICAL FACILITY

UPPER WIND DIRECTION		SPEED CLASS(MPH)							AVG.
	CALM	0.75 - 3.5	3.5 - 7.5	7.5 - 12.5	12.5 - 18.5	18.5 - 25.0	GREATER THAN 25.0	TOTAL	WIND SPEED
N	0.0	0.3644E-01	0.1984E+00	0.4049E+00	0.2024E+00	0.0	0.0	0.8422E+00	0.9765E+01
NNE	0.0	0.3644E-01	0.1741E+00	0.4008E+00	0.1053E+00	0.0	0.0	0.7167E+00	0.9194E+01
NE	0.4049E-02	0.4454E-01	0.1579E+00	0.3280E+00	0.6883E-01	0.0	0.0	0.6033E+00	0.8684E+01
ENE	0.0	0.2429E-01	0.1093E+00	0.2713E+00	0.6073E-01	0.0	0.0	0.4656E+00	0.9128E+01
E	0.4049E-02	0.5264E-01	0.1620E+00	0.3482E+00	0.4454E-01	0.0	0.0	0.6114E+00	0.8388E+01
ESE	0.0	0.2429E-01	0.2146E+00	0.2915E+00	0.3239E-01	0.0	0.0	0.5628E+00	0.8013E+01
SE	0.0	0.3239E-01	0.1498E+00	0.2348E+00	0.8098E-02	0.0	0.0	0.4251E+00	0.7692E+01
SSE	0.4049E-02	0.4859E-01	0.2065E+00	0.3806E+00	0.4049E-01	0.0	0.0	0.6802E+00	0.8303E+01
S	0.0	0.4049E-01	0.35235+00	0.6721E+00	0.1782E+00	0.0	0.0	0.1243E+01	0.9044E+01
SSW	0.4049E-02	0.5264E-01	0.3482E+00	0.1089E+01	0.2713E+00	0.4049E-02	0.0	0.1769E+01	0.9624E+01
SW	0.4049E-02	0.5264E-01	0.2470E+00	0.1069E+01	0.1782E+00	0.0	0.0	0.1551E+01	0.9234E+01
WSW	0.4049E-02	0.4049E-01	0.2551E+00	0.6114E+00	0.1377E+00	0.0	0.0	0.1049E+01	0.9015E+01
W	0.0	0.2429E-01	0.1903E+00	0.3968E+00	0.1012E+00	0.0	0.0	9.7126E+00	0.9136E+01
WNW	0.0	0.3239E-01	0.1579E+00	0.2713E+00	0.6883E-01	0.0	0.0	0.5304E+00	0.8772E+01
NW	0.0	0.3239E-01	0.1539E+00	0.2470E+00	0.5264E-01	0.0	0.0	0.4859E+00	0.8218E+01
NNW	0.4049E-02	0.5264E-01	0.1660E+00	0.3037E+00	0.8098E-01	0.0	0.0	0.6073E+00	0.8636E+01
TOTAL	0.2834E-01	0.6276E+00	0.3243E+01	0.7320E+01	0.1632E+01	0.4049E-02	0.0	0.1286E+02	0.8803E+01

NUMBER OF CALMS - 7
NUMBER OF BAD HOURS - 63

TABLE 2.3.6-1G

JOINT PERCENTAGE FREQUENCIES OF WIND DIRECTION AND SPEED
FOR THE PERIOD 4:00 PM 1/14/76 TO 11:00 PM 12/31/78
UPPER WIND LEVEL
STABILITY CLASS G
STABILITY CALCULATED FROM DIFF. TEMPERATURE

HARRIS ON-SITE METEOROLOGICAL FACILITY

UPPER WIND DIRECTION				SPEED CLASS(MPH)					AVG.
	CALM	0.75 - 3.5	3.5 - 7.5	7.5 - 12.5	12.5 - 18.5	18.5 - 25.0	GREATER THAN 25.0	TOTAL	WIND SPEED
N	0.0	0.7288E-01	0.3482E+00	0.4170E+00	0.6073E-01	0.0	0.0	0.8989E+00	0.7690E+01
NNE	0.0	0.7693E-01	0.3442E+00	0.4737E+00	0.6478E-01	0.0	0.0	0.9596E+00	0.7792E+01
NE	0.0	0.1134E+00	0.3118E+00	0.4130E+00	0.4859E-01	0.0	0.0	0.8867E+00	0.7477E+01
ENE	0.8098E-02	0.1377E+00	0.3320E+00	0.3685E+00	0.9312E-01	0.0	0.0	0.9393E+00	0.7559E+01
E	0.0	0.7693E-01	0.2348E+00	0.4130E+00	0.3644E-01	0.0	0.0	0.7612E+00	0.8075E+01
ESE	0.0	0.1215E+00	0.2227E+00	0.3563E+00	0.2834E-01	0.0	0.0	0.7288E+00	0.7362E+01
SE	0.8098E-02	0.1255E+00	0.2753E+00	0.3199E+00	0.3239E-01	0.0	0.0	0.7612E+00	0.7252E+01
SSE	0.4049E-02	0.1215E+00	0.4859E+00	0.5426E+00	0.5264E-01	0.0	0.0	0.1207E+01	0.7637E+01
S	0.8098E-02	0.1215E+00	0.5628E+00	0.6600E+00	0.9717E-01	0.0	0.0	0.1450E+01	0.7824E+01
SSW	0.8098E-02	0.1822E+00	0.7288E+00	0.1146E+01	0.1296E+00	0.0	0.0	0.2195E+01	0.8128E+01
SW	0.8098E-02	0.1539E+00	0.7045E+00	0.1105E+01	0.6478E-01	0.0	0.0	0.2037E+01	0.7913E+01
WSW	0.8098E-02	0.1336E+00	0.9110E+00	0.1300E+01	0.1660E+00	0.0	0.0	0.2518E+01	0.8124E+01
W	0.8098E-02	0.1458E+00	0.5749E+00	0.4940E+00	0.2429E-01	0.0	0.0	0.1247E+01	0.6925E+01
WNW	0.8098E-02	0.1377E+00	0.5345E+00	0.3685E+00	0.5668E-01	0.0	0.0	0.1105E+01	0.6907E+01
NW	0.8098E-02	0.1539E+00	0.6195E+00	0.2510E+00	0.8098E-02	0.0	0.0	0.1041E+01	0.5903E+01
NNW	0.8098E-02	0.1336E+00	0.4211E+00	0.4332E+00	0.6073E-01	0.0	0.0	0.1057E+01	0.7304E+01
TOTAL	0.8503E-01	0.2008E+01	0.7612E+01	0.9061E+01	0.1024E+01	0.0	0.0	0.1979E+02	0.7492E+01

NUMBER OF CALMS - 21
NUMBER OF BAD HOURS - 130

TABLE 2.3.6-1H

JOINT PERCENTAGE FREQUENCIES OF WIND DIRECTION AND SPEED
FOR THE PERIOD 4:00 PM 1/14/76 TO 11:00 PM 12/31/78
UPPER WIND LEVEL
SUMMARY
STABILITY CALCULATED FROM DIFF. TEMPERATURE

HARRIS ON-SITE METEOROLOGICAL FACILITY

UPPER WIND DIRECTION		SPEED CLASS(MPH)							AVG.
	CALM	0.75 - 3.5	3.5 - 7,5	7.5 - 12.5	12.5 - 18.5	18.5 - 25.0	GREATER THAN 25.0	TOTAL	WIND SPEED
N	0.0	0.3685E+00	0.2130E+01	0.3312E+01	0.1061E+01	0.8503E-01	0.0	0.6956E+01	0.9035E+01
NNE	0.0	0.3482E+00	0.2138E+01	0.3689E+01	0.9515E+00	0.2834E-01	0.0	0.7154E+01	0.8875E+01
NE	0.4049E-02	0.4211E+00	0.1814E+01	0.2964E+01	0.7693E+00	0.2834E-01	0.0	0.6000E+01	0.8635E+01
ENE	0.1215E-01	0.4211E+00	0.1652E+01	0.1842E+01	0.4049E+00	0.2024E-01	0.4049E-02	0.4357E+01	0.7928E+01
E	0.8098E-02	0.3887E+00	0.1591E+01	0.1692E+01	0.1822E+00	0.0	0.0	0.3863E+01	0.7509E+01
ESE	0.0	0.3685E+00	0.1603E+01	0.1316E+01	0.1458E+00	0.0	0.0	0.3433E+01	0.7152E+01
SE	0.8098E-02	0.3765E+00	0.1340E+01	0.1186E+01	0.1255E+00	0.8098E-02	0.0	0.3045E+01	0.7221E+01
SSE	0.8098E-02	0.4049E+00	0.1879E+01	0.2397E+01	0.4778E+00	0.2834E-01	0.3644E-01	0.5231E+01	0.8346E+01
S	0.8098E-02	0.4251E+00	0.2304E+01	0.3628E+01	0.1024E+01	0.9312E-01	0.1215E-01	0.7495E+01	0.8926E+01
SSW	0.1620E-01	0.5466E+00	0.2620E+01	0.5486E+01	0.2065E+01	0.3644E+00	0.4049E-01	0.1114E+01	0.9867E+01
SW	0.1620E-01	0.5305E+00	0.2891E+01	0.4648E+01	0.1705E+01	0.3806E+00	0.1012E+00	0.1027E+02	0.9688E+01
WSW	0.1620E-01	0.5143E+00	0.2737E+01	0.4065E+01	0.1207E+01	0.1862E+00	0.9717E-01	0.8823E+01	0.9187E+01
W	0.8098E-02	0.4130E+00	0.1761E+01	0.2089E+01	0.6802E+00	0.1458E+00	0.2429E-01	0.5122E+01	0.8763E+01
WNW	0.8098E-02	0.3725E+00	0.1591E+01	0.2231E+01	0.1117E+01	0.2713E+00	0.3644E-01	0.5628E+01	0.9824E+01
NW	0.8098E-02	0.4130E+00	0.1802E+01	0.2324E+01	0.9717E+00	0.1377E+00	0.8098E-02	0.5664E+01	0.9012E+01
NNW	0.1620E-01	0.4413E+00	0.1830E+01	0.2640E+01	0.8138E+00	0.7693E-01	0.0	0.5818E+01	0.8737E+01
TOTAL	0.1377E+00	0.6753E+01	0.3168E+02	0.4551E+02	0.1370E+02	0.1854E+01	0.3604E+00	0.1000E+03	0.8913E+01

NUMBER OF CALMS - 34
NUMBER OF BAD HOURS - 1256

2

TABLE 2.3.6-11

JOINT PERCENTAGE FREQUENCIES OF WIND DIRECTION AND SPEED
FOR THE PERIOD 4:00 PM 1/14/76 TO 11:00 PM 12/31/78
LOWER WIND LEVEL
STABILITY CLASS A
STABILITY CALCULATED FROM DIFF. TEMPERATURE

HARRIS ON-SITE METEOROLOGICAL FACILITY

LOWER WIND DIRECTION	SPEED CLASS(MPH)								AVG.
	CALM	0.75 - 3.5	3.5 - 7.5	7.5 - 12.5	12.5 - 18.5	18.5 - 25.0	GREATER THAN 25.0	TOTAL	WIND SPEED
N	0.0	0.2404E-01	0.3727E+00	0.2404E+00	0.8014E-02	0.0	0.0	0.6452E+00	0.7025E+01
NNE	0.0	0.4007E-02	0.2685E+00	0.2164E+00	0.0	0.0	0.0	0.4889E+00	0.7267E+01
NE	0.0	0.1603E-01	0.2164E+00	0.1523E+00	0.8014E-02	0.0	0.0	0.3927E+00	0.7216E+01
ENE	0.0	0.4007E-02	0.1643E+00	0.4809E-01	0.0	0.0	0.0	0.2164E+00	0.6358E+01
E	0.0	0.1202E-01	0.7614E-01	0.1202E-01	0.0	0.0	0.0	0.1002E+00	0.5621E+01
ESE	0.0	0.1202E-01	0.6011E-01	0.8014E-02	0.0	0.0	0.0	0.8014E-01	0.4889E+01
SE	0.0	0.2404E-01	0.6011E-01	0.4007E-02	0.0	0.0	0.0	0.8816E-01	0.4875E+01
SSE	0.0	0.8014E-02	0.1042E+00	0.8014E-02	0.4007E-02	0.0	0.0	0.1242E+00	0.5815E+01
S	0.0	0.1603E-01	0.1162E+00	0.2004E-01	0.8014E-02	0.0	0.0	0.1603E+00	0.6220E+01
SSW	0.0	0.2004E-01	0.2364E+00	0.2885E+00	0.1603E-01	0.0	0.0	0.5610E+00	0.7830E+01
SW	0.0	0.2404E-01	0.2765E+00	0.3807E+00	0.1242E+00	0.0	0.0	0.8054E+00	0.8773E+01
WSW	0.0	0.3606E-01	0.3086E+00	0.2605E+00	0.7213E-01	0.1603E-01	0.0	0.6983E+00	0.8303E+01
W	0.0	0.2004E-01	0.1964E+00	0.1202E+00	0.2805E-01	0.4007E-02	0.0	0.3687E+00	0.7431E+01
WNW	0.0	0.1202E-01	0.1723E+00	0.3566E+00	0.9217E-01	0.8014E-02	0.0	0.6412E+00	0.9461E+01
NW	0.0	0.4007E-02	0.2484E+00	0.2805E+00	0.5209E-01	0.0	0.0	0.5851E+00	0.8164E+01
NNW	0.0	0.1202E-01	0.2284E+00	0.3005E+00	0.3606E-01	0.0	0.0	0.5770E+00	0.8134E+01
TOTAL	0.0	0.2484E+00	0.3106E+01	0.2697E+01	0.4488E+00	0.2805E-01	0.0	0.6528E+01	0.7086E+01

NUMBER OF CALMS - 1
NUMBER OF BAD HOURS - 568

TABLE 2.3.6-15

JOINT PERCENTAGE FREQUENCIES OF WIND DIRECTION AND SPEED
FOR THE PERIOD 4:00 PM 1/14/76 TO 11:00 PM 12/31/78
LOWER WIND LEVEL
STABILITY CLASS B
STABILITY CALCULATED FROM DIFF. TEMPERATURE

HARRIS ON-SITE METEOROLOGICAL FACILITY

LOWER WIND DIRECTION	CALM	SPEED CLASS(MPH) 0.75 - 3.5	3.5 - 7.5	7.5 - 12.5	12,5 - 18.5	18.5 - 25.0	GREATER THAN 25.0	TOTAL	AVG. WIND SPEED
N	0.0	0.4007E-02	0.2525E+00	0.8014E-01	0.0	0.0	0.0	0.3366E+00	0.6520E+01
NNE	0.0	0.8014E-02	0.1883E+00	0.6812E-01	0.0	0.0	0.0	0.2645E+00	0.6505E+01
NE	0.0	0.2004E-01	0.2204E+00	0.7213E-01	0.4007E-02	0.0	0.0	0.3166E+00	0.6144E+01
ENE	0.0	0.1603E-01	0.1162E+00	0.1202E-01	0.0	0.0	0.0	0.1443E+00	0.5786E+01
E	0.0	0.8014E-02	0.9217E-01	0.1603E-01	0.0	0.0	0.0	0.1162E+00	0.5632E+01
ESE	0.0	0.1603E-01	0.1042E+00	0.4007E-02	0.0	0.0	0.0	0.1242E+00	0.5117E+01
SE	0.0	0.8014E-02	0.4408E-01	0.8014E-02	0.0	0.0	0.0	0.6011E-01	0.5274E+01
SSE	0.0	0.8014E-02	0.3606E-01	0.1603E-01	0.0	0.0	0.0	0.6011E-01	0.5651E+01
S	0.0	0.2404E-01	0.1122E+00	0.4408E-01	0.4007E-02	0.0	0.0	0.1843E+00	0.6514E+01
SSW	0.0	0.1603E-01	0.2364E+00	0.7614E-01	0.8014E-02	0.0	0.0	0.3366E+00	0.6574E+01
SW	0.0	0.1603E-01	0.2404E+00	0.1563E+00	0.3206E-01	0.8014E-02	0.0	0.4528E+00	0.7805E+01
WSW	0.0	0.4007E-01	0.1883E+00	0.2124E+00	0.2404E-01	0.4007E-02	0.4007E-02	0.4729E+00	0.7870E+01
W	0.0	0.2404E-01	0.8014E-01	0.8014E-01	0.2404E-01	0.4007E-02	0.0	0.2124E+00	0.7862E+01
WNW	0.0	0.1603E-01	0.1483E+00	0.1923E+00	0.5610E-01	0.8014E-02	0.0	0.4208E+00	0.8865E+01
NW	0.0	0.1603E-01	0.1803E+00	0.2284E+00	0.4007E-01	0.0	0.0	0.4648E+00	0.8273E+01
NNW	0.0	0.0	0.1643E+00	0.1122E+00	0.1603E-01	0.0	0.0	0.2925E+00	0.7494E+01
TOTAL	0.0	0.2404E+00	0.2404E+01	0.1378E+01	0.2084E+00	0.2404E-01	0.4007E-02	0.4260E+01	0.6743E+01

NUMBER OF CALMS - 0
NUMBER OF BAD HOURS - 23

TABLE 2.3.6-1K

JOINT PERCENTAGE FREQUENCIES OF WIND DIRECTION AND SPEED
FOR THE PERIOD 4:00 PM 1/14/76 TO 11:00 PM 12/31/78
LOWER WIND LEVEL
STABILITY CLASS C
STABILITY CALCULATED FROM DIFF. TEMPERATURE

HARRIS ON-SITE METEOROLOGICAL FACILITY

LOWER WIND DIRECTION	CALM	SPEED CLASS(MPH) 0.75 - 3.5	3.5 - 7.5	7.5 - 12.5	12.5 - 18.5	18.5 - 25.0	GREATER THAN 25.0	TOTAL	AVG. WIND SPEED
N	0.0	0.2004E-01	0.2845E+00	0.1683E+00	0.0	0.0	0.0	0.4729E+00	0.6561E+01
NNE	0.0	0.1603E-01	0.2204E+00	0.4408E-01	0.0	0.0	0.0	0.2805E+00	0.5820E+01
NE	0.0	0.2404E-01	0.1563E+00	0.4007E-01	0.0	0.0	0.0	0.2204E+00	0.5763E+01
ENE	0.0	0.2404E-01	0.1923E+00	0.3206E-01	0.0	0.0	0.0	0.2484E+00	0.5442E+01
E	0.0	0.2805E-01	0.1403E+00	0.4007E-02	0.0	0.0	0.0	0.1723E+00	0.4839E+01
ESE	0.0	0.1603E-01	0.1002E+00	0.4007E-02	0.0	0.0	0.0	0.1202E+00	0.4809E+01
SE	0.0	0.2004E-01	0.9217E-01	0.1603E-01	0.0	0.0	0.0	0.1282E+00	0.5046E+01
SSE	0.0	0.2404E-01	0.1443E+00	0.2004E-01	0.0	0.0	0.0	0.1883E+00	0.5356E+01
S	0.0	0.2805E-01	0.1763E+00	0.4007E-01	0.4007E-02	0.0	0.0	0.2484E+00	0.5730E+01
SSW	0.0	0.4007E-01	0.3166E+00	0.1122E+00	0.1603E-01	0.0	0.0	0.4849E+00	0.6445E+01
SW	0.0	0.6412E-01	0.3206E+00	0.1643E+00	0.3206E-01	0.0	0.0	0.5810E+00	0.7043E+01
WSW	0.0	0.2404E-01	0.2925E+00	0.2084E+00	0.3206E-01	0.1202E-01	0.0	0.5690E+00	0.7967E+01
W	0.0	0.1603E-01	0.2284E+00	0.9617E-01	0.1202E-01	0.0	0.0	0.3526E+00	0.6738E+01
WNW	0.0	0.3206E-01	0.1843E+00	0.1282E+00	0.8014E-01	0.4007E-02	0.0	0.4288E+00	0.8427E+01
NW	0.0	0.2805E-01	0.1803E+00	0.1964E+00	0.4408E-01	0.0	0.0	0.4488E+00	0.7818E+01
NNW	0.0	0.2805E-01	0.2444E+00	0.1563E+00	0.2004E-01	0.0	0.0	0.4488E+00	0.7000E+01
TOTAL	0.0	0.4328E+00	0.3274E+01	0.1431E+01	0.2404E+00	0.1603E-01	0.0	0.5394E+01	0.6300E+01

NUMBER OF CALMS - 0
NUMBER OF BAD HOURS - 18

TABLE 2.3.6-11

JOINT PERCENTAGE FREQUENCIES OF WIND DIRECTION AND SPEED
FOR THE PERIOD 4:00 PM 1/14/76 TO 11:00 PM 12/31/78
LOWER WIND LEVEL
STABILITY CLASS D
STABILITY CALCULATED FROM DIFF. TEMPERATURE

HARRIS ON-SITE METEOROLOGICAL FACILITY

LOWER WIND DIRECTION	SPEED CLASS(MPH) CALM	0.75 - 3.5	3.5 - 7.5	7.5 - 12.5	12.5 - 18.5	18.5 - 25.0	GREATER THAN 25.0	TOTAL	AVG. WIND SPEED
N	0.8014E-02	0.4007E+00	0.1659E+01	0.5290E+00	0.2805E-01	0.0	0.0	0.2625E+01	0.5706E+01
NNE	0.8014E-02	0.5209E+00	0.1675E+01	0.2124E+00	0.0	0.0	0.0	0.2416E+01	0.4967E+01
NE	0.8014E-02	0.4168E+00	0.1094E+01	0.2124E+00	0.8014E-02	0.0	0.0	0.1739E+01	0.5157E+01
ENE	0.8014E-02	0.3326E+00	0.8535E+00	0.1242E+00	0.0	0.0	0.0	0.1318E+01	0.4892E+01
E	0.0	0.2685E+00	0.6492E+00	0.5610E-01	0.0	0.0	0.0	0.9738E+00	0.4462E+01
ESE	0.0	0.2565E+00	0.5530E+00	0.2404E-01	0.0	0.0	0.0	0.8335E+00	0.4435E+01
SE	0.0	0.2044E+00	0.6171E+00	0.1242E+00	0.4007E-02	0.0	0.0	0.9497E+00	0.5093E+01
SSE	0.0	0.2805E+00	0.8255E+00	0.1883E+00	0.1603E-01	0.0	0.0	0.1310E+01	0.5345E+01
S	0.8014E-02	0.3045E+00	0.8575E+00	0.1883E+00	0.2805E-01	0.0	0.0	0.1386E+01	0.5398E+01
SSW	0.8014E-02	0.4729E+00	0.1250E+01	0.4889E+00	0.1322E+00	0.0	0.0	0.2352E+01	0.6156E+01
SW	0.8014E-02	0.4368E+00	0.1242E+01	0.7213E+00	0.1002E+00	0.1202E-01	0.0	0.2521E+01	0.6467E+01
WSW	0.8014E-02	0.3206E+00	0.1198E+01	0.5290E+00	0.9617E-01	0.5209E-01	0.0	0.2204E+01	0.6748E+01
W	0.8014E-02	0.3126E+00	0.6452E+00	0.2925E+00	0.6011E-01	0.0	0.0	0.1318E+01	0.6016E+01
WNW	0.0	0.2444E+00	0.7133E+00	0.4929E+00	0.1202E+00	0.4007E-02	0.0	0.1575E+01	0.6934E+01
NW	0.0	0.1923E+00	0.7373E+00	0.5530E+00	0.1122E+00	0.0	0.0	0.1595E+01	0.7101E+01
NNW	0.8014E-02	0.3526E+00	0.9537E+00	0.5690E+00	0.3606E-01	0.0	0.0	0.1919E+01	0.6207E+01
TOTAL	0.8014E-01	0.5318E+01	0.1552E+02	0.5306E+01	0.7413E+00	0.6812E-01	0.0	0.2704E+02	0.5693E+01

NUMBER OF CALMS - 20
NUMBER OF BAD HOURS - 129

TABLE 2.3.6-1M

JOINT PERCENTAGE FREQUENCIES OF WIND DIRECTION AND SPEED
FOR THE PERIOD 4:00 PM 1/14/76 TO 11:00 PM 12/31/78
LOWER WIND LEVEL
STABILITY CLASS E
STABILITY CALCULATED FROM DIFF. TEMPERATURE

HARRIS ON-SITE METEOROLOGICAL FACILITY

LOWER WIND DIRECTION		SPEED CLASS(MPH)							AVG.
	CALM	0.75 - 3.5	3.5 - 7.5	7.5 - 12.5	12.5 - 18.5	18.5 - 25.0	GREATER THAN 25.0	TOTAL	WIND SPEED
N	0.1202E-01	0.5891E+00	0.9297E+00	0.1563E+00	0.1202E-01	0.0	0.0	0.1699E+01	0.4637E+01
NNE	0.1202E-01	0.7974E+00	0.9337E+00	0.4007E-01	0.0	0.0	0.0	0.1783E+01	0.3850E+01
NE	0.1202E-01	0.7453E+00	0.6692E+00	0.8014E-01	0.0	0.0	0.0	0.1507E+01	0.4001E+01
ENE	0.1202E-01	0.5931E+00	0.4127E+00	0.9217E-01	0.4007E-02	0.0	0.0	0.1114E+01	0.4013E+01
E	0.8014E-02	0.5570E+00	0.3566E+00	0.4007E-01	0.8014E-02	0.0	0.0	0.9697E+00	0.3625E+01
ESE	0.4007E-02	0.4568E+00	0.2805E+00	0.3606E-01	0.0	0.0	0.0	0.7774E+00	0.3548E+01
SE	0.8014E-02	0.5330E+00	0.3486E+00	0.1603E-01	0.0	0.0	0.0	0.9056E+00	0.3353E+01
SSE	0.1202E-01	0.8696E+00	0.5971E+00	0.3206E-01	0.1202E-01	0.0	0.0	0.1523E+01	0.3588E+01
S	0.2004E-01	0.1362E+01	0.1058E+01	0.2084E+00	0.2004E-01	0.4007E-02	0.0	0.2673E+01	0.4064E+01
SSW	0.2004E-01	0.1386E+01	0.1499E+01	0.2284E+00	0.2404E-01	0.0	0.0	0.3158E+01	0.4291E+01
SW	0.1202E-01	0.8095E+00	0.9577E+00	0.3406E+00	0.2004E-01	0.0	0.0	0.2140E+01	0.4874E+01
WSW	0.8014E-02	0.4889E+00	0.6412E+00	0.16835+00	0.2004E-01	0.0	0.0	0.1326E+01	0.4810E+01
W	0.0	0.3366E+00	0.5169E+00	0.1082E+00	0.8014E-02	0.0	0.0	0.9697E+00	0.4645E+01
WNW	0.0	0.3847E+00	0.5129E+00	0.1202E+00	0.0	0.4007E-02	0.0	0.1022E+01	0.4628E+01
NW	0.0	0.4047E+00	0.8014E+00	0.1162E+00	0.1202E-01	0.0	0.0	0.1334E+01	0.4692E+01
NNW	0.8014E-02	0.4889E+00	0.7213E+00	0.1322E+00	0.2805E-01	0.0	0.0	0.1378E+01	0.4579E+01
TOTAL	0.1483E+00	0.1080E+02	0.1124E+02	0.1915E+01	0.1683E+00	0.8014E-02	0.0	0.2428E+02	0.4200E+01

NUMBER OF CALMS - 37
NUMBER OF BAD HOURS - 113

TABLE 2.3.6-1N

JOINT PERCENTAGE FREQUENCIES OF WIND DIRECTION AND SPEED
FOR THE PERIOD 4:00 PM 1/14/76 TO 11:00 PM 12/31/78
LOWER WIND LEVEL
STABILITY CLASS F
STABILITY CALCULATED FROM DIFF. TEMPERATURE

HARRIS ON-SITE METEOROLOGICAL FACILITY

LOWER WIND DIRECTION		SPEED CLASS(MPH)							AVG.
	CALM	0.75 - 3.5	3.5 - 7.5	7.5 - 12.5	12.5 - 18.5	18.5 - 25.0	GREATER THAN 25.0	TOTAL	WIND SPEED
N	0.2805E-01	0.6532E+00	0.3647E+00	0.8014E-02	0.0	0.0	0.0	0.1054E+01	0.3108E+01
NNE	0.2805E-01	0.6852E+00	0.1403E+00	0.0	0.0	0.0	0.0	0.8535E+00	0.2568E+01
NE	0.2805E-01	0.6492E+00	0.5610E-01	0.0	0.0	0.0	0.0	0.7333E+00	0.2303E+01
ENE	0.2805E-01	0.6452E+00	0.6011E-01	0.0	0.0	0.0	0.0	0.7333E+00	0.2347E+01
E	0.2004E-01	0.4688E+00	0.6011E-01	0.0	0.0	0.0	0.0	0.5490E+00	0.2253E+01
ESE	0.2404E-01	0.5450E+00	0.4007E-01	0.0	0.0	0.0	0.0	0.6091E+00	0.2066E+01
SE	0.2004E-01	0.43285+00	0.4007E-01	0.0	0.0	0.0	0.0	0.4929E+00	0.2130E+01
SSE	0.3206E-01	0.8375E+00	0.4007E-01	0.0	0.0	0.0	0.0	0.9096E+00	0.2028E+01
S	0.4408E-01	0.1082E+01	0.2004E+00	0.0	0.0	0.0	0.0	0.1326E+01	0.2384E+01
SSW	0.4809E-01	0.1186E+01	0.2965E+00	0.0	0.0	0.0	0.0	0.1531E+01	0.2544E+01
SW	0.3206E-01	0.8215E+00	0.2204E+00	0.0	0.0	0.0	0.0	0.1074E+01	0.2579E+01
WSW	0.2404E-01	0.5290E+00	0.1683E+00	0.0	0.0	0.0	0.0	0.7213E+00	0.2661E+01
W	0.4007E-02	0.3687E+00	0.1723E+00	0.0	0.0	0.0	0.0	0.5450E+00	0.2950E+01
WNW	0.0	0.3246E+00	0.1282E+00	0.0	0.0	0.0	0.0	0.4528E+00	0.2808E+01
NW	0.0	0.3086E+00	0.1242E+00	0.0	0.0	0.0	0.0	0.4328E+00	0.2777E+01
NNW	0.2004E-01	0.5049E+00	0.1964E+00	0.4007E-02	0.0	0.0	0.0	0.7253E+00	0.2764E+01
TOTAL	0.3807E+00	0.1004E+02	0.2308E+01	0.1202E-01	0.0	0.0	0.0	0.1274E+02	0.2517E+01

NUMBER OF CALMS - 95
NUMBER OF BAD HOURS - 58

TABLE 2.3.6-10

JOINT PERCENTAGE FREQUENCIES OF WIND DIRECTION AND SPEED
FOR THE PERIOD 4:00 PM 1/14/76 TO 11:00 PM 12/31/78
LOWER WIND LEVEL
STABILITY CLASS G
STABILITY CALCULATED FROM DIFF. TEMPERATURE

HARRIS ON-SITE METEOROLOGICAL FACILITY

LOWER WIND DIRECTION		SPEED CLASS(MPH)							AVG.
	CALM	0.75 - 3.5	3.5 - 7.5	7.5 - 12.5	12.5 - 18.5	18.5 - 25.0	GREATER THAN 25.0	TOTAL	WIND SPEED
N	0.5490E+00	0.1575E+01	0.8816E-01	0.0	0.0	0.0	0.0	0.2212E+01	0.1774E+01
NNE	0.5049E+00	0.1451E+01	0.2805E-01	0.0	0.0	0.0	0.0	0.1984E+01	0.1520E+01
NE	0.4688E+00	0.1342E+01	0.2004E-01	0.0	0.0	0.0	0.0	0.1831E+01	0.1566E+01
ENE	0.4168E+00	0.1194E+01	0.4007E-01	0.0	0.0	0.0	0.0	0.1651E+01	0.1558E+01
E	0.3687E+00	0.1050E+01	0.1202E-01	0.0	0.0	0.0	0.0	0.1431E+01	0.1451E+01
ESE	0.2885E+00	0.8215E+00	0.1202E-01	0.0	0.0	0.0	0.0	0.1122E+01	0.1495E+01
SE	0.2324E+00	0.6572E+00	0.2004E-01	0.0	0.0	0.0	0.0	0.9096E+00	0.1495E+01
SSE	0.2204E+00	0.6251E+00	0.3606E-01	0.0	0.0	0.0	0.0	0.8816E+00	0.1655E+01
S	0.3005E+00	0.8616E+00	0.4809E-01	0.1202E-01	0.0	0.0	0.0	0.1222E+01	0.1646E+01
SSW	0.3045E+00	0.8736E+00	0.2404E-01	0.0	0.0	0.0	0.0	0.1202E+01	0.1610E+01
SW	0.2725E+00	0.7734E+00	0.4007E-01	0.4007E-02	0.0	0.0	0.0	0.1090E+01	0.1713E+01
WSW	0.2284E+00	0.6492E+00	0.4809E-01	0.0	0.0	0.0	0.0	0.9257E+00	0.1636E+01
W	0.1763E+00	0.4969E+00	0.3206E-01	0.0	0.0	0.0	0.0	0.7053E+00	0.1621E+01
WNW	0.1282E+00	0.4688E+00	0.2805E-01	0.0	0.0	0.0	0.0	0.6251E+00	0.1755E+01
NW	0.1803E+00	0.5129E+00	0.2805E-01	0.4007E-02	0.0	0.0	0.0	0.7253E+00	0.1691E+01
NNW	0.3126E+00	0.8896E+00	0.3606E-01	0.0	0.0	0.0	0.0	0.1238E+01	0.1581E+01
TOTAL	0.4953E+01	0.1424E+02	0.5410E+00	0.2004E-01	0.0	0.0	0.0	0.1976E+02	0.1610E+01

NUMBER OF CALMS - 1236
NUMBER OF BAD HOURS - 88

TABLE 2.3.6-1P

JOINT PERCENTAGE FREQUENCIES OF WIND DIRECTION AND SPEED
FOR THE PERIOD 4:00 PM 1/14/76 TO 11:00 PM 12/31/78
LOWER WIND LEVEL
SUMMARY
STABILITY CALCULATED FROM DIFF. TEMPERATURE

HARRIS ON-SITE METEOROLOGICAL FACILITY

LOWER WIND DIRECTION				SPEED CLASS(MPH)					AVG.
	CALM	0.75 - 3.5	3.5 - 7.5	7.5 - 12.5	12.5 - 18.5	18.5 - 25.0	GREATER THAN 25.0	TOTAL	WIND SPEED
N	0.5971E+00	0.3266E+01	0.3951E+01	0.1182E+01	0.4809E-01	0.0	0.0	0.9044E+01	0.4584E+01
NNE	0.5530E+00	0.3482E+01	0.3454E+01	0.5810E+00	0.0	0.0	0.0	0.8071E+01	0.3998E+01
NE	0.5169E+00	0.3214E+01	0.2432E+01	0.5570E+00	0.2004E-01	0.0	0.0	0.6740E+01	0.3971E+01
ENE	0.4648E+00	0.2809E+01	0.1839E+01	0.3086E+00	0.4007E-02	0.0	0.0	0.5426E+01	0.3623E+01
E	0.3967E+00	0.2392E+01	0.1386E+01	0.1282E+00	0.8014E-02	0.0	0.0	0.4312E+01	0.3222E+01
ESE	0.3166E+00	0.2124E+01	0.1150E+01	0.7614E-01	0.0	0.0	0.0	0.3667E+01	0.3135E+01
SE	0.2605E+00	0.1879E+01	0.1222E+01	0.1683E+00	0.4007E-02	0.0	0.0	0.3534E+01	0.3439E+01
SSE	0.2645E+00	0.2653E+01	0.1783E+01	0.2645E+00	0.3206E-01	0.0	0.0	0.4997E+01	0.3670E+01
S	0.3727E+00	0.3679E+01	0.2569E+01	0.5129E+00	0.6412E-01	0.4007E-02	0.0	0.7201E+01	0.3869E+01
SSW	0.3807E+00	0.3995E+01	0.3859E+01	0.1194E+01	0.1964E+00	0.0	0.0	0.9625E+01	0.4634E+01
SW	0.3246E+00	0.2945E+01	0.3298E+01	0.1767E+01	0.3086E+00	0.2004E-01	0.0	0.8664E+01	0.5444E+01
WSW	0.2725E+00	0.2088E+01	0.2845E+01	0.1378E+01	0.2444E+00	0.8415E-01	0.4007E-02	0.6916E+01	0.5745E+01
W	0.1883E+00	0.1575E+01	0.1871E+01	0.6973E+00	0.1322E+00	0.8014E-02	0.0	0.4472E+01	0.5048E+01
WNW	0.1282E+00	0.1483E+01	0.1887E+01	0.1290E+01	0.3486E+00	0.2805E-01	0.0	0.5165E+01	0.6195E+01
NW	0.1803E+00	0.1467E+01	0.2300E+01	0.1378E+01	0.2605E+00	0.0	0.0	0.5586E+01	0.5890E+01
NNW	0.3486E+00	0.2276E+01	0.2545E+01	0.1274E+01	0.1362E+00	0.0	0.0	0.6580E+01	0.5068E+01
TOTAL	0.5566E+01	0.4133E+02	0.3839E+02	0.1276E+02	0.1807E+01	0.1443E+00	0.4007E-02	0.1000E+03	0.4578E+01

NUMBER OF CALMS - 1389
NUMBER OF BAD HOURS - 997

TABLE 2.3.6-2A

WIND DISTRIBUTION BY PASQUILL STABILITY CLASSES (STAR PROGRAM)

ANNUAL

RELATIVE FREQUENCY DISTRIBUTION
A STABILITY
SPEED(KTS)

STATION = RALEIGH,N.C. 55-64

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.000690	0.000354	0.000000	0.000000	0.000000	0.000000	0.001044
NNE	0.000458	0.000194	0.000000	0.000000	0.000000	0.000000	0.000652
NE	0.000295	0.000148	0.000000	0.000000	0.000000	0.000000	0.000444
ENE	0.000272	0.000171	0.000000	0.000000	0.000000	0.000000	0.000444
E	0.000423	0.000308	0.000000	0.000000	0.000000	0.000000	0.000731
ESE	0.000254	0.000137	0.000000	0.000000	0.000000	0.000000	0.000391
SE	0.000266	0.000126	0.000000	0.000000	0.000000	0.000000	0.000391
SSE	0.000217	0.000148	0.000000	0.000000	0.000000	0.000000	0.000365
S	0.000442	0.000263	0.000000	0.000000	0.000000	0.000000	0.000705
SSW	0.000445	0.000285	0.000000	0.000000	0.000000	0.000000	0.000731
SW	0.000897	0.000434	0.000000	0.000000	0.000000	0.000000	0.001331
WSW	0.000651	0.000445	0.000000	0.000000	0.000000	0.000000	0.001096
W	0.000775	0.000400	0.000000	0.000000	0.000000	0.000000	0.001174
WNW	0.000573	0.000263	0.000000	0.000000	0.000000	0.000000	0.000835

TABLE 2.3.6-2A (Continued)

WIND DISTRIBUTION BY PASQUILL STABILITY CLASSES (STAR PROGRAM)

ANNUAL   RELATIVE FREQUENCY DISTRIBUTION   STATION = RALEIGH,N.C. 55-64
A STABILITY
SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
NW	0.000395	0.000205	0.000000	0.000000	0.000000	0.000000	0.000600
NNW	0.000527	0.000308	0.000000	0.000000	0.000000	0.000000	0.000835
TOTAL	0.0007581	0.004190	0.000000	0.000000	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF A STABILITY = 0.011770

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH A STABILITY = 0.006622

TABLE 2.3.6-2B

WIND DISTRIBUTION BY PASQUILL STABILITY CLASSES (STAR PROGRAM)

ANNUAL RELATIVE FREQUENCY DISTRIBUTION STATION = RALEIGH,N.C. 55-64
B STABILITY
SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.001245	0.001781	0.001199	0.000000	0.000000	0.000000	0.004224
NNE	0.000853	0.001164	0.001039	0.000000	0.000000	0.000000	0.003056
NE	0.001054	0.001393	0.001085	0.000000	0.000000	0.000000	0.003532
ENE	0.000533	0.000890	0.000605	0.000000	0.000000	0.000000	0.002029
E	0.000594	0.000993	0.000833	0.000000	0.000000	0.000000	0.002420
ESE	0.000517	0.000788	0.000616	0.000000	0.000000	0.000000	0.001922
SE	0.000557	0.000970	0.000628	0.000000	0.000000	0.000000	0.002155
SSE	0.000576	0.000833	0.000582	0.000000	0.000000	0.000000	0.001991
S	0.001040	0.001792	0.001735	0.000000	0.000000	0.000000	0.004568
SSW	0.001387	0.001564	0.001450	0.000000	0.000000	0.000000	0.004401
SW	0.001902	0.002740	0.002443	0.000000	0.000000	0.000000	0.007085
WSW	0.001415	0.002055	0.001747	0.000000	0.000000	0.000000	0.005217
W	0.001568	0.002169	0.002158	0.000000	0.000000	0.000000	0.005895
WNW	0.001421	0.001678	0.001313	0.000000	0.000000	0.000000	0.004413

TABLE 2.3.6-2B (Continued)

WIND DISTRIBUTION BY PASQUILL STABILITY CLASSES (STAR PROGRAM)

ANNUAL RELATIVE FREQUENCY DISTRIBUTION STATION = RALEIGH,N.C. 55-64

B STABILITY

SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
NW	0.000973	0.001370	0.000913	0.000000	0.000000	0.000000	0.003257
NNW	0.000883	0.001119	0.000902	0.000000	0.000000	0.000000	0.002984
TOTAL	0.016520	0.023301	0.019328	0.000000	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF B STABILITY = 0.059149

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH B STABILITY = 0.009168

TABLE 2.3.6-2C

WIND DISTRIBUTION BY PASQUILL STABILITY CLASSES (STAR PROGRAM)

ANNUAL RELATIVE FREQUENCY DISTRIBUTION STATION = RALEIGH,N.C. 55-64

C STABILITY

SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.000836	0.002614	0.006256	0.001027	0.000057	0.000011	0.010803
NNE	0.000450	0.001439	0.004327	0.000696	0.000011	0.000011	0.006935
NE	0.000392	0.001564	0.005058	0.000913	0.000057	0.000000	0.007984
ENE	0.000399	0.001244	0.002923	0.000434	0.000000	0.000000	0.005000
E	0.000379	0.001279	0.003048	0.000502	0.000023	0.000000	0.005231
ESE	0.000340	0.001005	0.001712	0.000091	0.000000	0.000000	0.003149
SE	0.000307	0.001187	0.002021	0.000148	0.000000	0.000000	0.003664
SSE	0.000328	0.001085	0.002101	0.000263	0.000000	0.000000	0.003776
S	0.000578	0.002397	0.006165	0.000719	0.000034	0.000000	0.009894
SSW	0.000905	0.003334	0.006565	0.001153	0.000034	0.000000	0.011991
SW	0.001361	0.004806	0.009259	0.001347	0.000011	0.000000	0.016785
WSW	0.001003	0.003208	0.005309	0.000674	0.000011	0.000000	0.010205
W	0.000800	0.002923	0.005594	0.001005	0.000023	0.000000	0.010344
WNW	0.000638	0.002215	0.004338	0.000742	0.000046	0.000000	0.007979

TABLE 2.3.6-2C (Continued)

WIND DISTRIBUTION BY PASQUILL STABILITY CLASSES (STAR PROGRAM)

ANNUAL RELATIVE FREQUENCY DISTRIBUTION STATION = RALEIGH,N.C. 55-64
C STABILITY
SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
NW	0.000551	0.001827	0.004236	0.000879	0.000023	0.000000	0.007515
NNW	0.000572	0.001724	0.003539	0.000639	0.000011	0.000000	0.006486
TOTAL	0.009841	0.033850	0.072449	0.011234	0.000342	0.000023	

RELATIVE FREQUENCY OF OCCURRENCE OF C STABILITY = 0.127740

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH C STABILITY = 0.006976

TABLE 2.3.6-2D

WIND DISTRIBUTION BY PASQUILL STABILITY CLASSES (STAR PROGRAM)

ANNUAL

RELATIVE FREQUENCY DISTRIBUTION
D STABILITY
SPEED(KTS)

STATION = RALEIGH,N.C. 55-64

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.001991	0.006039	0.018175	0.014716	0.001747	0.000320	0.042988
NNE	0.001685	0.005309	0.016177	0.014316	0.002066	0.000285	0.039839
NE	0.001945	0.006085	0.016668	0.011576	0.000925	0.000080	0.037279
ENE	0.001629	0.005046	0.010720	0.005994	0.000251	0.000046	0.023686
E	0.001416	0.004886	0.010686	0.003904	0.003423	0.000068	0.021304
ESE	0.001234	0.003825	0.007090	0.002580	0.000274	0.000068	0.015071
SE	0.001022	0.003539	0.008608	0.002580	0.000308	0.000034	0.016092
SSE	0.001313	0.003608	0.007615	0.003699	0.000377	0.000023	0.016634
S	0.002016	0.007078	0.019168	0.011188	0.001153	0.000091	0.040695
SSW	0.002026	0.006667	0.019648	0.013540	0.001427	0.000171	0.043480
SW	0.001947	0.006553	0.015709	0.011085	0.001267	0.000160	0.036722
WSW	0.001517	0.004053	0.005434	0.004121	0.000422	0.000080	0.015628
W	0.001496	0.004281	0.005537	0.008220	0.001553	0.000126	0.021212
WNW	0.001226	0.003128	0.005434	0.011816	0.002375	0.000217	0.024196

TABLE 2.3.6-2D (Continued)

WIND DISTRIBUTION BY PASQUILL STABILITY CLASSES (STAR PROGRAM)

ANNUAL RELATIVE FREQUENCY DISTRIBUTION STATION = RALEIGH,N.C. 55-64

D STABILITY

SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
NW	0.001090	0.003140	0.006987	0.011519	0.002295	0.000251	0.025281
NNW	0.001153	0.003573	0.009031	0.009373	0.001336	0.000228	0.024694
TOTAL	0.024705	0.076811	0.182688	0.140230	0.018118	0.002249	

RELATIVE FREQUENCY OF OCCURRENCE OF D STABILITY = 0.444801

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH D STABILITY = 0.017661

TABLE 2.3.6-2E

WIND DISTRIBUTION BY PASQUILL STABILITY CLASSES (STAR PROGRAM)

ANNUAL RELATIVE FREQUENCY DISTRIBUTION STATION = RALEIGH,N.C. 55-64

E STABILITY

SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.000000	0.003939	0.006873	0.000000	0.000000	0.000000	0.010811
NNE	0.000000	0.003265	0.003356	0.000000	0.000000	0.000000	0.006622
NE	0.000000	0.003722	0.003322	0.000000	0.000000	0.000000	0.007044
ENE	0.000000	0.002980	0.002318	0.000000	0.000000	0.000000	0.005297
E	0.000000	0.004156	0.004624	0.000000	0.000000	0.000000	0.008779
ESE	0.000000	0.003025	0.002763	0.000000	0.000000	0.000000	0.005788
SE	0.000000	0.003345	0.002340	0.000000	0.000000	0.000000	0.005685
SSE	0.000000	0.003311	0.003356	0.000000	0.000000	0.000000	0.006667
S	0.000000	0.008665	0.009944	0.000000	0.000000	0.000000	0.018609
SSW	0.000000	0.008186	0.009658	0.000000	0.000000	0.000100	0.017844
SW	0.000000	0.006633	0.005948	0.000000	0.000000	0.000100	0.012581
WSW	0.000000	0.002500	0.001895	0.000000	0.000000	0.000000	0.004395
W	0.000000	0.002375	0.004395	0.000000	0.000000	0.000000	0.006770
WNW	0.000000	0.001792	0.004978	0.000000	0.000000	0.000000	0.006770

TABLE 2.3.6-2E (Continued)

WIND DISTRIBUTION BY PASQUILL STABILITY CLASSES (STAR PROGRAM)

ANNUAL RELATIVE FREQUENCY DISTRIBUTION STATION = RALEIGH,N.C. 55-64

E STABILITY

SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
NW	0.000000	0.001918	0.004921	0.000000	0.000000	0.000000	0.006839
NNW	0.000000	0.001998	0.005069	0.000000	0.000000	0.000000	0.007067
TOTAL	0.000000	0.061809	0.075760	0.000000	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF E STABILITY = 0.137570

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH E STABILITY = 0.000000

TABLE 2.3.6-2F

WIND DISTRIBUTION BY PASQUILL STABILITY CLASSES (STAR PROGRAM)

ANNUAL RELATIVE FREQUENCY DISTRIBUTION STATION = RALEIGH,N.C. 55-64

F STABILITY

SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.008955	0.009430	0.000000	0.000000	0.000000	0.000000	0.018385
NNE	0.006378	0.005594	0.000000	0.000000	0.000000	0.000000	0.011972
NE	0.005050	0.005137	0.000000	0.000000	0.000000	0.000000	0.010187
ENE	0.004837	0.004384	0.000000	0.000000	0.000000	0.000000	0.009221
E	0.005642	0.006051	0.000000	0.000000	0.000000	0.000000	0.011693
ESE	0.005481	0.004966	0.000000	0.000000	0.000000	0.000000	0.010447
SE	0.004368	0.003756	0.000000	0.000000	0.000000	0.000000	0.008124
SSE	0.004762	0.004738	0.000000	0.000000	0.000000	0.000000	0.009499
S	0.011355	0.012124	0.000000	0.000000	0.000000	0.000000	0.023479
SSW	0.014542	0.015127	0.000000	0.000000	0.000000	0.000100	0.029669
SW	0.012224	0.012296	0.000000	0.000000	0.000000	0.000100	0.024520
WSW	0.006704	0.005137	0.000000	0.000000	0.000000	0.000000	0.011842
W	0.006311	0.005754	0.000000	0.000000	0.000000	0.000000	0.012065
WNW	0.004924	0.004464	0.000000	0.000000	0.000000	0.000000	0.009388

TABLE 2.3.6-2F (Continued)

WIND DISTRIBUTION BY PASQUILL STABILITY CLASSES (STAR PROGRAM)

ANNUAL RELATIVE FREQUENCY DISTRIBUTION STATION = RALEIGH,N.C. 55-64
F STABILITY
SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
NW	0.004409	0.004532	0.000000	0.000000	0.000000	0.000000	0.008942
NNW	0.004764	0.004772	0.000000	0.000000	0.000000	0.000000	0.009537
TOTAL	0.110706	0.108263	0.000000	0.000000	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF F STABILITY = 0.218970

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH F STABILITY = 0.084494

TABLE 2.3.6-2G

WIND DISTRIBUTION BY PASQUILL STABILITY CLASSES (STAR PROGRAM)

ANNUAL RELATIVE FREQUENCY DISTRIBUTION STATION = RALEIGH,N.C. 55-64

ALL STABILITIES

SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.013149	0.024157	0.032503	0.015743	0.001804	0.000331	0.087688
NNE	0.009875	0.016965	0.024900	0.015013	0.002078	0.000297	0.069127
NE	0.009486	0.018050	0.026133	0.012490	0.000982	0.000080	0.067219
ENE	0.008073	0.014716	0.016565	0.006428	0.000251	0.000046	0.046079
E	0.008703	0.017673	0.019191	0.004407	0.000365	0.000068	0.050408
ESE	0.007822	0.013746	0.012181	0.002671	0.000274	0.000068	0.036763
SE	0.006990	0.012924	0.013597	0.002729	0.000308	0.000034	0.036581
SSE	0.007458	0.013723	0.013654	0.003962	0.000377	0.000023	0.039196
S	0.015870	0.032320	0.037013	0.011907	0.001187	0.000091	0.098389
SSW	0.018655	0.035163	0.037321	0.014693	0.001461	0.000171	0.107465
SW	0.018068	0.033462	0.033359	0.012433	0.001279	0.000160	0.098760
WSW	0.011126	0.017399	0.014385	0.004795	0.000434	0.000080	0.048218
W	0.010639	0.017901	0.017684	0.009225	0.001575	0.000126	0.057150
WNW	0.008538	0.013540	0.016063	0.012558	0.002420	0.000217	0.053336

TABLE 2.3.6-2G (Continued)

WIND DISTRIBUTION BY PASQUILL STABILITY CLASSES (STAR PROGRAM)

ANNUAL RELATIVE FREQUENCY DISTRIBUTION STATION = RALEIGH,N.C. 55-64

ALL STABILITIES

SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
NW	0.007277	0.012992	0.017056	0.012398	0.002318	0.000251	0.052292
NNW	0.007625	0.013494	0.018620	0.010012	0.001347	0.000228	0.051327
TOTAL	0.169353	0.308224	0.350226	0.151463	0.018461	0.002272	

RELATIVE FREQUENCY OF OCCURRENCE = 1.000000

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE = 0.124920

TABLE 2.3.6-3A
WIND DIRECTION PERSISTENCE DATA *
HARRIS ON-SITE METEROLOGICAL FACILITY
JANUARY 14, 1976 TO DECEMBER 31, 1978
STABILITY CLASS A
LOWER LEVEL WIND DIRECTION

LOWER LEVEL WIND DIRECTION	NUMBER OF OCCURRENCES - WIND DIRECTION PERSISTENCE (HOURS) 1	2	3	4	5 - 7	8 - 10	11 - 13	14 - 16	17 - 19	20 - 22	23 - 25	> 25
N	43	18	11	6	4							
NNE	24	13	4	7	4	1						
NE	20	10	8	2	6							
ENE	13	3	3	3	1							
E	6	4	2	2								
ESE	11	4	1									
SE	13	1	1									
SSE	9	7		1	1							
S	19	4	2									
SSW	29	12	8	12	4							
SW	32	26	16	5	9							
WSW	33	14	14	6	7							
W	29	11	2	2	2							
WNW	36	11	11	4	8							
NW	44	21	8	6	4							
NNW	31	15	6	3	9	1						
AVERAGE DURATION HOURS	1.0	2.0	3.0	4.0	5.6	8.5	0.0	0.0	0.0	0.0	0.0	0.0
MAXIMUM HOURS	1	2	3	4	7	9	0	0	0	0	0	0

NUMBER HOURS OF MISSING WIND DIRECTIONS: 49

*PERSISTENCE IS DEFINED AS A DELTA T EXISTING WITHIN A DEFINED WIND DIRECTION SECTOR AND IS NOT CONSIDERED TO BE INTERRUPTED IF IT DEPARTS FROM THAT DELTA T VALUE FOR UP TO 1 HOUR AND THEN RETURNS, OR IF THERE IS ONE HOUR OF MISSING DATA FOLLOWED BY A CONTINUED DELTA T VALUE. TWO OR MORE CONSECUTIVE HOURS OF LOST DATA ARE NOT INCLUDED IN THE PERSISTENCE DETERMINATION BUT ARE INDICATED AS "MISSING WIND DIRECTIONS".

2

TABLE 2.3.6-3B
WIND DIRECTION PERSISTENCE DATA *
HARRIS ON-SITE METEROLOGICAL FACILITY
JANUARY 14, 1976 TO DECEMBER 31, 1978
STABILITY CLASS B
LOWER LEVEL WIND DIRECTION

LOWER LEVEL WIND DIRECTION	NUMBER OF OCCURRENCES - WIND DIRECTION PERSISTENCE (HOURS)											
	1	2	3	4	5 - 7	8 - 10	11 - 13	14 - 16	17 - 19	20 - 22	23 - 25	> 25
N	45	11	5									
NNE	41	4	1	1	2							
NE	37	7	6									
ENE	21	6		1								
E	19	3	1									
ESE	15	4	1									
SE	14											
SSE	10	2										
S	22	6	2		1							
SSW	39	13	3	2	1							
SW	56	16	6									
WSW	62	16	3	1	2							
W	31	7	2									
WNW	53	16	4	2								
NW	48	19	4	2	2							
NNW	50	8	1									
AVERAGE DURATION HOURS	1.0	2.0	3.0	4.0	5.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MAXIMUM HOURS	1	2	3	4	6	0	0	0	0	0	0	0

NUMBER HOURS OF MISSING WIND DIRECTIONS: 18

*PERSISTENCE IS DEFINED AS A DELTA T EXISTING WITHIN A DEFINED WIND DIRECTION SECTOR AND IS NOT CONSIDERED TO BE INTERRUPTED IF IT DEPARTS FROM THAT DELTA T VALUE FOR UP TO 1 HOUR AND THEN RETURNS, OR IF THERE IS ONE HOUR OF MISSING DATA FOLLOWED BY A CONTINUED DELTA T VALUE. TWO OR MORE CONSECUTIVE HOURS OF LOST DATA ARE NOT INCLUDED IN THE PERSISTENCE DETERMINATION BUT ARE INDICATED AS "MISSING WIND DIRECTIONS".

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TABLE 2.3.6-3C
WIND DIRECTION PERSISTENCE DATA *
HARRIS ON-SITE METEROLOGICAL FACILITY
JANUARY 14, 1976 TO DECEMBER 31, 1978
STABILITY CLASS C
LOWER LEVEL WIND DIRECTION

LOWER LEVEL WIND DIRECTION	NUMBER OF OCCURRENCES - WIND DIRECTION PERSISTENCE (HORS) 1	2	3	4	5 - 7	8 - 10	11 - 13	14 - 16	17 - 19	20 - 22	23 - 25	> 25
N	67	15	5	2	1							
NNE	43	7	2	1								
NE	39	4	2									
ENE	33	8	4									
E	27	7	1									
ESE	14	2	4									
SE	15	2	3									
SSE	24	6	1	1								
S	35	11	1									
SSW	80	15	1	2								
SW	80	14	7	3								
WSW	72	9	9	1	1							
W	46	10	1	5	1							
WNW	67	7	5		1							
NW	64	13	4		1							
NNW	66	8	3	3								
AVERAGE DURATION HOURS	1.0	2.0	3.0	4.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MAXIMUM HOURS	1	2	3	4	5	0	0	0	0	0	0	0

NUMBER HOURS OF MISSING WIND DIRECTIONS: 17

*PERSISTENCE IS DEFINED AS A DELTA T EXISTING WITHIN A DEFINED WIND DIRECTION SECTOR AND IS NOT CONSIDERED TO BE INTERRUPTED IF IT DEPARTS FROM THAT DELTA T VALUE FOR UP TO 1 HOUR AND THEN RETURNS, OR IF THERE IS ONE HOUR OF MISSING DATA FOLLOWED BY A CONTINUED DELTA T VALUE. TWO OR MORE CONSECUTIVE HOURS OF LOST DATA ARE NOT INCLUDED IN THE PERSISTENCE DETERMINATION BUT ARE INDICATED AS "MISSING WIND DIRECTIONS".

TABLE 2.3.6-3D
WIND DIRECTION PERSISTENCE DATA *
HARRIS ON-SITE METEROLOGICAL FACILITY
JANUARY 14, 1976 TO DECEMBER 31, 1978
STABILITY CLASS D
LOWER LEVEL WIND DIRECTION

LOWER LEVEL WIND DIRECTION	NUMBER OF OCCURRENCES - WIND DIRECTION PERSISTENCE (HOURS)											
	1	2	3	4	5 - 7	8 - 10	11 - 13	14 - 16	17 - 19	20 - 22	23 - 25	> 25
N	145	61	24	13	18	10	4	1				
NNE	134	54	21	11	23	4	3	3	2		1	
NE	124	46	17	14	5	5	1					1
ENE	101	31	12	7	11	2	1					
E	83	34	11	2	7	2						
ESE	85	20	11	7	4							
SE	82	28	11	5	6	1						
SSE	98	31	15	11	10	2						
S	132	48	15	5	7	1						
SSW	203	65	26	11	14		2			1		
SW	219	71	33	14	16	5						
WSW	160	61	31	16	15	2						
W	141	37	12	4	5		1					
WNW	138	44	15	11	8	2	2					
NW	137	37	13	9	14	2						
NNW	148	52	20	15	14	3	1					
AVERAGE DURATION HOURS	1.0	2.0	3.0	4.0	5.5	8.8	11.6	14.7	17.5	20.0	24.0	28.0
MAXIMUM HOURS	1	2	3	4	7	10	13	16	18	20	24	28

NUMBER HOURS OF MISSING WIND DIRECTIONS: 88

*PERSISTENCE IS DEFINED AS A DELTA T EXISTING WITHIN A DEFINED WIND DIRECTION SECTOR AND IS NOT CONSIDERED TO BE INTERRUPTED IF IT DEPARTS FROM THAT DELTA T VALUE FOR UP TO 1 HOUR AND THEN RETURNS, OR IF THERE IS ONE HOUR OF MISSING DATA FOLLOWED BY A CONTINUED DELTA T VALUE. TWO OR MORE CONSECUTIVE HOURS OF LOST DATA ARE NOT INCLUDED IN THE PERSISTENCE DETERMINATION BUT ARE INDICATED AS "MISSING WIND DIRECTIONS".

TABLE 2.3.6-3E
WIND DIRECTION PERSISTENCE DATA *
HARRIS ON-SITE METEROLOGICAL FACILITY
JANUARY 14, 1976 TO DECEMBER 31, 1978
STABILITY CLASS E
LOWER LEVEL WIND DIRECTION

LOWER LEVEL WIND DIRECTION	NUMBER OF OCCURRENCES - WIND DIRECTION PERSISTENCE (HOURS) 1	2	3	4	5 - 7	8 - 10	11 - 13	14 - 16	17 - 19	20 - 22	23 - 25	> 25
N	153	35	20	10	14	3						
NNE	127	51	24	4	13	5						
NE	124	31	17	5	10	4	1	1				
ENE	123	22	8	5	5	1	2					
E	99	21	9	4	9	2						
ESE	100	20	5	2	5							
SE	109	27	9	3	1							
SSE	147	31	18	10	10	3						
S	176	59	39	16	23	1	1		1			
SSW	226	66	41	22	24	11		1				
SW	235	41	22	11	13	2						
WSW	126	27	24	7	8	1						
W	116	25	10	3	3		1					
WNW	120	29	12	3	4	1						
NW	117	34	10	8	11	2	1					
NNW	127	33	16	5	6	4						
	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
AVERAGE DURATION HOURS	1.0	2.0	3.0	4.0	5.6	8.5	11.5	15.0	18.0	0.0	0.0	0.0
MAXIMUM HOURS	1	2	3	4	7	10	13	15	18	0	0	0

NUMBER HOURS OF MISSING WIND DIRECTIONS: 103

*PERSISTENCE IS DEFINED AS A DELTA T EXISTING WITHIN A DEFINED WIND DIRECTION SECTOR AND IS NOT CONSIDERED TO BE INTERRUPTED IF IT DEPARTS FROM THAT DELTA T VALUE FOR UP TO 1 HOUR AND THEN RETURNS, OR IF THERE IS ONE HOUR OF MISSING DATA FOLLOWED BY A CONTINUED DELTA T VALUE. TWO OR MORE CONSECUTIVE HOURS OF LOST DATA ARE NOT INCLUDED IN THE PERSISTENCE DETERMINATION BUT ARE INDICATED AS "MISSING WIND DIRECTIONS".

TABLE 2.3.6-3F
WIND DIRECTION PERSISTENCE DATA *
HARRIS ON-SITE METEROLOGICAL FACILITY
JANUARY 14, 1976 TO DECEMBER 31, 1978
STABILITY CLASS F
LOWER LEVEL WIND DIRECTION

LOWER LEVEL WIND DIRECTION	NUMBER OF OCCURRENCES - WIND DIRECTION PERSISTENCE (HOURS) 1	2	3	4	5 - 7	8 - 10	11 - 13	14 - 16	17 - 19	20 - 22	23 - 25	< 25
N	113	28	14	6	6	1						
NNE	111	19	9	5	1							
NE	99	20	5	4	3							
ENE	68	19	10		3	1						
E	82	12	5	1	2							
ESE	97	15	3	1	1							
SE	82	10	1	4								
SSE	111	24	5	3	4							
S	121	45	14	9	5	1						
SSW	127	41	15	14	8	1	1					
SW	105	29	16	8	3	1						
WSW	90	19	6	5	3							
W	75	12	4	4								
WNW	70	14	3	1								
NW	82	7	3		1							
NNW	95	20	9	4	1							
	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
AVERAGE DURATION HOURS	1.0	2.0	3.0	4.0	5.4	9.0	11.0	0.0	0.0	0.0	0.0	0.0
MAXIMUM HOURS	1	2	3	4	7	10	11	0	0	0	0	0

NUMBER HOURS OF MISSING WIND DIRECTIONS: 51

*PERSISTENCE IS DEFINED AS A DELTA T EXISTING WITHIN A DEFINED WIND DIRECTION SECTOR AND IS NOT CONSIDERED TO BE INTERRUPTED IF IT DEPARTS FROM THAT DELTA T VALUE FOR UP TO 1 HOUR AND THEN RETURNS, OR IF THERE IS ONE HOUR OF MISSING DATA FOLLOWED BY A CONTINUED DELTA T VALUE. TWO OR MORE CONSECUTIVE HOURS OF LOST DATA ARE NOT INCLUDED IN THE PERSISTENCE DETERMINATION BUT ARE INDICATED AS "MISSING WIND DIRECTIONS".

TABLE 2.3.6-3G
WIND DIRECTION PERSISTENCE DATA *
HARRIS ON-SITE METEROLOGICAL FACILITY
JANUARY 14, 1976 TO DECEMBER 31, 1978
STABILITY CLASS G
LOWER LEVEL WIND DIRECTION

LOWER LEVEL WIND DIRECTION	NUMBER OF OCCURRENCES - WIND DIRECTION PERSISTENCE (HOURS) 1	2	3	4	5 - 7	8 - 10	11 - 13	14 - 16	17 - 19	20 - 22	23 - 25	< 25
N	198	55	28	11	11	2	1					
NNE	206	44	37	17	4							
NE	218	53	16	15	3							
ENE	200	35	27	6	2							
E	190	31	18	5	1							
ESE	165	27	8	3	2							
SE	140	17	10		3							
SSE	128	20	6	3	2							
S	150	30	12	3	3	1						
SSW	163	27	15	7	2							
SW	135	31	19	6	3							
WSW	161	15	6	4	6							
W	131	12	6	1	1	1						
WNW	126	9	4	1	2							
NW	125	16	11	3	1							
NNW	171	21	17	1	6	1						
AVERAGE DURATION HOURS	1.0	2.0	3.0	4.0	5.7	8.6	11.0	0.0	0.0	0.0	0.0	0.0
MAXIMUM HOURS	1	2	3	4	7	10	11	0	0	0	0	0

NUMBER HOURS OF MISSING WIND DIRECTIONS: 67

*PERSISTENCE IS DEFINED AS A DELTA T EXISTING WITHIN A DEFINED WIND DIRECTION SECTOR AND IS NOT CONSIDERED TO BE INTERRUPTED IF IT DEPARTS FROM THAT DELTA T VALUE FOR UP TO 1 HOUR AND THEN RETURNS, OR IF THERE IS ONE HOUR OF MISSING DATA FOLLOWED BY A CONTINUED DELTA T VALUE. TWO OR MORE CONSECUTIVE HOURS OF LOST DATA ARE NOT INCLUDED IN THE PERSISTENCE DETERMINATION BUT ARE INDICATED AS "MISSING WIND DIRECTIONS".

TABLE 2.3.6-3H
WIND DIRECTION PERSISTENCE DATA *
HARRIS ON-SITE METEROLOGICAL FACILITY
JANUARY 14, 1976 TO DECEMBER 31, 1978
SUMMARY
LOWER LEVEL WIND DIRECTION

LOWER LEVEL WIND DIRECTION	NUMBER OF OCCURRENCES - WIND DIRECTION PERSISTENCE (HOURS)											
	1	2	3	4	5 - 7	8 - 10	11 - 13	14 - 16	17 - 19	20 - 22	23 - 25	< 25
N	396	168	101	50	84	30	14	2	3	1		
NNE	440	153	95	66	62	20	7	3	4	1	1	
NE	463	130	65	41	47	19	7	1	3			1
ENE	399	110	60	31	39	6	7		1			
E	375	89	58	25	22	11	1	1				
ESE	361	87	43	27	22	2						
SE	358	88	36	19	20	3	1					
SSE	394	99	53	35	41	10	2					
S	434	149	86	54	62	13	4	2	1			
SSW	451	182	94	74	93	31	9	5	2			2
SW	445	158	111	61	93	27	8	2				
WSW	410	123	77	47	62	20	8	2	1	1		
W	393	97	56	25	25	7		2				
WNW	369	83	61	30	38	17	6	1	2			
NW	366	90	68	43	54	8	8	2		1		
NNW	421	107	84	45	55	16	5	3	1	1		
AVERAGE DURATION HOURS	1.0	2.0	3.0	4.0	5.7	8.8	11.7	14.9	17.7	20.8	24.0	29.6
MAXIMUM HOURS	1	2	3	4	7	10	13	16	19	22	24	30

NUMBER HOURS OF MISSING WIND DIRECTIONS: 371

*PERSISTENCE IS DEFINED AS A DELTA T EXISTING WITHIN A DEFINED WIND DIRECTION SECTOR AND IS NOT CONSIDERED TO BE INTERRUPTED IF IT DEPARTS FROM THAT DELTA T VALUE FOR UP TO 1 HOUR AND THEN RETURNS, OR IF THERE IS ONE HOUR OF MISSING DATA FOLLOWED BY A CONTINUED DELTA T VALUE. TWO OR MORE CONSECUTIVE HOURS OF LOST DATA ARE NOT INCLUDED IN THE PERSISTENCE DETERMINATION BUT ARE INDICATED AS "MISSING WIND DIRECTIONS".

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TABLE 2.3.6-31
WIND DIRECTION PERSISTENCE DAA *
HARRIS ON-SITE METEROLOGICAL FACILITY
JANUARY 14, 1976 TO DECEMBER 31, 1978
STABILITY CLASS A
UPPER LEVEL WIND DIRECTION

UPPER LEVEL WIND DIRECTION	NUMBER OF OCCURRENCES - WIND DIRECTION PERSISTENCE (HOURS)											
	1	2	3	4	5 - 7	8 - 10	11 - 13	14 - 16	17 - 19	20 - 22	23 - 25	< 25
N	38	22	5	8	3							
NNE	39	11	7	5	8	1						
NE	15	10	6	3	6							
ENE	12	6	4	2								
E	15	3		2	1							
ESE	12	4	3		1							
SE	6	2	1									
SSE	9	3	4									
S	23	6	4	1								
SSW	31	13	6	9	6							
SW	40	18	22	6	8	1						
WSW	40	17	8	7	6							
W	29	13	6	3								
WNW	37	16	9	7	8							
NW	33	14	10	8	2							
NNW	23	16	6	3	8	2						
AVERAGE DURATION HOURS	1.0	2.0	3.0	4.0	5.4	8.2	0.0	0.0	0.0	0.0	0.0	0.0
MAXIMUM HOURS	1	2	3	4	7	9	0	0	0	0	0	0

NUMBER HOURS OF MISSING WIND DIRECTIONS: 13

*PERSISTENCE IS DEFINED AS A DELTA T EXISTING WITHIN A DEFINED WIND DIRECTION SECTOR AND IS NOT CONSIDERED TO BE INTERRUPTED IF IT DEPARTS FROM THAT DELTA T VALUE FOR UP TO 1 HOUR AND THEN RETURNS, OR IF THERE IS ONE HOUR OF MISSING DATA FOLLOWED BY A CONTINUED DELTA T VALUE. TWO OR MORE CONSECUTIVE HOURS OF LOST DATA ARE NOT INCLUDED IN THE PERSISTENCE DETERMINATION BUT ARE INDICATED AS "MISSING WIND DIRECTIONS".

TABLE 2.3.6-3J

WIND DIRECTION PERSISTENCE DATA *

HARRIS ON-SITE METEROLOGICAL FACILITY

JANUARY 14, 1976 TO DECEMBER 31, 1978

STABILITY CLASS B

UPPER LEVEL WIND DIRECTION

UPPER LEVEL WIND DIRECTION	NUMBER OF OCCURRENCES - WIND DIRECTION PERSISTENCE (HOURS)											
	1	2	3	4	5 - 7	8 - 10	11 - 13	14 - 16	17 - 19	20 - 22	23 - 25	< 25
N	39	11	4		1							
NNE	48	6	3	2	1							
NE	32	8	3	1	1							
ENE	21	5	1									
E	20	4	1									
ESE	15	4	1									
SE	9	2										
SSE	20	2		1								
S	18	7	1	1	1							
SSW	41	11	4	1	3							
SW	66	12	5	4								
WSW	47	14	3	2	2							
W	32	4	5									
WNW	49	18	6	3	3							
NW	44	9	4	3	1							
NNW	42	4	2									
AVERAGE DURATION HOURS	1.0	2.0	3.0	4.0	5.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MAXIMUM HOURS	1	2	3	4	6	0	0	0	0	0	0	0

NUMBER HOURS OF MISSING WIND DIRECTIONS: 4

*PERSISTENCE IS DEFINED AS A DELTA T EXISTING WITHIN A DEFINED WIND DIRECTION SECTOR AND IS NOT CONSIDERED TO BE INTERRUPTED IF IT DEPARTS FROM THAT DELTA T VALUE FOR UP TO 1 HOUR AND THEN RETURNS, OR IF THERE IS ONE HOUR OF MISSING DATA FOLLOWED BY A CONTINUED DELTA T VALUE. TWO OR MORE CONSECUTIVE HOURS OF LOST DATA ARE NOT INCLUDED IN THE PERSISTENCE DETERMINATION BUT ARE INDICATED AS "MISSING WIND DIRECTIONS".

TABLE 2.3.6-3K
WIND DIRECTION PERSISTENCE DATA *
HARRIS ON-SITE METEROLOGICAL FACILITY
JANUARY 14, 1976 TO DECEMBER 31, 1978
STABILITY CLASS C
UPPER LEVEL WIND DIRECTION

UPPER LEVEL WIND DIRECTION	NUMBER OF OCCURRENCES - WIND DIRECTION PERSISTENCE (HOURS)											
	1	2	3	4	5 - 7	8 - 10	11 - 13	14 - 16	17 - 19	20 - 22	23 - 25	< 25
N	62	15	3				1					
NNE	53	6		3								
NE	42	6	2		1							
ENE	35	7										
E	29	4	1									
ESE	19	2	4									
SE	11	4	2									
SSE	22	6	4	1								
S	37	9	5	1	1							
SSW	84	12	2	3								
SW	80	15	3	4								
WSW	69	14	8	3	2							
W	51	10	2	1								
WNW	55	6	5	2								
NW	62	14	4									
NNW	65	10	2	1								
AVERAGE DURATION HOURS	1.0	2.0	3.0	4.0	5.0	0.0	11.0	0.0	0.0	0.0	0.0	0.0
MAXIMUM HOURS	1	2	3	4	5	0	11	0	0	0	0	0

NUMBER HOURS OF MISSING WIND DIRECTIONS: 7

*PERSISTENCE IS DEFINED AS A DELTA T EXISTING WITHIN A DEFINED WIND DIRECTION SECTOR AND IS NOT CONSIDERED TO BE INTERRUPTED IF IT DEPARTS FROM THAT DELTA T VALUE FOR UP TO 1 HOUR AND THEN RETURNS, OR IF THERE IS ONE HOUR OF MISSING DATA FOLLOWED BY A CONTINUED DELTA T VALUE. TWO OR MORE CONSECUTIVE HOURS OF LOST DATA ARE NOT INCLUDED IN THE PERSISTENCE DETERMINATION BUT ARE INDICATED AS "MISSING WIND DIRECTIONS".

TABLE 2.3.6-3L
WIND DIRECTION PERSISTENCE DATA *
HARRIS ON-SITE METEROLOGICAL FACILITY
JANUARY 14, 1976 TO DECEMBER 31, 1978
STABILITY CLASS D
UPPER LEVEL WIND DIRECTION

UPPER LEVEL WIND DIRECTION	NUMBER OF OCCURRENCES - WIND DIRECTION PERSISTENCE (HOURS)											
	1	2	3	4	5 - 7	8 - 10	11 - 13	14 - 16	17 - 19	20 - 22	23 - 25	< 25
N	126	51	18	14	24	7	6	1				
NNE	119	54	31	12	27	7	3		1			1
NE	118	34	19	7	16	4	1	1	1		1	
ENE	107	36	25	5	8	2						
E	77	28	13	7	6	2						
ESE	79	25	12	3	3	3						
SE	89	28	6	7	5		1					
SSE	88	34	15	7	14	1	2					
S	122	49	19	11	4	1						
SSW	181	65	25	16	17		1	1				
SW	182	71	41	19	23	2		1				
WSW	161	60	22	18	12	3						
W	139	31	19	4	4							
WNW	128	44	15	5	6	2	1		1			
NW	126	33	11	20	10	4						
NNW	126	44	23	6	12	3	1		1			
AVERAGE DURATION HOURS	1.0	2.0	3.0	4.0	5.5	8.6	11.3	14.5	17.7	0.0	24.0	34.0
MAXIMUM HOURS	1	2	3	4	7	10	13	15	19	0	24	34

NUMBER HOURS OF MISSING WIND DIRECTIONS: 101

*PERSISTENCE IS DEFINED AS A DELTA T EXISTING WITHIN A DEFINED WIND DIRECTION SECTOR AND IS NOT CONSIDERED TO BE INTERRUPTED IF IT DEPARTS FROM THAT DELTA T VALUE FOR UP TO 1 HOUR AND THEN RETURNS, OR IF THERE IS ONE HOUR OF MISSING DATA FOLLOWED BY A CONTINUED DELTA T VALUE. TWO OR MORE CONSECUTIVE HOURS OF LOST DATA ARE NOT INCLUDED IN THE PERSISTENCE DETERMINATION BUT ARE INDICATED AS "MISSING WIND DIRECTIONS".

2

TABLE 2.3.6-3M
WIND DIRECTION PERSISTENCE DATA *
HARRIS ON-SITE METEROLOGICAL FACILITY
JANUARY 14, 1976 TO DECEMBER 31, 1978
STABILITY CLASS E
UPPER LEVEL WIND DIRECTION

UPPER LEVEL WIND DIRECTION	NUMBER OF OCCURRENCES - WIND DIRECTION PERSISTENCE (HOURS)											
	1	2	3	4	5 - 7	8 - 10	11 - 13	14 - 16	17 - 19	20 - 22	23 - 25	< 25
N	124	34	9	12	15	4						
NNE	97	36	16	13	16	5						
NE	110	34	19	11	11	5	2	1				
ENE	74	20	13	10	9	3		1				
E	90	26	9	4	9	2						
ESE	71	19	11	7	5							
SE	80	26	5	4	3							
SSE	104	36	22	7	17	2						
S	144	51	37	21	28	5	1					
SSW	189	71	34	24	30	15	2	1				
SW	201	44	21	16	13	3						
WSW	131	43	21	5	13		1					
W	111	27	6	6	5		1					
WNW	100	32	14	10	2	1						
NW	82	26	13	6	15	2	1					
NNW	118	28	16	5	6	4						
AVERAGE DURATION HOURS	1.0	2.0	3.0	4.0	5.6	8.6	11.7	15.3	0.0	0.0	0.0	0.0
MAXIMUM HOURS	1	2	3	4	7	10	13	16	0	0	0	0

NUMBER HOURS OF MISSING WIND DIRECTIONS: 32

*PERSISTENCE IS DEFINED AS A DELTA T EXISTING WITHIN A DEFINED WIND DIRECTION SECTOR AND IS NOT CONSIDERED TO BE INTERRUPTED IF IT DEPARTS FROM THAT DELTA T VALUE FOR UP TO 1 HOUR AND THEN RETURNS, OR IF THERE IS ONE HOUR OF MISSING DATA FOLLOWED BY A CONTINUED DELTA T VALUE. TWO OR MORE CONSECUTIVE HOURS OF LOST DATA ARE NOT INCLUDED IN THE PERSISTENCE DETERMINATION BUT ARE INDICATED AS "MISSING WIND DIRECTIONS".

2

TABLE 2.3.6-3N
WIND DIRECTION PERSISTENCE DATA *
HARRIS ON-SITE METEROLOGICAL FACILITY
JANUARY 14, 1976 TO DECEMBER 31, 1978
STABILITY CLASS F
UPPER LEVEL WIND DIRECTION

UPPER LEVEL WIND DIRECTION	NUMBER OF OCCURRENCES - WIND DIRECTION PERSISTENCE (HOURS)											
	1	2	3	4	5 - 7	8 - 10	11 - 13	14 - 16	17 - 19	20 - 22	23 - 25	< 25
N	79	19	13	8	2	1						
NNE	66	23	4	5	3							
NE	67	15	9	3	3							
ENE	50	18	5	3	1							
E	54	17	11	2	2	2						
ESE	64	15	7		3							
SE	53	15	1	1	2							
SSE	73	23	8	4	1							
S	88	36	11	11	10	1						
SSW	106	52	16	13	16	4						
SW	102	44	11	18	7	5	1					
WSW	100	34	10	6	7							
W	73	18	7	4	5							
WNW	68	9	9	3	1							
NW	77	9	4		1							
NNW	70	18	7	4	2							
AVERAGE DURATION HOURS	1.0	2.0	3.0	4.0	5.6	8.3	11.0	0.0	0.0	0.0	0.0	0.0
MAXIMUM HOURS	1	2	3	4	7	9	11	0	0	0	0	0

NUMBER HOURS OF MISSING WIND DIRECTIONS: 16

*PERSISTENCE IS DEFINED AS A DELTA T EXISTING WITHIN A DEFINED WIND DIRECTION SECTOR AND IS NOT CONSIDERED TO BE INTERRUPTED IF IT DEPARTS FROM THAT DELTA T VALUE FOR UP TO 1 HOUR AND THEN RETURNS, OR IF THERE IS ONE HOUR OF MISSING DATA FOLLOWED BY A CONTINUED DELTA T VALUE. TWO OR MORE CONSECUTIVE HOURS OF LOST DATA ARE NOT INCLUDED IN THE PERSISTENCE DETERMINATION BUT ARE INDICATED AS "MISSING WIND DIRECTIONS".

TABLE 2.3.6-30
WIND DIRECTION PERSISTENCE DATA *
HARRIS ON-SITE METEROLOGICAL FACILITY
JANUARY 14, 1976 TO DECEMBER 31, 1978
STABILITY CLASS G
UPPER LEVEL WIND DIRECTION

UPPER LEVEL WIND DIRECTION	NUMBER OF OCCURRENCES - WIND DIRECTION PERSISTENCE (HOURS)										
	1	2	3	4	5 - 7	8 - 10	11 - 13	14 - 16	17 - 19	20 - 22	23 - 25	< 25
N	65	19	18	7	6							
NNE	68	26	11	7	7	2						
NE	56	26	12	5	7	2						
ENE	68	22	13	4	9	1						
E	44	28	11	3	6	1						
ESE	41	25	15	4	6							
SE	68	26	11	5	2							
SSE	56	32	16	10	12							
S	82	36	17	16	12		1					
SSW	95	53	26	22	22	6						
SW	113	56	26	18	16	3						
WSW	69	50	37	28	27	9	2					
W	97	29	22	11	5	1						
WNW	92	31	16	8	9	1						
NW	90	32	15	11	3	1						
NNW	70	36	16	9	8	1						
AVERAGE DURATION HOURS	1.0	2.0	3.0	4.0	5.6	8.5	11.6	0.0	0.0	20.0	0.0	0.0
MAXIMUM HOURS	1	2	3	4	7	10	12	0	0	20	0	0

NUMBER HOURS OF MISSING WIND DIRECTIONS: 38

*PERSISTENCE IS DEFINED AS A DELTA T EXISTING WITHIN A DEFINED WIND DIRECTION SECTOR AND IS NOT CONSIDERED TO BE INTERRUPTED IF IT DEPARTS FROM THAT DELTA T VALUE FOR UP TO 1 HOUR AND THEN RETURNS, OR IF THERE IS ONE HOUR OF MISSING DATA FOLLOWED BY A CONTINUED DELTA T VALUE. TWO OR MORE CONSECUTIVE HOURS OF LOST DATA ARE NOT INCLUDED IN THE PERSISTENCE DETERMINATION BUT ARE INDICATED AS "MISSING WIND DIRECTIONS".

2

TABLE 2.3.6-3P
WIND DIRECTION PERSISTENCE DATA *
HARRIS ON-SITE METEROLOGICAL FACILITY
JANUARY 14, 1976 TO DECEMBER 31, 1978
SUMMARY
UPPER LEVEL WIND DIRECTION

UPPER LVEL WIND DIRECTION	NUMBER OF OCCURRENCES - WIND DIRECTION PERSISTENCE (HOURS)											
	1	2	3	4	5 - 7	8 - 10	11 - 13	14 - 16	17 - 19	20 - 22	23 - 25	< 25
N	197	113	67	50	79	24	15	5	3			1
NNE	199	123	69	36	76	37	8	6	2			1
NE	225	100	52	34	52	24	10	2	6		1	
ENE	195	84	55	23	48	12	6	2	1			
E	135	83	46	23	35	13	4	2				
ESE	169	76	55	29	33	4	3					
SE	184	83	30	28	27	6	1					
SSE	181	97	60	34	73	13	4		1	1		
S	231	137	85	60	93	15	13	3				
SSW	252	149	94	72	137	44	17	11	2	2	1	2
SW	332	155	111	66	108	47	15	4	4			
WSW	241	156	102	60	99	38	17	2	1			
W	319	122	61	33	48	9	2	2				1
WNW	248	92	66	38	52	23	10	2	2	1		
NW	249	97	54	54	62	15	5	3	2			
NNW	235	114	87	36	50	21	5	4	1			
	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
AVERAGE DURATION HOURS	1.0	2.0	3.0	4.0	5.7	8.7	11.6	14.8	17.7	20.7	23.5	32.2
MAXIMUM HOURS	1	2	3	4	7	10	13	16	19	22	24	37

NUMBER HOURS OF MISSING WIND DIRECTIONS: 374

*PERSISTENCE IS DEFINED AS A DELTA T EXISTING WITHIN A DEFINED WIND DIRECTION SECTOR AND IS NOT CONSIDERED TO BE INTERRUPTED IF IT DEPARTS FROM THAT DELTA T VALUE FOR UP TO 1 HOUR AND THEN RETURNS, OR IF THERE IS ONE HOUR OF MISSING DATA FOLLOWED BY A CONTINUED DELTA T VALUE. TWO OR MORE CONSECUTIVE HOURS OF LOST DATA ARE NOT INCLUDED IN THE PERSISTENCE DETERMINATION BUT ARE INDICATED AS "MISSING WIND DIRECTIONS".

TABLE 2.3.6-4

EXTREME WINDS AND PRECIPITATION ASSOCIATED WITH HURRICANES
RALEIGH-DURHAM AIRPORT
(1950-1978)

Storm	Date	Maximum Winds (mph)	Maximum Precipitation (inches/hr)	24-hr Precipitation (inches)
Able	31 Aug. 1952	ESE 30 G 40	1.22	3.52
Barbara	13 Aug. 1953	NE 20 G 28	Trace	Trace
Carol	30 Aug. 1954	N 18	Trace	Trace
Edna	10 Sept. 1954	N 20; NNE 16 G 25	Trace	0.01
Hazel	15 Oct. 1954	WNW 43 G 90; NW 48 G 62	1.55	4.04
Connie	11-12 Aug. 1955	E 35 G 46; NE 39 G 54; N 40	0.30; 0.25	0.68; 0.75
Diane	16-17 Aug. 1955	SE 38 G 44; ENE 32 G 53	0.48; 0.70	1.23; 4.12
Ione	19 Sept. 1955	NNE 30; G 49	0.18	0.86
Flossy	26 Sept. 1956	NNE 28; G 46; NNE 29 G 41	0.37	2.31
Helene	27 Sept. 1958	N 29 G 46	Trace	0.07
Gracie	30 Sept. 1959	SSE 25 G 37	0.64	0.78
Brenda	29 July 1960	N 24	0.47	2.60
Donna	11 Sept. 1960	N 29 G 35	0.31	1.48
Esther	20 Sept. 1961	N 17	0.15	0.15
Alma	28 Aug. 1962	NW 16	Trace	Trace
Ella	18-19 Oct. 1962	NE 22 G 32	0.00	0.00
Ginny	20-21 Oct. 1963	NNE 21 G 32; N 22 G 29	0.00	0.00
Cleo	31 Aug. 1964	NNW 15	1.12	2.95
Dora	13 Sept. 1964	NNE 25 G 38	0.31	2.36
Gladys	22 Sept. 1964	N 18 G 25	0.00	0.00
Isbell	16 Oct. 1964	NE 20 G 29	0.19	0.55
Alma	11 June 1966	NNE 23 G 32	Trace	Trace
Doria	26-28 Aug. 1971	20 E, 15 NNW, 9N	.53; .08; Trace	1.23; .23; Trace
Ginger	30 Sept. - 2 Oct. 1971	32 NNW; 29 N; 14 W	.11; .34; .08	.61; 2.64; .33
Agnes	19-21 June 1972	14 E; 20 SE; 24 N	.03; .29; .55	.03; 1.3; 1.59

TABLE 2.3.6-4 (Cont'd)

Storm	Date	Maximum Winds (mph)	Maximum Precipitation (inches/hr)	24-hr Precipitation (inches)
Doria	9 Sept. 1967	15 N	.15	.89
Gladys	18-20 Oct. 1968	17 ESE; 15 S: 18 N	.12; .59; .01	.63; 1.84; .01
Eloise	22-26 Sept. 1975	16 E; 14 SSE	.24; .32	.95; .77
		16 SSE; 10 NW	.72; .50	1.26; 1.02
		10 WNW	.30	.44
Belle	8, 9 Aug. 1976	8 ENE; 13 NNW	.09. 0.0	.18; 0.00

NOTE: "G" indicates "gusts to"

REFERENCES: SECTION 2.3

2.3.1-1 U. S. Department of Commerce, Environmental Data Service, "Climatic Atlas of the United States," June, 1968.

2.3.2-1 Holzworth, G. C., Estimates of Mean Maximum Mixing Depths in the Contiguous United States, U. S. Weather Bureau Research Station, Cincinnati, Ohio. May, 1964.

2.3.2-2 Hosler, C. R., "Low-Level Inversion Frequency in the Contiguous United States," *Monthly Weather Review*, Vol. 89, September 1961, pp. 319-332.

2.3.2-3 Korshover, Julius, Climatology of Stagnating Anticyclones East of the Rocky Mountains, 1936-1970, NOAA Technical Memorandum ERL-ARL-34, U. S. Department of Commerce, National Oceanic and Atmospheric Administration, October, 1971.

2.3.3-1 Raleigh-Durham, North Carolina, 1978, "Local Climatological Data, Annual Summary with Comparitive Data," National Oceanic and Atmospheric Administration, National Climatic Center, Asheville, North Carolina.

2.3.3-2 Greensboro, North Carolina, 1978, "Local Climatological Data, Annual Summary with Comparitive Data, "National Oceanic and Atmospheric Administration, National Climatic Center, Asheville, North Carolina.

2.3.3-3 Charlotte, North Carolina, 1978, "Local Climatological Data, Annual Summary with Comparitive Data," National Oceanic and Atmospheric Administration, National Climatic Center, Asheville, North Carolina.

2.3.3-4 "Climatography of the United States No. 60, Climate of North Carolina," U. S. Department of Commerce, National Oceanic and Atmospheric Administration, National Climatic Center, Asheville, North Carolina, Reprinted July, 1978.

2.3.5-1 Saucier, W. J., "Some Features in the Diurnal Variations of Rain and Wind Over North Carolina," Water Resources Institute, University of North Carolina, "Water Resources Institute, University of North Carolina, June, 1972.

2.3.5-2 "Wind Distribution by Pasquill Stability Classes (Star Program), Raleigh, North Carolina 1954-1965", U. S. Department of Commerce, Environmental Science Services Administration, National Weather Records Center, Asheville, North Carolina.

2.3.6-1 NRC Regulatory Guide 1.23, "Onsite Meteorological Programs", February 17, 1972.

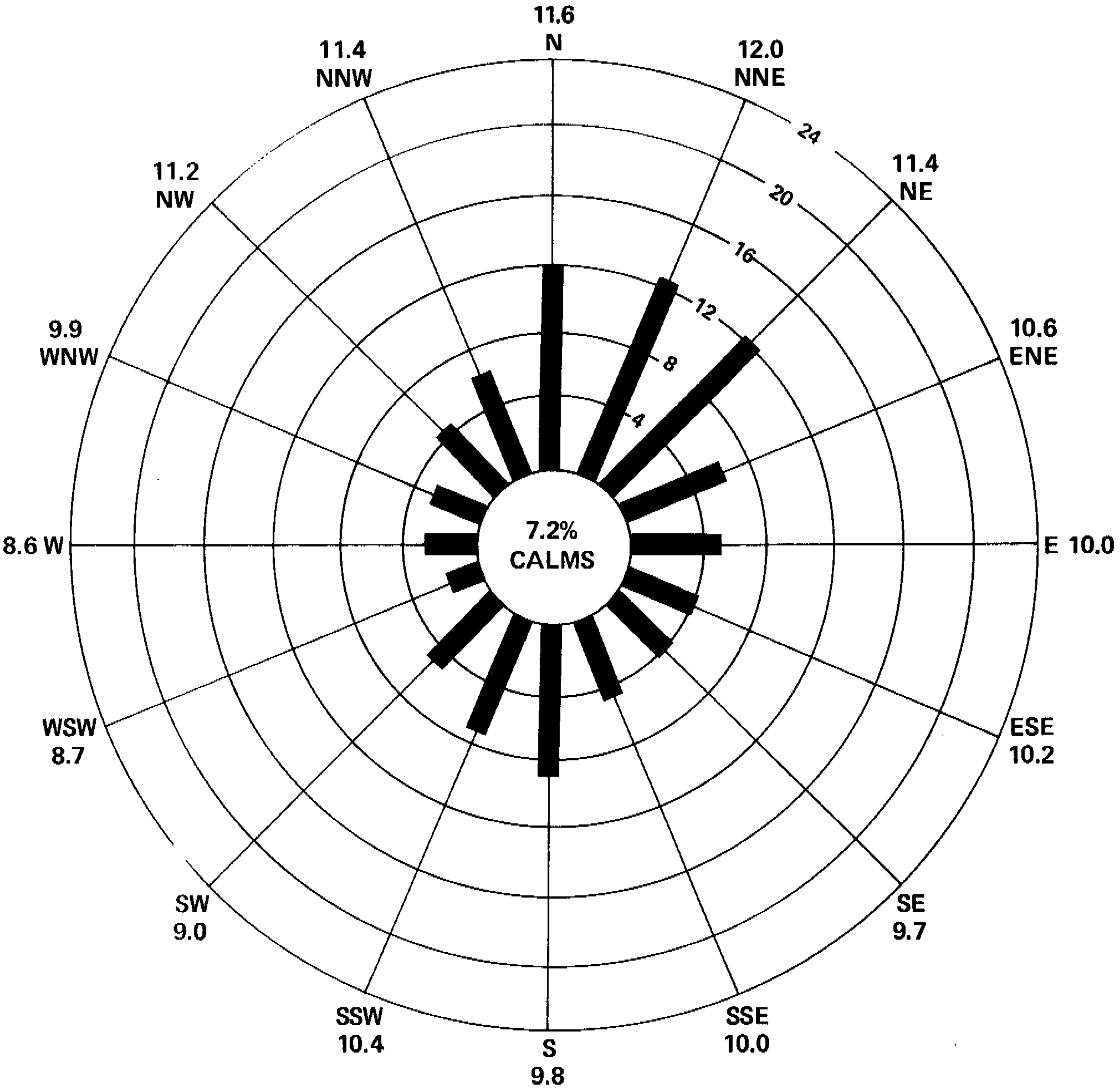
2.3.6-2 "Wind Distributions by Pasquill Stability Classes (Star Program), Greensboro, North Carolina, 1966-1970," U. S. Department of Commerce, Environmental Science Services Administration, National Climatic Center, Asheville, North Carolina.

2.3.6-3 "Wind Distributions by Pasquill Stability Classes (Star Program), Charlotte, North Carolina, 1966-1970," U. S. Department of Commerce, National Oceanic and Atmospheric Administration, National Climatic Center, Asheville, North Carolina.

REFERENCES: GENERAL

Byers, H. R., "General Meteorology," McGraw Hill, Inc., New York, New York, 1974.

Saucier, W. J., "Principles of Meteorological Analysis," The University of Chicago Press, Chicago, Illinois, 1955.



$\bar{U}$ = 9.9

$\bar{U}$ = ALL DIRECTIONAL AVERAGE WIND SPEED

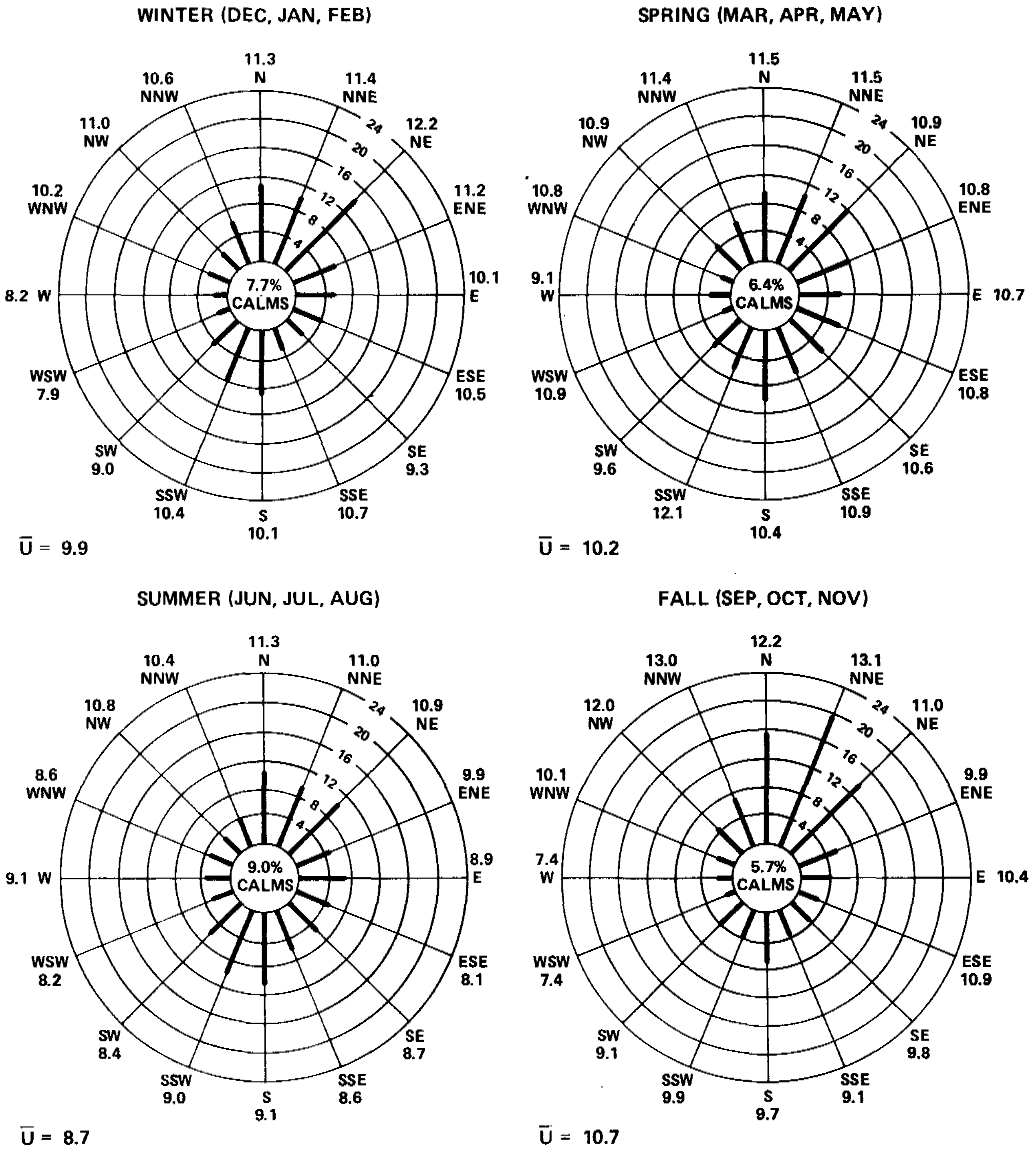
NOTE: DIRECTIONAL AVERAGE WIND SPEEDS (MPH) ARE DISPLAYED RADIALLY

▬ WIND DIRECTION (%)

SHEARON HARRIS
NUCLEAR POWER PLANT
Carolina
Power & Light Company
ENVIRONMENTAL REPORT

RALEIGH-DURHAM WEATHER SERVICE
PRECIPITATION WIND ROSE

FIGURE
2.3.5-1



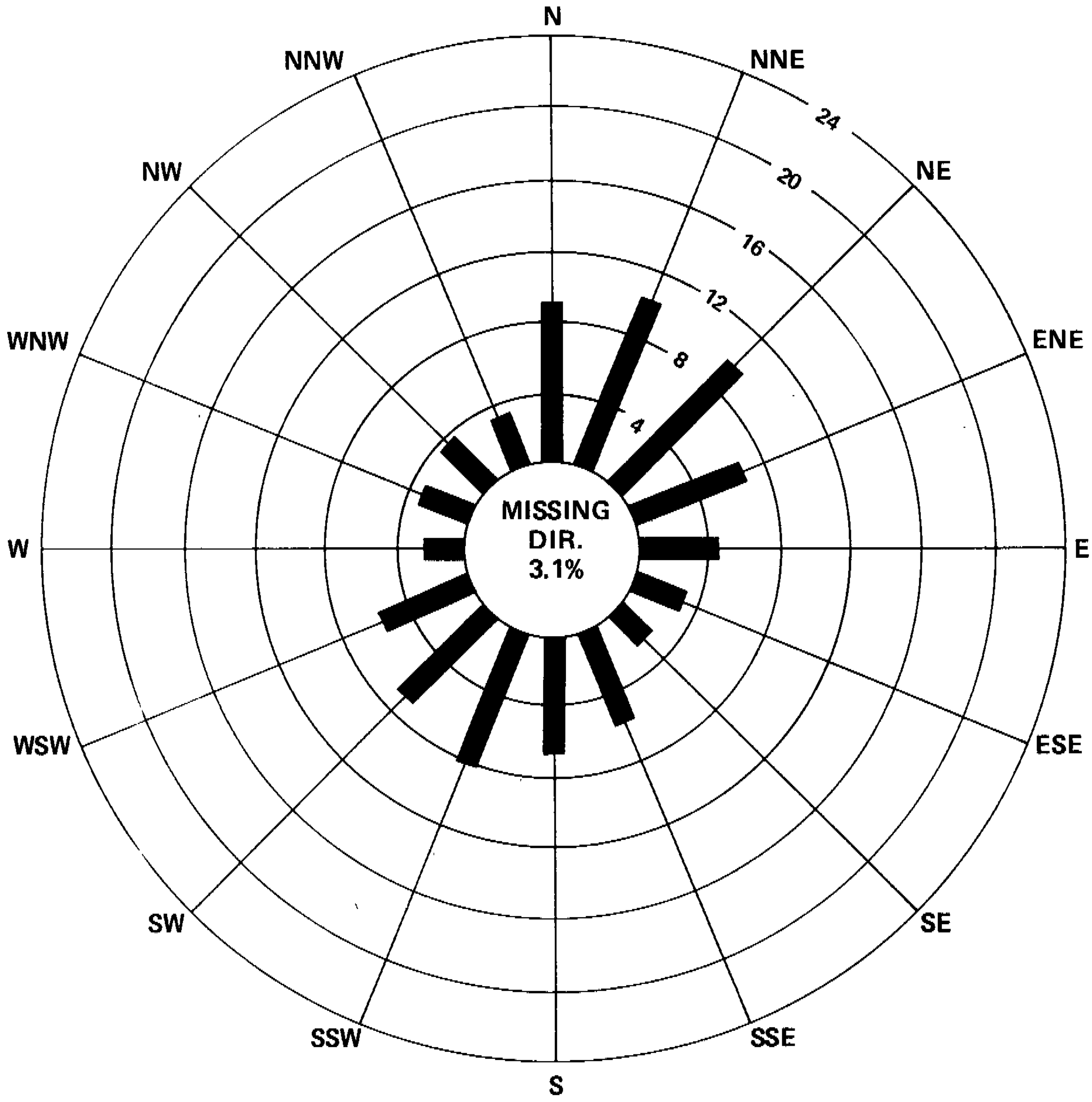
Ū = ALL DIRECTIONAL AVERAGE WIND SPEED

NOTE: DIRECTIONAL AVERAGE WIND SPEEDS (MPH) ARE DISPLAYED RADIALLY

——— WIND DIRECTION (%)

1955-1964

SHEARON HARRIS NUCLEAR POWER PLANT Carolina Power & Light Company ENVIRONMENTAL REPORT	RALEIGH-DURHAM WEATHER SERVICE SEASONAL PRECIPITATION WIND ROSE	FIGURE 2.3.5-2



$\bar{U}$ = NA

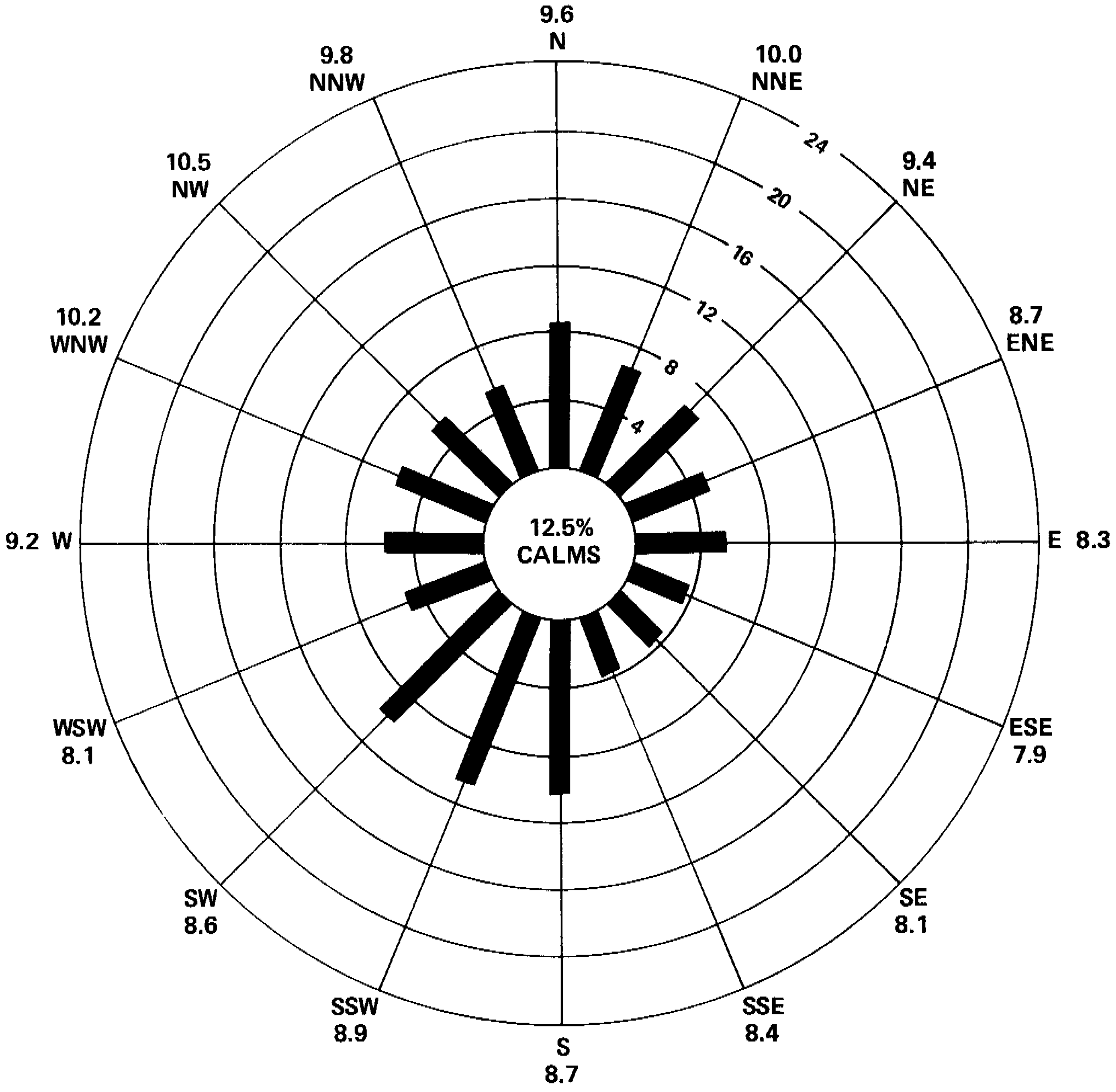
$\bar{U}$ = ALL DIRECTIONAL AVERAGE WIND SPEED

NOTE: DIRECTIONAL AVERAGE WIND SPEEDS (MPH) ARE DISPLAYED RADIALLY

▬ WIND DIRECTION (%)

1/14/76 - 12/31/78

SHEARON HARRIS NUCLEAR POWER PLANT Carolina Power & Light Company ENVIRONMENTAL REPORT	SHNPP PRECIPITATION WIND ROSE 12.5 METER LEVEL	FIGURE 2.3.5-3



$\bar{U}$ = 7.9

$\bar{U}$ = ALL DIRECTIONAL AVERAGE WIND SPEED

NOTE: DIRECTIONAL AVERAGE WIND SPEEDS (MPH) ARE DISPLAYED RADIALLY

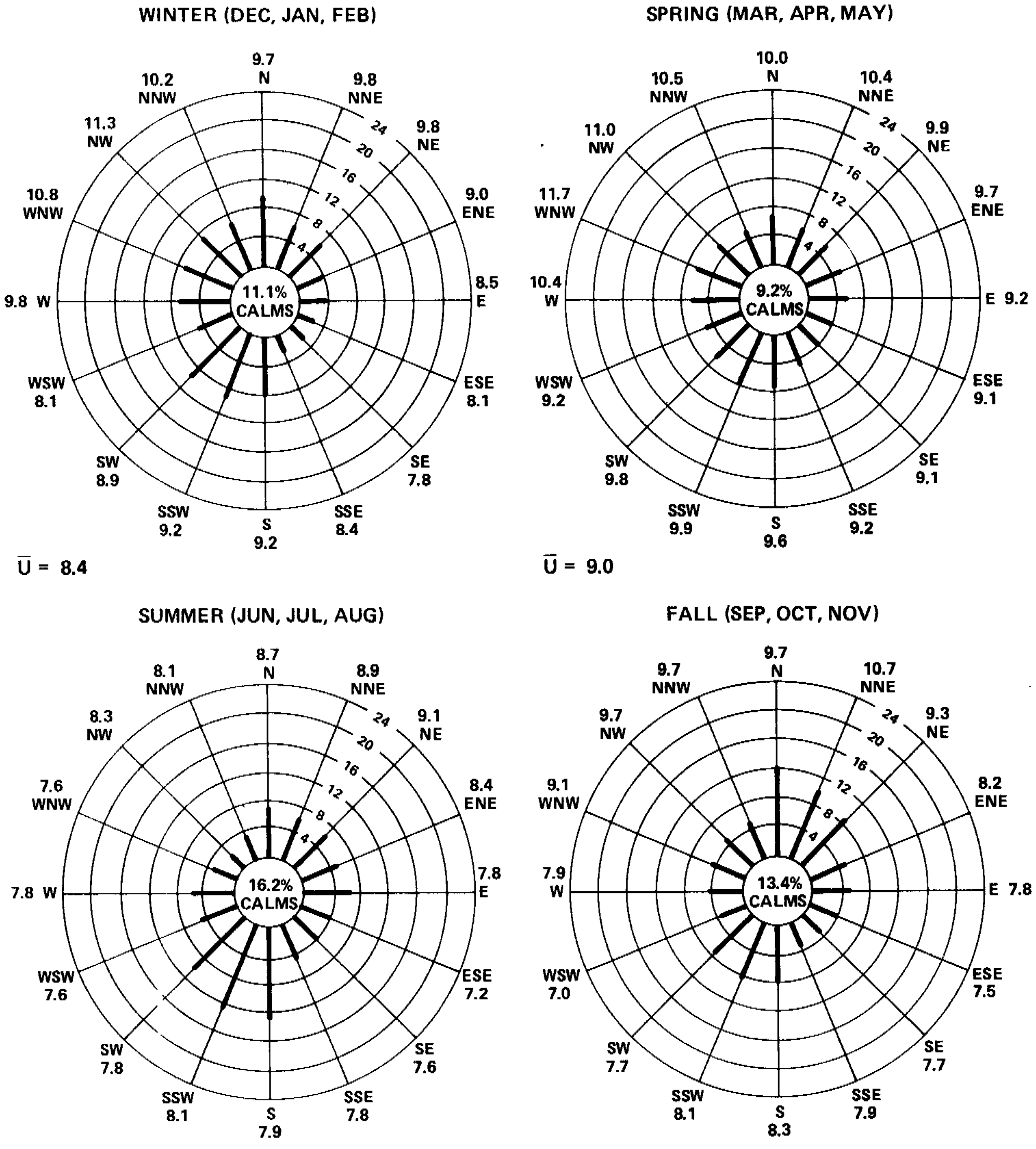
▬ WIND DIRECTION (%)

1955-1964

SHEARON HARRIS
NUCLEAR POWER PLANT
Carolina
Power & Light Company
ENVIRONMENTAL REPORT

RALEIGH-DURHAM WEATHER SERVICE
ALL WEATHER WIND ROSE

FIGURE
2.3.6-1



WINTER (DEC, JAN, FEB)

SPRING (MAR, APR, MAY)

SUMMER (JUN, JUL, AUG)

FALL (SEP, OCT, NOV)

Ū = ALL DIRECTIONAL AVERAGE WIND SPEED

NOTE: DIRECTIONAL AVERAGE WIND SPEEDS (MPH) ARE DISPLAYED RADIALLY

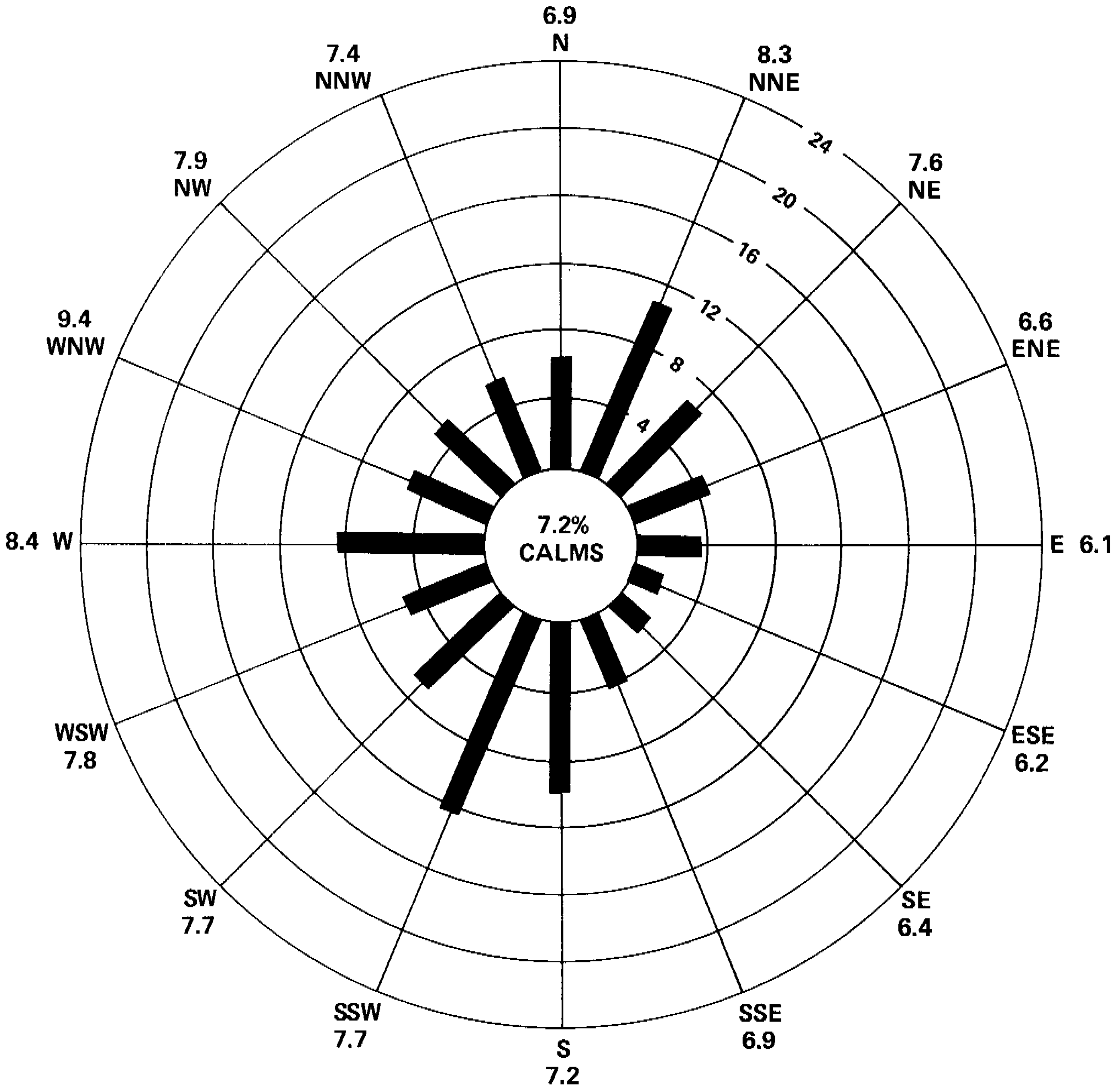
▬ WIND DIRECTION (%)

1955-1964

SHEARON HARRIS
NUCLEAR POWER PLANT
Carolina
Power & Light Company
ENVIRONMENTAL REPORT

RALEIGH-DURHAM WEATHER SERVICE
SEASONAL WIND ROSE

FIGURE
2.3.6-2



$\bar{U}$ = 7.0

$\bar{U}$ = ALL DIRECTIONAL AVERAGE WIND SPEED

NOTE: DIRECTIONAL AVERAGE WIND SPPEDS (MPH) ARE DISPLAYED RADIALLY

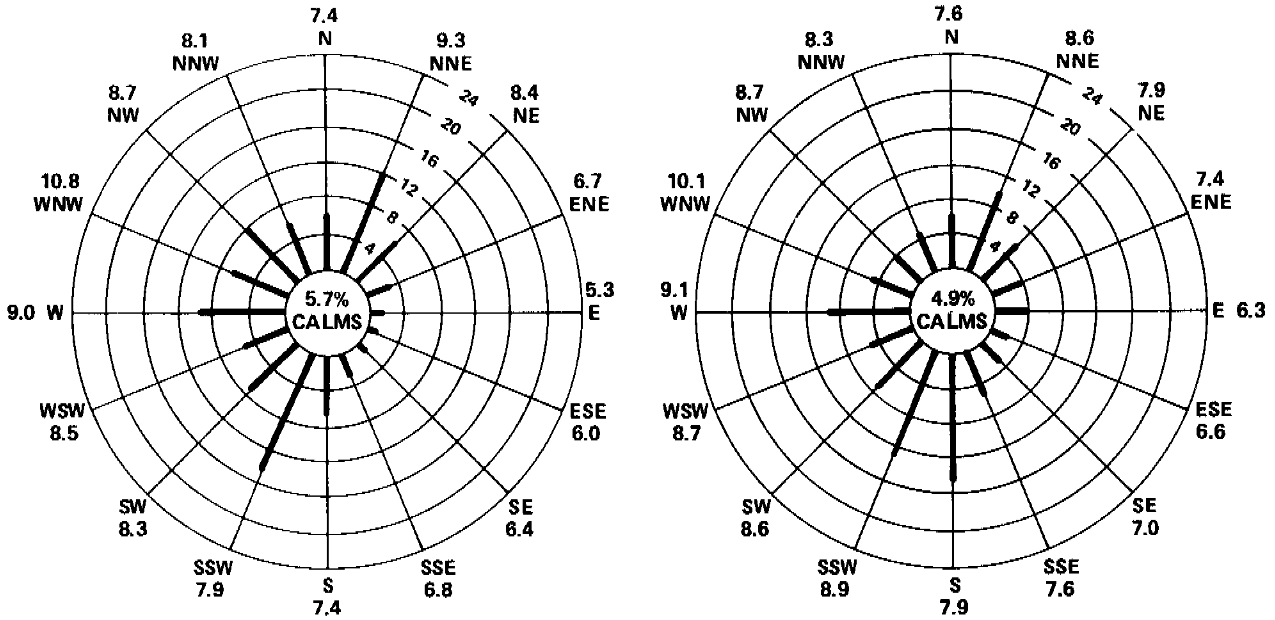
▬ WIND DIRECTION (%)

1966-1970

SHEARON HARRIS NUCLEAR POWER PLANT Carolina Power & Light Company ENVIRONMENTAL REPORT	GREENSBORO ALL WEATHER WIND ROSE	FIGURE 2.3.6-3

WINTER (DEC, JAN, FEB)

SPRING (MAR, APR, MAY)

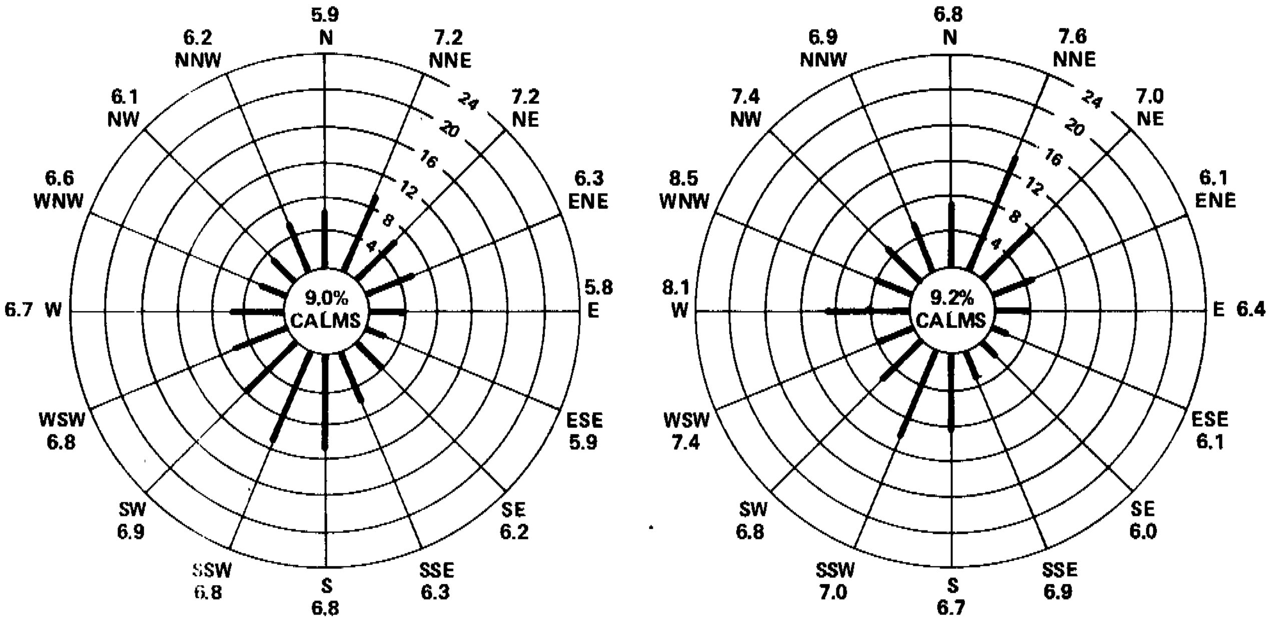


$\bar{U}$ = 7.9

$\bar{U}$ = 7.9

SUMMER (JUN, JUL, AUG)

FALL (SEP, OCT, NOV)



$\bar{U}$ = 6.0

$\bar{U}$ = 6.4

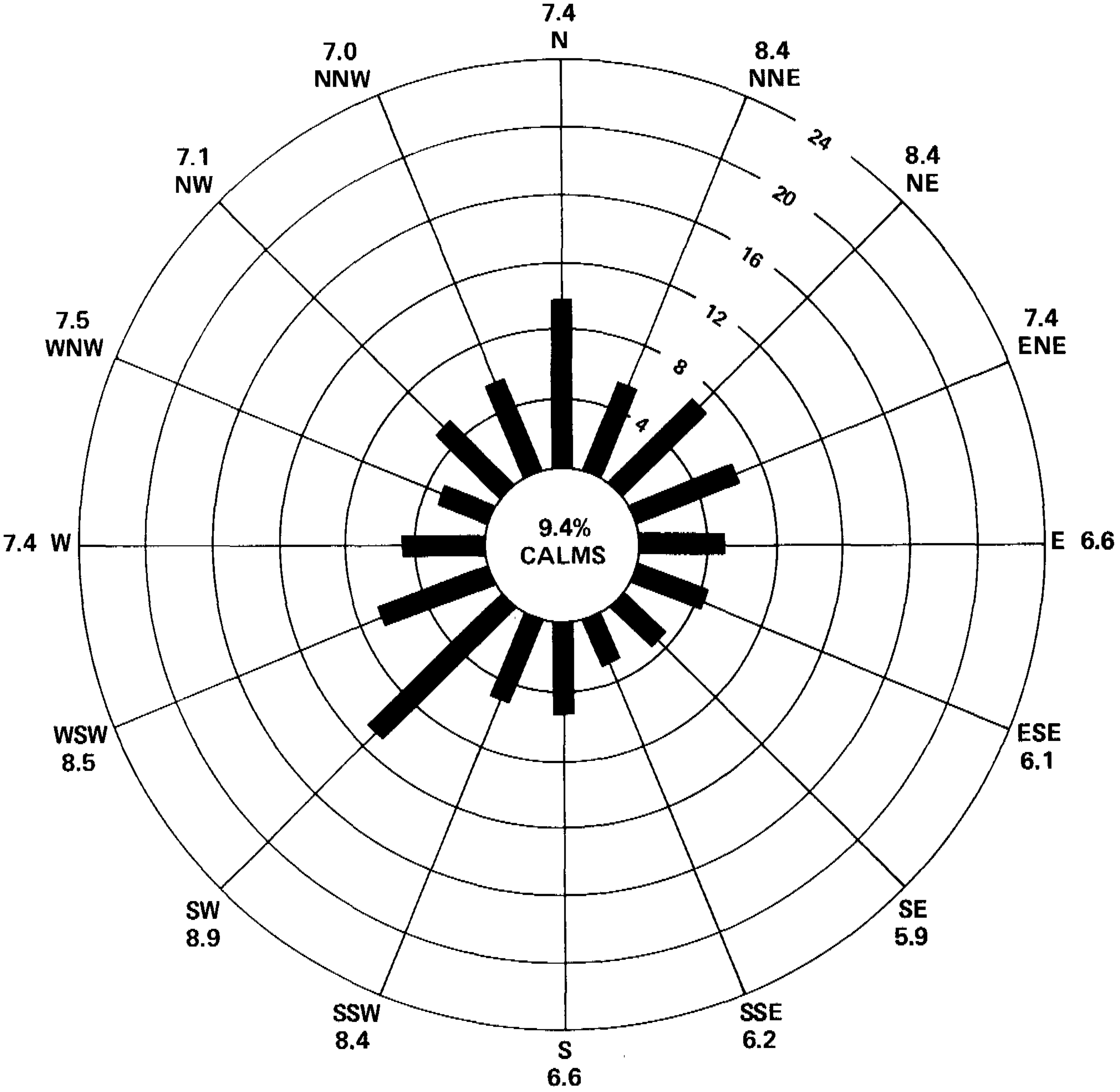
U = ALL DIRECTIONAL AVERAGE WIND SPEED

NOTE: DIRECTIONAL AVERAGE WIND SPEEDS (MPH) ARE DISPLAYED RADIALLY

▬ WIND DIRECTION (%)

1966-1970

SHEARON HARRIS NUCLEAR POWER PLANT Carolina Power & Light Company ENVIRONMENTAL REPORT	GREENSBORO SEASONAL WIND ROSE	FIGURE 2.3.6-4



$\overline{U}$ = 6.9

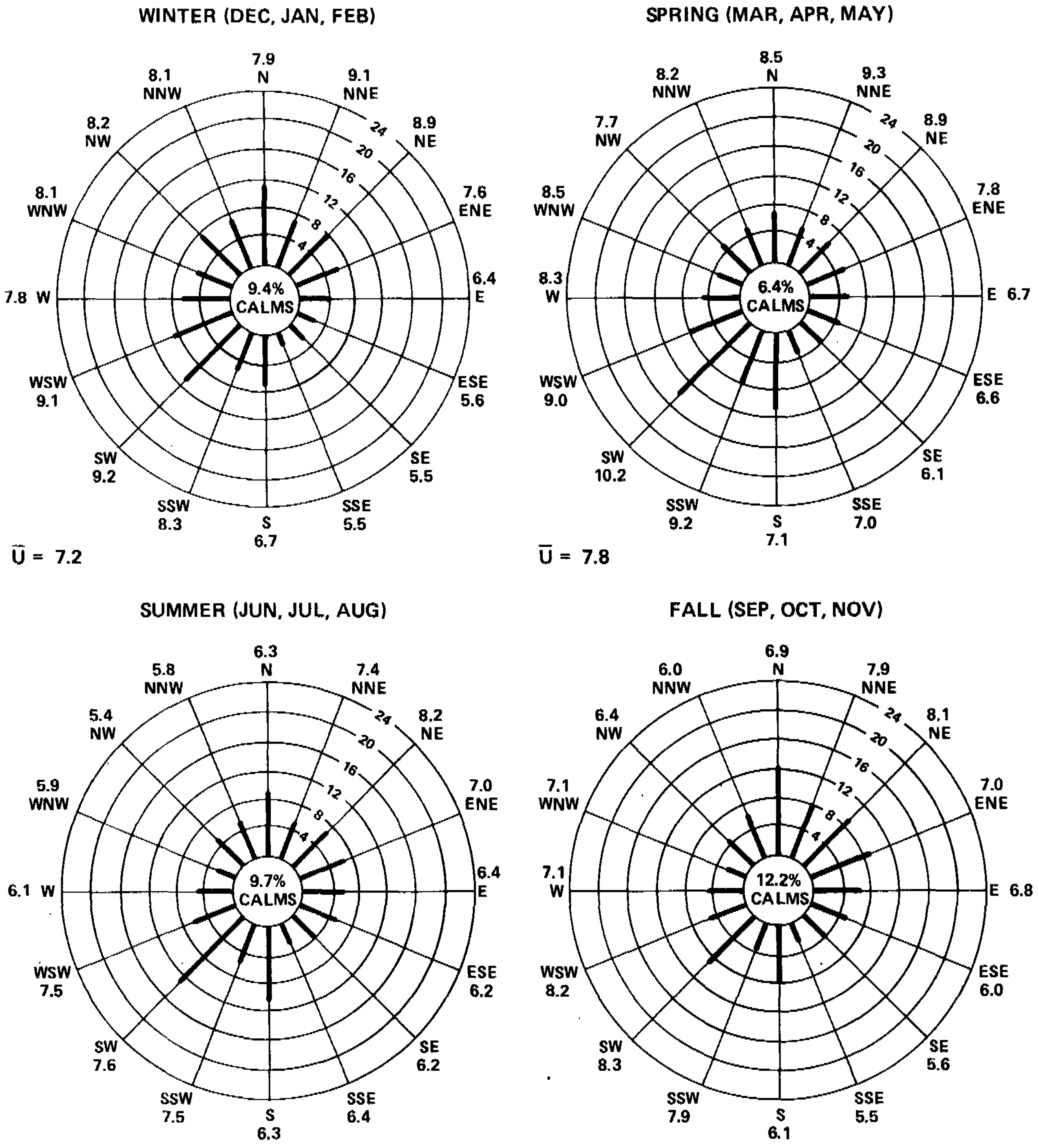
$\overline{U}$ = ALL DIRECTIONAL AVERAGE WIND SPEED

NOTE: DIRECTIONAL AVERAGE WIND SPEEDS (MPH) ARE DISPLAYED RADIALLY

■ WIND DIRECTION (%)

1966-1970

SHEARON HARRIS NUCLEAR POWER PLANT Carolina Power & Light Company ENVIRONMENTAL REPORT	CHARLOTTE ALL WEATHER WIND ROSE	FIGURE 2.3.6-5



$\bar{U}$ = 7.2

$\bar{U}$ = 7.8

$\bar{U}$ = 6.1

$\bar{U}$ = 6.2

$\bar{U}$ = ALL DIRECTIONAL AVERAGE WIND SPEED

NOTE: DIRECTIONAL AVERAGE WIND SPEEDS (MPH) ARE DISPLAYED RADIALLY

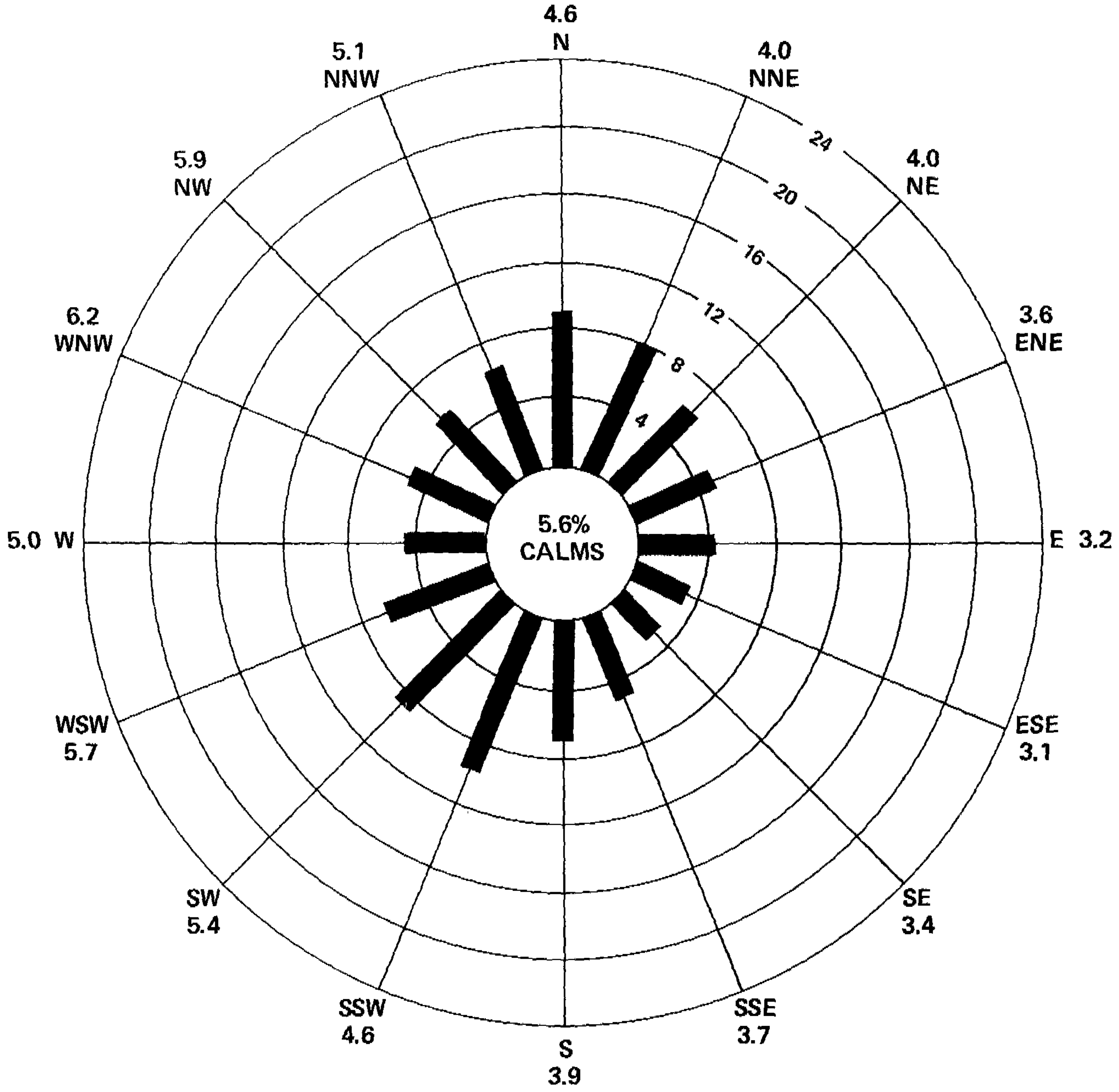
—— WIND DIRECTION (%)

1966-1970

SHEARON HARRIS
NUCLEAR POWER PLANT
Carolina
Power & Light Company
ENVIRONMENTAL REPORT

CHARLOTTE SEASONAL WIND ROSE

FIGURE
2.3.6-6



$\bar{U}$ = 4.6 MPH

$\bar{U}$ = ALL DIRECTION AVERAGE WIND SPEED

NOTE: DIRECTIONAL AVERAGE WIND SPEEDS (MPH) ARE DISPLAYED RADIALLY

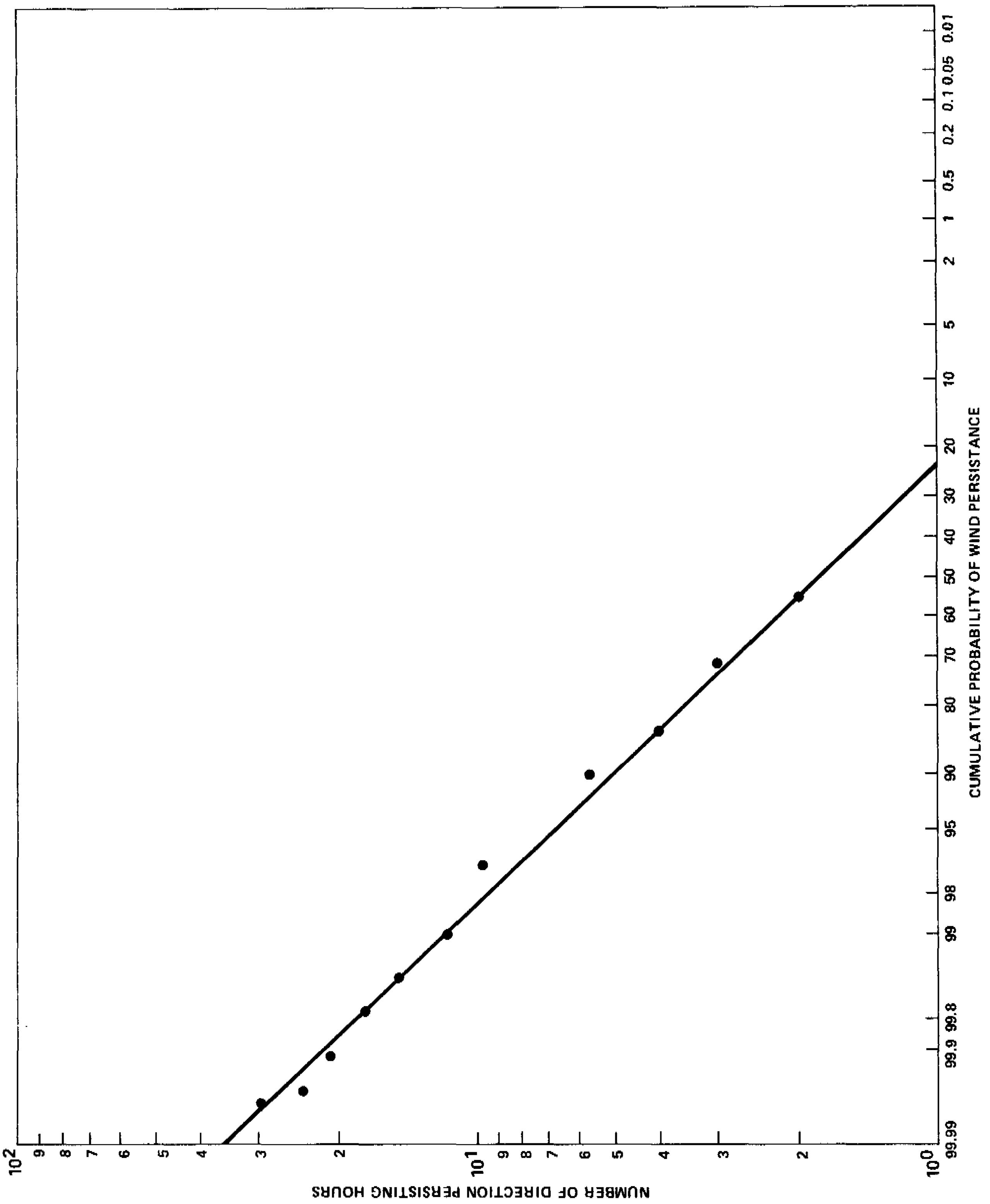
▬ WIND DIRECTION (%)

1/14/76 - 12/31/78

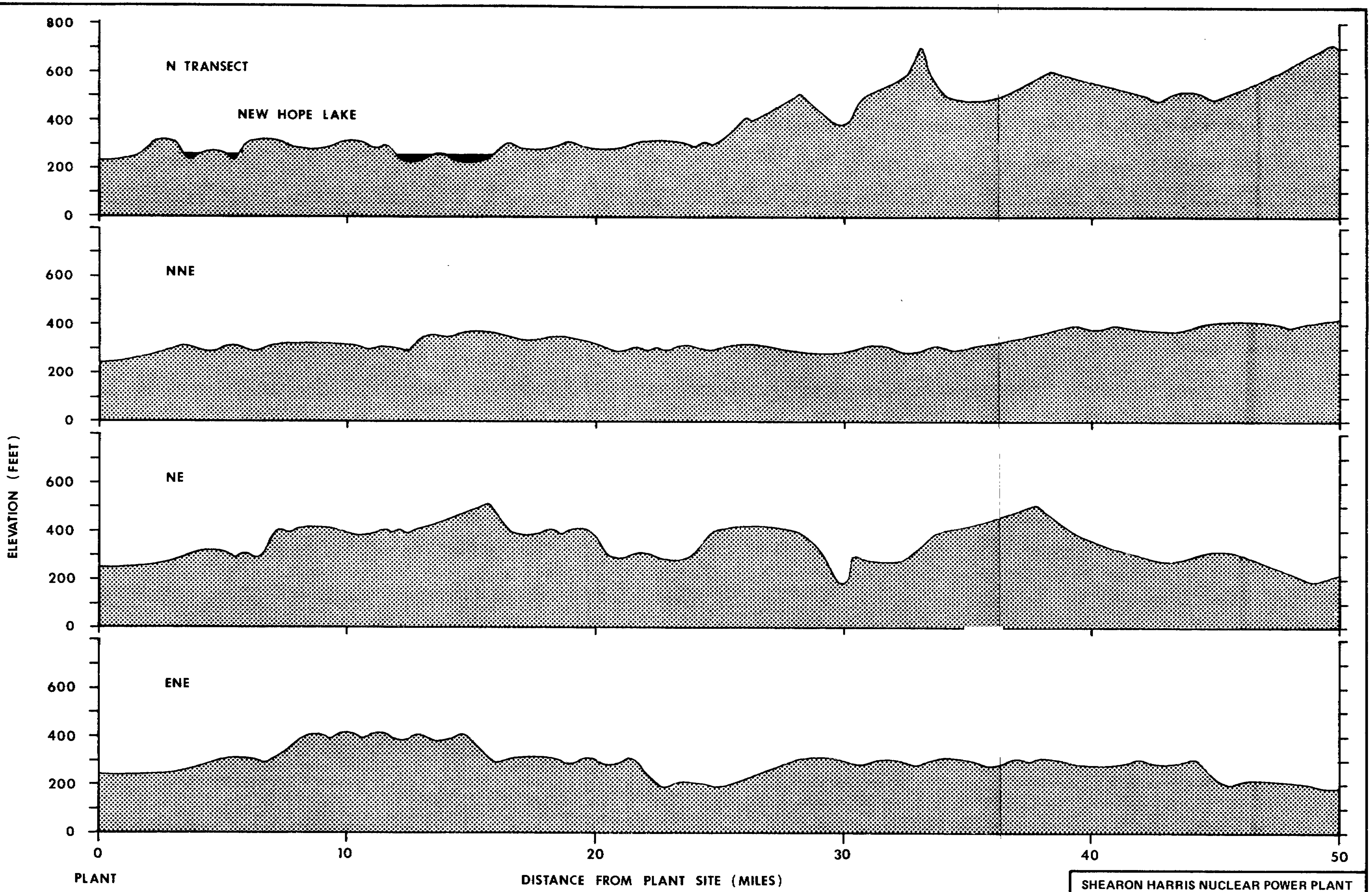
SHEARON HARRIS
NUCLEAR POWER PLANT
Carolina
Power & Light Company
ENVIRONMENTAL REPORT

SHNPP SITE WIND ROSE
12.5 METER LEVEL

FIGURE
2.3.6-7



SHEARON HARRIS NUCLEAR POWER PLANT Carolina Power & Light Company ENVIRONMENTAL REPORT	SHNPP 12.5M LEVEL WIND PERSISTANCE PROBABILITY	FIGURE 2.3.6-8



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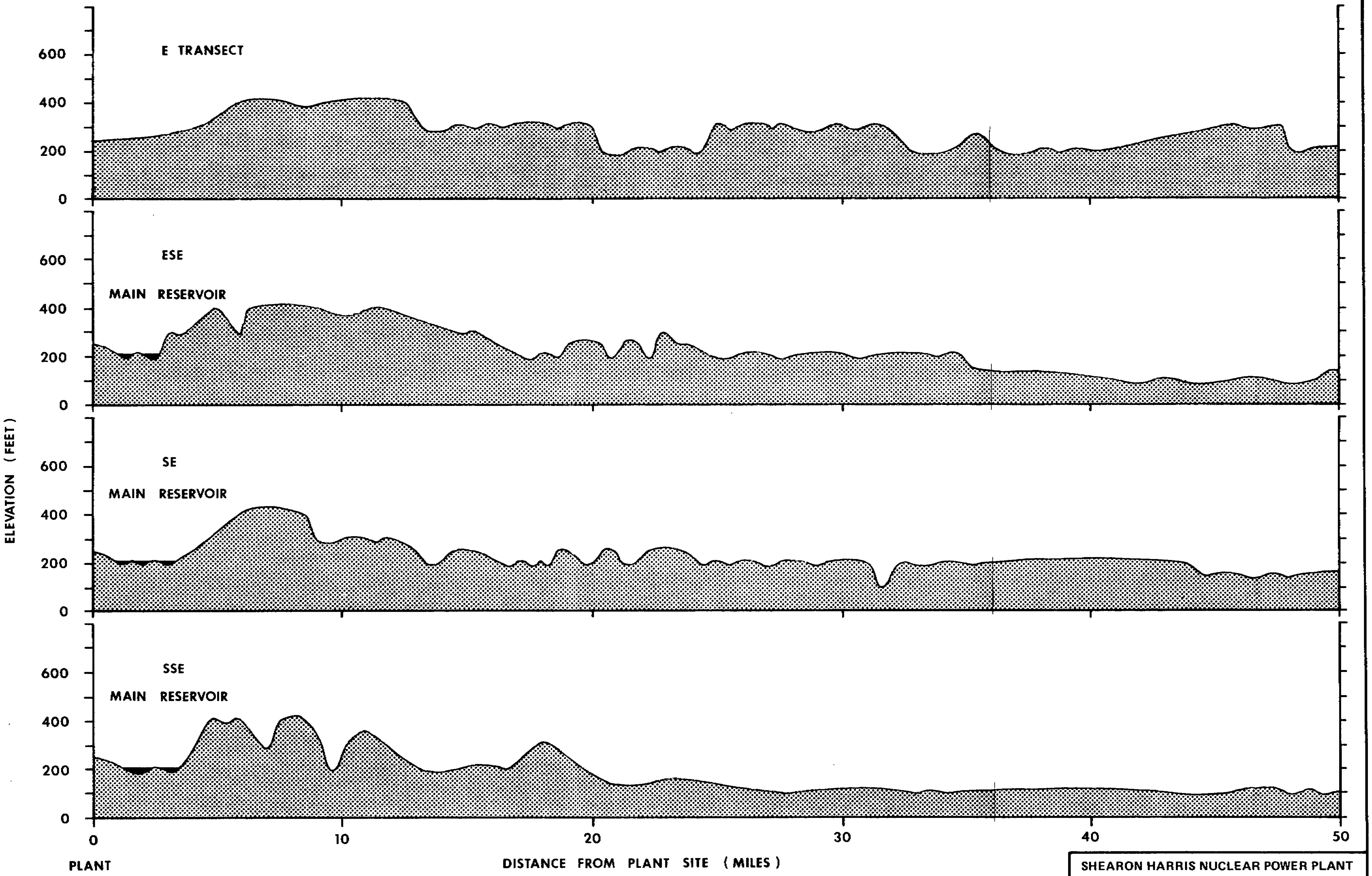
MAXIMUM ELEVATION VERSUS DISTANCE FROM THE CENTER OF THE PLANT

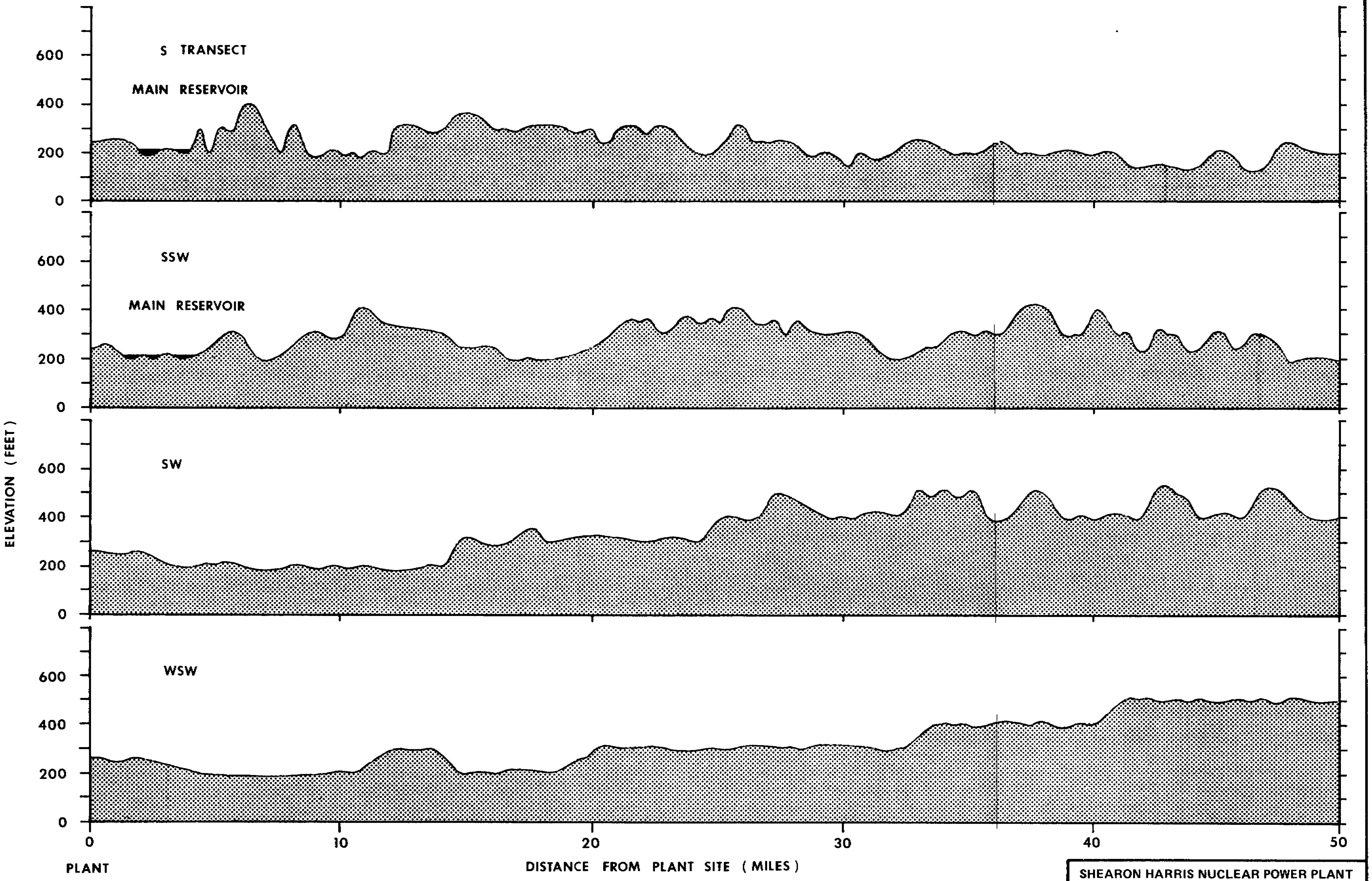
FIGURE 2.3.8-1



SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
ENVIRONMENTAL REPORT

MAXIMUM ELEVATION VERSUS DISTANCE FROM THE CENTER OF THE PLANT

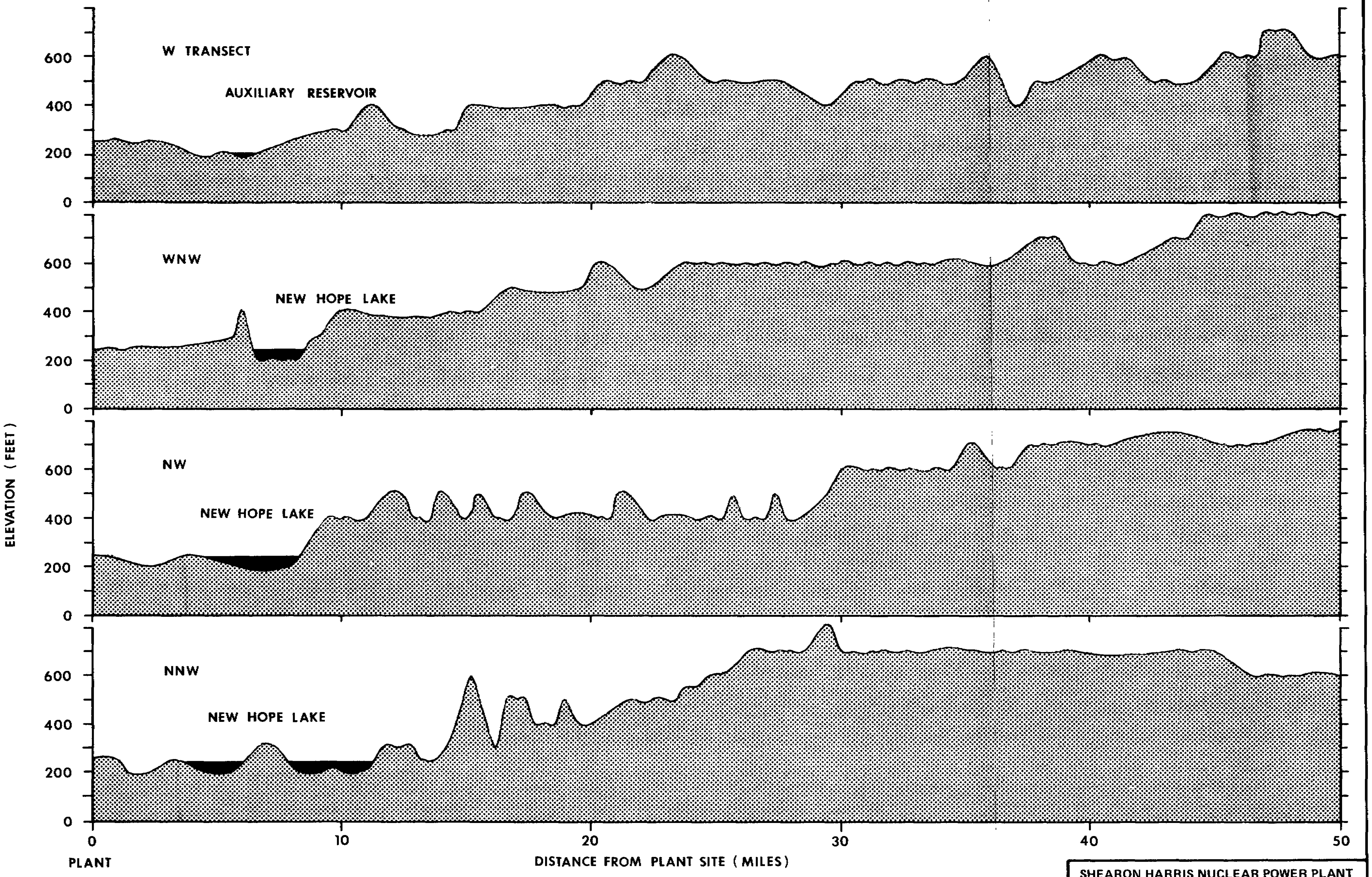
FIGURE 2.3.8-2



SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
ENVIRONMENTAL REPORT

MAXIMUM ELEVATION VERSUS DISTANCE FROM THE CENTER OF THE PLANT

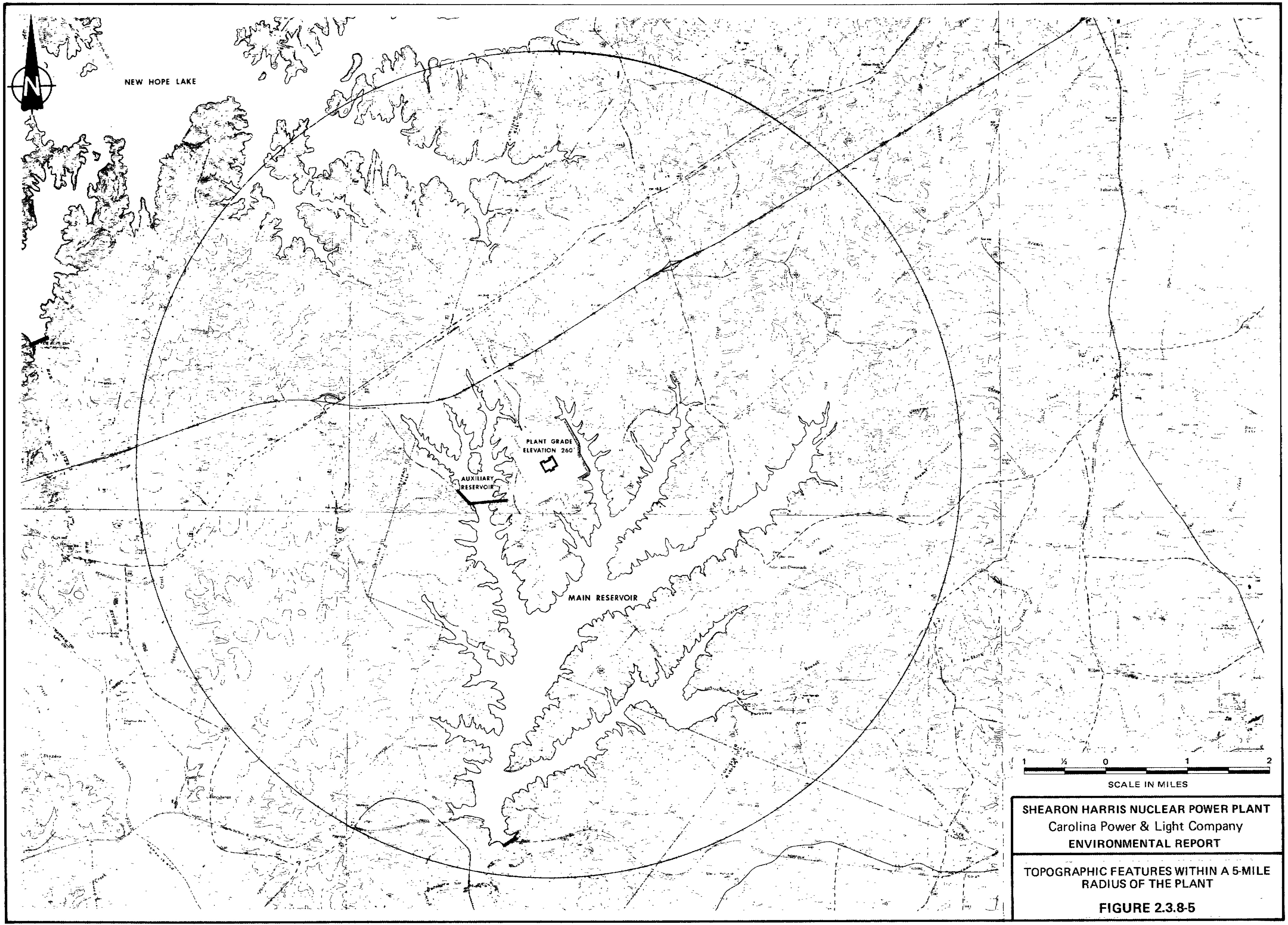
FIGURE 2.3.8-3



SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
ENVIRONMENTAL REPORT

MAXIMUM ELEVATION VERSUS DISTANCE FROM THE CENTER OF THE PLANT

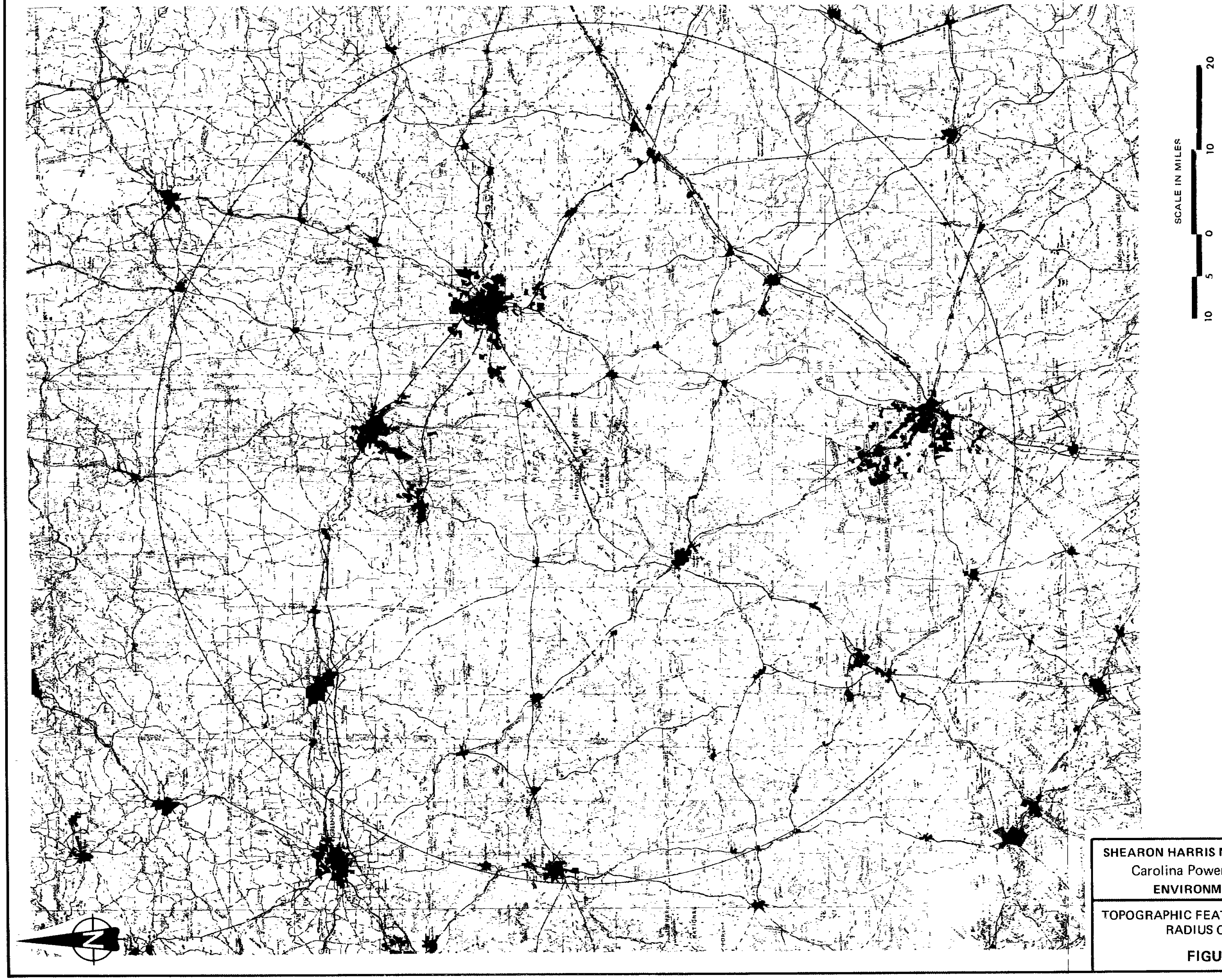
FIGURE 2.3.8-4



SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
ENVIRONMENTAL REPORT

TOPOGRAPHIC FEATURES WITHIN A 5-MILE RADIUS OF THE PLANT

FIGURE 2.3.8-5



SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
ENVIRONMENTAL REPORT

TOPOGRAPHIC FEATURES WITHIN A 50-MILE RADIUS OF THE PLANT

FIGURE 2.3.8-6

2.4 HYDROLOGY

2.4.1 INTRODUCTION

The Shearon Harris Nuclear Power Plant is located in the Buckhorn Creek basin, as shown on Figure 2.4.1-1. Buckhorn Creek is a tributary of the Cape Fear River, as shown on Figures 2.4.1-2 and 2.4.1-3. Buckhorn Creek is the source of surface water for the Main and Auxiliary Reservoirs for plant operation. For two unit operation a makeup system which will pump water from the Cape Fear River will also be available. The Cape Fear River Makeup System will be installed by Unit 2 fuel load date. Details of the Cape Fear River drainage basin and its relationship to Buckhorn Creek are shown on Figure 2.4.1-3.

The principal source of water for SHNPP is the Main Reservoir, which is impounded by an earth dam located on Buckhorn Creek just below its confluence with White Oak Creek. In addition to natural runoff, the water inventory in the reservoir system will be augumented by pumping from the Cape Fear River during two unit operation. Preexisting ponds and impoundments (shown on Figure 2.4.1-4), which were located within the boundary of the plant site, are not used for plant operation; none were located within the boundary of the plant island. Those which were located in the reservoir areas have been inundated by filling the reservoirs.

Filling of the main reservoir began in November, 1980, and as of September 30, 1982, the main reservoir water level was at Elevation 218.5 feet. Based on this actual water level and average and drought flow conditions, it is expected that the main reservoir will be filled as indicated on Table 2.4.1-1.

In addition to the Main Reservoir, an adjoining and independent Auxiliary Reservoir was constructed for emergency core cooling purposes. The Auxiliary Reservoir is on Tom Jack Creek near the plant. Buckhorn Creek's five tributaries (Tom Jack Creek, Thomas Creek, Little White Oak Creek, White Oak Creek, and Cary Creek) have been impounded by the Main Dam. A nameless tributary of Little White Oak Creek is located on the western half of the plant island, where grading raised the plant elevation to 260 ft. msl. The plant will not be subjected to flooding, since the design grade is well above the maximum water levels caused by the Probable Maximum Flood on the streams and reservoirs.

An outline of the small watersheds near the plant site is presented on Figure 2.4.1-4; this figure shows the small drainage areas and their divides before construction of the project. Comparison of Figure 2.4.1-4 with Figure 2.4.1-5 shows that construction of the project has not materially changed the drainage pattern.

Rivers, creeks, lakes, reservoirs, and ponds existing within a 5-mile and 25-mile radius of the plant site are shown on Figures 2.4.1-6 and 2.4.1-7, respectively.

The plant site is located in an area that has very little groundwater; groundwater is discussed in Section 2.4.3. Radionuclide release from the plant and possible groundwater pathways are discussed in Section 2.4.4. Users of surface water and groundwater are discussed in Section 2.4.5.

TABLE 2.4.1-1

MAIN RESERVOIR SCHEDULE

	Min. Operating Level (205.7 Ft.)	Normal Operating Level (220 Ft.)
Average Flow	Achieved February, 1982	March 1983
Drought Flow	Achieved February, 1982	Early 1985

5

2.4.2 SURFACE WATER HYDROLOGY

2.4.2.1 Introduction

Waterways and bodies of water within a 50-mile radius of the plant site (Figure 2.4.2-1) which could receive liquid releases from the SHNPP are only those downstream of the site, via Buckhorn Creek and the Cape Fear River. The Cape Fear River basin, for a distance of 50 mi. downstream from the site, is characterized by transition from the Piedmont area to the Coastal Plain. The low water profile of the Cape Fear River drops about 125 ft. from Buckhorn Dam at river mile 192 to Lock and Dam No. 3 at river mile 123, a gradient of 1.8 ft./mi. The terrain changes from rolling hills and a relatively narrow river valley near the site to nearly flat terrain below the confluence of Little River.

2.4.2.2 Cape Fear River

The Cape Fear River basin (Figure 2.4.1-3) is oblong in shape; its greatest width is about 60 mi. and its length is about 200 mi. The Cape Fear River is formed by the confluence of the Deep and Haw Rivers. It flows generally southeast about 198 mi. and empties into the Atlantic Ocean at Cape Fear, approximately 28 mi. below Wilmington, North Carolina. The basin has a total area of 9,136 sq. mi., of which 3,127 sq. mi. are located above the confluence of the Deep and Haw Rivers.

The lower Cape Fear River is an estuary; the tidal reach of the river extends to Lock and Dam No. 1 (at river mile 67), which is about 39 mi. above Wilmington. The river is navigable to Fayetteville, with a channel width of generally 400 ft. and depth ranging from 30 to 35 ft. from the Atlantic Ocean to Wilmington.

The average width of the Cape Fear River flood plain is approximately 2.2 mi. The difference between high and low stages is 69 ft. at Fayetteville and 44 ft. at Lock No. 2. The maximum flood flow of 150,000 cfs occurred on September 19, 1945 at Lillington.

The monthly average flows of the Cape Fear River at Buckhorn Dam, shown in Table 2.4.2-1, were obtained from the records at Lillington by a drainage area ratio of 3,196 sq. mi. at Buckhorn Dam to 3,440 sq. mi. at Lillington. This table has been updated to include data from 1979 to 1981.

Based on the period of record from 1924 to 1978, historical low flows were derived for the Cape Fear River at Buckhorn Dam from the Lillington data, and are presented in Table 2.4.2-2. Figure 2.4.2-2 shows the flow duration curve at Buckhorn Dam, and Figure 2.4.2-3 presents the low flow frequency analysis. The minimum daily flow of 10 cfs occurred on October 14, 1954; the seven consecutive day ten-year low flow is 72 cfs at Buckhorn Dam. Historical low flows presented in Table 2.4.2-2 have been updated to include data from 1979 to 1981.

The flow duration curve shown on Figure 2.4.2-2 does not take into consideration the effect of the U. S. Army Corps of Engineers comprehensive plan of development of water resources for the Cape Fear River basin

(Reference 2.4.2-1). The completion of the proposed dams will furnish a 5 | minimum continuous flow of 600 cfs at Lillington. In addition, flood peaks will be substantially reduced because of the retention capacity of the reservoirs.

2.4.2.2.1 Tributaries

The Cape Fear River has many tributary creeks, including approximately 30 that are more than three miles in length, in the area downstream of Buckhorn Dam. There are three major tributaries (Upper Little River, Little River, and Rockfish Creek) which drain the western portion of the basin. Most of the eastern part is drained by tributaries of the Black River, which enters the Cape Fear River at river mile 44, and is not within the region of influence of the SHNPP. There is only one small impoundment of concern, formed by Buckhorn Dam just upstream from the mouth of Buckhorn Creek. The maximum storage is 1600 ac.-ft., and it was used for hydroelectric power generation from 1908 until 1962. This Cape Fear River impoundment will be source of make-up water for the SHNPP reservoir system when Unit 2 is placed in operation. Any release from the SHNPP would affect only the Cape Fear River below Buckhorn Dam and the lower reaches of its tributaries. However, under flood conditions, backwater could extend further upstream. Table 2.4.2-3 lists the tributaries, the locations of their confluence with the Cape Fear River, and the estimated extent of backwater flooding during the flood of September 19, 1945, the largest one ever recorded (Reference 2.4.2-1).

Table 2.4.2-4 gives important flow characteristics for all of the USGS gaging stations within the area of interest (References 2.4.2-2 and 2.4.2-3).

The Cape Fear River has two major tributaries above Buckhorn Dam, the Haw and Deep Rivers, both of which originate in Forsyth County, North Carolina. The Deep River has a total length of 116 mi. and a drainage area of 1,422 sq. mi. The Haw River is about 90 mi. in length and drains approximately 1,705 sq. mi. Both rivers originate at elevations of about 1,000 ft. msl and have numerous falls and rapids; the Haw River has the steep gradient. The elevation of the junction of the two rivers is about 158 ft. msl.

Buckhorn Creek is a tributary of the Cape Fear River; its confluence with the Cape Fear is just downstream of Buckhorn Dam, as shown on Figure 2.4.1-1.

2.4.2.2.2 Dams, Reservoirs, and Locks on the Cape Fear River

There are a number of regulating structures and reservoirs on the Cape Fear River. The locations of these structures and reservoirs are shown on Figure 2.4.1-3. Lock and Dam Nos. 1, 2, and 3 are located at river mile points 67, 99, and 123, respectively. Buckhorn Dam is at river mile 192, and its spillway crest is at Elevation 158.18 ft. msl.

In addition to the existing Lockville Dam and Carbonton Dam on the lower reach of the Deep River, the U. S. Army Corps of Engineers has proposed a comprehensive plan of development of water resources for the Cape Fear River basin; a summary of this plan is shown in Table 2.4.2-5.

2.4.2.2.3 Streamflow Analysis

4

2.4.2.2.3.1 Streamflow Analysis for Two Unit Operation

Since the Cape Fear River will be a source of makeup water for the Main Reservoir when Unit 2 is placed in operation, the record of flows of this river at Lillington were analyzed to determine the low flow years which, when combined with the synthesized flows of Buckhorn Creek, would comprise the most critical flow periods (described in FSAR Section 2.4.11). The three most critical one-year periods of coincident flows, based on the synthesized flows of Buckhorn Creek and the adjusted flows of the Cape Fear River drainage area at Buckhorn Dam, were determined to be the following: 4

March 1933 through February 1934
February 1925 through January 1926
May 1941 through April 1942

Although the earliest Cape Fear River flow data dates back to 1923, there are good precipitation records for the Raleigh area which go back to 1867. A review of these records indicates that the lowest annual precipitation occurred in 1933, with a total of 29.93 in. Near record lows were also experienced in 1930, 1940, 1951, 1968, and 1980. It is probable, therefore, that the minimum flows experienced during the period of streamflow record represent the lowest values dating back to 1867, the beginning of precipitation data. However, drought frequency analyses were made based on the periods where flows could be synthesized from regional streamflow data, and therefore should be conservative. 4

Short duration minimum flows in Buckhorn Creek will have little effect on the project due to the large storage capacity of the Main Reservoir and pumping capability for additional make-up from the Cape Fear River. Therefore, isolated drought periods of less than four months were not considered. Drought periods of four and seven months were determined for each year of synthesized record of Buckhorn Creek and the Cape Fear River. The average 4, 7, or 12-month minimum flows of Buckhorn Creek and the Cape Fear River, for each of the three worst synthesized critical coincident flow periods, are shown in Table 2.4.2-6.

Based on frequency analyses for both Buckhorn Creek and the Cape Fear River, the estimated return period in years for the 4, 7, and 12-month droughts for the three worst coincident flow periods are as follows:

	Return Period (Yr.)		
Period of Record	1933-34	1925-26	1941-42
Average 4-month drought	35	11	23
Average 7-month drought	27	32	7
Average 12-month drought	47	22	9

The frequency analyses for Buckhorn Creek and the Cape Fear River (based on the period of record of 1924 through 1978) were utilized to estimate a severe drought having a return period of 100 years on both streams. The following 4 tabulation gives the average minimum flows for both Buckhorn Creek and the Cape Fear River for the various drought durations:

100-Year Drought

	Buckhorn Creek (cfs)		Cape Fear River (cfs)
	At CFR	At Main Dam	
Average 4-month minimum flow	4.1	3.7	178
Average 7-month minimum flow	7.7	6.9	312
Average 12-month minimum flow	26.0	23.2	770

The analyses of the three most critical periods of coincident flow assumed the operation of four units at the site with makeup from the Cape Fear River. For two unit operation, the average consumptive water use is estimated to be approximately 32.7 cfs and 34.2 cfs for the normal and worst monthly evaporative conditions at 75 percent power, respectively. A breakdown of the consumptive water use is shown on Table 2.4.2-19a. The original analyses for four unit operation assumed that forced evaporation for the normal and worst case was 67.2 cfs and 87.2 cfs, respectively. The assumptions on creek inflow, Cape Fear River makeup capability, seepage, natural evaporation, rainfall, makeup from the Main Reservoir to the Auxiliary Reservoir and reservoir levels are valid for two and four unit operation. Therefore, the original analyses for the three most critical periods of coincident flow predict minimum reservoir levels which are lower than the minimum levels which would be reached during two unit operation and confirm the adequacy of the reservoir to support the operation of two units. 4

In addition to the three most critical periods of coincident flow, two periods which represent the most critical periods for low flow in Buckhorn Creek were analyzed. These periods were:

February, 1951 through January, 1952
August, 1980 through July, 1981

In order to allow a comparison of the results of these analyses to the previous analyses, the conservative assumption of four unit evaporative losses was used in these analyses.

The results of these studies, shown on Tables 2.4.2-29 and 2.4.2-30, reinforce the conclusion that the reservoir provides an adequate water supply for two unit operation.

Average flows of Buckhorn Creek at the Main Dam are as follows. The 1951-1952 critical period had a 4 month average low flow of 5.8 cfs, a 7 month average low flow of 8.5 cfs and a 12 month average low flow of 26.5 cfs. The 1980-1981 critical period had a 4 month average low flow of 10.5 cfs, a 7 month average low flow of 11.5 cfs and a 12 month average low flow of 25.1 cfs. These streamflows have been added to Table 2.4.2-6 along with Cape Fear River flows during these periods.

Due to the topography of its valley, realignment of the Cape Fear River during operation of SHNPP is considered extremely remote. As explained in Table 2.4.2-5 and Reference 2.4.2-1, the comprehensive development plan for the Cape Fear River basin, proposed by the U. S. Army Corps of Engineers, will function to control flood flow on the river and, rather than diverting flow, will assure the availability of a 600 cfs minimum flow at Lillington.

2.4.2.2.3.2 Streamflow Analysis for One Unit Operation

The synthesized flows of Buckhorn Creek for 1924 to 1981 were analyzed to determine the most critical low flow period. This period was determined to be a 19 month historical drought of May 1980 through November 1981. The actual analysis was carried out for May 1980 through May 1982 to demonstrate reservoir recovery. The period had a 4 month average flow of 10.5 cfs, a 7 month average of 11.5 cfs and a 12 month average of 25.1 cfs and an average flow over the drought period of 26.6 cfs (DA = 71 sq. mi.). 4

The average minimum flows of the 100 year return period drought for Buckhorn Creek alone is the same as presented in Section 2.4.2.2.3.1. These flows for the various durations are:

	Buckhorn Creek 100 yr. low flow (cfs)	
	at CFR	at Main Dam
Average 4 month minimum flow	4.1	3.7
Average 7 month minimum flow	7.7	6.9
Average 12 month minimum flow	26.0	23.2

2.4.2.2.4 Floods on the Cape Fear River

4

Flow records for the Cape Fear River at Lillington date back to December 1923. The maximum flood flows at Buckhorn Dam are derived from the data at the Lillington gage by an adjustment based on the drainage area ratio. These flows are shown in Table 2.4.2-7. The frequency analysis (Reference 2.4.2-4) of these data is presented on Figure 2.4.2-4. The maximum flood flow at Buckhorn Dam of 139,370 cfs occurred on September 19, 1945. The bank-full flood flow at Fayetteville is about 35,000 cfs, and at Lock No. 2 it is about 20,000 cfs.

The nearest Seismic Category I structure to the Cape Fear River is the Main Dam, which has its top at Elevation 260 ft. msl, while the elevation of the Cape Fear River bank near Buckhorn Dam is in the vicinity of Elevation 160 ft. msl. This large difference in elevation precludes any over-topping of the Main Dam due to backwater effects of the PMF on the Cape Fear River. Backwater effects of the PMF in the river through Buckhorn Creek are considered to be small. The floodplains adjoining the Cape Fear River, Buckhorn Creek, and the SHNPP reservoirs are described below. 4

The downstream face of the Main Dam is protected by rock for possible wind wave action whenever backwater reaches the Main Dam. Therefore, the PMF and potential floods induced by failures of dams in the Cape Fear River upstream of Buckhorn Dam are not considered. 4 No specific design basis exists for downstream slope protection of the Main Dam. The rockfill shell does not require special slope protection because the Cape Fear River 500-year-flood backwater effect on Buckhorn Creek near the downstream face of the Main Dam is not expected to result in wave action on the dam. This is due to protection afforded by a small downstream fetch which severely limits the size of wind-generated waves. The oversize rock zone on the downstream face is primarily a construction-related feature. During construction of the Main Dam, oversize 5 rocks were plucked from each of the rockfill lifts in order to meet specifications. Where the oversize rocks were within practical limits (20 to 30 inches) they were placed near the downstream face in order to reduce handling of oversize material and provide additional protection to the downstream face.

Since the drainage area of Buckhorn Creek is small in comparison with that of the Cape Fear River at Buckhorn Dam, the construction of the Main Dam and the Auxiliary Dam of the project will have no significant effect on the 100-yr. and 500-yr. flood levels in the Cape Fear River. Consequently, the flood level shown on Figure 2.4.2-39 represents both the pre-construction and post-construction conditions.

The 100-yr. and 500-yr. floodplains adjoining the Cape Fear River in the vicinity of Buckhorn Creek are shown in Figure 2.4.2-39. The corresponding plains for Buckhorn Creek and the SHNPP reservoirs adjacent to the plant island are shown in Figure 2.4.2-40.

The flood profiles in the Cape Fear River are based on the following data provided by the U. S. Army Corps of Engineers (Reference 2.4.2-15):

Location	100-yr. Flood Water Level (Ft. above MSL)	Standard Project (approx. 500-yr.) Flood Water Level (Ft. above MSL)
10,000 ft. Upstream of Buckhorn Dam	168.5	186.5
Upstream Side of Buckhorn Dam	165.5	182.0
Downstream Side of Buckhorn Dam	159.5	182.0
4 miles Downstream of Buckhorn Dam	147.0	172.0

The flood water level profile slopes uniformly between the two locations upstream of the Buckhorn Dam as well as between the two locations downstream of the Buckhorn Dam.

The pre-construction flood profiles of Buckhorn Creek for the 100-yr. and 500-yr. floods were calculated using the HEC-2 computer program (Ref. 2.4.2-16). The 100-yr. and 500-yr. flood flows in Buckhorn Creek before plant construction were obtained from Figure 2.4.2-28 as 9,900 cfs and 16,000 cfs, respectively, at its confluence with the Cape Fear River. Based on these flows, the corresponding flows in the tributaries of Buckhorn Creek were estimated according to their drainage area ratios. Since the normal creek channel is rather shallow, the creek cross-sections for the flood flows were principally scaled from a 1/12000 scale map at 1000 to 2000 feet intervals. In addition, available project construction maps for the area below the Main

Dam and the USGS 1/24000 map of the area adjacent to the Cape Fear River were also used. Manning's n-values of 0.04 and 0.045 were selected for the main and flood channels, respectively, in the flood profiles computation.

The floodplains adjoining Buckhorn Creek and its tributaries were delineated from the 1/12000 contour map as shown in Figure 2.4.2-40.

The construction of the Main Dam and Auxiliary Dam of the plant will reduce the magnitude of the flood flows downstream of the plant because of the storage capacity of the two reservoirs created by the dams. Again, based on the drainage area ratio between that at each dam location and that of the entire Buckhorn Creek, the 100-yr. and 500-yr. floods adopted for the floodplain delineation are:

Flood	At Main Dam	At Auxiliary Dam
100-yr	8850 cfs	215 cfs
500-yr	14300 cfs	350 cfs

Both the Main Dam and Auxiliary Dam have uncontrolled spillways to release floods. The spillway rating curves for these dams are shown in Figures 2.4.2-31 and 2.4.2-32. The corresponding flood level in each reservoir was determined by applying the flood flows to the appropriate rating curve. Since the reservoirs are rather small, no backwater effect in the reservoirs was taken into consideration when the floodplains adjoining the reservoirs were delineated. 4

The floodplains adjoining the reach of Buckhorn Creek between the Main Dam and Cape Fear River after the construction of the Main Dam were not studied since the flood levels will be less than before construction.

The construction of the plant will increase the extent of the floodplains above the Main and Auxiliary Dams in Buckhorn Creek and reduce the flood magnitude below the Main Dam. The water level (WL) and stoarge capacity (SC) of both reservoirs at 100-yr. and 500-yr. flood are:

	Main Reservoir		Auxiliary Reservoir	
Flood	WL (ft) MSL	SC (Ac ft)	WL (ft) MSL	SC (Ac ft)
100-yr.	234.0	142×10^3	252.5	5.25×10^3
500-yr.	239.0	174×10^3	252.8	5.35×10^3

The storage capacities are obtained from Figures 2.4.2-7 and 2.4.2-8, the reservoir area and capacity curves, using the calculated water levels.

The pre-construction and post-construction floodplains for that portion of Buckhorn Creek that is influenced by the plant construction are entirely within the site boundary. There are no existing structures within these floodplains other than those constructed for plant use. These structures were designed to preclude adverse effects due to the probable maximum flood. Additional structures may be constructed to support the recreational use of the main reservoir. It is expected that the effect of floods will be considered in the design of these structures based on a cost/risk assessment.

4 Since the Cape Fear River floodplains are not increased due to plant construction, any pre-existing structures in these areas are not subject to increased risk of flood damage due to plant construction.

2.4.2.3 Buckhorn Creek

2.4.2.3.1 Preimpoundment Conditions

Buckhorn Creek has its headwaters in the vicinity of Holly Springs and Apex, North Carolina, and flows along a southwesterly course to its confluence with the Cape Fear River, about 12 miles northwest of the town of Lillington. As shown on Figure 2.4.1-1, the Buckhorn Creek system above the Main Dam has five named tributaries - Tom Jack Creek, Thomas Creek, Little White Oak Creek, White Oak Creek, and Cary Creek. These five creeks, together with Buckhorn Creek's own basin, drain a watershed area of approximately 79.5 sq. mi. The entire drainage basin lies near the eastern edge of the Piedmont Plateau; basin elevations range from about 450 ft. to 150 ft. msl.

There is no flow record for the Buckhorn Creek drainage basin before 1972, except for 13 days of low flow records taken at a station near Holly Springs, North Carolina. However, there are flow records for the Middle Creek basin which lies adjacent to the Buckhorn Creek basin on its eastern border within the same general region and also has its headwaters in the vicinity of Apex.

As explained in the FSAR, by correlation with adjacent streams (Middle Creek, Little River, and Deep River) streamflow data for Buckhorn Creek was developed.

With the synthesized data (1924-1939) and the observed data (1939-1978) of Middle Creek, the monthly flows of Buckhorn Creek for the entire period (1924-1978) were obtained; these are shown in Table 2.4.2-8. Correlation with other streams in the area was not as good as that of the streams discussed above. Details of the correlation are contained in FSAR Section 2.4.1.2.1.1.

4 The average flows of Middle Creek at Clayton, North Carolina, for the 39-year period (1939-1978) and the 55-year period (1924-1978) are 92.3 cfs and 89.4 cfs, respectively. The corresponding synthesized values of Buckhorn Creek are 90.9 cfs and 88.1 cfs, respectively.

4 The average flows of Middle Creek at Clayton, North Carolina for the three year period of 1979 through 1981 have been added to Table 2.4.2-8 and utilized in the 1980-81 drought analyses for one unit and two unit operation. The average flows for the 42-year period (1939-1981) and the 58 year period (1924-1981) are 90.8 cfs and 88.5 cfs. The corresponding synthesized values of Buckhorn Creek (DA=79.5 sq.mi.) are 89.4 cfs and 87.2 cfs respectively. These values are not significantly different from those given above.

Since June 1972, a stream gaging station has been in operation on Buckhorn Creek downstream of the Main Dam site in order to accumulate actual flow data prior to the impoundment of water in the Main Reservoir. The United States Geological Survey (USGS) installed and operates the Buckhorn Creek gaging station. The drainage area at this station is 74.2 sq. mi. The actual observed monthly flows and the calculated values derived by multiplying the ratio of the drainage area at the gage station to that of Middle Creek (D.A. 80.7 sq. mi.) by the corresponding data of Middle Creek are shown in Table 2.4.2-9. A correlation analysis has been made between the data from the observed and derived flows. It was found that the correlation coefficient is 0.95. The results of the analysis are shown on Figure 2.4.2-5.

From the above correlation analysis, it is concluded that the synthesized flow data of Buckhorn Creek from 1924 to 1978 can be utilized for hydrological studies. For the 1980-81 drought analysis for one unit and two unit operation, synthesized flow data of Buckhorn Creek from 1924 to 1981 was utilized. 4

Low flow frequency analyses have been performed for Buckhorn Creek by using the estimated data shown in Table 2.4.2-10. The minimum daily flow is estimated to have been zero on October 11 through 13, 1954. Figure 2.4.2-6 shows the 7-day low flow frequency analysis. The estimated seven consecutive day, ten-year frequency low flow for Buckhorn Creek based on the period analyzed is 0.9 cfs. 4

Flood flows on Buckhorn Creek are discussed in Section 2.4.2.3.3, Historical Floods, and Section 2.4.2.3.4, Probable Maximum Flood. Plant reservoirs on Buckhorn Creek are discussed in Section 2.4.2.3.2.

In view of the lack of historical evidence of any realignment of Buckhorn Creek, future realignment is considered to be extremely remote. Moreover, realignment in such a way that the runoff of the drainage basin would be diverted away from the reservoir system is impossible due to the contours of the basin.

Regardless of the continued availability of runoff to the reservoirs, the safety of the plant cannot be jeopardized by diverted flow. Operational commitments require shutdown of the plant when reservoir water levels reach designated low points. At these low points, there will still be sufficient water in the reservoirs to achieve safe shutdown of the plant.

2.4.2.3.2 Plant Reservoirs

The SHNPP reservoir system consists of the Main Reservoir and the Auxiliary Reservoir. The former is impounded by an earth dam on Buckhorn Creek about 4.3 miles above its confluence with the Cape Fear River, as shown on Figure 2.4.1-1. The latter is formed by an earth dam on Tom Jack Creek, immediately to the west of the plant island. Both the Main Dam and the Auxiliary Dam have crest elevations of 260 ft. msl. The Main Dam has an uncontrolled spillway at Elevation 220 ft. msl. Thus, the normal reservoir level will be Elevation 220 ft. msl., but under drought conditions it may decrease to a minimum of Elevation 205.7 ft. msl. during normal operation, and to Elevation 204.4 ft. msl. during emergency conditions. The Probable Maximum Flood (PMF) would cause a peak stillwater level of Elevation 238.9 ft. msl. The surface area of the Main Reservoir is 2350 ac. at the mnimum water level of Elevation 204.4 ft., 4100 ac. at Elevation 220 ft. msl., and 7300 ac. at Elevation 238.9 ft. msl., if the PMF occurs.

The Auxiliary Reservoir has an uncontrolled spillway at Elevation 252 ft. msl. The water level will be maintained at a minimum of Elevation 250 ft. by creek inflow and pumping from the Main Reservoir. At Elevation 250 ft. msl. the Auxiliary Reservoir covers an area of 317 ac. The PMF on the Auxiliary Reservoir would reach a maximum level of Elevation 256.0 ft; the reservoir area at this elevation would be 425 ac.

Discharge at the Main Dam may be completely eliminated for periods of up to two years while the reservoirs are filled and during periods of severe drought.

Figures 2.4.2-7 and 2.4.2-8 represent the area capacity curves for the Main and Auxiliary Reservoirs, respectively.

Section 2.4.2.3.1 describes the hydrology of the Buckhorn Creek basin and Section 2.4.2.2 describes the hydrology of the Cape Fear River basin under natural conditions. Pumping of makeup water from the Cape Fear River, evaporation from the reservoirs, and consumptive use of water by the cooling towers will produce substantially different hydrologic conditions in the Buckhorn Creek drainage basin. Considering the established criteria for pumping, the coincident average monthly flows of the Cape Fear River and Buckhorn Creek, and the losses due to evaporation and consumptive use, the average release from the Main Reservoir was predicted to be about 35 cfs for four unit operation and is currently predicted to be 48 cfs for two unit operation. Considering the average monthly flows for Buckhorn Creek and the losses due to evaporation and consumptive use, the average release from the Main Reservoir is predicted to be about 43 cfs for one unit operation.

During periods of low flow in the Cape Fear River, the withdrawal of makeup water from the river will be restricted so that net withdrawals will not exceed 25 percent of the river flow nor reduce the river flow below 600 cfs as measured at the Lillington gage. Based on the flow duration curve derived from the daily flow data at the Lillington gage, as adjusted by considering the drainage area at Buckhorn Dam, the 600 cfs Cape Fear River flow will be exceeded 74.0 percent of the time, as shown on Figure 2.4.2-2. The flow duration curve does not take into consideration the effects of the comprehensive plan of development of water resources for the Cape Fear River basin (Table 2.4.2-5 and Reference 2.4.2-1). The completion of the proposed Corps of Engineers dams will furnish a minimum continuous 600 cfs flow at Lillington; consequently the 600 cfs river flow requirement will be met or exceeded 100 percent of the time (except in years of severe drought).

Part of the makeup water for two unit operation is supplied by creek inflow and direct rainfall on the reservoirs, and the remainder by withdrawal from the Cape Fear River. The withdrawal requirement is greater in years of drought, and the restrictions on pumping result in less water being available for makeup. Five historical drought periods, a drought having a return period of 100 years, and an average year were analyzed for makeup requirements and for the quantity available for withdrawal from the Cape Fear River at Buckhorn Dam. These analyses were based on four unit forced evaporative losses and are, therefore, conservative for two unit operation.

One historical drought period and a drought having a return period of 100 years were analyzed for one unit operation without makeup from the Cape Fear River. To determine the minimum reservoir levels for one-unit operation under the drought conditions, it is conservatively assumed in these analyses that the starting level of the Main Reservoir is 216.3 ft msl which is the minimum reservoir level derived in Section 2.4.2.3.2.3 for a 7-year normal condition simulation. The analyses are shown on Tables 2.4.2-31 and 2.4.2-32 and the minimum levels reached are 211.0 ft. msl and 209.4 ft msl, for the 100 year and 1980-1981 droughts, respectively. These reservoir levels are well above the established shutdown level of 205.7 ft msl

The drought periods were analyzed by using maximized evaporation rates (Tables 2.4.2-11 through 2.4.2-16 and Tables 2.4.2-29 through 2.4.2-32). In addition, it was conservatively assumed that B. Everett Jordan (New Hope) Reservoir would be too depleted during the drought periods to supplement the natural flows of the Cape Fear River; a complete description of these analyses is in FSAR Section 2.4.11.

To represent the average year for four unit operation, the required withdrawal (Table 2.4.2-17) for the May 1941 - April 1942 period, determined by using average evaporation rates (Table 2.4.2-13), was used along with the historical flows for the calendar year 1974, in which the Cape Fear River flow was nearly equal to the historical average. This is actually a conservative representation of the average year, since creek inflow and rainfall contributions were below average for the 1941-1942 period.

The results of the above analyses, which are conservative for 2 unit operation, are presented in Table 2.4.2-18 as the percentage of available flow and total flow which the makeup requirements constitute. The amount "Available for Pumping" is the maximum withdrawal permitted under the 600 cfs and 25 percent restrictions. The required withdrawal during a 100-year drought for four unit operation was only 58.2 percent of the permitted withdrawal and only 10 percent of the total flow of the Cape Fear River for the year. In an average year, only 4.1 percent of the available flow, or 1 percent of the total flow, would have been required for makeup. Thus, it is concluded that even during extreme drought conditions, withdrawal of makeup water would be well within the restrictions, and would constitute only a small fraction of the flow of the Cape Fear River.

2.4.2.3.2.1 Accidental Spills

Any accidental liquid releases into the Main Reservoir would be diluted by the Main Reservoir, Buckhorn Creek, and the Cape Fear River before reaching Lillington, the location of the closest downstream surface water user. For a Main Reservoir normal level of Elevation 220 ft. msl., an Auxiliary Reservoir normal water level of Elevation 252 ft. msl., and assuming an overall 80 percent mixing efficiency, the dilution capacity is 61,400 ac. ft.

Releases from the Main Reservoir are further diluted by the Cape Fear River, which has an average flow of 3116 cfs in the vicinity of its confluence with Buckhorn Creek, compared to an average annual release from the reservoir of 43 cfs or 48 cfs for one or two unit operation, respectively. Consequently, the concentration of inadvertent releases from the Main Reservoir at points downstream of the project on the Cape Fear River is greatly reduced by the dilution capacity of the Reservoir-Cape Fear River system.

Under conditions of severe drought, where the dilution capacity of the Main Reservoir is reduced due to lower water levels, essentially no release will be made to the Cape Fear River. Thus, surface water sources downstream of the project are not subject to contamination during drought conditions.

2.4.2.3.2.2 Reservoir Water Level Fluctuation

2.4.2.3.2.2.1 Reservoir Water Level Fluctuation (Original Four Unit Case)

4 NOTE: The results of analyses utilizing four unit forced evaporation rates have been referenced as conservative evaluations of two unit operation in Section 2.4. Therefore, the following study of reservoir water level fluctuation for four unit operation has been retained in the text for comparative purposes.

4 Sources contributing to the Main Reservoir inflow for four unit operation with Cape Fear River makeup include direct Buckhorn Creek streamflow, pumped makeup water from the Cape Fear River at Buckhorn Dam, and overflow from the Auxiliary Reservoir. An additional contribution to the net volume derives from direct rainfall. Cooling tower evaporation, natural evaporation, and pumped makeup water from the Main Reservoir to the Auxiliary Reservoir account for the primary losses from the Main Reservoir storage.

To evaluate the fluctuation of inflow and outflow rates, as well as the net storage volume (or reservoir stage), a four-year reservoir operation study for four unit operation was conducted for the Main Reservoir during the period 1973 through 1977. Average streamflow of both Buckhorn Creek and the Cape Fear River during the period are reasonably close to the long-term annual averages. They are as follows: 4

	Average Streamflows (cfs)	
Water Year Periods	Buckhorn Creek at Corinth, NC	Cape Fear River at Lillington, NC
1973 through 1977	79	3815
1924 through 1978	82	3364

Although the Cape Fear River flow is above average during this period (due to a few very high monthly flows), Buckhorn Creek flow is slightly below the estimated long term average flow. Since Buckhorn Creek is the greater contributor during average conditions, and since very high monthly flows in the Cape Fear River do not influence operation due to the limited pumping capacity of the river makeup system, a study using this period (1973-1977) should generally reflect normal operating conditions. The inflow computation was carried out by using the following equation:

Inflow = Buckhorn Creek Streamflow Discharging Directly to the Main Reservoir
+ Makeup Water from Cape Fear River
+ Outflow from the Auxiliary Reservoir

The outflow and inflow are related through a continuity formula:

Outflow = Inflow + Direct Rainfall-Losses
- Changes in Reservoir Storage
where Losses = Forced and Natural Evaporation + Percolation

Both the outflow rate and the changes in reservoir storage are simultaneoously evaluated when the spillway stage-discharge relationship and the reservoir stage-area-capacity relationship are imposed on the above formula. The normal operating level of Elevation 220 ft. msl was used as the starting water level.

Figures 2.4.2-9 through 2.4.2-11 show the duration curves for inflow rate, outflow rate, and reservoir stage for the Main Reservoir assuming four unit operation. Average rates of natural and forced evaporation, as well as the rate of percolation loss used in this study, are shown in Table 2.4.2-19 for various months of the year. They are derived based on data shown in Table 2.4.2-20 and the reservoir water surface areas. On-site gaging records have been utilized for direct rainfall data.

In computing the volume of makeup water from the Cape Fear River, the maximum pumping capacity of 300 cfs is assumed with the restriction imposed by the North Carolina Division of Environmental Management that net withdrawals should not exceed 25 percent of river flow and that net withdrawals will not reduce the Cape Fear River streamflow at Lillington, North Carolina to less than 600 cfs. The computed range of fluctuation in reservoir levels for four unit operation is only 7.3 ft., with minimum and maximum levels, respectively, at Elevations 214.7 ft. msl and 222 ft. msl, in spite of the relatively low discharge capacity of the spillway. The mean inflow and outflow rates are 120 and 35 cfs, respectively.

A similar study as carried out for the Auxiliary Reservoir for four unit operation. Here the inflow only involves streamflow from the upstream drainage area of the Auxiliary Reservoir and makeup water from the Main Reservoir. There is no forced evaporation during normal operation. The results of this study are shown on Figures 2.4.2-12 through 2.4.2-14 for the Auxiliary Reservoir. Rates of evaporation and percolation losses are listed in Table 2.4.2-19. Due to a large surface area, which is about 20 percent of the tributary watershed area, and a relatively long discharge spillway crest (170 ft.) which passes floods quickly with only slight damping, the Auxiliary Reservoir level generally stays between Elevations 250 ft. msl and 252.5 ft. msl, with a 2.5 ft. of expected range of fluctuation during normal operation at the normal operating level of 252 ft. msl. The mean inflow and outflow rates are 2 and 1 cfs, respectively. 4

2.4.2.3.2.2.2 Reservoir Water Level Fluctuation for Two Unit Operation

For two unit operation, sources contributing to the Main Reservoir inflow include direct Buckhorn Creek streamflow, pumped make-up water from the Cape Fear River at Buckhorn Dam, and overflow from the Auxiliary Reservoir. An additional contribution to the net volume derives from direct rainfall. Cooling tower evaporation, natural evaporation, and pumped makeup water from the Main Reservoir to the Auxiliary Reservoir account for the primary losses from the Main Reservoir storage. 4

To evaluate the fluctuation of inflow and outflow rates, as well as the net storage volume (or reservoir stage), a seven-year reservoir operation study was conducted for the Main Reservoir during the period October, 1973 through September, 1980. Average streamflow of both Buckhorn Creek and the Cape Fear River during the period are reasonably close to the long-term annual averages. They are as follows:

	Average Streamflows (cfs)	
Water Year Periods	Buckhorn Creek at Corinth, N.C.	Cape Fear River at Lillington, N.C.
October, 1973 through September, 1980	79	3733
1924 through 1981	81	3354

Although the Cape Fear River flow is above average during this period (due to a few very high monthly flows), Buckhorn Creek flow is slightly below the estimated long term average flow. Since Buckhorn Creek is the greater contributor during average conditions, and since very high monthly flows in the Cape Fear River do not influence operation due to the limited pumping capacity of the river makeup system, a study using this period (1973-1980) should generally reflect normal operating conditions. The inflow computation was carried out by using the following equation:

Inflow = Buckhorn Creek Streamflow Discharging Directly to the Main Reservoir
+ Makeup Water from Cape Fear River
+ Outflow from the Auxiliary Reservoir

4

The outflow and inflow are related through a continuity formula:

Outflow = Inflow + Direct Rainfall-Losses
- Makeup Pumping to Auxiliary Reservoir
- Changes in Reservoir Storage
where Losses = Forced and Natural Evaporation + Percolation

Both the outflow rate and the changes in reservoir storage are simultaneously evaluated when the spillway stage-discharge relationship and the reservoir stage-area-capacity relationship are imposed on the above formula. The normal operating level of Elevation 220 ft. msl was used as the starting water level.

Figures 2.4.2-9a through 2.4.2-11a show the duration curves for inflow rate, outflow rate, and reservoir stage for the Main Reservoir for two unit operation averaging 75 percent power over one year. Normal rates of natural and forced evaporation, based on data shown in Table 2.4.2-20, are shown in Table 2.4.2-19a for various months of the year. The rate of percolation loss used in this study is also shown in Table 2.4.2-19a. Onsite gaging records have been utilized for direct rainfall data.

In computing the volume of makeup water from the Cape Fear River, the maximum pumping capacity of 300 cfs is assumed with the restriction imposed by the North Carolina Division of Environmental Management that net withdrawals should not exceed 25 percent of river flow and that net withdrawals will not reduce the Cape Fear River streamflow at Lillington, North Carolina to less than 600 cfs. The computed range of fluctuation in reservoir levels is only 4.3 ft., with minimum and maximum levels respectively at Elevations 217.7 ft. msl and 221.9 ft. msl, in spite of the relatively low discharge capacity of the spillway. The mean inflow and outflow rates are 90 and 48 cfs, respectively. The reservoir experiences discharges for 54 percent of the time. The average duration of discharge events is 24 days while that of no-discharge events is 20 days. The longest period the reservoir experiences no discharge is 186 days. The discharge has been assumed to occur only as flows over the spillway without using the low level release system.

A similar study was carried out for the Auxiliary Reservoir. Here the inflow only involves streamflow from the upstream drainage area of the Auxiliary Reservoir and makeup water from the Main Reservoir. There is no forced evaporation during normal operation. The results of this study are shown on Figures 2.4.2-12a through 2.4.2-14a for the Auxiliary Reservoir. Rates of evaporation losses are listed in Table 2.4.2-19a. Due to a large surface area, which is about 20 percent of the tributary watershed area, and a relatively long discharge spillway crest (170 ft.) which passes floods quickly with only slight damping, the Auxiliary Reservoir level generally stays between Elevations 250 ft. msl and 252.5 ft. msl, with a 2.5 ft. of expected range of fluctuation during normal operation at the normal operating level of Elevation 252 ft. msl. The mean inflow and outflow rates are 2 and 1.7 cfs, respectively.

A schematic indicating the elements and their directions involved in the computation of inflows and outflows for the Main and Auxiliary Reservoirs for two unit operation is on Figure 2.4.2-15. 4

2.4.2.3.2.2.3 Reservoir Water Level Fluctuation for One Unit Operation

For one unit operation, sources contributing to the Main Reservoir inflow include direct Buckhorn Creek streamflow and overflow from the Auxiliary Reservoir. An additional contribution to the net volume derives from direct rainfall. Cooling tower evaporation, natural evaporation, and pumped makeup water from the Main Reservoir to the Auxiliary Reservoir account for the primary losses from the Main Reservoir storage.

To evaluate the fluctuation of inflow and outflow rates, as well as the net storage volume (or reservoir stage), a seven-year reservoir operation study was conducted for the Main Reservoir during the period 1973 through 1980. Average streamflow of Buckhorn Creek during the period are reasonably close to the long-term annual averages. They are as follows:

Average Streamflow
(cfs)

Water Year Periods	Buckhorn Creek at Corinth, N.C.
1973 through 1980	79
1924 through 1981	81

Since Buckhorn Creek flow is slightly below the estimated long term average flow, a study using this period (1973-1980) should conservatively reflect normal operating conditions. The inflow computation was carried out by using the following equation:

Inflow = Buckhorn Creek Streamflow Discharging Directly to the Main Reservoir
+ Outflow from the Auxiliary Reservoir

The outflow and inflow are related through a continuity formula:

Outflow = Inflow + Direct Rainfall-Losses
- Makeup Pumping to Auxiliary Reservoir
- Changes in Reservoir Storage
where Losses = Forced and Natural Evaporation + Percolation

Both the outflow rate and the changes in reservoir storage are simultaneously evaluated when the spillway stage-discharge relationship and the reservoir stage-area-capacity relationship are imposed on the above formula. The normal operating level of Elevation 220 ft. msl was used as the starting water level. 4

Figures 2.4.2-9b, 2.4.2-10b, 2.4.2-10c, and 2.4.2-11b show the duration curves for inflow rate, outflow rate, and reservoir stage for the Main Reservoir for one unit operation averaging 75 percent power over one year. Normal rates of natural and forced evaporation based on data shown in Table 2.4.2-20 are shown in Table 2.4.2-19a for various months of the year. The rate of percolation loss used in the study is also shown on Table 2.4.2-19a. Onsite gaging records have been utilized for direct rainfall data.

The computed range of fluctuation in reservoir levels is only 5.5 ft., with minimum and maximum levels respectively at Elevations 216.3 ft. msl and 221.8 ft. msl, in spite of the relatively low discharge capacity of the spillway. The mean reservoir level is 219.4 ft msl. The mean inflow and outflow rates are 67.6 and 43 cfs, respectively. The 100 year drought monthly releases (based on a starting level of 216.3 ft. msl) and the monthly average releases computed in the normal operation study are listed on Table 2.4.2-33.

Operation of the Auxiliary Reservoir does not differ from the two unit case discussed in Section 2.4.2.3.2.2.2. 4

A schematic indicating the elements and their directions involved in the computation of inflows and outflows for the Main and Auxiliary Reservoirs for one unit operation is on Figure 2.4.2-15.

2.4.2.3.2.3 Reservoir Currents

Factors which may be involved in producing nontidal currents in the Main Reservoir are (1) wind stress, (2) flow-through of Buckhorn Creek runoff, and (3) rotation of the earth. Due to the size of the reservoir cross sections, the currents created by stream flow-through are generally negligible, except during very high floods. Such floods do not occur frequently enough to have a controlling influence on the surface water environment; therefore, they are not considered here. The modification of current patterns caused by the rotation of the earth is insignificant in a reservoir of this small size. The Main Reservoir currents are thus primarily induced by wind stress.

The current patterns of the Main Reservoir were studied theoretically by considering wind stress, wind direction, and reservoir bottom and shoreline configurations. Based on conservation of momentum and mass (Reference 2.4.2-5), current patterns were generated depending on direction and speed of wind. The joint frequency of wind direction and speed used here is based upon on-site meteorological data collected during the period January 14, 1976 to December 31, 1978 (Section 2.3). The computation was carried out for winds from the eight major compass points, 45 degrees apart. The winds were assumed to be uniform over the entire reservoir. Figures 2.4.2-16 through 2.4.2-23 present the computed current patterns and their frequencies of occurrence for the principal region of the Main Reservoir.

The meteorological observations (Section 2.3) indicate a predominantly bimodal tendency toward northeast and southwest in the diurnal distribution of wind directions. Consequently, the current patterns resulting from winds in these two general directions should be more common than from the others.

The computational procedures follow closely those described in Reference 2.4.2-5, in which an iterative finite-difference scheme is used to solve the following governing equation for stream functions for any given wind field over the surface of the Main Reservoir:

$$\frac{\partial}{\partial Y} \; \frac{1}{H} \quad \frac{T_{sx}}{\sigma} + \frac{k\partial\Psi}{H\partial Y} \quad - \quad \frac{\partial}{\partial X} \; \frac{1}{H} \quad - \frac{K}{H}\frac{\partial\Psi}{\partial X} + \frac{T_{sy}}{\sigma} = 0 \qquad (1)$$

in which H = water depth

K = coefficient of bottom friction. A value of 0.0025 is used here (Reference 2.4.2-5)

T_{sx}, T_{sy} = X and Y components of wind stress

Ψ = stream function

σ = density of water

$\frac{\partial}{\partial X}$ = partial derivative with respect to X

$\frac{\partial}{\partial Y}$ = partial derivative with respect to Y

The wind stress is computed by the following formulae: (Reference 2.4.2-5)

$$T_{sx}/\sigma = 1.1 \times 10^{-6} W^2 \cos \alpha$$

$$T_{sy}/\sigma = 1.1 \times 10^{-6} W^2 \sin \alpha$$

where: W = wind speed

α = angle of wind direction

The current velocity is computed from stream functions as follows:

X - component of current velocity $= U = \frac{-1}{H} \frac{\partial \psi}{\partial Y}$

Y - component of current velocity $= V = \frac{1}{H} \frac{\partial \psi}{\partial X}$

The current speed and direction in terms of angle counterclockwise from the east direction are, respectively,

$$W = \sqrt{U^2 + V^2}$$

and

$$\Theta = \mathrm{TAN}^{-1} \frac{V}{U}$$

Due to its small size, wind induced currents in the Auxiliary Reservoir will be insignificant.

2.4.2.3.2.4 Reservoir Temperatures

Seasonal surface water temperature variation of the reservoirs was analyzed according to typical energy balance methods; the analysis used the meteorological data shown in Table 2.4.2-20. By taking into account the conservation of energy, the major heat transfer mechanisms between the reservoirs and the atmosphere were developed to calculate natural equilibrium temperatures. The major heating processes include solar and atmospheric radiation, and the significant cooling processes include reflected radiation, emitted radiation, conduction, and evaporation. Streamflow through the reservoirs and Cape Fear River makeup water are not significant in the annual energy budget. Since cooling tower blowdown is from the cold water basin, it does not have a significant effect outside of the designated mixing zone.

Calculated natural equilibrium temperatures for the reservoirs range from approximately 39 F in the winter to approximately 82 F in the summer. Monthly temperatures are shown in Table 2.4.2-20. Monthly cooling tower blowdown temperatures are shown in Table 5.1.2-1.

2.4.2.3.2.5 Reservoir Morphometry

The Main Reservoir has a surface area of approximately 6.5 sq. mi. and an overall shoreline length of about 40 miles at the normal operating level of Elevation 220 ft. msl. Since the reservoir is formed by backwater inundation into downstream reaches of several tributary streams, its overall shape is dendritic. The reservoir is generally narrow with a slightly wider region at the main trunk area. The width varies between approximately 1000 and 4000 ft. There are seven major branches with lengths ranging from 1 to 4 mi.

The reservoir bottom is relatively flat at the main trunk area with elevations varying from 175 ft. msl at the downstream (south shore) end to 195 ft. msl at the upstream (north shore) region. The northern portion of the main trunk has a nearly constant depth of about 35 ft. and a steep shoreline on the east side. The depth, however, becomes variable toward the west shore, where the bottom slope is approximately 1 in 40. The southern portion of the main trunk is flat, with an average depth of about 45 ft. Bottom contours as well as shoreline configuration are shown on Figure 2.4.2-24.

At the normal operation level of Elevation 252 ft. msl, the surface area of the Auxiliary Reservoir is approximately 0.55 sq. mi. and the average depth is about 20 ft. There are about seven miles of shoreline. The reservoir consists of three branches, each roughly one mile in length and 1000 ft. in width. The bottom cross sections are generally V-shaped, sloping on the order of 1 in 15 toward the shores. Bottom contours and shoreline configuration are shown on Figure 2.4.2-24.

2.4.2.3.2.6 Reservoir Sedimentation

To estimate the effect of sedimentation on the Main Reservoir bottom and shoreline configuration, the following sediment rating formula was deduced from the sediment sampling data of Buckhorn Creek near Corinth, North Carolina (D.A. = 74.2 sq. miles) (Reference 2.4.2-6) by a regression analysis:

$$ISD = 0.0104\ IQ^{1.56}$$

in which IQ = instantaneous streamflow rate in cfs
and ISD = instantaneous sediment discharge in ton/day

The sediment discharge sampling record used is summarized in Table 2.4.2-28. This record consists of seventeen data points. The instantaneous streamflow rates associated with these samplings range from 1.1 to 4410 cfs. The seasonal distributions of these data points are six in winter, three in spring, five in summer, and three in fall. On Figure 2.4.2-41, these data points are shown with the rating curve representing the above formula. The parameters associated with the regression analysis are $r = 0.987$ and $S = 0.301$ in which r is the correlation coefficient and S is the standard error of estimate. 4

The above formula which relates instantaneous streamflow rates and sediment loads is then converted to a formula relating daily streamflows and daily sediment discharges by introducing a factor, IQP/Q, to account for the diurnal variations of streamflow:

$$SD = [(IQP/Q)^{0.56}]\ [0.0104\ Q^{1.56}]$$

in which IQP = instantaneous daily peak flow in cfs
SD = daily sediment load in tons/day
and Q = daily streamflow in cfs.

Conservatively, a constant value of $IQP/Q = 2.21$ is used. This value represents the maximum ratio in the 1972 to 1977 streamflow record (Reference 2.4.2-6) and occurs during the flood of February 2, 1973 having a peak discharge of 6920 cfs, while the corresponding daily streamflow is 3130 cfs. The above formula then becomes:

$$SD = [(2.21)^{0.56}]\ [(0.0104)\ Q^{1.56}]$$

$$= 0.0163\ Q^{1.56}$$

To estimate the total sediment load for the plant life of forty years, synthetic daily streamflow of Buckhorn Creek near Corinth, North Carolina, for the period were generated by employing two computing programs from the U.S. Army Corps of Engineers Hydrologic Engineering Center: Monthly Streamflow Simulation (HEC-4, Ref. 2.4.2-7) and Daily Streamflow Simulation. Five years (1972-77) of daily streamflow records of Buckhorn Creek near Corinth, North Carolina and thirty-eight years (1940-77) of monthly streamflow records of Middle Creek at Clayton, North Carolina (Section 2.4.2.3.1) were utilized as the inputs for the computer programs.

By assuming 100 percent sediment trap efficiency for the Main Reservoir, the total volume of sediment deposit from Buckhorn Creek is estimated to be about 460 ac. ft., accumulated over forty years of plant life. However, when Unit 2 operation necessitates pumping make-up water from the Cape Fear River, additional sediment will be added to the Main Reservoir. Conservatively 5 assuming the pumped-up sediment volume previously determined for four unit operation for forty years, this pumping is estimated to add 100 ac. ft. of sediment. The possible range of sediment accumulation (460 ac. ft. to 560 ac. ft.) represents only 0.7 to 0.8 percent of the Main Reservoir capacity at normal operating level and any noticeable effect of sediment on the shorelines and bottom configuration will be localized.

By assuming that the quantity of sediment loads is proportional to the drainage area, the total volume of deposit in the Auxiliary Reservoir for the length of the plant life is estimated to be 460 x 2.43/74.2 = 20 ac.ft., which is equivalent to 0.4 percent of the reservoir capacity at the normal operating level. The overall effect on the bottom and shoreline configuration is negligible. Sediment that is pumped up to the Auxiliary Reservoir from the 5 Main Reservoir is insignificant since the Main Reservoir serves as a sedimentation basin.

The sediment size distribution was estimated based upon regional data (Reference 2.4.2-6) to be 60 percent clay (finer than 0.004 mm), 35 percent silt (0.004 - 0.062 mm), and 5 percent sand (0.062 - 2.0 mm).

Since the total deposition of sediment in the reservoirs expected over the life of the plant is only 0.7 percent of the volume of the Main Reservoir and 0.4 percent of the volume of the Auxiliary Reservoir, it is not considered significant. Erosion of the plant island will be prevented by planting vegetation, paving, and control of storm runoff by catch basins and storm drains.

The operational program for monitoring sediment buildup in the emergency service water system (ESWS) canals and in the Auxiliary Reservoir is summarized as follows. Shearon Harris Nuclear Power Plant complies with NRC Regulatory Guide 1.127. Guidance in Sections C.2.d.(2) and C.2.d.(1), which discuss inspections for excessive sedimentation and changes leading to excessive sedimentation, and inspections of cooling water channels, is included in an on-site inspection program. Significant changes in the reservoir and channel profiles as a result of sedimentation will be evaluated with respect to hydraulic and hydrologic capacity at that time. Also, design and construction of the ESWS reservoir and channels were undertaken assuming that four nuclear power units would be constructed at this site. This results in conservative water capacity features for the two units presently planned.

2.4.2.3.2.7 Reservoir Operation

The safety-related cooling water canals (channels), reservoirs, and water control structures within the SHNPP reservoir system consist of the Main Reservoir and Dam, Auxiliary Reservoir and Dam, Auxiliary Reservoir Separating Dike, Auxiliary Reservoir Channel, Emergency Service Water Intake and Discharge Channels, and Cooling Tower Makeup Intake Channel. The design bases and operating modes of the reservoir system, as well as potential blockage of channels, are described in relation to the safety-related Emergency Service Water System, Ultimate Heat Sink, and the Cooling Tower Makeup System in FSAR Sections 2.4.11, 9.2.1, 9.2.5, and 10.4.5. Channel plans and sections are shown on Figures 2.4.2-25, 2.4.2-26, and 2.4.2-27. The size of the channels is sufficient to pass the required service water flow at a maximum velocity of two feet per second under the conditions of maximum Auxiliary Reservoir drawdown, indicated in Table 2.4.2-21, and maximum Main Reservoir drawdown during the 100-year drought, indicated in FSAR Section 2.4.11.

The SHNPP reservoir system constitutes the only water bodies that are of concern regarding protection of plant facilities from flood and wave runup; a discussion of the protection of channels and reservoirs is contained in Section 2.4.2.4.

The effects of failure of the Auxiliary Reservoir Separating Dike are discussed in FSAR Section 2.4.4. Uncontrolled spillways at both dams are designed to provide release of flood waters such that the reservoir water levels will not exceed the design bases of the dams (Section 2.4.2.3.4).

A low level release system incorporated into the Main Dam spillway can be utilized to release water from the main reservoir into the Buckhorn Creek. It consists of three (3) Howell Bunger valves located in the control pier and side abutments of the spillway. The valves have intakes in the reservoir at different elevations and locations. The arrangement is shown in FSAR Figures 2.5.6-1, 3.8.4-34, and 3.8.4-36 and the discharge capacity curves are shown in Figure 2.4.2-42. 5

The Howell Bunger valve in the central pier is a 24-inch valve with center line at El. 206.7 ft. A 36-inch diameter steel pipe with intake at El. 195.0 ft. in the reservoir conveys water to the valve. The valves in the two abutments of the spillway are 36-inch valves with center lines at El. 213.0 ft. The intake for the West abutment valve is in the abutment at El. 213.0 ft, whereas the East abutment has its intake inside the reservoir at El. 180.0 ft, connected to the valve by a 48-inch diameter steel pipe.

Ice formation in this locality is not expected to be severe enough under any circumstances to jeopardize the operation of the Cooling Tower Makeup Water System or the Emergency Service Water System. During conditions when the Auxiliary Reservoir water temperature falls below 35 F, the emergency service water pumps will be started. Heated water from the pump operation will be discharged into the Emergency Service Water Discharge Channel and the flow of water in the intake canal will prevent the formation of any ice. The plant will be shut down and cooled down if ice formation in either intake channel would jeopardize the emergency service water supply. A full discussion of ice effects is contained in FSAR Section 2.4.7.

In summary, the impact of the operation of SHNPP on the related water bodies will consist of a reduction of the discharge of Buckhorn Creek into the Cape Fear River, and the withdrawal for consumptive use of a maximum of 58.2 percent of the permitted amount, or 10 percent of the total flow of the Cape Fear River, in the 100-year drought. These percentages are conservatively based on the four unit case originally analyzed in FSAR Section 2.4. Any inadvertent liquid releases to the reservoir would be diluted by its large volume to acceptable levels; releases from the reservoir, which would not occur at all during low flow periods, would be further diluted by the large streamflow of the Cape Fear River.

Floods and sedimentation would have no adverse effects on the SHNPP or its operation. The reservoirs also provide adequate capacity for emergency cooling coincident with the 100-year drought.

2.4.2.3.3 Historical Floods on Buckhorn Creek

Before 1972, there were no flood records available for Buckhorn Creek. Records of flood flows since November 1939 are available for the Middle Creek Basin (Section 2.4.2.3.1). Based on the ratio of drainage areas of Middle Creek (80.7 sq. mi.) and Buckhorn Creek (79.5 sq. mi.), the corresponding maximum historical peak flows for Buckhorn Creek near its confluence with the Cape Fear River were determined and are listed in Tables 2.4.2-22 and 2.4.2-23 and the frequency analysis (Reference 2.4.2-4) of the data is shown on Figure 2.4.2-28. In Table 2.4.2-23, the recorded data after 1972 at the USGS gaging station on Buckhorn Creek near Corinth (D.A. = 74.2 sq. mi.) are also shown. The maximum flood flow of 6920 cfs occurred on February 2, 1973. This flow compares favorably with the calculated value of 7820 cfs. The calculated value is derived from recorded data of Middle Creek, and the record indicates that a dam failure occurred on Middle Creek in that flood.

A discussion of the floodplains adjoining the Cape Fear River, Buckhorn Creek and the SHNPP reservoirs is provided in Section 2.4.2.2.4.

2.4.2.3.4 Probable Maximum Flood (PMF)

The dams and spillways design flood is a probable maximum flood (PMF) on the respective drainage basins and reservoirs. The PMF has been defined as an estimate of the hypothetical flood characteristics that are considered to be the most severe "reasonably possible" at a particular location based on comprehensive hydrometeorological analysis of critical runoff-producing probable maximum precipitation (PMP) and hydrologic factors favorable for maximum flood runoff (Reference 2.4.2-8).

Using the above definition as a guide, the PMF's for the SHNPP were developed as follows:

a) The Buckhorn Creek drainage basin was first analyzed under its natural, pre-construction condition by using the HEC-1 computer program (Reference 2.4.2-9). A unit hydrograph was developed for the entire drainage basin based on the greatest flood of record for the history of the gage, February 2, 1973 (Tables 2.4.2-22 and 2.4.2-23); this is shown on Figure 2.4.2-29.

b) After construction of the Main Dam, the drainage basin above the dam is 71.0 sq. mi.; in order to have a detailed estimate of the PMF, the drainage basin was divided into nine sub-basins, two of which are located below the Main Dam site. Unit hydrographs were then developed for each sub-basin.

c) The PMP, the theoretically greatest precipitation over the applicable drainage area that would produce flood flows that have virtually no risk of being exceeded, was developed from the U.S. Weather Bureau's "Hydrometeorological Report No. 33" (Reference 2.4.2-10) and is shown in Table 2.4.2-24.

The PMP was applied to the unit hydrograph with the appropriate infiltration losses (Table 2.4.2-25) to develop the estimated flood hydrograph for each sub-basin, as well as for the entire drainage basin.

d) An antecedent precipitation, which has an intensity of 1/2 PMP, and the PMP were also applied to the unit hydrograph with appropriate infiltration losses to develop the estimated flood hydrograph for each sub-basin in order to have a more conservative estimate of the PMF still water level in the reservoir.

e) The total inflow into the Main Reservoir is the summation of the outflows from all of the sub-basins located above the Main Dam.

f) After obtaining the inflow hydrograph, the PMF was then routed through the Main Reservoir to estimate the PMF still water level in the reservoir.

The HEC-1 computer program (Reference 2.4.2-9) was used to determine the precipitation losses.

Figure 2.4.2-30 shows a map of the entire Buckhorn Creek drainage basin area, the sub-basin areas for the Auxiliary Reservoir and Main Reservoir, and the area between the Main Reservoir and just above its confluence with the Cape Fear River. As shown on Figure 2.4.2-30, the total inflow into the Auxiliary Reservoir is comprised of inflow from three areas.

Both the Main and Auxiliary Reservoirs have a spillway associated with each dam. The spillway at the Main Dam has a net crest length of 50 ft. with a pier at its mid-length, while the spillway at the Auxiliary Dam has a crest length of 170 ft. The rating curves for both spillways are shown on Figures 2.4.2-31 and 2.4.2-32. The capacity curves of both reservoirs are shown on Figures 2.4.2-7 and 2.4.2-8. The crest of the Main Dam Spillway is at Elevation 220 ft. msl and that of the Auxiliary Dam is at Elevation 252 ft. msl.

Application of the PMP, as shown in Table 2.4.2-25, to the unit hydrographs derived from the HEC-1 computer program results in the PMF for the entire Buckhorn Creek basin as well as for its sub-basins. The PMF hydrograph for Buckhorn Creek in its natural condition prior to construction of the reservoirs is shown on Figure 2.4.2-33. The peak flow is 52,000 cfs, which occurs about 29 hours from the beginning of the PMP. A separate and more severe local PMP was considered for the Auxiliary Reservoir. After obtaining the PMF hydrograph with a peak flow of 8340 cfs, the PMF was routed through the Auxiliary Reservoir, which reduced the peak flow to 5030 cfs, and resulted in an Auxiliary Reservoir water level of Elevation 256.0 ft. msl.

Figures 2.4.2-34 and 2.4.2-35 show the inflow flood hydrographs from overland flow and direct rainfall on the lake and residual land area, and the outflow hydrograph for both cases discussed above.

The instantaneous combined peak inflow to the Main Reservoir from all sources, indicated by Figure 2.4.2-36, would be about 161,710 cfs for the PMF, which includes release from the Auxiliary Reservoir. This combined peak would occur about 11 hours after the start of the storm. The combined inflow hydrograph was routed through the reservoir and an outflow hydrograph was developed with a peak flow of 11,030 cfs, and a resulting water level at Elevation 236.2 ft. msl.

An analysis was also made of the PMF approaching the Main Reservoir by assuming conservatively that the PMF were to begin five days after the start of a less severe storm, such as the standard project flood resulting from 1/2 PMP. For this assumed antecedent condition, the peak outflow is 14,190 cfs and the water level elevation in the Main Reservoir is 238.9 ft. msl, peaking about 33 hours after the start of the PMP. Figure 2.4.2-37 shows the inflow and outflow hydrograph for the probable maximum flood following the standard project flood.

As indicated by a comparison of Figures 2.4.2-33 and 2.4.2-37, the project will afford some flood protection to the area downstream of the Main Dam during a major storm. For the PMF, the peak outflow is reduced from 52,000 cfs for the natural condition to 14,190 cfs after construction of the project.

The coincident wind wave activities were determined in accordance with the procedures and methods presented in the U.S. Army Corps of Engineers ETL 1110-2-221 (Reference 2.4.2-14) and the Shore Protection Manual (Reference 2.4.2-11). For this study, the first reference was used to determine the wave characteristics, while the second reference was employed in computing the wave runup. Since no long term wind records are available for the plant site, the maximum wind velocity charts in Reference 2.4.2-14 were utilized to determine the design wind velocity. The PMH wind speed was taken from FSAR Section 2.4.5.1.

The wind setup, wave height, and wave period are a function of the effective fetch length, wind speed, wind duration, and water depth. These values are shown in Tables 2.4.2-26 and 2.4.2-27 for various critical locations where the maximum wind runup occurs. Figure 2.4.2-38 provides the locations of various fetches used in computing the wind setup, wave height, and wave period.

The probable maximum water level elevation at the Main Dam is approximately 243.1 ft. msl due to the PMF in the Main Reservoir coincident with the wave activity. This maximum water level is 16.9 ft. below the top of the Main Dam, Elevation 260 ft. msl. The probable maximum water level elevation at the Auxiliary Dam is approximately 258.0 ft. msl. This maximum water level is 2.0 ft. below the top of the Auxiliary Dam.

The upstream faces of the Main Dam and the Auxiliary Dam are protected by riprap; the former has a slope of 1 (vertical) to 2 (horizontal) and the latter, a slope of 1 (vertical) to 2-1/2 (horizontal).

For a maximum PMF stillwater elevation of 256.0 ft. msl in the Auxiliary Reservoir, the maximum water level elevation at the plant island is estimated to be 257.7 ft. msl, 2.3 ft. below the plant grade.

On the plant island, the southerly fill portion of the emergency service water intake channel and the embankment faces of the plant island which face the Main Reservoir are protected by a sacrificial spoil fill.

A complete discussion of the methods and data used to determine the PMF is contained in FSAR Section 2.4.3.

The Probable Maximum Hurricane (PMH) could cause a water level change of the Main and Auxiliary Reservoirs. The resulting high water levels are considered in the project design. The PMH water levels would be less than those of the PMF coincident with wind activity. A complete discussion of Probable Maximum Surge Flooding is contained in FSAR Section 2.4.5.

U.S. Highway 1 (which crosses a finger of the Auxiliary Reservoir) and the access roadway to the site from U.S. Highway 1 are protected from flooding. The relocated Southern Railroad, Durham Line, railroad embankment is above all wave runup heights.

Wave amplification due to "harbor resonance" will not occur on either reservoir at the plant site because the wind fetch is approximately 100 times longer than the significant wave length.

As it is located approximately 140 miles inland, the SHNPP site is not subjected to tsunamis.

2.4.2.4 Flood Protection

The estimated values of the maximum probable still water level and the wave runup-wind setup values at the plant and reservoir safety-related structures due to a sustained 45 mph wind coincident with a PMF are listed in Tables 2.4.2-26 and 2.4.2-27. Figure 2.4.2-38 provides the locations for wind fetch computations.

As discussed in Section 2.4.2.3, the plant is generally protected from wind-generated waves by high ground from all quadrants. The facilities located on the plant island will not be subjected to flooding because the plant grade, at Elevation 260 ft. msl, is 2.2 ft. higher than the maximum water levels around the plant island. FSAR Sections 2.4.3, 2.4.4, and 2.4.5 discuss the maximum water elevations in the Main and Auxiliary Reservoirs and around the plant island, where most of the safety-related facilities are located. FSAR Section 2.4.2.3 discusses the water level on the plant island due to probable maximum precipitation.

The Emergency Service Water Screening Structure, the Emergency Service Water Discharge Structure, and the Emergency Service Water and Cooling Tower Makeup Intake Structure are designed such that their decks are above all calculated water levels. Since they extend down below normal water level, they are also designed to withstand forces that could be imparted under the worst postulated flood, wave, and wind conditions. Safety related facilities other than those located on the plant island are the Main Dam, Auxiliary Dam, Auxiliary Reservoir Separating Dike, and Auxiliary Reservoir Channel. The dams, dike, and channel are discussed in FSAR Sections 2.4.4, 2.4.8, and 2.5.6.

Figure 2.4.2-30 shows a map of the entire Buckhorn Creek drainage basin area at the plant site, and the area up to its confluence with the Cape Fear River. There are no existing water control structures in the drainage basin other than the Main Dam, Auxiliary Reservoir Separating Dike, and Auxiliary Dam which have been constructed specifically for the SHNPP. Failure of the Auxiliary Dam, Auxiliary Reservoir Separating Dike, or Main Dam would not result in any rise of water level above Elevation 258.6 ft. msl. There are no other dams in the basin; therefore, the plant site with its grade at Elevation 260 ft. msl will not be flooded by dam failure. Additional discussion is contained in FSAR Section 2.4.4.

2.4.2.5 Water Quality Characteristics of Surface Waters

Approximately 500 water samples from the Cape Fear River and the Buckhorn Creek watershed have been analyzed for a variety of chemical parameters. Results of all analyses are included in the "Shearon Harris Nuclear Power Plant Preconstruction Monitoring Report" (Reference 2.4.2-12) and the "Shearon Harris Nuclear Power Plant Annual Environmental Monitoring Report" (Reference 2.4.2-13). Water quality is considered typical of Piedmont rivers and streams of similar size. Waters are moderately soft with moderate nutrient concentrations, and the pH generally ranges from 6.0 to 8.0.

The Cape Fear River basin is characterized by fine-grained soils that result in a typically turbid appearance of the river after moderate precipitation. This turbidity is caused by the suspension of fine-grained soils, not by heavy amounts of silt. The Buckhorn Creek basin also has silty-clay soils; runoff results in a turbide appearance while the silt load is light to moderate.

The Main Dam was one of the earlier items of construction. While erosion control practices were employed in construction of the dams, there were moderate amounts of silt in Buckhorn Creek as a result of erosion of the dam sites during construction. Completion of the dam created a sediment basin that trapped most of the silt resulting from erosion of the remainder of the construction sites.

The silt load discharged to the Cape Fear River resulting from construction of the SHNPP was minimized by use of standard erosion and sediment control measures as required by the State of North Carolina. Controlled grading andclearing reduced erosion exposure. Only those areas needed immediately for construction were cleared; grading was limited to areas that could be handled by erosion control practices. In clearing the reservoir, the root-mat remained except in the area between the low water level and a zone just above normal water level. In this area, stumps were either cut flush with the ground or removed, and the area was rough graded.

Runoff from upland areas was prevented from crossing construction sites by bench terraces and diversion ditches. Downspouts were paved or vegetated when practicable. Brush plug dams, burlap fences, or log dams were used in ditches to trap sediment and reduce the silt load to the Buckhorn-White Oak Creek system and the Cape Fear River.

Areas outside the reservoir which involve grading or construction of embankments, spoil areas, ditches, and channels were stabilized by the reestablishment of a vegetative cover as soon as practicable. Mulch was used to protect these areas until the vegetation was established.

2.4.2.6 Effects of Unit 2 Construction on Hydrology

As stated in FSAR Section 2.4.13, the subsurface portions of Seismic Category I structures on the plant island are designed for hydrostatic loading with the water table at Elevation 251 feet msl. The post-construction water table elevation at the plant is not expected to recover above the 236-ft. to 240-ft. elevation because of the topographic and drainage alterations made during construction.

It has been noted that there has been no significant inflow of ground water into the plant excavation during the past or current construction operations. There are no hydrologic reasons to believe that these conditions will be significantly altered during the construction of Unit 2.

Because of the low permeability (0.2 gpd/ft^2 or less) of the soil and saprolite at the plant island, and the absence of intrusive dikes in the immediate area of construction, no hydrologic problems are anticipated with the open excavation at Unit 2 while Unit 1 is in operation. Surficial runoff into the pit will be essentially eliminated by grading to direct surface drainage away from the excavation. Any water that may accumulate in the excavation will be removed by a sump pump.

Additional excavation that may be needed in conjunction with the construction of Unit 2 will intercept groundwater movement toward Unit 1 and thereby, will retard the recovery of the water table around Unit 1.

TABLE 2.4.2-1

ESTIMATED MONTHLY AVERAGE FLOW IN CAPE FEAR RIVER AT BUCKHORN DAM IN CUBIC FEET PER SECOND*
DRAINAGE AREA = 3196 sq. mi.

WATER YEAR	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	MEAN FOR WATER YEAR
1924	-	-	-	3920	5083	4013	4424	3073	1539	4480	2390	4201	-
1925	4187	1309	2275	13612	3995	3048	1058	1598	503	570	446	308	2879
1926	142	492	693	2630	7483	4606	3886	511	678	1583	847	266	1950
1927	83	279	2043	1236	4043	5816	1794	699	1078	3252	2343	1006	1828
1928	3517	1148	6902	1246	3543	2547	7560	4104	2639	1808	5357	21327	5116
1929	2238	889	862	1305	6471	15366	4254	3876	3682	4233	2357	1014	3872
1930	12665	5271	4380	4263	4995	2243	1808	979	1530	988	376	154	3315
1931	94	368	1863	2399	1082	1991	5073	4867	754	1332	6829	526	2284
1932	181	209	2130	6686	3807	6278	2276	1358	2861	409	477	334	2256
1933	2955	3613	8681	4902	5221	2583	3150	973	494	309	1170	746	2897
1934	123	131	223	395	1188	4095	5698	1681	4829	2408	1520	4785	2247
1935	985	1887	5236	4217	3511	6245	7013	2806	751	1101	282	2809	3166
1936	298	1672	1803	13872	10817	8753	12748	814	2705	1996	2493	726	4881
1937	3482	989	5926	13695	6199	3680	5533	1912	925	1044	3604	2458	4121
1938	1431	1149	1169	2975	1489	2431	2944	1246	2882	6558	1287	722	2218
1939	322	1628	2912	3168	12999	7812	3173	2733	1120	2330	8086	992	3889
1940	467	596	1001	1993	6302	3716	3587	1479	1600	669	3544	587	2111
1941	155	3054	1680	2550	1821	3908	5281	649	1214	2857	423	344	2030
1942	110	99	578	528	3083	5412	1429	2349	2216	671	1894	1915	1714
1943	1207	1608	6688	7334	4096	6113	4632	1265	1983	6184	608	791	3376
1944	195	361	870	4999	7325	10445	7406	2203	471	3694	1556	1495	3418
1945	5944	1890	3040	3314	7649	3570	1971	1426	416	2866	1766	20083	4448
1946	1831	1091	7723	6991	9666	2554	2608	4745	2462	3681	3045	1028	3928
1947	1817	1990	1585	8976	1950	4278	3984	876	543	636	477	3028	2529
1948	1495	6382	1898	3735	12135	6239	5038	1738	1694	876	1426	473	3559
1949	1974	8531	7969	4876	5802	3266	3307	5013	945	2967	5514	2392	4473
1950	3066	4408	2096	2785	2325	3799	1399	4492	1416	4201	850	721	2640
1951	835	584	2025	1337	1880	2980	5471	856	1160	550	690	158	1538

TABLE 2.4.2-1 (continued)

ESTIMATED MONTHLY AVERAGE FLOW IN CAPE FEAR RIVER AT BUCKHORN DAM IN CUBIC FEET PER SECOND*
DRAINAGE AREA - 3196 SQ. MI.

WATER YEAR	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	MEAN FOR WATER YEAR
1952	107	328	3040	4096	5799	13946	3653	2253	919	475	2340	6112	3602
1953	561	3984	2409	7923	8965	8684	3695	1562	1568	485	236	487	3344
1954	152	162	1675	9842	2617	4603	3908	1770	641	346	259	139	2027
1955	4524	930	3002	1797	6284	3101	3482	910	444	1318	4349	4355	2878
1956	1919	945	623	639	6226	5373	3505	2097	1002	1908	618	1896	2212
1957	3242	1668	3636	1688	8917	6307	2823	1593	3283	1301	2084	1863	3162
1958	2203	7410	5178	7831	6066	5110	9193	7990	1184	1467	1007	277	4564
1959	642	501	2446	2879	5155	3221	9888	1598	1987	3522	1777	2703	3001
1960	6062	2832	3340	4743	15942	9415	8802	2656	924	990	1803	971	4841
1961	798	526	855	1517	9271	5802	6626	3355	1927	1124	2227	412	2790
1962	166	290	2395	9294	6265	6370	8086	891	3429	2032	808	548	3369
1963	459	4322	4077	4975	5532	9313	1649	1325	919	615	399	437	2824
1964	352	1929	2727	6299	7112	4734	5920	933	696	935	2083	3629	3091
1965	6980	1173	4756	2447	6983	8881	2617	1350	4129	8209	2162	866	4251
1966	1125	619	506	1920	8294	8108	1469	3295	1023	394	900	815	2339
1967	459	536	1071	1576	4931	1567	1110	1486	550	504	4067	810	1537
1968	366	409	4825	7009	1531	4304	1483	1492	1146	918	299	89	2004
1969	497	1374	1426	2454	5966	6943	3774	1136	2541	1144	2752	1796	2626
1970	1686	507	2177	1810	5501	4130	5088	2025	530	651	2489	349	2332
1971	513	2251	1499	5080	7728	6252	3582	4741	1084	676	2837	1153	3177
1972	8739	2699	2820	3800	7602	2425	3098	4819	4371	1204	1219	615	3626
1973	1633	5265	9721	5852	10121	8195	10622	2827	5629	3258	1490	401	5378
1974	249	291	2239	5945	6434	3163	3827	4491	1636	776	2110	3954	2902
1975	545	626	3746	11420	6424	12804	3824	2952	1710	11346	1155	4047	5066
1976	1885	2230	2576	5304	3504	2128	1331	1359	3353	460	274	205	2059
1977	1438	706	4593	4360	1586	7707	3472	650	433	235	357	2016	2309
1978	1890	1494	2792	14252	3779	7093	4787	9870	2282	1702	2053	773	4425
1979	386	560	2382	8827	10377	9847	5546	4161	3572	932	569	5588	4352
1980	1822	5837	1653	5934	3183	9392	3920	2182	1964	1253	302	342	3150
1981	493	764	762	700	4129	1498	1053	601	792	2327	1817	1490	1350

*Estimated values based on data from USGS records of the Cape Fear River at Lillington, N.C. by drainage area relationship.

TABLE 2.4.2-2

MINIMUM FLOW* OF THE CAPE FEAR RIVER AT BUCKHORN DAM

Water Year	Date Occurred	Daily Minimum Flow (cfs)
1925	Sept. 13, 1925	59
6	Oct. 9, 1925	72
7	Oct. 8, 1926	20
8	Oct. 3, 1927	111
9	Dec. 10, 11, 1928	39
1930	Sept. 30, 1930	60
1	Oct. 8, 1930	45
2	Aug. 30, 1932	45
3	Oct. 3, 1932, July 7, 1933	68
4	Nov. 13, 1933	63
5	Aug. 14, 1935	63
6	Oct. 23, 1935	84
7	June 28, 1937	198
8	Sept. 12, 1938	177
9	Oct. 17, 1938	74
1940	Aug. 2, 1940	136
1	Oct. 23, 1940	58
2	Oct. 27, 1941	34
3	Aug. 23, 1943	110
4	Oct. 12, 13, 18, 1943	75
5	July 2, 1945	119
6	Sept. 18, 1946	308
7	Aug. 7, 1947	120
8	Sept. 26, 1948	56
9	Aug. 15, 1949	115
1950	Sept. 30, 1950	150
1	Sept. 11, 1951	56
2	Oct. 22, 26, 28, 1951	51
3	Sept. 0, 21, 1953	57
4	Oct. 25, 1953, Sept. 13, 14, 1954	58
5	Oct. 14, 1954	10
6	Sept. 24, 1956	76
7	July 15, 1957	119
8	Sept. 29, 1958	96
9	Sept. 29, 1959	143
1960	Aug. 22, 1960	178
1	Sept. 27, 1961	164
2	Oct. 29, 1961	70
3	Oct. 21, 1962	89
4	Oct. 21, 1963	87
5	June 7, 1965	342
6	Sept. 11, 1966	260
7	Oct. 17, 1966	98
8	Sept. 30, 1968	59
9	Oct. 1, 1968	42
1970	Sept. 21, 1970	172
1	Oct. 12, 1970	152
2	Sept. 15, 1972	322
3	Sept. 26, 1973	235
4	Oct. 24, 1973	158
5	Sept. 6, 1975	342
6	Sept. 2, 1976	110
7	July 30, 1977	98
8	Oct. 1, 1977	181
9	Oct. 25, 1978	211
1980	Aug. 17, 1980	183
1	July 2, 1981	134

*Derived from data of USGS Gaging Station at Lillington by the drainage areas ratio relationship.

TABLE 2.4.2-3

TRIBUTARIES OF CAPE FEAR RIVER
BETWEEN RIVER MILES 123 AND 192

Location	River mile	Enters*	1945 Flood Stage (ft. msl)	Backwater Distance (mi.)	Stream Length (mi.)
Buckhorn Dam	192.1	--	170	--	-
Fall Cr.	191.4	R	166	1.05	7.5
Buckhorn Cr.	191.1	L	165	4.11	15.0
Parkers Cr.	190.2	L	163	1.24	5.9
Daniels Cr.	188.8	R	160	1.58	8.0
Cedar Cr.	187.0	R	157	1.50	5.0
Camels Cr.	185.9	R	154	1.95	7.2
Avents Cr.	185.2	L	153	1.38	9.3
Fish Cr.	182.8	R	149	1.36	4.4
Hector Cr.	182.1	L	146	2.55	10.3
Neills Cr.	179.2	L	140	2.83	12.8
Lillington gage	178.0	--	137	--	--
Poorhouse Cr.	176.4	R	134	1.05	3.4
Buies Cr.	174.1	L	130	1.78	7.8
Thorntons Cr.	172.3	L	127	1.94	
Upper Little R.	170.1	R	120	11.35	48.8
Juniper Cr.	169.4	L	118	1.50	3.3
Lower Little R.	164.1	R	114	17.00	61.9
Unnamed Stream	161.7	R	110	3.1	3.1
Unnamed Stream	160.9	L	109	1.60	3.4
Unnamed Stream	159.4	L	108	1.49	2.6
Unnamed Stream	154.8	R	104	3.2	3.4
Unnamed Stream	153.8	R	103	3.67	7.6
Unnamed Stream	153.7	L	103	3.3	3.3
Unnamed Stream	151.5	R	102	1.54	3.4
Carvers Cr.	149.7	R	100	2.46	6.7
Unnamed Stream	147.1	L	96	7.2	7.2
Cross Cr.	142.8	R	90	2.23	12.4
Locks Cr.	142.2	L	89	4.61	10.4
Rockfish Cr.	136.0	R	83	9.3	39.0
Locks Cr.	134.3	L	82	4.8	5.5
Cedar Cr.	131.2	L	79	1.8	5.6
Big Alligator Swamp	130.7	L	78	1.5	3.6
Murphy Swamp	130.0	R	78	3.2	5.3
Grays Cr.	127.0	R	76	2.3	8.6
Willis Cr.	124.0	L	74	1.8	5.5
Lock & Dam No. 3	123.0	-	72	--	--
Tarheel gage	123.0	-	72	--	--

* Facing downstream, enters Cape Fear River on right (R) or left (L).

TABLE 2.4.2-4

FLOW CHARACTERISTICS AT USGS GAGING STATIONS[f] 4
Cape Fear River Basin

Name	Drainage Area, (sq. mi.)	Average Discharge (cfs)	Average Runoff (in./yr.[a]	Maximum Discharge (cfs)	7-Day 10-yr Low Flow (cfs)
Deep River at Moncure	1410	1453	13.99	80,300	21
Haw River near Haywood	1700	1552	12.40	25,800[b]	50
Buckhorn Creek near Corinth	74.2	83.5	15.28	6,920	0.9[d]
Cape Fear River at Lillington	3440	3364	13.28	150,000[c]	78
Flat Creek near Inverness	7.65	13.2	23.43	394	--
Little River at Lindene	460	557	16.44	13,500	51
Cape Fear River near Tarheel	4810	4982	14.06	112,000	390

Gage Locations:

Deep River - 4.5 mi. upstream from confluence with Cape Fear
Haw River - 3.9 mi. upstream from confluence with Cape Fear
Buckhorn Creek - 3.4 mi. upstream from mouth
Lillington - River Mile 178
Flat Creek - 0.4 mi. upstream from mouth
Little River - 4.5 mi. upstream from mouth
Tarheel - At Lock and Dam No. 3, River Mile 123.

Notes:

a. Average precipitation is 46 to 48 in./yr. 4

b. Since 1965

c. Estimated from extended rating curve

d. Simulated (see text and Figure 2.4.2-6)

e. Discontinued after 1971 Water Year

f. Based on data available through 1978 4

TABLE 2.4.2-5

COMPREHENSIVE PLAN OF DEVELOPMENT Of WATER RESOURCES FOR THE CAPE FEAR RIVER BASIN

ITEM	UNITS	B. EVERETT JORDAN (NEW HOPE PROJECT)	RANDLEMAN PROJECT	HOWARD MILL PROJECT
Status		Final Construction Stage	Early Design Stage	Authorized
Drainage area above damsite	sq. mi.	1,690	169	639
Location of Dam		2.5 mi. north of Moncure, N.C. on Haw River	5 mi. north of Randleman, N.C. on Deep River	3 mi. below Randolph County Line on Deep River
Dam:				
Type	-	Earth and Rockfill	Rolled Earth	Concrete
Total Length	ft.	1,330	2,400	2,700
Height above stream bed	ft.	113	108	101
Storage Capacity	ac.-ft.	778,000	108,000	233,000
Spillway:				
Type	-	Uncontrolled Side Channel	Uncontrolled Rock Saddle	Gated Concrete
Length of crest	ft.	800	400	200
Number and size of gates	-	None	None	5-40 ft. x 36 ft.

TABLE 2.4.2-5 (Continued)

COMPREHENSIVE PLAN OF DEVELOPMENT Of WATER RESOURCES FOR THE CAPE FEAR RIVER BASIN

ITEM	UNITS	B. EVERETT JORDAN (NEW HOPE PROJECT)	RANDLEMAN PROJECT	HOWARD MILL PROJECT
Outlet Works:				
Type	-	Concrete conduits located in instructures of all dams		
Diameter of sluice	ft.	19	12.8	8

References:

1. Design Memorandum 2, New Hope Project, Cape Fear Basin, N.C., Corps of Engineers, 1967
2. Design Memorandum 2, Randleman Lake Project, Cape Fear Basin, N.C., Corps of Engineers, 1975
3. Design Memorandum 2, Howards Mill Lake Project, Deep River, N.C., Corps of Engineers, 1975

TABLE 2.4.2-7

MAXIMUM FLOOD FLOW OF THE CAPE FEAR RIVER AT BUCKHORN DAM

Water Year	Date Occurred	Momentary Maximum Flow (cfs)
1924	Sept. 30, 1924	48580
5	Jan. 12, 1925	42920
6	Jan. 19, 1926	24360
7	Mar. 7, 1927	30850
8	Sept. 20, 1929	78040
9	Mar. 1, 1929	62900
1930	Oct. 2, 1929	99410
1	Aug. 21, 1931	27130
2	Mar 7, 1932	47290
3	Oct. 18, 1932	27130
4	Apr. 10, 1934	37160
5	Dec. 2, 1934	38090
6	Apr. 7, 1936	68010
7	Jan. 29, 1937	32330
8	July 27, 1938	43670
9	Feb. 10, 1939	44130
1940	Feb. 8, 1940	29730
1	Nov. 15, 1940	29360
2	Feb. 18, 1942	28620
3	July 14, 1943	38000
4	Sept. 30, 1944	43200
5	Sept. 19, 1945	139370
6	Feb. 11, 1946	50540
7	Jan. 14, 1947	36790
8	Feb. 15, 1948	46360
9	Nov. 29, 1948	49610
1950	May 15, 1950	33910
1	Apr. 9, 1951	32330
2	Mar. 5, 1952	71630
3	Feb. 16, 1953	40970
4	Jan. 23, 1954	52490
5	Oct. 17, 1954	46360
6	Mar. 17, 1956	43200
7	Feb. 2, 1957	38840
8	Nov. 26, 1957	43200
9	Apr. 20, 1959	37160
1960	Apr. 6, 1960	44130
1	Mar. 22, 1961	33910
2	Jan. 7, 1962	52490
3	Mar. 7, 1963	39300
4	Apr. 9, 1964	39300
5	July 28, 1965	53420
6	Mar. 1, 1966	45900
7	Aug. 25, 1967	24530
8	Jan. 15, 1968	33910
9	Feb. 3, 1969	29080
1970	Feb. 18, 1970	34560
1	Mar. 4, 1971	38370
2	Oct. 25, 1971	40790
3	Feb. 3, 1973	49990
4	Jan. 29, 1974	21280
5	July 16, 1975	44130
6	Jan. 28, 1976	17750
7	Jan. 10, 1977	23230
8	Apr. 27, 1978	34190
9	Feb. 26, 1979	45246
1980	Mar. 22, 1980	25549
1	Feb. 12, 1981	19510

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NOTE: Maximum flood flow derived from data of USGS Gaging Station at Lillington by the drainage area ratio relationship.

TABLE 2.4.2-8

ESTIMATED MONTHLY AVERAGE FLOWS OF BUCKHORN CREEK IN CUBIC FEET PER SECOND*
(AVERAGE 1924 - 1981 = 87.2)
DRAINAGE AREA = 79.5 SQ. MI.

WATER YEAR	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	MEAN FOR WATER YEAR
1922				21.7	62.1								-
1923				92.6	97.5	129.0	96.5	74.9	42.4	89.6	43.3	39.4	-
1924	15.8	30.5	50.2	90.6	94.6	94.6	99.5	86.7	50.2	74.9	39.4	86.7	72.8
1925	48.3	33.5	74.9	135.9	88.7	82.7	57.1	59.1	18.4	18.4	20.7	8.3	53.8
1926	6.5	14.2	24.0	90.0	98.0	87.0	84.2	24.0	26.6	60.1	38.4	12.8	47.1
1927	3.9	26.6	93.6	51.2	98.5	97.5	49.3	34.5	55.2	88.7	65.0	33.5	68.9
1928	101.5	44.3	108.4	65.0	96.5	84.7	110.3	96.5	75.8	50.2	96.5	141.8	78.2
1929	55.2	32.5	33.5	39.4	114.3	115.2	97.5	85.7	81.8	82.7	46.3	24.6	81.6
1930	107.4	92.6	91.6	98.5	95.5	92.6	86.7	32.0	126.1	26.6	9.9	9.9	53.1
1931	6.9	11.8	41.4	70.9	49.3	56.1	124.1	157.6	37.4	136.9	25.0	58.1	85.9
1932	15.8	10.8	65.0	108.4	112.3	134.0	69.0	46.3	57.1	13.8	13.8	3.0	64.5
1933	16.7	53.2	146.8	157.6	163.5	91.6	122.1	36.4	10.3	11.2	24.0	15.2	70.7
1934	7.3	4.3	10.3	9.3	17.2	79.2	136.0	34.9	123.1	81.8	121.2	108.4	61.1
1935	28.6	49.3	212.8	172.4	96.5	137.9	141.8	95.5	25.6	82.7	16.7	104.4	86.5
1936	19.7	65.0	79.8	291.6	290.6	217.7	258.1	30.5	106.4	86.7	105.4	37.4	157.3
1937	109.3	119.2	235.4	273.8	262.0	152.7	230.5	68.0	37.4	85.7	115.2	75.8	117.6
1938	28.6	34.5	45.3	78.8	49.3	52.2	93.6	40.3	170.4	90.6	36.4	153.7	78.9
1939	41.4	44.3	94.6	108.4	285.7	225.6	96.5	71.9	61.1	252.2	208.8	80.8	123.5
1940	28.6	31.7	40.8	68.0	124.6	138.2	132.5	52.1	20.4	7.9	36.2	12.5	60.0
1941	5.7	18.1	30.6	46.5	45.3	100.8	150.6	20.4	18.1	253.7	31.7	10.2	61.1
1942	9.1	6.8	53.3	31.7	71.4	148.3	64.6	60.0	68.0	37.4	146.1	118.9	68.0
1943	111.0	74.8	124.6	246.9	151.7	141.6	96.3	35.1	111.0	202.7	26.1	36.2	113.2
1944	14.7	28.3	70.3	207.2	201.6	336.3	222.0	66.9	18.1	17.0	43.0	15.9	103.0
1945	117.8	48.7	118.9	90.6	165.3	124.6	66.9	39.6	12.5	26.0	186.8	320.5	109.8
1946	59.0	46.5	234.1	268.4	203.8	99.7	134.8	134.8	41.9	65.7	44.2	40.8	114.4
1947	74.8	78.1	70.3	155.1	64.6	88.4	93.0	41.9	32.8	21.5	14.7	71.4	66.9
1948	32.8	164.2	70.3	114.4	368.0	205.0	125.7	35.1	19.3	10.2	11.3	14.7	96.3
1949	54.4	168.7	208.4	139.3	185.7	103.0	76.0	216.3	96.3	89.5	329.5	94.0	147.2

TABLE 2.4.2-8 (continued)

ESTIMATED MONTHLY AVERAGE FLOWS OF BUCKHORN CREEK IN CUBIC FEET PER SECOND*
(AVERAGE 1924 - 1981 = 87.2)
DRAINAGE AREA = 79.5 SQ. MI.

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WATER YEAR	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	MEAN FOR WATER YEAR
1950	37.4	73.6	61.1	90.6	80.5	82.7	43.0	63.5	23.8	109.8	13.6	15.9	57.8
1951	27.2	26.0	55.5	49.9	54.4	72.5	90.6	24.9	10.2	11.3	13.6	3.4	39.6
1952	2.3	6.8	19.3	47.6	109.8	346.5	79.3	44.2	20.4	18.1	116.6	234.4	86.0
1953	35.1	113.2	80.5	193.6	243.5	115.5	139.3	49.9	38.5	17.0	11.3	5.7	94.0
1954	3.4	7.9	72.5	390.7	180.1	163.1	132.5	80.5	19.3	14.7	6.8	1.1	86.1
1955	15.9	19.3	52.1	61.2	115.5	88.4	78.2	14.7	10.2	26.0	130.2	479.0	86.1
1956	47.6	52.1	39.6	38.5	164.2	185.7	132.5	78.2	52.1	40.8	20.4	21.5	72.5
1957	91.8	116.6	122.3	70.3	135.9	178.9	77.0	79.3	177.8	22.7	45.3	47.6	97.5
1958	103.0	223.1	223.1	205.0	202.7	175.5	157.4	325.0	45.3	38.5	96.3	19.3	150.6
1959	66.9	48.7	101.7	109.8	167.6	155.1	314.8	61.1	85.0	129.1	77.0	174.4	123.4
1960	207.6	134.8	103.0	169.9	382.8	231.0	200.4	108.7	27.2	60.0	104.2	46.4	152.9
1961	55.5	32.8	53.2	72.5	266.1	168.7	166.5	132.5	47.6	31.7	62.3	14.7	89.5
1962	9.1	18.1	73.6	178.9	128.0	173.3	201.6	27.2	32.8	171.0	44.2	14.7	88.3
1963	13.6	207.2	104.2	168.7	172.1	220.8	73.6	53.2	28.3	17.0	17.0	15.9	90.6
1964	10.2	118.9	140.4	165.3	191.4	171.0	195.9	35.1	15.9	9.1	23.8	58.9	94.0
1965	268.4	55.8	168.7	89.5	166.5	199.3	83.8	61.1	160.8	465.4	183.4	31.7	158.5
1966	31.7	27.2	24.9	69.1	192.5	188.0	61.1	122.3	63.4	14.7	14.7	19.3	67.9
1967	15.9	22.6	40.8	61.1	130.2	71.3	39.6	34.0	123.4	40.8	228.7	63.4	72.5
1968	22.6	28.3	158.5	189.1	63.4	90.6	62.3	31.7	23.8	31.7	4.5	1.1	57.8
1969	11.3	35.1	40.8	55.5	138.2	185.7	71.3	27.2	35.1	19.3	152.9	39.6	66.8
1970	60.0	35.9	64.9	66.4	140.9	106.4	125.1	43.6	11.4	20.3	34.1	5.1	59.0
1971	10.7	41.2	36.2	159.6	226.6	230.5	104.4	15.3	14.4	21.0	34.1	14.7	80.0
1972	207.0	86.9	76.3	96.8	209.8	99.5	100.5	83.5	33.3	35.9	24.9	22.5	89.7
1973	47.8	173.4	230.2	174.4	443.3	175.4	236.4	76.2	158.6	41.2	17.4	8.6	147.8
1974	6.1	4.6	45.0	91.5	175.4	111.3	80.5	78.1	35.1	10.9	106.4	82.3	67.9
1975	20.3	28.6	95.2	269.9	236.4	265.0	93.8	37.5	17.0	185.2	16.4	28.7	107.4
1976	24.9	41.9	92.5	143.8	106.4	75.2	34.7	35.3	74.4	14.1	4.4	5.9	54.3
1977	33.4	30.7	128.1	122.2	57.4	207.0	76.8	22.1	9.1	1.8	9.3	42.2	61.4
1978	41.7	75.5	72.6	272.8	92.9	183.2	252.2	164.5	53.6	40.1	37.2	8.5	108.4
1979	13.9	23.9	54.0	141.0	218.0	173.0	129.0	158.0	90.1	25.9	15.9	122.0	96.1
1980	51.2	209.0	74.4	133.0	108.0	223.0	120.0	44.0	38.8	17.6	5.2	5.5	85.6
1981	18.9	20.5	40.0	34.1	123.0	44.4	24.1	11.2	6.0	4.4	27.7	9.5	29.7

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*Estimated values based on data from USGS records of Deep River, 1924-30 (DA = 346 sq. mi.)
Little River, 1930-39 (DA = 229 sq. mi.)
Middle Creek, 1939-81 (DA = 80.7 sq. mi.)

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TABLE 2.4.2-9

COMPARISON OF MONTHLY AVERAGE FLOW BETWEEN ESTIMATED* AND ACTUAL FLOW OF BUCKHORN CREEK

(Drainage Area - 74.2 Sq. Mi. at Gage Station)

WATER YEAR	FLOW	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT
						(CFS)							
1971 TO 1972	ACTUAL									18.9	17.2	9.3	8.1
	ESTIMATED									31.1	33.5	23.3	21.0
1972 TO 1973	ACTUAL	15.8	147.0	221.0	135.0	344.0	158.0	178.0	35.1	153.0	32.5	15.4	4.8
	ESTIMATED	44.6	161.8	233.5	162.7	413.8	163.7	220.7	71.1	148.0	38.4	16.3	8.0
1973 TO 1974	ACTUAL	2.8	4.9	25.9	110.0	176.0	110.0	62.7	181.0	37.4	8.3	95.5	64.6
	ESTIMATED	5.7	4.3	42.0	85.4	163.7	103.9	75.1	91.6	32.7	10.2	99.3	76.8
1974 TO 1975	ACTUAL	10.3	12.0	68.8	299.0	188.0	209.0	52.1	24.4	12.7	191.0	8.5	34.4
	ESTIMATED	18.9	24.8	88.8	251.9	220.7	247.3	87.5	35.0	18.8	204.5	15.3	26.8
1975 TO 1976	ACTUAL	24.7	48.5	95.3	153.0	82.5	68.4	24.4	20.5	28.6	5.1	3.2	4.3
	ESTIMATED	23.3	39.1	86.3	134.2	99.3	70.2	32.4	32.5	69.4	13.2	4.1	5.5
1976 TO 1977	ACTUAL	14.1	13.9	89.8	150.0	40.2	279.0	66.1	8.5	4.9	1.7	3.5	12.4
	ESTIMATED	31.2	28.2	119.5	114.0	53.6	188.5	71.7	20.6	8.5	1.7	8.7	39.4

TABLE 2.4.2-9 (Continued)

COMPARISON OF MONTHLY AVERAGE FLOW BETWEEN ESTIMATED* AND ACTUAL FLOW OF BUCKHORN CREEK

(Drainage Area - 74.2 Sq. Mi. at Gage Station)

WATER YEAR	FLOW	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT
		(CFS)											
1977 TO 1978	ACTUAL	22.18	46.7	57.5	387	64.7	213	229	143	50.7	18.1	12.7	2.4
	ESTIMATED	38.9	70.4	67.8	254.7	86.7	171.0	235.4	153.5	50.0	37.4	34.8	7.9

* Calculated data, based upon actual Middle Creek data, as adjusted by drainage area ratios (Middle Creek DA=80.7 sq. mi., Buckhorn Creek at Gaging Station DA=74.2 sq. mi.

TABLE 2.4.2-10

CALCULATED MINIMUM FLOWS FOR BUCKHORN CREEK AT THE MAIN DAM (DA=71.0 sq. mi.)

Water Year	Date Minimum Flow Occurred	Minimum Flow *(cfs)
1940	Aug. 6, 1940	1.8
1	Oct. 8, 1940	3.2
2	Oct. 25, 26, 1941	2.7
3	Sept. 14, 15, 1943	8.3
4	Sept. 6, 7, 10, 11, 1944	6.0
5	June 7, 1945	4.4
6	Sept. 10, 1946	7.8
7	Aug. 16, 1947	6.2
8	Sept. 20, 21, 1948	1.1
9	July 30, Aug. 14, 1949	10.6
1950	Aug. 30, 1950	4.8
1	Sept. 14, 1951	1.0
2	Oct. 8-10, 1951	0.5
3	Sept. 22-24, 1953	0.4
4	Sept. 15-18, 26-30, 1954	0.1
5	Oct. 11-13, 1954	0
6	Sept. 19, 20, 1956	4.0
7	Aug. 15, 1957	3.2
8	Sept. 30, 1958	8.6
9	Oct. 1, 1959	9.7
1960	July 26, 1960	8.1
1	Sept. 26, 1961	6.6
2	Sept. 15, 1962	5.5
3	Aug. 19, 1963	4.9
4	July 3, 1964	4.5
5	June 7, 1965	14.1
6	Sept. 11, 12, 13, 1966	4.4
7	June 16, 17, 1967	6.4
8	Sept. 25, 26, 1968	0.4
9	Oct. 2, 3, 1968	0.5
1970	Sept. 26, 1970	1.7
1	Oct. 9, 1970	2.2
2	Sept. 15, 1972	6.0
3	Sept. 30, 1973 (Sept. 29, 30, 1973)	5.0 (3.0)**
4	Nov. 7, 1973 (Oct. 18, 19, 1973)	3.1 (1.0)**
5	June 26, 1975 (Aug. 30, Sept. 7, 1975)	6.0 (3.6)**
6	Sept. 1, 1976 (Sept. 2, 1976)	1.4 (0.04)**
7	Sept. 6, 1977 (July 30, 1977)	0.1 (0.1)**
8	Sept. 29, 1978 (Oct. 1, 1977)	3.0 (1.2)**

NOTES TO TABLE 2.4.2-10

* Calculated data, based upon actual Middle Creek data, as adjusted by drainage area ratios (Middle Creek DA=80.7 sq. mi., Buckhorn Creek at Main Dam DA=71.0 sq. mi.)

** Calculated data, based upon actual Buckhorn Creek data, as adjusted by drainage area ratios (Buckhorn Creek at gaging station DA=74.2 sq. mi., Buckhorn Creek at Main Dam DA=71.0 sq. mi.)

Table 2.4.2-11

RESERVOIR ANALYSIS
NORMAL OPERATIONS - ALL FOUR UNITS
CRITICAL PERIOD FEBRUARY 1925 - FEBRUARY 1926

												WATER USE AUX. RES.				MAIN RESERVOIR OPERATION								
YEAR	MO.	CREEK INFLOW DA=79.5 cfs	CORR. FOR MAIN+AUX DA R/O 64.00/79.50 cfs	ALLOW FOR SEEPAGE cfs	NET CREEK INFLOW ABOVE MAIN + AUX cfs	NET CREEK INFLOW ABOVE MAIN + AUX AcFt	MAKEUP FROM CAPE FEAR AcFt	TOTAL AVAIL INFLOW AcFt$^{(1)}$	FORCED EVAP. MAIN RES. AcFt	NAT EVAP. in.	DIR RF in.	NET EVAP. in.	RWL ft$^{(2)}$	AREA Acs	CONS Use-AcFt	RWL Ft.	AREA Acs	MAIN RES. NET EVAP. AcFt	AUX+MAIN NET EVAP. AcFt	TOTAL WATER USE FORCED & NET EVAP. AcFt	INCR. STOR. USE AcFt	TOTAL STOR. USE AcFt	RWL @ END MO. Ft	RES. AREA Ac	REQ. PUMP FROM CAPE FEAR AcFt
											A. Worst Monthly Evap. Condition														
1925	F	88.7	71.4	5.0	66.4	3682	16632	20314	3375	2.44	1.70	0.74	250	317	20	220.0	4118	254	274	3648	0	0	220.0	4118	0
	M	82.7	66.6	5.0	61.6	3780	18414	22194	3835	4.41	2.31	2.10	250	317	55	220.0	4118	721	776	4611	0	0	220.0	4118	831
	A	57.1	46.0	5.0	41.0	2433	16929	19362	3874	6.28	2.57	3.71	250	317	98	220.0	4118	1273	1371	5245	0	0	220.0	4118	2812
	M	59.1	47.6	5.0	42.6	2613	13563	16176	4223	7.70	4.11	3.59	250	317	95	220.0	4118	1232	1327	5550	0	0	220.0	4118	2937
	J	18.4	14.8	5.0	9.8	583	2079	2662	5243	8.21	2.60	5.61	250	317	148	220.0	4118	1925	2073	7316	4654	4654	218.9	3959	2079$^{(3)}$
	J	18.4	14.8	5.0	9.8	602	2673	3275	5585	9.23	1.98	7.25	250	317	192	218.9	3959	2392	2584	8168	4893	9548	217.9	3817	2673$^{(3)}$
	A	20.7	16.7	5.0	11.7	716	3465	4181	5467	8.51	3.42	5.09	250	317	134	217.9	3817	1619	1753	7221	3040	12587	217.2	3726	3465$^{(3)}$
	S	8.3	6.7	5.0	1.7	100	2079	2179	4177	6.30	4.36	1.94	250	317	51	217.2	3726	602	653	4831	2652	15239	216.5	3643	2079$^{(3)}$
	O	6.5	5.2	5.0	0.2	14	0	14	4165	4.64	2.16	2.48	250	317	66	216.5	3643	753	819	4983	4969	20208	215.1	3478	0
	N	14.2	11.4	5.0	6.4	382	2079	2461	3807	2.99	2.56	0.43	250	317	12	215.1	3478	125	137	3943	1482	21690	214.6	3428	2079$^{(3)}$
	D	24.0	19.3	5.0	14.3	879	2475$^{(4)}$	3354	3662	1.54	2.70	-1.16	250	317	-31	214.6	3428	-331	-362	3300	-54	21636	214.7	3430	2475$^{(3)}$
1926	J	90.0	72.5	5.0	67.5	4140	8217$^{(4)}$	12357	3625	1.42	4.29	-2.87	250	317	-76	214.7	3430	-820	-896	2729	-9628	12008	217.3	3744	8217$^{(3)}$
	F	98.0	78.9	5.0	73.9	4097	16335	20432	3375	2.44	1.70	0.74	250	317	20	217.3	3744	231	251	3625	-12008	0	220.0	4118	11536
											B. Normal Monthly Evap. Condition														
1925	F	88.7	71.4	5.0	66.4	3682	16632	20314	3097	2.08	1.70	0.38	250	317	10	220.0	4118	130	140	3237	0	0	220.0	4118	0
	M	82.7	66.6	5.0	61.6	3780	18414	22194	3656	3.91	2.31	1.60	250	317	42	220.0	4118	549	591	4247	0	0	220.0	4118	467
	A	57.1	46.0	5.0	41.0	2433	16929	19362	3803	5.52	2.57	2.95	250	317	78	220.0	4118	1012	1090	4893	0	0	220.0	4118	2460
	M	59.1	47.6	5.0	42.6	2613	13563	16176	4106	6.77	4.11	2.66	250	317	70	220.0	4118	913	983	5089	0	0	220.0	4118	2476
	J	18.4	14.8	5.0	9.8	583	2079	2662	5103	7.28	2.60	4.68	250	317	124	220.0	4118	1606	1730	6833	4171	4171	219.0	3973	2079$^{(3)}$
	J	18.4	14.8	5.0	9.8	602	2673	3275	5325	7.23	1.98	5.25	250	317	139	219.0	3973	1738	1877	7202	3927	8098	218.2	3859	2673$^{(3)}$
	A	20.7	16.7	5.0	11.7	716	3465	4181	5285	6.68	3.42	3.26	250	317	86	218.2	3859	1048	1134	6420	2239	10336	217.7	3794	3465$^{(3)}$
	S	8.3	6.7	5.0	1.7	100	2079	2179	4024	5.50	4.36	1.14	250	317	30	217.7	3794	360	390	4415	2236	12572	217.2	3727	2079$^{(3)}$
	O	6.5	5.2	5.0	0.2	14	0	14	3897	3.55	2.16	1.39	250	317	37	217.2	3727	432	469	4365	4351	16923	216.1	3588	0
	N	14.2	11.4	5.0	6.4	382	2079	2461	3561	2.31	2.56	-0.25	250	317	-7	216.1	3588	-75	-82	3480	1019	17942	215.8	3555	2079$^{(3)}$
1926	D	24.0	19.3	5.0	14.3	879	2475$^{(4)}$	3354	3388	1.33	2.70	-1.37	250	317	-36	215.8	3555	-406	-442	2946	-408	17534	215.9	3568	2475$^{(3)}$
	J	90.0	72.5	5.0	67.5	4140	8217$^{(4)}$	12357	3388	1.19	4.29	-3.10	250	317	-82	215.9	3568	-922	-1004	2384	-9973	7561	218.3	3875	8217$^{(3)}$
	F	98.0	78.9	5.0	73.9	4097	16335	20432	3097	2.08	1.70	0.38	250	317	10	218.3	3875	123	133	3230	-7561	0	220.0	4118	6694

NOTES: (1) Excluding Direct Rainfall.

(2) Assumes Auxiliary Reservoir maintained at Normal Water Level by pumping from Main Reservoir.

(3) Limited to available makeup.

(4) Limited by required filling of New Hope Reservoir.

Table 2.4.2-12

RESERVOIR ANALYSIS
NORMAL OPERATION - ALL FOUR UNITS
CRITICAL PERIOD MARCH 1933 - APRIL 1934

													WATER USE AUX. RES.			MAIN RESERVOIR OPERATION									
YEAR	MO.	CREEK INFLOW DA=79.5 cfs	CORR. FOR MAIN + AUX. DA R/O 64.00/79.50 cfs	ALLOW. FOR SEEPAGE cfs	NET CREEK INFLOW ABOVE MAIN + AUX. cfs	NET CREEK INFLOW ABOVE MAIN + AUX. AcFt	MAKEUP FROM CAPE FEAR AcFt	TOTAL AVAIL. INFLOW AcFt(1)	FORCED EVAP. MAIN RES. AcFt	NAT. EVAP. in.	DIR RF in.	NET EVAP. in.	RWL Ft(2)	AREA Acs	CONS Use-AcFt	RWL Ft	AREA Acs	MAIN RES. NET EVAP. AcFt	AUX. + MAIN NET EVAP. AcFt	TOTAL WATER USE FORCED & NET EVAP. AcFt	INCR. STOR. USE AcFt	TOTAL STOR. USE AcFt	RWL@ END MO. Ft	RES AREA Ac	REQ. PUMP FROM CAPE FEAR AcFt
												A. Worst Monthly Evap. Condition													
1933	M	91.6	73.7	5.0	68.7	4219	18414	22633	3835	4.41	2.01	2.40	250	317	63	220.0	4118	824	887	4722	0	0	220.0	4118	503
	A	122.1	98.3	5.0	93.3	5542	17820	23362	3874	6.28	5.33	0.95	250	317	25	220.0	4118	326	351	4225	0	0	220.0	4118	0
	M	36.4	29.3	5.0	24.3	1492	12078	13570	4223	7.70	2.66	5.04	250	317	133	220.0	4118	1730	1863	6086	0	0	220.0	4118	4594
	J	10.3	8.3	5.0	3.3	196	2079	2275	5243	8.21	1.44	6.77	250	317	179	220.0	4118	2323	2502	7745	5471	5471	218.8	3935	2079(3)
	J	11.2	9.0	5.0	4.0	247	693	940	5585	9.23	2.12	7.11	250	317	188	218.8	3935	2331	2519	8104	7165	12635	217.2	3725	693(3)
	A	24.0	19.3	5.0	14.3	879	13464	14343	5467	8.51	6.02	2.49	250	317	66	217.2	3725	773	839	6306	-8037	4598	218.9	3961	13464(3)
	S	15.2	12.2	5.0	7.2	430	7920	8350	4177	6.30	0.83	5.47	250	317	144	218.9	3961	1805	1949	6127	-2223	2375	219.4	4030	7920(3)
	O	7.3	5.9	5.0	0.9	54	0	54	4165	4.64	0.89	3.75	250	317	99	219.4	4030	1259	1358	5523	5470	7845	218.3	3866	0
	N	4.3	3.5	5.0	-1.5	-91	0	-91	3807	2.99	1.48	1.51	250	317	40	218.3	3866	487	527	4333	4425	12270	217.3	3736	0
	D	10.3	8.3	5.0	3.3	202	0	202	3662	1.54	0.92	0.62	250	317	16	217.3	3736	193	209	3871	3669	15939	216.3	3621	0
1934	J	9.3	7.5	5.0	2.5	153	1287	1440	3625	1.42	1.77	-0.35	250	317	-9	216.3	3621	-106	-115	3510	2071	18009	215.7	3552	1287(3)
	F	17.2	13.8	5.0	8.8	490	1188(4)	1678	3375	2.44	3.09	-0.65	250	317	-17	215.7	3552	-192	-209	3165	1487	19496	215.3	3503	1188(3)
	M	79.2	63.8	5.0	58.8	3607	18117(4)	21724	3835	4.41	5.03	-0.62	250	317	-16	215.3	3503	-181	-197	3638	-18086	1410	219.7	4063	18117(3)
	A	136.0	109.5	5.0	104.5	6206	17622	23828	3874	6.28	3.09	3.19	250	317	84	219.7	4063	1080	1164	5038	-1410	0	220.0	4118	242
												B. Normal Monthly Evap. Condition													
1933	M	91.6	73.7	5.0	68.7	4219	18414	22633	3656	3.91	2.01	1.90	250	317	50	220.0	4118	652	702	4358	0	0	220.0	4118	139
	A	122.1	98.3	5.0	93.3	5542	17820	23362	3803	5.52	5.33	0.19	250	317	5	220.0	4118	65	70	3873	0	0	220.0	4118	0
	M	36.4	29.3	5.0	24.3	1492	12078	13570	4106	6.77	2.66	4.11	250	317	109	220.0	4118	1410	1519	5625	0	0	220.0	4118	4133
	J	10.3	8.3	5.0	3.3	196	2079	2275	5103	7.28	1.44	5.84	250	317	154	220.0	4118	2004	2158	7261	4987	4987	218.9	3949	2079(3)
	J	11.2	9.0	5.0	4.0	247	693	940	5325	7.23	2.12	5.11	250	317	135	220.0	4118	1682	1817	7142	6202	11189	217.5	3769	693(3)
	A	24.0	19.3	5.0	14.3	879	13464	14343	5285	6.68	6.02	0.66	250	317	17	218.9	3949	207	224	5510	-8833	2356	219.4	4031	13464(3)
	S	15.2	12.2	5.0	7.2	430	7920	8350	4024	5.50	0.83	4.67	250	317	123	217.5	3769	1569	1692	5716	-2356	0	220.0	4118	7642
	O	7.3	5.9	5.0	0.9	54	0	54	3897	3.55	0.89	2.66	250	317	70	219.4	4031	913	983	4880	4826	4826	218.9	3954	0
	N	4.3	3.5	5.0	-1.5	-91	0	-91	3561	2.31	1.48	0.83	250	317	22	220.0	4118	273	295	3856	3948	8774	218.1	3840	0
	D	10.3	8.3	5.0	3.3	202	0	202	3388	1.33	0.92	0.41	250	317	11	218.9	3954	131	142	3530	3328	12102	217.3	3741	0
1934	J	9.3	7.5	5.0	2.5	153	1287	1440	3388	1.19	1.77	-0.58	250	317	-15	218.1	3840	-181	-196	3192	1752	13854	216.9	3687	1287(3)
	F	17.2	13.8	5.0	8.8	490	1188(4)	1678	3097	2.08	3.09	-1.01	250	317	-27	217.3	3741	-310	-337	2760	1082	14936	216.6	3653	1188(3)
	M	79.2	63.8	5.0	58.8	3607	18117(4)	21724	3656	3.91	5.03	-1.12	250	317	-30	216.9	3687	-341	-371	3285	-14936	0	220.0	4118	14614
	A	136.0	109.5	5.0	104.5	6206	17622	23828	3803	5.52	3.09	2.43	250	317	64	216.6	3653	834	898	4701	0	0	220.0	4118	0

NOTES: (1) Excluding Direct Rainfall.

(2) Assumes Auxiliary Reservoir maintained at Normal Water Level by pumping from Main Reservoir.

(3) Limited to available makeup.

(4) Limited by required filling of New Hope Reservoir.

Amendment No. 1

Table 2.4.2-13

RESERVOIR ANALYSIS
NORMAL OPERATIONS - ALL FOUR UNITS
CRITICAL PERIOD MAY 1941 - APRIL 1942

												WATER USE AUX. RES.				MAIN RESERVOIR OPERATION									
YEAR	MO.	CREEK INFLOW DA=79.5 cfs	CORR. FOR MAIN + AUX. DA R/O 64.00/79.50 cfs	ALLOW. FOR SEEPAGE cfs	NET CREEK INFLOW ABOVE MAIN + AUX. cfs	NET CREEK INFLOW ABOVE MAIN + AUX. AcFt	MAKEUP FROM CAPE FEAR AcFt	TOTAL AVAIL. INFLOW AcFt(1)	FORCED EVAP. MAIN RES. AcFt	NAT. EVAP. in.	DIR. RF in.	NET EVAP. in.	RWL FT(2)	AREA ACS	CONS. Use-AcFt	RWL Ft	AREA Acs	MAIN RES. NET EVAP. AcFt	AUX. + MAIN NET EVAP. AcFt	TOTAL WATER USE FORCED & NET EVAP. AcFt	INCR. STOR. USE AcFt	TOTAL STOR. USE AcFt	RWL @ END MO. Ft	RES. AREA Ac	REQ. PUMP. FROM CAPE FEAR AcFt
												A. Worst Monthly Evap. Condition													
1941	M	20.4	16.4	5.0	11.4	701	0	701	4223	7.70	2.08	5.62	250	317	148	220	4118	1929	2077	6300	5599	5599	218.7	3931	0
	J	18.1	14.6	5.0	9.6	569	4356	4925	5243	8.21	3.37	4.84	250	317	128	218.7	3931	1586	1714	6956	2032	7631	218.3	3873	4356(3)
	J	253.7	204.2	5.0	199.2	12229	9999	22228	5585	9.23	10.86	-1.63	250	317	-43	218.3	3873	-526	569	5016	-7631	0	220.0	4118	418
	A	31.7	25.5	5.0	20.5	1259	594	1853	5467	8.51	3.46	5.05	250	317	133	220.0	4118	1733	1866	7333	5480	5480	218.8	3935	594(3)
	S	10.2	8.2	5.0	3.2	191	2178	2369	4177	6.30	1.53	4.77	250	317	126	218.8	3935	1564	1690	5867	3498	8978	218.0	3834	2178(3)
	O	9.1	7.3	5.0	2.3	143	0	143	4165	4.64	1.93	2.71	250	317	72	218.0	3834	866	938	5102	4960	13938	216.9	3685	0
	N	6.8	5.5	5.0	0.5	28	0	28	3807	2.99	0.51	2.48	250	317	66	216.9	3685	761	827	4634	4606	18544	215.6	3535	0
	D	53.3	42.9	5.0	37.9	2327	693(4)	3020	3662	1.54	4.39	-2.85	250	317	-75	215.6	3535	-839	-914	2747	-273	18271	215.7	3544	693(3)
1942	J	31.7	25.5	5.0	20.5	1259	0(4)	1259	3625	1.42	1.29	0.13	250	317	3	215.7	3544	38	41	3667	2407	20678	215.0	3462	0
	F	71.4	57.5	5.0	52.5	2909	7128(4)	10037	3375	2.44	2.51	-0.07	250	317	-2	215.0	3462	-20	-22	3353	-6684	13994	216.8	3683	7128(3)
	M	148.3	119.4	5.0	114.4	7021	18414	25435	3835	4.41	5.04	-0.63	250	317	-17	216.8	3683	-193	-210	3625	-13994	0	220.0	4118	10598
	A	64.6	52.0	5.0	47.0	2792	12474	15266	3874	6.28	1.68	4.60	250	317	122	220.0	4118	1579	1701	5574	0	0	220.0	4118	2782
										Σ63.67															
												B. Normal Monthly Evap. Condition													
1941	M	20.4	16.4	5.0	11.4	701	0	701	4106	6.77	2.08	4.69	250	317	124	220	4118	1609	1733	5839	5138	5138	218.8	3945	0
	J	18.1	14.6	5.0	9.6	569	4356	4925	5103	7.28	3.37	3.91	250	317	103	218.8	3945	1285	1388	6492	1567	6705	218.5	3899	4356(3)
	J	253.7	204.2	5.0	199.2	12229	9999	22228	5325	7.23	10.86	-3.63	250	317	-96	218.5	3899	-1180	1276	4050	-6705	0	220.0	4118	0
	A	31.7	25.5	5.0	20.5	1259	594	1853	5285	6.68	3.46	3.22	250	317	85	220.0	4118	1105	1190	6475	4622	4622	218.9	3960	594(3)
	S	10.2	8.2	5.0	3.2	191	2178	2369	4024	5.50	1.53	3.97	250	317	105	218.9	3960	1310	1415	5439	3070	7692	218.3	3871	2178(3)
	O	9.1	7.3	5.0	2.3	143	0	143	3897	3.55	1.93	1.62	250	317	43	218.3	3871	523	566	4462	4320	12011	217.3	3744	0
	N	6.8	5.5	5.0	0.5	28	0	28	3561	2.31	0.51	1.80	250	317	48	217.3	3744	562	610	4170	4142	16153	216.3	3614	0
	D	53.3	42.9	5.0	37.9	2327	693(4)	3020	3388	1.33	4.39	-3.06	250	317	-81	216.3	3614	-921	-1002	2386	-634	15519	216.4	3634	693(3)
1942	J	31.7	25.5	5.0	20.5	1259	0(4)	1259	3388	1.19	1.29	-0.10	250	317	-3	216.4	3634	-30	-33	3355	2096	17615	215.9	3566	0
	F	71.4	57.5	5.0	52.5	2909	7128(4)	10037	3097	2.08	2.51	-0.43	250	317	-11	215.9	3566	-128	-139	2958	-7079	10536	217.7	3788	7128(3)
	M	148.3	119.4	5.0	114.4	7021	18414	25435	3656	3.91	5.04	-1.13	250	317	-30	217.7	3788	-357	-387	3269	-10536	0	220.0	4118	6784
	A	64.6	52.0	5.0	47.0	2792	12474	15266	3803	5.52	1.68	3.84	250	317	101	220.0	4118	1318	1419	5222	0	0	220.0	4118	2430
										Σ53.35															

NOTES: (1) Excluding Direct Rainfall.

(2) Assumes Auxiliary Reservoir maintained at Normal Water Level by pumping from Main Reservoir.

(3) Limited to available makeup.

(4) Limited by required filling of New Hope Reservoir.

Amendment No. 1

Table 2.4.2-14

RESERVOIR ANALYSIS
NORMAL OPERATIONS - ALL FOUR UNITS
CRITICAL YEAR 1925/26 - WORST MONTHLY EVAP. CONDITIONS
MONTHS OF NOVEMBER AND DECEMBER

					NET CREEK INFLOW ABOVE MAIN+AUX								WATER USE AUX. RES DUE TO NET EVAP.			MAIN RESERVOIR OPERATION								
MONTH & YEAR	DAY	CREEK INFLOW(1) cfs	CORR. FOR MAIN+AUX DA R/O 64.00/79.50 cfs	ALLOW FOR SEEPAGE cfs	cfs	AcFt	MAKEUP FROM CAPE(2) FEAR AcFt	TOTAL AVAIL(3) INFLOW AcFt	FORCED EVAP MAIN RES. AcFt	NAT. EVAP MAIN RES. in.	DIR RF in.	NET EVAP. =NAT. EV-RF in.	RWL(4) Ft	AREA AC	CONS. USE AcFt	RWL Ft	AREA AC	MAIN RES. NET EVAP. AcFt	AUX+MAIN NET EVAP. AcFt	FORCED + NET EVAP. AcFt	INCR. STOR. USE AcFt	TOTAL STOR. USE AcFt	RWL Ft	AREA AC
OCT. 25	31																					20208	215.1	3478
NOV. 25	1	1.3	1.0	5.0	-4.0	-8	0	-8	119	0.10	0.38	-0.28	250	317	-7	215.1	3478	- 81	- 88	30	38	20246	215.1	3477
	2	7.9	6.4	5.0	1.4	3	198	201	119	0.09	0.86	-0.77	250	317	-20	215.1	3477	-223	-243	-124	-325	19921	215.2	3488
	3	6.0	4.8	5.0	-0.2	0	0	0	123	0.09	0.00	0.09	250	317	2	215.2	3488	26	28	152	152	20073	215.1	3483
	4	5.1	4.1	5.0	-0.9	-2	0	-2	130	0.14	0.00	0.14	250	317	4	215.1	3483	41	45	174	176	20249	215.1	3477
	5	4.5	3.6	5.0	-1.4	-3	0	-3	130	0.14	0.00	0.14	250	317	4	215.1	3477	41	45	174	177	20426	215.0	3471
	6	4.5	3.6	5.0	-1.4	-3	0	-3	117	0.11	0.02	0.09	250	317	2	215.0	3471	26	28	145	148	20574	215.0	3466
	7	2.9	2.3	5.0	-2.7	-5	0	-5	114	0.08	0.06	0.02	250	317	1	215.0	3466	6	7	120	126	20700	215.0	3462
	8	4.0	3.2	5.0	-1.8	-4	0	-4	117	0.08	0.31	-0.23	250	317	-6	215.0	3462	- 66	- 72	45	48	20748	214.9	3460
	9	7.2	5.8	5.0	0.8	2	0	2	126	0.10	0.00	0.10	250	317	3	214.9	3460	29	32	157	156	20904	214.9	3455
	10	5.9	4.7	5.0	-0.3	0	0	0	130	0.12	0.00	0.12	250	317	3	214.9	3455	35	38	168	168	21072	214.8	3449
	11	10.3	8.3	5.0	3.3	7	0	7	137	0.14	0.00	0.14	250	317	4	214.8	3449	40	44	181	174	21246	214.8	3443
	12	8.7	7.0	5.0	2.0	4	198	202	135	0.14	0.64	-0.50	250	317	-13	214.8	3443	-143	-156	- 22	-224	21023	214.9	3451
	13	9.4	7.6	5.0	2.6	5	99	104	137	0.15	0.00	0.15	250	317	4	214.9	3451	43	47	184	80	21103	214.8	3448
	14	15.7	12.6	5.0	7.6	15	0	15	134	0.13	0.00	0.13	250	317	3	214.8	3448	37	40	175	160	21262	214.8	3442
	15	8.4	6.8	5.0	1.8	3	0	3	128	0.07	0.06	0.01	250	317	0	214.8	3442	3	3	131	128	21390	214.7	3438
	16	13.3	10.7	5.0	5.7	11	198	209	135	0.12	0.03	0.09	250	317	2	214.7	3438	26	28	163	- 46	21344	214.8	3440
	17	11.6	9.3	5.0	4.3	9	396	405	128	0.08	0.00	0.08	250	317	2	214.8	3440	23	25	153	-252	21092	214.8	3448
	18	9.4	7.6	5.0	2.6	5	0	5	132	0.07	0.00	0.07	250	317	2	214.8	3448	20	22	154	149	21241	214.8	3443
	19	6.7	5.4	5.0	0.4	1	0	1	134	0.11	0.03	0.08	250	317	2	214.8	3443	23	25	159	158	21400	214.7	3438
	20	8.8	7.1	5.0	2.1	4	396	400	130	0.08	0.02	0.06	250	317	2	214.7	3438	17	19	149	-251	21148	214.8	3446
	21	4.9	3.9	5.0	-1.1	-2	594	592	132	0.10	0.00	0.10	250	317	3	214.8	3446	29	32	163	-429	20720	214.9	3461
	22	3.8	3.1	5.0	-1.9	-4	0	-4	130	0.08	0.00	0.08	250	317	2	214.9	3461	23	25	155	159	20879	214.9	3456

NOTES: (1) Assumed only 50% of daily inflow based on Deep River at Ramseur.

(2) Limited by required filling of New Hope Reservoir.

(3) Excluding Direct Rainfall.

(4) Assumed Auxiliary Reservoir maintained at minimum water level by pumping from Main Reservoir.

Table 2.4.2-14 (Cont'd)

					NET CREEK INFLOW ABOVE MAIN+AUX								WATER USE AUX. RES DUE TO NET EVAP.			MAIN RESERVOIR OPERATION								
MONTH & YEAR	DAY	CREEK INFLOW(1) cfs	CORR. FOR MAIN+AUX DA R/O 64.00/79.50 cfs	ALLOW FOR SEEPAGE cfs	cfs	AcFt	MAKEUP FROM CAPE(2) FEAR AcFt	TOTAL AVAIL(3) INFLOW AcFt	FORCED EVAP MAIN RES. AcFt	NAT. EVAP MAIN RES. in.	DIR RF in.	NET EVAP. =NAT. EV-RF in.	RWL(4) Ft	AREA AC	CONS. USE AcFt	RWL Ft	AREA AC	MAIN RES. NET EVAP. AcFt	AUX+MAIN NET EVAP. AcFt	FORCED + NET EVAP. AcFt	INCR. STOR. USE AcFt	TOTAL STOR. USE AcFt	RWL Ft	AREA AC
NOV. 25	23	10.1	8.1	5.0	3.1	6	0	6	130	0.09	0.00	0.09	250	317	2	214.9	3456	26	28	158	152	21031	214.9	3450
	24	5.9	4.7	5.0	-0.3	0	0	0	130	0.10	0.00	0.10	250	317	3	214.9	3450	29	32	161	162	21193	214.8	3445
	25	5.5	4.4	5.0	-0.6	-1	0	-1	135	0.14	0.00	0.14	250	317	4	214.8	3445	40	44	179	180	21373	214.7	3439
	26	4.2	3.4	5.0	-1.6	-3	0	-3	117	0.09	0.12	-0.03	250	317	-1	214.7	3439	-9	-10	108	111	21484	214.7	3435
	27	9.4	7.6	5.0	2.6	5	0	5	108	0.02	0.03	-0.01	250	317	0	214.7	3435	-3	-3	105	100	21583	214.7	3432
	28	5.3	4.3	5.0	-0.7	-1	0	-1	105	0.00	0.00	0.00	250	317	0	214.7	3432	0	0	105	106	21690	214.6	3428
	29	2.9	2.3	5.0	-2.7	-5	0	-5	114	-0.01	0.00	-0.01	250	317	0	214.6	3428	-3	-3	111	116	21806	214.6	3424
	30	9.4	7.6	5.0	2.6	5	0	5	124	0.02	0.00	0.02	250	317	1	214.6	3424	6	7	130	125	21931	214.6	3420
DEC. 25	1	6.4	5.2	5.0	0.2	0	0	0	123	0.04	0.03	0.01	250	317	0	214.6	3420	3	3	126	126	22057	214.5	3415
	2	6.4	5.2	5.0	0.2	0	0	0	114	0.08	0.76	-0.68	250	317	-18	214.5	3415	-194	-212	-98	-98	21959	214.6	3419
	3	6.2	5.0	5.0	0.0	0	0	0	106	0.02	0.01	0.01	250	317	0	214.6	3419	3	3	109	109	22068	214.5	3415
	4	6.2	5.0	5.0	0.0	0	0	0	114	0.00	0.00	0.00	250	317	0	214.5	3415	0	0	114	114	22182	214.5	3411
	5	5.1	4.1	5.0	-0.9	-2	0	-2	117	0.06	0.05	0.01	250	317	0	214.5	3411	3	3	120	122	22304	214.5	3407
	6	4.0	3.2	5.0	-1.8	-4	0	-4	117	0.05	0.00	0.05	250	317	1	214.5	3407	14	15	132	136	22440	214.4	3402
	7	9.1	7.3	5.0	2.3	5	0	5	115	0.08	0.00	0.08	250	317	2	214.4	3402	23	25	140	135	22575	214.4	3398
	8	6.9	5.6	5.0	0.6	1	0	1	103	0.03	0.00	0.03	250	317	1	214.4	3398	8	9	112	111	22687	214.3	3394
	9	6.3	5.1	5.0	0.1	0	0	0	103	0.00	0.00	0.00	250	317	0	214.3	3394	0	0	103	103	22789	214.3	3390
	10	6.9	5.6	5.0	0.6	1	0	1	115	0.04	0.00	0.04	250	317	1	214.3	3390	11	12	127	126	22916	214.3	3386
	11	6.3	5.1	5.0	0.1	0	0	0	123	0.06	0.00	0.06	250	317	2	214.3	3386	17	19	142	141	23057	214.2	3381
	12	4.9	3.9	5.0	-1.1	-2	0	-2	132	0.08	0.00	0.08	250	317	2	214.2	3381	23	25	157	159	23216	214.2	3376
	13	3.4	2.7	5.0	-2.3	-4	0	-4	128	0.04	0.00	0.04	250	317	1	214.2	3376	11	12	140	145	23361	214.1	3371
	14	9.8	7.9	5.0	2.9	6	0	6	124	0.04	0.00	0.04	250	317	1	214.1	3371	11	12	136	131	23491	214.1	3366
	15	6.9	5.6	5.0	0.6	1	0	1	115	0.06	0.12	-0.06	250	317	-2	214.1	3366	-17	-19	96	95	23587	214.1	3363
	16	6.2	5.0	5.0	0.0	0	0	0	114	0.04	0.03	0.01	250	317	0	214.1	3363	3	3	117	117	23704	214.0	3359
	17	6.2	5.0	5.0	0.0	0	0	0	115	0.01	0.13	-0.12	250	317	-3	214.0	3359	-34	-37	78	78	23782	214.0	3356
	18	6.4	5.2	5.0	0.2	0	0	0	121	0.04	0.00	0.04	250	317	1	214.0	3356	11	12	133	133	23915	214.0	3351
	19	4.5	3.6	5.0	-1.4	-3	0	-3	128	0.07	0.42	-0.35	250	317	-9	214.0	3351	-98	-107	21	24	23939	213.9	3351
	20	7.1	5.7	5.0	0.7	1	0	1	132	0.08	0.38	-0.30	250	317	-8	213.9	3351	-84	- 92	40	39	23978	213.9	3349

NOTES: (1) Assumed only 50% of daily inflow based on Deep River at Ramseur.

(2) Limited by required filling of New Hope Reservoir.

(3) Excluding Direct Rainfall.

(4) Assumed Auxiliary Reservoir maintained at minimum water level by pumping from Main Reservoir.

Table 2.4.2-14 (Cont'd)

					NET CREEK INFLOW ABOVE MAIN+AUX								WATER USE AUX. RES DUE TO NET EVAP.			MAIN RESERVOIR OPERATION								
MONTH & YEAR	DAY	CREEK INFLOW(1) cfs	CORR. FOR MAIN+AUX DA R/O 64.00/79.50 cfs	ALLOW FOR SEEPAGE cfs	cfs	AcFt	MAKEUP FROM CAPE(2) FEAR AcFt	TOTAL AVAIL(3) INFLOW AcFt	FORCED EVAP MAIN RES. AcFt	NAT. EVAP MAIN RES. in.	DIR RF in.	NET EVAP. =NAT. EV-RF in.	RWL(4) Ft	AREA AC	CONS. USE AcFt	RWL Ft	AREA AC	MAIN RES. NET EVAP. AcFt	AUX+MAIN NET EVAP. AcFt	FORCED + NET EVAP. AcFt	INCR. STOR. USE AcFt	TOTAL STOR. USE AcFt	RWL Ft	AREA AC
DEC. 25	21	12.1	9.7	5.0	4.7	9	0	9	115	0.01	0.63	-0.62	250	317	-16	213.9	3349	-173	-189	-74	-84	23894	214.0	3352
	22	56.6	45.6	5.0	40.6	80	396	476	124	0.05	0.14	-0.09	250	317	- 2	214.0	3352	- 25	- 27	96	-380	23514	214.1	3365
	23	53.0	42.7	5.0	37.7	75	594	669	124	0.06	0.00	0.06	250	317	2	214.1	3365	17	19	142	-526	22988	214.2	3383
	24	27.4	22.1	5.0	17.1	34	594	628	126	0.04	0.00	0.04	250	317	1	214.2	3383	11	12	138	-489	22498	214.4	3400
	25	17.8	14.3	5.0	9.3	18	495	513	123	0.09	0.00	0.09	250	317	2	214.4	3400	26	28	151	-363	22136	214.5	3413
	26	14.0	11.3	5.0	6.3	12	396	408	114	0.06	0.00	0.06	250	317	2	214.5	3413	17	19	133	-276	21860	214.6	3422
	27	11.4	9.2	5.0	4.2	8	0	8	112	0.05	0.00	0.05	250	317	1	214.6	3422	14	15	128	119	21979	214.6	3418
	28	17.5	14.1	5.0	9.1	18	0	18	106	0.00	0.00	0.00	250	317	0	214.6	3418	0	0	106	88	22067	214.5	3415
	29	10.7	8.6	5.0	3.6	7	0	7	119	0.05	0.00	0.05	250	317	1	214.5	3415	14	15	135	127	22195	214.5	3411
	30	15.0	12.1	5.0	7.1	14	0	14	110	0.03	0.00	0.03	250	317	1	214.5	3411	9	10	119	105	22300	214.5	3407
	31	11.4	9.2	5.0	4.2	8	0	8	117	0.01	0.00	0.01	250	317	0	214.5	3407	3	3	120	112	22412	214.4	3403

NOTES: (1) Assumed only 50% of daily inflow based on Deep River at Ramseur.

(2) Limited by required filling of New Hope Reservoir.

(3) Excluding Direct Rainfall.

(4) Assumed Auxiliary Reservoir maintained at minimum water level by pumping from Main Reservoir.

Table 2.4.2-15

NORMAL OPERATION - ALL FOUR UNITS
100 YEAR RETURN PERIOD DROUGHT

											AUX. RES. OPERATION WATER USE AUX. RES. DUE TO NET EVAP.			MAIN RESERVOIR OPERATION									
MONTH	CREEK INFLOW D.A.=79.5	CORR. FOR MAIN + AUX. D.A. R/O 64/79.5	ALLOW FOR SEEPAGE	NET INFLOW ABOVE MAIN + AUX. DAM		MAKEUP FROM CAPE FEAR$^{(1)}$	TOTAL AVAILABLE INFLOW$^{(2)}$	NAT. EVAP.	DIR. R.F.	NET EVAP. = NAT. EVAP. - R.F.	RWL$^{(3)}$	AREA	CON. USE	RWL	AREA	MAIN RES. NET EVAP.	MAIN RES. FORCED EVAP.	TOTAL WATER USE MAIN + AUX.	INCR. STOR. USE	TOTAL STORAGE USE	RWL @ END OF MONTH	RES. AREA	REQUIRED PUMPING FROM CAPE FEAR RIVER
	cfs	cfs	cfs	cfs	AcFt	AcFt	AcFt	in.	in.	in.	ft	acs	AcFt	ft	ac	AcFt	AcFt	AcFt	AcFt	AcFt	ft	ac	AcFt
M	51.6	28.2	5.0	23.2	1423	9009	10432	7.70	2.16	5.54	250	317	146	220.0	4118	1901	5700	7747	0	0	220.0	4118	6324
J	12.5	3.6	5.0	-1.4	- 82	6930	6848	8.21	1.17	7.04	250	317	186	220.0	4118	2416	5630	8232	1384	1384	219.7	4064	6930$^{(4)}$
J	12.5	3.6	5.0	-1.4	- 85	1584	1499	9.23	1.72	7.51	250	317	198	219.7	4064	2543	5970	8712	7212	8596	218.1	3845	1584$^{(4)}$
A	12.5	3.6	5.0	-1.4	- 85	495	410	8.51	4.88	3.63	250	317	96	218.1	3845	1163	5870	7129	6718	15315	216.5	3641	495$^{(4)}$
S	4.1	0.0	5.0	-5.0	-297	0	-297	6.30	0.67	5.63	250	317	149	216.5	3641	1708	5590	7447	7744	23058	214.2	3381	0
O	4.1	0.0	5.0	-5.0	-307	0	-307	4.64	0.72	3.92	250	317	104	214.2	3381	1104	5570	6778	7085	30143	211.9	3139	0
N	4.1	0.0	5.0	-5.0	-297	0	-297	2.99	1.20	1.79	250	317	47	211.9	3139	468	5250	5765	6062	36206	209.9	2936	0
D	4.1	0.0	5.0	-5.0	-307	396	89	1.54	0.75	0.79	250	317	21	209.9	2936	193	5170	5384	5295	41500	208.0	2756	396$^{(4)}$
J	51.6	28.2	5.0	23.2	1423	1190	2613	1.42	1.44	-0.02	250	317	- 1	208.0	2756	- 5	5200	5195	2582	44083	207.1	2662	1190$^{(4)}$
F	51.6	28.2	5.0	23.2	1285	2480	3765	2.44	2.51	-0.07	250	317	- 2	207.1	2662	- 16	4700	4683	918	45001	206.7	2627	2480$^{(4)}$
M	51.6	28.2	5.0	23.2	1423	14800	16223	4.41	1.63	2.78	250	317	73	206.7	2627	609	5360	6042	-10180	34820	210.4	2982	14800$^{(4)}$
A	51.6	28.2	5.0	23.2	1377	17424	18801	6.28	4.33	1.95	250	317	52	210.4	2982	485	5310	5846	-12955	21866	214.6	3422	17424$^{(4)}$

KEY: (1) As limited by pumping (300 cfs) and withdrawal restrictions

(2) Excluding Direct Rainfall

(3) Assumes Auxiliary Reservoir maintained at Normal Water Level by pumping from Main Reservoir

(4) Limited to available makeup.

NOTES: (1) Revised Buckhorn Flow.

(2) 100% load factor cooling towers.

(3) Natural draft towers

(4) Filling of New Hope Reservoir coincident with filling of Shearon Harris Reservoir.

(5) 5 cfs blowdown.

5

Table 2.4.2-16

NORMAL OPERATION - ALL FOUR UNITS
100 YEAR RETURN PERIOD DROUGHT - WORST MONTHLY EVAP. CONDITION

				NET CREEK INFLOW ABOVE MAIN + AUX.								WATER USE AUX. RES. DUE TO NET EVAP.			MAIN RESERVOIR OPERATION								
MONTH	DAY	CREEK INFLOW(1) cfs	ALLOW. FOR SEEPAGE cfs	cfs	AcFt	MAKEUP FROM CAPE(2) FEAR AcFt	TOTAL AVAIL. INFLOW AcFt	FORCED EVAP. MAIN RES. AcFt	NAT. EVAP. in.	DIR. RF(3) in.	NET EVAP. =NAT. EV-RF in.	RWL Ft	AREA AC	CONS. USE AcFt	RWL Ft	AREA AC	MAIN RES. NET EVAP. AcFt	AUX+MAIN NET EVAP. AcFt	FORCED+ NET EVAP. AcFt	INCR. STOR. USE AcFt	TOTAL STOR. USE AcFt	RWL Ft	AREA AC
DEC	31											250	317								41500	208.0	2756
JAN	1	0	5.0	-5	-10	0	-10	153	0.01	0.56	-0.55	250	317	-15	208.0	2756	-126	-141	12	22	41522	208.0	2755
	2	0	5.0	-5	-10	0	-10	152	0.06	0.00	0.06	250	317	2	208.0	2755	14	16	167	177	41699	208.0	2749
	3	0	5.0	-5	-10	0	-10	148	0.06	0.00	0.06	250	317	2	208.0	2749	14	16	163	173	41873	207.9	2743
	4	0	5.0	-5	-10	0	-10	144	0.01	0.00	0.01	250	317	0	207.9	2743	2	2	147	156	42029	207.8	2737
	5	0	5.0	-5	-10	0	-10	148	0.02	0.04	-0.02	250	317	-1	207.8	2737	-5	-6	143	153	42182	207.8	2732
	6	0	5.0	-5	-10	0	-10	155	-0.02	0.00	-0.02	250	317	-1	207.8	2732	-5	-6	150	160	42342	207.7	2726
	7	0	5.0	-5	-10	0	-10	157	-0.01	0.00	-0.01	250	317	0	207.7	2726	-2	-2	154	164	42506	207.7	2720
	8	0	5.0	-5	-10	0	-10	148	0.00	0.00	0.00	250	317	0	207.7	2720	0	0	148	158	42664	207.6	2714
	9	0	5.0	-5	-10	0	-10	144	-0.01	0.00	-0.01	250	317	0	207.6	2714	-2	-2	141	151	42815	207.5	2709
	10	0	5.0	-5	-10	0	-10	148	0.02	0.00	0.02	250	317	1	207.5	2709	5	6	153	163	42978	207.5	2703
	11	0	5.0	-5	-10	0	-10	148	0.05	0.00	0.05	250	317	1	207.5	2703	11	12	161	170	43149	207.4	2697
	12	0	5.0	-5	-10	0	-10	155	0.01	0.14	-0.13	250	317	-3	207.4	2697	-29	-32	122	132	43281	207.4	2692
	13	0	5.0	-5	-10	0	-10	162	0.01	0.01	0.00	250	317	0	207.4	2692	0	0	162	172	43453	207.3	2686
	14	0	5.0	-5	-10	0	-10	168	0.06	0.00	0.06	250	317	2	207.3	2686	13	15	183	193	43646	207.2	2679
	15	0	5.0	-5	-10	0	-10	166	0.04	0.00	0.04	250	317	1	207.2	2679	9	10	176	186	43832	207.2	2672
	16	0	5.0	-5	-10	0	-10	157	0.02	0.00	0.02	250	317	1	207.2	2672	4	5	162	172	44004	207.1	2665
	17	0	5.0	-5	-10	0	-10	159	0.04	0.00	0.04	250	317	1	207.1	2665	9	10	169	179	44183	207.0	2659
	18	0	5.0	-5	-10	0	-10	159	0.07	0.00	0.07	250	317	2	207.0	2659	16	18	176	186	44369	206.9	2651
	19	0	5.0	-5	-10	0	-10	150	0.06	0.00	0.06	250	317	2	206.9	2651	13	15	165	175	44544	206.9	2645
	20	0	5.0	-5	-10	0	-10	152	0.07	0.00	0.07	250	317	2	206.9	2645	15	17	169	179	44723	206.8	2638
	21	0	5.0	-5	-10	0	-10	157	0.08	0.00	0.08	250	317	2	206.8	2638	18	20	177	187	44909	206.7	2631
	22	0	5.0	-5	-10	0	-10	162	0.09	0.58	-0.49	250	317	-13	206.7	2631	-107	-120	42	52	44961	206.7	2629
	23	0	5.0	-5	-10	0	-10	164	0.09	0.00	0.09	250	317	2	206.7	2629	20	22	186	196	45157	206.6	2621
	24	0	5.0	-5	-10	0	-10	155	0.00	0.00	0.00	250	317	0	206.6	2621	0	0	155	165	45322	206.6	2615
	25	0	5.0	-5	-10	0	-10	152	0.08	0.11	-0.03	250	317	-1	206.6	2615	-7	-8	145	155	45476	206.5	2609
	26	0	5.0	-5	-10	0	-10	155	0.06	0.00	0.06	250	317	2	206.5	2609	13	15	170	180	45656	206.4	2602
	27	0	5.0	-5	-10	594	584	157	0.09	0.00	0.09	250	317	2	206.4	2602	20	22	179	-405	45251	206.6	2618
	28	0	5.0	-5	-10	594	584	157	0.09	0.00	0.09	250	317	2	206.6	2618	20	22	179	-405	44846	206.8	2633
	29	0	5.0	-5	-10	0	-10	157	0.02	0.00	0.02	250	317	1	206.8	2633	4	5	162	172	45017	206.7	2627
	30	0	5.0	-5	-10	0	-10	155	0.04	0.00	0.04	250	317	1	206.7	2627	9	10	165	175	45192	206.6	2620
	31	0	5.0	-5	-10	0	-10	146	0.07	0.00	0.07	250	317	2	206.6	2620	15	17	163	173	45365	206.5	2613

NOTES: (1) Assumes zero inflow for January, February, and March.

(2) Ratio of annual 100-year flow CF/1933-34 flow CFxDaily Flow (1933-34). Rearranged to give more conservative drawdown. Also makeup limited by required filling of New Hope Reservoir.

(3) Ratio 100-year drought to minimum year flow (1933-34) x daily rainfall (1933-34).

Table 2.4.2-16 (Cont'd)

				NET CREEK INFLOW ABOVE MAIN+AUX.								WATER USE AUX. RES. DUE TO NET EVAP.						MAIN RESERVOIR OPERATION					
MONTH	DAY	CREEK INFLOW(1) cfs	ALLOW. FOR SEEPAGE cfs	cfs	AcFt	MAKEUP FROM CAPE(2) FEAR AcFt	TOTAL AVAIL. INFLOW AcFt	FORCED EVAP. MAIN RES. AcFt	NAT. EVAP. in.	DIR. RF(3) in.	NET EVAP. =NAT. EV-RF in.	RWL Ft	AREA AC	CONS. USE AcFt	RWL Ft	AREA AC	MAIN RES. NET EVAP. AcFt	AUX+MAIN NET EVAP. AcFt	FORCED+ NET EVAP. AcFt	INCR. STOR. USE AcFt	TOTAL STOR. USE AcFt	RWL Ft	AREA AC
JAN	31																				45365	206.5	2613
FEB	1	0	5.0	-5	-10	0	-10	146	0.06	0.77	-0.71	250	317	-19	206.5	2613	-155	-174	-27	-17	45348	206.5	2614
	2	0	5.0	-5	-10	495	485	150	0.01	0.00	0.01	250	317	0	206.5	2614	2	2	152	-333	45015	206.7	2627
	3	0	5.0	-5	-10	396	386	161	0.01	0.00	0.01	250	317	0	206.7	2627	2	2	163	-223	44792	206.8	2635
	4	0	5.0	-5	-10	396	386	159	0.03	0.00	0.03	250	317	1	206.8	2635	7	8	166	-220	44573	206.9	2644
	5	0	5.0	-5	-10	396	386	150	0.08	0.01	0.07	250	317	2	206.9	2644	15	17	167	-219	44354	206.9	2652
	6	0	5.0	-5	-10	396	386	157	0.10	0.00	0.01	250	317	3	206.9	2652	22	25	182	-204	44149	207.0	2660
	7	0	5.0	-5	-10	396	386	162	0.12	0.00	0.12	250	317	3	207.0	2660	27	30	192	-194	43955	207.1	2667
	8	0	5.0	-5	-10	0	-10	159	0.03	0.00	0.03	250	317	1	207.1	2667	7	8	166	176	44131	207.0	2660
	9	0	5.0	-5	-10	0	-10	150	0.08	0.05	0.03	250	317	1	207.0	2660	7	8	157	167	44299	207.0	2654
	10	0	5.0	-5	-10	0	-10	155	0.02	0.00	0.02	250	317	1	207.0	2654	4	5	160	170	44469	206.9	2648
	11	0	5.0	-5	-10	0	-10	168	0.08	0.15	-0.07	250	317	-2	206.9	2648	-15	-17	151	161	44629	206.8	2642
	12	0	5.0	-5	-10	0	-10	161	0.02	0.37	-0.35	250	317	-9	206.8	2642	-77	-86	75	85	44714	206.8	2638
	13	0	5.0	-5	-10	0	-10	161	0.12	0.00	0.12	250	317	3	206.8	2638	26	29	191	200	44914	206.7	2631
	14	0	5.0	-5	-10	0	-10	152	0.08	0.00	0.08	250	317	2	206.7	2631	18	20	172	182	45096	206.6	2624
	15	0	5.0	-5	-10	0	-10	148	0.02	0.00	0.02	250	317	1	206.6	2624	4	5	153	163	45259	206.6	2617
	16	0	5.0	-5	-10	0	-10	150	0.05	0.00	0.05	250	317	1	206.6	2617	11	12	162	172	45431	206.5	2611
	17	0	5.0	-5	-10	0	-10	150	0.01	0.00	0.01	250	317	0	206.5	2611	2	2	152	162	45593	206.4	2604
	18	0	5.0	-5	-10	0	-10	155	0.12	0.00	0.12	250	317	3	206.4	2604	26	29	184	194	45787	206.4	2597
	19	0	5.0	-5	-10	0	-10	148	0.03	0.46	-0.43	250	317	-11	206.4	2597	-93	-104	44	53	45841	206.3	2594
	20	0	5.0	-5	-10	0	-10	150	0.10	0.00	0.10	250	317	3	206.3	2594	22	25	174	184	46025	206.3	2587
	21	0	5.0	-5	-10	0	-10	146	0.03	0.00	0.03	250	317	1	206.3	2587	6	7	153	163	46188	206.2	2581
	22	0	5.0	-5	-10	0	-10	152	0.08	0.03	0.05	250	317	1	206.2	2581	11	12	164	174	46362	206.1	2574
	23	0	5.0	-5	-10	0	-10	152	0.11	0.00	0.11	250	317	3	206.1	2574	24	27	178	188	46550	206.0	2566
	24	0	5.0	-5	-10	0	-10	152	0.10	0.00	0.10	250	317	3	206.0	2566	21	24	176	186	46736	206.0	2558
	25	0	5.0	-5	-10	0	-10	157	0.11	0.31	-0.20	250	317	-5	206.0	2558	-43	-48	109	119	46855	205.9	2553
	26	0	5.0	-5	-10	0	-10	166	0.16	0.37	-0.21	250	317	-6	205.9	2553	-45	-51	116	126	46981	205.8	2548
	27	0	5.0	-5	-10	0	-10	164	0.14	0.00	0.14	250	317	4	205.8	2548	30	34	197	207	47188	205.8	2540
	28	0	5.0	-5	-10	0	-10	153	0.05	0.00	0.05	250	317	1	205.8	2540	11	12	165	175	47363	205.7	2532

NOTES: (1) Assumes zero inflow for January, February, and March.

(2) Ratio of annual 100-year flow CF/1933-34 flow CFxDaily Flow (1933-34). Rearranged to give more conservative drawdown. Also makeup limited by required filling of New Hope Reservoir.

(3) Ratio 100-year drought to minimum year flow (1933-34) x daily rainfall (1933-34).

Table 2.4.2-16 (Cont'd)

															MAIN RESERVOIR OPERATION							
MONTH	DAY	CREEK INFLOW(1) cfs	ALLOW. FOR SEEPAGE cfs	NET CREEK INFLOW ABOVE MAIN+AUX. cfs	AcFt	MAKEUP FROM CAPE(2) FEAR AcFt	TOTAL AVAIL. INFLOW AcFt	FORCED EVAP. MAIN RES. AcFt	NAT. EVAP. in.	DIR. RF(3) in.	NET EVAP. =NAT. EV-RF in.	WATER USE AUX. RES. DUE TO NET EVAP. RWL Ft	AREA AC	CONS. USE AcFt	RWL Ft	AREA AC	MAIN RES. NET EVAP. AcFt	AUX+MAIN NET EVAP. AcFt	FORCED+ NET EVAP. AcFt	INCR. STOR. USE AcFt	TOTAL STOR. USE AcFt	RWL Ft	AREA Ac
FEB	28	0																			47363	205.7	2532
MAR	1	0	5.0	-5	-10	495	485	146	0.11	0.00	0.11	250	317	3	205.7	2532	23	26	172	-313	47050	205.8	2545
	2	0	5.0	-5	-10	495	485	153	0.15	0.00	0.15	250	317	4	205.8	2545	32	36	189	-296	46754	205.9	2558
	3	0	5.0	-5	-10	396	386	153	0.06	0.00	0.06	250	317	2	205.9	2558	13	15	167	-219	46535	206.0	2567
	4	0	5.0	-5	-10	396	386	140	0.05	0.00	0.05	250	317	1	206.0	2567	11	12	152	-234	46301	206.1	2576
	5	0	5.0	-5	-10	99	89	155	0.11	0.00	0.11	250	317	3	206.1	2576	24	27	182	92	46393	206.1	2572
	6	0	5.0	-5	-10	396	386	159	0.14	0.00	0.14	250	317	4	206.1	2572	30	34	193	-193	46200	206.2	2580
	7	0	5.0	-5	-10	297	287	146	0.10	0.34	-0.24	250	317	-6	206.2	2580	-52	-58	88	-199	46001	206.3	2588
	8	0	5.0	-5	-10	396	386	148	0.10	0.00	0.10	250	317	3	206.3	2588	22	25	172	-214	45787	206.4	2597
	9	0	5.0	-5	-10	594	584	155	0.15	0.00	0.15	250	317	4	206.4	2597	32	36	191	-393	45394	206.5	2612
	10	0	5.0	-5	-10	396	386	148	0.05	0.04	0.01	250	317	0	206.5	2612	2	2	150	-236	45159	206.6	2621
	11	0	5.0	-5	-10	396	386	144	0.08	0.00	0.08	250	317	2	206.6	2621	17	19	164	-223	44936	206.7	2630
	12	0	5.0	-5	-10	396	386	150	0.11	0.00	0.11	250	317	3	206.7	2630	24	27	177	-209	44727	206.8	2638
	13	0	5.0	-5	-10	198	188	155	0.14	0.01	0.13	250	317	3	206.8	2638	29	32	187	-1	44726	206.8	2638
	14	0	5.0	-5	-10	198	188	162	0.15	0.34	-0.19	250	317	-5	206.8	2638	-42	-47	115	-73	44653	206.8	2641
	15	0	5.0	-5	-10	396	386	155	0.07	0.15	-0.08	250	317	-2	206.8	2641	-18	-20	135	-251	44402	206.9	2650
	16	0	5.0	-5	-10	594	584	153	0.11	0.00	0.11	250	317	3	206.9	2650	24	27	180	-404	43998	207.1	2665
	17	0	5.0	-5	-10	594	584	159	0.15	0.00	0.15	250	317	4	207.1	2665	33	37	196	-388	43611	207.2	2680
	18	0	5.0	-5	-10	594	584	157	0.16	0.02	0.14	250	317	4	207.2	2680	31	35	192	-392	43219	207.4	2694
	19	0	5.0	-5	-10	594	584	159	0.13	0.37	-0.24	250	317	-6	207.4	2694	-54	-60	99	-485	42733	207.6	2712
	20	0	5.0	-5	-10	594	584	162	0.18	0.17	0.01	250	317	0	207.6	2712	2	2	165	-420	42314	207.7	2727
	21	0	5.0	-5	-10	594	584	162	0.17	0.16	0.01	250	317	0	207.7	2727	2	2	165	-420	41894	207.9	2742
	22	0	5.0	-5	-10	594	584	164	0.19	0.00	0.19	250	317	5	207.9	2742	43	48	212	-372	41522	208.0	2755
	23	0	5.0	-5	-10	594	584	166	0.16	0.00	0.16	250	317	4	208.0	2755	37	41	207	-377	41145	208.2	2768
	24	0	5.0	-5	-10	594	584	162	0.19	0.00	0.19	250	317	5	208.2	2768	44	49	211	-373	40772	208.3	2781
	25	0	5.0	-5	-10	594	584	155	0.16	0.03	0.13	250	317	3	208.3	2781	30	33	189	-396	40376	208.4	2795
	26	0	5.0	-5	-10	594	584	161	0.13	0.00	0.13	250	317	3	208.4	2795	30	33	195	-389	39987	208.6	2809
	27	0	5.0	-5	-10	594	584	159	0.14	0.00	0.14	250	317	4	208.6	2809	33	37	195	-389	39598	208.7	2822
	28	0	5.0	-5	-10	594	584	155	0.15	0.00	0.15	250	317	4	208.7	2822	35	39	194	-390	39209	208.9	2835
	29	0	5.0	-5	-10	594	584	157	0.15	0.00	0.15	250	317	4	208.9	2835	35	39	196	-388	38821	209.0	2848
	30	0	5.0	-5	-10	594	584	166	0.16	0.00	0.16	250	317	4	209.0	2848	38	42	206	-376	38445	209.1	2861
	31	0	5.0	-5	-10	594	584	168	0.23	0.00	0.23	250	317	6	209.1	2861	55	61	229	-355	38090	209.2	2873

NOTES: (1) Assumes zero inflow for January, February, and March.

(2) Ratio of annual 100-year flow CF/1933-34 flow CFxDaily Flow (1933-34). Rearranged to give more conservative drawdown. Also makeup limited by required filling of New Hope Reservoir.

(3) Ratio 100-year drought to minimum year flow (1933-34) x daily rainfall (1933-34).

TABLE 2.4.2-17

CAPE FEAR RIVER
NUMBER PUMPING DAYS AND MAKEUP VOLUME
(Based on 25% Nat. Flow and 600 cfs Restriction)

Critical Year Period	Month	Total Number of Pumping Days in Month	Total Water Available for Pumping[(a)] ac-ft.
1925	Feb.	28	16632
	March	31	18414
	April	30	16929
	May	26	13563
	June	8	2079
	July	5	2673
	August	10	3465
	Sept.	4	2079
	Oct.	0	0
	Nov.	7	2079
	Dec.	5	2475 (b)
1926	Jan.	14	8217 (b)
	Feb.	28	16335
	March	31	18414
1933	March	31	18414
	April	30	17820
	May	24	12078
	June	7	2079
	July	2	693
	August	24	13464
	Sept.	15	7920

TABLE 2.4.2-17 (continued)

Critical Year Period	Month	Total Number of Pumping Days in Month	Total Water Available for Pumping[a] ac-ft.
1933	Oct.	0	0
	Nov.	0	0
	Dec.	0	0
1934	Jan.	6	1287
	Feb.	2	1188(b)
	March	31	18117(b)
	April	30	17622
1941	May	0	0
	June	9	4356
	July	19	9999
	August	2	594
	Sept.	5	2178
	Oct.	0	0
	Nov.	0	0
	Dec.	3	693(b)
1942	Jan.	0	0(b)
	Feb.	12	7128(b)
	March	31	18414
	April	25	12474

(a) As limited by 300 cfs maximum pumping capacity

(b) Filling of New Hope Reservoir included

TABLE 2.4.2-18

MAKEUP PUMPING FROM THE CAPE FEAR RIVER

Event	Required[a] Pumping (ac.-ft.)	Available[b] for Pumping (ac.-ft.)	Percent of Available Flow Pumped	Total Flow[c] (ac.-ft.)	Percent of Total Flow Pumped
March 1925 - Feb 1926	41,183	192,431	21.4	1,126,964	3.7
May 1933 - Apr 1934	49,584	193,521	25.6	934,054	5.3
May 1941 - Apr 1942	23,747	182,118	15.8	993,079	2.9
100-Year Drought	51,623	88,730	58.2	517,360	10.0
Average Year	24,164[d]	590,246	4.1	2,437,093	1.0

Notes:

[a] Maximinzed evaporation rates used except where noted.

[b] No withdrawals that reduce flow at Lillington below 600 cfs;
Max withdrawal is 25% of flow at Lillington;
Pumping capacity assumed unlimited.

[c] At Lillington

[d] Used requirements for May 1941 - April 1942 with average evaporation rates.

TABLE 2.4.2-19

AVERAGE EVAPORATION AND PERCOLATION LOSSES
FOUR-UNIT OPERATION

| 4

	MAIN RESERVOIR			AUXILIARY RESERVOIR	
Month	Natural Evaporation (inch/month)	Forced Evaporation (cfs)	Percolation Loss (cfs)	Natural Evaporation (inch/month)	Percolation Loss (cfs)
January	6.8	56.9	5.0	0.6	0.4
February	11.9	52.0	5.0	1.0	0.4
March	22.5	61.4	5.0	1.9	0.4
April	31.7	63.9	5.0	2.7	0.4
May	38.9	69.0	5.0	3.3	0.4
June	41.8	85.8	5.0	3.6	0.4
July	41.5	89.5	5.0	3.5	0.4
August	38.4	88.8	5.0	3.3	0.4
September	31.6	67.6	5.0	2.7	0.4
October	20.4	65.5	5.0	1.7	0.4
November	13.3	59.8	5.0	1.1	0.4
December	7.6	56.9	5.0	0.6	0.4

TABLE 2.4.2-19a

NORMAL EVAPORATION AND PERCOLATION LOSSES
TWO-UNIT OPERATION

	MAIN RESERVOIR			AUXILIARY RESERVOIR
Month	Natural Evaporation (inch/month)	Forced Evaporation (cfs)	Percolation Loss (cfs)	Natural Evaporation (inch/month)
January	1.19	29.0	5.0	1.19
February	2.08	29.4	5.0	2.08
March	3.91	31.0	5.0	3.91
April	5.52	33.2	5.0	5.52
May	6.77	34.4	5.0	6.77
June	7.28	35.6	5.0	7.28
July	7.23	36.2	5.0	7.23
August	6.68	35.8	5.0	6.68
September	5.50	34.8	5.0	5.50
October	3.55	33.0	5.0	3.55
November	2.31	31.0	5.0	2.31
December	1.33	29.2	5.0	1.33

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ONE UNIT OPERATION

	MAIN RESERVOIR			AUXILIARY RESERVOIR
Month	Natural Evaporation (inch/month)	Forced Evaporation (inch/month)	Percolation Loss (cfs)	Natural Evaporation (inch/month)
January	1.19	14.5	5	1.19
February	2.08	14.7	5	2.08
March	3.91	15.5	5	3.91
April	5.52	16.6	5	5.52
May	6.77	17.2	5	6.77
June	7.28	17.8	5	7.28
July	7.23	18.1	5	7.23
August	6.68	17.9	5	6.68
September	5.50	17.4	5	5.50
October	3.55	16.5	5	3.55
November	2.31	15.5	5	2.31
December	1.33	14.6	5	1.33

TABLE 2.4.2-20

NORMAL MONTHLY METEOROLOGICAL CONDITIONS AT SITE

Month	Average Dry Bulb[(1)] Temp. (F)	Wind[(1)] (mph)	Average Wet Bulb[(1)] Temp. (F)	Average Monthly Air Vapor Pressure (mm Hg)	Calculated Reservoir Equil. Water Temp. (F)
Jan.	41.6	8.5	37.6	4.4	40
Feb.	43.0	9.1	38.0	4.2	43
Mar.	49.5	9.6	43.0	5.5	53
Apr.	59.3	9.4	51.6	8.5	63
May	67.6	7.8	60.6	12.5	73
June	75.1	7.0	68.1	16.5	80
July	77.9	6.7	70.9	19.0	82
Aug.	76.9	6.6	70.4	18.6	81
Sept.	71.2	7.0	64.7	14.9	74
Oct.	60.5	7.2	54.8	10.0	62
Nov.	50.0	7.8	44.5	6.3	50
Dec.	41.9	7.9	36.9	4.7	39

(1) Raleigh-Durham Airport Data 1931-1960.

TABLE 2.4.2-21

AUXILIARY RESERVOIR OPERATION - LOSS OF ALL OTHER WATER SOURCES
SIMULTANEOUS ACCIDENT CONDITION IN ONE UNIT
AND NORMAL SHUTDOWN OF THREE UNITS*

Time After Accident mo	Inst. Heat Rejection 10^6 Btu/hr	Avg. For Period 10^6 Btu/hr	Effective Area 106sf	Unit Load Btu/sf/hr	Forced Evap. Rate In/mo	Forced During In	Evap. Period ac. ft.	Worst Natural Evap. During Period In	ac. ft.	Total Storage Use In Period ac. ft.	Summation of Storage Use ac. ft.	Residual Storage At End of Period ac. ft.	Water Level In Auxiliary Pond at End of Period ft.
0.0	1270											4400	250.0
		600	9.31	64.5	5.87	1.47	26	2.3	58	84	84		
0.25	257											4316	249.7
		243	9.15	26.6	2.27	0.57	10	2.3	58	68	152		
0.25	257											4248	249.4
		223	8.97	24.9	2.04	0.51	9	2.3	58	67	219		
0.50	229											4181	249.3
		214	8.92	24.0	2.04	0.51	9	2.3	58	67	286		
0.75	217											4114	249.0
		205	8.85	23.2	2.13	1.07	19	4.25	106	125	411		
1.00	210											3989	248.4
		195	8.72	22.4	1.92	0.96	17	4.25	106	123	534		
1.50	199											3866	249.1
		187	8.60	21.7	1.73	0.87	16	4.10	103	119	653		
2.00	190											3747	247.8
		180	8.50	21.2	1.62	0.81	14	4.10	103	117	770		
2.50	183											3630	247.2
		175	8.29	21.1	1.56	0.78	14	3.89	97	111	881		
3.00	177											3519	246.9
		170	8.20	20.7	1.62	0.81	14	3.89	97	111	992		
3.50	173											3408	246.5
4.00	167												

* This analysis is conservative for one and two unit operation since forced evaporation rates assume four unit operation and all other factors are the same.

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TABLE 2.4.2-22

ESTIMATED MAXIMUM FLOOD PEAKS FOR BUCKHORN CREEK AT THE CAPE FEAR RIVER DISCHARGE AREA = 79.5 Sq. Mi.

Water Year	Date Maximum Flood Occurred	Momentary Maximum (cfs)
1940	Apr. 22, 1940	568
41	July 15, 1941	1330
42	Sept. 8, 1942	1409
43	July 14, 1943	2226
44	Mar. 21, 1944	1576
45	Sept. 18, 1945	3408
46	April 27, 1946	936
47	Sept. 22, 1947	837
48	Feb. 14, 1948	1527
49	May 11, 1949	3212
1950	May 17, 1950	420
51	April 9, 1951	355
52	Sept. 1, 1952	4039
53	Feb. 16, 1953	1084
54	Jan. 23, 1954	3024
55	Sept. 4, 1955	5320
56	Mar. 17, 1956	1310
57	June 9, 1957	2000
58	May 7, 1958	3665
59	Sept. 4, 1959	1734
1960	Oct. 24, 1959	1665
61	Feb. 21, 1961	788
62	July 5, 1962	1950
63	Nov. 11, 1962	1527
64	Nov. 7, 1963	1113
65	July 28, 1965	5103
66	May 19, 1966	1970
67	June 19, 1967	1773
68	Jan. 15, 1968	699
69	Aug. 5, 1969	1724
1970	Oct. 3, 1970	656
71	March 4, 1971	1704
72	Oct. 7, 1971	809
73	Feb. 3, 1973	8383
74	Aug. 8, 1974	471
75	March 20, 1975	1862

NOTE: Estimated values are derived from USGS records of Middle Creek near Clayton, North Carolina, (DA = 80.7 sq. mi.) by drainage area relationship.

TABLE 2.4.2-22 (Continued)

ESTIMATED MAXIMUM FLOOD PEAKS FOR BUCKHORN CREEK AT THE CAPE FEAR RIVER DISCHARGE AREA = 79.5 Sq. Mi.

Water Year	Date Maximum Flood Occurred	Momentary Maximum (cfs)
1976	June 27, 1976	803
77	Sept. 8, 1977	968
78	Apr. 27, 1978	4413

NOTE: Estimated values are derived from USGS records of Middle Creek near Clayton, North Carolina, (DA = 80.7 sq. mi.) by drainage area relationship.

TABLE 2.4.2-23

ESTIMATED* AND MEASURED** MAXIMUM FLOOD PEAKS FOR BUCKHORN CREEK AT USGS GAGE STATION NEAR CORINTH, N. C. (D.A. = 74.2 sq. mi.)

WATER YEAR	DATE MAXIMUM FLOOD OCCURRED		MOMENTARY MAXIMUM (cfs)	
1973	February 3, 1973	(February 2)	7820*	(6920)**
1974	August 8, 1974	(August 7)	440*	(1410)**
1975	March 20, 1975	(July 16)	1740*	(2300)**
1976	June 27, 1976	(June 28)	750*	(1060)**
1977	September 8, 1977	(March 14)	900*	(2520)**
1978	April 27, 1978	(April 26)	4120*	(4660)**

* Estimated values are derived from USGS records of Middle Creek near Clayton, North Carolina, (D.A. = 80.7 sq. mi.) by drainage area relationship.

** USGS Gaging Station on Buckhorn Creek near Corinth, North Carolina, established in June, 1972.

TABLE 2.4.2-24

PROBABLE MAXIMUM PRECIPITATION

	Drainage Basin of Buckhorn Creek at Cape Fear River (D.A. = 79.5 sq. mi.)*		Drainage Basin of Buckhorn Creek at Main Dam (D.A. = 71.0 sq. mi.)*		Drainage Basin of Tom Jack Creek at Auxiliary Dam (D.A. = 2.43 sq. mi.)**	
Time (Hr)	Depth of PMP (in.)	1-Hr Increm. (in.)	Depth of PMP (in.)	1-Hr Increm. (in.)	Depth of PMP (in.)	1-Hr Increm (in.)
1		10.95		11.10		14.68
2		3.25		3.29		4.49
3		2.20		2.24		3.29
4		2.19		2.21		2.70
5		1.66		1.69		2.40
6	21.9	1.65	22.2	1.67	29.95	2.39
7		0.50		0.50		0.65
8		0.30		0.40		0.60
9		0.30		0.40		0.50
10		0.30		0.30		0.40
11		0.30		0.30		0.33
12	23.9	0.30	24.35	0.25	32.73	0.30
13		0.20		0.25		0.27
14		0.20		0.20		0.25
15		0.20		0.20		0.24
16		0.20		0.20		0.21
17		0.20		0.20		0.20
18		0.20		0.20		0.20
19		0.20		0.20		0.15
20		0.20		0.20		0.15
21		0.20		0.20		0.15
22		0.20		0.20		0.15
23		0.15		0.15		0.14
24	26.2	0.15	26.7	0.15	34.98	0.14
25						0.12
26						0.12
27						0.12

TABLE 2.4.2-24 (Continued)

PROBABLE MAXIMUM PRECIPITATION

	Drainage Basin of Buckhorn Creek at Cape Fear River (D.A. = 79.5 sq. mi.)*		Drainage Basin of Buckhorn Creek at Main Dam (D.A. = 71.0 sq. mi.)*		Drainage Basin of Tom Jack Creek at Auxiliary Dam (D.A. = 2.43 sq. mi.)**	
Time (Hr)	Depth of PMP (in.)	1-Hr Increm. (in.)	Depth of PMP (in.)	1-Hr Increm. (in.)	Depth of PMP (in.)	1-Hr Increm (in.)
28						0.12
29						0.12
30						0.11
31						0.11
32						0.11
33						0.11
34						0.10
35						0.10
36						0.10
48	29.6		29.8		38.10	

*A reduction of 10% in the PMP intensity for basin correction is included.

**PMP for a drainage area of 10 sq. mi. without basin correction.

TABLE 2.4.2-25

TIME DISTRIBUTION OF PROBABLE MAXIMUM PRECIPITATION

	Drainage Basin of Buckhorn Creek at Cape Fear River (D.A. = 79.5 sq. mi.)*	Drainage Basin of Buckhorn Creek at Main Dam (D.A. = 71.0 sq. mi.)*	Drainage Basin of Tom Jack Creek at Auxiliary Dam (D.A. = 2.43 sq. mi.)**
Time (Hr)	Incremental Rainfall (in.)	Incremental Rainfall (in.)	Incremental Rainfall (in.)
1	0.20	0.20	2.40
2	0.20	0.20	2.70
3	0.20	0.20	3.29
4	0.20	0.20	14.68
5	0.20	0.20	4.49
6	0.20	0.30	2.39
7	0.30	0.40	0.65
8	0.50	0.50	0.60
9	1.65	1.67	0.50
10	1.66	1.69	0.40
11	10.95	11.10	0.33
12	3.25	3.29	0.30
13	2.20	2.24	0.27
14	2.19	2.21	0.25
15	0.30	0.40	0.24
16	0.30	0.30	0.21
17	0.30	0.25	0.20
18	0.30	0.25	0.20
19	0.20	0.20	0.15
20	0.20	0.20	0.15
21	0.20	0.20	0.15
22	0.20	0.20	0.15
23	0.15	0.15	0.14
24	0.15	0.15	0.14
Subtotal	26.2	26.7	34.98

TABLE 2.4.2-25 (continued)

TIME DISTRIBUTION OF PROBABLE MAXIMUM PRECIPITATION

	Drainage Basin of Buckhorn Creek at Cape Fear River (D.A. = 79.5 sq. mi.)*	Drainage Basin of Buckhorn Creek at Main Dam (D.A. = 71.0 sq. mi.)*	Drainage Basin of Tom Jack Creek at Auxiliary Dam (D.A. = 2.43 sq. mi.)**
Time (Hr)	Incremental Rainfall (in.)	Incremental Rainfall (in.)	Incremental Rainfall (in.)
25			0.12
26			0.12
27			0.12
28			0.12
29			0.12
30			0.11
31			0.11
32			0.11
33			0.11
34			0.10
35			0.10
36			0.10
48			
TOTAL	29.6	29.8	38.10

TABLE 2.4.2-26

WAVE RUNUP PARAMETERS FOR STRUCTURES PROTECTED BY RIPRAP

Fetch$^{(a)}$	Safety Related Structure	Maximum Still Water Level (ft. MSL)	Wind Speed (mph)	Wind Direction	Effective Fetch Length (ft.)	Average Water Depth (ft.)	Significant Wave Height (ft.)	Maximum Wave Height (ft.)	Wave Length (ft.)	Wave Period (sec)	Significant Wave Runup (ft.)	Maximum Wave Runup (ft.)	Wave Setup (ft.)	Maximum Water Level (ft. MSL)
					(PMF - WATER LEVEL IN THE RESERVOIR)									
1	Main Dam^{d}	238.9$^{(b)}$	50.4	N	4720	30	2.4	4.0	40.1	2.8	3.3	4.1	0.1	243.1$^{(c)}$
2	Auxiliary Dam^{e}	256.0$^{(b)}$	52.9	NW	2120	15	1.6	2.7	24.8	2.2	1.8	1.9	0.1	258.0$^{(c)}$
3	Auxiliary Dam^{e}	238.9$^{(b)}$	50.2	S	5930	30	2.7	4.5	46.1	3.0	3.2	3.6	0.2	242.7$^{(c)}$
					(NORMAL OPERATION W.L. IN RESERVOIRS)									
7	Auxiliary Dam^{e}	252	123	NW	1285	10	3.2	5.4	50.8	3.2	3.6	3.8	0.4	256.2$^{(c)}$

Notes:

(a) See Figure 2.4.2-38
(b) See Section 2.4.2.3.4
(c) Maximum Water Level = Maximum Still Water Level + Maximum Wave Runup + Wind Setup
(d) Top of Main Dam = 260 ft. MSL
(e) Top of Auxiliary Dam 260 ft. MSL

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TABLE 2.4.2-27

WAVE RUNUP PARAMETERS FOR PLANT ISLAND

Fetch(a)	Safety Related Structure	Maximum Still Water Level (ft. MSL)	Wind Speed (mph)	Wind Direction	Effective Fetch Length (ft.)	Average Water Depth (ft.)	Significant Wave Height (ft.)	Maximum Wave Height (ft.)	Wave Length (ft.)	Wave Period (sec)	Significant Wave Runup (ft.)	Maximum Wave Runup (ft.)	Wave Setup (ft.)	Maximum Water Level (ft. MSL)
						(PMF - WATER LEVEL IN THE RESERVOIRS)								
4	Natural	256.0(b)	54.0	NNW	1410	17	1.3	2.2	19.5	2.0	1.1	1.3	0.1	257.4(c)
5	Sacrificial Spoil Fill	238.9(b)	51.8	SSE	4060	29	2.2	3.7	37.3	2.7	1.0	1.2	0.1	240.2(c)
6	Natural	256.0(b)	54.4	W	2000	19	1.6	2.6	23.9	2.2	1.4	1.6	0.1	257.7(c)
8	Sacrificial Spoil Fill	238.9(b)	50.9	S	3740	29	2.1	3.5	34.6	2.6	0.9	1.1	0.1	240.4(c)
						(NORMAL OPERATION W.L. IN RESERVOIRS)								
5	Sacrificial Spoil Fill	220	123	SSE	1970	16	4.0	6.7	62.7	3.5	1.8	2.0	0.5	222.5(c)
6	Natural	252	123	W	710	15	2.8	4.7	40.1	2.8	2.4	2.7	0.2	254.9(c)

(a) Figure 2.4.2-38
(b) See Section 2.4.2.3.4
(c) Maximum Water Level = Maximum Still Water Level + Maximum Wave Runup + Wind Setup
(d) Plant Grade = 260 ft. MSL

TABLE 2.4.2-28

SUMMARY OF SEDIMENT DISCHARGE SAMPLING RECORD FOR BUCKHORN CREEK NEAR CORINTH FOR THE PERIOD OF 1972 TO 1977

Date (Month/Day/Year)	Instantaneous Streamflow Rate (cfs)	Sediment Discharge Rates* (tons/day)
12/15/72	1400	1290
02/02/73	2730	2059
02/02/73	4410	3266
02/05/73	188	15
04/27/73	1020	323
04/27/73	1180	165
06/29/73	196	40
06/29/73	301	228
06/29/73	326	293
06/29/73	352	185
12/21/73	238	87
12/21/73	233	71
07/21/76	3.0	0.06
09/03/76	1.1	0.01
10/01/76	16.0	0.62
11/23/76	19.0	0.80
03/28/77	60.0	3.22

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*The sediment discharge rates are obtained by multiplying a factor of 1.04 to the suspended sediment discharge rates shown in Reference 2.4.2-6 to account for the bed-material discharge rates. This factor is derived from "Sediment Characteristics of Streams in the Eastern Piedmont and Western Coastal Plain Regions of North Carolina," USGS Water Supply Paper 1798-0, 1976, which indicates that the bed loads for several representative gaging stations in the State of North Carolina are in the range of 1% to 4% of suspended loads.

TABLE 2.4.2-29

RESERVOIR ANALYSIS NORMAL OPERATION - TWO UNITS
CRITICAL PERIOD- FEB. 1951 - JAN. 1952

						AUXILIARY RESERVOIR OPERATION			MAIN RESERVOIR OPERATION											
YEAR	MO.	CREEK INFLOW DA=79.5 CFS	NET EVAP In.	DIR RAIN In.	NET EVAP In.	CREEK INFLOW DA.RATIO CFS	NET EVAP. AcFt	RWL @ END OF MONTH FTMSL	CREEK INFLOW DA. RATIO CFS	PUMP TO AUX. RES. CFS	ALLOW FOR SEEP. CFS	AVAIL. MAKEUP CAPE FEAR AcFt	TOTAL AVAIL. WATER AcFt	AVE. SURF. AREA Ac	NET EVAP. AcFt	FORCED EVAP. (2) AcFt	INC. STOR. USE AcFt	TOTAL STOR. USE AcFt	RWL @ END OF MONTH FTMSL	REQ. PUMP CAPE FEAR AcFt
									A. Worst Monthly Evaporation Condition											
1951	F	54.4	2.44	1.86	0.58	1.27	15.5	250.2	41.9	0	5	16600	18650	4100	197	3375	0	0	220.0	1515
	M	72.5	4.41	2.47	1.94	1.69	52.2	250.4	55.9	0	5	18000	21130	4100	659	3835	0	0	220.0	1365
	A	90.6	6.28	4.49	1.79	2.11	48.6	250.6	69.8	0	5	17900	21756	4100	610	3874	0	0	220.0	632
	M	24.9	7.70	1.77	5.93	0.58	161.0	250.2	19.2	0	5	9130	10000	4100	1980	4223	0	0	220.0	5343
	J	10.2	8.21	3.43	4.78	0.24	128.0	250.0	7.9	0.80	5	7210	7335	4100	1590	5243	0	0	220.0	6713
	J	11.3	9.23	4.69	4.54	0.26	121.0	250.0	8.7	1.70	5	4240	4263	4050	1530	5585	2852	2852	219.2	4240(1)
	A	13.6	8.51	4.03	4.48	0.32	119.0	250.0	10.5	1.62	5	6290	6529	3990	1490	5467	428	3280	219.1	6290(1)
	S	3.4	6.30	1.38	4.92	0.08	131.0	250.0	2.6	2.12	5	0	-269	3910	1600	4177	6046	9326	217.5	0(1)
	O	2.3	4.64	2.90	1.74	0.05	46.4	250.0	1.8	0.70	5	0	-240	3720	540	4165	4945	14271	216.1	0(1)
	N	6.8	2.99	2.71	0.28	1.16	7.5	250.0	5.3	0	5	1390	1408	3590	83	3807	2482	16753	215.4	1390(1)
	D	19.3	1.54	3.24	-1.70	0.45	-45.5	250.3	14.8	0	5	10700	11303	3690	-523	3662	-8168	8585	217.7	10700(1)
1952	J	47.6	1.42	4.51	-3.09	1.11	-84.1	250.8	36.7	0	5	17700	19649	3960	-1020	3625	-8585	0	220.0	9241
									B. Normal Monthly Evaporation Condition											
1951	F	54.4	2.08	1.86	0.22	1.27	5.9	250.2	41.9	0	5	16600	18650	4100	75	3097	0	0	220.0	1123
	M	72.5	3.91	2.47	1.44	1.69	38.8	250.4	55.9	0	5	18000	21130	4100	490	3656	0	0	220.0	1016
	A	90.6	5.52	4.49	1.03	2.11	28.1	250.8	59.8	0	5	17900	21756	4100	352	3803	0	0	220.0	299
	M	24.9	6.77	1.77	5.00	0.58	136.0	250.4	19.2	0	5	9130	10000	4100	1680	4106	0	0	220.0	4916
	J	10.2	7.28	3.43	3.85	0.24	104.0	250.1	7.9	0	5	7210	7383	4100	1280	5103	0	0	220.0	6210
	J	11.3	7.23	4.69	2.54	0.26	67.9	250.0	8.7	0.12	5	4240	4460	4070	862	5325	1727	1727	219.5	4240(1)
	A	13.6	6.68	4.03	2.65	0.32	70.7	250.0	10.5	0.83	5	6290	6577	4050	894	5285	-400	1327	219.6	6290(1)
	S	3.4	5.50	1.38	4.12	0.08	110.0	250.0	2.6	1.77	5	0	-248	3970	1360	4024	5632	6959	218.1	0(1)
	O	2.3	3.55	2.90	0.65	0.05	17.3	250.0	1.8	0.23	5	0	-211	3800	206	3897	4314	11273	216.9	0(1)
	N	6.8	2.31	2.71	-0.4	0.16	-10.7	250.1	5.3	0	5	1390	1408	3690	-123	3561	2030	13303	216.3	1390(1)
	D	19.3	1.33	3.24	-1.91	0.45	-51.3	250.3	14.8	0	5	10700	11303	3810	-606	3388	-8465	4838	218.7	11700(1)
1952	J	47.6	1.19	4.51	-3.32	1.11	-90.7	250.9	36.7	0	5	17700	19649	4020	-1112	3388	-4838	0	220.0	5165

Key: (1) Limited to available makeup.

(2) Forced evaporation rates are conservatively based on four unit operation for comparability to Tables 2.4.2-11, 2.4.2-12, and 2.4.2-13.

TABLE 2.4.2-30

RESERVOIR ANALYSIS NORMAL OPERTATION - TWO UNITS

CRITICAL PERIOD AUGUST 1980 - JULY 1981

						AUXILIARY RESERVOIR OPERATION			MAIN RESERVOIR OPERATION											
YEAR	MO.	CREEK INFLOW DA=79.5 CFS	NET EVAP In.	DIR RAIN In.	NET EVAP In.	CREEK INFLOW DA.RATIO CFS	NET EVAP. AcFt	RWL @ END OF MONTH FTMSL	CFEEK INFLOW DA. RATIO CFS	PUMP TO AUX. RES. CFS	ALLOW FOR SEEP. CFS	AVAIL. MAKEUP CAPE FEAR AcFt	TOTAL AVAIL. WATER AcFt	AVE. SURF. AREA Ac	NET EVAP. AcFt	FORCED EVAP. (2) AcFt	INC. STOR. USE AcFt	TOTAL STOR. USE AcFt	RWL @ END OF MONTH FTMSL	REQ. PUMP CAPE FEAR AcFt
A. Worst Monthly Evaporation Condition																				
1980	A	5.2	8.51	0.76	7.75	0.12	207	250	4.09	3.23	5	246	-9	3960	2560	5467	8126	8126	217.8	246(1)
	S	5.5	6.30	3.62	2.68	0.13	72	250	4.34	1.07	5	849	746	3760	839	4177	4270	12396	216.6	849(1)
	O	18.9	4.64	2.19	2.45	0.45	65	250	14.80	0.61	5	2910	3475	3680	750	4165	1440	13836	216.2	2910(1)
	N	20.5	2.99	2.38	0.61	0.48	16	250	16.00	0	5	6730	7385	3720	189	3807	-3389	10447	217.3	6730(1)
	D	40.0	1.54	1.70	-0.16	0.94	-4	250.3	31.30	0	5	6850	8467	3855	-50	3662	-4855	5592	218.5	6850(1)
1981	J	34.1	1.42	1.04	0.38	0.81	10	250.4	26.70	0	5	6620	7954	3995	127	3625	-4202	1390	219.7	6620(1)
	F	123.0	2.44	3.53	-1.09	2.91	-30	251.0	96.30	0	5	15700	20771	4100	-371	3375	1390	0	220.1	0
	M	44.4	4.41	1.33	3.08	1.05	86	251.0	34.80	0	5	15900	17732	4100	1040	3835	0	0	220.0	3280
	A	24.1	6.28	1.04	5.24	0.57	144	250.6	18.90	0	5	11800	12627	4100	1760	3874	0	0	220.0	4800
	M	11.2	7.70	2.37	5.33	0.27	144	250.2	8.78	0	5	4420	4652	4080	1810	4223	1381	1381	219.6	4420(1)
	J	6.0	8.21	1.13	7.08	0.14	189	250	4.70	2.13	5	8250	8105	4065	2398	5243	-464	917	219.9	8250(1)
	J	4.4	9.23	2.90	6.33	0.10	169	250	3.43	2.64	5	9660	9401	4100	2162	5585	-917	0	220.0	8932(1)
B. Normal Monthly Evaporation Condition																				
1980	A	5.2	6.68	0.76	5.92	0.12	158	250	4.09	2.44	5	246	40	3970	1960	5285	7205	7205	218.0	246(1)
	S	5.5	5.50	3.62	1.88	0.13	50	250	4.34	0.71	5	849	768	3790	594	4024	3850	1105	217.0	849(1)
	O	18.9	3.55	2.19	1.36	0.45	36	250	14.80	0.13	5	2910	3505	3740	424	3897	818	11871	216.8	2910(1)
	N	20.5	2.31	2.38	-0.07	0.48	-2	250.1	16.00	0	5	6730	7385	3785	-22	3561	-3846	8025	217.8	6730(1)
	D	40.0	1.33	1.70	-0.37	0.94	-10	250.3	31.30	0	5	6850	8467	3925	-121	3388	-5200	2825	219.2	6850(1)
1981	J	34.1	1.19	1.04	0.15	0.81	4	250.5	26.70	0	5	6620	7954	4050	50	3388	-2825	0	220.0	4913
	F	123.0	2.08	3.53	-1.45	2.91	-40	251.1	96.30	0	5	15700	20771	4110	-497	3097	0	0	220.2	0
	M	44.4	3.91	1.33	2.58	1.05	73	251.1	34.80	0	5	15900	17732	4100	873	3656	0	0	220.0	3390
	A	24.1	5.52	1.04	4.48	0.57	125	250.8	18.90	0	5	11800	12627	4100	1500	3803	0	0	220.0	4480
	M	11.2	6.77	2.37	4.40	0.27	120	250.5	8.78	0	5	4420	4652	4080	1496	4106	950	950	219.7	4420(1)
	J	6.0	7.28	1.13	6.15	0.14	165	250	4.70	0.11	5	8250	8226	4080	2090	5103	-950	0	220.0	8167
	J	4.4	7.23	2.90	4.33	0.10	115	250	3.43	1.77	5	9660	9455	4100	1440	5325	0	0	220.0	6970

Key: (1) Limited to available makeup.

(2) Forced evaporation rates are conservatively based on four unit operation for comparability to Tables 2.4.2-11, 2.4.2-12, and 2.4.2-13.

TABLE 2.4.2-31

RESERVOIR ANALYSIS

NORMAL OPERATION - ONE UNIT
CRITICAL PERIOD MAY 1980 - MAY 1982

						AUXILIARY RESERVOIR OPERATION			MAIN RESERVOIR OPERATION									
Year	Mo.	CREEK INFLOW DA=79.5 CFS	NAT. EVAP. In.	DIR RAIN In.	NET EVAP. In.	CREEK INFLOW DA. RATIO CFS	NET EVAP. Ac.Ft.	RWL @ END OF MONTH FT.MSL	CREEK INFLOW DA.RATIO CFS	PUMP TO AUX RES. CFS	ALLOW FOR SEEP. CFS	TOTAL AVAIL WATER Ac.Ft	AVERAGE RES.SURF. AREA Ac	FORCED EVAP. Ac.Ft	NET EVAP. Ac.Ft	INCR. STOR. USE Ac.Ft	TOTAL STOR. USE Ac.Ft	RWL@ END OF MONTH FT.MSL
1980	M	44.0	7.70	2.75	4.95	1.07	132	250.0	34.80	1.08	5	1766	3636	1090	1500	824	14274	216.1
	J	38.8	8.21	3.37	4.84	0.94	129	250.0	30.70	1.23	5	1456	3620	1090	1460	1094	15368	215.8
	J	17.6	9.23	2.12	7.11	0.43	190	250.0	14.00	2.66	5	390	3544	1140	2100	2850	18218	214.9
	A	5.23	8.51	0.76	7.75	0.13	207	250.0	4.15	3.23	5	-251	3422	1130	2210	3591	21809	213.8
	S	5.54	6.30	3.62	2.68	0.13	72	250.0	4.42	1.07	5	-98	3322	1080	742	1920	23729	213.2
	O	18.9	4.64	2.19	2.45	0.46	65	250.0	15.10	0.60	5	584	3267	1070	667	1153	24882	212.8
	N	20.5	2.99	2.38	0.61	0.50	16	250.0	16.30	0	5	672	3246	988	165	481	25363	212.7
	D	40.0	1.54	1.70	-0.16	0.97	-4	250.3	31.90	0	5	1654	3225	959	-43	-738	24625	212.9
1981	J	34.1	1.42	1.04	0.38	0.82	10	250.4	27.20	0	5	1365	3253	953	103	-309	24316	213.0
	F	123	2.44	3.53	-1.09	2.97	-30	251.0	98.30	0	5	5182	3358	872	-305	-4615	19701	214.5
	M	44.4	4.41	1.33	3.08	1.06	86	251.0	35.40	0	5	1869	3436	1000	882	13	19714	214.5
	A	24.1	6.28	1.04	5.24	0.58	144	250.6	19.20	0	5	845	3412	1020	1490	1665	21379	213.9
	M	11.2	7.70	2.37	5.33	0.27	144	250.2	9.86	0	5	299	3332	1090	1480	2271	23650	213.2
	J	6.0	8.21	1.13	7.08	0.15	189	250.0	4.80	2.13	5	-139	3237	1090	1910	3139	26789	212.2
	J	4.38	9.23	2.90	6.33	0.11	169	250.0	3.51	2.64	5	-254	3128	1140	1650	3044	29833	211.2
	A	27.7	8.51	5.25	3.26	0.67	87	250.0	22.2	0.74	5	1012	3055	1130	830	948	30781	210.9
	S	9.53	6.30	1.61	4.69	0.23	125	250.0	7.66	1.87	5	47	2994	1080	1170	2203	32984	210.2
	O	21.4	4.64	3.91	0.73	0.52	20	250.0	17.2	0	5	750	2959	1070	180	500	33484	210.0
	N	9.6	2.99	0.98	2.01	0.23	54	250.0	7.61	0.46	5	128	2919	988	487	1349	34833	209.4
	D	42.6	1.54	4.44	-2.90	1.03	-78	250.5	34.30	0	5	1802	2926	959	-707	-1550	33283	210.1
1982	J	176.3	1.42	4.39	-2.97	4.25	-83	251.5	142	0	5	8424	3099	953	-767	-8238	25045	212.8
	F	152.7	2.44	3.97	-1.53	3.62	-45	252.0	122	0	5	6498	3349	872	-427	-6053	18992	214.7
	M	137.9	4.41	2.87	1.54	3.24	46	252.0	110	0	5	6456	3553	1000	456	-5000	13992	216.2
	A	57.2	6.28	3.32	2.96	1.35	87	251.7	45.3	0	5	2398	3657	1020	902	-476	13516	216.3
	M	63.3	7.70	2.34	5.36	1.50	156	251.6	50.1	0	5	2773	3672	1090	1640	-43	13473	216.4

NOTES : (1) Worst monthly evaporation rates used
(2) No makeup pumping from Cape Fear River
(3) Starting level = 216.3 FT MSL for Main Reservoir
= 250.0 FT MSL for Auxiliary Reservoir
(4) All creek inflows estimated from USGS records for Middle Creek at Clayton by drainage area ratio
(5) Preliminary, unpublished USGS flow records used for October 1981 through May 1982
(6) On-site rainfall records used.

TABLE 2.4.2-32

RESERVOIR ANALYSIS

NORMAL OPERATION - ONE UNIT

100-YEAR DROUGHT

					AUXILIARY RESERVOIR OPERATION			MAIN RESERVOIR OPERATION									
MO.	CREEK INFLOW DA=79.5 CFS	NAT. EVAP. In.	DIR RAIN In.	NET EVAP. In.	CREEK INFLOW DA.RATIO CFS	NET EVAP. Ac.Ft.	RWL @ END OF MONTH FT.MSL	CREEK INFLOW DA.RATIO CFS	PUMP TO AUX RES CFS	ALLOW FOR SEEP. CFS	TOTAL AVAIL WATER Ac.Ft	AVERAGE RES.SURF. AREA Ac	NET EVAP. Ac.Ft	FORCED EVAP. Ac.Ft.	INCR. STOR. USE Ac.Ft	TOTAL STOR. USE Ac.Ft	RWL @ END OF MONTH FT.MSL
M	51.6	7.70	2.16	5.54	1.25	148	250	40.8	1.15	5	2131	3660	1690	1090	649	14099	216.1
J	12.5	8.21	1.17	7.04	0.30	188	250	9.92	2.85	5	123	3580	2100	1090	3067	17166	215.2
J	12.5	9.23	1.72	7.51	0.30	200	250	9.95	2.95	5	123	3467	2170	1140	3187	20353	214.3
A	12.5	8.51	4.88	3.63	0.30	97	250	9.97	1.27	5	228	3736	1020	1130	1922	22275	213.6
S	4.1	6.30	0.67	5.63	0.10	150	250	3.25	2.42	5	-248	3282	1540	1080	2868	25143	212.7
O	4.1	4.64	0.72	3.92	0.10	105	250	3.25	1.60	5	-206	3184	1040	1070	2316	27459	212.0
N	4.1	2.99	1.20	1.79	0.10	48	250	3.26	0.70	5	-145	3124	466	988	1599	29058	211.5
D	4.1	1.54	0.75	0.79	0.10	21	250	3.26	0.24	5	-122	3084	203	959	1284	30342	211.0
J	51.6	1.42	1.44	-0.02	1.25	-1	250.3	41.50	0	5	2244	3080	-5	953	-1296	29046	211.5
F	51.6	2.44	2.51	-0.07	1.25	-2	250.5	41.40	0	5	2022	3120	-18	872	-1168	27879	211.9
M	51.6	4.41	1.63	2.78	1.24	75	250.5	41.40	0	5	2238	3147	729	1000	-509	27369	212.0
A	51.6	6.28	4.33	1.95	1.24	53	250.6	41.40	0	5	2166	3163	514	1020	-632	26737	212.2

4

NOTES :
(1) Worst monthly evaporation rates used
(2) No makeup pumping from Cape Fear River
(3) Starting level = 216.3 FT MSL for Main Reservoir
= 250.0 FT MSL for Auxiliary Reservoir
(4) Creek inflow and rainfall data from Table 2.4.2-15

TABLE 2.4.2-33

ONE-UNIT OPERATION

MONTHLY MAIN RESERVOIR RELEASE-AVERAGE AND 100-YEAR DROUGHT CONDITIONS

Month	Average (in CFS)	100-Year Drought (in CFS)
January	76.7	0
February	102.7	0
March	119.7	0
April	66.5	0
May	54.6	0
June	11.0	0
July	14.7	0
August	2.2	0
September	21.3	0
October	19.1	0
November	21.2	0
December	15.2	0

4

2.4.3 GROUNDWATER

2.4.3.1 Regional Groundwater Conditions

The site region encompasses parts of two distinct physiographic provinces: the Piedmont and the Coastal Plain (Figure 2.4.3-1). The Piedmont province is composed primarily of metamorphic rocks (slates, gneisses, and schists) ranging in age from Precambrian to late Paleozoic. The rocks are tightly to openly folded, faulted, and intruded by granitic rocks. Within the Piedmont province is the Deep River Triassic Basin; this basin is almost 100 mi. long and 5 to 20 mi. wide. The Basin is occupied by a wedge of Triassic sedimentary rocks which are primarily siltstones, sandstones, shales, claystones, conglomerates, and fanglomerates. The rocks, which generally dip 9° to 33° to the southeast, have been intruded by vertical to near vertical Mesozoic age diabase dikes.

The Coastal Plain province composes most of the eastern portion of the site region. The province is composed of Cretaceous to Holocene, weakly consolidated to unconsolidated sediments that dip very gently to the southeast.

2.4.3.1.1 Regional Aquifers

Groundwater availability within the site region is strongly controlled by the geology. In general, the Piedmont province is a poor source of groundwater, whereas most of the Coastal Plain province is a better groundwater source.

a) Crystalline Piedmont

The primary permeability of crystalline Piedmont rocks is low. Joints and fractures control the storage and movement of the groundwater. The openings are associated more with regional stress patterns than with lithology. Therefore, wide variations in yield may occur within the same lithologic unit. The variation within a unit is often as great as the variation between units. Table 2.4.3-1 illustrates the average yield per foot of well for different lithologic units. As indicated by the table, the average yield per foot of uncased well in the crystalline Piedmont rocks ranges from 0.15 to 0.20 gpm. Some localized areas of higher yield are found within highly fractured quartz dikes. Higher yielding wells are more common in relatively low topographic areas with large drainage areas, regardless of the lithologic unit.

b) Triassic Piedmont

The primary permeability of the Triassic aquifer in the site region is very low; rocks appear to be essentially dry. However, the Triassic rocks have joints resulting from stress releases. The jointing, which provides secondary permeability in the rocks, is filled with water below the water table. Joints are common to depths of 100 ft., but become less prevalent and tight below that depth.

Attempts to develop groundwater supplies from the Triassic sediments have met with limited success. However, groundwater is developed in hornfels areas adjacent to diabase dikes which have intruded the Triassic sediments.

The relationship of dikes, fractures, and groundwater flow is illustrated diagrammatically on Figure 2.4.3-2. The water entering the ground is confined laterally by the diabase dikes and vertically by the absence of open fractures or joints at depth in the Triassic sediments. This tends to divide the aquifer into subsystems bounded by diabase dikes. Wells in the region range up to 300 ft. in depth, have an average depth of 115.3 ft., and yield about 0.08 gpm per foot of uncased hole. Higher yields are obtained from wells developed adjacent to diabase dikes. When water requirements are large, surface water must be developed.

c) Coastal Plain

The Coastal Plain sediments contain some sand units that are capable of producing substantial amounts of water. Within the site region, the province contains two aquifers, the surface Pleistocene to Holocene sands, and the sand units of the Cretaceous formations. The surficial sand aquifers have relatively low sustained yields, although their permeability is relatively high; this is due to their limited vertical extent. The Cretaceous sands have higher permeabilities (Reference 2.4.3-1).

2.4.3.1.2 Regional Groundwater Use

Groundwater withdrawls within the site region are primarily for domestic use. Areas underlain by Coastal Plain sediments have a much higher groundwater usage. Figure 2.4.3-3 is a location map which shows municipalities (populations greater than 500) within 50 mi. of the site that use groundwater or groundwater along with surface water. Table 2.4.3-2 lists these municipalities, the number of wells in use, and the approximate total volume. 4 Within 10 mi. of the site, 36 public wells have been reported. Data for these wells are listed in Table 2.4.3-3; the well locations are shown on Figure 2.4.3-4.

2.4.3.2 Site Geohydrologic Characteristics

The entire project is located within the Buckhorn Creek watershed of the Piedmont near the Fall Line, the physiographic limit between the Coastal Plain and the Piedmont Plateau, in east-central North Carolina. Buckhorn Creek is a tributary of the Cape Fear River. The entire drainage area of Buckhorn Creek northwest of the Jonesboro Fault is underlain by Triassic rocks of the Newark Group. The drainage area of Buckhorn Creek that is located southeast of the Jonesboro Fault is relatively small and is underlain by Paleozoic crystalline rocks and igneous intrusives, as well as metamorphic rocks of the Carolina Slate Belt. Both the Triassic and Pre-Triassic rocks are overlain by an overburden of clayey soils and saprolite.

The plant site is located on a ridge bounded by Thomas Creek to the east, Tom Jack Creek to the west, and White Oak Creek to the southeast; these creeks are tributaries of Buckhorn Creek. The plant site has been graded to Elevation 260 ft. msl. The pre-grading site elevations ranged from about 210 to 280 ft. msl; the land surface generally sloped towards the east and southeast.

2.4.3.2.1 Hydraulic Characteristics

a) Overburden

The plant area is covered with residual soils derived from the underlying rocks. The numerous soil borings drilled in the plant island area as well as in the Auxiliary Reservoir area, confirm the existance of up to about 15 ft. of clayey soil and saprolite overlying the Triassic rocks. The excavation and mapping of trenches in the plant area, as well as the excavation and borings for the site fault investigation (Reference 2.4.3-2) also indicate the preponderance of clayey and silty loam soils.

The U. S. Soil Conservation Service soil survey of Wake County, 1970, classified the site soils as the Creedmoor-White Store Association (Reference 2.4.3-3). Some typical engineering properties of the Creedmoor-White Store soil series, as mapped in the site area and taken from the U. S. Soil Conservation Service soil survey of Wake County, 1970, are listed below. They indicate that the Creedmoor-White Store soil conditions are relatively impervious. The surficial clay and saprolite zones prevent ready recharge to the rocks below them, as indicated by the general dry state of these rocks (Reference 2.4.3-2).

CREEDMOOR-WHITE STORE ASSOCIATION
CREEDMOOR SOIL SERIES (Typical Profile)

DEPTH (in.)	TEXTURE	PERCENTAGE PASSING SIEVE No. 200 (0.074 mm)	PERMEABILITY (in. per hr.)	SHRINK-SWELL POTENTIAL
0-12	Sandy loam	30-45	2.0 - 6.3	Low
12-29	Clay loam	35-85	0.63 - 2.0	Moderate
29-58	Clay	70-95	0.2	High
58-96	Clay	35-90	0.2	Moderate

b) Triassic Rocks

The plant site and peripheral lands are underlain by Newark Group rocks (Triassic) which are the only source of groundwater at the site. They consist of claystone, shale, siltstone, sandstone, conglomerate, and fanglomerate. An exception to this lithology is the intrusion of thin diabase dikes in the rock; these dikes were mapped in connection with the fault investigation in the plant and the Auxiliary Dam areas (Reference 2.4.3-2 and 2.4.3-4). The diabase rock is weathered near the surface and is unweathered below depths of about 20 ft.

The primary permeability of Triassic rocks is very low and the rocks appear to be essentially dry. Some lenses of relatively higher permeability rock exist within the Triassic rocks; however, they are not extensive and are surrounded by materials of relatively lower permeability. The Triassic rocks have fractures that have resulted from stress releases. These fractures provide secondary permeability in the rocks and are filled with water below the water table. The fractures are common to depths of about 100 ft., but become less prevalent and tight below that depth. Below about 400 ft., the fractures are closed and sealed to water flow (as shown by tests and experience gained through private well drilling in the area). Recharge in the area occurs by percolation of precipitation through the overburden. Most of the precipitation, however, is either lost back to the atmosphere through evapo-transpiration or becomes surface runoff. The predominance of surface and near-surface deposits with extremely low permeabilities results in rapid runoff of precipitation. Therefore, natural recharge to the aquifer occurs at a very low rate.

The precipitation which percolates downward is confined laterally by the diabase dikes and vertically by the absence of open fractures or joints at depth in the Triassic rocks. Numerous attempts to develop groundwater supplies from the Triassic rocks have been unsuccessful since these rocks are tight and relatively dry. However, groundwater is developed in the Triassic basin from hornsfels zones adjacent to diabase dikes. The relationship of dikes and fractures to groundwater flow is illustrated diagrammatically on Figure 2.4.3-2.

Even though Triassic rocks constitute the major aquifer within the site environs, the aquifer exhibits very low permeability for groundwater storage and movement. Of the 57 wells with an average depth of 158 ft. constructed in the Triassic formation in western Wake County, 16 percent yield less than 1 gpm with the average production at 5 gpm. Such relatively low permeability indicates that the Triassic formation is the lowest productive aquifer in the region (Reference 2.4.3-4). Numerous borings carried out for soil and geologic information in the plant site and reservoir areas confirm the very low permeability of the Triassic formation.

Six site wells located in the proximity of the diabase dikes yielded specific capacity values from 24 hour driller's tests that ranged from 0.16 gpm/ft. to 0.59 gpm/ft. These specific capacity values correspond to transmissivity values of about 40 ft.^{2}/day to 130 ft.^{2}/day (Reference 2.4.3-5).

2.4.3.2.2 Onsite Use of Groundwater

2 Seven wells were completed during 1973 and are being used during the construction phase. Additionally, eight new wells were developed in the proximity of diabase dikes during 1977-1979; three more in 1980 and two more in 1981. Site wells are listed in Table 2.4.3-4 and are shown on Figure 2.4.3-5. Groundwater is being used at the site during the construction phase for (1) concrete batch plant and concrete placement, (2) office and plant use, and (3) grouting. Groundwater is not expected to be used for plant operation after the plant potable water system is installed. The estimated plant water requirements projected through the year 1982 are shown in Table 2.4.3-5.

Carolina Power & Light Company is the principal user of groundwater within two miles of the plant; there are only two domestic users within two miles of the plant, and both are up-gradient near the 7,000 ft. radius boundary.

2.4.3.2.3 Groundwater Levels and Movement

A piezometric-level map (Figure 2.4.3-5), based on water-level measurements taken before commencement of full-scale plant construction, shows that the general groundwater movement in the plant area at that time was to the southeast toward White Oak Creek. Most of the original site piezometers had been lost due to construction activities; therefore, sixteen new piezometers were constructed in December, 1979. A piezometric-level map, based on water-level readings in wells, in the sixteen new piezometers, and in two old piezometers that were taken during the winter of 1979-1980, is shown on Figure 2.4.3-6. The map, based on the highest water levels (not necessarily static levels) that were observed during the three-month period, shows that the general direction of groundwater movement at the site is still to the southeast towards White Oak Creek. However, the water levels have been significantly altered due to the ongoing pumpage from the site wells. Figure 2.4.3-6 shows that cones of depression had developed on the northeast and the southwest sides of the plant. Three of the piezometers have since been abandoned and one piezometer was destroyed as indicated on Table 2.4.3-4. 4

Fourteen of the piezometers that were installed in 1979 as well as two pre-construction piezometers and one new well, are currently available at the plant site. The piezometers and site wells provide data on water levels, hydraulic gradient, and direction of flow. Water levels in piezometers and site wells are measured periodically and analyzed to assess the effect of construction on the site ground-water regime. Water samples from three wells were analyzed to determine baseline water quality parameters (FSAR Table 2.4.13-8).

Once the plant begins operation, the ground-water data collection program will be modified to provide data on recharge to the aquifer, movement of water and changes in chemical quality of the ground water.

Current plans are to maintain a basic network of 12 wells to provide periodic data from the aquifer. These wells are: LP-1; LP-2; LP-8; LP-12; LP-13; LP-16; PZ-2; Well 4; Well 7-A; Well 8; Well 8-A; and Well 13. Wells 4, 7-A, and 8 will be sampled periodically to monitor the chemical properties of the water. The locations of these wells are shown on Figure 2.4.2-10. 4

Water levels in all network wells will be measured monthly by hydrologists or trained technicians using electric water-level sensing tapes. At least one well will be equipped with a continuous water-level recorder, such as a Stevens, Type F. Water samples will be taken at 3-month intervals from Wells 4, 7-A, and 8 for chemical analyses. Water-level and chemical data will be sent to the Company's hydrologists for synthesis and evaluation. The hydrologists will maintain up-to-date files on the data and will prepare brief periodic reports on the hydrologic condition of the aquifer. Periodic summary reports or FSAR updates as appropriate, will also be prepared and will discuss hydrologic changes in the aquifer, apparent effects of the reservoir on ground water and any potential ground-water related problems at the plant.

The operational monitoring program may be modified as the long term data base is established and as recommended by CP&L hydrologists.

2.4.3.2.4 Effects of Groundwater Usage

The population in the vicinity of the plant is small and groundwater usage is minimal due to low yields of wells. Most of the land within a two mile radius, and some beyond this distance, has been acquired by Carolina Power & Light Company. Therefore, the population in the plant vicinity is not likely to increase much and groundwater usage will remain essentially the same.

The yield of the Triassic aquifer is low and only a limited supply of groundwater is obtainable from the proximity of diabase dikes. Therefore, any increase in groundwater usage will be limited because of the poor permeability and storage characteristics of the aquifer.

Groundwater is being utilized at the site during construction. Table 2.4.3-5 shows the total site staff which is expected to decline. Site groundwater use is also expected to gradually decrease due to the decline in the construction activities.

Figures 2.4.3-5 and 2.4.3-6 compare the pre-contruction piezometric levels to those measured during the winter of 1979-1980. The groundwater levels, which have been affected considerably, are declining due to pumpage from the site wells. Cones of depression have developed on the northeast and southwest sides of the plant around wells which are being pumped. The direction of groundwater movement has already been reversed in the proximity of some wells, as depicted by these cones of depression.

The reservoirs at the Shearon Harris Nuclear Power Plant site comprise a total of approximately 4,417 acres in surface area and contain approximately 77,500 acre-feet of water at the normal pool elevations. The Main Reservoir elevation is 220 ft. msl, the elevation of the Auxiliary Reservoir is 252 ft. msl., and the cones of depression have water levels lower than elevation 190 ft. msl. When the reservoirs are at operating levels, the subsurface flow of water will be toward the cones of depression from the two reservoirs until construction use of groundwater has stopped and groundwater elevations stabilize.

Water is supplied to the reservoirs by stream flow, direct precipitation and runoff, and an insignificant quantity of ground-water influent from springs of intercepted permeable zones associated with intrusive rocks where they are in hydraulic contact with the reservoirs.

Because of the impervious nature of the soils and country rock, there is only insignificant interchange of water between the reservoirs and the aquifier. This condition is verified as shown in Figure 2.4.3-7. Note that the water levels in piezometers 8A and LP13 are at elevations 102.5 ft. (affected by pumping) and 189.3 ft., respectively, while the water level in the emergency intake canal, approximately 50 feet from both wells, is at elevation 245 ft.

In FSAR Table 2.4.13-7, the results of permeability determinations from down-hole pressure tests show that permeability values for the country rock range from 0.0096 to 0.265 gallons per day per square foot (gpd/ft^2) within the plant site. According to the USDA Soil Conservation Service soil survey of 5 Wake County, 1970, in the upper 96 inches of soil the permeability values range from 29.9 gpd/ft^2 to 94.2 gpd/ft^2 in the uppermost 12 inches of sandy loam, from 9.4 to 29.9 gpd/ft^2 in the next 17 inches of clay loam, and 3 gpd/ft^2 in the next 79 inches of clay. The saprolite zones below the surficial clay have much lower permeability values, as mentioned above, and prevent ready movement of water from the surface to the deeper soils.

The lack of data points outside the immediate vicinity of the plant island makes it impossible to prepare an accurate map of the piezometric surface in the offsite areas. However, in Figures 2.4.3-8 and 2.4.3-9, the pre-construction, current, and post-construction water-level conditions in the plant island area are illustrated. The post construction water levels are anticipated to closely duplicate the preconstruction conditions except where altered by the plant structure and, to some extent, in the immediate proximity of the reservoir and canals.

The permeability values of the soils and saprolite that underlie the reservoir are so low that nearly vertical gradients are expected. In areas where there may be a flow of water from the reservoir to the water table, the steep 5 hydraulic gradient will confine the flow path to within a short distance of the shoreline. Where fracture systems of intrusive dikes may be in hydraulic contact with the reservoir and the head relationships are such as to allow flow from the reservoir into the aquifer, the gradients will be less than in the country rock, but the flow path will be narrow and confined very closely to the fractured zones in the dikes. According to the observed behavior of water in the fracture system during the pumping test on wells 13 and 15, it is possible that measurable changes in the water level may occur a few hundreds of feet from the reservoir in such fracture systems. The reservoirs will produce no observable effects on the ground-water levels outside the Shearon Harris Nuclear Power Plant site.

2.4.3.3 Groundwater Quality

The chemical analyses of water from several wells in the site region located in the Raleigh and Durham areas of North Carolina are reported in References 2.4.3-4 and 2.4.3-6. Table 2.4.3-6 shows ranges in concentration and the median concentrations of chemical constituents in groundwater in the Durham and Raleigh areas. The chemical characteristics of groundwater in the two areas show little relationship to the rock units. Groundwater from the Triassic rocks usually contain more dissolved solids than water from other units.

Water samples from three site wells were analyzed to determine site groundwater quality parameters. The results of these analyses are shown in Table 2.4.3-7. The site wells can provide samples for analysis of groundwater in the event of inadvertent radioactive spills.

There will be so little seepage into the aquifer that the effects on water quality will be undetectable outside the CP&L property boundaries. The closest privately-owned well to the reservoir is on N. C. State Road 1128 at approximately 600 feet from the shoreline (Figure 2.4.3-11). The ground surface elevation at this well is greater than 30 feet above the normal pool level. This suggests that the direction of ground-water flow would be from 5 the well to the reservoir. Inspection of the topographic maps of the area indicates the expected direction of ground-water flow all around the reservoir is towards the reservoir. Possible exceptions may be in the stream 5 valley immediately downstream from the main dam where there might be some ground-water flow under and around the dam, and within a few feet of the general shoreline as the gradients adjust to the water levels in the reservoir.

The chemical and biological requirements for the plant make-up water are quite stringent and dictate that the high quality of the reservoir water must be maintained. Should any reservoir water seep into the surrounding streams, it would be filtered within the aquifer and would be of better quality than the water in the receiving streams.

TABLE 2.4.3-1

CAROLINA POWER & LIGHT COMPANY
SHEARON HARRIS NUCLEAR POWER PLANT

SUMMARY OF WATER-BEARING PROPERTIES OF MAPPED LITHOLOGIC UNITS IN DURHAM, N.C. AREA

MAP UNIT	NUMBER OF WELLS	AVERAGE DEPTH (FEET)	RANGE IN DEPTH	YIELD (GALLONS PER MINUTE) AVERAGE	YIELD (GALLONS PER MINUTE) PER FOOT OF WELL	YIELD (GALLONS PER MINUTE) PER FOOT OF UNCASED HOLE
Metavolcanic Unit	317	94.8	0-600	9.6	0.10	0.15
Argillite-Graywacke Unit	77	102.4	0-283	7.3	0.07	0.12
Triassic Unit	110	115.3	0-300	7.2	0.06	0.08
Granite Unit	61	82.5	0-400	8.2	0.10	0.18
Granodiorite Unit	22	86.7	0-400	10.0	0.12	0.20
Hornblende Gneiss Unit	11	60.7	-	4.0	0.07	-
Mica Gneiss and Schist Unit	4	134.0	-	8.8	0.07	-

NOTE: Data from Groundwater Bulletin Number 7, N. C. Department of Water Resources, May, 1966. (Reference 2.4.3-6). 2

TABLE 2.4.3-2

SHEARON HARRIS NUCLEAR POWER PLANT
DATA ON PUBLIC GROUNDWATER SUPPLY SYSTEMS WITHIN 50 MILES OF THE PLANT

| 4

Map*** No.	Community (Owner)*	Population Served	Water Use (Mgal/d) Total Avg.	Max.	% Ind.	Water Source	Allowable Draft (Mgal/day)	Raw Water Pumping Capacity (Mgal/day)	Water Storage (Mgal) Raw	Fin.	Treatment**	Treatment Plant Capacity (Mgal/Day)	Finished Water Quality (mg/l) D.S.	Hard.	Iron	Other
						GUILFORD COUNTY										
1	Gibonsville (M)	2,500	0.3	-	0.2	6 wells (bedrock)	-	0.7	0	0.35	ah	-	264	191	0.42	Mn 0.12
						RANDOLPH COUNTY										
2	Liberty (M)	2,250	0.34	0.37	0.15	7 wells (bedrock)	-	0.86	0.28	-	none	-	131	80	0.08	Mn 0.08
						JOHNSTON COUNTY										
3	Benson (M)	2,400	0.3	0.4	0.01	6 wells (Cretaceous sands), 3 wells (bedrock)	-	0.55	0	0.4	abdgh	-	166	64	0.03	Mn 0.10
4	Clayton (M)	4,300	0.45	-	0.05	16 wells (bedrock)	-	0.72	0	0.95	a	-	167	110	0.00	NO_3 20
5	Kenly (M)	1,400	0.10	0.18	0.01	5 wells (bedrock)	-	0.63	0	0.3	afi	-	104	54	0.03	
6	Selma (M)	4,200	0.4	-	0.01											
						4 wells (bedrock)		0.8			afgi	1.0	182	77	0.01	Mn 0.80
						Smithfield, NC	0.1-0.2									
						WAKE COUNTY										
7	Cary (M)	7,430	0.64	-	0.007				0	0.9						
						City of Raleigh	?	-								
						1 well (bedrock)	-	0.17			none	-	175	96	0.000	
8	Fuquay-Varina (M)	3,500	0.33	0.46	0.03	8 wells (bedrock)	-	1.6	0.06	0.3	abfg	0.58	154	66	1.2	Mn 0.5
9	Garner (M)	8,000	0.4	-	0.01											
						12 wells (bedrock)	-	0.86	0.62	-	none	-	188	105	0.46	Mn 0.08
						City of Raleigh	?									
10	Wendell (M)	2,200	0.19	0.30	0.02			1.0		0.60						
						Lake Johnson	-		200		acf	0.30	101	51	0.000	
						1 well (bedrock)		0.04			none	-			0.000	
						CUMBERLAND COUNTY										
11a	Cottonade-Summer Hill Water System (LaFayette Water Corp.)	3,700	0.29	-	0	14 wells (Cretaceous sands)	-	2.0	0	0.25	1	-	19	1	0.00	Cu 1.2 pH 4.9
11b	LaGrange Water System (P)	3,600	0.28	-	0	12 wells (Cretaceous sands)	-	0.73	0	0.21	ai	-	23	1	0.06	
11c	Loch Lomond - Devonwood Water System (Montclair Water Corporation)	2,600	0.14	-	0	6 wells (Cretaceous sands) 5 wells (bedrock)	-	0.66	0.32	-	none	-	27	1	0.05	
11d	Ponderosa Water System (Cumberland Water Company	5,800	0.48	-	0	10 wells (Cretaceous sands)	-	1.5	0	0.6	1	-	24	1	0.01	pH 4.9

TABLE 2.4.3-2 (Cont'd)

Map No.***	Community (Owner)*	Population Served	Water Use (Mgal/d) Total		%	Water Source	Allowable Draft (Mgal/day)	Raw Water Pumping Capacity (Mgal/day)	Water Storage (Mgal)		Treatment**	Treatment Plant Capacity (Mgal/Day)	Finished Water Quality (mg/l)			
			Avg.	Max.	Ind.				Raw	Fin.			D.S.	Hard.	Iron	Other
						CUMBERLAND COUNTY (Cont'd)										
12	LaFayette Village Sherwood Water System (LaFayette Water Corporation)	12,800	0.76	-	0	17 wells (Cretaceous sands)	-	2.7	0	0.62	i	-	111	9	0.00	
13	Montclair Water System (P)	4,600	0.25	-	0	5 wells (Cretaceous sands)	-	0.8	0	0.53	1	-	49	5	0.04	
14	Spring Lake (M)	11,000	0.6	-	0	6 wells (Cretaceous sands)	-	1.3	0	0.78	hi	-	97	12	0.01	
						HARNETT COUNTY										
15	Angier (M)	1,500	0.15	-	0.005	4 wells (bedrock)	-	0.33	0	0.85	abdf	0.22	59	28	0.326	Mn 0.07
						HOKE COUNTY										
16	Raeford (M)	3,000	2.04	-	1.5	11 wells (Cretaceous sands)	-	2.9	0	0.80	abhi	0.5	28	10	0.83	
						MOORE COUNTY										
17	Aberdeen (M)	3,300	0.3	-	0.06	7 wells (Cretaceous sands)	-	1.9	0	0.5	aj	-	6	21	0.12	
18	Carthage (M)	1,200	0.15	0.18	0.03					1.4	acdefi	0.35				
						Springs:										
						Town Pond No. 1	1.8	1.0	22				65	41	0.000	
						Nick's Creek		1.0								
19	Pinehurst (Pinehurst, Inc.)	1,200	36	-	0					0.92						
						Rattlesnake Creek	0.5	gravity	0		afhi	unknown	12	7	0.06	
						2 wells	-	0.4	0		ah	-	13	3	0.000	

NOTES:

*(M) = Municipal; (P) = Private, serving 500 or more customers

**Physical and chemical adjustments to water to improve its quality are indicated by one or more of the following letters:
a = chlorination; b = aeration; c = coagulation; d = sedimentation; e = taste and odor control, f = filtration;
g = softening; h = corrosion control; i = adjustment of pH; j = fluoridation; k = ammoniation; none = no treatment

Data from "Public Water Supplies of North Carolina", USGS Water Resources Investigation Report 78-16, April 1978.

***Figure 2.4.3-3

TABLE 2.4.3-3

CAROLINA POWER & LIGHT COMPANY
SHEARON HARRIS NUCLEAR POWER PLANT

PUBLIC WELLS WITHIN A 10-MILE RADIUS OF THE PLANT
(AS REGISTERED WITH N. C. DIVISION OF ENVIRONMENTAL MANAGEMENT)

LOCATION***	OWNER	MAXIMUM PUMPAGE RATE IN GPM	WATER* LEVEL IN FT.	TYPE OF USE
1	A. Town of Fuquay-Varina	225	145	Municipal
	B. Town of Fuquay-Varina	370	104	Municipal
	C. Town of Fuquay-Varina	63	308	Municipal
	D. Town of Fuquay-Varina	300	87	Municipal
	E. Town of Fuquay-Varina	205	135	Municipal
	F. Town of Fuquay-Varina	34	100	Municipal
	G. Town of Fuquay-Varina	65	230	Municipal
	H. Town of Fuquay-Varina	90	55	Municipal
2	A. Town of Holly Springs	50	160	Municipal
	B. Town of Holly Springs	55	105	Municipal
	C. Holly Springs School	0	15	School (standby)
	D. Pleasant Grove (near Holly Springs)	15	135	Trailer park
	E. W. A. Weston (near Holly Springs)	75	**	Trailer park
3	Darwood Thomas	**	**	Trailer park
4	James Pierson	**	**	Trailer park
5	A. Noah Jones	10	25	Trailer park
	B. Noah Jones	10	25	Trailer park
6	McCoy-Thomas	**	**	Trailer park
7	New Hope Trailer Park	**	**	Trailer park
8	Moncure School	8	22	School
9	Moncure Community Health Center	18	30	Clinic
10	City of Moncure	125	114	Municipal

TABLE 2.4.3-3 (Cont'd)

LOCATION***	OWNER	MAXIMUM PUMPAGE RATE IN GPM	WATER* LEVEL IN FT.	TYPE OF USE	4
11	Pleasant Hill Baptist Church	1	30	Public supply	
12	U. S. Army Corps of Engineers, B. Everett Jordan Dam	2.5	120	Public supply	
13	Frank Dickens (for Church)	2	30	Church	
14	Green Level Baptist Church	9	50	Public supply	
15	A. M. Council Community Store	35	**	Public supply	
16	Salem Baptist Church	3	25	Public supply	
17	D.R. Allen & Son, Inc.	1.5	75	Office	
18	Reichhold Chemical Co.	30	70	Office	
19	Jack O. Farrel	5	127	Trailer park	
20	Deep River Restaurant	10	237	Restaurant	
21	Lutheran Church Camp	12	270	Recreation	
22	Harris Energy and Environmental Center	9	144	Office	
23	Harris Energy and Environmental Center	18	208	Office	4
24	Harris Energy and Environmental Center	15	120	Office	

*Depth below ground surface
**Not available
***Figure 2.4.3-4 4

TABLE 2.4.3-4

CAROLINA POWER & LIGHT COMPANY
SHEARON HARRIS NUCLEAR POWER PLANT

LOCATION OF SITE WELLS AND PIEZOMETERS

PIEZOMETERS				WELLS			
PIEZOMETER NUMBER	PLANT COORDINATE	TOP OF PVC PIPE ELEVATION	GROUND ELEVATION	WELL NUMBER	PLANT COORDINATE	TOP OF CASING ELEVATION	GROUND ELEVATION
*PZ-2	N1414 W1172	264.54	263.15	1	N2956 W3357	262.21	259.84
PZ-G	N1871 W1172	263.93	262.91	2	N2651 W3030	261.42	260.12
LP-1	N3271 W3377	264.27	260.30	3	N2746 W3564	261.88	260.19
LP-2	N3495 W1748	261.69	258.20	4A	N1385 W3305	260.71	257.54
LP-3	N3019 W0492	256.25	261.75	5	N4020 W0977	245.05	244.06
LP-4	N2594 W1958	265.13	260.94	5A	N1178 W3980	266.88	264.48
LP-5	N1905 W3643	264.35	260.45	6	S0840 W0720	221.93	217.88
LP-6	N1886 W2442	264.97	261.15	7	N3694 W0170	254.04	253.26
LP-7	N2118 W1046	265.39	261.25	7A	N2461 W3400	261.68	260.19
(1) LP-8	N2050 W0089	263.95	259.96	8	N1714 W0907	260.34	258.18
LP-9	N0861 E0091	258.94	254.71	8A	N1007 W4186	261.02	259.57
LP-10	N0804 W0898	264.76	261.10	9	N2467 E0101	259.74	258.73
+LP-11	N0911 W1657	266.85	262.95	9A	S0427 E0106	233.65	231.60
LP-12	N0825 W2980	264.44	259.61	10	N2534 E0060	262.38	259.75
LP-13	N0389 W3288	262.90	259.03	11	N3810 W3758	256.11	255.03
LP-14	N0544 W2295	264.89	260.71	12	N0381 W3241	260.46	258.46
(2) LP-15	N0509 W1851	265.51	261.56	13	N3684 W0099	247.65	247.15
LP-16	N0219 W0898	263.30	259.35	14	N3239 W3673	271.50	270.25
				15	N3914 W0080	241.83	240.00

* Abandoned 1-23-81
+ Abandoned 5-07-80
(1) Destroyed 1980
(2) Abandoned 1980

TABLE 2.4.3-5

SHEARON HARRIS NUCLEAR POWER PLANT
ESTIMATED SITE GROUNDWATER USE

	Concrete		Construction		Operation		Total
Year	Production (yd.^{3})	Water Use*	Personnel	Water Use**	Staff	Water Use***	Water Use
1980	1.43×10^5	39,178	4076	20,380	0	0	59,558
1981	1.43×10^5	39,178	3510	17,550	86	860	57,588
1982	1.43×10^5	39,178	2899	14,495	203	2030	55,703

NOTE: All water uses are in gallons per day.

* Estimate based upon projected concrete production and observed consumption rate of 100 gallons per cubic yard

** Estimate based upon observed consumption rate of 5 gallons per person per day.

*** Estimate based upon projected consumption rate of 10 gallons per person per day.

TABLE 2.4.3-6

SHEARON HARRIS NUCLEAR POWER PLANT
MINIMUM, MAXIMUM, AND MEDIAN CONCENTRATIONS OF CHEMICAL CONSTITUENTS IN GROUNDWATER IN THE DURHAM AND RALEIGH, NC AREAS

Constituent	Durham Area			Raleigh Area		
	Minimum	Maximum	Median	Minimum	Maximum	Median
Silica (SiO_2)	6.6	47	25	8.4	47	32
Iron (Fe)	0.00	5.4	0.19	0.00	9.2	0.1
Calcium (Ca)	1.1	388	23	2.7	106	8.8
Magnesium (Mg)	0.4	89	7.9	0.2	63	3.7
Sodium (Na)	0.2	188	13	2.5	310	5.7
Potassium (K)	0.1	6.3	0.3	0.1	5.2	1.4
Bicarbonate (HCO_3)	14	412	111	10	360	44
Sulfate (SO_4	0.4	67	4.4	0.4	135	3.6
Chloride (Cl)	0.2	750	12	0.3	572	3.6
Fluoride (Fl)	0.0	1.5	0.1	0.0	2.0	0.1
Nitrate (NO_3)	0.0	75	3.2	0.0	74	3.6
Hardness	5	1340	86	8	388	37
Dissolved Solids	16	806	162	25	1180	90
Hydrogen-ion concentration (pH)	5.8	8.0	6.8	5.8	7.8	6.8
Specific conductance in micromhos	22	3100	255	32	2200	118

TABLE 2.4.3-7

CAROLINA POWER & LIGHT COMPANY
SHEARON HARRIS NUCLEAR POWER PLANT

CHEMICAL QUALITY OF SITE GROUNDWATER

ANALAYSIS PARAMETER	WELL NO. 2	WELL NO. 4	WELL NO. 7A
Color	3	0	0
pH	7.3	7.9	7.9
Alkalinity $CaCO_3$	107	134	140
Total Hardness	72	106	136
Iron	0.13	0.35	0.95
Manganese	0.24	0.38	0.29
Turbidity SiO_2	1	2	1
Acidity $CaCO_3$	11	3	5
Chloride	23	22	21
Sodium	35	30	19
Potassium	2.0	1.6	1.1
Fluoride	<0.10	<0.10	<0.10
Arsenic	<0.01	<0.01	<0.01
Cadmium	<0.01	<0.01	<0.01
Chromium^{+6}	<0.05	<0.05	<0.05
Copper	<0.05	<0.05	<0.05
Lead	<0.05	<0.05	<0.05
Zinc	0.40	0.10	<0.05
Calcium	14.8	21.0	26.5
Magnesium	7.5	11.0	15.4

Note: Analyses performed during March 1973 by N. C. Board of Health, Laboratory Division, Raleigh, N. C.

All results are expressed in parts per million except the parameters of color and pH.

2.4.4 RADIONUCLIDE RELEASE FROM THE PLANT

Normal releases of contaminants into the hydrosphere will have negligible effects on surface and groundwater uses.

Should an accidental release of contaminants occur, adverse effects, if any, will be restricted to the area within the plant island. The only water user within the plant island is the plant itself.

Dilution of contaminants, should they enter the reservoirs, will be sufficient to reduce concentrations below the limits specified in 10CFR20.

2.4.4.1 Groundwater Pathway

The only possible groundwater pathway to water users following a radioactive spill would be seepage through the soil. The plant and peripheral lands are underlain by the Triassic, Newark Group, aquifer. An accidental release of radionuclides at the site can be assumed conservatively to percolate downward to the aquifer instantaneously. The general direction of groundwater movement in the aquifer at the site is toward the southeast. However, ongoing pumpage at the site for construction water has altered the flow direction locally toward the pumping wells (Figure 2.4.3-6).

The value for porosity in the groundwater movement analysis was based on a measured value of permeability for the fracture system of the intrusive-rock dike between wells 13 and 15 (Figure 2.4.3-10). Inasmuch as hard-rock fracture systems are heteorogeneous and anisotropic, hydraulic characteristics for these systems can be grouped only in a broad category. In the system between wells 13 and 15, the measured permeability value of 2841 gpd/ft^2 compares with the lower part of the scale of values for gravel as given in Walton, pp. 33-36 (Reference 2.4.4-1). Values were estimated for porosity and "effective porosity" (specific yield) by using the same relative position as "permeability" on scales of these values given in that publication.

The range of values for permeability of gravel is given as 1,000 to 15,000 gpd/ft^2. Proportionally, the value of total porosity is estimated at 31 percent and the value of effective porosity (same as specific yield in Walton, 1970) is estimated at 17 percent. 4

Assuming the maximum parameters, it is established that the minimum time required for the groundwater to reach the closest community downstream from the plant would be about 144 years. This time estimate is based upon the following parameters: Corinth is the nearest town, approximately five miles to the southwest, where residents have wells of minimal production from the Triassic, Newark Group (Figure 2.3.8-5). The maximum measured site coefficient of permeability is 520 ft./yr. (FSAR Table 2.4.13-7). The maximum measured site hydrologic gradient is 0.06 ft/ft towards the SE from the Waste Processing Building (Figure 2.4.3-6). The effective porosity is 0.17.

The effective travel time of radionuclides which may contaminate the aquifer following a tank rupture would be considerably greater due to absorption and ion exchange on the underlying rock. The distribution coefficients (Kd) for cesium and strontium, the critical radionuclides, are assumed to be 20 and 2, respectively. These values were taken from Table VII 3-7 of Appendix VII of WASH 1400 and are conservative when compared to values reported in the literature (Reference 2.4.4-2). The calculated retention factors using these values for Kd, an effective porosity of 0.17 and a bulk dry weight density of 2.6 (FSAR Table 2.5.4-1; 162.8 lbs/ft^3) are 307 for cesium and 32 for strontium. Using these retention factors, the travel time for Cs-137 and Sr-90 for transport to the nearest community would be:

4

$$\text{Cs-137} = (144 \text{ yrs})\ (307) = 4.4 \times 10^4 \text{ yrs}$$
$$\text{Sr-90} = (144 \text{ yrs})\ (321) = 4.6 \times 10^3 \text{ yrs}$$

Assuming tritium to be in the form of water, the effective travel time for tritium would be 144 years. Based upon these effective travel times, radioactive decay would reduce the amount of tritium, CS-137 and Sr-90 which could potentially reach Corinth to negligible levels.

2.4.4 RADIONUCLIDE RELEASE FROM THE PLANT

Normal releases of contaminants into the hydrosphere will have negligible effects on surface and groundwater uses.

Should an accidental release of contaminants occur, adverse effects, if any, will be restricted to the area within the plant island. The only water user within the plant island is the plant itself.

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Assuming the maximum parameters, it is established that the minimum time required for the groundwater to reach the closest community downstream from the plant would be about 144 years. This time estimate is based upon the following parameters: Corinth is the nearest town, approximately five miles to the southwest, where residents have wells of minimal production from the Triassic, Newark Group (Figure 2.3.8-5). The maximum measured site coefficient of permeability is 520 ft./yr. (FSAR Table 2.4.13-7). The maximum measured site hydrologic gradient is 0.06 ft/ft towards the SE from the Waste Processing Building (Figure 2.4.3-6). The effective porosity is 0.17.

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$$\text{Sr-90} = (144\ \text{yrs})\ (32) = 4.6 \times 10^3\ \text{yrs}$$

Assuming tritium to be in the form of water, the effective travel time for tritium would be 144 years. Based upon these effective travel times, radioactive decay would reduce the amount of tritium, Cs-137 and Sr-90 which could potentially reach Corinth to negligible levels.

TABLE 2.4.4-1

Carolina Power & Light Company
Shearon Harris Nuclear Power Plant
PERMEABILITY OF MATERIALS IN PLANT SITE AND AUXILIARY RESERVOIR AREAS BASED ON DOWN-HOLE PRESSURE TESTS

Material	Boring	Depth Interval (Ft.)	Permeability (Ft./Yr.)
Medium-grained sandstone	TB-1-74	23-33	289.3
Fine sandstone	BP-62	25-35	169.4
Fine sandstone	BP-62	45-55	2.1
Fine sandstone	BP-62	125-135	2.4
Fine sandstone	BP-68	73-83	1.7
Fine sandstone	TB-1-74	53-63	217.2
Fine sandstone	TB-1-74	64.5-73	39.4
Fine sandstone	TB-2-74	67.5-74	202.4
Fine sandstone	TB-2-74	74-84	74.4
Fine sandstone	TB-3-74	20-25	16.5
Fine sandstone	TB-3-74	45-55	249.2
Fine sandstone	TB-3-74	65-75	88.8
Silty fine sandstone	TB-2-74	33.6-44	392.0
Sandy siltstone	BP-68	113-123	1.4
Sandy siltstone	BP-68	133-143	1.4
Sandy siltstone	BP-70	118-128	0.8
Sandy siltstone	BP-70	138-148	0.5
Siltstone	BP-68	63-73	1.3
Siltstone	BP-70	78-88	2.9
Shaly siltstone	BP-68	18-28	13.4
Shaly siltstone	BP-68	33-43	529.6
Shaly siltstone	BP-70	28-38	6.7

NOTE: BP refers to boring in the Plant Site Area; TB refers to test boring in Auxiliary Reservoir Area.

2.4.5 WATER USERS

There are no known domestic potable surface water users of Buckhorn Creek within the proposed reservoir area. There were numerous farm ponds within the reservoir area; however, these were not used for domestic consumption. The farm ponds were used for livestock; little, if any, irrigation water was withdrawn from the farm ponds. There are no surface water users of Buckhorn Creek downstream of the SHNPP project.

There are no known domestic potable water supply intakes on the Cape Fear River between Buckhorn Dam and Lillington, North Carolina. The nearest source of potable water supply downstream of the site is Lillington, North Carolina, approximately 12 mi. downstream on the Cape Fear River. Industrial and municipal surface water uses of the Cape Fear River downstream of Buckhorn Dam are shown in Tables 2.4.5-1 and 2.4.5-2, respectively. River basin drainage areas at the points of withdrawal are included to indicate the additional flow that is available, as compared with the drainage area of 3,196 sq. mi. at Buckhorn Dam. Most of the water withdrawn is returned to the Cape Fear River.

Carolina Power & Light Company's Brunswick Plant, located 19 miles south of Wilmington at Southport, N.C., nominally withdraws cooling water from the Cape Fear River. However, this user is not included on Table 2.4.1-5 since the withdrawal is within the tidal reaches of the river and does not constitute a consumptive use of river flow. The outfall of the Brunswick Plant is located on the Atlantic Ocean. The drainage area at the plant is 9090 square miles, and the withdrawal and discharge are both 1900 mgd. 4

Discussions with North Carolina State University's agriculture staff, U. S. Department of Agriculture and county agricultural extension chairmen indicate that there are no known withdrawals for irrigation from the Cape Fear River. The principal economic crop in the Cape Fear River basin is tobacco; however, the bottomland along the Cape Fear River is not generally suited to production of tobacco. Tobacco is grown in the uplands and irrigation water, if used, is taken from farm ponds or wells. The lands along the Cape Fear River are either wooded, pasture, or used for crops that are not generally irrigated in North Carolina. Public wells within ten miles of the site are listed in Table 2.4.3-3, along with their maximum pumpage rates, water levels, and use. Figure 2.4.3-4 shows the locations of these wells.

The nearest communities using groundwater for public water supply are Holly Springs and Fuquay-Varina; both are in Wake County. Holly Springs, about seven miles east of the plant site, has two wells which supply a total of about 40,000 gallons per day. Fuquay-Varina, about ten miles southeast of the plant site, has eight wells which supply about 400,000 gallons per day. These wells produce water from a crystalline rock aquifer of the Carolina Slate Belt. In the plant area, this aquifer is buried a few thousand feet beneath the Triassic sediments. The Holly Springs and Fuquay-Varina wells are not located in the Triassic Basin.

The closest community downstream from the plant site is Corinth, approximately five miles to the southwest, where a few homes have individual wells of minimal production from the Triassic, Newark group aquifer. The well depths range from 62 ft. to 140 ft., while their production varies from 0.5 to

13 gpm. The relative yield of the wells at Corinth are all less than 0.10 gpm per ft. of uncased hole.

Carolina Power & Light Company is the sole groundwater user within a two-mile radius of the plant site with the exception of two domestic users up gradient, near the 7,000 ft. radius boundary to the north and northwest.

2.4.5 WATER USERS

There are no known domestic potable surface water users of Buckhorn Creek within the proposed reservoir area. There were numerous farm ponds within the reservoir area; however, these were not used for domestic consumption. The farm ponds were used for livestock; little, if any, irrigation water was withdrawn from the farm ponds. There are no surface water users of Buckhorn Creek downstream of the SHNPP project.

There are no known domestic potable water supply intakes on the Cape Fear River between Buckhorn Dam and Lillington, North Carolina. The nearest source of potable water supply downstream of the site is Lillington, North Carolina, approximately 12 mi. downstream on the Cape Fear River. Industrial and municipal surface water uses of the Cape Fear River downstream of Buckhorn Dam are shown in Tables 2.4.5-1 and 2.4.5-2, respectively. River basin drainage areas at the points of withdrawal are included to indicate the additional flow that is available, as compared with the drainage area of 3,196 sq. mi. at Buckhorn Dam. Most of the water withdrawn is returned to the Cape Fear River.

Carolina Power & Light Company's Brunswick Plant, located 19 miles south of Wilmington at Southport, N.C., nominally withdraws cooling water from the Cape Fear River. However, this user is not included on Table 2.4.5-1 since the withdrawal is within the tidal reaches of the river and does not constitute a consumptive use of river flow. The outfall of the Brunswick Plant is located on the Atlantic Ocean. The drainage area at the plant is 9090 square miles, and the withdrawal and discharge are both 1900 mgd. 5

Discussions with North Carolina State University's agriculture staff, U. S. Department of Agriculture and county agricultural extension chairmen indicate that there are no known withdrawals for irrigation from the Cape Fear River. The principal economic crop in the Cape Fear River basin is tobacco; however, the bottomland along the Cape Fear River is not generally suited to production of tobacco. Tobacco is grown in the uplands and irrigation water, if used, is taken from farm ponds or wells. The lands along the Cape Fear River are either wooded, pasture, or used for crops that are not generally irrigated in North Carolina. Public wells within ten miles of the site are listed in Table 2.4.3-3, along with their maximum pumpage rates, water levels, and use. Figure 2.4.3-4 shows the locations of these wells.

The nearest communities using groundwater for public water supply are Holly Springs and Fuquay-Varina; both are in Wake County. Holly Springs, about seven miles east of the plant site, has two wells which supply a total of about 40,000 gallons per day. Fuquay-Varina, about ten miles southeast of the plant site, has eight wells which supply about 400,000 gallons per day. These wells produce water from a crystalline rock aquifer of the Carolina Slate Belt. In the plant area, this aquifer is buried a few thousand feet beneath the Triassic sediments. The Holly Springs and Fuquay-Varina wells are not located in the Triassic Basin.

The closest community downstream from the plant site is Corinth, approximately five miles to the southwest, where a few homes have individual wells of minimal production from the Triassic, Newark group aquifer. The well depths range from 62 ft. to 140 ft., while their production varies from 0.5 to

13 gpm. The relative yield of the wells at Corinth are all less than 0.10 gpm per ft. of uncased hole.

Carolina Power & Light Company is the sole groundwater user within a two-mile radius of the plant site with the exception of two domestic users up gradient, near the 7,000 ft. radius boundary to the north and northwest.

TABLE 2.4.5-1

CAPE FEAR RIVER INDUSTRIAL WATER WITHDRAWALS DOWNSTREAM OF BUCKHORN DAM

Industry	Location	Approximate River Drainage Area (sq. mi.)	Withdrawal (mgd)	Discharge (mgd)
DuPont	Fayetteville	4330	7.0	6.7
Rohm & Haas	Fayetteville	4330	4.0	2.6
Cape Fear Feed	Fayetteville	5330	1.8	1.5
Federal paper	Acme	5280	46.0	43.0
CP&L Sutton Plant	Wilmington	7050	6.0	0.0
DuPont	Wilmington	7050	9.3	6.0
Swift Agriculture Chemicals	Wilmington	7050	1.2	1.1
U.S. Steel Agriculture Chemicals	Wilmington	7050	1.6	1.6
Wright Chemical	Wilmington	7050	1.5	1.1

TABLE 2.4.5-2

CAPE FEAR RIVER MUNICIPAL WATER WITHDRAWALS DOWNSTREAM OF BUCKHORN DAM

Municipality	Approximate River Drainage Area (sq. mi.)	Average Withdrawal (mgd)
Lillington	3440	0.2
Dunn	3470	1.8
Fayetteville	4330	10.8
Wilmington	5190	8.7

REFERENCES: SECTION 2.4

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2.4.2-5 "Calculation of the Steady State Wind - Driven Circulation in Lake Ontario" by D B Rao and T S Murty, Arch. Met. Geoph. Biokl. Ser. A, 19, 195 - 210 (1970)

2.4.2-6 "Sediment Characteristics of Streams in the Eastern Piedmont and Western Coastal Plain Regions of North Carolina" USGS Water Supply Paper 1798-0, 1976.

2.4.2-7 HEC-4 Streamflow Simulation Package, Hydrologic Engineering Center, U. S. Army Corps of Engineers.

2.4.2-8 Design Basis Floods for Nuclear Power Plants, NRC Regulatory Guide 1.59, Rev 1, April 1976.

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2.4.2-12 Carolina Power & Light Company, "Shearon Harris Nuclear Power Plant Pre-Construction Monitoring Report, Terrestrial Biology June 1974 - January 1978 Water Chemistry 1972-1977," October 1978.

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2.4.2-16 HEC-2, *Water Surface Profiles*, Hydrologic Engineering Center, U. S. Army Corp of Engineers.

2.4.3-1 "Structural and Stratigraphic Framework, and Spatial Distribution of Permeability of the Atlantic Coastal Plain, North Carolina to New York," U. S. Geological Survey. Professional Paper No. 796, 1976.

2.4.3-2 "Fault Investigation, Shearon Harris Nuclear Power Plant, Units 1, 2, 3, and 4" for Carolina Power & Light Company, Ebasco Services Incorporated, New York, February, 1975.

2.4.3-3 "Soil Survey, Wake County, North Carolina," U. S. Soil Conservation Service, U. S. Department of Agriculture, in cooperation with N. C. Agricultural Experiment Station, November 1970.

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2.4.3-5 "Estimating the Transmissibility of Aquifers from the Specific Capacity of Wells," U. S. Geological Survey Water Supply Paper No. 1536-I, 1963.

2.4.3-6 "Geology and Groundwater in the Durham Area, North Carolina," Groundwater Bulletin No. 7, North Carolina Department of Water Resources, 1966.

2.4.4-1 Walton, W. C. 1970. Groundwater Resource Evaluation New York, McGraw-Hill Book Co., Inc., 664 pp. 4

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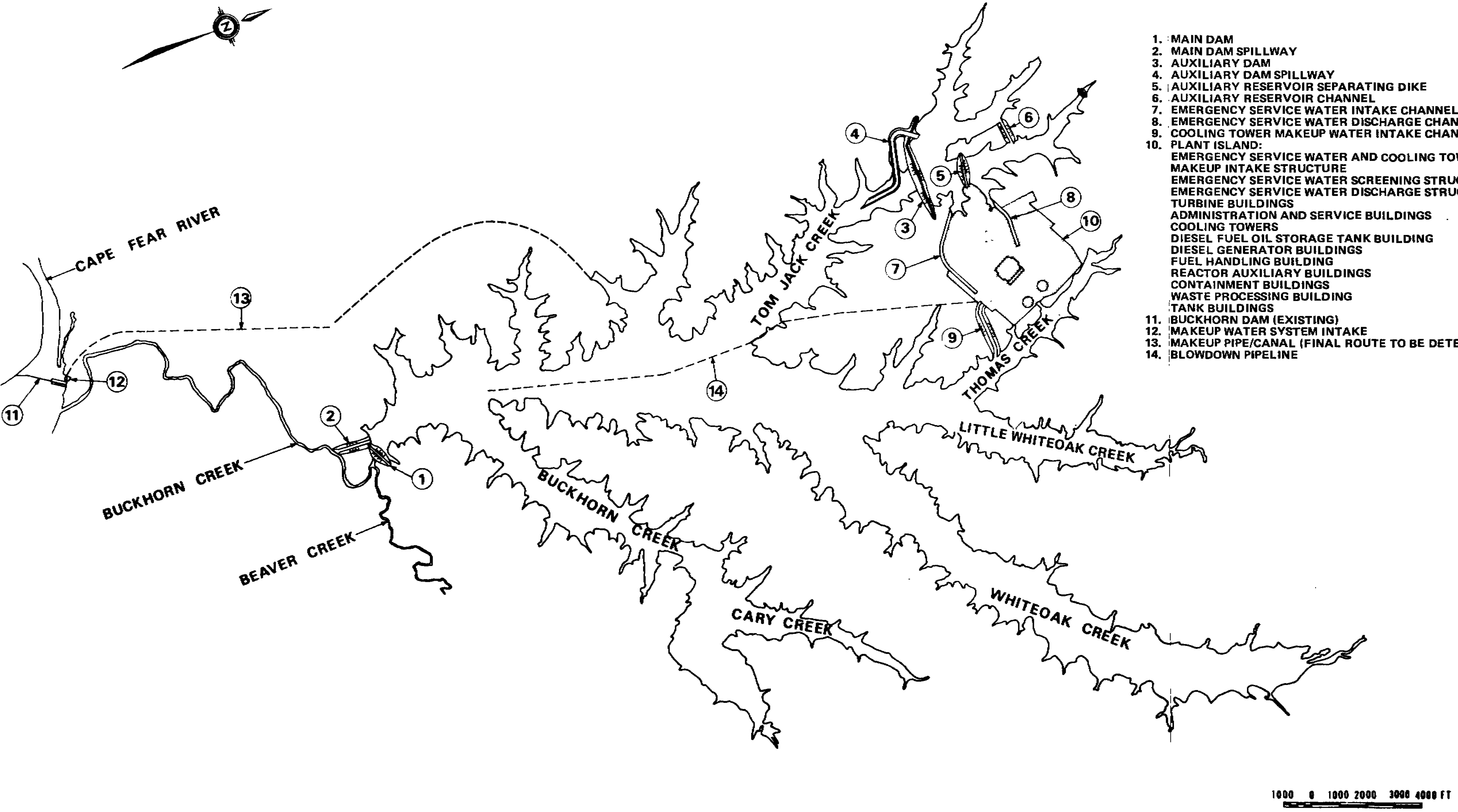

1. MAIN DAM
2. MAIN DAM SPILLWAY
3. AUXILIARY DAM
4. AUXILIARY DAM SPILLWAY
5. AUXILIARY RESERVOIR SEPARATING DIKE
6. AUXILIARY RESERVOIR CHANNEL
7. EMERGENCY SERVICE WATER INTAKE CHANNEL
8. EMERGENCY SERVICE WATER DISCHARGE CHANNEL
9. COOLING TOWER MAKEUP WATER INTAKE CHANNEL
10. PLANT ISLAND:
    EMERGENCY SERVICE WATER AND COOLING TOWER MAKEUP INTAKE STRUCTURE
    EMERGENCY SERVICE WATER SCREENING STRUCTURE
    EMERGENCY SERVICE WATER DISCHARGE STRUCTURE
    TURBINE BUILDINGS
    ADMINISTRATION AND SERVICE BUILDINGS
    COOLING TOWERS
    DIESEL FUEL OIL STORAGE TANK BUILDING
    DIESEL GENERATOR BUILDINGS
    FUEL HANDLING BUILDING
    REACTOR AUXILIARY BUILDINGS
    CONTAINMENT BUILDINGS
    WASTE PROCESSING BUILDING
    TANK BUILDINGS
11. BUCKHORN DAM (EXISTING)
12. MAKEUP WATER SYSTEM INTAKE
13. MAKEUP PIPE/CANAL (FINAL ROUTE TO BE DETERMINED)
14. BLOWDOWN PIPELINE

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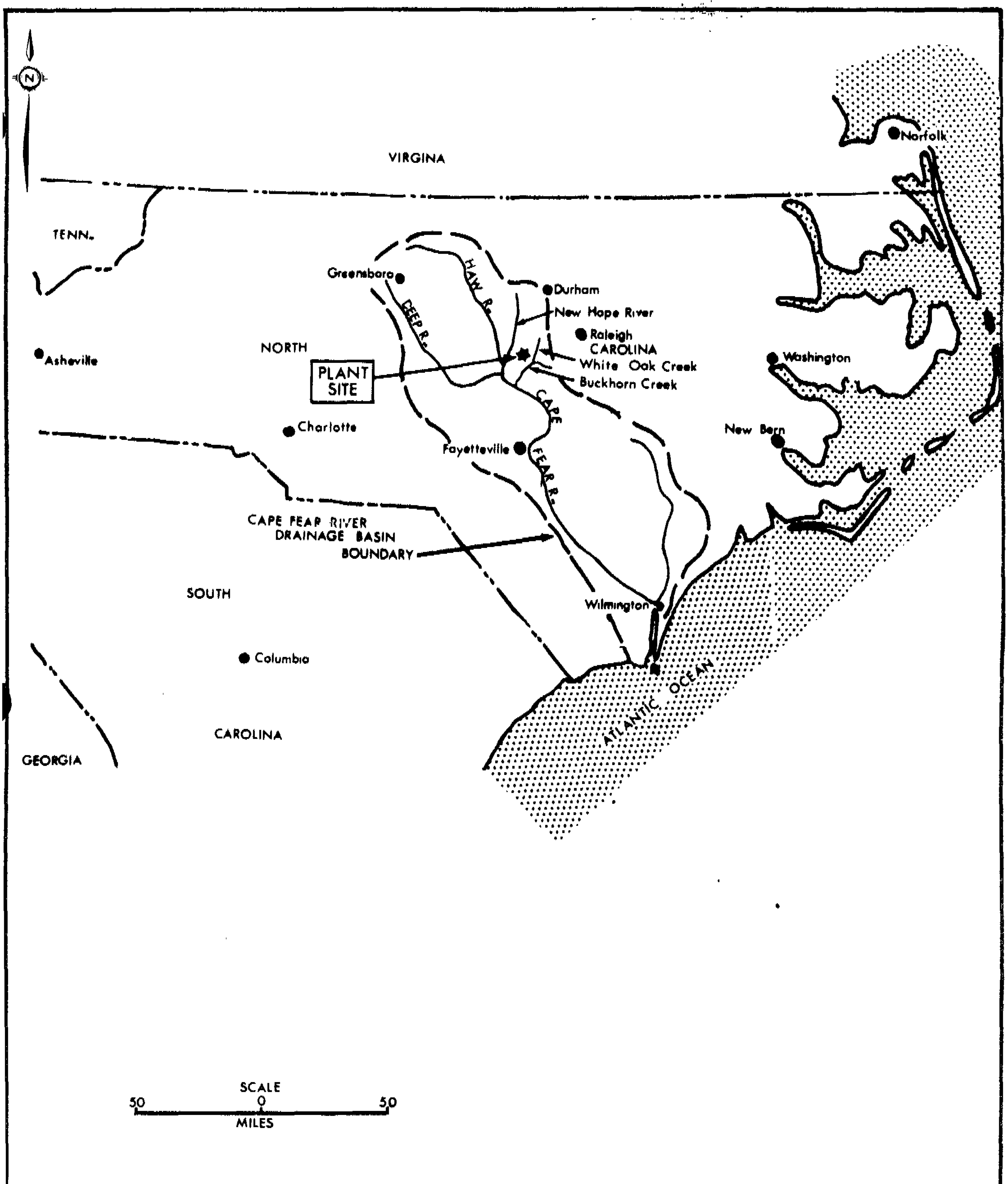
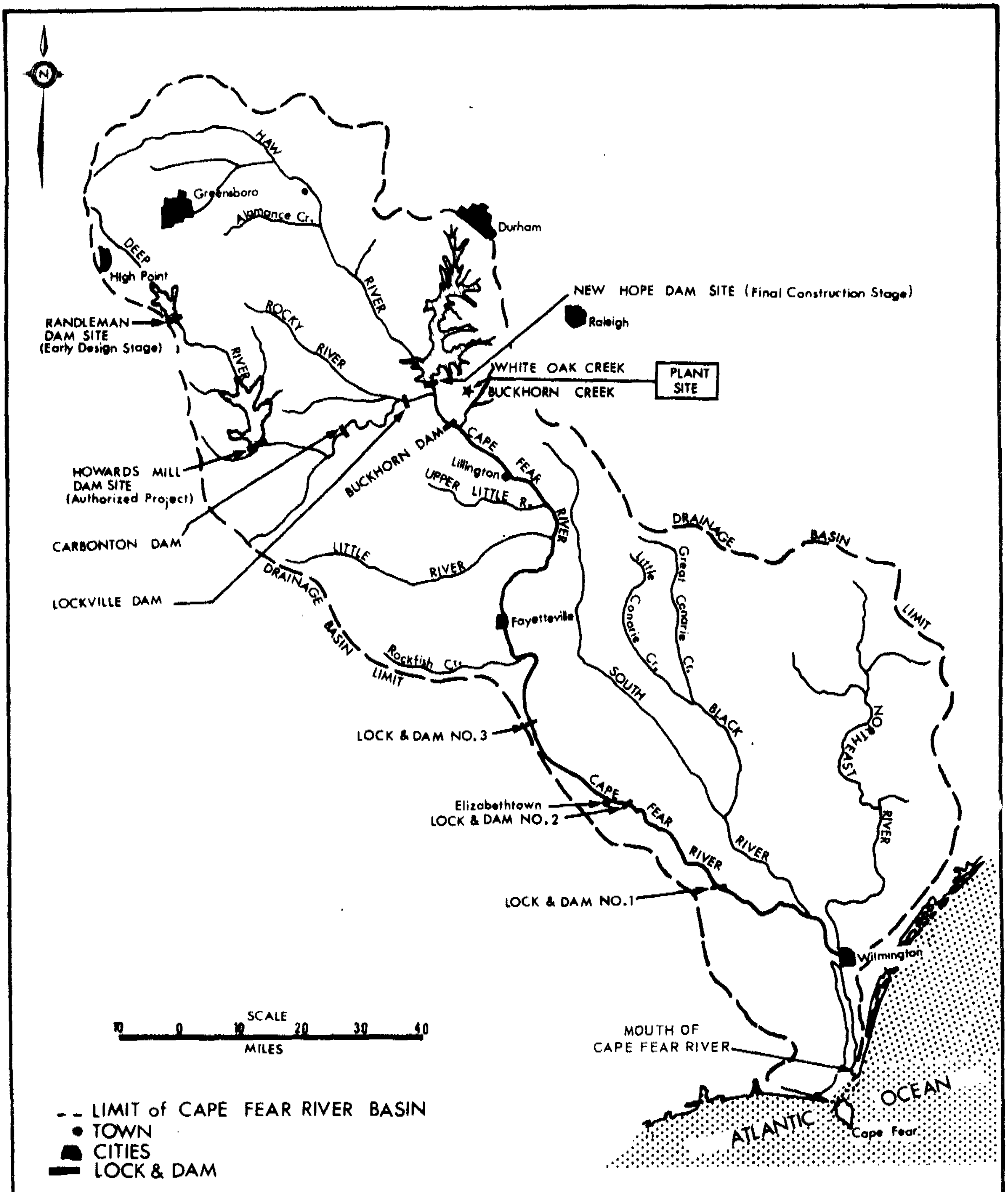
PROJECT SITE PLAN

FIGURE 2.4.1-1



SHEARON HARRIS NUCLEAR POWER PLANT Carolina Power & Light Company **ENVIRONMENTAL REPORT**	LOCATION OF CAPE FEAR RIVER BASIN	**FIGURE** **2.4.1-2**



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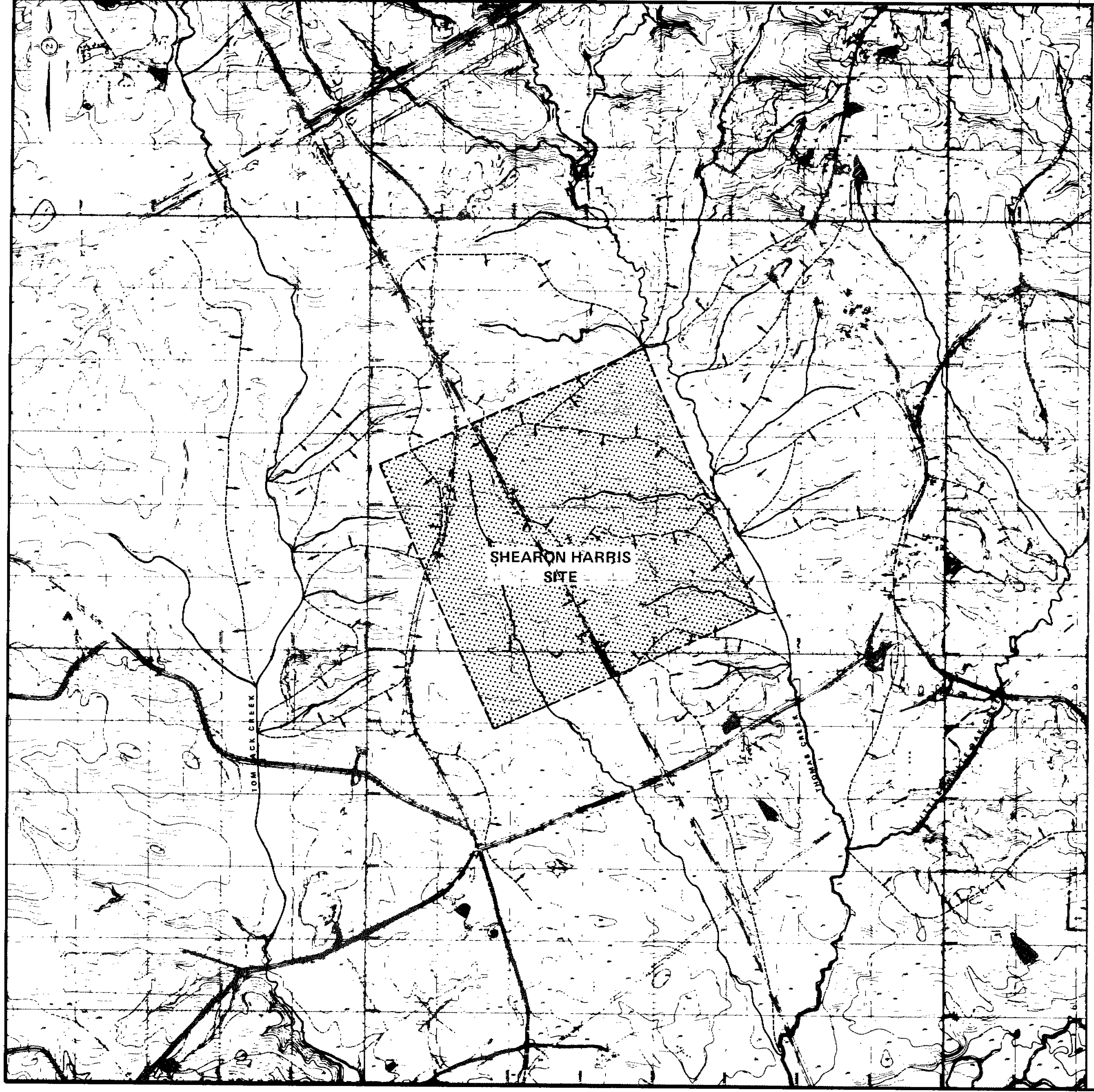
CAPE FEAR RIVER BASIN

FIGURE

2.4.1-3



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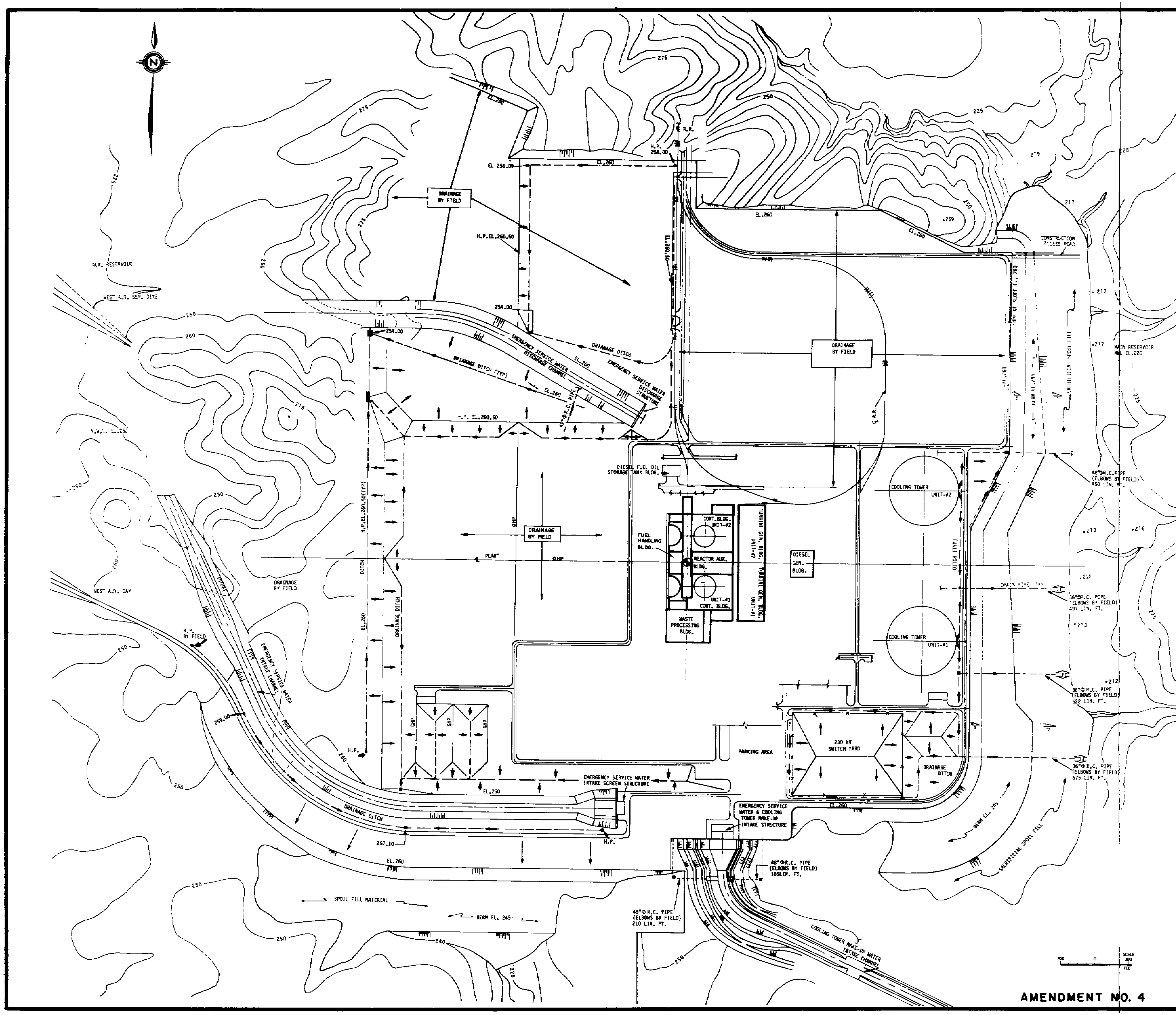
ENVIRONMENTAL REPORT

WATERSHEDS IN THE VICINITY OF SITE

FIGURE 2.4.1-4


N
DRAINAGE BY FIELD
EL 256.00
H.P.EL.260.50
EL.260
H.P. 258.00
R.R.
ALX. RESERVOIR
WEST AUX. SEP. DIKE
254.00
EMERGENCY SERVICE WATER DISCHARGE CHANNEL
DRAINAGE DITCH
DRAINAGE DITCH (TYP)
EMERGENCY SERVICE WATER DISCHARGE STRUCTURE
H.P. EL.260.50
DRAINAGE BY FIELD
CONSTRUCTION ACCESS ROAD
MAIN RESERVOIR N.W.L. EL.220
DIESEL FUEL OIL STORAGE TANK BLDG.
COOLING TOWER UNIT-#2
COOLING TOWER UNIT-#1
48"Φ R.C. PIPE (ELBOWS BY FIELD) 450 LIN. FT.
FUEL HANDLING BLDG.
CONT. BLDG. UNIT-#2
REACTOR AUX. BLDG.
UNIT-#1 CONT. BLDG.
TURBINE GEN. BLDG. UNIT-#2
TURBINE GEN. BLDG. UNIT-#1
DIESEL GEN. BLDG.
WASTE PROCESSING BLDG.
DRAINAGE BY FIELD
PLANT
GHP
H.P.EL.260.50(TYP)
DITCH
DRAINAGE DITCH
DITCH (TYP)
DRAIN PIPE TYP
36"Φ R.C. PIPE (ELBOWS BY FIELD) 497 LIN. FT.
36"Φ R.C. PIPE (ELBOWS BY FIELD) 522 LIN. FT.
36"Φ R.C. PIPE (ELBOWS BY FIELD) 675 LIN. FT.
WEST AUX. DAM
H.P. BY FIELD
EMERGENCY SERVICE WATER INTAKE CHANNEL
259.00
H.P.
230 kV SWITCH YARD
PARKING AREA
DRAINAGE DITCH
EMERGENCY SERVICE WATER INTAKE SCREEN STRUCTURE
EMERGENCY SERVICE WATER & COOLING TOWER MAKE-UP INTAKE STRUCTURE
DRAINAGE DITCH
257.10
EL.260
48"Φ R.C. PIPE (ELBOWS BY FIELD) 185 LIN. FT.
48"Φ R.C. PIPE (ELBOWS BY FIELD) 210 LIN. FT.
BERM EL. 245
SACRIFICIAL SPOIL FILL
SPOIL FILL MATERIAL
BERM EL. 245
COOLING TOWER MAKE-UP WATER INTAKE CHANNEL
275
250
225
217
213
216
214
212
240
SCALE

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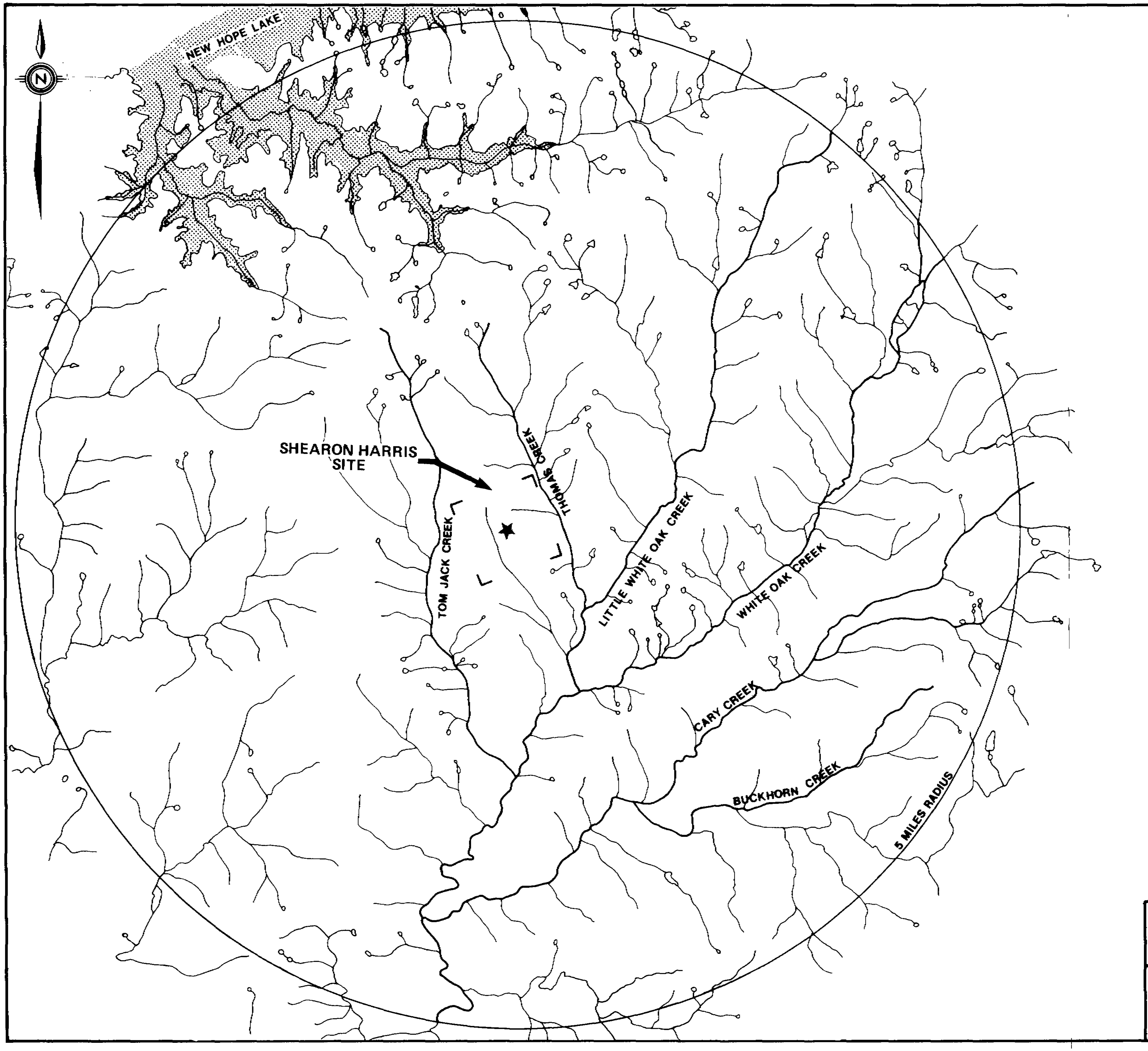
FINISHED CONTOURS & DRAINAGE PATTERN

FIGURE 2.4.1-5



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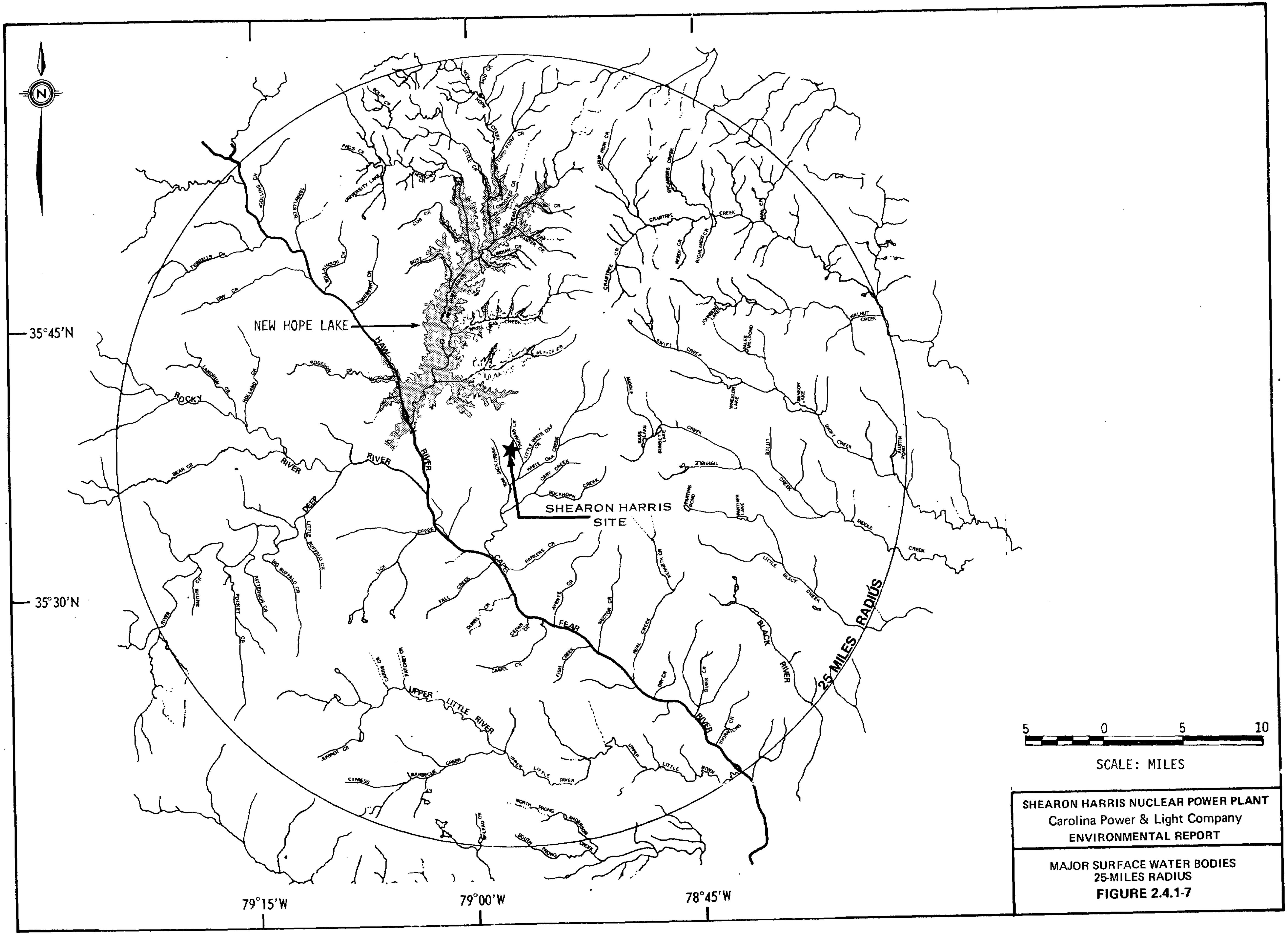
MAJOR SURFACE WATER BODIES
5-MILE RADIUS
FIGURE 2.4.1-6



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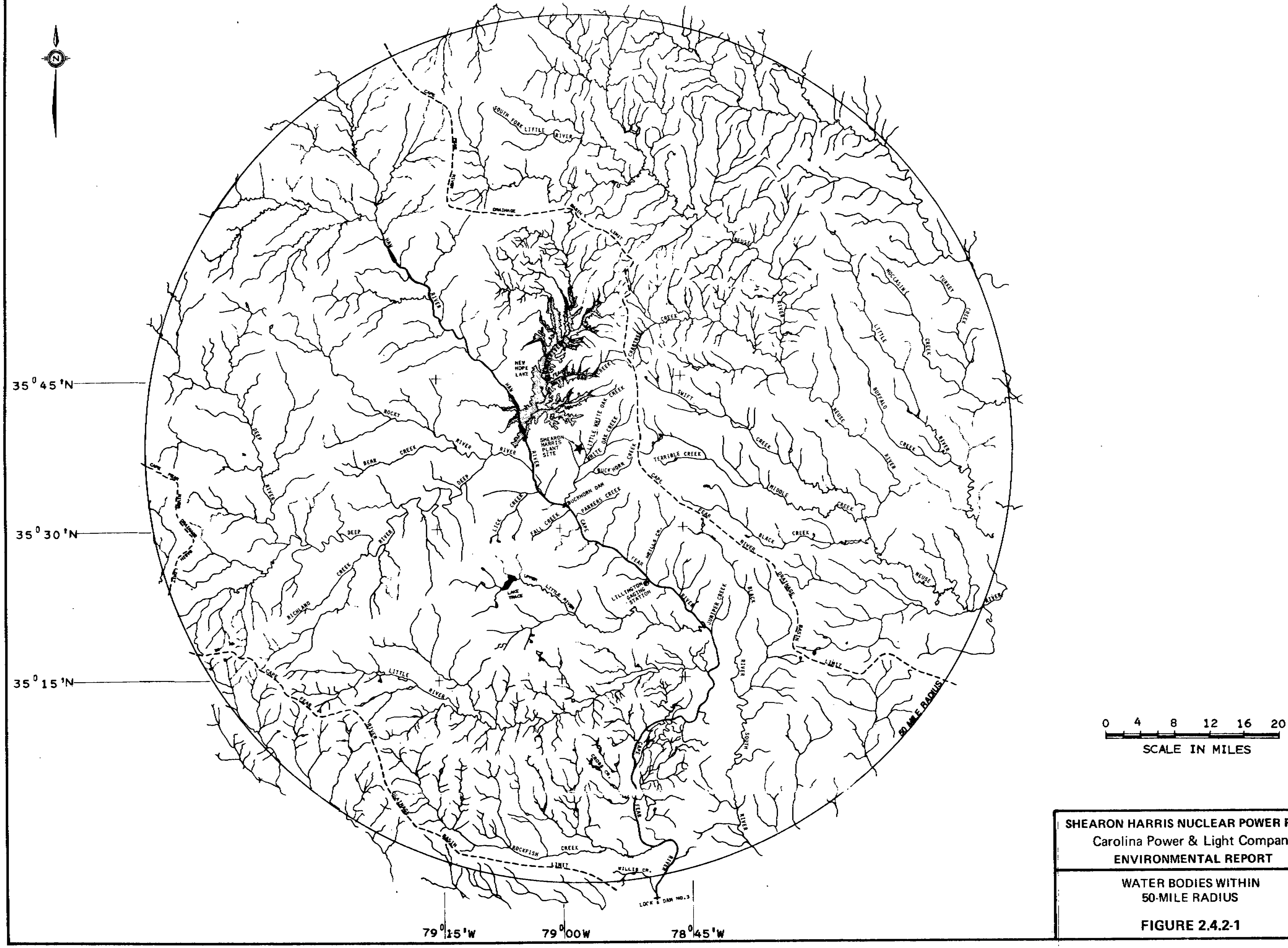
MAJOR SURFACE WATER BODIES
25-MILES RADIUS
FIGURE 2.4.1-7



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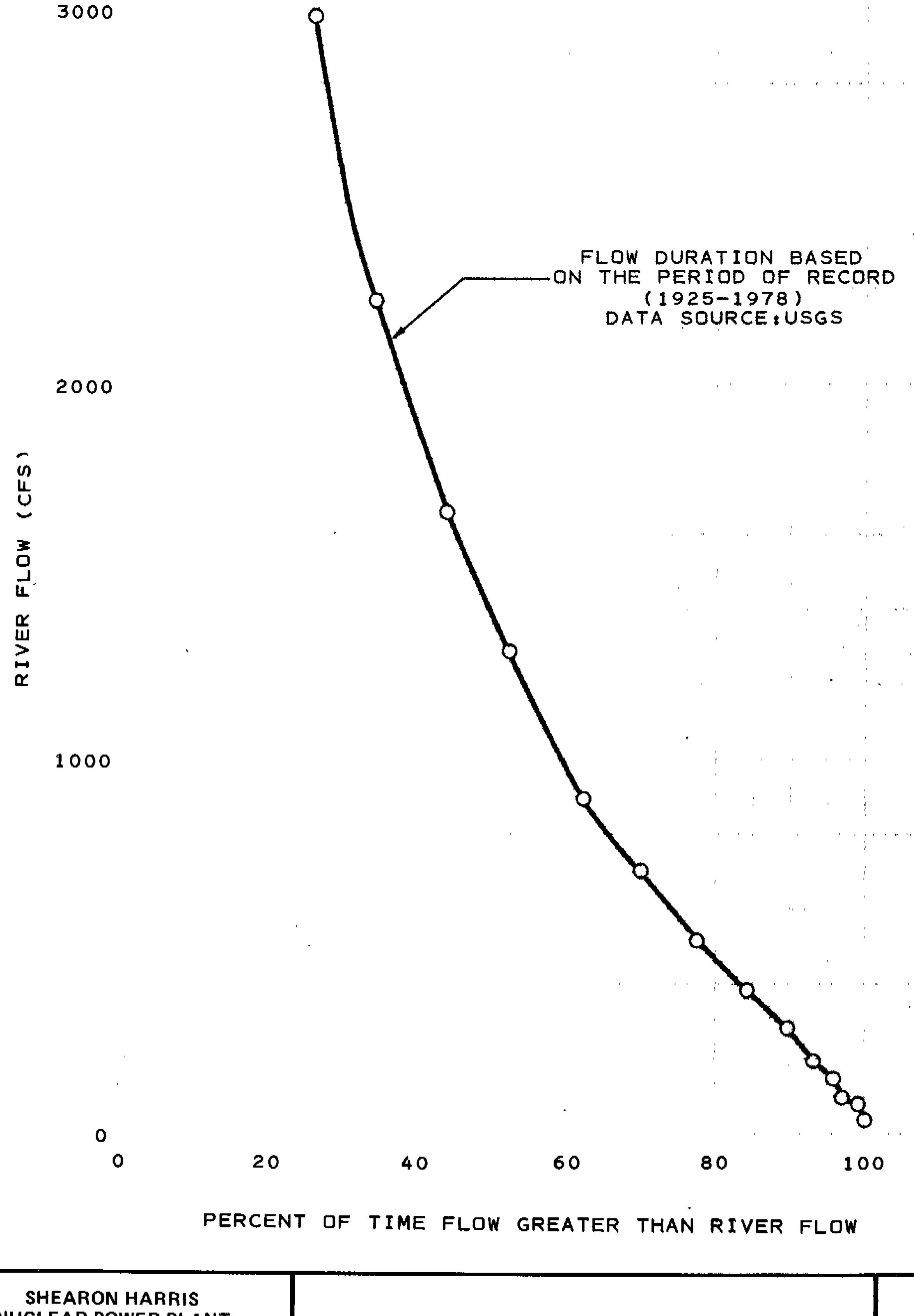
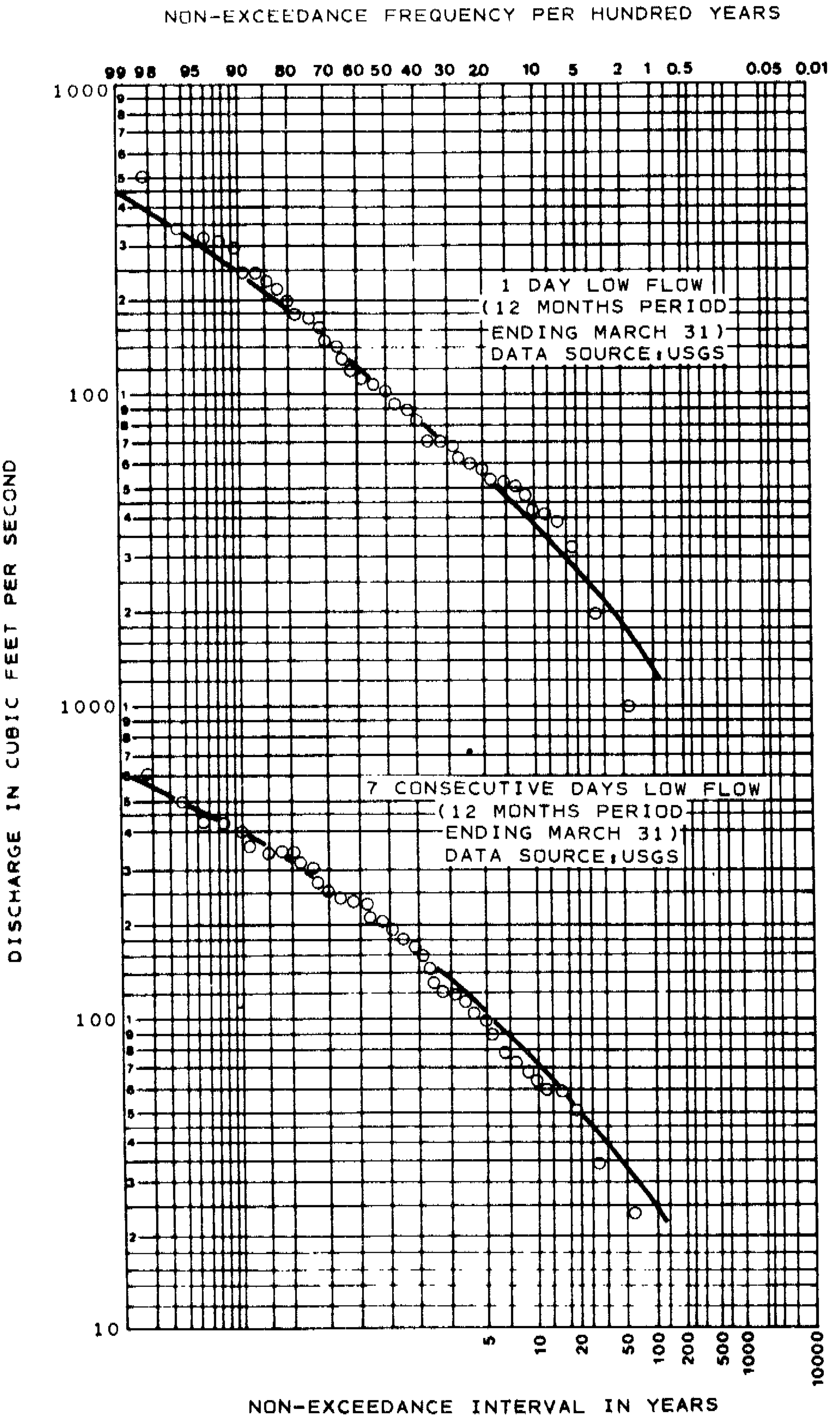
WATER BODIES WITHIN
50-MILE RADIUS

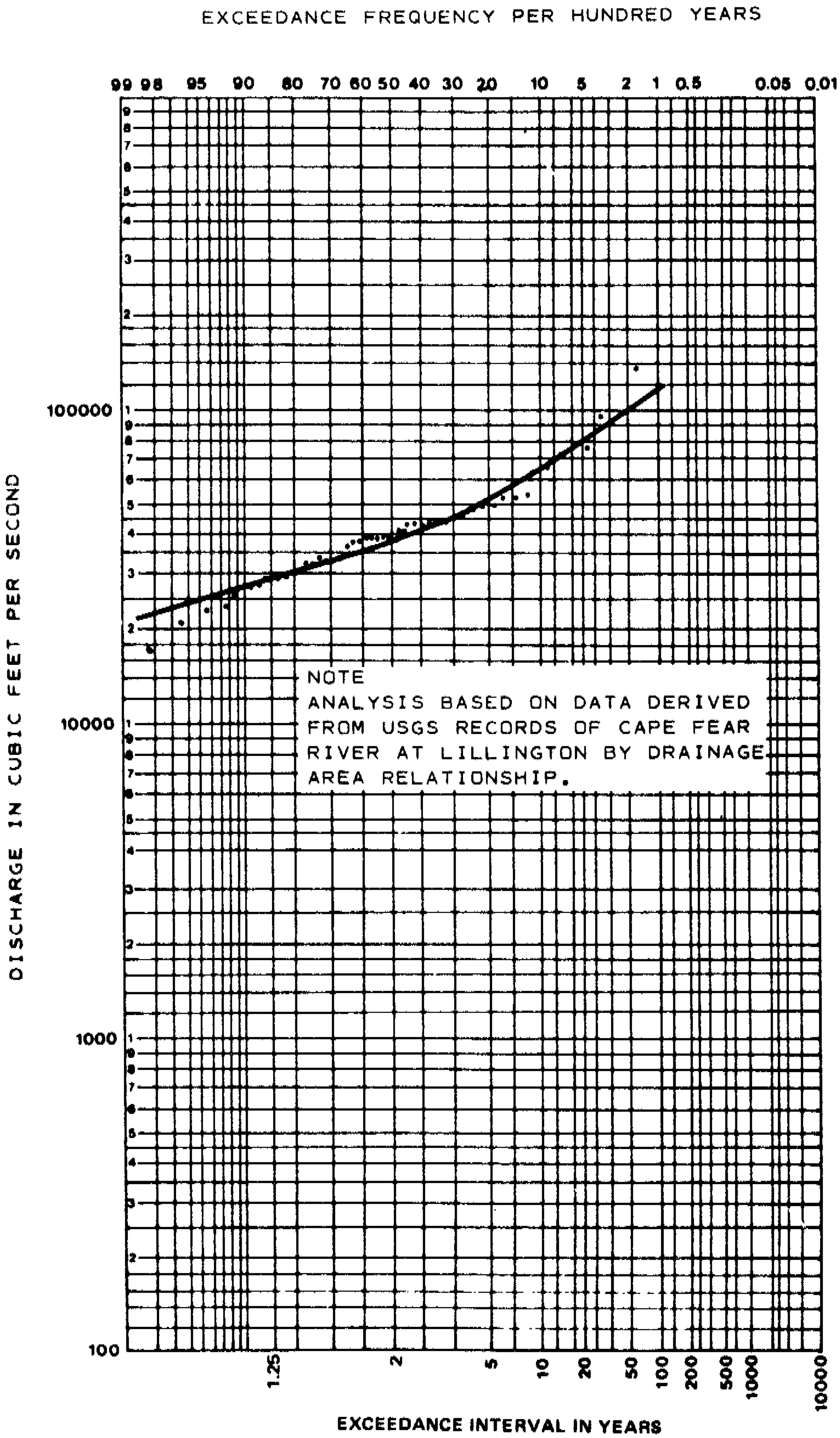
FIGURE 2.4.2-1



SHEARON HARRIS NUCLEAR POWER PLANT Carolina Power & Light Company ENVIRONMENTAL REPORT	CAPE FEAR RIVER FLOW (AT BUCKHORN DAM) DURATION CURVE	FIGURE 2.4.2-2



SHEARON HARRIS NUCLEAR POWER PLANT Carolina Power & Light Company ENVIRONMENTAL REPORT	CAPE FEAR RIVER 1-DAY AND 7-CONSECUTIVE DAYS LOW FLOW (AT BUCKHORN DAM) FREQUENCY ANALYSIS (LOG PEARSON TYPE III DISTRIBUTION) 1925 – 1978	FIGURE 2.4.2-3



NOTE
ANALYSIS BASED ON DATA DERIVED FROM USGS RECORDS OF CAPE FEAR RIVER AT LILLINGTON BY DRAINAGE AREA RELATIONSHIP.

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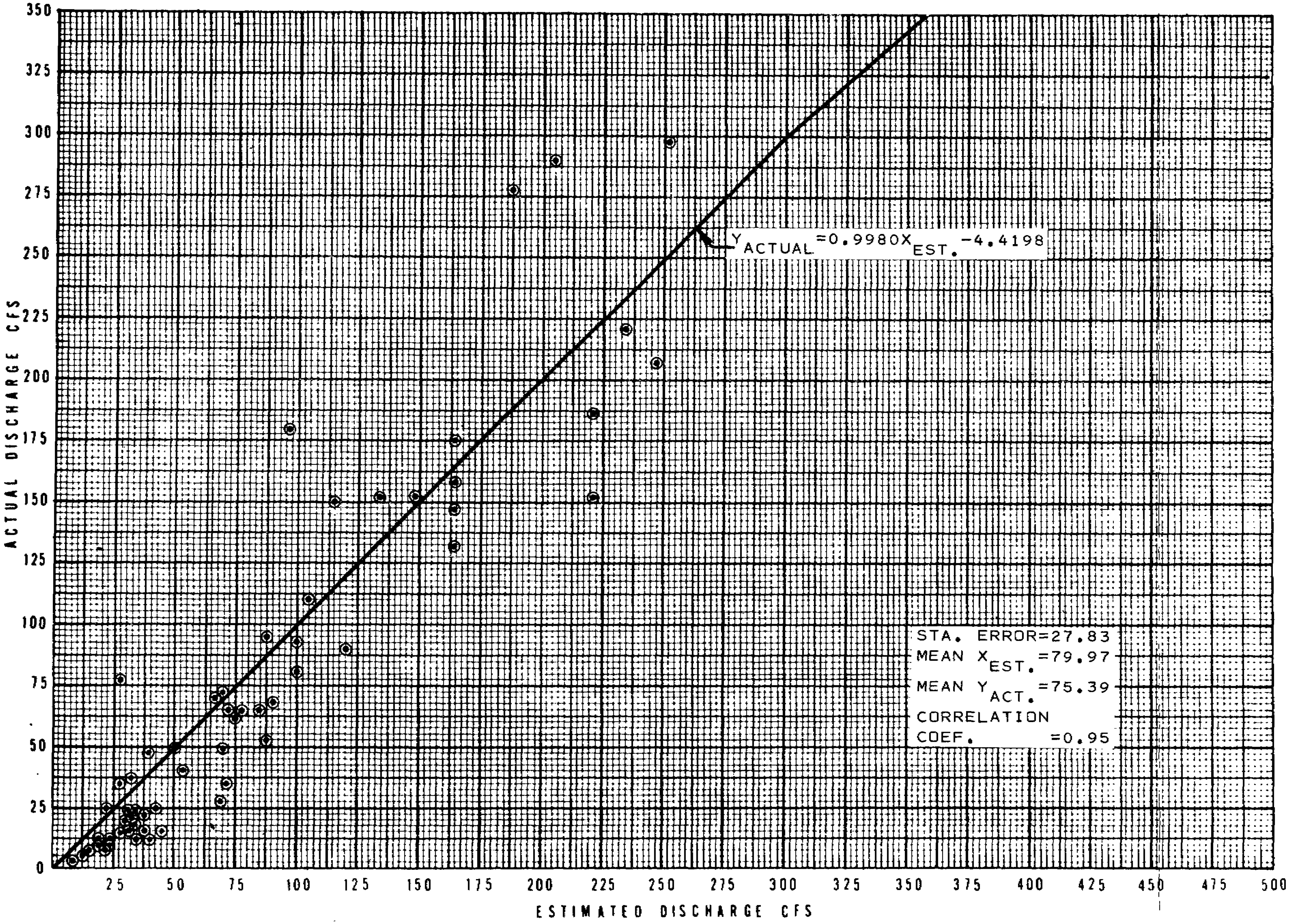
CAPE FEAR RIVER (AT BUCKHORN DAM) FLOOD PEAKS FREQUENCY ANALYSIS (LOG PEARSON TYPE III DISTRIBUTION) 1924 – 1978

FIGURE

2.4.2-4



DATA SOURCE: USGS

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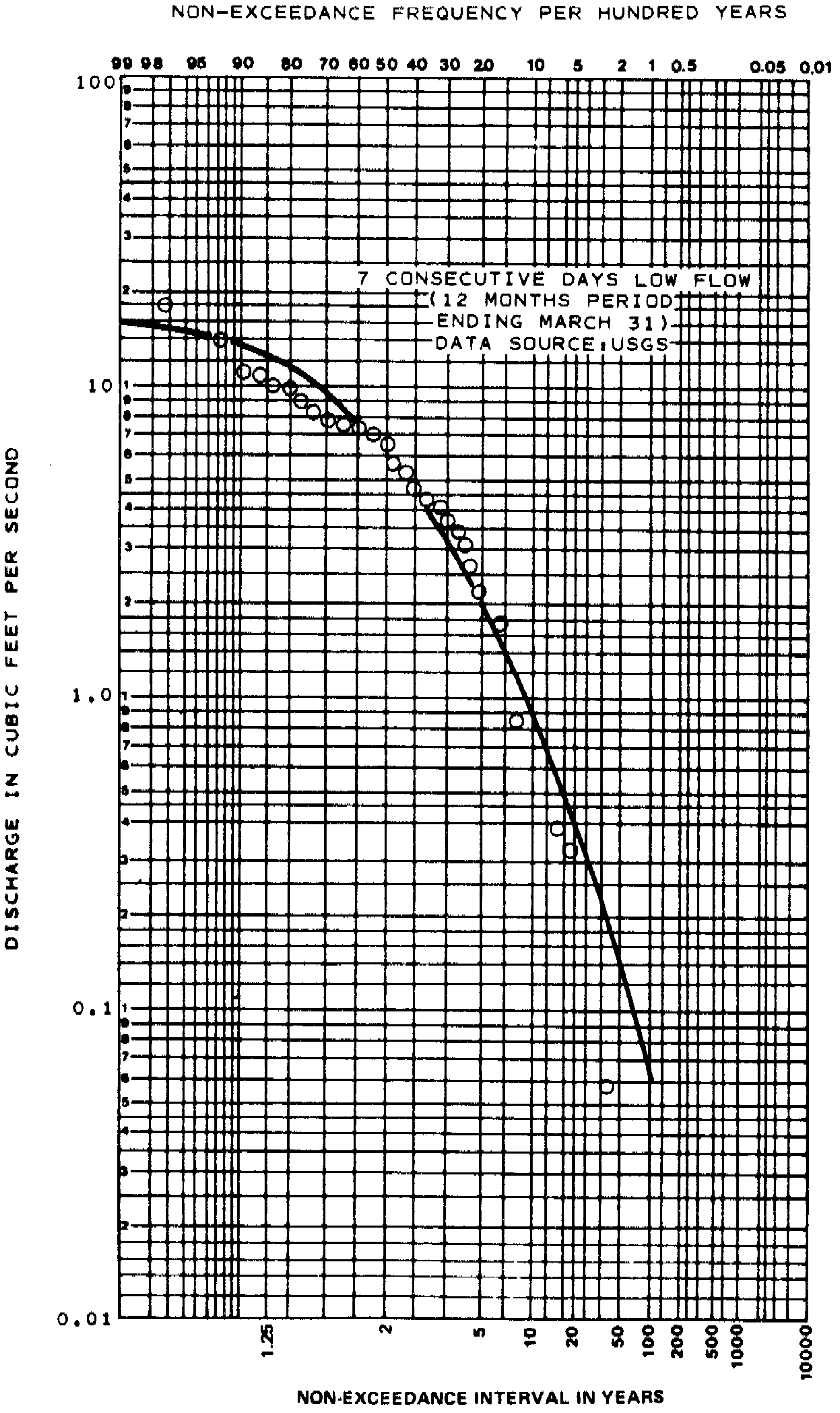
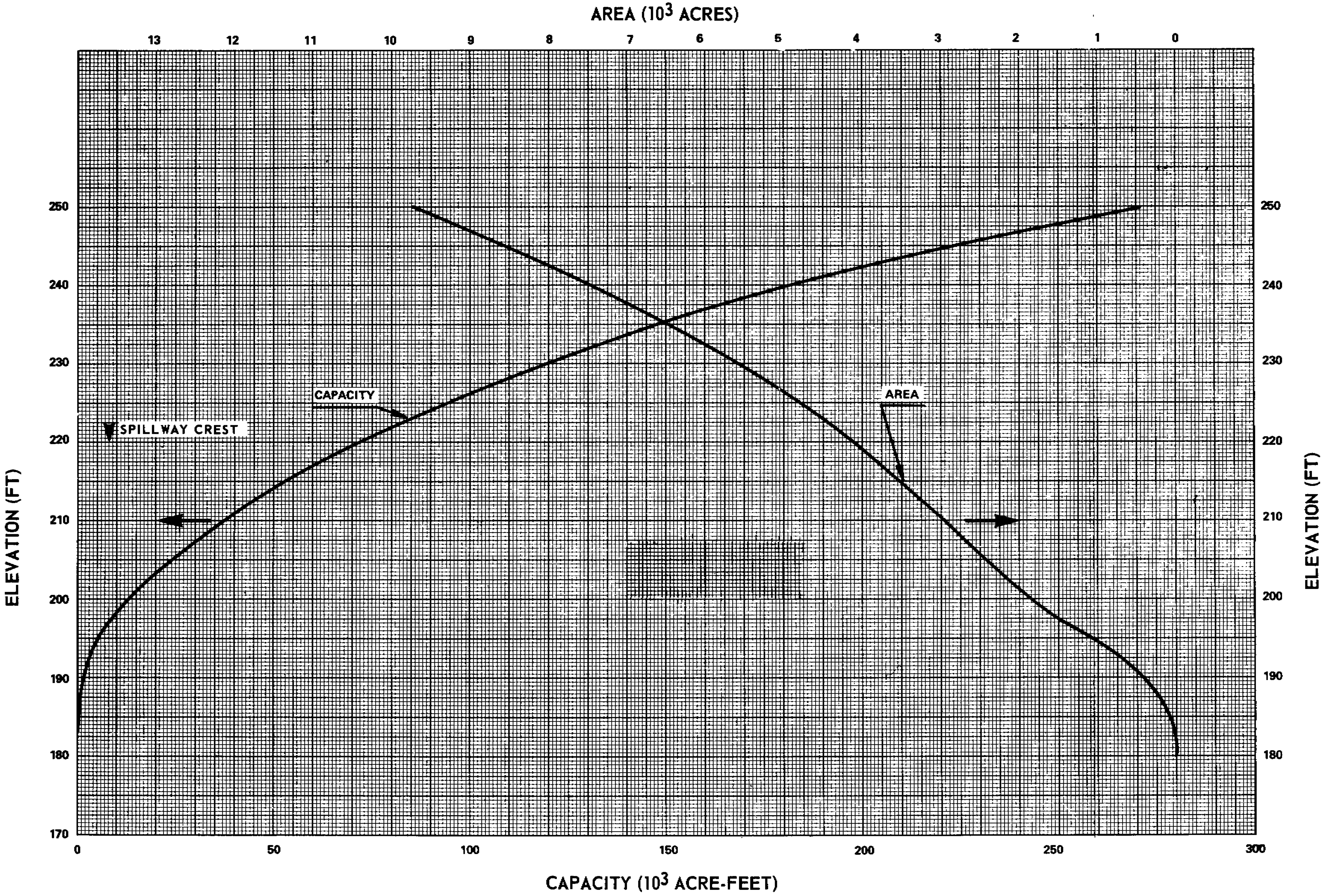
CORRELATION OF MONTHLY AVERAGE FLOW BETWEEN ESTIMATED & ACTUAL FLOW OF BUCKHORN CREEK
FIGURE 2.4.2-5



SHEARON HARRIS NUCLEAR POWER PLANT Carolina Power & Light Company ENVIRONMENTAL REPORT	BUCKHORN CREEK 7-CONSECUTIVE DAYS LOW FLOW FREQUENCY ANALYSIS (LOG PEARSON TYPE III DISTRIBUTION) 1941 – 1978	FIGURE 2.4.2-6



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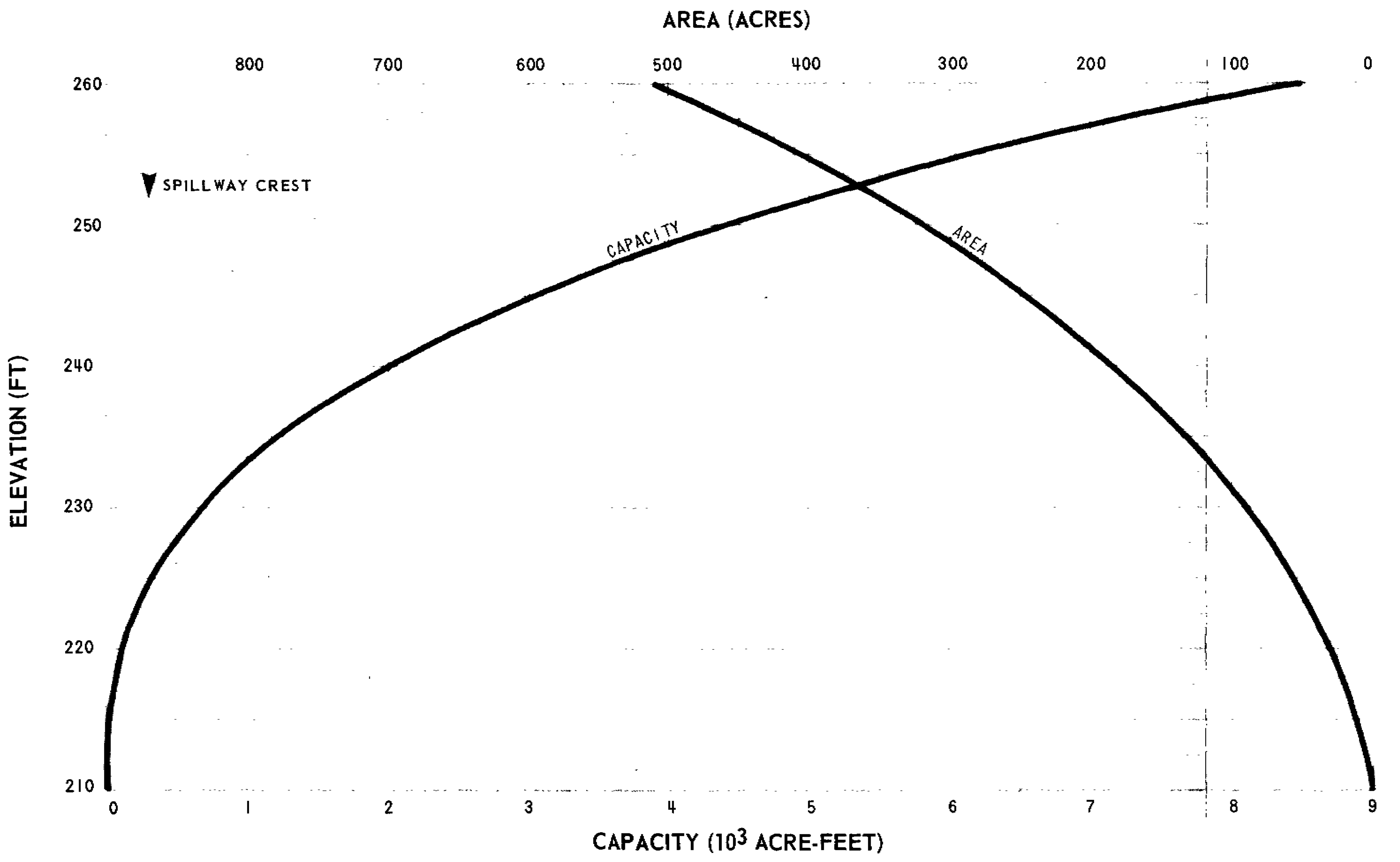
MAIN RESERVOIR AREA AND
CAPACITY CURVES

FIGURE 2.4.2-7



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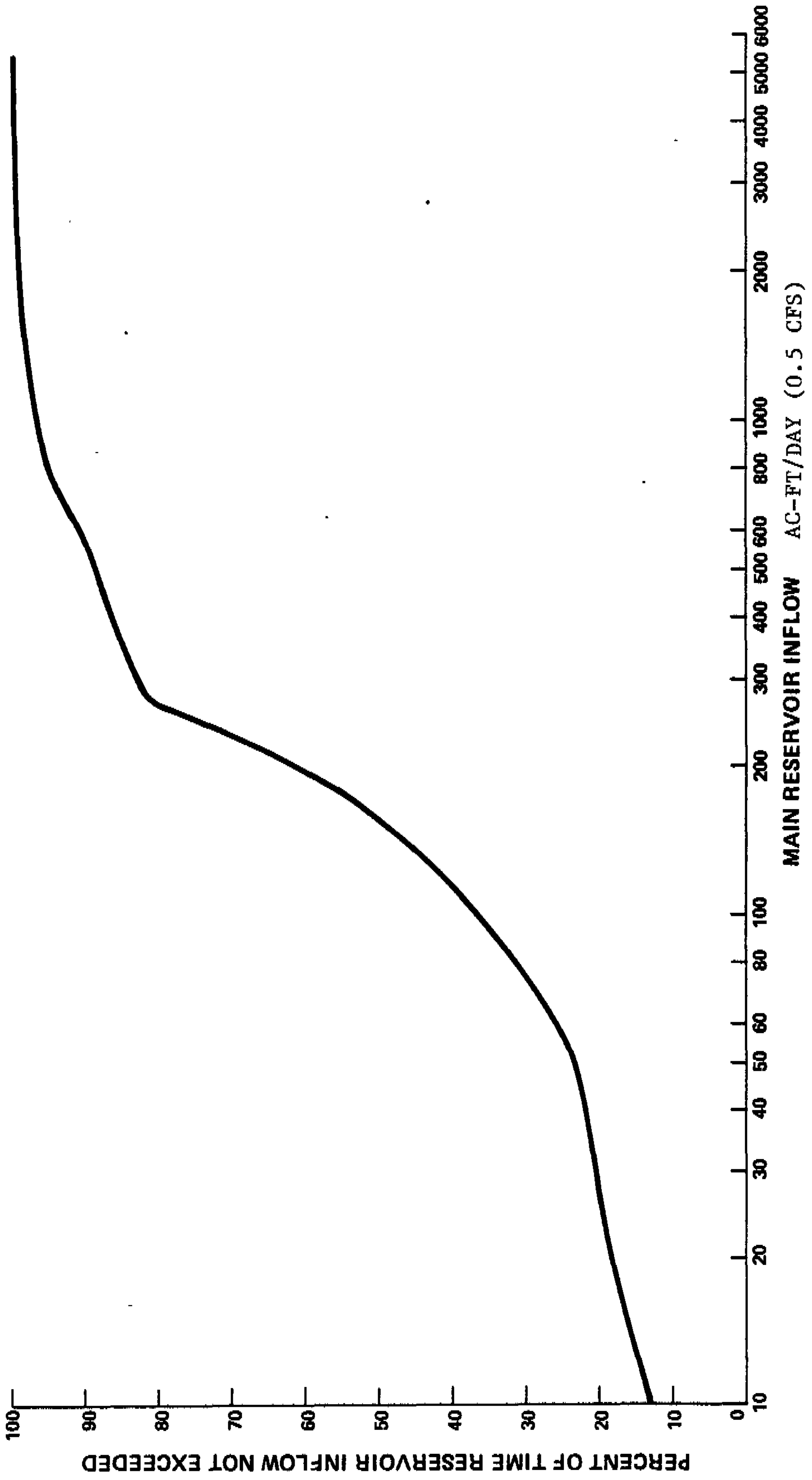
AUXILIARY RESERVOIR
AREA AND CAPACITY CURVES

FIGURE 2.4.2-8



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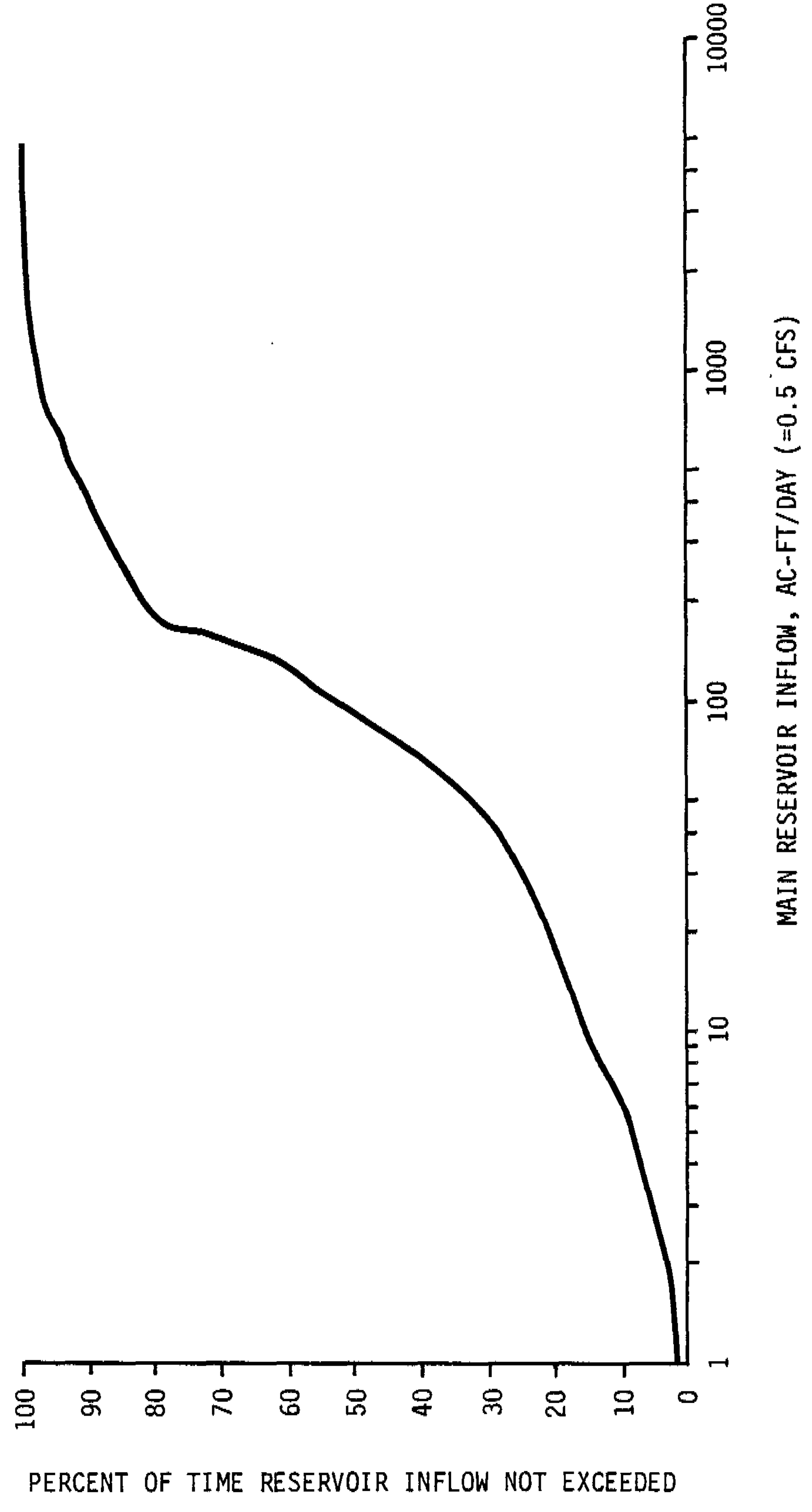

NOTES:

1. TWO-UNIT NORMAL OPERATION
2. NORMAL FORCED AND NATURAL EVAPORATION RATES USED
3. ANALYSIS BASED ON USGS DAILY STREAMFLOW RECORDS OF BUCKHORN CREEK AT CORINTH, N.C. AND CAPE FEAR RIVER AT LILLINGTON, N.C. FOR THE PERIOD OF OCTOBER 1973 THROUGH SEPTEMBER 1980

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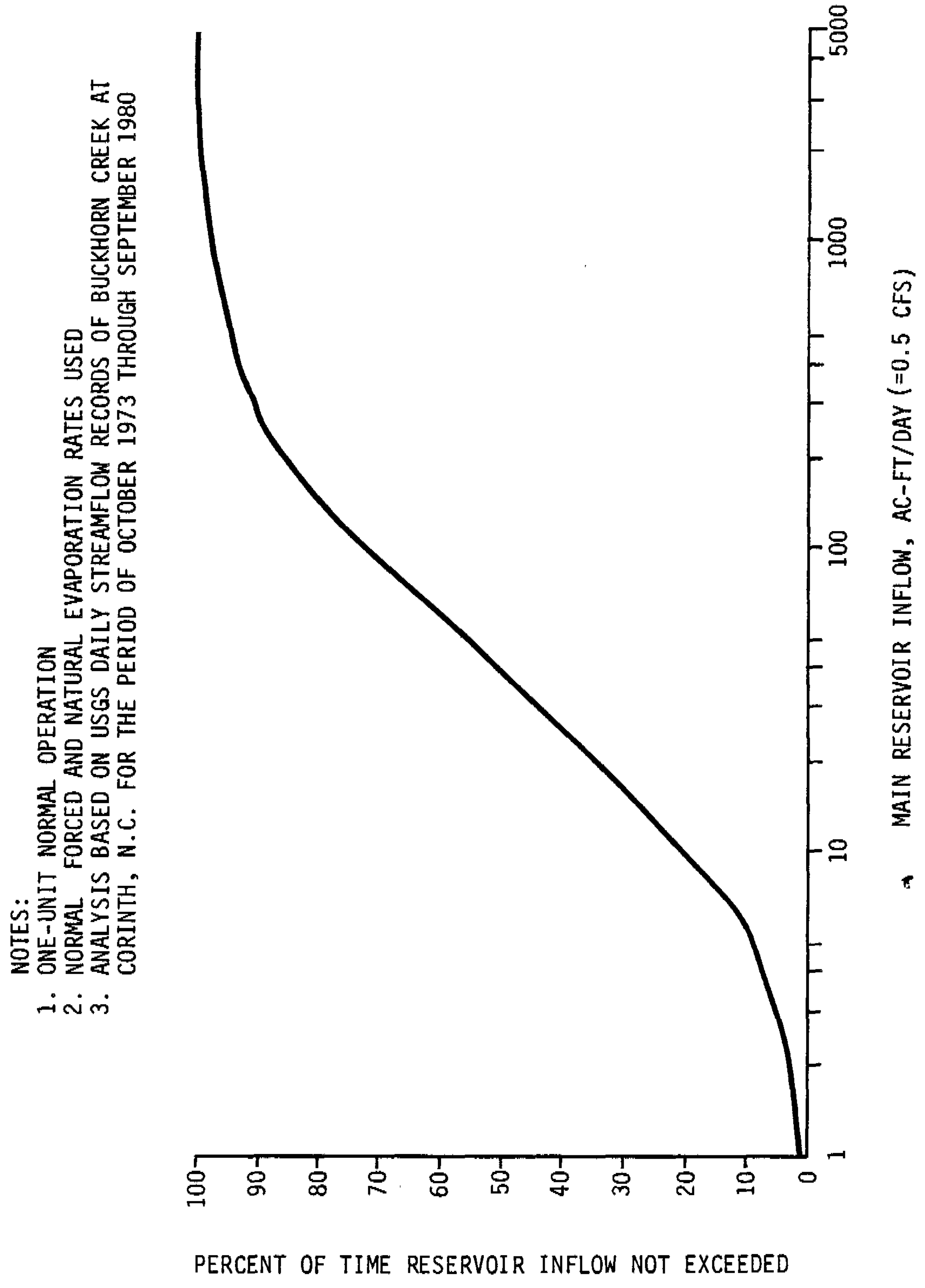
SHEARON HARRIS NUCLEAR POWER PLANT Carolina Power & Light Company ENVIRONMENTAL REPORT	TWO-UNIT OPERATION INFLOW DURATION CURVE SHNPP MAIN RESERVOIR	FIGURE 2.4.2-9a



NOTES:
1. ONE-UNIT NORMAL OPERATION
2. NORMAL FORCED AND NATURAL EVAPORATION RATES USED
3. ANALYSIS BASED ON USGS DAILY STREAMFLOW RECORDS OF BUCKHORN CREEK AT CORINTH, N.C. FOR THE PERIOD OF OCTOBER 1973 THROUGH SEPTEMBER 1980

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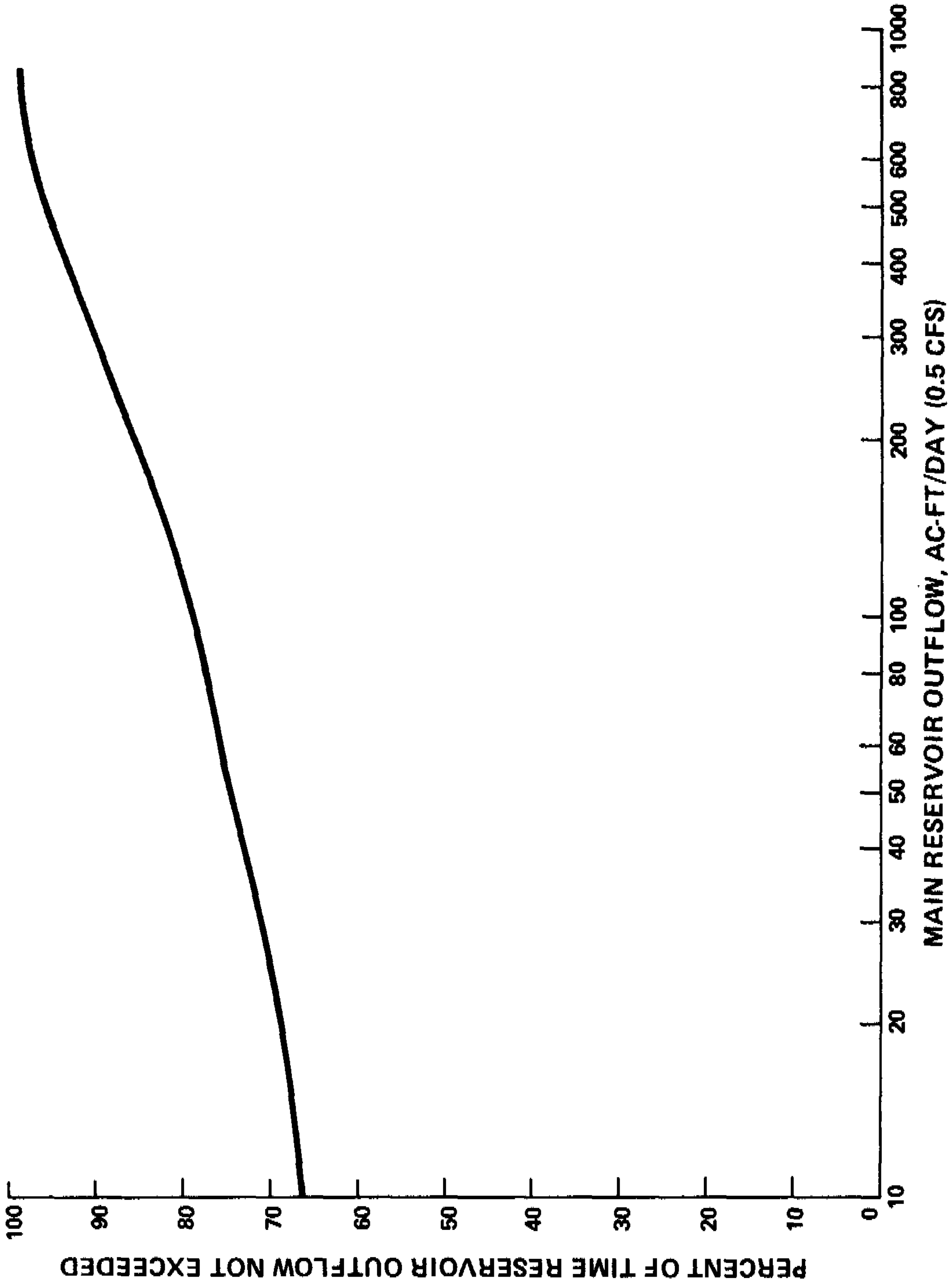
SHEARON HARRIS NUCLEAR POWER PLANT Carolina Power & Light Company **ENVIRONMENTAL REPORT**	ONE-UNIT OPERATION INFLOW DURATION CURVE SHNPP MAIN RESERVOIR	FIGURE **2.4.2-9b**



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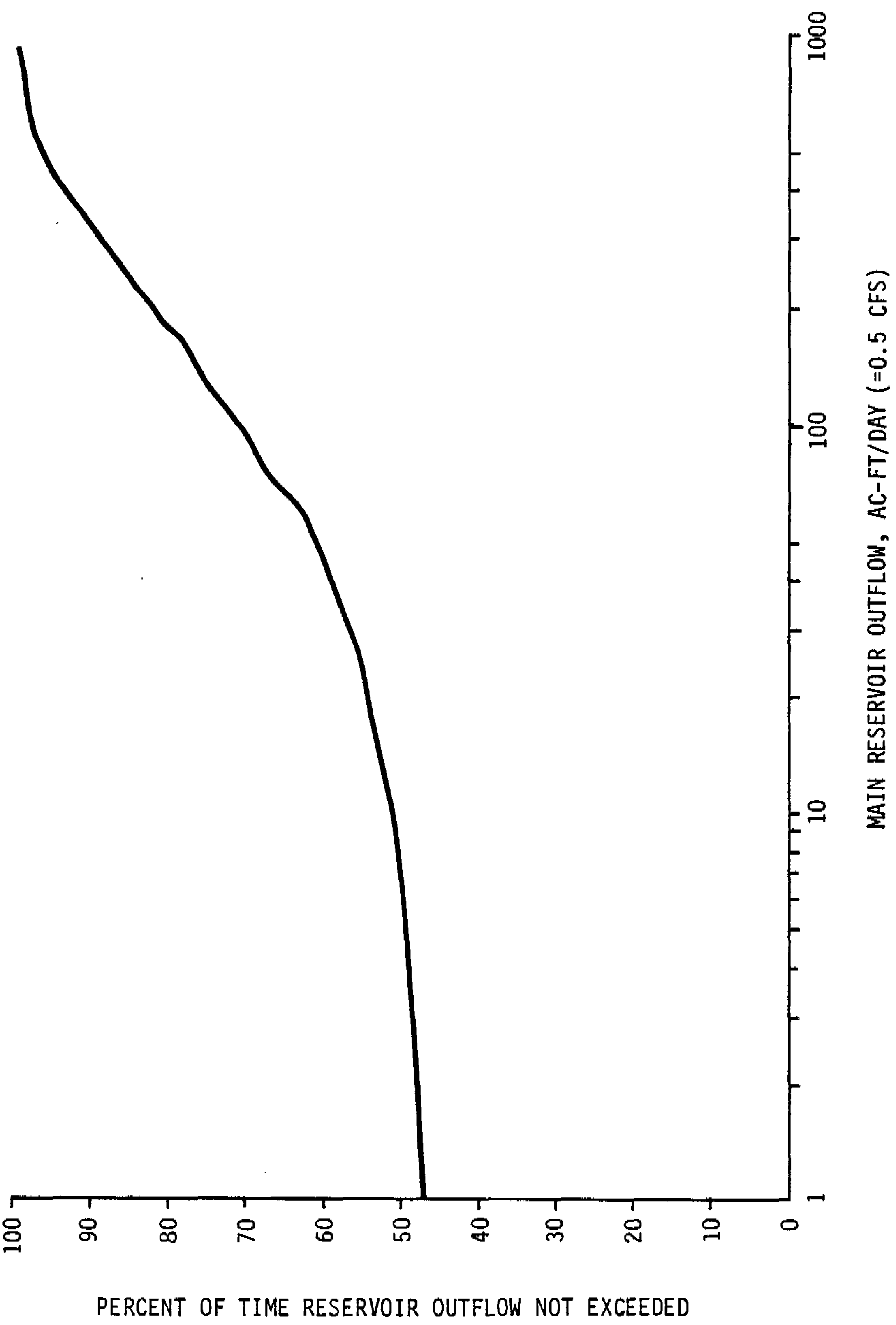
OUTFLOW DURATION CURVE SHNPP
MAIN RESERVOIR

FIGURE

2.4.2-10

NOTES:
1. TWO-UNIT NORMAL OPERATION
2. NORMAL FORCED AND NATURAL EVAPORATION RATES USED
3. ANALYSIS BASED ON USGS DAILY STREAMFLOW RECORDS OF BUCKHORN CREEK AT CORINTH, N.C. AND CAPE FEAR RIVER AT LILLINGTON, N.C. FOR THE PERIOD OF OCTOBER 1973 THROUGH SEPTEMBER 1980



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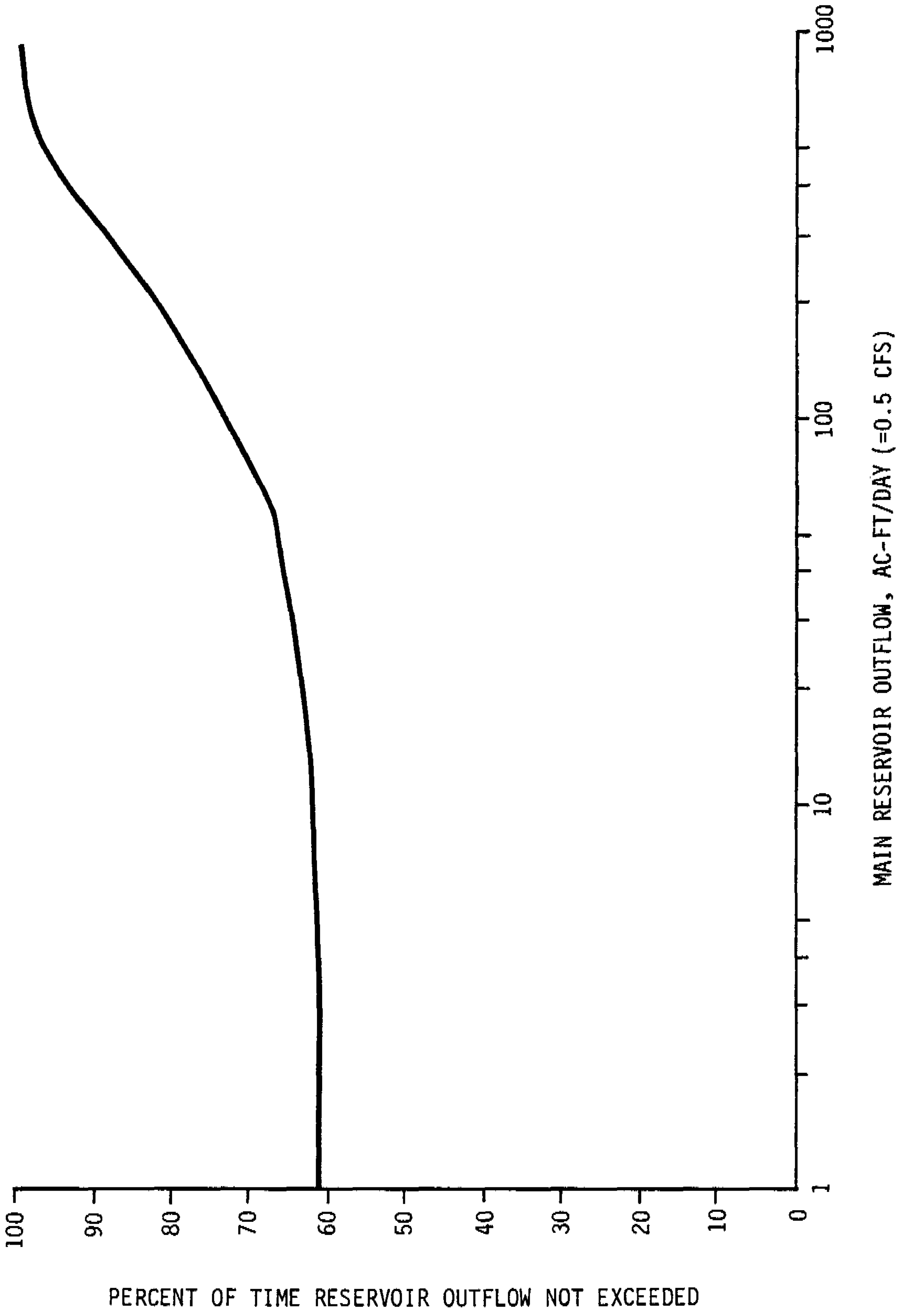
SHEARON HARRIS NUCLEAR POWER PLANT Carolina Power & Light Company **ENVIRONMENTAL REPORT**	TWO-UNIT OPERATION OUTFLOW DURATION CURVE SHNPP MAIN RESERVOIR	**FIGURE** **2.4.2-10a**

NOTES:
1. ONE-UNIT NORMAL OPERATION
2. NORMAL FORCED AND NATURAL EVAPORATION RATES USED
3. ANALYSIS BASED ON USGS DAILY STREAMFLOW RECORDS OF BUCKHORN CREEK AT CORINTH, N.C. FOR THE PERIOD OF OCTOBER 1973 THROUGH SEPTEMBER 1980



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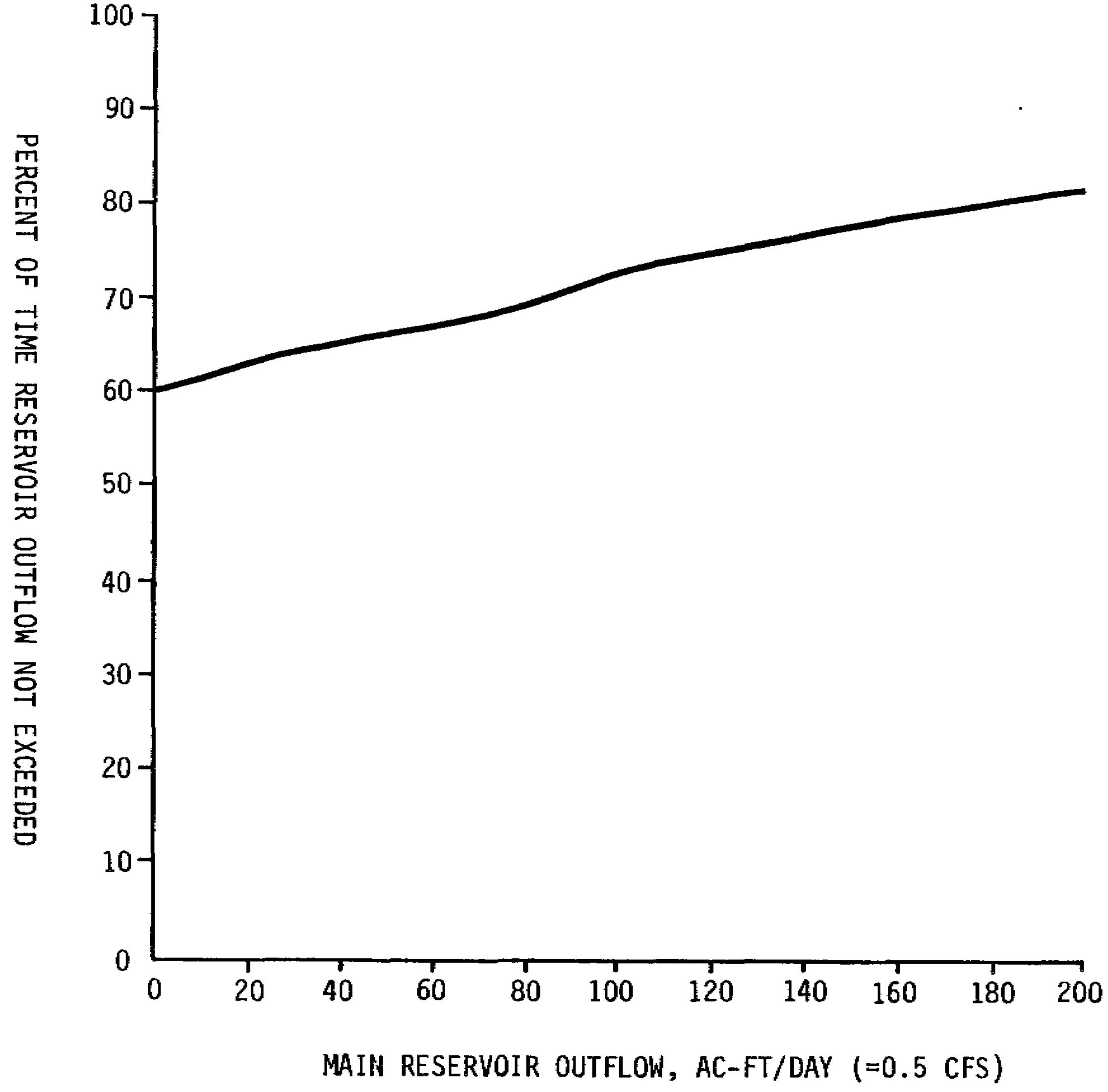
SHEARON HARRIS NUCLEAR POWER PLANT Carolina Power & Light Company ENVIRONMENTAL REPORT	ONE-UNIT OPERATION OUTFLOW DURATION CURVE (1-500 CFS) SHNPP MAIN RESERVOIR	FIGURE 2.4.2-10b

NOTES:
1. ONE-UNIT NORMAL OPERATION
2. NORMAL FORCED AND NATURAL EVAPORATION RATES USED
3. ANALYSIS BASED ON USGS DAILY STREAMFLOW RECORDS OF BUCKHORN CREEK AT CORINTH, N.C. FOR THE PERIOD OF OCTOBER 1973 THROUGH SEPTEMBER 1980
4. MAIN RESERVOIR OUTFLOW DURATION CURVE FOR 0 TO 100 CFS



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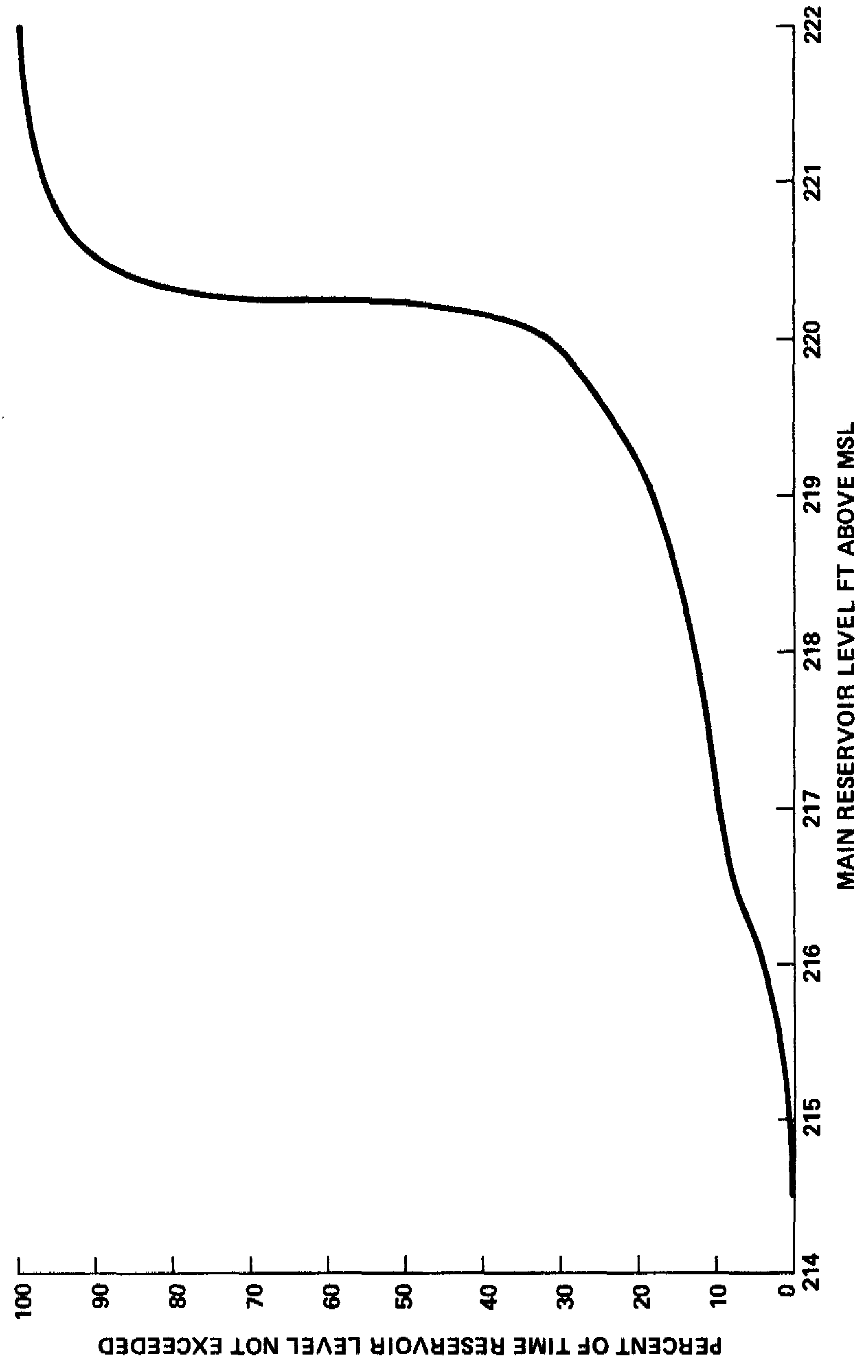
Carolina
Power & Light Company
ENVIRONMENTAL REPORT

ONE-UNIT OPERATION
OUTFLOW DURATION CURVE (0-100 CFS)
SHNPP MAIN RESERVOIR

FIGURE
2.4.2-10c



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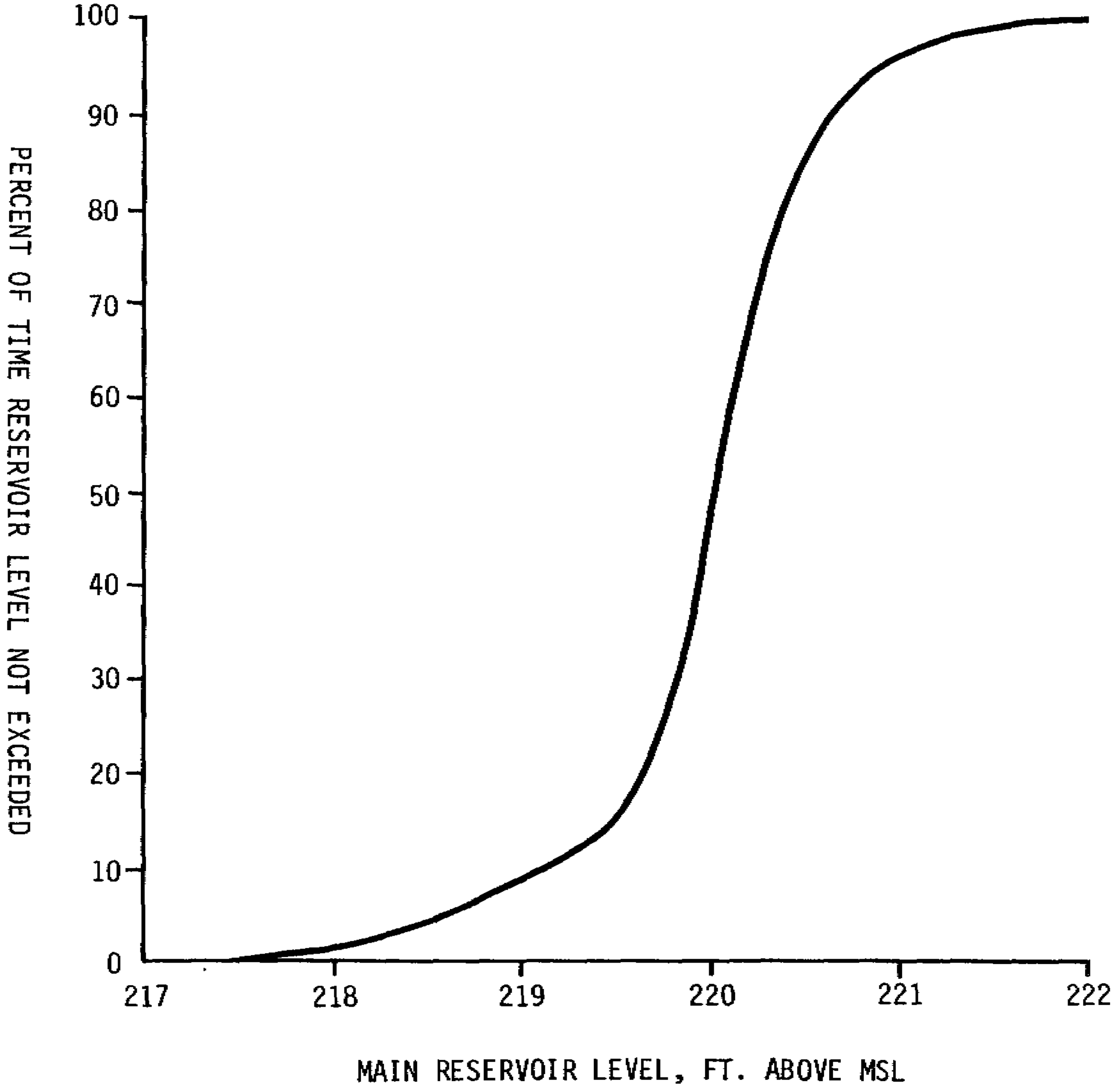
Power & Light Company
ENVIRONMENTAL REPORT

STAGE DURATION CURVE SHNPP
MAIN RESERVOIR

FIGURE

2.4.2-11

NOTES:
1. TWO-UNIT NORMAL OPERATION
2. NORMAL FORCED AND NATURAL EVAPORATION RATES USED
3. ANALYSIS BASED ON USGS DAILY STREAMFLOW RECORDS OF BUCKHORN CREEK AT CORINTH, N.C. AND CAPE FEAR RIVER AT LILLINGTON, N.C. FOR THE PERIOD OF OCTOBER 1973 THROUGH SEPTEMBER 1980



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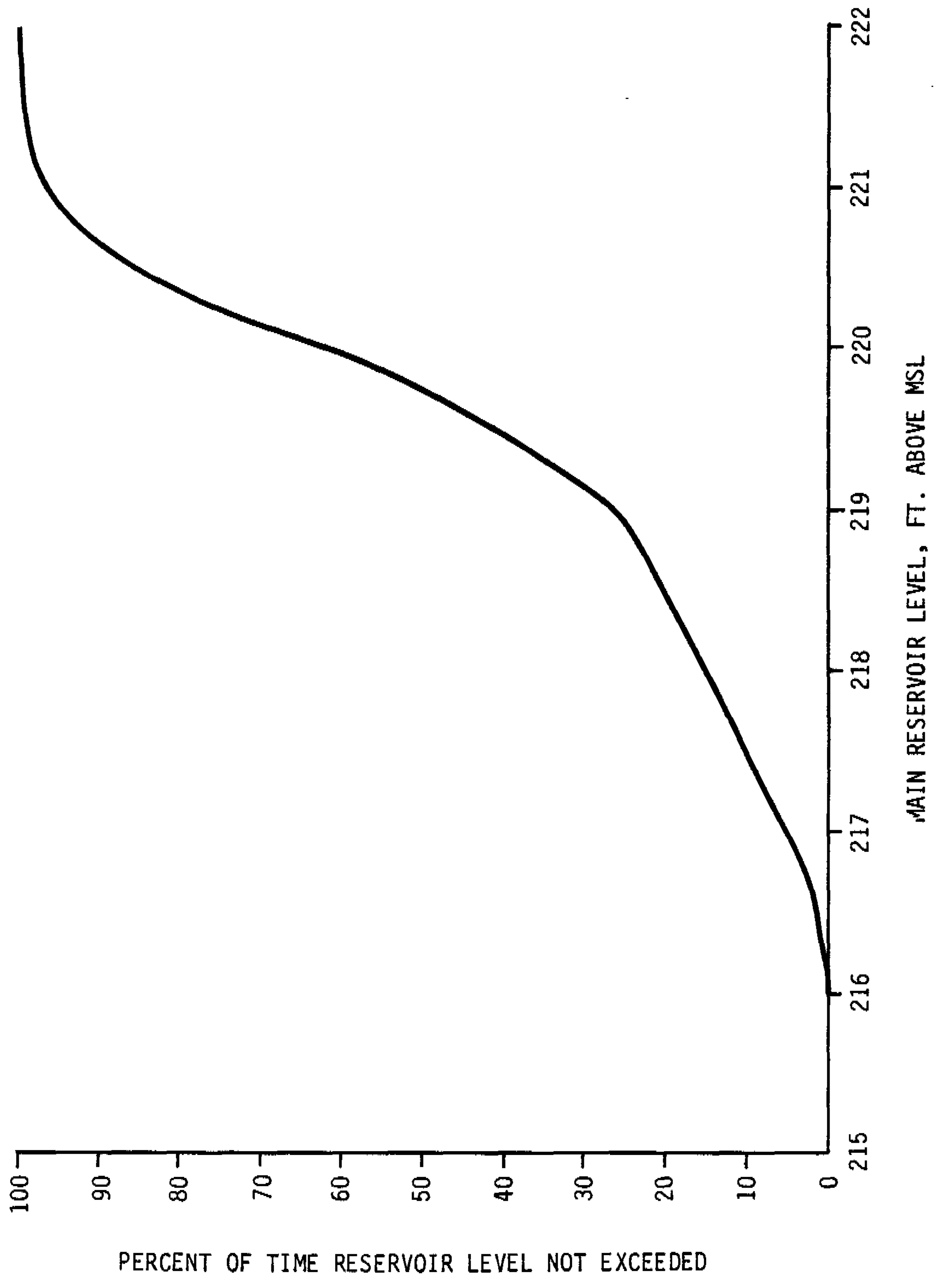
ENVIRONMENTAL REPORT

TWO-UNIT OPERATION
STAGE DURATION CURVE
SHNPP MAIN RESERVOIR

FIGURE

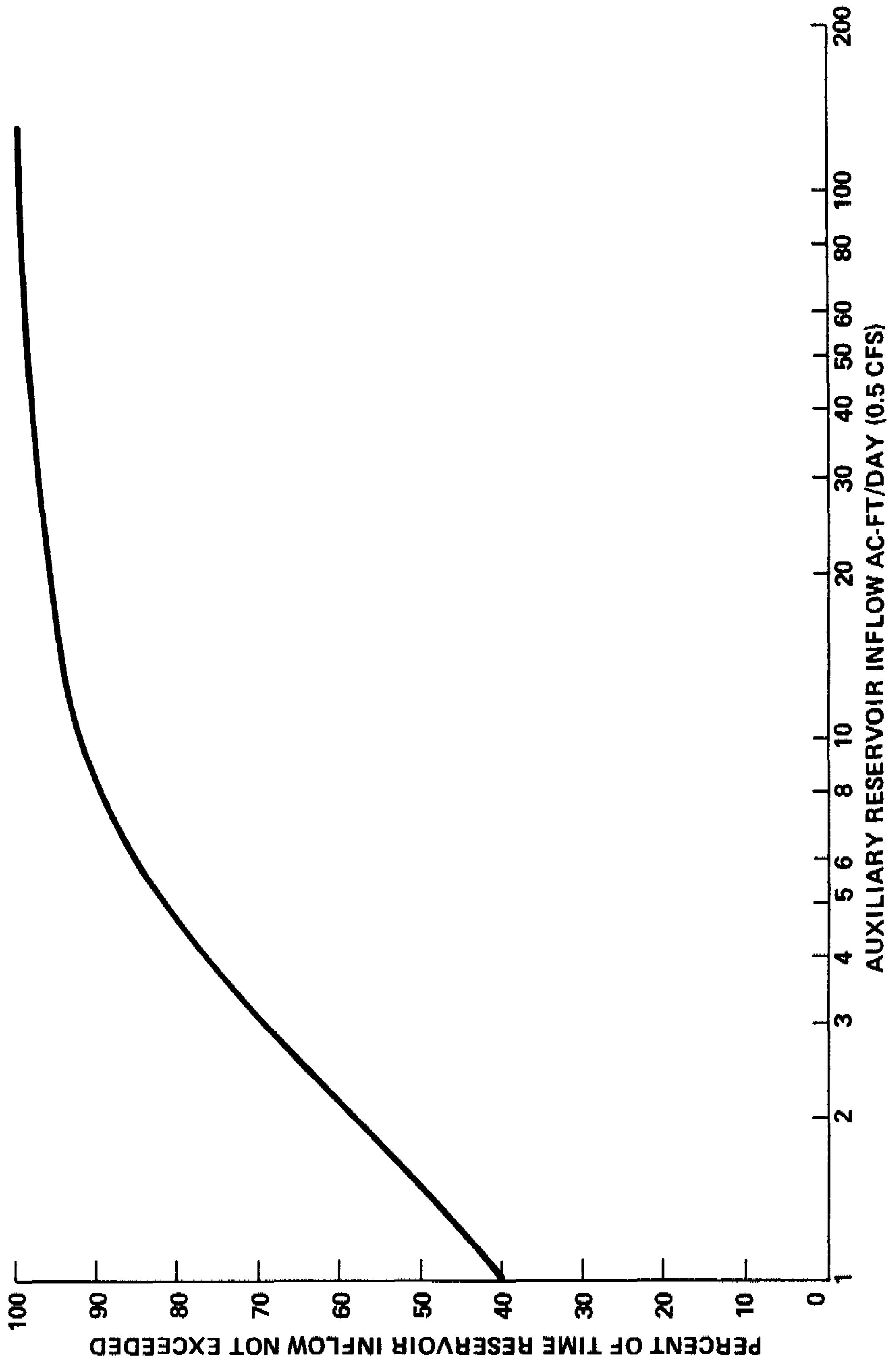
2.4.2-11a

NOTES:
1. ONE-UNIT NORMAL OPERATION
2. NORMAL FORCED AND NATURAL EVAPORATION RATES USED
3. ANALYSIS BASED ON USGS DAILY STREAMFLOW RECORDS OF BUCKHORN CREEK AT CORINTH. N.C. FOR THE PERIOD OF OCTOBER 1973 THROUGH SEPTEMBER 1980



AMENDMENT NO. 4

SHEARON HARRIS NUCLEAR POWER PLANT Carolina Power & Light Company ENVIRONMENTAL REPORT	ONE-UNIT OPERATION STAGE DURATION CURVE SHNPP MAIN RESERVOIR	FIGURE 2.4.2-11b

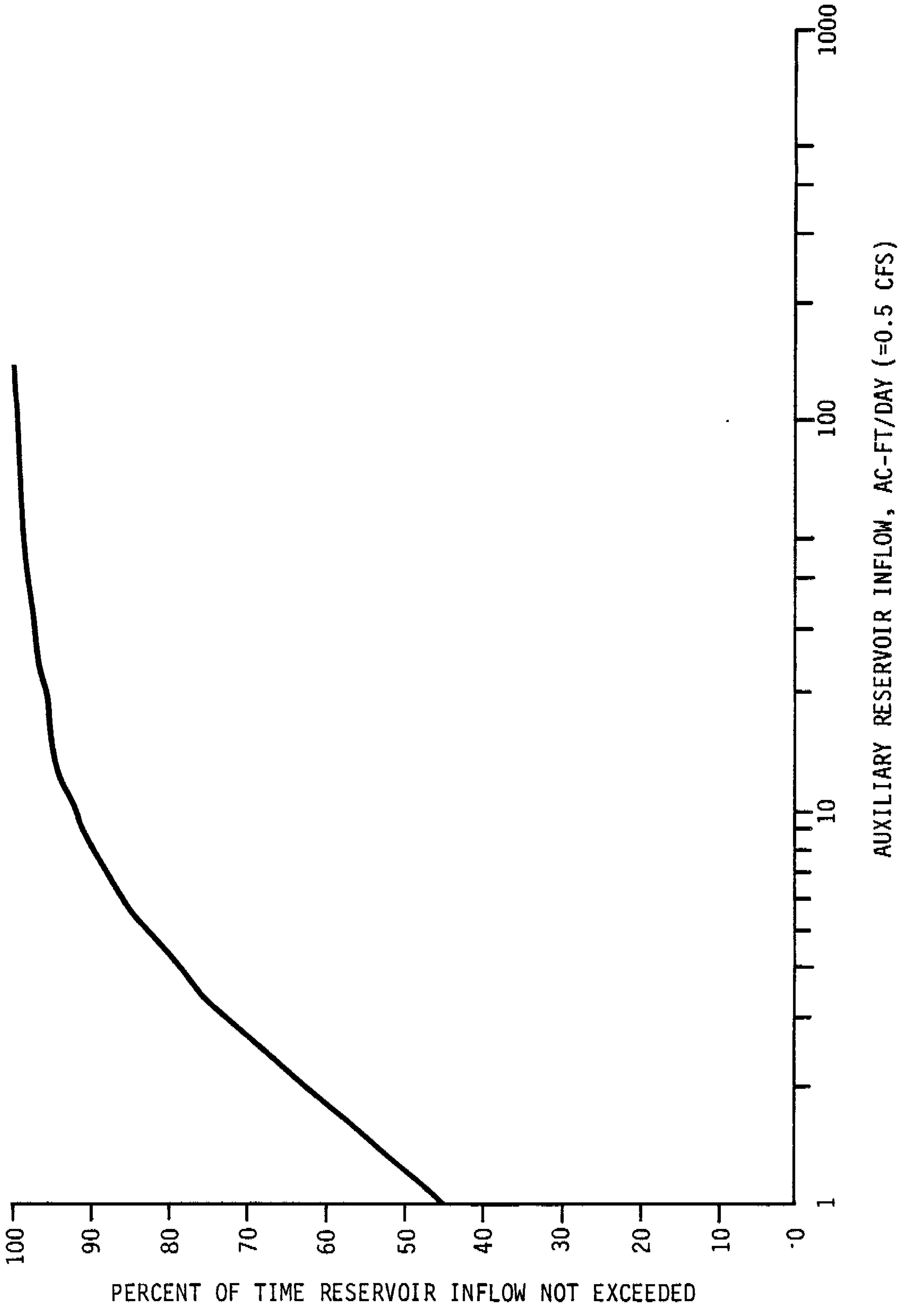


SHEARON HARRIS
NUCLEAR POWER PLANT
Carolina
Power & Light Company
ENVIRONMENTAL REPORT

INFLOW DURATION CURVE SHNPP
AUXILIARY RESERVOIR

FIGURE

2.4.2-12

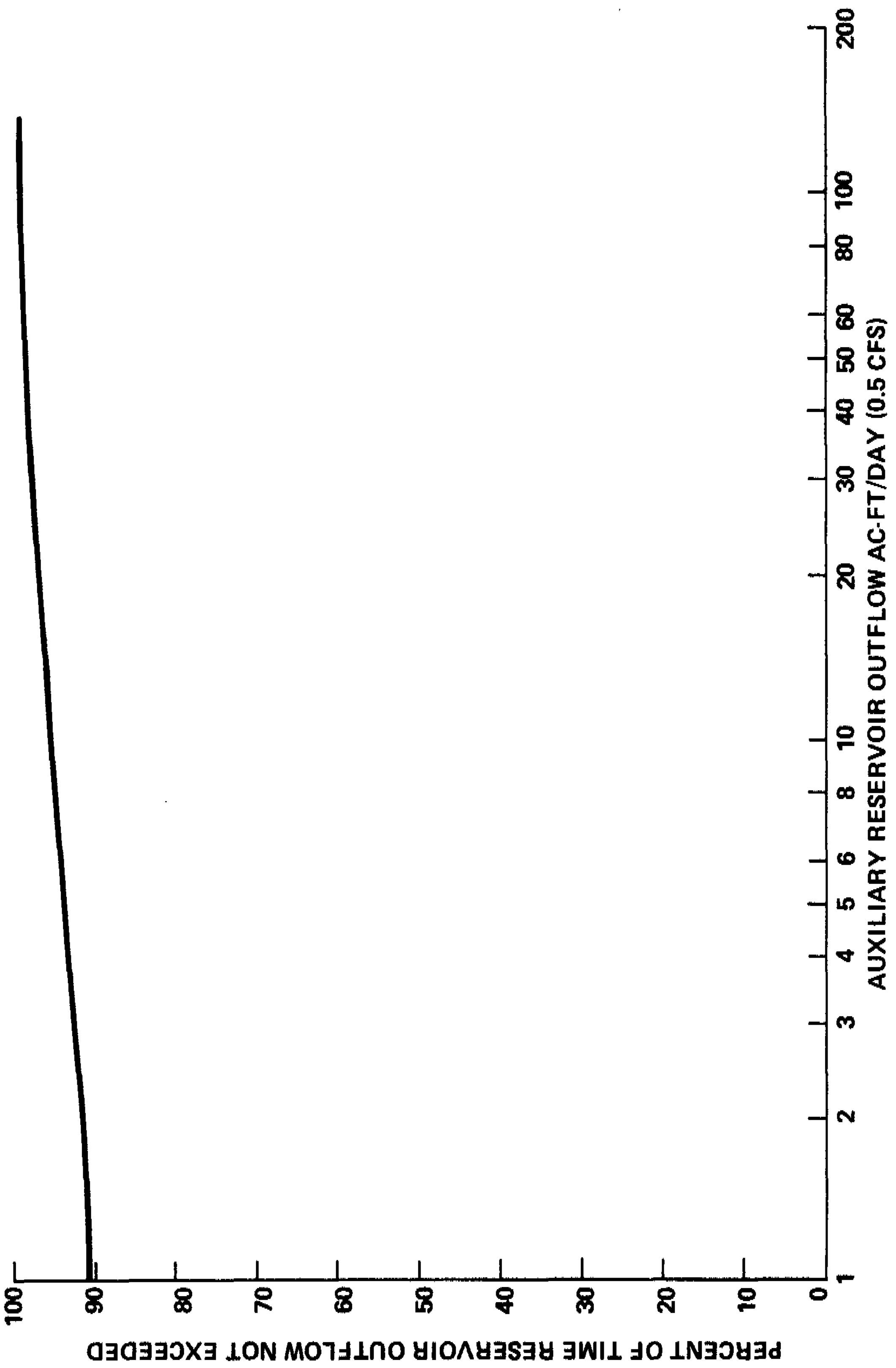


NOTES:

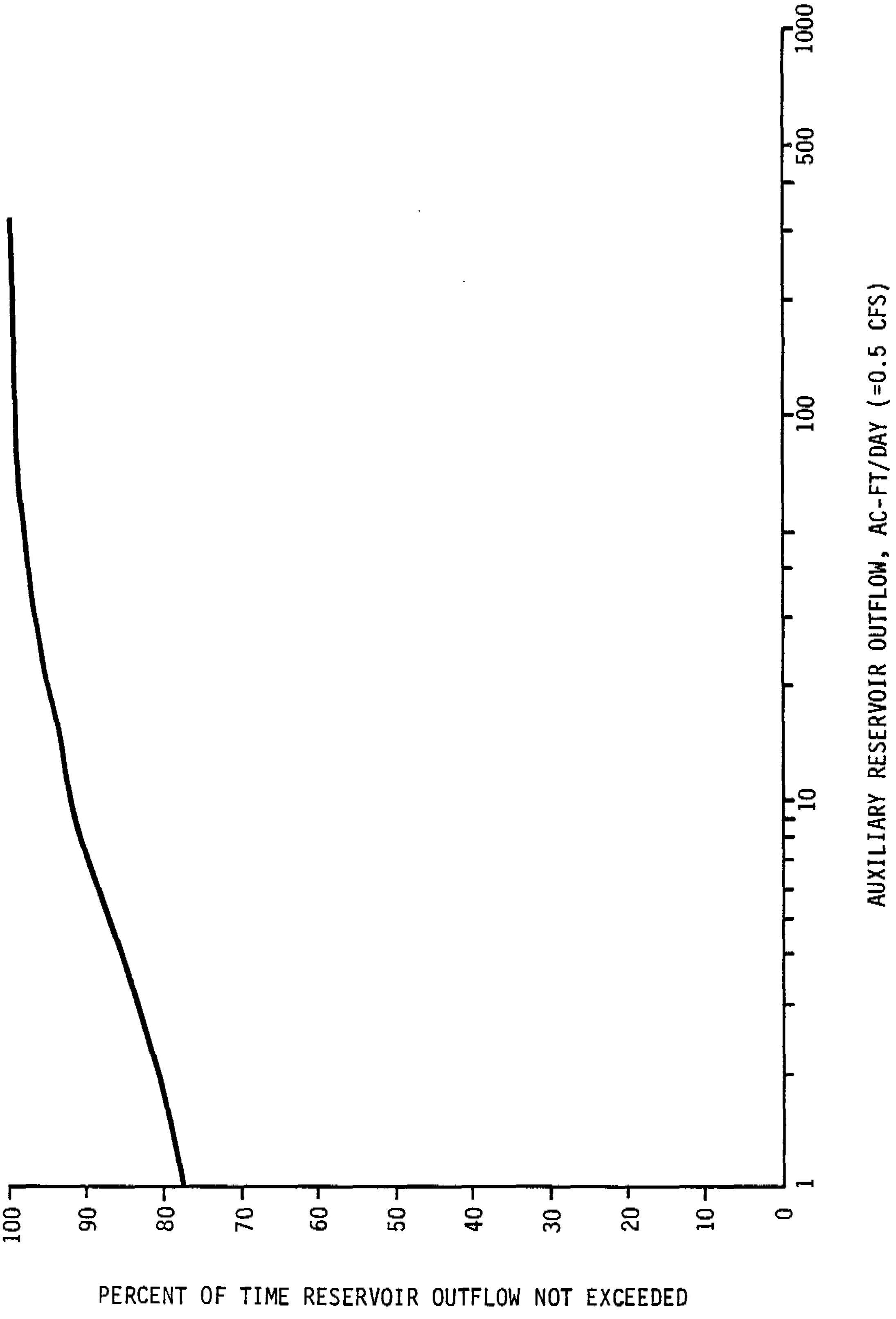
1. TWO-UNIT NORMAL OPERATION
2. NORMAL FORCED AND NATURAL EVAPORATION RATES USED
3. ANALYSIS BASED ON USGS DAILY STREAMFLOW RECORDS OF BUCKHORN CREEK AT CORINTH, N.C. AND CAPE FEAR RIVER AT LILLINGTON, N.C. FOR THE PERIOD OF OCTOBER 1973 THROUGH SEPTEMBER 1980

AMENDMENT NO. 4

SHEARON HARRIS NUCLEAR POWER PLANT Carolina Power & Light Company ENVIRONMENTAL REPORT	TWO-UNIT OPERATION INFLOW DURATION CURVE SHNPP AUXILIARY RESERVOIR	FIGURE 2.4.2-12a



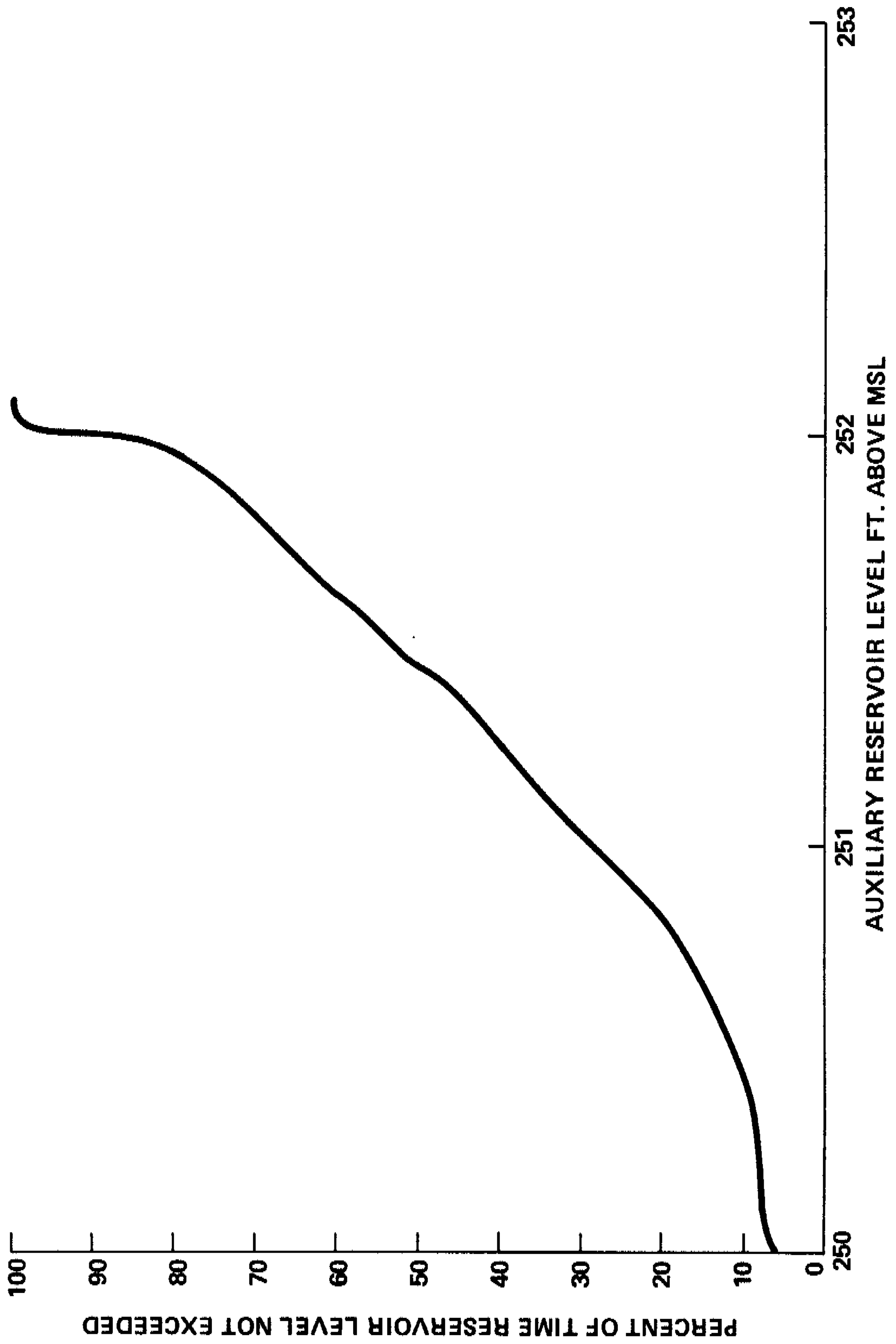
SHEARON HARRIS NUCLEAR POWER PLANT Carolina Power & Light Company ENVIRONMENTAL REPORT	OUTFLOW DURATION CURVE SHNPP AUXILIARY RESERVOIR	FIGURE 2.4.2-13



NOTES:
1. TWO-UNIT NORMAL OPERATION
2. NORMAL FORCED AND NATURAL EVAPORATION RATES USED
3. ANALYSIS BASED ON USGS DAILY STREAMFLOW RECORDS OF BUCKHORN CREEK AT CORINTH, N.C. AND CAPE FEAR RIVER AT LILLINGTON, N.C. FOR THE PERIOD OF OCTOBER 1973 THROUGH SEPTEMBER 1980

AMENDMENT NO. 4

SHEARON HARRIS NUCLEAR POWER PLANT Carolina Power & Light Company **ENVIRONMENTAL REPORT**	TWO-UNIT OPERATION OUTFLOW DURATION CURVE SHNPP AUXILIARY RESERVOIR	**FIGURE** **2.4.2-13a**



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NUCLEAR POWER PLANT
Carolina
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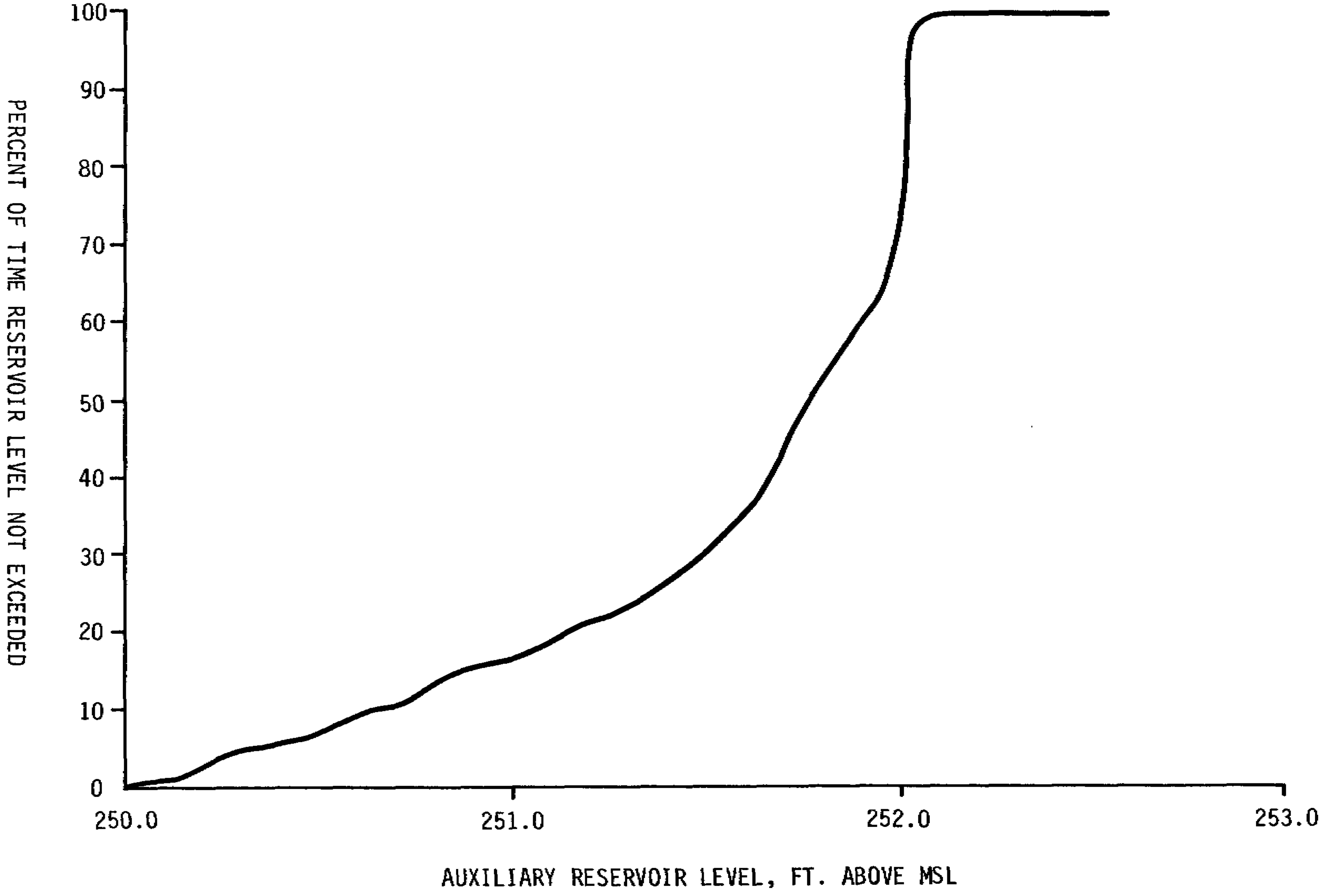
ENVIRONMENTAL REPORT

STAGE DURATION CURVE SHNPP
AUXILIARY RESERVOIR

FIGURE
2.4.2-14

NOTES:
1. TWO-UNIT NORMAL OPERATION
2. NORMAL FORCED AND NATURAL EVAPORATION RATES USED
3. ANALYSIS BASED ON USGS DAILY STREAMFLOW RECORDS OF BUCKHORN CREEK AT CORINTH, N.C. AND CAPE FEAR RIVER AT LILLINGTON, N.C. FOR THE PERIOD OF OCTOBER 1973 THROUGH SEPTEMBER 1980



AMENDMENT NO. 4

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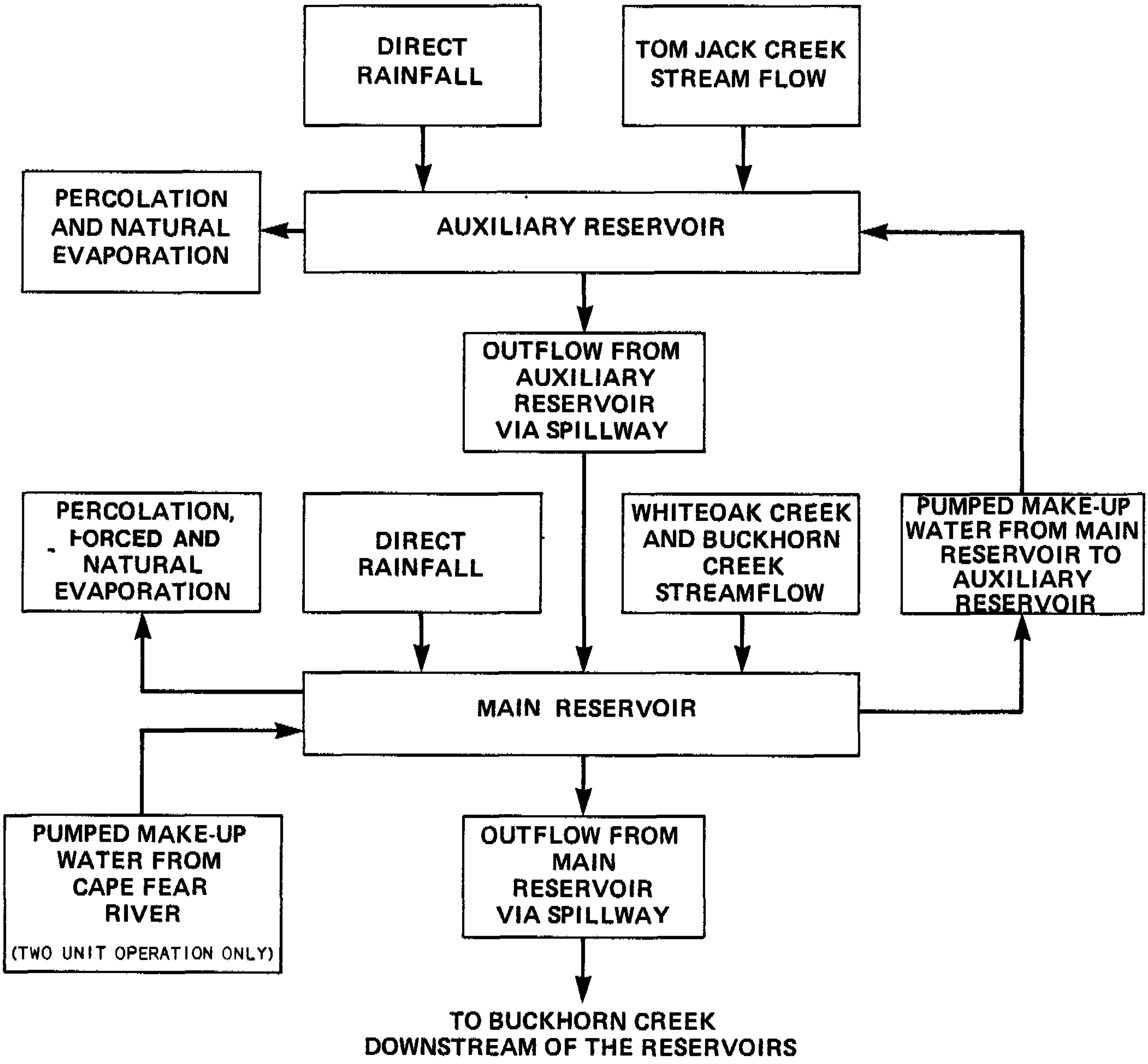
NUCLEAR POWER PLANT
Carolina
Power & Light Company
ENVIRONMENTAL REPORT

TWO-UNIT OPERATION
STAGE DURATION CURVE
SHNPP AUXILIARY RESERVOIR

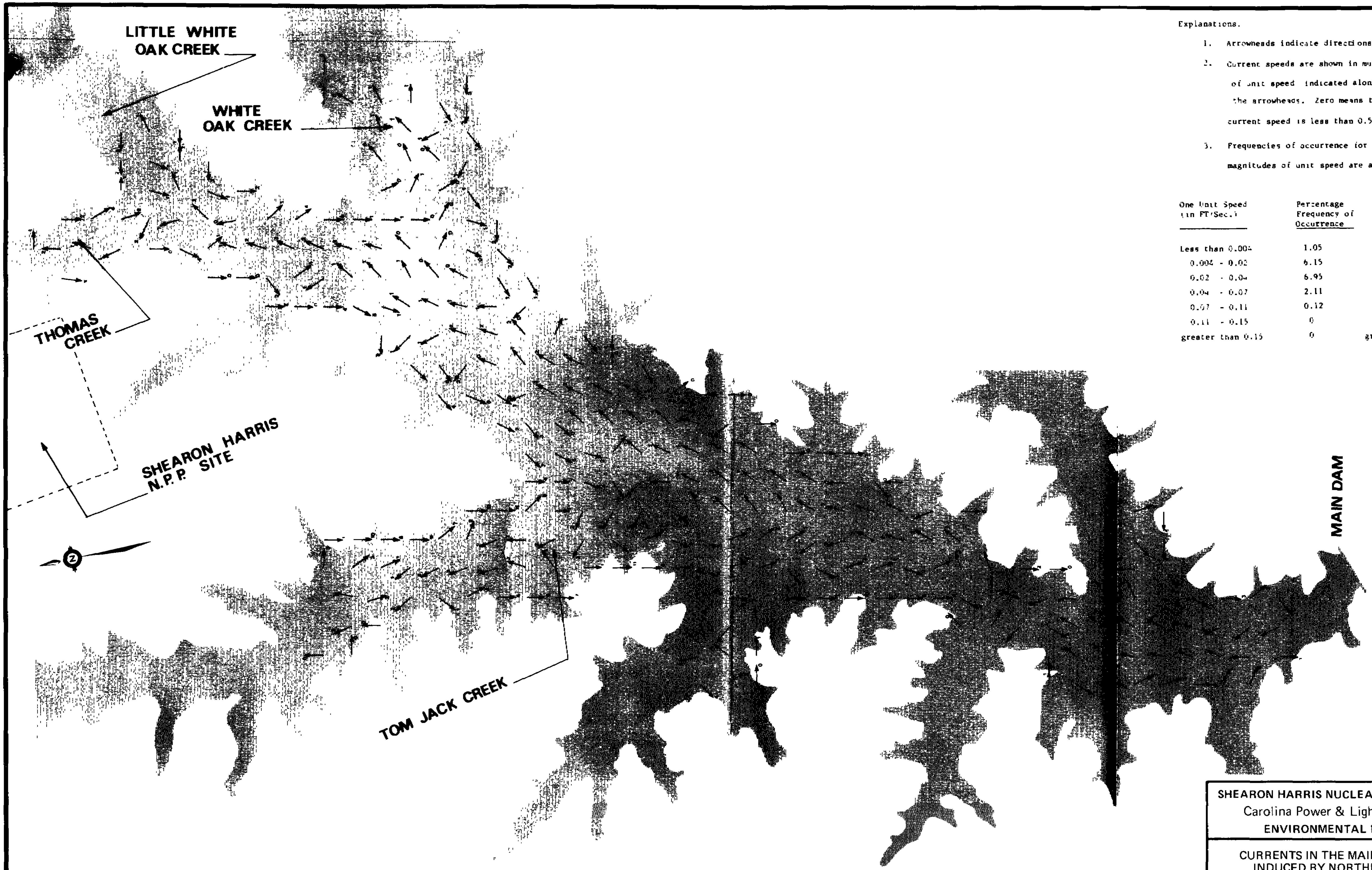
FIGURE

2.4.2-14a


DIRECT RAINFALL
TOM JACK CREEK STREAM FLOW
PERCOLATION AND NATURAL EVAPORATION
AUXILIARY RESERVOIR
OUTFLOW FROM AUXILIARY RESERVOIR VIA SPILLWAY
PERCOLATION, FORCED AND NATURAL EVAPORATION
DIRECT RAINFALL
WHITEOAK CREEK AND BUCKHORN CREEK STREAMFLOW
PUMPED MAKE-UP WATER FROM MAIN RESERVOIR TO AUXILIARY RESERVOIR
MAIN RESERVOIR
PUMPED MAKE-UP WATER FROM CAPE FEAR RIVER
(TWO UNIT OPERATION ONLY)
OUTFLOW FROM MAIN RESERVOIR VIA SPILLWAY
TO BUCKHORN CREEK DOWNSTREAM OF THE RESERVOIRS

AMENDMENT NO. 4

SHEARON HARRIS NUCLEAR POWER PLANT Carolina Power & Light Company ENVIRONMENTAL REPORT	ELEMENTS INVOLVED IN COMPUTATION OF SHNPP RESERVOIR SYSTEM INFLOWS AND OUTFLOWS	FIGURE 2.4.2-15



Explanations.

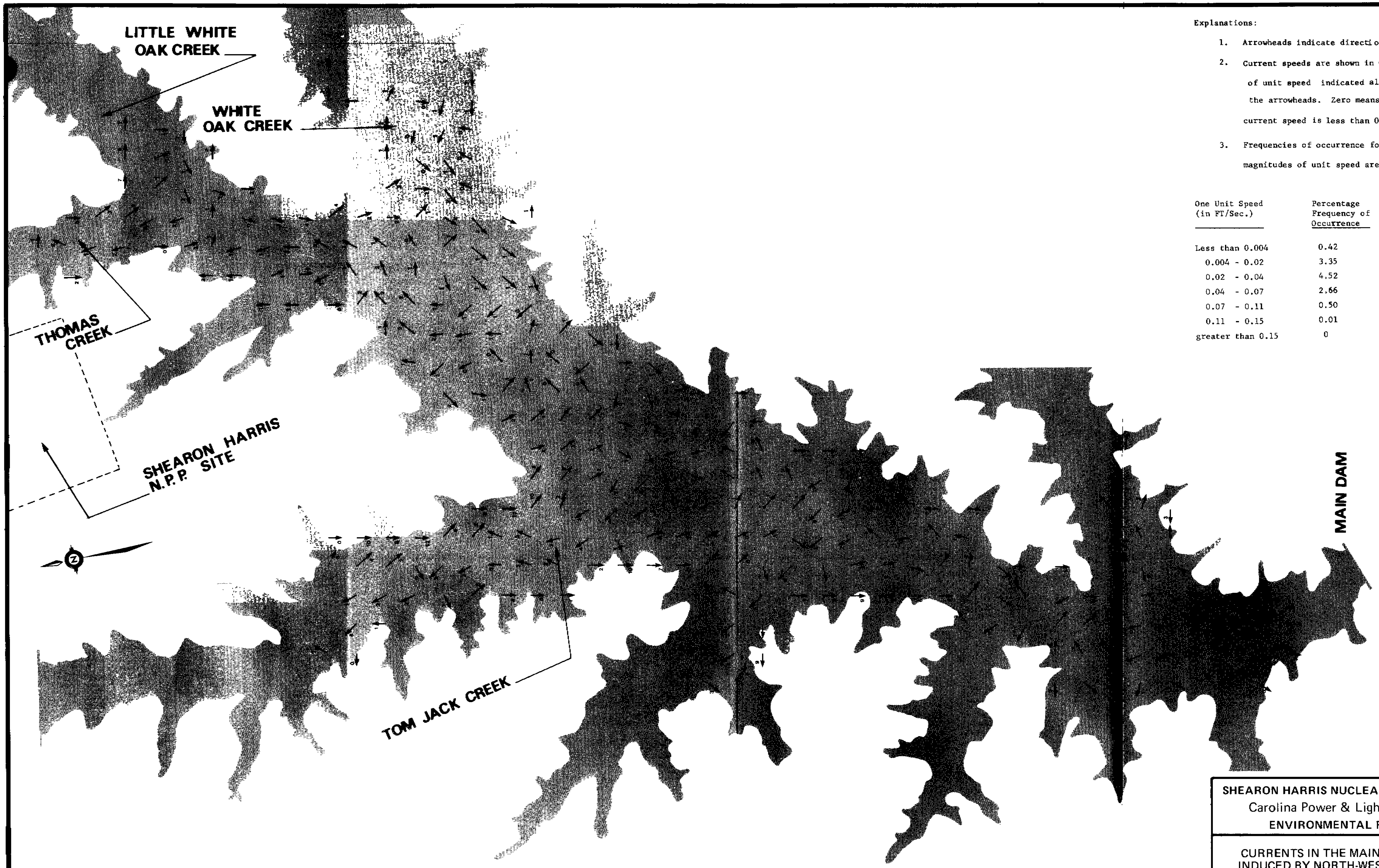
1. Arrowheads indicate directions of current.
2. Current speeds are shown in multiples of unit speed indicated alongside the arrowheads. Zero means the current speed is less than 0.5 unit speed.
3. Frequencies of occurrence for various magnitudes of unit speed are as follows:

One Unit Speed (in FT/Sec.)	Percentage Frequency of Occurrence	Corresponding Wind Speed (MPH)
Less than 0.004	1.05	Calm
0.004 - 0.02	6.15	0.75 - 3.5
0.02 - 0.04	6.95	3.5 - 7.5
0.04 - 0.07	2.11	7.5 - 12.5
0.07 - 0.11	0.12	12.5 - 18.5
0.11 - 0.15	0	18.5 - 25.0
greater than 0.15	0	greater than 25.0

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
ENVIRONMENTAL REPORT

CURRENTS IN THE MAIN RESERVOIR INDUCED BY NORTHERLY WIND

FIGURE 2.4.2-16



Explanations:

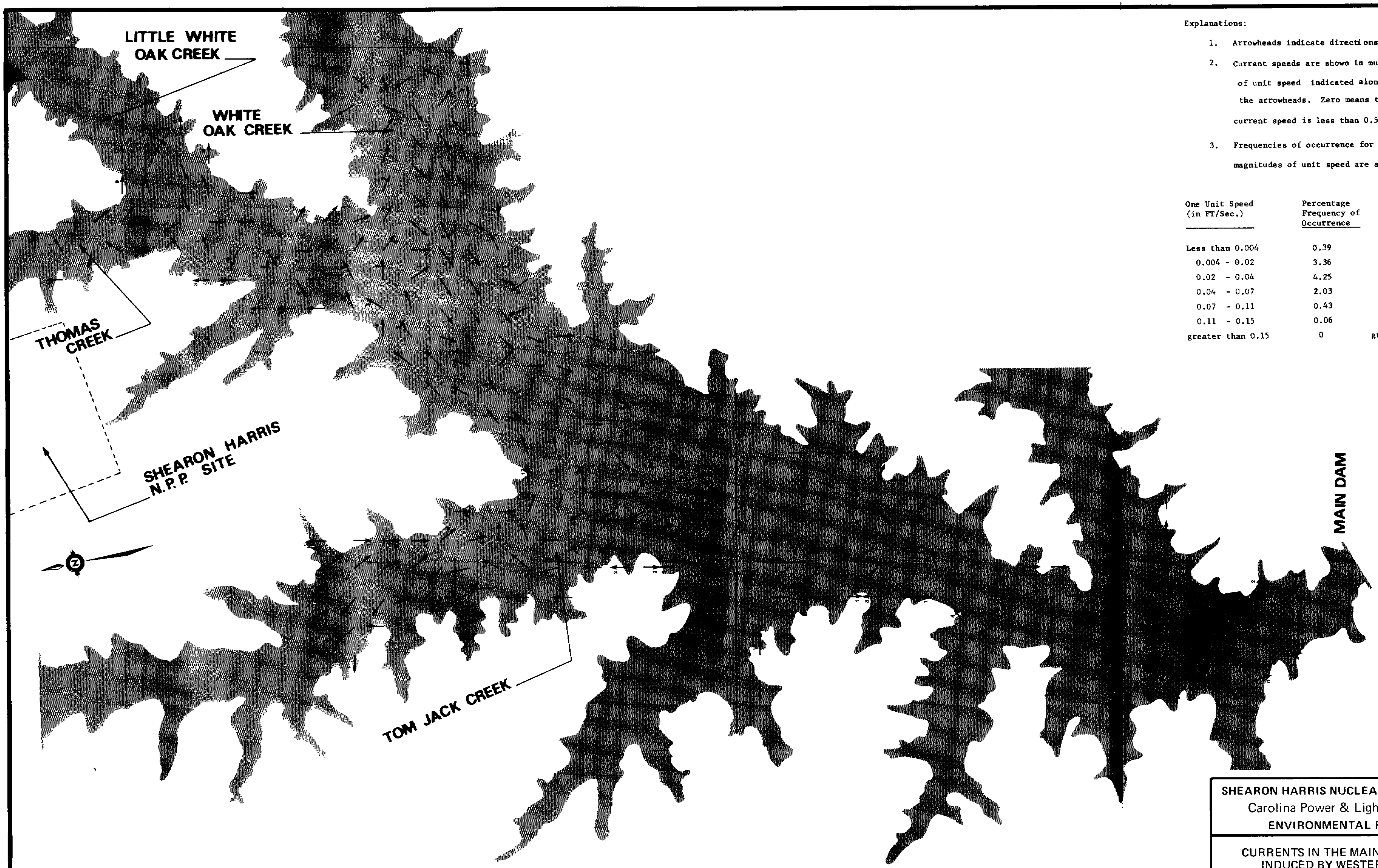
1. Arrowheads indicate directions of current.
2. Current speeds are shown in multiples of unit speed indicated alongside the arrowheads. Zero means the current speed is less than 0.5 unit speed.
3. Frequencies of occurrence for various magnitudes of unit speed are as follows:

One Unit Speed (in FT/Sec.)	Percentage Frequency of Occurrence	Corresponding Wind Speed (MPH)
Less than 0.004	0.42	Calm
0.004 - 0.02	3.35	0.75 - 3.5
0.02 - 0.04	4.52	3.5 - 7.5
0.04 - 0.07	2.66	7.5 - 12.5
0.07 - 0.11	0.50	12.5 - 18.5
0.11 - 0.15	0.01	18.5 - 25.0
greater than 0.15	0	greater than 25.0

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
ENVIRONMENTAL REPORT

CURRENTS IN THE MAIN RESERVOIR INDUCED BY NORTH-WESTERLY WIND

FIGURE 2.4.2-17



Explanations:

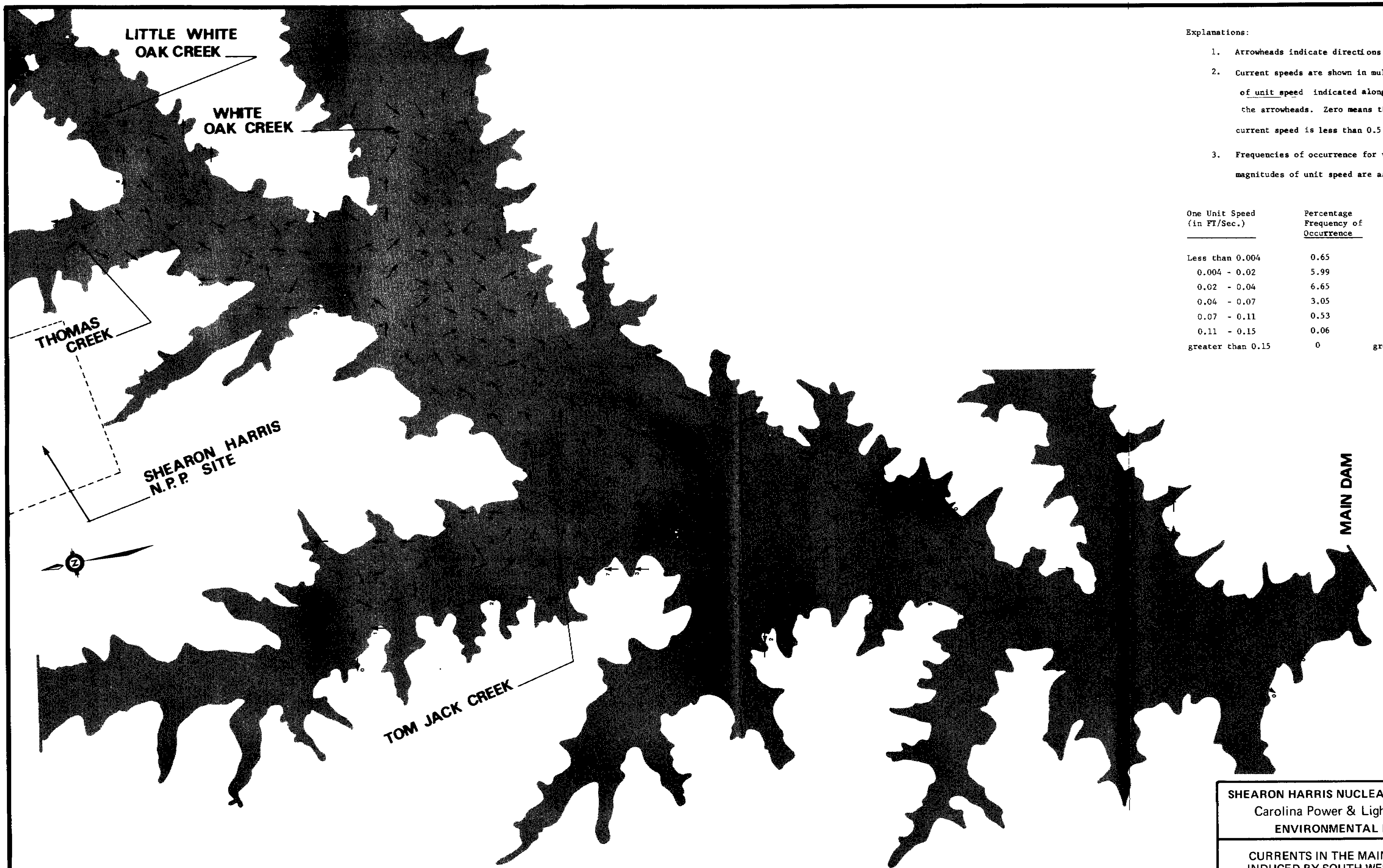
1. Arrowheads indicate directions of current.
2. Current speeds are shown in multiples of unit speed indicated alongside the arrowheads. Zero means the current speed is less than 0.5 unit speed.
3. Frequencies of occurrence for various magnitudes of unit speed are as follows:

One Unit Speed (in FT/Sec.)	Percentage Frequency of Occurrence	Corresponding Wind Speed (MPH)
Less than 0.004	0.39	Calm
0.004 - 0.02	3.36	0.75 - 3.5
0.02 - 0.04	4.25	3.5 - 7.5
0.04 - 0.07	2.03	7.5 - 12.5
0.07 - 0.11	0.43	12.5 - 18.5
0.11 - 0.15	0.06	18.5 - 25.0
greater than 0.15	0	greater than 25.0

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
ENVIRONMENTAL REPORT

CURRENTS IN THE MAIN RESERVOIR INDUCED BY WESTERLY WIND

FIGURE 2.4.2-18



Explanations:

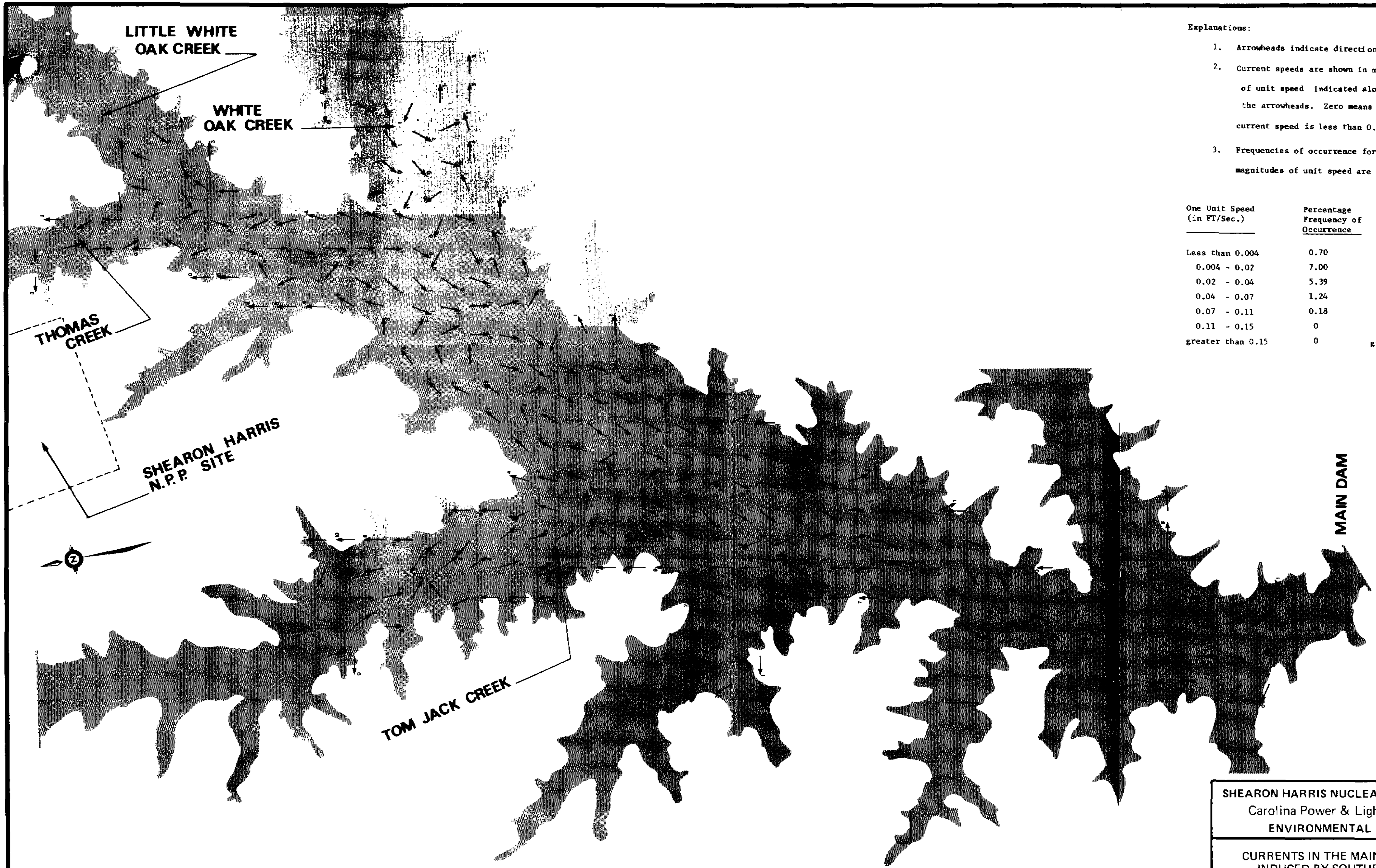
1. Arrowheads indicate directions of current.
2. Current speeds are shown in multiples of unit speed indicated alongside the arrowheads. Zero means the current speed is less than 0.5 unit speed.
3. Frequencies of occurrence for various magnitudes of unit speed are as follows:

One Unit Speed (in FT/Sec.)	Percentage Frequency of Occurrence	Corresponding Wind Speed (MPH)
Less than 0.004	0.65	Calm
0.004 - 0.02	5.99	0.75 - 3.5
0.02 - 0.04	6.65	3.5 - 7.5
0.04 - 0.07	3.05	7.5 - 12.5
0.07 - 0.11	0.53	12.5 - 18.5
0.11 - 0.15	0.06	18.5 - 25.0
greater than 0.15	0	greater than 25.0

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
ENVIRONMENTAL REPORT

CURRENTS IN THE MAIN RESERVOIR INDUCED BY SOUTH-WESTERLY WIND

FIGURE 2.4.2-19



Explanations:

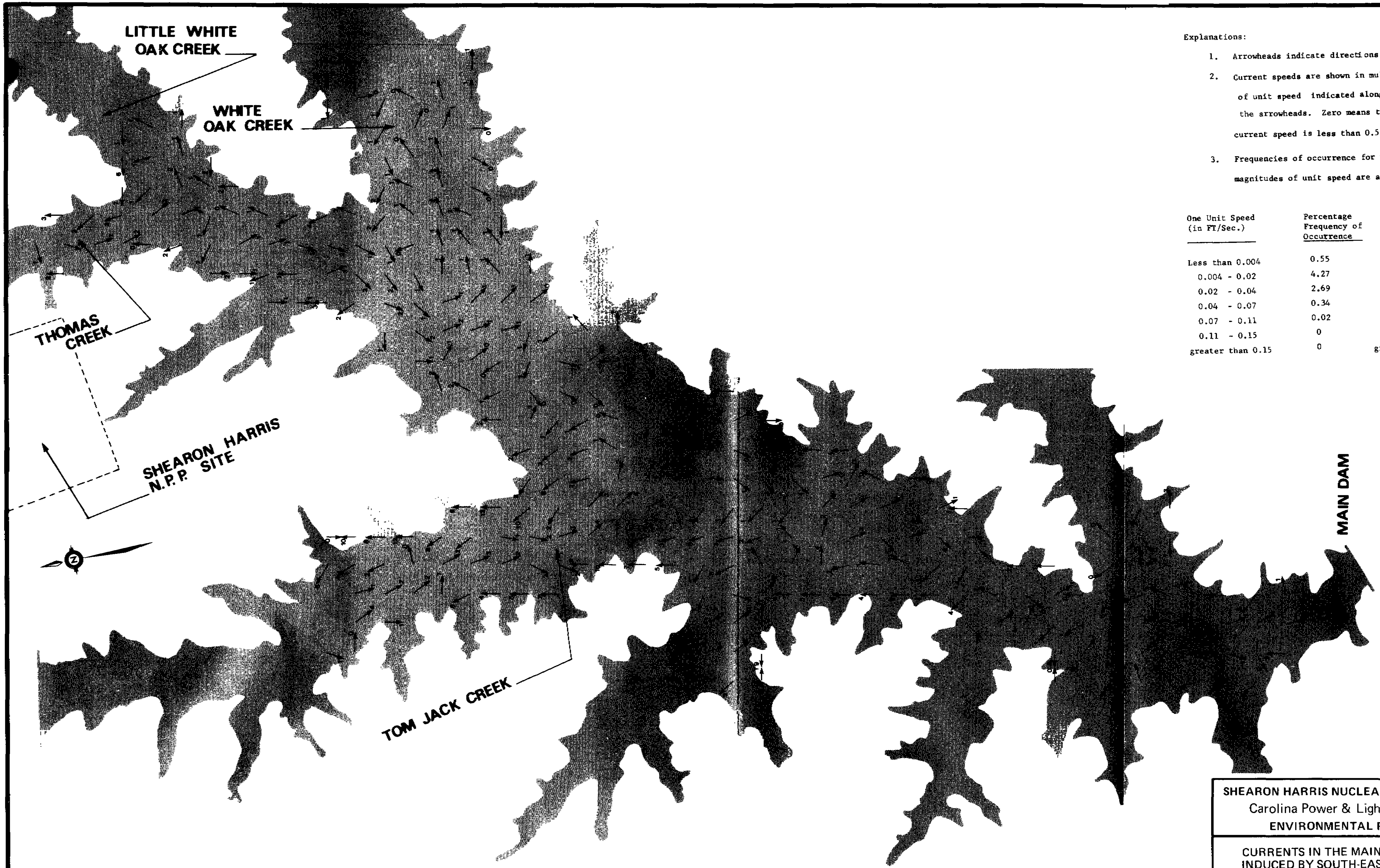
1. Arrowheads indicate directions of current.
2. Current speeds are shown in multiples of unit speed indicated alongside the arrowheads. Zero means the current speed is less than 0.5 unit speed.
3. Frequencies of occurrence for various magnitudes of unit speed are as follows:

One Unit Speed (in FT/Sec.)	Percentage Frequency of Occurrence	Corresponding Wind Speed (MPH)
Less than 0.004	0.70	Calm
0.004 - 0.02	7.00	0.75 - 3.5
0.02 - 0.04	5.39	3.5 - 7.5
0.04 - 0.07	1.24	7.5 - 12.5
0.07 - 0.11	0.18	12.5 - 18.5
0.11 - 0.15	0	18.5 - 25.0
greater than 0.15	0	greater than 25.0

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
ENVIRONMENTAL REPORT

CURRENTS IN THE MAIN RESERVOIR INDUCED BY SOUTHERLY WIND

FIGURE 2.4.2-20



Explanations:

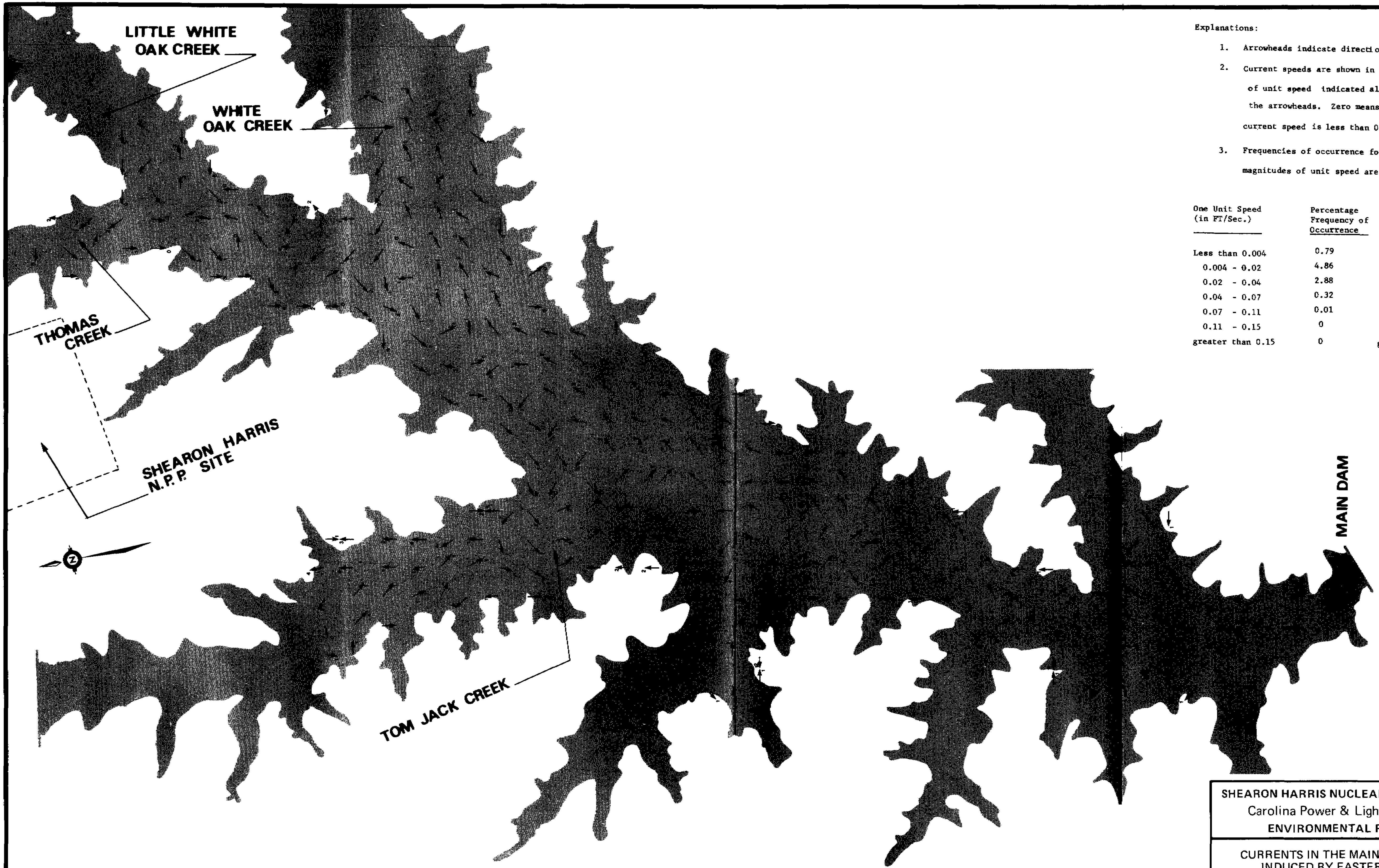
1. Arrowheads indicate directions of current.
2. Current speeds are shown in multiples of unit speed indicated alongside the arrowheads. Zero means the current speed is less than 0.5 unit speed.
3. Frequencies of occurrence for various magnitudes of unit speed are as follows:

One Unit Speed (in FT/Sec.)	Percentage Frequency of Occurrence	Corresponding Wind Speed (MPH)
Less than 0.004	0.55	Calm
0.004 - 0.02	4.27	0.75 - 3.5
0.02 - 0.04	2.69	3.5 - 7.5
0.04 - 0.07	0.34	7.5 - 12.5
0.07 - 0.11	0.02	12.5 - 18.5
0.11 - 0.15	0	18.5 - 25.0
greater than 0.15	0	greater than 25.0

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
ENVIRONMENTAL REPORT

CURRENTS IN THE MAIN RESERVOIR INDUCED BY SOUTH-EASTERLY WIND

FIGURE 2.4.2-21



Explanations:

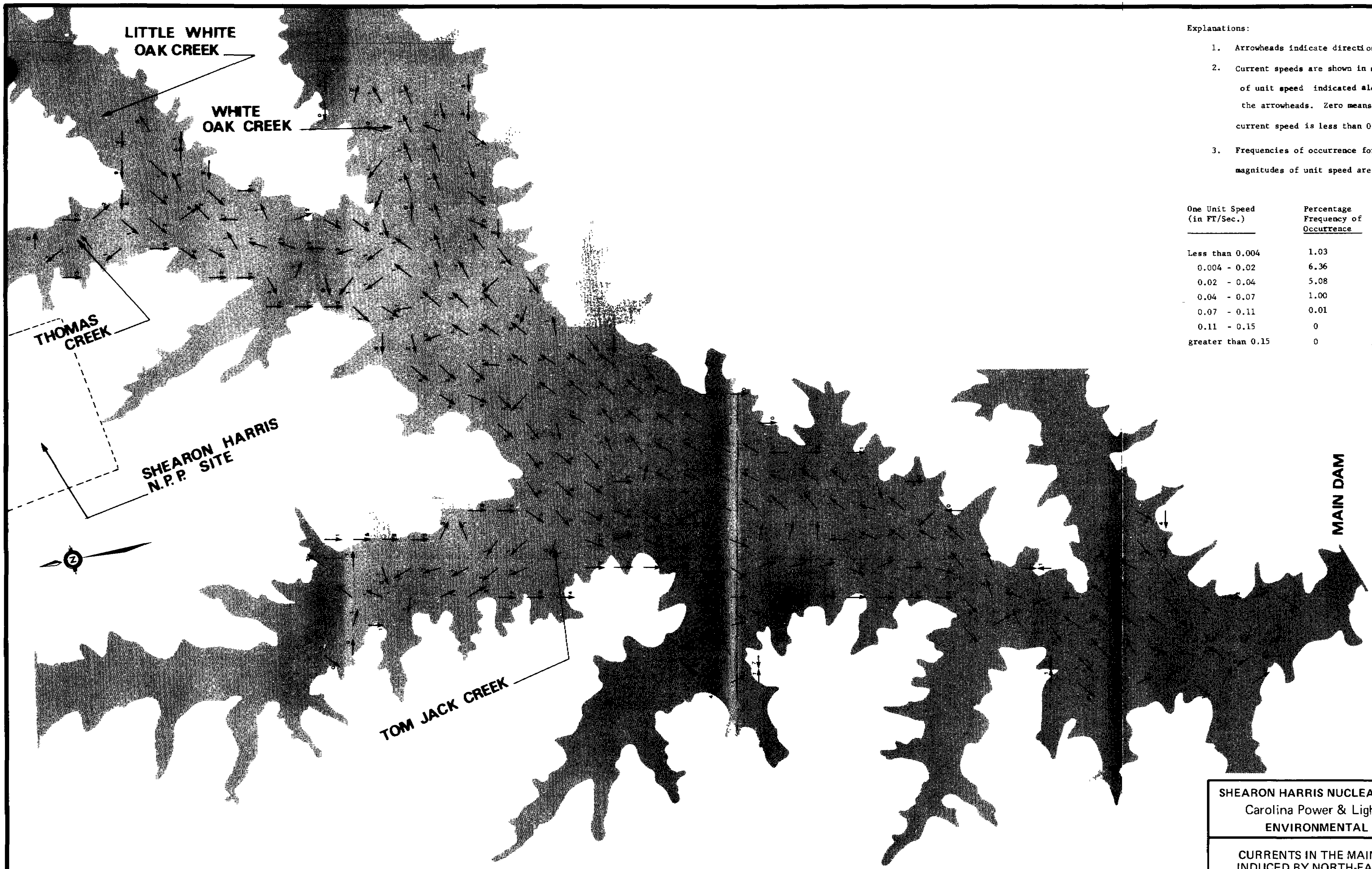
1. Arrowheads indicate directions of current.
2. Current speeds are shown in multiples of unit speed indicated alongside the arrowheads. Zero means the current speed is less than 0.5 unit speed.
3. Frequencies of occurrence for various magnitudes of unit speed are as follows:

One Unit Speed (in FT/Sec.)	Percentage Frequency of Occurrence	Corresponding Wind Speed (MPH)
Less than 0.004	0.79	Calm
0.004 - 0.02	4.86	0.75 - 3.5
0.02 - 0.04	2.88	3.5 - 7.5
0.04 - 0.07	0.32	7.5 - 12.5
0.07 - 0.11	0.01	12.5 - 18.5
0.11 - 0.15	0	18.5 - 25.0
greater than 0.15	0	greater than 25.0

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
ENVIRONMENTAL REPORT

CURRENTS IN THE MAIN RESERVOIR
INDUCED BY EASTERLY WIND

FIGURE 2.4.2-22



Explanations:

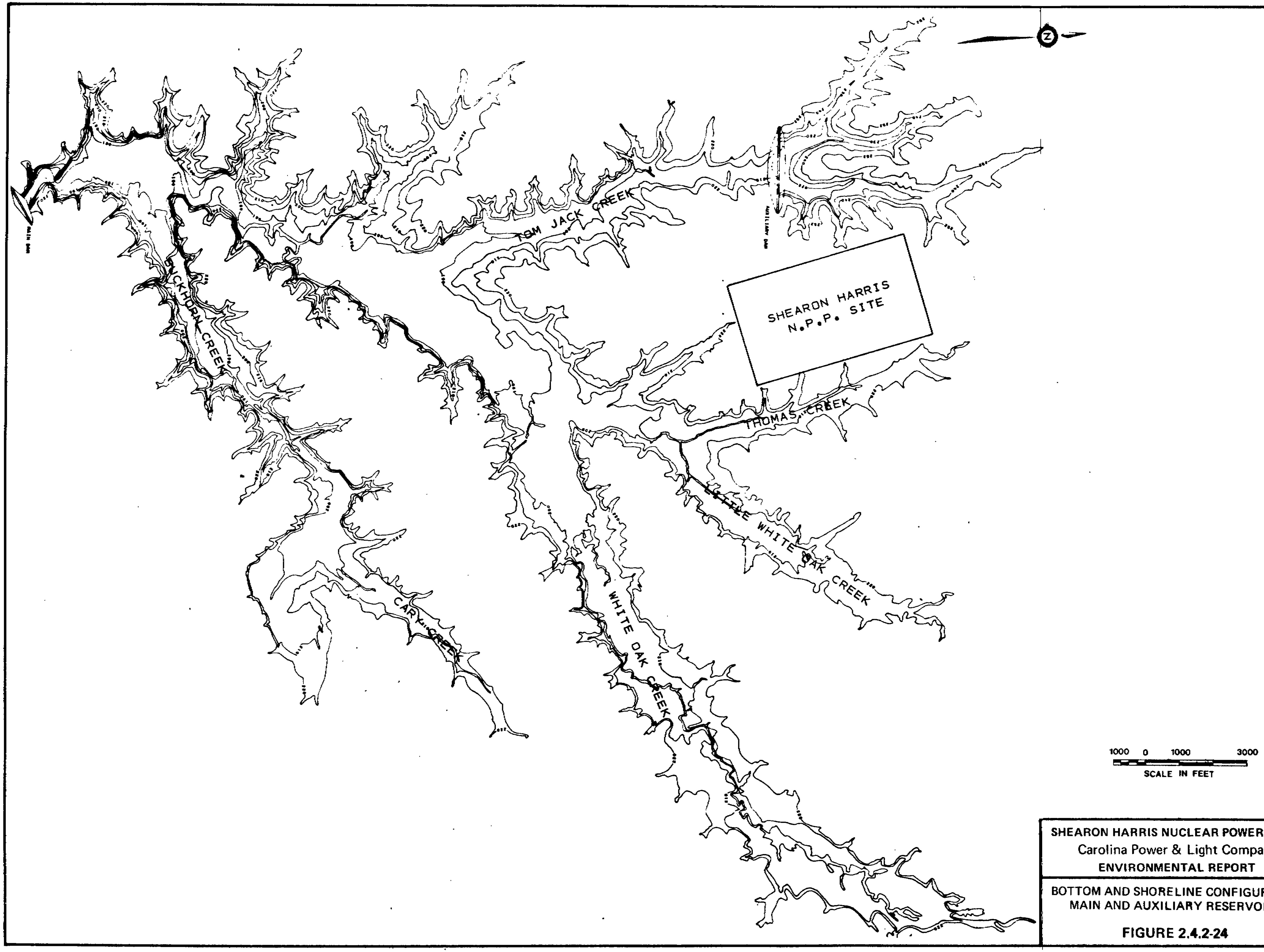
1. Arrowheads indicate directions of current.
2. Current speeds are shown in multiples of unit speed indicated alongside the arrowheads. Zero means the current speed is less than 0.5 unit speed.
3. Frequencies of occurrence for various magnitudes of unit speed are as follows:

One Unit Speed (in FT/Sec.)	Percentage Frequency of Occurrence	Corresponding Wind Speed (MPH)
Less than 0.004	1.03	Calm
0.004 - 0.02	6.36	0.75 - 3.5
0.02 - 0.04	5.08	3.5 - 7.5
0.04 - 0.07	1.00	7.5 - 12.5
0.07 - 0.11	0.01	12.5 - 18.5
0.11 - 0.15	0	18.5 - 25.0
greater than 0.15	0	greater than 25.0

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
ENVIRONMENTAL REPORT

CURRENTS IN THE MAIN RESERVOIR INDUCED BY NORTH-EASTERLY WIND

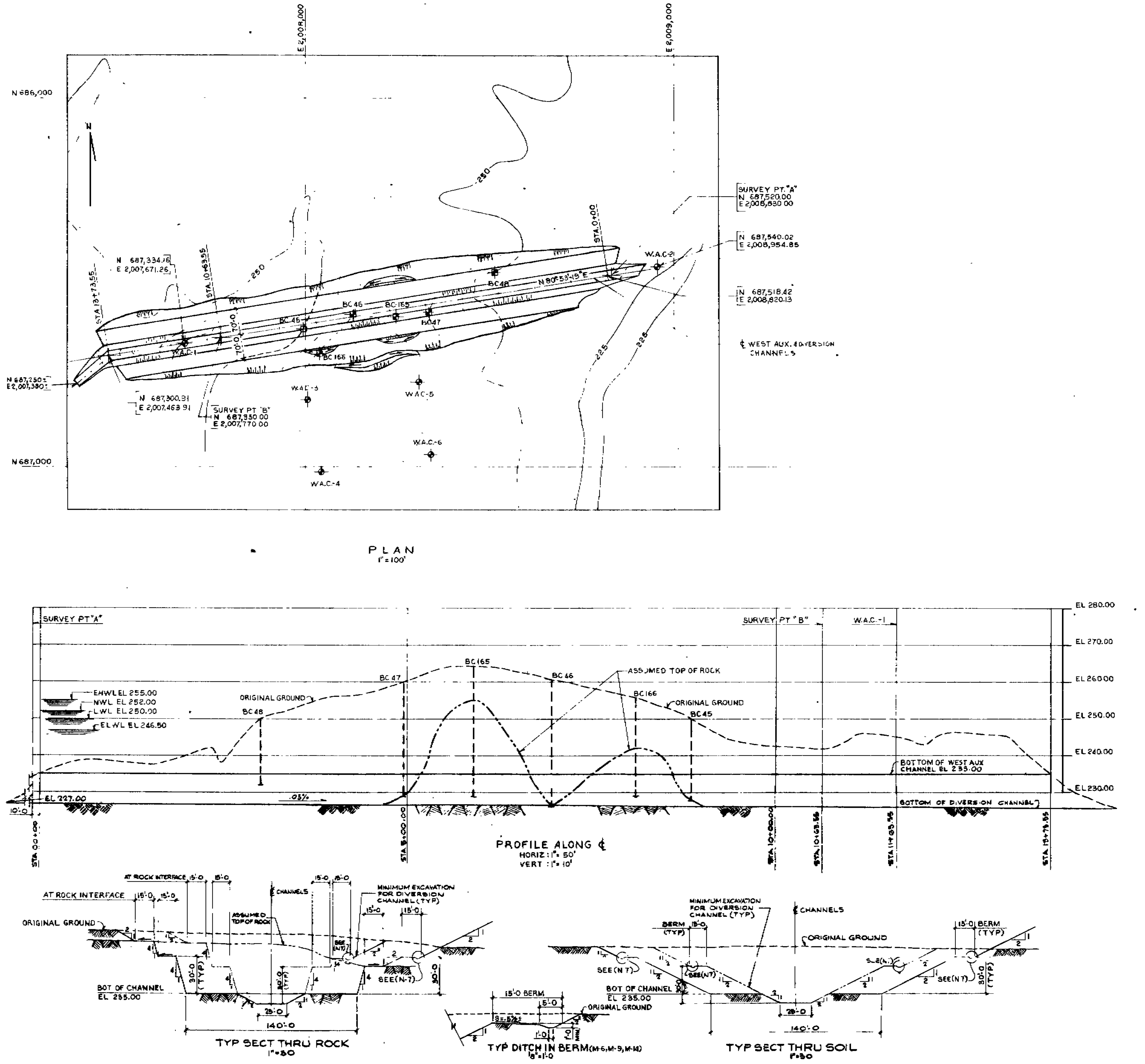
FIGURE 2.4.2-23



SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
ENVIRONMENTAL REPORT

BOTTOM AND SHORELINE CONFIGURATION, MAIN AND AUXILIARY RESERVOIRS

FIGURE 2.4.2-24



QUANTITIES (NET, BY FIELD UNLESS NOTED)

EXCAVATION

STRIPPING	20,380	CU.YD.
UNCLASSIFIED	136,476	CU.YD.
ROCK	15,055	CU.YD.

NOTES

THE SURVEY INFORMATION IS TAKEN FROM TOPOGRAPHIC MAPS PREPARED BY PHOTO SCIENCE, INC, UTILIZING STEREOPHOTOGRAMMETRIC METHODS FROM PHOTOGRAPHY DATED FEB 7, 1970 AND FEB 5, 1972 AND IS FOR INFORMATION PURPOSES ONLY. THE LOCATION OF ALL WORKING POINTS SHOWN ON THE DRAWINGS WILL BE CONFIRMED PRIOR TO START OF WORK.

HORIZONTAL CONTROL IS TAKEN FROM NORTH CAROLINA STATE PLANE COORDINATE SYSTEM

VERTICAL CONTROL IS TAKEN FROM U.S.C. AND G.S. DATUM.

SURVEY POINTS ARE TAKEN FROM ACTUAL GROUND SURVEYS BY MOORE GARDNER & ASSOCIATES INC. DATED AUG & SEPT 1972

CHANNEL EXCAVATION TO BE IN ACCORDANCE WITH EBASCO SPECIFICATION CAR-SH-CH4 "EMBANKMENTS, DAMS, DIKES & CHANNELS"

⌖ BC( ) INDICATES BORING NUMBER & LOCATION

⌖ INDICATES CONC. MONUMENT

EXCAVATE DIVERSION CHANNEL BEFORE CONSTRUCTING COFFERDAMS FOR WEST AUXILIARY SEPARATING DIKE AS PER DWG CAR-2167-G-6343

DIABASE DIKE AND THE FRACTURED AREA ADJACENT TO THE DIKE EXPOSED IN THE BED OR SIDE SLOPE OF THE OPEN CHANNEL SHALL BE COVERED WITH 3 INCH THICK LAYER OF CONCRETE OR SHOTCRETE AS PER SPECIFICATION CAR SH-CH-6 "CONCRETE".

REF DWG: CAR-2167-G-6371 (REV. 3)

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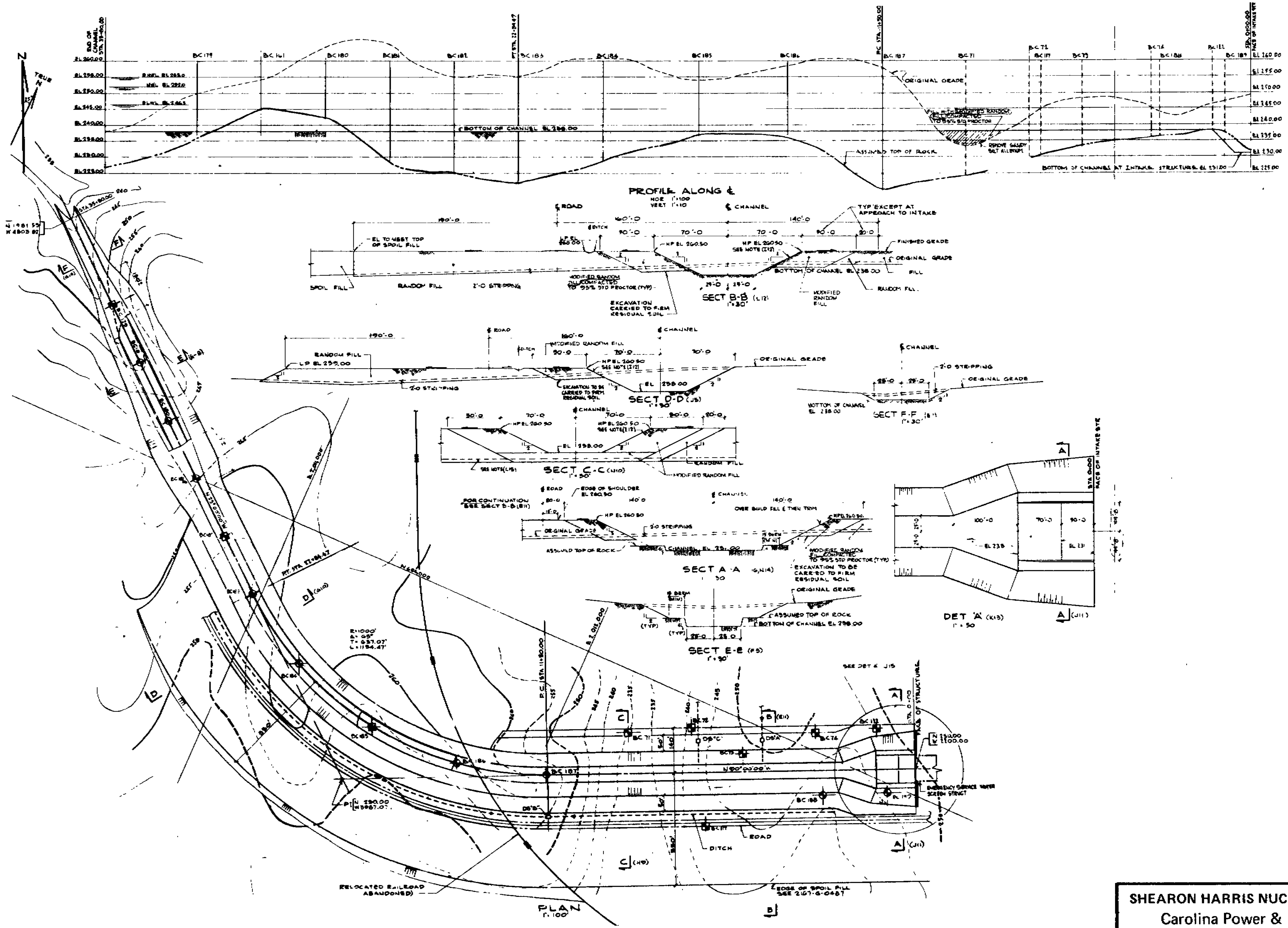
AUXILIARY RESERVOIR CHANNEL

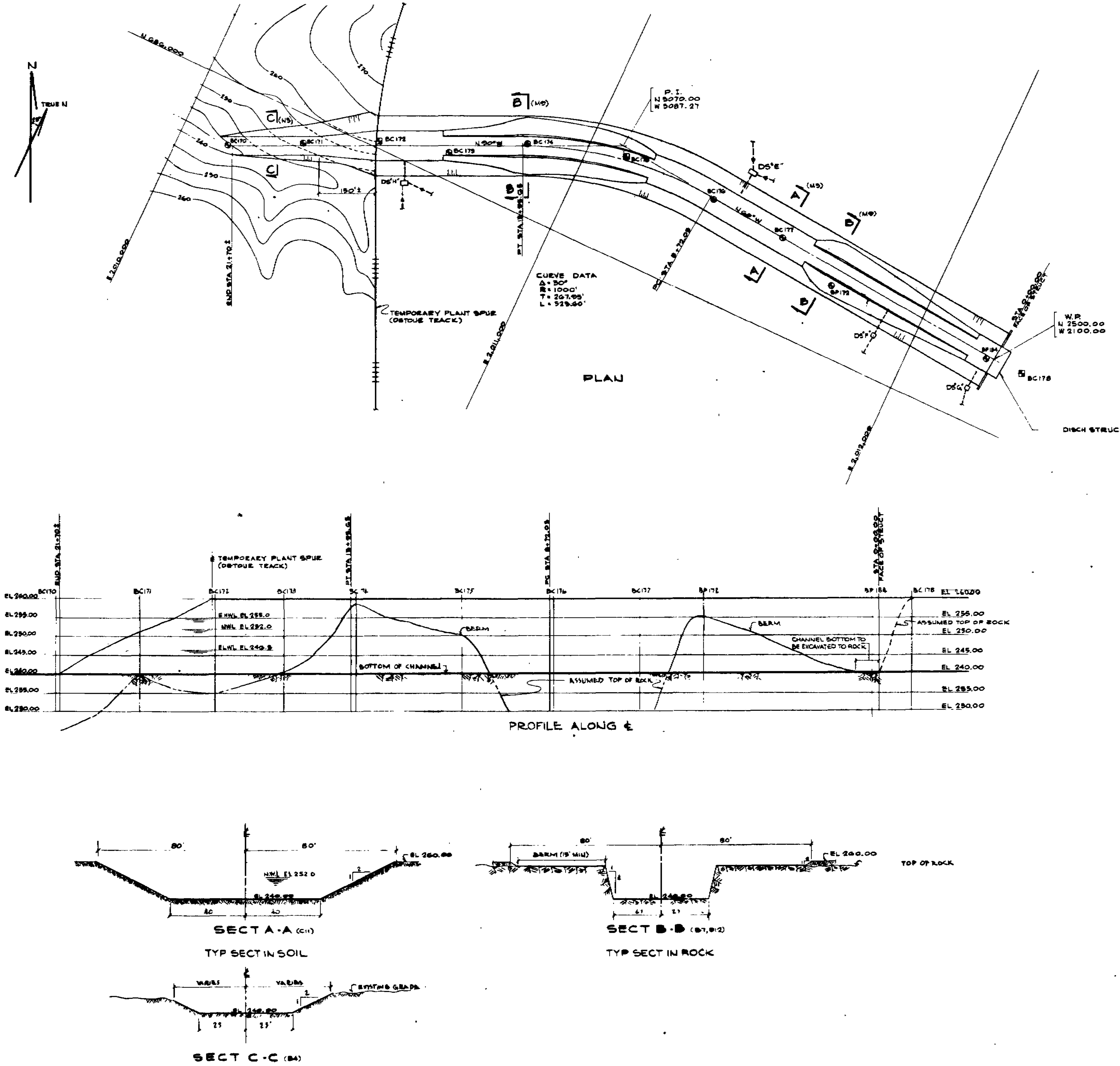
FIGURE 2.4.2-25


PROFILE ALONG ℄
ORIGINAL GRADE
BOTTOM OF CHANNEL EL 238.00
ASSUMED TOP OF ROCK
BOTTOM OF CHANNELS AT INTAKE STRUCTURE EL 231.00
SECT B-B
SECT D-D
SECT F-F
SECT C-C
SECT A-A
SECT E-E
DET 'A'
RANDOM FILL
SPOIL FILL
2'-0 STRIPPING
MODIFIED RANDOM FILL
EXCAVATION CARRIED TO FIRM RESIDUAL SOIL
EMERGENCY SERVICE WATER SCREEN STRUCT
RELOCATED RAILROAD (ABANDONED)
EDGE OF SPOIL FILL SEE 2167-G-0487
DITCH
ROAD
PLAN
1" = 100'

REF DWG: CAR-2167-G-2940 (REV. 2)

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
ENVIRONMENTAL REPORT

ESW – INTAKE CHANNEL
PLAN, SECTIONS & DETAILS
FIGURE 2.4.2-26

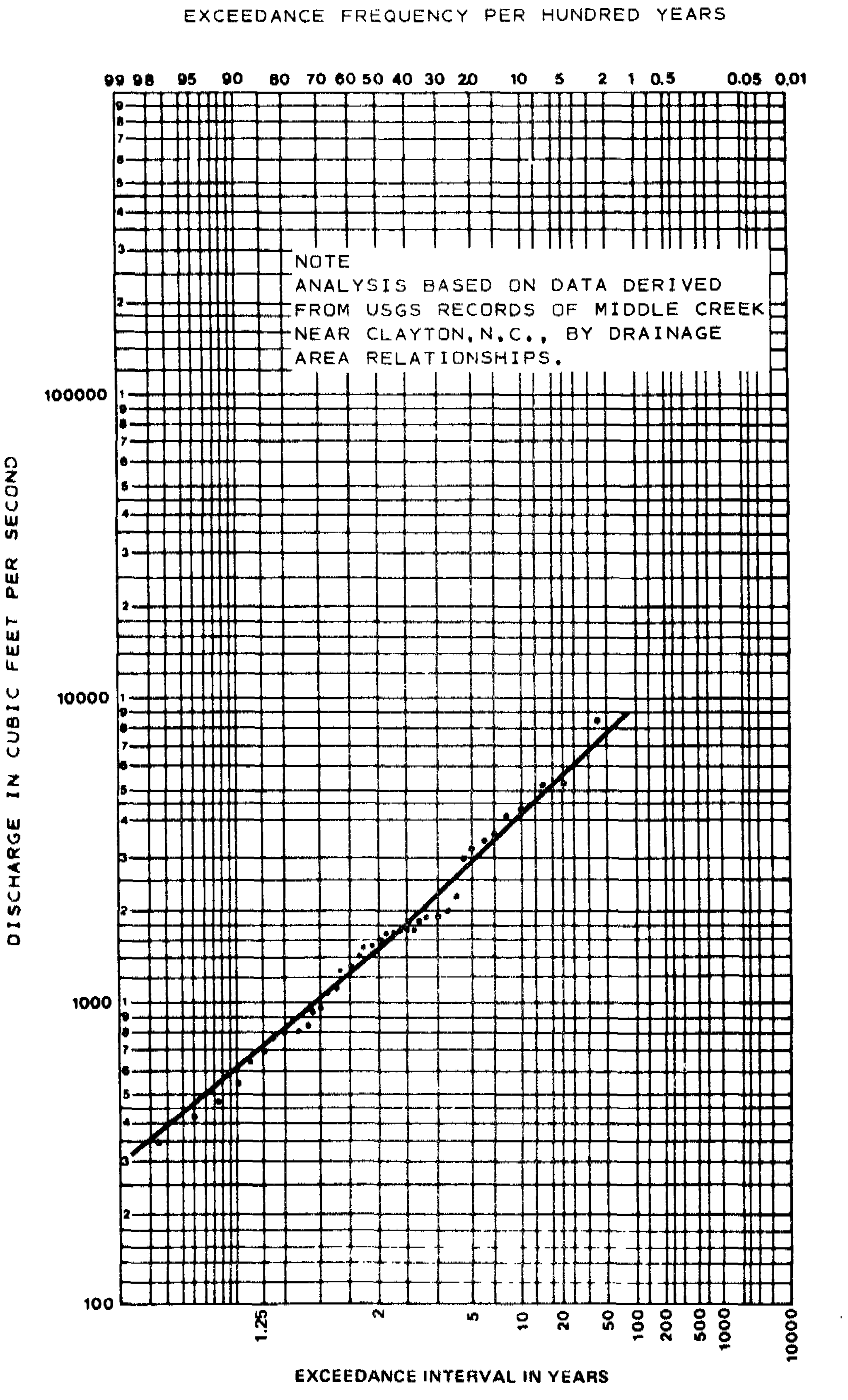


LEGEND
EHWL = EXTREME HIGH WATER LEVEL
ELWL = EXTREME LOW WATER LEVEL
NWL = NORMAL WATER LEVEL
DS DENOTES DROP STRUCTURE
⊞ DENOTES CORE BORING
⊕ DENOTES AUGER BORING

REF DWG: CAR-2167-G-2941 (REV. 1)

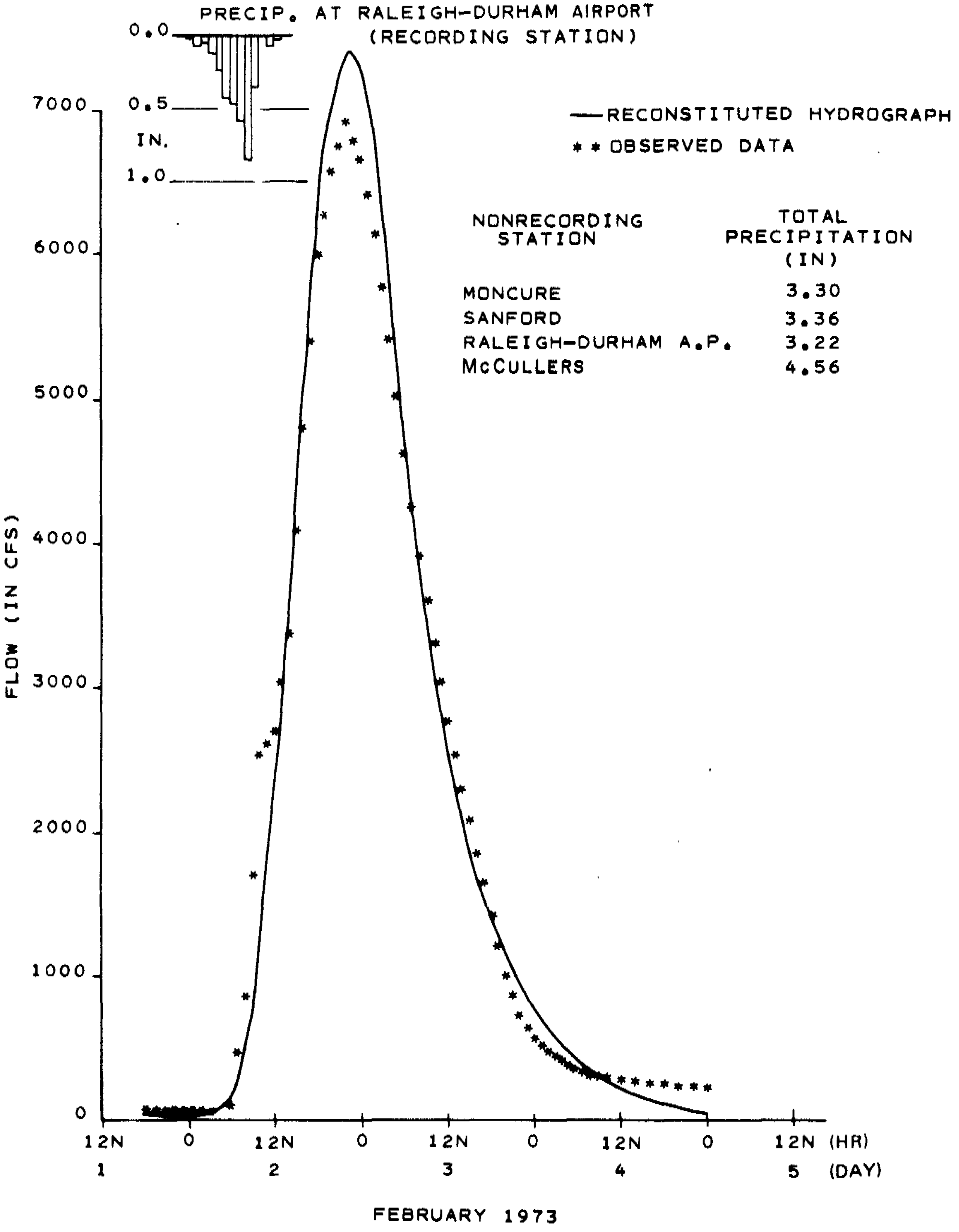
SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
ENVIRONMENTAL REPORT

ESW – DISCHARGE CHANNEL
PLAN, SECTIONS & DETAILS
FIGURE 2.4.2-27



NOTE
ANALYSIS BASED ON DATA DERIVED FROM USGS RECORDS OF MIDDLE CREEK NEAR CLAYTON, N.C., BY DRAINAGE AREA RELATIONSHIPS.

SHEARON HARRIS NUCLEAR POWER PLANT Carolina Power & Light Company **ENVIRONMENTAL REPORT**	BUCKHORN CREEK FLOOD PEAKS FREQUENCY ANALYSIS (LOG PEARSON TYPE III DISTRIBUTION) 1940 – 1978	**FIGURE** **2.4.2-28**



SHEARON HARRIS NUCLEAR POWER PLANT

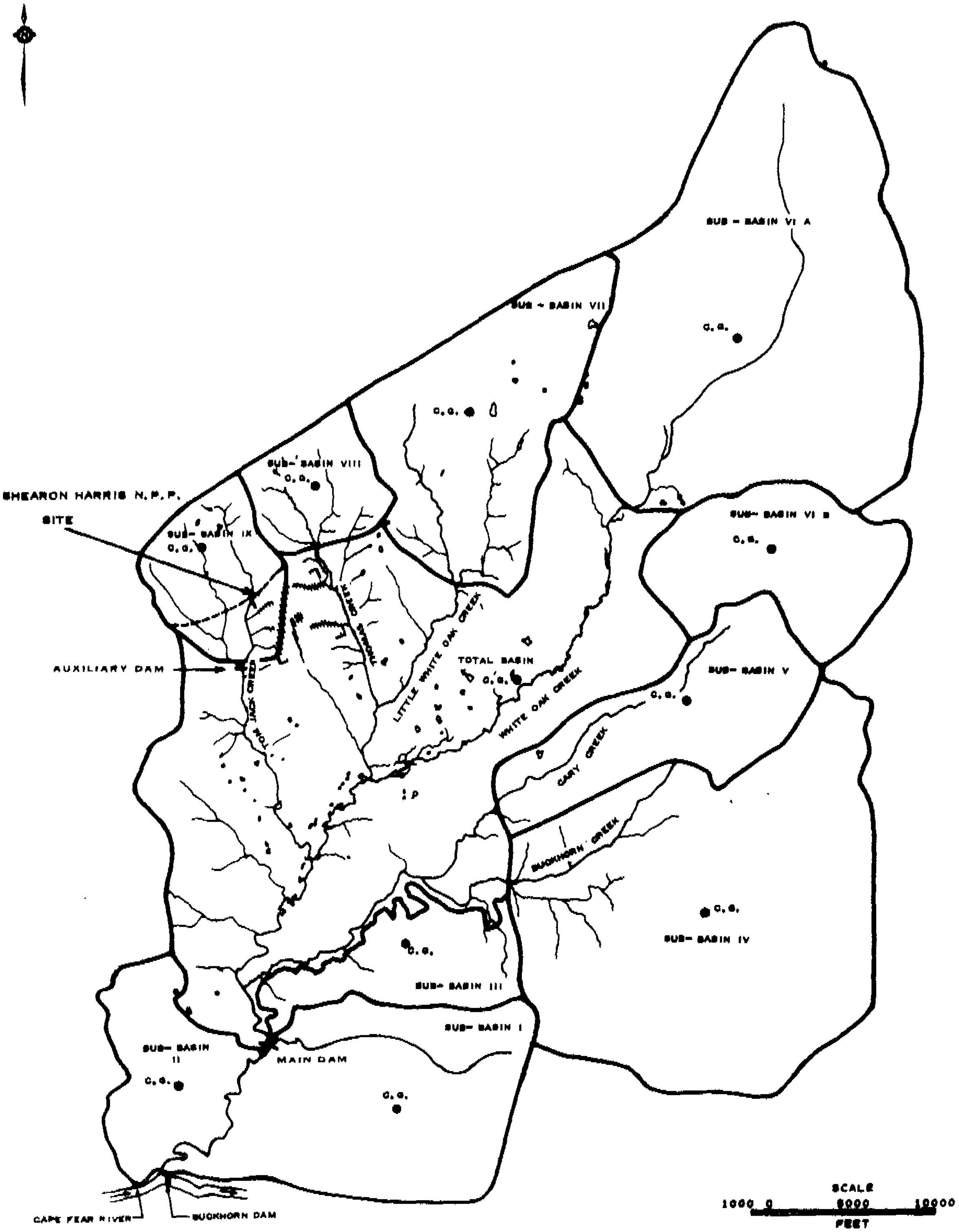
Carolina
Power & Light Company

ENVIRONMENTAL REPORT

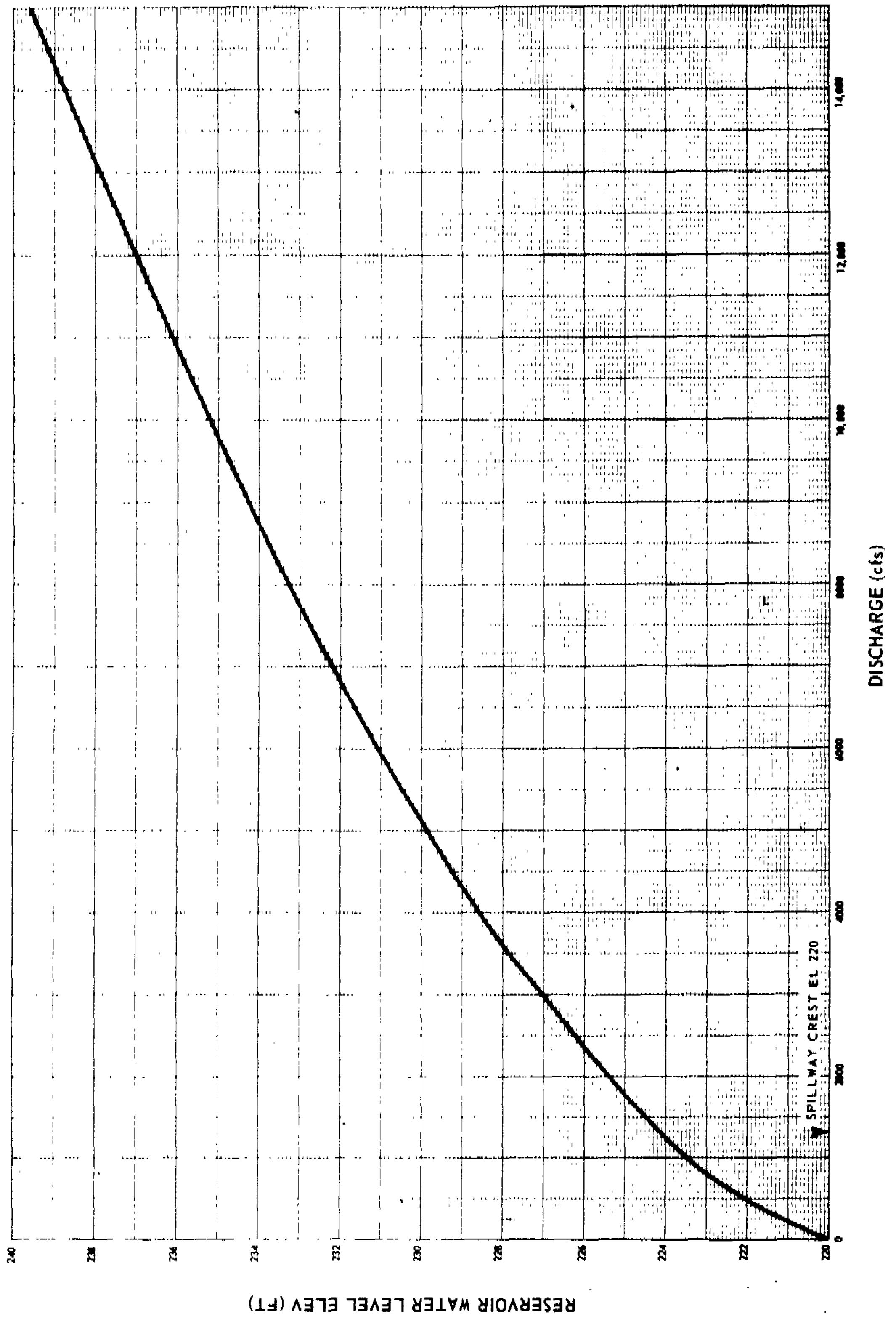
OBSERVED AND RECONSTITUTED HYDROGRAPHS FOR THE FEB 2-4, 1973 FLOOD ON BUCKHORN CREEK NEAR CORINTH, N.C.

FIGURE

2.4.2-29



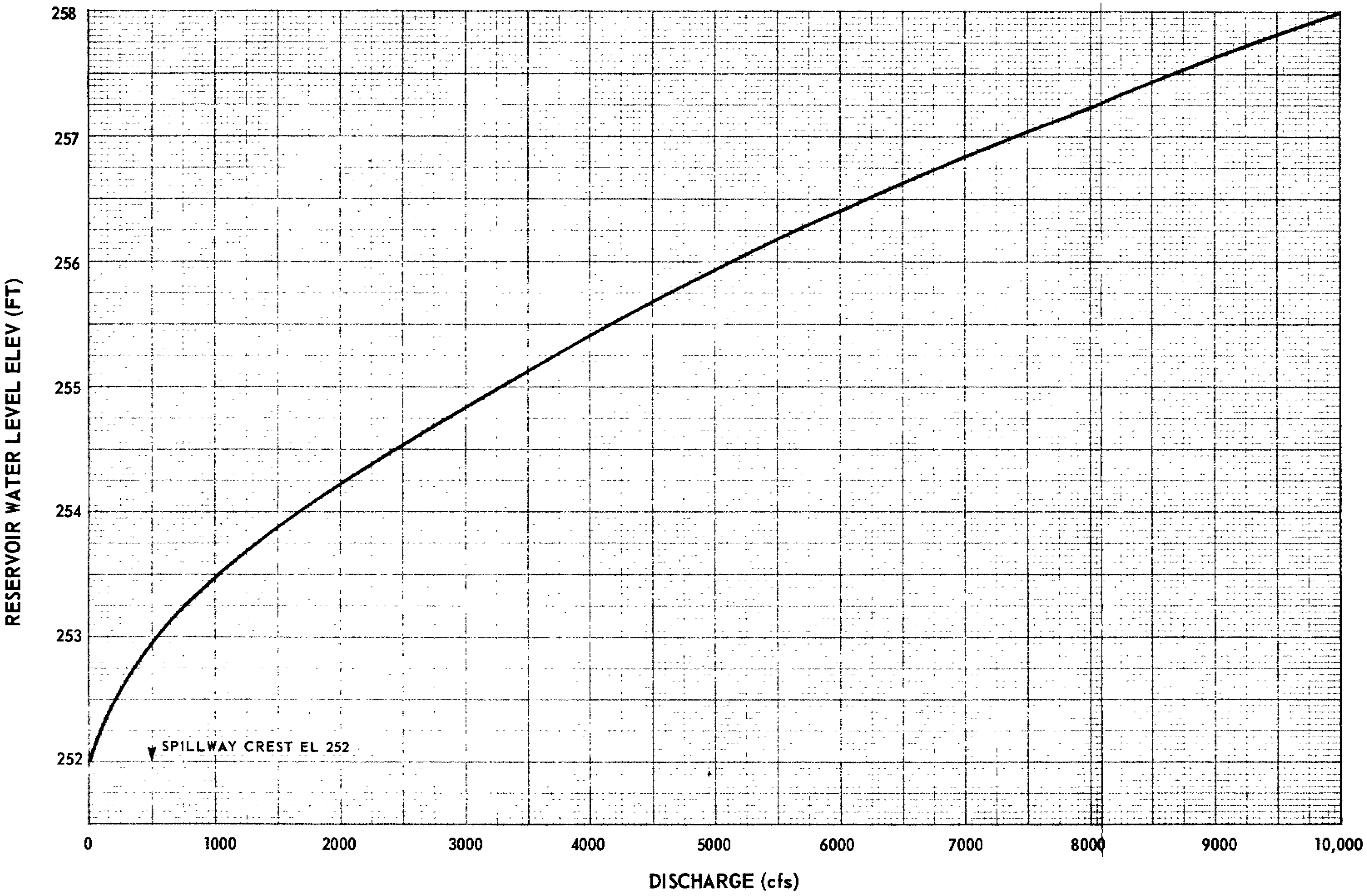
SHEARON HARRIS NUCLEAR POWER PLANT Carolina Power & Light Company ENVIRONMENTAL REPORT	BUCKHORN CREEK DRAINAGE AREA AND SUBBASINS I-IX	FIGURE 2.4.2-30



SHEARON HARRIS
NUCLEAR POWER PLANT
Carolina
Power & Light Company
ENVIRONMENTAL REPORT

MAIN DAM SPILLWAY RATING CURVE

FIGURE
2.4.2-31



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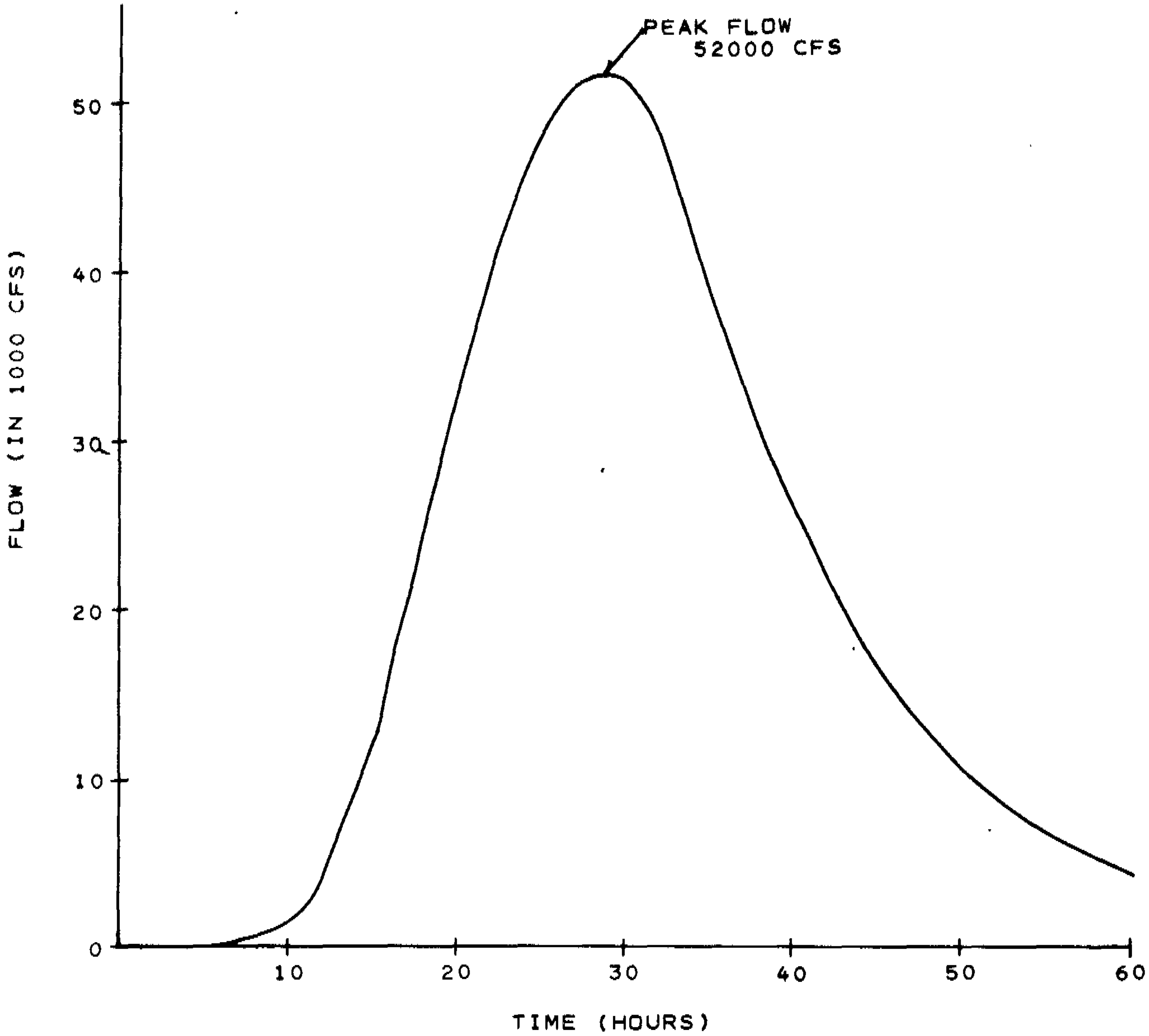
Carolina Power & Light Company
ENVIRONMENTAL REPORT

AUXILIARY DAM SPILLWAY
RATING CURVE
FIGURE 2.4.2-32



SHEARON HARRIS NUCLEAR POWER PLANT

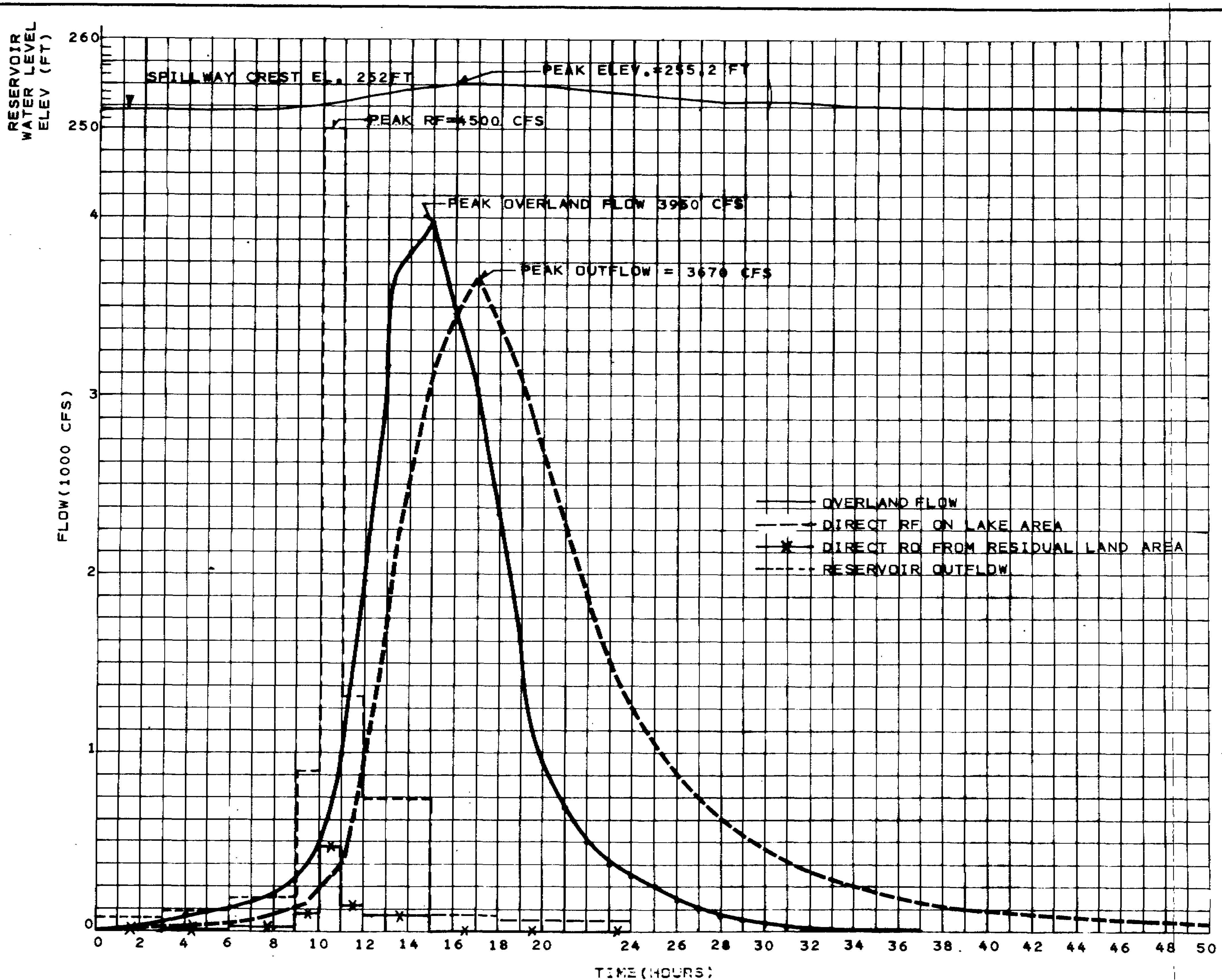
Carolina
Power & Light Company

ENVIRONMENTAL REPORT

PROBABLE MAXIMUM FLOOD HYDROGRAPH UNDER NATURAL CONDITIONS FOR ENTIRE BUCKHORN CREEK BASIN

FIGURE

2.4.2-33



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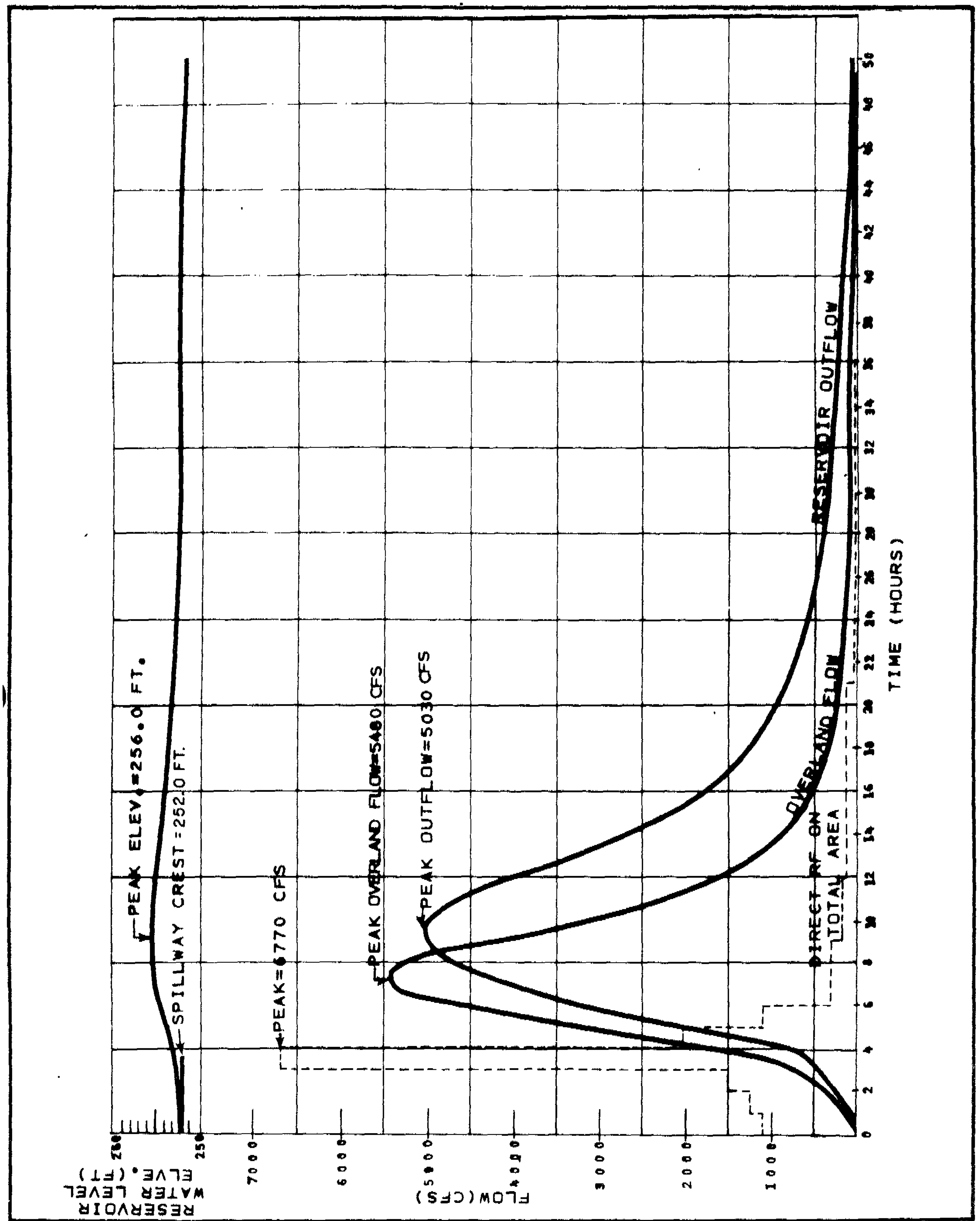
Carolina Power & Light Company
ENVIRONMENTAL REPORT

INFLOW, OUTFLOW, WATER LEVEL
HYDROGRAPHS (PMP = 26.7 IN.)
AUXILIARY RESERVOIR

FIGURE 2.4.2-34



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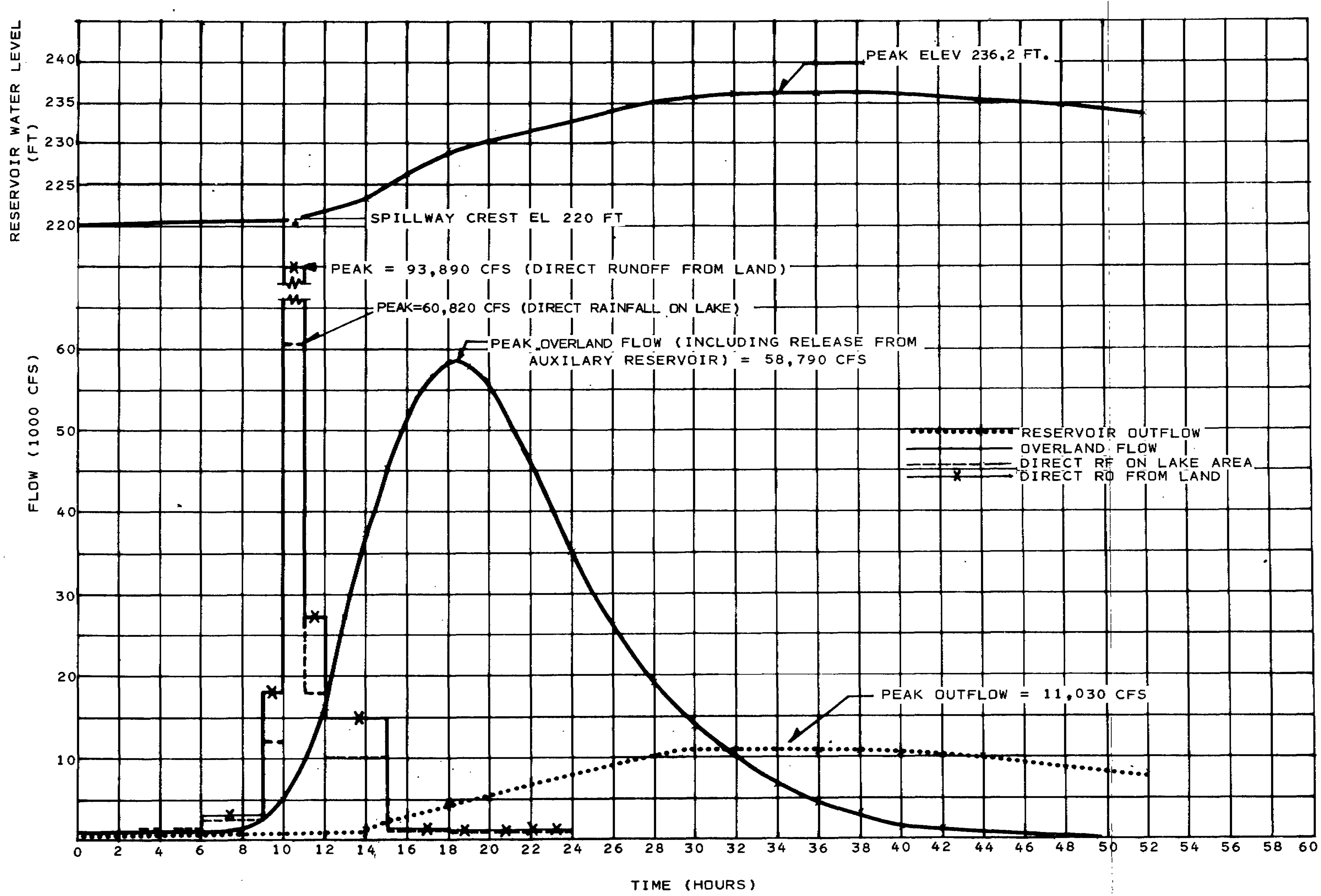
INFLOW, OUTFLOW, WATER LEVEL
HYDROGRAPHS (PMP = 36.32 IN.)
AUXILIARY RESERVOIR

FIGURE
2.4.2-35



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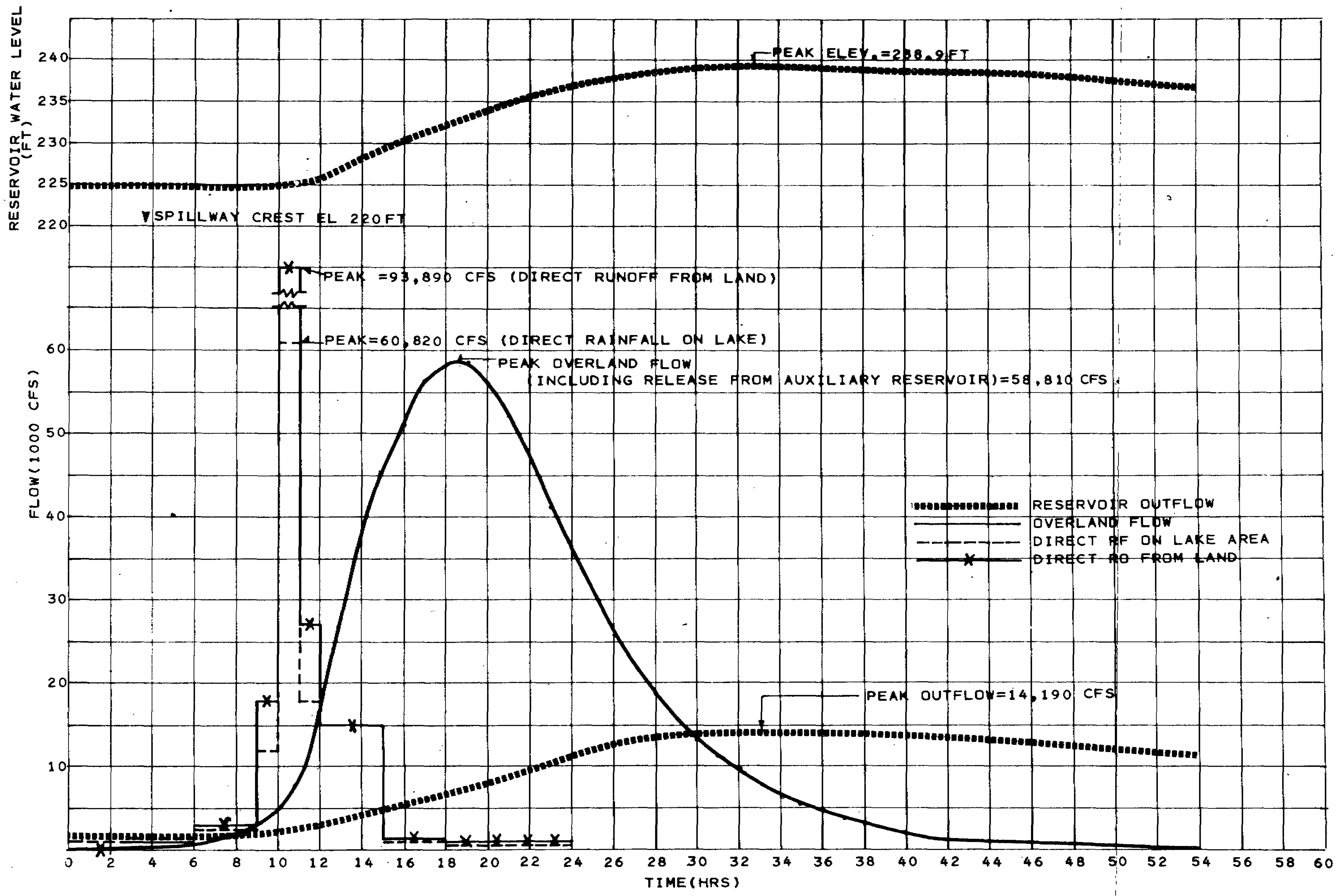
MAIN RESERVOIR INFLOW, OUTFLOW
WATER LEVEL HYDROGRAPHS
WITHOUT ANTECEDENT FLOOD
FIGURE 2.4.2-36



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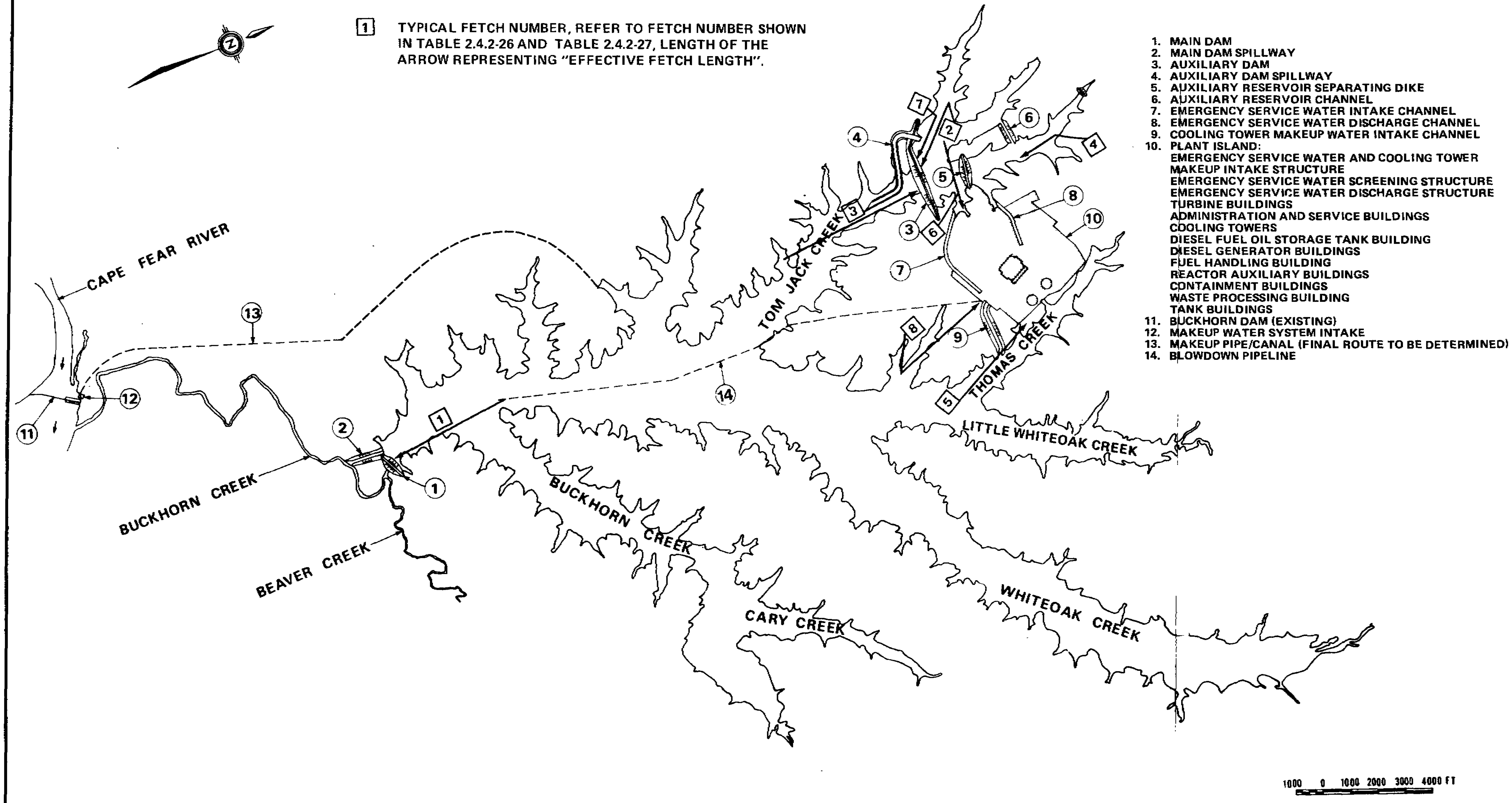
MAIN RESERVOIR INFLOW, OUTFLOW
WATER LEVEL HYDROGRAPHS WITH
STANDARD PROJECT FLOOD
FIVE DAYS PRIOR TO PMP FLOOD

FIGURE 2.4.2-37



1 TYPICAL FETCH NUMBER, REFER TO FETCH NUMBER SHOWN IN TABLE 2.4.2-26 AND TABLE 2.4.2-27, LENGTH OF THE ARROW REPRESENTING "EFFECTIVE FETCH LENGTH".

1. MAIN DAM
2. MAIN DAM SPILLWAY
3. AUXILIARY DAM
4. AUXILIARY DAM SPILLWAY
5. AUXILIARY RESERVOIR SEPARATING DIKE
6. AUXILIARY RESERVOIR CHANNEL
7. EMERGENCY SERVICE WATER INTAKE CHANNEL
8. EMERGENCY SERVICE WATER DISCHARGE CHANNEL
9. COOLING TOWER MAKEUP WATER INTAKE CHANNEL
10. PLANT ISLAND:
    EMERGENCY SERVICE WATER AND COOLING TOWER MAKEUP INTAKE STRUCTURE
    EMERGENCY SERVICE WATER SCREENING STRUCTURE
    EMERGENCY SERVICE WATER DISCHARGE STRUCTURE
    TURBINE BUILDINGS
    ADMINISTRATION AND SERVICE BUILDINGS
    COOLING TOWERS
    DIESEL FUEL OIL STORAGE TANK BUILDING
    DIESEL GENERATOR BUILDINGS
    FUEL HANDLING BUILDING
    REACTOR AUXILIARY BUILDINGS
    CONTAINMENT BUILDINGS
    WASTE PROCESSING BUILDING
    TANK BUILDINGS
11. BUCKHORN DAM (EXISTING)
12. MAKEUP WATER SYSTEM INTAKE
13. MAKEUP PIPE/CANAL (FINAL ROUTE TO BE DETERMINED)
14. BLOWDOWN PIPELINE

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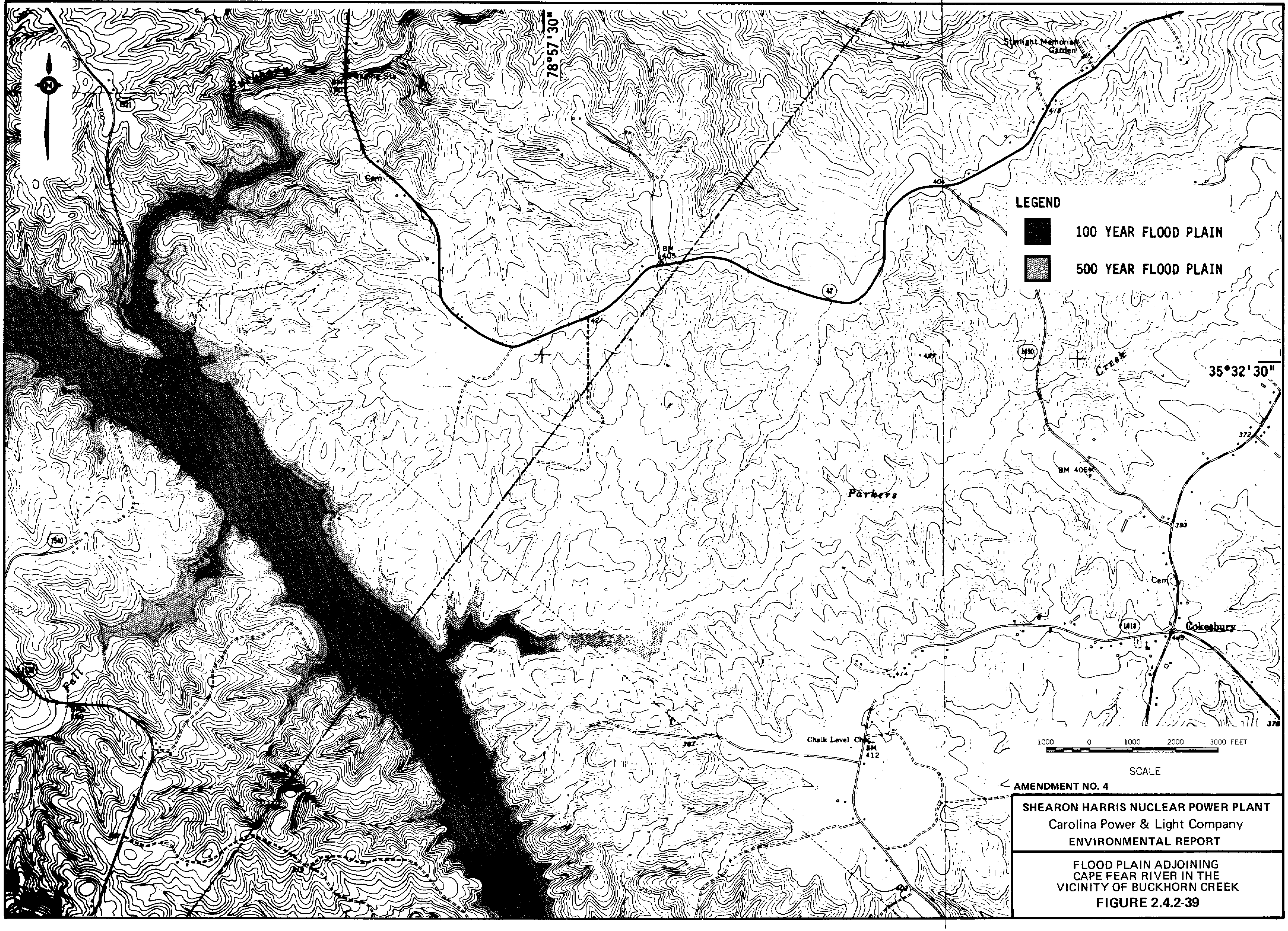
WIND FETCH

FIGURE 2.4.2-38



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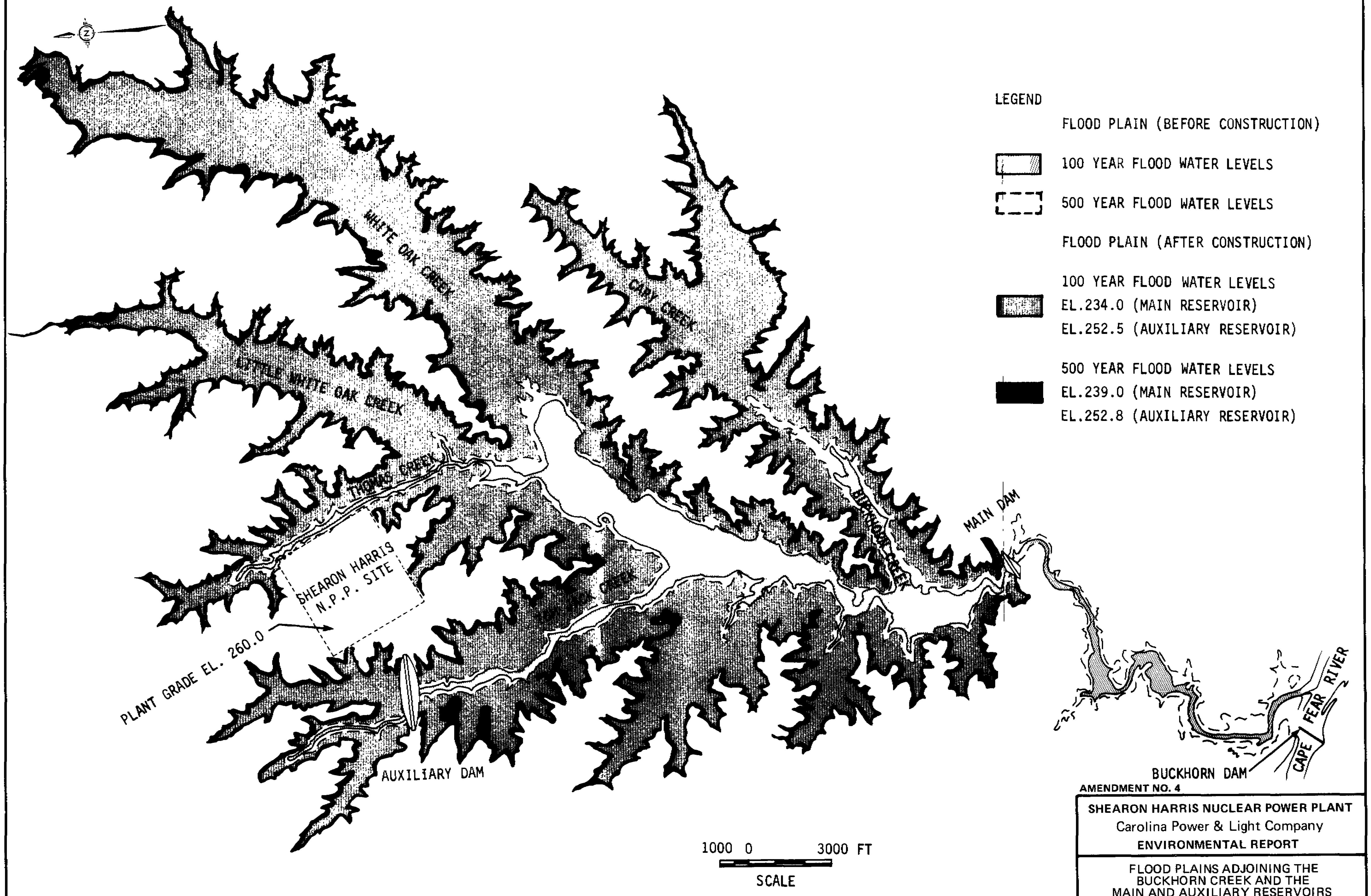
FLOOD PLAIN ADJOINING
CAPE FEAR RIVER IN THE
VICINITY OF BUCKHORN CREEK
FIGURE 2.4.2-39


Z
LEGEND
FLOOD PLAIN (BEFORE CONSTRUCTION)
▭ 100 YEAR FLOOD WATER LEVELS
┌┐ 500 YEAR FLOOD WATER LEVELS
FLOOD PLAIN (AFTER CONSTRUCTION)
▨ 100 YEAR FLOOD WATER LEVELS
EL.234.0 (MAIN RESERVOIR)
EL.252.5 (AUXILIARY RESERVOIR)
■ 500 YEAR FLOOD WATER LEVELS
EL.239.0 (MAIN RESERVOIR)
EL.252.8 (AUXILIARY RESERVOIR)
WHITE OAK CREEK
CARY CREEK
LITTLE WHITE OAK CREEK
THOMAS CREEK
SHEARON HARRIS N.P.P. SITE
PLANT GRADE EL. 260.0
BUCKHORN CREEK
MAIN DAM
AUXILIARY DAM
BUCKHORN DAM
CAPE FEAR RIVER
1000 0 3000 FT
SCALE

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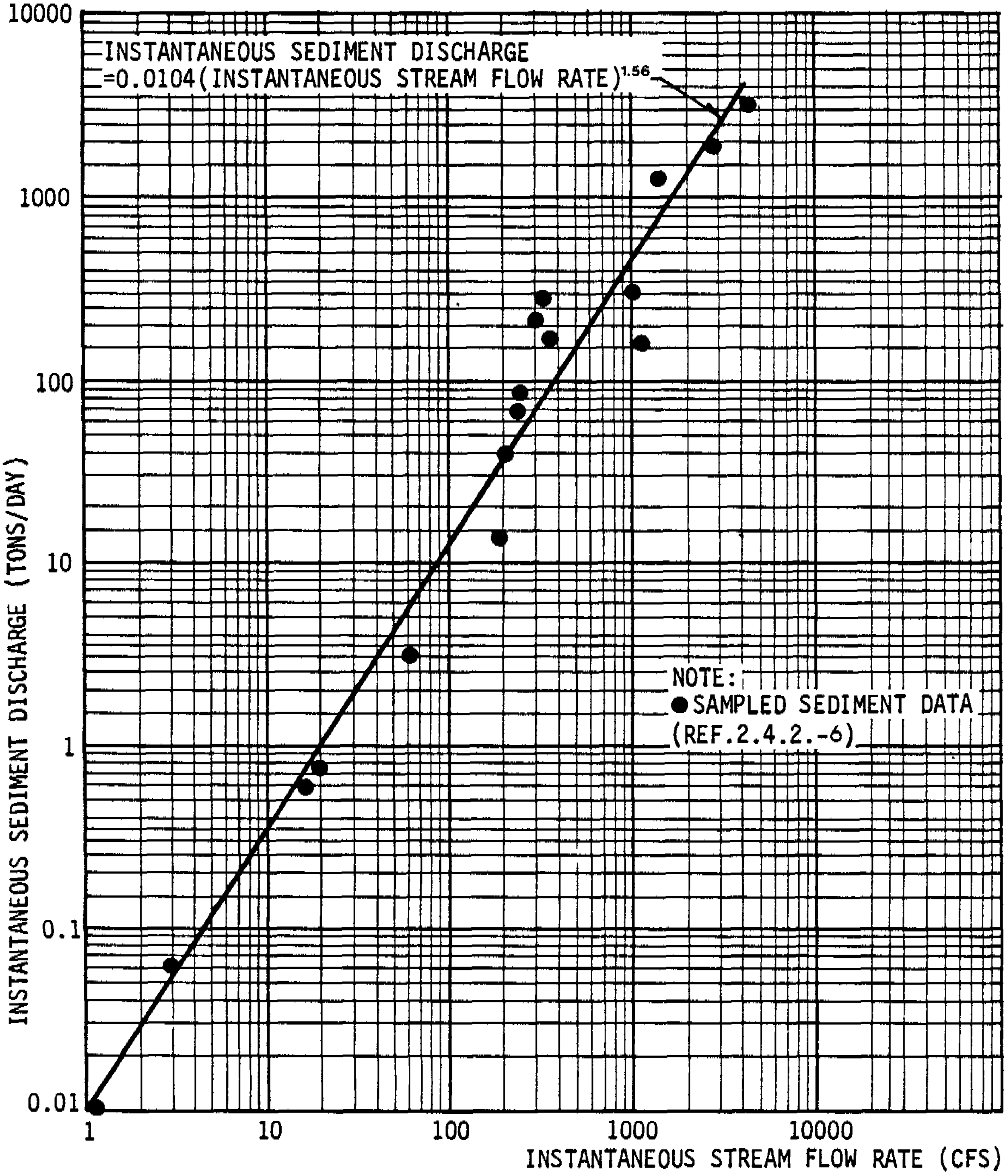
FLOOD PLAINS ADJOINING THE BUCKHORN CREEK AND THE MAIN AND AUXILIARY RESERVOIRS
FIGURE 2.4.2-40



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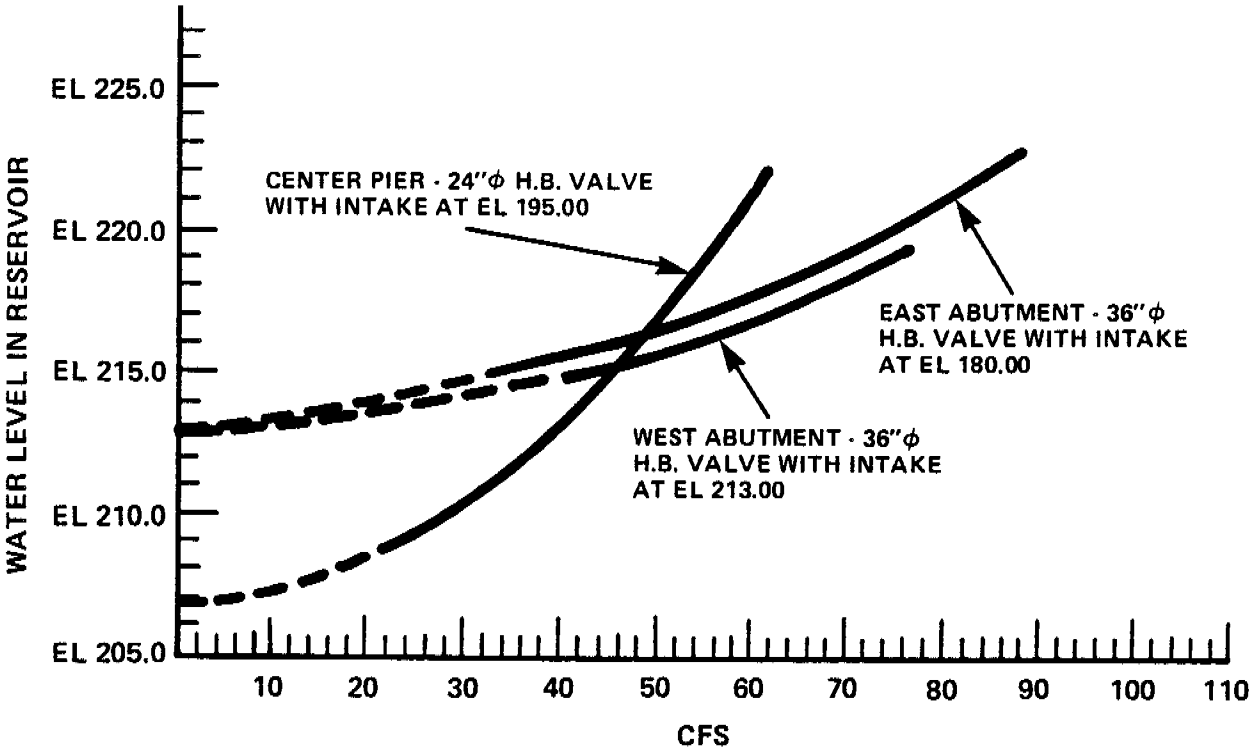
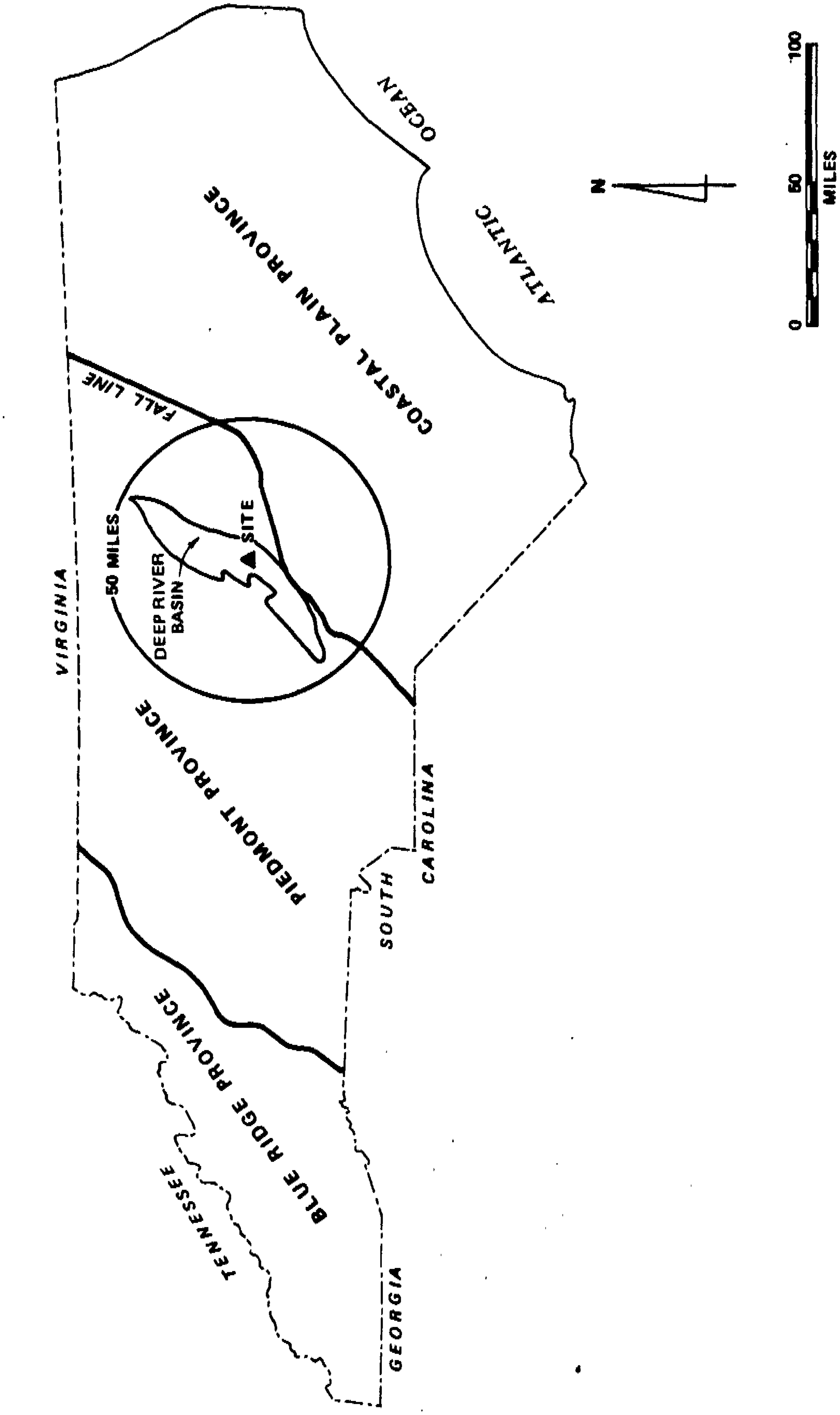
SHEARON HARRIS **NUCLEAR POWER PLANT** Carolina Power & Light Company **ENVIRONMENTAL REPORT**	SEDIMENT DISCHARGE RATING CURVE BUCKHORN CREEK NEAR CORINTH, N.C.	**FIGURE** 2.4.2-41



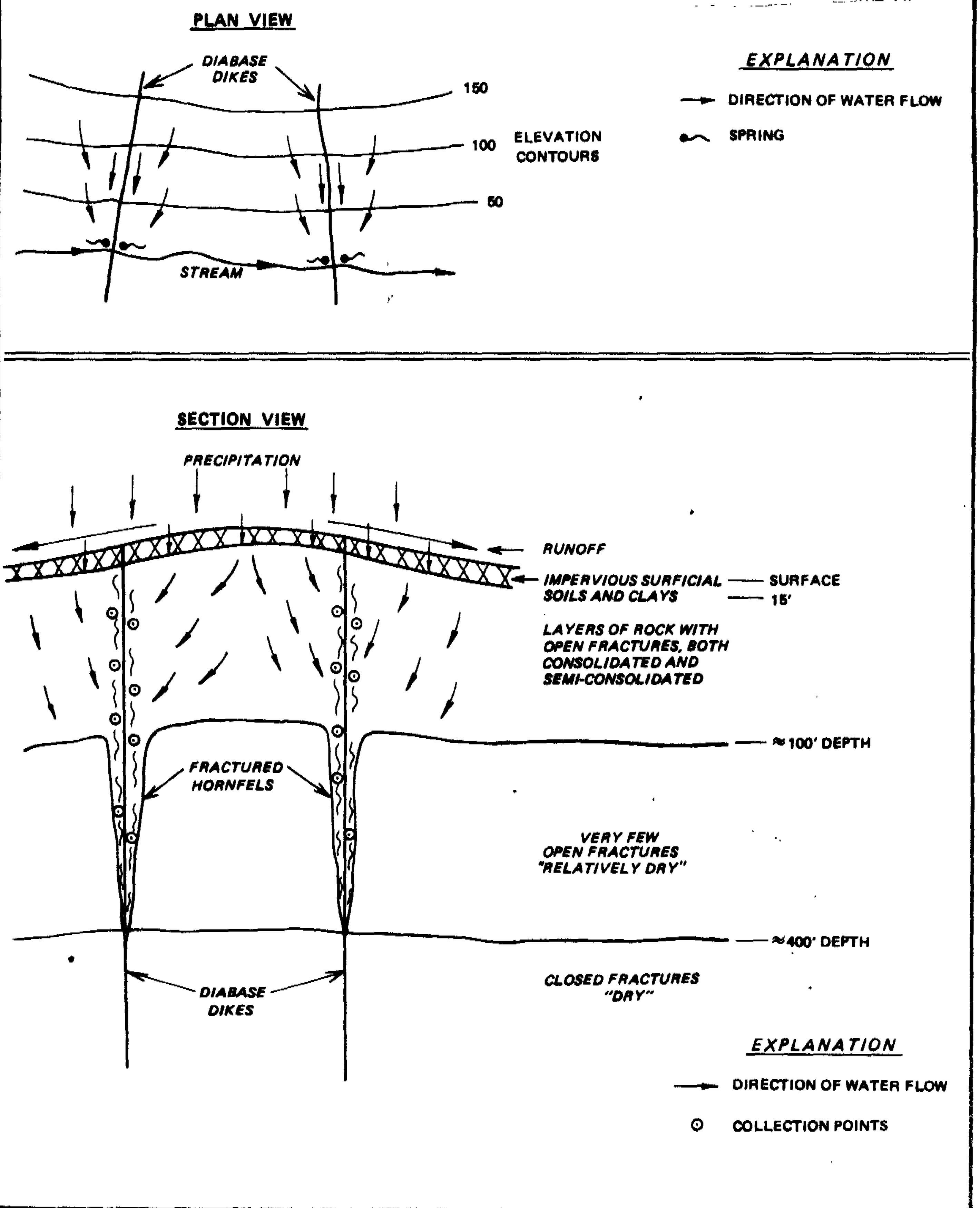
NOTE: VALVES ARE NOT TO BE OPERATED WHEN SPILLWAY IS IN OPERATION.

AMENDMENT NO. 4

SHEARON HARRIS NUCLEAR POWER PLANT Carolina Power & Light Company ENVIRONMENTAL REPORT	MAIN DAM DISCHARGE THRU HOWELL BUNGER VALVES	FIGURE 2.4.2-42



SHEARON HARRIS NUCLEAR POWER PLANT Carolina Power & Light Company ENVIRONMENTAL REPORT	LOCATION OF SITE REGION	FIGURE 2.4.3-1



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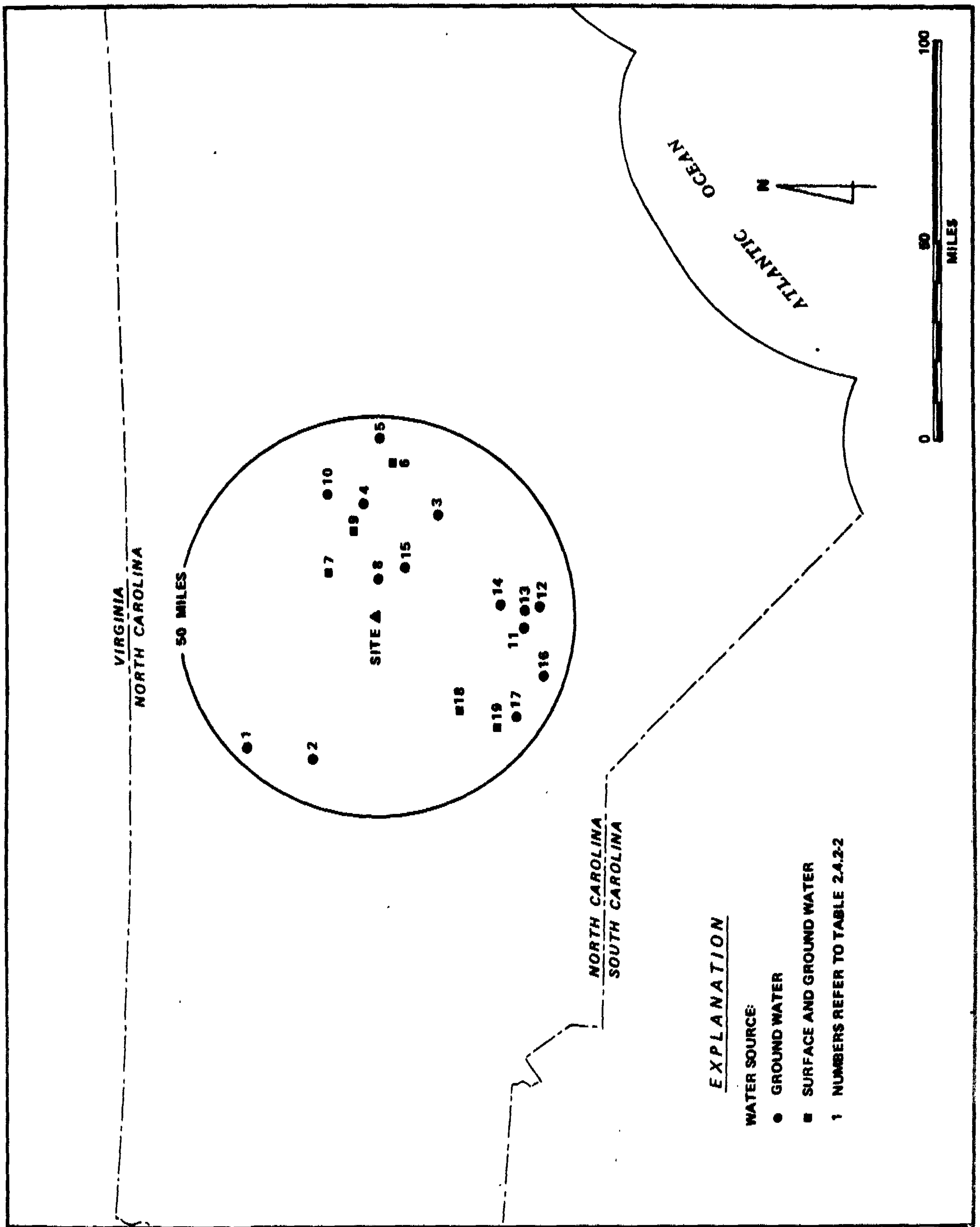
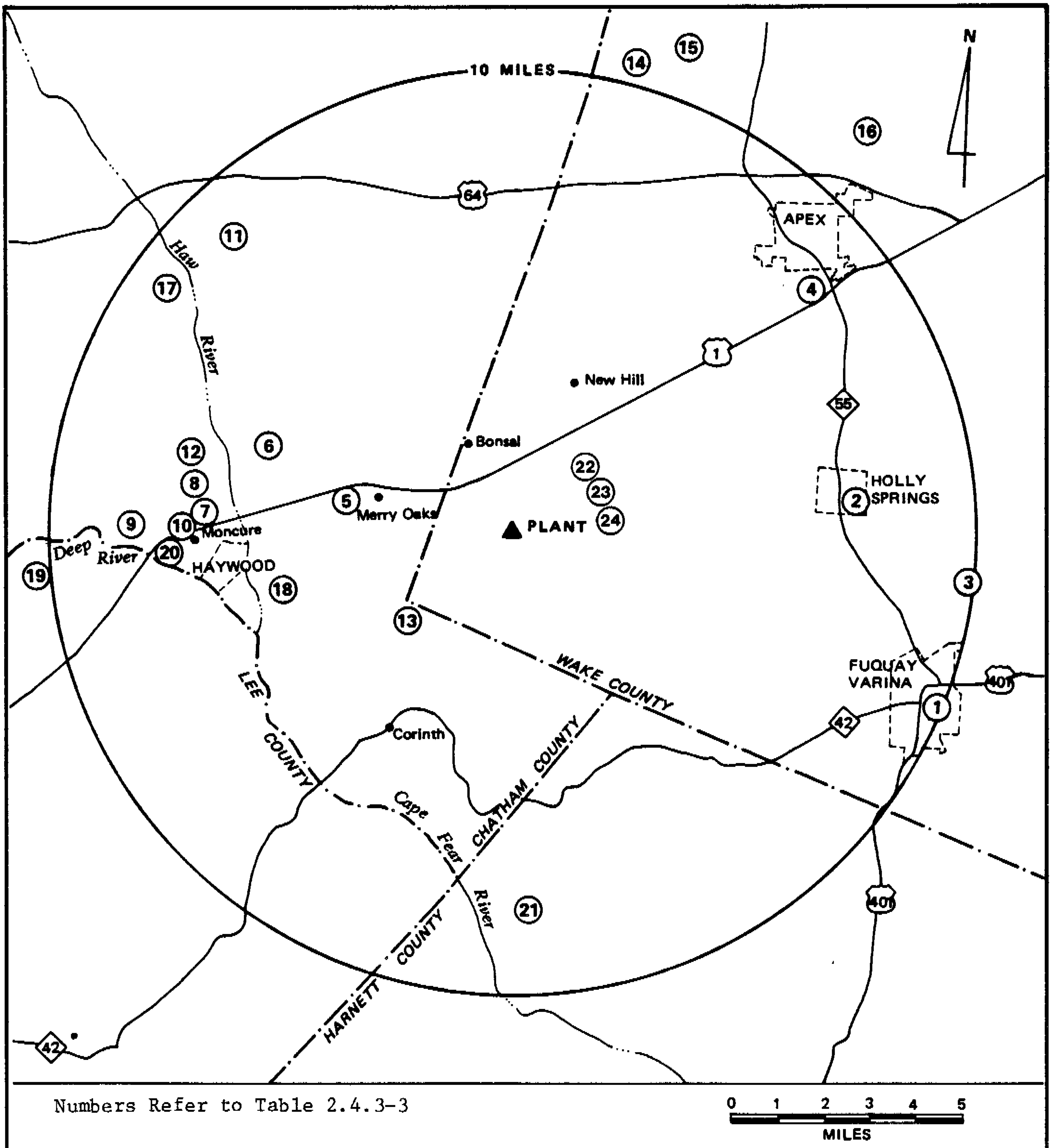
DIAGRAMMATIC RELATIONSHIP OF DIKES AND FRACTURES TO GROUND WATER

FIGURE
2.4.3-2



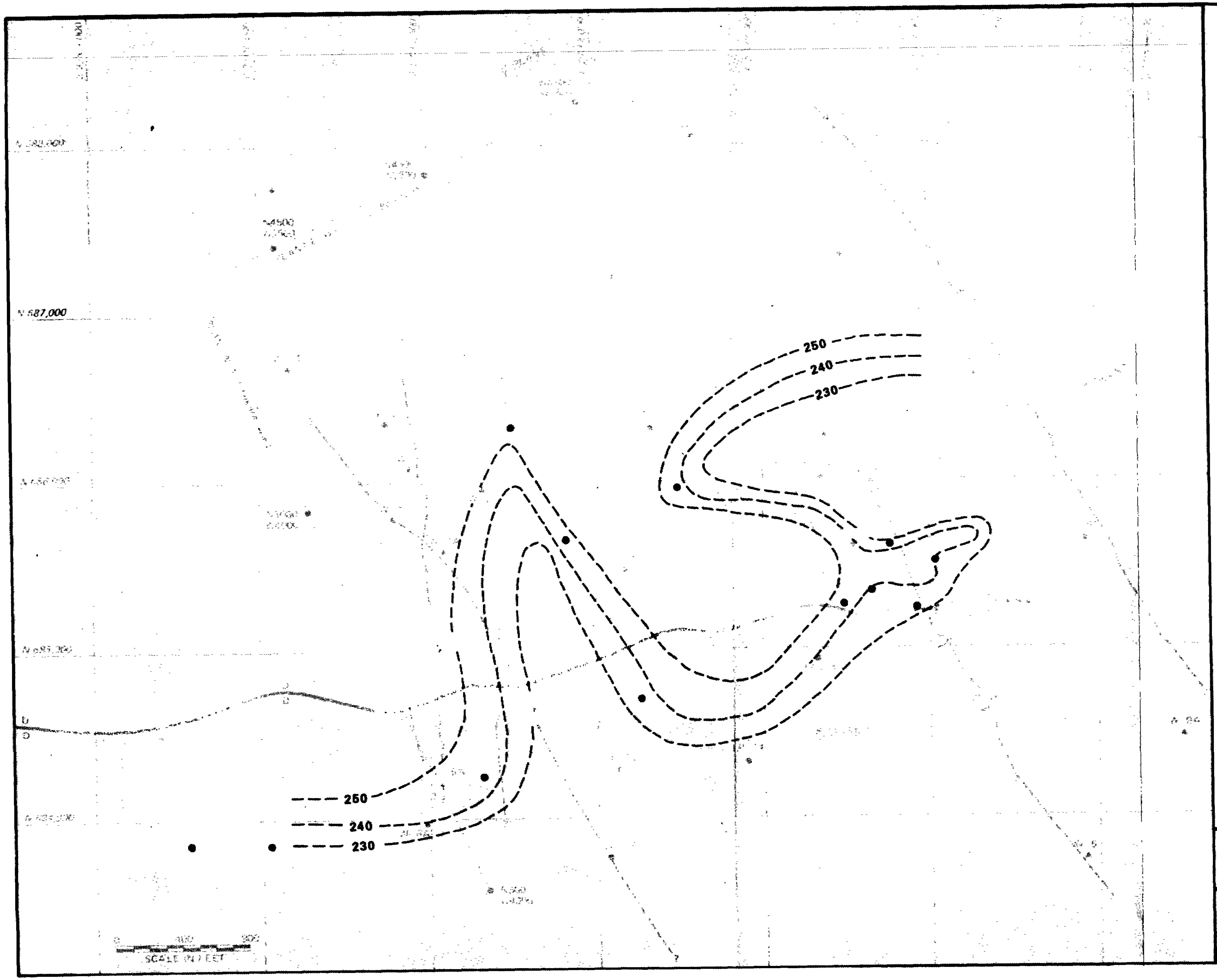
SHEARON HARRIS NUCLEAR POWER PLANT Carolina Power & Light Company ENVIRONMENTAL REPORT	LOCATION OF PUBLIC GROUND WATER SUPPLY SYSTEM WITHIN 50 MILES OF PLANT	FIGURE 2.4.3-3



Numbers Refer to Table 2.4.3-3

AMENDMENT NO. 4

SHEARON HARRIS NUCLEAR POWER PLANT Carolina Power & Light Company ENVIRONMENTAL REPORT	PUBLIC WELLS WITHIN 10 MILES OF THE PLANT	FIGURE 2.4.3-4



EXPLANATION

FAULT
U, UPTHROWN SIDE;
D, DOWNTHROWN SIDE

DIABASE DIKE

● PRECONSTRUCTION PIEZOMETER

PIEZOMETER

WATER WELL

— — — PIEZOMETRIC–LEVEL
CONTOUR INTERVAL 10 FEET

THE BASE MAP IS TAKEN FROM TOPOGRAPHIC MAPS PREPARED BY PHOTO SCIENCE INC. UTILIZING STEREOPHOTOGRAMMETRIC METHODS FROM PHOTOGRAPHY DATED FEB. 7, 1970 AND FEB. 5, 1972.
HORIZONTAL CONTROL IS TAKEN FROM NORTH CAROLINA STATE PLANE COORDINATE SYSTEM.
VERTICAL CONTROL IS TAKEN FROM U.S.C. AND G.S. DATUM.

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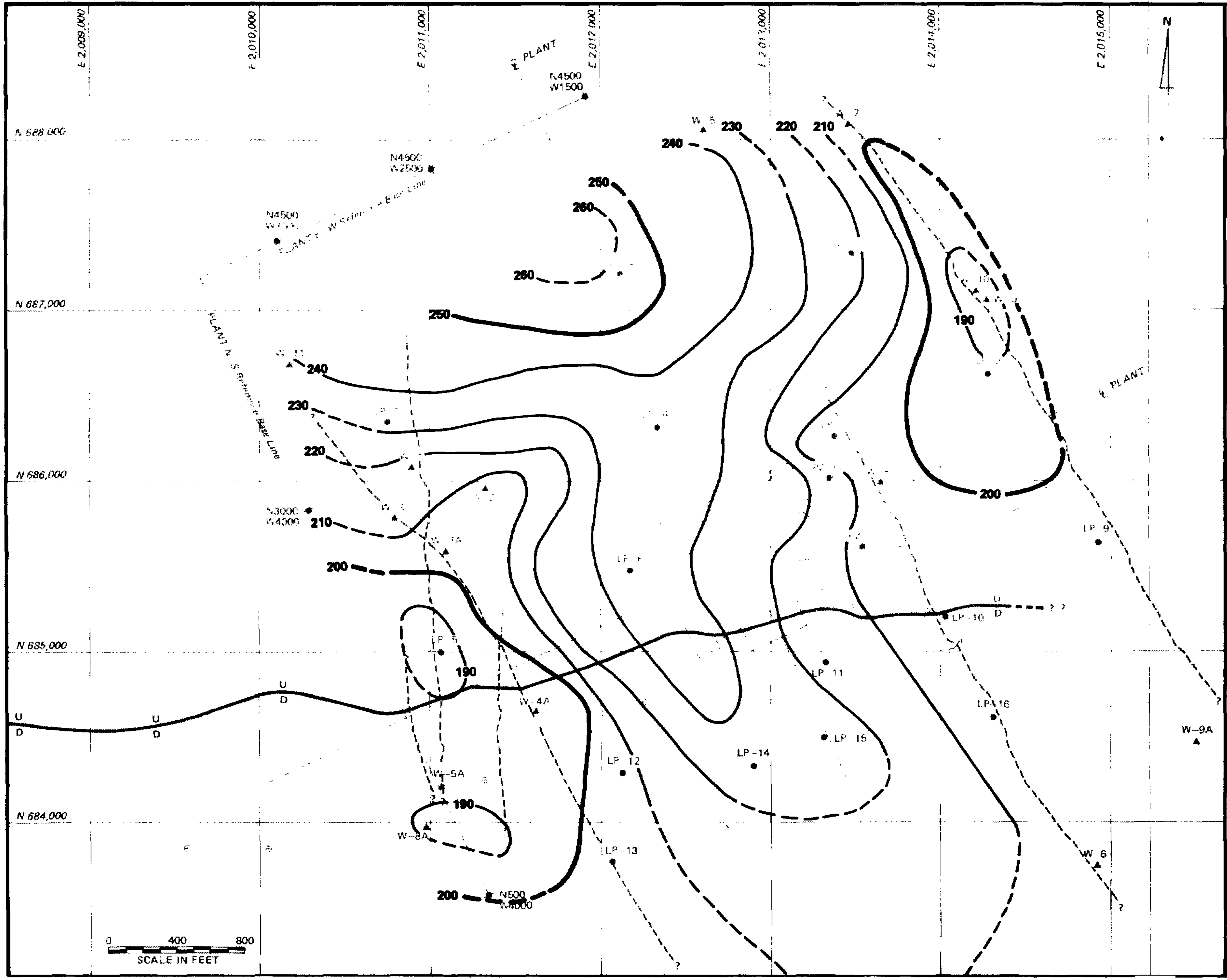
PRE-CONSTRUCTION
PIEZOMETRIC LEVELS

FIGURE 2.4.3-5



EXPLANATION

FAULT
U, UPTHROWN SIDE;
D, DOWNTHROWN SIDE

DIABASE DIKE

PRECONSTRUCTION PIEZOMETER

● PIEZOMETER

▲ WATER WELL

PIEZOMETRIC–LEVEL
CONTOUR INTERVAL 10 FEET

THE BASE MAP IS TAKEN FROM TOPOGRAPHIC MAPS PREPARED BY PHOTO SCIENCE INC. UTILIZING STEREOPHOTOGRAMMETRIC METHODS FROM PHOTOGRAPHY DATED FEB. 7, 1970 AND FEB. 5, 1972.
HORIZONTAL CONTROL IS TAKEN FROM NORTH CAROLINA STATE PLANE COORDINATE SYSTEM.
VERTICAL CONTROL IS TAKEN FROM U.S.C. AND G.S. DATUM.

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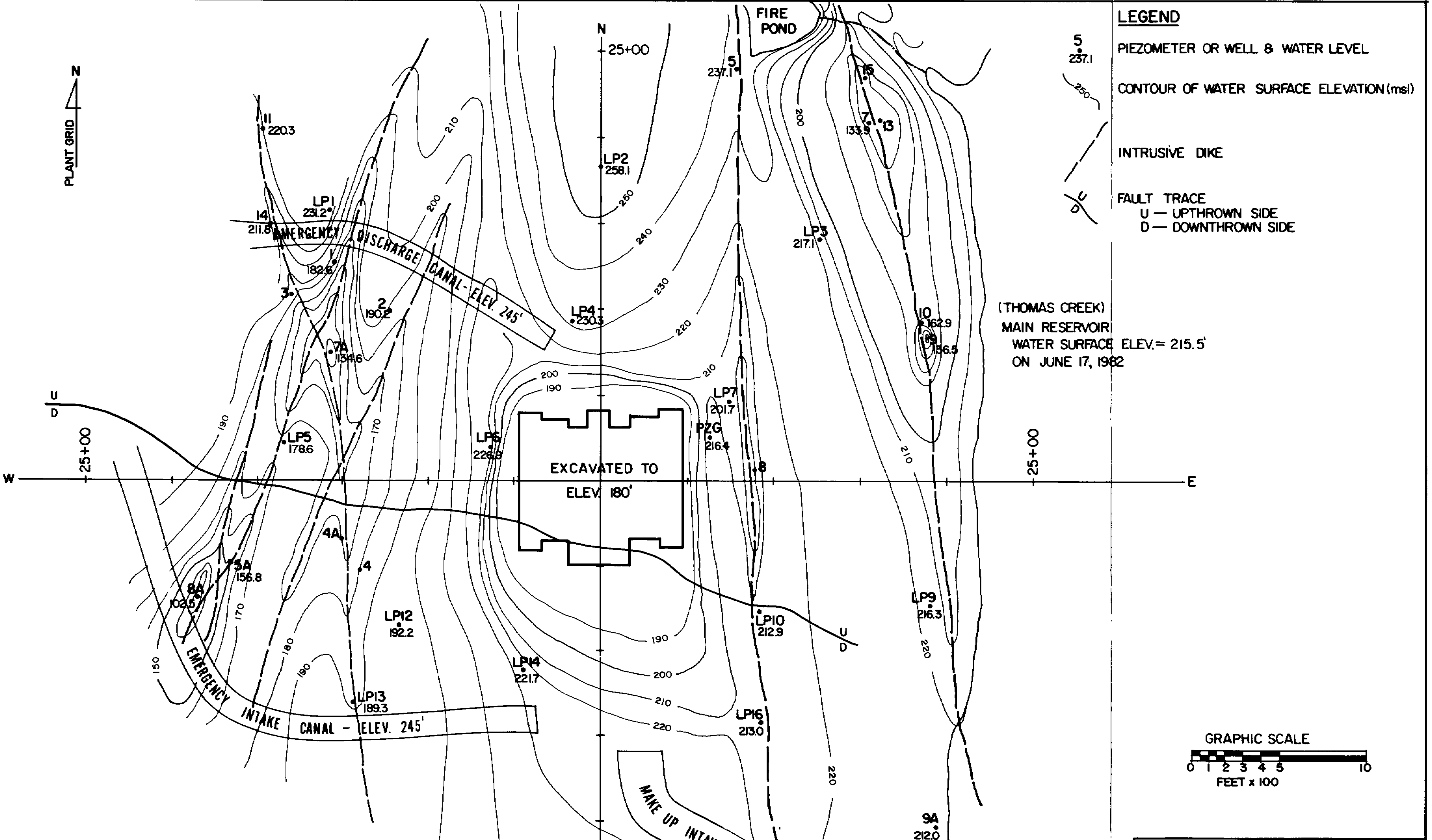
PIEZOMETRIC LEVELS,
WINTER 1979-1980

FIGURE 2.4.3-6



PIEZOMETRIC MAP OF THE PLANT ISLAND VICINITY ON JUNE 17, 1982

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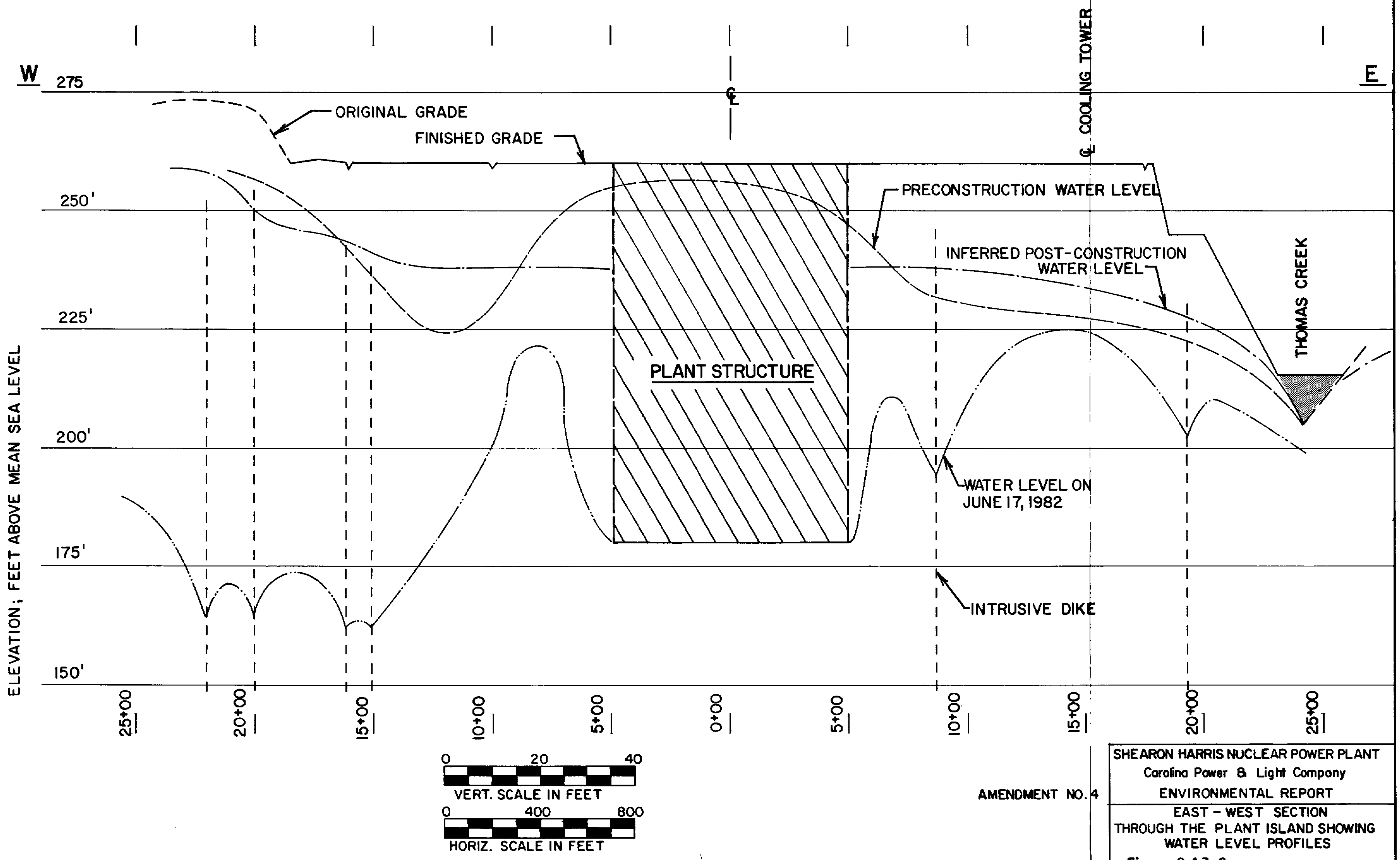
PIEZOMETRIC MAP OF THE PLANT VICINITY ON JUNE 17, 1982

Figure 2.4.3-7



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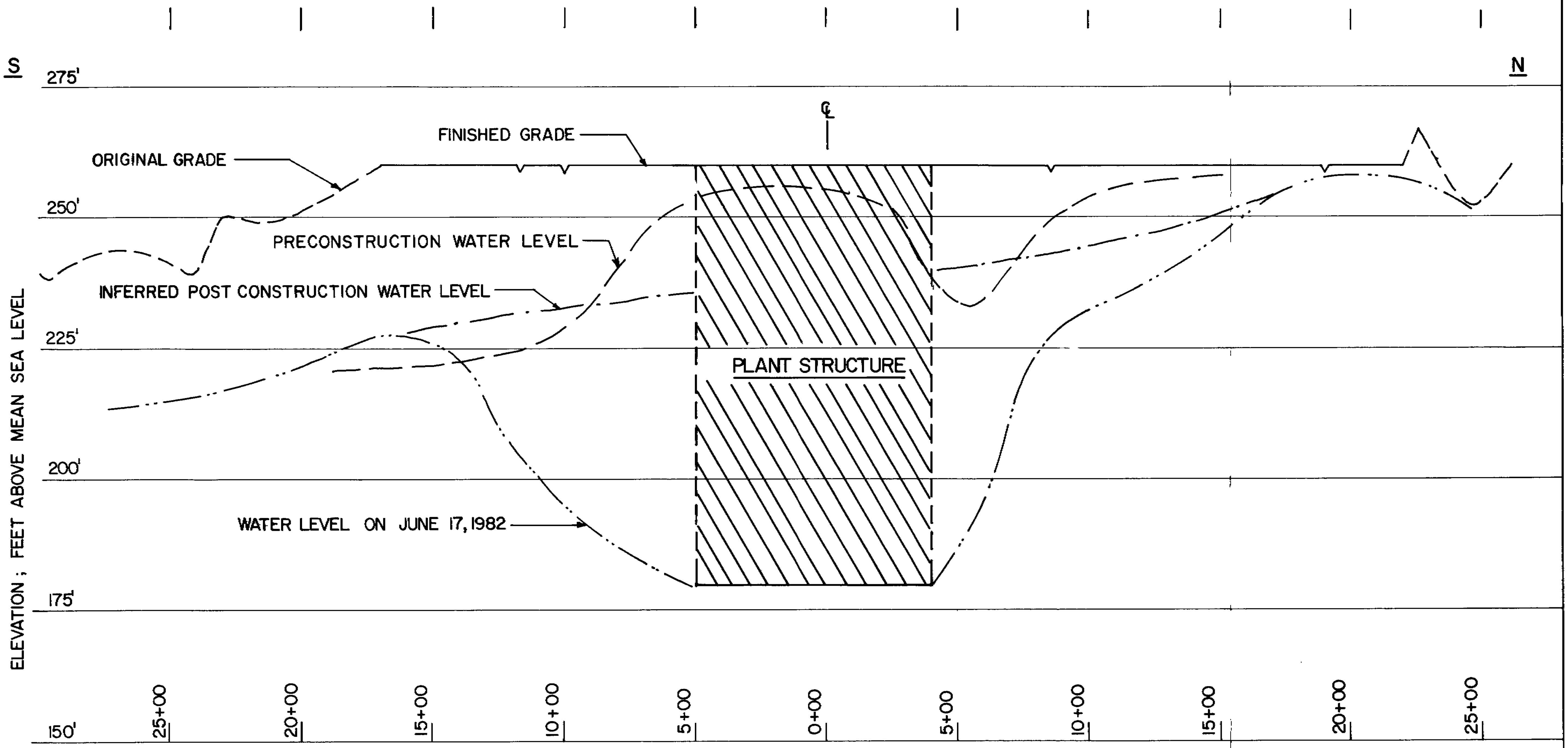
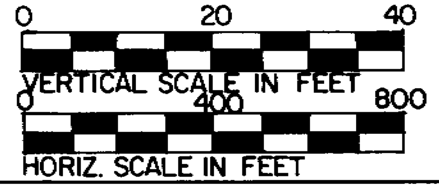
EAST - WEST SECTION THROUGH THE PLANT ISLAND SHOWING WATER LEVEL PROFILES

Figure 2.4.3-8





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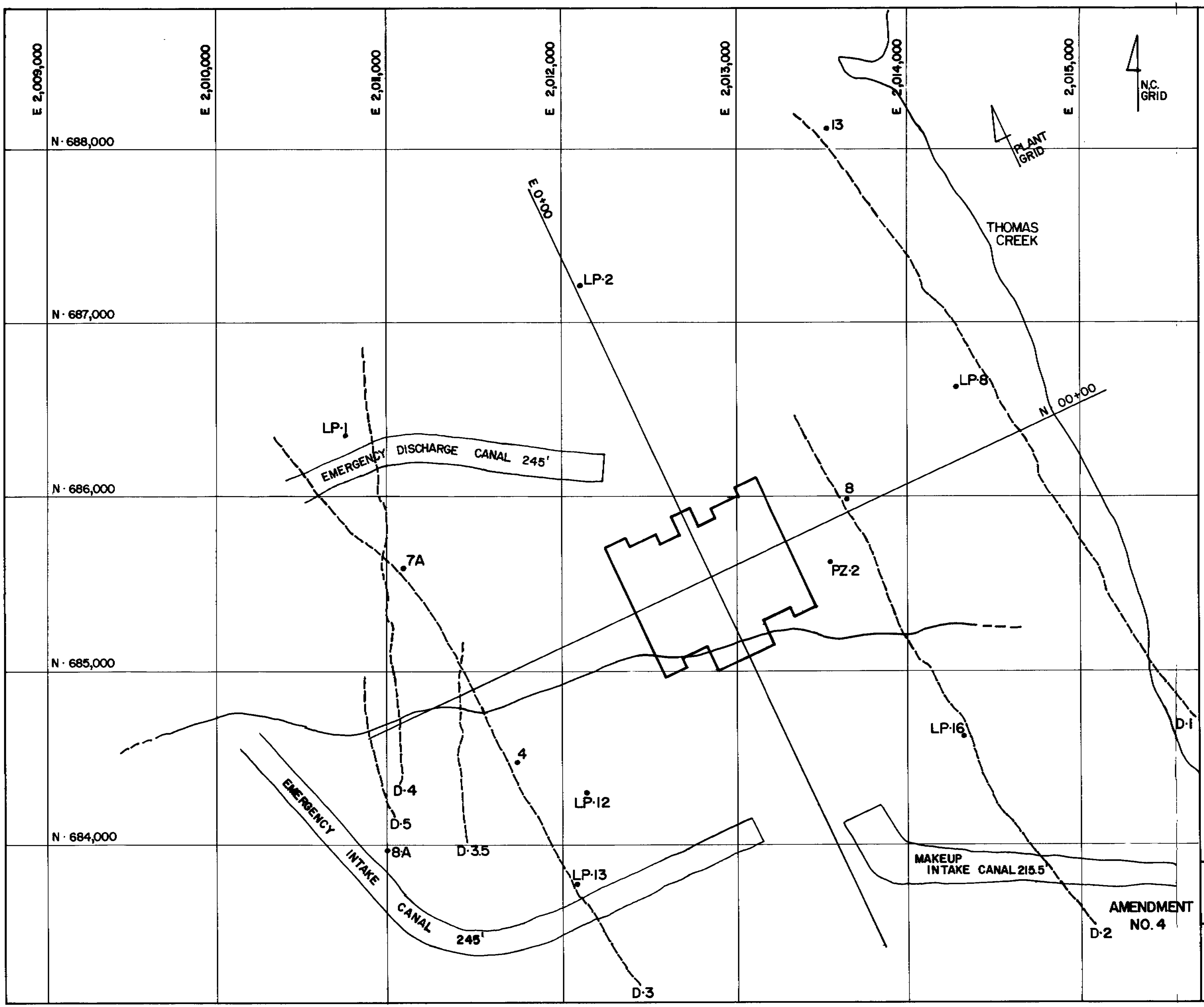
NORTH—SOUTH SECTION
THROUGH THE PLANT SITE SHOWING
WATER LEVEL PROFILES
Figure 2.4.3-9



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EXPLANATION

$\frac{U}{D}$ FAULT
U, UPTHROWN SIDE
D, DOWNTHROWN SIDE

--- DIABASE DIKE

● PERMANENT MONITOR WELL

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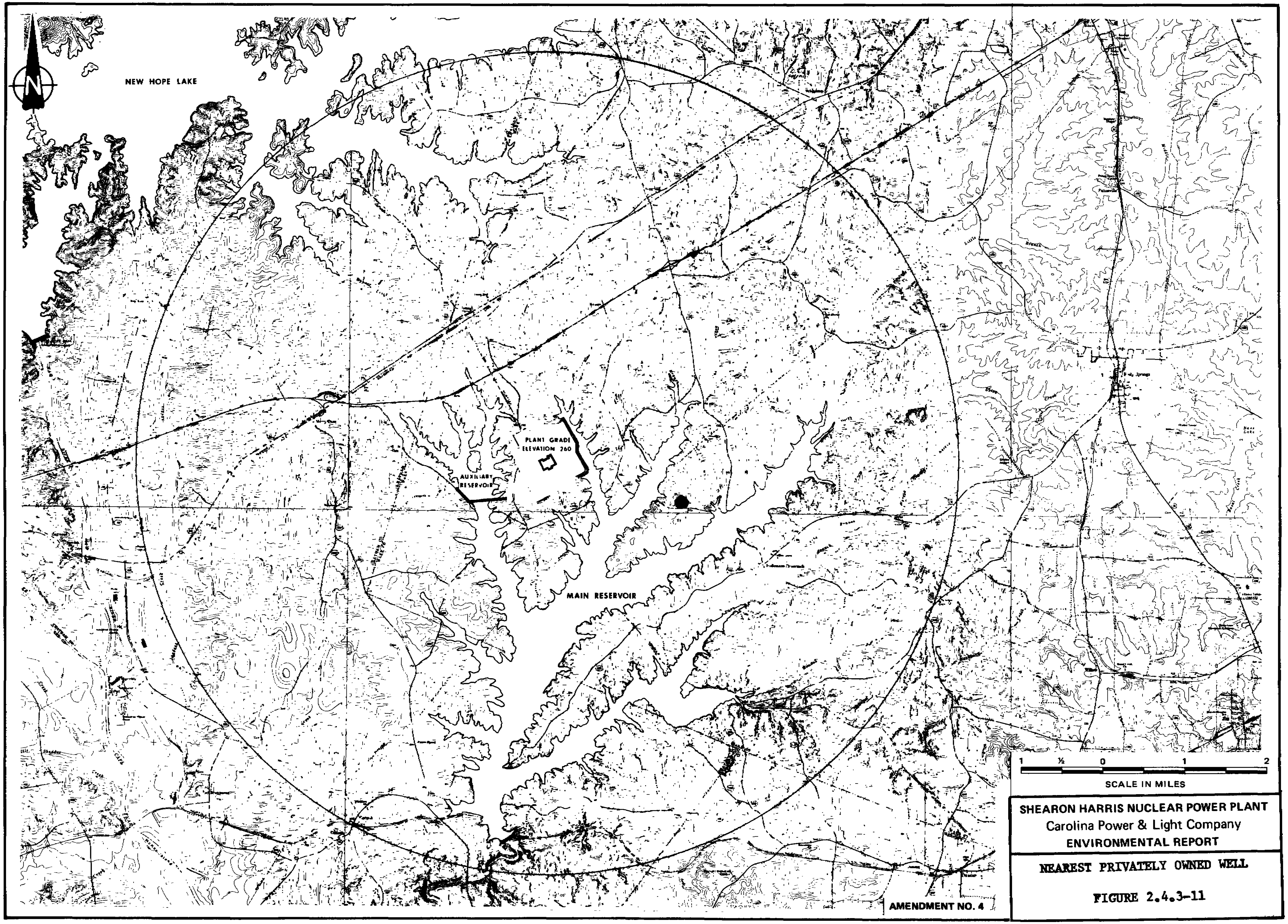
PERMANENT MONITOR WELL NETWORK

Figure 2.4.3-10



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NEAREST PRIVATELY OWNED WELL

FIGURE 2.4.3-11

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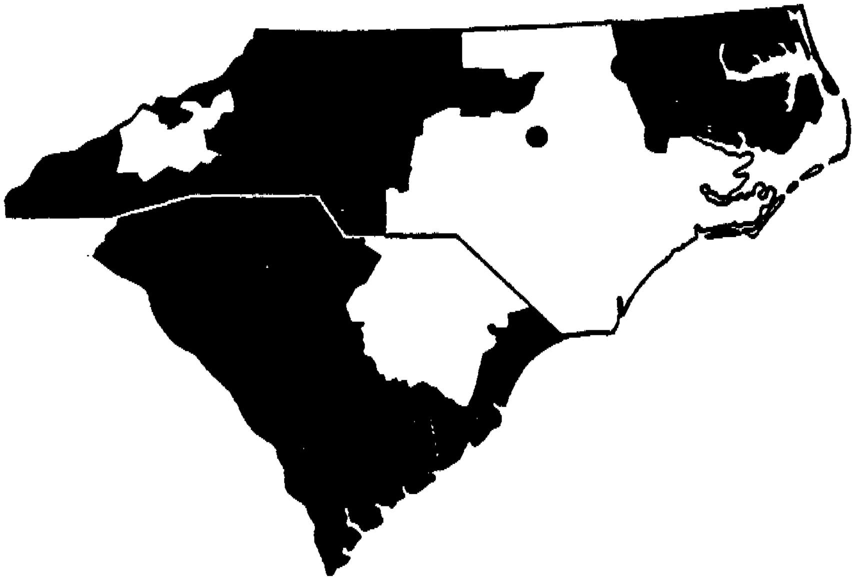
Shearon Harris Nuclear Power Plant Units 1, 2, 3 & 4



Environmental Report Operating License Stage

Carolina Power & Light Company

2.5 GEOLOGY

Section 2.5 of the Shearon Harris Nuclear Power Plant Final Safety Analysis Report provides a complete description of the major geological aspects of the site and its immediate environs.

2.6 REGIONAL HISTORIC, ARCHAEOLOGICAL, ARCHITECTURAL, SCENIC, CULTURAL, AND NATURAL FEATURES

The Research Laboratories of Anthropology of the University of North Carolina at Chapel Hill performed an archaeological and historical survey of the reservoir sites, dam sites, and makeup water pipeline route. Results of the survey indicated that there were no sites within these areas which were either included in or met minimal criteria for nomination to the National Register of Historic Places (Reference 2.6-1 and 2.6-2). In addition, the North Carolina State Historic Preservation Officer concurred that there were no sites within the reservoir areas that were eligible for inclusion into the National Register (Reference 2.6-3).

No sites listed in the National Registry of National Landmarks were located in the project area. No streams or segments of streams which were being considered for inclusion on a State listing of valuable river resources as defined in North Carolina's Natural and Scenic River Act of 1971 were affected by the project. Additionally, none of the streams or segments of streams in the project area were being considered for protection as defined by the Federal Wild and Scenic Rivers Act.

The entire project area, while rural in nature, was not considered aesthetically unique. However, effects of plant construction and operation have had and will have some visual impact on the area. These effects are discussed in Sections 3.3.2 and 3.9 of the SHNPP Construction Permit Environmental Report.

The NRC previously reviewed the proposed SHNPP transmission lines as presented in Section 3.11 of the SHNPP Construction Permit Environmental Report. This information requires no updating except the two 500 kV transmission lines have been cancelled and the Harris - Method 230 kV Line has been shortened and renamed the Harris - Cary Switching Line as discussed in Section 3.9. 3

REFERENCES: SECTION 2.6

2.6-1 Carolina Power & Light Company prepared by Trawick Ward. Research Laboratories of Anthropology, The University of North Carolina at Chapel Hill. Archaeological Survey and Evaluation of the Shearon Harris Nuclear Power Plant Cooling Lake Reservoir. Raleigh, N. C. 1978.

2.6-2 Ward, Trawick. Research Laboratories of Anthropology, The University of North Carolina at Chapel Hill. [Memoranda to Dr. J. L. Coe, Research Laboratories of Anthropology, The University of North Carolina at Chapel Hill.] June 18, 1977 and December 4, 1979.

2.6-3 Tise, Larry E. State Historic Preservation Officer, North Carolina Department of Cultural Resources. [Letter to Mr. Ralph L. Sanders, Carolina Power & Light Company.] March 9, 1978.

3

2.7 NOISE

2.7.1 INTRODUCTION

Sound can be described basically as variations in air pressure that can be detected by the human ear. To accurately describe sound, consideration must be given to the frequency and amplitude of sound. This can be accomplished by the use of a sound level meter where the amplitude of various frequencies of sound are measured in decibels (db) and weighted to obtain a level that correlates to man's perception of sound. The "A"-weighting scale of sound level meters is designed to accomplish this function by discriminating against low-frequency opponents of sound in a quantity proportional to a person's hearing ability. Measurements of this type are recorded as db(A).

A single db(A) reading tells little about environmental noise since environmental noise is considered to be a dynamic phenomenon which continually varies. For this reason, a statistical approach must be used to describe environmental noise. This is accomplished by showing the percentage of a specific measurement period each db(A) level is exceeded.

The descriptor L_N has been developed in formulating guidelines for community noise measurements and is used to represent a db(A) level exceeded N% of the measurement period. The sound level exceeded 10 percent of the time is expressed as L_{10} and represents higher-level, short-duration sounds. The descriptor L_{50}, the level exceeded 50 percent of the time, is used as a measure of the median sound level; L_{90}, the level exceeded 90 percent of the time, is used as a measure of residual sound.

Another descriptor for environmental noise measurements is L_{eq}. This represents the equivalent continuous db(A) level and accounts for both the magnitude and duration of sound occurring during the entire observation period.

2.7.2 NOISE SURVEY IN THE SHNPP AREA

In order to determine present ambient noise levels in the SHNPP site area, a noise survey was conducted on June 30, July 1-2, and July 9, 1979. Both daytime and nighttime noise level readings were taken. At the time of the survey, SHNPP was under construction.

2.7.2.1 Noise Measurement

Both daytime and nighttime noise measurements were taken to establish ambient noise levels within a 5-mile radius of the plant site, as recommended in NRC Regulatory Guide 4.2. Fourteen measurements were taken at seven different locations, as shown in Figure 2.7.2-1. These locations correspond to plant property boundary lines and were selected based on existing and/or future transmission line corridors and areas considered to be noise sensitive areas (see Table 2.7.2-1).

Ambient noise levels were measured with the B&K (Bruel & Kjaer) Type 4426 Noise Level Analyzer and Statistical Processor using a B&K Type 4165 Condenser Microphone with an omni-directional nose cone and wind screen. The microphone was mounted on a tripod at a height of approximately 5 ft. above ground level and placed approximately 30 ft. from the B&K Noise Level Analyzer. Ambient sound level measurements at 60-minute duration were taken, processed, and their histograms recorded on a B&K Type 2306 level recorder.

Weather measurements of barometric pressure, wind speed and direction, dry bulb temperature, dew point, and relative humidity were obtained for each measurement. These measurements were taken from weather instruments at the meteorological facility located on the SHNPP site and are shown in Table 2.7.2-2.

2.7.2.2 Survey Instrumentation

The B&K Type 4426 Noise Level Analyzer and Statistical Processor was the primary sound measuring device used in this survey. The B&K Type 4426 Noise Level Analyzer samples noise levels for a pre-set time period and automatically computes and stores "L" exceedance levels. These computed levels are instantly available on a digital display. For this survey, the instrument sampled sound levels at the selected locations for 60-minute periods.

Prior to and after taking sound level measurements at each location, the B&K Noise Level Analyzer was calibrated with a B&K Type 4230 Sound Level Calibrator. All measurements were taken using a Company procedure, established by the Transmission Line Engineering & Construction Section, for obtaining audible noise measurements. This procedure includes the setup, operation and calibration of the Noise Level Analyzer and recorder.

2.7.3 AMBIENT NOISE LEVELS AT THE SHNPP AREA

The noise level measurements are presented in Table 2.7.3-1 for the seven locations in the SHNPP area. These measurements represent samples of 60-minute duration of noise levels in this area. Cumulative distribution and distribution histogram plots for each of the measurements were recorded and have been placed on permanent file at CP&L.

5 This noise survey indicates that the residual sound level (L_{90}) in this area is relatively low with various transportation noises accounting for the higher level, short duration noises. The SHNPP was under construction at the time of this survey; however, all construction activities were terminated during the specified observation periods.

SHNPP ER

TABLE 2.7.2-1

AMBIENT NOISE MEASUREMENTS LOCATIONS

LOCATION	DESCRIPTION	RATIONALE
A	200 feet east of County Road 1127 on pipeline right-of-way.	Plant property boundary.
B	On County road 1134, south of US-1 overpass, at small cemetery.	Plant property boundary; cemetery - noise sensitive area.
C	On Road NC-1011, in front of Cedar Rock Church.	Nearby residential area; church - noise sensitive area.
D	On County Road 1911 at transmission line crossing, near Wake/Chatham County Line.	Plant property boundary; transmission line corridor.
E	At intersection of County Roads 1912 and 1913.	Plant property boundary; cemetery nearby - noise sensitive area.
F	On County road 1914 at Wake/Chatham County Line.	Plant property boundary.
G	On County Road 1130 at new transmission line corridor; in vicinity of Holleman's Crossroads.	Plant property boundary; residential area and small cemetery nearby - noise sensitive area.

SHNPP ER

TABLE 2.7.2-2

WEATHER OBSERVATIONS SHNPP AREA

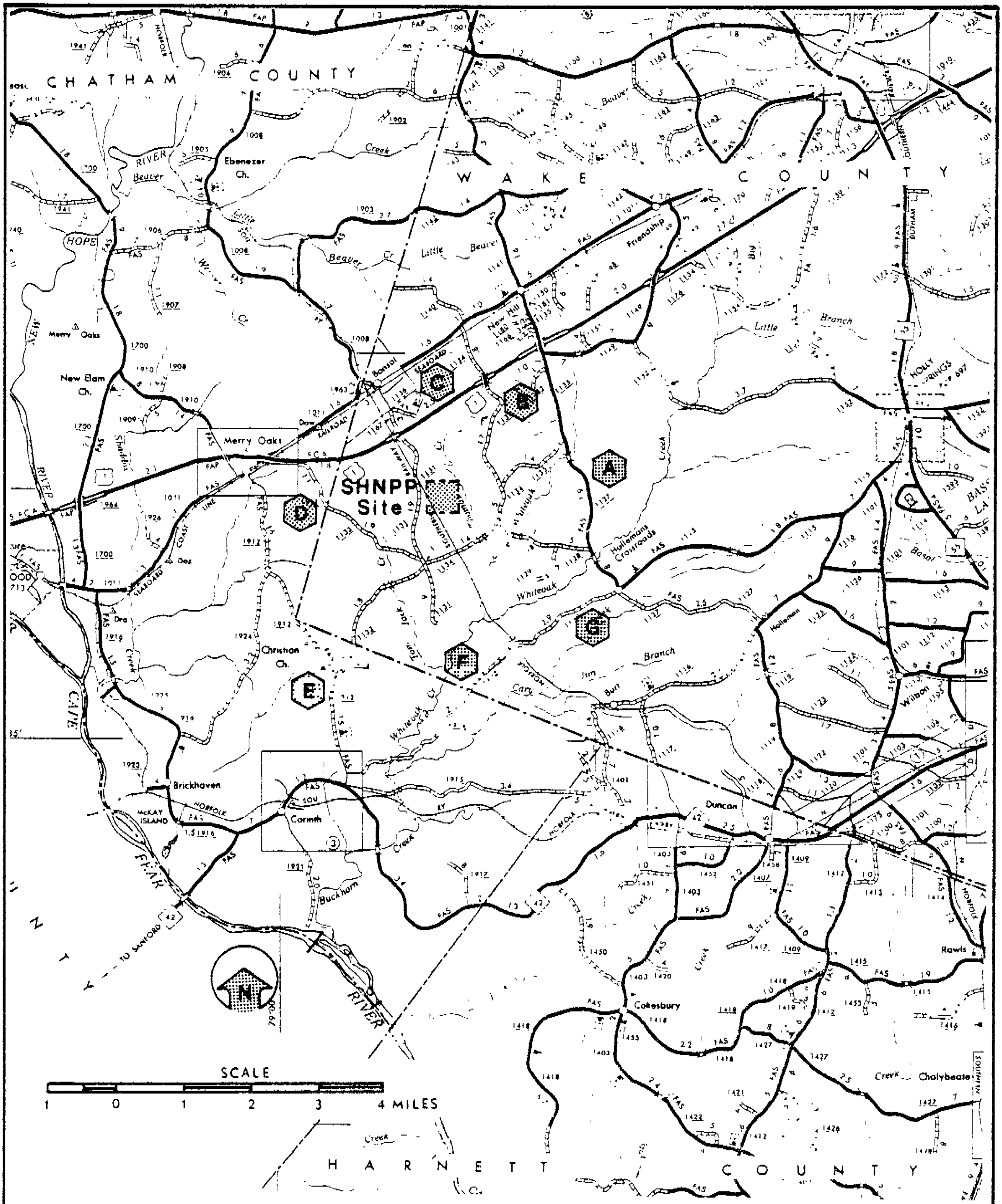
Location	Date	Time (EDT)	°F dT	°F Dew Pt.	RH %	Wind Mph	Wind Direction	Bar. Press. (mbar)
A	6/30/79	0830	69.7	67.0	91	3	SSW	1000.63
	7/01/79	2245	72.2	61.9	70	3	SSW	999.80
B	6/30/79	1345	83.9	62.1	48	8	SW	998.26
	7/09/79	0415	67.0	60.7	80	2	SE	1009.36
C	6/30/79	1530	87.1	60.1	40	12	SW	997.24
	7/02/79	0445	60.9	59.8	96	1	W	1000.61
D	6/30/79	1730	86.8	62.3	44	9	SSW	995.89
	7/09/79	0200	68.2	60.5	76	3	S	1010.21
E	7/10/79	1430	81.8	55.5	41	8	W	998.90
	7/02/79	0030	67.6	60.1	77	2	SE	1010.45
F	7/01/79	1645	83.3	55.9	39	13	WSW	998.35
	7/02/79	0045	67.4	61.0	80	3	SW	1000.43
G	6/30/79	1145	80.6	66.1	61	7	S	998.93
	7/02/79	0215	63.8	60.7	90	2	S	1000.70

TABLE 2.7.3-1

AMBIENT NOISE MEASUREMENTS
SHNPP AREA

db(A)

Location	Day	Date	Time	L_{1}	L_{2}	L_{5}	L_{10}	L_{20}	L_{50}	L_{90}	L_{99}	L_{min}	L_{max}	L_{eq}
A	Saturday	6/30/79	0830	49.3	47.3	44.3	42.5	40.3	37.8	35.8	35.8	32	60	40.0
	Sunday	7/01/79	2250	45.3	44.3	42.3	40.0	36.5	30.5	27.8	26.3	26	50	35.6
B	Saturday	6/30/79	1350	48.3	46.8	43.3	41.0	38.8	35.5	32.0	30.3	28	60	38.5
	Monday	7/09/79	0415	41.5	41.0	40.0	39.5	39.0	38.3	33.0	30.5	28	46	37.9
C	Saturday	6/30/79	1534	69.3	67.5	63.5	59.0	54.0	46.3	40.3	37.5	36	78	56.7
	Monday	7/02/79	0445	76.0	75.8	74.5	50.0	38.3	33.5	28.0	26.3	26	82	63.8
D	Saturday	6/30/79	1733	46.3	43.5	38.8	36.8	35.3	32.3	29.8	27.8	26	58	36.5
	Monday	7/09/79	0207	73.0	73.0	73.0	73.0	72.8	30.5	28.5	27.5	26	74	66.8
E	Sunday	7/01/79	1430	47.3	45.3	42.3	39.3	36.3	32.8	28.3	26.3	26	64	37.3
	Monday	7/09/79	0030	52.3	49.5	42.5	40.8	40.0	37.8	33.3	29.8	26	70	41.3
F	Sunday	7/01/79	1645	45.8	44.5	42.3	40.3	38.0	33.5	29.5	26.5	26	56	36.9
	Monday	7/02/79	0040	35.3	34.3	32.5	30.8	28.3	26.3	26.3	26.3	26	40	28.0
G	Saturday	6/30/79	1155	51.3	50.3	48.0	46.5	44.5	40.5	35.8	32.8	28	56	42.9
	Monday	7/02/79	0210	34.3	32.3	30.0	28.8	27.3	26.3	26.3	26.3	26	48	27.3



SHEARON HARRIS
NUCLEAR POWER PLANT
Carolina
Power & Light Company
ENVIRONMENTAL REPORT

AMBIENT NOISE MEASUREMENT LOCATIONS
SHNPP AREA

FIGURE
2.7.2-1

CHAPTER 3
THE STATION

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CHAPTER 3
THE STATION

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CHAPTER 3
THE STATION

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CHAPTER 3
THE STATION

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CHAPTER 3
THE STATION

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CHAPTER 3 LIST OF TABLES (Cont'd)

ENVIRONMENTAL REPORT - OPERATING LICENSE STAGE

CHAPTER 3 LIST OF TABLES (Cont'd)

ENVIRONMENTAL REPORT - OPERATING LICENSE STAGE

CHAPTER 3 LIST OF TABLES (Cont'd)

| 3

ENVIRONMENTAL REPORT - OPERATING LICENSE STAGE

CHAPTER 3 LIST OF FIGURES

FIGURE TITLE

ENVIRONMENTAL REPORT - OPERATING LICENSE STAGE

CHAPTER 3 LIST OF FIGURES (Cont'd)

5

ENVIRONMENTAL REPORT - OPERATING LICENSE STAGE

CHAPTER 3 LIST OF FIGURES (Cont'd)

3.0 THE STATION

3.1 EXTERNAL APPEARANCE

Major plant island structures include two Containment Buildings; Reactor Auxiliary Buildings including two buildings plus one common building; two Turbine Buildings housing two turbine-generators; one Waste Processing Building; a Service Building; one Fuel Handling Building; one Diesel Generator Building; a Water Treatment Facility; and two natural draft Cooling Towers. Figure 3.1-1 shows the SHNPP site plan. A pictorial representation of the plant is provided by Figure 3.1-2 and the plant profile is illustrated by Figures 3.1-3 and 3.1-4. 5

The Containments and Reactor Auxiliary Buildings have an as-poured natural concrete exterior finish, while the Fuel Handling Building has siding with an exterior finish that is compatible with the environment. In addition, the exposed steel areas of the Turbine Building are painted gray to harmonize with the other buildings. The plant profile is dominated by the two natural draft Cooling Towers, each approximately 520 ft. high. The Cooling Towers have an as-poured natural concrete surface. 5

The site area is a rolling, wooded, rural area dissected by small streams in the Piedmont region of North Carolina. The SHNPP site is approximately 10,800 acres, of which about 4,000 acres are inundated to form the Main Reservoir. The plant area was graded to approximate Elevation 260 ft. MSL. The surrounding terrain was undisturbed as far as possible. In general, the terrain rises to the north of the plant. The Main Reservoir is to the south, east, and west of the plant.

Appropriate planting and seeding will be used to integrate the plant components into the environmental setting. A number of intrinsic aesthetic impacts are associated with the reservoirs and the Cooling Tower complex, as discussed in Chapter 5.

The location and elevation of release points for gaseous wastes are identified in Table 3.1-1. FSAR Figure 9.4.0-2 shows the location of these release points relative to the site plan. The liquid release point (Cooling Tower blowdown line) is shown on Figure 2.4.1-1. 5

5

TABLE 3.1-1

PLANT AIRBORNE EFFLUENT RELEASE POINTS(1)

RELEASE POINT NO.	RELEASE POINT ELEV. (FT.MSL)	RELEASE POINT EL. ABOVE GRADE(3) (FT.)	DISTANCE TO NEAREST RESTRICTED AREA BOUNDARY (FT.)	BUILDING	UNIT(5) NO.	SYSTEM	CFM(2) PER SYSTEM	TOTAL CFM PER POINT	SIZE & SHAPE OF ORIFICE	APPROX VELOCITY (FPM)
1	346	86	435	Reactor	1	Normal Exhaust Sys.	148,000			
				Aux.	1	NNS-Ventilation Sys.	26,000			
				Bldg.	1	Emergency Exhaust Sys.	(6,000)			
						(Sub Total) Σ_1 =	174,000			
					2	Normal Exhaust Sys.	148,000			
					2	NNS-Ventilation Sys.	26,000			
					2	Emergency Exhaust Sys.	(6,000)			
						(Sub Total) Σ_2 =	174,000			
				Fuel Handling Bldg.	1-4	Upper Level Operating Floor Normal Exh. Sys.				
						(North)	40,000			
						(South)	40,000			
						Lower Level Operating Floor Normal Exh. Sys.				
						(North)	47,000			
						(South)	47,000			
						Emergency Exh. Sys.	(6,000)			
						(Sub Total) Σ_3 =	174,000			
				Containment	1	Normal Purge Exh. Sys.	1,500			
				Bldg.	1	Pre-Entry Purge Exh. Sys.	(37,000)			
						(Sub Total) Σ_4 =	1,500			

TABLE 3.1-1 (Continued)

PLANT AIRBORNE EFFLUENT RELEASE POINTS(1)

RELEASE POINT NO.	RELEASE POINT ELEV. (FT.MSL)	RELEASE POINT EL. ABOVE GRADE(3) (FT.)	DISTANCE TO NEAREST RESTRICTED AREA BOUNDARY (FT.)	BUILDING	UNIT(5) NO.	SYSTEM	CFM(2) PER SYSTEM	TOTAL CFM PER POINT	SIZE & SHAPE OF ORIFICE	APPROX VELOCITY (FPM)
				Containment Bldg. (Cont.)	2	Normal Purge Exh. Sys.	1,500			
					2	Pre-Entry Purge Exh. Sys.	(37,000)			
						(Sub Total) Σ_5	1,500			
1	346	86	435	Reactor Aux. Bldg.	1	Control Room Purge Exhaust System	(13,400)			
					2	Control Room Purge Exhaust System	(13,400)			
1	346	86	435	Reactor Aux. Bldg.	1	Switchgear Room Cable Vault Smoke Purge System	(8,000)			
					2	Switchgear Room Cable Vault Smoke Purge System	(8,000)			
					1	Electrical Equipment Protection Rooms - Smoke Purge System	(14,050)			
1	346	86	435	Reactor Aux. Bldg.	2	Electrical Equipment Protection Rooms - Smoke Purge System	(14,050)			
						$\Sigma_1 + \Sigma_2 + \Sigma_3 + \Sigma_4 + \Sigma_5$		525,000	Dia. = 13 ft. Circular	3955

TABLE 3.1-1 (Continued)

PLANT AIRBORNE EFFLUENT RELEASE POINTS(1)

RELEASE POINT NO.	RELEASE POINT ELEV. (FT.MSL)	RELEASE POINT EL. ABOVE GRADE(3) (FT.)	DISTANCE TO NEAREST RESTRICTED AREA BOUNDARY (FT.)	BUILDING	UNIT(5) NO.	SYSTEM	CFM(2) PER SYSTEM	TOTAL CFM PER POINT	SIZE & SHAPE OF ORIFICE	APPROX VELOCITY (FPM)
2(4)										

5

TABLE 3.1-1 (Continued)

PLANT AIRBORNE EFFLUENT RELEASE POINTS(1)

RELEASE POINT NO.	RELEASE POINT ELEV. (FT.MSL)	RELEASE POINT EL. ABOVE GRADE(3) (FT.)	DISTANCE TO NEAREST RESTRICTED AREA BOUNDARY (FT.)	BUILDING	UNIT(5) NO.	SYSTEM	CFM(2) PER SYSTEM	TOTAL CFM PER POINT	SIZE & SHAPE OF ORIFICE	APPROX VELOCITY (FPM)

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TABLE 3.1-1 (Continued)

PLANT AIRBORNE EFFLUENT RELEASE POINTS(1)

RELEASE POINT NO.	RELEASE POINT ELEV. (FT.MSL)	RELEASE POINT EL. ABOVE GRADE(3) (FT.)	DISTANCE TO NEAREST RESTRICTED AREA BOUNDARY (FT.)	BUILDING	UNIT(5) NO.	SYSTEM	CFM(2) PER SYSTEM	TOTAL CFM PER POINT	SIZE & SHAPE OF ORIFICE	APPROX VELOCITY (FPM)
3A	296	36	435	Turbine Bldg.	1	Combined Effluent from Condensate Polishers Cubicles and Mech. Vac. Pumps Effluent Treat. Sys.	22,650	22,650	Dia. = 44 in. Circular	2145
3B					2	Combined Effluent from Condensate Polishers Cubicles and Mech. Vac. Pumps Effluent Treat. System	22,650	22,650	Dia. = 44 in. Circular	2145
4A(4)										
4B(4)										
5	321	61	335	Waste Processing Bldg.	1-4	Office Area Exhaust Gen. Area Exh. Fan Filter Exh. System Office Area Economizer Fan	2,700 5,500 130,800 16,000			

5

5

TABLE 3.1-1 (Continued)

PLANT AIRBORNE EFFLUENT RELEASE POINTS[1]

RELEASE POINT NO.	RELEASE POINT ELEV. (FT.MSL)	RELEASE POINT EL. ABOVE GRADE[3] (FT.)	DISTANCE TO NEAREST RESTRICTED AREA BOUNDARY (FT.)	BUILDING	UNIT[5] NO.	SYSTEM	CFM[2] PER SYSTEM	TOTAL CFM PER POINT	SIZE & SHAPE OF ORIFICE	APPROX VELOCITY (FPM)
				Waste Processing Bldg.		Cold Laundry Dryers	18,000			
						Chiller Room Exhaust Fans	24,400		Rectangle	
						Cold & Hot Laundry	9,600			
						Control Room Smoke Exhausts	(28,000)			
						(Sub Total)		207,000	Dia. = 2 ft. Circular	1830
5A	321	61	335	Waste Processing Bldg.	1-4	Laboratory Fume Hood Exhausts	27,575			
						HVAC Equipment Room Exhaust Fans	25,000			
						Switchgear Room Exhaust Fans	24,500			
						Personnel Handling Exh. Fans	26,500		Dia. = 8 ft. Circular	2061
						(Sub Total)	103,575			
6	317	57	475	Reactor Aux. Bldg.	1	Control Room Normal Exhaust Sys.	800	800	Dia. = 2 in. Circular	1019

TABLE 3.1-1 (Continued)

PLANT AIRBORNE EFFLUENT RELEASE POINTS(1)

RELEASE POINT NO.	RELEASE POINT ELEV. (FT.MSL)	RELEASE POINT EL. ABOVE GRADE(3) (FT.)	DISTANCE TO NEAREST RESTRICTED AREA BOUNDARY (FT.)	BUILDING	UNIT(5) NO.	SYSTEM	CFM(2) PER SYSTEM	TOTAL CFM PER POINT	SIZE & SHAPE OF ORIFICE	APPROX VELOCITY (FPM)
7	317	57	335	Reactor Aux. Bldg.	2	Control Room Normal Exhaust Sys.	800	800	Dia. = 12 in. Circular	1013
8(4)										
9(4)										
10	305	64	450	Reactor Aux. Bldg.	1	Switchgear Room "A" Exhaust Sys.	3000	3000	20 in. x 20 in. Square	1080
11	305	64	250	Reactor Aux. Bldg.	2	Switchgear Room "A" Exhaust Sys.	3000	3000	20 in. x 20 in. Square	1080
12(4)										
13(4)										

TABLE 3.1-1 (Continued)

PLANT AIRBORNE EFFLUENT RELEASE POINTS[1]

RELEASE POINT NO.	RELEASE POINT ELEV. (FT.MSL)	RELEASE POINT EL. ABOVE GRADE[3] (FT.)	DISTANCE TO NEAREST RESTRICTED AREA BOUNDARY (FT.)	BUILDING	UNIT[5] NO.	SYSTEM	CFM[2] PER SYSTEM	TOTAL CFM PER POINT	SIZE & SHAPE OF ORIFICE	APPROX VELOCITY (FPM)
14	305	45	480	Reactor Aux. Bldg.	1	Switchgear Room "B" Exhaust Sys.	3000	3000	20 in. x 20 in. Square	1080
15	305	45	315	Reactor Aux. Bldg.	2	Switchgear Room "B" Exhaust Sys.	3000	3000	20 in. x 20 in. Square	1080
16[4]										
17[4]										
18	324	64	450	Reactor Aux. Bldg.	1	Equipment Protection Rooms Exhaust Sys.	850	850	Dia. = 12 in. Circular	1083
19	324	64	415	Reactor Aux. Bldg.	2	Equipment Protection Rooms Exhaust Sys.	850	850	Dia. = 12 in. Circular	1083
20[4]										
21[4]										

TABLE 3.1-1 (Continued)

PLANT AIRBORNE EFFLUENT RELEASE POINTS(1)

5

RELEASE POINT NO.	RELEASE POINT ELEV. (FT.MSL)	RELEASE POINT EL. ABOVE GRADE(3) (FT.)	DISTANCE TO NEAREST RESTRICTED AREA BOUNDARY (FT.)	BUILDING	UNIT(5) NO.	SYSTEM	CFM(2) PER SYSTEM	TOTAL CFM PER POINT	SIZE & SHAPE OF ORIFICE	APPROX VELOCITY (FPM)
22A	312	52	65	Diesel Generator Bldg.	1A	Diesel Generator Room Ventilation Exhaust	57,000	57,000	54 in. x 54 in. Square	2815
22B	312	52	65	Diesel Generator Bldg.	1A	Diesel Generator Room Ventilation Exhaust	57,000	57,000	54 in. x 54 in. Square	2815
23	312	52	65	Diesel Generator Bldg.	1A	Diesel Generator Exhaust & Day Tank Exhaust	29,900	29,900	6 ft. x 10 ft. Rectangle	498
24A	312	52	65	Diesel Generator Bldg.	1B	Diesel Generator Room Ventilation Exhaust	57,000	57,000	54 in. x 54 in. Square	2815
24B	312	52	65	Diesel Generator Bldg.	1B	Diesel Generator Room Ventilation Exhaust	57,000	57,000	54 in. x 54 in. Square	2815
25	312	52	65	Diesel Generator Bldg.	1B	Diesel Generator Exhaust & Day Tank Exhaust	29,900	29,900	6 ft. x 10 ft. Rectangle	498
26A	312	52	65	Diesel Generator Bldg.	2A	Diesel Generator Room Ventilation Exhaust	57,000	57,000	54 in. x 54 in. Square	2815

TABLE 3.1-1 (Continued)

PLANT AIRBORNE EFFLUENT RELEASE POINTS(1)

RELEASE POINT NO.	RELEASE POINT ELEV. (FT.MSL)	RELEASE POINT EL. ABOVE GRADE(3) (FT.)	DISTANCE TO NEAREST RESTRICTED AREA BOUNDARY (FT.)	BUILDING	UNIT(5) NO.	SYSTEM	CFM(2) PER SYSTEM	TOTAL CFM PER POINT	SIZE & SHAPE OF ORIFICE	APPROX VELOCITY (FPM)
26B	312	52	65	Diesel Generator Bldg.	2A	Diesel Generator Room Ventilation Exhaust	57,000	57,000	54 in. x 54 in. Square	2815
27	312	52	65	Diesel Generator Bldg.	2A	Diesel Generator Exhaust & Day Tank Exhaust	29,900	29,900	6 ft. x 10 ft. Rectangle	498
28A	312	52	65	Diesel Generator Bldg.	2B	Diesel Generator Room Ventilation Exhaust	57,000	57,000	54 in. x 54 in. Square	2815
28B	312	52	65	Diesel Generator Bldg.	2B	Diesel Generator Room Ventilation Exhaust	57,000	57,000	54 in. x 54 in. Square	2815
29	312	52	65	Diesel Generator Bldg.	2B	Diesel Generator Exhaust & Day Tank Exhaust	29,900	29,900	6 ft. x 10 ft. Rectangle	498
30A(4)										
30B(4)										
31(4)										

5

5

TABLE 3.1-1 (Continued)

PLANT AIRBORNE EFFLUENT RELEASE POINTS(1)

RELEASE POINT NO.	RELEASE POINT ELEV. (FT.MSL)	RELEASE POINT EL. ABOVE GRADE(3) (FT.)	DISTANCE TO NEAREST RESTRICTED AREA BOUNDARY (FT.)	BUILDING	UNIT(5) NO.	SYSTEM	CFM(2) PER SYSTEM	TOTAL CFM PER POINT	SIZE & SHAPE OF ORIFICE	APPROX VELOCITY (FPM)
32A(4)										
32B(4)										
33(4)										
34A(4)										
34B(4)										
35(4)										
36A(4)										
36B(4)										

5

TABLE 3.1-1 (Continued)

PLANT AIRBORNE EFFLUENT RELEASE POINTS(1)

RELEASE POINT NO.	RELEASE POINT ELEV. (FT.MSL)	RELEASE POINT EL. ABOVE GRADE(3) (FT.)	DISTANCE TO NEAREST RESTRICTED AREA BOUNDARY (FT.)	BUILDING	UNIT(5) NO.	SYSTEM	CFM(2) PER SYSTEM	TOTAL CFM PER POINT	SIZE & SHAPE OF ORIFICE	APPROX VELOCITY (FPM)	5
37(4)											5
38	305	45	550	RAB	1	Switchgear Rm "A" Exhaust	21,800	21,800	Dia. = 42 in. Circular	2266	
39	305	45	550	RAB	1	Switchgear Rm "B" Exhaust	22,700	22,700	Dia. = 42 in. Circular	2360	
40	324	64	550	RAB	1	Switchgear Rm "B" Rod Control Cabinet Rm Exhaust	4,000	4,000	Dia. = 24 in. Circular	1273	
41	305	45	550	RAB	2	Switchgear Rm "A" Exhaust	21,800	21,800	Dia. = 42 in. Circular	2266	
42	305	45	550	RAB	2	Switchgear Rm "B" Exhaust	22,700	22,700	Dia. = 42 in. Circular	2360	
43	324	64	550	RAB	2	Switchgear Rm "B" Rod Control Cabinet Rm Exhaust	4,000	4,000	Dia. = 24 in. Circular	1273	
44(4)											
45(4)											5
46(4)											

TABLE 3.1-1 (Continued)

PLANT AIRBORNE EFFLUENT RELEASE POINTS(1)

RELEASE POINT NO.	RELEASE POINT ELEV. (FT.MSL)	RELEASE POINT EL. ABOVE GRADE(3) (FT.)	DISTANCE TO NEAREST RESTRICTED AREA BOUNDARY (FT.)	BUILDING	UNIT(5) NO.	SYSTEM	CFM(2) PER SYSTEM	TOTAL CFM PER POINT	SIZE & SHAPE OF ORIFICE	APPROX VELOCITY (FPM)
47(4)										
48(4)										
49(4)										
50	281	21	55	Emergency Service Water Intake Structure	1A,2A	Emergency Service Water Intake Structure Pump Room Ventilation System	12,000	12,000	5 ft. x 5 ft. Rectangle	960
51	281	21	55	Emergency Service Water Intake Structure	1A,2A	Emergency Service Water Intake Structure Pump Room Ventilation System	12,000	12,000	5 ft. x 5 ft. Rectangle	960
52	281	21	55	Emergency Service Water Intake Structure	1A,2A	Emergency Service Water Intake Structure Electrical Equipment Room HVAC System	9,500	9,500	5 ft. x 5 ft. Rectangle	760
53	281	21	55	Emergency Service Water Intake Structure	1A,2A	Emergency Service Water Intake Structure Electrical Equipment Room HVAC System	9,500	9,500	5 ft. x 5 ft. Rectangle	760

TABLE 3.1-1 (Continued)

PLANT AIRBORNE EFFLUENT RELEASE POINTS(1)

5

RELEASE POINT NO.	RELEASE POINT ELEV. (FT.MSL)	RELEASE POINT EL. ABOVE GRADE(3) (FT.)	DISTANCE TO NEAREST RESTRICTED AREA BOUNDARY (FT.)	BUILDING	UNIT(5) NO.	SYSTEM	CFM(2) PER SYSTEM	TOTAL CFM PER POINT	SIZE & SHAPE OF ORIFICE	APPROX VELOCITY (FPM)
54	281	21	55	Emergency Service Water Intake Structure	1B,2B	Emergency Service Water Intake Structure Pump Room Ventilation System	12,000	12,000	5 ft. x 5 ft. Rectangle	960
55	281	21	55	Emergency Service Water Intake Structure	1B,2B	Emergency Service Water Intake Structure Pump Room Ventilation System	12,000	12,000	5 ft. x 5 ft. Rectangle	960
56	281	21	55	Emergency Service Water Intake Structure	1B,2B	Emergency Service Water Intake Structure Electrical Equipment Room HVAC System	9,500	9,500	5 ft. x 5 ft. Rectangle	760
57	281	21	55	Emergency Service Water Intake Structure	1B,2B	Emergency Service Water Intake Structure Electrical Equipment Room HVAC System	9,500	9,500	5 ft. x 5 ft. Rectangle	760
58(4)										
59(4)										

5

TABLE 3.1-1 (Continued)

PLANT AIRBORNE EFFLUENT RELEASE POINTS(1)

RELEASE POINT NO.	RELEASE POINT ELEV. (FT.MSL)	RELEASE POINT EL. ABOVE GRADE(3) (FT.)	DISTANCE TO NEAREST RESTRICTED AREA BOUNDARY (FT.)	BUILDING	UNIT(5) NO.	SYSTEM	CFM(2) PER SYSTEM	TOTAL CFM PER POINT	SIZE & SHAPE OF ORIFICE	APPROX VELOCITY (FPM)
60(4)										
61(4)										
62(4)										
63(4)										
64(4)										
65(4)										

5

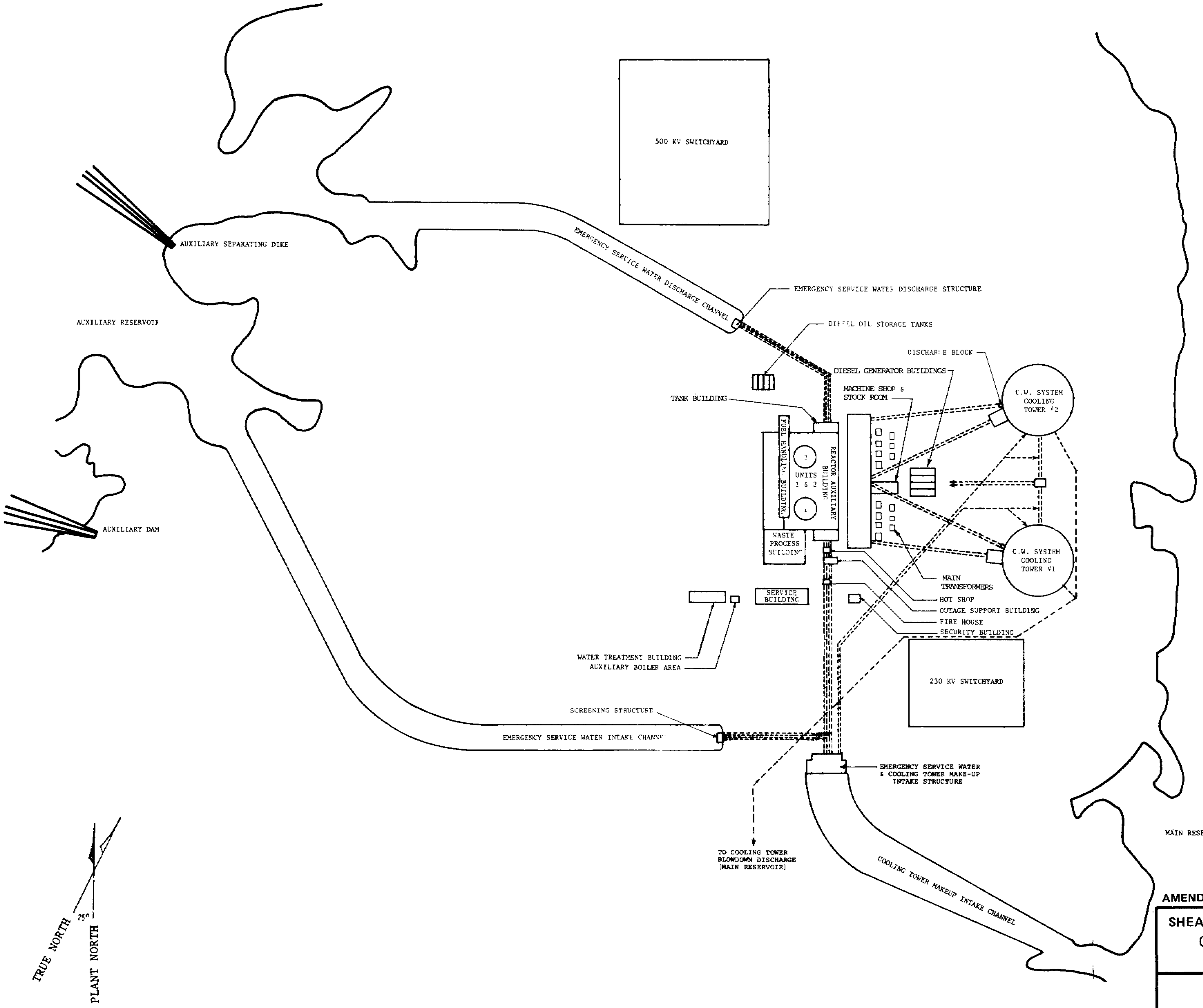
TABLE 3.1-1 (Continued)

PLANT AIRBORNE EFFLUENT RELEASE POINTS[1]

RELEASE POINT NO.	RELEASE POINT ELEV. (FT.MSL)	RELEASE POINT EL. ABOVE GRADE[3] (FT.)	DISTANCE TO NEAREST RESTRICTED AREA BOUNDARY (FT.)	BUILDING	UNIT[5] NO.	SYSTEM	CFM[2] PER SYSTEM	TOTAL CFM PER POINT	SIZE & SHAPE OF ORIFICE	APPROX VELOCITY (FPM)
66	264	4	100	Diesel Fuel Oil Pump Room	1A,1B,2A, 2B	Diesel Fuel Oil Transfer Pump Room Ventilation System	2,600	2,600	1 ft.-6 in. x 4 ft. Rectangle	867
67	264	4	100	Diesel Fuel Oil Pump Room	1A,1B,2A, 2B	Diesel Fuel Oil Transfer Pump Room Ventilation System	2,600	2,600	1 ft.-6 in. x 4 ft. Rectangle	867

NOTES:

1. For release points the release temperature varies between 60 F (minimum) and 120 F (maximum).
2. CFM given in parenthesis are for emergency conditions and thus are not included in the CFM subtotals or totals.
3. Grade El. 260 ft. MSL.
4. Release point eliminated due to cancellation of SHNPP Unit 3 and 4.
5. Equipment originally planned for use with SHNPP Units 3 and 4 which have been retained as backups for Units 1 and 2 will retain original equipment designations.

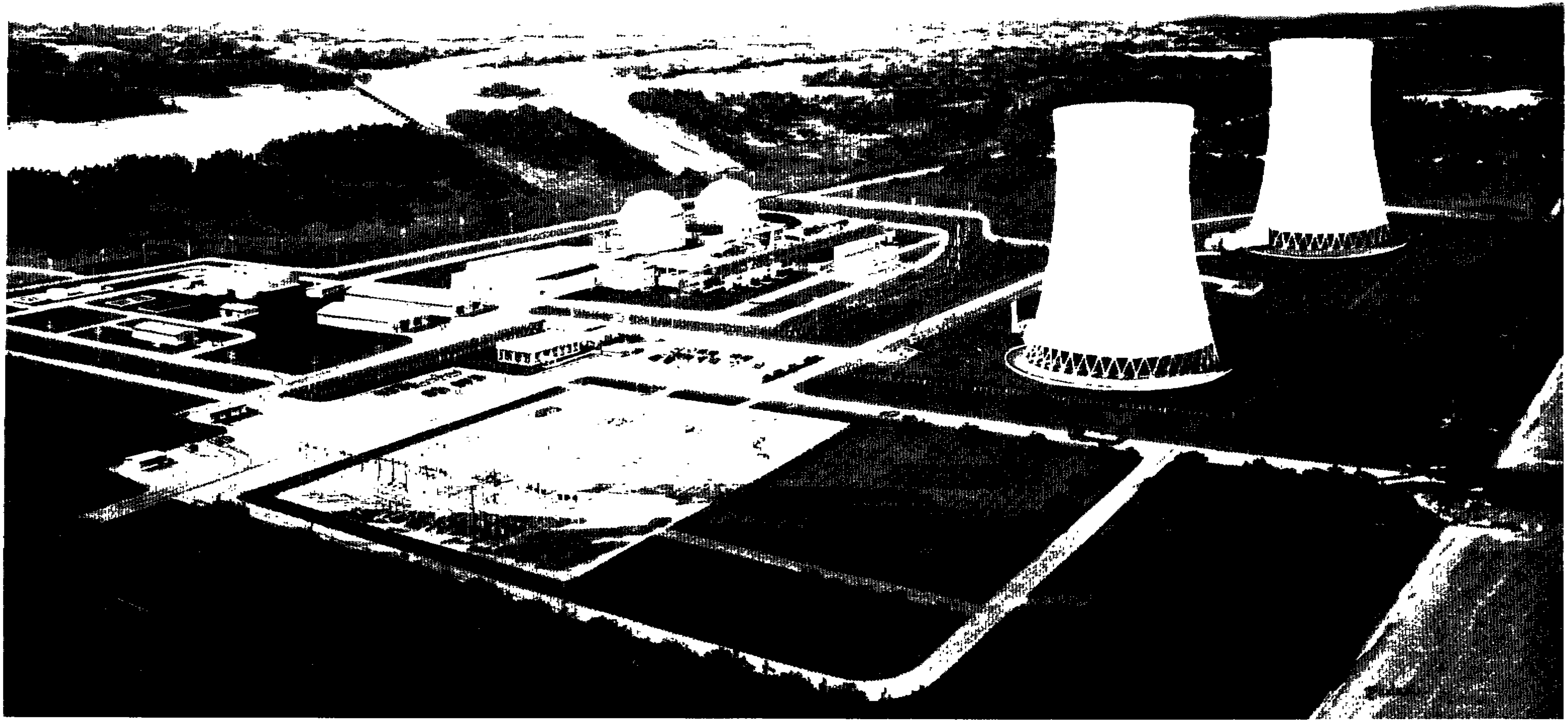

500 KV SWITCHYARD
AUXILIARY SEPARATING DIKE
AUXILIARY RESERVOIR
AUXILIARY DAM
EMERGENCY SERVICE WATER DISCHARGE CHANNEL
EMERGENCY SERVICE WATER DISCHARGE STRUCTURE
DIESEL OIL STORAGE TANKS
DISCHARGE BLOCK
DIESEL GENERATOR BUILDINGS
MACHINE SHOP & STOCK ROOM
TANK BUILDING
C.W. SYSTEM COOLING TOWER #2
FUEL HANDLING BUILDING
UNITS 1 & 2
2
1
REACTOR AUXILIARY BUILDING
WASTE PROCESS BUILDING
C.W. SYSTEM COOLING TOWER #1
MAIN TRANSFORMERS
SERVICE BUILDING
HOT SHOP
OUTAGE SUPPORT BUILDING
FIRE HOUSE
SECURITY BUILDING
WATER TREATMENT BUILDING
AUXILIARY BOILER AREA
230 KV SWITCHYARD
SCREENING STRUCTURE
EMERGENCY SERVICE WATER INTAKE CHANNEL
EMERGENCY SERVICE WATER & COOLING TOWER MAKE-UP INTAKE STRUCTURE
TO COOLING TOWER BLOWDOWN DISCHARGE (MAIN RESERVOIR)
COOLING TOWER MAKEUP INTAKE CHANNEL
MAIN RESERVOIR
25°
TRUE NORTH
PLANT NORTH

AMENDMENT NO. 5 (12/82)

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
ENVIRONMENTAL REPORT

SITE PLAN

FIGURE 3.1-1



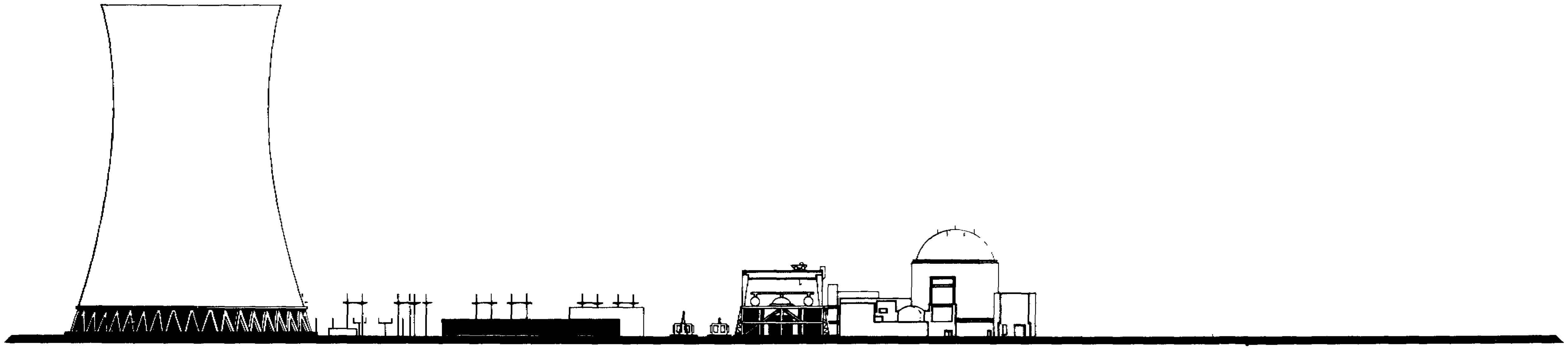
AMENDMENT NO. 5 (12/82)

SHEARON HARRIS
NUCLEAR POWER PLANT
Carolina
Power & Light Company
ENVIRONMENTAL REPORT

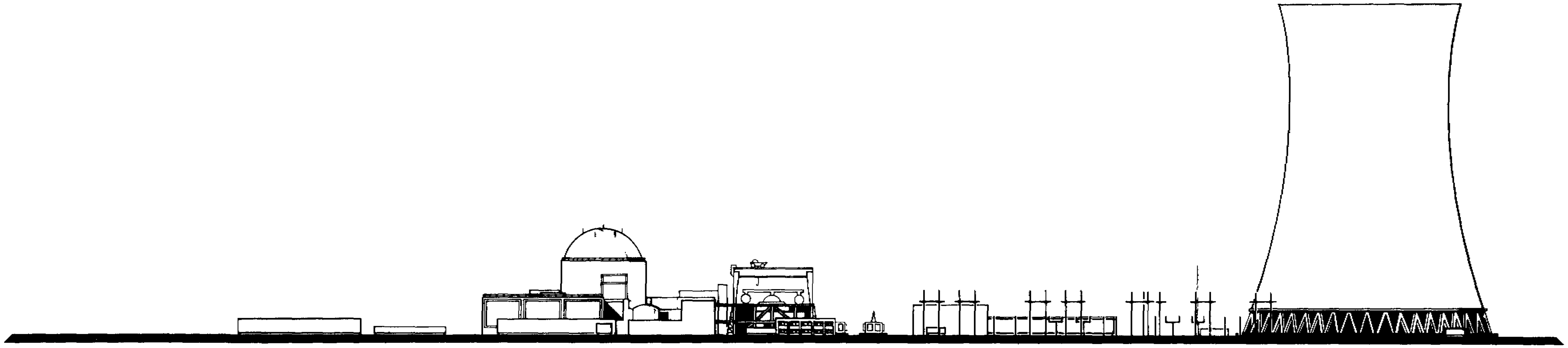
ARTIST'S RENDERING

FIGURE

3.1-2



NORTH ELEVATION

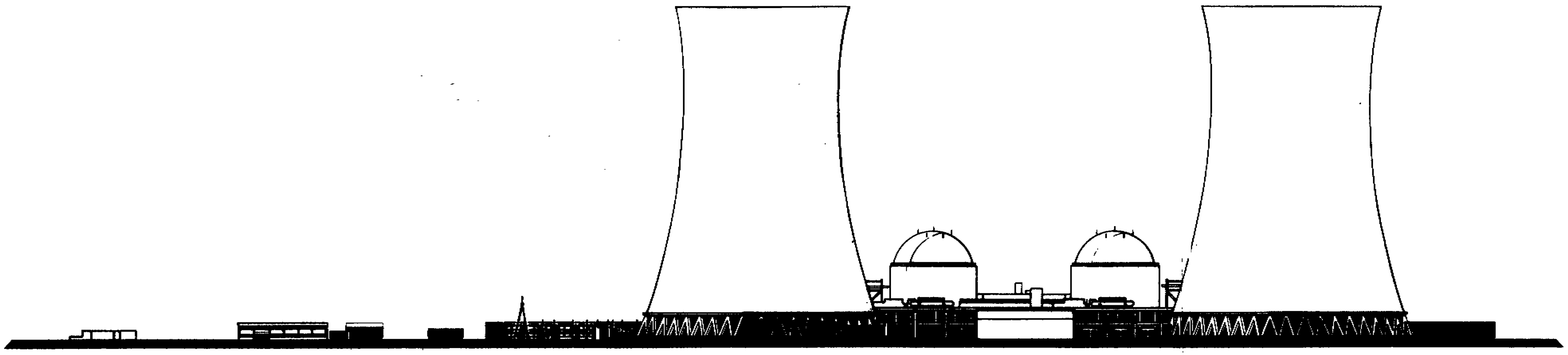


SOUTH ELEVATION

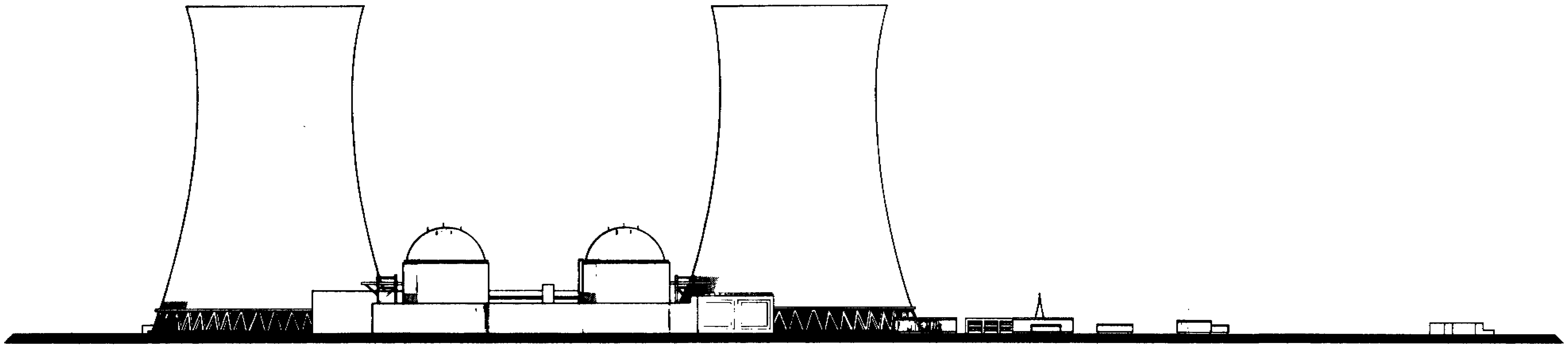
Amendment No. 5

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
ENVIRONMENTAL REPORT

PLANT PROFILES
NORTH AND SOUTH
FIGURE 3.1-3



EAST ELEVATION



WEST ELEVATION

Amendment No. 5

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
ENVIRONMENTAL REPORT

PLANT PROFILES
EAST AND WEST
FIGURE 3.1-4

3.2 REACTOR AND STEAM ELECTRIC SYSTEM

Each of the two Shearon Harris Nuclear Power Plant units consists of one Westinghouse pressurized water reactor, three steam generators, one turbine generator, a heat dissipation system, and associated auxiliaries and engineered safeguards. The reactor, the steam generators, and the other components of the nuclear steam supply system (NSSS) are designed and supplied by Westinghouse Electric Corporation. Each NSSS will be designed for an initial licensed power output of 2,785 MWt, which includes 10 MWt from the reactor coolant pumps. The ultimate output from each NSSS is expected to be 2,910 MWt, including 10 MWt from the reactor coolant pumps. The turbine generator, a multiflow, 1,800 rpm tandem compound unit initially delivering approximately 951 Mwe, is also supplied by Westinghouse. The architect-engineer for the plant is Ebasco Services, Inc. The in-plant power consumption is approximately 83 Mwe per unit resulting in an initial net rating for each unit of approximately 868 Mwe. 2

The reactor is fueled with uranium dioxide sintered fuel pellets in sealed zircaloy-4 fuel rod tubes. There are 157 fuel assemblies, each with a 17 x 17 rod array consisting of 264 fuel rods, 24 guide thimbles, and one position for incore instrumentation. The initial core consists of three regions. Region 1 is 2.1 weight percent (U235/U238) enriched; Region 2 is 2.6 weight percent enriched; and Region 3, the outermost core region, is 3.1 weight percent enriched. The core will be refueled at approximately annual intervals.

Turbine heat rates for various station loads are shown in Table 3.2-1. It should be noted that a dual pressure condenser is being installed. These heat rates are based on 4.05 and 2.83 in. HgA for the high pressure and low pressure zones, respectively. Operating back pressures are expected to range from highs of 4.15/2.95 in. HgA to lows of 2.45/1.73 in. HgA.

The plant is designed for an operating life of 40 years.

TABLE 3.2-1

TURBINE HEAT RATES FOR VARIOUS STATION LOADS

4

% Load	Turbine Heat Rate (Btu/Kw-Hr)
100	9,993
75	10,145
50	10,862

3.3 STATION WATER USE

The greatest quantity of water used at the plant is for the Circulating Water System. The primary heat sink for the Circulating Water System is provided by natural draft cooling towers. Makeup for the towers is withdrawn from the Main Reservoir, which is discussed in Section 2.4. The heat dissipation system is discussed further in Section 3.4, and the evaluation of its effects is described in Section 5.1.4. An evaluation of the physical effects are discussed in Section 5.1.2. The water use diagram for the plant water systems for maximum and monthly average flow rates to and from each system for maximum power operation (950MW/100% power), minimum anticipated power operation (600MW/approximately 62% power), and temporary shutdown is shown on Figure 3.3-1. This figure includes the source of water in each case. Table 3.3-1 provides the quantities of flow for the water use diagram. 4

Estimated frequency and duration of station outages and emergency systems usage resulting from insufficient supply of operational cooling water during drought periods of record is not applicable; the SHNPP Main Reservoir has more than sufficient storage to continue plant operation during all drought periods of record for both the Cape Fear River and Buckhorn Creek. The design basis for conservative storage in the Main Reservoir is a 100-year frequency drought for low flow in the Cape Fear River and a 100 year frequency drought for low flow in Buckhorn Creek. The plant will be shutdown if the minimum reservoir level of 205.7 ft. is reached. 4

Since the Cape Fear River is a source of makeup water, the record of flows of this river at Buckhorn Dam, shown in Table 2.4.2-1, was analyzed to determine the low flow years which, when combined with the synthesized flows in Buckhorn Creek (Table 2.4.2-8), would result in the most critical flow periods. These periods are summarized in Tables 2.4.2-11 through 2.4.2-13 and Tables 2.4.2-29 and 2.4.2-30. 4

The normal water level in the Main Reservoir is Elevation 220 ft. msl; however, this elevation varies depending on actual inflow conditions, consumptive use, makeup pumping rates, and downstream releases. Calculations were made to determine the required storage and makeup water requirements with the four 900 Mwe nuclear units operating, utilizing the water available for pumping for each of the most critical flow periods. The water consumption of two units is conservative compared to the four unit case. One unit operation without makeup was also analyzed and is summarized in Table 2.4.2-31. Operation of the reservoir is discussed in SHNPP Final Safety Analysis Report Section 2.4.11 and Section 2.4 of this report. 4

Tables 2.4.2-15 and 2.4.2-16 include separate tabulations of analyses of reservoir operation for the Main and Auxiliary reservoirs with four units operating for the 100-year return period drought. An analysis of the 100 yr. return period drought for one unit operation without makeup is shown in Table 2.4.2-32.

The Auxiliary Reservoir consumptive use during normal operation will be only net natural evaporation, which is natural evaporation minus direct rainfall, since the Auxiliary Reservoir is not used as the normal Service Water System heat sink. The water level in the Auxiliary Reservoir is maintained at a normal Elevation of 252 ft. msl by pumping from the Main Reservoir. The

Auxiliary Reservoir area of 317 acres at Elevation 250 ft. msl, is the basis
4 for net evaporation from the Auxiliary Reservoir.

The stage-duration curve for the Main Reservoir is shown on Figure 2.4.2-11.
The Main Reservoir level for a typical year will have approximately a 1.5-foot
drawdown based on the operation of four units at the site. This drawdown is
4 conservative for one or two unit operation. This potential drawdown probably
would occur in October and November and is not expected to have any effect on
the aquatic communities in the reservoir.

The ten-year frequency drought drawdown of approximately 4 to 5 ft. would
occur in the months of October through December based on the operation of four
4 units at the site. This drawdown is conservative for one or two unit
operation. A drawdown of this extent would uncover approximately 750 to 800
acres of the reservoir. Such a drawdown should have little or no detrimental
effects on fish populations.

As for the benthic population, there may be a numerical and diversity loss of some of the representatives of the Ephemeroptera, Plecoptera, Trichoptera, Amphipoda, and Gastropoda due to a drawdown associated with the ten-year frequency drought. However, representatives of several species of aquatic flies (larval stage) and worms may burrow in the exposed substrate, survive for several months, and recolonize littoral areas when the reservoir returns to normal pool.

Radwaste Systems are discussed in Section 3.5 and the effects of the discharge are described in Section 5.2.

The chemical waste system effluents are described in Section 3.6, and the evaluation of the effects of the discharge are discussed in Section 5.3. The flow between the chemical systems is shown on Figure 3.3-1 and the quantities are in Table 3.3-1.

The sanitary wastewater will be treated by one 25,000 gpd package treatment plant. The plants are described in Section 3.7 and the evaluation of the effects of the discharge are discussed in Section 5.4. NPDES effluent limits are contained in Appendix B, Volume 3. Potable water for plant use will be withdrawn from the Main Reservoir.

TABLE 3.3-1

SHNPP STATION WATER USE UNDER VARIOUS STATION CONDITIONS

STREAM**	FLOW* @ MAX POWER OPERATION	FLOW* @ MIN ANTICIPATED POWER OPERATION	FLOW* @ TEMP. SHUTDOWN	COMPONENT
1	21,000 gpm	21,000 gpm	21,000 gpm	Emergency Only
2c	450 MGM	58 MGM	5 MGM	Varies with dissolved solids
3c	827 MGM	105 MGM	9 MGM	Max flow 26,000 gpm
4c	827 MGM	105 MGM	9 MGM	Max flow 26,000 gpm
5c	377 MGM	47 MGM	4 MGM	Average meteorological Conditions
6c	483,000 gpm	284,000 gpm	0-284,000 gpm	
7c	483,000 gpm	284,000 gpm	0-284,000 gpm	
8c	300 gpm	176 gpm	0-176 gpm	
9	20,800	10,000	0-10,000	Intermittent operation
10c	300 gpm	176 gpm	0-176 gpm	
11	208,300	122,530	0-122,530	Condensate Polisher regenerations and rinse (intermittent operation)
12c	30,300 gpm	17,826 gpm	0-17,826 gpm	
13c	30,287 gpm	17,815 gpm	0-17,815 gpm	(Depending on #9 and #11
14c	315,900 gpm	185,800 gpm	0-185,800 gpm	
15c	315,900 gpm	185,800 gpm	0-185,800 gpm	
16c	30,000 gpm	17,650 gpm	0-17,650 gpm	
17c	30,000 gpm	17,650 gpm	0-17,650 gpm	
18c	50,000 gpm	50,000 gpm	50,000 gpm	
19c	891,600	891,600	891,600	(# 20 & 21 & 22)
20	208,300	208,300	208,300	
21	16,700	16,700	16,700	
22	666,600	666,600	666,600	
23c	2.5 MGM	2.5 MGM	2.5 MGM	
24c	2.5 MGM	2.5 MGM	2.5 MGM	
25	62,500	36,765	0-36,765	
26c	2,203,800	2,203,800	2,203,800	
27	666,600	666,600	666,600	
28	666,600	666,600	666,600	
29	330 lbs./month	330 lbs./month	330 lbs./month	Wet sludge
30	1.5 MGM	1.5 MGM	1.5 MGM	

4

TABLE 3.3-1 (continued)

SHNPP STATION WATER USE
UNDER VARIOUS STATION CONDITIONS

STREAM**	FLOW* @ MAX POWER OPERATION	FLOW* @ MIN ANTICIPATED POWER OPERATION	FLOW* @ TEMP. SHUTDOWN	COMPONENT
31	1,095,600	1,095,600	1,095,600	
32	15,000	15,000	15,000	
33	0-9,000	0-9,000	0-9,000	Make up as needed
34	375,000	375,000	375,000	
35	30,000	30,000	0-30,000	
36	0-15,000	0-15,000	0-15,000	See # 56
37	7,500	7,500	7,500	Alternate path to #55
38				Make up as required
39	33,300	33,300	33,300	
40	10,000	10,000	10,000	
41	10,000	10,000	10,000	+ purification during refueling
42				purification return
43c	7,500	7,500	7,500	
44c	441,600	441,600	441,600	
45c	375,000	375,000	375,000	
46c	375,000	375,000	375,000	
47	258,333	258,333	0-258,333	See # 65 & 66
48	6.0 MGM	6.0 MGM	6.0 MGM	Includes rainwater and fire runoff
49	0-1 MGM			Aux. Reservoir make up as needed
50	11,000	11,000	11,000	No fire + 360,000 for 2 hour supply
51				only in case of fire
52				only in case of fire
53	2.0 MGM	2.0 MGM	2.0 MGM	fire runoff (assuming 3 fires)
54	5,000	5,000	5,000	from reactor loop/CVCS
55	7,500	7,500	7,500	Alternate path # 37
56	15,000	15,000	15,000	from reactor loop/CVCS
57	66,600	66,600	66,600	See # 63
58	3,000	3,000	3,000	

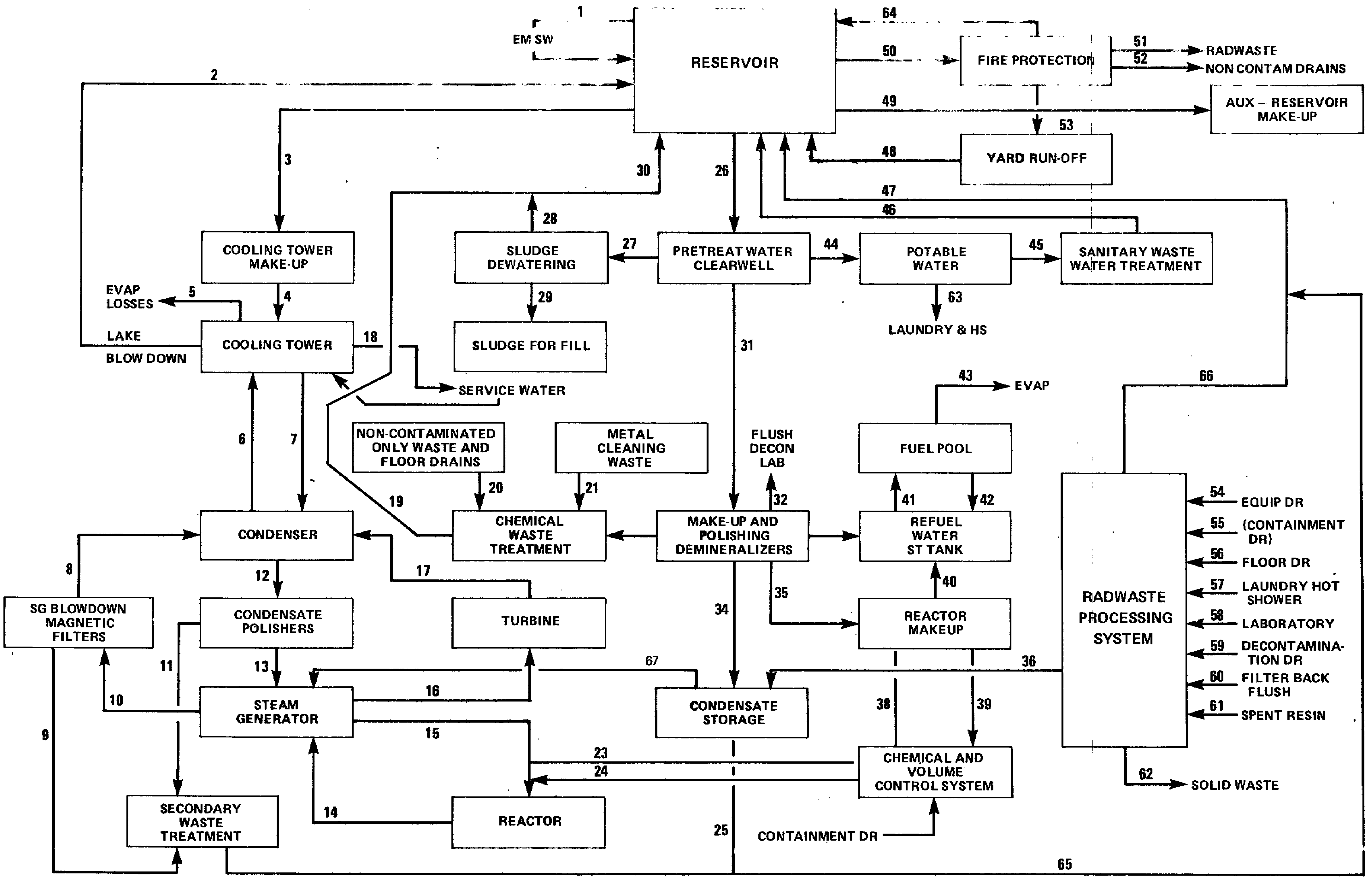
4

TABLE 3.3-1 (continued)

SHNPP STATION WATER USE
UNDER VARIOUS STATION CONDITIONS

STREAM**	FLOW* @ MAX POWER OPERATION	FLOW* @ MIN ANTICIPATED POWER OPERATION	FLOW* @ TEMP. SHUTDOWN	COMPONENT	
59	12,500	12,500	0-12,500		
60	4,100	4,100	4,100	Varies with no. of backflushes	
61	NA	NA	NA	(83 CFM)	
62	9,160	9,160	9,160	In 2,166 CFM solid waste	
63	66,600	66,600	66,600	See # 57	
64	7,500	7,500	7,500	(Fire pump test)	
65	166,600	96,765	96,765		
66	89,540	89,540	437,500		
67c	452,500	426,700	426,700	Makeup for #9 and #11	4

NOTE:
(1) * All flows in average gallon per month unless otherwise noted
(2) ** For streams refer to Figure 3.3-1
(3) MGM - Million Gallon per Month. Each reactor is assumed to operate 85% of the time. This yields a 309 day operating year. A month is considered 1/12 of this 309 day operating year. 4
(4) All data based on one unit. Double the given values for two units.
(5) Continuous flow under normal conditions is indicated by c.



SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
ENVIRONMENTAL REPORT

STATION WATER USE DIAGRAM
FIGURE 3.3-1

3.4.2 CIRCULATING WATER SYSTEM

The closed loop Circulating Water System for each unit shown in Figures 3.4.2-1 and 3.4.2-2 provides the main condenser with a continuous supply of cooling water for removing the heat rejected by the Turbines. The system is designed to operate continuously throughout the year under various ambient weather conditions. The CWS for each unit utilizes the following major components in its cycle:

a) Main condenser

b) Natural draft hyperbolic Cooling Tower to serve as the heat sink

c) Cooling tower basin

d) Three 33 1/3 percent capacity circulating water pumps

e) Chlorination system for circulating water treatment

f) Cooling tower makeup and blowdown water system

The total circulating water requirements are 483,000 gpm (1076 cfs) for each unit or a total of 966,000 gpm (2150 cfs) for two units. 4

3.4.2.1 System Description

The three 33 1/3 percent capacity circulating water pumps each rated at 161,000 gpm at 68 ft. total dynamic head take suction from each cooling tower basin and deliver the water to the condenser water boxes through two 120 in. diameter reinforced concrete pipes. After passing through the condenser tubes, the heated circulating water leaves the condenser outlet water boxes and returns through two 120 in. diameter reinforced concrete pipes to the cooling tower hot water distribution system. From there, the water will cascade down the lattice of fill material in the Cooling Tower. This cools the water by dissipating heat to the atmosphere by conduction and evaporation. The cooled water collects at the bottom of the Cooling Tower. The water then flows by gravity through the basin into the circulating water pump chamber.

Under conditions of full load, each unit transfers approximately 6.7×10^9 Btu/hr. of heat to the CWS, resulting in an approximate increase of 26F in the temperature of the water as it passes through the condenser. There is no physical contact between the condensing steam and the circulating water. Furthermore, since the steam side of the condenser operates at a vacuum under normal conditions, the possibility of steam side materials leaking into the circulating water is remote. 4

Heat dissipated to the atmosphere in the Cooling Tower will vary with the plant load. The only heated water discharged to the Main Reservoir will be from blowdown of the Cooling Towers to control dissolved solids in the closed cycle system. The blowdown will be at a maximum rate of 30 MGD for 2-unit operation and is taken from the coolest water in the system. The comparative maximum blowdown rate is 15 MGD for one-unit operation. This water will range from approximately 7F above the ambient Main Reservoir temperature in July, to approximately 28F above ambient in December.

3.4.2.2 Total Consumptive Water Use

The total consumptive water use in the operation of the Cooling Towers and other waste systems, varying throughout the year, are 46.3 cfs under average meteorological conditions and 51.5 cfs under extremely adverse meteorological conditions with the plant operating at 950 MW or 100 percent capacity. The average and maximum consumptive water use for one unit operation at
4 100 percent power is provided in Table 3.4.2-4. The station is assumed to operate 85 percent of the time, yielding a 309 day operating year. The station is assumed to operate at 100 percent power 95 percent of the operating year. The remaining 5 percent will occur during start-ups and shutdowns and will range between 0 and 100 percent power.

3.4.2.3 Design, Size, and Location of Cooling Towers

The SHNPP has two natural draft hyperbolic Cooling Towers, one per unit. Each Cooling Tower is approximately 410 ft. in diameter at the basin and about
4 520 ft. high. Other design parameters are given in Table 3.4.2-1. The location of each cooling tower is shown in Figure 3.1-1.

3.4.2.4 Chemical Characteristics of Cooling Towers

A chlorination system is utilized to control the growth of algae in the SHNPP units' condensers and the circulating water pipes. The chlorine requirements are expected to be approximately 3-5 ppm. The system normally operates for only two 30-minute cycles per day. Chlorine residual in the water in the cooling tower basin is controlled so that its concentration does not exceed 0.5 ppm in the Cooling Tower blowdown. Residual chlorine in the blowdown water averages less than 0.2 ppm.

Consequently, the blowdown rate of 30 MGD will have minimal effects, if any, on aquatic populations from the standpoint of chlorine discharges.

The impacted area is estimated at 5 acres. Also, little if any fouling in the plant heat exchangers is expected. The pH of the circulating water is controlled by the addition of sulphuric acid or sodium hydroxide as needed.

3.4.2.5 Drift and Drizzle of Cooling Towers

A very small fraction of the cooling water circulating through the Cooling Towers is carried as small droplets in the rising air which leaves the cooling tower top. This drift rate fraction (defined as kilograms (kg) of salt per second leaving the cooling tower top divided by the kg of salt per second circulation through the tower heat exchange section) will average about 2×10^{-5} (or 0.002 percent). The drift is dispersed at an elevated point and on most days of light wind, the moist plume will continue to rise so that little or no ground fogging or icing will occur. Total drift rate from the
4 cooling towers is estimated at 10 gpm per unit. Expected evaporative water losses are shown in Table 3.4.2-2.

3.4.2.6 Reasons for Selecting Cooling Towers

The original design of the cooling system for the SHNPP consisted of a 10,000 acre cooling lake. However, a regulatory decision by the State of North Carolina made this alternative unavailable. Therefore, Cooling Towers became necessary. The present cooling system consists of two (2) large Cooling Towers, one per unit and a 4000 acre makeup reservoir.

3.4.2.7 Cooling Tower Blowdown System

The blowdown is discharged into the Main Reservoir through a single port jet at a point approximately 3.5 miles south of the plant and about 1.0 miles north of the Main dam (see Figure 3.4.2-3). The exit diameter of the blowdown pipe is 48 inches. The discharge point is located at elevation 182 ft. (centerline of the pipe). The pipe at the discharge point is flat. The discharge velocity for one and two units is 1.9 ft. per second and 3.7 ft. per second, respectively. The maximum blowdown rate is 15 MGD for one unit or 30 MGD for both units.

3.4.2.7.1 System Description

All the effluent from the cooling tower blowdown, the waste processing building floor drains, laundry and hot shower tank drains, oil-water separator effluent, and self-cleaning strainers backwash is collected through junction boxes on the plant island and discharged to the Main Reservoir by gravity. A 48-inch diameter pipe carries the blowdown from the plant island to the discharge point. 4

3.4.2.7.2 Suspended Solids

Since the flow velocities in the cooling tower basin are very small, the majority of the suspended solids will settle out in the cooling tower basin. The transfer of suspended solids into the Main Reservoir is expected to be very small.

3.4.2.8 Reservoir and the Reservoir Makeup System

3.4.2.8.1 Function

There are two reservoirs and a two-stage reservoir make-up system to provide storage for normal operation make-up to the Cooling Towers, and emergency cooling water if the Cooling Towers or their associated components are not available. The Main Reservoir provides cooling tower make-up and Auxiliary Reservoir make-up and receives cooling tower blowdown; it also serves as an alternate source for emergency cooling water. The Auxiliary Reservoir is the preferred source of emergency cooling water. The Cape Fear River to Main Reservoir Make-Up System provides supplemental water to that of Buckhorn Creek inflow and precipitation. (The Main Reservoir to Auxiliary Reservoir make-up, which maintains the Auxiliary Reservoir at a minimum level elevation of 250 ft. MSL, is provided by the Cooling Tower Make-Up System.)

3.4.2.8.2 Description

As shown in Figure 3.4.2-3, the Main Reservoir is irregularly shaped, about eight miles long and has a shoreline length of approximately 74 miles. The

4000 ac. Main Reservoir was created by a dam located on Buckhorn Creek approximately two miles upstream of its confluence with the Cape Fear River. The length of the dam at its berm (Elevation 260 ft.) is 1215 ft. In addition to the Main Reservoir, the system consists of a small Auxiliary Reservoir of about 317 ac. which is impounded in the vicinity of the plant. A pumping station will be located on the Cape Fear River near the existing Buckhorn Dam for two unit operation. The Main Reservoir supplies the necessary storage for cooling tower operation to replace water lost from evaporation and drift and the Auxiliary Reservoir is used for emergency cool-down and plant shut down. The pumping station will supplement the flows in Buckhorn Creek which during drought periods are inadequate to support operation of the plant. 4

The Main Reservoir has a nominal water level Elevation 220 ft. MSL, a minimum elevation of about 205 ft. and a maximum elevation (including wave runup) of 243 ft. Maximum depth is 56 ft. and average depth 18.7 ft. An area-capacity curve for the Main Reservoir is presented as Figure 2.4.2-7. A 75-ft. long spillway with an elevation of 220 ft. is utilized to accommodate floods and other outflows from the reservoir. In addition to the spillway, low level release structures and diversion structures are installed.

The 317-acre Auxiliary Reservoir, which is a part of the Emergency Core Cooling System, has a minimum water level elevation of 250 ft. which is maintained by pumping from the Main Reservoir. The Auxiliary Dam has a concrete spillway section about 500 ft. wide with a sill elevation of 252 ft. and a crest length of 170 ft. The maximum depth of the Auxiliary Reservoir at minimum water level (Elevation 250 ft.) is 40 ft.

Figure 3.4.2-3 shows the area over which the blowdown mixing zone extends. This mixing is not always fully occupied by the elevated water temperatures, but represents the area which the heated discharge can influence, depending on Main Reservoir current patterns. Outside of this allowable mixing zone the Main Reservoir temperatures are within 5 F of equilibrium temperature, and less than 90 F. The Main Reservoir isotherms for summer and winter adverse meteorological conditions are shown in Figures 5.1.2-2 and 5.1.2-3. 4

Temperatures of 85-90 F are recorded naturally in this region of the state in lakes not receiving thermal effluents. In addition, studies conducted at H. B. Robinson Steam Electric Plant and Roxboro Steam Electric Plant cooling lakes which receive thermal effluents have shown good fishery populations at this temperature. The mixing zone will be up to approximately 200 ac., but the temperatures within the mixing zone will not exclude its use by aquatic organisms. A 7F increase above ambient water temperature during the summer and 28F above ambient in winter will dissipate quickly with no adverse effects on the aquatic populations.

3.4.2.8.3 Reservoir Makeup System

The Cape Fear River intake and pumping structure (shown on Figures 3.4.2-7, 3.4.2-8, and 3.4.2-9) will be located on the left bank upstream of Buckhorn Dam on the end of the Cape Fear Plant discharge canal (Figure 3.4.2-3). The system consists of makeup pumps, bar and valves, and instrumentation and controls. There are four pumps with a total capacity of 320 cfs (two 45 cfs pumps and two 115 cfs pumps). Provisions exist to install additional pumps, if needed, to increase the pumping capacity to a maximum of 500 cfs. 4

The intake structure consists of ten bays. Each large pump (including the two spare locations) is served by two adjoining bays, while each small pump is served by one bay. Each bay is provided with, in the direction of water flow, a coarse screen, stop log guides, a traveling screen, and guides for two fine screens.

Each trash rack measures 11 ft. 2 in. wide and extends from the floor of the intake structure to the underside of the top deck, a distance of 50 ft. The coarse screens consist of vertically oriented metal bars, rectangular in cross section, 3/8-in. thick by 3-in. deep, spaced on 3-in. centers. | 4

Each traveling screen measures 10 ft. wide and extends from the floor of the intake structure through the top deck where the drive mechanism and screen washing equipment is located. The traveling screens are fabricated of 14 gauge wire (0.08 in diameter) with clear openings 3/8-in. square.

The fine screen guides are provided for use only during periods when the traveling screens are down for maintenance. The two pairs of guides in a bay are used alternately to allow for continuous protection during manual cleaning of the fine screens. The fine screens are fabricated of 10 gauge wire (1/8 in. diameter) spaced on 1/2-in. centers, both vertically and horizontally. The overall dimensions of the fine screens in the Cape Fear River intake structure are 11 ft. 2 in. wide by 52 ft. 6 in. high. The stop log guides are provided to facilitate maintenance of equipment in a bay when the respective pump is not operating.

The intake structure is designed for a normal water level of Elevation 160 MSL, and high and low levels of Elevation 175.5 ft. and Elevation 158.15 ft., respectively. The normal water depth in the structure is 23 ft., and high and low depths are 38.5 ft. and 21.15 ft., respectively.

For screens serving the large pumps, the maximum flow through one screen, at normal water level, and assuming its redundant screen is blocked, is 114 cfs at 0.90 fps. Under low water level conditions the similar values are 114 cfs and 0.98 fps. For screens serving the small pumps, the maximum flow at normal water level is 45 cfs and 0.35 fps and at low water level it is 45 cfs at 0.39 fps.

Large debris accumulated at the coarse screens is removed by a manually | 4
operated trash rake. The trash rake travels on rails across the intake structure above the coarse screens and is lowered to remove debris from the water at the face of the coarse screens as required. Trash is lifted to the | 4
top deck of the intake structure and is deposited in strainer baskets at either end of the structure.

The traveling screens are equipped with baskets (ledges) fixed to the face of | 4
the screen that remove debris from the water as the screen revolves. The debris is automatically washed from the baskets as they pass above the top deck of the intake structure where troughs carry the debris and wash water to the strainer baskets at either side of the structure.

The traveling screen "baskets" discussed above are actually ledges or shelves at the bottom of each framed screen panel which serve to lift trash as the screens are rotated. These ledges ("baskets") are not designed for use in returning live fish to the Cape Fear River or the main reservoir. Generally, live fish will not remain on the ledges as the screens rotate.

As discussed in Section 5.1.3.4 of the OL-ER, the SHNPP intake structures on the Cape Fear River and at the plant were designed by following the recommendations set forth in EPA's April 1976, Development Document for Best Technology Available for the Location, Design, Construction and Capacity of Cooling Water Intake Structures for Minimizing Adverse Environmental Impact. The recommended design features include (1) use of a closed-cycle cooling system, (2) low intake velocities (less than 0.5 fps), (3) placement of the intakes in deeper, less productive waters, and (4) structural features (smooth surfaces, etc.) to minimize the intake structure's "attractiveness" to fish.

By conforming to these EPA recommended specifications, the impingement rates at the SHNPP intake structures will be minimal. This assessment was supported by written testimony presented on October 5, 1977, to the Atomic Safety and Licensing Board by Clarence R. Hickey, Jr., a fisheries biologist for the U.S. Nuclear Regulatory Commission. He stated that the SHNPP intake design "should result in low levels of impingement of reservoir fishes." Further, E. T. Heinen, then Chief of the Ecological Review Branch of Region IV EPA, stated in a letter dated August 30, 1977, to C. W. Hollis, Chief of the Regulatory Functions Branch of the U.S. Army Corps of Engineers in Wilmington, N.C., that, "no specific provisions for nekton return are necessary to this [the SHNPP] intake structure."

With the general agreement among the involved state and federal regulatory agencies and CP&L that impingement rates should be low at the SHNPP intake structures, and that a nekton return system is not necessary, no plans have been made to modify the traveling screen wash system for the return of live fish to the river or reservoir.

Water level controls on the reservoirs are minimal; only the low level release gates and valves have to be controlled initially. The Cape Fear River pumping station requires motor, valve, screen, and backwash controls. Instrumentation for the Main Reservoir consists of reservoir water level indicators, low level release indicators, valve and gate position indicators, and temperature sensors.

3.4.2.9 Cooling Tower Makeup System

Due to the loss of water caused by natural evaporation, drift, and blowdown requirements, continuous makeup water is provided to the plant's cooling system by means of cooling tower makeup systems. The cooling tower makeup system consists of cooling tower makeup pumps, a common header, a dual strainer system, piping, and a Cooling Tower Make-up Water Intake Channel from the Main Reservoir.

There is one cooling tower makeup pump per unit with one spare for the two units. The three cooling tower makeup pumps are located in the Emergency Service Water and Cooling Tower Makeup Water Intake Structure, headered together to supply both Cooling Towers. With two units operating at maximum makeup rates, only two of the three pumps will be operating simultaneously. Any two of the three pumps will supply the amount of makeup water required for the Circulating Water System. Each pump is sized for 26,000 gpm and a total dynamic head of approximately 135 ft. The withdrawal requirements for one- and two-unit operation are about 46 cfs and 92 cfs, respectively. 4

The cooling tower makeup pumps also supply makeup water to the plant water treatment facility at the rate of 600 gpm (2 units). This is included in the above rating of the pumps. 4

Each cooling tower makeup pump is located in a separate bay of the intake structure. Each bay is provided with, in the direction of water flow, a coarse screen, stop log guides, a traveling screen, and guides for two fine screens. Details of the structure can be seen on Figures 3.4.2-10 through 3.4.2-13. 4

Due to reduction in project size from four to two units, the portion of the Emergency Service Water and Cooling Tower Makeup Water Intake Structure that was intended to serve Units 3 and 4 will not be completed. Only the three cooling tower makeup pumps serving Units 1 and 2 will be installed. 4

Each coarse screen measures 10 ft. 2 in. wide and extends from the floor of the intake structure to the underside of the top deck, a distance of 70 ft. The detailed dimensions of the coarse screens are the same as those at the Cape Fear River intake structure.

Each traveling screen measures 9 ft. wide and is similar in other dimensions and materials to those described above for the Cape Fear River makeup intake structure. The fine screens have overall dimensions of 10 ft. 2 in. by 70 ft., and are otherwise similar to the fine screens of the Cape Fear River makeup intake structure, in both dimension and purpose. As in the Cape Fear River makeup intake structure, stop logs serve to facilitate maintenance of equipment in the bays.

The intake structure is designed for a normal water level of Elevation 220 ft. MSL, and high and low levels of Elevation 255 ft. MSL and 205.7 ft. MSL, respectively. (Although designed for a high water level of Elevation 255 ft. MSL, the maximum expected water level is approximately Elevation 240 ft. MSL.) The normal water depth in the structure is 30 ft., and high and low depths are 50 ft. and 15.7 ft., respectively. The maximum flow through a screen, at normal water level, is 67 cfs at 0.40 fps. Under low water level conditions the similar values are 63 cfs and 0.73 fps. Trash removal from the traveling screens is similar to that described for the Cape Fear River makeup intake structure.

Trash removed at both intake structures will be deposited in a landfill located on site.

Environmental Report Section 5.1.3.4 addresses the impact of the plant intake on the aquatic community. As stated in that section, the design criteria for the normally operating intake structures included a requirement that the intake velocities not exceed 0.5 fps at low water levels. This criteria is met for both intakes discussed above at the position of the stop log guides in the structures.

The location of the cooling tower makeup structure is shown in Figure 3.4.2-3. Details of the Cooling Tower Makeup Water Intake Channel and ESW and Cooling Tower Make-Up Intake Structure are shown on Figures 3.4.2-10, 3.4.2-11, 3.4.2-12, 3.4.2-13, and 3.4.2-14.

3.4.2.10 Dams and Dikes

There are three such structures: the Main Dam, the Auxiliary Reservoir Dam and the Auxiliary Reservoir Separating Dike.

The Main Dam is an earth-rockfill structure and the Auxiliary Reservoir Dam and the Auxiliary Reservoir Separating Dike are earth-random rockfill structures all designed to use locally available materials. Each dam has a cross section consisting of a central impervious core flanked by transition filter zones and compacted rock or random rockfill shells. The Auxiliary Reservoir Separating Dike has a cross section consisting of a central impervious core flanked by a random rockfill shell. The slopes of the structures are protected with riprap placed on crushed rock bedding where necessary.

The Main Dam has a maximum height above the stream bed of about 90 ft., and contains approximately 550,000 cu. yd. of compacted earth materials. The
4 Auxiliary Reservoir Dam, which is a part of the Ultimate Heat Sink is an earth-fill structure about 3,700 ft. long including the spillway section. The dam has a maximum height of about 50 ft. above the stream bed and will contain
4 approximately 600,000 yd.^{3} of compacted earth materials.

The foundation materials for the Main Dam and Spillway and the Cape Fear River to Main Reservoir makeup sytem are granite. The Main Dam core and shell and the Auxiliary Reservoir Dam core are founded on rock. A portion of the Auxiliary Reservoir Dam shell is founded on rock. The foundation materials of the Auxiliary Reservoir structures and the intake structure from the Main Reservoir are the Triassic claystones, sandstones, shales, and siltstone. Both the Main and Auxiliary Reservoir Dams are constructed to withstand the design basis earthquake.

3.4.2.11 Essential Features of Interior Flow Patterns in Regard to the Cooling Reservoir

The Auxiliary Reservoir performs its function as the Ultimate Heat Sink in the event of a loss of service water from the Cooling Towers. During Emergency Service Water System Operation, service water is drawn from and discharged to the Auxiliary Reservoir. The emergency service water is carried to the Emergency Service Water and Cooling Tower Makeup Intake Structure by gravity through the Emergency Service Water Intake Channel and Emergency Service Water Intake Screening Structure. The thermal effluents released during the emergency operating mode are discharged into the Auxiliary Reservoir through the Emergency Service Water Discharge Channel. The intake and discharge channels are separated by the Auxiliary Reservoir Separating Dike in order to prevent the thermal effluents from being withdrawn immediately after being discharged. The thermal effluents will ultimately be returned to the Emergency Service Water Intake Channel via the Auxiliary Reservoir Channel. As is seen from Figure 3.4.2-3, this arrangement provides for maximum recirculation of the thermal effluents within the Auxiliary Reservoir, and maximum efficiency of the heat sink.

The Main Reservoir functions as the Ultimate Heat Sink only in the unlikely event that the Auxiliary Reservoir is not available. Under this circumstance, emergency service water is carried to the Emergency Service Water and Cooling

Tower Makeup Intake Structure through the Cooling Tower Makeup Water Intake Channel from the Main Reservoir. The thermal effluents released are discharged into the Auxiliary Reservoir and then over the Auxiliary Reservoir Dam Spillway into the Main Reservoir.

The circulation path thus established is longer than the corresponding path established when only the Auxiliary Reservoir is utilized and therefore it provides more than adequate cooling.

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TABLE 3.4.2-1

DESIGN DATA FOR NATURAL DRAFT HYPERBOLIC COOLING TOWER

Water flow (gpm)	533,000
Hot water temperature (F) (Entering Water)	120
Cold water temperature (F) (Exiting Water)	95
Approach (F)	18
Design wet bulb (F)	77
Design relative humidity (%)	50
Heat load handled (10^6 Btu/hr.)	6,700
Cooling tower evaporative water losses	See Table 3.4.2-2

TABLE 3.4.2-2

COOLING TOWER EVAPORATIVE WATER LOSSES (Per Unit, 75 Percent Power)

	AVERAGE		
	Ambient Dry Bulb Temperature (F)	Dew Point Temperature (F)	Evaporation (GPM)
January	41.6	32.0	6,487
February	43.0	31.0	6,599
March	49.5	35.0	6,966
April	59.3	45.0	7,427
May	67.6	56.0	7,698
June	75.1	64.0	7,986
July	77.9	68.0	8,110
August	76.9	67.0	8,023
September	71.2	61.0	7,794
October	60.5	50.0	7,385
November	50.0	38.0	6,945
December	41.9	30.0	6,546
Annual Average	59.5	48.1	7,330

4

TABLE 3.4.2-3

BLOWDOWN FLOWS

MAXIMUM BLOWDOWN (GPM)

		1 Unit	2 Units
1)	Cooling Tower Blowdown	9,600	19,200
2)	Service Water Self-Cleaning Strainer Backwash	200*	400*
3)	Cooling Tower Make Up Self-Cleaning Strainer	160**	160**
4)	Yard Oil Separator	600	1,200
5)	Waste Processing Building	100	100
	Total (GPM)	10,660	21,060
	Total (CFS)	24 cfs	47 cfs

4

MINIMUM BLOWDOWN (GPM)

		1 Unit	2 Units
1)	Cooling Tower Blowdown	5,200	10,400
2)	Service Water Self-Cleaning Strainer Backwash	200	400
3)	Cooling Tower Make Up Self-Cleaning Strainer	160	160
4)	Yard Oil Separator	600	1,200
5)	Waste Processing Building	100	100
	Total (GPM)	6,260	12,260
	Total (CFS)	14 cfs	27 cfs

* Actual Flow per Strainer is 2000 GPM for 1 minute each nine (9) minutes.

** Actual Flow per Strainer is 1600 GPM for 1 minute each nine (9) minutes.

TABLE 3.4.2-4

PLANT CONSUMPTIVE WATER USE - UNITS 1 & 2(2)
AVERAGE AND MAXIMUM

	ONE UNIT OPERATION						TWO UNIT OPERATION					
	Forced Evaporative Cooling Tower Loss		Other Plant Water Consumption(1)		Total One Unit Consumption		Forced Evaporative Cooling Tower Loss		Other Plant Water Consumption(1)		Total Two Unit Consumption	
	AVG	MAX	AVG	MAX	AVG	MAX	AVG	MAX	AVG	MAX	AVG	MAX
JANUARY	20.0	21.0	2.0	5.3	22.0	26.3	40.0	42.0	2.0	5.3	42.0	47.3
FEBRUARY	20.1	21.2	2.1	5.3	22.2	26.5	40.2	42.4	2.1	5.3	42.3	47.7
MARCH	21.0	21.9	2.1	5.5	23.1	27.4	42.0	43.8	2.1	5.5	44.1	49.3
APRIL	22.2	22.5	2.2	5.6	24.4	28.1	44.4	45.0	2.2	5.6	46.6	50.6
MAY	23.1	23.8	2.3	6.0	25.4	29.8	46.2	47.6	2.3	6.0	48.5	53.0
JUNE	23.8	24.4	2.4	6.1	26.2	30.5	47.6	48.8	2.4	6.1	50.1	54.9
JULY	24.1	24.6	2.4	6.2	26.5	30.8	48.2	49.2	2.4	6.2	50.4	55.4
AUGUST	23.9	24.5	2.4	6.1	26.3	30.6	47.8	49.0	2.4	6.1	50.1	55.1
SEPTEMBER	23.4	24.1	2.3	6.0	25.7	30.1	46.8	48.2	2.3	6.0	49.1	54.2
OCTOBER	22.1	23.3	2.2	5.8	24.3	29.1	44.2	46.6	2.2	5.8	46.4	52.4
NOVEMBER	21.0	22.2	2.1	5.6	23.1	27.8	42.0	44.4	2.1	5.6	44.1	50.1
DECEMBER	19.9	21.1	2.0	5.3	21.9	26.4	39.8	42.2	2.0	5.3	41.8	47.5

(1) Conservatively assumed to be 10% of one unit forced evaporation rate.

(2) Operation of units at 100% power.

4

3.4.3 SERVICE WATER SYSTEM

The Service Water System for each unit provides redundant cooling water to those components necessary for safety either during normal operation or under accident conditions. It also supplies cooling water to various other heat loads in the primary and secondary portions of each unit including the Component Cooling Water System. There are two separate modes of operation of the Service Water System—normal operation and emergency operation.

a) Normal Operation

Normal operation consists of using the unit's circulating water when the Cooling Tower and all associated components are operative. The two Cooling Towers are interconnected to provide backup shutdown cooling in the event that one Cooling Tower is not available to perform the heat transfer function.

b) Emergency Operation

Emergency operation consists of using the Auxiliary Reservoir or Main Reservoir if neither Cooling Tower is available for service. The Auxiliary Reservoir is the preferred source of cooling water under these conditions. The Main Reservoir serves as a backup source of water in the unlikely event of unavailability of water from the Auxiliary Reservoir. 4 4

3.4.3.1 System Description

The Service Water System for each unit shown on Figures 3.4.2-1 and 3.4.2-2 consists of two 100 percent normal service water pumps, two 100 percent emergency service water pumps, two 100 percent service water booster pumps, associated piping, valves, and instrumentation. The system is designed such that during unit start-up and normal operation, service water requirements are met by one of the normal service water pumps taking suction from either of the two Cooling Towers; the Cooling Towers are interconnected for this provision. The pump furnishes all normal operating service water requirements for the unit through one single supply line. This supply line provides water to the component cooling heat exchangers, the containment fan coolers, and the HVAC equipment located in the Reactor Auxiliary and Waste Process Buildings and normal Turbine Building heat loads. The total service water requirements per unit are shown in Table 3.4.3-1.

During normal operation, the heated service water is discharged into the unit's circulating water downstream of the condenser. The normal operation of the Service Water System is designed to provide water at a temperature less than the maximum design temperature of 95F. The normal service water system heat load is 131.6×10^6 Btu/hr. Maximum service water system heat loads following a safe shutdown of one unit and during LOCA are shown in Tables 3.4.3-2 and 3.4.3-3, respectively.

Under emergency conditions, if both Cooling Towers become inoperative, the supply is switched to the emergency service water pumps taking suction from the Emergency Service Water Intake Structure supplied by the Auxiliary

Reservoir. Under this condition, the Turbine Building loads are isolated and the unit is maintained or brought to shutdown condition.

The Main Reservoir serves as a backup supply of water for the Auxiliary Reservoir if water from that source is not available. Valving is provided to switch suction from the Auxiliary to the Main Reservoir. Water is taken from the Main Reservoir via the Cooling Tower Makeup Water Intake Channel. Service water from the Main Reservoir is returned to the Auxiliary Reservoir.

Water from both the Main and Auxiliary Reservoirs passes through traveling screens. Concrete walls separate the intake into bays. Each emergency service water system pump is located in a separate bay with separate screens, and each pump discharges into a separate pipeline. Due to reduction in project size from four to two units, the portion of the Emergency Service Water and Cooling Tower Makeup Water Intake Structure that was intended to serve Units 3 and 4 will not be completed. Only the four emergency service water pumps serving Units 1 and 2 will be installed. 4

Chlorination of the service water system will be at least two hours/day/unit. However, depending upon such factors as the presence of Asiatic clams, it may be necessary to use low-level continuous chlorination. Due to the small amounts of water involved in the service water system compared to the circulating water system, residual chlorine is not expected from the service water system even if it is chlorinated continuously.

TABLE 3.4.3-1

SERVICE WATER REQUIREMENTS PER UNIT (gpm)

	Normal Operation(1)				Emergency Operation(2)				
	Startup	Normal Operation	Shutdown(3) at 4 Hours	Hot Standby	Post LOCA - Single Loop Injection	Post LOCA - Single Loop Recirculation	Post LOCA - Full Flow Injection	Post LOCA - Full Flow Recirculation	Loss of Off - Site Power Hot Standby Single Loop Flow
Component Cooling Water Heat Exchanger	12,000	12,000	24,000	12,000	12,000	12,000	24,000	24,000	12,000
Reactor Auxiliary Building HVAC Chillers	2,500	2,500	5,000	2,500	2,500	2,500	5,000	5,000	2,500
Standby Diesel Generator Coolers	1,250	1,250	2,500	1,250	1,250	1,250	2,500	2,500	1,250
Emergency Supply to Steam Generator Motor Driven Auxiliary Feed Pumps	-	-	-	-	450	450	900	900	450
Emergency Supply to Steam Generator Turbine Driven Auxiliary Feed Pumps	-	-	-	-	900	-	900	-	900
Boron Thermal Regeneration (CVCS) Chillers	414	414	414	414	-	-	-	-	-
Charging Pump Oil Coolers	90	90	90	90	90	90	90	90	90
SSE Fire Protection	-	-	-	-	200	200	200	200	200
Makeup to RAB Evaporator Air Coolers	10	10	10	10	-	-	-	-	-
Containment Fan Coolers	3,000	3,000	6,000	3,000	3,000	3,000	6,000	6,000	3,000

TABLE 3.4.3-1 (Continued)

SERVICE WATER REQUIREMENTS PER UNIT (gpm)

	Normal Operation(1)				Emergency Operation(2)				
	Startup	Normal Operation	Shutdown(3) at 4 Hours	Hot Standby	Post LOCA - Single Loop Injection	Post LOCA - Single Loop Recirculation	Post LOCA - Full Flow Injection	Post LOCA - Full Flow Recirculation	Loss of Off - Site Power Hot Standby Single Loop Flow
Containment Fan Coil Units (NNS)	2,400	2,400	2,400	2,400	-	-	-	-	-
Waste Processing Building Cooling Water Heat Exchanger	10,000	10,000	10,000	10,000	-	-	-	-	-
Waste Processing Building HVAC Chiller	4,300	4,300	4,300	4,300	-	-	-	-	-
Makeup to WPB Evaporative Air Coolers	20	20	20	20	-	-	-	-	-
Turbine Building Auxiliaries	11,032	11,032	11,032	11,032	-	-	-	-	-
Plant Sampling System	150	150	150	150	-	-	-	-	-
Emergency Service Water Intake Screen Wash Pump	-	-	-	-	270	270	540	540	270
Emergency Service Water Strainer Back Wash	-	-	-	-	650	650	1,300	1,300	650
Normal Service Water Strainer Back Wash	2,000	2,000	2,000	2,000	-	-	-	-	-
Diesel Generator Air Cooler	50	50	100	50	50	50	100	100	50

TABLE 3.4.3-1 (continued)

SERVICE WATER REQUIREMENTS PER UNIT (gpm)

	Normal Operation(1)				Emergency Operation(2)				
					Post LOCA - Single Loop		Post LOCA - Full Flow		Power Hot Standby
	Startup	Normal Operation	Shutdown(3) at 4 Hours	Hot Standby	Injection	Recirculation	Injection	Recirculation	Single Loop Flow
Emergency Service Water and Cooling Tower Makeup Water Intake Structure Air Coolers	50	50	100	50	50	50	100	100	50
Turbine Driven Auxiliary Feed Pump Oil Cooler	12	12	12	12	12	12	12	12	12
Radiation Monitor Coolers	110	110	110	110	40	40	50	50	40
Total Required Flow	49,448	49,448	68,298	49,448	21,582	20,582	41,722	40,822	21,482
Rated Pump Capacity	50,000	50,000	50,000	50,000	21,500	21,500	21,500	21,500	21,500
Number of Pumps Required	1	1	2	1	1	1	2	2	1

Notes: (1) Utilizes Normal Service Water Pumps
(2) Utilizes Emergency Service Water Pumps
(3) This is for accelerated cooldown - however, reactor can be cooled with only one Component Cooling Water Heat Exchanger.

TABLE 3.4.3-2

MAXIMUM SERVICE WATER SYSTEM HEAT LOADS FOLLOWING SAFE SHUTDOWN

Normal Shutdown at 4 hours (RHR system actuated, two trains in operation)

Heat Loads to Service Water System per Unit

Component Cooling Water Heat Exchangers 5

a) Sealwater Heat Exchanger	1.880 x 10^6 Btu/hr.
b) Letdown Heat Exchanger	4.800 x 10^6 Btu/hr.
c) RHR Pumps	0.280 x 10^6 Btu/hr.
d) RHR Heat Exchanger	161.960 x 10^6 Btu/hr.
e) SFPC Heat Exchanger	39.250 x 10^6 Btu/hr.
	208.17 x 10^6 Btu/hr. 5
Containment Fan Coolers	9.120 x 10^6 Btu/hr.
Reactor Auxiliary Building HVAC Chiller	17.312 x 10^6 Btu/hr.
Diesel Generator	41.320 x 10^6 Btu/hr.
Emergency SW Intake Structure Fan Cooler Units	0.142 x 10^6 Btu/hr.
Diesel Generator Building Fan Cooler Units	0.113 x 10^6 Btu/hr.
Total Heat Load to Service Water System per Unit	276.177 x 10^6 Btu/hr.
Total Heat Load to Service Water System per Unit When Component Cooling Water to the Spent Fuel Pool Cooling Heat Exchanger is Suspended	236.93 x 10^6 Btu/hr. 5

TABLE 3.4.3-3

MAXIMUM SERVICE WATER SYSTEM HEAT LOADS FOLLOWING LOCA

Safety Injection Phase (approximately 30 min. - 1 hour in duration)

Heat Load to Service Water System per Unit (assumes two SWS loops in operation),

Charging Pumps	0.225×10^6 Btu/hr.
Diesel Generator Building Fan Cooler Units	0.113×10^6 Btu/hr.
Containment Fan Coolers	331.320×10^6 Btu/hr.
Reactor Auxiliary Building HVAC Chiller	16.590×10^6 Btu/hr.
Standby Diesel Generators	41.320×10^6 Btu/hr.
Emergency SW Intake Structure Fan Cooler Units	0.142×10^6 Btu/hr.
Total	389.71×10^6 Btu/hr.

Recirculation Phase

Heat Load to Service Water System per Unit (assumes two SWS loops in operation),

Component Cooling Water Heat Exchanger	160.38×10^6 Btu/hr.
Containment Fan Coolers	339.32×10^6 Btu/hr.
Reactor Auxiliary Building HVAC Chiller	16.590×10^6 Btu/hr.
Standby Diesel Generators	41.320×10^6 Btu/hr.
Emergency SW Intake Structure Fan Cooler	0.142×10^6 Btu/hr.
Diesel Generator Building Fan Cooler Units	0.113×10^6 Btu/hr.
Total	549.865×10^6 Btu/hr.

3.4.4 ICE FORMATION/FREEZE PROTECTION

The following provisions exist to allow continued operation of the Service Water System during severe cold weather conditions. The emergency service water intake structures are illustrated in Figures 3.4.2-10 through 3.4.2-13 and Figures 3.4.4-1 and 3.4.4-2. Their relationships to the maximum and minimum reservoir water levels are shown in Figures 3.4.2-12 and 3.4.4-1.

a) Emergency Service Water Intake Structure Traveling Screens: Ice buildup on the traveling screens is prevented by use of a heated and insulated hood, circulating heated water through the Auxiliary Reservoir, and by continuously running the screens when icing conditions warrant it.

b) Emergency Service Water and Cooling Tower Makeup Intake Structure: Surface ice is prevented from entering the pump bay by a baffle wall extending one foot below the Main Reservoir normal water level (see Figure 3.4.2-12). In addition, ice formation in the structure will not jeopardize operation of the screens, (as indicated above) nor the operation of the pumps, since minimum submergence of the pump suctions are at least four feet below low water level. Similar design considerations exist at the Emergency Service Water Screening Structure where a baffle wall extending to Elevation 247.5 ft. prevents ice formation from jeopardizing service water flow from the Auxiliary Reservoir (see Figure 3.4.4-1).

c) Emergency Service Water Discharge Channel: Ice formation in this channel cannot jeopardize SWS performance, since the elevation of the SWS discharge will be above Elevation 250 ft. MSL.

Heated water is circulated through the Auxiliary Reservoir Discharge and Intake Channels during conditions when Auxiliary Reservoir temperatures are below 35 F. The plant will be shutdown and cooled down when ice formation in either channel would jeopardize the service water supply.

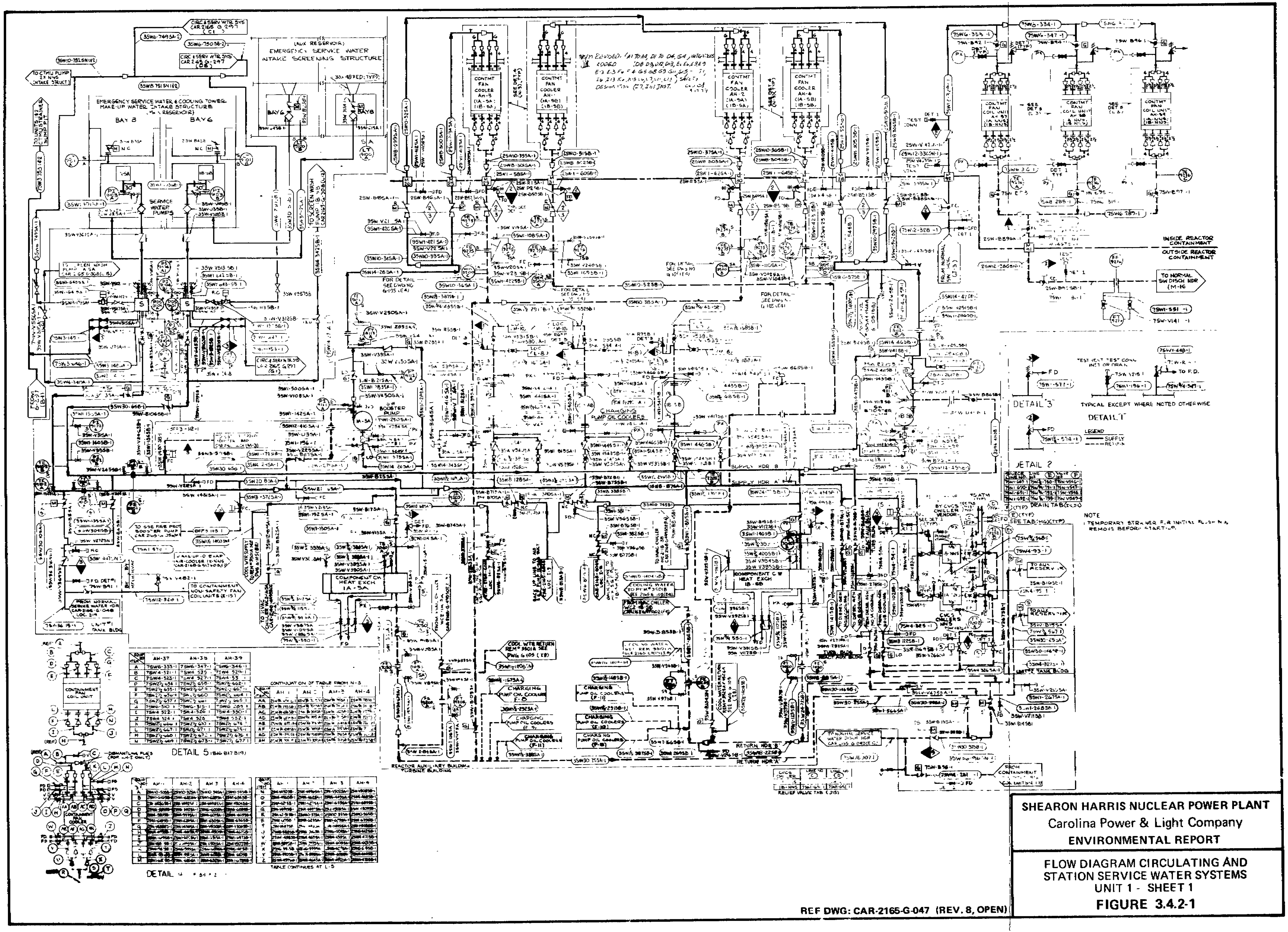
Those portions of the service water system piping in the Emergency Service Water Screening Structure and Emergency Service Water and Cooling Tower Makeup Intake Structure which are exposed to the outdoor elements are heat traced and insulated. Since the heat tracing is required only to maintain the Emergency Service Water System in a condition of readiness prior to system use, the heat tracing is not safety related nor is it connectable to the onsite emergency power supply. Failure of the heat tracing will be alarmed in the Control Room.

3.4.5 DISCHARGE OF HEAT AND ITS COMPLIANCE WITH THE NORTH CAROLINA DIVISION OF ENVIRONMENTAL MANAGEMENT

Carolina Power & Light Company has contacted the North Carolina Division of Environmental Management to discuss thermal discharge to the Auxiliary Reservoir during emergency conditions, including potential icing. The North Carolina Division of Environmental Management has accepted CP&L's position that thermal discharge could occur under the emergency conditions described above and has forwarded a written statement officially confirming their acceptance.

A copy of this letter was provided to the NRC in a CP&L letter from Mr. J. A. Jones to Mr. J. F. O'Leary dated May 31, 1974.

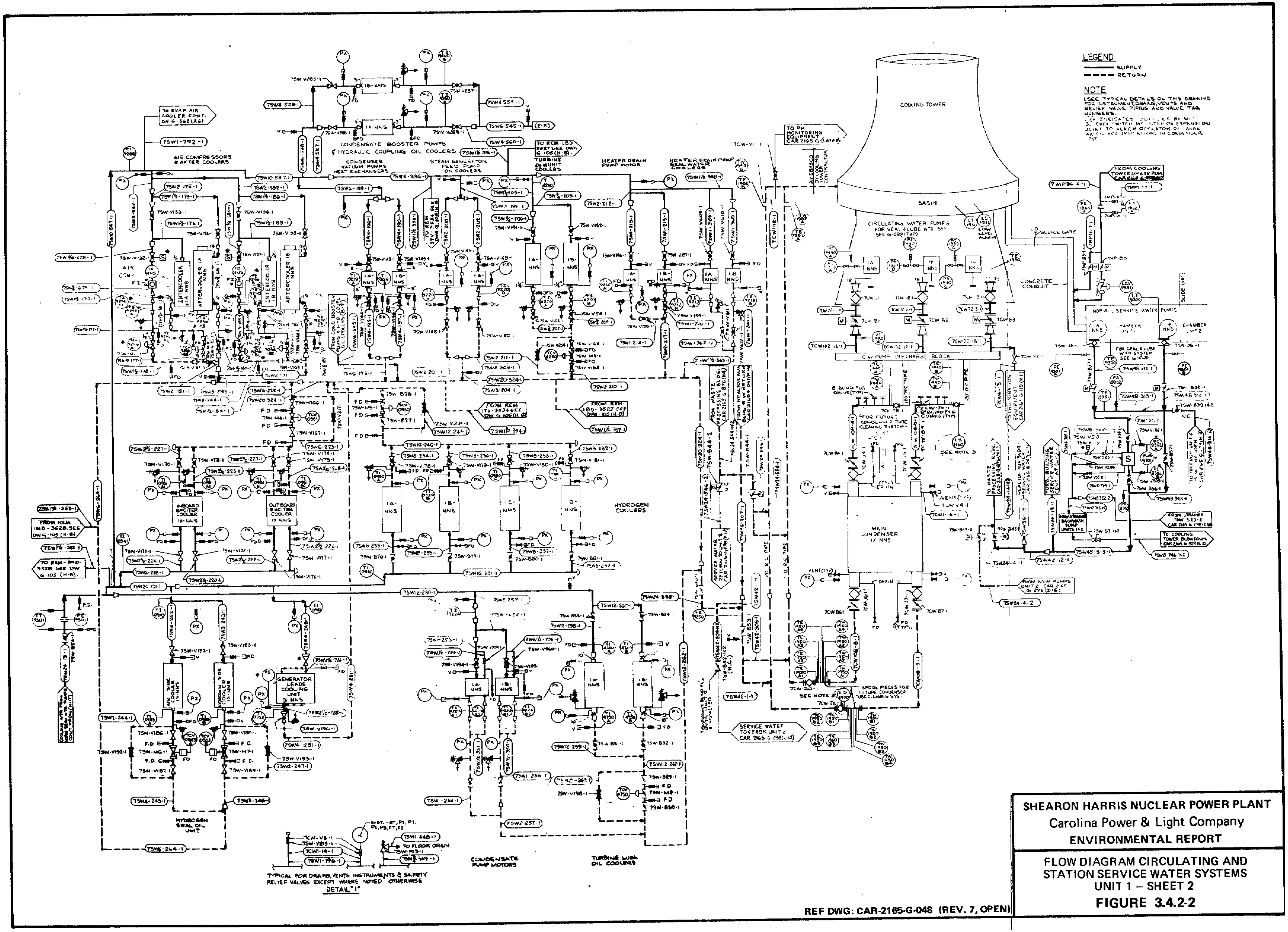
In addition, the NPDES permit, issued on July 12, 1982, discusses the restrictions on heated water discharge to the Auxiliary Reservoir. 4


EMERGENCY SERVICE WATER INTAKE SCREENING STRUCTURE
(AUX RESERVOIR)
EMERGENCY SERVICE WATER & COOLING TOWER MAKE-UP WATER INTAKE STRUCTURE
BAY 8
BAY 6
SERVICE WATER PUMPS
TO CT MU PUMP
TO SCREEN WASH
CONTMT FAN COOLER AH-3
CONTMT FAN COOLER AH-1
CONTMT FAN COOLER AH-2
CONTMT FAN COOLER AH-4
CONTMT FAN COIL UNIT AH-37
CONTMT FAN COIL UNIT AH-38
CONTMT FAN COIL UNIT AH-39
INSIDE REACTOR CONTAINMENT
OUTSIDE REACTOR CONTAINMENT
TO NORMAL SW DISCH HDR
DETAIL "3"
DETAIL "1"
TYPICAL EXCEPT WHERE NOTED OTHERWISE
LEGEND
SUPPLY
RETURN
DETAIL 2
NOTE
TEMPORARY STRAINER FOR INITIAL FLUSHING, REMOVE BEFORE START-UP.
CHARGING PUMP OIL COOLERS
SW BOOSTER PUMP
COMPONENT CW HEAT EXCH 1A-SA
COMPONENT CW HEAT EXCH 1B-SB
SUPPLY HDR A
SUPPLY HDR B
RETURN HDR B
RETURN HDR A
COOL WTR RETURN
CVCS CHILLER
REACTOR AUXILIARY BUILDING
TURBINE BUILDING
FROM CONTAINMENT
TO NORMAL SERVICE WATER DISCH HDR
CONTAINMENT FAN COIL UNIT
CONTAINMENT FAN COOLER
DETAIL 5
DETAIL 4
TABLE CONTINUES AT L-5
CONTINUATION OF TABLE FROM N-5

REF DWG: CAR-2165-G-047 (REV. 8, OPEN)

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
ENVIRONMENTAL REPORT

FLOW DIAGRAM CIRCULATING AND STATION SERVICE WATER SYSTEMS
UNIT 1 - SHEET 1
FIGURE 3.4.2-1

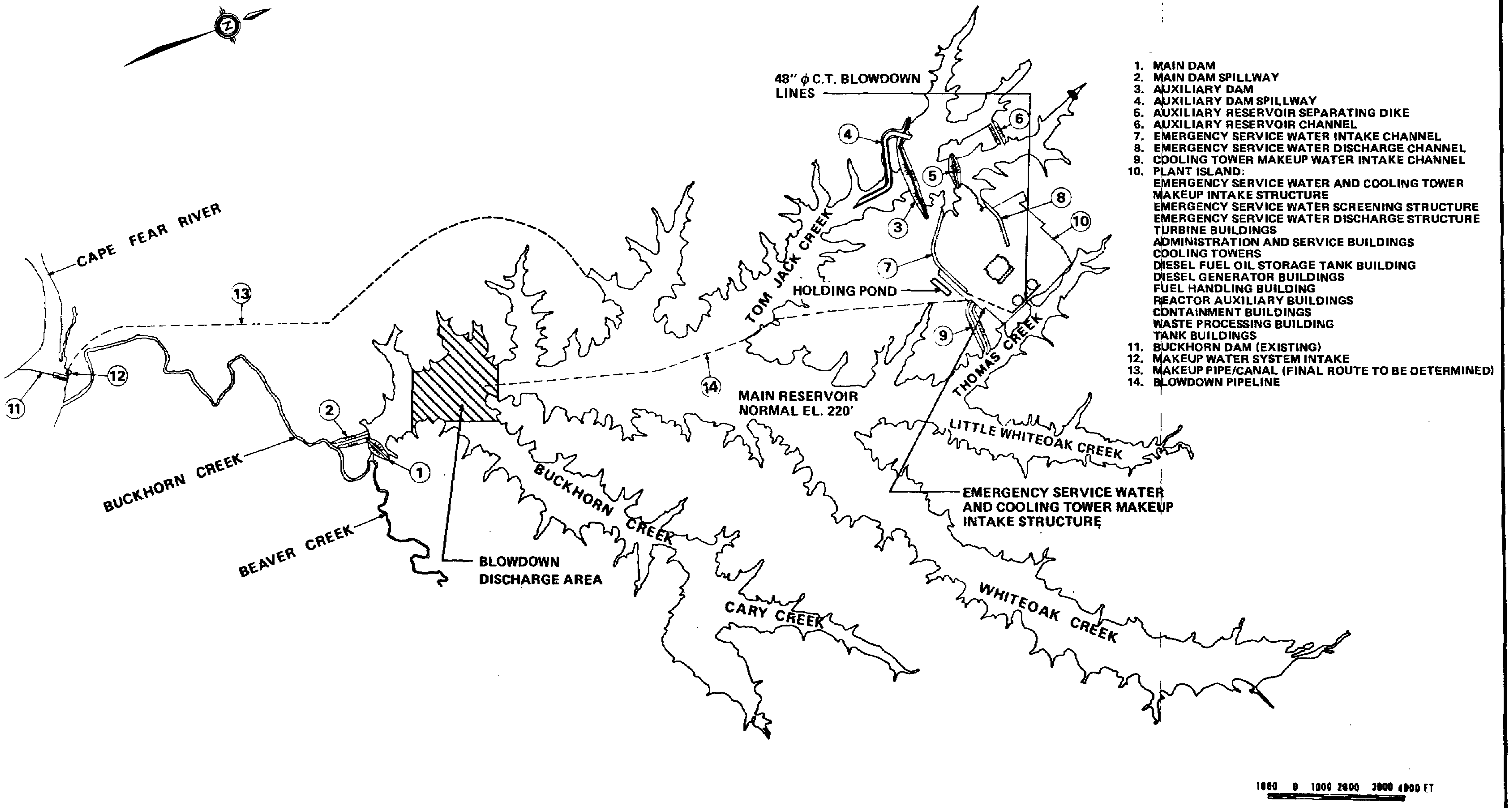

LEGEND
SUPPLY
RETURN
NOTE
1. SEE TYPICAL DETAILS ON THIS DRAWING FOR INSTRUMENT, DRAINS, VENTS AND RELIEF VALVE PIPING AND VALVE TAG NUMBERS.
COOLING TOWER
BASIN
CIRCULATING WATER PUMPS FOR SEAL & LUBE WTR SYS SEE G-098 (TYP)
C.W. PUMP DISCHARGE BLOCK
SLUICE GATE
CONCRETE CONDUIT
NORMAL SERVICE WATER PUMPS
FROM COOLING TOWER UP WTR PUM
MAIN CONDENSER 1X NNS
SEE NOTE 3
SPOOL PIECES FOR FUTURE CONDENSER TUBE CLEANING SYS
SERVICE WATER TO/FROM UNIT 2 CAR 2165 G 298 (L-13)
TO PH MONITORING EQUIPMENT CAR 2165 G (LATER)
CONDENSATE BOOSTER PUMPS & HYDRAULIC COUPLING OIL COOLERS
CONDENSER VACUUM PUMPS HEAT EXCHANGERS
STEAM GENERATOR FEED PUMP OIL COOLERS
TURBINE DEMUNIT COOLERS
HEATER DRAIN PUMP MOTOR
HEATER DRAIN PUMP SEAL WATER COOLERS
AIR COMPRESSORS & AFTER COOLERS
TO EVAP. AIR COOLER CONT. ON G-562 (A6)
AIR COMP.
INTERCOOLER
AFTERCOOLER
INBOARD EXCITER COOLER 1X NNS
OUTBOARD EXCITER COOLER 1X NNS
HYDROGEN COOLERS
AIR SIDE COOLER
HYDROGEN SIDE COOLER
GENERATOR LEADS COOLING UNIT 1X NNS
HYDROGEN SEAL OIL UNIT
CONDENSATE PUMP MOTORS
TURBINE LUBE OIL COOLERS
TYPICAL FOR DRAINS, VENTS INSTRUMENTS & SAFETY RELIEF VALVES EXCEPT WHERE NOTED OTHERWISE
DETAIL "I"
TO FLOOR DRAIN

REF DWG: CAR-2165-G-048 (REV. 7, OPEN)

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
ENVIRONMENTAL REPORT

FLOW DIAGRAM CIRCULATING AND STATION SERVICE WATER SYSTEMS UNIT 1 – SHEET 2

FIGURE 3.4.2-2



1. MAIN DAM
2. MAIN DAM SPILLWAY
3. AUXILIARY DAM
4. AUXILIARY DAM SPILLWAY
5. AUXILIARY RESERVOIR SEPARATING DIKE
6. AUXILIARY RESERVOIR CHANNEL
7. EMERGENCY SERVICE WATER INTAKE CHANNEL
8. EMERGENCY SERVICE WATER DISCHARGE CHANNEL
9. COOLING TOWER MAKEUP WATER INTAKE CHANNEL
10. PLANT ISLAND:
    EMERGENCY SERVICE WATER AND COOLING TOWER MAKEUP INTAKE STRUCTURE
    EMERGENCY SERVICE WATER SCREENING STRUCTURE
    EMERGENCY SERVICE WATER DISCHARGE STRUCTURE
    TURBINE BUILDINGS
    ADMINISTRATION AND SERVICE BUILDINGS
    COOLING TOWERS
    DIESEL FUEL OIL STORAGE TANK BUILDING
    DIESEL GENERATOR BUILDINGS
    FUEL HANDLING BUILDING
    REACTOR AUXILIARY BUILDINGS
    CONTAINMENT BUILDINGS
    WASTE PROCESSING BUILDING
    TANK BUILDINGS
11. BUCKHORN DAM (EXISTING)
12. MAKEUP WATER SYSTEM INTAKE
13. MAKEUP PIPE/CANAL (FINAL ROUTE TO BE DETERMINED)
14. BLOWDOWN PIPELINE

AMENDMENT NO. 4

SHEARON HARRIS NUCLEAR POWER PLANT
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PROJECT SITE PLAN
FIGURE 3.4.2-3

FIGURE 3.4.2-4

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FIGURE 3.4.2-5

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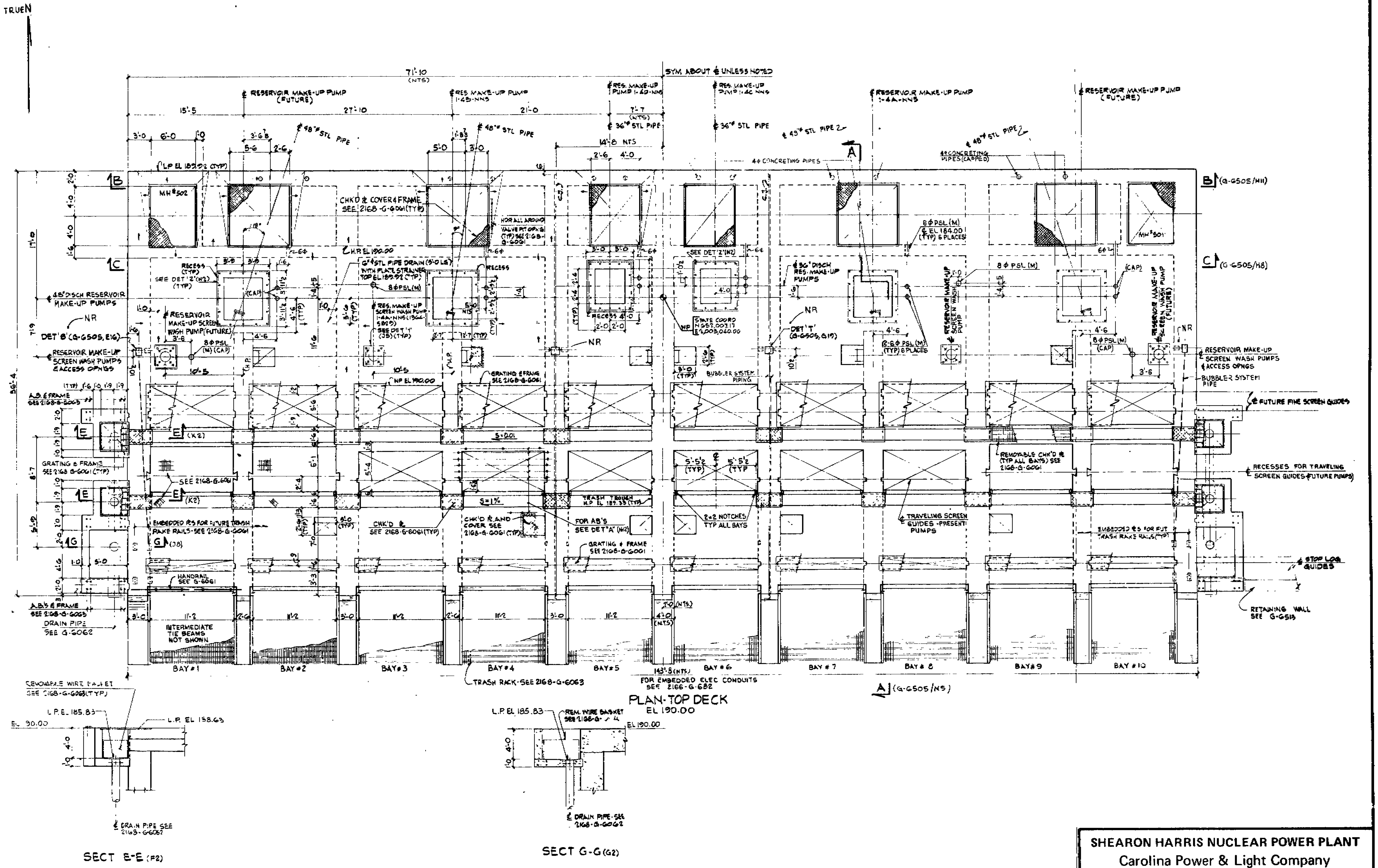
FIGURE 3.4.2-6

Deleted by Amendment No. 4


TRUE N
71'-10 (NTS)
SYM ABOUT ℄ UNLESS NOTED
℄ RESERVOIR MAKE-UP PUMP (FUTURE)
℄ RES. MAKE-UP PUMP 1-4B-NNS
℄ RES. MAKE-UP PUMP 1-4D-NNS
℄ RES. MAKE-UP PUMP 1-4C NNS
℄ RESERVOIR MAKE-UP PUMP 1-4A-NNS
℄ RESERVOIR MAKE-UP PUMP (FUTURE)
15'-5
27'-10
21'-0
7'-7 (NTS)
℄ 36"Ø STL PIPE
℄ 48"Ø STL PIPE
℄ 48"Ø STL PIPE 2
14'-8 NTS
4Ø CONCRETING PIPES
4Ø CONCRETING PIPES (CAPPED)
A
B (G-6505/H11)
C (G-6505/H8)
LP EL 189.92 (TYP)
MH#502
MH#501
CHK'D ℄ COVER & FRAME SEE 2168-G-6061 (TYP)
HDR ALL AROUND VALVE PIT OPNG (TYP) SEE 2168-G-6061
℄ H.P. EL 190.00
6" Ø STL PIPE DRAIN (5'-0 LG) WITH PLATE STRAINER TOP EL 189.92 (TYP)
8Ø PSL (M)
RECESS (TYP) SEE DET 'Z' (N2) (TYP)
(CAP)
℄ 48" DISCH RESERVOIR MAKE-UP PUMPS
℄ RESERVOIR MAKE-UP SCREEN WASH PUMP (FUTURE)
℄ RES. MAKE-UP SCREEN WASH PUMP 1-4A-NNS (1366-5829) SEE DET 'Y' (J5) (TYP)
DET 'B' (G-6505, E16)
NR
℄ RESERVOIR MAKE-UP SCREEN WASH PUMPS & ACCESS OPNGS
8Ø PSL (M) (CAP)
10'-5
HP EL 190.00
GRATING & FRAME SEE 2168-G-6061
SEE DET 'Z' (N2)
RECESS 4'-0
WP STATE COORD N 657,007.17 E 2,003,040.00
℄ 36" DISCH RES. MAKE-UP PUMPS
DET 'T' (G-6505, G19)
6Ø PSL (M) ℄ EL 184.00 (TYP) 6 PLACES
2-6Ø PSL (M) (TYP) 6 PLACES
℄ RESERVOIR MAKE-UP SCREEN WASH PUMP
℄ RESERVOIR MAKE-UP SCREEN WASH PUMP (FUTURE)
BUBBLER SYSTEM PIPING
BUBBLER SYSTEM PIPE
℄ FUTURE FINE SCREEN GUIDES
56'-4
A.B. & FRAME SEE 2168-G-6063
E (K2)
S=0.01
GRATING & FRAME SEE 2168-G-6061 (TYP)
SEE 2168-G-6061
5'-5½ (TYP)
REMOVABLE CHK'D ℄ (TYP ALL BAYS) SEE 2168-G-6061
℄ RECESSES FOR TRAVELING SCREEN GUIDES & FUTURE PUMPS
S=1%
TRASH TROUGH H.P. EL 189.33 (TYP)
EMBEDDED ℄S FOR FUTURE TRASH RAKE RAILS - SEE 2168-G-6061
G (J8)
CHK'D ℄ SEE 2168-G-6061 (TYP)
CHK'D ℄ AND COVER SEE 2168-G-6061 (TYP)
FOR AB'S SEE DET "A" (N12)
2×2 NOTCHES TYP ALL BAYS
℄ TRAVELING SCREEN GUIDES - PRESENT PUMPS
EMBEDDED ℄S FOR FUT TRASH RAKE RAILS (TYP)
GRATING & FRAME SEE 2168-G-6061
℄ STOP LOG GUIDES
HANDRAIL SEE G-6061
A.B.'S & FRAME SEE 2168-G-6063
DRAIN PIPE SEE G-6062
INTERMEDIATE TIE BEAMS NOT SHOWN
11'-2
3'-0
2'-6
7'-0 (NTS)
4'-0 (NTS)
RETAINING WALL SEE G-6518
BAY #1
BAY #2
BAY #3
BAY #4
BAY #5
BAY #6
BAY #7
BAY #8
BAY #9
BAY #10
TRASH RACK - SEE 2168-G-6063
143'-8 (NTS)
FOR EMBEDDED ELEC CONDUITS SEE 2166-G-682
A (G-6505/N5)
PLAN - TOP DECK
EL 190.00
REMOVABLE WIRE BASKET SEE 2168-G-6063 (TYP)
L.P. EL 185.83
L.P. EL 188.63
EL 190.00
℄ DRAIN PIPE SEE 2168-G-6062
SECT E-E (F2)
REM. WIRE BASKET SEE 2168-G-6063
SECT G-G (G2)

REF DWG: CAR-2167-G-6503 (REV 2)

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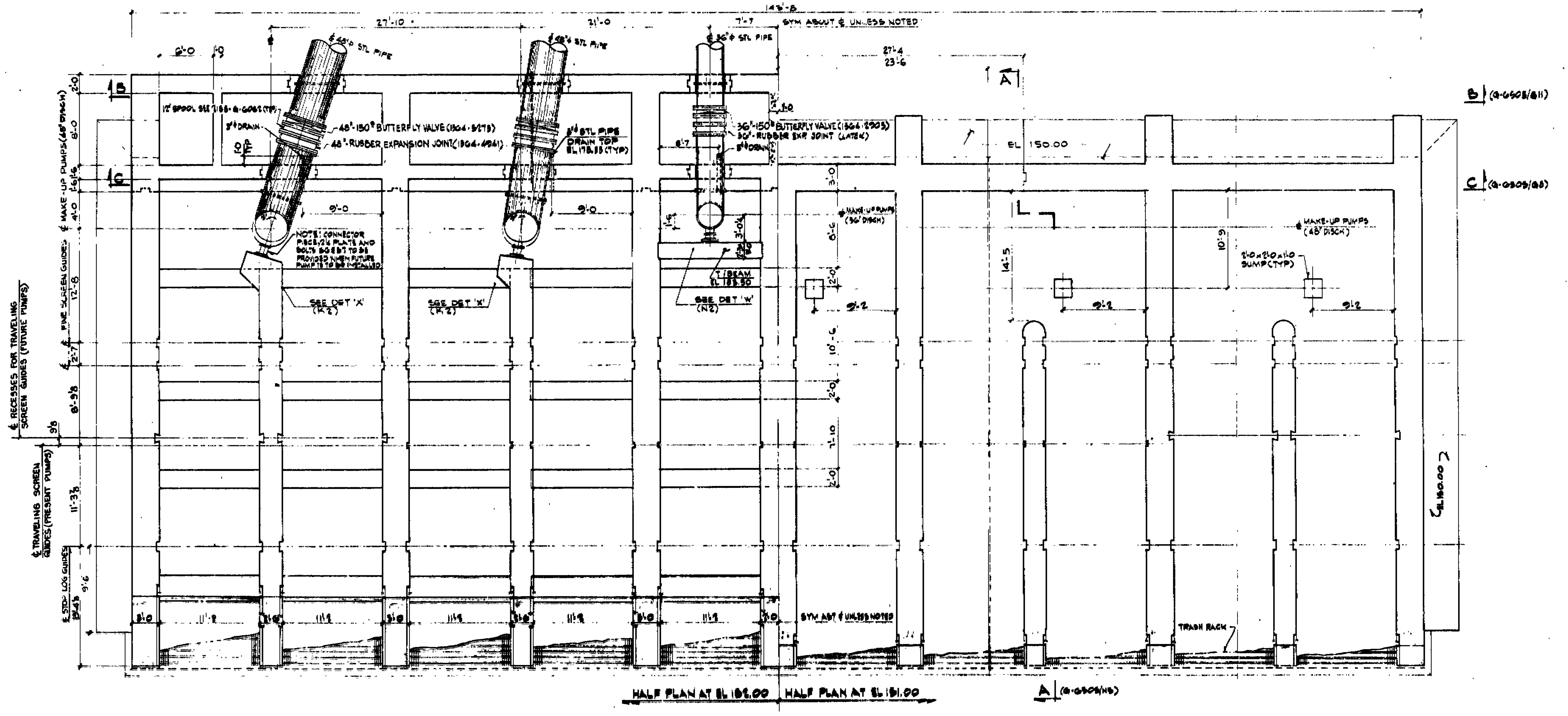
RESERVOIR MAKEUP WATER SYSTEM
INTAKE STRUCTURE – SHEET 1

FIGURE 3.4.2-7



REF DWG: CAR-2167-G-6504 (REV 2)

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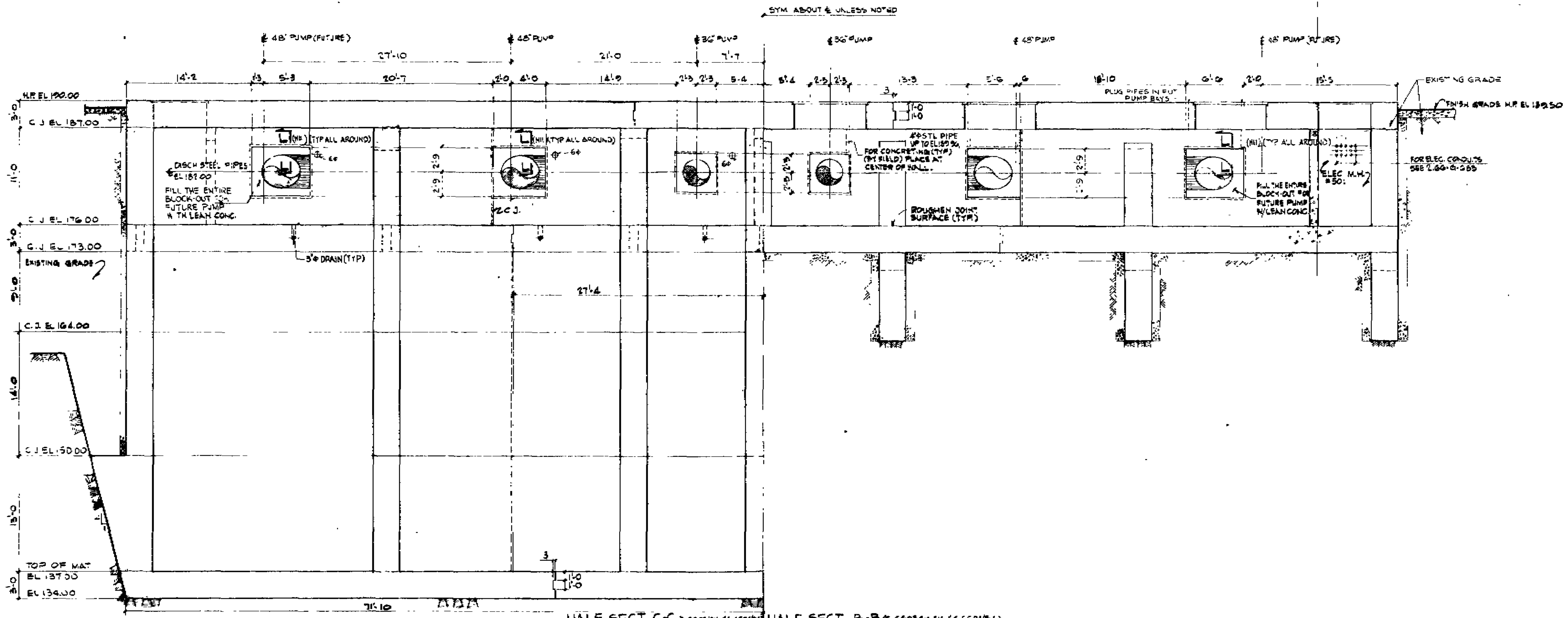
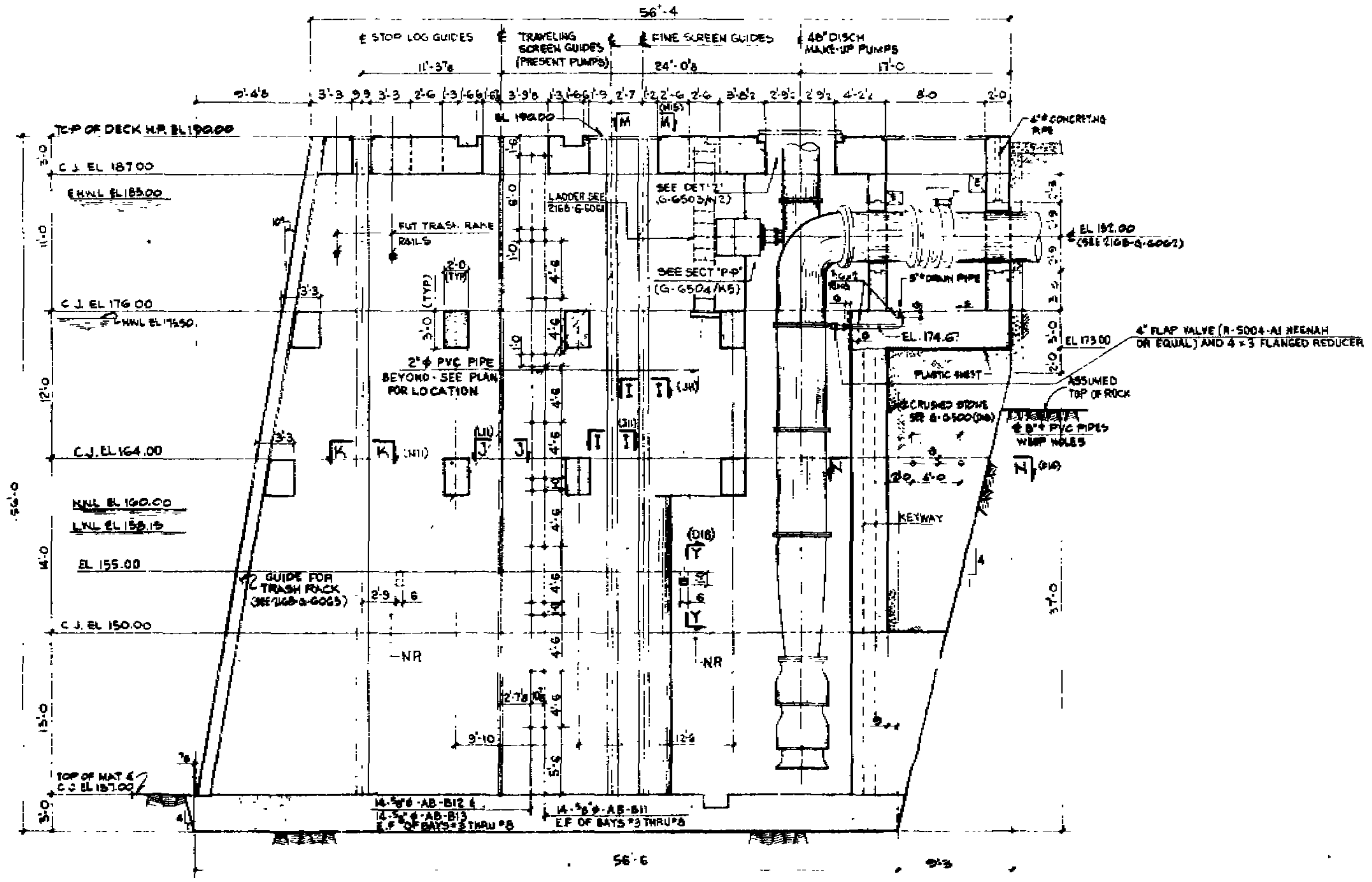
Carolina Power & Light Company
ENVIRONMENTAL REPORT

RESERVOIR MAKEUP WATER SYSTEM
INTAKE STRUCTURE – SHEET 2
FIGURE 3.4.2-8


SYM. ABOUT ℄ UNLESS NOTED
℄ 48" PUMP (FUTURE)
℄ 48" PUMP
℄ 36" PUMP
℄ 36" PUMP
℄ 48" PUMP
℄ 48" PUMP (FUTURE)
H.P. EL 190.00
C.J. EL 187.00
C.J. EL 176.00
C.J. EL 173.00
EXISTING GRADE
C.J. EL 164.00
C.J. EL 150.00
TOP OF MAT EL 137.00
EL 134.00
DISCH STEEL PIPES EL 187.00
FILL THE ENTIRE BLOCK-OUT FOR FUTURE PUMP WITH LEAN CONC.
5"⌀ DRAIN (TYP)
ROUGHEN JOINT SURFACE (TYP)
4"⌀ STL PIPE UP TO EL 189.50 FOR CONCRETING (TYP) (BY FIELD) PLACE AT CENTER OF WALL
PLUG PIPES IN FUT PUMP BAYS
ELEC. M.H. #501
FOR ELEC. CONDUITS SEE 2166-G-253
EXISTING GRADE
FINISH GRADE H.P. EL 189.50
27'-4
71'-10

HALF SECT C-C (G-6505/C16 & G-6504/C6) HALF SECT B-B (G-6503/G16 & G-6504/B6)

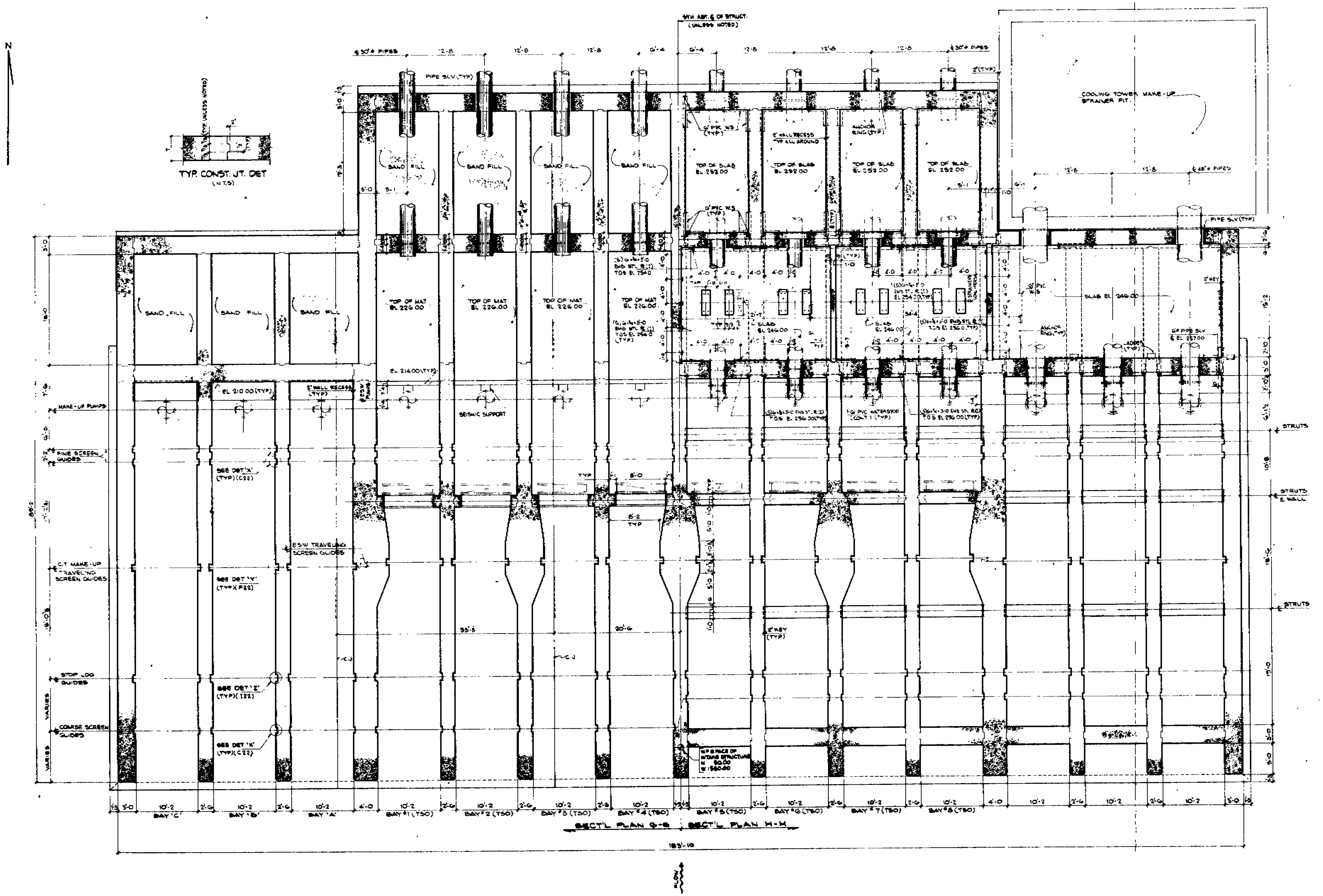


SECT A-A (G-6503/M11 & G-6904/H11)

REF DWG: CAR-2167-G-6505 (REV 2)

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
ENVIRONMENTAL REPORT

RESERVOIR MAKEUP WATER SYSTEM
INTAKE STRUCTURE – SHEET 3
FIGURE 3.4.2-9



REF DWG: CAR-2167-G-2845 (REV. 2)

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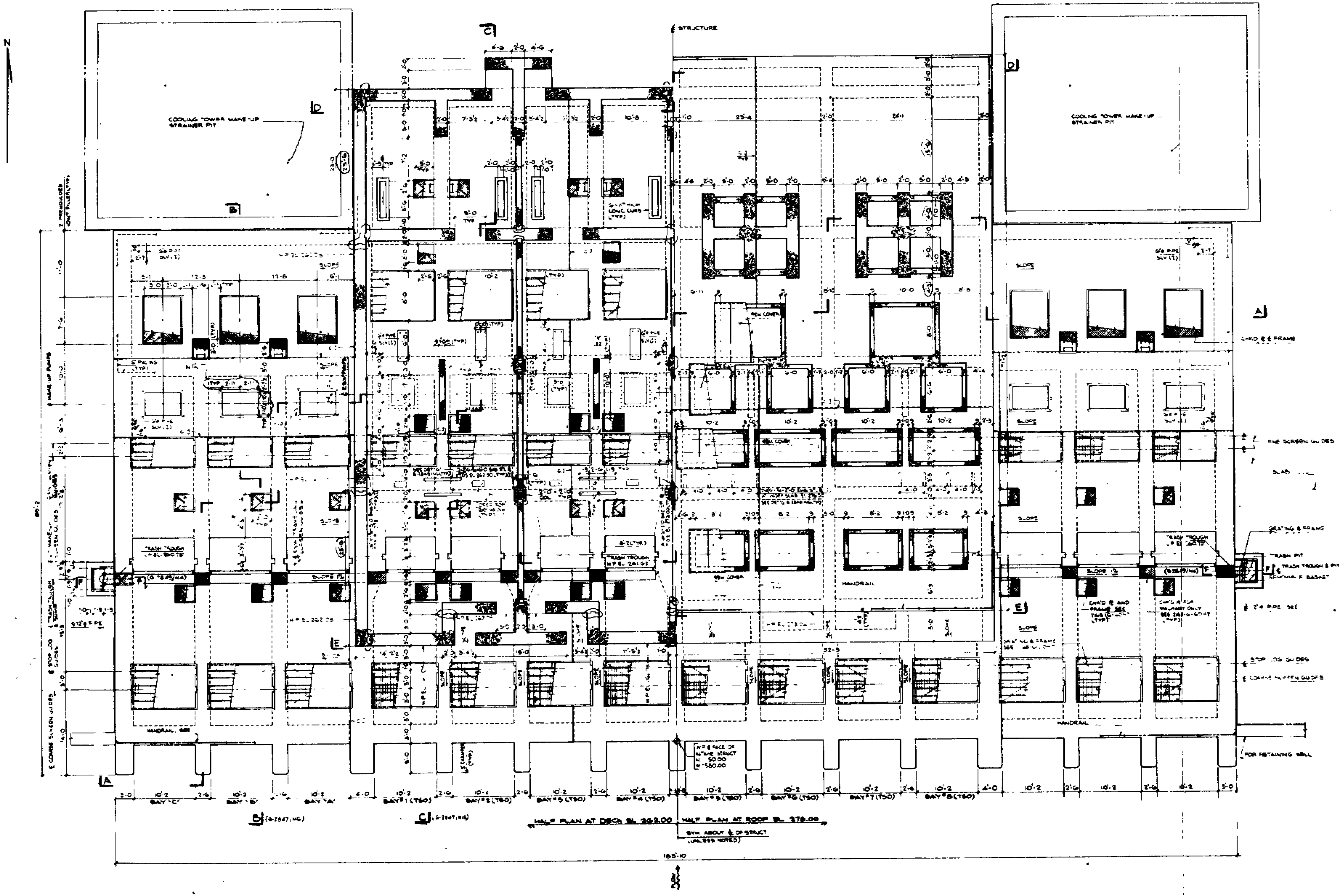
ESW AND CT MAKEUP INTAKE
STRUCTURE – SHEET 1

FIGURE 3.4.2-10

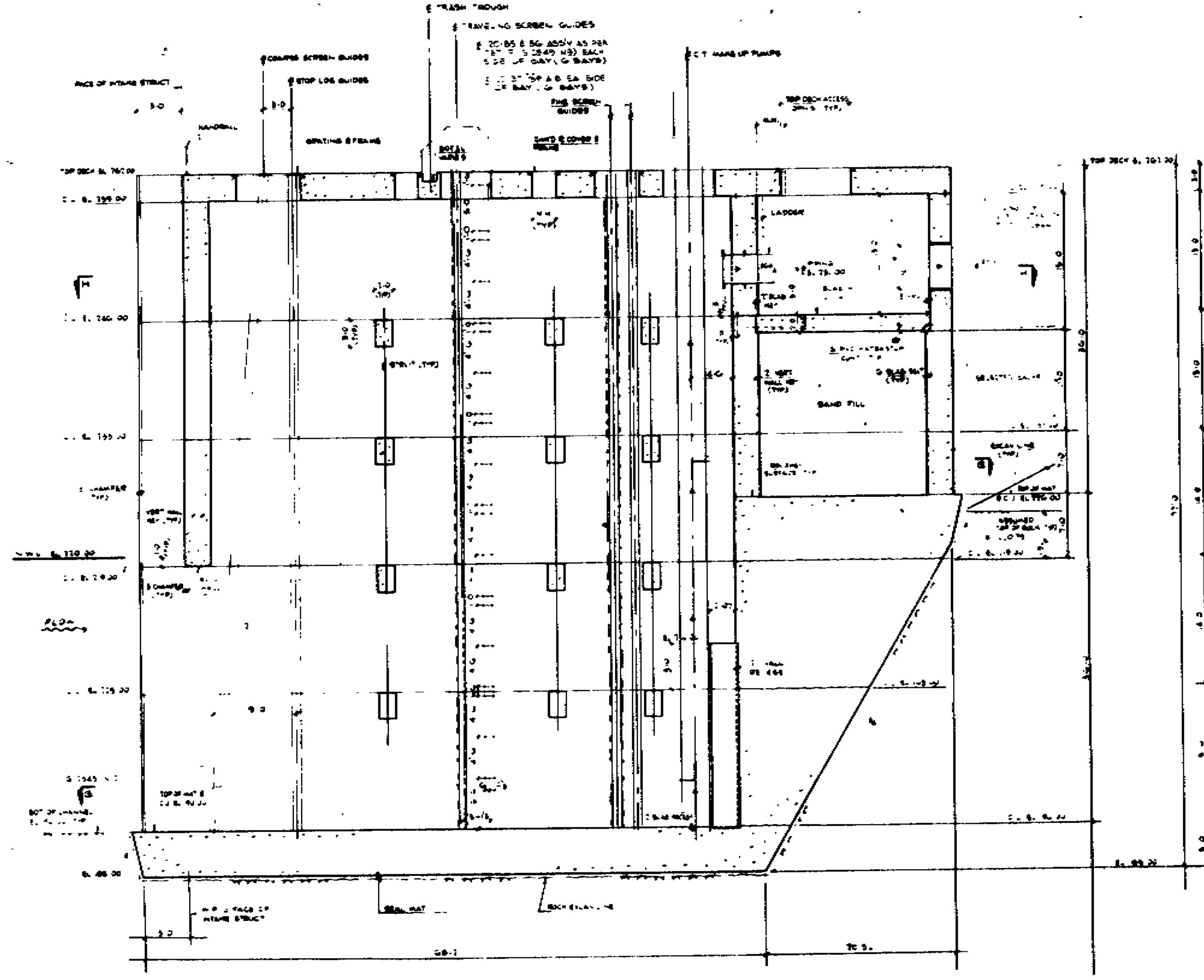


REF DWG: CAR-2167-G-2846 (REV.1)

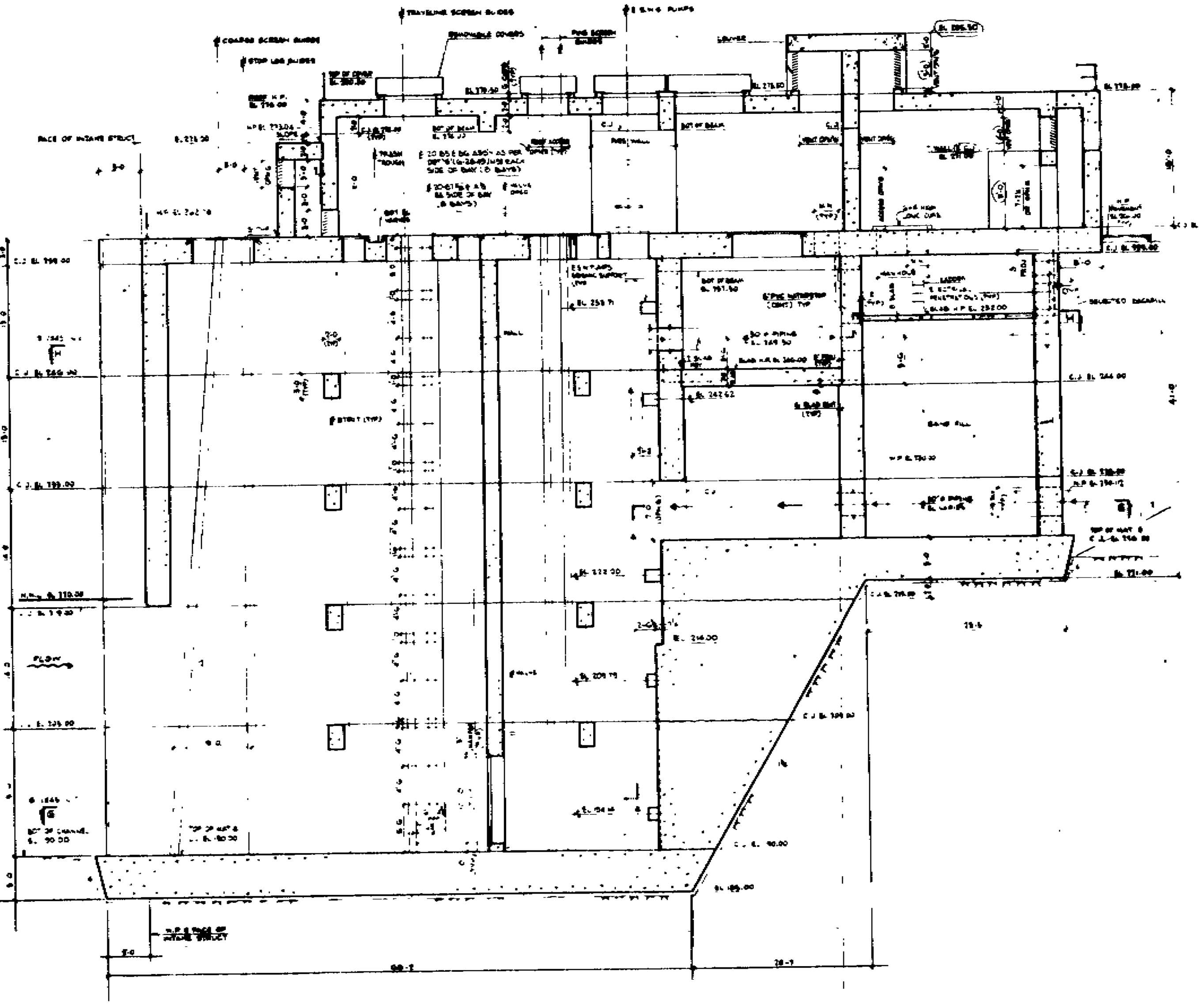
SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
ENVIRONMENTAL REPORT

ESW AND CT MAKEUP INTAKE
STRUCTURE – SHEET 2

FIGURE 3.4.2-11



SECT B-B



SECT C-C

REF DWG: CAR-2167-G-2847 (REV. 1)

SHEARON HARRIS NUCLEAR POWER PLANT
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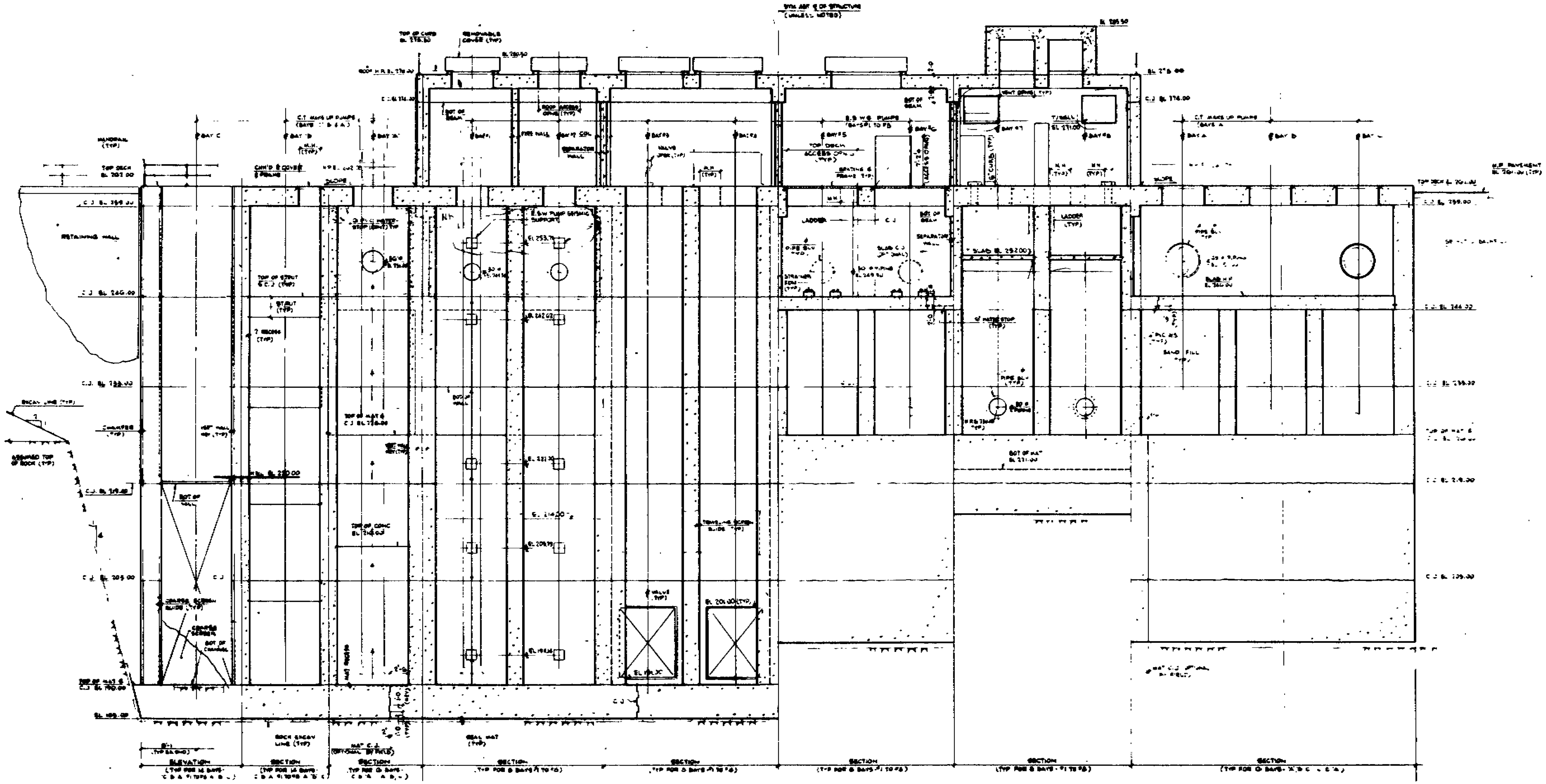
ENVIRONMENTAL REPORT

ESW AND CT MAKEUP INTAKE
STRUCTURE - SHEET 3

FIGURE 3.4.2-12



SECT A-A (G-2846/45)

REF DWG: CAR-2167-G-2848 (REV. 1)

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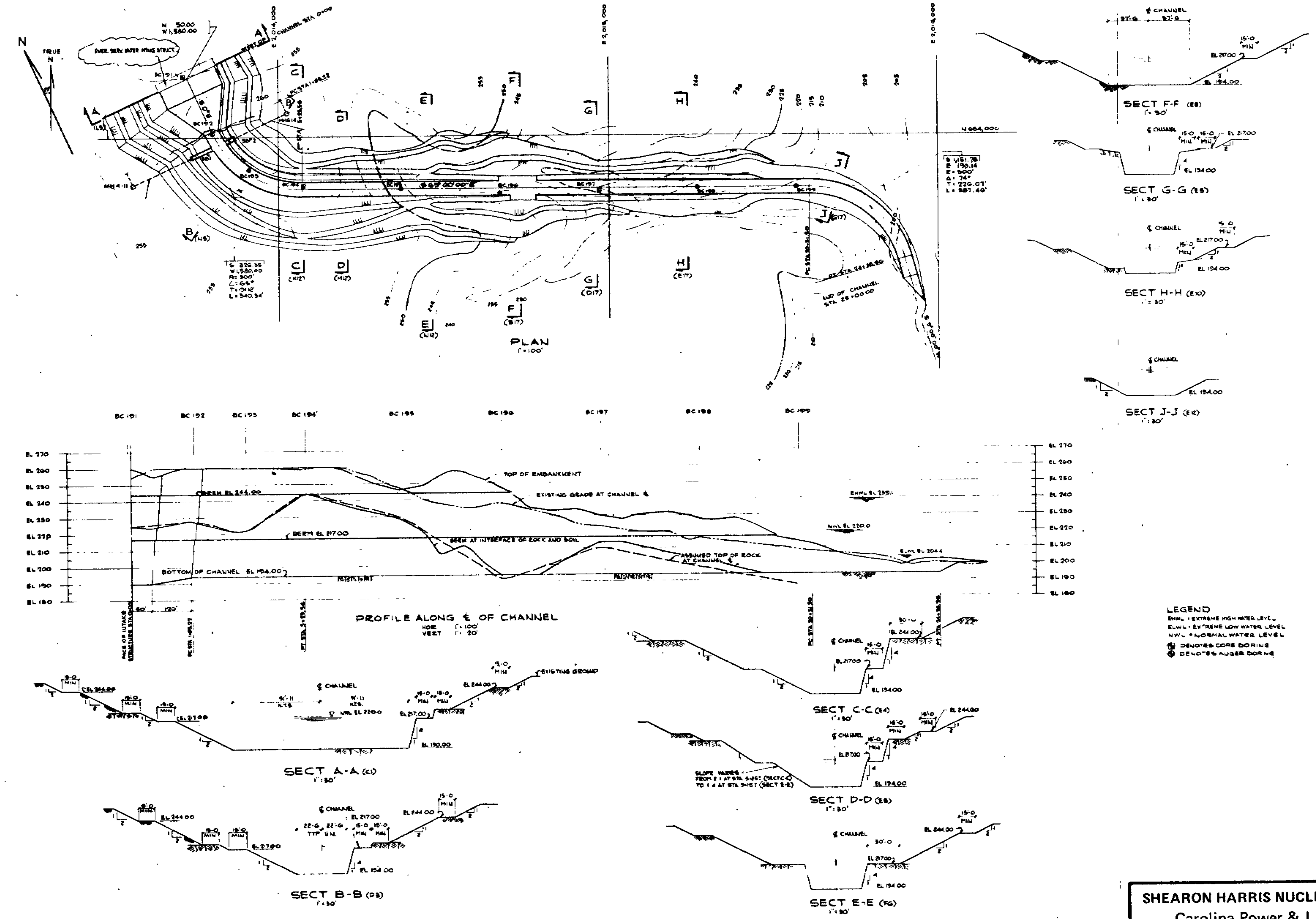
ENVIRONMENTAL REPORT

ESW AND CT MAKEUP INTAKE
STRUCTURE – SHEET 4

FIGURE 3.4.2-13



REF DWG: CAR-2167-G-2942 (REV. 1)

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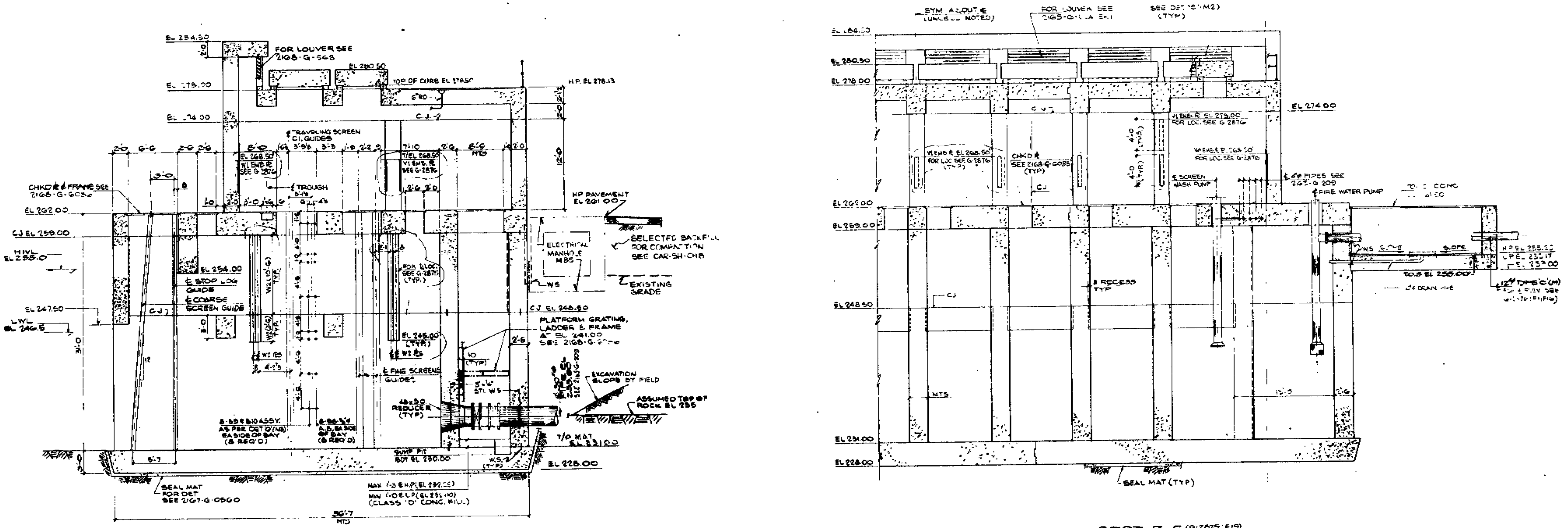
CTMW – INTAKE CHANNEL
PLAN AND SECTIONS

FIGURE 3.4.2-14


EL 284.50
FOR LOUVER SEE 2168-G-568
EL 280.50
TOP OF CURB EL 278.50
H.P. EL 278.13
EL 278.00
6"RD
EL 274.00
C.J.
TRAVELING SCREEN C.L. GUIDES
EL 268.50 W/ EMB. PL SEE G-2876
T/EL 268.50 W/ EMB. PL SEE G-2876
TROUGH
CHKD PL & FRAME SEE 2168-G-6086
EL 262.00
HP PAVEMENT EL 261.00
CJ EL 259.00
HWL EL 255.0
ELECTRICAL MANHOLE MBS
SELECTED BACKFILL FOR COMPACTION SEE CAR-SH-CH8
WS
EXISTING GRADE
EL 254.00
STOP LOG GUIDE
COARSE SCREEN GUIDE
FOR BLOC. SEE G-2875 (TYP.)
EL 247.50
CJ
LWL EL 246.5
CJ EL 248.50
PLATFORM GRATING, LADDER & FRAME AT EL 241.00 SEE 2168-G-
EL 245.00 (TYP.)
FINE SCREENS GUIDES
EXCAVATION SLOPE BY FIELD
ASSUMED TOP OF ROCK EL 235
48x30 REDUCER (TYP)
STL WS
8-B9 & B10 ASSY. AS PER DET 'Q'(N8) EA SIDE OF BAY (8 REQ'D)
8-B6 EA SIDE OF BAY (8 REQ'D)
SUMP PIT BOT EL 230.00
T/O MAT EL 231.00
EL 228.00
SEAL MAT FOR DET SEE 2167-G-0560
MAX 1'-3 & H.P.(EL 232.25)
MIN 1'-0 & L.P.(EL 232.10)
(CLASS 'D' CONC. FILL)
56'-7 NTS
SYM ABOUT ℄ (UNLESS NOTED)
FOR LOUVER SEE 2165-G-
SEE DET (TYP)
EL 284.50
EL 280.50
EL 278.00
EL 274.00
C.J.
W/ EMB. PL EL 273.00 FOR LOC. SEE G-2876
W/ EMB. PL EL 268.50 FOR LOC. SEE G-2876 (TYP)
CHKD PL SEE 2168-G-6085 (TYP)
W/ EMB. PL EL 265.50 FOR LOC. SEE G-2876
SCREEN WASH PUMP
4" PIPES SEE 2165-G 209
FIRE WATER PUMP
EL 262.00
EL 259.00
WS
SLOPE
H.P. EL 255.33
L.P. EL 255.17
EL 257.00
T.O.S EL 256.00
12" TYPE 'C'(M)
DRAIN PIPE
RECESS TYP
CJ
EL 248.50
NTS
EL 231.00
EL 228.00
SEAL MAT (TYP)

SECT A-A (G-2875/G7) (G-2876/H7 & H7)

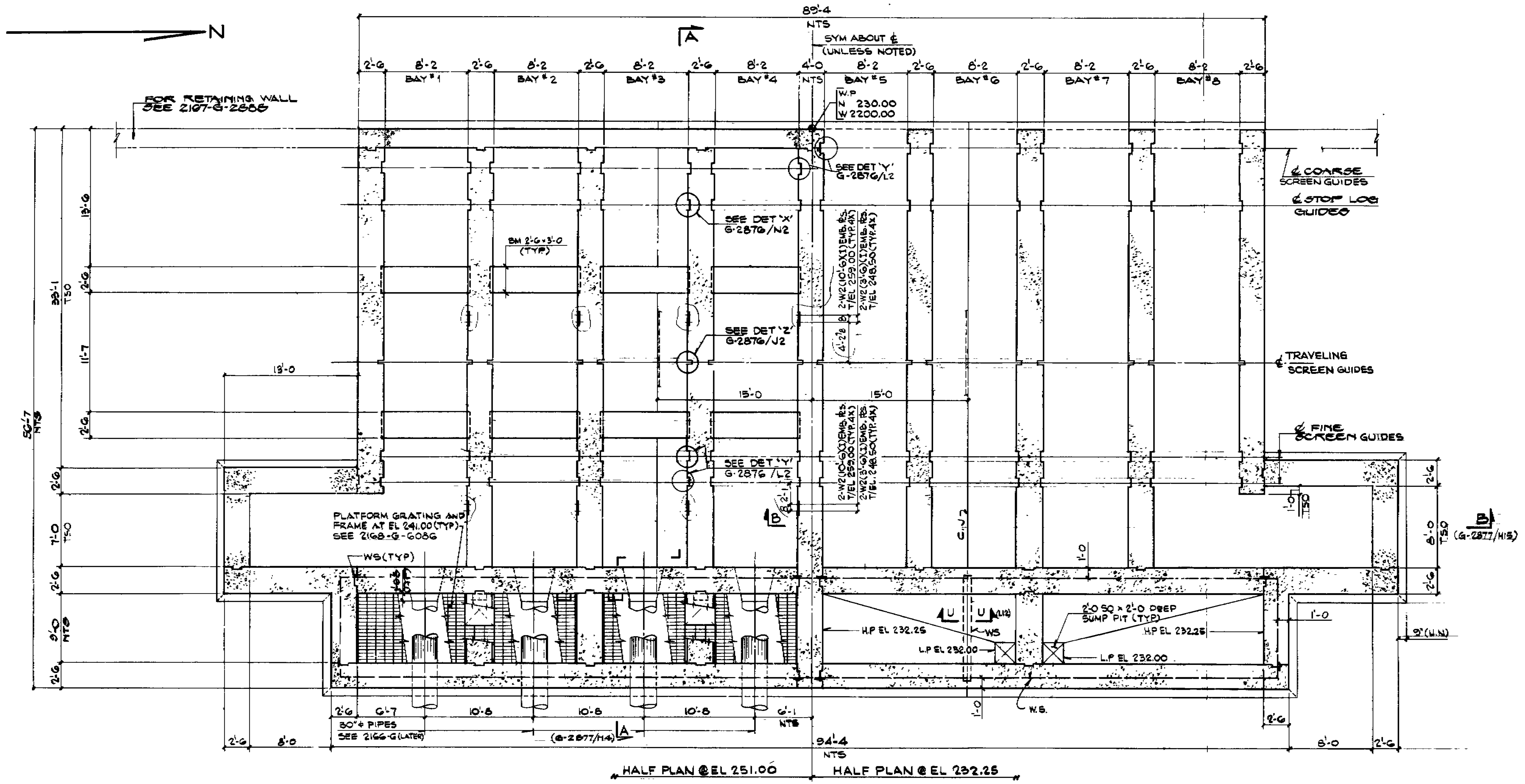
SECT B-B (G-2875/F15) (G-2876/F16 & L15)

REF DWG: PART OF CAR-2167-G-2875 (REV. 5)

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
ENVIRONMENTAL REPORT

EMERGENCY SERVICE WATER SYSTEM
AUXILIARY RESERVOIR
SCREEN STRUCTURE

FIGURE 3.4.4-1



PLAN

REF DWG: PART OF CAR-2167-G-2877 (REV. 5)

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
ENVIRONMENTAL REPORT

EMERGENCY SERVICE WATER SYSTEM
AUXILIARY RESERVOIR
SCREEN STRUCTURE
FIGURE 3.4.4-2

3.5 RADWASTE SYSTEMS AND SOURCE TERMS

3.5.1 SOURCE TERM

The operation of any nuclear power reactor results in the production of radioactive materials which are for the most part contained within the fuel elements of the reactor vessel. These radioactive materials are either direct products of the fission process or are materials activated in the nuclear core. Radioactive materials which escape from the fuel and those materials activated within the nuclear core are contained within the Reactor Coolant System (RCS) which is a completely enclosed system. Gaseous and liquid radioactive materials are normally removed from the reactor coolant under controlled conditions during clean-up processes or during deboration. In addition, small quantities of radioactive material may escape from the RCS due to leakage. The Chemical and Volume Control System, Boron Recycle System, Waste Processing System and Steam Generator Blowdown System are designed to contain and process radioactive effluents with "as low as reasonably achievable" release of radioactivity to the environment under normal operating conditions.

3.5.1.1 Normal Operation Source Terms Including Anticipated Operational Occurrences

The model for evaluating the expected fission product concentrations in the primary and secondary coolants under normal operating conditions including anticipated operational occurrences, was formulated as recommended by ANSI N237-1976 (Reference 3.5.1-1) and is the method recommended by NUREG-0017 (Reference 3.5.1-2). These concentrations are provided in Table 3.5.1-1 and the asssumptions used to calculate these activities are presented in Table 3.5.1-2. 5

3.5.1.2 Corrosion Products

The reactor coolant corrosion product concentrations are presented in Tables 3.5.1-1. The normal operational corrosion product reactor activities are from NUREG-0017.

3.5.1.3 Nitrogen-16 Activity

Nitrogen-16 is produced by the O^{16} (n,p) N^{16} reaction. The N^{16} decays, emitting high-energy gammas 78 percent of the time. The gamma energies are 6.13 Mev, 69 percent of the time and 7.14 Mev, 9 percent of the time. The N-16 half-life is 7.11 sec. The threshold for the reaction is 10.2 Mev.

The N-16 activity of the coolant is the controlling radiation source in the design of the secondary shielding and is tabulated in the Table 3.5.1-3 in μCi as a function of transport time in a reactor coolant loop.

The pressurizer nitrogen-16 activity calculations are based on an insurge to the pressurizer following a 10 percent step load power decrease. It is assumed that the incoming reactor coolant mixes only with the pressurizer liquid below the first baffle (109 $ft.^3$) and that the nitrogen-16 concentration is correct for decay during transit through the surge line.

With these assumptions, the pressurizer nitrogen-16 activity is found to be 13.3 micro-Curies per gram.

3.5.1.4 Carbon-14 Production

The following discussion on carbon-14 production is taken from NUREG-0017. The principal source of carbon-14 is oxygen-17 (n,a) carbon-14. The production rate of carbon-14 from oxygen-17 is given by the equation:

$$Q = N_o \sigma_o \phi mtps \text{ (Ci/yr.)}$$

where:

m is 3.3×10^4 kg, the mass of water in the core,

N_o is 1.3×10^{22} atoms 0-17/kg natural water,

p is 0.8, the plant capacity factor

s is 1.03×10^{-22} Ci/atom, the specific activity of C-14,

t is 3.15×10^7 sec./yr., the maximum irradiation time per year,

σ_o is 2.4×10^{-25} cm^2, the thermal neutron cross section of oxygen-17,

ϕ is 3.0×10^{13} neutrons/cm^2-sec, the average thermal neutron flux

Based on the above parameters, the carbon-14 production rate is 8 Ci/yr.

3.5.1.5 Tritium

3.5.1.5.1 Production

5

Deleted by Amendment No. 5

5

Based on the reported liquid and gaseous tritium releases at nine operating PWRs, NUREG-0017 has developed a tritium production rate of 0.4 Ci/yr. per Mwt. This methodology will be used to calculate the normal operational, including anticipated operational occurrences, tritium production rate (please note that production rate and release rate are the same thing).

3.5.1.5.2 Concentration

The concentration of tritium in the plant coolant water is a function of:

a) The inventory of tritiated liquids in the plant,

b) The rate of production of tritium due to activation in the reactor coolant as well as release from the fuel, and

c) The extent to which tritiated water is recycled or discharged from the plant. The tritium concentrations given in NUREG-0017 are representative of PWRs with a moderate amount of tritium recycle and will be used as the normal operational source terms.

3.5.1.6 Spent Fuel Pool Fission Product and Corrosion Product Activities

5 Spent fuel pool expected fission and corrosion product specific activities are given in Table 3.5.1-5 for the start of the refueling period. It is assumed that upon shutdown for refueling, the RCS is cooled down for a period of approximately two days. During this period, the primary coolant letdown is through the purification filter, purification heat exchanger, and volume control tank. This serves two purposes; removing the noble gases in the volume control tank avoids large activity releases to the Containment following reactor vessel head removal, and the ion exchanger and filter reduces dissolved fission and corrosion products in the coolant which would otherwise enter the spent fuel pool and refueling water cavity. At the end of this period, the coolant above the reactor vessel flange is partially drained. The reactor vessel head is unbolted and the refueling water cavity is filled with approximately 475,000 gallons of water from the refueling water storage tank. Remaining reactor coolant volume containing radioactivity is then mixed with water in the refueling cavity. The refueling cavity water mixes with the

spent fuel pool water via transfer tube and fuel transfer canal. After refueling, the spent fuel pool is isolated and the water in the refueling cavity is returned to the refueling water storage tank. This series of events determines the total activity to the spent fuel pool. The specific activities of the radionuclides given in Table 3.5.1-5 are based upon a volume of 960,250 gallons. The initial radioactivity level will be reduced by decay during refueling and by operation of the Spent Fuel Pool Cooling and Cleanup System. 5

Based on a spent fuel pool volume of 398,000 gallons, a processing rate of 325 gallons per minute through the Spent Fuel Pool Cleanup System, and a combined decontamination factor of 2 for Cs, Rb, and 10 for all others for the filter and demineralizer, the cleanup rate for Cs, Rb and other particulate radionuclides is 0.59 and 1.06 cycles per day, respectively.

The fuel pool activities under normal operating conditions are also presented in Table 3.5.1-5. These values are obtained using the method described for design basis values with the exception that normal primary coolant activities presented in Table 3.5.1-1 are used instead of design basis primary coolant activities.

As discussed in Section 9.1 of the FSAR, the fuel storage pools will be used for storage of PWR and BWR spent fuel shipped from other nuclear plants on the CP&L system. Since this fuel will have been out of the reactor for a minimum of 90 days prior to being shipped to SHNPP, it will not contribute significantly to the fuel pool activities calculated above.

3.5.1.7 Leakage Sources 5

Systems containing radioactive liquids are potential sources of leakage to the environment. Table 3.5.1-6 provides a listing of assumed leakage values from valves and pumps. Leakage of primary coolant into the containment building atmosphere, which is ultimately exhausted to the environment at times of containment purge, is assumed to be one percent per day of the primary coolant noble gas activity and .001 percent per day of the iodine activity in the primary coolant. An additional potential source of gaseous discharge is coolant leakage (via the CVCS and BRS) into the Reactor Auxiliary Building.

A leakage rate for each unit of 160 lb./day of a mixture of hot and cold primary coolant leakage is assumed, with an iodine and noble gas partition factor of .0075 and 1.0 respectively. The liquid from these leakage sources is collected and processed in the Liquid Waste Management System which is described in Section 3.5.2.

Primary to secondary leakage can result in the buildup of radionuclides in the secondary coolant and Steam Generator Blowdown System (SGBS). Under normal operation a leakage rate of 100 lb./day is assumed. The activity can ultimately result in discharge of small amounts of liquid and gaseous wastes to the environment. The discharge of liquid waste can result from liquid leakage to the turbine building sump and the release of portions of processed blowdown. It is assumed that leakage to the turbine building sump is five gpm and that all of steam generator blowdown is processed and returned to the secondary coolant system.

Gaseous releases from the secondary side can result from main steam leakage, the gland seal system exhaust and the discharge of noncondensible gases from the SGBS flash tank. Overall main steam leakage is assumed to be approximately 1700 lb./hr. and originates from many sources, each too small to identify. Turbine gland seal steam flow is sent to a gland steam condenser resulting in negligible discharges. Since all noncondensible gases from the SGBS flash tank are vented to the condenser, these releases are also negligible.

The above leakage rates and partition coefficients are based on the recommendations and experience presented in NUREG-0017.

Releases inside the plant are handled by the appropriate ventilation system. Containment air purification and cleanup systems are described in Section 9.4.5 of the FSAR. Reactor Auxiliary Building and Turbine Building Area Ventilation Systems are discussed in Section 9.4 of the FSAR and continuous radiation monitors are discussed in Section 12.3.4 of the FSAR.

3.5.1.8 Spent Resin Volumes

The spent demineralizer resin supplied to the Solid Waste Management System from demineralizers in the Nuclear Steam Supply System is presented in Table 3.5.1-7. The information is based on plant experience as further outlined in Reference 3.5.1-3.

3.5.1.9 Source Term Data

Data needed for radioactive source term calculations required by Regulatory Guide 4.2 are contained in Appendix A of this report.

TABLE 3.5.1-1

NORMAL OPERATIONAL PRIMARY AND SECONDARY COOLANT ACTIVITIES
(μCi/gm)

5

Nuclide	Primary Coolant	Secondary Coolant	
		Water	Steam
Kr-83m	2.40×10^{-2}	nil	8.16×10^{-9}
Kr-85m	1.18×10^{-1}	nil	4.10×10^{-8}
Kr-85	8.34×10^{-3}	nil	2.87×10^{-9}
Kr-87	6.98×10^{-2}	nil	2.29×10^{-8}
Kr-88	2.24×10^{-1}	nil	7.56×10^{-8}
Kr-89	6.01×10^{-3}	nil	2.07×10^{-9}
Xe-131m	1.99×10^{-2}	nil	6.91×10^{-9}
Xe-133m	1.11×10^{-1}	nil	3.85×10^{-8}
Xe-133	$5.46 \times 10^{+0}$	nil	1.87×10^{-6}
Xe-135m	1.55×10^{-2}	nil	5.29×10^{-9}
Xe-135	3.37×10^{-1}	nil	1.15×10^{-7}
Xe-137	1.08×10^{-2}	nil	3.69×10^{-9}
Xe-138	5.25×10^{-2}	nil	1.76×10^{-8}
Br-83	5.63×10^{-3}	7.91×10^{-8}	7.91×10^{-10}
Br-84	3.11×10^{-3}	2.21×10^{-8}	2.21×10^{-10}
Br-85	3.61×10^{-4}	3.49×10^{-10}	3.49×10^{-12}
I-130	2.35×10^{-3}	4.23×10^{-8}	4.23×10^{-10}
I-131	2.86×10^{-1}	5.55×10^{-6}	5.55×10^{-8}
I-132	1.17×10^{-1}	2.20×10^{-6}	2.20×10^{-8}
I-133	4.18×10^{-1}	7.84×10^{-6}	7.84×10^{-8}
I-134	5.60×10^{-2}	5.19×10^{-7}	5.19×10^{-9}
I-135	2.17×10^{-1}	3.73×10^{-6}	3.73×10^{-8}
Rb-86	9.00×10^{-5}	4.71×10^{-9}	4.71×10^{-12}
Rb-88	2.40×10^{-1}	1.28×10^{-6}	1.28×10^{-9}
Cs-134	2.63×10^{-2}	1.38×10^{-6}	1.38×10^{-9}
Cs-136	1.38×10^{-2}	7.19×10^{-7}	7.19×10^{-10}
Cs-137	1.90×10^{-2}	9.93×10^{-7}	9.98×10^{-10}
N-16	4.00×10^{-1}	1.00×10^{-6}	1.00×10^{-7}
H-3	1.00×10^{-0}	1.00×10^{-3}	1.00×10^{-3}
Cr-51	2.00×10^{-3}	5.58×10^{-8}	5.58×10^{-11}
Mn-54	3.26×10^{-4}	1.23×10^{-8}	1.23×10^{-11}
Fe-55	1.68×10^{-3}	4.94×10^{-8}	4.94×10^{-11}
Fe-59	1.05×10^{-3}	3.71×10^{-8}	3.71×10^{-11}
Co-58	1.68×10^{-2}	4.95×10^{-7}	4.95×10^{-10}
Co-60	2.10×10^{-3}	5.55×10^{-8}	5.55×10^{-11}
Sr-89	3.68×10^{-4}	1.24×10^{-8}	1.24×10^{-11}
Sr-90	1.05×10^{-5}	2.47×10^{-10}	2.47×10^{-13}
Sr-91	7.33×10^{-4}	12.59×10^{-8}	1.59×10^{-11}
Y-90	1.29×10^{-6}	5.20×10^{-11}	5.20×10^{-14}

TABLE 3.5.1-1 (Cont'd)

NORMAL OPERATIONAL PRIMARY AND SECONDARY COOLANT ACTIVITIES
(μCi/gm)

Nuclide	Primary Coolant	Secondary Coolant	
		Water	Steam
Y-91m	4.29×10^{-4}	1.38×10^{-8}	1.38×10^{-11}
Y-91	6.72×10^{-5}	1.86×10^{-9}	1.86×10^{-12}
Y-93	3.83×10^{-5}	7.88×10^{-10}	7.88×10^{-13}
Zr-95	6.31×10^{-5}	2.47×10^{-9}	2.47×10^{-12}
Nb-95	5.26×10^{-5}	2.48×10^{-9}	2.48×10^{-12}
Mo-99	8.99×10^{-2}	2.60×10^{-6}	2.60×10^{-9}
Tc-99m	5.50×10^{-2}	2.63×10^{-6}	2.63×10^{-9}
Ru-103	4.73×10^{-5}	1.24×10^{-9}	1.24×10^{-12}
Ru-106	1.05×10^{-5}	2.47×10^{-10}	2.47×10^{-13}
Rh-103m	5.35×10^{-5}	2.70×10^{-9}	2.70×10^{-12}
Rh-106	1.20×10^{-5}	7.12×10^{-10}	7.12×10^{-13}
Te-125m	3.05×10^{-5}	6.19×10^{-10}	6.19×10^{-13}
Te-127m	2.94×10^{-4}	6.18×10^{-9}	6.18×10^{-12}
Te-127	9.59×10^{-4}	2.40×10^{-8}	2.40×10^{-11}
Te-129m	1.47×10^{-3}	3.72×10^{-8}	3.72×10^{-11}
Te-129	1.90×10^{-3}	7.77×10^{-8}	7.77×10^{-11}
Te-131m	2.72×10^{-3}	6.85×10^{-8}	6.85×10^{-11}
Te-131	1.32×10^{-3}	3.08×10^{-8}	3.08×10^{-11}
Te-132	2.88×10^{-2}	6.45×10^{-7}	6.45×10^{-10}
Ba-137m	1.92×10^{-2}	1.58×10^{-6}	1.58×10^{-9}
Ba-140	2.32×10^{-4}	6.24×10^{-9}	6.24×10^{-12}
La-140	1.62×10^{-4}	4.68×10^{-9}	4.68×10^{-12}
Ce-141	7.37×10^{-5}	2.48×10^{-9}	2.48×10^{-12}
Ce-143	4.34×10^{-5}	6.79×10^{-10}	6.79×10^{-13}
Ce-144	3.47×10^{-5}	1.23×10^{-9}	1.23×10^{-12}
Pr-143	5.27×10^{-5}	1.25×10^{-9}	1.25×10^{-12}
Pr-144	3.96×10^{-5}	3.21×10^{-9}	3.21×10^{-12}
Np-239	1.29×10^{-3}	3.93×10^{-8}	3.93×10^{-11}

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TABLE 3.5.1-2

PARAMETERS USED TO DESCRIBE THE REACTOR SYSTEM - REALISTIC BASIS

			SHNPP	ANSI N237 RANGE	
Parameter	Symbol	Units	Value	Maximum	Minimum
Thermal power	P	mwt	2900	3800	3000
Steam flowrate	FS	lb/hr	1.2×10^7	1.7×10^7	1.3×10^7
Weight of water in reactor coolant system	WP	lb.	3.9×10^5	6.0×10^5	5.0×10^5
Weight of water in all steam generators	WS	lb.	3.3×10^5	5.0×10^5	4.0×10^5
Reactor coolant letdown flow (purification)	FD	lb/hr	3.0×10^4	4.2×10^4	3.2×10^4
Reactor coolant letdown flow (yearly average for boron control)	FB	lb/hr	3.0×10^2	1.0×10^3	2.5×10^2
Steam generator blowdown flow (total)	FBD	lb/hr	1.5×10^5	1.0×10^4	8.0×10^3
Flow through the the purification system cation demineralizer	FA	lb/hr	3.0×10^3	7.5×10^3	0.0
Ratio of condensate demineralizer flowrate to the total steam flowrate	NC	-	0.7	0.75*	0.55*

* Values from NUREG 0017

TABLE 3.5.1-3

REACTOR COOLANT N-16 ACTIVITY*

Position in Loop	Loop Transit Time (sec.)	N-16 Activity (μCi/gram)
Leaving core	0	217
Leaving reactor vessel	1.2	193
Entering steam generator	1.5	187
Leaving steam generator	5.5	127
Entering reactor coolant pump	6.1	120
Entering reactor vessel	6.8	112
Entering Core	7.9	110
Leaving core	8.7	217

* From Westinghouse Proprietary Document Radiation Analysis Manual, CQL/3-1, Model 312, CP&L, SHNPP, Unit 1-4.

Table 3.5.1-4 deleted by Amendment No. 5

TABLE 3.5.1-5

SPENT FUEL POOL SPECIFIC ACTIVITY (μCi/gm)

Nuclide	Spent Fuel Pool Concentration
	Normal
I-131	1.9×10^{-5}
I-133	2.7×10^{-5}
Mo-99	5.8×10^{-6}
Cs-134	1.7×10^{-6}
Cs-137	1.2×10^{-6}
Cr-51	1.3×10^{-8}
Mn-54	2.1×10^{-8}
Co-58	1.1×10^{-6}
Co-60	1.4×10^{-7}
Fe-59	1.1×10^{-7}
H-3	1.0

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TABLE 3.5.1-6

EQUIPMENT LEAKAGE ASSUMPTIONS

Valves	
Seat Leakage	10 cc/hr./in. Seat Diameter
Stem Leakage	10 cc/hr./in. Stem Diameter
Pumps	
Centrifugal	50 cc/hr.
Positive Displacement	1 gal./hr.
Pump Flanges	30 cc/hr.

TABLE 3.5.1-7

EXPECTED SPENT RESIN VOLUME

(Two Units) 5

Item	Number	Resin Volume Each (ft.^{3})	Replacement Frequency (number/year)
CVCS mixed bed demineralizers	4	30	1
CVCS cation bed demineralizer	2	20	1
Recycle evaporator feed demineralizers	2*	30	1
Recycle evaporator condensate demineralizer	2*	30	1
Thermal regeneration demineralizers	8	75	1

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* Common to Units 1 and 2

3.5.2 LIQUID RADWASTE SYSTEMS

The Liquid Waste Processing System (LWPS) provides for the collection, storing, processing, and controlled release of radioactive and potentially radioactive liquids associated with the operation of the nuclear power plant. The discharge of treated wastes is controlled and monitored to ensure that any discharges are as low as are reasonably achievable (ALARA) and that they are in conformance with the requirements specified in 10CFR20 and 10CFR50.

3.5.2.1 Design and Operation 5

The LWPS is designed to collect all primary plant radioactive waste water and by processing, reduce the radionuclide concentration and upgrade its quality to permit reuse or discharge to the environs. In addition, the LWPS is designed to treat occasional batches of secondary liquids should leakage or other occurrences produce radioactive liquids in the secondary system. Differences in primary and secondary system water chemistry must be considered prior to reusing liquids from these sources.

The LWPS is divided into four subsystems; the Equipment Drain Treatment System, Floor Drain Treatment System, Laundry and Hot Shower Treatment System, and the Secondary Waste Treatment System. These subsystems segregate the various types of liquid radwaste based on their source because of their composition and process requirements. The segregation is used to provide the maximum water quality and radionuclide removal prior to release of treated water to the environs.

The design and operation of the LWPS including system descriptions and component design parameters are discussed in detail in Section 11.2 of the SHNPP FSAR.

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Provisions have been made to sample and analyze processed liquids before they are recycled or discharged to the environment. Based on laboratory analysis and the limitations of 10CFR20 and 10CFR50, Appendix I, these fluids will be either released under controlled conditions via the cooling tower blowdown system or retained for further processing. The system is capable of processing all wastes generated during operation of the Reactor Coolant System for both units.

The annual input waste volumes for the systems and discharge quantities are shown in Table A.4.1-1 of Appendix A. This table indicates the source of the influent, the volume of flow (per day and per year) and the activity of each source. Table 3.5.2-2 details the anticipated operational occurrences which were considered in the design of the LWPS for normal operation. Table A.4.1-2 of Appendix A shows the evaluation of the LWPS and indicates the capabilities of the LWPS to process the waste surge flows of anticipated operational occurrences, and the redundant process equipment to handle equipment downtime. This evaluation shows that the LWPS has sufficient capability and redundancy to process surge waste flows associated with anticipated operational occurrences such as waste flows from back-to-back refuelings and equipment downtime.

3.5.2.2 System Radioactive Release Requirements 5

The LWPS limits releases to the environs of liquid radwaste to meet the as low as reasonably achievable (ALARA) criteria. The design release limits are based on normal operation of each unit, including anticipated operational occurrences. 5

The LWPS provides for the collection and processing of radioactive and potentially radioactive liquids associated with the operation of the SHNPP. The processed liquid is either recycled in the plant or discharged to the environment. The radioactivity removed from the liquids is concentrated in filters, ion exchange resin, and concentrator bottoms. These concentrated wastes are sent to the Solid Waste Processing System for packaging and eventual shipment to an approved offsite disposal location. If the water is to be recycled back to the RCS, it must meet the purity requirements for reactor coolant. If the liquid is to be discharged, the activity level must be consistent with the discharge criteria of 10CFR20 and 10CFR50, Appendix I. The LWPS is capable of monitoring radioactive liquid discharge from the system to ensure that activity concentrations do not exceed predetermined limits. If a limit is exceeded, discharge will be automatically terminated.

An estimate of the normal liquid effluent from each unit, including anticipated operational occurrence, is presented in Table 3.5.2-4. Table 3.5.2-5 presents the assumptions used. The values were obtained using the guidance presented in NUREG 0017, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from PWRs," (April 1976). 5

The amount of tritium released via the liquid pathway is calculated from the volume of reactor coolant that is released in the nonrecyclable waste streams. The concentration of tritium in wastes originating from reactor coolant during normal operation is taken as 1 micro-Ci./gm., consistent with Table 3.5.1-2, Tritium in liquid that leaks into, or is used as makeup to, the secondary system is considered to be released in liquid effluents through the turbine building floor drain discharge. The parameters for reactor coolant activity prior to processing are used to calculate the tritium concentrations in the waste streams.

Release of liquid radioactivity is through the cooling tower discharge line. Radioactive liquid effluent concentrations in the reservoir and the cooling tower discharge for normal operation and the potential doses caused by the release of radioactivity in the liquid effluents are discussed in Section 5.2.

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5 3.5.2.3 Expected and Design Inventories

The expected inventories of radionuclides in the process streams are given in Tables A.4.1-4 through A.4.1-7 of Appendix A.

The activities of liquids in the primary coolant are given in Table 3.5.1-2 for normal operations. The annual volumes and activity fractions are given in Table A.4.1-1 of Appendix A.

3.5.2.4 Provisions to Prevent Uncontrolled Releases

Instrumentation and controls are provided to isolate the LWPS in the event of excessive radioactivity in the system to prevent inadvertent releases of the activity. The monitoring of effluent is described in Section 3.5.5 and is designed as required by NRC Regulatory Guide 1.21. The LWPS is also monitored for flow, temperature, conductivity, pH, pressure and level to ensure system operations are performing as expected and that system limitations are not exceeded. Accordingly, the monitoring system meets the requirements of General Design Criteria 64 of 10CFR50, Appendix A.

Design features are included as system safeguards and precautionary measures to control leakage, spillage and overflow. Tanks and other equipment are provided with level indication and alarms for high-level conditions. The level alarms alert the operators when tanks are nearly full and operator initiated transfer from filled tanks to alternate tanks will proceed. For tanks containing significant radioactivity and thus requiring shielding, curbings are provided in the tank cubicle entrances to prevent spread of liquid from the cubicle in the case of overflow. The floors in the cubicles are pitched to floor drains located at low points to facilitate floor drainage. These floor drains are drained to sumps or tanks which collect any fluid overflows where it can be routed back to the LWPS for processing.

The refueling water storage tank and the reactor make-up water storage tank are the only tanks that hold processed liquid radwaste (including BRS and LWPS), which are not totally enclosed in a building. These tanks have level detection instrumentation which annunciates in the Control Room on a high level condition. Any flow from these tanks through overflow nozzles is contained within the retention dikes or ponds surrounding the tank. If a sample analysis indicates that treatment of the water is required due to its radioactive or chemical content, alternate connections can be used to route this spillage to the Liquid Waste Processing System.

Collection tanks and tanks which receive processed waste are generally provided in pairs. The pairing of tanks allows one tank to be in the fill

mode while the other tank is in the sampling, recirculation, process or
standby mode. Since the volume of influent waste (see Tables A.4.1-1 and
A.4.1-2 of Appendix A) can be processed with approximately 10 percent 5
operational time or less using the subsystems described in this section, an
empty standby tank is normally available for any filled tank. Thus, switching
from one tank to another prevents overflow of a tank.

In compliance with Regulatory Guide 1.21, radiation monitors are provided
before the three environmental discharge points. In the event of an
off-standard radiological condition, these monitors automatically terminate 5
the release. During plant operation, periodic testing will be done as
described in FSAR Section 11.2 to verify that systems and components are
operating as designed. When off-standard quality exists, the fluids are
sampled, analyzed, and routed for further treatment.

Thus, the system controls provide interlocks to prevent spillage from both potential operator errors as well as equipment failure and provisions to collect all leakage within the Waste Processing Building and from the recycle holdup tank which is located in the Reactor Auxiliary Building. Therefore, operator errors or equipment malfunction (single failures) do not result in uncontrolled releases of radioactive material to the environment.

Table 11.2.1-7 of the SHNPP FSAR lists the tanks outside of Containment and their conformance with the guidelines of ETSB II-1 (Rev. 1).

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Deleted by Amendment No. 5

Deleted pages 3.5.2-6 through 3.5.2-15

Table 3.5.2-1 deleted by Amendment No. 5

Deleted pages 3.5.2-16 and 3.5.2-17

TABLE 3.5.2-2

ANTICIPATED OPERATIONAL OCCURRENCES AND OFF-STANDARD VOLUMES

A) The Floor Drain Treatment System will process the wastes which are detailed in Table 3.5.2-1.

B) Total processing capability of CVCS and FDS water is maintained assuming failure of or required maintenance on either the boric acid concentrator or the floor drain evaporator.

C) Total processing capability of CVCS and FDS water could be maintained for simultaneous failure or required maintenance of the boric acid concentrator and the floor drain evaporator if one evaporator is returned to service within thirty days. However, holdup tanks must be near minimum level at the time both evaporators are removed from service. Load following operations or cold shutdown and startup could result in waste in excess of storage capacity of holdup tanks and floor drain tanks.

D) To maintain total process capability:

1) Condenser leaks must be isolated quickly and repaired.

2) Primary-to-secondary leakage must be low to prevent radioactive buildup in excess of technical specifications for steam generator activity.

3) The plant could not be started up from a cold shutdown condition without the availability of at least one of the BRS evaporators.

E) Total process capability of detergent waste water is maintained provided chemical discharges are acceptable for release to the environment.

Table 3.5.2-3 deleted by Amendment No. 5

TABLE 3.5.2-4

RADIOACTIVE LIQUID EFFLUENTS (PER UNIT)

	Annual Releases to Cooling Tower Blowdown							
Nuclide	Boron RS (Curies)	Misc. Waste (Curies)	Secondary (Curies)	Turb Bldg (Curies)	Total LWS (Curies)	Adjusted Total (Ci/Yr.)	Detergent Wastes (Ci/Yr.)	Total (Ci/Yr.)
Corrosion and Activation Products								
Cr 51	4.54E-06	7.07E-05	2.15E-08	5.52E-07	7.58E-05	2.22E-04	0.	2.20E-04
Mn 54	1.24E-06	1.46E-05	6.75E-09	1.23E-07	1.60E-05	4.67E-05	3.30E-05	8.00E-05
Fe 55	6.64E-06	7.66E-05	2.77E-08	4.91E-07	8.38E-05	2.45E-04	0.	2.50E-04
Fe 59	2.93E-06	4.10E-05	1.65E-08	3.68E-07	4.43E-05	1.30E-0	0.	1.30E-04
Co 58	5.34E-05	6.96E-04	2.40E-07	4.91E-06	7.54E-04	2.21E-03	1.32E-04	2.30E-03
Co 60	8.38E-06	9.62E-05	3.14E-08	5.53E-07	1.05E-04	3.07E.04	2.87E-04	5.90E-04
Np239	2.67E-07	8.23E-06	1.59E-09	3.63E-07	8.86E-06	2.59E-05	0.	2.60E-05
Fission Products								
Sr 89	1.07E-06	1.47E-05	5.67E-09	1.23E-07	1.59E-05	4.64E-05	0.	4.60E-05
Zr 95	1.96E-07	2.58E-06	1.18E-09	2.46E-08	2.81E-06	8.20E-06	4.62E-05	5.40E-05
Nb 95	2.12E-07	2.46E-06	1.36E-09	2.47E-08	2.60E-06	7.90E-06	6.60E-05	7.40E-05
Mo 99	2.32E-05	6.96E-04	1.34E-07	2.43E-05	7.44E-04	2.17E-03	0.	2.20E-03
Tc 99M	2.21E-05	6.59E-04	1.28E-07	2.39E-05	7.05E-04	2.06E-03	0.	2.10E-03
Ru106	4.03E-08	4.73E-07	1.36E-10	2.46E-09	5.16E-07	1.51E-06	7.92E-05	8.10E-05
Ag110M	0.	0.	0.	0.	0.	0.	1.45E-05	1.50E-05
Te127M	1.01E-06	1.26E-05	3.16E-09	6.14E-08	1.37E-05	4.01E-05	0.	4.00E-05
Te127	1.01E-06	1.29E-05	3.14E-09	1.75E-07	1.41E-05	4.13E-05	0.	4.10E-05
Te129M	3.68E-06	5.45E-05	1.53E-08	3.68E-07	5.86E-05	1.71E-04	0.	1.70E-04
Te129	2.36E-06	3.50E-05	9.81E-09	2.50E-07	3.76E-05	1.10E-04	0.	1.10E-04
I130	3.76E-07	1.96E-05	1.09E-09	3.01E-06	2.30E-05	6.72E-05	0.	6.70E-05
Te131M	2.32E-07	8.14E-06	9.85E-10	5.93E-07	8.97E-06	2.62E-05	0.	2.60E-05
I131	2.47E-03	5.82E-02	1.47E-05	5.41E-04	6.13E-02	1.79E-01	2.05E-06	1.80E-01
Te132	8.97E-06	2.63E-04	4.10E-08	6.08E-06	2.78E-04	8.13E-04	0.	8.10E-04
I132	9.34E-06	3.51E-04	4.97E-08	4.10E-05	4.01E-04	1.17E-03	0.	1.20E-03
I133	1.96E-04	7.77E-03	8.08E-07	6.40E-04	8.61E-03	2.52E-02	0.	2.50E-02
CS124	2.27E-04	1.20E-03	4.29E-07	1.37E-05	1.44E-03	4.22E-03	4.29E-04	4.60E-03
I135	6.00E-06	5.53E-04	8.79E-09	2.00E-04	7.58E-04	2.22E-03	0.	2.20E-03

TABLE 3.5.2-4 (Cont'd)

Nuclide	Annual Releases to Cooling Tower Blowdown Boron RS (Curies)	Misc. Waste (Curies)	Secondary (Curies)	Turb Bldg (Curies)	Total LWS (Curies)	Adjusted Total (Ci/Yr.)	Detergent Wastes (Ci/Yr.)	Total (Ci/Yr.)
Cs136	4.08E-05	3.63E-04	1.04E-07	7.06E-06	4.21E-04	1.23E-03	0.	1.20E-03
Cs137	1.67E-04	8.73E-04	3.15E-07	9.94E-06	1.05E-03	3.07E-03	7.92E-04	3.90E-03
Ba137M	1.56E-04	8.16E-04	2.94E-07	9.29E-06	9.82E-04	2.87E-03	0.	2.90E-03
Ba140	3.10E-07	6.20E-06	1.61E-09	6.13E-08	6.58E-06	1.92E-05	0.	1.90E-05
La140	3.46E-07	6.05E-06	1.83E-09	4.81E-08	7.45E-06	2.18E-05	0.	2.20E-05
Ce144	1.31E-07	1.55E-06	6.74E-10	1.23E-08	1.70E-06	4.96E-06	1.72E-04	1.80E-04
ALL OTHERS	1.49E-06	2.07E-05	5.82E-09	2.30E-06	2.45E-05	7.18E-05	0.	7.20E-05
TOTAL (EXCEPT TRITIUM)	3.41E-03	7.30E-02	1.74E-05	1.53E-03	7.79E-02	2.28E-01	2.06E-03	2.30E-01

TRITIUM RELEASE 150 CURIES PER YEAR

Boron Rs = Shimbleed and Equipment Drains
Misc. Wastes = Floor Drains and S.W. Low Cond
Secondary = Blowdown and Regenerant Sols.

TABLE 3.5.2-5

ASSUMPTIONS USED TO CALCULATE RADIOACTIVE LIQUID EFFLUENTS

Stream	Flow Rate (Gal/Day)	Fraction Of PCA	Fraction Discharged	Collection Time (Days)	Decay Time (Days)
Shimbleed Rate	8.64E+02	1.000	0.100	49.000	1.000
Equipment Drains	2.05E+02	1.000	0.100	49.000	1.000
Floor Drains	4.75E+02	0.070	0.100	21.000	2.200
S.W. Low Cond.	8.00E+02	0.000	0.100	1.000	0.083
Blowdown	4.32E+05		0.000	0.000	0.000
Regenerant Sols	4.80E+03		0.100	1000	0.560

Stream	Decontamination Factors		
	I	CS	Others
Shimbleed	1.00E+03	1.00E+04	1.00E+04
Equipment Drains	1.00E+03	1.00E+04	1.00E+04
Floor Drains	1.00E+01	1.00E+01	1.00E+01
S.W. Low Cond.	1.00E+04	2.00E+02	1.00E+04
Blowdown	1.00E+00	1.00E+00	1.00E+00
Regenerant Sols	1.00E+04	1.00E+05	1.00E+05

Table 3.5.2-6 deleted by Amendment No. 5

Table 3.5.2-7 deleted by Amendment No. 5

Table 3.5.2-8 deleted by Amendment No. 5

Table 3.5.2-9 deleted by Amendment No. 5

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Table 3.5.2-10 deleted by Amendment No. 5

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Table 3.5.2-11 deleted by Amendment No. 5

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Table 3.5.2-12 deleted by Amendment No. 5

Table 3.5.2-13 deleted by Amendment No. 5

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Table 3.5.2-14 deleted by Amendment No. 5

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Table 3.5.2-15 deleted by Amendment No. 5

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3.5.3 GASEOUS RADWASTE SYSTEMS

During power generation, radioactive material is released from the plant to the atmosphere in gaseous effluents which include low concentrations of fission-product noble gases (krypton and xenon), halogens (mostly iodine), and particulate material. The systems for the treatment of radioactive gaseous waste are shown on FSAR Figures 11.3.2-1 and 11.3.2-2. The primary sources of gaseous radioactive waste from each unit are listed as follows: | 5

a) Gaseous Waste Processing System (GWPS)

b) Reactor Containment Building (RCB) Heating, Ventilating, and Air Conditioning (HVAC) System

c) Reactor Auxiliary Building (RAB) HVAC System

d) Turbine Generator Building (TGB) HVAC System and process vents

e) Fuel Handling Building (FHB) HVAC System

f) Waste Processing Building (WPB) HVAC System

The design objectives of the gaseous waste systems are twofold. The first objective is to process and control the release of gaseous radioactive effluents to the site environs so that the total radiation exposure to offsite persons is ALARA and does not exceed applicable regulations. The second objective is to remove fission product gases from the primary coolant and process these gases before they are stored or released. These objectives are accomplished while maintaining inplant radiation exposure ALARA.

3.5.3.1 Gaseous Waste Processing System | 5

3.5.3.1.1 Function

The waste gas system removes fission gases from contaminated fluids and contains them indefinitely to eliminate the need for regularly scheduled discharge of radioactive gases from the system into the atmosphere during normal plant operation. Since the system also provides for reducing the concentration of fission gases in the reactor coolant to a low residual level, it functions to reduce the escape of radioactive gases during maintenance operations or through unavoidable equipment leaks. Design is based on continuous operation of the Nuclear Steam Supply System assuming that fission products associated with one percent of the core power generation are available for leakage from the fuel into the coolant through defects in the cladding. This condition is assumed to exist over the full life of the plant. Decayed gases will be released periodically. Therefore, the system includes provisions to sample and isolate each of the gas decay tanks. Controls are provided to make certain that these releases are made within the established Technical Specification limits.

3.5.3.1.2 Description

The design and operation of the Gaseous Waste Processing System including system descriptions and component design parameters are discussed in detail in Section 11.3 of the SHNPP FSAR. The process parameters for the GWPS for 90-day holdup and release are identified in Table 3.5.3-2.

5

Decayed gases will be released periodically and facilities are provided for controlled discharge of gas from the system.

Before a tank is emptied to the atmosphere, a gas sample must be analyzed to determine and record the activity to be removed. After sampling, the tank is isolated until its contents are discharged. If release is to the atmosphere, a trip valve in the discharge line will close automatically if there is a high activity level in the plant vent effluent.

5

3.5.3.2 Building HVAC Systems

The HVAC systems for each building are discussed in detail in Section 9.4 of the SHNPP FSAR.

3.5.3.3 Gaseous Radioactive Releases

Gaseous radioactive effluent will be released in accordance with the guidelines of 10CFR20 and 10CFR50, Appendix I. The GWPS is capable of monitoring radioactive gaseous discharge to the environment to ensure that activity concentrations do not exceed predetermined limits. If a limit is exceeded, discharge will be automatically terminated.

5 An estimate of the normal gaseous effluent from the facility, including anticipated operational occurrences, is presented in Tables A.6.3-1 and A.6.3-2 of Appendix A. The values were obtained using the guidance of NUREG-0017, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from PWRs" (April, 1976) and the assumptions given in Tables A.6.3-1 and A.6.3-2 of Appendix A.

The tritium released through the ventilation exhaust systems during normal operation was also calculated. The exhaust quantity of tritium available for release was calculated using a functional relationship derived from measured liquid and vapor tritium releases at operating PWRs and the integrated thermal power output during the calendar year in which the release occurs. It is assumed that the tritium released through the ventilation exhaust systems is the total tritium available for release minus the tritium calculated to be released through the liquid pathway. The annual average concentrations of these normal operational effluents at the site boundary are discussed in Section 5.2. The concentrations are based on the highest annual average 5 atmospheric dispersion factor, including terrain and recirculation correction factors, at the site boundary. The potential doses caused by the release of radioactivity in the gaseous effluent are also discussed in Section 5.2.

Section 3.1 presents the location of all gaseous release points, and provides the height and inside dimensions of each release point along with the effluent temperature and exit velocity.

Table 3.5.3-1 deleted by Amendment No. 5

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TABLE 3.5.3-2

PROCESS PARAMETERS FOR GWPS - 90 DAY HOLDUP AND RELEASE (NOTES 1 & 2)

ITEM DESCRIPTION GAS STREAMS	TEMP F	PRESS PSIG	FLOW SCFM	N_2 + He %	H_2 %	ISOTOPIC CONCENTRATION, μC/CC (Note 3) KR85	KR85M	KR87	KR88	XE-133	XE-133M	XE-135
1. Volume Control Tank Purge (Note 5)	130	18	1.4	0	100	2.07×10^{-2}	3.10×10^{-1}	1.08×10^{-1}	4.94×10^{1}	1.44×10^{1}	3.01×10^{-1}	8.99×10^{-1}
2. Gas Decay Tank Disch.	AMB	20	40	99.9	0.1	1.24	2.22×10^{-1}	2.14×10^{-2}	2.22×10^{-1}	8.83×10^{1}	2.54	1.27
3. Compressor Suction	AMB	0.5	41.4	96.6	3.4	1.2	2.25×10^{-1}	2.43×10^{-2}	2.31×10^{-1}	8.58×10^{1}	2.46	1.26
4. Comp. Disch.	140	30	41.4	96.6	3.4	1.2	2.25×10^{-1}	2.43×10^{-2}	2.31×10^{-1}	8.58×10^{1}	2.46	1.26
5. Recombiner Disch.	140	20	40	99.9	0.1	1.25	2.33×10^{-1}	2.52×10^{-2}	2.39×10^{-1}	8.88×10^{1}	2.55	1.3
6. Misc. Vents-Evaps. RCDT. Recycle Holdup Tank Educator (Note 5)	140	0.5	NEG.	0	100	0	0	0	0	0	0	0
7. Recombiner Oxygen Supply	AMB	50	0.7	0	0	0	0	0	0	0	0	0

ITEM DESCRIPTION LIQUID STREAMS	TEMP F	PRESS PSIG	FLOW GPD	ISOTOPIC CONCENTRATION, μC/CC (Note 5) KR85	KR85M	KR87	KR88	XE-133	XE-133M	XE-135
1. Waste Gas Compressor Drain	140	40	0	2.94×10^{-1}	5.49×10^{-2}	5.94×10^{-3}	5.64×10^{-2}	1.73×10^{1}	4.96×10^{-1}	2.53×10^{-1}
2. Recombiner Drain	140	30	12	2.48×10^{-1}	4.64×10^{-2}	5.02×10^{-3}	4.77×10^{-2}	1.46×10^{1}	4.2×10^{-11}	2.14×10^{-1}
3. Gas Decay Tank Drains	AMB	20	36	1.18×10^{-1}	2.1×10^{-2}	2.02×10^{-3}	2.1×10^{-2}	6.9	1.98×10^{1}	9.9×10^{-2}
4. System Drains to Vol. Control Tank	140	30-45	48	1.5×10^{-1}	2.73×10^{-2}	2.77×10^{-3}	2.76×10^{-2}	8.83	2.53×10^{1}	1.28×10^{-1}

TABLE 3.5.3-2 (Cont'd.)

PROCESS PARAMETERS FOR GWPS - 90 DAY HOLDUP AND RELEASE (NOTES 1 & 2)

ITEM DESCRIPTION GAS STREAMS	TEMP F	PRESS PSIG	VOL. FT.^{3}	N_2 %	H_2 %	COMPONENT INVENTORY, CURIES (Note 6) KR85	KR85M	KR87	KR88	XE-133	XE-133M	XE-135
A. Compressor	140	40	4	98.3	1.7	5.25×10^{-1}	9.35×10^{-2}	9.02×10^{-3}	9.35×10^{-2}	3.72×10^{1}	1.07	5.34×10^{-1}
B. Recombiner	140	30	4	99.9	0.1	4.29×10^{-1}	7.64×10^{-2}	7.37×10^{-3}	5.24×10^{-1}	3.04×10^{1}	8.73×10^{-1}	4.37×10^{-1}
C. Gas Decay Tank	AMB	20	600	99.9	0.1	3.05	5.43	5.24×10^{-1}	5.43	2.16×10^{3}	6.21×10^{1}	3.1×10^{1}
TOTAL SYSTEM						1.23×10^{2}	5.6	5.4×10^{-1}	5.6	7.20×10^{3}	6.4×10^{1}	3.2×10^{1}

TABLE 3.5.3-2 (continued)

PROCESS PARAMETERS FOR GWPS - 90 DAY HOLDUP AND RELEASE

NOTES:

1. Basis: Type of Operation = Periodic Release of Gases

   Power Level = 2900 MWt

   Number of Units = 2

   Normal Operation Gas Decay Tanks in Rotational Use = 4

   GDT Operating Interval = 1 day

   Stripping Efficiency = 0.4

   Accumulation Period = 90 Days

2. Concentrations based on stripping fractions from Table 3.5.3-6 and reactor coolant activities from Table 3.5.3-7. 2

3. Concentrations in μc per cc of gas at atmospheric pressure and 140 F.

4. Parameters reflect the combined gas streams from two operating reactors.

5. Concentrations in μc per cc at room temperature.

6. NEG - Negligible

7. AMB - Ambient

Table 3.5.3-3 deleted by Amendment No. 5

Deleted pages 3.5.3-11 through 3.5.3-13

Table 3.5.3-4 deleted by Amendment No. 5

Table 3.5.3-5 deleted by Amendment No. 5

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Table 3.5.3-6 deleted by Amendment No. 5

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Table 3.5.3-7 deleted by Amendment No. 5

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3.5.4 SOLID WASTE PROCESSING SYSTEM

The Solid Waste Processing System (SWPS) collects, controls, processes, packages, handles, and temporarily stores radioactive waste generated as a result of normal operation of the plant, including anticipated operational occurrences. The SWPS prepares waste material for transportation to an off-site disposal facility. The SWPS is shared by the two units. 5

3.5.4.1 Design Objectives

The SWPS provides a reliable means for handling radioactive wastes while maintaining radiation exposure levels to the public and plant personnel within the permissible limits of 10CFR20 and 10CFR50. 5

In order to accomplish these design objectives, the following specific criteria are satisfied:

a) The SWPS is designed to provide for the collection, processing, packaging, and storage of solid wastes resulting from plant operations without limiting the operation or availability of the plant. Types of wastes and quantities (maximum and expected volumes) given in Table A.7.1-1 of Appendix A as inputs to the SWPS are accommodated in the system design. 5

b) The SWPS is designed to provide at least 60 days storage of spent resin in the spent resin tank during normal generation rates.

c) The SWPS storage area is capable of accommodating at least one full off-site waste shipment. 5

d) The SWPS is designed to provide at least one-day storage of evaporator bottoms production during normal generation rates.

e) The SWPS is designed to provide a reliable means of remotely handling spent resins and evaporator bottoms. A reliable means is provided to remotely handle filter particulates as required. The handling of this solid radwaste will be done while maintaining the exposure levels to plant personnel within the permissible limits of 10CFR20.

f) The SWPS is designed to prevent the release of significant quantities of radioactive materials to the environs in order to keep the exposure to the public and operating personnel within the requirements of 10CFR20 and 10CFR50.

g) All radioactive waste is packaged (including the shipping container) in a manner which will allow shipment and burial in accordance with 49CFR170-179, 10CFR20, and 10CFR71.

5 h) The SWPS is designed to provide remote handling of containers used in the packaging of spent resins, filter particulates, and evaporator bottoms.

i) The SWPS is designed in accordance with seismic and quality assurance requirements of ETSB 11-1 (Rev. 1). Design of the structure housing the SWPS to Seismic Category I requirements prevents uncontrolled releases of radioactivity due to anticipated operational occurrences. Foundations and adjacent walls are designed to the Seismic Category I criteria to a height sufficient to contain the liquid inventory in the building. SHNPP FSAR Section 3.2 lists the seismic and quality group classifications of the SWPS.

3.5.4.2 System Description

The SWPS consists of several subsystems: 1) waste collection and pretreatment subsystem; 2) waste solidification subsystem; 3) volume reduction subsystem; 4) dry waste compaction subsystem; and 5) drummed waste handling and storage subsystem. The SWPS converts liquid wastes generated during normal plant operation into solid wastes which are then suitable for off-site burial.

The design and operation of the Solid Waste Processing System including system descriptions and component design parameters are discussed in detail in Section 11.4 of the SHNPP FSAR.

5

5

The input waste streams (maximum and expected volumes) are identified on Table A.7.1-1 of Appendix A. The expected volume of wastes to be shipped off site were calculated using nuclide activity inputs to the SWPS shown on Tables A.7.1-2 through A.7.1-4.

Processed waste is shipped and buried in accordance with 49CFR173. The expected volume of wastes to be shipped off site are given in Table A.7.2-1 of Appendix A. The associated curie content, including a listing by principal nuclides, is given in Table 3.5.4-6 for spent resins with six months decay. The basis for the activities is the radionuclides removed from the liquid processing streams. The activities for the particulates, spent resins, and concentrates are consistent with the sources presented in Section 3.5.1 (Source Terms), and the processing described in Section 3.5.2 and FSAR Section 11.2 (Liquid Waste Processing System).

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Table 3.5.4-1 deleted by Amendment No. 5

Table 3.5.4-2 deleted by Amendment No. 5

Deleted pages 3.5.4-6 and 3.5.4-7

Table 3.5.4-3 deleted by Amendment No. 5

Deleted pages 3.5.4-8 and 3.5.4-9

Table 3.5.4-4 deleted by Amendment No. 5

Deleted pages 3.5.4-10 and 3.5.4-11

Table 3.5.4-5 deleted by Amendment No. 5

TABLE 3.5.4-6

NUCLIDE ACTIVITY SHIPPED FROM THE SOLID RADWASTE SYSTEM (μ'Ci-g) Normal Operations

Isotope	Evaporator(1) Bottoms	Back Wash(2) Filter Sludge	Spent Resin(3)
Br 83	5.05E-05	1.98E-01	1.41E-08
Br 84	1.50E-07	3.99E-03	1.23E-06
I 130	1.08E-03	0.	1.61E-07
I 131	9.97E+00	2.20E+02	9.58E+00
I 132	3.80E-02	3.93E+00	1.55E-03
I 133	8.60E-01	1.85E+02	6.97E-03
I 134	2.10E-05	2.43E-01	1.80E-08
I 135	9.20E-02	3.59E+01	1.04E-02
Rb 86	6.17E-03	0.	4.30E-06
Rb 88	4.60E-07	0.	6.86E-05
Cs 134	4.03E+00	1.21E+01	4.80E+01
Cs 136	1.05E+00	6.27E+00	1.98E+00
Cs 137	2.96E+00	8.57E+00	3.16E-03
Cr 51	1.71E-02	1.81E+01	1.34E-05
Mn 54	4.58E-03	3.01E+00	6.01E-06
Fe 55	2.42E-01	1.36E+00	2.60E-04
Fe 59	1.09E-02	9.56E+00	9.69E-06
Co 58	1.96E-01	1.53E+02	1.96E-04
Co 60	3.10E-02	1.94E+01	4.10E-01
Sr 89	3.97E-02	2.95E-01	3.66E-05
Sr 90	1.54E-03	8.61E-03	1.69E-06
Sr 91	1.92E-04	1.80E-01	2.99E-08
Y 90	1.13E-06	8.78E-03	2.30E-10
Y 91M	1.39E-08	1.80E-02	1.26E-11
Y 91	7.48E-04	5.61E-01	7.04E-07
Y 93	1.18E-06	1.03E-01	1.81E-10
Zr 95	8.08E-04	5.25E-01	1.83E-06
Nb 95	6.16E-04	4.36E-01	1.62E-06
Mo 99	8.00E-02	6.78E+02	1.73E-06
Tc 99M	6.70E-02	*.97E+01	8.76E-09
Ru 103	4.76E-04	3.92E-01	5.02E-07
Ru 106	2.96E-04	8.96E-02	2.86E-06
Rh 103M	2.80E-09	3.04E-03	2.06E-12
Te 125M	3.40E-03	0.	2.21E-06
Te 127M	3.70E-02	0.	3.37E-05
Te 127	2.30E-04	0.	3.60E-08
Te 129M	1.36E-01	0.	1.15E-04
Te 129	1.76E-06	0.	1.02E-09
Te 131M	8.70E-03	0.	9.80E-07
Te 131	1.87E-08	0.	9.47E-11
Te 132	3.60E-01	0.	7.59E-06
Ba 140	1.20E-02	0.	6.99E-06
La 140	6.92E-05	9.75E-01	4.77E-03
Ce 141	6.75E-04	6.07E-01	5.77E-07

TABLE 3.5.4-6 (continued)

Isotope	Evaporator(1) Bottoms	Back Wash(2) Filter Sludge	Spent Resin(3)
Ce 143	1.33E-05	2.44E-01	2.07E-09
Ce 144	7.88E-04	2.94E-01	5.89E-06
Pr 143	2.87E-04	4.25E-01	1.76E-07
Pr 144	5.78E-11	0.	1.33E-12
Np 239	9.32E-03	0.	1.77E-06
TOTAL	2.03E+01	1.45E+03	5.99E+01

NOTES:

(1) The inputs consist of waste evaporator bottoms, RO concentrate evaporator bottoms, SW high conductivity evaporator bottoms and boron recycle evaporator bottoms.

(2) The inputs consist of reactor coolant filter, fuel pool filter/demineralizer, secondary waste filter, waste evaporator filter, laundry and hot shower filter, and floor drain filter.

(3) The inputs consist of waste evaporator condensate demineralizer, floor drain monitor demineralizer, laundry & hot shower demineralizer, secondary waste (SW) low conductivity demineralizer, CVCS mixed bed and cation bed, boron thermal regeneration demineralizer and boron recycle evaporator feed demineralizer.

Table 3.5.4-7 deleted by Amendment No. 5

Table 3.5.4-8 deleted by Amendment No. 5

3.5.5 PROCESS AND EFFLUENT MONITORING

3.5.5.1 Liquid Effluent Monitoring

The ultimate liquid effluent release point to the environment is the cooling tower blowdown discharge pipeline which is shown on Figure 2.4.1-1, with the exception of storm drains which discharge directly to the Main and Auxiliary Reservoirs. The following liquid effluent streams are monitored for radioactive contamination prior to discharge to the environment.

3.5.5.1.1 Service Water Monitors

The service water monitors are part of the safety related portion of the Radiation Monitoring System (RMS) and provide an indication to operations personnel of the activity in the Service Water System downstream of each of the emergency containment fan coolers. These monitors detect radioactive leakage from the Component Cooling Water System into the Service Water System, and as such provide additional assurance that radioactivity will not be released undetected from the plant. Each of the four emergency containment fan coolers per unit is monitored.

The monitors provide a high radiation alarm when concentrations reach preset limits. The receipt of these alarms will alert the operator to the presence of leakage so that the leaking service water fan cooler can be isolated.

3.5.5.1.2 Turbine Building Drain Monitors

The turbine building drain monitors provide an indication to operations personnel of the activity in the effluent from the industrial waste sump to the cooling tower blowdown via the yard oil separator. 5

These monitors provide a high radiation alarm when concentrations reach a preset limit. When the radiation level exceeds the preset value, or on monitor failure, the monitor closes the flow control valve to the yard oil separator, and opens the flow control valve to divert the flow to the secondary waste treatment system for processing. 5

3.5.5.1.3 Tank Area Drain Transfer Pumps Monitors

The tank area drain transfer pumps monitors provide an indication to operations personnel of the activity in the effluent from the tank area.

These monitors provide a high radiation alarm when concentrations reach a preset limit. Ordinarily, this effluent is rainwater, which flows to the Storm Drain System; however, in the event of a major spillage of either the condensate storage tank or the refueling water storage tank this may be contaminated. When the radiation level exceeds the preset value, this flow is diverted to the floor drain tanks by automatic closure of the flow control valve to the Storm Drain System, and opening of the flow control valve to the floor drain tanks.

This monitor is not provided with a record of effluent flow releases.

3.5.5.1.4 Treated Laundry and Hot Shower Tank Pumps Monitors

The treated laundry and hot shower tank pump monitors provide an indication to operations personnel of the activity in the effluent from the treated laundry and hot shower tank to the cooling tower blowdown.

These monitors provide a high radiation alarm when concentrations reach preset limits. On high alarm, or monitor failure, the effluent discharge is terminated automatically by shutting the automatic flow control valve on the discharge line.

3.5.5.1.5 Waste Monitor Tanks Discharge Monitors

The waste monitor tanks discharge monitors provide an indication to operations personnel of the activity in the effluent from the waste monitor tanks to the cooling tower blowdown.

These monitors provide a high radiation alarm when concentrations reach preset limits. On high alarm, or monitor failure, the effluent discharge is terminated automatically by shutting the automatic flow control valve on the discharge line.

3.5.5.1.6 Secondary Waste Sample Tank

The secondary waste sample tank monitors provide an indication to operations personnel of the activity in the effluent from the secondary waste sample tank to the cooling tower blowdown.

These monitors provide a high radiation alarm when concentrations reach preset limits. On high alarm, or monitor failure, the effluent discharge is terminated automatically by shutting the automatic flow control valve on the discharge line.

3.5.5.2 Gaseous Effluent Monitoring

Gaseous effluent releases which may be radioactively contaminated are monitored. Figures 3.5.5-1, 3.5.5-3, and 3.5.5-4 are schematic representations of the potentially radioactively contaminated sources to the plant vent stacks. FSAR Figure 9.4.0-2 identifies the location of the plant vent stack release points relative to the site plan. The monitoring features associated with each potentially radioactively contaminated gaseous effluent stream are discussed below. 5

3.5.5.2.1 Fuel Handling Building (FHB) Normal Exhaust Monitors

The FHB normal exhaust monitors provide an indication to operations personnel of the activity in the Fuel Pool Ventilation System serving the operating floor and spent fuel pools. These exhausts contribute to release point 1 shown in Figure 3.5.5-1.

These monitors provide a high radiation alarm when concentration levels reach preset limits. The receipt of these alarms will alert the operator to the presence of low level leakage so that additional radiation surveys and sampling can be effected in order to locate leakage source.

3.5.5.2.2 Fuel Handling Building (FHB) Emergency Exhaust Monitors

The FHB emergency exhaust monitors are part of the safety related portion of the RMS and are located downstream of the HEPA-charcoal filter units of each of the two emergency exhaust ducts. These monitors measure effluent releases during and after a fuel handling accident. These exhausts contribute to release point 1 as shown in Figure 3.5.5-1. 5

3.5.5.2.3 Plant Vent Stack Monitors

The plant vent stack monitors are part of the safety related portion of the RMS and provide an indication to operations personnel of the activity of release point 1 as shown in Figure 3.5.5-1. The release point, common to two units, is monitored with a monitor dedicated to each unit. Each monitor is an airborne particulate, iodine and noble gas monitor. 5

The plant vent radiation monitors are designed to representatively sample, monitor, indicate and store the radioactivity levels in the plant effluent gases being discharged from the plant vent stack. It provides a continuous indication of the activity levels of radioactive materials released to the environment so that determination of the total materials released can be made.

3.5.5.2.4 Reactor Auxiliary Building (RAB) Normal Exhaust Monitors

The RAB normal exhaust monitors provide an indication to operations personnel of the general activity levels in the RAB, and as such provide an additional assurance that radioactivity will not be released undetected from the plant. These exhausts contribute to release point 1 as shown in Figure 3.5.5-1. 5

These monitors provide a high radiation alarm when concentrations reach preset limits. The receipt of these alarms will alert the operator to the presence of low level leakage so that additional radiation surveys and sampling can be effected in order to locate the source of leakage.

3.5.5.2.5 Reactor Auxiliary Building (RAB) Emergency Exhaust Monitors

Each of the RAB Emergency Exhaust Systems will be monitored for effluent release. 5 Activity released from the critical components of the Containment Spray System and RHR System during post-accident conditions will be sampled downstream of the HEPA-charcoal filter units provided for each RAB Emergency 5

Exhaust System. These monitors provide a high radiation alarm when concentrations reach preset limits.

3.5.5.2.6 Condenser Vacuum Pump Effluent Treatment System Monitors

5 The condenser vacuum pump monitors measure noncondensable fission product gases in the condenser vacuum pump discharge during normal operations. The presence of radioactivity in this line would indicate a primary to secondary leak in the steam generators. The predominant isotopes would be Kr-85 and Xe-133 with the presence of iodine. A heat exchanger and heater to prevent condensation is provided.

These monitors provide a high radiation alarm when concentrations reach preset limits. Detection of a high radiation level causes automatic termination of the discharge to the atmosphere and redirection of the discharge through the condensate vacuum pumps effluent treatment system. Ordinarily, during normal operations, this effluent pathway is monitored; however, during the hogging mode when the condenser is not contaminated, the condenser vacuum pump effluent bypasses the monitor and exhausts directly to atmosphere to allow for a more rapid achievement of the desired condenser vacuum.

3.5.5.2.7 Waste Processing Building (WPB) Exhaust System Monitors

The WPB exhaust monitors provide an indication to operations personnel of the overall airborne activity in the Waste Processing Building at effluent release point 5 as shown in Figure 3.5.5-4.

The monitors provide a high radiation alarm when concentration levels reach preset limits. Also, the WPB exhaust monitors serve to detect radioactivity passing through the vent stack from the gas decay tanks to atmosphere and serve to trip the flow control valve in the waste decay tank discharge line when the radiation level exceeds a preset value. Waste gas release is an operator decision based on meteorological conditions and activity contained in the waste gas. There is normally no need to vent the Waste Gas Processing System, although occasional discharges will be required to perform maintenance. When the operator has decided to release waste gas, he first samples the gas to determine its activity concentration. With this information and total pressure in the tank, the operator knows the quantity of activity to be released as well as the rate at which the gas can be released. To make the actual release, he must unlock and then open the manual isolation valve at the tank discharge and set the discharge flow control valve at the desired rate based on the vent stack activity monitor. Discharge flow is maintained at a constant rate by a pressure regulator upstream of the flow control valve. If the discharge flow rate results in an excessive radiation release rate, the flow control valve is tripped shut by the vent stack monitor.

3.5.5.2.8 Waste Processing Building (WPB) Exhaust System Monitors

The WPB exhaust monitors provide an indication to operations personnel of the overall airborne activity in the Waste Processing Building at effluent release point 5A shown in Figure 3.5.5-4.

These monitors provide a high radiation alarm when concentrations levels reach preset limits. The receipt of these alarms will alert the operator to the presence of low level leakage so that additional radiation surveys and sampling can be effected in order to locate the leakage source. As such, these monitors provide additional assurance that radioactivity will not be released undetected from the plant.

3.5.5.2.9 Continuous Containment Purge Monitors

The continuous containment purge monitor is part of the safety related portion of the RMS and provides an indication to operations personnel of the activity of the effluent being exhausted from the containment through the 8-in. continuous containment purge line, and released at release point 1 shown in Figure 3.5.5-1. 5

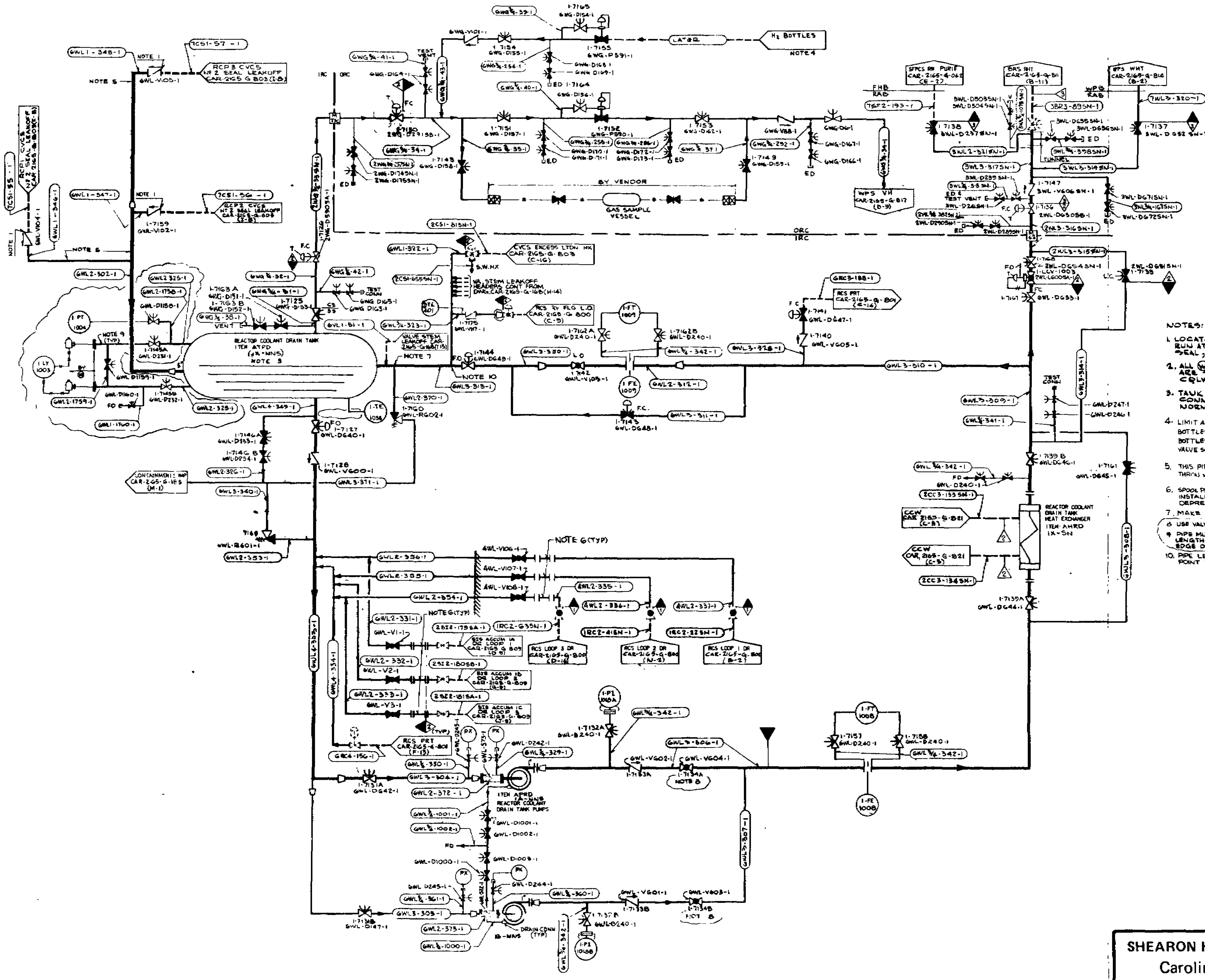
These monitors provide a high radiation alarm when concentration levels reach preset limits. The receipt of these alarms will alert the operator to the presence of low level leakage so that additional radiation surveys and sampling can be effected in order to locate the leakage source. As such, these monitors provide additional assurance that radioactivity will not be released undetected from the plant.

REFERENCES: SECTION 3.5

3.5.1-1 "Source Term Specification," ANSI N237-1976, American National Standards Institute.

3.5.1-2 "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Pressurized Water Reactors (PWR-GALE Code)," NUREG-0017, U.S. Nuclear Regulatory Commission, April, 1976.

3.5.1-3 "Source Term Data for Westinghouse Pressurized Water Reactors," WCAP-8253, Amendment 1, July, 1975.


H2 BOTTLES
NOTE 4
BY VENDOR
GAS SAMPLE VESSEL
ORC
IRC
RCP3 CVCS NO 2 SEAL LEAKOFF CAR-2165 G 803 (I-B)
RCP2 CVCS NO 2 SEAL LEAKOFF CAR-2165-G-803 (F-8)
RCP1 CVCS NO 2 SEAL LEAKOFF CAR-2165-G-803 (I-8)
NOTE 1
NOTE 5
NOTE 6
NOTE 7
NOTE 8
NOTE 9 (TYP)
NOTE 10
NOTE 6 (TYP)
CVCS EXCESS LTDN HX CAR-2165-G-803 (C-16)
VA. STEM LEAKOFF HEADERS CONT FROM DWG. CAR-2165-G-168 (H-14)
RCS RV FLG LO CAR-2165-G-800 (C-5)
RCS PRT CAR-2165-G-801 (C-16)
VALVE STEM LEAKOFF CAR-2165-G-168 (I-5)
REACTOR COOLANT DRAIN TANK ITEM ATPD (4X-MNS) NOTE 3
VENT
TEST CONN
S.W.HX
CONTAINMENT NHP CAR-2165-G-183 (M-1)
SFPCS RW PURIF CAR-2165-G-062 (E-2)
BRS RHT CAR-2165-G-811 (B-11)
WPS WHT CAR-2165-G-814 (B-8)
WPS VH CAR-2165-G-817 (D-9)
FHB RAB
WPB RAB
TUNNEL
RCS LOOP 3 DR CAR-2165-G-800 (D-16)
RCS LOOP 2 DR CAR-2165-G-800 (N-3)
RCS LOOP 1 DR CAR-2165-G-800 (B-2)
B2B ACCUM 1A DR LOOP 1 CAR-2165-G-809 (D-9)
B2B ACCUM 1B DR LOOP 2 CAR-2165-G-809 (A-9)
B2B ACCUM 1C DR LOOP 3 CAR-2165-G-809 (C-8)
RCS PRT CAR-2165-G-801 (F-13)
REACTOR COOLANT DRAIN TANK HEAT EXCHANGER ITEM AHRD 1X-SN
CCW CAR-2165-G-811 (C-8)
CCW CAR-2165-G-821 (C-8)
ITEM APRD 1A-NNS REACTOR COOLANT DRAIN TANK PUMPS
DRAIN CONN (TYP)
1B-NNS
1-PT 1004
1-LT 1003
1-FT 1009
1-FE 1009
1-TE 1056
1-FT 1008
1-FE 1008
1-PI 1050A
1-PI 1050B
PX
FO
FC
LO
ED
FD
REF DWG: CAR-2165-G-813 (REV 5, OPEN)

NOTES:

1. LOCATE CHECK VALVE IN HORIZONTAL RUN AT LEAST 2 FT. BELOW NO. 3 SEAL, 8 FT. ABOVE RCDT LEVEL.
2. ALL Ⓦ ITEM NO'S. ON THIS DWG. ARE SHOWN WITHOUT PREFIX CQLWP.
3. TANK INLET AND RECIRCULATION CONNECTIONS ARE BELOW THE NORMAL WATER LEVEL.
4. LIMIT AVAILABLE H2 SUPPLY TO TWO STANDARD BOTTLES. PRESSURE REGULATOR SUPPLIED ON BOTTLES TO BE SET AT [illegible] psig PROVIDE A RELIEF VALVE SET AT 100 PSIG.
5. THIS PIPING SHOULD BE SLOPED DOWNWARD THROUGHOUT THE RUN TO THE DRAIN [illegible]
6. SPOOL PIECE NORMALLY REMOVED ONLY TO BE INSTALLED WHEN DRAINING, AFTER DEPRESSURIZATION
7. MAKE CONNECTION ON SIDE OR BOTTOM
8. USE VALVE TO LIMIT PUMP RUNOUT.
9. PIPE MUST BE MINIMUM 3 INCHES IN LENGTH FROM WELD OF FLANGE TO EDGE OF VALVE
10. PIPE LENGTH DOWNSTREAM OF THIS POINT TO BE AS LONG AS PRACTICAL

REF DWG: CAR-2165-G-813 (REV 5, OPEN)

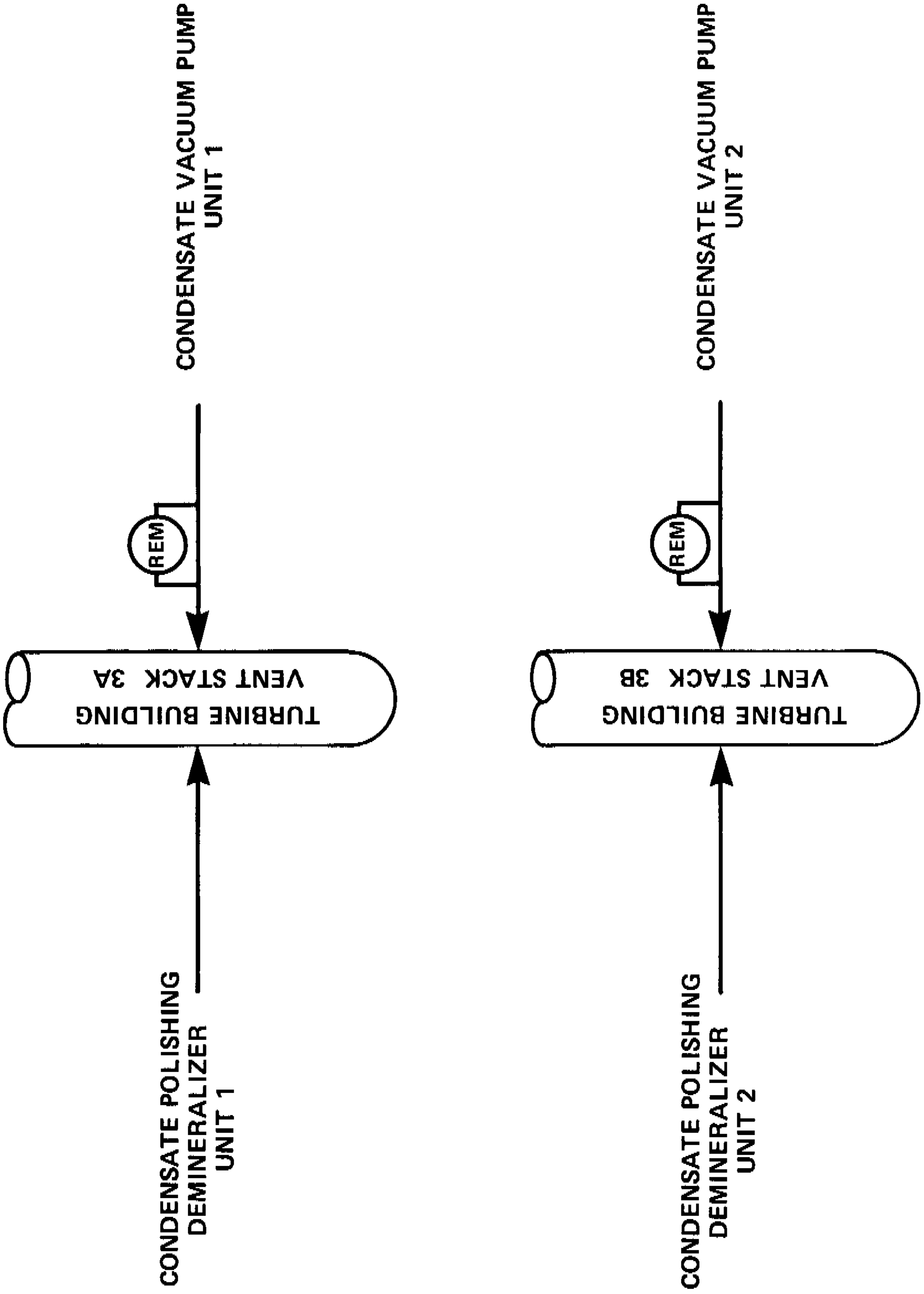
SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
ENVIRONMENTAL REPORT

FLOW DIAGRAM – CONTAINMENT
BUILDING WASTE PROCESSING
SYSTEM – UNIT 1
FIGURE 3.5.2-1

THIS FIGURE HAS BEEN DELETED

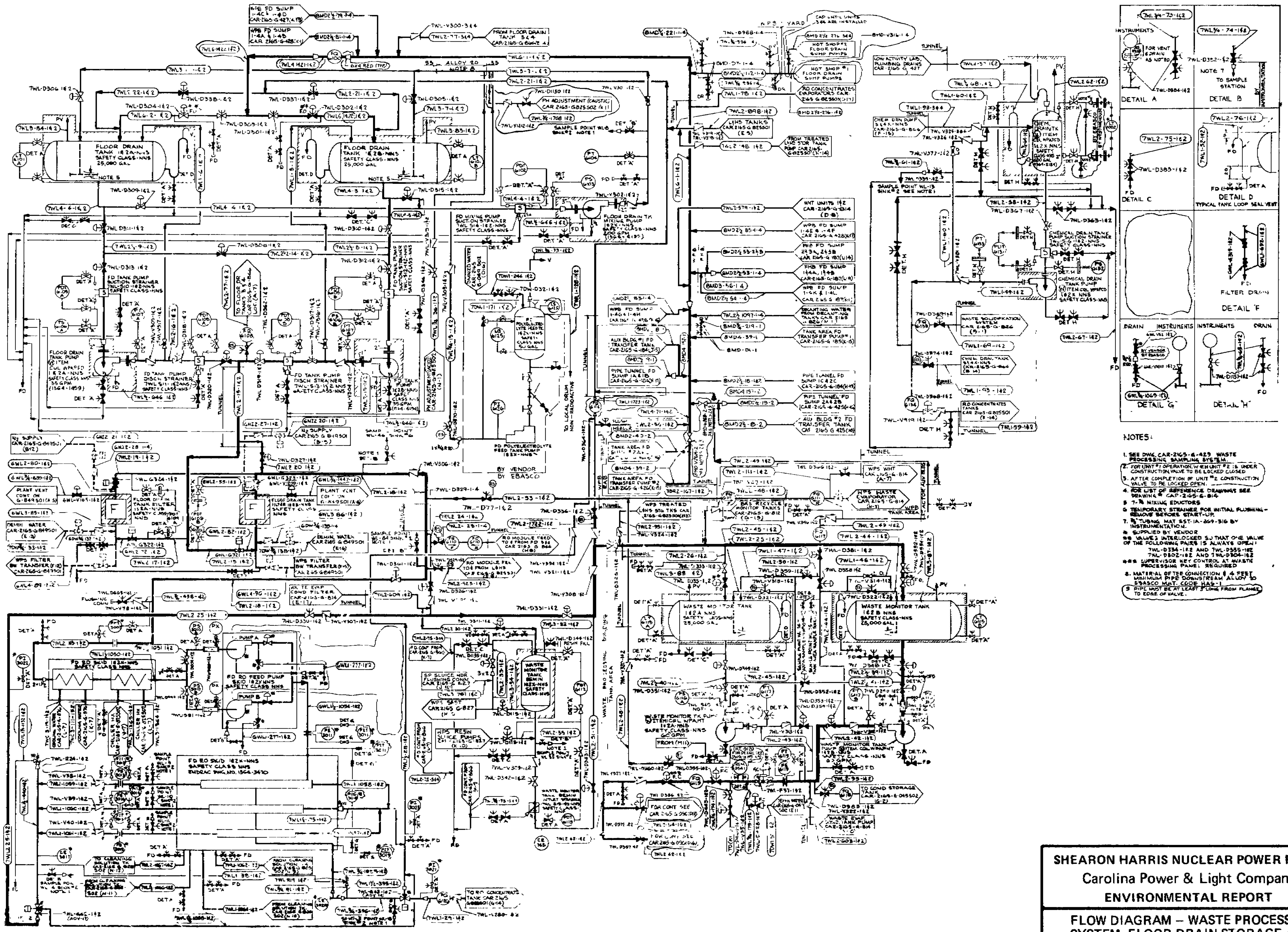
AMENDMENT NO. 5 (12/82)

SHEARON HARRIS NUCLEAR POWER PLANT Carolina Power & Light Company ENVIRONMENTAL REPORT	RELEASE POINT 2	FIGURE 3.5.5-2


CONDENSATE VACUUM PUMP UNIT 1
REM
TURBINE BUILDING VENT STACK 3A
CONDENSATE POLISHING DEMINERALIZER UNIT 1
CONDENSATE VACUUM PUMP UNIT 2
REM
TURBINE BUILDING VENT STACK 3B
CONDENSATE POLISHING DEMINERALIZER UNIT 2

AMENDMENT NO. 5 (12/82)

SHEARON HARRIS NUCLEAR POWER PLANT Carolina Power & Light Company **ENVIRONMENTAL REPORT**	RELEASE POINTS 3A, 3B	**FIGURE** **3.5.5-3**


FLOOR DRAIN TANK 1&2A-NNS SAFETY CLASS-NNS 25,000 GAL
FLOOR DRAIN TANK 1&2B-NNS SAFETY CLASS-NNS 25,000 GAL
FD TANK PUMP SUCTION STRAINER
FD TANK PUMP DISCH STRAINER
FLOOR DRAIN TANK PUMP
FD MIXING PUMP SUCTION STRAINER
FLOOR DRAIN TK MIXING PUMP
PH ADJUSTMENT (CAUSTIC)
SAMPLE POINT
FD POLYELECTROLYTE FEED TANK PUMP
BY VENDOR
BY EBASCO
TO LOCAL DRUM NON-RADIOACTIVE
N2 SUPPLY
PLANT VENT
FLOOR DRAIN TANK FILTER
DEMIN WATER
WPS FILTER BW TRANSFER
FD RO SKID 1&2X-NNS SAFETY CLASS NNS
FD RO FEED PUMP SKID 1&2X-NNS
PUMP A
PUMP B
FD RO SKID 1&2X-NNS SAFETY CLASS NNS ENDRAC DWG. NO. 1564-3470
WASTE MONITOR TANK DEMIN
SP SLUICE HDR FLUSHING CONN
WPS SAST
HPS RESIN SLUICE PUMPS
WASTE MONITOR TANK 1&2A-NNS SAFETY CLASS-NNS 25,000 GAL
WASTE MONITOR TANK 1&2B-NNS SAFETY CLASS-NNS 25,000 GAL
WASTE MONITOR TK PUMP
WASTE PROCESSING TANK AREA
TUNNEL
CHEM DRAIN TANK 1&2X-NNS
CHEMICAL DRAIN TANK PUMP SUCTION STRAINER
CHEMICAL DRAIN TANK PUMP
LOW ACTIVITY LAB PLUMBING DRAINS
HOT SHOP FLOOR DRAIN
RO CONCENTRATES EVAPORATORS
LINS TANKS
FROM TREATED LND STOR TANK PUMP
WHT UNITS 1&2
WPS FD SUMP
RAB FD SUMP
FHB FD SUMP
DECANTING WATER FROM DECANT'NG TANKS
TANK AREA FD TRANSFER PUMPS
AUX BLDG #1 FD TRANSFER TANK
PIPE TUNNEL FD SUMP
AUX BLDG #2 FD TRANSFER TANK
WASTE SOLIDIFICATION SYSTEM
CHEM DRN TANK
RO CONCENTRATES TANKS
NPS WASTE EVAPORATOR
TO COND STORAGE TANK
WASTE EVAP CONC TANK PUMP
TO RO CONCENTRATE TANK
TO CLEANING SOLUTION TK
DETAIL A
DETAIL B
DETAIL C
DETAIL D
TYPICAL TANK LOOP SEAL VENT
DETAIL E
FILTER DRAIN
DETAIL F
DETAIL G
DETAIL H
INSTRUMENTS
DRAIN
TO SAMPLE STATION
NOTE 7

NOTES:

1. SEE DWG. CAR-2165-G-429 WASTE PROCESSING SAMPLING SYSTEM.
2. FOR UNIT #1 OPERATION, WHEN UNIT #2 IS UNDER CONSTRUCTION VALVE TO BE LOCKED CLOSED
3. AFTER COMPLETION OF UNIT #2 CONSTRUCTION VALVE TO BE LOCKED OPEN.
4. FOR LIST OF REFERENCE DRAWINGS SEE DRAWING # CAR-2165-G-814
5. 7-¾ MIXING EDUCTORS
6. TEMPORARY STRAINER FOR INITIAL FLUSHING - REMOVE BEFORE START-UP.
7. ⅜" TUBING MAT SST-IA-269-316 BY INSTRUMENTATION.

* SUPPLIED BY VENDOR

** VALVES INTERLOCKED SO THAT ONE VALVE OF THE FOLLOWING PAIRS IS ALWAYS OPEN:

7WL-D334-1&2 AND 7WL-D335-1&2
7WL-D302-1&2 AND 7WL-D304-1&2

*** SUPERVISOR KEY CONTROL AT WASTE PROCESSING PANEL REQUIRED

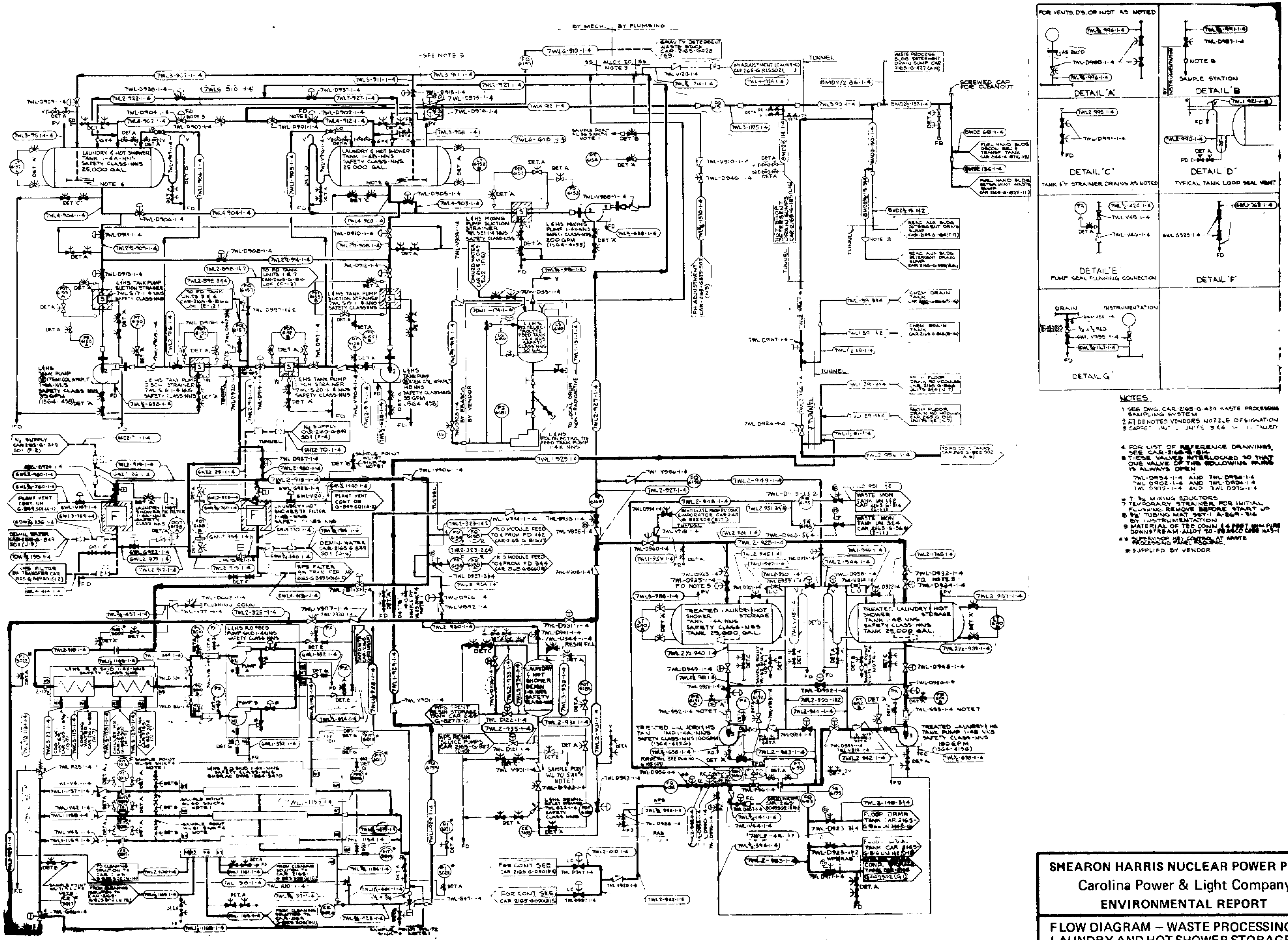
8. MATERIAL OF TEE CONNECTION & 4 FEET MINIMUM PIPE DOWNSTREAM ALLOY 20 EBASCO MAT. CODE HAS-1
9. PIPE MUST BE AT LEAST 3" LONG FROM FLANGE TO EDGE OF VALVE.

REF DWG: CAR-2165-G-816 (REV 6)

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
ENVIRONMENTAL REPORT

FLOW DIAGRAM – WASTE PROCESSING SYSTEM, FLOOR DRAIN STORAGE AND TREATMENT UNITS 1 & 2

FIGURE 3.5.2-4


BY MECH. BY PLUMBING
TUNNEL
LAUNDRY & HOT SHOWER TANK 1-4A-NNS SAFETY CLASS-NNS 25,000 GAL.
LAUNDRY & HOT SHOWER TANK 1-4B-NNS SAFETY CLASS-NNS 25,000 GAL.
L&HS MIXING PUMP 1-4A-NNS SAFETY CLASS-NNS 200 GPM (1564-4195)
L&HS TANK PUMP
TREATED LAUNDRY & HOT SHOWER STORAGE TANK 1-4A-NNS SAFETY CLASS-NNS TANK 25,000 GAL.
TREATED LAUNDRY & HOT SHOWER STORAGE TANK 1-4B-NNS SAFETY CLASS-NNS TANK 25,000 GAL.
TREATED LAUNDRY & HS TANK PUMP 1-4B-NNS SAFETY CLASS-NNS 100 GPM (1364-4196)
WASTE MON TANK
DETAIL 'A'
DETAIL 'B'
DETAIL 'C'
TANK & Y STRAINER DRAINS AS NOTED
DETAIL 'D'
TYPICAL TANK LOOP SEAL VENT
DETAIL 'E'
PUMP SEAL FLUSHING CONNECTION
DETAIL 'F'
DETAIL 'G'
FOR VENTS, D'S, OR INST AS NOTED
SAMPLE STATION
DRAIN
INSTRUMENTATION
SCREWED CAP FOR CLEANOUT
FOR CONT SEE CAR 2165-G-0901 S01
SEE NOTE 5

NOTES

1 SEE DWG. CAR-2165-G-429 WASTE PROCESSING SAMPLING SYSTEM
2 ▣ DENOTES VENDORS NOZZLE DESIGNATION
3 CAPSET [illegible] UNITS 3 & 4 [illegible] INSTALLED
4. FOR LIST OF REFERENCE DRAWINGS, SEE CAR-2165-G-814
5 THESE VALVES INTERLOCKED SO THAT ONE VALVE OF THE FOLLOWING PAIRS IS ALWAYS OPEN

7WL-D934-1-4 AND 7WL-D936-1-4
7WL-D902-1-4 AND 7WL-D904-1-4
7WL-D975-1-4 AND 7WL-D976-1-4

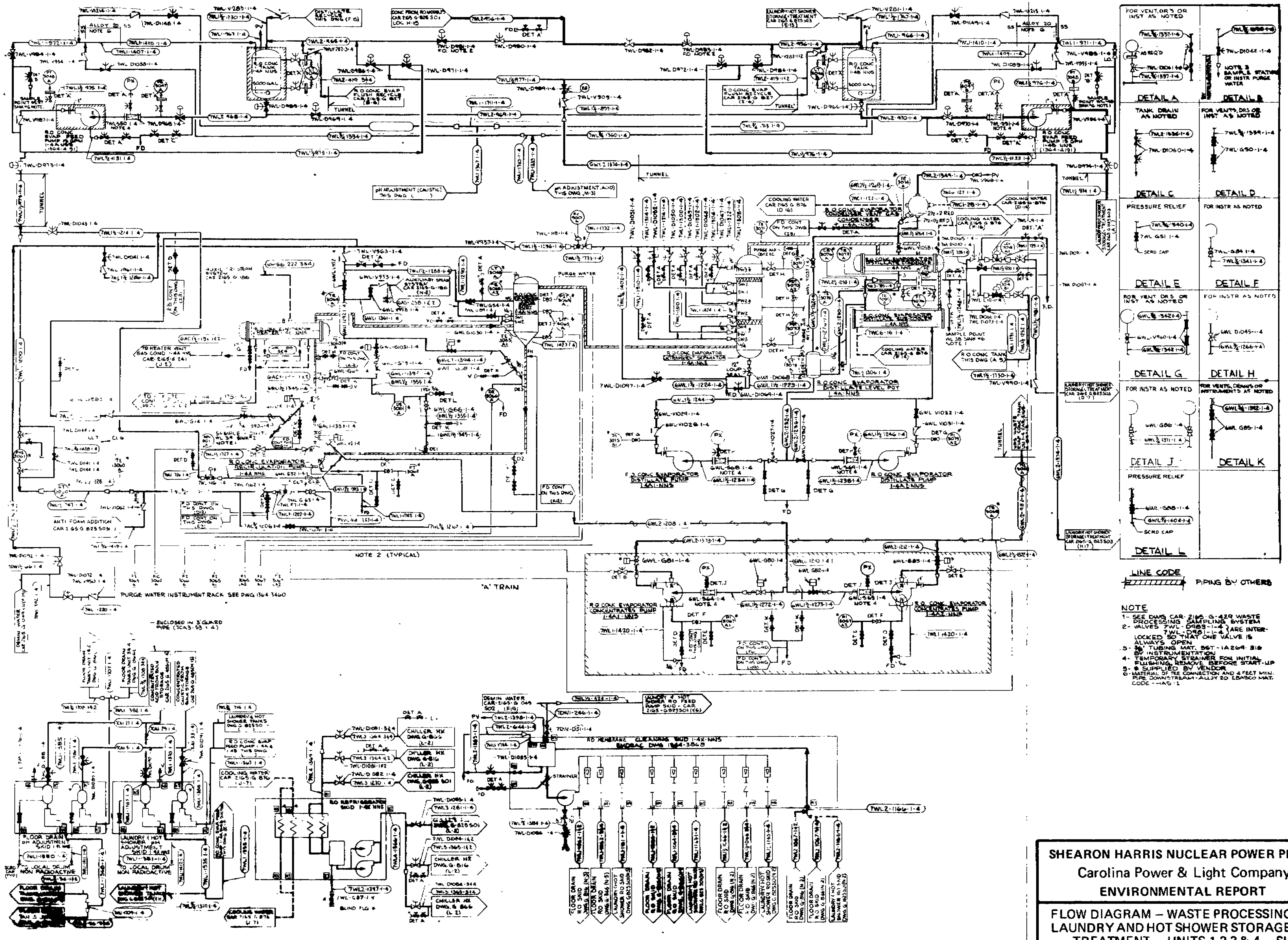
6 1-¾ MIXING EDUCTORS
7 TEMPORARY STRAINER FOR INITIAL FLUSHING. REMOVE BEFORE START UP
8 ⅜" TUBING MAT SST-1 A-269-316 BY INSTRUMENTATION
9 MATERIAL OF TEE CONN & 6 FEET MIN. PIPE DOWNSTREAM ALLOY 20-EBASCO CODE NAS-1
** SUPERVISOR KEY CONTROL AT WASTE PROCESSING PANEL REQUIRED.
* SUPPLIED BY VENDOR

REF DWG: CAR-2165-G-825 S01 (REV 6, OPEN)

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
ENVIRONMENTAL REPORT

FLOW DIAGRAM – WASTE PROCESSING SYS LAUNDRY AND HOT SHOWER STORAGE AND TREATMENT – UNITS 1,2,3 & 4 – SH 1

FIGURE 3.5.2-5


DETAIL A
DETAIL B
DETAIL C
DETAIL D
DETAIL E
DETAIL F
DETAIL G
DETAIL H
DETAIL J
DETAIL K
DETAIL L
FOR VENT, DRS OR INST AS NOTED
TANK DRAIN AS NOTED
FOR INSTR AS NOTED
PRESSURE RELIEF
SCRD CAP
TUNNEL
R.O. CONC TANK 1-4A NNS
R.O. CONC TANK 1-4B NNS
5000 GAL
R.O. CONC EVAP FEED PUMP
R.O. CONC EVAPORATOR DISTILLATE PUMP 1-4A1-NNS
R.O. CONC EVAPORATOR DISTILLATE PUMP 1-4A2-NNS
R.O. CONC EVAPORATOR CONCENTRATES PUMP 1-4A1-NNS
R.O. CONC EVAPORATOR CONCENTRATES PUMP 1-4A2-NNS
R.O. CONC EVAPORATOR DISTILLATE LEVEL POT 1-4A-NNS
R.O. CONC EVAPORATOR RECIRCULATION PUMP 1-4A-NNS
R.O. CONC EVAPORATOR ENTRAINMENT SEPARATOR 1-4A-NNS
R.O. CONC EVAPORATOR CONDENSER VENT GAS CONDENSER 1-4A-NNS
ALLOY 20
NOTE 2 (TYPICAL)
'A' TRAIN
PURGE WATER INSTRUMENT RACK SEE DWG 1364-3460
PURGE WATER
ANTI FOAM ADDITION
ENCLOSED IN 3" GUARD PIPE
FLOOR DRAIN pH ADJUSTMENT SKID
LAUNDRY & HOT SHOWER pH ADJUSTMENT SKID
TO LOCAL DRUM NON RADIOACTIVE
RO REFRIGERATION SKID 1-4E NNS
CHILLER HX
RO MEMBRANE CLEANING SKID 1-4X-NNS
STRAINER
BLIND FLG
DEMIN WATER
COOLING WATER
pH ADJUSTMENT (CAUSTIC) THIS DWG
pH ADJUSTMENT (ACID) THIS DWG
SAMPLE POINT
FD

LINE CODE

▨ PIPING BY OTHERS

NOTE

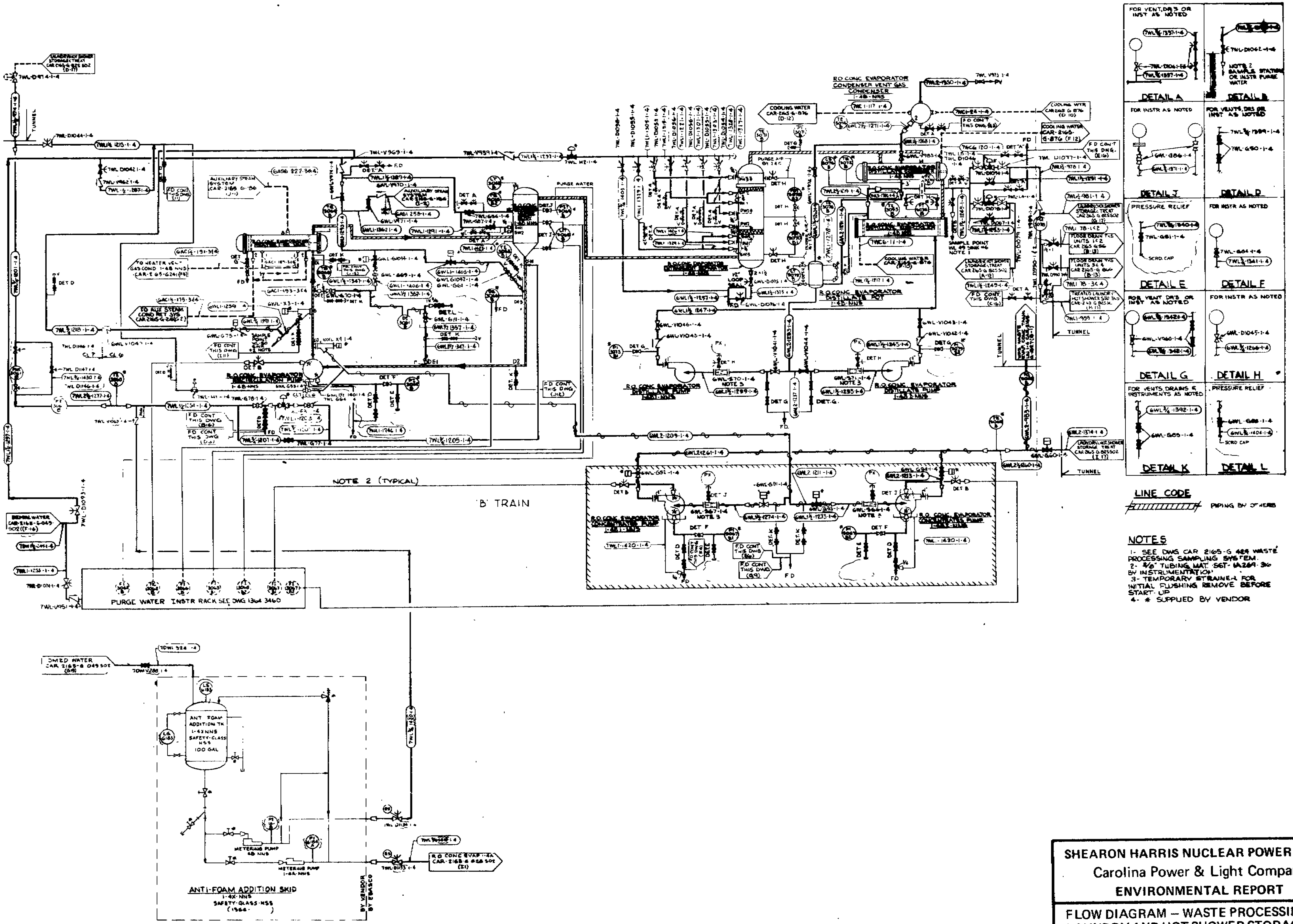
1- SEE DWG CAR-2165-G-429 WASTE PROCESSING SAMPLING SYSTEM
2- VALVES 7WL-D983-1-4 } ARE INTER-
7WL-D981-1-4 } LOCKED SO THAT ONE VALVE IS ALWAYS OPEN
3- 3/8" TUBING MAT. 56T-1A269-316 BY INSTRUMENTATION
4- TEMPORARY STRAINER FOR INITIAL FLUSHING, REMOVE BEFORE START-UP
5- ● SUPPLIED BY VENDOR
6- MATERIAL OF TEE CONNECTION AND 4 FEET MIN. PIPE DOWNSTREAM - ALLOY 20 EBASCO MAT. CODE - HAS-1

REF DWG: CAR-2165-G825 S02 (REV 5, OPEN)

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
ENVIRONMENTAL REPORT

FLOW DIAGRAM – WASTE PROCESSING SYS
LAUNDRY AND HOT SHOWER STORAGE AND
TREATMENT – UNITS 1,2,3 & 4 – SH 2

FIGURE 3.5.2-6


'B' TRAIN
NOTE 2 (TYPICAL)
PURGE WATER INSTR RACK SEE DWG 1364 3460
R.O. CONC EVAPORATOR CONDENSER VENT GAS CONDENSER 1-4B-NNS
R.O. CONC. EVAPORATOR RECIRCULATION PUMP 1-4B-NNS
R.O. CONC. EVAPORATOR DISTILLATE PUMP 1-4B-NNS
R.O. CONC. EVAPORATOR DISTILLATE POT 1-4B-NNS
R.O. CONC. EVAPORATOR CONCENTRATES PUMP
AUXILIARY STEAM SYSTEM
COOLING WATER
TO HEATER VENT
TO AUX STEAM COND RET SYS
PURGE WATER
TUNNEL
DEMIN WATER
DMZD WATER CAR 2165-G 049 S02
ANTI FOAM ADDITION TK 1-4X-NNS SAFETY-CLASS NSS 100 GAL
METERING PUMP
ANTI-FOAM ADDITION SKID 1-4X-NNS SAFETY-CLASS-NSS
BY VENDOR BY EBASCO
R.O. CONC EVAP 1-4A CAR-2165-G 825 S01
DETAIL A
DETAIL B
DETAIL J
DETAIL D
DETAIL E
DETAIL F
DETAIL G
DETAIL H
DETAIL K
DETAIL L
PRESSURE RELIEF
SCRD CAP
LINE CODE
PIPING BY OTHERS

NOTES

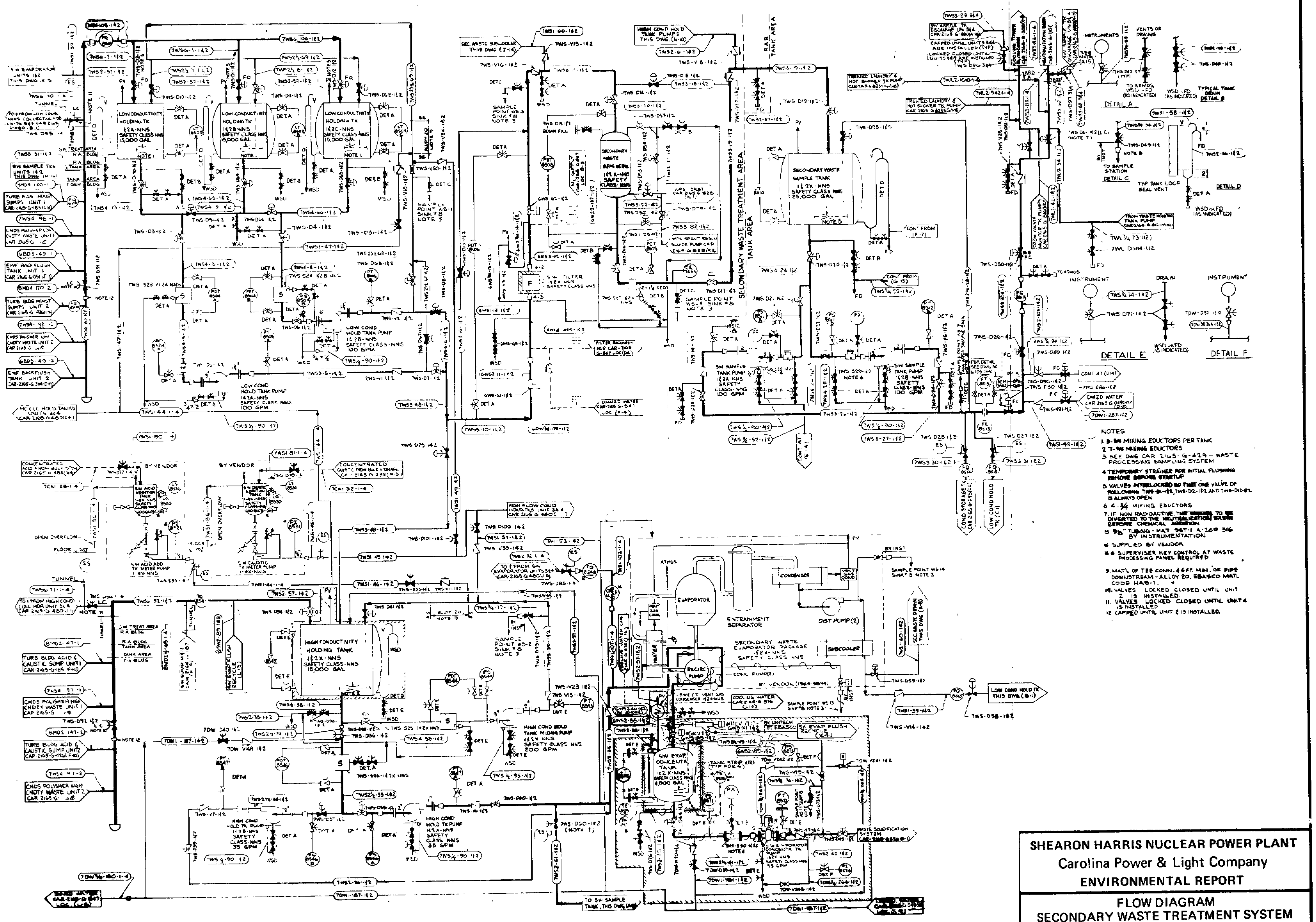
1- SEE DWG CAR 2165-G 484 WASTE PROCESSING SAMPLING SYSTEM.
2- 3/8" TUBING MAT. SGT-1A269-36 BY INSTRUMENTATION
3- TEMPORARY STRAINER FOR INITIAL FLUSHING REMOVE BEFORE START-UP
4- * SUPPLIED BY VENDOR

REF DWG: CAR-2165-G-825 S03 (REV 4)

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
ENVIRONMENTAL REPORT

FLOW DIAGRAM – WASTE PROCESSING SYS LAUNDRY AND HOT SHOWER STORAGE AND TREATMENT – UNITS 1,2,3 & 4 – SH 3

FIGURE 3.5.2-7



NOTES

1. 3-¾ MIXING EDUCTORS PER TANK
2. 7-¾ MIXING EDUCTORS
3. SEE DWG CAR 2165-G-429 – WASTE PROCESSING SAMPLING SYSTEM
4. TEMPORARY STRAINER FOR INITIAL FLUSHING REMOVE BEFORE STARTUP.
5. VALVES INTERLOCKED SO THAT ONE VALVE OF FOLLOWING TWS-D1-1&2, TWS-D2-1&2 AND TWS-D12-1&2 IS ALWAYS OPEN
6. 4-¾ MIXING EDUCTORS
7. IF NON RADIOACTIVE, THE WASTE TO BE DIVERTED TO THE NEUTRALIZATION BASIN BEFORE CHEMICAL ADDITION.
8. ⅜" TUBING - MAT SST-1 A-269 316 BY INSTRUMENTATION

* SUPPLIED BY VENDOR

** SUPERVISER KEY CONTROL AT WASTE PROCESSING PANEL REQUIRED

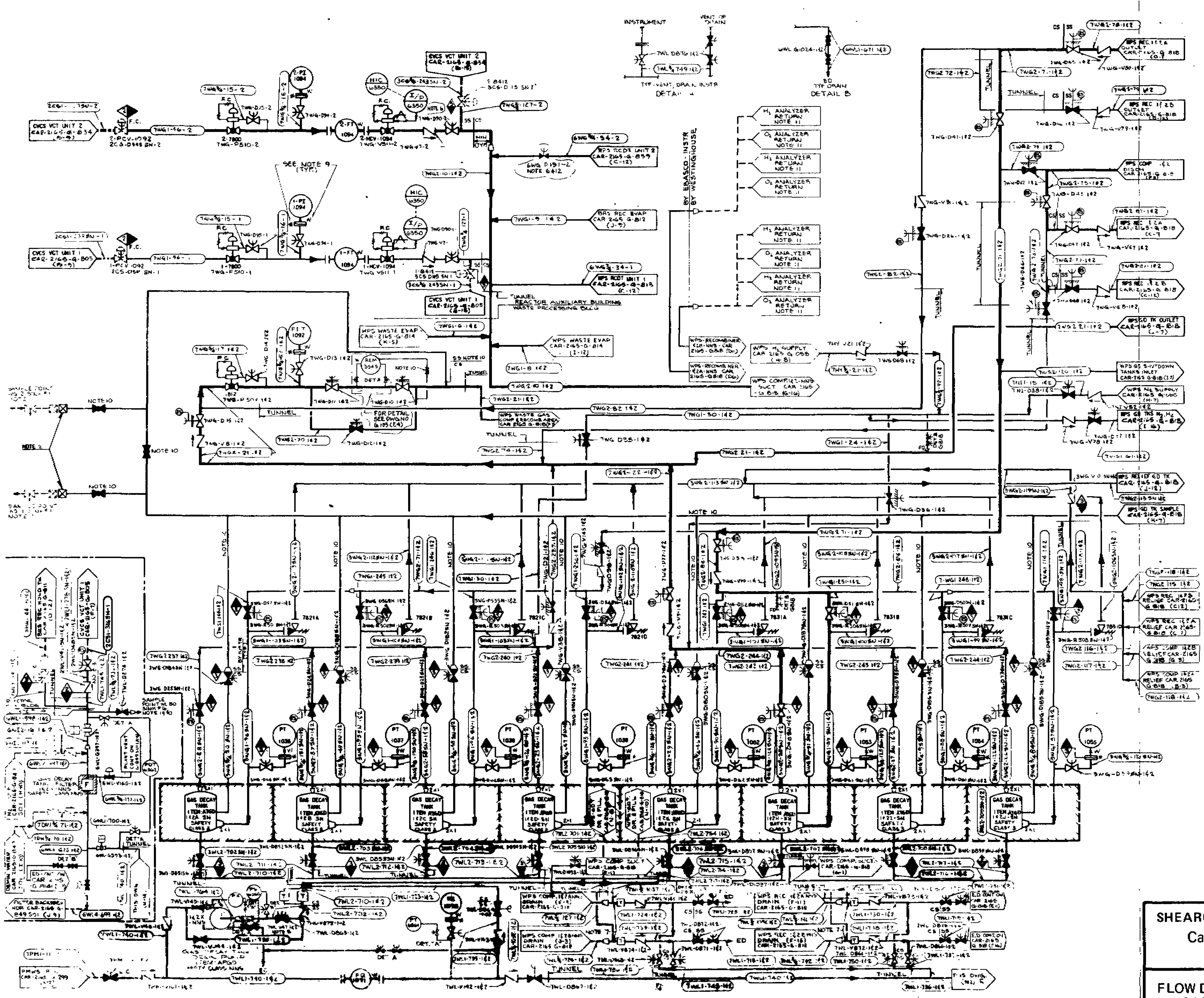
9. MAT'L OF TEE CONN. & 4 FT. MIN. OF PIPE DOWNSTREAM - ALLOY 20, EBASCO MATL CODE HAB-1.
10. VALVES LOCKED CLOSED UNTIL UNIT 2 IS INSTALLED.
11. VALVES LOCKED CLOSED UNTIL UNIT 4 IS INSTALLED
12. CAPPED UNTIL UNIT 2 IS INSTALLED.

REF DWG: CAR-2165-G-090 (REV 4, OPEN)

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
ENVIRONMENTAL REPORT

FLOW DIAGRAM
SECONDARY WASTE TREATMENT SYSTEM
UNITS 1 & 2

FIGURE 3.5.2-8

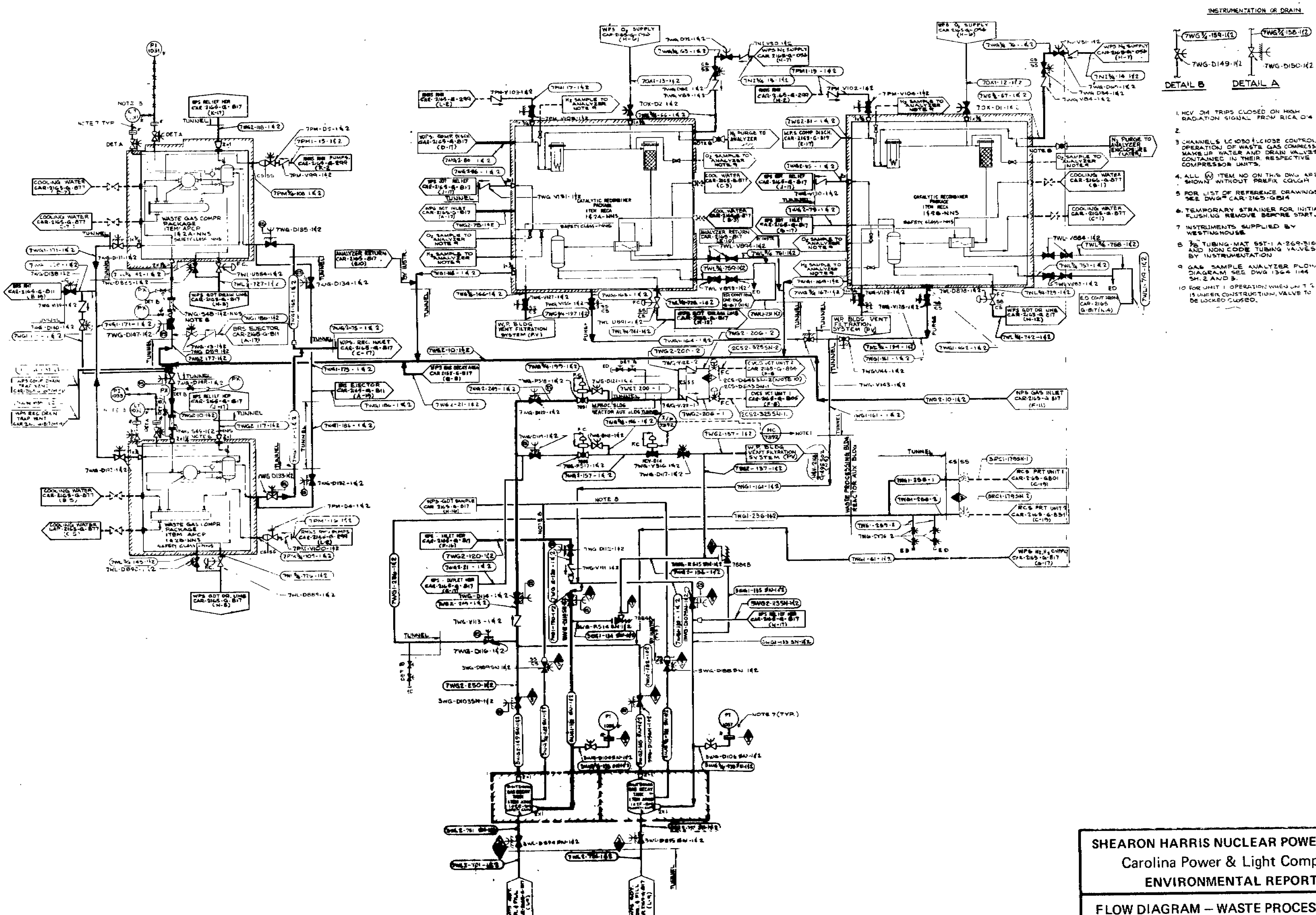

INSTRUMENT
VENT OR DRAIN
TYP. VENT, DRAIN, INSTR
DETAIL A
DETAIL B
TUNNEL
REACTOR AUXILIARY BUILDING
WASTE PROCESSING BLDG
SEE NOTE 9 (TYP)
BY EBASCO - INSTR BY WESTINGHOUSE
H2 ANALYZER RETURN NOTE 11
O2 ANALYZER RETURN NOTE 11
CVCS VCT UNIT 2 CAR-2165-G-834
CVCS VCT UNIT 1 CAR-2165-G-805
BRS REC EVAP CAR 2165-G-812
WPS WASTE EVAP CAR-2165-G-814
GAS DECAY TANK
NOTE 10
FOR DETAIL SEE DWG NO G 105 (C4)

NOTES:
1. SEE DWG. CAR-2165-G 429 — WASTE PROCESSING SAMPLING SYSTEM
2. QUICK CONNECT COUPLINGS PIPED TO RECEIVE PLANT GAS SAMPLING VESSEL.
3. LOCATE VALVE WL-V475N & WL D485N NEAR CVCS VOLUME CONTROL TANK IN REACTOR AUXILIARY BUILDING
4. ALL Ⓦ NO. ON THIS DWG. ARE SHOWN WITHOUT PREFIX CQLGH.
5. FOR LIST OF REFERENCE DRAWINGS SEE DWG # CAR-2165-G 814.
6. FOR UNIT #1 OPERATION WHEN UNIT #2 IS UNDER CONSTRUCTION, VALVE TO BE LOCKED CLOSED.
7. LOCATE TEE CONNECTION AS CLOSE TO GAS TRAPS AS POSSIBLE
8. TEMPORARY STRAINER FOR INITIAL FLUSHING - REMOVE BEFORE START UP.
9. INSTRUMENTS SUPPLIED BY WESTINGHOUSE
10. 3/8" TUBING MAT SST : A-269-316 AND NON CODE TUBING VALVES BY INSTRUMENTATION
11. GAS SAMPLE ANALYZER FLOW DIAGRAM SEE DWG 364-1144 SH 2 & SH 3.
12. AFTER COMPLETION OF UNIT #2 CONSTRUCTION VALVE TO BE LOCKED OPEN

REF DWG: CAR-2165-G-817 (REV 7, OPEN)

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
ENVIRONMENTAL REPORT

FLOW DIAGRAM – WASTE PROCESSING SYS
GAS DECAY STORAGE – UNITS 1 & 2
FIGURE 3.5.3-1


INSTRUMENTATION OR DRAIN
7WG-D149-1&2
7WG-D150-1&2
DETAIL B
DETAIL A
WASTE GAS COMPR PACKAGE ITEM APCP 1&2A-NNS
WASTE GAS COMPR PACKAGE ITEM APCP 1&2B-NNS
CATALYTIC RECOMBINER PACKAGE ITEM RECA 1&2A-NNS
CATALYTIC RECOMBINER PACKAGE ITEM RECA 1&2B-NNS
COOLING WATER
TUNNEL
W.P. BLDG VENT FILTRATION SYSTEM (PV)
ANALYZER RETURN
BRS EJECTOR
WPS GAS INLET
WASTE PROCESSING BLDG
REACTOR AUX BLDG
NOTE 7 (TYP.)

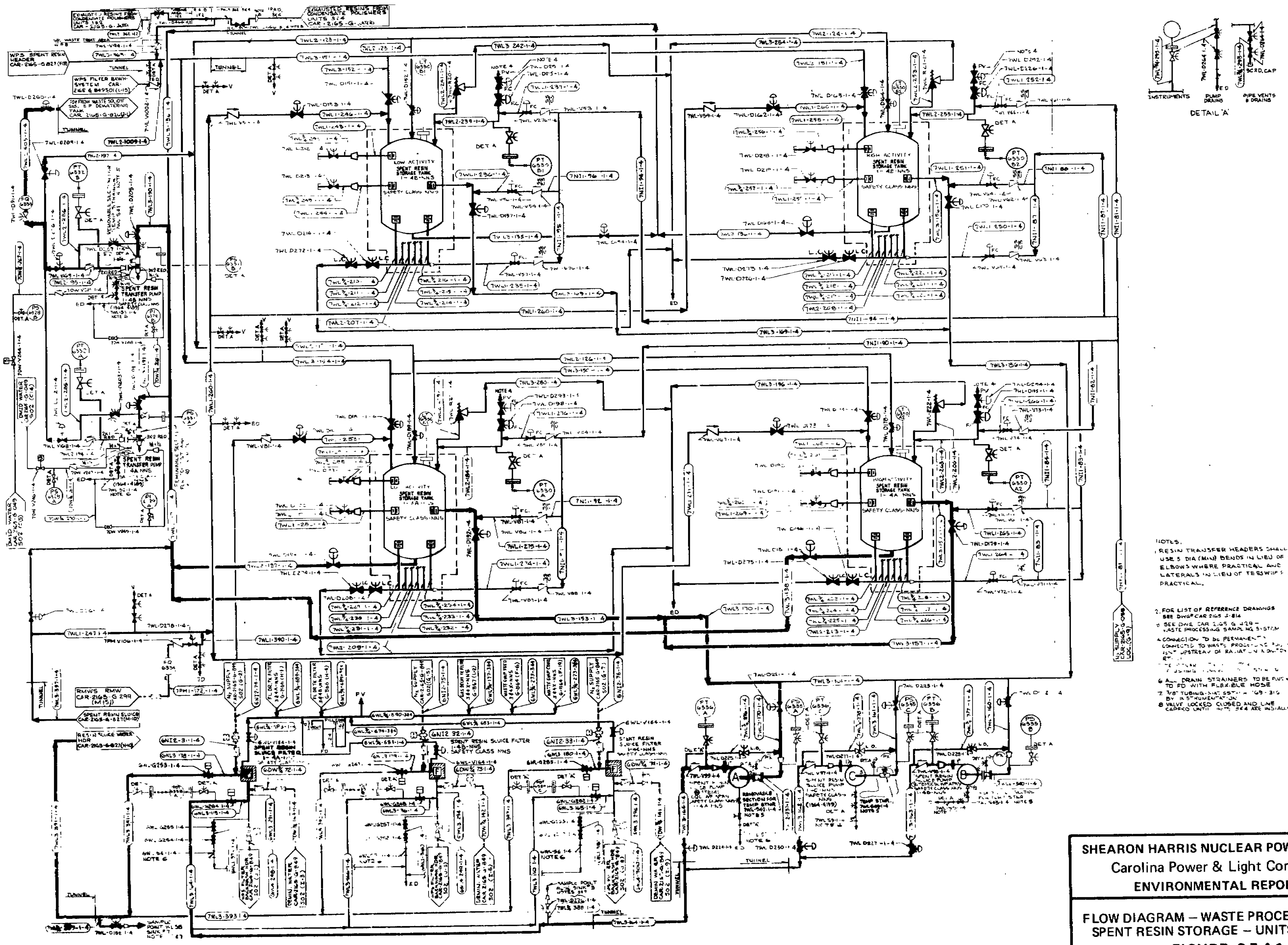
1. HCV 014 TRIPS CLOSED ON HIGH RADIATION SIGNAL FROM RICA 014
2.
3. CHANNELS LC1030 & LC1032 CONTROL OPERATION OF WASTE GAS COMPRESSOR MAKEUP WATER AND DRAIN VALVES CONTAINED IN THEIR RESPECTIVE COMPRESSOR UNITS.
4. ALL Ⓦ ITEM NO ON THIS DWG ARE SHOWN WITHOUT PREFIX CQLGH
5. FOR LIST OF REFERENCE DRAWINGS SEE DWG# CAR-2165-G814
6. TEMPORARY STRAINER FOR INITIAL FLUSHING REMOVE BEFORE START UP
7. INSTRUMENTS SUPPLIED BY WESTINGHOUSE
8. 3/8" TUBING-MAT SST-1 A-269-316 AND NON CODE TUBING VALVES BY INSTRUMENTATION
9. GAS SAMPLE ANALYZER FLOW DIAGRAM SEE DWG 1364 1144 SH. 2 AND 3.
10. FOR UNIT 1 OPERATION WHEN UNIT 2 IS UNDER CONSTRUCTION, VALVE TO BE LOCKED CLOSED.

REF DWG: CAR-2165-G-818 (REV 7, OPEN)

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
ENVIRONMENTAL REPORT

FLOW DIAGRAM – WASTE PROCESSING SYS
WASTE GAS COMPR AND RECOMBINER
UNITS 1 & 2

FIGURE 3.5.3-2


LOW ACTIVITY SPENT RESIN STORAGE TANK 1-4B-NNS SAFETY CLASS NNS
HIGH ACTIVITY SPENT RESIN STORAGE TANK 1-4B-NNS SAFETY CLASS NNS
LOW ACTIVITY SPENT RESIN STORAGE TANK 1-3A-NNS SAFETY CLASS NNS
HIGH ACTIVITY SPENT RESIN STORAGE TANK 1-4A-NNS SAFETY CLASS NNS
SPENT RESIN TRANSFER PUMP 1-4B NNS
SPENT RESIN TRANSFER PUMP 4A NNS
SPENT RESIN SLUICE FILTER 1-4A
SPENT RESIN SLUICE FILTER 1-4B-NNS SAFETY CLASS NNS
SPENT RESIN SLUICE FILTER 1-4C-NNS SAFETY CLASS NNS
SPENT RESIN SLUICE PUMP
REMOVABLE SECTION FOR TEMP STNR
TUNNEL
DET A
DETAIL 'A'
INSTRUMENTS
PUMP DRAINS
PIPE VENTS & DRAINS
WPS SPENT RESIN HEADER CAR-2165-G-827
WPS FILTER BKWH SYSTEM CAR-2166-B-49501
EXHAUSTED RESINS FROM CONDENSATE POLISHERS UNITS 1&2 CAR-2165-G-(LATER)
EXHAUSTED RESINS FROM CONDENSATE POLISHERS UNITS 3&4 CAR-2165-G-(LATER)
RMWS RMW CAR-2165-G-299
SPENT RESIN SLUICE CAR-2165-G-827
RESIN SLUICE WATER HDR CAR-2165-G-827
N2 SUPPLY CAR-2165-G-058 LOC. (G-9)
DEMIN WATER CAR-2165-G-049 502 (C-6)
PV
ED
FD
FC
LC
SAMPLE POINT

NOTES.

1. RESIN TRANSFER HEADERS SHALL USE 5 DIA (MIN) BENDS IN LIEU OF ELBOWS WHERE PRACTICAL AND LATERALS IN LIEU OF TEES WHERE PRACTICAL.

2. FOR LIST OF REFERENCE DRAWINGS SEE DWG CAR 2165 G-814

3. SEE DWG CAR 2165 G 429 – WASTE PROCESSING SAMPLING SYSTEM

4. CONNECTION TO BE PERMANENTLY CONNECTED TO WASTE PROCESSING [illegible] UPSTREAM OF RADIATION MONITOR [illegible]

5. [illegible]

6. ALL DRAIN STRAINERS TO BE [illegible] TO FD WITH FLEXIBLE HOSE

7. 3/8" TUBING-MAT SST [illegible] 169 - 316 BY INSTRUMENTATION

8. VALVE LOCKED CLOSED AND LINE CAPPED UNTIL UNITS 3&4 ARE INSTALLED

REF DWG: CAR-2165-G-815 (REV. 6, OPEN)

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
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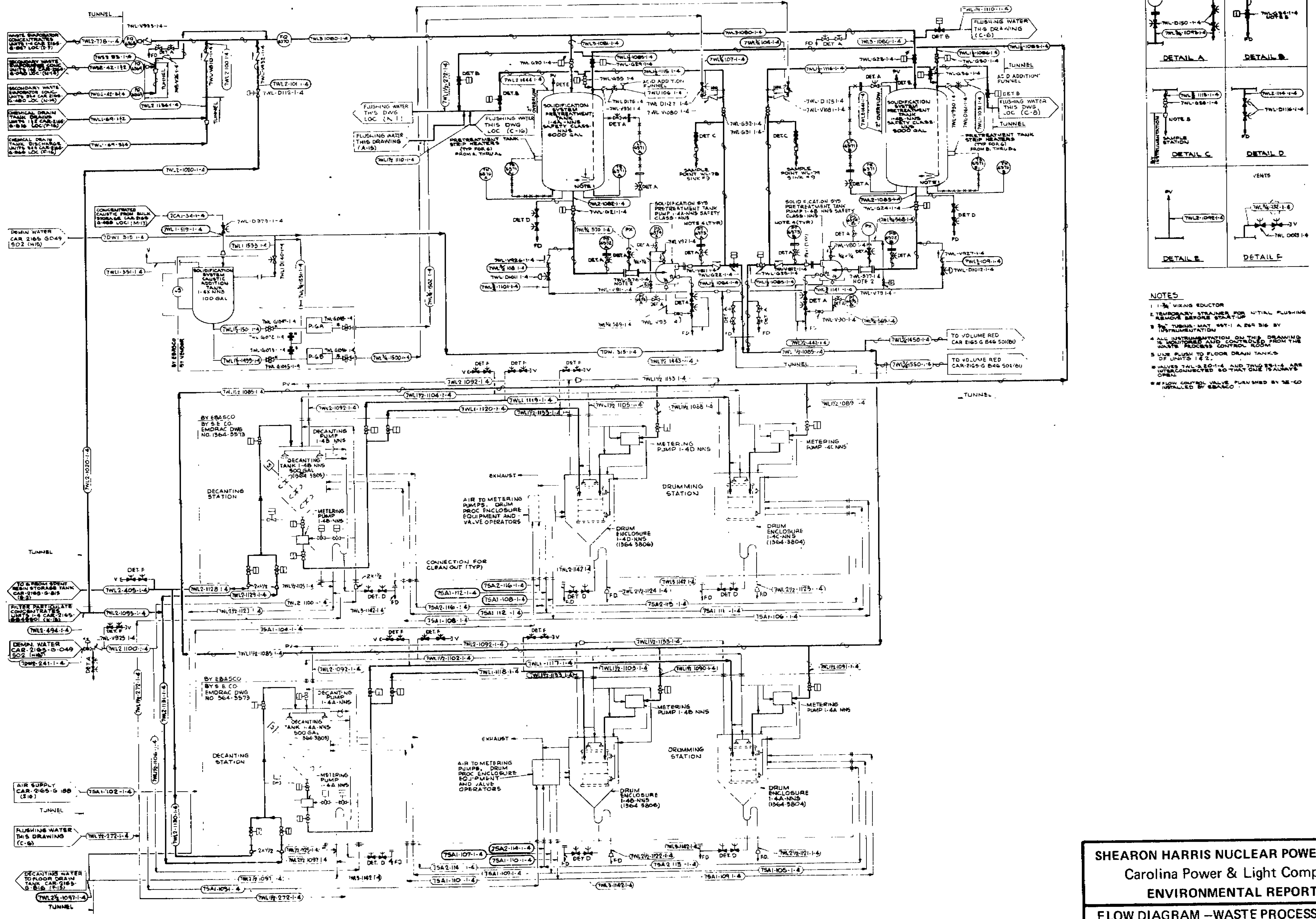
FLOW DIAGRAM – WASTE PROCESSING SYS
SPENT RESIN STORAGE – UNITS 1,2,3 & 4
FIGURE 3.5.4-1


TUNNEL
WASTE EVAPORATOR CONCENTRATES UNITS 1-4 CAR 2165-G-867 LOC (D-7)
SECONDARY WASTE EVAPORATOR CONC. UNITS 1&2 CAR-2165-G-803 LOC (N-18)
SECONDARY WASTE EVAPORATOR CONC. UNITS 3&4 CAR 2165-G-480 LOC (N-14)
CHEMICAL DRAIN TANK DRAINS UNITS 1&2 CAR-2165-G-816 LOC (F-16)
CHEMICAL DRAIN TANK DISCHARGE UNITS 3&4 CAR-2165-G-866 LOC (F-16)
FLUSHING WATER THIS DWG LOC (N-11)
FLUSHING WATER THIS DRAWING (A-15)
FLUSHING WATER THIS DWG LOC (C-16)
PRETREATMENT TANK STRIP HEATERS (TYP FOR 6) FROM A THRU A6
SOLIDIFICATION SYSTEM PRETREATMENT TANK 1-4A-NNS SAFETY CLASS NNS 5000 GAL
SOLIDIFICATION SYSTEM PRETREATMENT TANK 1-4B-NNS SAFETY CLASS NNS 5000 GAL
ACID ADDITION FUNNEL
SAMPLE POINT WL-78 SINK #9
SAMPLE POINT WL-79 SINK #9
SOLIDIFICATION SYS PRETREATMENT TANK PUMP 1-4A-NNS SAFETY CLASS-NNS
SOLIDIFICATION SYS PRETREATMENT TANK PUMP 1-4B NNS SAFETY CLASS NNS
NOTE 4 (TYP)
FLUSHING WATER THIS DRAWING (C-6)
FLUSHING WATER THIS DWG LOC (C-8)
PRETREATMENT TANK STRIP HEATERS (TYP FOR 6) FROM B1 THRU B6
TO VOLUME RED CAR 2165 G 846 S01(B1)
TO VOLUME RED CAR-2165-G 846 S01(B1)
CONCENTRATED CAUSTIC FROM BULK STORAGE CAR 2165 G-488 LOC (M-13)
DEMIN WATER CAR 2165 G049 S02 (H15)
SOLIDIFICATION SYSTEM CAUSTIC ADDITION TANK 1-4X NNS 100 GAL
BY EBASCO BY VENDOR
TWL-1020-1-4
BY EBASCO BY S E CO EMDRAC DWG NO. 1364-3573
DECANTING PUMP 1-4B NNS
DECANTING TANK 1-4B NNS 500 GAL (1364 3805)
DECANTING STATION
METERING PUMP 1-4B-NNS
EXHAUST
AIR TO METERING PUMPS, DRUM PROC ENCLOSURE EQUIPMENT AND VALVE OPERATORS
METERING PUMP 1-4D NNS
DRUMMING STATION
METERING PUMP 1-4C NNS
DRUM ENCLOSURE 1-4D-NNS (1364 3806)
DRUM ENCLOSURE 1-4C-NNS (1364-3804)
CONNECTION FOR CLEAN OUT (TYP)
TO & FROM SPENT RESIN STORAGE TANK CAR-2165-G-815 (B-3)
FILTER PARTICULATE CONCENTRATES UNITS 1-4 CAR 2165-G-850 (K-18)
DEMIN. WATER CAR-2165-G-049 S02 (H15)
BY EBASCO BY S E CO EMDRAC DWG NO 364-3573
DECANTING PUMP 1-4A-NNS
DECANTING TANK 1-4A-NNS 500 GAL 364-3805
METERING PUMP 1-4A NNS
METERING PUMP 1-4B NNS
METERING PUMP 1-4A NNS
DRUM ENCLOSURE 1-4B-NNS (1364 3806)
DRUM ENCLOSURE 1-4A-NNS (1364-3804)
AIR SUPPLY CAR-2165-G 188 (S10)
FLUSHING WATER THIS DRAWING (C-6)
DECANTING WATER TO FLOOR DRAIN TANK CAR-2165-G-816 (F-15)
DETAIL A
DETAIL B
DETAIL C
DETAIL D
DETAIL E
DETAIL F
INSTRUMENTS & DRAINS
INSTRUMENTATION
SAMPLE STATION
VENTS

NOTES

1. 1-¾" MIXING EDUCTOR
2. TEMPORARY STRAINER FOR INITIAL FLUSHING REMOVE BEFORE START-UP
3. ⅜" TUBING - MAT 997-1 A 269 316 BY INSTRUMENTATION
4. ALL INSTRUMENTATION ON THIS DRAWING IS MONITORED AND CONTROLLED FROM THE WASTE PROCESS CONTROL ROOM
5. LINE FLUSH TO FLOOR DRAIN TANKS OF UNITS 1 & 2.

* VALVES 7WL-G20-1-4 AND 7WL-G29-1-4 ARE INTERCONNECTED SO THAT ONE IS ALWAYS OPEN.

** FLOW CONTROL VALVE FURNISHED BY SE-CO INSTALLED BY EBASCO

REF DWG: CAR-2165-G-826 (REV 3, OPEN)

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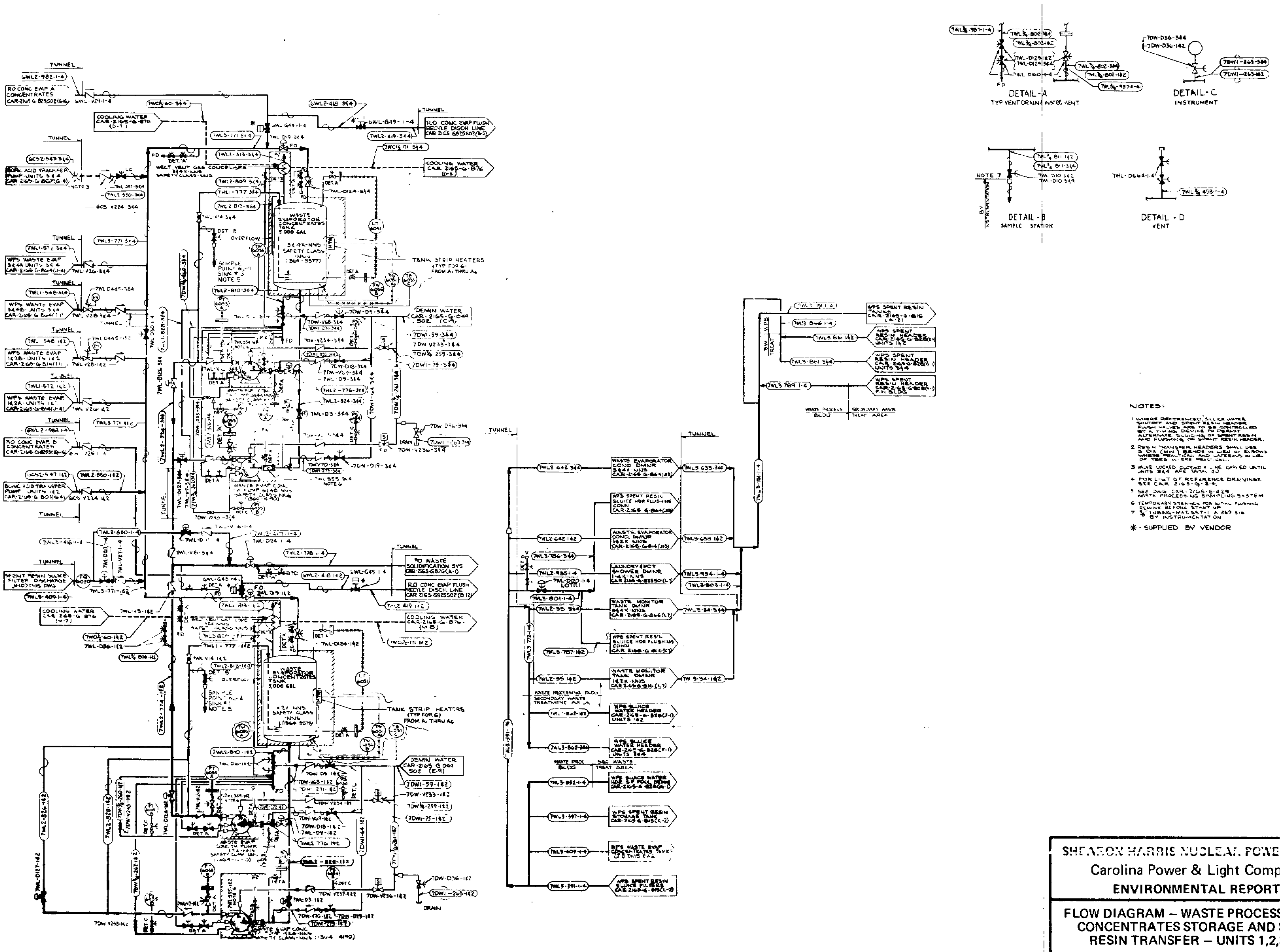
FLOW DIAGRAM – WASTE PROCESSING SYS
RADWASTE SOLIDIFICATION
UNITS 1,2,3 & 4
FIGURE 3.5.4-2


TUNNEL
RO CONC EVAP A CONCENTRATES
COOLING WATER CAR-2165-G-B76
R.O CONC EVAP FLUSH RECYLE DISCH LINE CAR 2165 G82550Z(B-5)
COOLING WATER CAR 2165-G-B76
BORIC ACID TRANSFER PUMP UNITS 3&4 CAR-2165-G-B67
VENT VENT GAS CONDENSER
WASTE EVAPORATOR CONCENTRATES TANK 5,000 GAL
3&4 X-NNS SAFETY CLASS
TANK STRIP HEATERS (TYP FOR 6) FROM A1 THRU A6
DET A
DET B
OVERFLOW
SAMPLE POINT WL-3 SINK # 3 NOTE 5
WPS WASTE EVAP 3&4A UNITS 3&4
WPS WASTE EVAP 3&4B UNITS 3&4
WPS WASTE EVAP 1&2B UNITS 1&2
WPS WASTE EVAP 1&2A UNITS 1&2
RO CONC EVAP B CONCENTRATES
BORIC ACID TRANSFER PUMP UNITS 1&2
DEMIN WATER CAR-2165-G-044 S02
WASTE EVAP CONC PUMP 3&4B NNS SAFETY CLASS NNS
SPENT RESIN SLUICE FILTER DISCHARGE
TO WASTE SOLIDIFICATION SYS CAR-2165-G826
R.O CONC EVAP FLUSH RECYLE DISCH LINE CAR 2165 G82550Z (B-12)
COOLING WATER CAR-2165-G-B76 (M-7)
COOLING WATER CAR-2165-G-B76 (M-8)
WASTE EVAPORATOR CONCENTRATES TANK 5,000 GAL
1&2 NNS SAFETY CLASS
TANK STRIP HEATERS (TYP FOR 6) FROM A1 THRU A6
SAMPLE POINT WL-4 SINK # 4 NOTE 5
DEMIN WATER CAR-2165-G-044 S02 (E-9)
WASTE EVAP CONC PUMP 1&2A NNS SAFETY CLASS NNS
DRAIN
WASTE EVAPORATOR COND DMNR 3&4X-NNS CAR-2165-G-864
WPS SPENT RESIN SLUICE HDR FLUSHING CONN CAR-2165-G-864
WASTE EVAPORATOR COND DMNR 1&2X-NNS CAR-2165-G-814
LAUNDRY & HOT SHOWER DMNR 1-4X-NNS CAR 2165-G-82550
WASTE MONITOR TANK DMNR 3&4X-NNS CAR 2165-G-866
WPS SPENT RESIN SLUICE HDR FLUSHING CONN CAR 2165-G-816
WASTE MONITOR TANK DMNR 1&2X-NNS CAR 2165-G-816
WASTE PROCESSING BLDG
SECONDARY WASTE TREATMENT AREA
WPS SLUICE WATER HEADER CAR-2165-G-828 UNITS 1&2
WPS SLUICE WATER HEADER CAR-2165-G-828 UNITS 3&4
WASTE PROC BLDG
SEC WASTE TREAT AREA
WPS SLUICE WATER HDR SF POOL DEMIN CAR-2165-G-828
WPS SPENT RESIN STORAGE TANK CAR-2165-G-815
WPS WASTE EVAP CONCENTRATES TANKS OF THIS DWG
WPS SPENT RESIN SLUICE FILTERS CAR-2165-G-815
WPS SPENT RESIN TANKS CAR-2165-G-815
WPS SPENT RESIN HEADER CAR-2165-G-828 UNITS 1&2
WPS SPENT RESIN HEADER CAR-2165-G-828 UNITS 3&4
WPS SPENT RESIN HEADER CAR-2165-G-828 F.H. BLDG
SW WPB TREAT
WASTE PROCESS BLDG
SECONDARY WASTE TREAT AREA
DETAIL - A
TYP VENT OR DRAIN INSTR VENT
DETAIL - C
INSTRUMENT
NOTE 7
DETAIL - B
SAMPLE STATION
DETAIL - D
VENT
F.D
DRAIN

NOTES:

1. WHERE REFERENCED SLUICE WATER SHUTOFF AND SPENT RESIN HEADER FLUSH VALVES ARE TO BE CONTROLLED BY A TIMING DEVICE TO PERMIT ALTERNATE SLUICING OF SPENT RESIN AND FLUSHING OF SPENT RESIN HEADER.
2. RESIN TRANSFER HEADERS SHALL USE 5 DIA (MIN) BENDS IN LIEU OF ELBOWS WHERE PRACTICAL AND LATERALS IN LIEU OF TEES WHERE PRACTICAL.
3. VALVE LOCKED CLOSED & LINE CAPPED UNTIL UNITS 3&4 ARE INSTALLED
4. FOR LIST OF REFERENCE DRAWINGS SEE CAR 2165-G-3.4.
5. SEE DWG CAR-2165-G-429 WASTE PROCESSING SAMPLING SYSTEM
6. TEMPORARY STRAINER FOR INITIAL FLUSHING REMOVE BEFORE START UP
7. 3/8" TUBING-MAT. SST-1 A 269 3.6 BY INSTRUMENTATION

✱ - SUPPLIED BY VENDOR

REF DWG: CAR-2165-G-827 (REV 6)

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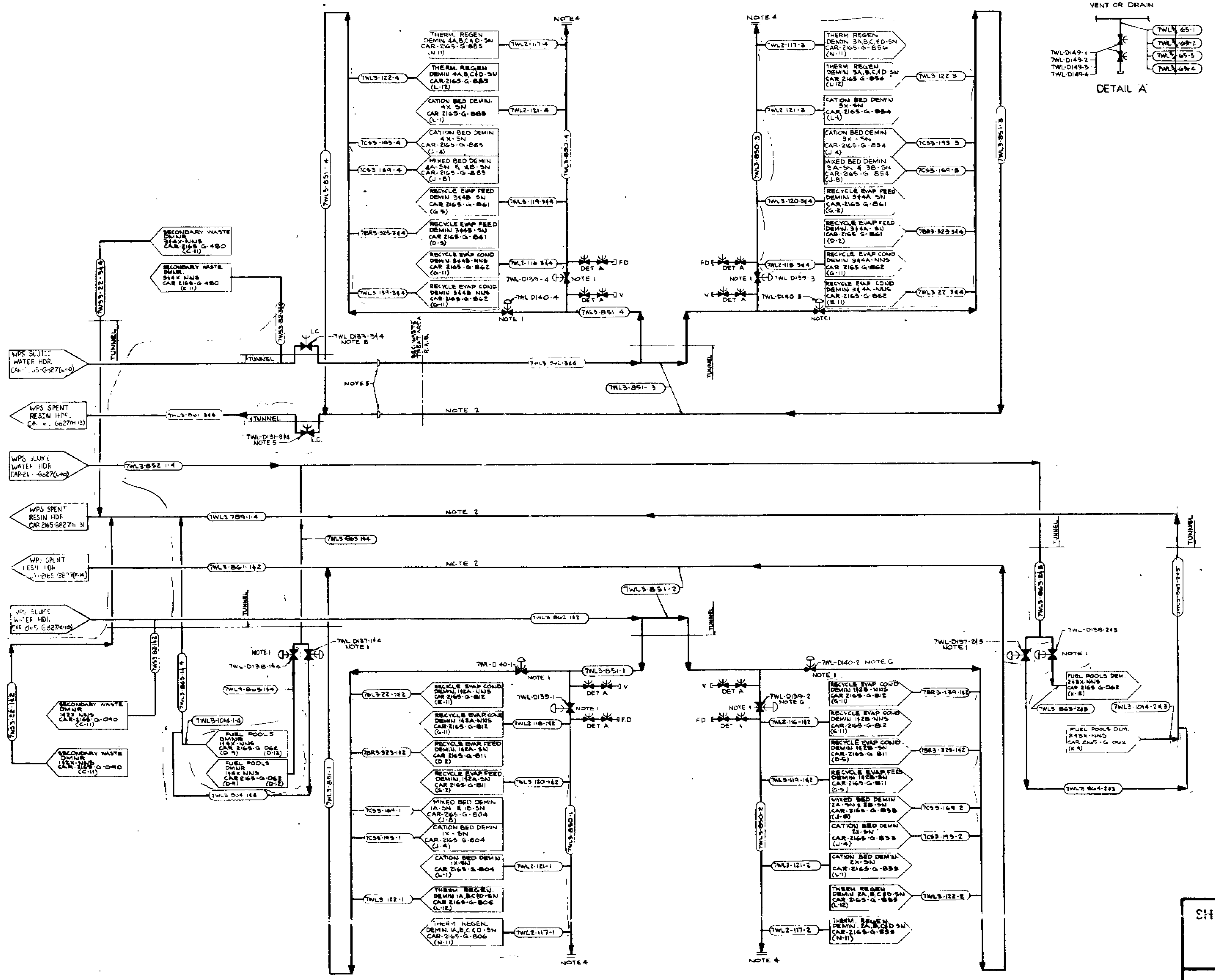
FLOW DIAGRAM – WASTE PROCESSING SYS
CONCENTRATES STORAGE AND SPENT
RESIN TRANSFER – UNITS 1,2,3 & 4

FIGURE 3.5.4-3


VENT OR DRAIN
7WL-D149-1
7WL-D149-2
7WL-D149-3
7WL-D149-4
7WL-65-1
7WL-65-2
7WL-65-3
7WL-65-4
DETAIL 'A'
NOTE 4
THERM. REGEN DEMIN 4A,B,C,&D-SN CAR-2165-G-885 (N-11)
THERM. REGEN DEMIN 4A,B,C,&D-SN CAR-2165-G-885 (L-12)
CATION BED DEMIN. 4X-SN CAR-2165-G-885 (L-1)
CATION BED DEMIN 4X-SN CAR-2165-G-883 (J-4)
MIXED BED DEMIN 4A-SN & 4B-SN CAR-2165-G-883 (J-8)
RECYCLE EVAP FEED DEMIN 344B-SN CAR 2165-G-861 (G-9)
RECYCLE EVAP FEED DEMIN 344B-SN CAR 2165-G-861 (D-9)
RECYCLE EVAP COND DEMIN 344B-NNS CAR 2165-G-862 (G-11)
RECYCLE EVAP COND DEMIN 344B NNS CAR-2165-G-862 (G-11)
7WL2-117-4
7WL3-122-4
7WL2-121-4
7CS3-193-4
7CS3-169-4
7WL3-119-344
7BR3-325-344
7WL2-116-344
7WL3-139-344
7WL3-852-4
7WL3-851-4
7WL-D139-4
7WL-D140-4
NOTE 1
DET A
FD
V
THERM REGEN DEMIN 3A,B,C,&D-SN CAR-2165-G-856 (N-11)
THERM REGEN DEMIN 3A,B,C,&D-SN CAR-2165-G-856 (L-12)
CATION BED DEMIN 3X-SN CAR-2165-G-854 (L-1)
CATION BED DEMIN 3X-SN CAR-2165-G-854 (J-4)
MIXED BED DEMIN 3A-SN & 3B-SN CAR-2165-G-854 (J-8)
RECYCLE EVAP FEED DEMIN 344A SN CAR-2165-G-861 (G-2)
RECYCLE EVAP FEED DEMIN 344A-SN CAR-2165-G-861 (D-2)
RECYCLE EVAP COND DEMIN 344A-NNS CAR 2165-G-862 (G-11)
RECYCLE EVAP COND DEMIN 344A-NNS CAR-2165-G-862 (E-11)
7WL2-117-3
7WL3-122-3
7WL2-121-3
7CS3-193-3
7CS3-169-3
7WL3-120-344
7BR3-325-344
7WL2-118-344
7WL3-22-344
7WL3-850-3
7WL3-851-3
7WL-D139-3
7WL-D140-3
SECONDARY WASTE DMNR 344X-NNS CAR-2165-G-480 (C-11)
SECONDARY WASTE DMNR 344X NNS CAR 2165-G 480 (C-11)
7WS3-22-344
7WS3-82-344
TUNNEL
LC
7WL-D133-344 NOTE 5
7WL-D131-344 NOTE 5
L.C.
SEC WASTE TREAT AREA
R.A.B.
NOTE 5
NOTE 2
7WL3-861-344
7WL3-84C-344
WPS SLUICE WATER HDR. CAR-2165-G-827(L-10)
WPS SPENT RESIN HDR. CAR-2165-G-827(H-13)
WPS SLUICE WATER HDR CAR-2165-G-827(L-10)
WPS SPENT RESIN HDR CAR 2165-G-827(G-3)
WPS SPENT RESIN HDR CAR-2165-G-827(F-14)
WPS SLUICE WATER HDR. CAR-2165-G-827(K-10)
7WL3-852-1-4
7WL3-789-1-4
7WL3-865-144
7WL3-861-142
7WL3-851-2
7WL3-862-142
7WS3-82-142
7WS3-22-142
7WL3-865-144
7WL3-1016-1-4
SECONDARY WASTE DMNR 142X-NNS CAR-2165-G-090 (C-11)
SECONDARY WASTE DMNR 142X-NNS CAR-2165-G-090 (C-11)
FUEL POOLS DMNR 144X-NNS CAR-2165-G-062 (D-9) (D-12)
FUEL POOLS DMNR 144X NNS CAR-2165-G-062 (D-9) (D-12)
7WL3-866-144
7WL-D137-144 NOTE 1
7WL-D138-144
7WL-D140-1
7WL3-851-1
7WL-D139-1
7WL3-851-1
7WL3-850-1
RECYCLE EVAP COND DEMIN 142A-NNS CAR-2165-G-812 (E-11)
RECYCLE EVAP COND DEMIN 142A-NNS CAR-2165-G-812 (G-11)
RECYCLE EVAP FEED DEMIN 142A-SN CAR 2165-G-811 (D-2)
RECYCLE EVAP FEED DEMIN 142A-SN CAR 2165-G-811 (G-2)
MIXED BED DEMIN 1A-SN & 1B-SN CAR-2165-G-804 (J-8)
CATION BED DEMIN 1X-SN CAR-2165-G-804 (J-4)
CATION BED DEMIN 1X-SN CAR-2165-G-804 (L-1)
THERM REGEN DEMIN 1A,B,C&D-SN CAR 2165-G-806 (L-12)
THERM REGEN DEMIN 1A,B,C,&D-SN CAR-2165-G-806 (N-11)
7WL3-22-142
7WL2-118-142
7BR3-325-142
7WL3-120-142
7CS3-169-1
7CS3-193-1
7WL2-121-1
7WL3-122-1
7WL2-117-1
7WL-D140-2 NOTE 6
7WL-D139-2 NOTE 6
7WL3-850-2
RECYCLE EVAP COND DEMIN 142B-NNS CAR-2165-G-812 (G-11)
RECYCLE EVAP COND DEMIN 142B-NNS CAR-2165-G-812 (G-11)
RECYCLE EVAP COND DEMIN 142B-NNS CAR-2165-G-811 (D-5)
RECYCLE EVAP FEED DEMIN 142B-SN CAR-2165-G-811 (G-5)
MIXED BED DEMIN 2A-SN & 2B-SN CAR-2165-G-833 (J-8)
CATION BED DEMIN 2X-SN CAR-2165-G-833 (J-4)
CATION BED DEMIN 2X-SN CAR-2165-G-833 (L-1)
THERM REGEN DEMIN 2A,B,C&D-SN CAR-2165-G-835 (L-12)
THERM. REGEN DEMIN 2A,B,C&D-SN CAR-2165-G-835 (N-11)
7BR3-139-142
7WL2-116-142
7BR3-325-142
7WL3-119-142
7CS3-169-2
7CS3-193-2
7WL2-121-2
7WL3-122-2
7WL2-117-2
7WL-D137-243 NOTE 1
7WL-D138-243
7WL3-865-243
7WL3-863-243
7WL3-1014-243
7WL3-864-243
FUEL POOLS DEMIN 243X-NNS CAR 2165-G-062 (K-12)
FUEL POOLS DEMIN 243X-NNS CAR 2165-G-062 (K-9)

NOTES:

1 WHERE REFERENCED, SLUICE WAT R SHUT OFF AND SPENT RESIN HEADER FLUSH VALVES [illegible] CONTROLLED BY A TIMING [illegible] UNIT [illegible] AND FLUSHING [illegible] HEADER

2 RESIN TRANSFER [illegible] (MIN) BEND [illegible] WHERE PRACTICAL AND [illegible] LIEU OF TEE [illegible] WHERE PRACTICAL

3 FOR [illegible] REFERENCE [illegible] DWG NO CAR-2165-G-814

4 BLIND FLANGES PROVIDED FOR FUTURE CONNECTIONS [illegible]

5 VALVE LOCKED CLOSED AND LINE CAPPED UNTIL UNITS 3&4 ARE INSTALLED

6 FOR UNIT#1 OPERATION, WHEN UNIT#2 IS UNDER CONSTRUCTION, VALVE TO BE LOCKED CLOSED

REF DWG: CAR-2165-G-828 (REV 4, OPEN)

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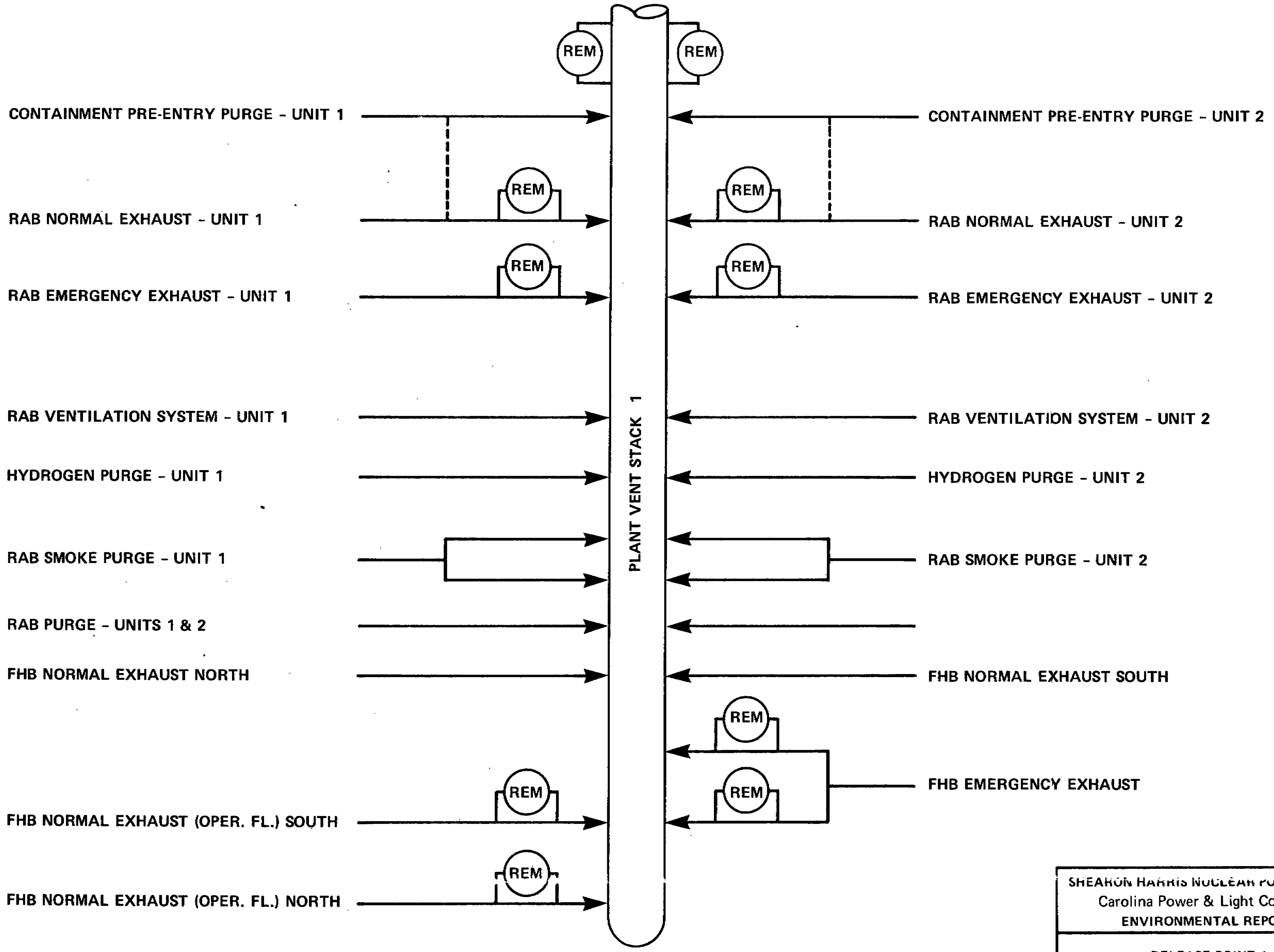
FLOW DIAGRAM – WASTE PROCESSING SYS
SPENT RESIN TRANSFER – UNITS 1,2,3 & 4
FIGURE 3.5.4-4


REM
REM
CONTAINMENT PRE-ENTRY PURGE - UNIT 1
CONTAINMENT PRE-ENTRY PURGE - UNIT 2
REM
REM
RAB NORMAL EXHAUST - UNIT 1
RAB NORMAL EXHAUST - UNIT 2
REM
REM
RAB EMERGENCY EXHAUST - UNIT 1
RAB EMERGENCY EXHAUST - UNIT 2
PLANT VENT STACK 1
RAB VENTILATION SYSTEM - UNIT 1
RAB VENTILATION SYSTEM - UNIT 2
HYDROGEN PURGE - UNIT 1
HYDROGEN PURGE - UNIT 2
RAB SMOKE PURGE - UNIT 1
RAB SMOKE PURGE - UNIT 2
RAB PURGE - UNITS 1 & 2
FHB NORMAL EXHAUST NORTH
FHB NORMAL EXHAUST SOUTH
REM
REM
FHB EMERGENCY EXHAUST
REM
FHB NORMAL EXHAUST (OPER. FL.) SOUTH
REM
FHB NORMAL EXHAUST (OPER. FL.) NORTH

SHEARON HARRIS NUCLEAR POWER PLANT
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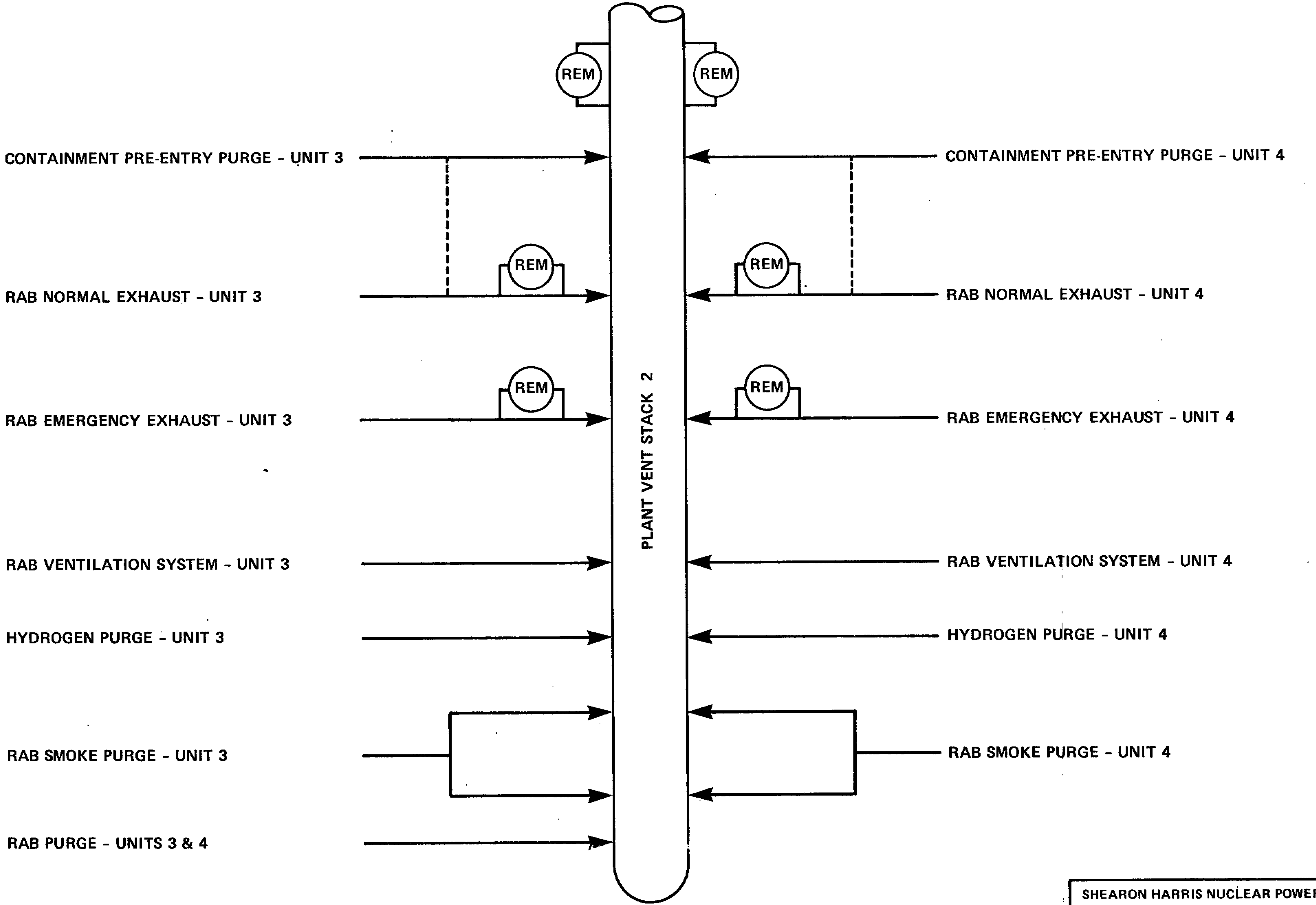
RELEASE POINT 1

FIGURE 3.5.5-1


REM
REM
CONTAINMENT PRE-ENTRY PURGE - UNIT 3
CONTAINMENT PRE-ENTRY PURGE - UNIT 4
REM
REM
RAB NORMAL EXHAUST - UNIT 3
RAB NORMAL EXHAUST - UNIT 4
REM
REM
RAB EMERGENCY EXHAUST - UNIT 3
RAB EMERGENCY EXHAUST - UNIT 4
PLANT VENT STACK 2
RAB VENTILATION SYSTEM - UNIT 3
RAB VENTILATION SYSTEM - UNIT 4
HYDROGEN PURGE - UNIT 3
HYDROGEN PURGE - UNIT 4
RAB SMOKE PURGE - UNIT 3
RAB SMOKE PURGE - UNIT 4
RAB PURGE - UNITS 3 & 4

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
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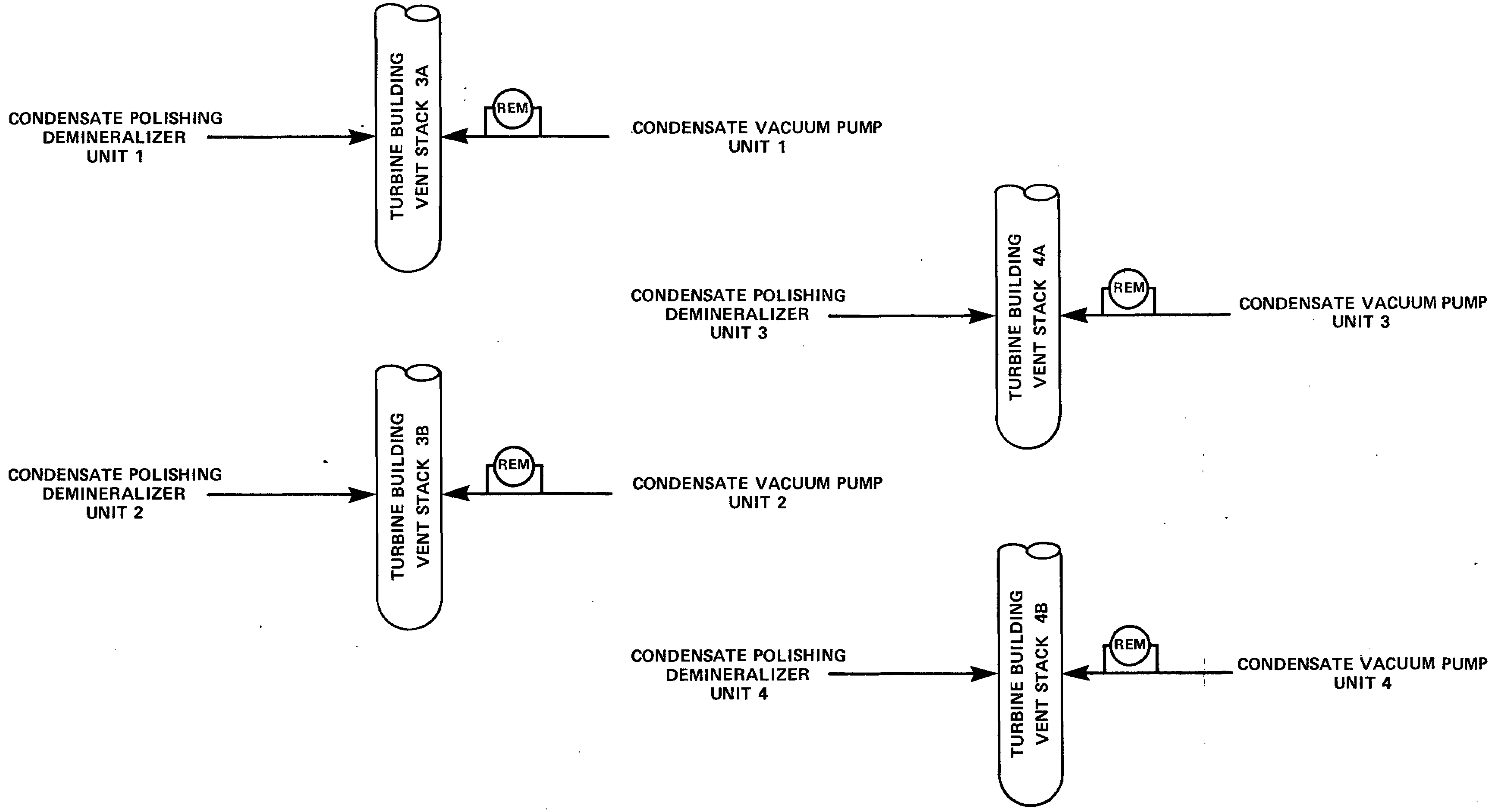
RELEASE POINT 2

FIGURE 3.5.5-2


CONDENSATE POLISHING DEMINERALIZER UNIT 1
TURBINE BUILDING VENT STACK 3A
REM
CONDENSATE VACUUM PUMP UNIT 1
CONDENSATE POLISHING DEMINERALIZER UNIT 3
TURBINE BUILDING VENT STACK 4A
REM
CONDENSATE VACUUM PUMP UNIT 3
CONDENSATE POLISHING DEMINERALIZER UNIT 2
TURBINE BUILDING VENT STACK 3B
REM
CONDENSATE VACUUM PUMP UNIT 2
CONDENSATE POLISHING DEMINERALIZER UNIT 4
TURBINE BUILDING VENT STACK 4B
REM
CONDENSATE VACUUM PUMP UNIT 4

SHEARON HARRIS NUCLEAR POWER PLANT
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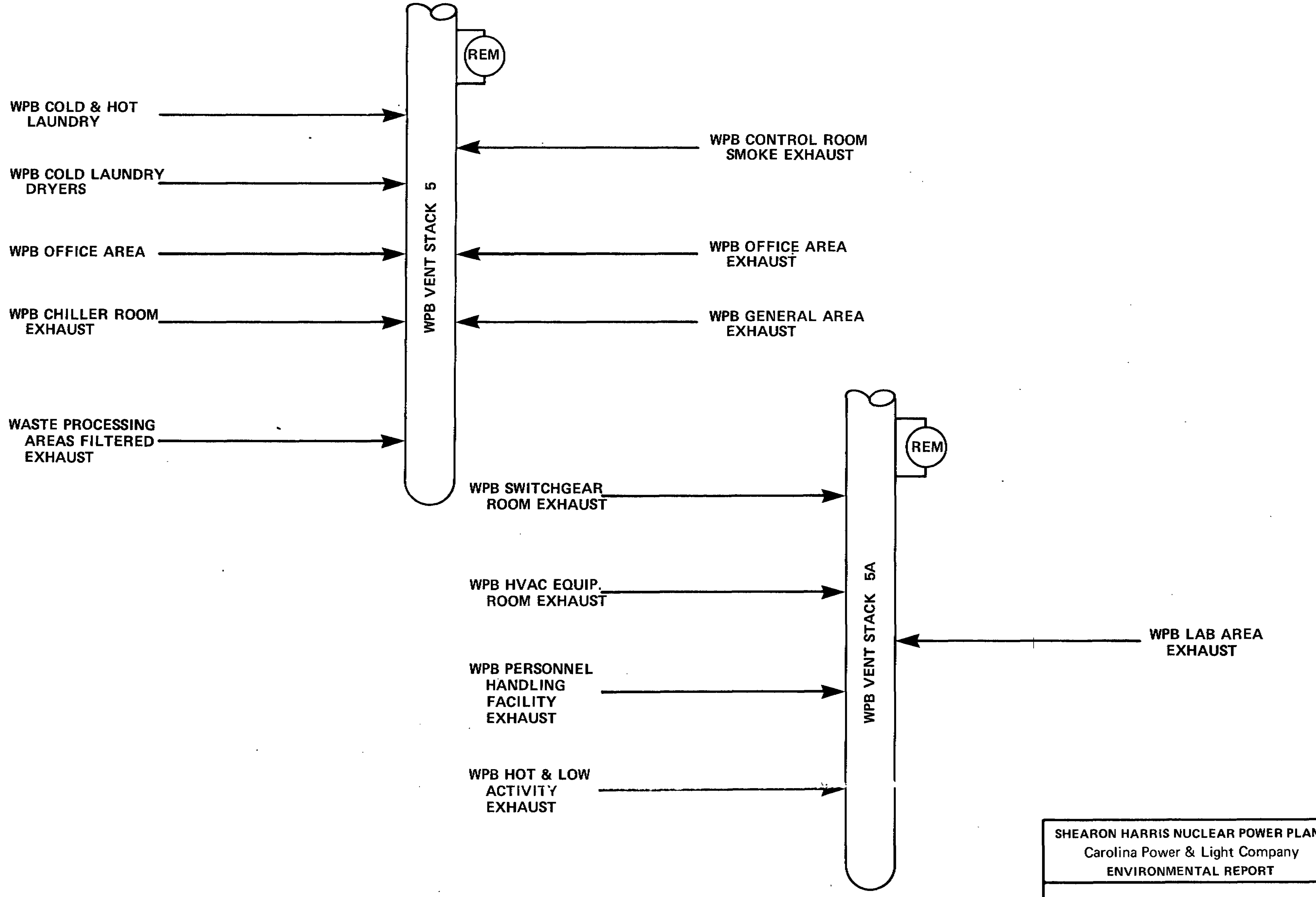
RELEASE POINTS 3A, 3B, 4A, 4B

FIGURE 3.5.5-3


REM
WPB COLD & HOT LAUNDRY
WPB CONTROL ROOM SMOKE EXHAUST
WPB COLD LAUNDRY DRYERS
WPB VENT STACK 5
WPB OFFICE AREA
WPB OFFICE AREA EXHAUST
WPB CHILLER ROOM EXHAUST
WPB GENERAL AREA EXHAUST
WASTE PROCESSING AREAS FILTERED EXHAUST
REM
WPB SWITCHGEAR ROOM EXHAUST
WPB HVAC EQUIP. ROOM EXHAUST
WPB VENT STACK 5A
WPB LAB AREA EXHAUST
WPB PERSONNEL HANDLING FACILITY EXHAUST
WPB HOT & LOW ACTIVITY EXHAUST

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
ENVIRONMENTAL REPORT

RELEASE POINTS 5 AND 5A

FIGURE 3.5.5-4

3.6 CHEMICAL AND BIOCIDE SYSTEMS

3.6.1 INTRODUCTION

During operation of the Shearon Harris Nuclear Power Plant (SHNPP), chemical wastes are generated from various systems and processes such as the water treatment facilities, the corrosion control processes, laboratory analyses, the Boron Recycle System, the Potable and Sanitary Water System, auxiliary boilers, and laundry operations.

Depending on its source, a liquid chemical waste may be radioactive or nonradioactive. The liquid radioactive chemical wastes are processed through the Waste Management System, where they are collected, monitored, filtered, demineralized, evaporated, or otherwise treated. The details of the Waste Management System are given in Section 3.5. Cooling tower blowdown is discussed in Section 3.4 and sanitary, oily waste, and yard runoff are addressed in Section 3.7. This section describes the sources and treatment of non-radioactive chemical wastes.

3.6.2 CHEMICAL WASTES

The non-radioactive chemical wastewaters typically consist of demineralizer regenerants, sanitary wastes, metal cleaning waste, oily waste, and floor drainage. All of these wastewaters, with the exception of sanitary waste, are conveyed to the SHNPP chemical waste treatment facilities. In the treatment facilities, wastes are combined and treated. This treatment facility consists of collection systems for all plant wastes. These waste systems are treated differently depending on the actual pollutant content of the waste. SHNPP waste treatment subsystems are low conductivity waste, high conductivity waste, waste neutralization and waste settling basin. Metal cleaning wastes are treated in the above systems. Flow diagrams for the waste systems are shown on Figures 3.6.2-1 and 3.6.2-2. As shown in these figures, all treated wastes are discharged to the Main Reservoir via the cooling tower blowdown line.

Table 3.6.2-1 presents a summary of the various chemical wastes for each unit and their flows, sources, frequency, and concentration before and after treatment (if any). Table 3.6.2-2 shows the waste concentrations and the applicable effluent limitations and State water quality standards.
Table 3.6.2-3 gives the frequency of use of the chemicals, their purpose, and maximum and average quantities used annually. These amounts are based on the current plant design and anticipated plant operation. These amounts may change as the projected commercial operation date for Unit 1 is approached. 4

3.6.2.1 Chemicals Released from the Primary Water Treatment Plant and the Demineralized Water System

Main Reservoir water is used as a raw water source for the plant. Depending on its intended use, the water is directly used, pretreated and used, or pretreated and demineralized for use.

The Primary Filtered Makeup Water System provides required pretreatment. This facility consists of two upflow filters, each having a capacity of 750 gpm. Only one filter will normally be working at a time. High molecular weight polyelectrolite is mixed into the water to induce adsorption so that microscopic particles are retained in the filter media. The raw water may be continuously chlorinated to a combined chlorine concentration of 0.5 ppm to oxidize organic matter and inhibit biological growth on the filters. Each filter is flushed as needed. The filter flush water is decanted in a settling basin where the solids settle. The supernatant water is discharged to the Main Reservoir. The flush water contains suspended solids polyelectrolytes and residual chlorine. The estimated concentrations in the wastewater, before mixing with the circulating cooling water, are indicated in Table 3.6.2-1.

The Demineralized Water System consists of two carbon filters, two cation exchange units, one degasifier, two anion exchange units, and two mixed bed units. These units constitute two independent trains, each of 300 gpm capacity, and each capable of meeting the normal daily requirements. Additional information is contained in FSAR Section 9.2.3.

When the cation exchangers or the mixed bed units are exhausted, they are regenerated with solutions of sulfuric acid and sodium hydroxide.
The mineral constituents in the Main Reservoir water which are removed by the ion exchange resins are released from the resins by washing them with the acid and hydroxide solutions. The estimated concentration of total dissolved solids and sulfates in the regenerant waste will be up to 3,318 ppm and 2,212 ppm respectively.

The spent regeneration waste flows to the chemical waste treatment system for treatment and disposal, as shown in Figure 3.6.2-1. The spent regeneration waste is intermittent and will average about 550,000 gal./day.

3.6.2.2 Chemicals Released from Plant Corrosion Control Processes

A number of chemicals are used for corrosion control in various plant systems, generally in small quantities under highly controlled conditions. The following chemicals are used in various plant systems at SHNPP.

a) Hydrazine - Hydrazine is added to the condensate system to remove oxygen which causes corrosion problems. The hydrazine concentration is maintained at 10 to 50 ppb which is sufficient to scavenge all the oxygen without over-feeding. The end products of the reaction between oxygen and hydrazine are free nitrogen gas and water. Hydrazine is also added to the Reactor Coolant System during start-up and to other closed cooling systems when oxygen removal is required.

b) Ammonia - Ammonia is used to maintain a pH of 8.2 to 9.2 in the steam generator and the condensate and feedwater system. Usually, a concentration of about 450 ppb exists in the system.

c) Lithium Hydroxide - A small amount (0.2 to 1 ppm) of lithium hydroxide is used for pH adjustment in the Reactor Coolant System. Lithium hydroxide is removed from the coolant through ion exchange. When the ion exchange resin is exhausted, it is packaged in drums for disposal as a radioactive solid waste. The handling of radioactive wastes is described in detail in Section 3.5.

Approximately 9 kilograms per unit of lithium (Li^7) will be used per year. | 2

d) Sodium Chromate and Sodium Phosphate - In the closed cooling systems, a mixture of sodium chromate and sodium phosphate is used to inhibit corrosion. A concentration of about 500 ppm is maintained in these systems.

Since the systems utilizing these chemicals are closed systems, there is normally no release of these chemicals to the environment. However, during equipment maintenance, the water drained from the Closed Cooling Water Systems flows to tanks for later treatment in the Waste Mangement System, for later return to these systems for reuse or for discharge. Table 3.6.2-3 lists these and other chemicals indicating their use, frequency of use and their annual consumption.

3.6.2.3 Release of Chemicals from the Control Laboratory

SHNPP has a chemistry and radiation measurement laboratory equipped with all the chemicals and instrumentation needed for water and wastewater analyses. Some typical determinations done at the SHNPP laboratory are: alkalinity, ammonia, boron, calcium, conductance, fluoride, hydrogen, hardness, hydrazine, nitrogen, iodine, iron, lithium, oxygen, pH, silica, strontium, sulfate, temperature, color, and turbidity. CP&L may contract with an outside laboratory or use the lab at the Shearon Harris Energy and Environmental Center to measure parameters such as biochemical oxygen demand (BOD), chemical oxygen demand (COD), total solids, oil and grease, fecal coliform, and copper.

The drainage from the radio-chemical sinks and the water and wastewater analyses sinks is collected in the drain tank and treated in the Waste Management System.

3.6.3 CHEMICALS RELEASED FROM THE BIOCIDE CONTROL SYSTEM

Each unit is served by a single-shell divided water box condenser and uses the Cooling Tower to supply circulating water. Three circulating pumps are interconnected by a common discharge header serving the condenser. The effluent from the condenser is returned to the Cooling Tower.

Chlorine in the form of a chlorine solution generated from liquid chlorine in a chlorinator is applied periodically to the Cooling Tower Intake Structure and the Emergency Service Water and Cooling Tower Make-up Intake Structure to control slime growth in the condenser tubes and in the circulating water lines. Shock treating is performed two times a day using approximate 30-minute chlorination periods.

The chlorine dosage is subject to seasonal variation. During the summer months, with the increased chlorine demand, the maximum dosage of chlorine may be required whereas in the cooler winter months, a lesser dosage may suffice.

The actual operating chlorine dosage is determined by a residual chlorine test in the condenser's effluent header. The chlorine feed rate and treatment time

2 are established to deliver up to 0.5 ppm free chlorine residual in the condenser effluent. Since only one unit is chlorinated at a time, the concentration in the cooling tower blowdown will not exceed 0.2 ppm chlorine residual when both units are operating.

3.6.4 MISCELLANEOUS CHEMICAL WASTES

a) Non-Radioactive Oil Waste - In the Turbine Building, the floor drains, curbed oil area drains, and equipment drains are combined into a common Industrial Waste System. Liquid from this system is directed to two internal industrial waste sumps, where it is pumped to the yard oil separator. In all other buildings, the equipment drains from equipment using oil as part of its function or process, as well as the floor drains in curbed oil areas, are routed to that building's oil sump. Sump pumps in all buildings in the nuclear island transport the oil waste to the turbine building industrial waste discharge header, where it combines and passes through a radiation monitor. If the waste is not radioactive, it flows to the yard oil separator. The effluent from the oil separator is released to the Storm Water Drainage System, which discharges to the Main Reservoir. Removed oil is collected in tanks for offsite treatment and disposal.

If the radiation monitor indicates radioactivity is present, the oil waste is routed to the Waste management system. the treatment of radioactive wastes is described in Section 3.5.

In the Service Building, the liquid drainage from equipment using oil is routed through equipment drains and floor drains to the internal oil separator in this building. The clear effluent is released to the Storm Water Drainage System and is subsequently discharged to the Main Reservoir. The removed oil is collected in tanks for offsite treatment and disposal.

b) Floor Drains - The Floor Drain System includes the floor drains in the Waste Processing Building, the Reactor Auxiliary Building, and the Fuel Handling Building.

Non-radioactive floor drainage is collected from the floor drain in the battery rooms and the electrical penetration and cable vault areas in the Reactor Auxiliary Building, standby diesel generator rooms, and the Turbine Building.

The floor drains in the battery rooms discharge to the local neutralizing tanks for neutralization. The waste then flows to the sanitary sewers for further disposal.

The standby diesel generator rooms are provided with floor drains which discharge into an oil sump. Two gpm sump pumps discharge the sump content to the yard oil separator which discharges oil free water to the Cooling Tower Blowdown System.

The Turbine Building is provided with floor drains to accept normal maintenance washdown wastewater, as well as any potential discharges from a piping rupture. Like other turbine building drainage wastes under normal conditions, the floor drain discharges are routed to the turbine building industrial waste sumps for discharge to the yard oil separator.

c) Preoperational Systems Hydrostatic Testing and Flushing Wastewater - Since it is not anticipated that the preoperational cleaning of systems at SHNPP will require the use of acid or caustic reagents, there will not be any metal cleaning wastes. However, during the preoperational phase, systems conveying fluids will undergo flushing and/or hydrostatic testing. Flushing consists of the high velocity flow of potable or demineralized water through these systems for the purpose of removing construction debris, dirt, etc. which might have accumulated during construction. Hydrostatic testing is a procedure used to test for leaks. An EPA approved dye will be used during the condenser hydrostatic testing procedure.

Hydrazine and ammonia are expected to be added to the flush and hydrostatic testing water. In addition, some systems might require the use of a wetting agent to complete these procedures.

The hydrostatic testing and flushing wastes for each unit are expected to be produced on a one time basis and are anticipated to produce a combined total volume of from 15 to 20 million gallons of wastewater. These wastewaters will be collected, sampled, treated as necessary to meet discharge requirements, and released to the Main Reservoir.

d) Periodic Discharge - Steam Generator Blowdown - Under normal operating conditions, the steam generator blowdown is treated in the Steam Generator Blowdown System and reused by returning the water to the condenser. If under certain circumstances the steam generator blowdown is not returned to the condenser, the blowdown, if found to be non-radioactive, is conveyed to the SHNPP chemical treatment systems for treatment and disposal. 2

TABLE 3.6.2-1

CHEMICAL WASTE DISCHARGE SUMMARY PER UNIT
(Sheet 1 of 2)

Type of Waste	Source	Frequency of Discharge	Quantity (gal./yr.)	Chemical & Pollutant Content	Estimated Concentration in Waste (ppm)	Estimated Average Concentration After Treatment (ppm)	Released to:
Reactor Coolant	Boron Recycle System	Periodically	685,000$^{(a)}$	Boron	10	10	(c)
Nonrecoverable Water	Waste Management System (Miscellaneous Waste)	Periodically	437,500	Dirt	30	30	(c)
Detergent Waste	Waste Management System (Laundry Wastes)	Periodically	680,000	Detergent, Dirt	1000	30	(c)
Electromagnetic Filter Flush	Steam Generator Blowdown System	Periodically	250,000	Total Suspended Solids	0-1,000	30	(c)
Turbine Building Drains	Condenser Feedwater Equipment Drains	Daily	1,000,000	Hydrazine	0.05	0.05	(c)
				Ammonia	0-1	0-1	
	Floor Drains	Daily	1,500,000	Detergent, Dirt	0.1	0.1	(c)
				Oil & Greaste	20	15	
				Total Suspended Solids	30	30	
Regenerative Solutions	Demineralized Water Systems	Periodically	10,500,000	Total Suspended Solids	115	30	(c)
				Total Dissolved Solids	3,318	3,318	
				Sulfates	2,212	2,212	
				pH	2-13	6-9	

TABLE 3.6.2-1 (continued)

Type of Waste	Source	Frequency of Discharge	Quantity (gal./yr.)	Chemical & Pollutant Content	Estimated Concentration in Waste (ppm)	Estimated Average Concentration After Treatment (ppm)	Released to:
Filter Flush Water	Primary Water Treatment Plant	Daily (2-3 times a day, each for 10 minutes)	8,000,000	Total Suspended Solids	1,000	30	(c)
				Polyelectrolyte	1-2	1-2	
Sanitary	Station Sewage Treatment Plant	Continuous	4,500,000	Residual Chlorine	0-.5	0-.5	(c)
				BOD	250	30	
				Total Suspended Solids	250	30	
Chemical Cleaning Solutions	Secondary System	Once at the start of plant	20,000,000	Oil & Grease	(b)	15	(c)
				Hydrazine	50-90	Not Known (b)	
				Total Suspended Solids	>30	30	
				Copper	>1.0	1.0	
				Iron	>1.0	1.0	
				pH	(b)	5-9	
Chemical Cleaning Solutions	Heat Exchange Equipment	Periodically	200,000	pH	(b)	6-9	(c)
				Oil & Grease	(b)	15	
				Copper	>1.0	1.0	
				Iron	>1.0	1.0	
				Total Suspended Solids	>30	30	

(a) Maximum of 144,000 gallons per day discharged.

(b) Not possible to predict.

(c) SHNPP Cooling Tower Blowdown System

TABLE 3.6.2-2

SUMMARY OF CHEMICAL WASTE COMPLIANCE WITH APPLICABLE STANDARDS/PER UNIT

(Sheet 1 of 2)

Waste Source	Quantity (gal./yr.)	Chemical & Pollutent Content	Estimated Average Concentration After Treatment (ppm)	EPA Effluent Limitations (40CFR423) (ppm)	Estimated Increase in Average Concentration of Water (ppm)	State of North Carolina Water Quality Standards
Boron Recycle System	685,000	Boron(b)	10	--	0.5	No standards
Waste Management	437,000	Detergent, Dirt	30	TSS-Avg-30/ Max-100	0.24	(e)
Laundry, Showers	680,000	Detergent, Dirt	30	TSS-Avg-30/ Max-100	(f.)	(e)
Condenser Feedwater Equipment Drains	1,000,000	Hydrazine(b)	0.05	--	0.5	No numerical criteria
		Ammonia(b)	0-1	--	0.31	No numerical criteria
Floor Drains	1,500,000	Oil & Grease	15	O&G: Avg-15/ Max-20	(f)	(e)
		Total Suspended Solids	30	TSS: Avg-30/ Max-100	(f)	(e)
Demineralized Water System	10,500,000	Total Dissolved Solids(b)	3,318	--	4.2	No numerical criteria
		Sulfates(b)	2,212	--	2.8	No numerical criteria
		Ph	6-9	6-9	No change(c)	6.5-9.0

TABLE 3.6.2-2 (continued)

Waste Source	Quantity (gal./yr.)	Chemical & Pollutent Content	Estimated Average Concentration After Treatment (ppm)	EPA Effluent Limitations (40CFR423) (ppm)	Estimated Increase in Average Concentration of Water (ppm)	State of North Carolina Water Quality Standards
Primary Water Treatment Plant Flush Water	8,000,000	Suspended Solids	30	TSS-Avg-30/ Max-100	(f)	(e)
		Polyelectrolyte(b)	1-2(e)		Trace	No numerical criteria
Sewage Treatment Plant	4,500,000	Residual Chlorine	0-0.5	--	Trace	(e)
		B O D	30	Avg-30-Max-45	Trace	(e)
		Total Suspended Solids	30	Avg-30-Max-100	(f)	(e)
Preoperational Flushing and Hydrostatic Testing	20,000,000	Hydrazine(b)	Not known	--	(d)	No numerical criteria
		Total Suspended Solids	30	TSS-Avg-30/ Max-100	(f)	(e)
		Copper	1.0	Avg-1.0/Max-1.0	0.02	(e)
		Iron	1.0	Avg-1.0/Max-1.0	0.02	(e)
		pH	6-9	6-9		(e)
Steam Generator Blowdown System Electromagnetic Filter Flush	250,000	Total Suspended Solids	30	30	(f)	(e)
		Copper	1.0	Avg-1.0/Max-1.0	0.02	(e)
		Iron	1.0	Avg-1.0/Max-1.0	0.02	(e)
		pH	6-9	6-9		(e)

(a) Cooling Tower Blowdown Flow is 50 MGD.

(b) No EPA effluent limitations.

(c) There will be no perceptible change in pH.

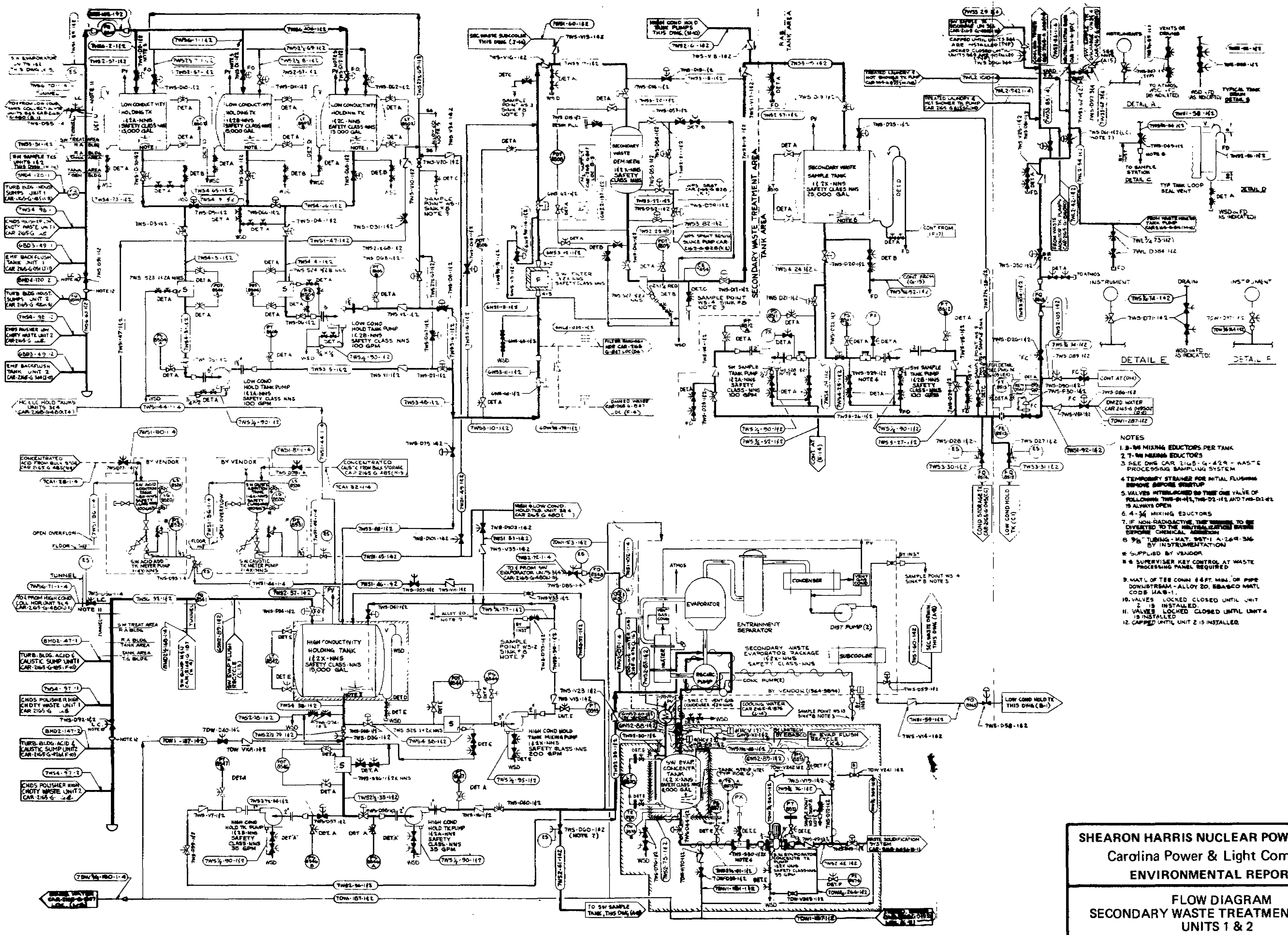
(d) Not possible to predict.

(e) Same as 40CFR423.

(f) The sources of TSS have been combined and results stated with the Demineralized Water System in Table 3.6.2-1. This quantity has no substantial effect on the total suspended solids in the cooling tower blowdown stream.

TABLE 3.6.2-3
CHEMICAL ADDITIVES AND THEIR ANNUAL CONSUMPTION/PER UNIT

Chemical	System Served	Use	Frequency of Use	Annual Consumption	
				Average	Maximum
1. Boron	Reactor Coolant System	Reactivity control	Intermittent	200 pounds	--
2. Hydrazone	Reactor Coolant System; Secondary System	Oxygen control Oxygen control	Infrequent Continuous	51 pounds 5,000 pounds	4600 pounds --
3. Ammonia	Secondary System	pH control	Continuous	2,000 pounds	--
4. Polyelectrolyte	Primary Water Treatment Plant	To induce adsorption	Continuous	165 pounds	220 pounds
5. Corrosion Inhibitor Sodium Chromate	Closed Cooling Water Systems	To inhibit corrosion	At the start and then as needed	500 pounds	--
6. Chlorine	Sewage Treatment Plant	To kill disease-causing organisms; to oxidize organic matter	Continuous	3.9 tons	--
7. Sulfuric Acid	Demineralized Water System	To regenerate	Daily	98 tons	--
8. Sodium Hydroxide	Demineralized Water System	To regenerate demineralizers	Daily	49 tons	--
9. Lithium	Reactor Coolant System	pH control	Intermittent	9 kilograms	--
10. Nitrogen	Various Primary Systems	Cover gas	Intermittent	300,000 scf	--
11. Hydrogen	Reactor Coolant System	Oxygen control	Continuous	8,500 scf	--
12. Detergent	Laundry	Cleaning	As needed	305 pounds	--
13. Corrosion Inhibitor Sodium Chromate	HVAC Chilled Water System	Corrosion inhibitor	Daily	50 pounds	--
14. Sodium Phosphate	Heat Exchange Equipment	Corrosion inhibitor	As Needed	2,100 Pounds	--


LOW CONDUCTIVITY HOLDING TK 1&2A-NNS SAFETY CLASS NNS 15,000 GAL
LOW CONDUCTIVITY HOLDING TK 1&2B-NNS SAFETY CLASS NNS 15,000 GAL
LOW CONDUCTIVITY HOLDING TK 1&2C-NNS SAFETY CLASS NNS 15,000 GAL
LOW COND HOLD TANK PUMP 1&2B-NNS SAFETY CLASS NNS 100 GPM
LOW COND HOLD TANK PUMP 1&2A-NNS SAFETY CLASS NNS 100 GPM
SECONDARY WASTE DEMINERAL 1&2 X-NNS SAFETY CLASS NNS
S.W. FILTER 1&2X-NNS SAFETY CLASS NNS
SECONDARY WASTE TREATMENT AREA
R.A.B. TANK AREA
SECONDARY WASTE SAMPLE TANK 1&2X-NNS SAFETY CLASS NNS 25,000 GAL
SW SAMPLE TANK PUMP 1&2A-NNS SAFETY CLASS-NNS 100 GPM
SW SAMPLE TANK PUMP 1&2B-NNS SAFETY CLASS-NNS 100 GPM
SW ACID ADDITION TANK
SW CAUSTIC ADDITION TANK
SW ACID ADD TK METER PUMP 1-4X-NNS
SW CAUSTIC TK METER PUMP 1-4X-NNS
BY VENDOR
OPEN OVERFLOW
FLOOR
TUNNEL
HIGH CONDUCTIVITY HOLDING TANK 1&2X-NNS SAFETY CLASS-NNS 15,000 GAL
HIGH COND HOLD TK PUMP 1&2B-NNS SAFETY CLASS-NNS 35 GPM
HIGH COND HOLD TK PUMP 1&2A-NNS SAFETY CLASS-NNS 35 GPM
HIGH COND HOLD TANK MIXING PUMP 1&2X-NNS SAFETY CLASS-NNS 200 GPM
EVAPORATOR
ENTRAINMENT SEPARATOR
CONDENSER
DIST PUMP (2)
SUBCOOLER
SECONDARY WASTE EVAPORATOR PACKAGE 1&2X-NNS SAFETY CLASS-NNS
RECIRC PUMP
S.W. EVAP. CONCENTR. TANK 1&2 X-NNS SAFETY CLASS NNS 6,000 GAL
S.W. EVAPORATOR CONCENTR. TK PUMP 1&2X-NNS SAFETY CLASS-NNS 35 GPM
COOLING WATER CAR 2165-G-876
WASTE SOLIDIFICATION SYSTEM
LOW COND HOLD TK THIS DWG (B-1)
TO SW SAMPLE TANK, THIS DWG (A-6)
DETAIL A
DETAIL B
DETAIL C
DETAIL D
DETAIL E
DETAIL F
INSTRUMENTS
VENTS OR DRAINS
TO ATMOS.
TYPICAL TANK DRAIN
TO SAMPLE STATION
TYP TANK LOOP SEAL VENT
INSTRUMENT
DRAIN
DMZD WATER CAR 2165-G-0950Z
COND STORAGE TK
LOW COND HOLD TK (C-1)
SAMPLE POINT WS-4 SINK #8 NOTE 3
SAMPLE POINT WS-2 SINK #8 NOTE 3
SAMPLE POINT WS 13 SINK #8 NOTE 3
CONCENTRATED ACID FROM BULK STOR CAR 2165 G 485
CONCENTRATED CAUSTIC FROM BULK STORAGE CAR 2165 G 485
S.W. TREAT AREA
R.A. BLDG
TANK AREA
T.G. BLDG
TURB. BLDG. ACID & CAUSTIC SUMP UNIT 1 CAR 2165-G-485
TURB. BLDG. ACID & CAUSTIC SUMP UNIT 2
CNDS POLISHER HIGH CNDTY WASTE UNIT 1 CAR 2165-G
CNDS POLISHER HIGH CNDTY WASTE UNIT 2 CAR 2165-G
EMF BACKFLUSH TANK UNIT 1
EMF BACKFLUSH TANK UNIT 2
TURB BLDG HOUST SUMPS UNIT 1
TURB BLDG HOUST SUMPS UNIT 2
S.W. EVAPORATOR

NOTES

1. 3-¾ MIXING EDUCTORS PER TANK
2. 7-¾ MIXING EDUCTORS
3. SEE DWG CAR 2165-G-429 - WASTE PROCESSING SAMPLING SYSTEM
4. TEMPORARY STRAINER FOR INITIAL FLUSHING REMOVE BEFORE STARTUP
5. VALVES INTERLOCKED SO THAT ONE VALVE OF FOLLOWING 7WS-D1-1&2, 7WS-D2-1&2 AND 7WS-D12-1&2 IS ALWAYS OPEN
6. 4-¾ MIXING EDUCTORS
7. IF NON-RADIOACTIVE, THE WASTE TO BE DIVERTED TO THE NEUTRALIZATION BASIN BEFORE CHEMICAL ADDITION
8. ⅜" TUBING - MAT. SST-1 A-269-316 BY INSTRUMENTATION

* SUPPLIED BY VENDOR

** SUPERVISER KEY CONTROL AT WASTE PROCESSING PANEL REQUIRED

9. MAT'L OF TEE CONN & 4 FT. MIN. OF PIPE DOWNSTREAM - ALLOY 20, EBASCO MAT'L CODE HAB-1.
10. VALVES LOCKED CLOSED UNTIL UNIT 2 IS INSTALLED.
11. VALVES LOCKED CLOSED UNTIL UNIT 4 IS INSTALLED
12. CAPPED UNTIL UNIT 2 IS INSTALLED.

REF DWG: CAR-2165-G-090 (REV 4, OPEN)

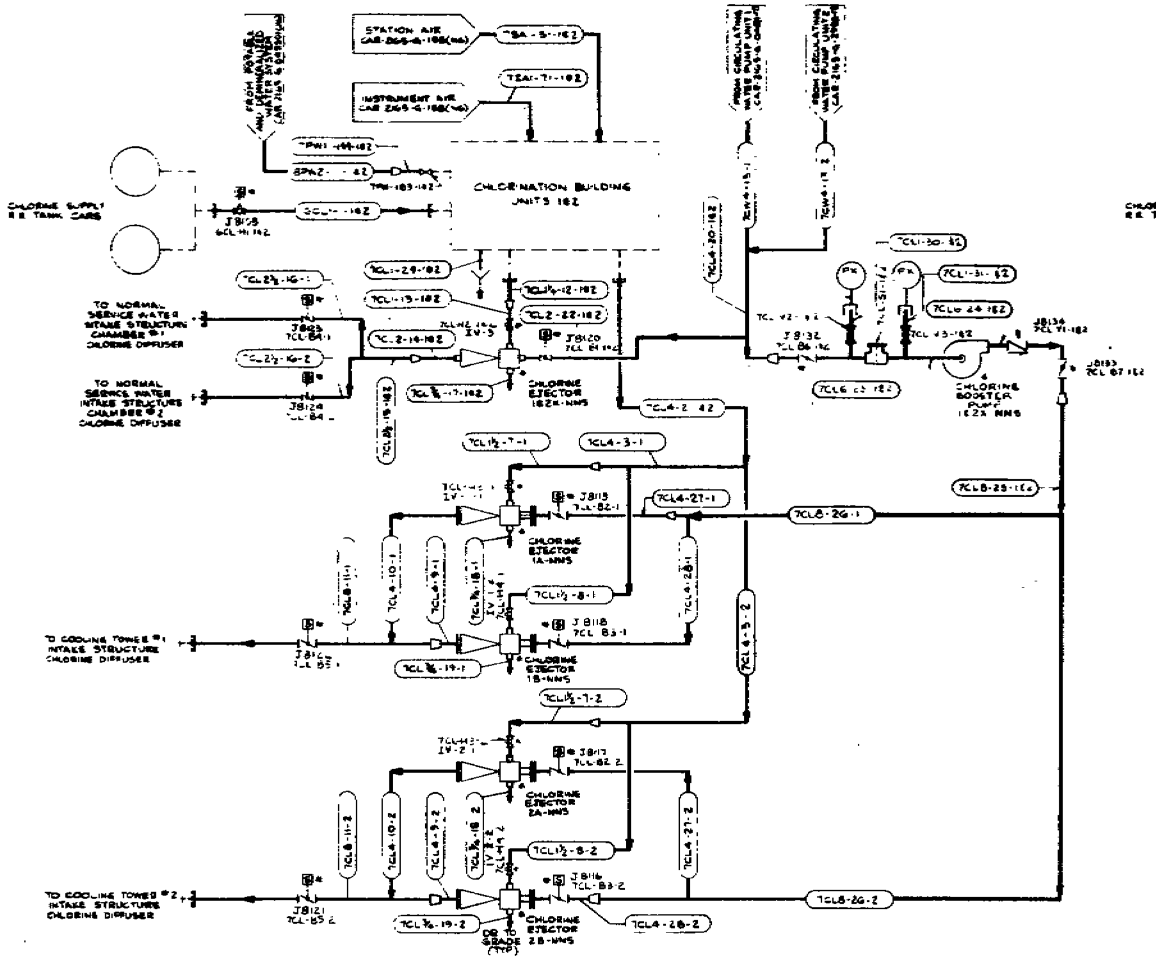
SHEARON HARRIS NUCLEAR POWER PLANT

Carolina Power & Light Company

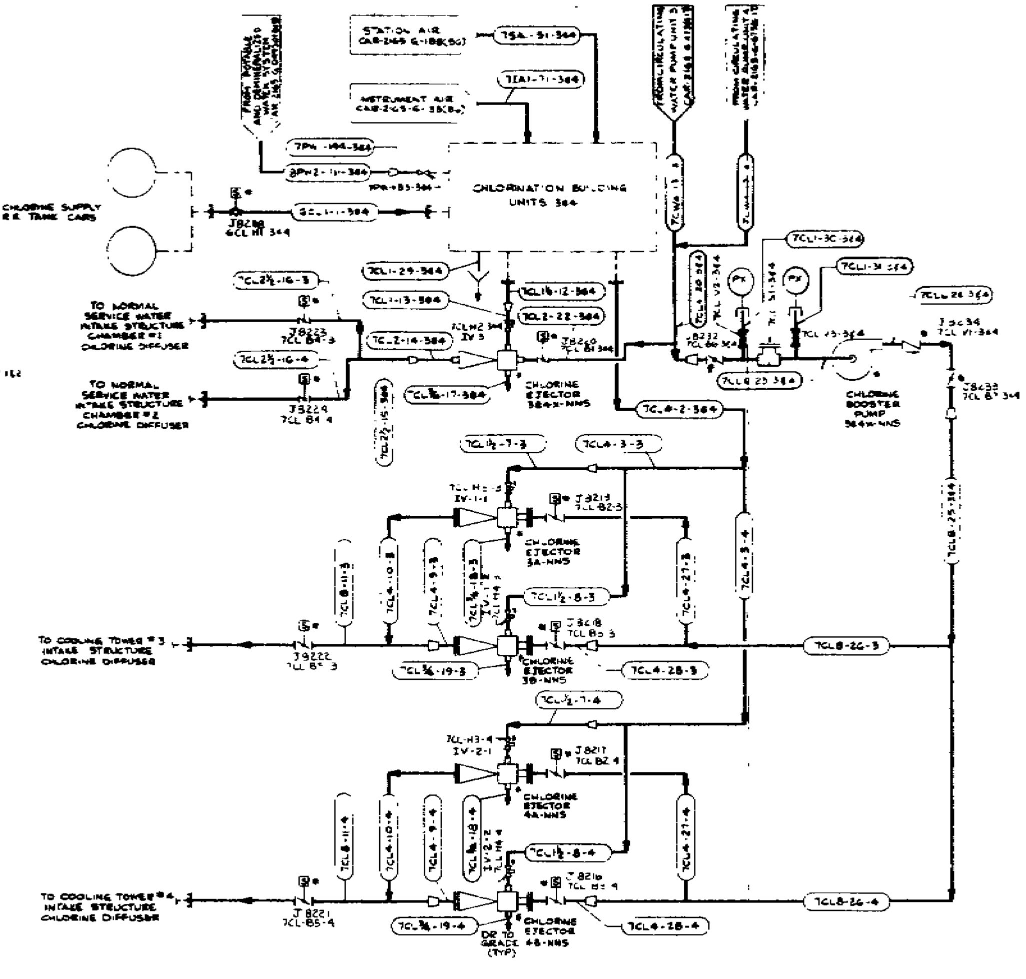
ENVIRONMENTAL REPORT

FLOW DIAGRAM
SECONDARY WASTE TREATMENT SYSTEM
UNITS 1 & 2

FIGURE 3.6.2-1


STATION AIR
INSTRUMENT AIR
FROM POTABLE AND DEMINERALIZED WATER SYSTEM
FROM CIRCULATING WATER PUMP UNIT 1
FROM CIRCULATING WATER PUMP UNIT 2
CHLORINE SUPPLY R.R. TANK CARS
CHLORINATION BUILDING UNITS 1&2
TO NORMAL SERVICE WATER INTAKE STRUCTURE CHAMBER #1 CHLORINE DIFFUSER
TO NORMAL SERVICE WATER INTAKE STRUCTURE CHAMBER #2 CHLORINE DIFFUSER
CHLORINE EJECTOR 1&2X-NNS
CHLORINE BOOSTER PUMP 1&2X NNS
CHLORINE EJECTOR 1A-NNS
TO COOLING TOWER #1 INTAKE STRUCTURE CHLORINE DIFFUSER
CHLORINE EJECTOR 1B-NNS
CHLORINE EJECTOR 2A-NNS
TO COOLING TOWER #2 INTAKE STRUCTURE CHLORINE DIFFUSER
CHLORINE EJECTOR 2B-NNS
DR TO GRADE (TYP)
J8134 7CL V1-1&2
J8133 7CL B7 1&2

CHLORINATION SYSTEM UNITS 1&2

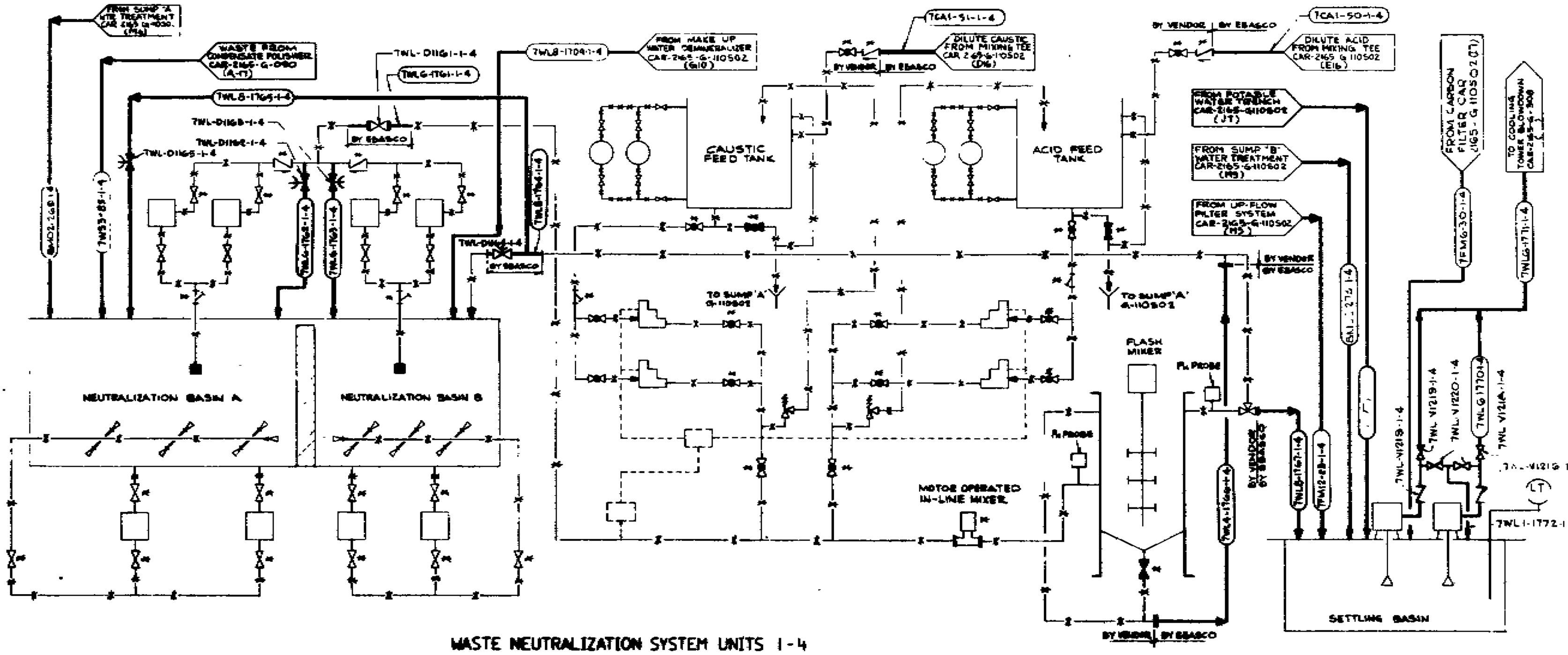

STATION AIR
INSTRUMENT AIR
FROM POTABLE AND DEMINERALIZED WATER SYSTEM
FROM CIRCULATING WATER PUMP UNIT 3
FROM CIRCULATING WATER PUMP UNIT 4
CHLORINE SUPPLY R.R. TANK CARS
CHLORINATION BUILDING UNITS 3&4
TO NORMAL SERVICE WATER INTAKE STRUCTURE CHAMBER #1 CHLORINE DIFFUSER
TO NORMAL SERVICE WATER INTAKE STRUCTURE CHAMBER #2 CHLORINE DIFFUSER
CHLORINE EJECTOR 3&4X-NNS
CHLORINE BOOSTER PUMP 3&4X-NNS
CHLORINE EJECTOR 3A-NNS
TO COOLING TOWER #3 INTAKE STRUCTURE CHLORINE DIFFUSER
CHLORINE EJECTOR 3B-NNS
CHLORINE EJECTOR 4A-NNS
TO COOLING TOWER #4 INTAKE STRUCTURE CHLORINE DIFFUSER
CHLORINE EJECTOR 4B-NNS
DR TO GRADE (TYP)
J8438 7CL B7 3&4

CHLORINATION SYSTEM UNITS 3&4

NOTES

* INDICATES VENDOR SUPPLIED EQUIPMENT

I - TEMPORARY STRAINER FOR INITIAL FLUSHING REMOVE BEFORE START-UP


FROM SUMP 'A' WTE TREATMENT
WASTE FROM CONDENSATE POLISHER
FROM MAKE UP WATER DEMINERALIZER
DILUTE CAUSTIC FROM MIXING TEE
DILUTE ACID FROM MIXING TEE
BY VENDOR
BY EBASCO
CAUSTIC FEED TANK
ACID FEED TANK
FROM POTABLE WATER TRENCH
FROM SUMP 'B' WATER TREATMENT
FROM UP-FLOW FILTER SYSTEM
FROM CARBON FILTER
TO COOLING TOWER BLOWDOWN
TO SUMP 'A'
NEUTRALIZATION BASIN A
NEUTRALIZATION BASIN B
FLASH MIXER
PH PROBE
MOTOR OPERATED IN-LINE MIXER
SETTLING BASIN

WASTE NEUTRALIZATION SYSTEM UNITS 1-4

REF DWG: CAR-2165-G-110 S01 (REV 1)

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
ENVIRONMENTAL REPORT

FLOW DIAGRAM – MISCELLANEOUS WATER TREATMENT SYSTEMS
FIGURE 3.6.2-2

3.7 SANITARY AND OTHER WASTES

3.7.1 INTRODUCTION

This section describes the solid, liquid, and gaseous wastes generated during station operation which are not described in Section 3.6. Included are sanitary wastes, storm runoff, and emissions from the diesel engines and auxiliary boilers.

3.7.2 SANITARY WASTES

The domestic wastewater from all sections of the plant is treated by a 25,000 gpd capacity extended aeration plant. The extended aeration plant consists of a reversible comminutor with automatic by-pass and bar screen, and equalization tank with dual pumps and automatic by-pass, two aeration chambers with isolation capabilities, a clarifier, a sludge digestor, a chlorination chamber with dual hypochlorinators, and froth control system. 5

The domestic waste passes through the comminutor (which reduces the solids to a maximum size of 1/4 in.) to the equalization tank. Dual pumps transfer the waste at a constant rate to the aeration chambers where it is subjected to aerobic action for a minimum of 24 hours. Effluent from the aeration tank flows to the clarifier where the sludge is settled and returned to the aeration tank. The clarified liquid flows to the chlorine contact tank and is then released to the Main Reservoir. Excessive sludge is removed at regular intervals and transported by truck to sewage treatment facilities for disposal.

The effluent from the treatment system will comply with the following discharge limitations as established in the NPDES Permit:

Effluent Characteristic	Daily Average	Daily Maximum
Flow	0.050 MGD	0.075 MGD
BOD	30 mg/l	45 mg/l
TSS	30 mg/l	45 mg/l

3.7.3 STORM DRAINAGE SYSTEM

The storm drainage system collects rainfall runoff and routes it to the nearest receiving stream. Concrete drain pipe with corresponding catch basins and manholes were installed throughout the uncovered plant areas to collect runoff. The plant area was graded to drain toward the ditches and catch basins.

In areas such as the switchyard where storm runoff may be contaminated, its discharge is controlled by an approved Spill Prevention Control and Countermeasure plan pursuant to 40 CFR 112.

3.7.4 OTHER WASTES

Chemical combustion by-products will be released to the atmosphere during the operation of auxiliary boilers and occasional testing of emergency diesel generators and a diesel fire pump.

5 Standby Diesel Generators - The plant employs a total of four diesel engines, two per unit, as a part of the emergency generating system. Each generator is rated at 6500 kW and uses approximately 445 gal./hr. of No. 2 oil when operating at full capacity. While the emergency use of these generators cannot be predicted, each will be tested at full capacity one hour per month, with no more than two generators operating simultaneously per week.

5 The total planned use of all four diesel engines thus amounts to a maximum of 48 hours per year. The diesel oil will have a maximum allowable ash content of 0.02 percent and sulphur content of less than 0.7 percent. The average temperature of exhaust gases released to the atmosphere is estimated at 780 F at full load. Due to the emergency standby nature of these generators, they are exempt from the "Proposed Rules for Stationary Internal Combustion Engines" (40 CFR60 Subpart FF, Sections 60.320-60.324). The products of combustion are estimated as follows:

5

Pollutant	Tons/Year (4 diesel engines)
Particulate	0.02
SO_2	0.53
CH_x	0.095
NO_x	5.30

Auxiliary Boilers - The purpose of the auxiliary boilers is to provide an independent nonradioactive steam source for the reactor support system and balance-of-plant process equipment. Under normal operation, auxiliary steam is extracted from either the main or extraction steam system, depending on the load or extraction pressure, with the auxiliary boilers acting as a backup source. The Auxiliary Steam System is designed on the basis of one of the
5 two SHNPP units as the normal source. However, through a system of tie-in piping, there is the flexibility to extract steam from one or both units or one unit and the auxiliary boilers. The common tie-in also gives the flexibility to isolate steam from a unit with steam generator tube leakage.

5 There are two auxiliary boilers for the two SHNPP units. Each boiler is rated at 71,000 lbs./hr., 230 psig, and 399 F steam temperature and will be fired by No. 2 oil of the same quality as used in the diesel engines with a heat input of 80 MBtu/hr. at maximum capacity.

Based on the stated design of the Auxiliary Steam System, the auxiliary boilers will be used, for limited periods, during such occurrences as start-up when only Unit 1 is on line or re-fueling or maintenance outages when steam is not available from an operating unit. In addition, auxiliary boilers will be used to provide steam for the cleaning of various plant components during initial plant start-up of Unit 1. The normal use of both auxiliary boilers, however, is estimated at no more than 5 percent of the time, or 438 hours per year each. The expected waste emissions from each boiler operating at the maximum continuous rating are as follows:

Pollutant	Tons/Year
Particulate	0.41
SO_2	14.5
CO	0.33
CO_2	3,310
CH_4	.10
NO_x	6.0

Diesel Fire Pump - The Fire Protection System has one 300 hp diesel fire pump. The pump has a capacity of 2500 gpm and requires approximately 15.75 gallons per hour of No. 2 oil when operating at full capacity. The pump will be tested approximately one hour per month. Emissions released to the atmosphere from the operation of the diesel fire pump are negligible.

3.8 RADIOACTIVE MATERIAL MOVEMENT

Transportation of new fuel to the SHNPP and spent fuel and waste from the SHNPP will be within the scope of Paragraph (g) of 10CFR Part 51.20. As such, the environmental impacts of the transportation of fuel and wastes will be as set forth in Summary Table S-4 of 10CFR, Part 51. While the transportation of spent fuel from other plants for storage at the SHNPP (as described in Sections 9.1.1 through 9.1.4 of the SHNPP Final Safety Analysis Report) will result in additional environmental impact when that fuel is ultimately moved from the SHNPP, the total environmental impact of radioactive material movement to and from the SHNPP will not exceed that set forth in Summary Table S-4.

In accordance with Regulatory Guide 4.2, no further environmental analysis of radioactive material movement is required.

3.9 TRANSMISSION FACILITIES

The transmission facilities description as presented in Section 3.11 of the SHNPP Construction Permit Environmental Report requires no updating except for those items mentioned below. 3

The Harris-Method Line now terminates at the Cary Switching Station instead of the Method Substation as indicated in Section 3.11.8.2 of the SHNPP Construction Permit Environmental Report. This line will be referred to as the Harris-Cary Switching Line. 3 This termination point is the same location as illustrated in Figure 3.11-6 of the SHNPP Construction Permit Environmental Report, and is approximately five miles shorter than the originally-proposed line. The location of this line is identified in Figure 3.9.0-1.

Since Units 3 and 4 were cancelled, no 500 kV transmission lines will be constructed for the Shearon Harris Plant. 3

All Harris Plant transmission lines are illustrated in Figures 3.9.0-1 through 3.9.0-4 and their current status is given in Table 3.9.0-1. Each transmission line that is now constructed is operating independently of the Harris Plant and will be connected into the switchyard when the plant becomes operational.

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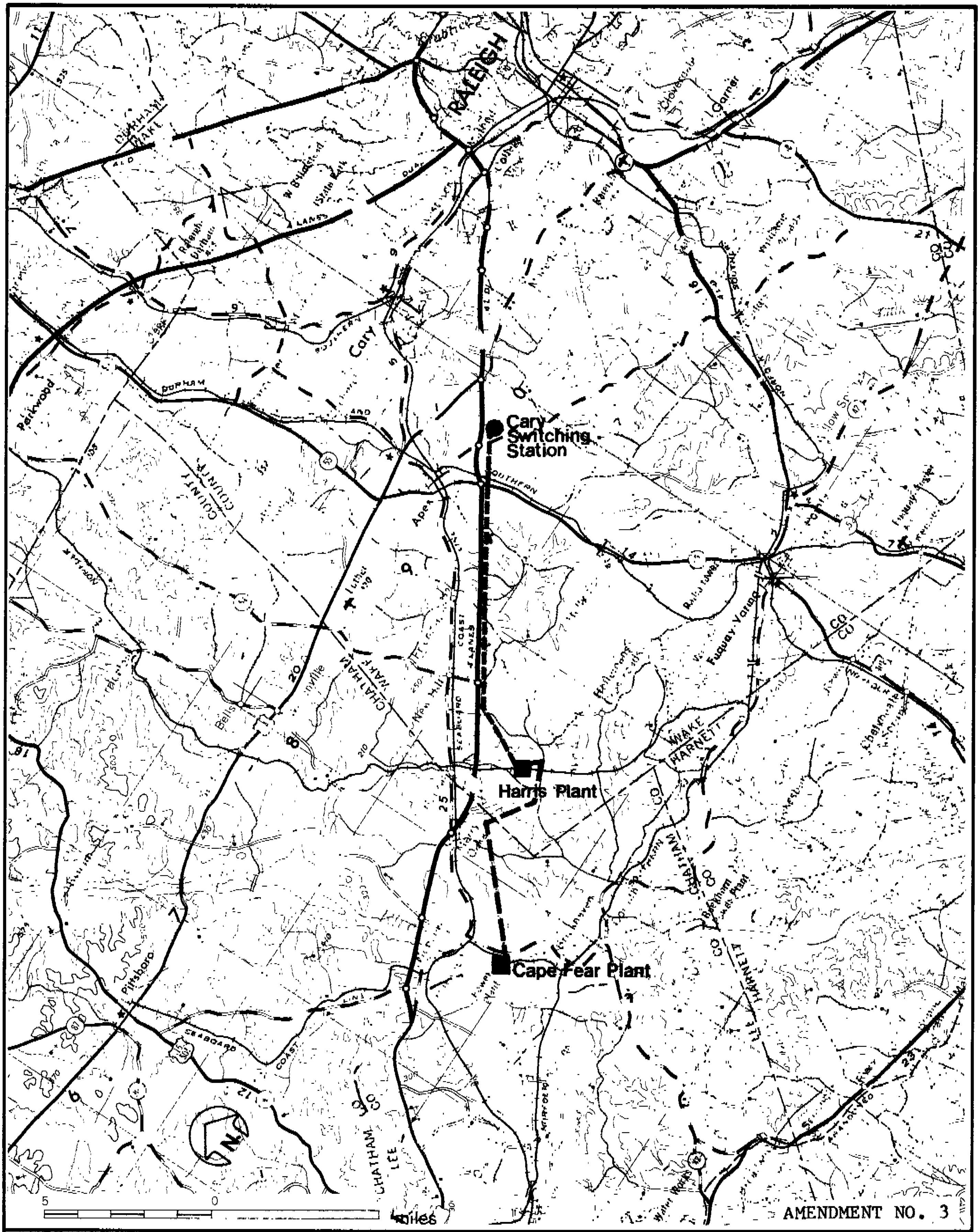
TABLE 3.9.0-1

STATUS (MAY 1982) OF ALL SHNPP TRANSMISSION LINES

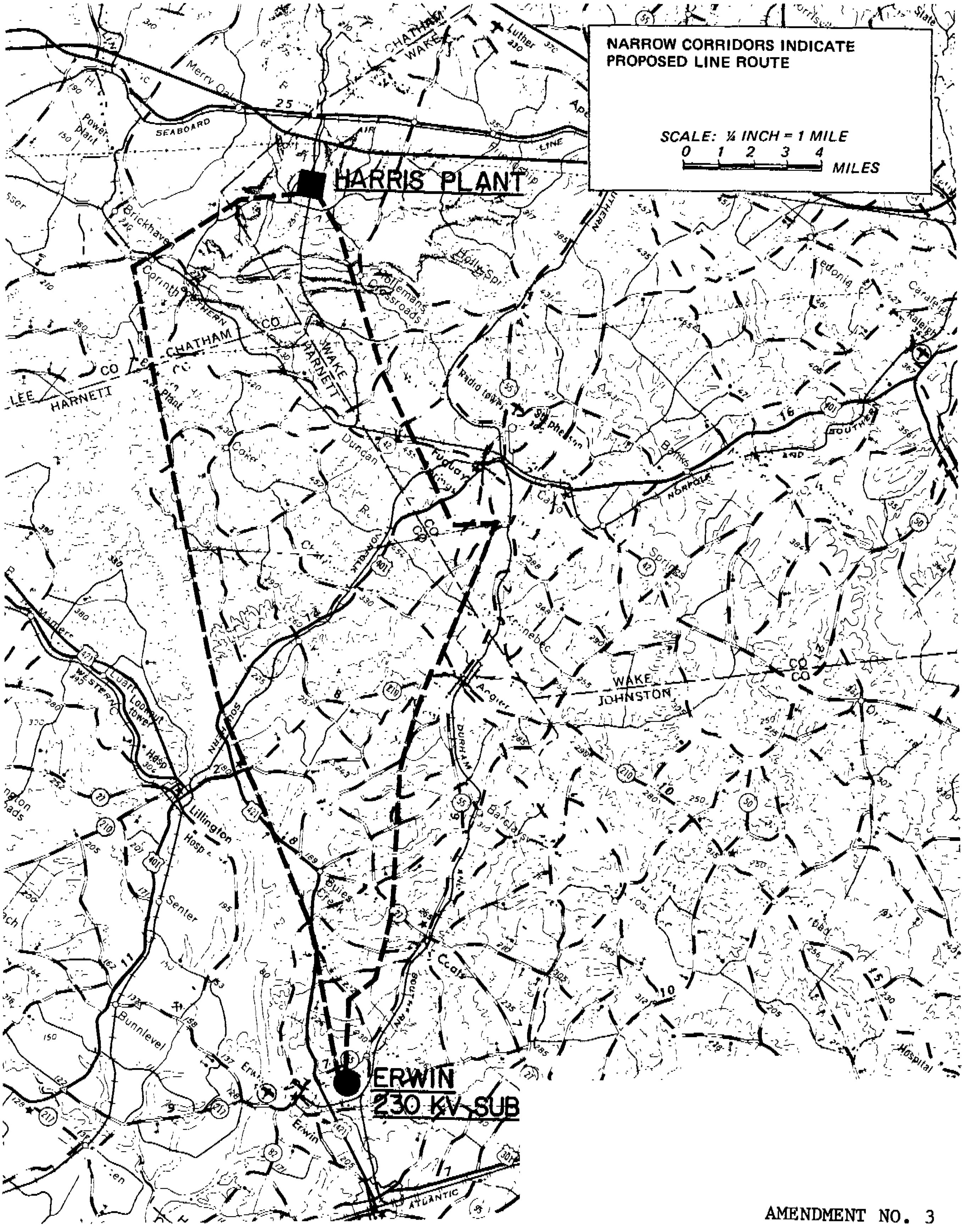
3

Line Name	Current Status	Date Construction Will Begin
Harris-Cary Switching (Formerly Method)	Constructed	-
Harris - Cape Fear	Constructed	-
Harris - Asheboro	Partially Constructed (5.4 miles)	September 1982 (remainder)
Harris - Fayetteville	Partially Constructed (20.6 miles)	January 1983 (remainder)
Harris - Lillington - Erwin South	-	1987 (Subject to change)
Harris - Fuquay - Erwin North	Constructed	-



AMENDMENT NO. 3

SHEARON HARRIS NUCLEAR POWER PLANT Carolina Power & Light Company ENVIRONMENTAL REPORT	HARRIS - CARY SWITCHING 230 kv LINE and HARRIS - CAPE FEAR 230 kv LINE	FIGURE 3.9.0 - 1



AMENDMENT NO. 3

SHEARON HARRIS NUCLEAR POWER PLANT

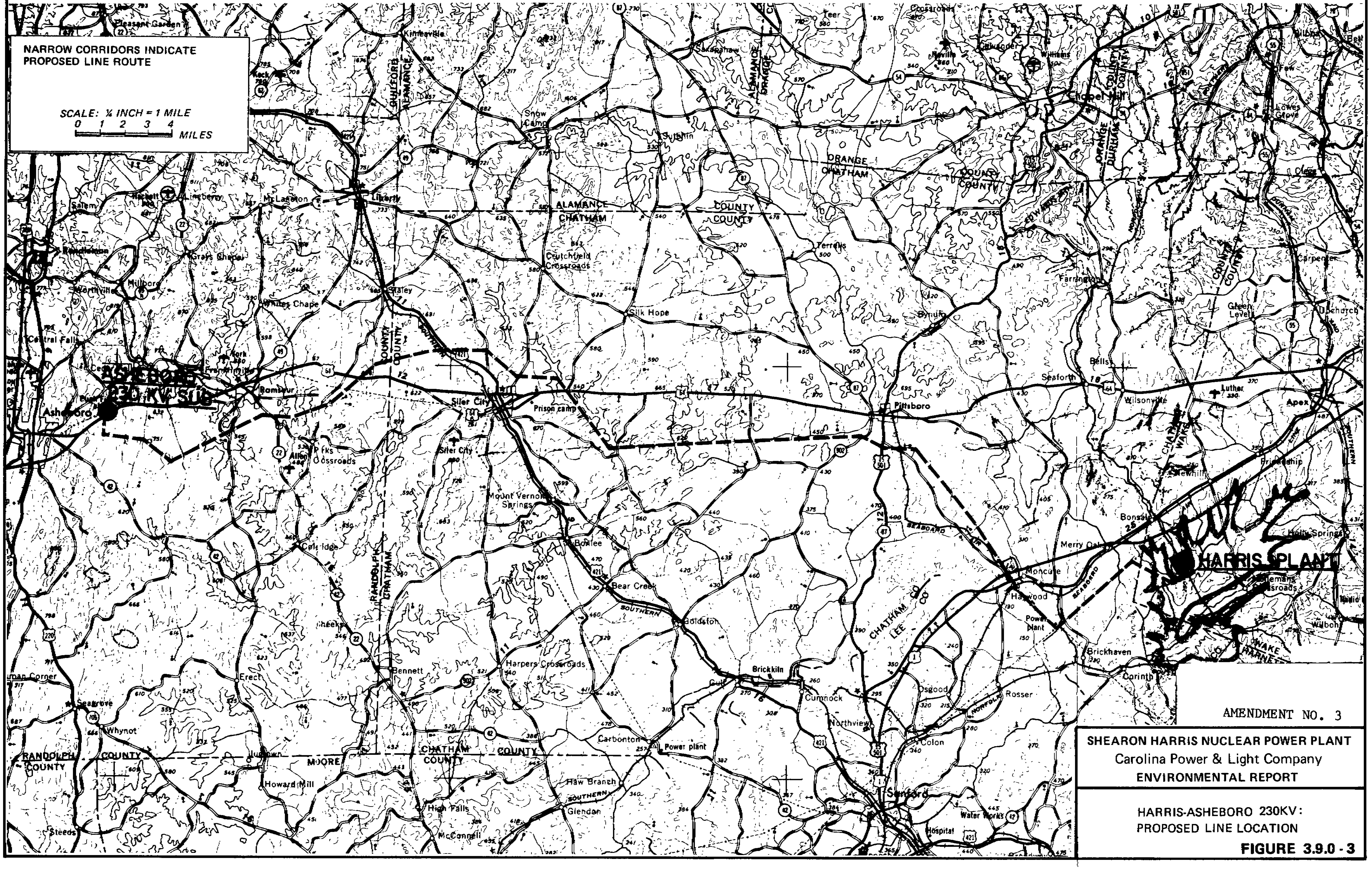
Carolina
Power & Light Company

ENVIRONMENTAL REPORT

HARRIS-LILLINGTON-ERWIN SOUTH* &
HARRIS-FUQUAY-ERWIN NORTH 230KV LINES
*PROPOSED LINE LOCATION

FIGURE

3.9.0 - 2

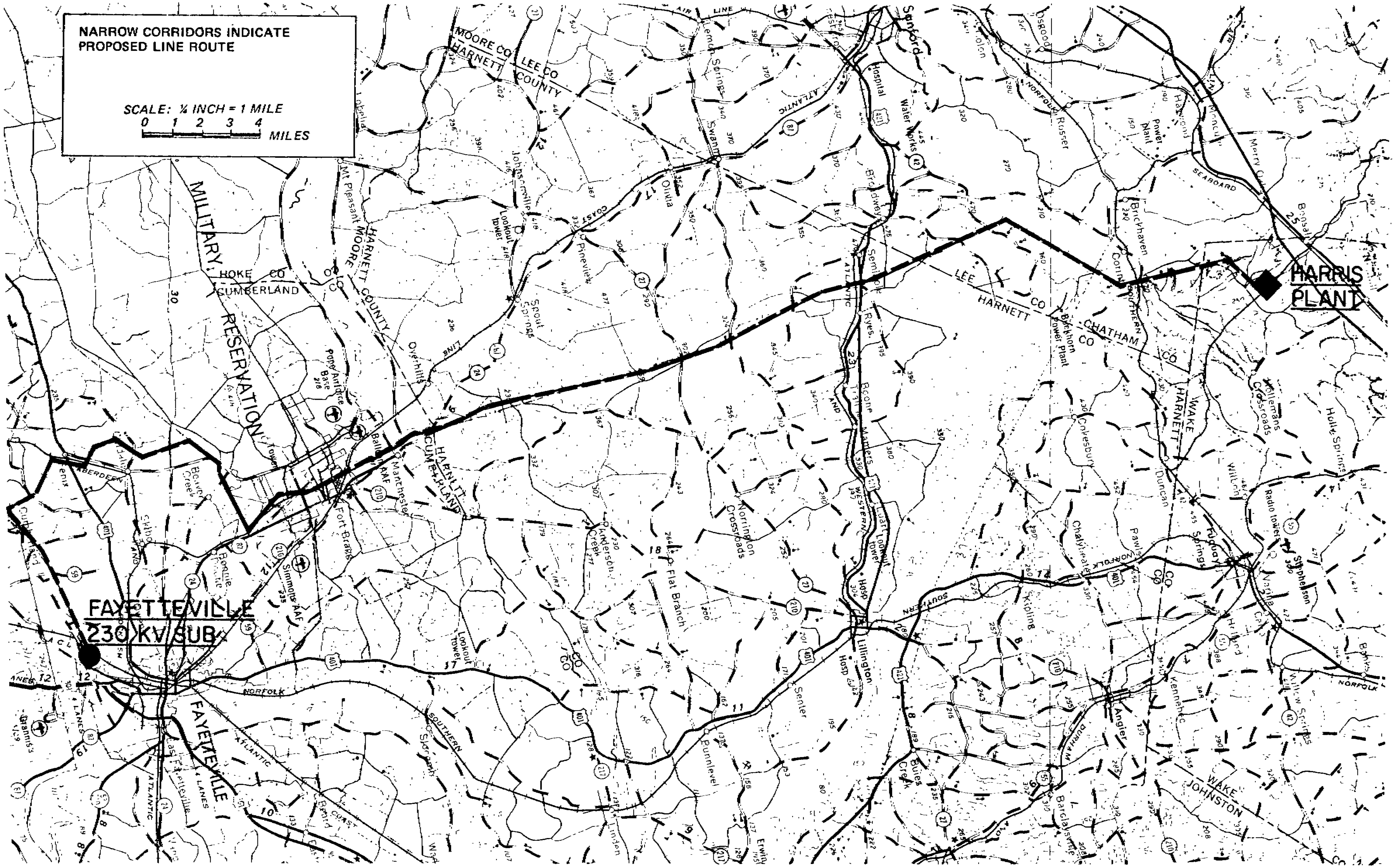


AMENDMENT NO. 3

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
ENVIRONMENTAL REPORT

HARRIS-ASHEBORO 230KV:
PROPOSED LINE LOCATION

FIGURE 3.9.0 - 3



AMENDMENT NO. 3

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
ENVIRONMENTAL REPORT

HARRIS-FAYETTEVILLE 230KV:
PROPOSED LINE LOCATION

FIGURE 3.9.0-4

CHAPTER 4

ENVIRONMENTAL EFFECTS OF SITE PREPARATION, STATION CONSTRUCTION, AND TRANSMISSION FACILITIES CONSTRUCTION

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3

CHAPTER 4

ENVIRONMENTAL EFFECTS OF SITE PREPARATION, STATION CONSTRUCTION, AND TRANSMISSION FACILITIES CONSTRUCTION

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CHAPTER 4 LIST OF TABLES

4.0 ENVIRONMENTAL EFFECTS OF SITE PREPARATION, STATION CONSTRUCTION, AND TRANSMISSION FACILITIES CONSTRUCTION

4.1 SITE PREPARATION AND STATION CONSTRUCTION

The intent of this section is to discuss potential areas of impact associated with site construction activities at the Shearon Harris Nuclear Power Plant. Section 4.5 identifies mitigative measures and assesses the type and extent of the resulting impact. Land area requirements (Table 4.1-1) and estimated construction work force (Table 4.1-2) are also tabulated in this section.

Construction activities commenced on January 14, 1974, following issuance of the Limited Work Authorization and on January 27, 1978, following issuance of the Construction Permit. Construction activities will be continuous until commercial operation of the second unit is achieved. | 2

4.1.1 LAND RESOURCES

Land resources affected by construction activities were 5,338 acres (Table 4.1-1) of the approximately 10,800 acre site area. The following serves as a general checklist to facilitate identification of potential areas of construction impact. These areas are discussed in detail in Section 4.5. | 2

a) Runoff and erosion

b) Vehicle washdown

c) Solid and liquid waste disposition

d) Dust

e) Noise

f) Fuel and oil storage

g) Landscape restoration

h) Explosives

i) Smoke

j) Excavation

k) Agricultural productivity

l) Transportation

4.1.2 CULTURAL RESOURCES

There were no areas of historical, archaeological, or natural significance that were affected by construction (see Section 2.6). However, two benchmarks used by the U. S. Geodetic Survey were located within the area affected by project construction. The North Carolina Geodetic Survey requested that CP&L destroy each of these markers, and the U. S. Geodetic Survey was informed of their destruction.

4.1.3 TERRESTRIAL COMMUNITIES

The most significant unavoidable impact on the terrestrial ecosystem resulting from site preparation and construction of SHNPP was the conversion of the previously existing terrestrial wildlife habitat of the Main and Auxiliary Reservoir areas to aquatic ecosystems. Other terrestrial habitat losses or modifications have resulted from construction of various facilities such as the transmission corridors, makeup water pipeline, access roads, and pump station at the Cape Fear River (Table 4.1-1).

2 As discussed in Section 2.2.1.1, the native flora of the site had been previously disturbed by agricultural and timber production activities and was typical of the vegetation found throughout the Piedmont of North Carolina. Thus, the development of the SHNPP site involved only a small part of a large area of similar habitat. The area cleared for the reservoirs and plant facilities was composed primarily of second growth pine and pine-hardwood communities common to this area of the Piedmont. These pine communities and several other plant communities once located in the area cleared for the 2 reservoirs (Section 2.2.1.1) were partially replaced by aquatic communities as the reservoirs are filled and natural succession occurred. Aquatic vegetation developed mainly in the shallow areas of the reservoirs.

Present vegetation along the margin of the reservoirs may gradually shift in composition to species characteristic of wetter habitats. Natural vegetation in the areas used for plant site facilities will be replaced by ornamental plants, lawns, and various other cover species.

Where the cleared areas are inundated, the overall long-term effect is the loss of that land's terrestrial productivity for as long as the reservoir exists. In other areas where cleared land is revegetated naturally or by means of artificial seeding or planting, the habitat alteration resulting from construction will cause only temporary changes in the species diversity and population levels. As such areas progress through the stages of secondary succession, wildlife will repopulate the available habitat.

The most obvious and important unavoidable effect of construction on wildlife was the displacement or loss of the individual animals occupying the areas which were cleared. The larger, more mobile animals were able to avoid immediate destruction by moving into adjacent areas. However, intraspecific and interspecific competition for food and space probably increased, especially where existing wildlife populations were at or near the habitat's carrying capacity. Ultimately, it can be expected that the animal populations in these areas will reach an equilibrium with each other and the available habitat, reflecting an overall loss approximately equal to the number of animals originally displaced from the areas cleared. Many of the smaller, less mobile animals were not capable of escaping the clearing process and probably were eliminated immediately.

Movement of workers and equipment during peak periods of site preparation and construction will temporarily disrupt normal behavior patterns of some local fauna. Movement patterns, antipredatory behavior, reproductive behavior, and general intraspecific auditory communication between some species may be affected by noise, traffic, and dust resulting from construction activities. Such effects will be short-term and will not have serious long-term consequences. In areas where animals are driven out or disturbed during construction, the return or recovery of those animal populations is expected to be quite rapid.

Once construction activities are completed, some areas of land previously committed to construction activities or other land use will be reforested or revegetated. As these areas progress through natural successional stages, both food and cover will be provided for many wildlife species.

The reservoirs constructed for the operation of the SHNPP will significantly increase the value of the site as waterfowl and furbearer habitat. The aquatic environment will enhance local populations of certain species of waterfowl by providing food, resting places, and in some cases, nesting sites. Furbearing species which characteristically inhabit aquatic communities will benefit by the increase in shoreline habitat. Many woodland, marsh, and wading species of birds will utilize the shoreline habitat around the reservoirs. The reservoirs and the margins of the reservoirs also provide suitable habitat for many amphibian and aquatic reptile species.

Of the threatened and endangered terrestrial vertebrate and plan species identified on or near the SHNPP site, none are expected to be adversely affected by site preparation or construction activities. A discussion of these species and their status at the SHNPP site is in Section 2.2.3. 2

4.1.4 AQUATIC COMMUNITIES

The local flora and fauna inhabiting the various creeks comprising the Whiteoak-Buckhorn drainage basin are discussed in Section 2.2.0. These local communities exhibited alterations of species composition and relative abundance as the system of free flowing streams was impounded for the Main and Auxiliary Reservoirs. Alterations in species composition and relative abundance occur as organisms well adapted for stream (lotic) habitat are replaced by plants and animals which are better adapted for lake (lentic) habitats. 2

Although erosion control measures designed to minimize siltation and sedimentation effects were initiated after approval by appropriate regulatory agencies, construction activities for reservoir basin clearing and site preparation, as expected, have resulted in some impacts to the periphytic, benthic and fish communities. Changes in these communities that occurred during the initial stage of construction activity included decreased abundance and diversity of aquatic communities, reduction of silt intolerant organisms, limitation of food and habitats, interference with filter feeding activities, and scouring. Because all these effects are associated with siltation and sedimentation resulting from land clearing and other initial construction activities, it is expected that the stream communities will temporarily recover prior to filling of the reservoirs. However, with the completion of the Main and Auxiliary Reservoir Dams and the filling of the reservoirs, the following changes in algal, benthic macroinvertebrate, and fish communities will occur:

a) Algal Community - The periphytic algae present in the SHNPP stream system are predominantly rheophilic (those found mainly in flowing waters); however, some are also common in the littoral zones of lakes. The benthic algal forms present in the streams will be replaced by planktonic forms as the reservoirs are filled. Consequently, the plankton assemblage will be more important to productivity than periphytic species.

A species shift is expected from the dominant stream benthic diatom population to small green algae with true planktonic diatoms predominating in the reservoirs. Some blue-green algae will also exist in the reservoirs. *Achnanthes*, *Cocconeis*, *Gomphonema*, *Navicula*, and *Nitzschia* are some of the common benthic genera presently found in the streams which will not be as abundant in the reservoirs. *Asterionella*, *Cyclotella*, *Melosira*, and *Synedra*, common planktonic diatoms, are present in the SHNPP streams and can be expected to be found in abundance when the reservoirs are filled.

1 There is a possibility, depending on the flushing rate, of eutrophication occurring in some of the shallow arms of the reservoir due to high nutrient loadings from the creeks feeding the arms. With a slow flushing rate, a potential for excessive blue-green algae populations and eutrophication could occur in the shallow areas.

Zooplankton expected to be found in the reservoirs should be similar to
genera found in lakes of the Piedmont of North Carolina. Genera that may be
present include the rotifers (*Keratella*, *Polyarthra*, and *Synchaeta*); the
cladocerans (*Bosmina*, *Ceriodaphnia*, and *Daphnia*); the copepods (*Diaptomus*,
1 *Mesocyclops*, and *Cyclops*); and the larvae of the dipteran,
Chaoborus. A stable zooplankton population will not be achieved until
2 to 4 years after the reservoirs are filled, and so considerable fluctuation
in densities and species may be expected during this period.

b) Benthic Macroinvertebrate Community - As the reservoirs begin filling,
a succession of benthic macroinvertebrate communities will occur. This
1 succession may follow a pattern similar to that reported by Weiss et al.
for Belews Lake, North Carolina (Reference 4.1.4-1). According to Weiss et al., the succession of the benthic community began as water filled Belews Lake. The Belews Lake data indicated a decline in the number of taxa collected due to a loss of rheophilic organisms inhabiting lotic environments. The initial stage of lake colonization was marked by high local densities of many different kinds of organisms distributed in highly mosaic patterns. This initial stage was overlapped by a second stage of colonization when benthic species favored by water level fluctuations and high debris levels became dominant. A third stage of colonization, characterized by organisms adapted to lower water level fluctuations and lower debris concentrations, was observed when Belews Lake reached normal pool.

After the SHNPP reservoirs reach normal pool, a further succession in the benthic macroinvertebrate community may continue for a period of time until factors such as immigration, competition, predation, water level fluctuations, and food availability establish a stable community structure.

Of the benthic organisms which will eventually inhabit the reservoirs, the Diptera (e.g., Chaoborus, Procladius, and Chironomus) and Oligochaeta (Tubificidae) are expected to be important in the sublittoral and profundal zones. The Diptera (e.g., Chironomus, Polypedilum, Dicrotendipes, and Pseudochironomus), as well as selected Trichoptera, Ephemeroptera, and Oligochaeta groups, may dominate the littoral zones of the reservoirs.

c) Fishery Community - An alteration of the fish species composition and relative abundance in the Whiteoak-Buckhorn Creek drainage will result as the SHNPP reservoirs are filled. Some of the common stream species that might be replaced are rosyside dace (Clinostomus funduloides), creek chub (Semotilus atromaculatus), bluehead chub (Nocomis leptocephalus), margined madtom (Noturus insignis), and tessellated darter (Etheostoma olmstedi). These species prefer the riffle-pool habitat available in the streams. After impoundment of the streams, these species will be replaced by other species which are better adapted for the habitat offered in the reservoirs. Some of the species that will benefit and proliferate under reservoir conditions are creek chubsucker (Erimyzon oblongus), green sunfish (Lepomis cyanellus), bluegill (Lepomis macrochirus), largemouth bass (Micropterus salmoides), and golden shiner (Notemigonus chrysoleucas).

In the first years after impoundment, it is expected that catfish and suckers, which are primarily detritus feeders, will become abundant. As the benthic and plankton communities mature, food items favored by sunfish and bass will become more abundant, providing food supplies for the expansion of these populations. The green sunfish, bluegill, largemouth bass, and other game species present in the Whiteoak-Buckhorn Creek system are expected to develop into a sport fishery as the Main Reservoir ages.

4.1.5 EFFECTS ON GROUNDWATER

Site groundwater will be used to support construction activities. The effects of this use on groundwater is discussed in Section 2.4.3.

TABLE 4.1-1

LAND AREA REQUIREMENTS AFFECTED BY STATION AND STATION RELATED FACILITIES

The total site is approximately 10,800 acres (See Figure 2.1.1-1); the following acreage was required for actual construction work:

Facilities	Acres
Main Reservoir	4,121
Main Dam	40
Main Dam Access Road	4
Main Reservoir Makeup System	57
Auxiliary Reservoir	335
Auxiliary Dam Spillway	7
Auxiliary Dam	138
Auxiliary Separating Dike	12
Auxiliary Reservoir Channel	7
Borrow Areas for Main and Auxiliary Reservoir Dams	76
Main Plant	437
Aggregate Rescreen	1
Main Access Road	17
Cooling Tower Blowdown Line	13
Construction Access Road	6
Emergency Service Water Channels	6
Southwest Spoil Area for Main Plant	23
Plant Access Railroad Spur	8
Spoil Areas for Railroad Relocations	30
Subtotal	5,338

2

TABLE 4.1-1 (Continued)

LAND AREA REQUIREMENTS AFFECTED BY STATION AND STATION RELATED FACILITIES

Facilities	Acres	
Subtotal	5,338	2
Onsite and Offsite Transmission Line Corridors (pre-existing rights-of-way not included; onsite rights-of-way acreage not additive to the 5,338 acres required for onsite construction)	2,560	
Total	7,898	2

TABLE 4.1-2

ANNUAL SCHEDULE OF ESTIMATED WORK FORCE

PROJECT ESTIMATED MAN/YEARS

	Daniel (Inc. Manual & Supervision)	Contracts (Inc. Guards & Switchyard)	CP&L Site NPCD	CP&L Site OA	CP&L Operations	Total
As of 12/81:	8,856	1,369	513	166	-	10,904
1982	3,135	451	167	106	-	3,859
1983	3,397	181	170	141	-	3,889
1984	2,282	373	170	157	520	3,502
1985	1,582	309	170	162	540	2,763
1986	921	45	138	144	590	1,838
1987	418	37	109	123	632	1,319
1988	209	8	41	107	632	997
1989	-	-	-	-	632	632
TOTAL	20,800	2,773	1,478	1,106	3,546	29,703

Note: The above totals include personnel for Units 1 and 2 based on a fuel load date of December 1984 for Unit 1 and June 1988 for Unit 2.

REFERENCES SECTION 4.1:

4.1.4-1 Weiss, C. M., T. P. Anderson, P. G. Campbell, D. R. Lenet, J. H. Moore, and S. L. Pfaender. Environmental Comparison Belews Lake - Year III and Lake Hyco, North Carolina, July 1972 - 1973. University of North Carolina -Chapel Hill, Department of Environmental Science and Engineering. Chapel Hill, N.C. April, 1974.

4.2 TRANSMISSION FACILITIES CONSTRUCTION

The purpose of this section is to describe the effects of transmission facilities construction on plant, wildlife, and human populations. Appendix 4.2A includes a copy of all correspondence between CP&L and the State Historical Preservation Officer for the proposed Harris Plant-Asheboro 230 kV Line and the Harris Plant-Fayetteville 230 kV Line. Information presented in Sections 3.11.5 and 3.11.9 of the SHNPP Construction Permit Environmental Report requires no updating except for the exclusion of all remarks regarding 500 kV transmission lines and the Harris-Method 230 kV Line has been shortened and renamed the Harris-Cary Switching line as discussed in Section 3.9.

3

REFERENCES: Section 4.2

4.2.1-1 Cloninger, R. A.; Garton, J. S.; Cumbie, P. M.; and Berg, S. D. "The Occurrence of Nongame Wildlife in Piedmont Transmission Corridor Rights-of-Way." Charlotte, North Carolina: Duke Power Company, 1976.

4.2.4-1 U. S. Department of Agriculture. Soil Loss Prediction. Soil Conservation Service Technical Guide Section III-B. Spartanburg, South Carolina, 1961.

APPENDIX 4.2A

STATE HISTORIC PRESERVATION OFFICE CORRESPONDENCE

2

APPENDIX 4.2A

STATE HISTORIC PRESERVATION OFFICE CORRESPONDENCE

Appendix 4.2A includes a copy of all correspondence between CP&L and the State Historical Preservation Officer for the proposed Harris Plant-Asheboro 230 kV Line and the Harris Plant-Fayetteville 230 kV Line.

The Harris Plant-Cape Fear Plant 230 kV Line was constructed parallel to an existing line and the Harris Plant-Method 230 kV Line was constructed along an existing line's corridor. These lines did not involve extensive interaction between CP&L and the State Historic Preservation Office.

The Harris-Fuquay-Erwin (North) 230 kV Line was located in 1975. Since all correspondence was through personal interview, no written correspondence is available. Interviews were held by Mr. Ken Rudder (CP&L) with Mr. Pat Garrow (N.C. Department of Archives & History, Archaeology Section) and Ms. Kathaleen Pepi (N.C. Department of Archives & History, Historical Section) on June 18 and June 13, 1975, respectively. 2

The Harris-Lillington-Erwin (South) 230 kV Line is proposed as predominantly (80%) a rebuild of an existing line. No extensive interaction with the State Historic Officer was necessary.

FORM 21-50M

CP&L
Carolina Power & Light Company
Raleigh, N. C. 27602

COPY

April 30, 1979

Ms. F. Langdon Edmunds
North Carolina Division of Archives
& History
109 East Jones Street
Raleigh, North Carolina 27602

Dear Ms. Edmunds:

CP&L is conducting an environmental inventory of an area in Randolph and Chatham Counties in order to route a 230 kV power transmission line. As part of the inventory, we need information regarding the archaeological and historical resources of the study area.

We are requesting that such an evaluation of the archaeological and historical resources be made including an indication of the significance of these resources. If you wish, our personnel will perform the historical inventory, as in the past, by searching the structures files. Please contact Ms. Jan Heard at 836-6052 if this is acceptable to you.

Enclosed is a map of the study area. Thank you for your cooperation in this matter.

Yours very truly,

Bobby J. Ward

Bobby J. Ward, Ph.D.
Principal Scientist
Terrestrial-Analytical Unit

JLH/kc
Enclosure

cc: Mr. R. L. Sanders

bcc: File: Harris-Asheboro Cultural Resources ✓

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ra W. Hodgkins,
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mes B. Hunt, Jr.,
overnor

May 25, 1979

Mr. Bobby J. Ward, Ph.D.
Principal Scientist
Terrestrial-Analytical Unit
Carolina Power & Light Company
P. O. Box 1551
Raleigh, N.C. 27602

Re: Proposed 230 kV Transmission Line, Randolph and Chatham Counties

Dear Dr. Ward:

Thank you for your letter of April 30, 1979, concerning the proposed transmission line.

The staff of the Archaeology Branch has conducted a file search of the proposed project area. Enclosed is a map depicting the locations of the known recorded archaeological sites within the vicinity and a listing of these sites along with their cultural affiliation. Although all of these sites have not been evaluated as to their eligibility for inclusion in the National Register of Historic Places, none is currently listed in the Register. The following sites have been evaluated and do not appear to meet the criteria for inclusion in the National Register:

31 Ch 1a

31 Rd 1a, 1b, 1c, 1d, 197-202, 205-207, 209-217, 219-228, 231, 232, 234, 237-241, 243, 244, 246, 247, 249-251, 254 and 255.

The following sites have either not been evaluated or require further investigation prior to an evaluation:

31 Rd 25, 102, 103, 183, 192, 203, 204, 208, 218, 229, 230, 233, 235, 236, 242, 245, 248, 252 and 253.

We hope this information will be of use to you and your staff. When alternates have been selected, please forward them to this office in order that we may make any necessary recommendations concerning archaeological investigation.

In addition, we have conducted a search of our maps and files and have located the following structures of historical or architectural importance within the project area:

Chatham County

Wade Hadley House, brick Victorian house located on south side of Raleigh Street near juction with Fourth Street

Hadley Hotel, ca. 1912, Main Street

Dowd Place, two-story frame house with kitchen dependency, SR 1006, two miles southeast of Oakley Baptist Church

Jones Farm, log springhouse, ease side of SR 1006, south of SR 1130

Cheek House, Georgian house, south side of SR 1130, 0.5 mile west of SR 1132

Billy Brooks House, Civil War era house, SR 1128

Jordan House, Federal house, east side of SR 1100

Hoose Fox House, frame house, southeast side of SR 1102

Federal house, SR 1006

Colonel Lane House, SR 1100

Randolph County

Columbia Manufacturing Company, Ramseur, on Deep River

Coleridge Historic District, Coleridge on NC 22/42

In addition, a comprehensive inventory of historically and architecturally significant structures in Randolph County is currently being conducted and is near completion. Pursuant to Part 800.4 of the Advisory Council on Historic Preservation's revised procedures for compliance with Section 106, we recommend that you contact Mr. Mac Whatley, 526 Springwood Road, Asheboro, N.C. 27203, concerning other sites which may be affected by the project.

There is also an active historical society in Chatham County which may have additional information, and we recommend you contact Mr. Wade Hadley, Jr., president, Chatham County Historical Society, P. O. Box 12, Pittsboro, N.C. 27312

Thank you for your cooperation and consideration. If you have any questions concerning the above comments, please contact Ms. F. Langdon Edmunds, Environmental Review Coordinator, at 919/733-4763.

Sincerely,

Larry E. Tise
State Historic Preservation Officer

LET:slw

cc: Mr. Mac Whatley
Mr. Wade Hadley, Jr.

Enclosures

FORM 22-50M

CP&L
Carolina Power & Light Company

COPY

December 3, 1979

Ms. Langdon Edmunds
North Carolina Division of
Archives and History
109 East Jones Street
Raleigh, North Carolina 27602

Dear Ms. Edmunds:

Carolina Power & Light Company has reevaluated the need for power in the Siler City area. This has resulted in an expanded study area for the routing of the Siler City segment of the Harris-Asheboro 230 kV transmission line. In a letter dated April 30, 1979, from Dr. B. J. Ward, we requested information from you concerning an area between Siler City and Asheboro with U.S. 64 being (approximately) the northern boundary. This study area has been expanded northward and eastward of Siler City as shown on the enclosed map. The area outlined in red is the additional area for which we are now requesting information.

As in our previous requests, we need information regarding the archaeological and historical resources of the study area and the significance of these resources. If you wish, our personnel will perform the historical inventory by searching the structures' files, as has been done in the past. Please contact Ms. Jan Heard at 362-8633, Extension 66, if this is acceptable to you.

The expeditious receipt of this information would be greatly appreciated. I am requesting the information by December 14, 1979. Thank you for your cooperation.

Yours very truly,

RC Yates

Richard C. Yates
Senior Scientist

RCY/jeh
Enclosure
bcc: Ms. J. L. Heard/Harris-Asheboro: Cultural ✓
Resources (w/o enclosure)
Dr. W. T. Hogarth (w/o enclosure)
Dr. B. J. Ward (w/o enclosure)

NORTH CAROLINA DEPARTMENT OF CULTURAL RESOURCES

Raleigh,
North Carolina
27611

Division of
Archives and History
Larry E. Tise, Director

Sara W. Hodgkins,
Secretary
James B. Hunt, Jr.,
Governor

December 19, 1979

Mr. Richard C. Yates
Senior Scientist
Shearon Harris Energy and
Environmental Center
Route 1, Box 327
New Hill, N.C. 27562

Re: Siler City Segment of the Harris-Asheboro 230 kV
Transmission Line, Chatham County

Dear Mr. Yates:

Thank you for your letter concerning the above proposed transmission line.

There are no known recorded archaeological sites within the project boundaries. However, the project area has never been systematically surveyed in order to determine the location or significance of archaeological resources.

The environmental characteristics of the study area indicate that there is a high probability that archaeological resources are present. Previous archaeological surveys within the southern piedmont have located numerous prehistoric sites in identical topographic situations as the project area. From these surveys, it has been demonstrated that broad ridge systems in close proximity to permanent bodies of water and flat upland terraces located adjacent to stream confluences area areas of high probability for prehistoric habitation sites. Such areas adjacent to the Rocky River and its tributaries are topographic situations favored by the prehistoric occupants of the areas and are predicted to be rich in archaeological resources.

It is important that archaeological resources be considered in the early stages of the planning process in order to avoid adverse effects to significant sites. If your engineer will send the locations of the various alternate routes to this office when they are available, we will gladly comment and make recommendations as to which alternate would be most desirable from the standpoint of archaeological resources. In this way, any necessary survey work can be recommended in a timely fashion. This is the most advantageous procedure to follow so that adequate archaeological work, if necessary, can be done without causing construction delays.

In addition, Ms. Jan Heard of your staff has consulted our files for potential effects of the proposed project on structures of architectural or historical significance.

We hope that this information will be of use to you and your staff. If you have any questions concerning the above comments, please contact

Ms. F. Langdon Edmunds, Environmental Review Coordinator, at 919/733-4763.

Sincerely,

Brent D. Glass, Deputy State
Historic Preservation Officer

BDG:slw

FORM 22-50M

CP&L
Carolina Power & Light Company

COPY

April 2, 1980

Mr. Brent D. Glass
Deputy State Historic Preservation Officer
North Carolina Department of Cultural Resources
Division of Archives and History
Jones Street
Raleigh, North Carolina 27611

Dear Mr. Glass:

In response to your letter to me dated December 19, 1979, I am providing a map depicting the alternative routes considered for the Siler City-Asheboro segment of the Harris-Asheboro 230 kV transmission line. The proposed route, selected after evaluating all alternatives shown, is highlighted. Our location process determined that the proposed route constitutes the most desirable location within the study area. There are no adverse impacts on known archaeological or historical sites on this route.

I would appreciate your comments regarding the impact of this route on potential archaeological resouces and required mitigation, if any, by April 18, 1980. If you have any questions, please contact me at 362-8633, Extension 25.

Yours very truly,

RC Yates

Richard C. Yates
Senior Scientist

JLH/jeh
Enclosure
bcc: Dr. B. J. Ward
Ms. J. L. Heard/Harris-Asheboro ✓(w/o enclosure)
Expanded Cultural Resources Site
Mr. Bill Moeller

flo

RTH
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aleigh,
orth Carolina
7611

ivision of
chives and History
rry E. Tise, Director

ra W. Hodgkins,
ecretary
mes B. Hunt, Jr.,
overnor

May 15 1980

Mr. Richard C. Yates
Senior Scientist
Carolina Power and Light Company
Shearon Harris Energy & Environmental Center
Route 1, Box 327
New Hill, N.C. 27562

Re: Siler City-Asheboro Segment, Harris-Asheboro
230 kV Transmission Line, Chatham and Randolph Counties

Dear Mr. Yates:

Thank you for your letter of April 2, 1980 concerning the above project. The staff of the Archaeology and Historic Preservation Section has reviewed the above selected alternate and would like to comment.

In terms of archaeological resources, the proposed alternate (Number 3) contains a high probability for the presence of significant archaeological resources. Although none of the proposed transmission line area has been surveyed, recent investigations in the Siler City vicinity located several prehistoric archaeological sites, two of which are considered eligible for inclusion in the National Register of Historic Places. We therefore recommend that the proposed project area be surveyed by an experienced professional archaeologist prior to project implementation.

Enclosed is a list of the members of the North Carolina Archaeological Council which has been provided to this office by the NCAC as a guide to the professionally employed archaeologists in North Carolina. This office also maintains a file of letters from other individuals and organizations who have expressed interest in conducting contract work in North Carolina, which is available for examination. If additional names are desired, we recommend that you consult the current listing of the members of the Society of Professional Archeologists, or contact the society's secretary/treasurer, Dr. J. Ned Woodall, Wake Forest University, Box 7808, Reynolda Station, Winston-Salem, N.C. 27109. Any of the above persons, or any other experienced professional archaeologist, may be contacted in order to conduct the recommended investigations.

In addition, the staff of the Division of Archives and History has conducted a search of our maps and files and has located the following structures of historical or architectural importance within the project area:

> Victorian Antique House, located on the south side of NC 64, 0.1 mile west of Rocky River.

The above comments are made pursuant to Section 106 of the National Historic Preservation Act of 1966, the Advisory Council on Historic Preservation's Regulations for Compliance with Section 106, codified at 36 CFR Part 800, and to Executive Order 11593, "Protection and Enhancement of the Cultural Environment."

Thank you for your cooperation and consideration. If you have questions concerning the above comments, please contact Ms. F. Langdon Edmunds, Environmental Review Coordinator, at 919/733-4763.

Sincerely,

Brent D. Glass

Brent D. Glass, Deputy
State Historic Preservation Officer

BDG:slw

Enclosures

ARCHAEOLOGICAL SURVEY REPORT GUIDELINES FOR A-95 REVIEW
(Effective January 1, 1979)

The following is a checklist of the information to be included in each survey report submitted to this office for review in connection with the A-95 process. This data is necessary for us to complete our review, and reports that fail to include the following will be returned to the principal investigator prior to our evaluation.

1. Project title.
2. Clearinghouse number of project, if available.
3. Project location, including county.
4. Contracting agency or individual.
5. Principal Investigator and crew.
6. Date(s) of investigation.
7. Brief scope of work.
8. Acreage involved in project area and the present land use.
9. Previous archaeological investigations in area, if any, and results.
10. Discussion of survey techniques. This should include a discussion of each survey strategy employed, if more than one, for each type of ground cover present within the project area.
11. Subsurface testing. If subsurface testing was done, the locations of each test and the results should be included.
12. Number of sites located, as well as type and cultural affiliation. The definition of "site" utilized in the survey should also be explicitly stated.
13. Consideration of historic archaeological sites, if present.
14. Significance of each site. This should include not only a significance statement for each site, but also a specific discussion of the criteria utilized in determining eligibility for inclusion in the National Register of Historic Places.
15. Photographs of any standing structures described in the report and, if required by the scope of work, any present within the project area.
16. Recommendations for further work for sites to be affected by the project.
17. Recommendations for sites located but not affected by the project. This should also include a discussion of eligibility for inclusion in the National Register of Historic Places.
18. Bibliography.
19. Map(s) clearly delineating project area, surveyed areas, sites, and subsurface tests.
20. The Archaeology Branch of North Carolina computerized site forms should not be included within the report, but should accompany the report when it is submitted to this office.

MEMBERS OF THE NORTH CAROLINA ARCHAEOLOGICAL COUNCIL

Dr. Hetty Jo Brumbach
Dr. J. Ned Woodall
Department of Anthropology
Wake Forest University
Winston-Salem, N. C. 27109
(919) 761-5497, 761-5282 (lab)

Mr. Peter P. Cooper, II
Department of Anthropology
Catawba College
Salisbury, N. C. 28144
(704) 637-4111

Dr. David McLean
Department of Social Sciences
St. Andrews College
Laurinburg, N. C. 28352
(919) 276-3652

Mr. Michael Sellon, Director
Indian Museum of the Carolinas
607 Turnpike Road
Laurinburg, N. C. 28352
(919) 276-5880

Dr. Jill Loucks
Dr. Harvard Ayers
Department of Anthropology
Appalachian State University
Boone, N. C. 28607
(704) 262-2295, 262-2294

Dr. Joffre L. Coe
Mr. Trawick Ward
Mr. Jack Wilson
Research Laboratories of Anthropology
University of North Carolina
Chapel Hill, N. C. 27514
(919) 933-6574

Dr. Charles Michael Baker
Department of Sociology and Anthropology
Western Carolina University
Cullowhee, N. C. 28723
(704) 227-7120

Dr. Joseph Mountjoy
Dr. Louise Robbins
Department of Anthropology
University of North Carolina
Greensboro, N. C. 27405
(919) 379-5178

Dr. Michael Hammond
Mr. Patrick H. Garrow
Mr. Jack Bernhardt
Soil Systems, Inc.
Suite 195, 4900 Waters Edge Drive
Raleigh, N. C. 27606
(919) 851-5800 <u>OR</u>
525 Webb Industrial Drive
Marietta, Georgia 30062
(404) 424-6200

Dr. David S. Phelps
Department of Sociology and Anthropology
East Carolina University
Greenville, N. C. 27334
(919) 757-6883, 757-6905 (lab)

Dr. Fred W. Fischer
Department of Sociology and Anthropology
University of North Carolina
Charlotte, North Carolina 28223
(704) 597-2252

Dr. Irwin Rovner
Department of Anthropology
North Carolina State University
Raleigh, N. C. 27607
(919) 737-2491

Dr. John Alden
Department of Anthropology
Duke University
Durham, N. C. 27706
(919) 684-5012

Dr. Tom Loftfield
Department of Sociology and Anthropology
University of North Carolina
Wilmington, N. C. 28401
(919) 791-4330, extension 2420

Mr. Michael Corkran
U.S. Corps of Engineers
Post Office Box 1890
Wilmington, N. C. 28401
(919) 343-4750

Mr. Tom Padgett
Planning and Research Branch
Division of Highways
Department of Transportation
Raleigh, N. C. 27611
(919) 733-3141

<u>Division of Archives and History</u>*

Department of Cultural Resources
109 E. Jones Street
Raleigh, N. C. 27611

*Archaeology Branch
Ms. Jacqueline R. Fehon
Mr. Thomas D. Burke
Mr. John W. Clauser, Jr.
Ms. Carol S. Spears
Ms. Kathryn A. Youngs
Ms. Cheryl Claassen-MacClelland
(919) 733-7342

*Historic Sites Section
Mr. Thomas C. Funk
(919) 733-6065

*Underwater Archaeology Branch
Mr. Gordon P. Watts, Jr.
Box 58
Kure Beach, N. C. 28449
(919) 458-8405

*In accordance with Division policy, employees of the Division of Archives and History do not conduct archaeological contract work in North Carolina.

This list is provided as a public service by the Division of Archives and History, Department of Cultural Resources, Raleigh, North Carolina. The Division of Archives and History assumes no responsibility for the accuracy of this list.

ARCHAEOLOGICAL SURVEY REPORT GUIDELINES FOR A-95 REVIEW
(Effective January 1, 1979)

The following is a checklist of the information to be included in each survey report submitted to this office for review in connection with the A-95 process. This data is necessary for us to complete our review, and reports that fail to include the following will be returned to the principal investigator prior to our evaluation.

1. Project title.
2. Clearinghouse number of project, if available.
3. Project location, including county.
4. Contracting agency or individual.
5. Principal Investigator and crew.
6. Date(s) of investigation.
7. Brief scope of work.
8. Acreage involved in project area and the present land use.
9. Previous archaeological investigations in area, if any, and results.
10. Discussion of survey techniques. This should include a discussion of each survey strategy employed, if more than one, for each type of ground cover present within the project area.
11. Subsurface testing. If subsurface testing was done, the locations of each test and the results should be included.
12. Number of sites located, as well as type and cultural affiliation. The definition of "site" utilized in the survey should also be explicitly stated.
13. Consideration of historic archaeological sites, if present.
14. Significance of each site. This should include not only a significance statement for each site, but also a specific discussion of the criteria utilized in determining eligibility for inclusion in the National Register of Historic Places.
15. Photographs of any standing structures described in the report and, if required by the scope of work, any present within the project area.
16. Recommendations for further work for sites to be affected by the project.
17. Recommendations for sites located but not affected by the project. This should also include a discussion of eligibility for inclusion in the National Register of Historic Places.
18. Bibliography.
19. Map(s) clearly delineating project area, surveyed areas, sites, and subsurface tests.
20. The Archaeology Branch of North Carolina computerized site forms should not be included within the report, but should accompany the report when it is submitted to this office.

NORTH
CAROLINA
DEPARTMENT
OF
CULTURAL
RESOURCES

Raleigh,
North Carolina
27611

Division of
Archives and History
Larry E. Tise, Director

Sara W. Hodgkins,
Secretary
James B. Hunt, Jr.,
Governor

August 11, 1980

Mr. Wade Brickhouse
Carolina Power and Light Company
P. O. Box 1551
Raleigh, N.C. 27602

Re: Siler City-Asheboro Segment, Harris-Asheboro 230 kV
Transmission line, Chatham and Randolph Counties

Dear Mr. Brickhouse:

The staff of the Archaeology and Historic Preservation Section has reviewed the selected alternate at your request; we would like to revise our earlier comments to be more specific.

As we have stated previously, the proposed alternate contains a high probability for the presence of significant archaeological resources. However, as we agreed in our meeting of August 5, 1980, there are certain areas along the proposed line which may be expected to yield more information than others. These areas have been delineated in green on the enclosed map. We therefore recommend that these areas be surveyed by an experienced professional archaeologist prior to project implementation.

Enclosed is a list of the members of the North Carolina Archaeological Council which has been provided to this office by the NCAC as a guide to the professionally employed archaeologists in North Carolina. This office also maintains a file of letters from other individuals and organizations who have expressed interest in conducting contract work in North Carolina, which is available for examination. If additional names are desired, we recommend that you consult the current listing of the members of the Society of Professional Archeologists, or contact the society's secretary/treasurer, Dr. J. Ned Woodall, Wake Forest University, Box 7808, Reynolda Station, Winston-Salem, N.C. 27109. Any of the above persons, or any other experienced professional archaeologist, may be contacted in order to conduct the recommended investigations.

Thank you for your cooperation and consideration. If you have questions concerning the above comments, please contact Ms. F. Laugdon Edmunds, Environmental Review Coordinator, at 919/733-4763.

Sincerely,

Larry E. Tise
State Historic Preservation Officer

LET:slw

Enclosures

MEMBERS OF THE NORTH CAROLINA ARCHAEOLOGICAL COUNCIL

Dr. Hetty Jo Brumbach
Dr. J. Ned Woodall
Department of Anthropology
Wake Forest University
Winston-Salem, N. C. 27109
(919) 761-5497, 761-5282 (lab)

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Dr. Tom Loftfield
Department of Sociology and Anthropology
University of North Carolina
Wilmington, N. C. 28401
(919) 791-4330, extension 2420

Mr. Michael Corkran
U.S. Corps of Engineers
Post Office Box 1890
Wilmington, N. C. 28401
(919) 343-4750

HARRIS PLANT-FAYETTEVILLE 230 kV LINE

CORRESPONDENCE WITH THE STATE HISTORIC PRESERVATION OFFICE

February 26, 1979

Ms. Delores Hall
North Carolina Department of
  Cultural Resources
Division of Archives & History
Archeology Branch
109 East Jones Street
Raleigh, North Carolina 27611

Dear Ms. Hall:

I am compiling data for an environmental inventory to be used in locating a new 230 kV transmission line. On behalf of CP&L, I am requesting your expertise in regard to the location archeological sites within the study area.

The proposed transmission line will extend from the Harris Plant to the Fayetteville Substation. We anticipate constructing the line on a 100' wide right-of-way utilizing wood H-frame structures. The entire study area encompasses portions of Chatham, Cumberland, Harnett, Lee and Wake Counties.

On the study area map, please indicate any archeological sites within the study area and give a brief description of each. If you have any other information or thoughts that you feel will help us in our location work, please feel free to interject them.

Your assistance in this project is greatly appreciated and I look forward to hearing from you. If I can be of any assistance, please call me at 919-836-6922.

Sincerely,

C. W. Brickhouse
Technician
Transmission Line Location & Engineering

CWB/njbMl

February 26, 1979

Ms. Langdon Edmunds
N. C. Department of Cultural Resources
Division of Archives and History
109 East Jones Street
Raleigh, North Carolina 27611

Dear Ms. Edmunds:

I am compiling data for an environmental inventory to be used in locating a new 230 kV transmission line. On behalf of Carolina Power & Light Company, I am requesting the expertise of you and your associates in regard to the presence of historical sites within the area. Attached you will find a map illustrating the Harris-Fayetteville Study Area.

The proposed transmission line will extend from the Harris Plant to the Fayetteville Substation. We anticipate constructing the line on a 100' wide right-of-way utilizing wood H-frame structures. The study area encompasses portions of Chatham, Cumberland, Harnett, Lee, and Wake Counties.

On the attached map I have highlighted historic site locations from our files. If you have any other information or thoughts that you feel will help us in our location work, please feel free to interject them.

Your assistance in this project is greatly appreciated, and I look forward to hearing from you. If I can be of any assistance, please call me at 836-6922.

Yours very truly,

C. W. Brickhouse
Technician
Transmission Line Location & Engineering

CWB/njbM2

Attachment

HARRIS-FAYETTEVILLE/HISTORIC SITES

Chatham County

No sites in study area.

Cumberland County

36c - Parker's Grove United Methodist Church
37c - Sardis Presbyterian Church
NR - Ellerslie House

Harnett County

6h - Campbell College
10h - Paul Green House
11h - Indian Museum

Lee County

6L - Buckhorn Dam Canal and Power Plant
7L - Avents Ferry

Wake County

31w - House at Holleman's Crossroads, large Neo-classical Revival.

3/1/79

NORTH
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OF
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RESOURCES

Raleigh,
North Carolina
27611

Division of
Archives and History
Larry E. Tise, Director

Sara W. Hodgkins,
Secretary
James B. Hunt, Jr.,
Governor

March 19, 1979

Mr. C. W. Brickhouse, Technician
Transmission Line Location & Engineering
Carolina Power & Light Company
P. O. Box 1551
Raleigh, N.C. 27602

Re: Proposed 230 KV transmission line from the Harris Plant
to the Fayetteville Substation, Chatham, Cumberland,
Harnett, Lee and Wake Counties

Dear Mr. Brickhouse:

Thank you for your letter of February 26, 1979.

Enclosed is the map depicting the known recorded archaeological sites within the proposed study area for the above project. Also enclosed is a brief description of each of the sites and their location. This list, of course, represents only those sites noted in our files and in no way constitutes a complete listing of all of the archaeological resources present within the study area. Little systematic investigation has taken place in the area and more sites are being discovered with every survey.

None of these sites is currently listed in the National Register of Historic Places or has been placed on the study list for the Register. However, many of these sites have not yet been evaluated for their eligibility for inclusion in the National Register. The area of the Cape Fear River and confluences of creeks and streams are particularly sensitive in terms of archaeological resources. We recommend that your office forward the locations of alternate routes for this line as soon as they are available in order that we may evaluate their potential effects upon cultural (architectural, archaeological, and historic) resources.

In addition, we have conducted a search of our maps and files, and are aware of no structures of historic or architectural significance which will be affected by the project.

Thank you for your cooperation and consideration. If you have questions concerning this comment, please contact Ms. F. Langdon Edmunds, Environmental Review Coordinator, at 919/733-4763.

Sincerely,

Brent D. Glass

Brent D. Glass, Deputy State
Historic Preservation Officer

BDG:slw

Enclosures

4.3 RESOURCES COMMITTED

The irreversible and irretrievable commitments of resources associated with plant construction are discussed in Section 7.0 of the SHNPP Construction Permit Environmental Report. In addition, associated with the construction of the plant, there was an alteration and/or loss of wildlife habitats and some direct and indirect mortality of flora and fauna (Section 4.1). However, this was considered a relatively small commitment of wildlife resources when compared to the availability of like or similar habitats and wildlife throughout the region.

Specific losses include: (1) loss of the terrestrial productivity of approximately 5338 acres of land and (2) loss of stream productivity due to the conversion of a lotic (stream) system to a lentic (lake) system. |1

Losses of individuals and local populations of some species were the only irreversible or irretrievable commitment of wildlife resources. While habitats were altered during construction, they are capable of returning to their natural state following decommissioning and dismantling of the project. No individual species was eradicated, no identifiable impact on endangered or threatened species occurred, and no unique natural areas were destroyed.

4.4 RADIOACTIVITY

Since the SHNPP is a two-unit generating plant and the units will be constructed over a period of several years, there will be a considerable number of construction workers on site completing Unit 2 while Unit 1 is operating. The estimated annual doses at various locations for these personnel are included in the SHNPP Final Safety Report Section 12.4. 2

4.5 CONSTRUCTION IMPACT CONTROL PROGRAM

This section describes measures designed to mitigate undesirable effects of construction. It also details the program which monitors activities affecting site-related environmental quality.

4.5.1 CONSTRUCTION ACTIVITIES AND MITIGATIVE MEASURES

Construction facilities at the SHNPP site are categorized as either permanent plant construction or temporary construction facilities. Some standard construction practices which apply to all areas of construction are also presented in the following discussion.

4.5.1.1 Standard Construction Practices

a) Runoff and Erosion Control - The initial construction phase included clearing areas required for both permanent facilities and support activities. Only minimum required acreage was disturbed at any time thus reducing erosion exposure. However, the magnitude of the project required various methods and significant effort to control runoff and erosion and minimize sedimentation. Erosion and Sedimentation Control Plans which included all disturbed areas were prepared for the N. C. Sedimentation Control Commission. In clearing the Main and Auxiliary Reservoirs, the root mat was left. The natural regrowth of vegetation from the root mat was an important factor in reducing erosion and siltation. Brush barriers and silt fences were placed at the edge of creeks and in hollows. On creek banks trees were felled with chain saws and most of the other vegetation was left in place to form natural buffer zones. Construction areas to be graded were protected by such measures as downstream sediment ponds, rock filter dams, brush barriers, and ditch checks prior to initiating major soil disturbing activities.

In areas used for support of activities such as parking, shops, storage areas and roads, the soil was stabilized with road base stone. Drainage was accomplished with ditches and runoff was directed to sediment ponds. Unpaved site roads tend to be dusty due to the volume of traffic. Water trucks are employed to recycle water collected in designated sediment ponds back to the roads for dust control. Other available water sources such as nearby farm ponds on CP&L property are also used.

As detailed in the erosion control plans, areas where grading was completed were reseeded after completion of the work. Both cut and fill slopes were reseeded, as well as spoil areas and spoil slopes.

b) Vehicle Washdown - Waste water from washing vehicles and equipment is collected in an oil separation and retention pond serving the repair shop and equipment yard. The oil is collected from the surface with oil absorbent pads.

c) Waste Disposition - Solid wastes generated during construction activities are collected, stored and sorted for salvageable items. Merchantable scrap is sold to various scrap dealers and removed from the site. Combustible solid wastes (paper, wood, and other cellulose materials) are incinerated in a refuse burner permitted by the North Carolina Division of Environmental Management.

Waste oil is collected at the site and disposed of by CP&L's Materials Recovery Unit - Disposal located in the corporate office. Sanitary food waste and scrap are collected and disposed of off site by an independent contractor. Nonbiodegradable material is buried on site in a solid waste disposal area permitted by the N. C. Division of Health Services, Solid and Hazardous Waste Management Branch.

The sanitary wastes from toilets in the construction offices are treated in an extended aeration type treatment plant and the effluent discharged to a ground level vegetated disposal area approved by the North Carolina Division of Environmental Management. Excess sludge is removed from site by contractural agreement. In the plant construction area, mobile toilet trailers and portable chemical toilets are used. Chemical toilets are provided and serviced under local contract. Residue from chemical toilets and mobile toilet trailers is removed from the site by contractural agreement.

d) Dust Control - Dust caused by the movement of construction vehicles is controlled by periodically spraying unpaved areas with water provided by sediment basins, on-site ponds and excavation dewatering discharge. The frequencies of spraying and the quantity of water sprayed are determined by visual inspections and existing weather conditions.

Equipment with the potential to emit large quantities of dust, e.g., the concrete batch plant cement storage silos, are equipped with filter bag systems as required by applicable air quality permits.

e) Noise Control - Construction equipment units are provided with standard mufflers to reduce noise from operation. The construction activities create noise; but because of the remote location of the site and sparse population, the impact on the human environment is minimal. The nearest resident to the main plant site is 1.5 miles. A noise monitoring survey made near this residence shows that the most prominent background noise is truck traffic on a nearby approach road. Plant construction noise is a distant "rumble".

The level of noise generated creates a predicted community reaction of "sporadic complaints" from this type community. However, no noise complaints have been received.

In summary, utilizing the latest Environmental Protection Agency and Edison Electric Institute environmental noise evaluation guides, it has been shown that noise from construction activities at the Harris Site does not present any significant environmental problem to nearby residents.

f) Fuel and Oil Storage - As required by 40 CFR Part 112, the plant has a Spill Prevention Control and Countermeasure Plan for the construction period. This plan, Technical Procedure 20, is attached as Appendix 4.5A. According to the plan, the storage areas for bulk quantities of gasoline, diesel, fuel oil, waste oil, and lubricants are equipped with berms capable of containing potential leaks from the storage containers.

g) Landscape Restoration - Cleanup and restoration of areas affected by construction activities are conducted as outlined in Erosion and

Sedimentation Control Plans approved by the N. C. Sedimentation Control Commission of the North Carolina Department of Natural Resources and Community Development. The disturbed areas are graded to the natural contour of the land or as shown on construction drawings. The entire area to be seeded is cultivated to a depth of two to four in. parallel to the line of embankment or ditches to minimize erosion. Fertilizer is applied prior to preparation of the seedbed at rates and types recommended by the seeding specification. Grass seed is distributed uniformly over the moistened seedbed and rolled or hydroseeded. Areas not showing sufficient growth to prevent erosion are reseeded. Additional inspections, reseeding, and fertilizing are performed until good growth is attained.

Pine seedlings were planted in abandoned roads, fields, and other cleared areas not necessary for construction support.

h) Explosives - The heaviest concentration of blasting occured during excavation for the power block. The magnitude of blasts was limited because of fresh concrete placements which required that particle velocity due to blasting be limited to low values.

The nature of the rock being blasted did not require heavy loading for required breakup. Stemming or depth of shots was usually 20-30 ft. from the surface for maximum breakup.

i) Smoke - Open burning of cleared and grubbed material is allowed by the N.C. Division of Environmental Management rules and regulations. Approximately 5,800 acres were cleared and vegetation was piled and burned. Merchantable timber and pulpwood was harvested prior to machine clearing to eliminate its waste and to reduce the volume to be burned. Consultations were held with representatives of the Air Quality Section of the North Carolina Division of Environmental Management to minimize the temporary environmental impact. Measures taken were: (1) reducing smoke by limiting the amount of material ignited at any one time, and (2) igniting material when atmospheric conditions were favorable for smoke dispersion.

4.5.1.2 Station-Related Excavations

a) Main Plant Building Complex (Power Block) - Construction of the power block required excavation to approximately 80 ft. below the existing elevation, all in a Triassic sedimentary formation, which allowed steep sidewall slopes. Surface water was diverted away from the excavation and into erosion control devices. Rainwater pumped from the excavation was also routed into sediment control devices.

b) Reservoirs - Dam and dike construction associated with the reservoirs utilized earth and rock fill materials which were obtained from required excavations where possible. This included utilizing large portions of the spillway excavations for the required cofferdams and embankments. Unsuitable materials were spoiled in low areas within the impoundment area and erosion control measures were implemented.

Cofferdam slopes were seeded with grass cover, and silt fences were also used to minimize erosion. Dam outer slope surfaces were covered with riprap or seeded as required as construction progressed in order to minimize erosion by weather or wave action. Clearing the reservoirs required leaving the root mat and constructing silt fences and brush barriers to control erosion.

c) Plant Construction Access Road - Cut and fill slopes were reseeded as necessary. Sediment control ponds were also constructed before grading to further control erosion and minimize sedimentation.

d) General - Virtually all of the erosion from construction activities settled in the Main Reservoir area which was inundated.

4.5.1.3 Temporary Construction Facilities

Facilities used to support permanent plant construction are categorized as temporary construction facilities. These facilities include the shops, offices, parking lots, concrete production area, and temporary roads. When construction activities are completed, facilities such as temporary parking lots, roads, and the land occupied by shops, offices, and the concrete batch plant which are not incorporated into the finished plant will be cleared and relandscaped to conform to the surroundings. Building material used during the construction of the power block and related facilities, together with permanent plant equipment, requires enclosed storage and large open storage area. Upon completion of construction these areas will be cleaned up and relandscaped to conform to the surroundings.

4.5.1.4 Agricultural Productivity

The major soil types in the site area are Creedmoor and White Store, both derived from Triassic shale and rock. The agricultural capability level of these soil types is severely limited. About 2 percent of the approximately 10,800 acres of land included in the plant site were devoted to crop production. Most of the cleared areas in the project were fields associated with dairies that were too distant for convenient use; any loss in production was not significant. Timber and paper companies owned the majority of the land which was in pine tree production, mostly on formerly cropped and abandoned fields.

4.5.1.5 Transportation

The only major highway in the vicinity of the site is U.S. 1. This highway, which passes approximately 7,000 ft. northwest of the power block, had a daily vehicle use of approximately 3,000 prior to construction. Although vehicular traffic has increased due to construction activity, the highway itself has been essentially unaffected by the site development. The only exception is the installation of longer culverts and building the embankment for future third and fourth lanes where the highway crosses the upper fingers of the Auxiliary Reservoir.

State Road 1127, which is a paved road near the northeastern end of the Main Reservoir, was partially relocated and raised to cross one finger of the reservoir. Service was maintained during the relocation. Approximately 17 miles of unpaved secondary roads located in Wake and Chatham counties were closed.

The N. C. Department of Transportation abandoned maintenance on these roads. Those which served as construction roads were closed when they were no longer needed. Since these unpaved roads only served the few families originally located on the site, their closing represented an insignificant impact on the surrounding community. As roads were closed, they were plowed and planted in pine seedlings. No private property owners were denied access to their property by the closing of roads.

Major access to the site for construction workers is SR 1134 from the north and SR 1127/SR 1135 from the south. Major access for construction materials is SR 1134 and SR 1127/SR 1135. State Road 1127 has been paved for a number of years. The relocated portion of SR 1135 and a section of SR 1134 were paved to facilitate traffic flow. The remainder of SR 1134 was not paved.

A 2.65 mile segment of the Norfolk Southern Railroad main line in the vicinity of the Main Dam was relocated, and rail passage is unaffected. The Durham Branch of the Norfolk Southern Railroad which traversed the plant site and Main Reservoir in a north-south direction was temporarily relocated around the plant. Original plans were that this branch would be permanently relocated around the reservoir as well; however, that portion south of the plant, through the reservoir and to its southern terminus at Duncan was abandoned. Normal rail service was provided to the northern portion the line.

4.5.1.6 Groundwater

The construction site is supplied with potable and concrete mixing water from local wells. Construction use of groundwater has no impact on groundwater users in the vicinity. (See Section 2.4 and Section 2.4.13 of the SHNPP Final Safety Analysis Report).

4.5.1.7 Safeguarding Against Possible Cave-Ins In Excavations

Excavation was performed in accordance with Ebasco specifications. These specifications, which were developed based upon subsurface investigation, call for the following slopes: (1) Residual Soil - 2:1, (2) Weathered Rock - 1:1, and (3) Blasted Rock - 1/4:1.

4.5.2 MONITORING PROGRAM

A program for environmental protection was initiated at the site to establish construction practices and on-site monitoring to minimize negative impacts that may be caused by construction activities. Additionally, the control program was instituted to ensure that construction activities conform to the environmental protection commitments set forth in the Revised Final Environmental Statement, Construction Permit, and applicable federal, State, and local environmental regulations.

Implementation of the control program is the responsibility of CP&L. Responsibility for monitoring, documenting, and reporting to ensure compliance to the program is assigned to the site environmental engineer. He is also responsible for providing evaluations of the environmental impact of construction activities, coordinating sampling and reporting required by federal and state permits, and consulting with the contractors when resolution or interpretation of commitments of the control program is needed.

Mitigative measures are monitored in accordance with Shearon Harris Nuclear Power Plant Technical Procedure TP-18, Environmental Protection Control, which is attached as Appendix 4.5B. This document lists the various environmental commitments and establishes a monitoring procedure. Monitoring method, frequency, acceptance criteria, corrective measures, reporting format, and responsible party are designated for each commitment along with the appropriate reference for each commitment.

APPENDIX 4.5A

Carolina Power & Light Company

Shearon Harris Nuclear Power Plant

Spill Prevention Control and Countermeasures

Technical Procedure

TP-20

FORM NO. 1778A

CONSTRUCTION PROCEDURES MANUAL SHNPP	Procedure No. TP-20	Date As Approved
TECHNICAL PROCEDURE	Revision	1
DESCRIPTION SPILL PREVENTION CONTROL AND COUNTERMEASURES	Page 1	of 2

CAROLINA POWER & LIGHT COMPANY

SHEARON HARRIS NUCLEAR POWER PLANT

TECHNICAL PROCEDURE

TP-20

Oct. 03, 1979 Rev. 1

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Rev.	Description	Approvals		Date
0	Issued for Use	Originator	Ronald A. Brown	2-23-78
		Constructor	W. D. Goodman	2-24-7
		CP&L	R M Lucas	2-25-7
1	Revised as Noted.	Originator	L. F. Alexander	10-1-7
		Constructor	W. D. Goodman	10-1-7
		CP&L	R M Lucas	10-2-7
		Originator		
		Constructor		
		CP&L		
		Originator		
		Constructor		
		CP&L		
		Originator		
		Constructor		
		CP&L		

CONSTRUCTION PROCEDURES MANUAL SHNPP	Procedure No. TP-20 — Date As Approved
TECHNICAL PROCEDURE	Revision 1
DESCRIPTION SPILL PREVENTION CONTROL AND COUNTERMEASURES	Page 2 of 2

1.0 SCOPE

This procedure covers the plan for spill prevention control and countermeasures to be implemented at SHNPP to comply with the requirements of 40 CFR Part 112.

2.0 REFERENCES

2.1 TP-18 - Environmental Protection Control
2.3 Tank Truck Unloading Procedure
2.3 Oil Spill Notification Procedure

R1

3.0 GENERAL

3.1 Waste oil will not be used in any manner that leads to dispersion of oil into the environment.

4.0 PROCEDURE

4.1 The ENVIRONMENTAL ENGINEER shall ensure that the provisions of Appendix A are implemented.

5.0 EXHIBITS AND APPENDICES

5.1 Appendix A - Spill Prevention Control and Countermeasure Plan (Rev. 1-9/79) R1

SPILL PREVENTION CONTROL AND COUNTERMEASURE PLAN
Shearon Harris Nuclear Power Plant

Purpose

The purpose of this plan is to discuss procedures, methods, and equipment for preventing the discharge of oil into or upon the surface waters of the United States as a results of activities carried on by the Carolina Power & Light Company (hereinafter called the Company) at its Shearon Harris Nuclear Plant. While it is intended that this plan satisfy the requirements of 40 CFR Part 112, additional measures which may have been taken, or are to be taken by the Company are also included in the discussion. The perceived need for these measures may have resulted from the peculiar circumstances of this plant or from the Company's best judgment of how to achieve the ultimate goal of preventing an oil discharge into surface waters as defined in 40 CFR Part 112. As this plan serves as a general description of the present and future efforts, specific written inspection and test procedures are attached as an appendix to this plan or are on file at the plant.

Scope

This plan details the requirements set forth in 40 CFR Part 112 effective January 10, 1974, as they apply to oil containment facilities.

The Harris Site is in an early phase of construction. Above-ground oil containments at the site include two tanks with a capacity of 8,000 gallons each and two with an approximate 2,000-gallon capacity. There are two buried tanks with capacities of 8,000 gallons each.

Definitions

(a) "Discharge" includes, but is not limited to, any spilling, leaking, pumping, pouring, emitting, emptying, or dumping of oil from its designated container. "Discharge" shall not include any discharge of oil which is authorized by a permit.

(b) "Oil" means oil of any kind or in any form, including but not limited to petroleum, fuel oil, sludge, oil refuse, and oil mixed with water.

(c) "Regional Administrator" means the Regional Administrator of the Environmental Protection Agency, or his designee.

(d) "Spill Event" means a discharge of oil into or upon any surface waters in harmful quantities as defined in 40 CFR Part 110.

General Description of Oil Containment Facilities

As previously mentioned under "Scope" earlier in this SPCC Plan, there are two 8,000-gallon tanks and two 2,000-gallon tanks above ground, and two 8,000-gallon tanks below ground at the site.

Facility Drainage

At this time, drainage at the Harris Plant site will in no way affect any possible oil spill or oil spill prevention methods or procedures.

Bulk Storage Tanks and Secondary Containment

The two above-ground 8,000-gallon capacity oil storage tanks and the two 2,000-gallon capacity tanks have been provided as common secondary containment dike capable of retaining the entire contents of the 8,000-gallon tanks. The dike is discussed more fully under "Major Identifiable Projects That May Have Bearing on the SPCC Plan." The two 8,000-gallon capacity oil storage tanks located below ground have been cathodically protected as well as coated with anti-corrosives.

Facility Transfer Operations

This section is not applicable to the Harris construction site at this time.

Tank Vehicle Unloading

An unloading pad has been provided for trucks in the area adjacent to the four above-ground tanks. This pad is described later in this plan under "Major Identifiable Projects . . . ." A truck also supplies oil to the underground tanks. Here a pit has been dug which is capable of containing the entire contents of the small truck. All drainage from the area immediately adjacent to the unloading dock is directed toward the holding pit. Any small, local spill could be cleaned up by plant personnel trained in implementing oil spill clean-up procedures using oil absorbent materials on site.

Two persons are present during hose connect/disconnect operations to assure that no oil is flowing before hoses are hooked up or disconnected.

Inspections and Records

Regular inspections are made of the four above-ground oil tanks with respect to their valves and metal surface. Inspections are also made of the secondary containment dike and corresponding manual valve surrounding these tanks. Records of the inspections are signed and dated by the employee who made the inspection. Any trouble found on an inspection is reported to an appropriate person responsible for correcting the deficiency.

Written procedures for all inspections are maintained at the plant. Inspection records referred to in this plan are filed and kept at the plant for at least three years.

Oil Spill Collectors

Petro-trap absorbant pads are kept on-site for any emergency oil spill. These reusable pads collect up to thirty times their weight in most any oily liquid but reject water, making them ideal for cleaning up any spill into a body of water. A specially designed "wringer" is also kept on-site for rapid reuse of the petro-traps.

Security

The entire plant area is fenced and a security guard is present 24 hours a day.

Valves of the oil tank are kept closed when not in use. The manually controlled valve installed in the secondary containment dike is kept locked closed.

Personnel Training and Spill Prevention Procedures

Periodic briefings are scheduled for operating personnel to assure that personnel responsible for implementing oil spill preventive measures are well-trained and kept up to date on spill prevention procedures, known spill events, failures, malfunctioning components, and recently developed precautionary measures. Written plant procedures regarding oil-related inspections as well as the oil spill notification procedure are reviewed regularly.

Amendments to the SPCC Plan

The site manager or his designee shall complete a review and evaluation of the SPCC Plan at least once every three years. As a result of this review and evaluation, the plan shall be amended within six months of the review to include more effective prevention and control technology if: (1) such technology will significantly reduce the likelihood of a "spill event" from the facility, and (2) if such technology has been field-proven at the time of the review. The amendment will become effective when it has been approved by the plant manager, and reviewed and certified by a professional engineer.

Major Identifiable Projects That May Have Bearing on the SPCC Plan

The four above-ground tanks have recently been provided an earthfill secondary containment dike ranging from 6 inches to 21 inches in height above ground level. A 9" pipe drain with a manually controlled gate valve was installed to release retained stormwater runoff from within the diked area. Water is released only after a visual inspection under responsible supervision has determined that no oil contaminants are present in the runoff water. The dike was designed to retain the entire contents of both 8,000-gallon tanks in the unlikely event that both should rupture at the same time.

An unloading pad for trucks was installed immediately adjacent to the dike wall. The elevated pad is sloped back into the diked area so that any oil spilled due to unloading operations or truck rupture would flow into and be contained within the dike.

Any oil found within the diked area could be cleaned up by trained plant personnel using on-site absorbent materials.

The gate valve is normally kept closed and locked. It is opened only to release runoff water and is locked closed again as soon as the water release process is completed.

Prior Spill Events

The Harris construction site has not experienced an oil spill as defined in 40 CFR Part 112 in the last 12 months.

APPROVED: R M Parsons
R. M. Parsons
Site Manager - SHNPP

CERTIFIED:
Registered Professional Engineer

APPENDIX 4.5B

Carolina Power & Light company

Shearon Harris Nuclear Power Plant

Environmental Protection Control

TP-18

FORM NO. 1778A

CONSTRUCTION PROCEDURES MANUAL SHNPP	Procedure No. TP-18 — Date As Approved
TECHNICAL PROCEDURE	Revision 2
DESCRIPTION ENVIRONMENTAL PROTECTION CONTROL	Page 1 of 8

CAROLINA POWER & LIGHT COMPANY
SHEARON HARRIS NUCLEAR POWER PLANT
TP-18

NOV 5 1979 Rev. 2
MAY 29 1979 Rev. 1

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Rev	Description		Approvals	Date
0	Issued for Use	Originator		2-23
		Constructor	W.D. Goodman	2-24-7
		CP&L	AM Lucas	2-25-7
1	Revised as Noted.	Originator	L F	5-23-79
		Constructor	W. D. Goodman	5-24-7
		CP&L	AM Lucas	5-28-7
2	Revised as Noted. Updated Appendix A.	Originator	L F	10-24-7
		Constructor	W.D. Goodman	10-29-7
		CP&L	AM Lucas	10-30-7
		Originator		
		Constructor		
		CP&L		
		Originator		
		Constructor		
		CP&L		

1.0 SCOPE

This procedure covers the plan for monitoring and controlling construction activities to minimize environmental impacts at the SHNPP site and incorporates commitments from the following references. R1

The control program described herein will comply with paragraph 3.5(2) of the construction permit which is repeated here for ready reference.

> "The applicant shall establish a control program which shall include written procedures and instructions to control all construction activities as prescribed herein and shall provide for (periodic management audits) to determine the adequacy of implementation of environmental conditions. The applicant shall maintain sufficient records to furnish evidence of compliance with all the environmental conditions in the Final Environmental Statement".

2.0 REFERENCES

2.1 Well Construction Permits from N. C. Division of Environmental Management.

1 - No. 922 November 13, 1972
2 - No. 1145 April 17, 1973
3 - No. 1290 - July 16, 1973
4 - No. 2497 - July 14, 1977

2.2 Permit for construction and operation of extended aeration plant issued by N. C. Division of Environmental Management.

2.3 Permit for constructing a water intake structure and excavating water access channel at Cape Fear River Buckhorn Dam issued by Department of Army Corps of Engineers.

2.4 Permit for placing fill material in Watery Branch, Buckhorn Creek and Beaver Dam Creek issued by Department of Army Corps of Engineers.

2.5 Permit for construction of earthen dam to establish makeup water reservoir issued by Department of Army Corps of Engineers.

2.6 Soil Erosion and Sediment Control Plans approved by N. C. Department of Natural Resources and Community Development.

1. Norfolk Southern Railway Relocation
2. Realignment of SR 1134
3. East Access Road
4. 20 Acre Segment of Plant Area R2
5. Erosion Control Plan for the Cooling Tower Blowdown Line
6. Main Dam Sediment and Erosion Control Plan
7. West Axuiliary Dam Construction
8. SR 1127 Relocation
9. Site Master Plan (480 Acres) R2
10. NC 42 Relocation

2.7 TP-20, Spill Prevention Control and Countermeasures

2.8 Oil Spill Notification Procedure

2.9 Operation of air cleaning devices installed on concrete batch plant issued by N. C. Division of Environmental Management Permit No. 3629.

2.10 Operation of refuse burner issued by N. C. Division of Environmental Management Permit No. 3632.

2.11 Ebasco Specification CAR-SH-CH-8, "Excavation, Backfill, Filling and Grading".

2.12 Ebasco Specification CAR-SH-CH-4, "Embankments, Dams, Dikes and Channels".

2.13 NRC General Construction Permit No. CPPR-158. R2

3.0 GENERAL

3.1 Construction Traffic

1. Minimize soil disturbance during construction.
    1. Workers will be directed to use only specified parking areas that have gravel base.
    2. All excavation and fill will be performed in accordance with erosion and sediment control plans approved by the N. C. Division of Environmental Management.

3. Control of erosion and resulting siltation will be directed toward attacking the source with additional measures before trying to improve sediment pond efficiency or capacity.

3.2 Air Pollution Control

1. Dust will be controlled by sprinkling water if excessive dust levels are observed by Environmental Engineer.
2. Dust bags, i.e. "Dust Dustless" devices will be used to control cement dust in conjunction with concrete batch plant operation and receiving cement. Dust control devices will be operated to ensure compliance with N. C. Division of Environmental Management specifications.
3. Open burning will be in accordance with the North Carolina Administrative Code 15 NC AC 2D 0520 Control and Prohibition of Open Burning. Open burning of land refuse will be monitored to ensure complete burning before discontinuing work in any area.
4. Construction debris will not be open burned. An approved refuse burner will be used for burning all cellulose base construction waste.

3.3 Liquid and Solid Wastes Management

1. Liquid wastes, such as oil or fuel, shall be stored on site until there are suitable off site disposal facilities. E2
2. Runoff from the equipment wash down pad will be routed through the oil spearation device for sediment and oil removal.
3. The concrete truck washout system will be used to wash out concrete trucks and to dispose of rejected nonconforming concrete. Water is recycled through the system and salvaged sand and aggregate is removed for reuse.

4. Contractors are required to maintain their traveling equipment to minimize oil, grease and hydraulic leakages. Major maintenance of equipment will be carried out in specified maintenance areas or in an otherwise acceptable manner. At other times minor maintenance will be carried out in place in a manner that minimizes loss of oil or fluid.

5. Construction scrap of non-cellulose base shall be collected in designated areas for salvage or burial in an approved waste disposal site or off site disposal. R1

6. Scrap and waste of cullulose base such as wood scraps, paper and other combustible materials shall be burned in the approved refuse burner. Paper and organic materials collected in the office building and warehouse may be disposed of off site by a contractor who supplies and services metal "dempster dumpster" type containers. R1

7. Lunch scraps in the field will be collected and disposed of off site. R1

8. Metal scrap or material having economic value shall be collected in a designated area for pickup and subsequent recycling by contract scrap dealers.

9. Sanitary wastes from buildings will be treated by an extended aeration treatment system with settlement of fine solids and post chlorination of the effluent. The effluent will then be pumped to a grassed area and released through a perforated pipe for overland effluent disposal. R1

10. Approved portable sanitary units will be placed in major and outlying construction area for construction personnel. These units will be serviced by an approved licensed contractor and wastes conveyed off site for proper treatment and disposal. R1

11. "Petrotraps" will be kept on site to trap oil in the event of a spill.

3.4 Preservation of Historic Finds

1. If any feature of archeological significance is discovered in a work area the work forces are required to stop work immediately and notify the discipline engineer.
2. Work will not be resumed until the area is investigated and released by the discipline engineer or his designated representative.

3.5 References 2.1 through 2.12 are the permits, procedures and specifications applicable to the performance of this procedure.

4.0 PROCEDURE

4.1 A comprehensive program for inspecting, testing and monitoring the Erosion and Sediment Control Systems will be implemented under the control and guidance of the Environmental Engineer. Contractors and the constructor shall conform to all environmental controls and provide information to the Environmental Engineer in accordance with the contracts. The monitoring and inspection shall be in accordance with Appendix A.

4.2 Responsibilities

1. Site Manager

The Site Manager has the responsibility of over-all implementation of the Environmental Protection Control Plan to ensure compliance with provisions of the plan. He will notify the Manager - Power Plant Construction in the event of major environmental impact.

2. Senior Resident Engineer R2

The Senior Resident Engineer reports to the Site Manager and has the general responsibility for monitoring all site construction activities to ensure compliance with provisions of this plan.

3. Environmental Engineer
    1. The Environmental Engineer reporting to the Resident Engineer will be responsible for supervising and accomplishing the duties set forth by the Environmental Control Program.
    2. The Senior Resident Engineer may assign personnel from the Field Engineering Staff to oversee the environmental controls in their respective areas. If unexpected environmental impact occurs in their respective areas the designated personnel will immediately report this to the Environmental Engineer for his appropriate action. The Environmental Enginneer or his designee will be responsible for performing the necessary record keeping duties. R2 R2
    3. The Environmental Engineer shall also be responsible for identifying non-compliances, recommending solutions, coordinating with other affected project site personnel and verification of solutions.
4. Project Manager

    The Project Manager reports to the Site Manager and has the general responsibility to ensure that Daniel Contract Personnel conduct their respective activities in accordance with the Environmental Control Program.

4.3 Long term monitoring and laboratory services are supplied by CP&L Company Technical Services Group. These services will be utilized as much as practical although their functions are not related to or required by this procedure.

4.4 Additional Licensing and/or Permits

If it becomes desirable to implement a construction activity which was not previously anticipated, the request for permission to construct, whether by written permit or license, shall be initiated by the Manager - Power Plant Construction in writing to the Vice President - Technical Services.

5.0 EXHIBITS AND APPENDICES

5.1 Appendix A - Environmental Commitments and Monitoring Procedures (Rev. 2-10/79) R2

ENVIRONMENTAL COMMITMENTS [illegible]D MONITORING PROCEDURES

NUMBER	COMMITMENT	REFERENCE	MONITORING METHOD	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE MEASURES	REPORTING FORMAT	RESPONSIBILITY
1	Check effluent from retention ponds for discharge of oil, grease	2.7 2.8	Observe pond for oil sheene	As required by NPDES Permit & by engineer no less than once per mo.	No discharge of oil or grease	Notify contractor or constructor to comply (memo or letter)	Inspector's report (see ref. 2.8 if oil is spilled)	Environmental Engineer
2	Assure that Contractor will further treat finished slopes by seeding within 30 working days of project completion	2.6	Visual Inspection	As required	Contract work item complete	Letter from Site Manager to Contractor	Inspector's Daily Report	Contract Engineer and Environmental Engineer
3	Inspect to ensure contractor is sequencing his excavation and fill operations so as to maintain constructed sediment and erosion control/devices and effecting minimum erosion.	2.11	Inspection	Daily	Contract compliance	Notify contractor to take remedial action	Daily Report	Environmental Engineer

NUMBER	COMMITMENT	REFERENCE	MONITORING METHOD	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE MEASURES	REPORTING FORMAT	RESPONSIBILITY
4	Inspect to ensure that liquid wastes such as chemicals, fuels, or lubricants are collected into oil spill prevention devices for salvage or disposal off-site	2.7	Visual Inspection	Weekly	Compliance	Require Contractor to relocate and/or make secure	Weekly Report	Environmental Engineer
5	Inspect to ensure that constructor uses designated maintenance areas for major equipment maintenance for other than field servicing & minor maintenance	2.7	Visual Inspection	Weekly	Compliance	Contractor shall remedy	Weekly Report	Environmental Engineer
6	Inspect to ensure contractor compliance with deposition of construction scrap into areas designated by the Engineer, for salvage, incineration, burial or off site disposal.	2.6 2.10	Visual Inspection	Monthly	Compliance with specification	Notify constructor to remedy	Memo to Construction	Environmental Engineer

NUMBER	COMMITMENT	REFERENCE	MONITORING METHOD	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE MEASURES	REPORTING FORMAT	RESPONSIBILITY
7	Inspect to ensure compliance with air pollution control regulations during open burning of tree wastes resulting from clearing operations	3.2.3	Visual Inspection	During open burning activity	Compliance with NC Administrative Code 15 NC AC 2D 0520 - Control and prohibition of Open Burning	Memo or letter to contractor	Daily report when event occurs	Contract Engineer and Environmental Engineer
8	Contractor to construct erosion and sedimentation control system as per soil and erosion control plans	2.6	Visual Inspection and admi-	Daily during construction of system	Compliance with specifications	Adjust as necessary	Daily report when active	Contract Engineer and Environmental Engineer
9	Inspect retention pond dams, diversion berms and drainage control devices for overflow and deterioration.	2.5	Visual Inspection	Monthly or after any major storm	Dams, tight, berms not eroded	Fill holes & compact dams. Clean out sediment ponds. Modify drainage pattern.	Daily report when event occurs	Environmental Engineer

NUMBER	COMMITMENT	REFERENCE	MONITORING METHOD	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE MEASURES	REPORTING FORMAT	RESPONSIBILITY
10	Inspect sediment control devices for satisfactory operation, structural soundness, excessive flow, and reserve storage capacity	2.6	Visual Inspection	Weekly or after any major storm	Proper operation no excess scour below structures	Adjust as necessary	Daily Report when event occurs	Environmental Engineer
11	Inspect seed certification for conformance to State of N.C. Dept. of Agriculture Seed Certification Requirements.	2.6	Inspect on date of delivery of seed or soon thereafter	Prior to unsealing suppliers seed packages	Attached certification of conformance and seed date as required	Do not open or use non-certified seed	Department of Transportation Seed-Tags on file.	Contract Engineer and Environmental Engineer
12	During concrete plant operation, inspect to ensure cement dust discharge is in compliance with North Carolina Air Quality Regulations	2.9 Permit No 3629	Inspect	Weekly	No excessive cement dust	Replace and/or repair equipment	Daily Report	Environmental Engineer

NUMBER	COMMITMENT	REFERENCE	MONITORING METHOD	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE MEASURES	REPORTING FORMAT	RESPONSIBILITY
13	During construction of pipe lines for makeup, construction and blowdown water, inspect to insure that erosion control measures are kept concurrent with advancement of construction, i.e., finish grading and seeding to follow within 30 working days after backfilling	2.5; 2.6	Visual Inspection	As Required	No excessive erosion or sediment transport, flooding, etc.	Contractor shall remedy	Daily Report when active and significant	Contract Engineer and Environmental Engineer
14	Before commencing construction for the Cape Fear River makeup water structure, the Contractor shall submit detailed plans showing methods of controlling construction runoff, erosion and sedimentation	2.3; 2.5; 2.6	Review of plans	As Required	Approval of methods proposed	Engineer/ Contractor meeting to discuss alternatives make field adjustments	Monthly Report, Daily Report	Contractor/ Engineer
15	Inspect sewage disposal for compliance with permit	2.2	Inspection	Twice Monthly	No discharge to surface water	Modify Effluent Discharge Pattern	Memo to Temporary Services	Environmental Engineer

NUMBER	COMMITMENT	REFERENCE	MONITORING METHOD	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE MEASURES	REPORTING FORMAT	RESPONSIBILITY
16	Inspect sewage disposal personnel for compliance with permit	2.2	Inspection	Monthly	Operator licensed maintained current	Operator will renew license	Monthly Inspection	Contract and Environmental Engineers
17	Monitor river intake operation of contractor	2.3	Review of plans and inspection	Weekly	Compliance with erosion and sediment control plan	Contractor will remedy	Weekly inspection	Environmental Engineer
18	Monitor river intake operation of contractor to insure waste material disposed of properly	2.3 Permit for water intake structure	Inspection	Weekly	Soil material above wetlands	Remove material from critical areas	Weekly inspection	Environmental Engineer
19	Check Master Erosion and Sediment Control Plan	2.6	Inspection	Monthly	Compliance	Constructor will remedy	Monthly Report	Environmental Engineer
20	Regular inspection of above ground tank valve and metal surface	2.7	Visual Inspection	Monthly	No Leaks	Repair	Monthly Report Sign & Date	Environmental Engineer

NUMBER	COMMITMENT	REFERENCE	MONITORING METHOD	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE MEASURES	REPORTING FORMAT	RESPONSIBILITY
21	Regular inspection of oil containment dike and drain valve	2.7	Visual Inspection	Monthly or as required	Dike in good condition drain valve locked closed	Repair	Monthly Report	Environmental Engineer
22	Periodic Personnel Briefings	2.7	Review preventive measures, procedures & notification plans	Quarterly	Personnel Informed	N/A	Quarterly Report	Environmental Engineer
23	Inspect refuse burner for compliance with permit	2.10	Visual Inspection	Twice Monthly	Compliance with permit	Notify construction to remedy	Twice Monthly Report	Environmental Engineer
24	Inspect to ensure that emergency oil spill collectors are on site	2.7 2.8	Inspect Warehouse	Monthly	Sufficient "Petrotraps" on site	Notify purchasing	Monthly Report	Environmental Engineer

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5.0 ENVIRONMENTAL EFFECTS OF STATION OPERATION

5.1 EFFECTS OF OPERATION OF HEAT DISSIPATION SYSTEM

5.1.1 EFFLUENT LIMITATIONS AND WATER QUALITY STANDARDS

Carolina Power & Light Company has been authorized to discharge wastewater from the SHNPP pursuant to the National Pollutant Discharge Elimination System (NPDES) Permit No. NC 0039586 (see Appendix B) approved by the North Carolina Environmental Management Commission (EMC), Department of Natural Resources and Community Development (DNRCD) on July 12, 1982. The EMC has been delegated authority to carry out the NPDES program by the United States Environmental Protection Agency (EPA). Effluent limitations and water quality standards for the discharges of cooling tower blowdown, sanitary waste treatment, metal cleaning wastes, low volume wastes and point source runoff from construction to the receiving waters (Harris Reservoir on Buckhorn Creek) are set in accordance with the provision of North Carolina General Statute 143-215.1, other lawful standards and regulations promulgated and adopted by the North Carolina EMC, and the Federal Water Pollution Control Act, as amended by the Clean Water Act of 1977, and in particular 40CFR Part 423.13 (Steam Electric Power Generating Point Source Category). 4 4

The NPDES Permit requires that each parameter identified in the various waste streams shall not result in the violation of Class "C" water quality standards including the temperature of blowdown discharge from the cooling system. A water body designated as Class "C" shall be suitable for fishing and for the propagation of fish and wildlife.

Heated water discharges to the Auxiliary Reservoir will be in accordance with Part III-E of the NPDES Permit.

The discharges from the SHNPP will not affect the quality of waters of any other state.

5.1.2 PHYSICAL EFFECTS

All steam electric generating plants must release heat to the environment as an inevitable consequence of producing useful electricity. Heat from the fission of nuclear fuel in each SHNPP unit is used to produce high temperature and pressure steam. This steam is expanded through a turbine where the thermal energy of the steam is converted to mechanical energy. This mechanical energy is used to drive the generator which in turn converts the mechanical energy of rotation to electrical energy. The process has a limited efficiency, however, and the steam, after having expanded through the turbine, must be condensed back into water. This is done by extracting the latent heat of condensation from the steam and transferring it to the circulating water; this heat transfer is made in the condenser.

For two units, a total of 2150 cfs is passed through the condensers in the closed cycle cooling tower system. A condenser is a large rectangular vessel which contains thousands of small tubes through which the circulating water passes. Exhaust steam leaving the turbine flows over and around the outside of these tubes, condenses to water, and drops to the bottom of the condenser where it is collected for reuse in the cycle. In the process, the latent heat of condensation of the steam is transferred to the circulating water. Under conditions of full load, each unit transfers approximately 6.7 x 10^9 Btu/hr. of heat to the water, resulting in an approximate 26 F increase in the temperature of the water as it passes through the condenser. There is no physical contact between the condensing steam and the circulating water.

Furthermore, since the steam side of the condenser operates at a vacuum under normal conditions, the possibility of steam side materials leaking into the circulating water is remote. After passing through the condensers, the heated water is conveyed to the cooling towers.

As the water flows through the cooling towers to be used again in the plant condensers, it is cooled by dissipating heat to the atmosphere by evaporation and conduction. The only heated water discharged to the reservoir is blowdown of the cooling towers to control dissolved solids in the closed cycle system. Conduction from the water in the cooling towers is proportional to the difference in water temperature and air temperature. Evaporative heat losses are proportional to the difference in saturation vapor pressure of the cooling water and the water vapor pressure of the air. Total consumptive water use for two units in the operation of the cooling towers is 46.3 cfs under average meteorological conditions and 51.5 cfs under extremely adverse meteorological conditions with the plant operating at 100 percent capacity. A design curve for the cooling towers, Figure 5.1.2-4 , provides the cold water temperature as a function of wet bulb temperature for 30 percent, 50 percent, 75 percent, and 100 percent relative humidity.

Heat released to the Main Reservoir is only in the cooling tower blowdown, with a maximum release rate of 15 MGD for one unit operation and 30 MGD for two unit operation. Blowdown is taken from the coolest water in the system and released through a single port jet diffuser. This water has a design average range (as originally reported in the Construction Permit Environmental Report) from approximately 7 F above ambient pond temperature in July, to approximately 28 F above ambient in December. As previously reported in CP&L testimony during the Fall 1977 Atomic Safety & Licensing Board hearings, the highest average summer and winter increases in water temperatures above ambient reservoir temperatures at the end of the diffuser are 9 F (July) and 32 F (December), respectively (Reference 5.1.2-1). This higher average results from a worst case condition which includes mechanical failure and adverse weather conditions.

The discharge point is on the reservoir bottom in water approximately 40 ft. deep. 4 A discharge rate of 30 MGD results in a maximum mixing zone of only 120 acres in the winter and in the more critical summer months, approximately 20 acres. The mixing zone is the area within which State thermal water quality standards can be legally exceeded. That is, under State/federal law, this is the area of the reservoir that temperature could legally rise above 90 F and/or 5 F above ambient reservoir temperature. Outside this area, temperatures would not exceed 90 F or 5 F above ambient. 4 A mixing zone of only 120 acres in the winter and 20 acres in the summer is small compared to the size of the reservoir (approximately 4,000 acres). The pending State NPDES permit acknowledges the necessary mixing zone for cooling tower blowdown.

Figures 5.1.2-1, 5.1.2-2, and 5.1.2-3 show the mixing area and the isotherms under adverse meteorological conditions, winter and summer, respectively. The thermal mixing zone was calculated by utilizing an approach described below. The thermal plumes shown on Figures 5.1.2-2 and 5.1.2-3 are conservatively based on surface cooling with no credit for dilution or diffusion. In the short-term, there is some entrainment of cooler reservoir water by the discharge jet. However, in the long-term, with the absence of significant currents in the reservoir, the area of discharge approaches a condition where the plume rises to the surface near the point of discharge at a relatively uniform temperature and dissipates its excess heat through surface advection and evaporation. Because no diffusion or mixing was assumed, the two unit model represents the worst case. Consequently, no attempt has been made to model one unit operations separately. More sophisticated three dimensional modeling was considered inappropriate under the circumstances. The simplified methodology results in the uniform circular nature of the plume isotherms. Thus, with the given heat load, the area within the isotherms is dependent on the heat of evaporation and the heat of conduction from the water surface.

The heat of evaporation and the heat of conduction for cooling pond surfaces were calculated by the method outlined in the publication, "The Capacity of Cooling Ponds to Dissipate Heat," by W. D. Patterson, J. L. Leoporati and 4 M. J. Scarpa, (Reference 5.1.2-3) for presentation at the 33rd Annual Meeting of the American Power Conference, held in Chicago, Illinois during April, 1971.

The following are excerpted from this publication:

1. Heat of Conduction

   $Hc = .26(73 + 7.3W)\ (Ts - Ta)\ (P/760)$ BTU/ft^2/day

   where:

   Hc = heat of conduction in BTU/ft^2/day

W = wind speed in MPH

Ts = pond surface temperature in degrees F

Ta = dry bulk air temperature in degrees F

P = station atmosphere pressure in mm Hg.

This equation relates heat lost by conduction to heat lost by evaporation and was first explored by I. S. Bowen in "The Ratio of Heat Losses by Conduction and Evaporation from any Water Surface, "Physical Review 27", No. 2, June, 1926. (Reference 5.1.2-4)

2. Heat of Evaporation

$He = (73 + 7.3W)\ (e_s - e_a)\ \mathrm{BTU/ft^2/day}$

where: 4

He = heat of evaporation in $\mathrm{BTU/ft^2/day}$

W = wind speed in MPH

e_s = saturation vapor pressure determined from the water surfaces temperature in mm Hg

e_a = air-vapor pressure in mm Hg

This equation known as the Meyer evaporation equation expresses the relationship that evaporation is directly proportional to the product of the vapor pressure gradient between the air and water surface and the wind speed. Meyer's work is summarized in J. Edinger and J. Geyer's, "Heat Exchange in the Environment," EEI Publication No. 65-902, June, 1965 (Reference 5.1.2-2). Although many equations have been proposed to calculate the evaporation from a water surface, the Meyer equation has been chosen because it is very compatible with the meteorological data available at most sites.

Table 5.1.2-2 attached is a tabulation of the meteorological data used in this study. These average monthly meteorological parameters were compiled from observations made at the weather station at Raleigh, North Carolina.

As noted above, major reservoir winter and summer isotherms of adverse meteorological conditions are shown on Figures 5.1.2-2 and 5.1.2-3. The predicted cooling tower blowdown temperatures and ambient reservoir temperatures are shown by months in Table 5.1.2-1.

Drawdown conditions will affect the percentage of lake surface area required for mixing and compliance with the 5 F rise and 90 F maximum thermal limits prescribed in N. C. Water Quality Standards, but the frequency and duration of any significant drawdown is such that the overall impact would be slight. The frequency of 5 and 15 foot drawdowns are once in 10 and once in 100 years, respectively, based on operation of a four unit station. These values are conservative for one and two unit operation. 4

DRAWDOWN FREQUENCY

Reservoir Elevation ft. above MSL	Area Acres	Volume Acre - Ft.	Frequency
4 220	4100	72,150	Normal
215	3250	54,000	10-yr.
205	2150	24,000	100-yr.

These drawdowns could occur during any season but would probably not occur in the spring. Severe drawdowns would tend to last for weeks, not months or years.

TABLE 5.1.2-1

PREDICTED AVERAGE MONTHLY TEMPERATURES

Month	Natural Equilibrium Temperature (°F)	Worst Case Blowdown Temperature (°F)(1)
January	40	71
February	43	72
March	53	74
April	63	79
May	73	85
June	80	89
July	82	91
August	81	90
September	74	87
October	62	81
November	50	75
December	39	71

4

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(1) Average temperature across mixing zone assuming 100 percent power operation for two units. 4

TABLE 5.1.2-2

METEOROLOGICAL DATA FOR ISOTHERM STUDY

Month	Ho	S	Ta	W	P	Dp
January	1140	49	41.6	8.5	760	32
February	1510	56	43.0	9.1	760	31
March	2210	60	49.5	9.6	760	35
April	2580	64	59.3	9.4	760	45
May	2915	67	67.6	7.8	760	56
June	2950	65	75.1	7.0	760	64
July	2950	62	77.9	6.7	760	68
August	2765	62	76.9	6.6	760	67
September	2385	65	71.2	7.0	760	61
October	1845	66	60.5	7.2	760	50
November	1440	61	50.5	7.9	760	38
December	1105	51	41.9	8.0	760	30

4

Definitions:

Ho - Solar radiation constant determined by latitude of site and month of the year in BTU/ft^2/DAY
S - Percentage of sunshine
Ta - Average dry bulk air temperature in degrees F
W - Wind speed in miles per hours
P - Station pressure in mm Hg
Dp - Dew Point in degrees F

5.1.3 BIOLOGICAL EFFECTS

5.1.3.1 Impact of Thermal Discharges on the Aquatic Community of the Main Reservoir

The thermal impact on the aquatic ecology of the Main Reservoir from operation of the plant circulating and service water systems will be minimized through the use of two natural draft cooling towers operated as a closed-cycle system. Operation of the system was discussed in the SHNPP Construction Permit Environmental Report Section 3.3.1. Heated discharges from the cooling tower blowdown system will increase water temperature in an area of approximately 3 percent of the total reservoir during winter and 0.5 percent during summer at normal pool (Reference 5.1.3-1). The discharge point for blowdown is located on the reservoir bottom in approximately 12m (40 ft) of water. The impact will be even less than that discussed in Section 3.1.1 of the SHNPP Construction Permit Environmental Report because the number of units at the site has been reduced to two, the increased discharge volume per unit will reduce the concentration of the chemical components in the blowdown discharge (except chlorine), the deeper discharge area will be a less attractive habitat for aquatic organisms (particularly fish), and there will be no increase in the temperature difference (ΔT) between the discharged water and the ambient water temperature with the new design. 4 4 4

The new discharge point should result in minimal thermal impact on the algal community in the reservoir. The temperature of the blowdown will be similar to that discussed in Section 3.3.1 of the SHNPP Construction Permit Environmental Report. The thermal impact of the discharge will be minor under conditions when ambient reservoir temperatures are below the optimum ranges for phytoplankton. Diatoms appear to exhibit best growth at temperatures between 2 C and 10 C (35.6 F and 50.0 F); green algae at temperatures above 10 C (50.0 F), and blue green algae above 24 C (75.2 F) (Reference 5.1.3-2). Ambient temperatures above 30 C (86.0 F), coupled with additional heat stress from the discharge, would have an adverse effect on the algae (References 5.1.3-3 and 5.1.3-4). Blue-green algae are known to be thermophilic; and, under favorable conditions (input of nutrients and warm water), they may reach "bloom" conditions in the reservoir. Primary productivity will be decreased in the area of the discharge; but, since the mixing zone will only encompass about 3 percent of the reservoir in winter and 0.5 percent in summer, the overall impact and any long-term effects will be minimal. 4

The benthic community in the area of the discharge point may exhibit reduced organism abundance and/or decreased numbers of species (i.e., reduced species diversity). This reduction, if any, in organism abundance or diversity may be a reflection of increased temperature, substrate scouring, or a combination of both factors. This reduction, however, is expected to occur in only a limited area of the reservoir located in the immediate vicinity of the discharge point, and should not affect the general community structure or ecology of the benthic macroinvertebrates inhabiting undisturbed areas of the reservoir.

The discharge is expected to have a limited impact on the fish community. The mixing zone (ranging from 20 to 120 acres) is a small portion (0.5 to 3 4 percent) of the total reservoir (approximately 4000 acres). The discharge will have a ΔT above the ambient reservoir temperature of 5.0 C (9 F) in July and 17.8 C (32 F) in December. This temperature will decrease to 32.2 C (90 F) or no more than 2.8 C (5 F) above ambient reservoir temperatures at the edge of the defined mixing zone. The average summer temperature of 31.1 C to 33.3 C (88 F to 92 F) at the warmest portion of the mixing zone should not result in fish kills. The upper lethal temperature limits (upper temperature levels at which significant mortality occurs) listed for the important fish species expected in the reservoir (Table 5.1.3-1) indicate that the highest temperature encountered in the mixing zone (33.3 C or 92 F) can be tolerated for a short period by most of the fishes. Not all of the species listed in Section 2.2.0 as important fish species are included in Table 5.1.3-1. The species not included are also warm water organisms, similar to others in the table; so no major differences should exist among the temperature tolerance ranges. Of the fishes not included, the redear sunfish (Lepomis microlophus) should be similar in tolerance to the bluegill and largemouth bass, and the snail bullhead (Ictalurus brunneus) should be similar to the white and channel catfishes. Temperatures have been recorded in excess of 31 C (87.8 F) during routine water chemistry sampling in the area by Aquatic Control, Inc. (Reference 5.1.3-5). This indicates the warm water species present should not be adversely affected by the thermal discharges from the cooling towers. The area involved is small in comparison to the rest of the reservoir; therefore, even those fish species not able to tolerate these temperatures should be able to avoid the small portion of the mixing zone that has these elevated temperatures.

Overall, the thermal impact from this plant is minimized through plant design. The use of cooling towers and continuous blowdown (except during chlorination) limits the thermal impact on the aquatic communities of the reservoir. All discharges will meet the NPDES Permit requirements within the small mixing zone of the reservoir (Section 5.1.1).

5.1.3.2 Impact of Reactor Shutdown on the Aquatic Community of the Main Reservoir

Station induced changes in the Main Reservoir water temperatures due to reactor shutdown may periodically occur. Refueling necessitates reactor shutdown and normally occurs every year on a rotating schedule for each unit. Also, mechanical problems infrequently cause reactor shutdown.

The effect of the resulting changes in water temperature on the plankton and benthic macroinvertebrate community is unclear and not well documented in the published literature. Due to the relatively low volumes of heated blowdown discharged and the temperature limitations of the NPDES Permit, the effect of periodic shutdowns is expected to be minimal and restricted to a relatively small area of the reservoir.

In case of reactor shutdown, the possibility of cold shock affecting the fish community is expected to be minimal. The continuous blowdown (except during chlorination) and open water discharge allow for slow temperature change and reacclimation of the fishes during a shutdown. In addition, the fishes are able to leave the small heated area and utilize other areas of the reservoir.

The fish most susceptible to cold shock in this area is gizzard shad, which is not an important recreational species. This fish has often been associated in other locations with die-offs from cold shock or winter kills. A CP&L study on the Cape Fear Steam Electric Plant (Reference 5.1.3-6) shows that although there was a natural winter kill during the study period, gizzard shad were still the most numerous and healthy population of the area. If there is a fish die-off from cold shock, it would most likely take place in the gizzard shad population. This species should easily recover from any thermal effects occurring in the small mixing zone, as it did in the Cape Fear Steam Electric Plant 316(b) Study (Reference 5.1.3-6).

5.1.3.3 Impact of Chemical Discharges on the Aquatic Community

See Section 5.3 of this report.

5.1.3.4 Impact of Plant Intakes on the Aquatic Community

The intake structures for the SHNPP have been designed to minimize the impact of the water intake system. This has been discussed in Section 3.3.1 of the the SHNPP Construction Permit Environmental Report and in Reference 5.1.3-1. The design of the intake structures (on the Cape Fear River and at the plant) has followed the recommendations of EPA's 1976 Developmental Document for Best Technology Available for the Location, Design, Construction and Capacity of Cooling Water Intake Structures for Minimizing Adverse Environmental Impact (Reference 5.1.3-7).

These recommendations include the use of a closed-cycle cooling system, low intake velocities (less than 0.5 fps), placement of the intake in deeper, less productive waters, and construction to minimize the structures' "attractiveness" to fish. These criteria have been followed for both intake structures (river and reservoir) in order to minimize the impact through impingement (trapping fish against the intake screens) and entrainment (organisms pumped through the intake screens into the condensers). These impacts are discussed more fully in Reference 5.1.3-1. Also described is an increase in intake volume from 115 cfs to 185 cfs. Since that time there has been a decrease to 93 cfs due to elimination of Units 3 and 4. This should slightly decrease the impingement and entrainment rate. These impacts are still much less than would result with a once-through cooling system (2000 cfs). The minimized entrainment and impingement impacts for selected portions of the aquatic community are discussed in the remainder of this section. 4

The relatively small amount of water used by a closed-cycle cooling system and the deep water intake location will minimize the effect of plant entrainment upon plankton. This location will be below the euphotic zone where most of the phytoplankton will be concentrated and should not inhibit these populations in the reservoir. Periphytic organisms comprise the major component of river primary productivity, so the contribution of true planktonic individuals is small. Thus, entrainment of these plankters from the Cape Fear River in the makeup water is not expected to significantly reduce productivity in the river. Those organisms that are successful in surviving mechanical damage through the pumps should find the reservoir a suitable habitat.

The major effect of the plant intake will be entrainment of phytoplankton and zooplankton into the condenser system. This will result in essentially 100 percent mortality of the entrained organisms through plant passage due to the combination of mechanical damage, heat stress and chemical treatment (Reference 5.1.3-8). Similarly, benthic macroinvertebrates entrained in the plant circulating and service water system will experience 100 percent mortality due to combined thermal, chemical, and physical stresses. However, 4 due to the relatively small average daily withdrawal of water (i.e., 0.05 to 0.1 percent of the total reservoir volume) from the reservoir, the rate of benthic macroinvertebrate removal will be of minor importance to the overall benthic community.

The effect of benthic macroinvertebrate losses from the Cape Fear River associated with entrainment is more difficult to assess. It is presently known that large numbers of lotic macroinvertebrate forms passively or behaviorally enter the water column as benthic drift during periods of darkness or high discharges. The true lotic benthic forms entrained at the Cape Fear River probably will not survive the transition from lotic (i.e., river) to a lentic (i.e., reservoir) habitat. It is not clear at this time what percentage of the benthic species inhabiting areas upstream of Buckhorn Dam are true rheophilic forms. In addition, neither data indicating abundance and species composition of benthic species present in the drift near the proposed Cape Fear River intake structure, nor predictions on the abundance or composition of benthic species expected to be entrained are presently available. Without the benefit of data indicating the species composition or abundance of benthic organisms entering the drift above Buckhorn Dam, no clear assessment of the possible effects of benthic macroinvertebrate entrainment can be made. On the other hand, it seems likely that a portion of the true lentic or facultative lentic forms present in the Cape Fear River may survive the physical stress of entrainment to become seed stock for benthic colonization of the reservoir.

The effect of fish entrainment is discussed in the SHNPP Construction Permit Environmental Report in Section 3.3.1. A certain percentage of fish pumped into the reservoir from the river may survive to help stock the new reservoir. However, those pumped into the plant from the reservoir will, most likely, have a 100 percent mortality rate, due to the resulting mechanical damage, thermal stress, and chemical treatment. This impact, however, has been minimized through the use of design criteria of the plant intake structure and the small area of the reservoir being influenced by the plant intake.

Generally, the impact of the intake systems of the SHNPP has been minimized through the design of the plant and its intake structures. The comparatively small amount of water used by a closed-cycle cooling system also restricts the impact to a small portion of the reservoir. This indicates that the intake effects should be minimal for the aquatic communities in the reservoir and the river.

5.1.3.5 Impact of Modification of Natural Water Circulation on the Aquatic Community

The impact of withdrawal of makeup water from the Cape Fear River to the Main Reservoir is the most significant modification in the normal water circulation pattern. However, regulations set by the State of North Carolina that do not allow withdrawals of more than 25 percent of the river's flow or reduction of the river flow below 600 cfs as measured at the Lillington gage station will minimize the effects on the aquatic communities of the river.

Since the makeup water intake is located above Buckhorn Dam on the Cape Fear River in an impounded area, the water chemistry parameters and plankton populations which develop in the reservoir are expected to be similar to those observed in the Cape Fear River upstream of the dam. Similar habitats (flora and fauna) are expected in both areas (river above the dam and reservoir) and the effects due to the alteration in the natural water circulation will be minimal.

Another modification of natural water circulation is the alteration of 3.5 miles of Buckhorn Creek below the Main Dam. Without the release of water from the reservoir to Buckhorn Creek and since only two small streams join Buckhorn Creek downstream of the dam, there will be little creek flow for six or more months each year. During periods of severe drought there could be no releases for periods longer than one year. It seems likely that this reduced normal discharge will result in a decrease in available habitat for the aquatic organisms present in this section of the stream. In addition, the proposed reduction in flow will be reflected in a reduction in the abundance and divesity of true lotic benthic macroinvertebrate forms inhabiting the creek during low discharge periods. The benthic fauna of Buckhorn Creek may be dominated during low discharges by species which preferentially inhabit pools or other slow-flowing portions of streams and rivers. 4

TABLE 5.1.3-1

TEMPERATURE TOLERANCE RANGES OF IMPORTANT FISH SPECIES EXPECTED IN THE SHNPP RESERVOIR 1

Species	Age Group	Optimum Growth Temperature		Upper Lethal Temperature	
		°C	°F	°C	°F
Gizzard Shad	Under Yearling*	-	-	34.0 -36.5	93.0 -97.8
(Dorosoma cepedianum)	Not Specified+	-	-	36.1	97.0
Largemouth Bass	Not Specified*	32.0	90.0	34.0	93.0
(Micropterus salmoides)	Not Specified*	-	-	31.5 -36.4	88.7 -97.5
	Juvenile*	23.0 -31.0	73.4 -87.9	33.0 -36.0	91.4 -96.9
	Larvae*	20.0 -30.0	68.0 -86.0	-	-
	Adult*	22.0	71.6	-	-
	Adult**	22.1 -32.0	71.8 -89.6	30.6 -38.0	87.0 -100.4
Bluegill	Not Specified*	32.0	90.0	35.0	95.0
(Lepomis macrochirus)	Adult*	-	-	30.5 -33.8	86.9 -92.9
	Juvenile*	22.0 -34.0	71.6 -93.1	27.0 -37.0	80.6 -98.6
	Adult*	24.0 -30.0	75.1 -86.0	31.0 -33.0	87.9 -91.4
	Adult**	24.0 -32.2	75.2 -90.0	33.8 -42.8	92.9 -109.0
Black Crappie	Not Specified*	27.0	81.0	-	-
(Pomoxis nigromaculatus)	Juvenile*	22.0 -25.0	71.6 -77.0	33.0	91.4
	Juvenile**	22.0 -32.2	71.6 -90.0	33.0	91.4
White Crappie	Not Specified*	28.0	82.0	-	-
(Pomoxis annularis)	Juvenile*	25.0	77.0	33.0	91.4
	Juvenile*	25.0 -32.2	77.0 -90.0	33.0	91.4

TABLE 5.1.3-1 (CONTINUED)

TEMPERATURE TOLERANCE RANGES OF IMPORTANT FISH SPECIES EXPECTED IN THE SHNPP RESERVOIR

Species	Age Group	Optimum Growth Temperature		Upper Lethal Temperature	
		°C	°F	°C	°F
Channel Catfish	Not Specified*	32.0	90.0	35.0	95.0
(*Ictalurus punctatus*)	Juvenile*	-	-	35.5 -38.0	95.9 -100.5
	Adult*	-	-	30.4 -33.5	86.8 - 92.3
	Larvae*	27.0 -31.0	80.6 -87.9	31.0	87.9
	Juvenile*	26.0 -34.0	79.9 -93.1	30.0 -38.0	86.0 -100.5
	Adult*	23.9 -32.0	75.0 -89.6	32.8 -37.8	91.0 -100.1
White Catfish (*Ictalurus catus*)	Not Specified++	-	-	29.2 -32.0	84.6 - 87.9

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*Brungs, William A. and Bernard R. Jones, "Temperature Criteria for Freshwater Fish: Protocol and Procedures," EPA, 1977.

**Brown, Huntting W., "Handbook of the Effects of Temperature on Some North American Fishes," American Electric Power Service Corp., 1975.

+Clark, John C., Thermal Pollution and Aquatic Life, Scientific American, 220(3):3-12, 1969.

++Kendall, A. W. and F. J. Schwartz, Lethal Temperature and Salinity Tolerances for White Catfish, Ictalurus catus, from Patuxent River, Maryland, Ches. Sci., 9(2):103-108, 1968.

5.1.4 EFFECTS OF HEAT DISSIPATION

Reference is made to Sections 3.3.2 and 3.3.3 of the SHNPP Construction Permit Environmental Report. The reduction from four to two generating units will reduce the number of cooling towers from four to two, and will reduce the tower water consumption proportionally. There have been no other changes in the information previously reported in these sections with the exception of the predicted evaporative water losses from operation of the cooling towers. The revised evaporative water loss predictions are in Table 3.4.2-2. 4

REFERENCES: SECTION 5.1

5.1.2-1 Hogarth, William T. Testimony before the Atomic Safety & Licensing Board in the Matter of Carolina Power & Light Company (Shearon Harris Nuclear Power Plant Units 1, 2, 3 and 4). September 5, 1977.

5.1.2-2 "Heat Exchange in the Environment", Edinger and Geyer, EEI Publication No. 65-902, June, 1965.

5.1.2-3 "The Capacity of Cooling Ponds to Dissipate Heat", by W. D. Patterson, J. L. Leoporati and M. J. Scarpa. 33rd Annual Meeting of the American Power Conference, Chicago, Illinois. April, 1971 4

5.1.2-4 "The Ratio of Heat Losses by Conduction and Evaporation from any Water Surface", *Physical Review 27*, No. 2, June, 1926.

5.1.3-1 Hogarth, William T. Testimony Before the Atomic Safety & Licensing Board in the Matter of Carolina Power & Light Company (Shearon Harris Nuclear Power Plant Units 1, 2, 3, and 4). September 5, 1977.

5.1.3-2 Knight, Robert L. Entrainment and Thermal Shock Effects on Phytoplankton Numbers and Diversity. UNC Depart. of Envir. Sci. and Engineer. ESE Pub. No. 336 1973.

5.1.3-3 Patrick, Ruth. Effects of Abnormal Temperatures on Algal Communities. Thermal Ecology. ERDA Tech. Info. Center. 1974.

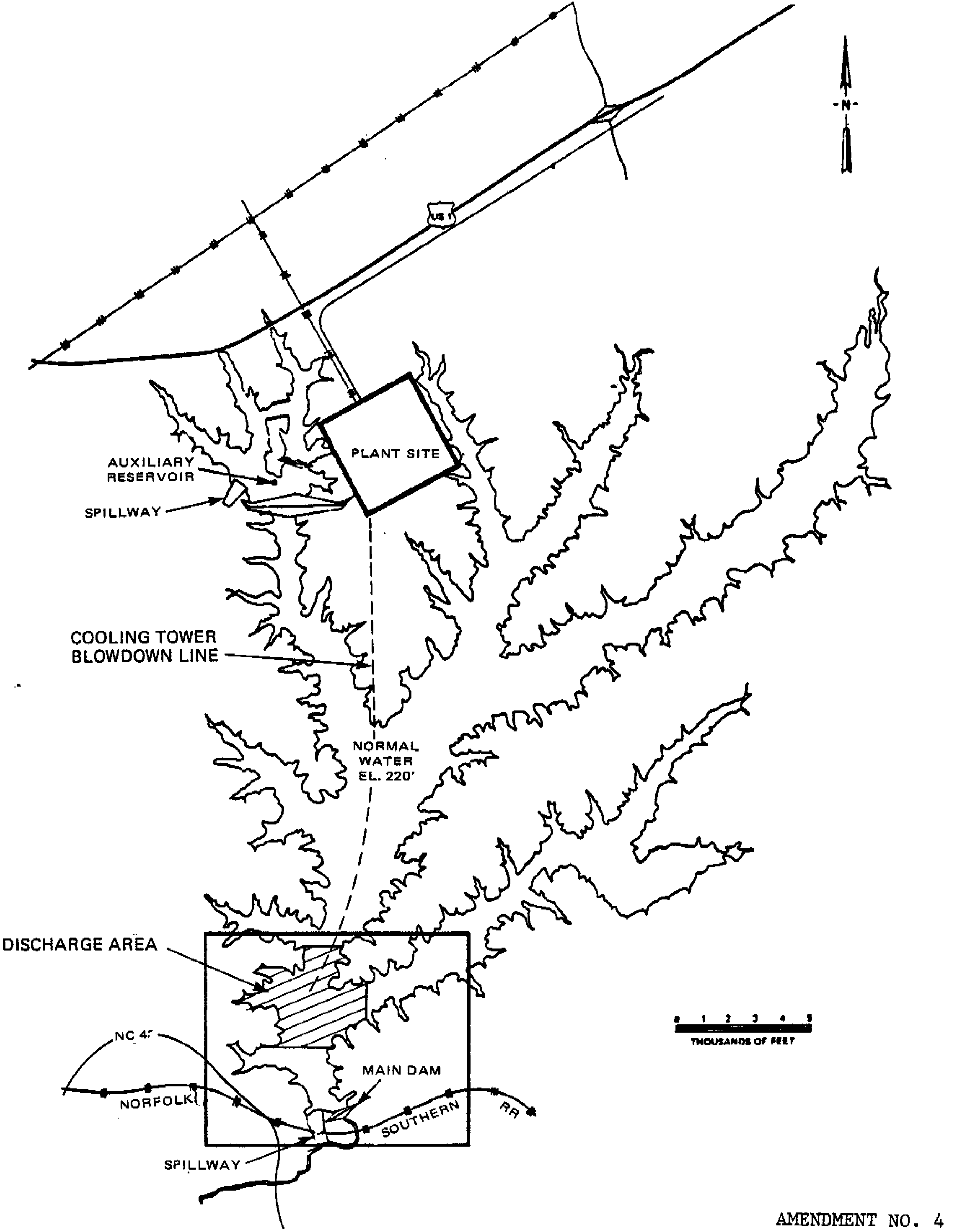
5.1.3-4 Morgan, R. P. II, and R. G. Stross. Destruction of Phytoplankton in the Cooling Water Supply of a Steam Electric Station, Chesapeake Sci. 10 (3 and 4): 165-171.

5.1.3-5 Carolina Power and Light Company prepared by Aquatic Control, Inc. Baseline Biota of the Shearon Harris Nuclear Power Plant Area, North Carolina. Raleigh, N.C. [1974].

5.1.3-6 Carolina Power & Light Company. Cape Fear Steam Electric Generating Plant 316(b) Demonstration. Raleigh, N. C. 1977.

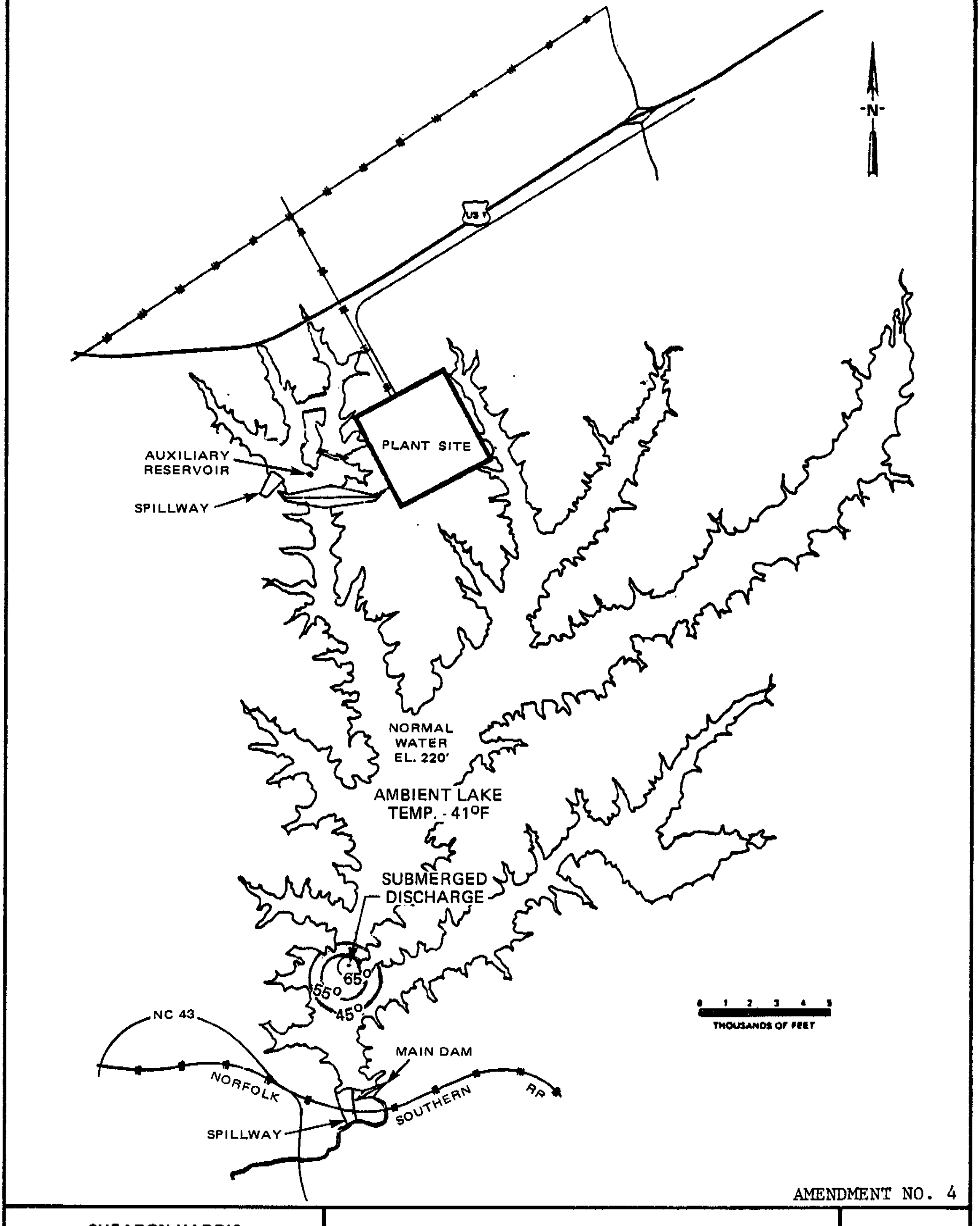
5.1.3-7 U.S. Environmental Protection Agency. Developmental Document for Best Technology Available for the Location, Design, Construction and Capacity of Cooling Water Intake Structures for Minimizing Adverse Environmental Impact. April 1976.

5.1.3-8 Gentile, J. H., J. Cardin, M. Johnson, and S. Sosnowski. Power Plants, Chlorine and Estuaries. Ecol. Res. Journ. EPA: 600/2-76-055. Duluth, Minn. 1976.



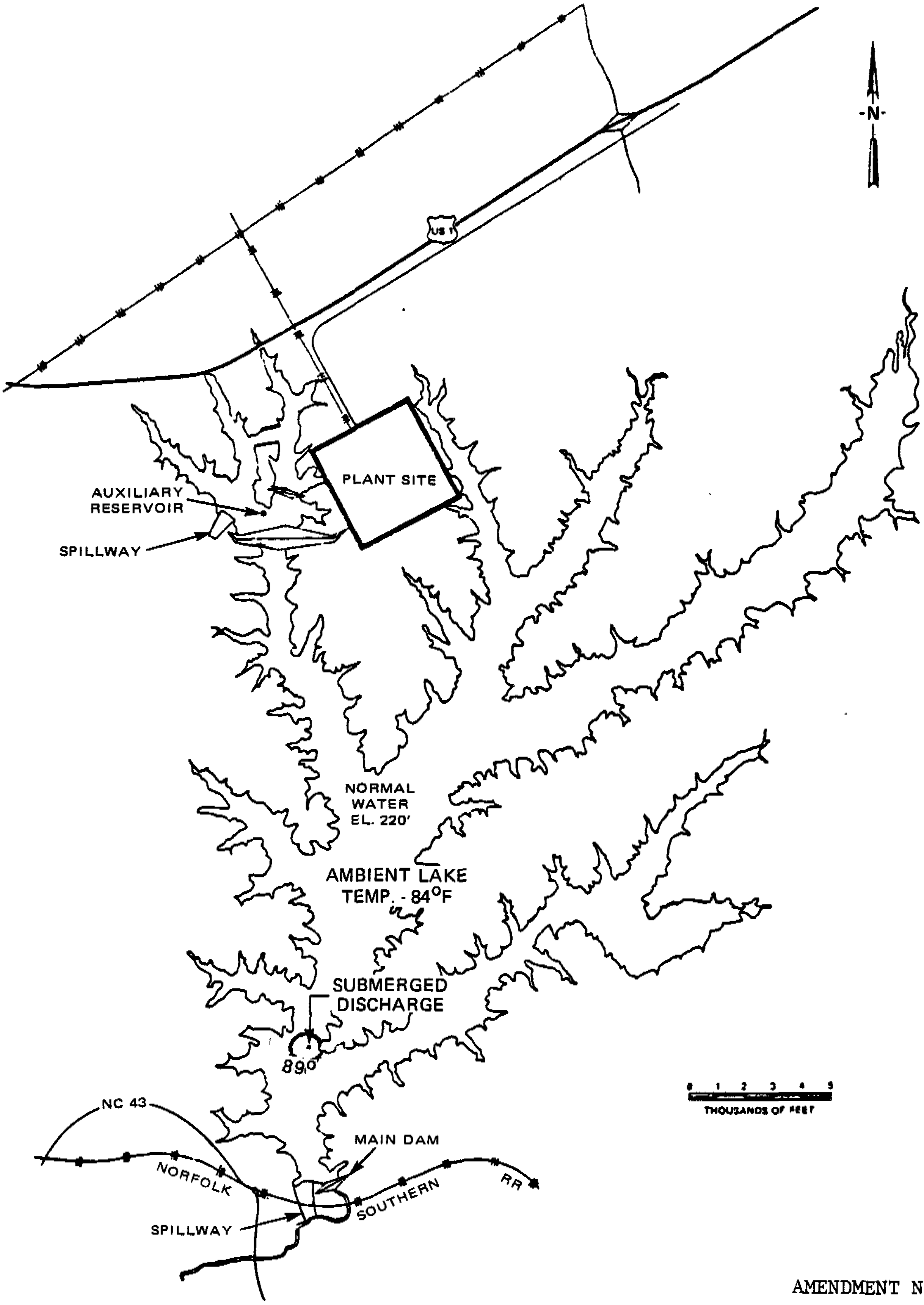
AMENDMENT NO. 4

SHEARON HARRIS NUCLEAR POWER PLANT Carolina Power & Light Company ENVIRONMENTAL REPORT	MAIN RESERVOIR MIXING AREA	FIGURE 5.1.2-1



AMENDMENT NO. 4

SHEARON HARRIS NUCLEAR POWER PLANT Carolina Power & Light Company **ENVIRONMENTAL REPORT**	MAIN RESERVOIR ISOTHERMS ADVERSE WINTER METEOROLOGICAL CONDITIONS	**FIGURE** **5.1.2-2**



AMENDMENT NO. 4

SHEARON HARRIS NUCLEAR POWER PLANT

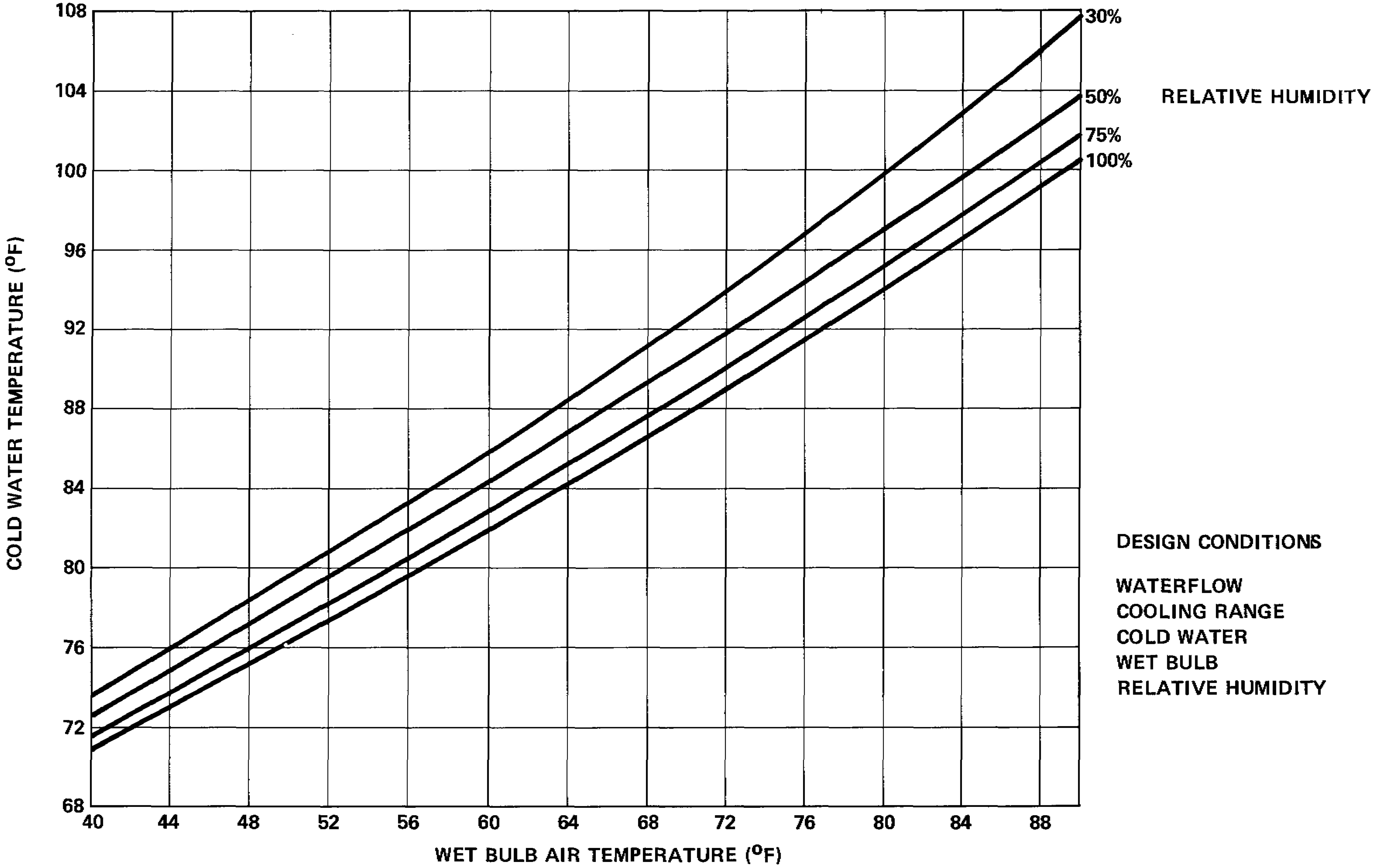
Carolina
Power & Light Company

ENVIRONMENTAL REPORT

MAIN RESERVOIR ISOTHERMS
ADVERSE SUMMER
METEOROLOGICAL CONDITIONS

FIGURE

5.1.2-3



DESIGN CONDITIONS

WATERFLOW	533000.	USGPM
COOLING RANGE	25.00	°F
COLD WATER	95.00	°F
WET BULB	77.00	°F
RELATIVE HUMIDITY	50	%

PERFORMANCE CURVES COLD WATER TEMPERATURE IN FUNCTION OF WET BULB AIR TEMPERATURE AND RELATIVE HUMIDITY

WATERFLOW	533000.USGPM
RANGE	25.00 °F

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Carolina Power & Light Company
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NATURAL DRAFT COOLING TOWER
PERFORMANCE CURVES

FIGURE 5.1.2-4

5.2 RADIOLOGICAL IMPACT FROM ROUTINE OPERATION

As discussed in Section 3.5, small quantities of radioactive materials are released to the environment during the normal operation of the SHNPP. These materials are dispersed in the air and water in the vicinity of the site and present a source of radiation exposure for organisms inhabiting the area. It is expected that this will result in radiological impacts that are a small fraction of those from naturally occurring radiation.

The fundamental equation used to calculate the radiological impact of plant releases is:

$$R_{ipr} = C_{ip} U_p D_{ipr}$$

where:

R_{ipr} = the dose rate to organism r from nuclide i via pathway p.
C_{ip} = the concentration of nuclide i in the medium of pathway p.
U_p = usage, i.e., the exposure time or intake rate associated with pathway p.
D_{ipr} = the dose factor for organism r from nuclide i via pathway p.

The above equation may be tailored to calculate the dose rate from intake of, as well as exposure to, radionuclides for each organism. The specific models that have been used are those presented in the Nuclear Regulatory Commission Technical Report WASH-1258 for biota other than man and in NRC Regulatory Guide 1.109 for man.

5.2.1 EXPOSURE PATHWAYS

5.2.1.1 Organisms Other Than Man

Aquatic biota may be exposed to external radiation from radionuclides in the water and sediment and to internal radiation from the assimilation of these radionuclides. In addition to uptake via the ingestion of food organisms, fish and invertebrates can acquire radionuclides through direct absorption from the water and can at least partially assimilate radioactivity from ingested sediment. Figure 5.2.1-1 is a flow chart representing the transfer of radionuclides through the aquatic ecosystem. The flow chart is equally applicable to the Cape Fear River and the Main Reservoir. 2

The organisms which constitute the lower trophic levels of the aquatic food web (plankton and benthic invertebrates) in the Cape Fear River and the Buckhorn Creek system are described in Section 2.2.2. Dominant phytoplankton are the green algae (Chlorophyta), blue-green algae (Cyanophyta) and diatoms (Bacillariophyceae). Zooplankton expected to inhabit the reservoirs should be similar to genera found in other lakes of the Piedmont of North Carolina. Genera that will predominate include the rotifers (Keratella, Polyarthra, and Synchaeta); the cladocerans (Bosmina, Ceriodaphnia, and Daphnia); the copepods (Diaptomus, Mesocyclops, and Cyclops); and the larvae of the dipteran, Chaoborus. Rotifers probably will be the dominant taxa in the reservoirs while the cladocerans and copepods will be secondarily dominant. A stable zooplankton population will not be achieved until 2 to 4 years after the reservoirs are filled, and so considerable fluctuation in densities and species may be expected during this period. Benthic macroinvertebrates typically play an important role in the aquatic food web, serving as a link between the detrital level and the higher trophic levels. Mayfly larvae, dipteran larvae, and molluscs are examples of the benthic macroinvertebrates that are found in the Cape Fear River and associated streams and creeks in the vicinity of SHNPP. Fish feeding upon the plankton, benthic macroinvertebrates, and other fish, constitute a higher trophic level of the aquatic food web. Fish found in the SHNPP site vicinity are listed in Table 2.2.2-2.

The terrestrial ecology of the SHNPP area is described in Section 2.2.1. Terrestrial biota may be exposed to external radiation from immersion in the plant's gaseous effluents, from swimming in water containing the plant's liquid effluents, and from direct shine from radionuclides that have deposited on the ground and shoreline. Internal exposure of terrestrial organisms may result from the inhalation of radioactive materials from the plant's gaseous effluents and from the ingestion of foods that have assimilated radioactive materials from both gaseous and liquid plant effluents. Figure 5.2.1-2 presents the pathways by which terrestrial biota other than man are exposed to radioactive material released from the SHNPP.

The routes of internal exposure to terrestrial biota other than man are highly varied due to the diversified feeding habits of the animals living in the vicinity of the site. The vegetation in the region will receive radionuclides from deposition onto the plant foliage and from the uptake of radioactivity initially deposited on the ground. Deer, rabbits, squirrels and other herbivorous animals could then be internally exposed from the ingestion of this vegetation. In turn, foxes, bobcats, and other predatory animals living in the vicinity may be internally exposed to radiation from feeding on those animals that have concentrated radionuclides in their flesh.

5.2.1.2 Man

As a result of the operation of the SHNPP there are several potential radiation exposure pathways to man. Figure 5.2.1-3 presents the various potential pathways. These potential pathways may be divided into two categories: those pathways resulting in a radiation dose via internal exposure, and those pathways resulting in a dose via external exposure. External exposure to an individual may result from contact with radioactivity deposited on the ground, immersion of an individual in a cloud containing radioactive gaseous effluents, or direct contact with water containing radioactive liquid effluents while an individual is swimming or engaged in a similar activity. Internal exposures may result from the ingestion of various foods, and inhalation.

5.2.1.2.1 Internal Exposure

4 Liquid effluents from SHNPP are combined with the cooling tower blowdown and discharged into the Main Reservoir via a submerged discharge line. The annual average flow from the reservoir into the Cape Fear River will be approximately 43 cfs for one unit operation and 48 cfs for two unit operation. It is anticipated that makeup water will be pumped from the Cape Fear River into the Main Reservoir periodically during the SHNPP operating lifetime. This indicates that the internal exposure pathway via domestic potable water intake from the Cape Fear River (nearest approximately 12 miles downstream from the plant site, Section 2.4.5) and via commercial fish and shellfish consumption (only negligible fish and shellfish catch within 50 miles of the reservoir, Section 2.1.3) will be minimal. However, recreational use of the Main Reservoir can result in internal exposures through the aquatic food chain.

The aquatic food chains, including well water, will be monitored during preoperational and operational stages in order to accurately assess the radiological impact of the liquid effluents and to verify the accuracy of preoperational estimates.

Although the majority of the land within a five mile radius of the plant site is wooded, several dairy farms and residential vegetable gardens exist within this area; therefore there exist four additional potential routes of internal radiation exposure to man. These routes result from the deposition of radioactive wastes discharged into the atmosphere. The first route is air-grass-milk-man; the second, the air-vegetable-man route; the third, the air-grass-meat-man route; and the fourth, inhalation. The locations of the nearest milk cow, meat animal, residence garden and site boundary for SHNPP is presented in Table 2.1.3-1. Expanded development of this area is not anticipated due to the poor permeability characteristics of the soils and lack of adequate sewage and water systems.

4 For dose calculations f_p, the fraction of the year that animals graze or pasture, and f_s, the fraction of daily feed that is pasture grass when the animal grazes on pasture, were both set equal to one. These parameters appear in Equation C-11 of Regulatory Guide 1.109. This approach is extremely

conservative in that it assumes the animals derive 100 percent of their annual food intake from pasture grass which maximizes the contribution of these pathways to human exposure.

According to the North Carolina Crop & Livestock Reporting Service, leafy vegetables (collards, in particular) are grown throughout the year in the four counties surrounding the site. It should be noted that green leafy vegetables were not included in population dose assessments since there is no significant commercial production in the vicinity of SHNPP. For the maximum individual t_e, the period of leafy vegetable exposure during the growing season, was set equal to 1440 hours (60 days) based on Table E-15 of Regulatory Guide 1.109 for use in Equation C-5 of the guide. The fact that collards are grown all year is not directly relevant since dose is controlled by t_e and the maximum individuals's ingestion rate for leafy vegetables. 4

For individual dose calculations, f_g (the fraction of produce ingested from the garden of interest) was set equal to 0.76, and f_l (the fraction of leafy vegetables ingested from the garden of interest) was set equal to 1.0. These values were taken from Table E-15 and used in Equation C-13 of Regulatory Guide 1.109.

The majority of the land within a 50-mile radius of the plant is devoted to agricultural activity which includes the following crops: grain, cotton, tobacco, soybeans, hay, vegetables and peanuts; livestock includes hogs, chickens, turkeys and dairy products. Section 2.1.3 describes in detail the land uses of this area.

5.2.1.2.2 External Exposure Pathways

People living in the vicinity of or frequenting the plant site are subject to low level external exposures due to plant liquid and gaseous effluent releases. The general public has access to the Main Reservoir, therefore, the principle external exposure from plant liquid effluents is a result of direct contact with water in the Main Reservoir while swimming, boating or fishing. The principle external exposure from plant gaseous releases will be the result of immersion in a cloud containing radioactive gaseous releases.

5.2.2 RADIOACTIVITY IN THE ENVIRONMENT

In Section 3.5, the radionuclides discharged in the liquid and gaseous effluents are provided. This section considers how these effluents are distributed in the environment surrounding the SHNPP site. Specifically, estimates have been made for the radionuclide concentration: a) in the water and sediment in the Main Reservoir; b) in the atmosphere around the site; and c) on land areas and vegetation surrounding the plant.

The models and assumptions used to determine annual average air concentration (χ/Q), depleted concentration, and deposition (D/Q) are described in Section 6.1.3. The meteorological data used in these models is described in detail in Section 2.3. The concentrations were calculated at points within a radial grid of sixteen 22.5 degree sectors centered at true north and extending to a distance of 50 miles from the station. The data points are located in each sector at 0.5, 1.5, 2.5, 3.5, 4.5, 7.5, 15, 25, 35, and 45 miles. In addition, calculations were also made at the critical receptors in each sector within five miles of the site. These distances and directions are presented in Table 5.2.2-1 along with the χ/Q, depleted χ/Q and D/Q.

The highest ground level airborne concentrations in the vicinity of the site due to gaseous releases have been calculated using these meteorological data and the source terms presented in Section 3.5. The concentrations are presented in Table 5.2.2-2. The concentrations of radionuclides on the ground and in vegetation are controlled by the deposition of gaseous effluents since irrigation of cropland with reservoir water is not anticipated. These concentrations are also presented in Table 5.2.2-2 at the same location as the maximum airborne concentration.

5.2.2.1 Surface Water Models

A simplified approach has been used to predict the transport of liquid radioactive effluents. This approach is conservative in that it overestimates the radiological impact of the normal operation of SHNPP. Discussions of the basic hydrologic and water use data of the area are provided in Section 2.1.3 and 2.4.

5.2.2.1.1 Transport Models

Liquid radioactive wastes are diluted by the cooling tower blowdown flow prior to being released to the Main Reservoir. Using the source term for liquid radioactive waste from Section 3.5, the expected concentrations of radionuclides in the cooling tower blowdown and the Main Reservoir are presented in Table 5.2.2-3a for one unit operation and in Table 5.2.2-3b for two unit operation. The concentrations in the reservoir were calculated using the completely mixed, closed loop dispersion model presented in NRC Regulatory Guide 1.113. The steady state concentration of a particular nuclide can be calculated using Equation 45 of Regulatory Guide 1.113. Stream dilution is not applicable for SHNPP since discharge is to the Main Reservoir and not to a free-flowing stream. 4

For two unit operation with a cooling tower discharge of 16.5 cfs per unit and utilization of a makeup system from the Cape Fear River, the activity is assumed to mix uniformly in a reservoir volume of 3.14×10^9 cu. ft. (mean reservoir level at 220 ft.) and is diluted through normal water inflow and outflow with the discharge rate from the reservoir assumed to be 48 cfs; i.e., the normal reservoir level and discharge rate for two unit operation from Section 2.4.2. For one unit operation with a cooling tower discharge rate of 16.5 for one unit and no makeup to the reservoir from the Cape Fear, the activity is assumed to mix with a reservoir volume of 2.92 x 10^9 cu. ft. (mean reservoir level at 219.4 ft.) and is diluted through normal water inflow and outflow with the discharge rate of the reservoir assumed to be 43 cfs; i.e., the normal reservoir level and discharge rate for two unit operation from Section 2.4.2.

To calculate the maximum radiological impact, it was assumed that the critical biota, including man, are exposed to these reservoir concentrations.

5.2.2.1.2 Sediment Uptake Models

To calculate the exposure from shoreline activities, an estimate of the concentrations of radionuclides in the reservoir sediment was made using the "effective" surface model presented in the Nuclear Regulatory Commission Regulatory Guide 1.109.

Although radionuclide concentrations in the reservoir sediment have been calculated, no credit has been claimed for concentration reductions of radionuclides in the surface water resulting from sediment uptake.

5.2.2.1.3 Water Use Models

To calculate the radiological impact of liquid effluents from the normal operation of SHNPP, it has been assumed that the maximum exposed individual catches and consumes all of his fish from the reservoir. The nearest present and known future locations where an individual can obtain aquatic food are both approximately 0.4 miles NE from the centerline of Unit 1. This location is on the shore of the Main Reservoir. For catches from the Main Reservoir, transit time was assumed to be zero and dilution is a function of nuclide half-life. Dilution factors at points downstream on the Cape Fear River are
5 discussed in SHNPP FSAR Section 2.4.12. The calculated annual average release rate from the reservoir was approximately 43 cfs for one unit operation and 48 cfs for two unit operation.

Recreational usage factors for present and known future aquatic areas used to calculate doses to the maximum adult (the age group found to receive the highest dose) were assumed to be 12 hours/year at the shoreline, 100 hours/year for swimming and 52 hours/year for boating. The shoreline usage factor was taken from Table E-5 of Regulatory Guide 1.109. Swimming and boating usage factors are contained in NRC's LADPOT code which was used to calculate doses from liquid pathways. These factors may also be found in WASH-1258.

5.2.2.2 <u>Groundwater Models</u>

All plant liquid effluents are released to the Main Reservoir. In addition, because of the low hydraulic gradient and permeability of the region described in Section 2.4, groundwater transport to surrounding private wells is extremely slow and hence, the radiological impact from the groundwater pathway is negligible. See Section 2.4.3 for additional information of groundwater.

TABLE 5.2.2-1

CRITICAL RECEPTOR LOCATIONS

Receptor	Direction	Distance (Kilometers)	χ/Q (sec./m^3)	Depleted χ/Q (sec./m^3)	D/Q (m^2)
Site Boundary	NNE	2.1	5.4(-6)	4.6(-6)	8.9(-9)
Residence	NNE	2.7	3.2(-6)	2.7(-6)	4.9(-9)
Milk Cow	N	2.9	2.7(-6)	2.2(-6)	3.2(-9)
Meat Animal	N	2.9	2.7(-6)	2.2(-6)	3.2(-9)
Garden	NNE	2.7	3.2(-6)	2.7(-6)	4.9(-9)

TABLE 5.2.2-2

SITE BOUNDARY* CONCENTRATIONS OF GASEOUS EFFLUENTS

	Airborne (μCi/cc)	Air C/MPC	On Ground (pCi/m2)	In Vegetation (pCi/kg)
Kr 83M	1.71E-13	5.70E-08	0	0
Kr 85M	2.91E-12	2.91E-05	0	0
Kr 85	3.76E-11	1.25E-04	0	0
Kr 87	5.13E-13	2.57E-05	0	0
Kr 88	4.10E-12	2.05E-04	0	0
Xe131M	2.22E-12	5.56E-06	0	0
Xe133M	7.87E-12	2.62E-05	0	0
Xe133	4.62E-10	1.54E-03	0	0
Xe135	1.20E-11	1.20E-04	0	0
Xe138	1.71E-13	5.70E-08	0	0
I131	7.87E-15	7.87E-05	1.30E+01	1.99E+00
I133	1.03E-14	2.57E-05	1.85E+00	4.19E-01
Mn 54	8.38E-16	8.38E-07	5.22E+01	2.18E-01
Fe 59	2.74E-16	1.37E-07	2.53E+00	5.68E-02
Co 58	2.74E-15	1.37E-06	9.30E+02	7.51E-01
Co 60	1.30E-15	4.33E-06	4.42E-02	3.57E-01
Sr 89	6.16E-17	2.05E-07	6.58E-01	1.32E-02
Sr 90	1.11E-17	3.71E-07	7.26E+00	3.42E-03
Cs134	8.38E-16	2.09E-06	1.28E+02	2.22E-01
Cs137	1.40E-15	2.80E-06	9.26E+02	4.06E-01
H 3	9.92E-11	4.96E-04		
TOTAL C/MPC		2.70E-03		

5

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* Calculated at 2.14 kilometers in the NNE direction.

Table 5.2.2-3 deleted by Amendment No. 5

TABLE 5.2.2-3a

NORMAL OPERATIONAL CONCENTRATION OF RADIONUCLIDES IN LIQUID EFFLUENTS ASSUMING OPERATION OF UNIT 1 WITH NO MAKE-UP FROM CAPE FEAR RIVER

	AVERAGE RESERVOIR		COOLING TOWER BLOWDOWN	
ISOTOPE	CONC. (μCi/ML)	C/MPC	CONC. (μCi/ML)	C/MPC
H3	4.88E-08	1.63E-05	1.27E-05	4.24E-03
Cr 51	5.76E-14	2.88E-11	1.87E-11	9.33E-09
Mn 54	2.55E-14	2.55E-10	6.78E-12	6.78E-08
Fe 55	8.08E-14	1.01E-10	2.12E-11	2.65E-08
Fe 59	3.68E-14	7.36E-10	1.10E-11	2.20E-07
Co 58	6.84E-13	7.60E-09	1.95E-10	2.17E-06
Co 60	1.91E-13	6.38E-09	5.00E-11	1.67E-06
Np239	2.17E-15	2.17E-11	2.20E-12	2.20E-08
Sr 89	1.32E-14	4.42E-09	3.90E-12	1.30E-06
Zr 95	1.59E-14	2.65E-10	4.58E-12	7.63E-08
Nb 95	2.02E-14	2.02E-10	6.28E-12	6.28E-08
Mo 99	2.08E-13	5.21E-09	1.87E-10	4.66E-06
Tc 99M	2.42E-14	8.07E-12	1.78E-10	5.94E-08
Ru106	2.32E-14	2.32E-09	6.87E-12	6.87E-07
Ag110M	4.76E-15	1.59E-10	1.27E-12	4.24E-08
Te127M	1.23E-14	2.45E-10	3.39E-12	6.78E-08
Te127	7.27E-16	3.63E-12	3.48E-12	1.74E-08
Te129M	4.61E-14	2.31E-09	1.44E-11	7.21E-07
Te129	2.50E-16	3.13E-13	9.33E-12	1.17E-08
I130	1.54E-15	5.13E-10	5.68E-12	1.89E-06
Te131M	1.31E-15	3.28E-11	2.20E-12	5.51E-08
I131	3.18E-11	1.06E-05	1.53E-08	5.09E-02
Te132	8.52E-14	4.26E-09	6.78E-11	3.39E-06
I132	5.42E-15	6.78E-10	1.02E-10	1.27E-05
I133	9.27E-13	9.27E-07	2.12E-09	2.12E-03
Cs134	1.48E-12	1.65E-05	3.90E-10	4.33E-05
I135	2.82E-11	7.05E-09	1.87E-10	4.66E-05
Cs136	2.56E-13	4.27E-09	1.02E-10	1.70E-06
Cs137	1.27E-12	6.35E-08	3.31E-10	1.65E-05
Ba140	4.043-15	2.02E-10	1.61E-12	8.06E-08
La140	1.41E-15	7.06E-11	1.87E-12	9.33E-08
Ce144	5.73E-14	5.73E-09	1.53E-11	1.53E-04
Total C/MPC		1.40E-04		5.74E-02

(1) Per Unit

TABLE 5.2.2-3b

NORMAL OPERATIONAL CONCENTRATION OF RADIONUCLIDES IN LIQUID EFFLUENTS$^{(1)}$ ASSUMING OPERATION OF UNITS 1 AND 2 WITH MAKE-UP FROM CAPE FEAR RIVER

ISOTOPE	AVERAGE RESERVOIR CONC. (µCi/ML)	AVERAGE RESERVOIR C/MPC	COOLING TOWER BLOWDOWN CONC. (µCi/ML)	COOLING TOWER BLOWDOWN C/MPC
H3	4.37E-08	1.46E-05	1.27E-05	4.24E-03
Cr 51	5.19E-14	2.60E-11	1.87E-11	9.33E-09
Mn 54	2.28E-14	2.28E-10	6.78E-12	6.78E-08
Fe 55	7.24E-14	9.06E-10	2.12E-11	2.65E-08
Fe 59	3.31E-14	6.62E-10	1.10E-11	2.20E-07
Co 58	6.15E-13	6.83E-09	1.95E-10	2.17E-06
Co 60	1.72E-13	5.72E-09	5.00E-11	1.67E-06
Np239	2.00E-15	2.00E-11	2.20E-12	2.20E-08
Sr 89	1.19E-14	3.97E-09	3.90E-12	1.30E-06
Zr 95	1.43E-14	2.39E-10	4.58E-12	7.63E-08
Nb 95	1.82E-14	1.82E-10	6.28E-12	6.28E-08
Mo 99	1.92E-13	4.79E-09	1.87E-10	4.66E-06
Tc 99M	2.25E-14	7.50E-12	1.78E-10	5.94E-08
Ru106	2.56E-14	2.59E-09	6.87E-12	6.87E-07
Ag110M	4.27E-15	1.42E-10	1.27E-12	4.24E-08
Te127M	1.10E-14	2.20E-10	3.39E-12	6.78E-08
Te127	6.75E-16	3.37E-12	3.48E-12	1.74E-08
Te129M	4.16E-14	2.08E-09	1.44E-11	7.21E-07
Te129	2.33E-16	2.91E-13	9.33E-12	1.17E-08
I130	1.43E-15	4.76E-10	5.68E-12	1.89E-06
Te131M	1.21E-15	3.04E-11	2.20E-12	5.51E-08
I131	2.89E-11	9.65E-05	1.53E-08	5.09E-02
Te132	7.83E-14	3.91E-09	6.78E-11	3.39E-06
I132	5.04E-15	6.30E-10	1.02E-10	1.27E-05
I133	8.58E-13	8.58E-07	2.12E-09	2.12E-03
Cs134	1.33E-12	1.48E-05	3.90E-10	4.33E-05
I135	2.62E-11	6.55E-09	1.87E-10	4.66E-05
Cs136	2.33E-13	3.88E-09	1.02E-10	1.70E-06
Cs137	1.14E-12	5.69E-08	3.31E-10	1.65E-05
Ba140	3.673-15	1.83E-10	1.61E-12	8.06E-08
La140	1.30E-15	6.51E-11	1.87E-12	9.33E-08
Ce144	5.13E-14	5.13E-09	1.53E-11	1.53E-04
Total C/MPC		1.27E-04		5.74E-02

(1) Per Unit

5.2.3 DOSE RATE ESTIMATES FOR BIOTA OTHER THAN MAN

Using the models outlined in NRC Technical Report WASH-1258, annual average radiation doses were estimated for terrestrial and aquatic organisms living in the vicinity of SHNPP. These are the organisms which are expected to receive the greatest exposures.

Table 5.2.3-1 lists theoretical doses to typical biota associated with the Main Reservoir and shoreline environment for one unit operation with no makeup from the Cape Fear River and two unit operation with makeup from the Cape Fear River. The one unit case assumes a mean reservoir level of 219.4 ft, uniform mixing with the reservoir volume at this level, i.e., 2.92 X 10^9 cu. ft., and a reservoir average outflow of 43 cfs (Section 2.4.2). The two unit case assumes a mean reservoir level of 220 ft., uniform mixing with the reservoir volume at this level, i.e., 3.14 X 10^9 cu. ft., and a reservoir outflow of 48 cfs. 4

It can be seen that all doses to organisms directly associated with the Main Reservoir environment are small. Animals not directly associated with the Main Reservoir environment, such as deer, would receive an external dose of less than 0.1 mrad/yr. when continuously occupying areas close to the plant boundary. A slight additional thyroid dose may be received by animals grazing close to the plant from the deposition of radioiodines released in the plant's gaseous effluent.

Numerous investigations have been made on the effects of radioactivity on biota. No effects have been observed at dose rates as low as those associated with the plant effluents. Investigations of Chironomid larvae (bloodworms), living in bottom sediments near Oak Ridge, Tennessee, where they were irradiated at the rate of about 230 to 240 rad/yr. for more than 130 generations, have shown no decrease in abundance, even though a slightly increased number of chromosome aberrations have occurred (Reference 5.2.3-1).

Studies on the Columbia River, Washington, have shown that irradiation of salmon eggs and larvae at a rate of 500 mrad/day did not affect the number of adult fish returning from the ocean or their ability to spawn (Reference 5.2.3-2). Other studies were made on the effect of released radionuclides on spawning salmon in the Columbia River. These studies have shown that when all reactors at the Hanford facility were operating, salmon have not been affected by dose rates in the range of 100 to 200 mrads/wk. (Reference 5.2.3-3).

Thus, applying the results of the referenced studies to evaluate the potential effects on reservoir biota, there should be no perceptible impact on biota from the radioactive material released by SHNPP.

TABLE 5.2.3-1

DOSES TO BIOTA OTHER THAN MAN FROM LIQUID EFFLUENTS

a. UNIT 1 WITH NO MAKEUP FROM CAPE FEAR

(mrad/year/unit)

	INTERNAL	EXTERNAL	TOTAL
Fish	1.81	1.76	3.57
Invertebrate	0.80	3.52	4.32
Algae	0.90	negligible	0.90
Muskrat	9.49	1.18	10.7
Raccoon	0.52	0.88	1.40
Heron	55.0	1.17	56.1
Duck	8.36	1.76	10.1

4

a. UNITS 1 AND 2 WITH MAKEUP FROM CAPE FEAR

(mrad/year/unit)

	INTERNAL	EXTERNAL	TOTAL
Fish	2.01	1.96	3.97
Invertebrate	0.88	3.91	4.79
Algae	1.00	negligible	1.00
Muskrat	10.5	1.31	11.8
Raccoon	0.56	0.98	1.55
Heron	60.9	1.30	62.2
Duck	9.27	1.96	11.2

5.2.4 DOSE RATE ESTIMATES FOR MAN

5.2.4.1 Liquid Pathways

The calculated maximum individual doses from all aquatic pathways of radiation exposure are based on radionuclide concentrations calculated to occur in the Main Reservoir. Theoretical doses are presented for releases made under the conditions which will exist for one unit operation, i.e., no makeup from Cape Fear and under the conditions which will exist for two unit operation with makeup from the Cape Fear in Tables 5.2.4-1a and 5.2.4-1b, respectively. It should be noted that these are doses to a hypothetical individual and that the maximum dose to a real individual will be less. 4

The usage factors and dose calculational models were taken from NRC Regulatory Guide 1.109.

5.2.4.2 Gaseous Pathways

The calculated maximum individual radiation doses from gaseous pathways of exposure are based on the atmospheric dispersion and deposition rate factors presented in Table 5.2.2-1. The resultant doses are presented in Table 5.2.4-2.

The usage factors and dose calculational models were taken from NRC Regulatory Guide 1.109.

5.2.4.3 Direct Radiation from Facility

Since access to the area surrounding the plant to a distance of approximately 2076 meters will be restricted, it is not expected that any member of the general public will be close to the plant site long enough to receive any measurable radiation from this pathway. In addition, all radioactive material within SHNPP is shielded such that the radiation level in all unrestricted areas is kept below 0.25 mrem/hr. At the site boundary this results in an annual dose from this pathway of less than 0.01 mrem.

5.2.4.4 Annual Population Doses

The radiological impact on the general population depends not only on the release of radiological material from SHNPP, but also upon the land and water use of the region surrounding the site. Section 2.1.3 presents a detailed discussion of land and water usage in the area. Based upon the data supplied there, conservative estimates have been made of the exposure of the general population to radiation.

The population-integrated doses due to radioactive material in the plant's liquid effluents have not been evaluated because of the low reservoir discharge flow rate.

The annual population-integrated doses from gaseous effluents have been evaluated for the following principal exposure pathways: noble gas submersion, inhalation of airborne effluents, ingestion of contaminated foods (milk, meat, and vegetation), and external irradiation from activity deposited on the ground. The site-specific data provided in Section 2.1.3 were used as the food production rates and distribution.

Table 5.2.4-1 deleted by Amendment No. 5

TABLE 5.2.4-1a

INDIVIDUAL DOSES FROM LIQUID RADIOACTIVE RELEASES (UNIT 1 WITH NO MAKE-UP FROM CAPE FEAR RIVER)

	DOSE TO ADULT* (mrem/yr./unit)	
	LIVER+	TOTAL BODY
Fish	0.90	0.70
Invertebrate	0.02	0.01
Drinking	(No public domestic water supply from the reservoir)	
Shoreline	negligible	negligible
Swimming	negligible	negligible
Boating	negligible	negligible
Total	0.92	0.71

4

* Dose to adult is greater than the dose to any other age group.

+ Dose to liver is greater than the dose to any other organ.

negligible is less than 10^{-2} mrem/yr./unit.

TABLE 5.2.4-1b

INDIVIDUAL DOSES FROM LIQUID RADIOACTIVE RELEASES (UNITS 1 AND 2 WITH MAKE-UP FROM CAPE FEAR RIVER)

	DOSE TO ADULT* (mrem/yr./unit)	
	LIVER+	TOTAL BODY
Fish	0.80	0.59
Invertebrate	0.02	0.01
Drinking	(No public domestic water supply from the reservoir)	
Shoreline	negligible	negligible
Swimming	negligible	negligible
Boating	negligible	negligible
Total	0.82	0.60

4

* Dose to adult is greater than the dose to any other age group.

+ Dose to liver is greater than the dose to any other organ.

negligible is less than 10^{-2} mrem/yr./unit.

TABLE 5.2.4-2

POTENTIAL DOSES FROM GASEOUS RADIOACTIVE RELEASES - ONE UNIT - NORMAL OPERATION +

Site Boundary Air Doses' (mrad/yr./unit)

Gamma	2.6(-1)
Beta	6.2(-1)

Maximum Individual Doses (mrem/yr./unit)

Total Body	Adults	Teenagers	Children	Infants
Immersion[2]	9.5(-2)	9.5(-2)	9.5(-2)	9.5(-2)
Inhalation[2]	5.8(-2)	3.2(-2)	3.3(-2)	3.5(-2)
Ground Deposition[2]	4.6(-2)	4.6(-2)	4.6(-2)	4.6(-2)
Vegetables[2]	1.9(-1)	1.7(-1)	2.5(-1)	-
Milk (Cow)[3]	5.9(-2)	6.0(-2)	8.8(-2)	1.3(-1)
Meat[3]	2.2(-2)	1.0(-2)	1.2(-2)	-
Total**	4.7(-1)	4.1(-1)	5.2(-1)	3.1(-1)

Skin	Adults	Teenagers	Children	Infants
Immersion[2]	2.6(-1)	2.6(-1)	2.6(-1)	2.6(-1)
Inhalation[2]	5.8(-2)	3.2(-2)	3.2(-2)	3.4(-2)
Ground Deposition[2]	5.4(-2)	5.4(-2)	5.4(-2)	5.4(-2)
Vegetables[2]	1.7(-1)	1.5(-1)	2.4(-1)	-
Milk (Cow)[3]	4.9(-2)	5.0(-2)	7.9(-2)	1.2(-1)
Meat[3]	2.1(-2)	9.7(-3)	1.2(-2)	-
Total**	6.1(-1)	5.6(-1)	6.8(-1)	4.7(-1)

TABLE 5.2.4-2 (Cont'd)

Thyroid*	Adults	Teenagers	Children	Infants
Immersion[2]	9.5(-2)	9.5(-2)	9.5(-2)	9.5(-2)
Inhalation[2]	1.2(-1)	8.4(-2)	1.0(-1)	1.5(-1)
Ground Deposition[2]	4.6(-2)	4.6(-2)	4.6(-2)	4.6(-2)
Vegetables[2]	3.1(-1)	2.6(-1)	4.0(-1)	-
Milk (Cow)[3]	3.5(-1)	5.0(-1)	9.7(-1)	2.3(+0)
Meat[3]	3.2(-2)	1.7(-2)	2.3(-2)	-
Total**	9.5(-1)	1.0(+0)	1.6(+0)	2.6(+0)

+ All doses calculated at the critical receptor location, i.e. that location for which the combination of receptor distance and direction gives the worst meteorological conditions (χ/Q and D/Q).

1 Calculated at the critical site boundary location, 1.33 miles in the NNE direction. $\chi/Q = 5.4E-06$ sec./m^3 D/Q = 8.9E-09 m^{-2}

2 Calculated at the critical residence and garden location, 1.70 miles in the NNE direction $\chi/Q = 3.2E-06$ sec./m^3 D/Q = 4.9E-09 m^{-2}

3 Calculated at the critical cow location, 1.80 miles in the N direction. $\chi/Q = 2.7E-06$ sec./m^3 D/Q = 3.2E-09 m^{-2}

* All other organ doses are less than the thyroid doses.

** For comparison to the September 4, 1975 Annex limits, multiply the total doses by two. 4

5.2.5 SUMMARY OF ANNUAL RADIATION DOSES

Table 5.2.5-1 summarizes the estimated annual radiation dose to the regional population (during commercial operation of SHNPP) from all station-related sources for a single unit. This tabulation includes, out to a distance of 50 miles from the site: a) the total of the whole-body doses to the population attributed to gaseous effluents; and b) the total of the thyroid doses to the population from radioiodine and particulates. Table 5.2.5-2 compares the calculated individual doses for both units to the September 4, 1975, Annex to Appendix I to 10CFR50. The results reveal that the calculated exposures are within the design objective guidelines of Appendix I to 10CFR50. 4 4

TABLE 5.2.5-1

ANNUAL POPULATION - INTEGRATED DOSES

(man-rem/yr/unit)

4

	Total Body	Thyroid
Immersion	0.74	-
Direct from ground	0.21	-
Inhalation	1.54	2.51
Ingestion - Milk	0.52	2.70
Meat	0.09	0.12
Total	3.10	5.33

TABLE 5.2.5-2

COMPLIANCE WITH 10CFR50, APPENDIX I

Type of Dose	September 4, 1975 Annex, Guidelines	SHNPP Calculated Exposure
A. LIQUID EFFLUENTS		
Dose to whole body (mrem/yr.) from all pathways	5	1.58
Dose to any organ (mrem/yr.) from all pathways	5	2.16
Total quantity of radioactivity released in liquid effluents (except H-3 and dissolved gases) (curies)	10	0.46
B. GASEOUS EFFLUENTS		
Gamma air dose (mrad/yr.)	10	0.52
Beta air dose (mrad/yr.)	20	1.24
Dose to whoe body (mrem/yr.) of an individual	5	1.04
Dose to skin on an (mrem/yr.) individual	15	1.36
Iodine -131 released to the atmosphere (curie)	2	0.09
Resulting dose to any organ (mrem/yr.) from all pathways	15	5.2

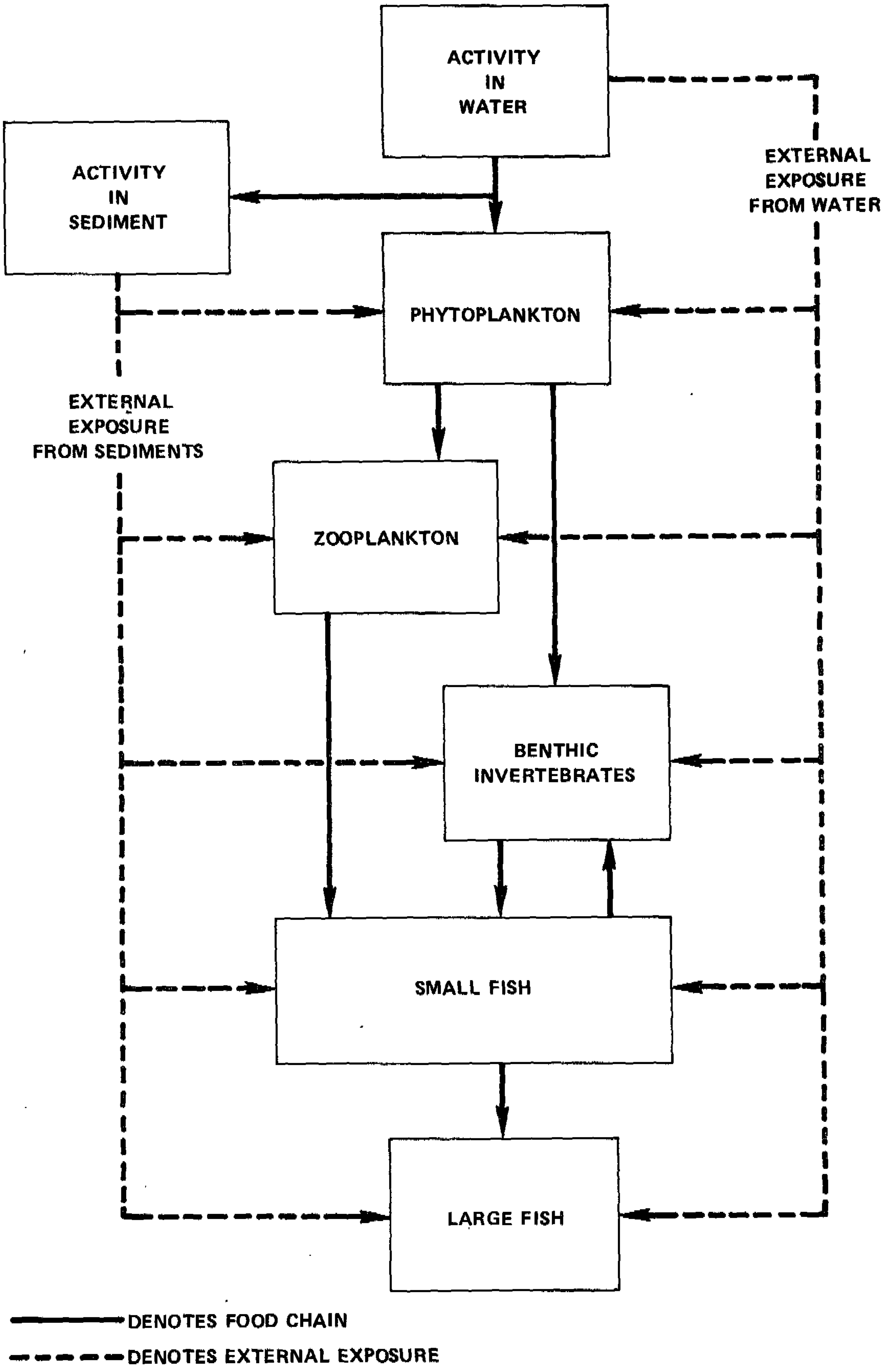
4

REFERENCES: SECTION 5.2

5.2.3-1 Blaylock, B.G., "Cytogenetic Study of a Natural Population of *Chironomus* Inhabiting and Area Contaminated by Radioactive Waste," *Disposal of Radioactive Wastes into Seas, Oceans and Rivers*, pp. 835-845. 1979.

5.2.3-2 Templeton, W.L., R.E. Nakatani and E.E. Held. "Radiation Effects," *Radioactivity in the Marine Environment*, Committee on Oceanography, National Research Council, National Academy of Sciences, pp. 223-239. 1971.

5.2.3-3 Watson, D.G., and W.L. Templeton, "Thermal Luminescent Dosimetry of Aquatic Organisms", *Third National Symposium on Radioecology*, Oak Ridge, TN. 1971.



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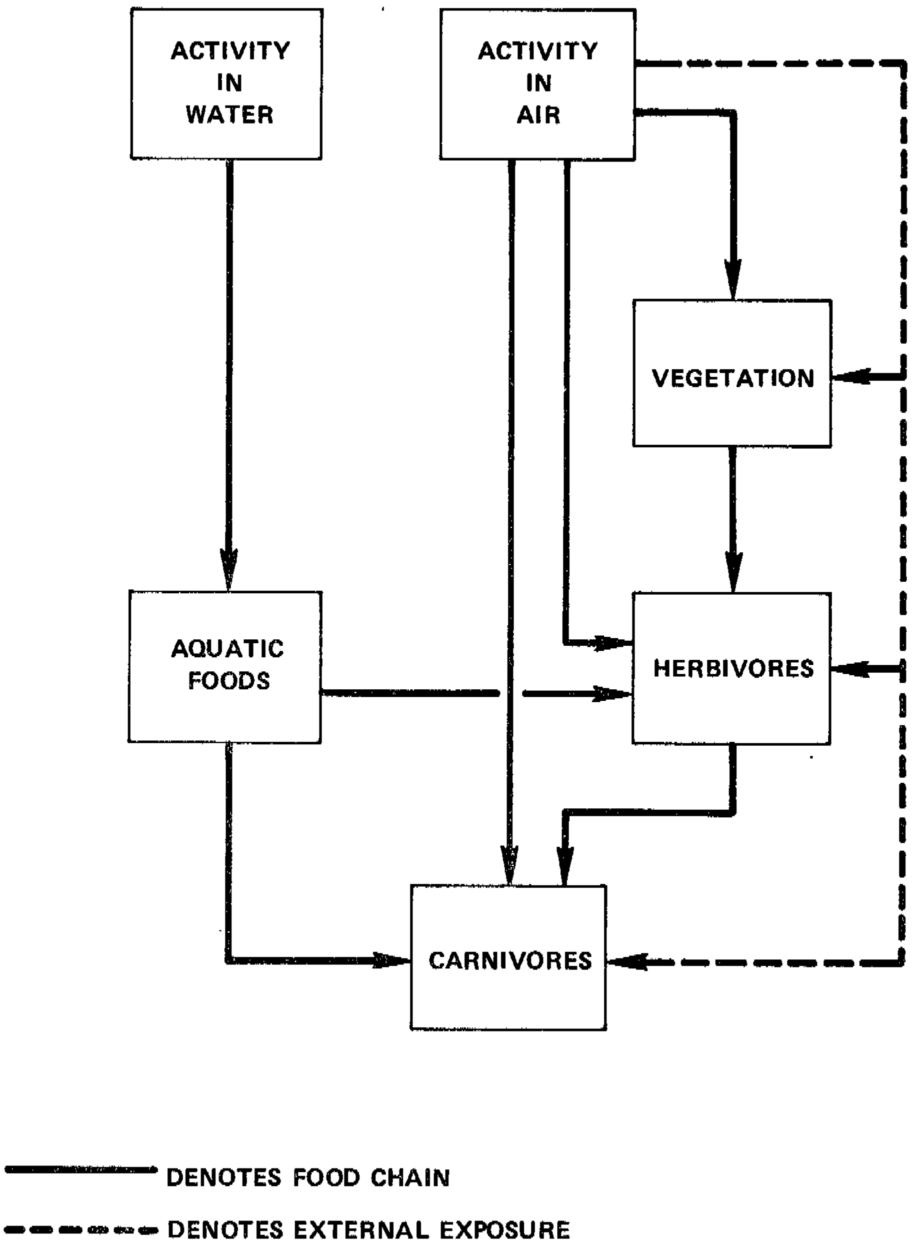
RADIATION EXPOSURE PATHWAYS TO AQUATIC ORGANISMS

FIGURE 5.2.1-1



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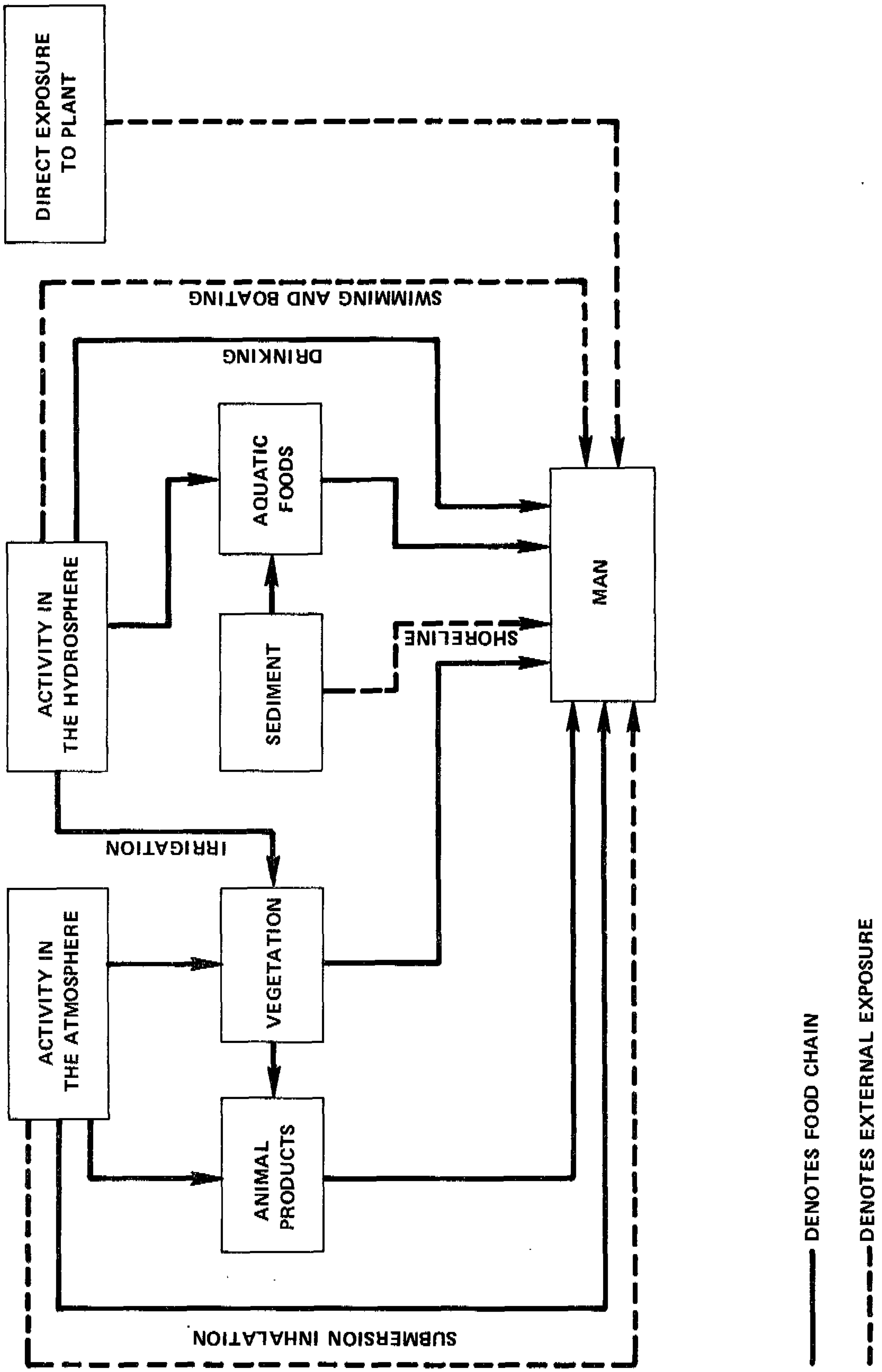
RADIATION EXPOSURE PATHWAYS TO TERRESTRIAL ORGANISMS

FIGURE 5.2.1-2



SHEARON HARRIS NUCLEAR POWER PLANT Carolina Power & Light Company **ENVIRONMENTAL REPORT**	RADIATION EXPOSURE PATHWAYS TO MAN	**FIGURE** **5.2.1-3**

5.3 EFFECT OF CHEMICAL AND BIOCIDE DISCHARGES

5.3.1 INTRODUCTION

This section describes the impacts of the chemical and biocide discharges from SHNPP on the water quality of the Main Reservoir. The various chemical and biocide systems which produce these wastes are discussed in Section 3.6. The quantity of each waste discharged, its constituents and their concentrations are listed in Table 3.6.2-1. The applicable Environmental Protection Agency effluent limitations and the State of North Carolina Water Quality Standards are indicated in Table 3.6.2-2. The Preoperational Environmental Monitoring Program to establish the ambient water quality of the Main Reservoir prior to the discharge of the wastes from SHNPP is explained in Section 6.1.1.

The chemical additions discussed in Section 3.6 are projections based on the
current design and anticipated operation of plant systems. These additions 4
may change as the projected commercial operation date for Unit 1 is
approached. The effects of any changes will be evaluated. Federal
requirements per 10CFR423 and State requirements are as described in
Section 3.6. There are no permit requirements regarding minimum release flows
from the Main Reservoir, and during periods of low flow in the Cape Fear River
there would not normally be any discharge of water to the Cape Fear River.

5.3.2 MIXING AND DILUTION

The wastewaters from SHNPP as indicated in Table 3.6.2-1, are treated and released to the Cooling Tower Blowdown System and discharged to the Main Reservoir.

Dilution and mixing of these discharges into the Main Reservoir was calculated
based on a model which accounted for the availability of the lake volume for
mixing, the natural inflow, makeup from the Cape Fear River, and discharge
from the Main Reservoir. The basic method was to perform a mass balance to
calculate equilibrium concentrations during several types of conditions such
as normal and drought conditions. The discharge point for the blowdown pipe
was selected based on the above calculations. Based on the limited flow
within the Main Reservoir and the slow rate of change in reservoir
concentrations, two zones of concentration were assumed. The first zone is 4
the 120 acre mixing zone and the other zone is the remainder of the Main
Reservoir, (See Figure 5.1.2-1). The entire lake volume available for mixing
was calculated as having equilibrium concentrations.

4

5.3.3 BIOLOGICAL EFFECTS OF BIOCIDE DISCHARGE

Intermittent chlorination will most likely be needed during the year. Discharge of free available chlorine is controlled to restrict this concentration to a maximum of 0.5 ppm, with an average of 0.2 ppm. This discharge will also undergo rapid dilution in the Main Reservoir.

Chlorination will result in the production of chlorine residuals, chloramines, and chloroorganics which may have some toxic effects in the immediate discharge area. Chlorine in the blowdown is expected to inhibit phytoplankton in the immediate discharge area.

Although the concentrations of the diluted chemical discharge will be below the toxic limits reported for most aquatic life, it is unclear whether the benthic macroinvertebrate community in the immediate discharge area may experience some chronic toxic effects as a result of individual chemicals acting independently or synergistically with other chemical components present in the aquatic environment. The published literature contains only limited information on the acute and chronic effects of cooling tower blowdown on benthic macroinvertebrate communities. Dickson, et al. (Reference 5.3.3-1), reported snail deaths apparently directly related to blowdown discharges. The toxicity reported by these authors may not be a function of chlorine toxicity alone, but rather may involve copper toxicity acting either independently or synergistically with chlorine. According to Larson, et al. (Reference 5.3.3-2), little is known about the acute or chronic toxicity of organic chloramines as well as other chemical species present in blowdown. These authors state that much work needs to be done to determine the occurrence of different forms of residual chlorines and their effect on aquatic organisms. Regardless, the acute toxic effects, if any, of SHNPP blowdown should be limited to the immediate discharge area.

The chlorine content of the cooling tower blowdown will have little or no effect on the fish community outside the mixing zone. The chlorine discharged will be diluted below acceptable levels within the mixing zone and will not be detrimental to the remainder of the reservoir (Reference 5.3.3-3).

Overall, the impact of chlorine blowdown on the aquatic communities existing in the reservoir will be minimal and is expected to be restricted to the immediate discharge area of the reservoir. The discharge location and design is expected to minimize the effect of blowdown on aquatic communities inhabiting the reservoir.

5.3.4 BIOLOGICAL EFFECTS OF CHEMICAL DISCHARGE

The chemicals listed in Section 3.6 represent only the known substances that will be used, but other chemicals may be used in amounts that will later be determined by station operation. The impacts and effect of these chemicals cannot be assessed at this time but must be assessed if additional chemicals are used at a later date in plant operations. All of the chemicals listed in Section 3.6 in plant operations meet North Carolina water standards except possibly for iron which is predicted to exceed the 1 mg/l limit. Most of this iron will be due to natural inputs and not due to plant operation, and therefore the amounts added by the plant will be minimal and have very little impact on the aquatic biota.

Although no North Carolina standards are set for nitrogen and phosphorus in Class C water, there will be an impact on the reservoir chemistry and biota by these nutrients. The estimated natural loading of nitrogen and phosphorus in

1978 was 22,000 kg (48,500 lbs) and 5080 kg (11,200 lbs), respectively. This was due to natural concentrations in the Buckhorn watershed creeks.

The evidence for probable eutrophication, based on models from other lakes, would suggest the potential for the Main Reservoir to become eutrophic due to natural loading of nutrients. The operation of the plant will accelerate the eutrophication process. The fishing potential should be good except that fish kills may occur if oxygen depletion due to algal respiration or bloom die-offs occurs.

The quantities of dissolved solids are expected to be below the threshold for significant biological impacts. Rapid variations of concentration toward either more or less concentration are not expected. The Main Reservoir is classified by North Carolina as Class C. The concentrations of chemicals in the SHNPP Cooling Tower Blowdown System after discharging to the Main Reservoir are such that the North Carolina standards for Class C waters are met. The "Best Usage" of Class C waters is fish and wildlife propagation, secondary recreation, agriculture, and other uses requiring waters of lower quality.

REFERENCES: SECTION 5.3

5.3.3-1 Dickson, Kenneth L., Albert C. Hendricks, John S. Crossman, and John Cairns, Jr. Effects of Intermittently Chlorinated Cooling Tower Blowdown on Fish and Vertebrates. Env. Sci. & Tech. 8: 845-849. 1974.

5.3.3-2 Larson, Gary L., V. L. Snoeyiek and F. I. Markus. Toxicity of Residual Chlorine Compounds to Aquatic Organisms. EPA Ecological Research Series 600/3-78-023. 1978. 1

5.3.3-3 Hogarth, William T. Testimony Before the Atomic Safety & Licensing Board in the Matter of Carolina Power & Light Company (Shearon Harris Nuclear Power Plant Units 1, 2, 3, and 4). September 5, 1977.

5.4 EFFECTS OF SANITARY WASTE DISCHARGES

After a thorough evaluation of the receiving water (Harris Reservoir), the State of North Carolina has issued a National Pollutant Discharge Elimination System (NPDES) Permit authorizing, in part, sanitary waste discharges from SHNPP. The NPDES Permit requires compliance with specified effluent standards that are consistent with secondary treatment as shown in the following table:

Discharge Limitation Associated with Degree of Treatment

Effluent Characteristic	Secondary	
	Daily Avg.	Daily Max.
BOD	*30 mg/l	*45 mg/l
TSS	*30 mg/l	*45 mg/l
OIL and GREASE	*15 mg/l	*20 mg/l

*This represents the standard specified in the NPDES permit for SHNPP.

There is no effluent standard for nitrogen or phosphorous discharges from sanitary wastes.

It is apparent from the requirements of the NPDES permit that the impact to the water quality of the Harris Reservoir from the discharge of sanitary wastes will be minimal. This is supported by the issuance of an effluent standard based permit which indicates that the receiving water is not a water quality limited body.

As an illustrative example of the minimal impact of the sanitary waste discharge to the Harris Reservoir water quality, a calculation was made to estimate the mixing zone required for the maximum effluent BOD_5 concentration of 45 mg/l to reach the natural assumed BOD_5 concentration of 5 mg/l. Assuming a mixing depth of 5 feet, an effluent flow rate of 0.05 MGD, and a mixing time of one day, it is estimated that an area of less than 0.5 acre would be required. With a total surface area of approximately 4000 acres, it is clear from this conservative calculation that the sanitary waste discharge will have minimal impact to the integrity of the water quality in Harris Reservoir.

5.5 EFFECTS OF OPERATION AND MAINTENANCE

Information presented in Section 3.11.9.3 of the SHNPP Construction Permit Environmental Report requires no updating except for the exclusion of all remarks regarding 500 kV transmission lines and the Harris-Method 230 kV Line has been shortened and renamed the Harris-Cary Switching Line as discussed in Section 3.9. Any questions concerning an Erosion Control Plan for the Harris-Harnett Line are no longer relevant since that line will not exist. 3

5.6 OTHER EFFECTS

5.6.1 NOISE

The SHNPP will produce noise during normal operation. The plant's predicted environmental noise emission will have little impact on the residents living at or near the plant boundary. The methods of predicting the noise emission and the associated community reaction to this noise are taken from the Edison Electric Institute's Power Plant Environmental Noise Guide (Reference 5.6.1-1). The Noise Guide incorporates EPA and HUD concepts on community noise impact (References 5.6.1-2, 5.6.1-3).

5.6.2 PLANT NOISE EMISSION PREDICTION

State-of-the-art techniques were used to predict the noise levels which will be produced during full operation of the plant. Each significant sound producing component of the plant was identified. The sound intensity, usage factor, and directivity of the sound sources were considered for each of the sound producing components. This analysis yielded a list of eight major noise producing components. This list is shown in Table 5.6.2-1.

Octave band sound energy levels were developed for each of the eight major noise sources at the plant. For the purpose of predicting off-site noise emissions, the plant was treated as a single source point. This is possible due to the geometric symmetry of the plant. Correction factors due to distance from source to receiver, including hemispheric spreading, air molecular absorption, and anomolous excess attenuation were applied. The sound level emissions produced by the major plant noise sources are greatly reduced at the plant boundary due to these distance correction factors. Table 5.6.2-3 shows the "distance term" for various distances from a noise source. This term is used in the following equation to calculate the noise attenuation due to distance:

$$L_p = L_w - DT \quad \text{, where}$$ 4

L_p = sound pressure level at distance (d) from the noise source,

L_w = sound power level of the noise source, and

DT = Distance Term for distance (d).

Table 5.6.2-2 shows the estimated sound pressure level at each of the seven locations which result from the operation of the SHNPP.

5.6.3 COMMUNITY REACTION TO PLANT NOISE

A Composite Noise Rating (CNR) system is presented by the Noise Guide as the earliest, widely accepted procedure for evaluating the annoyance of environmental noise. The CNR system uses subjective and objective factors in predicting community reaction to environmental noise. These factors include the intensity of the new noise in the community, the existing background noise levels in the community, temporal and spectral characteristics of the new noise, and previous community noise exposure. The Noise Guide adds to the CNR by including considerations of low frequency noise impact and community attitudes toward the noise source. This Modified Composite Noise Rating (MCNR) is used to predict the community reaction to SHNPP noise emissions at seven sites near the plant boundary. These sites are representative of the communities and terrain surrounding the plant.

A community noise survey was conducted at each of the seven sites. The method and complete results of these surveys are shown in Section 2.7.2.

Table 5.6.2-2 shows the background noise levels and the predicted noise levels at the sites resulting from the operation of the SHNPP. The background noise levels and the predicted noise levels are used in the MCNR along with correction factors to predict the expected community reaction to SHNPP noise emissions. The following three groups of correction factors were considered in predicting community reactions.

a) Temporal and Seasonal Factor - The noise produced by the plant will not be intermittent. It will be produced throughout all seasons of the year and during both the day and night hours. No corrections to the MCNR are needed due to this continuous operation. Noise produced in the daytime only or during the winter only could decrease adverse reactions in the communities.

b) Spectral Character of the Noise - The noise produced by the plant does not contain tonal components, impulsive sounds, or very low frequency sounds. The absence of these types of sound indicates that no correction to the MCNR is needed. The presence of these types of sound could increase adverse reactions in the communities.

c) Previous Noise Exposure and Community Attitudes - The communities near the SHNPP have experienced some previous noise exposure. The local attitudes toward the plant range from non-committal to positive. Therefore, no correction to the MCNR is needed. No prior noise exposure or poor community relations could increase adverse community reactions. Considerable previous noise exposure could decrease community reactions.

The MCNR system uses a chart to predict community reaction to environmental noise. This chart is shown in Figure 5.6.3-1. The noise level rank used in this chart is derived by plotting the octave band sound pressure levels created by the plant noise emissions onto a subdivided grid shown in Figure 5.6.3-2. The highest zone into which the spectrum protrudes is designated as the noise level rank. When all correction factors have been considered, the resulting noise level rating is plotted on Figure 5.6.3-1. The average community reaction is predicted by following the point of the noise level rating to the line of average expected response. The expected community response is then read at the left side of the chart. The average community reactions for each of the seven sites are shown in Table 5.6.2-2.

REFERENCES SECTION 5.6

5.6.1-1 Edison Electric Institute, "Electric Power Plant Environmental Noise Guide," 1978.

5.6.1-2 U. S. Environmental Protection Agency, "Information on Levels of Environmental Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety," 550/9-74-004, U. S. Government Printing Office, Washington, D. C., 1974.

5.6.1-3 U. S. Department of Housing and Urban Development, "Noise Abatement and Control: Department Policy, Implementation, Responsibilities and Standards," Circular 1390.2, 1971.

TABLE 5.6.2-1

MAJOR NOISE SOURCES AT SHNPP

Two cooling tower rims

Two condensers

Four steam generator feed pump motors 2

Two turbine generator assemblies

Two cooling tower stacks

Six 336 MVA transformers

Four deaerator vents

Four steam generator feed pumps

TABLE 5.6.2-2

PREDICTED COMMUNITY REACTION TO SHNPP NOISE EMISSIONS

Receiver Point[1]	Background Noise Level	SHNPP Noise Emission Level	Predicted Total Noise Level	Average Expected Community Response
	dB(A)	dB(A)	dB(A)	
A	33.8	25.8	34.4	No reaction
B	29.9	28.5	32.2	Sporadic Complaints
C	38.3	25.9	38.5	No reaction
D	27.8	28.5	31.1	Sporadic Complaints
E	26.3	18.7	27.0	Sporadic Complaints
F	27.5	21.2	28.4	Sporadic Complaints
G	33.8	23.7	34.2	No reaction

4

[1] See Section 2.7.2

TABLE 5.6.2-3

"DISTANCE TERM" FOR CALCULATING SOUND PRESSURE LEVEL AT DISTANCES OF 1 M TO 5000 M FROM A SOUND SOURCE.

Includes hemispherical spreading, molecular absorption, and anomalous excess attenuation. Based on standard day conditions.

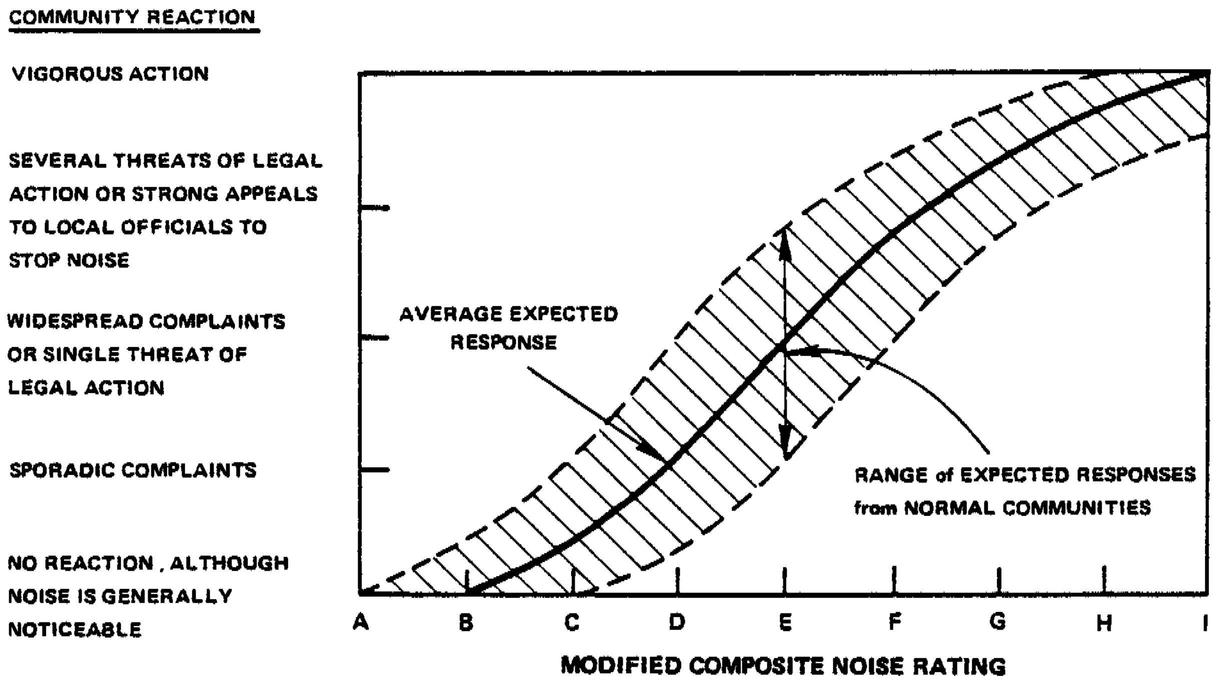
Distance m	"Distance Term" (in dB) by Octave Frequency Band (Hz)								
	31	63	125	250	500	1000	2000	4000	8000
1.0	8	8	8	8	8	8	8	8	8
1.3	10	10	10	10	10	10	10	10	10
1.6	12	12	12	12	12	12	12	12	12
2	14	14	14	14	14	14	14	14	14
2.5	16	16	16	16	16	16	16	16	16
3.2	18	18	18	18	18	18	18	18	18
4	20	20	20	20	20	20	20	20	20
5	22	22	22	22	22	22	22	22	22
6.3	24	24	24	24	24	24	24	24	24
8	26	26	26	26	26	26	26	26	26
10	28	28	28	28	28	28	28	28	29
13	30	30	30	30	30	30	30	30	31
16	32	32	32	32	32	32	32	32	33
20	34	34	34	34	34	34	34	34	35
25	36	36	36	36	36	36	36	36	37
32	38	38	38	38	38	38	38	38	40
40	40	40	40	40	40	40	41	41	42
50	42	42	42	42	42	42	43	44	45
63	44	44	44	44	44	45	45	46	48
79	46	46	46	46	46	47	47	49	51
100	48	48	48	48	49	49	50	51	54
112	49	49	49	49	50	50	51	53	56
126	50	50	50	50	51	51	52	54	58
141	51	51	51	51	52	52	53	56	60
158	52	52	52	52	53	53	55	58	61
177	53	53	53	54	54	55	56	59	63
199	54	54	54	55	55	56	57	61	65
223	55	55	55	56	56	57	59	63	67
250	56	56	56	57	57	58	60	65	70
281	57	57	58	58	59	60	62	67	73
315	58	58	59	59	60	61	63	69	77
354	59	59	60	60	61	62	65	71	80
397	60	60	61	61	62	64	67	74	83
445	61	62	62	62	64	65	69	77	87
500	62	63	63	64	65	67	70	79	91
560	64	64	64	65	66	68	72	83	96
630	65	65	65	66	68	70	75	86	101
710	66	66	67	68	69	72	77	90	106
790	67	67	69	69	71	73	79	94	113
890	68	68	70	71	72	75	82	98	119
1000	69	69	71	72	74	78	85	103	126
1120	70	70	72	74	76	81	88	108	134
1260	71	72	74	75	77	83	91	114	142
1410	72	73	75	76	79	85	95	120	153
1580	74	74	76	78	81	88	99	128	164
1770	75	75	78	81	83	91	103	135	176
1990	76	77	79	82	86	94	108	143	190
2230	77	78	81	84	88	97	113	152	204
2500	78	79	83	86	91	101	118	163	222
2810	80	82	85	88	94	105	125	175	241
3150	81	83	87	90	97	109	131	187	261
3540	83	85	89	93	100	114	139	202	284
3970	84	86	91	96	104	119	148	219	312
4450	85	88	93	98	107	125	154	235	339
5000	87	90	96	102	111	131	167	256	372

From Reference 5.6.1-1

5.7 RESOURCES COMMITTED

The irreversible and irretrievable commitment of resources associated with the operation of the SHNPP is discussed in Section 7.0 of the SHNPP Construction 4 Permit Environmental Report. Additionally, about 52 metric tons of U^{235} will be consumed over the 40-year life of the plant. This assumes a throwaway fuel cycle for the life of the plant.

Commitment of terrestrial and aquatic wildlife resources is limited to losses of individuals and local populations of some species. Losses will be restricted to relatively small numbers in comparison to total numbers of individuals of affected species in both the immediate area and neighboring regions. No individual species will be eradicated, no identifiable impact on endangered or threatened species will occur, and no unique natural areas will be destroyed.



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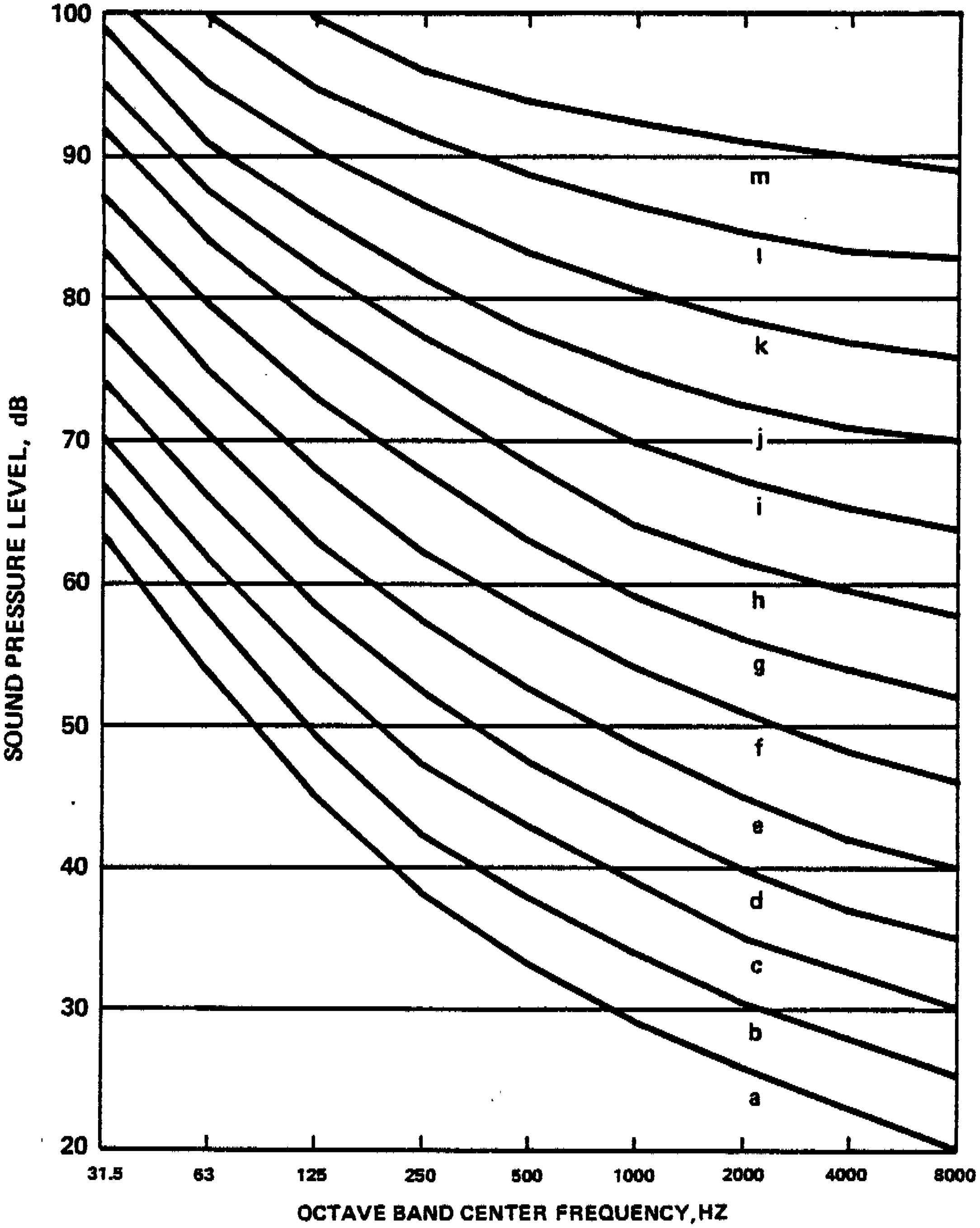
ESTIMATED COMMUNITY RESPONSE vs.
MODIFIED COMPOSITE NOISE RATING

FIGURE
5.6.3 - 1



SHEARON HARRIS NUCLEAR POWER PLANT Carolina Power & Light Company ENVIRONMENTAL REPORT	NOISE LEVEL RANK CURVES FOR MODIFIED CNR RATING SYSTEM	FIGURE 5.6.3-2

5.7 RESOURCES COMMITTED

The irreversible and irretrievable commitment of resources associated with the operation of the SHNPP is discussed in Section 7.0 of the SHNPP Construction Permit Environmental Report. Additionally, about 107 metric tons of U^{235} will be consumed over the 40-year life of the plant. This assumes a throwaway fuel cycle for the life of the plant.

Commitment of terrestrial and aquatic wildlife resources is limited to losses of individuals and local populations of some species. Losses will be restricted to relatively small numbers in comparison to total numbers of individuals of affected species in both the immediate area and neighboring regions. No individual species will be eradicated, no identifiable impact on endangered or threatened species will occur, and no unique natural areas will be destroyed.

5.8 DECOMMISSIONING AND DISMANTLING

Prior to decommissioning the SHNPP, CP&L will have the benefit of industry experience and technological improvements in future decommissioning. Before the end of the station's useful lifetime, CP&L will prepare a proposed decommissioning plan for review by the NRC. The plan will comply with NRC decommissioning rules and regulations then in effect.

5.8.1 DECOMMISSIONING ALTERNATIVES

While decommissioning will occur only after the termination of plant operation, it is expected that it will be accomplished through the application of one of the presently available alternative methods. The experience gained in the continued use of these methods and any developing variations for nuclear plant decommissionings in the interim years will further ensure the effectiveness of the SHNPP decommissioning.

Currently, three alternatives for decommissioning commercial nuclear power reactors have been considered in several studies (see References 5.8.1-1 and 5.8.1-2): safe storage with deferred dismantlement, permanent entombment, and immediate dismantlement. The major characteristics of each of these methods are described below:

Safe Storage with Deferred Dismantlement - Radioactive materials and contaminated areas are secured and structures and equipment are maintained as necessary to assure the protection of the public from the residual radioactivity. During the period of Safe Storage, the facility remains limited to nuclear uses. Dismantlement is deferred to allow the radioactivity within the station to decay to lower levels. Upon completion of dismantlement, the property is released for unrestricted use.

Permanent Entombment - The highly radioactive or contaminated components (e.g, the pressure vessel and internal components of the reactor) are sealed within a structure integral with the biological shield. All fuel assemblies, radioactive liquids and other wastes, and certain selected components would be shipped offsite. The sealing structure provides integrity over the period of time in which significant quantities of radioactivity remain with the material in the entombment. An appropriate and continuing surveillance program is utilized.

Immediate Dismantlement - Radioactive materials are removed and the station is disassembled and decontaminated during the four-year period following final cessation of power production operations. Upon completion, the property is released for unrestricted use.

Experience with decommissioning of civilian nuclear power reactors in the United States includes the shutdown or dismantling of several facilities. In these decommissionings some version of each of the three primary methods described above has been employed. The Carolina Virginia Tube Reactor and the Pathfinder Reactor decommissionings are examples of the safe storage (mothballing) method, while the Hallam Nuclear Power Facility, the Boiling Nuclear Superheater Power Station, and the Piqua Reactor decommissionings were of the entombment type. The Elk River Reactor decommissioning is most nearly exemplary of the application of the removal/dismantling technology. Although the sizes of the facilities decommissioned to date have been significantly smaller than SHNPP, the experience gained reinforces the conclusion that SHNPP can be decommissioned while protecting the health and safety of the public.

5.8.2 COST OF DECOMMISSIONING

Reference 5.8.1-1 provides an estimate of the costs for decommissioning using immediate dismantlement and safe storage with deferred dismantlement. These cost estimates are for a reference 1175 MW(e) station. Site specific estimates for other Carolina Power & Light Company operating nuclear plants
5 suggest that the cost for decommissioning SHNPP could be somewhat greater than the above referenced study predicts, but certainly within the same order of magnitude. The estimated decommissioning costs for the referenced study are summarized in Table 5.8.2-1. Immediate dismantling is estimated to require six years to complete, including two years of planning and preparation prior to final reactor shutdown, at a cost of $42 million. Preparations for safe storage are estimated to require about three years to complete, including 1-1/2 years for planning and preparation prior to final reactor shutdown, at a cost of $13 million. The cost of continuing care during the safe storage period was estimated to be $80,000 annually.

The cost of decommissioning by safe storage with deferred dismantlement is estimated to be slightly higher than immediate dismantlement. Cost reductions resulting from reduced volumes of radioactive material for disposal due to decay of the radioactive contaminants during the deferment period are offset by the accumulated costs of surveillance and maintenance during the safe storage period.

5.8.3 SAFETY IMPACT OF DECOMMISSIONING

Reference 5.8.1-1 evaluated the radiological and nonradiological safety impacts from normal decommissioning operations and potential accidents during the immediate dismantlement and safe storage decommissioning modes. The results of this evaluation are shown on Table 5.8.3-1. The principal radiation dose to the public is from the transportation of materials from the reactor station to disposal facilities. The estimated dose to the public resulting from decommissioning operations and from safe storage is extremely small.

Less than 5 lost-time injuries from industrial-type accidents are predicted to occur during the decommissioning effort, with one additional injury predicted to result from transportation operations. Essentially no fatalities are predicted to occur as a result of decommissioning operations, including transportation.

TABLE 5.8.2-1

TOTAL ESTIMATED COSTS FOR POSSIBLE DECOMMISSIONING CHOICES

Decommissioning Mode	Decommissioning Costs ($ millions)(a)(b) Number of Years After Reactor Shutdown Dismantlement is Deferred 0	10	30	50	100
Immediate Dismantlement	42.1	--	--	--	--
Preparations for Safe Storage	--	12.6	12.6	12.6	12.6
Continuing Care	--	0.6	2.2	3.7	7.8
Deferred Dismantlement	--	37.0	37.0	30.5(c)	30.4(c)
Total Decommissioning Cost	42.1	50.2	51.8	46.8	50.8

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(a) Values include a 25% contingency.

(b) Values are in constant 1978 dollars.

(c) These reduced values result from lesser amounts of contaminated materials for burial in a licensed disposal site.

TABLE 5.8.3-1

SUMMARY OF SAFETY ANALYSIS FOR DECOMMISSIONING THE REFERENCE PWR

Type of Safety Concern	Source of Safety Concern	Units	Immediate Dismantlement	Safe Storage with Deferred Dismantlement After			
				10 Years	30 Years	50 Years	100 Years
Public Safety[a]							
Radiation Exposure	Decommissioning Operations	man-rem	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	Transportation	man-rem	22	(c)	(c)	(c)	(c)
	Safe Storage	man-rem	--	neg.[b]	neg.[b]	neg.[b]	neg.[b]
Occupational Safety							
Serious Lost-time Injuries	Decommissioning Operations	total no.	4.0	4.9	4.9	4.9	4.9
	Transportation	total no.	1.1	1.2	1.2	1.2	1.2
	Safe Storage	total no.	--	0.96	1.2	1.4	1.9
Fatalities	Decommissioning Operations	total no.	0.029	0.029	0.029	0.029	0.029
	Transportation	total no.	0.068	0.075	0.075	0.075	0.075
	Safe Storage	total no.	--	0.00087	0.0026	0.0045	0.0087

TABLE 5.8.3-1 (cont'd)

SUMMARY OF SAFETY ANALYSIS FOR DECOMMISSIONING THE REFERENCE PWR

Type of Safety Concern	Source of Safety Concern	Units	Immediate Dismantlement	Safe Storage with Deferred Dismantlement After			
				10 Years	30 Years	50 Years	100 Years
Occupational Safety (cont'd)							
Radiation Exposure	Decommissioning Operations	man-rem	1200	760	460	440	430
	Transportation	man-rem	100	(c)	(c)	(c)	(c)
	Safe Storage	man-rem	--	10	14	14	14

(a) Radiation doses from postulated accidents are not included.

(b) neg. = negligible. Radiation doses to the public from normal continuing care activities were not analyzed in detail, but are expected to be significantly smaller than those from decommissioning operations.

(c) Not estimated.

REFERENCES: SECTION 5.8

5.8.1-1 R. I. Smith, G. J. Konzek, and W. E. Kennedy, Jr. *Technology, Safety and Costs of Decommissioning a Reference Pressurized Water Reactor Power Station*, Report of U. S. Nuclear Regulatory Commission by Battelle, Pacific Northwest Laboratory, NUREG/CR-0130, June 1978.

5.8.1-2 Atomic Industrial Forum, "An Engineering Evaluation of Nuclear Power Reactor Decommissioning Alternatives," AIF/NESP-009, AIF. Washington, D. C. 1976.

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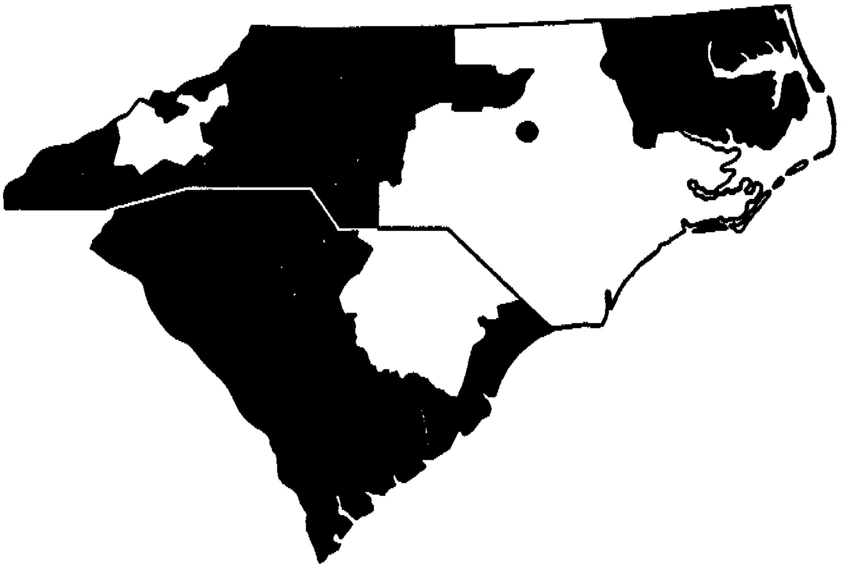

Environmental Report Operating License Stage

Carolina Power & Light Company

CHAPTER 6
EFFLUENT AND ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS

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CHAPTER 6
EFFLUENT AND ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS

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6.0 EFFLUENT AND ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS

6.1 APPLICANT'S PREOPERATIONAL ENVIRONMENTAL PROGRAMS

6.1.1 SURFACE WATER

6.1.1.1 Physical and Chemical Parameters

Baseline, pre-construction and construction phase physical and water chemistry sampling programs conducted at the SHNPP site are described in detail in References 6.1.1-1 and 6.1.1-2. During each month sampled, water chemistry samples were collected from at least six stream stations and two Cape Fear River stations, one above Buckhorn Creek and one below. Samples were collected for baseline studies on a monthly basis from February 1972 to June 1975. During subsequent pre-construction monitoring, sampling occurred in December 1975, June 1976, and February, June, and December 1977. Monthly sampling was reinitiated in February 1978 for construction phase monitoring.

Laboratory analyses included the determination of concentrations of solids, nutrients, and metals, as well as other water quality characteristics such as pH, alkalinity, hardness, and conductivity. Water temperature, dissolved oxygen, and pH were recorded in the field.

Analyses were performed by Southern Testing and Research Laboratories, Inc. (ST & RL) or by the CP&L Analytical Chemistry Laboratory. Methods used by ST & RL followed procedures of the Association of Official Agriculture Chemists. Methods used by the CP&L Laboratory followed procedures published by the U.S. Environmental Protection Agency (Reference 6.1.1-3), the American Public Health Association (References 6.1.1-4, 5) and the American Society for Testing and Materials (References 6.1.1-6, 7, 8).

6.1.1.2 Ecological Parameters

Studies designed to evaluate the environmental impact of construction and operation of the SHNPP began in 1972 with baseline biological surveys by Aquatic Control, Inc. These studies included quarterly sampling of fish, benthos, and plankton at several stream and river stations. The sampling program included seine and electrofishing sampling for fish, Surber and Ekman sampling for benthos and net plankton sampling. Details of the program are given in References 6.1.1-9, 10, 11.

In 1975, CP&L personnel assumed responsibility for conducting the pre-construction monitoring program and continued quarterly sampling at three creek and four river stations until 1976, when semiannual sampling was initiated. The CP&L sampling program (Reference 6.1.1-12) included electrofisher and hoop net sampling for fish, artificial substrate and Petite ponar sampling for benthos, and periphytometer and net sampling for plankton. In 1978, quarterly sampling began again with initiation of the construction monitoring program at seven creek and two river stations. The same sampling methods were used as in the pre-construction program.

Algae were identified to the lowest practicable taxa by using suitable taxonomic keys. Taxonomic experts were consulted if any questions on methodology or identifications occurred. Aliquots of samples (as well as permanent diatom slides) were retained for reference. Numerical abundance and species composition of algal organisms were calculated. The data were compared among stations and years in order to monitor any effects that environmental perturbations may have caused. These comparisons also were used to observe natural temporal and spatial variability in the ecosystem.

Benthic macroinvertebrates collected during these studies were identified to the lowest practicable taxa with the aid of suitable taxonomic keys. Selected organisms collected during the SHNPP study are maintained in the CP&L benthic reference collection. When necessary, benthic organisms were sent to benthic macroinvertebrate experts for verification of organism identification. Variations in benthic community distribution or organism abundance were reflected in species presence or absence and relative abundance comparisons.

The collected fishes were identified to the lowest practicable taxa by using applicable taxonomic keys and range distributions. Species that had questionable identifications were sent to fisheries taxonomic experts for verification. A reference collection of the fishes collected on the SHNPP site is maintained. The collection is continually updated and replenished to ensure that good quality specimens are available for reference. When possible, a size range for each species is maintained. By the use of species diversity indices, similarity comparisons, and equitability formulae, as well as general species and abundance comparisons over the years, important characteristics and variations of the fisheries communities of the area were observed.

6.1.2 GROUNDWATER

Groundwater is being utilized at the site during the construction phase for: (1) concrete batch plant and concrete placement; (2) office and plant use; and (3) grouting. Groundwater levels are being monitored periodically at the plant island in 16 piezometers and 18 wells. The site wells can provide samples for analysis of the groundwater in the event of inadvertant radioactive spills. 4

6.1.2.1 Physical and Chemical Parameters

The site area is underlain by Triassic rocks which are the only source of groundwater at the Plant site. The Triassic rocks are overlain by a thin overburden of clayey soils and saprolite. A detailed geological investigation was conducted in connection with the site fault. This investigation included the excavation of trenches, borings, geophysical investigations, and geological mapping (Reference 2.4.3-2). Results of the site geological investigation, as well as site wells and borings, provide information regarding the nature and configuration of the Triassic rocks.

Groundwater levels were measured in site piezometers at the Preliminary Safety Analysis Report stage. However, most of these peizometers were lost due to construction activities. Therefore, 16 new piezometers were installed in November, 1979. Water levels in 15 of these piezometers, in site wells, and in two pre-construction piezometers, are being measured periodically to obtain the spatial and themporal variations in groundwater levels. 4

Water samples from the site wells were analyzed to obtain baseline water quality information. The samples were analyzed by the North Carolina Board of Health, which employs standard analytical techniques (Table 2.4.3-7).

6.1.2.2 Models

Section 2.4.3 was prepared using a qualitative assessment supported by a preliminary quantitative analysis of groundwater in the vicinity of SHNPP. Additional data is being developed to monitor additional changes in the site groundwater regime. The model used in predicting groundwater flows follows the basic methods using Darcy's law and conversion of Darcy velocities to seepage velocities using aquifer porosity (Reference 6.1.2-1).

6.1.3 AIR

6.1.3.1 METEOROLOGY

Collection of SHNPP onsite meteorological data began in March 1973. A 225-foot guyed, open latticed tower supports the 10-meter and 60-meter levels of instrumentation. Wind direction, wind speed, wind variance (sigma theta), and dewpoint temperatures are collected at both levels. Ambient temperature is measured at the lower 10-meter level. The differential temperature between the 10-meter and 60-meter levels is measured by twin, redundant delta temperature systems operating simultaneously. Solar radiation and precipitation are collected near ground level. The wind sensors are mounted on 12-foot booms oriented perpendicular to the general NE-SW prevailing wind flow to minimize tower shadow effects. Temperature probes and the lithium chloride dewpoint sensor are housed in Climet aspirated shields mounted on 8-foot booms. A complete specification of major system component operating conditions is presented in Table 6.1.3-1; component manufacturer model numbers may be found in Table 6.1.3-2. Operational sensor accuracy are presented in Table 6.1.3-3 and sensor elevations are found in Table 6.1.3-4.

The meteorological tower is located 1.1 miles northeast of the reactor complex, with the base of the tower at the finished plant grade level of 260 ft. above msl. A topographical map showing the meteorological tower with respect to the reactor complex is given in Figure 2.1.1-2.

6.1.3.1.1 Equipment

An environmentally controlled shelter, housing recording instruments, signal conditioning devices, and remote data access equipment is located about 40 ft. northwest of the tower, perpendicular to the prevailing wind flow to minimize air trajectory deviations. A complete illustration of the meteorological facility layout is presented in Figure 6.1.3-1.

The Westinghouse Environmental Monitoring System was the primary data collection system until January, 1979. This system converts sensor outputs to a proportional number of pulses that are electronically integrated and recorded on magnetic tape in 15-minute averaging periods. A direct readout of all parameters is possible through the use of test jacks for each parameter and a pulse test counter. This pulse test counter sums the pulses produced in a specific time interval. The number of pulses can be converted to engineering units by use of a linear relationship of the form $y = mx+b$.

Esterline Angus Twin Strip Chart Recorders are used for providing an analog record of the upper and lower level wind direction and speed to back up the Westinghouse System. In addition, upper and lower level wind speed and direction, differential temperature (both systems), and ambient temperature parameters are telemetered to the CP&L general office on an hourly basis via telephone lines to the site, giving the capability of detecting malfunctions of these parameters.

Beginning in January 1979, a modified data collection system became operational at the SHNPP meteorological site. The sensors employed and their specification remain the same as previously outlined in Table 6.1.3-1 through

6.1.3-4. The primary component of the modified data collection system is a Monitor Labs (ML) 9300 data logger located at the meteorological site. Climatronics translator cards are used to convert precipitation sensor pulses, temperature and differential temperature sensor milliamps, and lithium chloride dewpoint sensor resistance to the 0-5 volt range for input to the data logger. Remote site data storage is accomplished by interfacing the ML 9300 to a Techtran Model 9512 Micro Disc (floppy disc).

The ML 9300 scans all sensor inputs except precipitation each ten seconds. The precipitation input is converted to a constant voltage proportional to the amount of precipitation. This precipitation voltage is then input to the ML 9300 and scanned once each 15 minutes. All inputs are digitized, converted to engineering units and averaged for 15-minutes by the ML 9300. These 15-minute averages are then output to the Techtran 9512 Micro Disc for storage. The average is considered valid if at least 60 of the ten-second instantaneous scans (ten minutes) were collected during a 15-minute averaging period.

A Harris S125 minicomputer located at the CP&L general offices in Raleigh is utilized to access data from the Techtran Micro-Disc located at the SHNPP meteorological site. The S125 minicomputer automatically calls the Techtran Model 9512 once per day to retrieve the data and store it on magnetic tapes in Raleigh for further use in diffusion analysis.

The total system accuracy is a combination of the individual component error contributed from the sensor, processor card and ML 9300 data logger. Two types of errors are present:

Type I — Absolute error-random. Errors in this category are sensor and processor errors which include other "noise" sources. Sensor and processor errors are generally assumed to be dependent, in the absence of direct evidence of independence.

Type II — Absolute error-systematic. Errors in this category are of the "calibration" type and are expected to be steady over each averaging period. The digital data logger errors are treated as Type II.

The error contribution of Monitor Labs 9300 data logger is equal to ±0.02 percent per Reading, ± 0.01 percent over the Range and +1 Digit.

In this system, the "Reading" is the full scale value; the "Range" is the maximum ±12 volt range permitted; the "±1 Digit" is equal to 0.0001 volt, approximately the analog to digital converter resolution. Thus, the error due to the digital data logger alone is as follows:

Reading (5V)(±0.0002) = ±0.0010V

Range (12V)(±0.0001) = ±0.0012V

±1 Digit 1 part in 12,000 = ±0.0001V

Taking the square root of the sum of squares will yield the following data logger error:

$$\text{Data logger error} = \sqrt{(\pm 0.0010V)^2 + (\pm 0.0012V)^2 + (\pm 0.0001V)^2} = 0.0016V$$

Then for the wind speed parameter as an example, the digital data logger error for the sensor having a range of 0 to 100 mph corresponding to 0 to 5 volts, is:

$$\begin{aligned}\text{Data logger error (wind speed)} &= (100\ \text{mph}/5\ \text{volts})\ (0.0016\ \text{volts}) \\ &= 0.032\ \text{mph}.\end{aligned}$$

Calculations for the total composite digital system errors for a 15-minute averaging period are outlined in Table 6.1.3-5.

The Westinghouse system remains operational and is used in a backup capacity, as are the strip charts for the upper and lower wind speed and direction.

6.1.3.1.2 Data Analysis

The Westinghouse system magnetic tape cassettes are changed and brought back to the general office once per month for translating. Computer programs convert all parameter pulses into engineering units. The data is then reviewed and checked for consistency with the onsite strip charts and United States Weather Service data at the Raleigh-Durham Airport. The finished data is then stored on magnetic history tapes. Routine computer outputs from this data include:

a) Monthly Data Summaries listing maximum temperature, minimum temperature, average temperature, barometric pressure, precipitation, solar radiation, and upper level and lower level dewpoint temperature as a daily average and monthly average.

b) Hourly averages of precipitation, barometric pressure, ambient temperature, differential temperature, upper and lower level dewpoint, upper and lower level wind direction and wind speed, upper and lower level variance (sigma theta), pasquill stability classes as outlined in Regulatory Guide 1.23 computed from the average of the two delta temperature systems, and accumulated solar radiation (langleys/minute).

c) The 15-minute averages of both upper level and lower level wind direction, speed, and sigma theta, barometric pressure, and accumulated solar radiation.

d) Joint wind frequency distributions by stability class and speed class as outlined in Regulatory Guide 1.23 for both upper and lower levels showing average wind speeds, and number of bad data hours.

The data collected by the ML 9300 is stored in engineering units on history tapes at the CP&L general offices in Raleigh.

Computer output information on this system is incomplete at this time.

The analog strip charts are changed twice per month. They are used as backup material to provide checks on the other systems and to provide consistency of data.

6.1.3.1.3 Quality Control and System Maintenance

An onsite maintenance and calibration program was initiated in January 1976. Scheduled calibrations are carried out on a semi-annual basis such that:

a) All wind systems are changed out and replaced with NBS traceable calibrated wind sensors per Regulatory Guide 1.23.

b) All ambient and differential temperature systems are changed out and replaced with NBS traceable calibrated systems per Regulatory Guide 1.23.

c) The lithium chloride bobbin is changed in this dewpoint sensor.

d) The Cambridge dewpoint systems are changed out.

e) Calibrations of the barometric pressure, solar radiation, and precipitation systems are verified (sensors are changed out on an annual basis).

f) All other onsite equipment is calibrated or has its calibration verified.

In addition to the scheduled semi-annual calibrations, interim electronic checks are performed at six-week intervals. A further enhancement of data recovery is achieved by operating twin, redundant delta temperature systems simultaneously, side by side. Comparison of the two systems on a real time basis through the hourly data (received at our general offices) gives the capabilities to detect discrepancies in either system, usually within 24 hours (except weekends).

6.1.3.2 Model

Two different types of diffusion models were used for estimating the relative concentration (χ/Q) referenced in this report. Relative concentrations which would occur during periods of up to 26 days following a theoretical accident are calculated with the short-term average model. The long-term model is used to estimate annual average χ/Q values.

6.1.3.2.1 Short-Term (Accident) Diffusion Model

Short-term relative concentrations were calculated for this project using hourly onsite meteorological data for the three years between January 16, 1976, and December 31, 1978, and were performed in accordance with the criteria provided in Draft NRC Regulatory Guide 1.XXX, "Atmospheric Dispersion Models for potential Accident Consequence Assessments at Nuclear Power Plants", September 30, 1977. Design basis accident χ/Q's are calculated using one of the following three formulae:

a) During conditions of neutral (D) and stable (E, F, and G) stability when the wind velocity at the 10-meter level is less than 6 m/sec., credit for horizontal plume meander was considered by determining χ/Q using equation (1). This value was used if it was less than the higher of the χ/Q values obtained using equations (2) or (3). 3

$$\frac{\bar{\chi}}{Q} = \frac{1}{u_{10}\pi\Sigma_y\sigma_z} \qquad \text{(Equation 1)}$$

$$\frac{\bar{\chi}}{Q} = \frac{1}{u_{10}\,(\pi\sigma_y\sigma_z + A/2)} \qquad \text{(Equation 2)}$$

$$\frac{\bar{\chi}}{Q} = \frac{1}{u_{10}\,(3\pi\,\sigma_y\sigma_z)} \qquad \text{(Equation 3)}$$

where:

χ/Q = the relative concentration (sec./m^3) at ground level

π = 3.14159

u_{10} = the wind speed (m/sec.) at ten meters above ground grade.

Σy = the lateral plume spread (m), at a function of atmospheric stability, wind speed u_{10} and downwind distance from release. For distances to 800 meters, $\Sigma_y = M\sigma_y$ with M being a function of atmospheric stability and wind speed (see Figure 6.1.3-2). For distances greater than 800 meters, $\Sigma_y = (M-1)\,\sigma_{y\ 800m} + \sigma_y$. 3

σ_y = the lateral plume spread (m), a function of atmospheric stability and distance, (Figure 6.1.3-3).

σ_z = the vertical plume spread (m), a function of atmospheric stability and distance, (Figure 6.1.3-4) and,

A = the smallest vertical plane, cross-sectional area (m^2) of the building from which the effluent is released.

3

b) During all other atmospheric stability and/or wind speed conditions, χ/Q is the greater value calculated from either Equation 2 or 3.

The average χ/Q values were calculated for appropriate time periods during the course of the postulated accident as described below. The time periods for averaging were represented by intra-diurnal, diurnal and synoptic meteorological regimes (e.g., 8 and 16 hours and 3 and 26 days as presented in Section 2.3.4 of Regulatory Guide 1.70). The χ/Q value for each appropriate time period at the distance of interest for each cardinal direction sector was obtained by a logarithmic interpolation between the calculated value that was selected using the procedure described below, assumed as a "2-hour" value, and the annual average (8760-hour) value at the distance of interest in that direction sector. The annual average χ/Q value was calculated using the method described in Section 6.1.3.2.2.

In order to allow for changes in airflow trajectory, plume segmentation (particularly in light wind, stable conditions), wind speed and direction frequency variations from year to year, the following procedure was used to determine the distance at which the calculations of atmospheric dilution (χ/Q) were made.

For each of the 16 cardinal wind direction sectors, the distance to the exclusion area used for χ/Q computations at the minimum exclusion area boundary was the minimum distance from SHNPP plant center to the nearest point of the exclusion area boundary within a 45-degree sector centered on the compass direction of interest. Over those areas where the exclusion boundary was extended over the Main Reservoir, the distance for that sector was taken to be the distance over which the Company intends to have control.

To choose the correct χ/Q value to be used in the consequence assessment analyses, cumulative probability distributions of the χ/Q values, as determined from above at a specified distance were constructed for each of the 16 cardinal compass point directions (22-1/2 degree direction sectors). Each directional probability distribution was normalized to 100 percent. Since the joint frequency table data was used to calculate the χ/Q values, the cumulative probability distribution function was computed to envelope the data points.

The effective probability level (P_e) for the selection of the χ/Q value in each direction sector was defined by the following equation:

$$P_e = \frac{P\ (N/n)}{S} \qquad \text{(Equation 4)}$$

where: P = Probability Level.

N = Total number of hours having wind and stability data in the meteorological data record.

n = Total number of hours having wind flow in the direction of interest

S = Total number of sectors (16).

For the realistic accident assessment χ/Q determination as described in Section 2.3.4 of Regulatory Guide 1.70, P should be selected as 50 percent.

Note that P_e can exceed 100 percent if n is sufficiently small. In those directions, the selection of a χ/Q value may be ignored unless the χ/Q values for that sector are very high when compared with χ/Q values of P_e in other direction sectors. For each assessment, the χ/Q values that are selected for the 16 directions are compared and the highest value is utilized.

Using the described procedure and the available onsite joint frequency data, χ/Q values were calculated using the Exclusion Area for the appropriate time periods. Results obtained from these calculations are presented in the SHNPP FSAR in Section 2.3.4.

6.1.3.2.2 Long-Term (Routine Operation) Diffusion Model Estimates

Onsite annual joint frequencies of wind direction, wind speed, and stability class for the lower level of wind sensors were determined from hourly averages of temperature differences between the two wind sensing levels. These parameters were used as input to a computerized Gaussian model which calculates annual average χ/Q values for distances to 50 miles from the SHNPP. The basic equation used in the diffusion model is:

$$(5) \quad \frac{\overline{\chi}(x,k)}{Q} = \frac{2.032}{x} RF_k(x) \sum_{ij} DEPL_{ijk}(x) \bullet DEC_i(x) \bullet f_{ijk} \left[\overline{u}_i \left(\sigma_{zj}^2(x) + \frac{D_z^2}{\pi}\right)^{1/2}\right]^{-1}$$

$$(6) \quad \frac{\overline{\chi}(x,k)}{Q} = \frac{2.032}{x} RF_k(x) \sum_{ij} DEPL_{ijk}(x) \bullet DEC_i(x) \bullet f_{ijk} \left(\sqrt{3}\ \overline{u}_i \sigma_{zj}(x)\right)^{-1}$$

where:

$\frac{\overline{\chi}(x,k)}{Q}$ = average effluent concentration normalized by source strength at distance x and direction k;

$\overline{u}_i$ = mid-point values of the ith wind speed class;

$\sigma_{zj}(x)$ = vertical (x) spread of effluent at distance x for jth stability class;

f_{ijk} = joint probability of the ith wind speed class, jth stability class, and kth wind direction;

x = downwind distance from release point or building;

$DEC_i(x)$ = reduction factor due to radioactive decay at distance x for the ith wind speed class;

$DEPL_{ijk}(x)$ = reduction factor due to plume depletion at distance x for the ith wind speed class, jth stability class, and kth wind direction;

$RF_k(x)$ = correction factor for air recirculation and stagnation at distance x and kth wind direction; and

D_z = the building height from which effluent is released which is used to describe the dilution due to the building wake, effect.

Equation 5 represents the maximum building wake dilution allowed; the computer code uses the higher value of (χ/Q) calculated from Equation 5.

The computer code used to generate the annual long-term values is the NRC program "XOQDOQ" described in NUREG-0324. The recirculation factors for an inland location are specified as input along with the exclusion boundary distances and the special points of interest.

The results obtained from these calculations are presented in the SHNPP FSAR in Section 2.3.5.

6.1.3.3 Operational Meteorological Monitoring Program

The operational phase of the onsite meteorological monitoring program will be basically a continuation of the preoperational program with certain modifications. The instrument modifications were made in 1979 and described in Section 6.1.3.1. Additionally, the meteorological information will be collected by the SHNPP Radiation Monitoring System (RMS) for display and utilization in the plant control room.

The RMS will be linked in parallel to the existing meteorological collection system and continuously transmit information on site weather conditions display and emergency response. The RMS system will store the onsite data for future reference, however it will not be used in report preparation, since the data will be unedited.

Meteorological data transmitted to CP&L's General Office in Raleigh will be periodically reviewed by the meteorological staff and posted to reflect deviations in instrumentation calibrations or other known anomalies. The edited meteorological data set will be transmitted to the RMS computer system onsite and used as the primary source of information in the generation of reports and analysis requiring onsite meteorological information.

The program will be continued during operation of the plant for the following reasons:

a) To enable the use of current data from the onsite monitoring system in making decisions concerning the environmental and radiological impact of plant operations.

b) To provide current data to be used as input for calculating radiological diffusion estimates to describe the effects of an accidental release of radioactive material into the atmosphere.

c) To provide data to be combined with that previously collected in order to continually update the onsite meteorological record used in the development of long-term radiological diffusion estimates for routine operations.

d) To provide a correlation between atmospheric diffusion conditions and the results of the environmental surveillance program.

TABLE 6.1.3-1

OPERATING CONDITIONS

Wind Sensor:	-40F to +120F, up to 100 percent relative humidity, up to 125 miles per hour wind speed
Temperature Sensors:	-50F to +130F
Aspirated Temperature Shields:	-60F to +150F
Honeywell Dew Point Sensor	-40F to +160F, 11 percent relative hunidity and above
Cambridge Dew Point System:	
Transmitter Unit:	-80F to +160F
Control Unit	-80F to +120F
Total Precipitation Sensor:	No Limitations
Solar Radiation Sensor	No Limitations
Barometric Pressure Sensor:	-30F to +170F, 0 - 90 percent relative humidity
Magnetic Tape Recording Packages:	-20F to +140F
Strip Chart Recorder:	+20F to +120F
Signal Converter: (transmuter)	-40F to +120F, 5 percent to 95 percent relative humidity
Telecoder^{R} (Encoder):	0F to +120F, 0 to 100 percent relative humidity at +77F to 104F without condensation

TABLE 6.1.3-2

MAJOR COMPONENTS

COMPONENT	MANUFACTURER	MODEL NUMBER
SENSORS:		
Wind Sensor	Meteorology Research, Inc.	1074-22
Single-Element Temperature Sensor	Rosemount	104ABG-1
Dual Element Temperature Sensor	Rosemount	104ABG-2
Dew Point Sensor	Honeywell	SSP029D021
Total Precipitation Sensor	Weathermeasure Corp.	P-511E
Solar Radiation Sensor	Eppley Laboratory, Inc.	8-48
Barometric Pressure Sensor	Rosemount	1105A9A1
Cambridge Dew Point Sensor (transmitter unit)	EG&G International, Inc.	110
SENSOR SUPPORT EQUIPMENT:		
Cambridge Dew Point Control Unit	EG&G International, Inc.	110-C1
Strip Chart Recorders for Wind Speed & Direction	Esterline Angus	E1102R
Aspirated Temperature Shield for Single-Element Temperature Sensor	Climet	016-1
Aspirated Temperature Shield for Dual-Element Temperature Sensor and Honeywell Dew Point Sensor	Climet	016-2

TABLE 6.1.3-3

COMPONENT ACCURACY

Wind Sensor:	
Wind Speed:	±0.4 mph or 1 percent of sensor reading, whichever is greater (1.0 mph maximum at 100 mph) 4
Wind Direction, 0 to 540 degrees	±5.4 degrees
Honeywell Dew Point Sensor:	±2F at or above 11 percent relative humidity
Cambridge Dew Point System:	±0.5F (error extreme) above a dew point of -20F (excluding readout instrumentation). Error extreme increases in approximately linear fashion to ±2 degrees at -80F.
Solar Radiation Sensor: (pyranometer)	±0.04 calories/square centimeter/minute (langleys)
Differential Temperature System:	±0.186F over ambient temperature range from -50 to +130F
Ambient Temperature System:	±.498F
Magnetic Tape Recorder:	±1 pulse per interval
Strip Chart Recorder:	±1 percent of full scale, Dir = 5.4 degrees, Speed = 1.0 mph
Total Precipitation Sensor:	±0.5 percent (calibrated at 0.5 in. per hour)
Barometric Pressure Sensor:	±0.006 of mercury. (Temperature effect: ±0.1 in. of mercury per 100 degrees of Fahrenheit operating temperature span.)

TABLE 6.1.3-4

SHNPP OPERATIONAL SENSOR ELEVATIONS

SENSORS	OPERATIONAL ELEVATIONS ABOVE TOWER BASE (METERS)
Wind	10 and 60
Honeywell Dew Point	10
Cambridge Dew Point	10 and 60
Solar Radiation	1.5
Differential Temperature	10 to 60
Precipitation	1.5
Barometric Pressure	1.5

TABLE 6.1.3-5

SHNPP MODIFIED DATA COLLECTION SYSTEM ERRORS

A. WIND SPEED (WS)

Type 1 Error	Scale 0-100 mph
a. Sensor: 0.4 mph or 1 percent, whichever is greater	1.0 mph
b. Processor: 0.5 percent of full scale	0.5 mph
Type 2 Error	
c. Data Logger:	0.032 mph

Digital System Error (WS, 15 min. ave.) = $\frac{(a+b)^2}{N-1} + C^2$

N = No. of samples per 15 minute average = 90

Digital System Error (WS, 15 minute average) = ... 0.162 mph

B. WIND DIRECTION (WD)

Type 1 Error	Scale 0 to 540 Degrees
a. Sensor	5.4 degrees
b. Processor: 0.5 percent of full scale	2.7 degrees
	2.7 degrees
Type 2 Error	
c. Data Logger	0.173 degrees

Digital System Error (WD, 15 minute average) = ...0.876 degrees

C. WIND VARIANCE (WV)

Type 1 Error	Scale 0 to 45 Degrees
a. Sensor	5.4 degrees
b. Processor: ±0.5 percent full scale	0.225 degrees
Type 2 Error	
c. Data Logger:	0.0144 degrees

Digital System Error (WV, 15 minute average) = ...0.596 degrees

TABLE 6.1.3-5 (Cont'd)

D. CAMBRIDGE DEW POINT SYSTEM

	Scale -40 to 120F
Type 1 Error	
a. Sensor System	0.5F
Type 2 Error	
b. Data Logger:	0.051F
Digital System Error (Cambridge DP, 15 minute average) = ...	0.074F

E. HONEYWELL DEW POINT SYSTEM

	Scale -50 to 100F
Type 1 Error	
a. Sensor	2.0F
b. Processor: 0.05 percent full scale	0.075F
Type 2 Error	
c. Data Logger:	0.048F
Digital System Error (Honeywell DP, 15 minute average) = ...	0.225F

F. DIFFERENTIAL TEMPERATURE (DT)

	Scale -10 to +15F
Type 1 Error	
a. Sensor	0.186F
b. Processor: .05 percent full scale	0.0125F
Type 2 Error	
c. Data Logger:	0.008F
Digital System Error (DT, 15 minute average) = ...	0.0225F

G. AMBIENT TEMPERATURE (T)

	Scale -50 to 130F
Type 1 Error	
a. Sensor	0.498F
b. Processor: 0.05 percent full scale	0.090F
Type 2 Error	
c. Data Logger:	0.0576F
Digital system Error (T, 15 minute average) = ...	0.0849F

TABLE 6.1.3-5 (Cont'd)

H. BAROMETRIC PRESSURE (BP)

Type 1 Error	Scale 28 to 32 in. Hg
a. Sensor: (at 70F, error = $V(0.006)^2+(0.1)^2$)	0.01 in. Hg
b. Processor: 0.5 percent of full scale	0.02 in. Hg
Type 2 Error	
c. Data Logger:	0.00128 in. Hg
Digital System Error (BP, 15 minute average) = ...	.0034 in. Hg

I. TOTAL PRECIPITATION (P)

Type 1 Error	Scale 0 to 1 in.
a. Sensor: 1 pulse per 0.01 in. of precipitation and 0.5 percent of full scale	0.0050 in.
b. Processor: ±0.05 percent full scale	0.0005 in.
Type 2 Error	
c. Data Logger:	0.00032 in.
Digital System Error (P, 1 sample per 15 minute period) = $(a+B)^2 + C^2 =$	0.0055 in.

J. SOLAR RADIATION

Type 1 Error	Scale 0 to 2 Langleys
a. Sensor	0.04 Langleys
b. Preamplifier: ±0.25 percent full scale	0.005 Langleys
c. Processor: ±0.05 percent full scale	0.001 Langleys
Type 2 Error	
d. Data Logger:	0.00064 Langleys
Digital System Error (Solar Radiation, 15 min. avg.) = ...	0.0049 Langleys

6.1.4 LAND

6.1.4.1 Geology and Soils

Information on geology and soils was obtained from exploration programs which were designed primarily to provide data for site feasibility studies and for site safety analysis. Detailed discussions of these exploration programs are included in Sections 2.5.1 and 2.5.6 of the Final Safety Analysis Report for SHNPP. The following is a brief summary of the relevant programs: 2

6.1.4.1.1 Preliminary Field Investigations

General - Preliminary field investigations were performed to evaluate the engineering geologic and seismologic characteristics of the site. The field exploration program consisted of:

a) an engineering geologic survey of the site and surrounding areas;

b) a test boring program;

c) a trench excavation program; and

d) a seismic refraction survey.

Engineering Geologic Survey - A comprehensive survey was conducted to identify the engineering geologic characteristics of the site and surrounding area. This investigation included a Brunton Compass survey and detailed inspections of: 1) rock cores from test borings; 2) surface features; 3) exposed road cuts, 4) excavated trenches, and 5) bedrock outcrops. 2

Geologic maps, literature, gravity survey data, aerial photographs, and topographic maps were examined. Representatives of local and state agencies, universities, and private organizations were interviewed to obtain engineering geologic data.

Geologic Borings - Numerous geologic borings were drilled to investigate the bedrock composition, orientation, and quality across the site. The locations of the borings included the proposed plant area and the axis of the Auxiliary Reservoir Dam and spillway. The location of these borings is shown on Figure 6.1.4-1.

Trench Excavation Program - Twelve thousand one hundred and twenty feet of trenching was performed at the site to supplement the information obtained from the bedrock. The locations of these trenches are shown on Figure 6.1.4-1. Portions of Trenches 1 and 2 are adjacent to the plant site. Trenches 3 and 4 are located on the auxiliary reservoir dam alignment.

Seismic Refraction Surveys - The seismic refraction surveys were performed along six seismic lines for a total length of approximately 5,000 linear feet. The purpose of these surveys was to determine the depth and configuration of the bedrock surface in the plant and Auxiliary Reservoir Dam areas. The locations of the seismic lines are shown on Figures 6.1.4-2, 6.1.4-3, and 6.1.4-4.

6.1.4.1.2 Design Subsurface Investigations

An extensive program of design subsurface investigations was conducted in order to evaluate foundation conditions for the plant and other structures such as dams, dikes, channels, roads, and railways, and to explore and sample potential borrow areas.

Foundation Borings and Excavations - Several hundred borings were drilled to evaluate foundation conditions for the power plant, the Main Reservoir Dam, the Auxiliary Reservoir Dam, the Auxiliary Reservoir Separating Dike, the Auxiliary Reservoir, the Emergency Service Water Intake and Discharge Channels, the Cooling Tower Make-up Water Intake Channel, other reservoir-related structures, and relocated highways and railroads. The locations of borings in the power plant vicinity are shown in Figures 6.1.4-1, 6.1.4-5, and 6.1.4-6. Locations of borings in the Main Reservoir Dam area are shown in Figures 6.1.4-7 and 6.1.4-8, and borehole locations in the Auxiliary Reservoir Dam area are shown in Figures 6.1.4-3 and 6.1.4-4.

Two test trenches were excavated in the foundation for the Auxiliary Reservoir Dam with a Case 580B backhoe for the purpose of obtaining undisturbed representative block samples of the dam's foundation soils. The location of the trenches, identified as TPA 1 and TPA2, are shown in Figure 6.1.4-3.

Borrow Area Borings and Test Pits - Uncased auger borings were drilled in three potential borrow areas in order to obtain 25 lb. bag samples of soil for laboratory investigations. Test pits were also excavated in each borrow area to obtain 300 lb. representative soil samples containing the proper proportion of the different types of soil observed in the pit. The locations of boreholes and test pits in Borrow Area Y are shown in Figure 6.1.4-2; those in Borrow Area Z are shown in Figure 6.1.4-3; and those in Borrow Area M in Figure 6.1.4-7.

Seismic Refraction Survey - A seismic refraction survey consisting of six survey lines was conducted along the Main Dam centerline and in the spillway area in order to determine depth to bedrock and general excavation conditions. The locations of these survey lines are shown in Figures 6.1.4-7 and 6.1.4-8.

6.1.4.2 Land Use and Demographic Surveys

The majority of the land use characteristics for the area immediately surrounding the plant (0 mi. to 5 mi.) were collected by actual on-site observations. Specific on-site surveys were documented as indicated by respective references throughout Section 2.1. Surveys were conducted as near to the tendering date of this report as was reasonably possible.

Where required, source literature and materials were used, as indicated by text references. An attempt was made to use the most current literature available. On occasion, personal communications were necessary to document data.

Data used for estimating population distribution within three miles of the
plant was compiled from an on-site house count survey. Numbers of individuals
residing in each house were estimated by using the average number of "persons
per household" for each respective township as reported in the *1980 Census of
Population and Housing* (Reference 6.1.4-1). Population distribution for the 1
area three to 50 miles was estimated by using methods described in the
Electric Power Research Institute's *Guidelines for Estimating Present and
Forecasting Future Population Distributions Surrounding Reactor Sites* (Draft
of a Standard) (Reference 6.1.4-2). All population estimates were based on
the *1980 Census of Population and Housing* (Reference 6.1.4-1), and population
projections were based on population growth patterns and projections, as 1
described in *Update North Carolina Population Projections* (Reference 6.1.4-3).

Age distributions for the mid-life of the first operational unit were
predicted by applying the percentages of the projected age distributions of
the United States population for the year 2008 to projected population of the 1
site area for the year 2008 (Reference 6.1.4-4). Use of the United States
population age distribution met criteria as specified in Appendix D of
Regulatory Guide 4.2, Revision 2.

6.1.4.3 Ecological Parameters (Terrestrial)

Preoperational programs used to determine the ecological characteristics of
the terrestrial biota of the SHNPP site are described briefly in Section 6.1 1
of the Revised Final Environmental Statement (Reference6.1.4-5). Detailed
descriptions of baseline programs are included in reports prepared by Aquatic
Control, Inc. (References 6.1.4-6, 7) and by CP&L (Reference 6.1.4-8).
Descriptions of construction phase monitoring are included in Reference
6.1.4-9 and 6.1.4-10. 1

Pre-operational programs included roadside bird surveys, small mammal trapping, gray squirrel leafnest surveys, gamebird call count surveys, quarter/method vegetation analysis, and qualitative observation of terrestrial flora and fauna throughout the SHNPP site. The gray squirrel leafnest surveys were performed annually for four years (1974-1977). The gamebird call count surveys were performed monthly from April through August during two consecutive years (1976 and 1977). All other surveys were performed quarterly except the quarter method vegetation analysis which was conducted biennially. Small mammal trapping was temporarily discontinued during 1976 and 1977 but was reinitiated in 1978.

Taxonomic identification of the plant and animal specimens observed during these programs were made by using standard taxonomic keys, field guides, and other scientific literature. Scientists and reference collections at North Carolina State University and the North Carolina State Museum of Natural History were consulted when positive identification of specimens was difficult or not conclusive.

Reference collections of representative specimens are maintained in the CP&L herbarium and terrestrial vertebrate collection. Some specimens collected by Aquatic Control, Inc. during the early phases of the baseline program were deposited in Ball State University collections at Muncie, Indiana.

6.1.5 RADIOLOGICAL MONITORING

The objectives of the Shearon Harris Nuclear Power Plant Environmental Monitoring Program are to: (1) measure exposure rates and radionuclide concentrations within the important exposure pathways to man in the plant environs, (2) determine and assess trends of radionuclide concentrations in the plant environs, and (3) provide data to support public reassurance that dose rates and radionuclide concentrations within transport pathways contribute only insignificant radiation exposure to the public. In general the environmental data serves to demonstrate that the mathematical models used to estimate population exposure generated by plant effluent releases are reasonable and that all significant transport pathways to man have been included in estimating the public exposure.

The program is conducted in two phases (preoperational and operational). The preoperational phase determines the pre-existing baseline data representative of the air, water, shoreline sediments, and other food chain components of the plant environs prior to fuel loading. The operational phase extends such determinations throughout the operating life of the plant. Direct comparisons of operational data to the baseline data provide information concerning the radiological impact of the operating plant on the environment.

External exposure to gaseous radioactive wastes and ingestion of radioactive contaminated food and water are the primary exposure pathways to man. The proposed monitoring program emphasizes sampling and analyzing environmental elements which include these pathways. The proposed sample types, locations, frequencies, and analyses are included in Table 6.1.5-1 in accordance with current guidance (Reference 6.1.5-1). This proposal is considerably different from the Construction Permit Environment Report and the Final Environmental Statement which was based on previous guidance policy (Reference 6.1.5-2).

6.1.5.1 Preoperational Phase

The preoperational phase of the program begins with gathering local and regional radiological data from existing literature. This information provides the initial guidance as to the existing radiological status of the environs. Such information is valuable in selection and design of the analytical elements of the program. Such data is presented in Tables 6.1.5-2, 6.1.5-3, 6.1.5-4, and 6.1.5-5.

The program is designed considering the major or significant transport pathways that will deliver a radiological dose to man during normal plant operations. The environmental sampling surveillance program accumulates data at various stages within each pathway. Existing data from these stages serve to indicate the desired sensitivity of the analytical procedures to facilitate a comparison of preoperational data to post-operational data.

The sampling for the preoperational program begins in graduated steps. The first field sampling is to be initiated two years prior to fuel loading. Table 6.1.5-6 outlines the schedule for the environmental monitoring program in this phase.

6.1.5.1.1 Background Radiological Characteristics

The background radiological characteristics of a site will vary as a function of time and location and will be due to natural background and manmade sources. Table 6.1.5-2 presents a summary of the exposures associated with some of the more significant sources of natural background and manmade exposures.

a) Natural Background (References 6.1.5-3, 6.1.5-4, and 6.1.5-5) - Natural background exposures consist of internal exposures from naturally occurring radionuclides incorporated into body tissues following ingestion or inhalation and external exposures from terrestrial and cosmic radiation.

The internal exposures are predominantly from radioactive potassium, K-40. These exposures vary slightly as a function of age and sex.

The exposures from terrestrial radiation are predominantly due to the radionuclides of the uranium and thorium natural decay series and K-40. The exposures from this source can vary greatly as a function of location because of the variability of the K-40, uranium and thorium content of different mineral formations. In addition, the exposures can change as a function of time at a given location. One of the major causes of this variability is the changing moisture content of the soil. Following a heavy rainfall, the high moisture content of the soil can act as a shield. On the other hand, the water can also act as a barrier to the natural diffusion of radon (Rn-222) and thoron (Rn-220) gas, resulting in their buildup in the soil and associated increase in the radiation field above the soil.

External exposure to cosmic radiation is due to galactic and solar radiation. Galactic radiation is composed predominantly of protons and alpha particles of uncertain extraterrestrial origin. These particles strike the atmosphere and produce secondary radiations which result in exposures. Solar radiation is due to the outward flux of charged particles from the surface of the sun. These particles are of relatively low energy and cannot penetrate the earth's magnetic field. However, large magnetic disturbances on the sun can result in solar flares and the release of highly energetic emissions which can result in human exposures to radiation.

The exposures from cosmic radiation vary as a function of latitude and altitude. Exposure is higher closer to the North and South Poles, and it increases with altitude (see Table 6.1.5-3). The exposures also vary as a function of time because of magnetic disturbances associated with solar flares, as discussed above.

b) Manmade Exposures - Fallout and the diagnostic use of x-rays are the major sources of manmade exposures. The dose to any organ from x-rays varies greatly depending on the organ exposed.

The average exposure from fallout in the northern hemisphere was 4 mrem/yr. in 1969 (Reference 6.1.5-4). This source of exposure has declined sharply since the nuclear test ban treaty. However, recent atmospheric testing by the

People's Republic of China has perturbed this general downward trend (Reference 6.1.5-6).

c) Regional Data - Table 6.1.5-4 presents a year summary of airborne particulate gross beta concentrations compared with the activity of the rainfall per unit area at Columbia, South Carolina. Table 6.1.5-5 presents a year summary of pasteurized milk in Charlotte, North Carolina.

6.1.5.1.2 Preoperational Environmental Radiological Surveillance Program

a) The objectives of the preoperational program are:

1) To measure background levels and their variations along the anticipated critical pathways in the area surrounding the Harris Site.

2) To train personnel

3) To evaluate procedures, equipment and techniques.

4) To ensure compatible operability of all elements of the environmental monitoring program prior to fuel loading.

b) The sampling design of the preoperational program is identical to that of the operational program as described in the following section.

6.1.5.2 Operational Phase

6.1.5.2.1 Sampling Design

a) General Design of Sampling and Analyses - The sampling design of the operational phase of the environmental monitoring program is summarized in Table 6.1.5-1 and Figure 6.1.5-1. Table 6.1.5-1 describes the sampling media, frequency of sampling, sampling location and types and frequency of laboratory analyses. Figure 6.1.5-1 displays the positions of the sampling locations relative to the plant.

The program, as described, is subject to some modification as it progresses. The bases for modification may include:

1) Inaccessibility of selected sites due to conditions not currently existing.

2) Identification of new sample types, analytical techniques, sample locations, etc. which may provide more meaningful data

3) Seasonal unavailability of specified environmental material

4) malfunction of automatic sampling equipment (however every effort will be made to complete corrective action prior to the next sampling period.)

All deviations from the sampling schedule will be documented. This program will operate in accordance with guidance of the Radiological Effluent Technical Specification and the Offsite Dose Calculation Manual (ODCM).

The Operational Phase will include an annual census during the growing season to determine the location of the nearest milk animal and nearest garden greater than 500 square feet producing broad leaf vegetation in each of the 16 meteorological sectors within a distance of 5 miles. If it is learned from this census that the milk animals or gardens are present at a location which yields a calculated thyroid dose greater than those previously sampled, then the higher calculated dose sample locations will be added to the surveillance program as soon as practicable. The sampling location (excluding the control sample location) having the lowest calculated dose will be dropped from the surveillance program at the end of the grazing or growing season during which the census was conducted.

b) Rationale for Sampling Locations

1) Airborne Iodine and Particulate

The air sampling program was designed to provide basic data in estimating the radiation dose to man delivered through the air transport pathway. The primary elements affecting the dose to man from the SHNPP plant through this pathway is the activity from radioactive iodines and airborne particulates. This activity is inhaled and otherwise ingested by man; thereby, developing an internal dose to man. The program provides an estimator that is in addition to the effluent diffusion and dose models which apply to all sectors on a continuous and integrated annual dose basis. The additional estimator will serve to validate or refute the model predictions.

The air sampling program samples environmental air which is representative of breathing air within the selected sectors at zones near the plant boundary. Three sectors were chosen on the basis of predicted annual average D/Q values and, in part, land use. The three sectors N, NNE, and NE represent three of the four sectors which had the highest predicted D/Q values (See Tables 6.1.5-7 and 6.1.5-8). These sectors contain an area that, although sparsely populated, is accessible by the public; some reasonable probability exists that individuals of the general public could from time to time become dose recipients in these sectors.

The sector having the third highest D/Q value was the south sector. Sampling in this sector was rejected because the plant property extends about 3.5 miles from the plant or another 2.1 miles beyond the exclusion boundary. In this area there are no accessible sites with utilities available and public occupancy would be extremely low. As such, measurements made in this area would have little relevancy to estimating dose to the general public.

A fourth air sampling site is located at New Hill, N. C. in the north sector which is 3.5 miles from the plant. New Hill represents the community having the highest D/Q value. Data from this position will be used to similarly evaluate the diffusion and dispersion calculations as they would relate to this population.

A fifth sampling station is located $\geq$12 miles in the west northwest sector, a low D/Q sector, to provide a control data point for comparison with the data from the other four sites. The control station should be minimally affected by plant effluents and therefore will serve to delineate the net plant effect at the other four stations.

2) Water Sampling

(a) Surface Water Sampling Locations - Surface water of the Main Reservoir will be sampled to provide a sensitive trend indicator of the potential dose available to man in the aquatic transport pathway. Although surface water is not directly consumed by the public without considerable processing, it does contribute to the raw water used by several municipal water systems and also provides the drinking water for the Shearon Harris Nuclear Power Plant. Data from the surface water sampling will also be useful in determining the adequacy of the drinking water sampling program as a primary estimator of population dose.

Two surface water sampling stations were chosen to optimize the sensitivity of the cooling tower blowdown lines. After mixing with the average Main Reservoir volume of 75,000 ac. ft., a small fraction will flow over the Main Dam Spillway and into the Cape Fear River.

The unaffected surface water sampling site is at CP&L's Cape Fear Plant near Moncure, N. C. This site is upstream on the Cape Fear River near the confluence of the Haw River and the Deep River about 4.5 miles downstream of the Jordan Dam. Data from this location will be indicative of trends occurring in background unaffected by the plant operations.

The affected surface water sampling location is at the spillway of the plant's 4,000 acre Main Reservoir which will be the receiving body for some low level quantities of liquid radioactive wastes. These wastes would be treated wastes released in limited quantities through the cooling water system to the surface water.

(b) Ground Water Sampling Locations - Data from the ground water sampling system will be used to demonstrate that no significant liquid transport of radioactive wastes is occurring within the ground water system. Since the plant is situated on only one minor aquifer flowing within the Triassic rock formation, only negligible transport should occur in the single aquifer.

The aquifer will be sampled from a common header of deep wells in the proximity of the diabase dikes. The header combines the well waters which will most likely be affected by plant radioactivity releases.

(c) Drinking Water - Samples representative of radioactivity in public drinking water are to be used to directly monitor the ingestion of radioactivities in the water-to-man pathway. This will be accomplished using raw untreated water at the point where the nearest downstream municipality draws its water supply from the Cape Fear River. Such samples will in some cases exhibit higher activities than will occur in the processed water since for some radionuclides the water treatment and distribution process will provide a reduction of activity in the consumed water.

The sampling point for the drinking water pathway is located at the intake of the Lillington, North Carolina water treatment plant. Lillington is the first downstream municipality utilizing the waters of the Cape Fear River for a source of drinking water. The single point will also serve as a conservative estimator for the municipalities of Dunn, North Carolina and Fayetteville, North Carolina both withdrawing water a few miles downstream from Lillington.

The control or unaffected sample point used to compare with the drinking water sample will be the surface water sampled at CP&L's Cape Fear Plant. Comparisons of data from this control point with the samples at Lillington will provide the most sensitive estimator of the activity consumed through the public drinking water supplies downstream on the Cape Fear River.

3) Shoreline Sediments

Shoreline sediments are sampled in the zone in which cooling tower blowdown water discharged from the plant mixes with the Main Reservoir water. The information from this sample will provide an indication of the trends with which radionuclides pool in the benthic sediments component of the Main Reservoir system. Sampling at this point provides the optimum sensitivity for the indicator in that Main Reservoir concentrations of discharged radionuclides should be the highest in this zone.

4) Milk

Milk is sampled at four locations within a five-mile radius to provide primary data on the transport of radionuclides along the air-pasture-cow-milk transport pathway to man. The locations include three operating commercial dairies and a single family milk cow. The family milk cow was selected because it grazes at a distance of 1.9 miles from the plant site, the closest milk producer to the plant. The other three locations include all commercial milk producers located within the five-mile radius of the plant.

A fifth milk sampling location was chosen in the WNW sector at a distance of greater than 10 miles. This information is to provide an estimate of activity in the unaffected milk. Such an estimate or control data will provide a comparison basis for the other sampling points.

It should be recognized that the single family cow sampling point will periodically be an unreliable sample source in that the cow will not produce milk during periods of breeding and pregnancy. This is obviously no great problem because during these periods the pathway to man ceases to exist also and loss of data becomes unimportant.

5) Fish

Fish sampling produces data indicative of the potential radionuclide consumption by man through an aquatic pathway. In addition,the data provides an integrating trend monitor of the radioactivities in the Main Reservoir. The fish sampling is accomplished in the Main Reservoir itself and upstream of the Buckhorn Dam on the Cape Fear River. The two data points provide the most valid comparisons for affected and unaffected samples.

6) Food Products

Food products are sampled to provide data on ingestion of radionuclides near the end of the air-vegetation-man pathway. The most sensitive sample media was determined to be broad leaf plants whose leaves constitute the consumed product. Three sampling points are family gardens located in three sectors having predicted D/Q values higher than the median for the surrounding area.

The locations were chosen on the basis of proximity to the plant, reliability of the garden's existence and representation of existing residents. The control location was placed in Pittsboro, N. C. approximately 12 miles from the plant in the west northwest sector which has a lower than average D/Q value. Comparisons of these data points provide the most sensitive evaluations of the air-food crop-man transport pathway.

7) External Radiation Measurements

Thermoluminescent dosimeters (TLD) will be used to determine external gamma exposure in each of the sectors around the plant. This is accomplished by locating dosimeters in each of sixteen sectors around the plant. The location will form two concentric rings; the inner ring at the site exclusion boundary and the outer ring with a variable radius of from four to five miles. In addition TLD Stations will be established in four of the nearby communities; Apex, Holly Springs, New Hill and Fuquay-Varina to provide a better estimate of the population doses there.

Two control stations are located in separate sectors having lower than average D/Q values. These stations are located at distances greater than 10 miles from the plant. To provide added insurance that at least one of these locations is an effective control station, they are placed in nearly opposite sectors, one in the WNW sector and one in the east sector.

At each location the site is surveyed to determine the nature of the external radiation fields and to detect anomalies that may affect the TLD results. The TLD stations were placed in locations with minimum radiation rates. In addition the dosimeters will be placed approximately 2 meters above the ground level in unpopulated areas and 3 meters above ground level in the populated areas. The higher position was deemed necessary to discourage vandalism and theft of the dosimeters.

6.1.5.3 Analytical Techniques

Sampling and radiochemical analysis will be conducted by CP&L at the Shearon Harris Energy & Environmental Center. The collection, processing, radiochemical separations and analysis of environmental samples will be performed in accordance with the techniques (or comparable techniques) described in HASL-300 (Reference 6.1.5-7), Regulatory Guide 4.15 (Reference 6.1.5-8), and NCRP-50 (Reference 6.1.5-9). The following are the analytical techniques that will be used:

a) External Gamma Dosimetry - External gamma dosimetry will be performed using a thermoluminescent dosimetry (TLD) system. The TLD system will meet the performance and acceptance criteria presented in Regulatory Guide 4.13. Each TLD station will have two or more phosphors in a packet.

b) Gross Beta - The analysis of gross beta radioactivity measurements will be made utilizing a Beckman Widebeta II proportional counter. The air particulate samples will be mounted in two-inch stainless steel planchets and counted directly.

c) Tritium - Tritium measurements will be made by using a Beckman LS-233 liquid scintillation counter. Water samples requiring tritium analysis will be distilled prior to analysis.

d) Gamma Spectral Analyses - Gamma spectrum analysis will utilize a lithium-drifted germanium detector with a thin aluminum window housed in a steel and lead shield. The analyzer system will be a Nuclear Data 4420 with ND 812 computer.

e) Radiochemical Analyses - Iodine-131 in milk will be analyzed by using anion exchange resin, sodium hypochloride leach, and organic extraction. Iodine is precipitated as silver iodide, collected on a tared filter, dried, and counted on a beta-gamma coincidence system.

6.1.5.4 Lower Limits of Detection

The lower limits of detection (LLD) will be sufficiently sensitive to permit the program to detect concentrations of radionuclides in the environment which could cause exposures in excess of the limitations of Appendix I to 10CFR50. Table 6.1.5-9 presents the lower limits of detection for selected radionuclides and sample types. However, LLDs well below these values should be achievable.

6.1.5.5 Quality Control Program

The purpose of this program is to assure that the preoperational and operational radiological monitoring measurements are valid. This program will include the use of control logs or charts, splitting samples with independent laboratories, separate technician analysis of duplicate or spike samples, and participation in the EPA's Environmental Radioactivity Laboratory Intercomparison Studies (cross-check) Program.

Control charts or logs record the periodic analyses of standard radionuclide samples and backgrounds. These document the stability of each counting instrument. Any significant deviation in the measurement of a standard sample from previous analysis may indicate a system malfunction or calibration shift which causes erroneous results. Sample splitting consists of dividing an environmental sample, such as milk, surface water or food crop, etc., into two or more portions prior to processing. Each portion is sent to independent laboratories for analyses. Participation in the EPA Intercomparison Program and comparisons of analyses with independent laboratories provide additional checks to either validate the program's analyses or to detect significant analytical errors as they develop.

Quality controls will be applied to the entire sample collection procedure to ensure that representative samples are obtained and that samples are not changed, cross-contaminated, or otherwise affected prior to their analysis because of handling errors or because of their storage environment.

The quality control program applied to the sample collection, handling, transport, storage, and documentation is primarily based on detailed procedures. The program is strengthened by periodic administrative checks and inspections as well as by continuous monitoring of the "error" rate detected by the analytical group.

The procedures contain detailed instructions on the sample size, location, frequency, labeling, transportation, storage, and corrective action to be taken if a sampler is out of service. They also detail the required documentation and chain of custody of the samples.

TABLE 6.1.5-1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Sample Point	Sample Point, Description Distance, & Direction[1]	Sampling and Collection Frequency	Analysis Frequency	Analysis
1. Airborne Particulates and Radioiodine	1	0.3 mi. S. on Rd. #1134 from Rd. #1011 intersection 2.5 mi. N. sector of site.	Continuous operating sampler with sample collection as required by dust loading, but at least once per 7 days	Weekly Weekly Quarterly	Gross Beta[2] I-131 (charcoal canisters[3]) Gamma Isotopic[5] Composite by Location
	2	1.6 mi. S. on Rd. #1134 from Rd. #1011 intersection 1.5 mi. NNE sector of site	Continuous operating sampler with sample collection as required by dust loading, but at least once per 7 days	Weekly Weekly Quarterly	Gross Beta[2] I-131 (charcoal canisters[3]) Gamma Isotopic[5] Composite by Location
	3	0.9 mi. S. on Rd. #1135 from U.S. #1 intersection 2.6 mi NE sector of site	Continuous operating sampler with sample collection as required by dust loading, but at least once per 7 days	Weekly Weekly Quarterly	Gross Beta[2] I-131 (charcoal canister[3]) Gamma Isotopic[5] Composite by Location

4

TABLE 6.1.5-1 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Sample Point	Sample Point, Description Distance, & Direction[1]	Sampling and Collection Frequency	Analysis Frequency	Analysis
	4	New Hill 3.5 mi. NNE sector of site	Continuous operating sampler with sample Collection as required by dust loading but at least once per 7 days	Weekly Weekly Quarterly	Gross Beta[2] I-131 (charcoal canisters[3]) Gamma Isotopic[5] Composite by Location
	5	Pittsboro ≥12 mi. WNW sector of site (Control Station)[4]	Continuous operating sampler with sample collection as required by dust loading, but at least once per 7 day	Weekly Weekly Quarterly	Gross Beta[2] I-131 (charcoal canisters[3]) Gamma Isotopic[5] Composite by Location
2. Direct Radiation	1	0.3 mi. S on Rd. #1134 from Rd. 1011 intersection 2.5 mi. N. sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	2	1.6 mi. S. on Rd. #1134 from Rd. 1011 intersection 1.5 mi. NNE sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose

TABLE 6.1.5-1 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Sample Point	Sample Point, Description Distance, & Direction[1]	Sampling and Collection Frequency	Analysis Frequency	Analysis
2. Direct Radiation (Continued)	3	0.9 mi. S. on Rd. #1135 from U.S. #1 intersection 2.6 mi. NE sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	4	New Hill 3.5 mi. NNE sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	5	Pittsboro ≥12 mi. WNW sector of site (control station)[4]	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	6	Intersection of Rd. #1134 & #1135 0.9 mi. ENE sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	7	House Ruins on Rd. #1134 0.8 mi. E. sector of site	Continuous mesurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	8	Dead End of Rd. #1134 0.7 mi. ESE sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose

4

TABLE 6.1.5-1 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Sample Point	Sample Point, Description Distance, & Direction[1]	Sampling and Collection Frequency	Analysis Frequency	Analysis
2. Direct Radiation (Continued)	9	1 mi. W. of Hollomans xRd. 2.3 mi. SE sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	10	Train Crossing under Rd. 1130 2.2 mi. SSE sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	11	0.3 mi. E. of intersection Rd. 1131 & 1134 0.7 mi. S. sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	12	Intersection @ Rd. #1131 & #1133 0.8 mi. SSW sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	13	1.0 mi. S. of R/R on Rd. 1131 0.7 mi. SW sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	14	Dead End of Rd. 1191 1.1 mi. WSW sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose

4

TABLE 6.1.5-1 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Sample Point	Sample Point, Description Distance, & Direction[1]	Sampling and Collection Frequency	Analysis Frequency	Analysis
2. Direct Radiation (Continued)	15	Cem. on Rd. 1191 1.8 mi. W. sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	16	1.2 mi. E. of intersection of U. S. #1 and Rd. 1011 1.7 mi. WNW sector of site.	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	17	Intersection of US #1 and Aux. Res. 1.4 mi. NW sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	18	0.6 mi. N. on U.S. #1 from Station #17 1.3 mi. NNW sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	19	Triple H Dairy 4.9 mi. NNE sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	20	Intersection 1149 & U. S. #1 4.7 mi. NE sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose

4

TABLE 6.1.5-1 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Sample Point	Sample Point, Description Distance, & Direction[1]	Sampling and Collection Frequency	Analysis Frequency	Analysis
2. Direct Radiation (Continued)	21	1.3 mi. E. of intersection 1152 & 1153 on Rd. 1152 4.8 mi. ENE sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	22	Ragan's Dairy Farm 4.6 mi. E. sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	23	Holloman Cem. 5.0 mi. ESE sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	24	Sweet Springs Church 4.7 mi. SE sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	25	0.23 mi. W. of intersection of 1401 & 1402 on Rd. 1402 4.8 mi. SSE sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	26	Spillway on Main Res. 4.6 mi. S. sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose

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TABLE 6.1.5-1 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Sample Point	Sample Point, Description Distance, & Direction[1]	Sampling and Collection Frequency	Analysis Frequency	Analysis
2. Direct Radiation (Continued)	27	Buckhorn Church 4.8 mi. SSW sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	28	0.6 mi. from Intersection 1916 & 1924 on Rd. 1924, 4.8 mi. SW sector of	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	29	Industrial waste pond on Rd. 1916, 5.6 mi. WSW sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	30	Exit intersection of Rd. 1700 & U.S. #1 5.1 mi. W. sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	31	Intersection of Rd. 1910 & 243 4.5 mi. WNW sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	32	Intersection of Rd. 1008 & 262, 4.8 mi. NW sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose

4

TABLE 6.1.5-1 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Sample Point	Sample Point, Description Distance, & Direction[1]	Sampling and Collection Frequency	Analysis Frequency	Analysis
2. Direct Radiation (Continued)	33	1.6 mi. E. from intersection 1008 & 1903 on Rd. 1903, 4.5 mi. from site NNW sector.	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	34	Apex (Population Center) 8.6 mi. NE. sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	35	Holly Springs 6.9 mi. E. sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	36	Intersection of Rd. 1393 & 1421 11.2 mi. E. sector of site (Control Station)[4]	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	37	Fuquay-Varina (Population Center) 9.7 mi. ESE sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
3. Waterborne					
a. Surface Water	26	Spillway on Main Res. 4.6 mi. S. sector of site	Composite sample[5] collected over a period of ≤31 days	Monthly Monthly Quarterly	Gross Beta Gamma Isotopic Tritium

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TABLE 6.1.5-1 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Sample Point	Sample Point, Description Distance, & Direction[1]	Sampling and Collection Frequency	Analysis Frequency	Analysis
3. Waterborne (Continued) a. Surface Water (Continued)	38	Cape Fear Steam Electric Plant Intake Structure (Control Station)[4] 6.1 mi. WSW sector of site	Composite sample[5] collected over a period of $\leq$31 days	Monthly Monthly Quarterly	Gross Beta Gamma Isotopic Tritium
	40	Lillington's Water Municipality 15.0 mi. SSE sector of site	Composite sample[5] collected over a period of $\leq$31 days	Monthly Monthly Quarterly	Gross Beta Gamma Isotopic Tritium
b. Groundwater	39	On site, deep well in the proximity of the diabase dikes	Grab sample Quarterly	Quarterly Quarterly	Gamma Isotopic[4] Tritium
c. Drinking	38	Cape Fear Steam Electric Plant Intake Structure (Control Station)[3] 6.1 mi. WSW sector of site	Composite sample[5] over two-week period if I-131 analysis is performed, monthly composite otherwise	I-131 on each composite when the dose[6] calculated for the consumption of the water is greater than 1 mrem per yr. Monthly Monthly Quarterly	I-131 Gross Beta Gamma Isotopic Tritium

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TABLE 6.1.5-1 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Sample Point	Sample Point, Description Distance, & Direction[1]	Sampling and Collection Frequency	Analysis Frequency	Analysis
3. Waterborne (Continued) c. Drinking (Continued)	40	Lillington's Water Municipality 15.0 mi. SSE sector of site	Composite sample[5] over two-week period if I-131 analysis is performed, monthly composite otherwise	I-131 on each composite when the dose[6] calculated for the water is greater than 1 mrem per yr.	I-131
				Monthly	Gross Beta
				Monthly	Gamma Isotopic
				Quarterly	Tritium
d. Sediment from Shoreline	41	Shoreline of Mixing Zone of Cooling Towers 2.8 mi. SSW sector of site	Surface soil sample semiannually	Semiannually	Gamma Isotopic[4]
4. Ingestion					
a. Milk	42	Louis Fish Res. (single cow) 1.9 mi. NW sector of site	Grab samples semi-monthly when animals are on pasture, monthly @ other times	Each sample	I-131 & Gamma Isotopic[4]
	19	Triple H. Dairy 4.9 mi. NNE sector of site	Grab samples semi-monthly when animals are on pasture, monthly @ other times	Each sample	I-131 & Gamma Isotopic[4]

4

TABLE 6.1.5-1 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Sample Point	Sample Point, Description Distance, & Direction[1]	Sampling and Collection Frequency	Analysis Frequency	Analysis
4. Ingestion (Continued) a. Milk (Continued)	43	Goodman's Farm 2.3 mi. N. sector of site	Grab samples semi-monthly when animals are on pasture, monthly @ other times	Each sample	I-131 & Gamma Isotopic[4]
	22	Ragan's Dairy Farm 4.6 mi. E. sector of site	Grab samples semi-monthly when animals are on pasture, monthly @ other times	Each sample	I-131 & Gamma Isotopic[4]
	5	Pittsboro (Control Station)[4] ≥12 mi. WNW sector of site	Grab samples semi-monthly when animals are on pasture, monthly @ other times	Each sample	I-131 & Gamma Isotopic[4]
b. Fish	44	Site varies within the Harris impoundment	One sample of each of the following: 1. Free Swimmers 2. Bottom Feeders semiannually	Semiannually	Gamma Isotopic[4] on edible portion for each
	45	Site varies above Buckhorn Dam on Cape Fear River (Unaffected by Site) (Control Station)[4]	One sample of each of the following: 1. Free Swimmers 2. Bottom Feeders semiannually	Semiannually	Gamma Isotopic[4] on edible portion for each
c. Food Products	46	Behind nursing home 2.3 mi. NE. sector of site	Broad leaf vegetation at time of each harvest	At time of each harvest	Gamma Isotopic[4]

TABLE 6.1.5-1 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Sample Point	Sample Point, Description Distance, & Direction[1]	Sampling and Collection Frequency	Analysis Frequency	Analysis
4. Ingestion (Continued) c. Food Products (Continued)	47	Plant access Rd. 1.7 mi. NNE sector of site	Broad leaf vegetation at time of each harvest	At time of each harvest	Gamma Isotopic[4]
	43	Goodman's Farm 2.3 mi. N. sector of site	Broad leaf vegetation at time of each harvest	At time of each harvest	Gamma Isotopic[4]
	5	Pittsboro ≤12 mi. WNW sector of site (Control Station)[3]	Broad leaf vegetation at time of each harvest	At time of each harvest	Gamma Isotopic[4]

4

NOTES TO TABLE 6.1.5-1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

1. Sample locations are shown on Figure 6.1.5-1.

2. Particulate samples will be analyzed for gross beta radioactivity 24 hours or more following filter change to allow for radon and thorium daughter decay. If gross beta activity is greater than ten times the yearly mean of the control sample station activity, gamma isotopic analysis will be performed on the individual samples. | 4

3. Control sample stations (or background stations) are located in areas that are unaffected by plant operations. All other sample stations that have the potential to be affected by radioactive emissions from plant operations are considered indicator stations.

4. Gamma isotopic analysis means the identification and quantification of gamma-emitting radionuclides that may be attributable to the effluents from the plant operations.

5. Composite samples will be collected with equipment (or equivalent) which is capable of collecting an aliquot at time intervals which are very short (e.g., every 2 hours) relative to the compositing period (e.g., monthly).

6. The dose will be calculated for the maximum organ and age group, using the methodology contained in Regulatory Guide 1.109, Rev. 1 and the actual parameters particular to the site.

TABLE 6.1.5-2

NATURAL BACKGROUND AND MANMADE EXPOSURES

Natural Background	Dose (mrem/yr)
Cosmic Radiation	44
Radionuclides in the Body	18
External Gamma Radiation	40
Total	102
Manmade Exposures	
Medical & Dental	73
Fallout	4
Occupational Exposure	0.8
Nuclear Power	0.003
Total	77.803

2

Source:

Advisory Committee on the Biological Effects of Ionizing Radiations, The Effects on Populations of Exposure to Low Levels of Ionizing Radiation, U.S. National Academy of Sciences, National Research Council, Washington, D.C. 1972, Page 50.

TABLE 6.1.5-3

BETA-GAMMA ACTIVITY DURING AIRCRAFT ASCENT AND DESCENT - MARCH 17, 1960

Ascent at Long Beach		Descent at Miami	
Altitude (ft.)	Dose Rate (mr./hr.)	Altitude (ft.)	Dose Rate (mr./hr.)
0	0.01	33,000	0.20
2,000	0.02	32,500	0.12
4,000	0.02	30,000	0.13
5,000	0.03	29,000	0.11
6,000	0.02	28,000	0.10
8,000	0.03	25,000	0.08
10,000	0.025	24,000	0.08
12,000	0.030	18,000	0.05
14,000	0.03	17,000	0.03
16,000	0.035	16,000	0.03
18,000	0.040	14,000	0.03
20,000	0.05	10,000	0.02
21,000	0.05	9,000	0.02
23,000	0.09	4,000	0.01
24,000	0.08	2,000	0.01
26,000	0.09	0	0.01
27,500	0.10		
28,000	0.09		
29,000	0.11		
30,000	0.11		
32,000	0.15		
32,500	0.16		
33,100	0.20		

Source: U. S. Department of Health, Education, and Welfare, Public Health Service, RADIOLOGICAL HEALTH DATA Monthly Report - February,1961, p. 88.

TABLE 6.1.5-4

July, 1978 thru June, 1979
Airborne Particulate Gross Beta Concentration
and Rainfall Data
Columbia, South Carolina

Date	pCi/m^3 Max	pCi/m^3 Min	pCi/m^3 Avg	mm Rainfall	nCi/m^2 Act
7/78	0.09	0.03	0.06	67.5	0.22
8/78	0.07	0.02	0.04	36.3	0.17
9/78	0.07	0.03	0.05	52.5	0.15
10/78	0.05	0.03	0.04	10.0	0.04
11/78	0.19	0.02	0.06	31.3	0.09
12/78	0.13	0.02	0.06	43.8	<0.01
1/79	0.08	0.02	0.04	139.0	0.28
2/79	0.04	0.01	0.03	194.0	0.19
3/79	0.07	0.03	0.04	82.5	0.16
4/79	0.07	0.01	0.04	66.3	0.14
5/79	0.05	0.02	0.03	162.5	0.28
6/79	0.07	0.02	0.03	155.0	0.20

Source: U. S. Environmental Protection Agency, Environmental Radiation Data, Reports: 15, 16, 17 & 18, Technical Services Branch, Eastern Environmental Radiation Facility, Montgomery, Alabama

TABLE 6.1.5-5

July, 1978 thru June, 1979
Pasteurized Milk - Charlotte, N. C.

2

Radionuclide Concentration	^{137}Cs pCi/l ±e	^{140}Ba pCi/l ±e	^{131}I pCi/l ±e
Date			
July 78	18 ± 15	-7 ± 19	2 ± 13
August 78	11 ± 15	-5 ± 19	-5 ± 13
September 78	11 ± 15	-4 ± 19	-9 ± 13
October 78	7 ± 7	2 ± 8	5 ± 7
November 78	8 ± 15	9 ± 20	-1 ± 13
December 78	6 ± 15	9 ± 20	6 ± 13
1/2/79	3 ± 15	-11 ± 19	-10 ± 13
1/8/79	6 ± 7	-4 ± 8	4 ± 7
2/5/79	8 ± 15	-2 ± 20	4 ± 13
3/5/79	8 ± 15	1 ± 20	-6 ± 13
4/2/79	-2 ± 15	-3 ± 20	1 ± 13
5/7/79	16 ± 15	2 ± 20	1 ± 13
6/4/79	5 ± 15	-7 ± 19	2 ± 13

e = 2 Sigma Counting Error

Source: U. S. Environmental Protection Agency, Environmental Radiation Data, Reports: 15, 16, 17 & 18, Technical Services Branch, Eastern Environmental Radiation Facility, Montgomery, Alabama

TABLE 6.1.5-6

Preoperational Schedule for the Environmental Surveillance Program

Monitoring Activities	Months Prior to Fuel Load	Sampling Frequency
Direct Radiation	24	Quarterly
Fish	24	Semiannually
Food Products	24	At time of Harvest
Sediments from Shoreline	24	Semiannually
Airborne Particulates	12	Weekly
Milk (except iodine)	12	Semimonthly
Surface Water	12	Composite over two weeks
Ground Water	12	Quarterly
Drinking Water	12	Composite over two weeks
Airborne Iodine	6	Weekly
Milk (Iodine)	6	Semimonthly

4

TABLE 6.1.5-7

ANNUAL AVERAGE DILUTION FACTORS AT THE SHNPP MINIMUM EXCLUSION BOUNDARY [1/16/76 - 1/15/79]

		(Sec/m^3)			(m^{-2})
		χ/Q	χ/Q	χ/Q	D/Q
Receptor Location From Plant Center	Distance (Meters)*	No Decay Undepleted	2.26 Day Decay Undepleted	8.00 Day Decay Depleted	
N	2043	$5.6X10^{-6}$	$5.5X10^{-6}$	$4.8X10^{-6}$	$7.6X10^{-9}$
NNE	2133	$5.4X10^{-6}$	$5.3X10^{-6}$	$4.6X10^{-6}$	$8.9X10^{-9}$
NE	2133	$4.3X10^{-6}$	$4.2X10^{-6}$	$3.7X10^{-6}$	$8.0X10^{-9}$
ENE	2133	$3.3X10^{-6}$	$3.3X10^{-6}$	$2.9X10^{-6}$	$6.4X10^{-9}$
E	2133	$2.4X10^{-6}$	$2.4X10^{-6}$	$2.1X10^{-6}$	$4.1X10^{-9}$
ESE	2133	$2.1X10^{-6}$	$2.1X10^{-6}$	$1.8X10^{-6}$	$4.8X10^{-9}$
SE	2133	$2.5X10^{-6}$	$2.4X10^{-6}$	$2.1X10^{-6}$	$5.2X10^{-9}$
SSE	2133	$4.0X10^{-6}$	$3.9X10^{-6}$	$3.4X10^{-6}$	$6.1X10^{-9}$
S	2194	$6.0X10^{-6}$	$5.9X10^{-6}$	$5.1X10^{-6}$	$7.9X10^{-9}$
SSW	2133	$6.0X10^{-6}$	$5.9X10^{-6}$	$5.1X10^{-6}$	$7.5X10^{-9}$
SW	2133	$5.5X10^{-6}$	$5.3X10^{-6}$	$4.7X10^{-6}$	$6.2X10^{-9}$
WSW	2133	$4.8X10^{-6}$	$4.7X10^{-6}$	$4.1X10^{-6}$	$5.0X10^{-9}$
W	2133	$4.1X10^{-6}$	$4.0X10^{-6}$	$3.5X10^{-6}$	$4.0X10^{-9}$
WNW	2103	$3.5X10^{-6}$	$3.4X10^{-6}$	$3.0X10^{-6}$	$3.5X10^{-9}$
NW	2024	$3.3X10^{-6}$	$3.2X10^{-6}$	$2.8X10^{-6}$	$3.8X10^{-9}$
NNW	2024	$4.0X10^{-6}$	$3.9X10^{-6}$	$3.4X10^{-6}$	$5.3X10^{-9}$

* Based on 45 degree sector centered on compass direction of interest as described in ER Section 6.1.3.2.1.

TABLE 6.1.5-8

Distance (miles) Within Five Miles of Center Line of First Operational Unit to Nearest Site Boundary, Residence, Garden, Milk Cow, Milk Goat, and Meat Animal as of May 12, 1982 4

	Site Boundary	Residence	Garden	Milk Cow	Milk Goat	Meat Animal	
N	1.3	2.2	2.2	1.8	-	1.8	4
NNE	1.3	1.7	1.8	4.3	-	3.1	
NE	1.3	2.2	2.2	-	-	2.2	
ENE	1.3	2.0	1.9	-	-	1.9	
E	1.4	1.8	2.1	4.4	-	4.4	4
ESE	1.3	2.7	2.7	-	-	2.8	
SE	1.3	4.2	4.2	-	-	4.2	
SSE	2.0	-	-	-	-	-	
S	2.2	-	-	-	-	-	
SSW	1.5	4.0	4.0	-	-	4.3	
SW	1.5	2.8	2.8	-	-	2.8	
WSW	1.3	4.3	4.3	-	-	4.3	
W	1.3	2.8	2.8	-	-	3.0	
WNW	1.4	2.1	2.1	-	-	2.0	
NW	1.3	1.8	1.9	-	-	1.7	4
NNW	1.3	1.5	1.4	-	4.6	1.7	

TABLE 6.1.5-9(1)

DETECTION CAPABILITIES FOR ENVIRONMENTAL SAMPLE ANALYSIS[a]

Lower Limit of Detection (LLD)[b]

Analysis	Water (pCi/l)	Airborne Particulate or Gas (pCI/m3)	Fish (pCi/kg,wet)	Milk (pCi/l)	Food Products (pCi/kg, wet)	Sediment (pCi/kg, dry)
gross beta	4	1×10^{-2}				
^{3}H	2000					
^{54}Mn	15		130			
^{59}Fe	30		260			
$^{58,60}Co$	15		130			
^{65}Zn	30		260			
^{95}Zr	30					
^{95}Nb	15					
^{131}I	1[c]	7×10^{-2}		1	60	
^{134}Cs	15	5×10^{-2}	130	15	60	150
^{137}Cs	18	6×10^{-2}	150	18	80	180
^{140}Ba	60			60		
^{140}La	15			15		

Note: This list does not mean that only these nuclides are to be detected and reported. Other peaks which are measurable and identifiable, together with the above nuclides, shall also be identified and reported.

TABLE 6.1.5-9 (Continued)

NOTES

[a] Acceptable detection capabilities for thermoluminescent dosimeters used for environmental measurements are given in Regulatory Guide 4.13.

[b] Table 2 indicates acceptable detection capabilities for radioactive materials in environmental samples. These detection capabilities are tabulated in terms of the lower limits of detection (LLDs). The LLD is defined, for purposes of this guide, as the smallest concentration of radioactive material in a sample that will yield a net count (above system background) that will be detected with 95% probability with only 5% probability of falsely concluding that a blank observation represents a "real" signal.

For a particular measurement system (which may include radiochemical separation):

$$\text{LLD} = \frac{4.66\ s_b}{E \cdot V \cdot 2.22 \cdot Y \cdot \exp(-\lambda \Delta t)}$$

where:

LLD is the "a priori" lower limit of detection as defined above (as pCi per unit mass or volume). (Current literature defines the LLD as the detection capability for the instrumentation only, and the MDC, minimum detectable concentration, as the detection capability for a given instrument, procedure, and type of sample.)

s_b is the standard deviation of the background counting rate or of the counting rate of a blank sample as appropriate (as counts per minute)

E is the counting efficiency (as counts per disintegration)

V is the sample size (in units of mass or volume)

2.22 is the number of disintegrations per minute per picocurie

Y is the fractional radiochemical yield (when applicable)

λ is the radioactive decay constant for the particular radionuclide

Δt is the elasped time between sample collection (or end of the sample collection period) and time of counting

The value of S_b used in the calculation of the LLD for a particular measurement system should be based on the actual observed variance of the background counting rate or of the counting rate of the blank samples (as appropriate) rather than on an unverified theoretically predicated variance.

TABLE 6.1.5-9 (Continued)

In calculating the LLD for a radionuclide determined by gamma-ray spectrometry, the background should include the typical contributions of other radionuclides normally present in the samples (e.g., potassium-40 in milk samples). Typical values of E, V, Y and Δt should be used in the calculation.

It should be recognized that the LLD is defined as an _a priori_ (before the fact) limit representing the capability of a measurement system and not as _a posteriori_ (after the fact) limit for a particular measurement.*

[c]LLD for drinking water samples.

---

*For a more complete discussion of the LLD, and other detection limits, see the following:

(1) HASL Procedures Manual, _HASL-300_ (revised annually).

(2) Currie, L. A., "Limits for Qualitative Detection and Quantitative Determination - Application to Radiochemistry" _Anal. Chem. 40_, 586-93 (1968).

(3) Hartwell, J. K., "Detection Limits for Radioisotopic Counting Techniques," Atlantic Richfield Hanford Company Report _ARH-2537_ (June 22, 1972).

Reference 1. U. S. Nuclear Regulatory Commission, Branch Technical Position, "Environmental Monitoring For Direct Radiation," December 21, 1979.

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6.1.1-1 Carolina Power & Light Company, "Shearon Harris Nuclear Power Plant Pre-Construction Monitoring Report, Terrestrial Biology (June 1974 -January 1978), Water Chemistry (1972-1977)," Raleigh, N. C., 1978.

6.1.1-2 ____________, "Shearon Harris Nuclear Power Plant, Annual Environmental Monitoring Report, Water Chemistry, Aquatic Biology, Terrestrial Biology, 1978," Raleigh, N. C., 1979.

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6.1.1-4 American Public Health Association, "Standard Methods for the Examination of Water and Waste Water," U. S. Government Printing Office, Washington, D. C., 13th Ed., 1971.

6.1.1-5 ____________, "Standard Methods for the Examination of Water and Waste Water," U. S. Government Printing Office, Washington, D. C., 14th Ed., 1975.

6.1.1-6 American Society for Testing and Materials, "Water Part 31," American Society for Testing and Materials, Philadelphia, 1976.

6.1.1-7 ____________, "Water Part 31," American Society for Testing and Materials, Philadelphia, 1972.

6.1.1-8 ____________, "Water Part 31," American Society for Testing and Materials, Philadelphia, 1974.

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6.1.1-10 ____________, "Baseline Biota of the Shearon Harris Nuclear Power Plant Study Area, June 1973 - May 1974," Raleigh, N. C., 1975.

6.1.1-11 ____________, "Aquatic Baseline Biota of the Shearon Harris Study Area, North Carolina, 1974-1975," Raleigh, N. C., 1976.

6.1.1-12 Carolina Power & Light Company, "Annual Report: Shearon Harris Nuclear Power Plant, Baseline Monitoring Program, Aquatic Biology Unit, 1976 and 1977," Raleigh, N. C., 1978.

6.1.2-1 Bouwer, H., "Groundwater Hydrology," McGraw Hill, Inc., New York, New York, 1978.

6.1.4-1 U. S. Department of Commerce, Bureau of the Census, 1980 Census of Population and Housing, North Carolina, Final Population and Housing Unit Counts. PHC80-V-35. Washington, D.C. March 1981. 1

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6.1.4-2 Electric Power Research Institute prepared by Sigma Research, Inc. Guidelines for Estimating Present and Forecasting Future Population Distributions Surrounding Power Reactor Sites, Special Report EPRI EA-427-SR Palo Alto, Ca., 1976.

6.1.4-3 State of North Carolina, Office of State Budget and Management. Update North Carolina Population Projections. Raleigh, North Carolina. July 1981.

6.1.4-4 U. S. Department of Commerce, Bureau of the Census, Projections of the Population of the United States: 1977 to 2050, Series P-25, No. 704, U. S. Government Printing Office, Washington D. C., 1977.

6.1.4-5 United States Atomic Energy Commission, Revised Final Environmental Statement Related to Construction of Shearon Harris Nuclear Power Plant, Units 1, 2, 3 and 4 Carolina Power & Light Company, 1974.

6.1.4-6 Carolina Power & Light Company prepared by Aquatic Control, Inc., Baseline Biota of the Shearon Harris Nuclear Power Plant Area, North Carolina. Raleigh, N.C., [1974].

6.1.4-7 ________________, prepared by Aquatic Control, Inc., Baseline Biota of the Shearon Harris Nuclear Power Plant Study Area, June 1973 - May 1974, Raleigh, N.C., 1975.

6.1.4-8 ________________. Shearon Harris Nuclear Power Plant Pre-Construction Monitoring Report, Terrestrial Biology (June 1974 - January 1978), Water Chemistry (1972 - 1977), Raleigh, N.C., 1978.

6.1.4-9 ________________. Shearon Harris Nuclear Power Plant, Annual Environmental Monitoring Report, Water Chemistry, Aquatic Biology, Terrestrial Biology, 1978 Raleigh, N.C., 1979.

6.1.4-10 ________________. Shearon Harris Nuclear Power Plant, Annual Environmental Monitoring Report for 1979, Raleigh, N. C. 1981. |2

6.1.5-1 (Draft) Radiological Effluent Technical Specifications for PWR's NUREG-0472 Revision 3, March, 1979.

6.1.5-2 U. S. Nuclear Regulatory Commission, Regulatory Guide 4.8 Environmental Technical Specifications for Nuclear Power Plants, December, 1975.

6.1.5-3 National Council on Radiation Protection and Measurements, Natural Background Radiation in the United States, NCRP Report No. 45, Washington, D. C., 1975.

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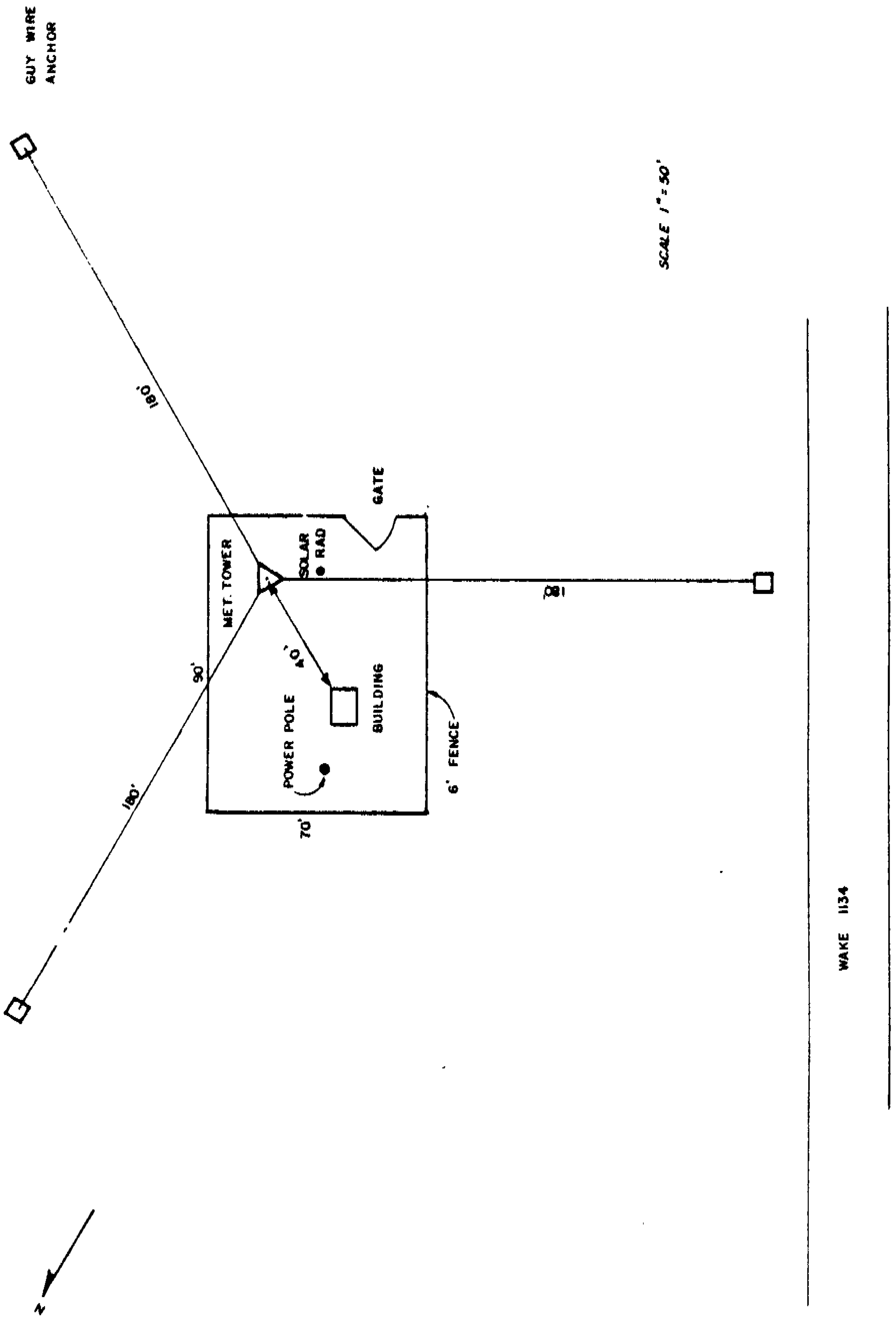
6.1.5-7 John H. Harley. *Health and Safety Laboratory Procedures Manual.* U. S. Atomic Energy Commission. New York, N. Y., 1972, (including Supplements 1 and 2), HASL-300.

6.1.5-8 U. S. Nuclear Regulatory Commission, Regulatory Guide 4.15. "Quality Assurance for Radiological Monitoring Programs (Normal Operations) - Effluent Streams and the Environment" Revision 1, February, 1979.

6.1.5-9 National Council on Radiation Protection and Measurements. "Environmental Radiation Measurements," NCRP Report No. 50, December, 1976.



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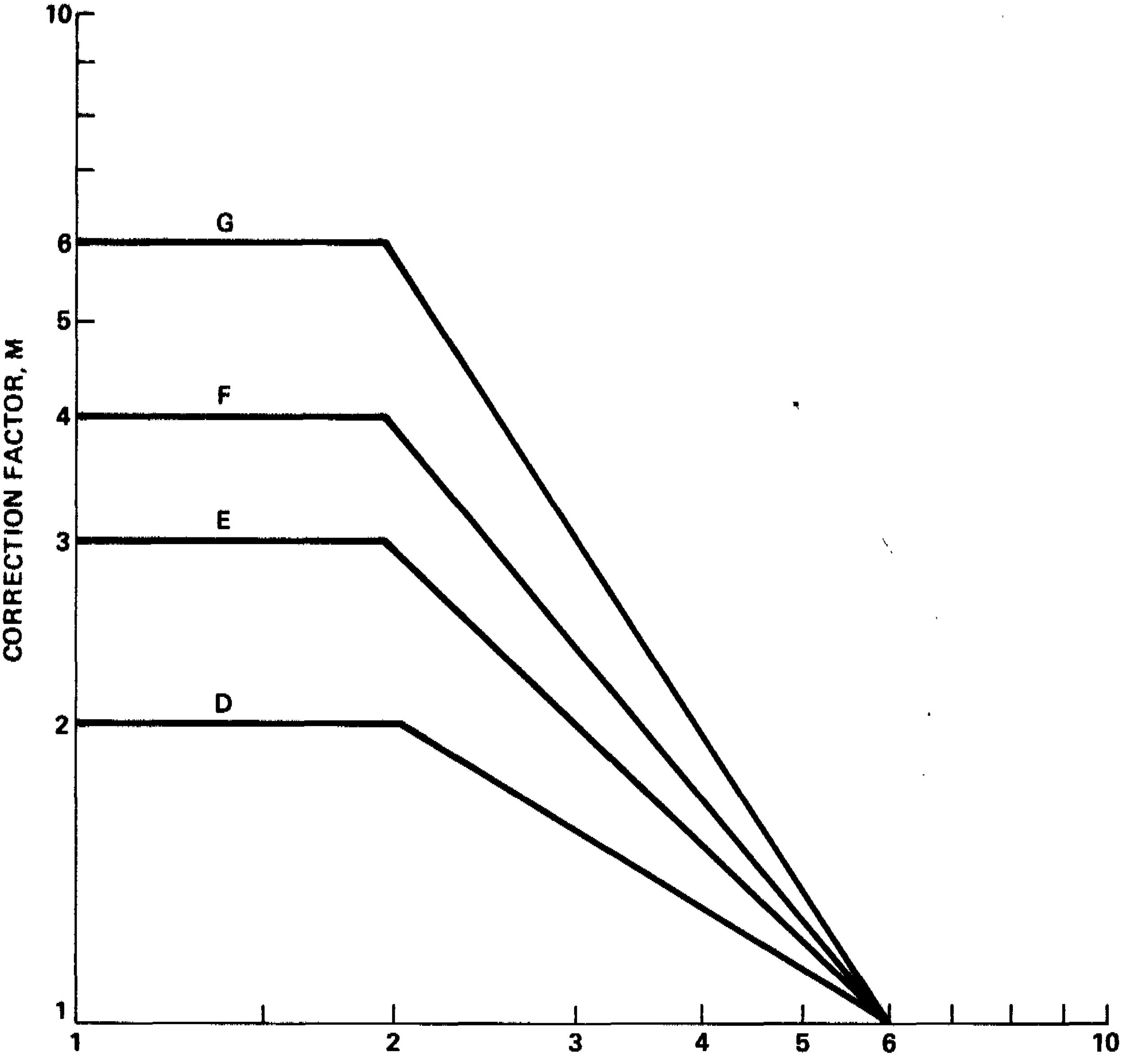
METEOROLOGICAL FACILITY

FIGURE 6.1.3-1



CORRECTION FACTORS FOR PASQUILL-GIFFORD σ_y VALUES.

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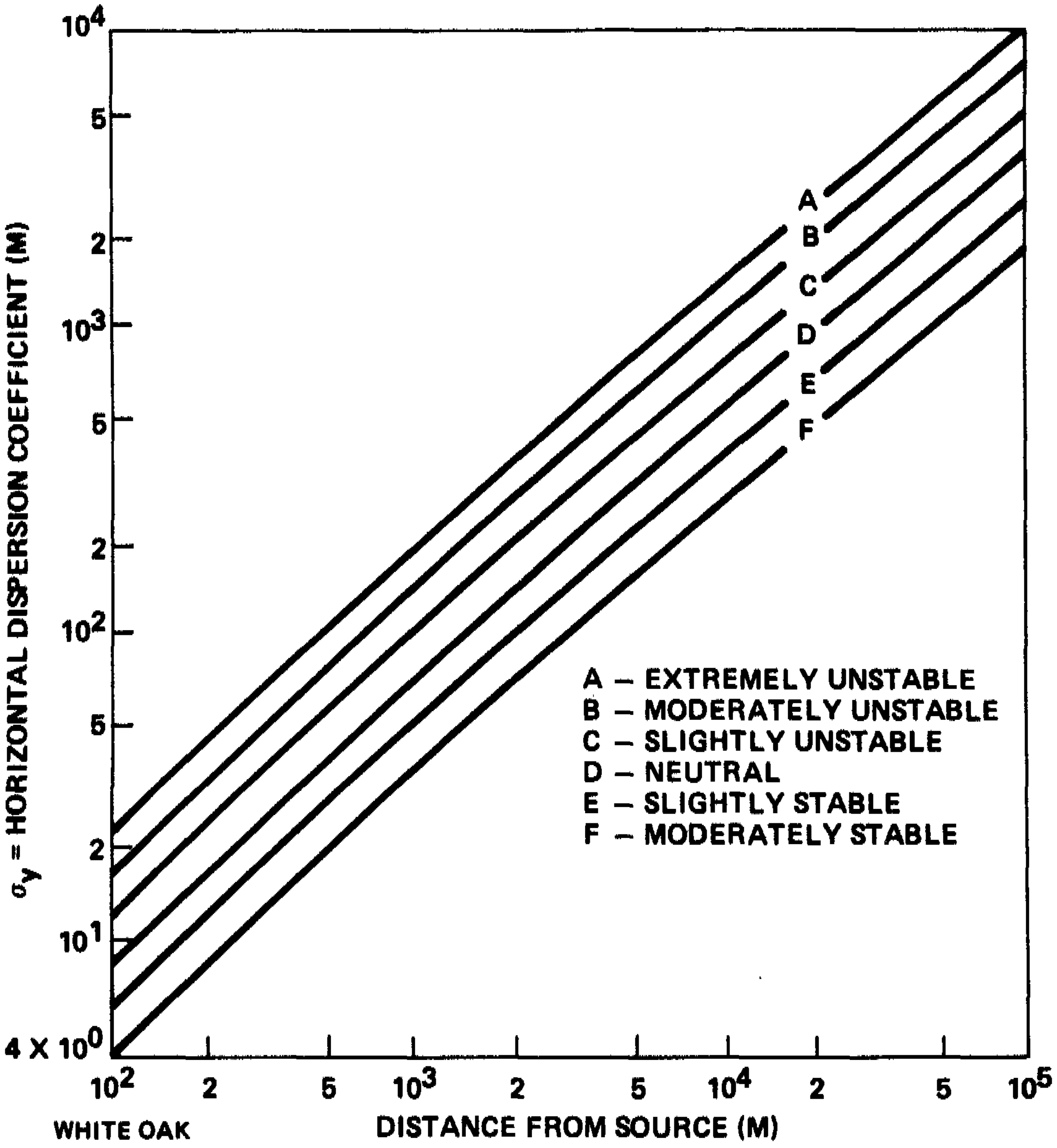
WIND MEANDER CORRECTION FACTORS

FIGURE
6.1.3-2

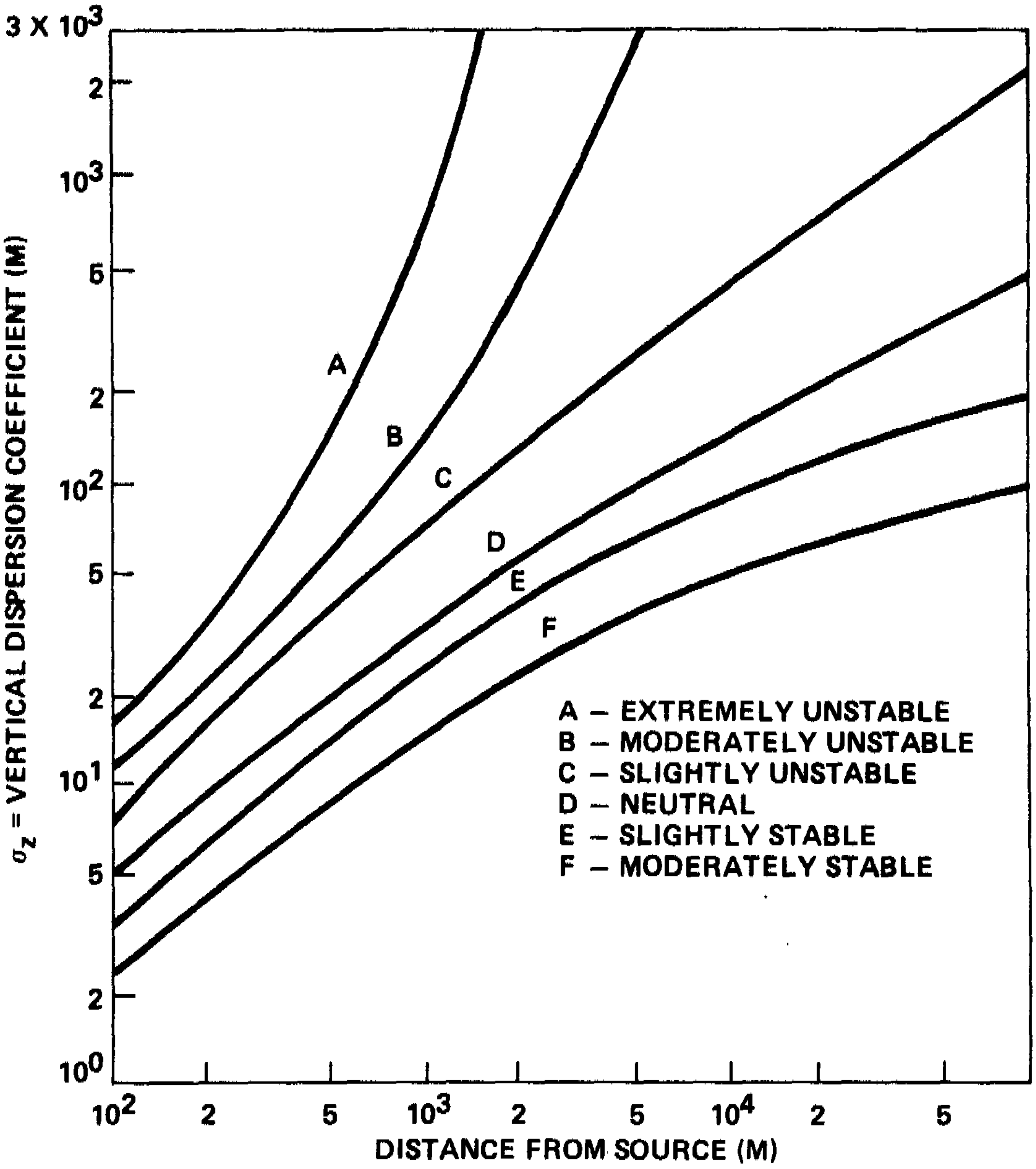


LATERIAL DIFFUSION, σ_y, VS. DOWNWIND DISTANCE FROM SOURCE FOR PASQUILL'S TURBULENCE TYPES.

FOR PURPOSES OF ESTIMATING σ_y DURING EXTREMELY STABLE (G) CONDITIONS, WIHTOUT PLUME MEANDER OR OTHER LATERIAL ENHANCEMENT, THE FOLLOWING APPROXIMATION IS APPROPRIATE:

$$\sigma_y (G) = \frac{2}{3} \sigma_y (F)$$

SHEARON HARRIS NUCLEAR POWER PLANT Carolina Power & Light Company ENVIRONMENTAL REPORT	HORIZONTAL DISPERSION COEFFICIENTS FOR VARIOUS DISTANCES FROM SOURCE	FIGURE 6.1.3-3

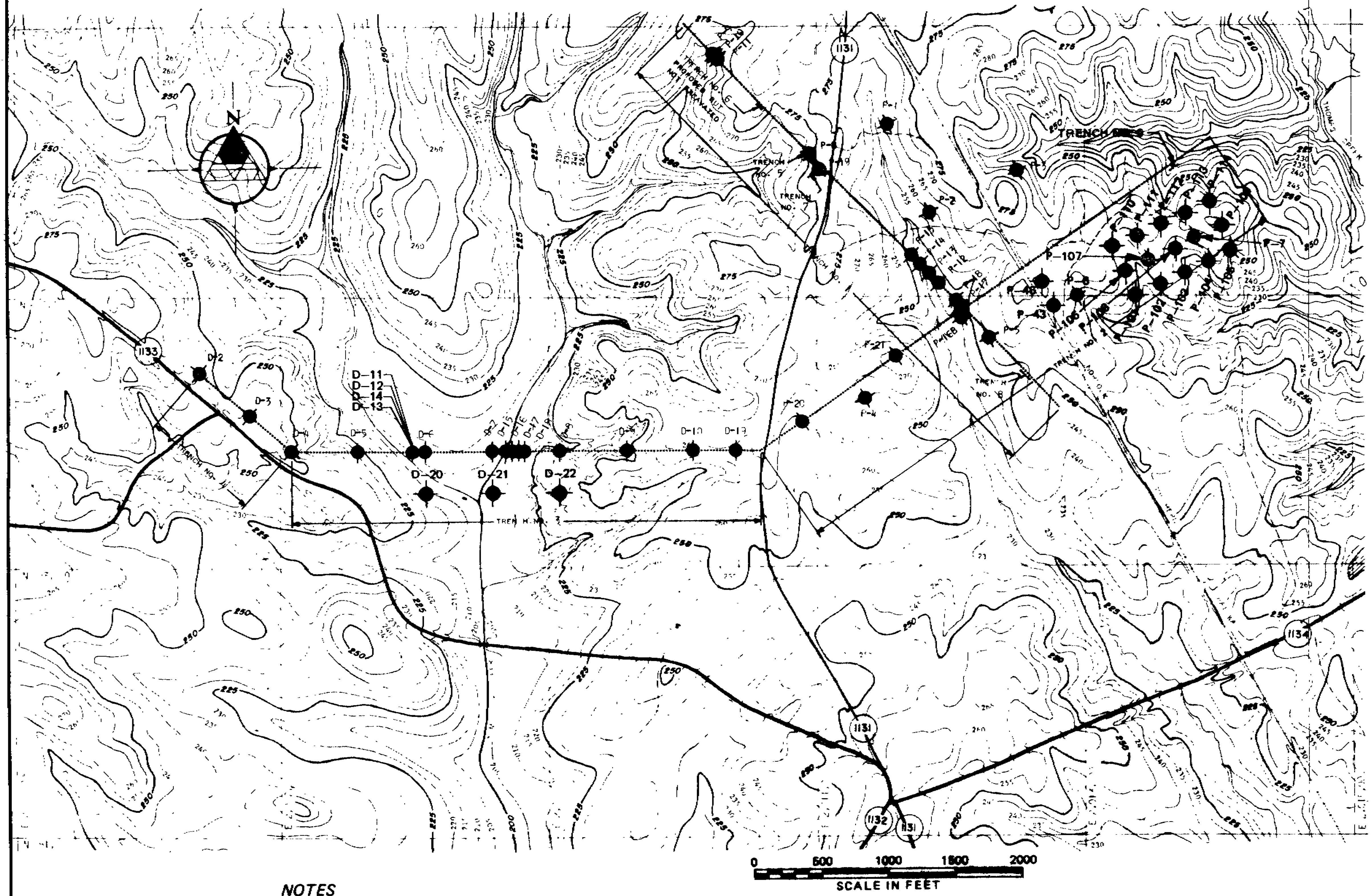


VERTICAL DIFFUSION, σ_y, VS. DOWNWIND DISTANCE FROM SOURCE FOR PASQUILL'S TURBULENCE TYPES

FOR PURPOSES OF ESTIMATING σ_z DURING EXTREMELY STABLE (G) CONDITIONS, THE FOLLOWING APPROXIMATION IS APPROPRIATE:

$$\sigma_z\,(G) = \frac{3}{5}\,\sigma_z\,(F)$$

SHEARON HARRIS NUCLEAR POWER PLANT Carolina Power & Light Company ENVIRONMENTAL REPORT	VERTICAL DISPERSION COEFFICIENTS FOR VARIOUS DISTANCES FROM SOURCE	FIGURE 6.1.3-4



EXPLANATION

● borings drilled for geologic investigation

······· trenches excavated for geologic investigation

NOTES

This map was prepared from portions of the following maps:

- *White Oaks Area Site 1*, by Photo Science Inc., Gaithersburg, Md., dated March 1970,
- *Wake County*, by the North Carolina State Highway Commission, revised June 1968,
- *Carolina Power & Light Co., Whiteoak Site*, by Ebasco Services Inc., revised Oct. 13, 1970.

Horizontal control taken from the North Carolina State Plane Coordinate System.

Vertical control taken from U.S.C.&G.S. datum.

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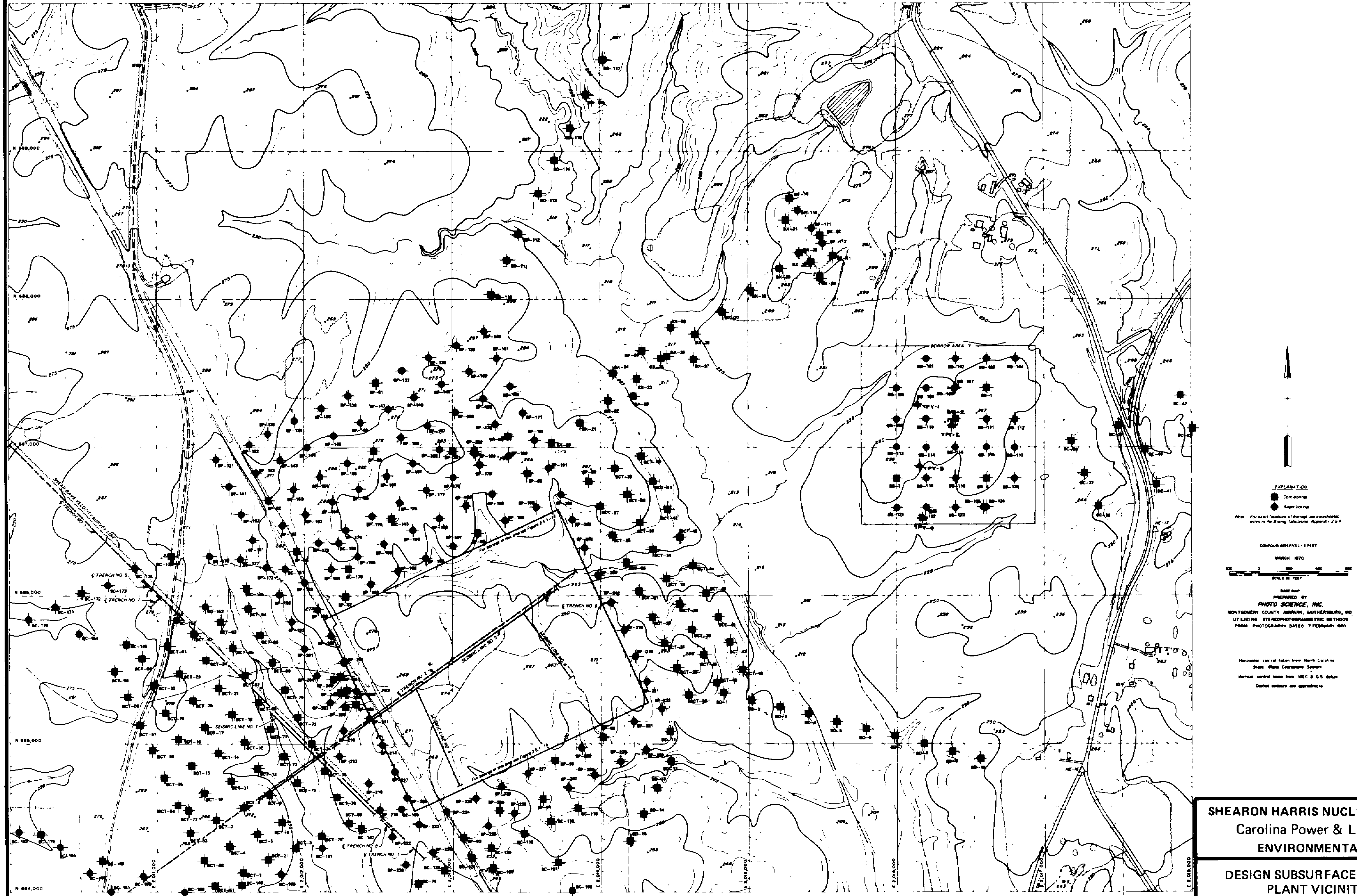
PRELIMINARY SUBSURFACE INVESTIGATION;
PLANT VICINITY

FIGURE 6.1.4-1



Note For exact locations of borings see coordinates listed in the Boring Tabulation Appendix 2.5.A

BASE MAP
PREPARED BY
PHOTO SCIENCE, INC.
MONTGOMERY COUNTY AIRPARK, GAITHERSBURG, MD.
UTILIZING STEREOPHOTOGRAMMETRIC METHODS
FROM PHOTOGRAPHY DATED 7 FEBRUARY 1970

Horizontal control taken from North Carolina State Plane Coordinate System

Vertical control taken from USC & GS datum

Dashed contours are approximate

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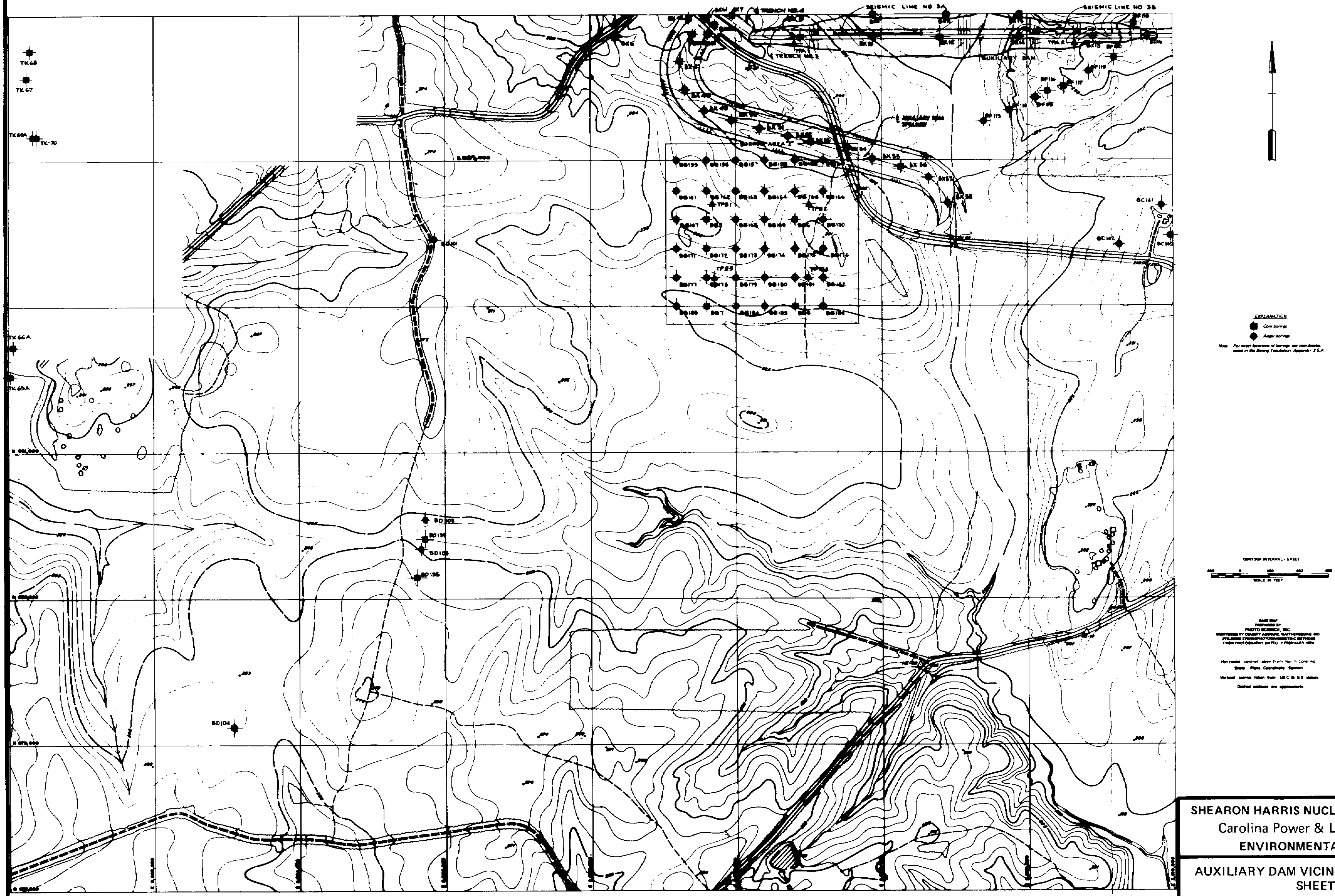
Carolina Power & Light Company
ENVIRONMENTAL REPORT

DESIGN SUBSURFACE INVESTIGATION;
PLANT VICINITY, SHEET 1

FIGURE 6.1.4-2


SEISMIC LINE NO 3A
SEISMIC LINE NO 3B
TRENCH NO 1
TRENCH NO 2
AUXILIARY DAM
AUXILIARY DAM SPILLWAY
BORROW AREA
TK 68
TK 67
TK 69A
TK-70
TK 66A
TK 65A
BD101
BD 102
BD 135
BD 136
BD 104
BC141
BC142
BX 55
BX 56
BX57
BX 58
BF115
BF116
BF117
BF119
TPB1
TPB2
EXPLANATION
Core borings
Auger borings
Note For exact locations of borings see coordinates listed in the Boring Tabulation Appendix 2.5.A
CONTOUR INTERVAL = 5 FEET
200 0 200 400 600
SCALE IN FEET
BASE MAP
PREPARED BY
PHOTO SCIENCE, INC
MONTGOMERY COUNTY AIRPARK, GAITHERSBURG MD
UTILIZING STEREOPHOTOGRAMMETRIC METHODS
FROM PHOTOGRAPHY DATED 7 FEBRUARY 1970
Horizontal control taken from North Carolina State Plane Coordinate System
Vertical control taken from USC & GS datum
Dashed contours are approximate

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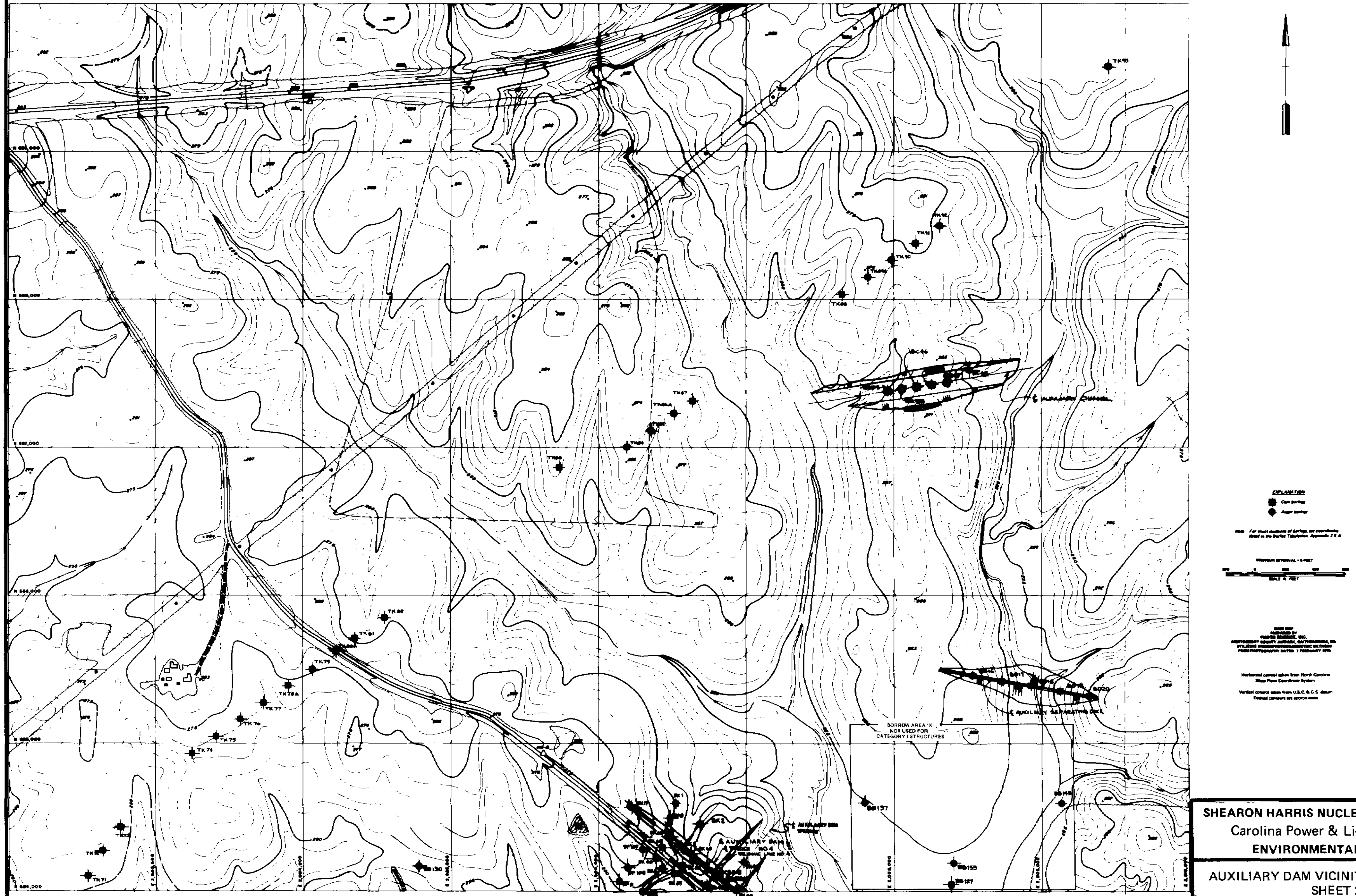
AUXILIARY DAM VICINITY EXPLORATION
SHEET 1

FIGURE 6.1.4-3



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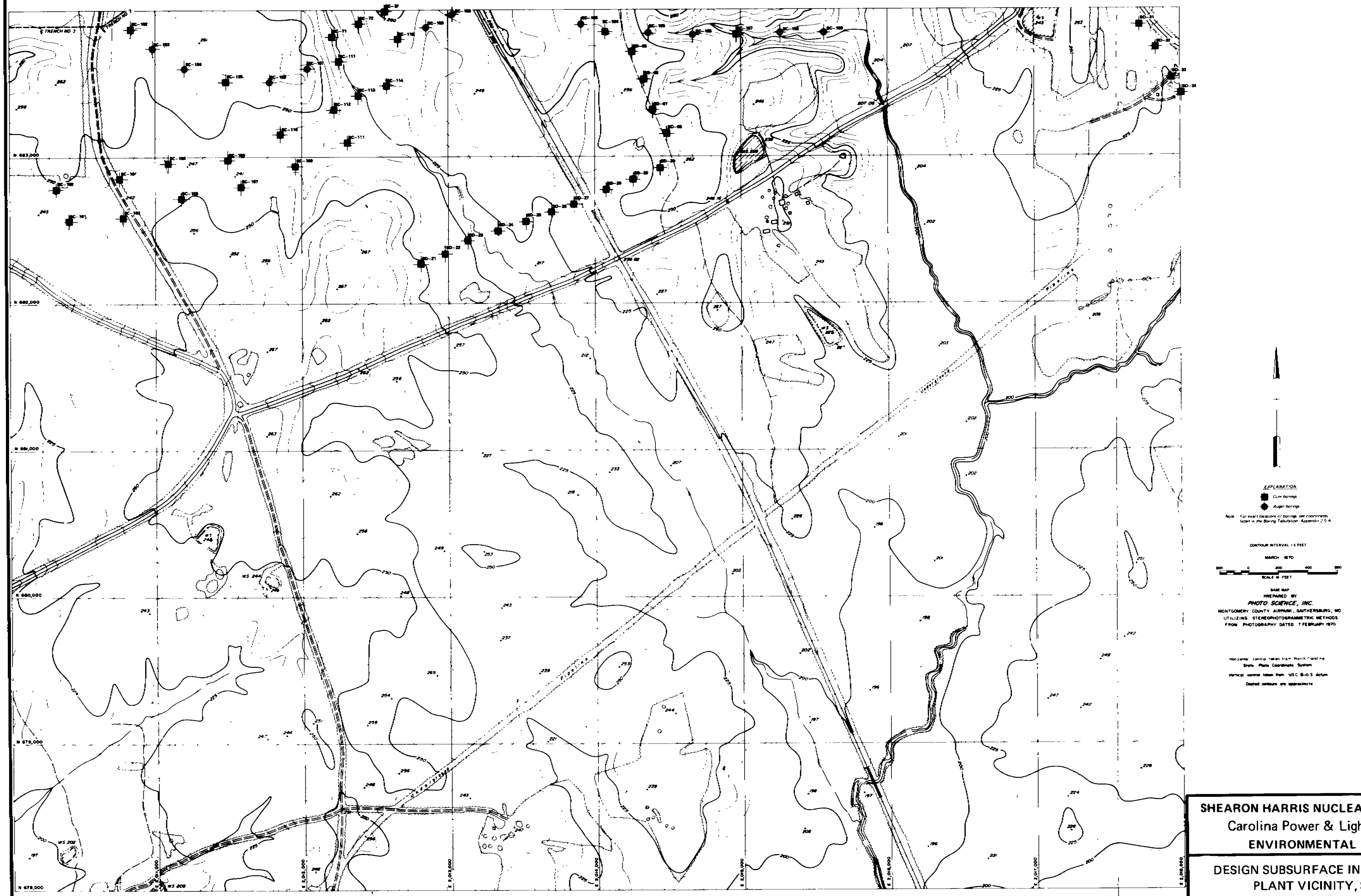
AUXILIARY DAM VICINITY EXPLORATION
SHEET 2

FIGURE 6.1.4-4



EXPLANATION

■ Core borings

◆ Auger borings

Note: For exact locations of borings see coordinates listed in the Boring Tabulation, Appendix 2.5.4.

CONTOUR INTERVAL = 5 FEET

MARCH 1970

BASE MAP
PREPARED BY
PHOTO SCIENCE, INC.
MONTGOMERY COUNTY AIRPARK, GAITHERSBURG, MD
UTILIZING STEREOPHOTOGRAMMETRIC METHODS
FROM PHOTOGRAPHY DATED 7 FEBRUARY 1970

Horizontal control taken from North Carolina State Plane Coordinate System

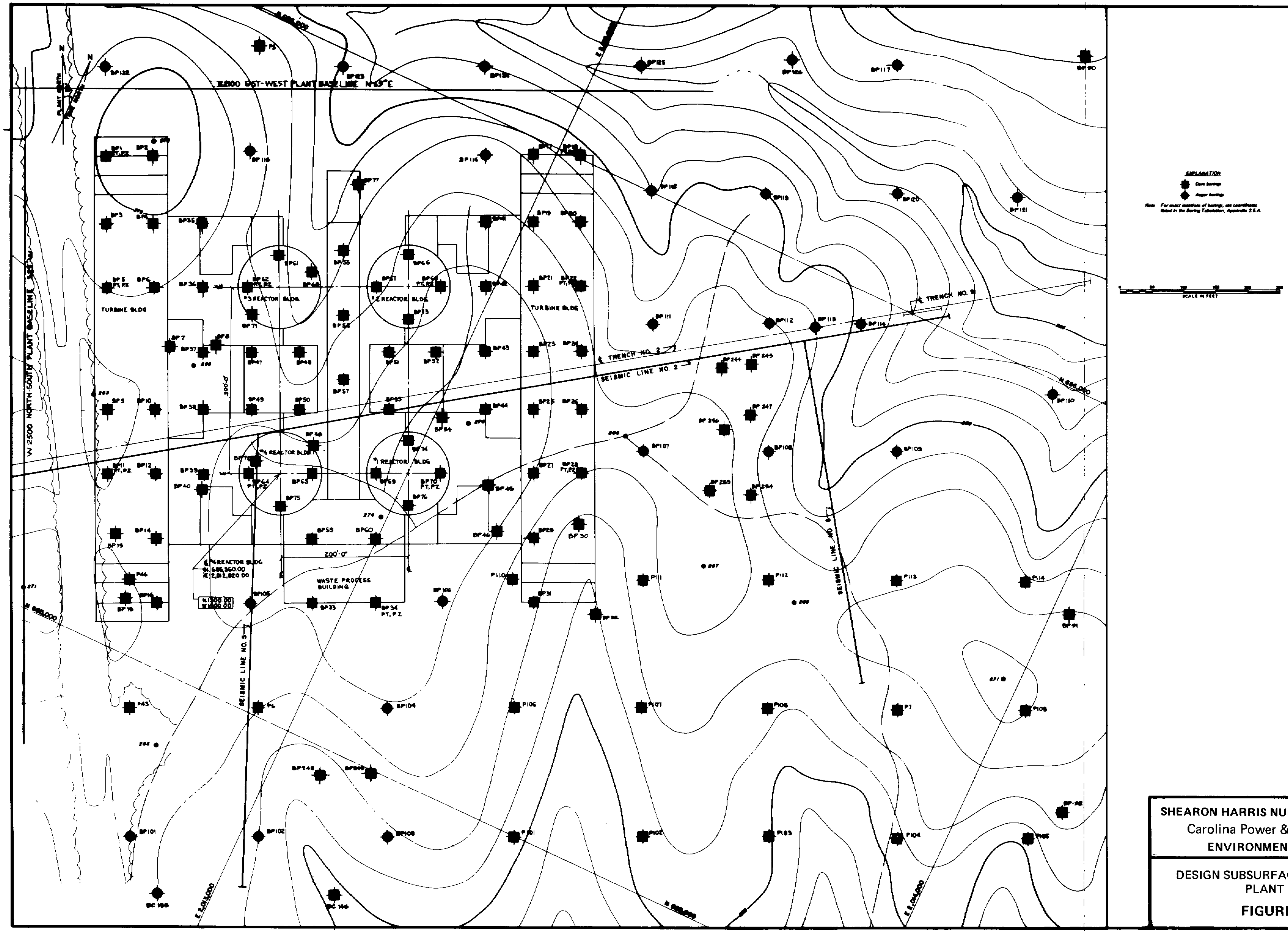
Vertical control taken from USC & G S datum

Dashed contours are approximate

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
ENVIRONMENTAL REPORT

DESIGN SUBSURFACE INVESTIGATION;
PLANT VICINITY, SHEET 2

FIGURE 6.1.4-5



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Carolina Power & Light Company
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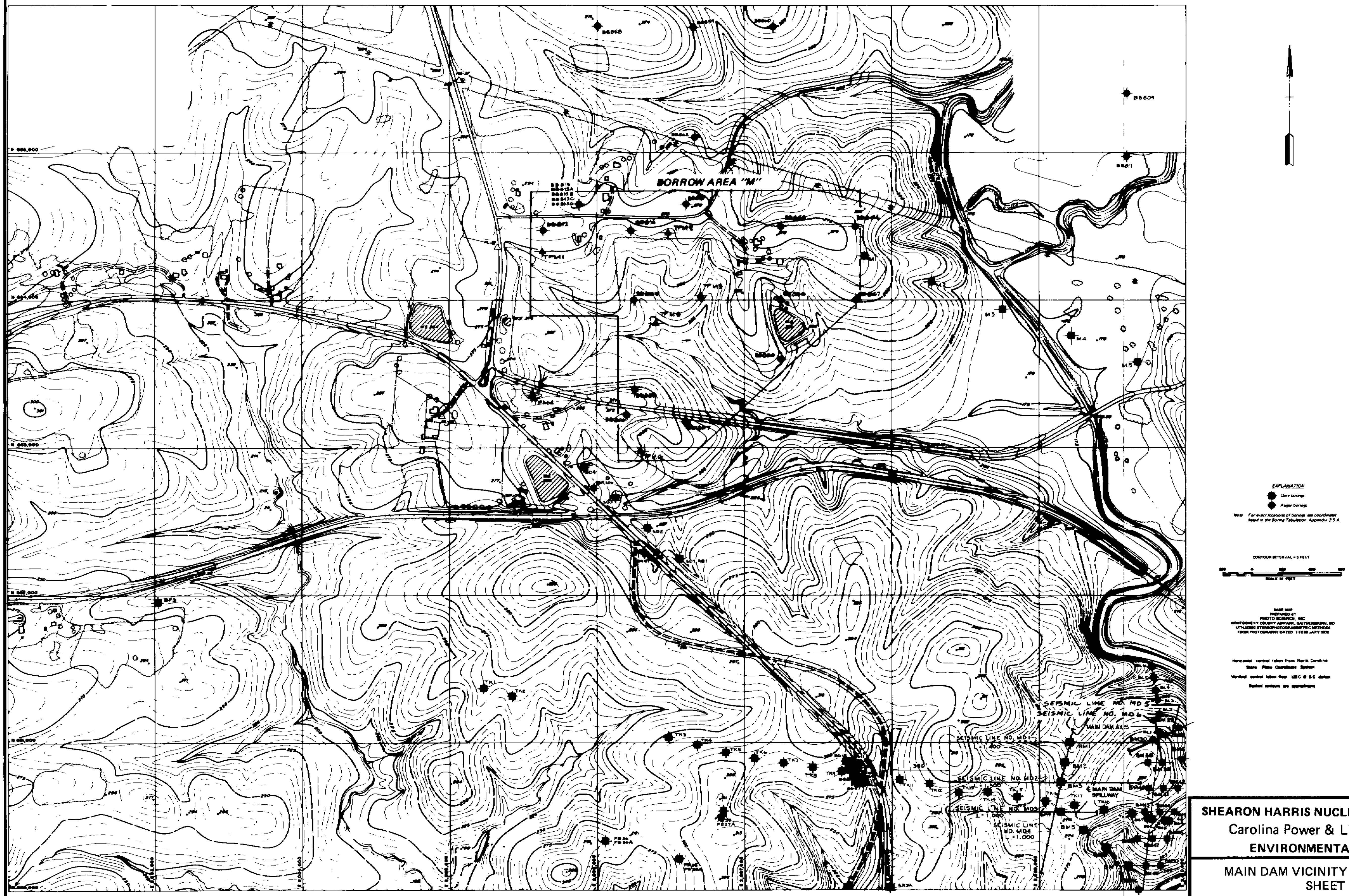
DESIGN SUBSURFACE INVESTIGATION; PLANT ISLAND

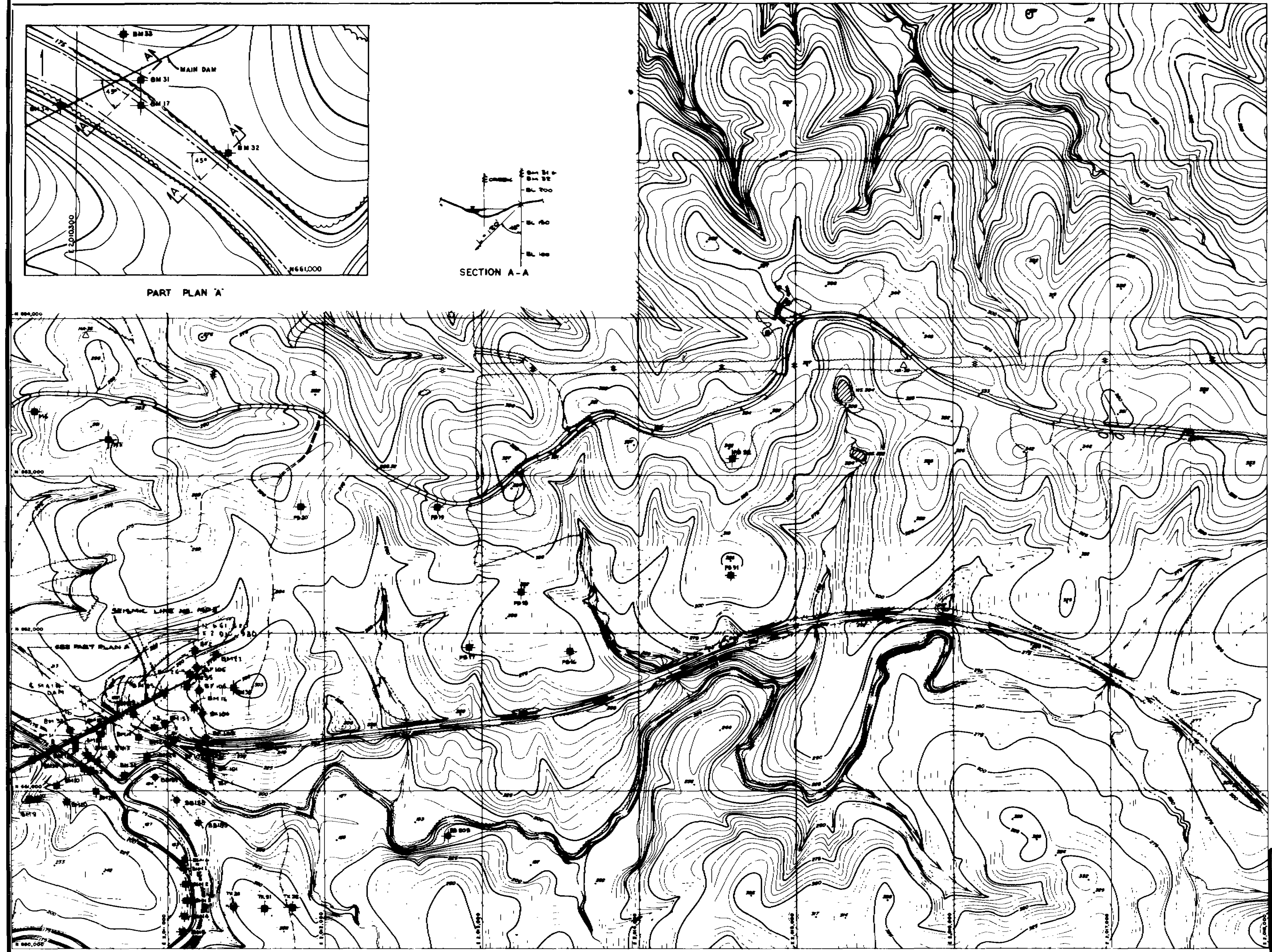
FIGURE 6.1.4-6


BORROW AREA "M"
SEISMIC LINE NO. MD5
SEISMIC LINE NO. MD6
MAIN DAM AXIS
SEISMIC LINE NO. MD1
L = 1,200
SEISMIC LINE NO. MD2
L = 1,500
SEISMIC LINE NO. MD3
L = 1,000
SEISMIC LINE NO. MD4
L = 1,000
℄ MAIN DAM SPILLWAY
EXPLANATION
Core borings
Auger borings
Note For exact locations of borings see coordinates listed in the Boring Tabulation Appendix 2.5.A
CONTOUR INTERVAL = 5 FEET
SCALE IN FEET
BASE MAP
PREPARED BY
PHOTO SCIENCE, INC
MONTGOMERY COUNTY AIRPARK, GAITHERSBURG, MD
UTILIZING STEREOPHOTOGRAMMETRIC METHODS
FROM PHOTOGRAPHY DATED 7 FEBRUARY 1970
Horizontal control taken from North Carolina State Plane Coordinate System
Vertical control taken from USC & GS datum
Dashed contours are approximate

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
ENVIRONMENTAL REPORT

MAIN DAM VICINITY EXPLORATION
SHEET 1

FIGURE 6.1.4-7


PART PLAN 'A'
SECTION A-A
MAIN DAM
BM 33
BM 31
BM 17
BM 32
BM 34
45°
A
N661,000
E 2,010,500
EL 200
EL 150
EL 100
SEISMIC LINE NO. 4
SEE PART PLAN 'A'
℄ MAIN DAM
PB 19
PB 20
PB 17
PB 16
PB 18
PB 21
N 664,000
N 663,000
N 662,000
N 661,000
N 660,000
EXPLANATION
Core borings
Auger borings
Note: For exact locations of borings see coordinates listed in the Boring Tabulation Appendix 2.5.A
CONTOUR INTERVAL - 5 FEET
SCALE IN FEET
PREPARED BY
PHOTO SCIENCE, INC.
MONTGOMERY COUNTY AIRPARK, GAITHERSBURG, MD.
UTILIZING STEREOPHOTOGRAMMETRIC METHODS
FROM PHOTOGRAPHY DATED 7 FEBRUARY 1970
Horizontal control taken from North Carolina State Plane Coordinate System
Vertical control taken from USC & GS datum
Dashed contours are approximate

SHEARON HARRIS NUCLEAR POWER PLANT
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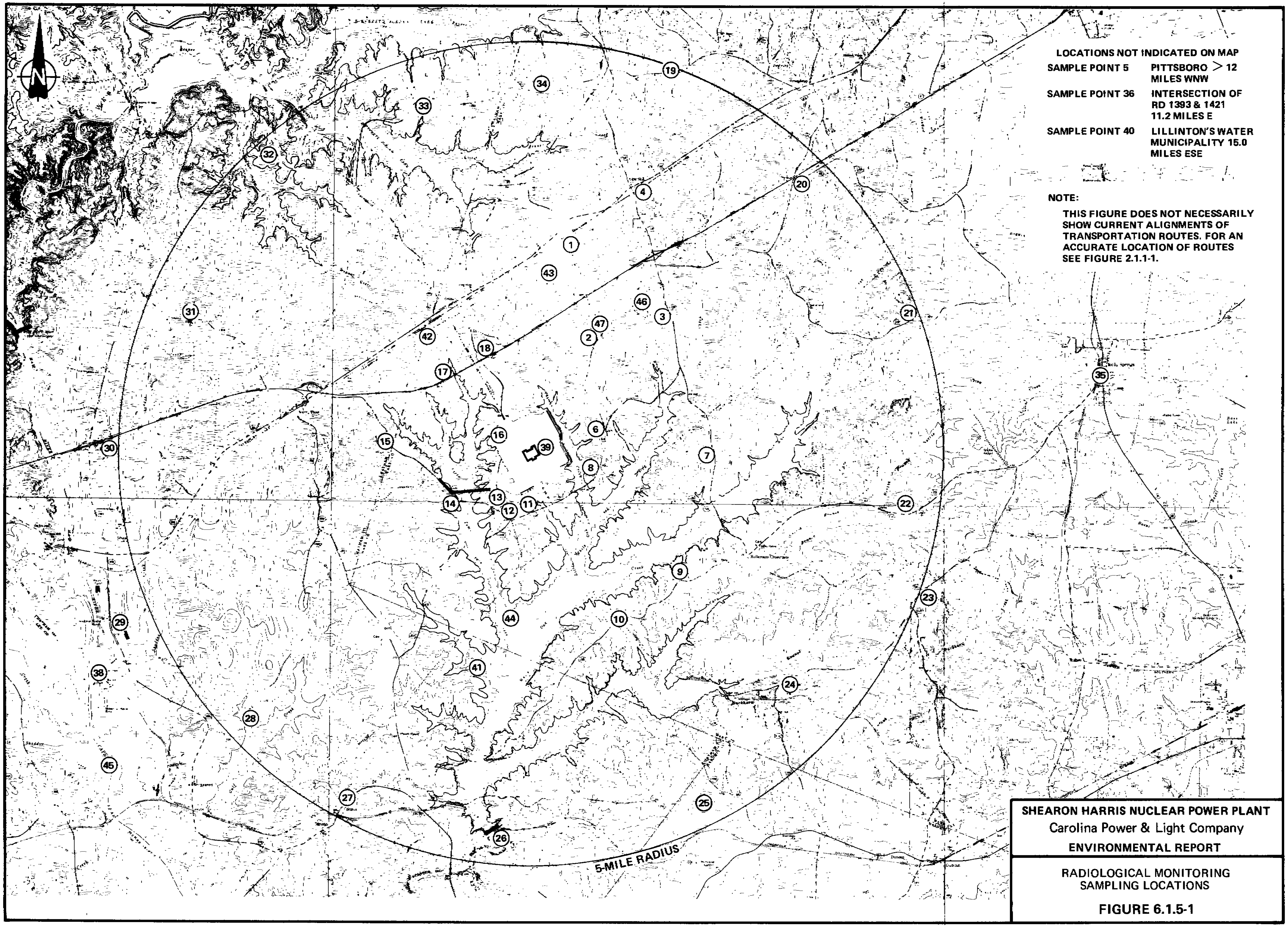
ENVIRONMENTAL REPORT

MAIN DAM VICINITY EXPLORATION
SHEET 2

FIGURE 6.1.4-8



LOCATIONS NOT INDICATED ON MAP

SAMPLE POINT 5	PITTSBORO > 12 MILES WNW
SAMPLE POINT 36	INTERSECTION OF RD 1393 & 1421 11.2 MILES E
SAMPLE POINT 40	LILLINTON'S WATER MUNICIPALITY 15.0 MILES ESE

NOTE:

THIS FIGURE DOES NOT NECESSARILY SHOW CURRENT ALIGNMENTS OF TRANSPORTATION ROUTES. FOR AN ACCURATE LOCATION OF ROUTES SEE FIGURE 2.1.1-1.

SHEARON HARRIS NUCLEAR POWER PLANT

Carolina Power & Light Company

ENVIRONMENTAL REPORT

RADIOLOGICAL MONITORING SAMPLING LOCATIONS

FIGURE 6.1.5-1

6.2 OPERATIONAL MONITORING PROGRAM

6.2.1 NON-RADIOLOGICAL (BIOLOGICAL) MONITORING PROGRAM

The preoperational non-radiological (biological) monitoring program required in the Revised Final Environmental Statement (Reference 6.2.1-1) will be conducted until one year after both units are in commercial operation. This monitoring program will span the period of both operation and construction phases of the two units. Future monitoring programs beyond that described above will be governed by the NPDES permit and/or the Operating License requirements. 2

6.2.2 RADIOLOGICAL MONITORING PROGRAM

The operational radiological monitoring program will be a continuation of the preoperational radiological monitoring program described in Section 6.1.5. In general, it is anticipated that this program will continue for the operating life of the station. Modifications may be proposed at any time with appropriate justification.

6.2.3 METEOROLOGICAL MONITORING PROGRAM

The operational meteorological monitoring program will be a continuation of the preoperational monitoring program described in Section 6.1.3. The only anticipated change will be the inclusion of the Radiological Monitoring System computer (RMS-21) which will interrogate the meteorological station on a regular interval for the purpose of displaying the collected data in the reactor control room for emergency response purposes. No meteorological parameters currently being monitored (as per Section 6.1.3) are expected to be discontinued; however, additional parameters may be monitored with appropriate justification.

REFERENCES SECTION 6.2:

6.2.1-1 United States Atomic Energy Commission, Directorate of Licensing, "Revised Final Environmental Statement Related to Construction of Shearon Harris Nuclear Power Plant Units 1, 2, 3, and 4," March 1974.

6.3 RELATED ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS

Two environmental studies which included investigation of the immediate SHNPP site area were conducted by the North Carolina Wildlife Resources Commission (Reference 6.3-1) and the United States Bureau of Sport Fisheries and Wildlife (Reference 6.3-2). Both studies were completed prior to CP&L's baseline investigations. The first of these studies was a survey and classification of the Cape Fear River and its tributaries including the Buckhorn-Whiteoak Creek system. The other provided general information about the fish and wildlife inhabiting the Whiteoak Creek watershed. | 1

Another study conducted by the North Carolina Wildlife Resources Commission near the SHNPP site (Reference 6.3-3) was a survey and classification of the Deep and Haw Rivers and their tributaries.

The North Carolina Department of Human Resources conducts a continuing radiation surveillance program which involves monitoring of a variety of sample media in 19 North Carolina counties. The sampling location nearest the SHNPP is in Raleigh (Wake County) North Carolina (Reference 6.3-4). | 1

No other related environmental studies are known to have been conducted near the SHNPP site. Furthermore, there are no ongoing environmental studies or known plans to conduct such studies in the SHNPP area by other (non-CP&L) agencies.

REFERENCES: SECTION 6.3

6.3-1 Louder, D. E., Survey and Classification of the Cape Fear River and Tributaries, North Carolina. North Carolina Wildlife Resources Commission. Raleigh, N. C. 1963. 1

6.3-2 Huber, R. T., Preliminary Biology Investigation, Whiteoak Creek Watershed (CNI Watershed 3-14). Unpublished report. U. S. Bureau of Sport Fisheries and Wildlife. Raleigh, N. C. 1969. 1

6.3-3 Carnes, W. C., James R. Davis and Buford L. Tatum Survey and Classification of the Deep-Haw Rivers and Tributaries, North Carolina. North Carolina Wildlife Resources Commission. Raleigh, N. C. 1964. 1

6.3-4 Brown, Dayne H., Environmental Radiation Surveillance - 1978 Report. North Carolina Department of Human Resources, Division of Facility Services, Radiation Protection Section. Raleigh, N. C. Undated. 1

6.4 PREOPERATIONAL ENVIRONMENTAL RADIOLOGICAL MONITORING DATA

At the present time, there is no preoperational radiological environmental data for the Shearon Harris Nuclear Power Plant. The preoperational program described in Section 6.1.5 shall be conducted in accordance with the schedule given in Table 6.1.5-6. 4

CHAPTER 7
ENVIRONMENTAL EFFECTS OF ACCIDENTS

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7.0 ENVIRONMENTAL EFFECTS OF ACCIDENTS

7.1 STATION ACCIDENT INVOLVING RADIOACTIVITY

7.1.1 INTRODUCTION

Accidents which cause concern from the environmental protection standpoint are those which might result in an uncontrolled release of radioactive materials to the environment. Numerous barriers and features are provided which guard against accidental or uncontrolled releases of radioactive materials from the plant. These barriers are 1) the sealed metal cladding tubes which contain the fuel pellets, 2) the Reactor Coolant System which encloses the reactor, and 3) the Containment which houses the Reactor Coolant System. Additional protection of the public is provided by safety features which control the release of radioactivity in the event of an accident, and the site location, which further reduces the potential effects to the general public of an accidental release of radioactivity.

Various postulated incidents and accidents have been analyzed and reported in detail in the Final Safety Analysis Report (FSAR) for the Shearon Harris Nuclear Power Plant. These analyses demonstrate that the plant can be operated safely and that maximum radiation exposures from credible accidents would be within the guidelines of 10CFR100. To provide a high degree of assurance that the radiation doses will be within these guidelines under any credible circumstances, the analyses have been performed using very conservative calculations and assumptions.

Because of the degree of conservatism built into the analyses reported in the FSAR, the doses calculated are far in excess of what would be realistically reported.

To facilitate the assessment of the impact of possible incidents and accidents in a realistic manner, and therefore to allow a judgment as to the potential environmental risk inherent to the operation of the Shearon Harris Nuclear Power Plant further analyses have been made. As compared to the FSAR analyses, the environmental risk analyses are intended to be more realistic. For example, realistic values have been assigned to such parameters as filter efficiencies and atmospheric diffusion.

7.1.2 ANALYSIS OF ENVIRONMENTAL EFFECTS OF ACCIDENTS

A variety of accidents and incidents have been analyzed covering a wide range of severity to facilitate a realistic assessment of environmental risk. Table 7.1.2-1 summarizes the events which were considered. These represent a spectrum of events from relatively minor to the most severe which could credibly be postulated. The classification follows that of Regulatory Guide 4.2, Revision 2, "Preparation of Environmental Reports for Nuclear Power Plants." Calculated results of these events are shown in Table 7.1.2-2 in terms of exclusion area boundary and integrated population doses. Details of the parameters used for each accident are included in the discussion of that event.

7.1.3 DOSE CALCULATION METHODOLOGY

The radiological impacts of the postulated events are evaluated in terms of the radiation doses delivered to individuals and to the population as a whole. Whole body doses due to external exposure and thyroid doses due to inhalation are calculated for: 1) an individual at the exclusion area boundary and 2) the population within 50 miles of the Shearon Harris Nuclear Power Plant site. The calculated exposures are limited to whole body and thyroid gland because these are the critical organs of exposure for the radionuclides of potential concern.

Doses are calculated using the following equations for individual exposure:

$$D_{WB} = \sum_{t}\sum_{i} Q_{it}\ (\chi/Q)_{EZB,t}\ 0.25 E_{\gamma i}$$

$$D_{THY} = \sum_{t}\sum_{i} Q_{it}\ (\chi/Q)_{EZB,t}\ B_t\ DCF_i$$

where:

D_{WB} = total whole body dose, in rems

D_{THY} = total thyroid dose, in rems

Q_{it} = release of isotope, i, during time period, t, in curies

$(\chi/Q)_{EZB,t}$ = dispersion factor applicable for the exclusion zone boundary during time period, t, in sec./m^3

$E_{\gamma i}$ = average gamma energy of isotope i, in MeV per disintegration

B_t = breathing rate applicable for time period, t, in m^3/sec.

DCF_i = thyroid inhalation dose conversion factor for isotope, i, in rems per curie inhaled

These equations are consistent with those given in NRC Regulatory Guide 1.4. The breathing rates used in the calculation of doses are those in NRC Regulatory Guide 1.4. The isotopic data used are presented in Table 7.1.3-1.

The population doses are calculated using the following equations:

$$D_{POP-WB} = \sum_{j} (\chi/Q)_j\ P_j \sum_{t}\sum_{i} Q_{it}\ 0.25\ E_{\gamma i}$$

$$D_{POP-TH} = \sum_{j} (\chi/Q)_j\ P_j \sum_{t}\sum_{i} Q_{it}\ B_t\ DCF_i$$

where:

D_{POP-WB} = whole body population dose, in man-rems

D_{POP-TH} = thyroid population dose, in man-rems

$(\chi/Q)_j$ = dispersion factor applicable for midpoint of position, j, in sec./m^3

P_j = estimated population in position, j, in persons

The positions, j, referred to are 80 areas generated by dividing the 50-mile radius area into five ten-mile annuli and 16 direction sectors. Again this equation is consistent with the models in Regulatory Guide 1.4.

Population doses were calculated using the projected population for the year 2000 which is presented in Section 2.1.2.

The dispersion factors applicable for the exclusion zone boundary and population locations were determined at 10 percent of the levels of NRC Regulatory Guide 1.4. Population doses were calculated by weighting the effects in different directions by the frequency the wind blows in each direction, assuming an isotropic 10 percent wind direction persistence frequency. This is consistent with guidance in NRC Regulatory Guide 4.2.

7.1.4 CLASS 1: TRIVIAL INCIDENTS

Pursuant to NRC Regulatory Guide 4.2, Class 1 incidents have not been considered because of their trivial consequences.

7.1.5 CLASS 2: SMALL RELEASES OUTSIDE CONTAINMENT

Pipes, valves and flanges of systems containing fluids or gases with potentially significant radioactive concentrations are designed, fabricated and erected to minimize leakages that may occur during normal plant operations.

Although constructed with the intention of having no leakage, wear and use-related activities can cause small leakage source terms. These low level releases are evaluated as routine releases and are included in the plant release source terms discussed in Section 3.5. The environmental consequences of these low level releases are given in Section 5.2. In all cases the resultant doses are well within the requirements set forth in 10CFR20 and 10CFR50.

7.1.6 CLASS 3: RADWASTE SYSTEM FAILURE

7.1.6.1 Introduction

Class 3 accidents are identified as postulated accidents initiated by equipment failure or operator error that result in the release of radioactive contaminants to the atmosphere of the Waste Processing Building. Accidents that are considered in this category are: equipment leakage or malfunction of a gas decay tank, equipment leakage or malfunction of a liquid radwaste storage tank, rupture of a gas decay tank, and rupture of a liquid radwaste storage tank.

7.1.6.2 Equipment Leakage or Malfunction of a Gas Decay Tank

7.1.6.2.1 Description

For the purposes of this analysis it is assumed that an inadvertent venting occurs in which a portion of the radioactivity contained in a gas decay tank is released to the environment via the plant stack. This event could result from an operator error.

7.1.6.2.2 Calculation Assumptions

a) Twenty-five percent of the average inventory in a gas decay tank has been assumed to be released via the gas decay tank discharge header (see Table 7.1.6-1, Part I).

b) The airborne radioactivity released via the gas decay tank discharge is vented unfiltered to the environment.

7.1.6.2.3 Probability of Occurrence

Due to the design of the gas decay tanks and the quality control during fabrication, the possibility of a release of the stored radioactive gases in the gas decay tanks as a result of component failure and inadvertent venting is considered small.

7.1.6.2.4 Radiological Effects

Using the assumptions stated, the following offsite doses have been calculated:

	Whole Body	Thyroid
Exclusion Area Boundary (rems)	2.5×10^{-4}	0.0
Population Dose (man-rems)	9.8×10^{-1}	0.0

7.1.6.3 Equipment Leakage or Malfunction of a Liquid Waste Holdup Tank

7.1.6.3.1 Description

This postulated accident is defined as an unspecified leak or malfunction that results in the release of a portion of the average inventory of the tank containing the largest quantities of significant isotopes in the Waste Management System. This tank is identified as a liquid waste holdup tank located in the Waste Processing Building. The airborne radioactivity released from this tank during the accident is then vented directly to the environment.

7.1.6.3.2 Calculation Assumptions

a) Twenty-five percent of the average inventory in a liquid waste holdup tank has been assumed to be released into the Waste Processing Building.

b) An iodine partition factor of 0.001 for air to water has been assumed.

c) The airborn radioactivity released into the Waste Processing Building is released unfiltered to the environment via the plant vent. (See Table 7.1.6-1, Part II).

7.1.6.3.3 Probability of Occurrence

Postulated events that could result in the release of quantities as large as 25 percent of the radioactive inventory of a liquid waste holdup tank are cracks in the steel tank and operator error.

The possibility of small cracks, and resulting low level leak rates is given primary consideration in the design of the system and components. The liquid waste holdup tanks are not subject to high pressures or unusual stresses. Considering these factors, the possibility of a failure of a liquid holdup waste tank is considered small.

A liquid radwaste release initiated by an operator error is also considered a remote possibility. Operating techniques and administrative procedures which will be utilized emphasize detailed system and equipment operating instruction and will minimize the potential for operator error.

In the unlikely event that a release of liquid radioactive wastes does occur, floor drain sump pumps located in the Waste Processing Building will automatically activate and remove the spilled liquid upon receipt of a high water level alarm in the sump pump floor drains.

In view of the above discussion, the possibility of an accident of this type occurring is considered small.

7.1.6.3.4 Radiological Effects

Using the assumptions stated, the following doses have been calculated:

	Whole Body	Thyroid
Exclusion Area Boundary (rem)	0.0	1.5×10^{-5}
Population Dose (man-rems)	0.0	5.7×10^{-2}

7.1.6.4 Rupture of a Gas Decay Tank

7.1.6.4.1 Description

This postulated accident is defined as an unspecified event that initiates the complete rupture of a gas decay tank. The airborne radioactivity released from this tank during the accident is assumed to be vented directly to the environment via the plant vent.

7.1.6.4.2 Calculation Assumptions

a) One hundred percent of the average tank inventory has been assumed to be released, as shown in Table 7.1.6-1, Part III. This evaluation is based on normal operating conditions.

b) The airborne radioactivity released into the Waste Processing Building has been assumed to be released unfiltered to the environment.

7.1.6.4.3 Probability of Occurrence

The likelihood of an inadvertent gas decay tank rupture is considered small. The radioactive gases stored in the decay tanks will consist of fission product gases, hydrogen, and nitrogen cover gas. The nitrogen will be added in the various collection and holdup tanks to preclude the possibility of obtaining a flammable mixture of hydrogen gas. Hence, a tank rupture as a result of ignition of hydrogen in the decay tank is considered remote. The system will also be designed to appropriate industry and Seismic Class I component standards. In addition, a system monitor with associated alarms, isolation valves, and system surveillance will assure that the possibility of this type of accident is small.

7.1.6.4.4 Radiological Effects

Using the assumptions stated, the following doses have been calculated:

	Whole Body	Thyroid
Exclusion Area Boundary (rems)	1.0×10^{-3}	0.0
Population Dose (man-rems)	3.9	0.0

7.1.6.5 Rupture of a Liquid Radwaste Holdup Tank

7.1.6.5.1 Description

This postulated accident is defined as an unspecified event that initiates the complete rupture of the tank containing the largest quantity of significant isotopes in the Waste Management System. This tank has been identified as a liquid waste holdup tank located in the Waste Processing Building. The airborne radioactivity released from this tank during the postulated accident is then vented to the environment via the plant vent.

7.1.6.5.2 Calculation Assumptions

a) One hundred percent of the average inventory of a liquid waste holdup tank has been assumed to be released into the Waste Processing Building.

b) An iodine partition factor of 0.001 for air to water has been assumed.

c) The airborne radioactivity released has been assumed to be released unfiltered to the environment (see Table 7.1.6-1, Part IV).

7.1.6.5.3 Probability of Occurrence

The discussion concerning the remoteness of an equipment leakage or malfunction accident of a liquid radwaste tank is equally applicable to a complete release accident. The possibility of a complete rupture or complete malfunction accident is therefore considered even less than that of the partial release accident described in Section 7.1.6.3.

7.1.6.5.4 Radiological Effects

Using the assumptions stated, the following offsite doses have been calculated:

	Whole Body	Thyroid
Exclusion Area Boundary (rems)	0.0	5.8×10^{-5}
Population Dose (man-rems)	0.0	2.3×10^{-1}

7.1.7 CLASS 4: FISSION PRODUCTS TO PRIMARY SYSTEM (Boiling Water Reactors)

This class of accidents is not applicable to facilities, such as the Shearon Harris Nuclear Power Plant that utilize pressurized water reactors.

7.1.8 CLASS 5: FISSION PRODUCTS TO PRIMARY AND SECONDARY SYSTEMS (Pressurized Water Reactors)

7.1.8.1 Fuel Cladding Defects and Steam Generator Leaks

Pipes, valves and flanges of systems containing fluids with potentially significant radioactive concentrations are designed, fabricated and erected, to the degree practicable, to minimize leakage that may occur during normal plant operation. Although constructed with the intention of having no leakage, wear and use related activities can cause primary to secondary steam generator leakage.

The assumptions, conditions and methodology used to determine these low level releases and subsequent doses are described in Section 5.2 of this report.

7.1.8.2 Off-Design Transient that Induces Fuel Failure Above That Expected and Steam Generator Leaks (such as flow blockage and flux maldistributions)

7.1.8.2.1 Description

An off-design transient that could induce fuel rod failures has been identified as a single reactor coolant pump shaft seizure accident, and, in this analysis, is postulated as the instantaneous seizure of the pump shaft. The reactor coolant flow following such an event would be rapidly reduced. Since a rapid reduction in coolant flow results in a rapid reduction in the margin to departure from nucleate boiling (DNB), a low DNB ratio trip occurs (overtemperature delta T).

In order to assess the radiological consequences of this accident, the reactor coolant radionuclide inventory after the accident has been adjusted to account for the additional fission product release resulting from failure of the fuel cladding by the accident. For the purposes of this analysis, the quantity of noble gases and radioiodines released from the secondary system has been considered to be proportional to the amount of steam that passes through the condenser hotwell during the cooldown period, the condenser hotwell iodine partition factor, and the concentration of radioiodine in the turbine steam.

In the course of the cooldown period, which is assumed to be carried out by dumping steam to the main condenser with the aid of the turbine bypass valves, approximately 1,274,465 lb. of steam are dumped to cool the unit. After the unit is sufficiently cooled, the main condenser is shutdown and the condenser vacuum pump discharge to the atmosphere is terminated.

7.1.8.2.2 Calculation Assumptions

a) Of the core inventory, 0.02 percent of the noble gases and 0.02 percent of the core inventory of halogens have been assumed to be released into the reactor coolant.

b) The reactor coolant inventory prior to the accident has been based on 0.5 percent failed fuel.

c) Secondary system equilibrium radioactivity prior to the transient has been calculated assuming a 20 gal./day steam generator leak rate and 10 gpm steam generator blowdown rate.

d) The radioactivity contained in 1,274,465 lb. of steam is assumed to pass through the main condenser hotwell during the duration of the accident. This activity is given in Table 7.1.6-1, Part V.

e) A main condenser iodine partition factor of 0.001 has been assumed.

7.1.8.2.3 Probability of Occurrence

Components and materials used to construct the reactor coolant pumps are of the type that have been used successfully in other nuclear power plants. The equipment is designed to Seismic Category I standards and to the best commercial standards and practices. In addition, the reactor coolant pumps are designed, fabricated, and constructed under a comprehensive quality assurance program to assure compliance with all applicable specifications and codes. Considering these precautions, the possibility of an accident of this type occurring during the lifetime of the plant is considered to be remote.

7.1.8.2.4 Radiological Effects

Using the assumptions stated, the following offsite exposures have been calculated:

	Whole Body	Thyroid
Exclusion Area Boundary(rems)	5.5×10^{-5}	6.1×10^{-7}
Population Dose (man-rems)	2.1×10^{-1}	2.3×10^{-3}

7.1.8.3 Steam Generator Tube Rupture

7.1.8.3.1 Description

A steam generator tube rupture accident is an accident that causes a penetration of the barrier between the Reactor Coolant System and the Main Steam System. Integrity of this barrier is significant from the radiological safety standpoint, since a leaking steam generator tube would allow transport of reactor coolant into the Main Steam System. Radioactivity contained in the reactor coolant would mix with shell side water in the affected steam generator. This radioactivity would then pass to the turbine and condenser.

The noncondensible radioactive materials in the condenser hotwell would then be discharged to the environment through a charcoal bed adsorber by the condenser vacuum pumps.

It is assumed that after 30 minutes the operator has diagnosed the problem and has closed the main steam and feewater isolation valves of the leaking steam generator. Radioactivity levels in the steam generator blowdown lines from the damaged steam generator are the main indicator. Plant cooldown is then initiated by dumping steam from the remaining two intact steam generators. After the temperature of the reactor coolant is sufficiently reduced, the operator initiates shutdown cooling and isolates the intact steam generators. During the plant cooldown period the operator manually regulates safety injection and charging flow rates in order to maintain adequate pressurizer water level.

Secondary system activity after steam generator tube rupture was calculated by assuming that the reactor coolant leaks from the primary to secondary system for thirty minutes following the tube rupture. For the purposes of this analysis the post tube rupture secondary system activity has been conservatively assumed to consist of original equilibrium activity plus the activity associated with the leaking reactor coolant. The quantity of noble gases and radioiodines released has been assumed to be proportional to the flow rate of steam through the condenser.

7.1.8.3.2 Calculation Assumptions

a) During the first 30 minutes following a steam generator tube rupture, 15 percent of the reactor coolant has been assumed to leak from the primary to secondary system.

b) The average primary reactor coolant inventory prior to the accident is based on 0.5 percent failed fuel.

c) The equilibrium reactor coolant radionuclide concentration prior to the incident is based on a primary to secondary steam generator leak rate of 20 gal. per day and a steam generator blowdown rate of 10 gpm.

d) During the plant cooldown the activity contained in 1,274,465 lbs. of steam was assumed to pass through the condenser hotwell from the intact and faulted steam generators.

e) Iodine partition factors of 0.01 and 0.001 have been assumed for the steam generators and condenser hotwell respectively. The activity released to the environment is presented in Table 7.1.6-1, Part VI.

7.1.8.3.3 Probability of Occurrence

The probability for catastrophic failure of a steam generator tube is considered minimal. The pressures calculated to cause a rupture are far in excess of normal operating conditions. The more probable modes of failure result in considerably smaller penetrations of the pressure barrier. They involve the formation of etch pits, small cracks in the U-tubes or cracks in the welds joining the tubes to the tube sheet. These releases are evaluated under normal plant operations in Section 5.2.

7.1.8.3.4 Radiological Effects

Using the assumptions stated, the following offsite doses have been calculated:

	Whole Body	Thyroid
Exclusion Area Boundary (rems)	4.3×10^{-3}	1.2×10^{-6}
Population Dose (man-rems)	1.7×10^{1}	4.6×10^{-3}

7.1.9 CLASS 6: REFUELING ACCIDENTS

7.1.9.1 Introduction

Class 6 accidents are postulated events that might occur during refueling operations in the Containment Building. The accidents considered in Class 6 are the dropping of a fuel bundle assembly and dropping a heavy object onto the reactor core.

7.1.9.2 Fuel Assembly Drop

7.1.9.2.1 Description

This accident has been postulated to be an equipment failure or mishandling event that results in the dropping of a spent fuel assembly into the refueling cavity during refueling operations. It is further assumed that the assembly falls from a height sufficient to rupture one row of fuel rods, whose gap activity is subsequently released to the refueling cavity water. The radioactive gases then bubble through the refueling pool water which entrains most of the iodine. The remainder escapes to the Containment Building atmosphere. The airborne radioactivity is then passed through charcoal and HEPA filters before being released to the environment.

7.1.9.2.2 Calculation Assumptions

a) This accident occurs one week after reactor shutdown.

b) The equilibrium gap activity (noble gases and halogens) in one row of fuel rods, which is equivalent to 17 fuel rods, is released into the refueling pool water. The gas gap activity has been assumed to be one percent of the total activity of a fuel rod.

c) An iodine decontamination factor (initial activity/final activity) in water of 500 has been assumed.

d) 1.0 percent of the airborne radioactivity released into the Containment Building leaks to the environment unfiltered prior to isolation of the containment.

e) 99.0 percent of the airborne radioactivity released into the Containment Building has been assumed to be released to the environment via charcoal and HEPA filters.

f) A filter efficiency of 99 percent for the charcoal filters has been assumed. Total activity released to the environment following the accident is included in Table 7.1.6-1, Part VII.

7.1.9.2.3 Probability of Occurrence

The possibility of damage to a fuel assembly as a consequence of equipment failure or mishandling is minimized through equipment design, detailed refueling procedures and personnel training.

The reliability of the fuel handling equipment, including the bridge and trolley, the lifting mechanism, the transfer mechanism and all associated instrumentation and controls, is ensured through adoption of preoperational check-out tests. The maximum elevation to which the fuel assemblies can be raised is limited by the design of the handling hoists and minipulators. The refueling equipment platform assembly is constructed to Seismic Category I standards.

Considering the precautions that are taken in the design and the operation procedures that are required, the possibility of a refueling accident occurring during the lifetime of the plant is considered to be remote.

7.1.9.2.4 Radiological Effects

Using the assumptions stated, the following offsite doses have been calculated:

	Whole Body	Thyroid
Exclusion Area Boundard (rems)	3.3×10^{-5}	5.6×10^{-5}
Population Dose (man-rems)	1.3×10^{-1}	2.2×10^{-1}

7.1.9.3 Heavy Object Drop Onto Fuel In Core

7.1.9.3.1 Description

This postulated accident assumes that a heavy object is dropped onto the reactor core as a result of an equipment failure or mishandling event. It is further postulated that the heavy object is dropped from a height sufficient to rupture one fuel assembly whose gap activity is subsequently released to the reactor core coolant. The radioactive gases then bubble through the reactor coolant with most of the iodine being entrained. The remainder is then released to the containment atmosphere.

The airborne radioactivity is then passed through charcoal and HEPA filters before being released to the environment.

7.1.9.3.2 Calculation Assumptions

a) This accident occurs 100 hours after reactor shutdown.

b) The equilibrium gap activity (noble gases and halogens) in one average fuel assembly has been assumed to be one percent of the total activity of the fuel rod.

c) An iodine decontamination factor (inital activity/final activity) in water of 500 has been assumed.

d) 1.0 percent of the airborne radioactivity released into the Containment Building leaks to the environment unfiltered prior to isolation of the containment.

e) 99.0 percent of the airborne radioactivity released into the Containment Building has been assumed to be released to the environment via charcoal and HEPA filters.

f) A filter efficiency of 99 percent for the charcoal filters has been assumed. The total activity released to the environment following the accident is included in Table 7.1.6-1, Part VIII.

7.1.9.3.3 Probability of Occurrence

The discussion concerning the remoteness of a fuel bundle drop onto the reactor core is equally applicable to a heavy object drop onto the reactor core.

The frequency of handling heavy objects over the reactor core is small compared to that of handling fuel assemblies. In addition, the probability of equipment failure during handling operations involving fuel assemblies and heavy objects is of the same order of magnitude. Therefore, the possibility of a heavy object drop accident is considered even more remote than the possibility of a fuel handling accident.

7.1.9.3.4 Radiological Effects

Using the assumptions stated, the following offsite doses have been calculated:

	Whole Body	Thyroid
Site Boundary (rems)	7.6×10^{-4}	1.2×10^{-3}
Population Dose (man-rems)	2.9	4.5

7.1.10 CLASS 7: SPENT FUEL HANDLING ACCIDENTS

7.1.10.1 Introduction

Class 7 accidents are identified as postulated events that involve the handling of spent fuel during refueling operations in the Fuel Handling Building. The accidents considered in Class 7 are: dropping of a fuel assembly in the fuel storage pool, dropping of a heavy object onto a fuel storage rack, and the dropping of a loaded spent fuel shipping cask.

Since spent fuel from the Brunswick Steam Electric Plant may be stored in the SHNPP spent fuel pools, an evaluation of spent fuel handling accidents involving Brunswick spent fuel is also addressed. Brunswick is a two-unit boiling water reactor which has a thermal power level of 2436 Mw per unit. Spent fuel from Brunswick would undergo a minimum 120 day decay and cooling period prior to being shipped to SHNPP for storage.

7.1.10.2 Fuel Assembly Drop In Fuel Storage Pool

7.1.10.2.1 Description

This event postulates that a spent fuel assembly is dropped in the fuel storage pool by the fuel handling crane and onto a spent fuel rack. The assembly falls through the pool water from an unspecified height above the storage rack. Upon impact, the fuel rods fail and release their gas gap activity into the spent fuel pool. The released radioactive gases then bubble through the spent fuel storage water with most of the iodine being entrained and the remainder being released to the fuel handling building atmosphere.

Upon receipt of a signal for high radioactivity, the isolation dampers of the normal ventilation system will close and the fuel handling building emergency ventilation system will be started.

7.1.10.2.2 Calculation Assumptions

a) The accident occurs one week after reactor shutdown.

b) An average of one percent of the noble gas activity and one percent of the halogen core activity is in each fuel rod gap and is available for release if the fuel rod is damaged.

c) It is assumed that one row of fuel rods fail.

d) An iodine decontamination factor of 500 in the refueling pool water has been assumed.

e) The airborne radioactivity is passed through 99 percent efficient charcoal filters before being released to the environment (see Table 7.1.6-1, Part IX).

For accidents involving Brunswick spent fuel, all of the above assumptions remain the same except for the following:

a) The accident occurs 120 days after reactor shutdown.

b) It is assumed that one row of fuel rods (six rods) fail.

7.1.10.2.3 Probability of Occurrence

The discussion concerning the remoteness of a Class 6 fuel assembly drop accident is equally applicable to this Class 7 accident. As discussed previously, the possibility of a fuel assembly drop accident is considered remote.

7.1.10.2.4 Radiological Effects

Using the assumptions stated, the following offsite doses have been calculated:

	SHNPP Fuel		Brunswick Fuel	
	Whole Body	Thyroid	Whole Body	Thyroid
Exclusion Area Boundary (rems)	3.3×10^{-5}	2.8×10^{-5}	1.3×10^{-6}	2.3×10^{-8}
Population Dose (man-rems)	1.3×10^{-1}	1.1×10^{-1}	5.1×10^{-3}	9.1×10^{-5}

7.1.10.3 Heavy Object Drop Onto Fuel Rack

7.1.10.3.1 Description

This hypothetical accident postulates that an unspecified heavy object is dropped onto the spent fuel storage rack and results in the release of radioactive gases from the damaged fuel elements. The released radioactive gases then bubble through the spent fuel storage pool water, with the iodine gases undergoing a scrubbing process as the gas bubbles rise to the surface of the water. The noble gases and remaining iodine gas are then released to the fuel handling building atmosphere where the same ventilation procedures enacted during fuel assembly drop accident apply.

The operating procedures and the design of the spent fuel handling area and fuel handling equipment at the SHNPP are such that no identifiable heavy objects can be dropped on a spent fuel storage rack during any refueling operations.

However, to provide an upper limit estimate for the maximum hypothetical release for an accident of this type, it is postulated that an unspecified heavy object is dropped onto the spent fuel racks resulting in the release of the gap activity (noble gases and halogens) in one average fuel assembly into the spent fuel pool.

7.1.10.3.2 Calculation Assumptions

a) The accident occurs 30 days after reactor shutdown.

b) An average of one percent of the noble gas core activity and one percent of the halogen core activity is in each fuel rod gas gap and is available for release if the fuel rod is damaged.

c) The gas gap activity in one average fuel assembly (264 fuel rods) has been assumed to be released into the spent fuel storage pool.

d) An iodine decontamination factor of 500 has been assumed.

e) The airborne radioactivity is passed through 99 percent efficient charcoal filters before being released to the environment (see Table 7.1.6-1, Part X).

For accidents involving Brunswick spent fuel, all of the above assumptions remain the same except for the following:

a) The accident occurs 120 days after reactor shutdown.

b) The gas gap activity in an average fuel assembly (35 fuel rods) has been assumed to be released into the spent fuel storage pool.

7.1.10.3.3 Probability of Occurrence

Because design and procedures preclude the dropping of heavy objects that could result in an accident of this nature, the opportunity for occurrence of this type of accident is considered nonexistent.

7.1.10.3.4 Radiological Effects

Using the assumptions stated, the following offsite doses have been calculated:

	SHNPP Fuel		Brunswick Fuel	
	Whole Body	Thyroid	Whole Body	Thyroid
Exclusion Area Boundary (rems)	$2.5x10^{-5}$	$6.1x10^{-5}$	$7.5x10^{-6}$	$1.3x10^{-7}$
Population Dose (man-rems)	$9.8x10^{-2}$	$2.4x10^{-1}$	$2.9x10^{-2}$	$5.3x10^{-4}$

7.1.10.4 Fuel Cask Drop Accident

7.1.10.4.1 Description

The design of the Fuel Handling Building is such that the only transfer operation that could involve the dropping of a loaded spent fuel cask a significant distance is the transfer of the spent fuel cask from the spent fuel cask loading pool to the decontamination area, and thence to the railcar transporter. In no case will the cask design criteria be exceeded (drop not to exceed the equivalent of a 30 ft. drop through air).

Spent fuel transfer operations begin when the spent fuel assemblies are lowered from the spent fuel storage pool area by a building crane into the cask located on the bottom of the spent fuel cask loading pool. The building crane then lifts and transfers the loaded cask to the decontamination area. It is during this operation that a cask drop accident is postulated to occur, initiated by an undefined failure of the cask handling crane. Following the failure, the cask is assumed to fall from its maximum height and strike the spent fuel cask decontamination area floor releasing the gas gap activities. These gases are then released to the environment through the fuel handling building ventilation system.

7.1.10.4.2 Calculation Assumptions

a) The fuel shipping cask contains seven fuel assemblies.

b) All of the noble gas gap activity from one fully loaded fuel shipping cask (120 days cooling) is released. This activity is shown in Table 7.1.6-1, Part XI.

c) An average of one percent of the noble gas core activity is in each fuel rod gap and is available for release if the fuel rod is damaged.

For all accidents involving Brunswick spent fuel, all of the above assumptions remain the same except the following:

a) The fuel shipping cask contains 18 fuel assemblies.

7.1.10.4.3 Probability of Occurrence

Equipment design, operating procedures, and personnel training will minimize the possiblility of a fuel cask drop accident during the lifetime of the plant. In addition, the design of the spent fuel cask equipment limits the maximum lifting height of a spent fuel cask to the equivalent of 30 ft. through air to an unyielding surface. Spent fuel casks are designed to withstand a 30 ft. drop onto an unyielding surface without rupture, as required by 10CFR71. In practice, these assumed releases are not expected to occur.

7.1.10.4.4 Radiological Effects

Using the assumptions stated, the following offsite doses have been calculated:

	SHNPP Fuel		Brunswick Fuel	
	Whole Body	Thyroid	Whole Body	Thyroid
Exclusion Area Boundary (rems)	3.5×10^{-6}	0.0	1.4×10^{-4}	1.2×10^{-3}
Population Dose (man-rems)	1.4×10^{-2}	0.0	5.3×10^{-1}	4.7×10^{0}

7.1.11 CLASS 8: ACCIDENT INITIATION EVENTS CONSIDERED IN DESIGN BASIS EVALUATION IN THE SAFETY ANALYSIS REPORT

7.1.11.1 Introduction

Class 8 events are those accidents considered in Chapter 15 of the Final Safety Analysis Report (FSAR). These accidents are evaluated using highly conservative assumptions as to the design basis events to establish the performance requirements of the engineered safety features. The highly conservative assumptions used in the FSAR and NRC safety evaluations are not suitable for evaluating the environmental risks of Class 8 events because their use would result in an unrealistic overestimate of the risk. For this reason, events in Class 8 shall be more realistically evaluated. Accidents considered are:

a) a pipe break accident resulting in a small loss of coolant,

b) a pipe break accident resulting in a large loss of coolant,

c) a control rod ejection accident,

d) an instrument line break accident,

e) a small steamline break accident, and

f) a large steamline break accident.

7.1.11.2 Loss-of-Coolant Accident: Break in a Small Pipe

7.1.11.2.1 Description

A loss-of-coolant accident represents a malfunction of the Reactor Coolant System that interrupts normal cooling operations and results in the release of primary coolant, containing radioactive fission products, to the Containment. The activity is then released to the atmosphere via leakage from the Containment.

7.1.11.2.2 Calculation Assumptions

a) The average radioactivity inventory in the primary coolant has been assumed to be released into the Containment. This inventory has been calculated assuming operation with 0.5 percent failed fuel.

b) A containment leak rate of 0.1 percent/day for the duration of the accident has been assumed.

c) Five percent of the halogens and all of the noble gases are assumed to remain airborne and available for leakage from the Containment. The releases to the environment are presented in Table 7.1.11-1.

7.1.11.2.3 Probability of Occurrence

A loss-of-coolant accident is a design basis accident for the plant. Therefore, consideration of factors relating to the prevention and mitigation of this accident is contained throughout the entire Final Safety Analysis Report. However, some of the more significant considerations warrant summarization here.

The plant has been designed, fabricated and constructed under a comprehensive quality assurance program to assume compliance with all applicable specifications and codes.

All reactor coolant system components are designed and fabricated in accordance with the American Society of Mechanical Engineers (ASME), Boiler and Pressure Vessel Code, Section III. The Reactor Coolant System in the Containment is designed to withstand the loads imposed by the design basis loss-of-coolant accident and the design basis earthquake without the loss of functions required for emergency reactor shutdown and emergency core cooling.

The major reactor coolant system components are designed for a 40 yr. operating lifetime. Components are of materials that are compatible with coolant chemistry. Fatigue analyses based on conservative design cyclic transients and primary stress combinations have been evaluated in accordance with the applicable codes. Overpressure protection is assured by ASME Code safety valves.

Engineereed safety features act to control and mitigate the consequences of a loss-of-coolant accident for the entire spectrum of pipe break sizes.

After installation, the Reactor Coolant System is hydrostatically tested and leak tested. A series of tests is conducted prior to reactor fueling, during fueling and following initial criticality.

Technical specifications, operating procedures and other administrative controls assure plant operating conditions within limits previously determined to be acceptable. An extensive in-service inspection program requires periodic surveillance and inspection of safety related equipment and components during plant operation.

Considering the above discussion, and that presented in the FSAR; the possibility of an occurrence of this accident is considered remote.

7.1.11.2.4 Radiological Effects

Using the assumptions stated, the following offsite exposures have been calculated:

	Whole Body	Thyroid
Exclusion Area Boundary (rems) (two hour dose)	8.6×10^{-8}	2.1×10^{-6}
Population Dose (man-rems)	1.7×10^{-3}	5.4×10^{-2}

7.1.11.3 Loss-of-Coolant Accident: Large Pipe Break

7.1.11.3.1 Description

This accident is postulated as an unspecified event that results in the rupture of a large primary coolant pipe and subsequent release of the average radioactive inventory in the primary coolant. A portion of the core inventory from fuel rods that fail during the accident is also released to the containment atmosphere. Of this release, a portion of the halogens and all of the noble gases have been assumed to become airborne in the Containment and available for leakage. This accident is analyzed using realistic values for containment leak rates, iodine removal efficiencies and atmospheric dispersion factors.

7.1.11.3.2 Calculation Assumptions

a) The average radioactivity inventory in the primary coolant (based on 0.5 percent failed fuel) plus two percent of the core inventory of halogens and noble gases have been assumed to be released into the Containment.

b) A primary containment leak rate of 0.1 percent/day for the duration of the accident has been assumed.

c) Five percent of the halogens and all of the noble gases are assumed to remain airborne and available for leakage from the Containment. The releases to the environment are presented in Table 7.1.11-2.

7.1.11.3.3 Probability of Occurrence

Much of the discussion concerning the remoteness of a small pipe break accident is equally applicable to a large pipe break accident. The possibility of a large loss-of-coolant accident (LOCA) pipe break, however, is considered even less than that of a small LOCA pipe break because of the additional material that must fail.

7.1.11.3.4 Radiological Effects

Using the assumptions stated, the following offsite doses have been calculated:

	Whole Body	Thyroid
Exclusion Area Boundary (rems) (two hour dose)	1.8×10^{-3}	9.6×10^{-2}
Population Dose (man-rems)	1.7×10^{1}	2.2×10^{3}

7.1.11.4 Break in Instrument Line from Primary System that Penetrates the Containment (Lines not Provided with Isolation Capabilities Inside Containment)

Instrument lines which are part of the reactor coolant system pressure boundary have one automatic isolation valve inside and one automatic isolation valve outside the Containment. Accordingly, there are no identifiable instrument lines, containing significant quantities of radionuclides, from the primary system that penetrate the Containment that are not provided with isolation capabilities inside the Containment. This accident is therefore not applicable to this plant.

7.1.11.5 Control Rod Ejection Accident

7.1.11.5.1 Description

A rod cluster control assembly (RCCA) ejection accident is postulated to follow this sequence of events: after ejection of a RCCA, the core power rises rapidly for a brief period. The rise is terminated by the Doppler effect. Reactor shutdown is initiated by the high linear power level trip and the power transient is then completed. The core is protected against severe fuel damage by the allowable RCCA patterns and by the high power trip; the maximum enthalpy in the fuel during the transient is limited to an acceptable value.

The only significant doses due to this postulated accident would result from activity released from the Containment since offsite power is assumed to be available for this analysis. The radioactivity released to the Containment following this accident will consist of the radioactivity contained in the Reactor Coolant System prior to the accident, plus any radioactive gases released from the fuel rods initiated by fuel rod perforation. The noble gases released from the damaged fuel rods have been assumed to be immediately and completely released to the Containment. The released iodines will volatilze and be partially scrubbed out by the reactor coolant.

Assumptions regarding containment leak rate and meteorological diffusion are identical to those taken for the evaluation of the Design Basis LOCA.

7.1.11.5.2 Calculation Assumptions

a) The average radioactivity in the primary coolant based on 0.5 percent failed fuel and 0.2 percent of the core inventory is released instantaneously into the containment atmosphere.

b) A containment leak rate of 0.1 percent/day for the duration of the accident has been assumed.

c) Five percent of the halogens and all of the noble gases are assumed to remain airborne and available for leakage from the containment. The releases are presented in Table 7.1.11-3.

7.1.11.5.3 Probability of Occurrence

Rapid ejection of a rod cluster control assembly (RCCA) from the core would require a complete circumferential rupture of the control rod drive mechanism (CRDM) housing, or of the CRDM nozzle on the reactor vessel head. The CRDM housing and CRDM nozzle are an extension of the reactor coolant system boundary and are designed and manufactured to Section III of the ASME Boiler and Pressure Vessel Code. Considering these design precautions, the occurrence of such a RCCA ejection is considered highly unlikely.

7.1.11.5.4 Radiological Effects

Using the assumptions stated, the following offsite doses have been calculated:

	Whole Body	Thyroid
Exclusion Area Boundary (rems) (two hour dose)	1.8×10^{-4}	9.6×10^{-3}
Population Dose (man-rems)	1.7	$2.2 \times 10^{+2}$

7.1.11.6 Large Steamline Break Accident

7.1.11.6.1 Description

A rupture in the Main Steam System increases the rate of heat extraction by the steam generators and causes cooldown of the reactor coolant. With a negative moderator coefficient of reactivity, the cooldown will produce a positive reactivity addition.

The decrease in main steam pressure will initiate a reactor trip and close the main steam isolation valves. If the break occurs between the steam generator and the isolation valve, blowdown of the affected steam generator continues. Flow from the intact steam generator stops with closure of both isolation valves, either of which is capable of stopping flow. Since the steam generators are designed to withstand reactor coolant system operating pressure on the tube side with atmospheric pressure on the shell side, the continued integrity of the reactor coolant system barrier is assured.

This analysis postulates that a circumferential rupture of a steam line occurs upstream of the main steam isolation valve outside the Containment. All of the mass leaving the break is assumed to be in the steam phase.

7.1.11.6.2 Calculation Assumptions

a) Reactor coolant activity prior to the incident has been based on 0.5 percent failed fuel.

b) Secondary system equilibrium radionuclide concentration prior to the incident has been caculated assuming a 20 gal./day steam generator leak rate and a 10 gpm steam generator blowdown rate.

c) During the eight hour course of the accident, a reduction factor of 0.5 has been applied to the primary coolant source in the steam generator.

d) The total quantity of steam leaving the break during the accident is 1.1×10^5 lbs., with an iodine partition factor of 0.1. The activity released is given in Table 7.1.11-4, Part I.

7.1.11.6.3 Probability of Occurrence

Components of the Main Steam System are constructed in accordance with applicable ANSI codes, standards, and practices that have been accepted and safely used in other nuclear and fossil fueled plants. In addition, all components of the Main Steam System are fabricated under a comprehensive quality assurance program to assure compliance with all applicable specifications and codes.

The main steamline is designed and installed under Seismic Category I standards, up to the last seismic restraint just inside the reactor auxiliary building wall, including the main steamline isolation valve. Therefore, the possibility of a complete severence accident is considered to be extremely remote.

7.1.11.6.4 Radiological Effects

Using the assumptions stated, the following offsite exposures have been calculated:

	Whole Body	Thyroid
Exclusion Area Boundary (rems) (eight hour dose)	1.1×10^{-6}	1.8×10^{-4}
Population Dose (man-rems)	5.6×10^{-3}	9.7×10^{-1}

7.1.11.7 Small Steamline Break

This accident has not been analyzed separately. The only assumption for this accident that is different from those for the large steamline break is that a halogen reduction factor of 0.1 instead of 0.5 is used for that portion of the accident when the steam generator tubes are covered by feedwater. Since this length of time will be much less than the time required to cool the plant, the greater credit taken for halogen reduction will have only minimal effect on the total environmental consequences of the accident. The environmental consequences of the small steamline break are considered to be essentially the same as those for the large steamline break.

TABLE 7.1.2-1

ACCIDENT CLASSIFICATION

Class	Description
1.0	Trivial Incidents
2.0	Small Release Outside Containment
3.0	Radwaste System Failure
3.1	Equipment Leakage or Malfunction (Waste Gas Decay Tank)
3.2	Equipment Leakage or Malfunction (Liquid Waste Storage Tank)
3.3	Rupture of a Waste Gas Decay Tank
3.4	Rupture of a Liquid Waste Storage Tank
4.0	Fission Products to Primary System (BWR)
5.0	Fission Products to Primary and Secondary Systems (PWR)
5.1	Fuel Caldding Defects and Steam Generator Leak
5.2	Off-Design Transient that Induces Fuel Failure above that Expected and Steam Generator Leak
5.3	Steam Generator Tube Rupture
6.0	Refueling Accidents
6.1	Fuel Bundle Drop
6.2	Heavy Object Drop Onto Fuel in Core
7.0	Spent Fuel Handling Accident
7.1	Fuel Assembly Drop in Fuel Storage Pool
7.2	Heavy Object Drop Onto Fuel Rack
7.3	Fuel Cask Drop

TABLE 7.1.2-1 (Cont'd)

ACCIDENT CLASSIFICATION

Class	Description
8.0	Accident Initiation Events Considered in Design Basis Evaluation in the Safety Analysis Report
8.1	Small Loss-of-Coolant Accident, Pipe Break
8.2	Large Loss-of-Coolant Accident, Pipe Break
8.3	Break in Instrument Line from Primary System that Penetrates the Containment (Lines not provided with isolation capability inside containment)
8.4	Rod Ejection Accident
8.5	Large Steamline Break
8.6	Small Steamline Break

TABLE 7.1.2-2

SUMMARY OF CALCULATED OFFSITE DOSES FROM PLANT ACCIDENT

	Accidents	Whole Body Dose (rems) At Exclusion Area Boundary	Thyroid Dose (rems) At Exclusion Area Boundary	Whole Body Population Dose (man-rems)	Thyroid Population Dose (man-rems)
1)	Equipment Leakage or Malfunction (Waste Gas Decay Tank)	2.5(-4)	0.0	9.8(-1)	0.0
2)	Equipment Leakage or Malfunction (Liquid Waste Storage Tank)	0.0	1.5(-5)	0.0	5.7(-2)
3)	Rupture of a Waste Gas Decay Tank	1.0(-3)	0.0	3.9	0.0
4)	Rupture of a Liquid Waste Holdup Tank	0.0	5.8(-5)	0.0	2.3(-1)
5)	Off-Design Transient that Induces Fuel Failure above that Expected and Steam Generator Leak	5.5(-5)	6.1(-7)	2.1(-1)	2.3(-3)
6)	Steam Generator Tube Rupture	4.3(-3)	1.2(-6)	1.7(+1)	4.6(-3)
7)	Fuel Bundle Drop Onto the Fuel in Core	3.3(-5)	5.6(-5)	1.3(-1)	2.2(-1)
8)	Heavy Object Drop Onto the Fuel Core	7.6(-4)	1.2(-3)	2.9	4.5
9)	Fuel Assembly Drop Onto the Fuel Storage Pool	3.3(-5)	2.8(-5)	1.3(-1)	1.1(-1)
10)	Heavy Object Drop onto the Fuel Rack	2.5(-5)	6.1(-5)	9.8(-2)	2.4(-1)
11)	Fuel Cask Drop	3.5(-6)	0.0	1.4(-2)	0.0

TABLE 7.1.2-2 (Cont'd)

SUMMARY OF CALCULATED OFFSITE DOSES FROM PLANT ACCIDENT

Accidents	Whole Body Dose (rems) At Exclusion Area Boundary	Thyroid Dose (rems) At Exclusion Area Boundary	Whole Body Population Dose (man-rems)	Thyroid Population Dose (man-rems)
12) Small Loss-of-Coolant Accident	8.6(-8)	2.1(-6)	1.7(-3)	5.4(-2)
13) Large Loss-of-Coolant Accident	1.8(-3)	9.6(-2)	1.7(+1)	2.2(+3)
14) Rod Ejection Accident	1.8(-4)	9.6(-3)	1.7	2.2(+2)
15) Large Steamline Break	1.1(-6)	1.8(-4)	5.6(-3)	9.7(-1)
16) Small Steamline Break	**	**		

* ( ) Denotes power of 10.

** See discussion in Section 7.1.11.7

TABLE 7.1.3-1

CORE INVENTORY AND ISOTOPE PROPERTIES

Isotope	Radioactive Decay Constant (per sec.)	Total Core Activity (Ci)	Thyroid Dose Conversion Factor (rem/Ci - Inhaled)	Direct Dose Conversion Factor $\frac{(\text{rems} - \text{m}^3)}{(\text{sec.} - \text{Ci})}$*
Kr-85m	4.41(-5)**	3.2(7)	-	3.61(-2)
Kr-85	2.21(-9)	8.0(5)	-	6.11(-4)
Kr-87	1.48(-4)	6.2(7)	-	3.61(-1)
Kr-88	6.95(-5)	8.0(7)	-	4.17(-1)
Xe-131m	6.68(-7)	5.5(5)	-	7.78(-4)
Xe-133	1.52(-6)	1.7(8)	-	6.94(-3)
Xe-135m	7.42(-4)	4.5(7)	-	9.72(-2)
Xe-135	2.11(-5)	4.5(7)	-	5.83(-2)
Xe-138	8.04(-4)	1.5(8)	-	3.33(-1)
I-131	9.96(-7)	7.2(7)	1.48(6)	8.61(-2)
I-132***	2.6 (-6)	1.1(8)	5.35(4)	5.56(-1)
I-133	9.20(-6)	1.6(8)	4.0(5)	1.22(-1)
I-134	2.20(-4)	1.9(8)	2.5(4)	5.56(-1)
I-135	2.86(-5)	1.5(8)	1.24(5)	4.17(-1)

* Atomic Energy Commission, Final Environmental Statement Concerning: Numerical Guides for Objectives and Limiting Conditions for Operation to Meet the Criteria "As Low As Practicable" for Light-Water Cooled Nuclear Power Reactor Effluent Volume 2, Table A-4, Pg 3, F-53 (July 1973).

** ( ) Denotes power of 10.

*** Decay constant of precursor used.

TABLE 7.1.6-1

PART I

ACTIVITY RELEASED TO THE ENVIRONMENT FOLLOWING A WASTE GAS DECAY TANK EQUIPMENT LEAKAGE OR MALFUNCTION ACCIDENT

Isotope	Activity Released (Ci)
Kr-85m	1.9(+0)
Kr-85	1.8(+3)
Kr-87	1.4(-1)
Kr-88	1.4(+0)
Xe-133	1.8(+3)
Xe-135	8.0(+0)
Xe-138	5.0(-3)

PART II

ACTIVITY RELEASED TO THE ENVIRONMENT FOLLOWING A LIQUID RADWASTE HOLDUP TANK LEAKAGE OR MALFUNCTION ACCIDENT

Isotope	Activity Released (Ci)
I-131	1.6(-3)
I-132	7.8(-6)
I-133	2.6(-4)
I-134	1.4(-6)
I-135	4.2(-5)

TABLE 7.1.6-1 (Cont'd)

PART III

ACTIVITY RELEASED TO THE ENVIRONMENT FOLLOWING A RUPTURE OF A WASTE GAS DECAY TANK

Isotope	Activity Released (Ci)
Kr-85m	5.7(+0)
Kr-85	7.2(+3)
Kr-87	5.4(-1)
Kr-88	5.6(+0)
Xe-133	7.2(+3)
Xe-135	3.2(+1)
Xe-138	2.0(-2)

PART IV

ACTIVITY RELEASED TO THE ENVIRONMENT FOLLOWING A RUPTURE OF A LIQUID RADWASTE HOLDUP TANK

Isotope	Activity Released (Ci)
I-131	6.4(-3)
I-132	3.1(-5)
I-133	1.0(-3)
I-134	5.5(-6)
I-135	1.7(-4)

TABLE 7.1.6-1 (Cont'd)

PART V

ACTIVITY RELEASED TO THE ENVIRONMENT FOLLOWING AN OFF-DESIGN TRANSIENT THAT INDUCES FUEL FAILURE ABOVE THAT EXPECTED ACCIDENT

Isotope	Activity Released (Ci)
Kr-85m	9.4(-1)
Kr-85	1.2(-1)
Kr-87	1.8(+0)
Kr-88	2.3(+0)
Xe-133	8.4(+0)
Xe-135	1.4(+0)
Xe-138	4.3(+0)
I-131	4.1(-5)
I-132	2.8(-5)
I-133	8.1(-5)
I-134	2.5(-5)
I-135	6.0(-5)

PART VI

ACTIVITY RELEASED TO THE ENVIRONMENT FOLLOWING A STEAM GENERATOR TUBE RUPTURE ACCIDENT

Isotope	Activity Released (Ci)
Kr-85m	2.8(+1)
Kr-85	1.0(+2)
Kr-87	1.7(+1)
Kr-88	5.1(+2)
Xe-133	3.7(+3)
Xe-135	1.0(+2)
Xe-138	8.9(+0)
I-131	9.1(-5)
I-132	9.4(-5)
I-133	1.4(-4)
I-134	1.9(-5)
I-135	6.4(-5)

TABLE 7.1.6-1 (Cont'd)

PART VII

ACTIVITY RELEASED TO THE ENVIRONMENT FOLLOWING A FUEL ASSEMBLY DROP ACCIDENT IN REFUELING POOL

Isotope	Activity Released (Ci)
Kr-85	3.3
Xe-133	2.0(+2)
Xe-135	5.6(-4)
I-131	6.4(-3)
I-133	7.0(-5)

PART VIII

ACTIVITY RELEASED TO THE ENVIRONMENT FOLLOWING A HEAVY OBJECT DROP INTO FUEL IN THE CORE

Isotope	Activity Released (Ci)
Kr-85	5.1(+1)
Xe-133	6.3(+3)
Xe-135	1.5
I-131	1.3(-1)
I-133	1.5(-2)

PART IX

ACTIVITY RELEASED TO THE ENVIRONMENT FOLLOWING A FUEL ASSEMBLY DROP ACCIDENT IN SPENT FUEL POOL

Isotope	Activity Released (Ci)	
	SHNPP Fuel	Brunswick Fuel
Kr-85	3.3(0)	1.2(+2)
Xe-131m	--	8.6(-2)
Xe-133	2.8(+2)	1.4(-3)
Xe-135	5.6(-4)	--
I-131	3.2(-3)	2.6(-6)
I-133	4.9(-5)	--

TABLE 7.1.6-1 (Cont'd)

PART X

ACTIVITY RELEASED TO THE ENVIRONMENT FOLLOWING A HEAVY OBJECT DROP ONTO FUEL IN THE STORAGE POOL

Isotope	Activity Released (Ci)	
	SHNPP Fuel	Brunswick Fuel
Kr-85	5.0(+1)	7.2(+2)
Xe-131m	6.2	5.0(-1)
Xe-133	2.2(+2)	8.0(-3)
I-131	6.9(-3)	1.5(-5)
I-133	8.0(-12)	--

PART XI

ACTIVITY RELEASED TO THE ENVIRONMENT FROM A FUEL CASK DROP ACCIDENT

Isotope	Activity Released (Ci)	
	SHNPP Fuel	Brunswick Fuel
Kr-85	3.5(+2)	1.3(+4)
Xe-131m	2.4(-1)	9.0(0)
Xe-133	1.1(-2)	1.4(-1)
I-131	--	1.4(-1)

TABLE 7.1.11-1

ACTIVITY RELEASED TO THE ATMOSPHERE FROM A LOSS OF COOLANT ACCIDENT - SMALL PIPE BREAK

	Duration of Release			
Isotope	0-8 hr.	8-24 hr.	1-4 day	4-30 day
Kr-85m	*	*	*	*
Kr-85	*	*	*	2.7(+0)
Kr-87	*	*	*	*
Kr-88	*	*	*	*
Xe-131m	*	*	*	*
Xe-133	1.2(+0)	2.3(+0)	8.3(+0)	1.6(+1)
Xe-135	*	*	*	*
Xe-138	*	*	*	*
I-131	6.5(-4)	1.2(-3)	4.8(-3)	1.4(-2)
I-132	6.6(-4)	1.2(-3)	3.7(-3)	4.1(-3)
I-133	8.6(-4)	1.2(-3)	1.5(-3)	1.5(-4)
I-134	*	*	*	*
I-135	3.6(-4)	2.2(-4)	*	*

+ ( ) Denotes power of 10.

* Indicates release is less than 1.0 Ci for noble gas and 10^{-4} for iodine

TABLE 7.1.11-2

ACTIVITY RELEASED TO THE ATMOSPHERE FROM A LOSS OF COOLANT ACCIDENT - LARGE PIPE BREAK

	Duration of Release			
Isotope	0-8 hr.	8-24 hr.	1-4 day	4-30 day
Kr-85m	1.2(+2)+	4.3(+1)	3.7(+0)	*
Kr-85	5.4(+0)	1.1(+1)	4.8(+1)	4.1(+2)
Kr-87	9.6(+1)	1.4(+0)	*	*
Kr-88	2.3(+2)	3.5(+1)	*	*
Xe-131m	3.6(+0)	7.1(+0)	2.9(+1)	1.2(+2)
Xe-133	1.1(+3)	2.1(+3)	7.4(+3)	1.5(+4)
Xe-135	2.2(+2)	1.9(+2)	7.9(+1)	*
Xe-138	4.3(+1)	*	*	*
I-131	2.4(+1)	4.5(+1)	1.7(+2)	5.2(+2)
I-132	3.5(+1)	6.4(+1)	2.0(+2)	2.2(+2)
I-133	4.7(+1)	6.3(+1)	8.2(+1)	8.3(+0)
I-134	1.0(+1)	1.8(-2)	*	*
I-135	3.4(+1)	2.2(+1)	5.1(+0)	3.1(-3)

+ ( ) Denotes power of 10.

* Indicates release is less than 1.0 Ci for noble gas and 10^{-4} for iodine

TABLE 7.1.11-3

ACTIVITY RELEASED TO THE ATMOSPHERE FROM A CONTROL ROD EJECTION ACCIDENT

	Duration of Release			
Isotope	0-8 hr.	8-24 hr.	1-4 day	4-30 day
Kr-85m	1.2(+1)+	4.3(+0)	3.7(-1)	*
Kr-85	5.4(-1)	1.1(+0)	4.8(+0)	4.1(+1)
Kr-87	9.6(+0)	1.4(-1)	*	*
Kr-88	2.3(+1)	3.5(+0)	*	*
Xe-131m	3.6(-1)	7.1(-1)	2.9(+0)	1.2(+1)
Xe-133	1.1(+2)	2.1(+2)	7.4(+2)	1.5(+3)
Xe-135	2.2(+1)	1.9(+1)	7.9(+0)	*
Xe-138	4.3(+0)	*	*	*
I-131	2.4(+0)	4.5(+0)	1.7(+1)	5.2(+1)
I-132	3.5(+0)	6.4(+0)	2.0(+1)	2.2(+1)
I-133	4.7(+0)	6.3(+0)	8.2(+0)	8.3(-1)
I-134	1.0(+0)	1.8(-3)	*	*
I-135	3.4(+0)	2.2(+0)	5.1(-1)	3.1(-4)

+ ( ) Denotes power of 10.

* Indicates release is less than 1.0 Ci for noble gas and 10^{-4} for iodine

TABLE 7.1.11-4

PART I

ACTIVITY RELEASED TO THE ATMOSPHERE AS A RESULT OF A LARGE STEAMLINE BREAK ACCIDENT

Isotope	Activity Released (Ci)	
	0-2 Hrs.	2-8 Hrs.
Xe-133	8.8(-1)*	2.6
I-131	5.0(-3)	1.4(-3)
I-133	7.6(-3)	2.0(-2)
I-135	4.0(-3)	1.1(-2)

PART II

ACTIVITY RELEASED TO THE ATMOSPHERE AS A RESULT OF A SMALL STEAMLINE BREAK ACCIDENT

(See discussion in Section 7.1.11.7)

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* Denotes power of ten.

7.2 TRANSPORTATION ACCIDENTS INVOLVING RADIOACTIVITY

The transportation of fuel and wastes to and from the Shearon Harris Nuclear Power Plant will be within the scope of Paragraph (g) of 10CFR Part 51.20. As such, the environmental impacts of the transportation of fuel and wastes under both normal and accident conditions will be as set forth in Summary Table S-4 of 10CFR Part 51. Therefore, in accordance with Regulatory Guide 4.2, no further environmental analysis of radioactive material movement is required.

7.3 OTHER ACCIDENTS

7.3.1 INTRODUCTION

The SHNPP like any other large industrial plant, could experience non-nuclear industrial accidents during its lifetime. Typical accidents that might occur are small electrical fires, chemical spills, etc. The administrative procedures and safety equipment at SHNPP will limit accidents of this type, so that their environmental consequences will be minimal.

7.3.2 CHEMICALS STORED ONSITE

The types, quantities and storage location of the major chemicals that will be stored on site are given in Table 7.3.2-1. Solutions of sodium hydroxide and sulfuric acid are not considered to present any significant threat to the environment because of their low volatility. The failure of tanks containing pressurized gases, except chlorine, will not result in adverse environmental effects. Most of these gases are asphyxiants and are stored in relatively small quantities.

7.3.2.1 Aqua Ammonia

The accidental spillage of aqueous solutions of ammonia could result in the emission of ammonia vapors that are irritating to the eyes and lungs of the personnel exposed. Ammonia vapor in the air has explosive limits of 16 to 25 percent NH_3 by volume. However, these concentrations are seldom encountered in the handling of ammonia; accordingly the relative fire and explosion hazards are small.

7.3.2.2 Hydrazine

Hydrazine is a toxic, colorless, fuming, oily liquid with an odor resembling that of ammonia. It is a reactive reducing agent that is used to remove residual oxygen from the condensate and auxiliary boiler feedwater. If a hydrazine tank were to leak, a dilute solution would be routed to the floor drain.

7.3.2.3 Fuel Oil

Diesel fuel oil is stored in tanks at several locations in buildings and the yard area. In all cases except for automotive use (see Section 7.3.2.4) the tanks have curbs high enough to contain the entire contents of the tank. Should an oil fire occur, sulfur dioxide, carbon monoxide, hydrocarbons, nitrogen oxides, and particulates would be emitted into the air until the fire is extinguished. The environmental impact of such a fire would be similar to that caused by any typical small oil fire, and would result in a short-term, localized degradation of the ambient air quality.

7.3.2.4 Gasoline

Gasoline and diesel fuel to be used in automobiles is stored underground in compliance with the Environmental Protection Agency regulations for spill prevention control and countermeasure plans.

7.3.2.5 Turbine Lube Oil

Turbine lube oil is stored in the Turbine Building for each Unit. Provisions such as curbs and an oil separator on the floor drain prevents this oil from leaking to the environment. The environmental impact of a fire would be the same as for fuel oil.

7.3.3 CHLORINE GAS RELEASE

7.3.3.1 Mode of Chlorine Gas Release

As indicated in Table 7.3.2-1, liquified chlorine is stored onsite in one
5 60,000 lb. container. The container could fail in two possible modes and
release its chlorine content. The first and most severe failure mode is the complete loss of container integrity. In this case, a large fraction (e.g., 20 percent) of the chlorine content is released instantaneously to the environment. Such an occurrence is considered highly improbable and consequently will not be considered in the environmental impact assessment of a chlorine release.

The more probable mode of chlorine release will result from mechanical failures in the chlorination system such as, valve leakage due to failure to seat properly or cracks in pipe welds. In such occurrences, chlorine will be released slowly to the environment until the leak is detected. The evaluation of the environmental consequences of a continuous chlorine release has been performed assuming that such failures in the chlorination system were to take place. The results are given in Table 7.3.3-1.

7.3.3.2 Calculation Assumptions

The effects of a chlorine gas release from a 60,000 lb. container have been calculated using the following assumptions:

a) distance to the exclusion area boundary is 2024m,

b) discharge is through a 2-in. orifice at an initial outside temperature of 80 F,

c) a maximum release rate of 30 lb./sec. is based on models presented in Reference 7.3.3-1. The average release rate is 15 lb./sec. for the release duration,

d) dispersion factors are 1/10 of those given in Regulatory Guide 1.4,

e) the thickness of the layer of chlorine spilled on the ground is 1.0 cm,

f) evaporation rate of chlorine from a flat surface in sun-light is 6.3 lb./hr./ft.^{2} based on Reference 7.3.3-2.

7.3.3.3 Consequences

Table 7.3.3-1 gives the expected concentrations of chlorine at the exclusion area boundary. The physiological effects to humans during exposure to chlorine at various levels of concentration in air are presented in Table 7.3.3-2, as given in Reference 7.3.3-3. As shown in Table 7.3.3-1, the dangerous levels of chlorine above 40 ppm would be experienced only for a short period. Furthermore, it is very unlikely that anyone would remain at the exclusion boundary for the duration of the accident. A more probable event would be that personnel would detect the chlorine gas and remove themselves from the affected area. The resulting consequences would be less significant. In any event, it may be concluded that the physiological effects experienced by a person during the course of the accident will vary from severe coughing to mild throat irritation.

Considering the low occurrence probability of this accident and the relatively mild consequences should it occur, this accident is not considered to be a severe risk.

TABLE 7.3.2-1

POTENTIALLY HAZARDOUS CHEMICALS STORED AT SHNPP

Chemical	Location	No. of Tanks/ Capacity Each	
Sulfuric Acid H_2SO_4 (66 Be)	At Cooling Towers	2/7800 gal.	5
	At Turbine Bldg.	1/5473 gal.	
	At Water Treatment Bldg.	1/7820 gal.	
Sodium Hydroxide NaOH (50%)	At Cooling Towers	2/1700 gal.	5
	At Turbine Bldg.	1/8883 gal.	
	At Water Treatment Bldg.	1/10,500 gal.	
Nitrogen N_2 (liquid)	Gas Storage Area	1 System/ 10,584 gal.	
Carbon Dioxide CO_2 (liquid)	Gas Storage Area	1 System/ 4,000 lb. liquid 1,290 lb. vapor	
Hydrogen H_2 (liquid)	Gas Storage Area	1 System/ 1,500 gal.	5
Chlorine Cl_2 (liquid)	Storage Shed At Cooling Tower	1/60,000 lbs.	
Ammonia	At Turbine Bldg. Turbine Bldg.	2/1,500 gal. 2/300 gal.	

TABLE 7.3.2-1 (Cont'd)

POTENTIALLY HAZARDOUS CHEMICALS STORED AT SHNPP

Chemical	Location	No. of Tanks/ Capacity Each
Fuel Oil	Diesel Gen. Fuel Tank Bldg.	2/175,000 gal.
	Diesel Gen. Bldg.	4/3,000 gal.
	Aux. Boiler Storage Tanks in Yard	2/110,000 gal.
	Diesel Fire Pump Tank in Yard	1/550 gal.
	Underground in Yard	1/10,000 gal.
Gasoline	Underground in Yard	2/10,000 gal.
Turbine Lube Oil Reservoir	Turbine Bldg.	2/14,422 gal.
Turbine Lube Oil Batch	Turbine Bldg.	2/14,000 gal.
Hydrazine	Turbine Bldg.	2/150 gal.

5

TABLE 7.3.3-1

CONCENTRATION OF CHLORINE GAS AT EXCLUSION AREA BOUNDARY FOLLOWING ACCIDENTAL RELEASE

TIME (min.)	CONCENTRATION (ppm)
5	15.2
10	20.2
15	24.4
20	27.9
25	30.9
30	33.4
35	35.5
40	37.4
45	38.9
50	40.2
55	41.4
60	42.3
70	30.3
80	21.8
90	15.7
100	11.3
120	5.9

TABLE 7.3.3-2

PHYSIOLOGICAL EFFECTS OF EXPOSURES TO CHLORINE IN AIR

EFFECT	CHLORINE (ppm)
Detectable	3.0 - 3.5
Throat Irritation	10 - 15
Coughing	30
Dangerous 30 minute exposure	40 - 60
Fatal	
30 minute exposure	1000
10 minute exposure	1800

REFERENCES: SECTION 7.3

7.3.3-1 Equations 5-133, 5-134, 5-135, Robert H. Perry/Cecil H. Chilton, "Chemical Engineer's Handbook," 5th Edition.

7.3.3-2 A. E. Howerton, PPG Industries, Corpus Christi, Texas, "Estimating Area Affected by a Chlorine Release," [CHE Symposium on loss prevention in the Process Industries, 64th National Meeting, New Orleans, LA., March 16-20, 1969.]

7.3.3-3 Technical and Engineering Service Bulletin 7, Industrial Chemical Division, Allied Chemical Corporation, October, 1971.

CHAPTER 8
BENEFITS AND COSTS

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8.0 BENEFITS AND COSTS

8.1 BENEFITS

This section describes certain of the social and economic benefits associated with the operation of the SHNPP. The social and economic impacts of plant construction and eventual plant operation as well as the relative benefits and costs of alternative sites and alternative energy sources, are discussed in detail in the SHNPP Construction Permit Environmental Report.

The Commission has amended 10 CFR Part 51, "Licensing and Regulatory Policy and Procedures for Environmental Protection" effective April 26, 1982, to provide that "need for power" and "alternative energy sources" need not be considered in ongoing and future operating license proceedings for nuclear power plants, absent a showing of "special circumstances" pursuant to 10 CFR 2.758. See 47 Fed. Reg. 12940 (March 26, 1982). In promulgating this rule, the Commission established a presumption of continuing validity at the Operating License stage of the favorable cost-benefit balance already struck in the Construction Permit proceeding. Thus, in the Commission's Statement of Background of the Rule, published with the final rule, the Commission explained:

> In accordance with the Commission's NEPA responsibilities, the need for power and alternative energy sources are resolved in the construction permit proceeding. The Commission stated its tentative conclusion that while there is no diminution of the importance of these issues at the construction permit stage, the situation is such that at the time of the operating license proceeding the plant would be needed to either meet increased energy needs or replace older less economical generating capacity and that no viable alternatives to the completed nuclear plant are likely to exist which could tip the NEPA cost-benefit balance against issuance of the operating license. Past experience has shown this to be the case. In addition, this conclusion is unlikely to change even if an alternative is shown to be marginally environmentally superior in comparison to operation of a nuclear facility because of the economic advantage which operation of nuclear power plants has over available fossil generating plants. 47 Fed. Reg. at 12940. 5

The SHNPP Operating License Environmental Report was prepared prior to the adoption of the new rule by the Commission. This amendment revises the cost-benefit section to reflect the production cost savings which directly result from operation of the SHNPP as compared to system production costs without SHNPP being available. This analysis simply confirms the Commission's experience that the operation of a nuclear facility provides a substantial cost savings to the overall system cost in generating electricity and validates the cost-benefit balance struck at the Construction Permit proceeding.

The only analysis of costs and benefits required at the Operating License stage as a result of the new Commission Rule is one that compares the environmental costs of plant operation with the benefits from production cost savings resulting from the SHNPP operation. Certainly the major benefit from operation of the SHNPP is approximately eleven billion kilowatt-hours of electrical energy that will be produced annually (once both units are

operational). The addition of the SHNPP will also improve CP&L's ability to
meet system load requirements by adding 1800 megawatts of electrical
generating capacity. This additional capacity contributes to an adequate
reserve margin and reduces the possibility of interruptions of power supply.
5 Secondary benefits from the operation of the SHNPP will include tax revenues
generated, increased employment opportunities, increased regional product, and
increased knowledge as a result of environmental studies. However, these
benefits were discussed in detail in the Construction Permit Environmental
Report and need not be restated here.

8.1.1 PRIMARY BENEFITS

Each SHNPP Unit has an expected net generating capacity of 900 megawatts. The expected average annual generation per unit (assuming a capacity factor of 70 percent) is 5.52 billion kilowatt-hours electrical energy. Table 8.1.1-1 shows the projected proportional distribution of the generated electricity by user class.

The need for the power generated by the SHNPP has been discussed in detail in the SHNPP Construction Permit Environmental Report, and it is not at issue at the Operating License stage. The additional 1800 megawatts installed capacity will contribute to system generation reserve margin and system reliability, decreasing the possibility of interruption in power supply. For purposes of a cost-benefit comparison consistent with the Commission's recently adopted Rule on need-for-power and alternative energy sources, CP&L prepared an analysis of the savings in system production costs associated with the availability of the SHNPP as compared to system production costs without the SHNPP capacity. The results of this analysis are summarized in Table 8.1.1-2. The analysis was performed by utilizing a production cost simulation computer model to project the total system production cost over the 10-year period from 1986 through 1995. The production cost modeling assumptions include CP&L's December 1981 load forecast, commercial operation dates of March 1986 for the SHNPP Unit 1 and March 1989 for the SHNPP Unit 2, and an average annual capacity factor for each SHNPP unit of approximately 70 percent. This analysis reveals that the 5 total system production cost savings for the first ten years of operation alone (1986-1995) will be approximately $2.021 billion (1986 dollars). For comparison, total system production costs without the SHNPP were calculated by assuming that replacement capacity would principally be coal generation.

A sensitivity study was performed to determine the effects on this analysis if lower than predicted capacity factors for the SHNPP were taken into consideration. If the annual average SHNPP capacity factor is assumed to be 60 percent or 50 percent, the anticipated system production cost savings resulting from operation of the SHNPP during the same ten year period are calculated to be approximately $1.560 billion and $1.056 billion (in 1986 dollars), respectively. A sensitivity study was also performed to determine the impact on production cost savings assuming zero load growth. Even if system load remained at 1981 levels during the ten year period from 1986 through 1995, the cost savings from the operation of the SHNPP are estimated to be approximately $1.136 billion (1986 dollars). Finally, the estimated production cost savings from operation of the SHNPP were calculated assuming only Unit 1 was available during the same ten year period. The anticipated system production cost savings from the operation of Unit 1 alone are estimated to be $1.131 billion (in 1986 dollars). These sensitivity studies confirm that even with unusually low capacity factors or assuming a constant electrical demand based on 1981 demand figures, the total system savings is over a billion dollars. Such savings will accrue not just for the ten year period of this analysis but for the entire plant life.

TABLE 8.1.1-1

ESTIMATED BENEFITS OF SHNPP

DIRECT BENEFITS	
Number of Units	2
Capacity Per Unit	900,000 KW
Expected Average Annual Generation Per Unit*	5.52×10^9 KWH
Proportional Distribution of Electrical Energy Per Unit**	
Industrial	2.02×10^9 KWH
Residential	1.27×10^9 KWH
Commercial	0.88×10^9 KWH
Public Street and Highway Lighting	0.02×10^9 KWH
Other Sales to Public Authority	0.11×10^9 KWH
Sales for Resale	1.22×10^9 KWH
INDIRECT BENEFITS	
Taxes	See Table 8.1.2-1

5

* Assuming 70 percent capacity factor
** For the period 1986 through 1995

TABLE 8.1.1-2

SYSTEM PRODUCTION COST[1]
(millions of dollars)

Year	With Harris[2] Plant	Without Harris Plant	Production Cost Savings[3]
1986[4]	967	1,067	100
1987	1,109	1,234	125
1988	1,192	1,377	185
1989[4]	1,297	1,601	304
1990	1,432	1,743	311
1991	1,599	2,087	488
1992	1,843	2,352	509
1993	2,047	2,551	504
1994	2,371	2,892	521
1995	2,607	3,092	485

5

NOTE:
[1] Nominal dollars
[2] The capacity factor for the Harris Plant is assumed to be approximately 70 percent during commercial operation.
[3] The total in 1986 dollars is $2,021 million
[4] Commercial operation is assumed to begin in March 1986 for Unit 1 and March 1989 for Unit 2.

SHNPP FUEL COST

The average fuel cost for SHNPP operating from 1986 through 1995 is 6.7 mills/KWH in 1986 dollars.

8.1.2 SECONDARY BENEFITS

The operation of the SHNPP will benefit the regional economy by providing employment opportunities, increased regional product, tax revenues and increased knowledge of the regional environment as a result of environmental studies. This information was provided in the Construction Permit Environmental Report and is not at issue at the Operating License stage. In response to an NRC Staff inquiry, included in this section is updated information on ad valorem taxes.

8.1.2.1 Taxes and Tax Effects

Estimated ad valorem taxes to be paid to government agencies are as shown in Table 8.1.2-1. The estimated taxes were computed based on the CP&L's 1982 Construction Budget projections, the 1982 ratio of assessed value to undepreciated original cost, and the 1982 Wake County tax ratio of $0.83 per $100 valuation. The State of North Carolina's ratio of assessed value to undepreciated original cost has varied historically from one to three percent per year. The County tax rate is dependent on many factors including County services and tax base. However, as expenditures on the SHNPP units increase the taxable base, the County tax rate should not increase as it otherwise might. Table 8.1.2-1 shows total estimated ad valorem taxes related to the SHNPP, and therefore includes the estimated tax of the portion of the SHNPP being purchased by the North Carolina Eastern Municipal Power Agency. 5

TABLE 8.1.2-1

ESTIMATED AD VALOREM TAXES
(thousands of dollars)

Estimated Ad Valorem Tax on the Shearon Harris Nuclear Power Plant for 1986 through 1995: (thousands of dollars)

YEAR	UNIT 1	UNIT 2	TOTAL
1986	10,423		10,423
1987	12,508		12,508
1988	12,508		12,508
1989	12,508	7,403	19,911
1990	12,508	8,884	21,392
1991	12,508	8,884	21,392
1992	12,508	8,884	21,392
1993	12,508	8,884	21,392
1994	12,508	8,884	21,392
1995	12,508	8,884	21,392

5

The estimated tax is computed based on the Company's 1982 construction budget projections, the 1982 ratio of assessed value to undepreciated original cost, and the 1982 Wake County tax rate of $0.83 per $100 valuation. The State's ratio of assessed value to undepreciated original cost has historically varied approximately from one to three percent per year. The above estimate includes the tax related to the portion of the SHNPP being purchased by the North Carolina Eastern Municipal Power Agency.

8.2 COST

8.2.1 INTERNAL COST

Total Fuel Cycle costs over the life of the project are estimated to be $1.592 billion; other operating and maintenance costs, $1.049 billion (both in 1986 dollars).

Uranium and Conversion cost estimates are based primarily on existing contracts with market price estimates used as a supplement as needed. Future cost estimates are determined by applying escalation rates by component as supplied by Data Resources Incorporated (DRI). Enrichment cost estimates are based on a Requirements Contract with the Department of Energy which extends through 2002. Fabrication cost estimates are based on the contract cost for the initial core of each SHNPP unit. Future cost estimates are determined using market prices obtained from Pickard, Lowe & Garrick, Inc. and escalated using DRI indices. Carrying charge estimates are based on CP&L's projected cost of money. Spent Fuel Storage and Disposal costs are determined using the 1 mill/kwh value as specified in the recently passed Senate bill (S.1662) (Reference 8.2.1-1). Future Spent Fuel Storage and Disposal costs are determined by applying escalation rates supplied by DRI.

The O&M costs are based on a 1982 estimate of company and contract payroll and 5
materials, and services required for operation and maintenance of the SHNPP. As a result of operation of the SHNPP, CP&L expects to spend approximately $615 million of the total O&M cost in salaries. These salaries are based on the company's estimate of all company personnel, both onsite and offsite, required by the project and any contract labor required.

Decommissioning costs for a 1175 MW(e) Reference Nuclear Plant in 1978 dollars will probably fall within the range of $42.1 million for immediate dismantlement to $51.8 million for safe storage with deferred dismantlement (Reference 5.8.1-1). The cost for SHNPP may be somewhat higher. Decommissioning costs are discussed in Section 5.8.

Levelized revenue requirements are shown in Table 8.2.1-1. Each Unit has a depreciable lifetime of 25 years. Since the first Unit is assumed to begin commercial operation in 1986 and the second in 1989, the depreciable life of the project is 28 years. All levelized revenue requirements are computed over this period.

TABLE 8.2.1-1

ESTIMATED COSTS OF ELECTRICAL ENERGY GENERATION[1]

Fixed Charges	Lifetime Levelized Costs Mills/Killowatthour[2]	Initial Year[3] millions of dollars
Adminstrative & General[4]	7.2	41.3
Fuel Cycle Costs		
Uranium/Conversion/Enrichment	12.2	28.9
Fabrication	2.3	5.5
Spent Fuel Storage/Disposal	2.5	6.0
Carrying Charges	0.9	2.1
Subtotal	17.9	42.5
Operation & Maintenance Costs	12.3	36.1
Nuclear Liability Insurance	0.1	0.6
Decommissioning Costs	See Section 5.8	

5

[1] Using 70 percent capacity factor

[2] Levelized 1986-2014

[3] First 12 months of operation of Unit 1.

[4] Administrative & General is the only component of the fixed charge rate that would be affected substantially if SHNPP is not granted an operating license.

8.2.2 EXTERNAL COSTS

Beyond the primary internal costs of the operation of SHNPP, there is a potential for external economic and social costs. As much as possible, the probable number and location of any population group affected, the estimated economic and social impact, and special measures taken to alleviate the impact are described for each potential cost.

8.2.2.1 Long-Term External Costs

Possible long-term external costs from operation of any nuclear generating facility include impairment of recreational values; deterioration of aesthetic and scenic values; restrictions on access to areas of scenic, historic, or cultural interest; degradation of areas having historic, cultural, natural, or archaeological value; removal of land from present or contemplated alternative uses; creation of locally adverse meteorological conditions; creation of noise, reduction of regional products, lost income from recreation or tourism; lost income of commercial fishermen; decrease in real estate values; increased costs to local governments and increased regulatory cost. A discussion of the anticipated external costs of the operation of the SHNPP in these areas follows.

a) Impairment of Recreational Values

The Main Reservoir and adjacent lands will provide a significant recreational resource available for public use. CP&L's land and reservoir use policy is described in Section 2.1.3. Operation of SHNPP will generally not affect recreational use of these areas; however, control of areas within the exclusion area boundaries may be established as discussed in FSAR Section 2.1.2. 5

b) Deterioration of Aesthetic and Scenic Values

Because the site was not previously considered aesthetically unique (Section 2.6) the Main Reservior coupled with its accessibility to the public for recreational use has enhanced the aesthetic value of the area. However, the SHNPP has some visual impact on the area. One major negative visual impact results from the presence of the 526 ft. natural draft cooling towers which are visible over long distances.

c) Restriction of Access and Degradation to Areas of Scenic, Historic, or Cultural Interest

The regional historic, archaeological, architectural, scenic, cultural, and natural features are discussed in Section 2.6. Recognized and maintained areas of scenic, historic, or cultural significance are not located in or near the project area. Therefore, operation of the plant will not restrict access or degrade any such area.

d) Removal of Land from Present or Contemplated Alternative Uses

The site related removal of land from its preconstruction uses was addressed in the Construction Permit Environmental Report. (See Section 4.5.1.4)

e) Creation of Locally Adverse Meteorological Conditions

The possibility of the creation of adverse meteorological conditions due to plant operation was addressed prior to issuance of the Construction Permit. Refer to Sections 3.3.2 and 3.3.3 of the SHNPP Construction Permit Environmental Report and Sections 5.1.2.1, 5.1.2.2, and 5.1.2.3 of the Revised Final Environmental Statement - Construction Permit Stage. No significant changes have been made, except that the cooling tower evaporative losses have been revised. An updated discussion of plume, fogging, icing, and drift is included in Section 3.4 and 5.1.4 of this report. None of these factors is expected to have a significant impact on the local meteorological conditions.

f) Creation of Noise

The SHNPP produces noise during normal operation. However, the plant's predicted environmental noise emission will have little impact on the residents living at or near the plant boundary. (Section 5.6)

g) Reduction of Regional Products

There is no significant reduction of regional products due to the operation of SHNPP.

h) Lost Income from Recreation or Tourism

There are no nearby recreational or tourist sites or facilities that are expected to be impaired by environmental disturbances caused by the SHNPP. Therefore, no loss of income to such developments is anticipated.

5 i) Lost Income of Commercial Fishermen

As discussed in Section 2.1.3, commercial fish and shellfish catch is negligible within 50 miles of the SHNPP and was non-existent at the site. Therefore, no loss of income to commercial fishermen results from the operation of SHNPP.

j) Decrease in Real Estate Values

Decreases of real estate values in areas adjacent to the facility are not expected to occur. Present trends in real estate indicate an appreciation in property values in areas near the plant site. If present trends continue, the operation of the plant will not adversely affect local real estate values.

k) Increased Cost to Local Governments

Increased costs to local governments for service required by the permanently employed workers and their families are expected to be minimal. Additionally, these employees will help support local governments through local expenditures and taxes.

l) Increased Regulatory Cost to Taxpayers

Based upon 1983 Nuclear Regulatory Commission budget estimates, the cost to the taxpayers to regulate the SHNPP will be approximately $3 million per unit

in 1983. This estimate was calculated conservatively by dividing the total 1983 NRC budget (Reference 8.2.2-1) by the number of nuclear plants either operating or under construction and subtracting fees paid to the NRC by CP&L for certain routine inspections. This calculation therefore ignores all other activities regulated by the NRC. One could assume this reflects the annual cost for regulation in 1983 dollars and make future projections accordingly. 5
However, we are unable to project the future NRC cost of regulation. The estimated cost to the North Carolina taxpayers to administer the SHNPP National Pollutant Discharge Elimination System permit would be approximately $2,100 per year (Reference 8.2.2-2).

REFERENCES: SECTION 8.2

8.2.1-1 Congressional Budget Office, "Financing Radioactive Waste Disposal," September, 1982.

8.2.2-1 Budget Estimates Fiscal Year 1983, NUREG-0870, U.S. Nuclear Regulatory Commission, January, 1982. 5

8.2.2-2 Letter from R. Paul Wilms, Assistant Director, Division of Environmental Management, N.C. Department of Natural Resources and Community Development to S. R. Zimmerman, Manager, Licensing and Permits, Carolina Power & Light Company. October 25, 1982.

CHAPTER 9
ALTERNATIVE ENERGY SOURCES AND SITES

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9.0 ALTERNATIVE ENERGY SOURCES AND SITES

This section is written in accordance with Nuclear Regulatory Commission, Regulatory Guide 4.2, (Part 6.b), pertaining to the "Applicants Environmental Report - Operating License Stage." This report is an updating of the previously completed "Applicants Environmental Report, Construction Permit Stage for Shearon Harris Nuclear Power Plant Unit Nos. 1, 2, 3, and 4" submitted by Carolina Power & Light Company on June 8, 1971. The Construction Permit Stage Environmental Report and the "Revised Final Environmental Statement Related to the Construction of Shearon Harris Nuclear Power Plant Units 1, 2, 3, and 4" issued by the United States Atomic Energy Commission, Directorate of Licensing, in March 1974, as supplemented contain a complete description of the process utilized to select the energy source and site now represented by the Shearon Harris Nuclear Power Plant. 5

Table 9.0-1 provides a 10-year projection for system delivered fuel costs. 5

TABLE 9.0-1

SYSTEM FUEL COST PROJECTION

(MILLS/KWH)

Year	Coal	Propane	Oil	Natural Gas	Nuclear
1986	28	141	230	152	7
1987	31	158	234	171	7
1988	33	178	264	193	8
1989	37	215	294	218	9
1990	39	255	334	245	10
1991	43	266	395	275	11
1992	47	286	374	294	12
1993	51	317	429	328	13
1994	56	344	440	351	15
1995	59	375	479	385	16

5

CHAPTER 10

STATION DESIGN ALTERNATIVES

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10.0 STATION DESIGN ALTERNATIVES

10.1 CIRCULATING SYSTEM (exclusive of intake and discharge)

The circulating water system implemented for the SHNPP was selected and approved during the construction permit review. Section 3.4 of the Environmental Report - Operating License Stage provides a description of this system including those changes resulting from the cancellation of SHNPP Units 3 and 4. 5

10.2 INTAKE STRUCTURE

The design of the cooling tower makeup intake structure (2.2.8.4 ER-CP) for the SHNPP was selected and approved during the Construction Permit review and requires no updating except as discussed below:

Section 3.4 of the Environmental Report - Operating License Stage, which has been updated to incorporate changes in design due to the cancellation of SHNPP Units 3 and 4, discusses the cooling tower makeup intake structure. 5

As discussed during the Construction Permit ASLB hearing held in the fall of 1977, due to the increased cooling tower blowdown and the makeup to the towers, and to limit the approach velocities to 0.5 fps at the makeup water intake structure, the width of each cooling tower makeup pump bay was increased by approximately 2 ft. (an increase from approximately 8 ft. to 10 ft.). Other dimensions of the pump bays did not change appreciably, although changes were required in screens, piping, and other mechanical equipment on the structure to accommodate the increase in cooling tower makeup. The screens are wider, the pumps are greater capacity, and the piping is larger diameter.

10.3 DISCHARGE SYSTEM

The discharge system for SHNPP was selected and approved during the Construction Permit review. Changes to this system were identified by amendment to the Construction Permit Stage Environmental Report, and were discussed in detail during the fall 1977 Construction Permit ASLB hearings. Section 3.4 of the Environmental Report - Operating License Stage, which has been updated to incorporate changes due to cancellation of SHNPP Units 3 and 4, describes the discharge system. 5

10.4 CHEMICAL WASTE TREATMENT

The chemical waste treatment system for SHNPP was selected and approved during the Construction Permit review. Changes and further information in these systems were identified in amendments to the SHNPP Construction Permit Environmental Report. Section 3.6 of the Environmental Report - Operating License Stage, which has been updated to incorporate changes due to the cancellation of SHNPP Units 3 and 4, discusses the chemical waste treatment system. 5

10.5 BIOCIDE TREATMENT

The method of biocide treatment for SHNPP was selected and approved during the Construction Permit review. Changes and further information on these systems were identified in amendments to the SHNPP Construction Permit Environmental Report. Section 3.6 of the Environmental Report - Operating License Stage, which has been updated to include changes due to the cancellation of SHNPP Units 3 and 4, discusses the biocide treatment system. 5

10.6 SANITARY WASTE SYSTEM

10.6.1 GENERAL DESCRIPTION

There will be one extended aeration package treatment plant for Units 1 and 2 5
capable of handling 25,000 gpd at maximum flow for normal operation. The
amount of chlorine discharged from the treatment facility will be
approximately .05 pound per day. The suspended solids and the five-day BOD of 5
the effluent each will not exceed a daily average of 30 mg/l, and 45 mg/l
maximum for any one day. The effluent will be released to the Main Reservoir
via the cooling tower blowdown discharge line. The system is considered a
secondary-level treatment system.

10.6.2 ALTERNATIVE SYSTEM

The sanitary waste system described in the SHNPP Construction Permit Environmental Report was a tertiary-level treatment system. The design parameters associated with each system are identified in Table 10.6-1.

10.6.3 COMPARISON OF ALTERNATIVES

A National Pollutant Discharge Elimination System (NPDES) Permit authorizing
sanitary waste discharges from SHNPP has been approved by the State of North 5
Carolina. The NPDES Permit requires compliance with specified effluent
standards that are consistent with secondary treatment rather than tertiary
treatment, as shown in the following table. There are no State-required
standards for nitrogen or phosphorous discharges from sanitary wastes from
this facility.

Discharge Limitation Associated With Degree of Treatment

Effluent Characteristic	Secondary		Tertiary
	Daily Avg.	Daily Max.	Daily Avg.
BOD	*30 mg/l	*45 mg/l	5 mg/l
TSS	*30 mg/l	*45 mg/l	5 mg/l

(*Standard specified in the NPDES permit for SHNPP.)

It is apparent from the requirements of the NPDES permit that the State 5
expects the impact to the water quality of the Harris Reservoir from the
discharge of sanitary wastes to be minimal. This is supported by (1) the 5
State issuance of an effluent standard permit which indicates that the
receiving waters are not a water quality limited body, (2) the State allowance
of secondary treatment in lieu of tertiary treatment, and (3) the absence of a
nitrogen or phosphorus effluent standard. Further discussion of the impact of
the sanitary waste system discharge is contained in Section 5.4.

A calculation was made to estimate the mixing zone required for a maximum BOD$_5$ concentration of 45 mg/l in the effluent to reach the assumed natural BOD$_5$ concentration of 5 mg/l. Assuming a mixing depth of 5 ft., an effluent flow rate of 0.05 mgd, and a mixing time of one day, it is estimated that an area of less than 0.5 acre would be required. With a total surface area of 4100 acres, it is clear from this conservative calculation that the sanitary waste discharge will have a minimal impact on the integrity of water quality in the Harris Reservoir, and on the ecological systems therein.

10.6.4 CONCLUSION

The secondary-level treatment system for sanitary wastes meets the effluent requirements of the N. C. Environmental Management Commission, N. C. Department of Natural Resources and Community Development, and U. S. EPA effluent limitations for the sanitary waste component of waste water discharges from a steam electric power plant.

TABLE 10.6-1

SHEARON HARRIS NUCLEAR POWER PLANT
SANITARY WASTE TREATMENT SYSTEM COMPARISON

	SECONDARY	TERTIARY
Flow (average gpd)	25,000	25,000
Chlorine Added (lb./Day)	0.15	0.15
Other Chemicals:		
Alum (lb./Day)	0	0.7
Cost ($/Day)	0	2.00
Discharge BOD (ppm):		
Average	30	7
Maximum	45	10
Nutrients:		
Nitrogen (ppm)	75	20 (est.)
Phosphorus (ppm)	15	3
Chlorine Discharge (lb./Day)	0.1	0.1
Est. Cost of Plant (March 1980 Dollars)	125,000.00	234,000.00
Operational Cost (Estimated $/Yr.)		
Personnel & Equipment	780.00	2,340.00
Energy (Differential)	Base	90.00

10.7 LIQUID RADWASTE SYSTEM

The liquid radwaste system as described in Section 3.5.2 is designed to meet the requirements of Appendix I of 10CFR50 and its radioactive releases will be as low as is reasonably achievable. Therefore, no further consideration has been given to the reduction of radiological impacts in formulating alternative plant designs.

10 8 GASEOUS RADWASTE SYSTEM

The gaseous radwaste system as described in Section 3.5.3 is designed to meet the requirements of Appendix I of 10CFR50 and its radioactive releases will be as low as is reasonably achievable. Therefore, no further consideration has been given to the reduction of radiological impacts in formulating alternative plant designs.

10.9 TRANSMISSION FACILITIES

The line location information presented in Section 3.11.8.2 of the Construction Permit Environmental Report requires no updating except that all remarks regarding 500 kV transmission lines should be excluded and the Harris-Method 230 kV Line has been shortened and renamed the Harris-Cary Switching Line as discussed in Section 3.9.

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10.10 OTHER SYSTEMS

There are no other systems associated with an adverse environmental effect that differ from the design that was reviewed and approved during the Construction Permit review.

CHAPTER 11
SUMMARY COST BENEFIT ANALYSIS

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11.0 SUMMARY COST BENEFIT ANALYSIS

11.1 BENEFITS

The savings in system production costs as a result of the operation of the SHNPP is estimated to be $2,021 billion (1986 dollars) for the first ten years of plant operation. Comparable savings are expected to accrue over the entire plant life.

Each SHNPP Unit has an expected net generating capacity of 900 megawatts. The expected average annual generation per unit (assuming a capacity factor of 70 percent) is 5.52 billion kilowatt-hours of electrical energy.

Sensitivity studies demonstrate significant savings even at an assumed capacity factor of 60 or 50 percent or assuming no growth rate whatsoever in CP&L's system demand. This analysis takes no credit for the fact that the SHNPP will be needed to meet anticipated demand and to provide an adequate reserve margin.

11.2 COST 5

The cost for fuel, operations, and maintenance of SHNPP over the life of the project is expected to be approximately $2,578 million (1986 dollars). In addition, there are other external costs (Section 8.2.2) due to the environmental impacts discussed in Chapters 4 and 5. These costs, while difficult to quantify, have been investigated and are believed not to be significant when compared to the benefits derived from the project. Decommissioning costs for an 1175 MW(e) Reference Nuclear Plant in 1978 dollars will probably fall within the range of $42.1 million for immediate dismantlement to $51.5 million for safe storage with deferred dismantlement, depending on the method selected. The cost for SHNPP may be somewhat higher. (See Section 5.8).

11.3 CONCLUSIONS

The benefits from operation of the SHNPP significantly outweigh the minimal environmental costs. The analysis of costs and benefits from SHNPP operation validates the cost-benefit balance struck at the Construction Permit stage.

CHAPTER 12
ENVIRONMENTAL APPROVALS AND CONSULTATIONS

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12.0 ENVIRONMENTAL APPROVALS AND CONSULTATIONS

12.1 INTRODUCTION

The purpose of this chapter is to identify and relate the status of those licenses, permits, or approvals which were obtained before and after construction of the Shearon Harris Nuclear Power Plant (SHNPP) and its transmission system commenced. Because of the complexity of the project and the extent of data required to satisfy permit requirements, applications for the majority of licenses followed formal application to the Atomic Energy Commission in September, 1971, for a Construction Permit. Tables 12.1-1 and 12.1-2 present the status of various permits and licenses required for the completion of the SHNPP and its transmission system, respectively.

12.2 AGENCY APPROVALS

12.2.1 FEDERAL AGENCY APPROVALS

Permits or approvals from the following federal agencies must be obtained before authorization is given for construction. These agencies were notified of the SHNPP before the respective permit applications were submitted.

12.2.1.1 U. S. Nuclear Regulatory Commission

The U. S. Nuclear Regulatory Commission (NRC), formerly the U. S. Atomic Energy Commission (AEC), is responsible for regulation of the design, construction, and operation of all nuclear power facilities installed within the boundaries of the United States or possessions of the United States.

The procedure for environmental study is set forth in 10CFR51. Each applicant filing for an initial construction permit must submit its own Construction Permit Environmental Report (CPER) to the NRC. This report presents the applicant's assessment of the environmental impact of the planned facility and possible alternatives which would alter the impact. The NRC receives the applicant's assessment and issues its Draft Environmental Impact Statement. This statement is then circulated to other responsible agencies and made available to the general public. After comments are received from these sources, the NRC prepares a Final Environmental Impact Statement and makes a final recommendation on the utility's application for a Construction Permit.

When application is made for an Operating License, the applicant submits an Operating License Environmental Report which updates the CPER, noting any changes which have occurred since the original report. Then, a new detailed Environmental Impact Statement is prepared by the NRC, and a final recommendation on the applicant's Operating License is prepared. When all environmental and safety questions have been satisfactorily answered, the applicant is granted an Operating License. 3

12.2.1.2 U. S. Army Corps of Engineers

As stated in Section 10 of the River and Harbor Act of 1899, the U. S. Army Corps of Engineers (Corps) is responsible for the issuance of permits authorizing the obstruction or alteration of any navigable water of the U. S. including the construction of any structure in or over any navigable water of the U. S., the excavation from or depositing of material in such waters, and the accomplishment of any other work affecting the course, location, condition, or capacity of such waters. Additionally, Section 404 of the Federal Water Pollution Control Act as amended by the Clean Water Act of 1977 (Clean Water Act) assigned to the Corps the responsibility for issuing permits to discharge dredged or fill material into the waters of the U. S. at specified disposal sites.

In accordance with these two Acts, the Corps reviews the Construction Permit. This review is coordinated with state agencies, U. S. Environmental Protection Agency, and U. S. Department of Interior. The Department of Interior advises the Corps on fish and wildlife matters pursuant to the Fish & Wildlife Coordination Act and Endangered Species Act.

12.2.1.3 Federal Aviation Administration

As defined in Part 77 of the Federal Aviation Regulations, the Federal Aviation Administration (FAA) is responsible for determining whether proposed construction or use of construction equipment would be an obstruction to air navigation, whether it should be marked and lighted to enhance safety in air navigation, and whether supplemental notice of start and completion of construction or use of construction equipment is required to permit timely charting and notification to airmen. The FAA is notified of proposed construction or use of construction equipment by submitting Form 7460-1 entitled "Notice of Proposed Construction or Alteration."

12.2.2 NORTH CAROLINA PERMITS, AGREEMENTS AND OTHER APPROVALS

The following state agencies require issuance of permits and/or approvals. Comments concerning the economic impact of SHNPP from State, local, and regional planning authorities were coordinated through the North Carolina Department of Administration's Clearinghouse and Information Center.

12.2.2.1 North Carolina Utilities Commission

The issuance of a Certificate of Public Convenience and Necessity from the North Carolina Utilities Commission is required before a public utility may begin construction or operation of a plant. The Commission reviews extensive information concerning the proposed project and conducts a public hearing in its determination of need and convenience. Major factors considered include estimated construction costs, environmental impact, utility justification, and site specific information.

12.2.2.2 North Carolina Division of Environmental Management

The North Carolina Environmental Management Commission (EMC) is charged with the responsibility of protecting, preserving, and enhancing the water and air resources of the State. In order for the EMC to effectively and efficiently fulfill its responsibilities and carry out its policy, the N. C. Division of

Environmental Management (DEM) was created to perform administrative and technical duties for the EMC.

The construction of a well requires a permit from DEM as outlined in Title 15, Subchapter 2C of the North Carolina Administrative Code (NCAC). In a well construction permit application, DEM considers public health and possible groundwater contamination, impact to groundwater use, proximity to other wells, well yield, and impact to existing groundwater table.

The construction and operation of a wastewater treatment facility which does not discharge to the waters of the State require permits from DEM (see 15NCAC 2H .0200). In issuing these permits, DEM is responsible for determining the ability of the treatment system to prevent discharges to surface waters and adverse impact to groundwater resources.

Permits are also required from DEM for emission of pollutants to the atmosphere as outlined in 15 NCAC 2H .0600. Factors considered in this regulatory review include public health, plant and animal life, impact to ambient air quality, available technology, and cost of proposed project.

As outlined in Section 401 of the Clean Water Act, any applicant for a federal license or permit to conduct any activity which may result in any discharge to navigable waters shall be required to obtain State certification that such discharge would comply with the water quality standards as provided in Sections 301, 302, 303, 306, and 307 of the Act. DEM is responsible for this certification in North Carolina.

A National Pollutant Discharge Elimination System (NPDES) permit is required for the discharge of pollutants into navigable waters as outlined in Section 402 of the Clean Water Act. This permitting authority has been delegated by EPA to DEM.

The design of both intakes was discussed with DEM. CP&L has since been verbally informed that both intakes meet the criteria of Section 316(b) of the Clean Water Act. 2

DEM has the authority to control the consumptive use of water in the State by the use of Special Orders and will do so when they deem it appropriate for the wise and fair use of the water resource.

12.2.2.3 North Carolina Division of Health Services

The Division of Health Services requires a permit be obtained before constructing an impoundment (see 10 NCAC 10C .0400) so that the Division may ensure protection of public health and prevention of insect-borne diseases. Particular attention is given to reservoir clearing specifications and mosquito control measures.

12.2.2.4 North Carolina Division of Earth Resources

The N. C. Division of Earth Resources requires significant earth disturbing activities have approved erosion control plans pursuant to the Sedimentation Pollution Control Act of 1973. The Division conducts periodic inspections to determine the adequacy of installed control measures and the need for additional ones.

12.2.2.5 North Carolina Department of Transportation

Permission to relocate or close existing bridges and roads to construct electric generating plants and supporting facilities must be obtained from the North Carolina Department of Transportation (DOT). The Department of Transportation as the regulatory agency considers factors such as current standards on road construction, volume and type of road use involved, public inconvenience created by the proposed relocation and public benefits of the proposed relocation outlined in the applicant's plans.

12.2.3 COUNTY AGENCIES

The following county agencies require issuance of permits and/or approvals.

12.2.3.1 Wake and Chatham County Commissioners

County Commissioners must approve the abandonment of roads in their respective counties. Once the Commissioners approve, they must petition the North Carolina Board of Transportation for State approval.

12.2.3.2 Wake County Planning Board

Through County zoning regulations, the Wake County Planning Board regulates the size of buildings and other structures, percentage of a lot that may be occupied, the size of open spaces and yards, density of population, and the location and use of buildings and land. Compliance with these regulations requires a Land Use Permit.

TABLE 12.1-1

Shearon Harris Nuclear Power Plant Permits/Approvals and Status

Agency	Permit or Approval	Status	
U. S. Nuclear Regulatory Commission	Construction Permit	Issued January 27, 1978	
	Operating License	Requested Issue Date May, 1985	5
U. S. Army Corps of Engineers	Permit for the construction of makeup water intake structure and excavation of water access channel on Cape Fear River	To be requested six months prior to construction of Cape Fear Makeup Water System	
	Permit for placement of fill material in Watery Branch, Buckhorn Creek, and Beaver Dam Creek for the relocation of Norfolk Southern Railway main track	Requested August 24, 1976 Issued October 28, 1976	
	Permit for placement of fill material in Buckhorn Creek for the construction of makeup reservoir dam and associated facilities	Requested May 31, '77 Issued October 13, 1977	
Federal Aviation Administration	Determination to obstruction mark and light two mobile tower cranes for use at the SHNPP site	Requested December 2, 1977 Approved December 13, 1977	
	Determination to obstruction mark and light two natural draft towers	Requested October 5, 1977 Approved November 1, 1977 Notified May 1982 of Cancellation of Units 3 & 4	
	Determination to obstruction mark and light a crane for the construction of Unit No. 1 at SHNPP	Requested October 11, 1979 Approved October 25, 1979	
	Determination to obstruction mark and light meteorology tower	Requested October 31, 1972 Issued November 8, 1972	
North Carolina Utilities Commission	Certificate of Public Convenience and Necessity	Requested August 14, 1971 Issued February 29, 1972	

TABLE 12.1-1 (Continued)

Agency	Permit or Approval	Status
North Carolina Division of Environmental Management	Permit for construction of potable water supply wells	Issued November 13, 1972; April 17 and July 16, 1973; and July 14, 1977
	Permit for construction and operation of temporary 20,000 gpd extended aeration waste treatment plant	Requested July 8, 1974 Issued September 30, 1974
	Permit for operation of air cleaning devices installed on the concrete batch plant	Requested May 26, 1977 Issued September 28, 1977
	Permit for construction and operation of refuse burner	Requested May 10, 1977 Issued September 28, 1977
	Certification pursuant to Section 401 of the Clean Water Act	Requested March 3, 1973 Certified December 20, 1973 Modified Request July 22, 1977 Recertified Sept. 14, 1977
	NPDES Permit for discharge of waste water resulting from construction and operation of SHNPP	Requested July 28, 1977 Issued July 12, 1982 5
	Special Order for water withdrawal	Issued July 19, 1973
North Carolina Division of Health Services	Approval for construction and reservoir filling of Main Reservoir and Auxiliary Reservoir	Requested February 11, 1974 Pending final construction inspection
North Carolina Division of Earth Resources	Approval of plans to disturb land at construction site	Erosion Control and Sedimentation Plans are submitted for review and approval as needed
North Carolina Department of Transportation	Approval to modify N. C. 42 in Chatham County in order to eliminate railroad grade crossing with relocated Norfolk Southern main line	Agreed February 17, 1977 Accepted April 24, 1978

TABLE 12.1-1 (Continued)

Agency	Permit of Approval	Status	
North Carolina Department of Transportation	Approval to modify U. S. 1 in Wake County	Agreed May 14, 1979 Acceptance pending	
	Approval to relocate SR 1127 in Wake County	Agreed December 29, 1978 Acceptance pending	
	Approval to improve SR 1135 and portions of SR 1134 in Wake County	Agreed November 7, 1979 Acceptance pending	
	Approval to modify SR 1921, SR 1914, and N. C. 42 in Chatham County where makeup water system from Cape Fear River crosses	To be requested six months prior to construction of Cape Fear Makeup Water System	4
Wake and Chatham County Commissioners and North Carolina Board of Transportation	Approval to abandon following roads:		
	<u>Wake County</u> Portions of SR 1116, SR 1134, and SR 1135, Entirety of SR 1128, SR 1129, SR 1131, SR 1132, and SR 1133	Petition by Wake County Commissioners March 23, 1978 Approved by Board of Transportation April 21, 1978	
	<u>Chatham County</u> Portions of SR 1913, SR 1914, and SR 1915	Petition by Chatham County Commissioners April 5, 1979 Approved by Board of Transportation April 21, 197	
Wake County Planning Department	Permit for land use in Wake County	Requested April 11, 1974 Issued March 20, 1978	

TABLE 12.1-2

Shearon Harris Transmission System Permits/Approvals and Status

Transmission Line Name	Permit or Approval (Agency)	Status
Harris-Cary Switching	Approval of plans to disturb land along construction right-of-way (N. C. Division of Land Resources)	Line Constructed Approval Granted
Harris-Cape Fear	Approval of plans to disturb land along construction right-of-way (N. C. Division of Land Resources)	Line Constructed Approval Granted
Harris-Asheboro	Approval of plans to disturb land along construction right-of-way (N. C. Division of Land Resources)	Partially Constructed Approval Granted Additional request to be submitted when required 3
	Encroachment agreement to cross limited or controlled access highways (N. C. Department of Transportation)	Partially Constructed Approval Granted Additional request to be submitted when required
Harris-Fayetteville	Approval of plans to disturb land along construction right-of-way (N. C. Division of Land Resources)	Partially Constructed Approval Granted Additional request to be submitted when required
	Permit to cross navigable waters (U. S. Army Corps of Engineers)	Approval Granted
	Encroachment agreement to cross limited or controlled access highways (N.C. Department of Transportation)	Approval Granted
Harris-Erwin (South)	Approval of plans to disturb land along construction right-of-way (N. C. Division of Land Resources)	Request to be submitted when required

TABLE 12.1-2 (Continued)

Transmission Line Name	Permit or Approval (Agency)	Status
Harris-Erwin (North)	Approval of plans to disturb land along construction right-of-way (N. C. Division of Land Resources)	Line Constructed Approval Granted

3

CHAPTER 13
REFERENCES

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13.0 REFERENCES

All references used in the SHNPP Environmental Report - Operating License Stage are listed at the end of the individual sections in which they are referenced.

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ENVIRONMENTAL REPORT - OPERATING LICENSE STAGE

APPENDIX A LIST OF FIGURES (Cont'd)

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APPENDIX A

BASIC DATA FOR SOURCE TERM CALCULATIONS

APPENDIX A

BASIC DATA FOR SOURCE TERM CALCULATIONS

A.1 General (Reference FSAR 11.1; ER 3.5.1)

1. The maximum core thermal power evaluated for safety considerations in the FSAR:

   2900 Mwt

2. Core properties:

   a. The total mass of uranium and plutonium in an equilibrium core:

      Uranium - 159,412 lbs.
      Plutonium - 0 lbs.

   b. The percent enrichment of uranium in reload fuel:

      2.96 percent

   c. The percent of fissile plutonium in reload fuel:

      0.0%

3. Regulatory Guide (RG) 1.112 was used in estimating source terms in the primary coolant.

4. The quantity of tritium released in liquid and gaseous effluents:

   Liquid: 150 Ci/yr. per reactor
   Gaseous: 580 Ci/yr. per reactor

A.2 <u>Primary System</u> (Reference FSAR 11.1, 11.2; ER 3.5.1, 3.5.2)

1. The total mass of coolant in the primary system, excluding the pressurizer and primary coolant purification system at full power:

   3.9×10^5 lbs.

2. The average primary system letdown rate to the primary coolant purification system:

   60 gpm

3. The average flowrate through the primary coolant purification system cation demineralizers.

   6.0 gpm

4. The average Shim bleed flow:

   0.6 gpm

A.3 Secondary System (Reference FSAR 10.4, 11.1, 11.2; ER 3.5.1, 3.5.2)

1. The number and type of steam generators and the carryover factor used in the evaluation for iodine and nonvolatiles:

    Three recirculating, U-tube steam generators per unit
    Partition Factor for iodines: 0.01
    Partition Factor for nonvolatiles: 0.001

2. The total steam flow in the secondary system:

    12,2 x 106 lbs./hr.

3. The mass of steam in each steam generator at full power:

    9,000 lbs.

4. The mass of liquid in each steam generator at full power:

    101,000 lbs.

5. The total mass of coolant in the secondary system at full power:

    330,000 lbs.

6. The primary-to-secondary system leakage rate used in the evaluation:

    100 lb./day

7. Steam Generator Blowdown and Blowdown Purification Systems:

The Steam Generator Blowdown System (SGBS), shown on FSAR Figure 10.1.0-6 is used in conjunction with the Secondary Sampling System to control the chemical composition of water in the secondary side of the steam generator shells within specified limits and to prevent the buildup of corrosion products. Steam Generator Blowdown System removes contaminants and corrosion product accumulations from the steam generators to maintain secondary water chemistry within prescribed limits. 5

The design and operation of the SGBS including system descriptions and component design parameters are discussed in detail in SHNPP FSAR Section 10.4.8.

5

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8. The fraction of the steam generator feedwater processed through the condensate demineralizer is 0.7. The decontamination factors used in the evaluation of the condensate demineralizers are:

    Anion = 10
    Cs, Rb = 2
    All other cations: 10

9. Condensate demineralizers:

    a. Average flowrate:

    8.54×10^6 lb./hr.

b. Demineralizer type:

Mixed bed

c. Number and size of demineralizers:

5 in service (1 standby)
258 $ft.^3$ each

d. Regeneration frequency:

30 days

e. Ultrasonic resin cleaning is not used.

f. Regenerant volume and activity:

Approximately 34,000 gal./regeneration at 0.001 RCS activity.

TABLE A.3.7-1

Deleted by Amendment No. 5

Deleted Pages A.3-5 and A.3-6

A.4 Liquid Waste Processing System (Reference FSAR 11.2; ER 3.5.2)

1.

a. Sources, flowrates, and expected activities (fraction of primary coolant activity) for all inputs to each system:

See Table A.4.1-1

b. Holdup times associated with collection, processing, and discharge of all liquid streams:

See Table A.4.1-2

c. Liquid input flowrates and tank volumes were the only parameters considered in calculating holdup times:

See Table A.4.1-2

d. Decontamination factor for each processing step:

See Table A.4.1-3

e. Fraction of each processing stream expected to be discharged over the life of the station.

Subsystem	Fraction Discharged
Equipment Drain	0.1
Floor Drain	0.1
Sec. Waste Low Cond.	0.1
Sec. Waste High Cond.	0.1
Laundry & Hot Shower	1.0

f. Demineralizer Regeneration* (one unit)

Condensate Demineralizers*

Time between regenerations		30 Days (each bed)
Regenerant Volumes	Lo Cond.	3.667 Gal./Day
	High Cond.	2,000 Gal./Day
Fraction of PCA	Lo Cond.	0
	High Cond.	0.001
Fraction of regenerant discharge		0.1

* The condensate demineralizers only will be regenerated.

** Based on 30-day average condensate cycle with 12,000 gal. High Conductivity and 22,000 gal. Low Conductivity per regeneration. There are five condensate demineralizers per unit in service at all times.

g. Liquid source term by radionuclide in Ci/yr. for normal operation, including anticipated operational occurrences:

See Tables A.4.1-4 through A.4.1-7

2. P&IDs and process flow diagrams for the liquid radwaste systems:

5 See FSAR Figures 11.2.2-1 through 11.2.2-8.

TABLE A.4.1-1

LIQUID WASTE PROCESSING SYSTEM
SCHEDULE OF INFLUENT WASTE STREAMS

Subsystem	Source	Volume Gal./Year(1)	Volume Gal./Day(2)	Number of Process Train	Activity(8) Fraction of RCS
Equipment Drain Treatment System	Equipment Drains & Leakoffs	120,000	410	1	1
Floor Drain Treatment System	Reactor Auxiliary Building Floor Drain System	145,000	400	2	0.1
	Laboratory Equipment Rinses	72,500	200		0.002
	Miscellaneous Floor Drains	127,750	350		0.07
		345,250	950		
Laundry & Hot Shower Treatment System	Laundry & Hot Shower Drains	1,915,000	17,500(3)	1	(4)
Secondary Waste Low Conductivity Subsystem	EMF Backflush	584,000	1,600	2	0.0002
	Industrial Sumps Condensate Polisher	5,256,000	14,400		(5)
	Low Conductivity Waste(7)	3,212,000	22,000(6)		(5)
		9,052,000	38,000(7)		
Secondary Waste High Conductivity Subsystem	Condensate Polisher Regeneration(7)	1,752,000	12,000(7)	2	0.005

5

TABLE A.4.1-1 (Cont'd)

5

(1) Based on influents from two Units.

(2) Daily average per processing train.

(3) Annual average 10,493, abnormal flow for 200 days = 17,500.

(4) Activities: normal 1.01 x 10^{-4} µCi/gram; design basis 2.64 x 10^{-4} µCi/gram.

(5) Same activity as secondary steam condensate.

(6) Based on 30-day average condensate cycle, with 12,000 gal. high conductivity and 22,000 gal. low conductivity waste per regeneration.

(7) Expected maximum flow during periodic regeneration.

(8) Reactor Coolant System activity given in Table 3.5.1-1.

TABLE A.4.1-2

SUMMARY - LIQUID WASTE PROCESSING SYSTEM CAPABILITIES
TWO UNITS

Subsystem	Influent Waste Volume Gallons/Yr.	Process Capacity gpm	Process Capacity Gallons/Yr.	Fraction of Process Capacity Used	Tanks Name	Storage Capacity Tank Quantity	Volume Per Tank (Gallons)	No. of Days Storage Waste Input(1)	Redundant Process Subsystem
Equipment Drain Treatment System	120,000	15	7.88×10^{6}	.015	Waste Hold-Up Tank	1	25,000	49	
Floor Drain Treatment System	345,250	30	$1.58\times10^{7(3)}$	.022	Floor Drain Tank	4	25,000	84	Laundry and Hot Shower
Laundry and Hot Shower Treatment System	1,915,000	30	$1.26\times10^{7(3)}$	.15	Laundry and Hot Shower Tank	2	25,000	2.3	Floor Drain
Secondary Waste Low Conductivity Subsystem	10,752,000(2)	100	$5.26\times10^{7(3)}$	.20	Low Conductivity Holding Tank	3	15,000	1	SW Low Conductivity B System Demineralizer
Secondary Waste High Conductivity Subsystem	1,752,000	15	$7.88\times10^{6(3)}$	.22	High Conductivity Holding Tank	1	15,000	1	SW High Conductivity B System Evaporator

(1) Based on 80% tank volume. Daily average given in Table 3.5.2-1.

(2) Condensate includes 1,700,000 gallons of secondary waste high conductivity

(3) Based on 80% equipment availability (292 days) when system does not have a dedicated spare.

5

TABLE A.4.1-3

DECONTAMINATION FACTORS** LIQUID WASTE PROCESSING SYSTEM

Demineralizers*	Cs, Rb	All Other Nuclides
Floor Drain Treatment System	10	10
Equipment Drain Treatment System	2 (10)	10^2 (10)***
Laundry & Hot Shower Treatment System	2	10^2
SW Low Conductivity Subsystem	2	10^2
SW High Conductivity Subsystem	10	10
Condensate (mixed bed)	2	10

Evaporators	Iodine	Cr,Mn,Co,Fe,Ag,Zr, Nb,Ru,Rh,La,Ce,Pr	All Other Nuclides
Floor Drain Treatment System	10^3	10^3****	10^4
Equipment Drain Treatment System	10^3	10^3	10^4
Laundry & Hot Shower Treatment System	10^2	10^2	10^2
SW High Conductivity Subsystem	10^3	10^4	10^4

Filters	Mo,Tc, (Plateout)+^{Y}		Cr,Mn,Co,Fe,Ag,Zr, Nb,Ru,Rh,La,Ce,Pr	All Other Nuclides
Floor Drain Treatment System	10^2	10	10****	1
Equipment Drain Treatment System	10^2	10	10	1
Laundry & Hot Shower Treatment System	10^2	10	10	1
SW Low Conductivity Subsystem	10^2	10	10	1

Reverse Osmosis	All Nuclides
Floor Drain Treatment System	10
Laundry & Hot Shower Treatment System	30

TABLE A.4.1-3 (Continued)

DECONTAMINATION FACTORS**
LIQUID WASTE PROCESSING SYSTEM

* All demineralizers are mixed bed demineralizers except for the Floor Drain demineralizer which is a cation bed.

** Inlet Concentration/Product Concentrations. Data taken from NUREG-0017, unless otherwise indicated.

*** The DF is given in parenthesis after a demineralizer.

**** WASH 1528 and NUREG-0017 lists DF = 1 for filters and DF = 10^4 for evaporators. The same overall applies here but is apportioned differently to permit computer calculation of activity deposited on the filters.

+ DF taken from ANS 55.2/N199-1976

TABLE A.4.1-4

NUCLIDE CONCENTRATION OF PROCESS LOCATION IN THE EQUIPMENT DRAIN TREATMENT SYSTEM (μCi/g) NORMAL OPERATION

Isotope	Outlet, Waste Holdup Tank	Outlet, Waste Evap Feed Filter	Outlet, Waste Evaporator	Outlet, Waste Evap Condensate Demin.	Outlet, Waste Evap Condensate Tank
Br 83	1.66E-05	1.66E-05	1.66E-09	1.66E-10	1.32E-10
Br 84	1.95E-06	1.95E-06	1.95E-10	1.95E-11	1.96E-15
I 130	3.62E-05	3.62E-05	3.62E-08	3.62E-09	2.22E-08
I 131	6.73E-02	6.73E-02	6.73E-05	6.73E-06	6.52E-05
I 132	3.29E-04	3.29E-04	3.29E-07	3.29E-08	2.32E-08
I 133	1.08E-02	1.08E-02	1.08E-05	1.08E-06	8.04E-06
I 134	5.84E-05	5.84E-05	5.84E-08	5.84E-09	5.14E-11
I 135	1.79E-03	1.79E-03	1.79E-06	1.79E-07	7.21E-07
Rb 86	4.17E-05	4.17E-05	4.17E-09	4.17E-10	4.12E-09
Rb 88	8.25E-05	8.25E-05	8.25E-09	8.25E-10	1.17E-17
Cs 134	2.57E-02	2.57E-02	2.57E-06	2.57E-07	2.57E-06
Cs 136	4.92E-03	4.92E-03	4.92E-07	4.92E-08	4.82E-07
Cs 137	1.90E-02	1.90E-02	1.90E-06	1.90E-07	1.90E-06
Cr 51	1.16E-03	1.16E-04	1.16E-07	1.16E-08	1.15E-07
Mn 54	3.08E-04	3.08E-05	3.08E-08	3.08E-09	3.08E-08
Fe 55	1.65E-03	1.65E-03	1.65E-07	1.65E-08	1.65E-07
Fe 59	7.39E-04	7.39E-05	7.39E-08	7.39E-09	7.35E-08
Co 58	1.34E-02	1.34E-03	1.34E-06	1.34E-07	1.33E-06
Co 60	2.08E-03	2.08E-04	2.08E-07	2.08E-08	2.08E-07
Sr 89	2.69E-04	2.69E-04	2.69E-08	2.69E-09	2.68E-08
Sr 90	1.05E-05	1.05E-05	1.05E-09	1.05E-10	1.05E-09
Sr 91	8.73E-06	8.73E-06	8.73E-10	8.73E-11	4.65E-10
Y 90	1.02E-07	1.02E-08	1.02E-12	1.02E-13	9.29E-13
Y 91M	4.29E-07	4.29E-08	4.29E-12	4.29E-13	2.84E-15
Y 91	5.08E-05	5.08E-06	5.08E-10	5.08E-11	5.06E-10
Y 93	4.90E-07	4.90E-08	4.90E-12	4.90E-13	2.73E-12
Zr 95	4.93E-05	4.93E-06	4.93E-09	4.93E-10	4.91E-09
Nb 95	3.38E-05	3.38E-06	3.38E-09	3.38E-10	3.35E-09
Mo 99	7.39E-03	7.39E-05	7.39E-09	7.39E-10	6.74E-09
Tc 99M	4.09E-04	4.09E-06	4.09E-10	4.09E-11	1.49E-10

TABLE A.4.1-4 (Continued)

NUCLIDE CONCENTRATION OF PROCESS LOCATION IN THE EQUIPMENT DRAIN TREATMENT SYSTEM (μCi/g) NORMAL OPERATION

Isotope	Outlet, Waste Holdup Tank	Outlet, Waste Evap Feed Filter	Outlet, Waste Evaporator	Outlet, Waste Evap Condensate Demin.	Outlet, Waste Evap Condensate Tank
Ru 103	3.18E-05	3.18E-06	3.18E-09	3.18E-10	3.16E-09
Ru 106	1.00E-05	1.00E-06	1.00E-09	1.00E-10	1.00E-09
Rh 103M	6.12E-08	6.12E-09	6.12E-12	6.12E-13	9.97E-15
Te 125M	2.31E-05	2.31E-05	2.31E-09	2.31E-10	2.30E-09
Te 127M	2.51E-04	2.51E-04	2.51E-08	2.51E-09	2.51E-08
Te 127	1.10E-05	1.10E-05	1.10E-09	1.10E-10	5.70E-10
Te 129M	9.20E-04	9.20E-04	9.20E-08	9.20E-09	9.13E-08
Te 129	2.58E-06	2.58E-06	2.58E-10	2.58E-11	1.12E-12
Te 131M	9.66E-05	9.66E-05	9.66E-09	9.66E-10	7.81E-09
Te 131	6.43E-07	6.43E-07	6.43E-11	6.43E-12	2.77E-17
Te 132	2.77E-03	2.77E-03	2.77E-07	2.77E-08	2.56E-07
Ba 140	8.16E-05	8.16E-05	8.16E-09	8.16E-10	8.00E-09
La 140	8.03E-06	8.03E-07	8.03E-10	8.03E-11	6.90E-10
Ce 141	4.58E-05	4.58E-06	4.58E-09	4.58E-10	4.55E-09
Ce 143	1.77E-06	1.77E-07	1.77E-10	1.77E-11	1.47E-10
Ce 144	3.27E-05	3.27E-06	3.27E-09	3.27E-10	3.27E-09
Pr 143	1.95E-05	1.95E-06	1.95E-09	1.95E-10	1.92E-09
Pr 144	1.30E-08	1.30E-08	1.30E-12	1.30E-13	8.14E-22
Np 239	8.95E-05	8.95E-05	8.95E-09	8.95E-10	8.04E-09
TOTAL	1.6194E-01	1.3807E-01	8.7660E-05	8.7660E-06	8.1349E-05

TABLE A.4.1-5

NUCLIDE CONCENTRATION OF PROCESS LOCATION IN THE FLOOR DRAIN TREATMENT SYSTEM (μCi/g) NORMAL OPERATION

Isotope	Outlet, Floor Drain Tank	Outlet, Reverse Osmosis, Feed Filter	Outlet, Floor Drain, Reverse Osmosis	Outlet, Waste Monitor Demin.	Outlet, Waste Monitor Tank
Br 83	2.57E-06	2.57E-06	2.57E-07	2.57E-08	1.07E-09
Br 84	3.07E-07	3.07E-07	3.07E-08	3.07E-09	1.62E-15
I 130	5.59E-06	5.59E-06	5.59E-07	5.59E-08	3.03E-08
I 131	8.97E-03	8.97E-03	8.97E-04	8.97E-05	8.62E-05
I 132	5.10E-05	5.10E-05	5.10E-06	5.10E-07	1.82E-08
I 133	1.66E-03	1.66E-03	1.66E-04	1.66E-05	1.15E-05
I 134	9.13E-06	9.13E-06	9.13E-07	9.13E-08	1.32E-11
I 135	2.77E-04	2.77E-04	2.77E-05	2.77E-06	8.82E-07
Rb 86	4.31E-06	4.31E-06	4.31E-07	4.31E-08	4.23E-08
Rb 88	1.32E-05	1.32E-05	1.32E-06	1.32E-07	1.02E-08
Cs 134	1.82E-03	1.82E-03	1.82E-04	1.82E-05	1.82E-05
Cs 136	5.68E-04	5.68E-04	5.68E-05	5.68E-06	5.54E-06
Cs 137	1.33E-03	1.33E-03	1.33E-04	1.33E-05	1.33E-05
Cr 51	1.08E-04	1.08E-05	1.08E-06	1.08E-07	1.06E-07
Mn 54	2.23E-05	2.23E-06	2.23E-07	2.23E-08	2.22E-08
Fe 55	1.17E-04	1.17E-04	1.17E-05	1.17E-06	1.17E-06
Fe 59	6.23E-05	6.23E-06	6.23E-07	6.23E-08	6.19E-08
Co 58	1.06E-03	1.06E-04	1.06E-05	1.06E-06	1.05E-06
Co 60	1.46E-04	1.46E-05	1.46E-06	1.46E-07	1.46E-07
Sr 89	2.23E-05	2.23E-05	2.23E-06	2.23E-07	2.21E-07
Sr 90	7.34E-07	7.34E-07	7.34E-08	7.34E-09	7.34E-09
Sr 91	1.35E-06	1.35E-06	1.35E-07	1.35E-08	6.11E-09
Y 90	1.57E-08	1.57E-09	1.57E-10	1.57E-11	1.39E-11
Y 91M	6.72E-08	6.72E-09	6.72E-10	6.72E-11	6.78E-15
Y 91	4.13E-06	4.13E-07	4.13E-08	4.13E-09	4.11E-09
Y 93	7.58E-08	7.58E-09	7.58E-10	7.58E-11	3.62E-11
Zr 95	3.94E-06	3.94E-07	3.94E-08	3.94E-09	3.92E-09
Nb 95	2.98E-06	2.98E-07	2.98E-08	2.98E-09	2.96E-09
Mo 99	1.14E-03	1.14E-05	1.14E-06	1.14E-07	1.01E-07
Tc 99M	6.33E-05	6.33E-07	6.33E-08	6.33E-09	1.78E-09

TABLE A.4.1-5 (Continued)

NUCLIDE CONCENTRATION OF PROCESS LOCATION IN THE FLOOR DRAIN TREATMENT SYSTEM (μCi/g) NORMAL OPERATION

Isotope	Outlet, Floor Drain Tank	Outlet, Reverse Osmosis Feed Filter	Outlet, Floor Drain, Reverse Osmosis	Outlet, Waste Monitor Demin.	Outlet, Waste Monitor Tank
Ru 103	2.74E-06	2.74E-07	2.74E-08	2.74E-09	2.72E-09
Ru 106	7.20E-07	7.20E-08	7.20E-09	7.20E-10	7.19E-10
Rh 103M	9.56E-09	9.56E-10	9.56E-11	9.56E-12	2.99E-15
Te 125M	1.88E-06	1.88E-06	1.88E-07	1.88E-08	1.87E-08
Te 127M	1.91E-05	1.91E-05	1.91E-06	1.91E-07	1.91E-07
Te 127	1.70E-06	1.70E-06	1.70E-07	1.70E-08	7.44E-09
Te 129M	8.23E-05	8.23E-05	8.23E-06	8.23E-07	8.15E-07
Te 129	4.02E-07	4.02E-07	4.02E-08	4.02E-09	4.31E-12
Te 131M	1.49E-05	1.49E-05	1.49E-06	1.49E-07	1.14E-07
Te 131	1.02E-07	1.02E-07	1.02E-08	1.02E-09	1.02E-17
Te 132	4.24E-04	4.24E-04	4.24E-05	4.24E-06	3.84E-06
Ba 140	9.47E-06	9.47E-06	9.47E-07	9.47E-08	9.24E-08
La 140	1.24E-06	1.24E-07	1.24E-08	1.24E-09	1.02E-09
Ce 141	4.11E-06	4.11E-07	4.11E-08	4.11E-09	4.07E-09
Ce 143	2.73E-07	2.73E-08	2.73E-09	2.73E-10	2.16E-10
Ce 144	2.36E-06	2.36E-07	2.36E-08	2.36E-09	2.36E-09
Pr 143	2.22E-06	2.22E-07	2.22E-08	2.22E-09	2.17E-09
Pr 144	2.09E-09	2.09E-09	2.09E-10	2.09E-11	5.74E-23
Np 239	1.38E-05	1.38E-05	1.38E-06	1.38E-07	1.20E-07
TOTAL	1.8042E-02	1.5576E-02	1.5576E-03	1.5576E-04	1.4387E-04

TABLE A.4.1-6

NUCLIDE CONCENTRATION OF PROCESS LOCATION IN THE SECONDARY WASTE TREATMENT SYSTEM (μCi/g) NORMAL OPERATION

Isotope	Outlet, High Cond. Holding Tank	Outlet, Low Cond. Holding Tank	Outlet, SW Evaporator	Outlet, SW Filter	Outlet, SW Demin.	Outlet, SW Sample Tank
Br 83	4.06E-06	1.95E-08	4.06E-10	1.95E-08	1.95E-10	9.81E-09
Br 84	4.86E-07	2.64E-09	4.86E-11	2.64E-09	2.64E-11	1.76E-10
I 130	6.49E-06	1.65E-08	6.49E-09	1.65E-08	1.65E-10	1.43E-08
I 131	1.37E-03	2.43E-06	1.37E-06	2.43E-06	2.43E-08	2.40E-06
I 132	8.05E-05	3.95E-07	8.05E-08	3.95E-07	3.95E-09	1.92E-07
I 133	1.44E-03	3.18E-06	1.44E-06	3.18E-06	3.18E-08	2.92E-06
I 134	1.44E-05	7.79E-08	1.44E-08	7.79E-08	3.79E-10	1.33E-08
I 135	4.01E-04	1.29E-06	4.01E-07	1.29E-06	1.29E-08	1.00E-06
Rb 86	4.42E-07	7.57E-10	4.42E-11	7.57E-10	3.79E-10	7.54E-10
Rb 88	2.09E-05	1.13E-07	2.09E-09	1.13E-07	5.66E-08	1.41E-09
Cs 134	1.31E-04	2.23E-07	1.31E-08	2.23E-07	1.11E-07	2.23E-07
Cs 136	6.72E-05	1.16E-07	6.72E-09	1.16E-07	5.79E-08	1.15E-07
Cs 137	9.50E-05	1.61E-07	9.50E-09	1.61E-07	8.04E-08	1.61E-07
Cr 51	9.88E-06	1.68E-08	9.88E-10	1.68E-09	1.68E-11	1.68E-09
Mn 54	1.63E-06	2.75E-09	1.63E-10	2.75E-10	2.75E-12	2.75E-10
Fe 55	8.40E-06	1.42E-08	8.40E-10	1.42E-08	1.42E-10	1.42E-08
Fe 59	5.21E-06	8.85E-09	5.21E-10	8.85E-10	8.85E-12	8.83E-10
Co 58	8.36E-05	1.42E-07	8.36E-09	1.42E-08	1.42E-10	1.41E-08
Co 60	1.05E-05	1.77E-08	1.05E-09	1.77E-09	1.77E-11	1.77E-09
Sr 89	1.83E-06	3.10E-09	1.83E-10	3.10E-09	3.10E-11	3.10E-09
Sr 90	5.25E-08	8.86E-11	5.25E-12	8.86E-11	8.86E-13	8.86E-11
Sr 91	1.75E-06	4.77E-09	1.75E-10	4.77E-09	4.77E-11	3.99E-09
Y 90	5.68E-09	1.05E-11	5.68E-13	1.05E-12	1.05E-14	1.02E-12
Y 91M	1.06E-07	5.70E-10	1.06E-11	5.70E-11	5.70E-13	9.11E-12
Y 91	3.34E-07	5.66E-10	3.34E-11	5.66E-11	5.66E-13	5.65E-11
Y 93	9.55E-08	2.53E-10	9.55E-12	2.53E-11	2.53E-13	2.15E-11
Zr 95	3.14E-07	5.32E-10	3.14E-11	5.32E-11	5.32E-13	5.32E-11
Nb 95	2.60E-07	4.43E-10	2.60E-11	4.43E-11	4.43E-13	4.43E-11
Mo 99	3.98E-04	7.30E-07	3.98E-08	7.30E-09	7.30E-11	7.11E-09
Tc 99M	9.36E-05	3.11E-07	9.36E-09	3.11E-09	3.11E-11	2.34E-09

TABLE A.4.1-7

NUCLIDE CONCENTRATION OF PROCESS LOCATION IN THE LAUNDRY AND HOT SHOWER (L&HS) TREATMENT SYSTEM (μCi/g) NORMAL OPERATION

Isotope	Outlet, L&HS Tank	Outlet, Reverse Osmosis Feed Filter	Outlet, L&HS Reverse Osmosis	Outlet, L&HS Demin.	Outlet, L&HS Storage Tank
I 131	9.17E-07	9.17E-07	3.06E-08	3.06E-10	2.94E-08
Zr 95	2.24E-06	2.24E-07	7.45E-09	7.45E-11	7.42E-09
Nb 95	3.18E-06	3.18E-07	1.06E-08	1.06E-10	1.05E-08
Ru 103	2.23E-07	2.23E-08	7.42E-10	7.42E-12	7.36E-10
Ru 106	3.86E-06	3.86E-07	1.29E-08	1.29E-10	1.28E-08
Cs 134	2.10E-05	2.10E-05	7.00E-07	3.50E-07	6.99E-07
Cs 137	3.86E-05	3.86E-05	1.29E-06	6.43E-07	1.29E-06
Ce 144	8.03E-06	8.03E-07	2.68E-08	2.68E-10	2.67E-08
Mn 54	1.61E-06	1.61E-07	5.36E-09	5.36E-11	5.35E-09
Co 58	6.30E-06	6.30E-07	2.10E-08	2.10E-10	2.09E-08
Co 60	1.45E-05	1.45E-06	4.83E-08	4.83E-10	4.83E-09
Ag 110M	7.07E-07	7.07E-08	2.36E-09	2.36E-11	2.35E-09
TOTAL	1.0114E-04	6.4568E-05	2.1523E-06	9.9477E-07	2.1505E-06

TABLE A.4.1-7 (Continued)

NUCLIDE CONCENTRATION OF PROCESS LOCATION IN THE SECONDARY WASTE TREATMENT SYSTEM (μCi/g) NORMAL OPERATION

Isotope	Outlet, High Cond. Holding Tank	Outlet, Low Cond. Holding Tank	Outlet, SW Evaporator	Outlet, SW Filter	Outlet, SW Demin.	Outlet, SW Sample Tank
Ru 103	2.34E-07	3.98E-10	2.34E-11	3.98E-11	3.98E-13	3.97E-11
Ru 106	5.25E-08	8.85E-11	5.25E-12	8.85E-12	8.85E-14	8.85E-12
Rh 103M	1.51E-08	8.11E-11	1.51E-12	8.11E-12	8.11E-14	1.58E-12
Te 125M	1.52E-07	2.57E-10	1.52E-11	2.57E-10	2.57E-12	2.56E-10
Te 127M	1.47E-06	2.48E-09	1.47E-10	2.48E-09	2.48E-11	2.48E-09
Te 127	2.23E-06	6.18E-09	2.23E-10	6.18E-09	6.18E-11	5.14E-09
Te 129M	7.27E-06	1.24E-08	7.27E-10	1.24E-08	1.24E-10	1.23E-08
Te 129	6.34E-07	3.38E-09	6.34E-11	3.38E-09	3.38E-11	8.29E-10
Te 131M	1.03E-05	2.10E-08	1.03E-09	2.10E-08	2.10E-10	1.98E-08
Te 131	1.61E-07	8.71E-10	1.61E-11	8.71E-10	8.71E-12	3.14E-11
Te 132	1.30E-04	2.35E-07	1.30E-08	2.35E-07	2.35E-09	2.30E-07
Ba 140	1.13E-06	1.94E-09	1.13E-10	1.94E-09	1.94E-11	1.93E-09
La 140	6.63E-07	1.28E-09	6.63E-11	1.28E-10	1.28E-12	1.23E-10
Ce 141	3.65E-07	6.20E-10	3.65E-11	6.20E-11	6.20E-13	6.19E-11
Ce 143	1.70E-07	3.38E-10	1.70E-11	3.38E-11	3.38E-13	3.21E-11
Ce 144	1.73E-07	2.93E-10	1.73E-11	2.93E-11	2.93E-13	2.93E-11
Pr 143	2.57E-07	4.41E-10	2.57E-11	4.41E-11	4.41E-13	4.39E-11
Pr 144	3.30E-09	1.81E-11	3.30E-13	1.81E-11	1.81E-13	1.94E-13
Np 239	5.58E-06	1.04E-08	5.58E-10	1.04E-08	1.04E-10	1.01E-08
TOTAL	4.4084E-03	9.5649E-06	3.4227E-06	8.3607E-06	3.8404E-07	7.3906E-06

A.5 Gaseous Waste Processing System (Reference FSAR 11.3, ER 3.5.3)

1. Volumes (ft.^{3}/yr.) of gases stripped from the primary coolant:

Stable Fission Gases	25 scf/yr.
Hydrogen and Oxygen Impurities	440 scf/yr.
Helium	512 scf/yr.
Total for 2 units	977 scf/yr.

2. A description of the process used to hold up gases stripped from the primary system during normal operations and reactor shutdown is provided in FSAR Section 11.3.

The process flow diagrams and piping and instrumentation diagrams for the Gaseous Waste Processing System are shown on FSAR Figures 11.3.2-1, 11.3.2-2, 11.3.2-5 and 11.3.2-6. FSAR Tables 11.3.2-7 and 11.3.2-8 provide the component descriptions and instrumentation design parameters for the Gaseous Waste Processing System. 5

Deleted by Amendment No. 5

Table A.5.2-1 deleted by Amendment No. 5

A.6 Ventilation and Exhaust Systems (Reference FSAR 6.5, 9.4; ER 3.5.3, 3.5.5)

1. Provisions incorporated to reduce radioactivity releases through the ventilation or exhaust systems:

   a. Containment Ventilation System

      1) Airborne Radioactivity Removal System

         FSAR Section 9.4.7.2.1 provides a description of the Airborne Radioactivity Removal System. Design data for principal system components are presented in FSAR Table 9.4.7-1. 5

      2) Containment Atmosphere Purge Exhaust System

         FSAR Section 9.4.7.2.2 provides a description of the Containment Atmosphere Purge Exhaust System. The design data for principal system components are presented in FSAR Tables 9.4.7-2, 9.4.7-3, and 9.4.7-4. 5

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5

b. Turbine Building Area Ventilation System

1) Condensate Polishing Demineralizer Area Ventilation System

FSAR Sections 9.4.4.1.1 and 9.4.4.2.1 provide a description of the Condensate Polishing Demineralizer Area Ventilation System. Design data for principal system components are presented in FSAR Table 9.4.4-1.

5

2) Condensate Vacuum Pump Effluent Treatment System (CVPETS)

FSAR Sections 9.4.4.1.4 and 9.4.4.2.4 provide a description of the CVPETS. Design data for principal system components are presented in FSAR Table 9.4.4-4. 5

5

c. Reactor Auxiliary Building Ventilation System

1) RAB Normal Ventilation System (RABNVS)

FSAR Sections 9.4.3.1.1 and 9.4.3.2.1 provide a description of the RABNVS. Design data for principal system components are presented in FSAR Table 9.4.3-1.

5

5

2) RAB NNS Ventilation System

FSAR Sections 9.4.3.1.2 and 9.4.3.2.2 provide descriptions of the RAB NNS Ventilation System. Design data for principal system components are presented in FSAR Table 9.4.3-1.

5

3) RAB Emergency Exhaust System

FSAR Section 6.5.1 provides a description of the RAB Emergency Exhaust System. Design data for principal system components are presented in FSAR Table 6.5.1-3.

5

5

4) Control Room Emergency Filtration System

FSAR Section 9.4.1 provides a description of the Control Room Emergency Filtration System. Design details of the principal system components are presented in FSAR Table 9.4.1-1.

5

5

d. Waste Processing Building Ventilation Systems

1) Waste Processing Areas Ventilation System

FSAR Sections 9.4.3.1.3 and 9.4.3.2.3 provide a description of the Waste Processing Building Ventilation Systems. Design data for principal system components are presented in FSAR Table 9.4.3-2.

5

5

2) WPB Laboratory Areas HVAC System

FSAR Sections 9.4.3.1.7 and 9.4.3.2.7 provide descriptions of the WPB Laboratory Areas HVAC System. Design data for principal system components are presented in FSAR Table 9.4.3-6.

5

5

e. Fuel Handling Building Ventilation System

1) Air Conditioning System for the Operating Floor of Fuel Handling Building

FSAR Sections 9.4.2.1.1 and 9.4.2.2.1 provide descriptions of the Air Conditioning System for the operating floor of the FHB. Design data for system components is presented in FSAR Table 9.4.2-1.

5

5

2) Fuel Handling Building (FHB) Emergency Exhaust System

FSAR Sections 6.5.1.1.1 and 6.5.1.2.1 provide descriptions of the FHB Emergency Exhaust System. System component design data are shown in FSAR Table 6.5.1-1.

5

3) Normal Ventilation System for Areas Below Operating Floor of FHB

FSAR Sections 9.4.2.1.3 and 9.4.2.2.3 provide descriptions of the Normal Ventilation System for areas below the operating floor of the FHB.

5

4) Spent Fuel Pool Pump Room Ventilation System

FSAR Sections 9.4.2.1.4 and 9.4.2.2.4 provide descriptions of the Spent Fuel Pool Pump Room Ventilation System. Design data for system components is presented in FSAR Table 9.4.2-2.

2. Decontamination factors assumed and the bases:

Charcoal Adsorber	DF = 10
HEPA Filter	DF = 100

These DF's are based on NUREG 0017.

3. Release rates for radioiodine, noble gases, and radioactive particulates (Ci/yr.) and the bases:

   See Tables A.6.3-1 and A.6.3-2.

4. Release points to the environment, including height, effluent temperature and exit velocity (See Table A.6.4-1).

5. The Containment Ventilation System is described under paragraph A.6.1. The free volume of the Containment Building is 2.365×10^6 ft.^{3}.

Table A.6.1-1 deleted by Amendment No. 5

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TABLE A.6.1-2

NORMAL CONTAINMENT PURGE MAKE-UP SYSTEM COMPONENTS NON-NUCLEAR SAFETY UNITS

1. Make-Up Prefilter

Quantity	1 bank
Type	Medium efficiency extended media
Material	Glass fiber
Air Flow, acfm	1500

2. Make-Up Heating Coil

Quantity	1 bank
Type	Electric
Code	Underwriter Laboratory (UL) National Electric Manufacturing Association (NEMA), National Electric Code (NEC)
Air Flow, acfm	1500

3. Fans

Quantity	2 (one standby)
Type	Centrifugal
Material	Carbon Steel
Air Flow, Each Fan acfm	1500
Static Pressure, in. wg	4.86
Code	Air Movement and Control Association Inc. (AMCA), Anti-Friction Bearing Manufacturer's Association (AFBMA)

4. Fan Motors

Quantity	2, one per fan
Type	3 HP, 460 volt, 60 Hz, 3 phase Induction Type
Insulation	Class B Powerhouse

Table A.6.1-2 deleted by Amendment No. 5

Deleted Pages A.6-15 and A.6-16

Table A.6.1-3 deleted by Amendment No. 5

Deleted pages A.6-17 and A.6-18

Table A.6.1-4 deleted by Amendment No. 5

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Table A.6.1-5 deleted by Amendment No. 5

Deleted Pages A.6-21 through A.6-24

Table A.6.1-6 deleted by Amendment No. 5

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Table A.6.1-7 deleted by Amendment No. 5

Deleted Pages A.6-27 through A.6-37

Table A.6.1-8 deleted by Amendment No. 5

Deleted Pages A.6-38 through A.6-42

Table A.6.1-9 deleted by Amendment No. 5

Deleted Pages A.6-43 through A.6-47

Table A.6.1-10 deleted by Amendment No. 5

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TABLE A.6.3-1

GASEOUS RADIOACTIVE RELEASES - ONE UNIT - NORMAL OPERATION (Curies/year)

	WASTE GAS DECAY TANKS(1)		BUILDING VENTILATION			CONDENSOR VACUUM PUMP EXHAUST	TOTAL
	SHUTDOWN	NORMAL OPERATION	CONTAINMENT	REACTOR AUXILIARY	TURBINE		
KR 83M	0	0	1.0E+00	0.	0.	0.	1.0E+00
KR 85M	0	0	1.2E+01	3.0E+00	0.	2.0E+00	1.7E+01
KR 85	3.0E+00	2.1E+02	4.0E+00	0.	0.	0.	2.2E+02
KR 87	0.	0.	2.0E+00	1.0E+00	0.	0.	3.0E+00
KR 88	0.	0.	1.6E+01	5.0E+00	0.	3.0E+00	2.4E+01
KR 89	0.	0.	0.	0.	0.	0.	0.
XE 131M	0.	3.0E+00	1.0E+01	0.	0.	0.	1.3E+01
XE 133M	0.	0.	4.3E+01	2.0E+00	0.	1.0E+00	4.6E+01
XE 133	0.	1.0E+00	2.5E+03	1.2E+02	0.	7.2E+01	2.7E+03
XE 135M	0.	0.	0.	0.	0.	0.	0.
XE 135	0.	0.	5.9E+01	7.0E+00	0	4.0E+00	7.0E+01
XE 137	0.	0.	0.	0.	0.	0.	0.
XE 138	0.	0.	0.	1.0E+00	0.	0.	1.0E+00
TOTAL NOBLE GASES							3.1E+03
I 131	0.	0.	1.3E-02	4.5E-03	3.0E-04	2.8E-02	4.6E-02
I 133	0.	0.	1.1E-02	6.7E-03	4.2E-04	4.2E-02	6.0E-02
H 3	-	-	-	-	-	-	5.8E+02(2)
C 14	-	-	-	-	-	-	8.0E+00(2)
Ar 41	-	-	-	-	-	-	2.5E+01(2)

TABLE A.6.3-1 (continued)

	WASTE GAS DECAY TANKS(1)		BUILDING VENTILATION			CONDENSOR VACUUM PUMP EXHAUST	TOTAL
	SHUTDOWN	NORMAL OPERATION	CONTAINMENT	REACTOR AUXILIARY	TURBINE		
MN 54	0.	4.5E-03	2.2E-04	1.8E-04	0.	0.	4.9E-03
FE 59	0.	1.5E-03	7.3E-05	6.0E-05	0.	0.	1.6E-03
CO 58	0.	1.5E-02	7.3E-04	6.0E-04	0.	0.	1.6E-02
CO 60	0.	7.0E-03	3.3E-04	2.7E-04	0.	0.	7.6E-03
SR 89	0.	3.3E-04	1.7E-05	1.3E-05	0.	0.	3.6E-04
SR 90	0.	6.0E-05	2.9E-06	2.4E-06	0.	0.	6.5E-05
CS 134	0.	4.5E-03	2.2E-04	1.8E-04	0.	0.	4.9E-03
CS 137	0.	7.5E-03	3.7E-04	3.0E-04	0.	0.	8.2E-03

(1) Waste gas decay tank releases assumed after a 90 day decay period.

(2) Calculated using guidance of NUREG-0017, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from PWRs."

TABLE A.6.3-2

ASSUMPTIONS USED TO CALCULATE GASEOUS RADIOACTIVE RELEASES

GASEOUS WASTE INPUTS

There is continuous low volume purge of volume control tank flow rate through gas stripper (gpm)	16.1444
Holdup time (days) for Xe from Reactor Coolant System	90.0
Holdup time (days) for Kr from Reactor Coolant System	90.0
Fill time (days) for holdup system for gas stripping	0.0
Primary coolant leak to Reactor Auxiliary Building (lb./day)	160.
Reactor auxiliary building leak iodine partition factor	0.0075
Gas decay tank particulate release fraction	1.0
Reactor auxiliary building iodine release fraction	0.1
Particulate release fraction	0.01
Containment free volume (10^6 ft.^{3})	2.3650
Frequency of primary coolant degassing (times/yr.)	2.0
Primary to secondary leak rate (lb./day)	100.0
The Airborne Activity Removal System (kidney filter) is in operation.	
Containment atmosphere cleanup rate (thousand CFM)	20.0
Purge time of Containment (hours)	16.0
Fraction iodine bypassing condensate demineralizer	0.30
Iodine partition factor (gas/liquid) in steam generator	0.01
Frequency of containment building high volume purge (times/yr.)	4.0
Containment-high volume purge iodine release fraction	0.1
building particulate release fraction	0.01
Containment-low volume rate (cfm)	1500.0
Containment-low volume iodine release fraction	0.1
Particulate release fraction	0.01
Steam leak to Turbine Building (lb./hr.)	1700.0
Steam generator blowdown tank vent flag	0.0
Fraction of iodine released from condenser air ejector offgas treatment system	1.0

TABLE A.6.4-1

PLANT AIRBORNE EFFLUENT RELEASE POINTS(1)

5

RELEASE POINT NO.	RELEASE POINT ELEV. (FT.MSL)	RELEASE POINT EL. ABOVE GRADE(3) (FT.)	DISTANCE TO NEAREST RESTRICTED AREA BOUNDARY (FT.)	BUILDING	UNIT(5) NO.	SYSTEM	CFM(2) PER SYSTEM	TOTAL CFM PER POINT	SIZE & SHAPE OF ORIFICE	APPROX. VELOCITY (FPM)
1	346	86	435	Reactor Aux. Bldg.	1	Normal Exhaust Sys.	148,000			
					1	NNS-Ventilation Sys.	26,000			
					1	Emergency Exhaust Sys.	(6,000)			
						(Sub Total) $\Sigma 1$ =	174,000			
					2	Normal Exhaust Sys.	148,000			
					2	NNS-Ventilation Sys.	26,000			
					2	Emergency Exhaust Sys.	(6,000)			
						(Sub Total) $\Sigma 2$ =	174,000			
				Fuel Handling Bldg.	1-4	Upper Level Operating Floor Normal Exh. Sys. (North)	40,000			
						(South)	40,000			
						Lower Level Operating Floor Normal Exh. Sys. (North)	47,000			
						(South)	47,000			
						Emergency Exh. Sys.	(6,000)			
						(Sub Total) $\Sigma 3$ =	174,000			
				Containment Bldg.	1	Normal Purge Exh. Sys.	1,500			
					1	Pre-Entry Purge Exh. Sys.	(37,000)			
						(Sub Total) $\Sigma 4$ =	1,500			

TABLE A.6.4-1 (Continued)

PLANT AIRBORNE EFFLUENT RELEASE POINTS(1)

RELEASE POINT NO.	RELEASE POINT ELEV. (FT.MSL)	RELEASE POINT EL. ABOVE GRADE(3) (FT.)	DISTANCE TO NEAREST RESTRICTED AREA BOUNDARY (FT.)	BUILDING	UNIT(5) NO.	SYSTEM	CFM(2) PER SYSTEM	TOTAL CFM PER POINT	SIZE & SHAPE OF ORIFICE	APPROX. VELOCITY (FPM)
				Containment Bldg. (Cont.)	2	Normal Purge Exh. Sys.	1,500			
					2	Pre-Entry Purge Exh. Sys.	(37,000)			
						(Sub Total) Σ5	1,500			
1	346	86	435	Reactor Aux. Bldg.	1	Control Room Purge Exhaust System	(13,400)			
					2	Control Room Purge Exhaust System	(13,400)			
1	346	86	435	Reactor Aux. Bldg.	1	Switchgear Room Cable Vault Smoke Purge System	(8,000)			
					2	Switchgear Room Cable Vault Smoke Purge System	(8,000)			
					1	Electrical Equipment Protection Rooms - Smoke Purge System	(14,050)			
1	346	86	435	Reactor Aux. Bldg.	2	Electrical Equipment Protection Rooms - Smoke Purge System	(14,050)			
						$\Sigma_1 + \Sigma_2 + \Sigma_3 + \Sigma_4 + \Sigma_5$		525,000	Dia. = 13 ft. Circular	3955

TABLE A.6.4-1 (Continued)

PLANT AIRBORNE EFFLUENT RELEASE POINTS(1)

RELEASE POINT NO.	RELEASE POINT ELEV. (FT.MSL)	RELEASE POINT EL. ABOVE GRADE(3) (FT.)	DISTANCE TO NEAREST RESTRICTED AREA BOUNDARY (FT.)	BUILDING	UNIT(5) NO.	SYSTEM	CFM(2) PER SYSTEM	TOTAL CFM PER POINT	SIZE & SHAPE OF ORIFICE	APPROX. VELOCITY (FPM)
2(4)										

5

TABLE A.6.4-1 (Continued)

PLANT AIRBORNE EFFLUENT RELEASE POINTS[1]

RELEASE POINT NO.	RELEASE POINT ELEV. (FT.MSL)	RELEASE POINT EL. ABOVE GRADE[3] (FT.)	DISTANCE TO NEAREST RESTRICTED AREA BOUNDARY (FT.)	BUILDING	UNIT[5] NO.	SYSTEM	CFM[2] PER SYSTEM	TOTAL CFM PER POINT	SIZE & SHAPE OF ORIFICE	APPROX. VELOCITY (FPM)

Deleted by Amendment No. 5

5

TABLE A.6.4-1 (Continued)

PLANT AIRBORNE EFFLUENT RELEASE POINTS[1]

RELEASE POINT NO.	RELEASE POINT ELEV. (FT.MSL)	RELEASE POINT EL. ABOVE GRADE[3] (FT.)	DISTANCE TO NEAREST RESTRICTED AREA BOUNDARY (FT.)	BUILDING	UNIT[5] NO.	SYSTEM	CFM[2] PER SYSTEM	TOTAL CFM PER POINT	SIZE & SHAPE OF ORIFICE	APPROX. VELOCITY (FPM)
3A	296	36	435	Turbine Bldg.	1	Combined Effluent from Condensate Polishers Cubicles and Mech. Vac. Pumps Effluent Treat. Sys.	22,650	22,650	Dia. = 44 in. Circular	2145
3B					2	Combined Effluent from Condensate Polishers Cubicles and Mech. Vac. Pumps Effluent Treat. System	22,650	22,650	Dia. = 44 in. Circular	2145
4A[4]										
4B[4]										
5	321	61	335	Waste Processing Bldg.	1-4	Office Area Exhaust	2,700			
						Gen. Area Exh. Fan	5,500			
						Filter Exh. System	130,800			
						Office Area Economizer Fan	16,000			

TABLE A.6.4-1 (Continued)

PLANT AIRBORNE EFFLUENT RELEASE POINTS(1)

RELEASE POINT NO.	RELEASE POINT ELEV. (FT.MSL)	RELEASE POINT EL. ABOVE GRADE(3) (FT.)	DISTANCE TO NEAREST RESTRICTED AREA BOUNDARY (FT.)	BUILDING	UNIT(5) NO.	SYSTEM	CFM(2) PER SYSTEM	TOTAL CFM PER POINT	SIZE & SHAPE OF ORIFICE	APPROX. VELOCITY (FPM)
				Waste Processing Bldg.		Cold Laundry Dryers	18,000			
						Chiller Room Exhaust Fans	24,400		Rectangle	
						Cold & Hot Laundry	9,600			
						Control Room Smoke Exhausts	(28,000)			
						(Sub Total)		207,000	Dia. = 2 ft. Circular	1830
5A	321	61	335	Waste Processing Bldg.	1-4	Laboratory Fume Hood Exhausts	27,575			
						HVAC Equipment Room Exhaust Fans	25,000			
						Switchgear Room Exhaust Fans	24,500			
						Personnel Handling Exh. Fans	26,500		Dia. = 8 ft. Circular	2061
						(Sub Total)	103,575			

TABLE A.6.4-1 (Continued)

PLANT AIRBORNE EFFLUENT RELEASE POINTS[1]

RELEASE POINT NO.	RELEASE POINT ELEV. (FT.MSL)	RELEASE POINT EL. ABOVE GRADE[3] (FT.)	DISTANCE TO NEAREST RESTRICTED AREA BOUNDARY (FT.)	BUILDING	UNIT[5] NO.	SYSTEM	CFM[2] PER SYSTEM	TOTAL CFM PER POINT	SIZE & SHAPE OF ORIFICE	APPROX. VELOCITY (FPM)

5

NOTES:

1. For release points the release temperature varies between 60 F (minimum) and 120 F (maximum).

2. CFM given in parenthesis are for emergency conditions and thus are not included in the CFM subtotals or totals.

3. Grade El. 260 ft. MSL.

4. Release point eliminated due to cancellation of SHNPP Units 3 and 4.

5. Equipment originally planned for use with SHNPP Units 3 and 4 which has been retained as backup for Units 1 and 2 will retain original equipment designation. 5

A.7 Solid Waste Processing Systems (Reference FSAR 11.4, ER 3.5.4)

1. The input source, volume, and activity of principal radionuclides for the Solid Waste Processing System are provided in Tables A.7.1-1 through A.7.1-4.

2. The Waste Processing Building general arrangement diagrams (FSAR Figures 1.2.2-49 and 1.2.2-54) show the location of the storage areas for solid waste. Based on the outputs of Tables A.7.2-1, an average storage time of 30 days is provided. In actual operation, higher activity containers will be stored for a longer period. 5

3. Process flow diagrams for the Solid Waste Processing System are provided on FSAR Figures 11.4.2-1 through 11.4.2-3.

TABLE A.7.1-1

SOLID PROCESSING SYSTEM INPUTS*
(TWO UNITS)

Source	Form	Quantity (ft.^{3}/yr.)
Spent Resins	Dewatered Resin	
CVCS/BRS (1)		325
Radwaste		1600
Fuel Pool		200
Condensate Polishers (2)		900
Subtotal:		3025
Evaporator Bottoms		
Waste Evap. (3)	12% $Na_2B_4O_7$	325
Reverse Osmosis Conc Evap. (4)	12% Boric and other salts	2500
Secondary Waste Evap. (5)	22% Na_2SO_4	9350
Boron Recycle Evap. (6)	4% H_3BO_3	2050
Subtotal:		14,225
Filter Particulates (7)	3% filter sludge	3,600
Dry Solids	Paper, rags, etc.	24,000
Chemical Drains	Misc. Chem. Solutions	250

NOTES: (Bases for values)

1) Normally changed during annual refueling.
2) Deep bed condensate polisher resin life of three years.
3) Based on volume reduction ratio of 50, from Equipment Drain.
4) Based on volume reduction ratio of 120 from Floor Drain and Laundry & Hot Shower Drain
5) Based on volume reduction ratio of 25.
6) Based on 10% disposal of evaporator bottoms, 90% recycled.
7) Includes fuel pool demineralizer filter sludge.

*Table gives maximum annual volumes; for expected volumes delete spent resin from the condensate demineralizers and the detergent evaporator bottoms. Thus, the expected volumes are those associated with primary systems and the maximum volumes include volumes associated with the secondary systems.

TABLE A.7.1-2

NUCLIDE ACITIVTY INPUTS TO THE SOLID RADWASTE SYSTEM, EVAPORATOR CONCENTRATES (μ-Ci/g) NORMAL OPERATIONS

Isotope	Waste Evaporator Bottoms	RO Concentrate Evaporator Bottoms	S.W. High Conductivity Evaporator Bottoms
Br 83	1.24E-03	4.69E-05	1.01E-04
Br 84	1.46E-04	1.25E-06	1.21E-05
I 130	2.71E-03	2.73E-04	1.62E-04
I 131	5.04E+00	5.93E-01	3.42E-02
I 132	2.46E-02	8.91E-04	2.01E-03
I 133	8.07E-01	9.18E-02	3.60E-02
I 134	4.37E-03	6.11E-05	3.60E-04
I 135	1.34E-01	1.05E-02	1.00E-02
Rb 86	3.13E-03	2.88E-04	1.10E-05
Rb 88	6.18E-03	2.98E-05	5.21E-04
Cs 134	1.93E+00	1.25E-01	3.29E-03
Cs 136	3.69E-01	3.78E-02	1.68E-03
Cs 137	1.42E+00	9.27E-02	2.37E-03
Cr 51	8.67E-03	7.23E-04	2.47E-04
Mn 54	2.31E-03	1.62E-04	4.07E-05
Fe 55	1.24E-01	7.87E-03	2.10E-04
Fe 59	5.54E-03	4.20E-04	1.30E-04
Co 58	1.00E-01	7.18E-03	2.09E-03
Co 60	1.56E-02	1.09E-03	2.62E-04
Sr 89	2.02E-02	1.50E-03	4.57E-05
Sr 90	7.86E-04	4.96E-05	1.31E-06
Sr 91	6.54E-04	6.03E-05	4.37E-05
Y 90	7.66E-07	9.94E-08	1.42E-07
Y 91M	3.22E-06	4.31E-08	2.65E-06
Y 91	3.81E-04	2.78E-05	8.35E-06
Y 93	3.68E-06	3.48E-07	2.39E-06
Zr 95	3.69E-04	4.26E-05	7.84E-06
Nb 95	2.53E-04	4.29E-05	6.51E-06
Mo 99	5.54E-03	7.18E-04	9.94E-03
Tc 99M	3.07E-04	2.27E-05	2.34E-03
Ru 103	2.38E-04	2.01E-05	5.86E-06
Ru 106	7.52E-05	3.28E-05	1.31E-06
Rh 103M	4.59E-07	7.01E-09	3.78E-07
Te 125M	1.73E-03	1.27E-04	3.79E-06
Te 127M	1.89E-02	1.29E-03	3.66E-05
Te 127	8.23E-04	7.44E-05	5.58E-05
Te 129M	6.90E-02	5.53E-03	1.82E-04
Te 129	1.93E-04	3.49E-06	1.59E-05
Te 131M	7.24E-03	8.72E-04	2.58E-04
Te 131	4.82E-05	3.23E-07	4.02E-06
Te 132	2.08E-01	2.71E-02	3.24E-03
Ba 140	6.12E-03	6.32E-04	2.82E-05
La 140	6.02E-05	7.55E-06	1.66E-05
Ce 141	3.43E-04	2.76E-05	9.11E-06

TABLE A.7.1-2 (continued)

Isotope	Waste Evaporator Bottoms	RO Concentrate Evaporator Bottoms	S.W. High Conductivity Evaporator Bottoms
Ce 143	1.32E-05	1.62E-06	4.26E-06
Ce 144	2.45E-04	7.38E-05	4.33E-06
Pr 143	1.46E-04	1.48E-05	6.42E-06
Pr 144	9.78E-07	4.52E-09	8.25E-08
Np 239	6.72E-03	8.68E-04	1.40E-04
TOTAL	1.03E+01	1.01E+00	1.10E-01

TABLE A.7.1-3

NUCLIDE ACTIVITY INPUTS TO THE SOLID RADWASTE SYSTEM, SPENT RESINS (μ-Ci/Batch) NORMAL OPERATION

Isotope	Waste Evaporator Condensate Demin	Floor Drain Monitor Demin	Laundry & H.S. Demin	Secondary Waste Low-Cond. Demin
Br 83	1.14E-01	1.82E+01		7.85E-01
BR 84	1.38E-02	2.21E+00		9.47E-02
Ir130	2.46E+00	3.95E+01		1.71E+00
I 131	4.64E+03	6.96E+04	2.24E+01	3.04E+03
I 132	2.25E+01	3.61E+02		1.57E+01
I 133	7.32E+02	1.17E+04		5.08E+02
I 134	4.07E+00	6.52E+01		2.80E+00
I 135	1.22E+02	1.95E+03		8.45E+01
Rb 86	3.38E-01	3.69E+01		8.26E-01
Rb 88	6.03E-01	9.67E+01		2.07E+00
Cs 134	5.03E+02	1.78E+04	6.86E+02	4.11E+02
Cs 136	3.60E+01	4.66E+03		1.03E+02
Cs 137	3.86E+02	1.30E+04	1.28E+03	3.01E+02
Cr 51	1.09E+01	9.55E+01		4.27E+00
Mn 54	5.66E+00	2.16E+01	1.02E+01	9.86E-01
Fe 55	3.26E+01	1.14E+03		5.21E+01
Fe 59	8.51E+00	5.74E+01		2.58E+00
Co 58	1.82E+02	1.00E+03	3.60E+01	4.51E+01
Co 60	4.18E+01	1.44E+02	9.46E+01	6.55E+00
Sr 89	3.26E+00	2.06E+02		9.31E+00
Sr 90	2.13E-01	7.19E+00		3.29E-01
Sr 91	5.94E-02	9.55E+00		4.05E-01
Y 90	6.94E-05	1.11E-02		4.74E-04
Y 91M	2.99E-04	4.80E-02		2.04E-03
Y 91	6.44E-02	3.85E+00		1.74E-01
Y 93	3.34E-04	5.35E-02		2.27E-03
Zr 95	6.53E-01	3.69E+00	1.26E+01	1.67E-01
Nb 95	3.50E-01	2.70E+00	1.59E+01	1.21E-01
MO 99	5.02E-01	8.04E+01		3.42E+00
Tc 99M	2.79E-02	4.46E+00		1.91E-01
Ru 103	3.47E-01	2.51E+00	1.14E+00	1.13E-01
Ru 106	1.87E-01	7.00E-01	2.46E+01	3.19E-02
Rh 103M	4.26E-04	6.82E-03		2.91E-04
Te 125M	2.94E-01	1.75E+01		7.90E-01
Te 127M	3.85E+00	1.83E+02		8.28E+00
Te 127	7.47E-02	1.20E+01		5.09E-01
Te 129M	9.31E+00	7.43E+02		3.33E+01
Te 129	1.78E-02	2.86E+00		1.22E-01
Te 131M	6.56E-01	1.05E+02		4.47E+00
Te 131	4.61E-03	7.38E-01		3.14E-02
Te 132	1.88E+01	3.01E+03		1.28E+02
Ba 140	5.96E-01	7.75E+01		3.39E+00
La 140	5.45E-02	8.74E-01		3.72E-02

TABLE A.7.1-3 (continued)

Isotope	Waste Evaporator Condensate Demin	Floor Drain Monitor Demin	Laundry & H.S. Demin	Secondary Waste Low-Cond. Demin
Ce 141	4.60E-01	3.71E+00		1.66E-01
Ce 143	1.20E-02	1.93E-01		8.18E-03
Ce 144	5.96E-01	2.29E+00	5.08E+01	1.05E-01
Pr 143	1.45E-01	1.84E+00		8.03E-02
Pr 144	9.56E-05	1.54E-02		6.56E-04
Np 239	6.08E-01	9.73E+01		4.15E+00
TOTAL	6.77E+03	1.26E+05	2.24E+03	4.78E+03

TABLE A.7.1-4

NUCLIDE ACTIVITY INPUTS TO THE SOLID RADWASTE SYSTEM, FILTER SLUDGE (μ-Ci/Batch), NORMAL OPERATION

Isotope	Reactor Coolant Filter	Fuel Pool Filter	Secondary Waste Filter	Waste Evaporator Filter	Laundry & H.S. Filter	Floor Drain Filter
Br 83	0.	9.79E+04	0.	0.		0.
Br 84	0.	1.42E+04	0.	0.		0.
I 130	0.	0.	0.	0.		0.
I 131	0.	1.06E+07	0.	0.	0.	0.
I 132	0.	1.41E+07	0.	0.		0.
I 134	0.	4.21E+05	0.	0.		0.
I 135	0.	6.07E+06	0.	0.		0.
Rb 86	0.	0.	0.	0.		0.
Rb 88	0.	0.	0.	0.		0.
Cs 134	0.	5.48E+05	0.	0.	0.	0.
Cs 136	0.	2.95E+05	0.	0.		0.
Cs 137	0.	3.88E+05	0.	0.	5.47E+02	0.
Cr 51	3.62E+05	7.37E+04	6.12E-01	1.09E+05		7.26E+03
Mn 54	5.91E+04	1.23E+04	1.00E-01	5.71E+04	1.10E+02	1.52E+03
Fe 55	0.	6.16E+04	0.	0.		0.
Fe 59	1.90E+05	3.89W+04	3.22E-01	8.54E+04		4.22E+03
Co 58	3.04E+06	6.15E+05	5.16E+00	1.83E+06	4.28E+02	7.19E+04
Co 60	3.81E+05	7.80E+04	6.46E-01	4.22E+05	9.90E+02	9.99E+03
Sr 89	0.	1.35E+04	0.	0.		0.
Sr 90	0.	3.90E+02	0.	0.		0.
Sr 91	0.	2.22E+04	0.	0.		0.
Y 90	2.27E+02	0.	3.74E-04	6.94E+00		9.52E-01
Y 91M	1.57E+04	0.	4.96E-03	2.99E+01		4.43E-04
Y 91	1.22E+04	0.	2.063-02	6.46E+03		2.80E+02
Y 93	5.74E+03	0.	8.23E-03	3.34E+01		2.47E+00
Zr 95	1.14E+04	0.	1.94E-02	6.56E+03	1.52E+02	2.67E+02
Nb 95	9.52E+03	0.	1.61E-02	3.51E+03	2.15E+02	2.02E+02
Mo 99	1.74E+07	0.	2.87E+01	5.52E+05		7.60E+04
Tc 99M	7.97E+06	0.	1.02E+01	3.07E+04		1.33E+03

TABLE A.7.1-4 (continued)

Isotope	Reactor Coolant Filter	Fuel Pool Filter	Secondary Waste Filter	Waste Evaporator Filter	Laundry & H.S. Filter	Floor Drain Filter
Ru 103	8.56E+03	0.	1.45E-02	3.48E+03	1.51E+01	1.86E+02
Ru 106	1.90E+03	0.	3.23E-03	1.89E+03	2.63E+02	4.91E+01
Ru 103M	2.22E+03	0.	8.40E-04	4.26E+00		1.96E-04
Te 125M	0.	0.	0.	0.		0.
Te 127M	0.	0.	0.	0.		0.
Te 127	0.	0.	0.	0.		0.
Te 129M	0.	0.	0.	0.		0.
Te 129	0.	0.	0.	0.		0.
Te 131M	0.	0.	0.	0.		0.
Te 131	0.	0.	0.	0.		0.
Te 132	0.	0.	0.	0.		0.
Ba 140	0.	0.	0.	0.		0.
La 140	2.79E+04	0.	4.53E-02	5.45E+02		6.99E+01
Ce 141	1.33E+04	0.	2.26E-02	4.61E+03		2.78E+02
Ce 143	7.40E+03	0.	1.19E-02	1.20E+02		1.48E+01
Ce 144	6.29E+03	0.	1.07E-02	6.01E+03	5.47E+02	1.61E+02
Pr 143	9.50E+03	0.	1.60E-02	1.45E+03		1.48E+02
Pr 144	0.	0.	0.	0.		0.
Np 239	0.	0.	0.	0.		0.
TOTAL	2.95E+07	3.55E+07	4.60E+01	3.12E+06	2.77E+03	1.74E+05

TABLE A.7.2-1

OUTPUT FROM SOLID WASTE PROCESSING SYSTEM* (TWO UNITS)

5

Source	Form	Quantity (cu ft./yr.)	Quantity*** (drums/year)
Spent Resins	Solidified	4,250 (1)	850(3)
Evaporator Bottoms	Solidified	21,350** (1)	4,270**
Filter Particulates	Solidified	5,400** (1)	1,080**
Dry Solids	Compressed	6,000 (2)	1,000
Chemical Drains	Solidified	375 (1)	75
TOTAL:			7,275

5

Notes: (Bases for Values)

1) Based on two volumes of waste per volume of solidification agent.

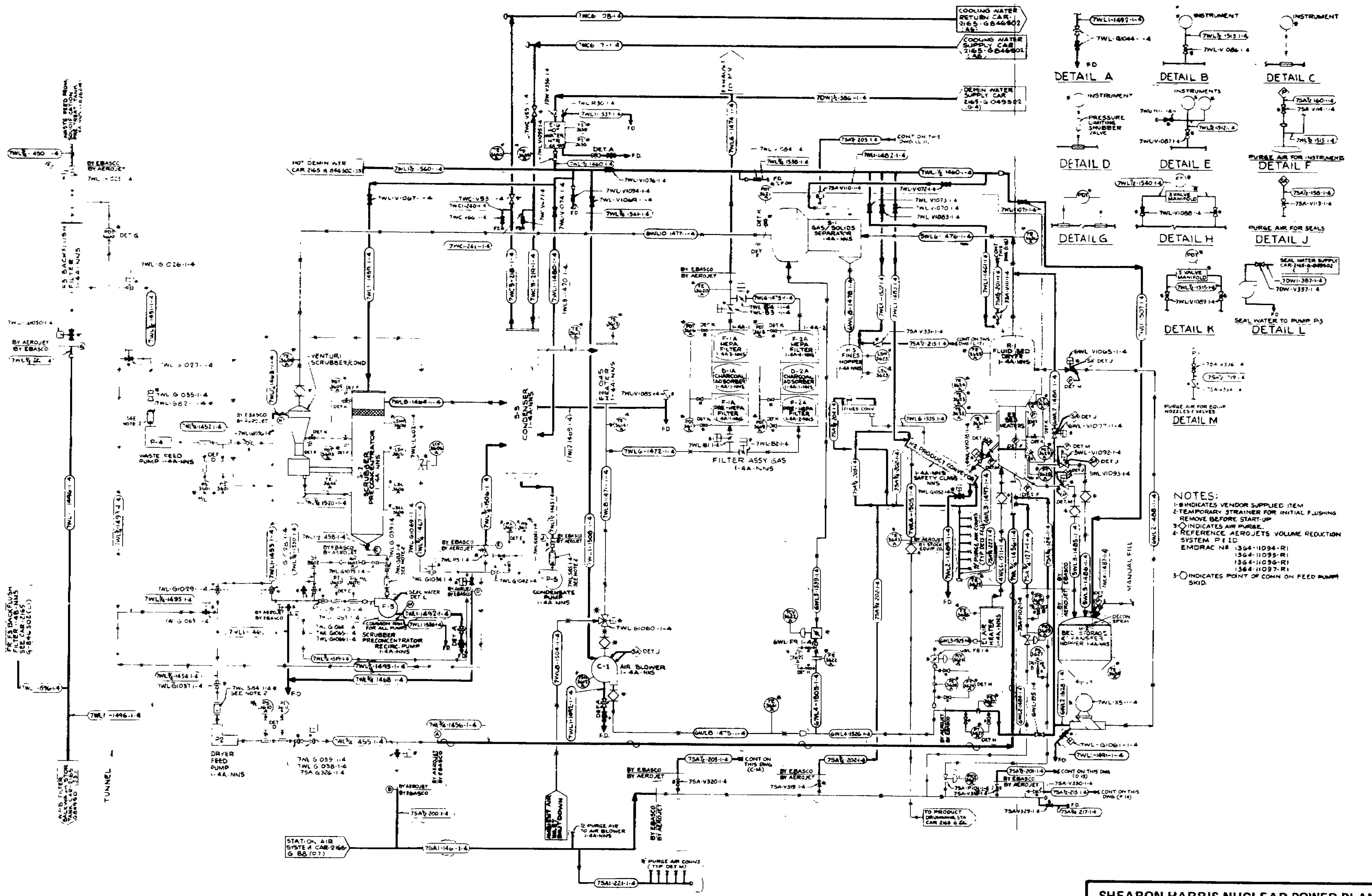
2) Based on a four to one reduction ratio.

3) Based on 55 gal. drums. High Integrity Containers (HIC) may be used as an alternative method of packaging. 5

* Table gives maximum annual volumes; for expected volumes delete spent resin from the condensate demineralizers and the detergent evaporator bottoms. Thus, the expected volumes are those associated with primary systems and the maximum volumes include volumes associated with the secondary systems.

** With the volume reduction subsystem the outputs of evaporator bottoms will be 2540 cu ft/yr, 508 drums/yr; the outputs of filter particulates will be 643 cu ft/yr, 129 drums/yr. 5

*** These estimates are conservative since the volume per drum is assumed to be substantially less than the actual volume of the 55 gal. drums.



COOLING WATER RETURN CAR-2165-G846S02 (A6)
COOLING WATER SUPPLY CAR-2165-G846S02 (A6)
DEMIN WATER SUPPLY CAR-2165-G049S02 (G-4)
HOT DEMIN WTR CAR 2165 G 846S02-(S)
DETAIL A
DETAIL B
DETAIL C
DETAIL D
DETAIL E
DETAIL F
DETAIL G
DETAIL H
DETAIL J
DETAIL K
DETAIL L
DETAIL M
INSTRUMENT
INSTRUMENTS
PRESSURE LIMITING SNUBBER VALVE
3 VALVE MANIFOLD
PURGE AIR FOR INSTRUMENTS
PURGE AIR FOR SEALS
SEAL WATER SUPPLY CAR-2165-G-846S02
SEAL WATER TO PUMP P3
PURGE AIR FOR EQUIP NOZZLES & VALVES
VENTURI SCRUBBER/COND
SCRUBBER PRECONCENTRATOR 1-4A-NNS
WASTE FEED PUMP 1-4A-NNS
P-4
S-3 CONDENSER 1-4A-NNS
E-2 GAS HEATER 1-4A-NNS
CONDENSATE PUMP 1-4A-NNS
P-5
F-3
COMMON RING FOR ALL PUMPS
SCRUBBER PRECONCENTRATOR RECIRC PUMP 1-4A-NNS
GAS/SOLIDS SEPARATOR 1-4A-NNS
F-1A HEPA FILTER
F-2A HEPA FILTER
D-1A CHARCOAL ADSORBER 1-4A-NNS
D-2A CHARCOAL ADSORBER 1-4A-NNS
F-1A PRE-HEPA FILTER
F-2A PRE-HEPA FILTER
FILTER ASSY GAS 1-4A-NNS
H-5 FINES HOPPER 1-4A-NNS
R-1 FLUID BED DRYER 1-4A-NNS
BED HEATERS
PRODUCT CONVEYOR
SAFETY CLINGS
AIR HEATER 1-4A-NNS
C-1 AIR BLOWER 1-4A-NNS
BED STORAGE & TRANSFER HOPPER 1-4A-NNS
DECON SPRAY
MANUAL FILL
DRYER FEED PUMP 1-4A-NNS
P-2
STATION AIR SYSTEM CAR-2165-G 88 (D7)
1/2" PURGE AIR TO AIR BLOWER 1-4A-NNS
1/2" PURGE AIR CONNS (TYP DET M)
TO PRODUCT DRUMMING STA CAR 2165 G 86
CONT ON THIS DWG
BY EBASCO
BY AEROJET
FD
TUNNEL
FR F5 BACKFLUSH FILTER 1-4B-NNS SEE CAR-2165 G-846S02 (L-1)
WASTE FEED FROM SOLIDIFICATION TRAN. TANK
SEE NOTE 2

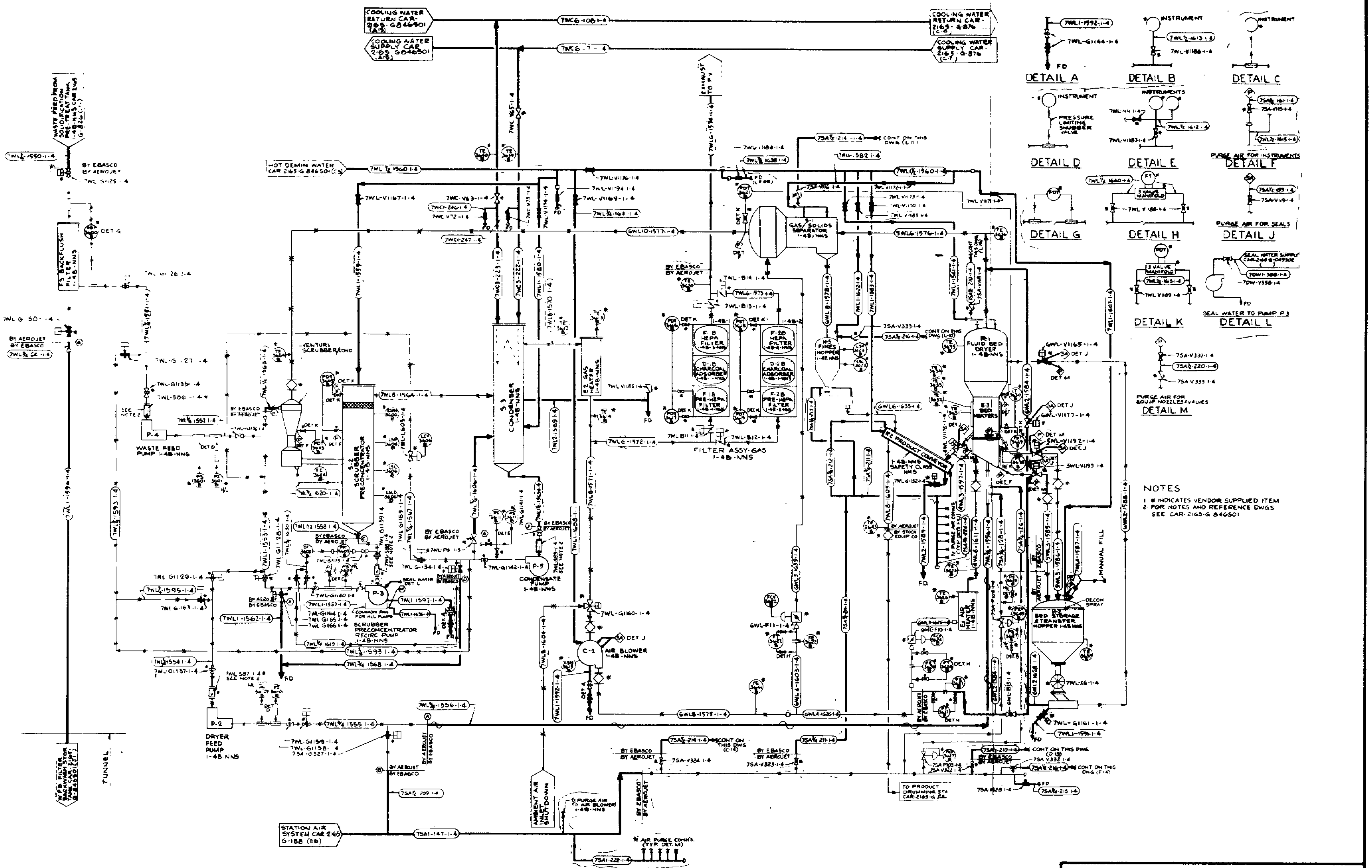
NOTES:
1-# INDICATES VENDOR SUPPLIED ITEM
2-TEMPORARY STRAINER FOR INITIAL FLUSHING REMOVE BEFORE START-UP
3-◇ INDICATES AIR PURGE.
4-REFERENCE AEROJETS VOLUME REDUCTION SYSTEM P&ID EMDRAC N# 1364-11094-R1
1364-11095-R1
1364-11096-R1
1364-11097-R1
5-○ INDICATES POINT OF CONN ON FEED PUMP SKID.

REF DWG: CAR-2165-G-846 S01 (REV 2, OPEN)

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
ENVIRONMENTAL REPORT

FLOW DIAGRAM – WASTE PROCESSING SYS
VOLUME REDUCTION – UNITS 1,2,3 & 4
SHEET 1

FIGURE A.7.3-2


COOLING WATER RETURN CAR-2165-G846501 (A-3)
COOLING WATER SUPPLY CAR 2165-G846501 (A-3)
COOLING WATER RETURN CAR-2165-G-876 (C-7)
COOLING WATER SUPPLY CAR-2165-G-876 (C-7)
7WCG-1061-1-4
HOT DEMIN WATER CAR 2165-G 846501 (C-5)
7WL 1/2-1560-1-4
EXHAUST TO P.V.
WASTE FEED FROM SOLIDIFICATION PRE-TREAT TANK 1-4B-NNS CAR 2165 G-826 (-)
F-3 BACKFLUSH FILTER 1-4B-NNS
P-4 WASTE FEED PUMP 1-4B-NNS
VENTURI SCRUBBER/COND
S-2 SCRUBBER PRECONCENTRATOR 1-4B-NNS
P-3 SCRUBBER PRECONCENTRATOR RECIRC PUMP 1-4B-NNS
COMMON PAN FOR ALL PUMPS
SEAL WATER DET L
S-3 CONDENSER 1-4B-NNS
P-5 CONDENSATE PUMP 1-4B-NNS
E-2 GAS HEATER 1-4B-NNS
C-1 AIR BLOWER 1-4B-NNS
GAS/SOLIDS SEPARATOR 1-4B-NNS
F-1B HEPA FILTER
D-1B CHARCOAL ADSORBER
F-1A PRE-HEPA FILTER
F-2B HEPA FILTER
D-2B CHARCOAL ADSORBER
F-2A PRE-HEPA FILTER
FILTER ASSY-GAS 1-4B-NNS
H-5 FINES HOPPER 1-4B-NNS
R-1 FLUID BED DRYER 1-4B-NNS
E-3 BED HEATERS
R-2 PRODUCT CONVEYOR 1-4B-NNS SAFETY CLASS NNS
E-1 AIR HEATER
H-2 BED STORAGE & TRANSFER HOPPER 1-4B-NNS
DECON SPRAY
MANUAL FILL
P-2 DRYER FEED PUMP 1-4B-NNS
W.P.B. FILTER BACKWASH STOR TANK CAR 2165-G-846501 (F-7)
TUNNEL
STATION AIR SYSTEM CAR 2165 G-188 (E6)
7SA1-147-1-4
AMBIENT AIR INLET SHUT DOWN
PURGE AIR TO AIR BLOWER 1-4B-NNS
AIR PURGE CONN'S. (TYP. DET. M)
TO PRODUCT DRUMMING STA CAR-2165-G-846
BY EBASCO BY AEROJET
CONT ON THIS DWG
DETAIL A
DETAIL B
DETAIL C
DETAIL D
DETAIL E
DETAIL F
DETAIL G
DETAIL H
DETAIL J
DETAIL K
DETAIL L
DETAIL M
INSTRUMENT
PRESSURE LIMITING SNUBBER VALVE
3 VALVE MANIFOLD
PURGE AIR FOR INSTRUMENTS
PURGE AIR FOR SEALS
SEAL WATER SUPPLY CAR-2165-G-0495OE
SEAL WATER TO PUMP P3
PURGE AIR FOR EQUIP NOZZLES & VALVES
FD
NOTES
1. # INDICATES VENDOR SUPPLIED ITEM
2. FOR NOTES AND REFERENCE DWGS SEE CAR-2165-G 846501

REF DWG: CAR-2165-G-846 S02 (REV 2, OPEN)

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
ENVIRONMENTAL REPORT

FLOW DIAGRAM – WASTE PROCESSING SYS
VOLUME REDUCTION – UNITS 1,2,3 & 4
SHEET 2

FIGURE A.7.3-3

APPENDIX B

FINAL
NPDES
PERMIT

North Carolina Department of Natural Resources & Community Development
James B. Hunt, Jr., Governor
Joseph W. Grimsley, Secretary
DIVISION OF ENVIRONMENTAL MANAGEMENT

July 12, 1982

Mr. P. W. Howe
CP&L - Shearon Harris
411 Fayetteville Street Mall
Raleigh, North Carolina 27602

Subject: Permit No. NC0039586
CP&L Shearon Harris
Wake County

Dear Mr. Howe:

In accordance with your application for discharge Permit received August 1, 1977, we are forwarding herewith the subject State - NPDES Permit. This permit is issued pursuant to the requirements of North Carolina General Statutes 143-215.1 and the Memorandum of Agreement between North Carolina and the U. S. Environmental Protection Agency dated October 19, 1975.

If any parts, requirements, or limitations contained in this Permit are unacceptable to you, you have the right to an adjudicatory hearing before a hearing officer upon written demand to the Director within 30 days following receipt of this Permit, identifying the specific issues to be contended. Unless such demand is made, this Permit shall be final and binding.

Please take notice that this Permit is not transferable. Part II, B.2. addresses the requirements to be followed in case of change in ownership or control of this discharge.

This Permit does not affect the legal requirement to obtain other Permits which may be required by the Division of Environmental Management. If you have any questions concerning this Permit, please contact Mr. Bill Mills, telephone (919)733-5181.

Sincerely yours,

Robert F. Helms
Director

cc: Mr. Jim Patrick, EPA
Raleigh Regional Office
Raleigh Regional Office Manager

P. O. Box 27687 Raleigh, N. C. 27611-7687

STATE OF NORTH CAROLINA
DEPARTMENT OF NATURAL RESOURCES & COMMUNITY DEVELOPMENT
DIVISION OF ENVIRONMENTAL MANAGEMENT

PERMIT

To Discharge Wastewater Under the NATIONAL
POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of North Carolina General Statute 143-215.1, other lawful standards and regulations promulgated and adopted by the North Carolina Environmental Management Commission, and the Federal Water Pollution Control Act, as amended,

Carolina Power and Light Company

is hereby authorized to discharge wastewater from a facility located at

Shearon Harris Nuclear Power Plant
Wake County

to receiving waters of Harris Reservoir on Buckhorn Creek

in accordance with effluent limitations, monitoring requirements, and other conditions set forth in Parts I, II, and III hereof.

This permit shall become effective July 12, 1982.

This permit and the authorization to discharge shall expire at midnight on June 30, 1987.

Signed this day of July 12, 1982.

Robert F. Helms, Director
Division of Environmental Management
By Authority of the Environmental
Management Commission

Page of
Permit No. NC
0039586

SUPPLEMENT TO PERMIT COVER SHEET

Carolina Power and Light Company

is hereby authorized to: (include only appropriate items)

1. Enter into a contract for construction of wastewater treatment facilities

2. Make an outlet into Harris Reservoir on Buckhorn Creek

3. Construct and operate a facilities to control pollutants from cooling tower blowdown, sanitary sewage treatment plant, metal cleaning and low volume wastes in accordance with applicable effluent limits located at Shearon Harris Nuclear Power Plant

   subject to Part III, condition No. C. of this Permit, and

4. Discharge from said treatment works into the Harris Reservoir Buckhorn Cr which is classified Class "C".

A. ( ). EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning at first discharge and lasting until expiration permittee is authorized to discharge from outfall(s) serial number(s). 001-Cooling tower blowdown to Harri Such discharges shall be limited and monitored by the permittee as specified below: Reservoir

Effluent Characteristics	Discharge Limitations				Monitoring Requirements		
	Kg/day (lbs/day)		Other Units (Specify)				
	Daily Avg.	Daily Max.	Daily Avg.	Daily Max.	Measurement Frequency	Sample Type	Sample Location
Flow			1/	30 mgd	Continuous or Pump Log	Recorder	E
Temperature			1/		1/	1/	1/
Zinc**			1.0 mg/l	1.0 mg/l	1/Week	Grab	E*
Total Chromium**			0.2 mg/l	0.2 mg/l	1/Week	Grab	E*
Phosphours**			5 mg/l	5 mg/l	1/Week	Grab	E*
			Average	Instantaneous Maximum			
Free available Chlorine 2/			0.2 mg/l	0.5 mg/l	1/Week	Multiple Grab	At each tower
Total Residual Chlorine 2/					1/Week	Multiple Grab	At each tower

1/ Discharge of blowdown from the cooling system shall be limited to the minimum discharge of recirculating water necessary for the purpose of discharging materials contained in the process, the further build-up of which would cause concentrations or amounts exceeding limits of established engineering practice. The discharge shall not result in th violation of Class "C" water quality standards outside of a mixing zone of 200 acres around the point of discharge. This mixing zone is for temperature and chlorine. The temperature within the mixing zone shall not :(1) prevent free passage of fish around or cause fish mortality within the mixing zone;(2) result in offensive conditions;(3) produce undesirable aquatic life or result in a dominance of nuisance species outside of the zone(4)endanger the public healt or welfare. Monitoring adequate to demonstrate compliance with the blowdown minimization, water quality standards fo temperature outside of the mixing zone, and prohibitions within the mixing zone shall be proposed by the permittee si months prior to start-up and, upon approval of the proposal, the results submitted with the monthly monitoring report The permittee may discharge cooling water to the auxillary reservoir in compliance with Part III-E of this Permit.

2/ Neither free available chlorine nor total residual may be discharged from any unit for more than two hours in any one day and not more than one unit in any plant discharge free available or total residual chlorine at any one time unless the permittee can demonstrate to the Director Division of Environmental Management that the unit in question cannot operate at or below this level of chlorination. The permittee shall record and report the times of release as a part of the monthly monitoring report.

3/ No later than three years after promulgation or July 1, 1987, whichever is earlier, Total Residual Chlorine shall not exceed a maximum concentration of 0.14 mg/l in the combined cooling tower blowdown discharge. Note: In the event t

(Continued on next page)

( ) EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

3/ (continued) BAT regulations for control are promulgated in a manner inconsistent with the October 14, 1980, proposed guidelines, requirements of this paragraph shall be modified consistent with the promulgated regulations (40 CFR 423). There shall be no discharge of detectable amounts of materials added for corrosion inhibitition or any chemical added which contain the 129 priority pollutants.

* Effluent prior to mixing with any other waste stream.

** Effective after July, 1983. These limitations and monitoring requirements apply only if these materials are added by the permittee.

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored weekly on a grab sample of the effluent.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

A. ( ). EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning on initiation of discharge and lasting until expiration permittee is authorized to discharge from outfall(s) serial number(s). 002 Sanitary waste treatment plant discharge to Harris reservoir on Buckhorn Creek
Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristics	Discharge Limitations				Monitoring Requirements		
	Kg/day (lbs/day)		Other Units (Specify)				
	Daily Avg.	Daily Max.	Daily Avg.	Daily Max.	Measurement Frequency	Sample Type	Sample * Location
Flow			0.05 MGD	0.075 MGD	Continuous or pump log	Recorder	I or E
BOD			30 mg/l	45 mg/l	Monthly	Composite	E
TSS			30 mg/l	45 mg/l	Quarterly	Composite	E

* I-Influent, E-Effluent

The pH shall not be less than 6.0 , standard units nor greater than 9.0 standard units and shall be monitored monthly on a grab sample of the effluent.

There shall be no discharge of floating solids or visible foam in other than trace amounts outside of an area 5 mete

7

A. ( ). EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning upon initiation of discharge and lasting until expiration permittee is authorized to discharge from outfall(s) serial number(s). 003 metal cleaning wastes Such discharges shall be limited and monitored by the permittee as specified below: discharged to Harris Reservoir on Buckhorn Cree

Effluent Characteristics	Discharge Limitations Kg/day (lbs/day) Daily Avg.	Kg/day (lbs/day) Daily Max.	Other Units (Specify) Daily Avg.	Other Units (Specify) Daily Max.	Monitoring Requirements Measurement Frequency	Sample Type	Sample Locatio
Flow			0.8		During discharge	1/	E*
TSS	(Quantities of pollutants discharged shall not exceed the quantity obtained by multiplying the flow of metal cleaning wastes generated times the concentrations listed to the right.)		30 mg/l	100 mg/l	Daily during discharge	Grab	E*
Oil & Grease			15 mg/l	20 mg/l	Daily during discharge	Grab	E*
Copper, Total			1.0 mg/l	1.0 mg/l	Daily during discharge	Grab	E*
Iron, Total			1.0 mg/l	1.0 mg/l	Daily during discharge	Grab	E*

*Effluent prior to mixing with any other waste stream

1/ Commensurate with treatment system installed

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored daily during discharge on a grab sample of the effluent. *

There shall be no discharge of floating solids or visible foam in other than trace amounts outside of an area 5

A. ( ). EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning upon initiation of discharge and lasting until expiration permittee is authorized to discharge from outfall(s) serial number(s). 004 low volume wastes discharged Such discharges shall be limited and monitored by the permittee as specified below: to Harris Reservoir on Buckhorn Creek

Effluent Characteristics	Discharge Limitations				Monitoring Requirements		
	Kg/day (lbs/day)		Other Units (Specify)				
	Daily Avg.	Daily Max.	Daily Avg.	Daily Max.	Measurement Frequency	Sample Type	Sample Location
Flow			1.5 MGD		1/	1/	1/
TSS	170(375)	568(1251)			Weekly	Grab	Effluent*
Oil & Grease	85(187)	113(250)			Weekly	Grab	E*

1/ Commensurate with treatment system installed

*Effluent prior to mixing with any other waste stream

Low volume wastes shall mean but not all inclusive, taken collectively as if from one source, wastewater from wet scrubber air pollution control system, ion exchange, water treater systems, water treatment evaporator blowdown, laboratory and sampling streams, floor drainage, cooling tower basin cleaning wastes, blowdown from recirculating house service water systems, and steam generator blowdown.

Prior to Start-up of Unit #2, quantity limitations shall be one-half of the limitations shown.

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored weekly on a grab sample of the effluent.

There shall be no discharge of floating solids or visible foam in other th

A. ( ). EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning upon initiation of discharge and lasting until expiration permittee is authorized to discharge from outfall(s) serial number(s). 005 Point Source run-off from construction Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristics	Discharge Limitations				Monitoring Requirements		
	Kg/day (lbs/day)		Other Units (Specify)				
	Daily Avg.	Daily Max.	Daily Avg.	Daily Max.	Measurement Frequency	Sample Type	Sample Location

int source run-off from construction is permitted in compliance with a sedimentation and erosion control plan approved by e Land Quality Section of the Division of Land Resources.

B. SCHEDULE OF COMPLIANCE

1. The permittee shall achieve compliance with the effluent limitations specified for discharges in accordance with the following schedule:

   Not Applicable.

2. No later than 14 calendar days following a date identified in the above schedule of compliance, the permittee shall submit either a report of progress or, in the case of specific actions being required by identified dates, a written notice of compliance or noncompliance. In the latter case, the notice shall include the cause of noncompliance, any remedial actions taken, and the probability of meeting the next scheduled requirement.

Act used herein means the Federal Water Pollution Control Act, As amended.
DEM used herein means the Division of Environmental Management of the Department of Natural Resources and Community Development
"EMC" used herein means the North Carolina Environmental Management Commission.

C. MONITORING AND REPORTING

1. Representative Sampling

Samples and measurements taken as required herein shall be representative of the volume and nature of the monitored discharge.

2. Reporting

Monitoring results obtained during the previous month(s) shall be summarized for each month and reported on a Monthly Monitoring Report Form (DEM No. MR 1.0, 1.1, and 1.4) postmarked no later than the 45th day following the completed reporting period. The first report is due on . The DEM may require reporting of additional monitoring results by written notification. Signed copies of these, and all other reports required herein, shall be submitted to the following address:

Division of Environmental Management
Water Quality Section
Post Office Box 27687
Raleigh, North Carolina 27611

3. Definitions

a. The "daily average" discharge means the total discharge by weight during a calendar month divided by the number of days in the month that the production or commercial facility was operating. Where less than daily sampling is required by this permit, the daily average discharge shall be determined by the summation of all the measured daily discharges by weight divided by the number of days sampled during the calendar month when the measurements were made.

b. The "daily maximum" discharge means the total discharge by weight during any calendar day.

4. Test Procedures

Test procedures for the analysis of pollutants shall conform to The EMC regulations published pursuant to N. C. G. S. 143-215.63 et seq.. The Water and Air Quality Reporting Act, Section 304(g), 13 USC 1314, of the Federal Water Pollution Control Act, As Amended, and Regulation 40 CFR 136.

5. Recording Results

For each measurement or sample taken pursuant to the requirements of this permit, the permittee shall record the following information:

a. The exact place, date, and time of sampling;

b. The dates the analyses were performed;

c. The person(s) who performed the analyses;

d. The analytical techniques or methods used; and

e. The results of all required analyses.

6. Additional Monitoring by Permittee

If the permittee monitors any pollutant at the location(s) designated herein more frequently than required by this permit, using approved analytical methods as specified above, the results of such monitoring shall be included in the calculation and reporting of the values required in the Monthly Monitoring Report Form (DEM MR 1.0, 1.1, 1.4) Such increased monitoring frequency shall also be indicated. The DEM may require more frequent monitoring or the monitoring of other pollutants not required in this permit by written notification.

7. Records Retention

All records and information resulting from the monitoring activities required by this permit including all records of analyses performed d calibration and maintenance of instrumentation and recordings from continuous monitoring instrumentation shall be retained by the permittee for a minimum of three (3) years, or longer if requested by the State Division of Environmental Management or the Regional Administrator of the Environmental Protection Agency.

MANAGEMENT REQUIREMENTS

1. Change in Discharge

All discharges authorized herein shall be consistent with the terms and conditions of this permit. The discharge of any pollutant identified in this permit more frequently than or at a level in excess of that authorized shall constitute a violation of the permit. Any anticipated facility expansions, production increases, or process modifications which will result in new, different, or increased discharges of pollutants must be reported by submission of a new NPDES application or, if such changes will not violate the effluent limitations specified in this permit, by notice to the DEM of such changes. Following such notice, the permit may be modified to specify and limit any pollutants not previously limited.

2. Non compliance Notification

If, for any reason, the permittee does not comply with or will be unable to comply with any effluent limitation specified in this permit, the permittee shall provide the Division of Environmental Management with the following information, in writing, within five (5) days of becoming aware of such condition:

a. A description of the discharge and cause of noncompliance; and

b. The period of noncompliance, including exact dates and times; or, if not corrected; the anticipated time the noncompliance is expected to continue, and steps being taken to reduce, eliminate and preve recurrence of the noncomplying discharge.

3. Facilities Operation

The permittee shall at all times maintain in good working order and operate as efficiently as possible all treatment or control facilities or systems installed or used by the permittee to achieve compliance with the terms and conditions of this permit.

4. Adverse Impact

The permittee shall take all reasonable steps to minimize any adverse impact to navigable waters resulting from noncompliance with any effluent limitations specified in this permit, including such accelerated or additional monitoring as necessary to determine the nature and impact of the noncomplying discharge.

5. Bypassing

Any diversion from or bypass of facilities necessary to maintain compliance with the terms and conditions of this permit is prohibited, except (i) where unavoidable to prevent loss of life or severe property damage, or (ii) where excessive storm drainage or runoff would damage any facilities necessary for compliance with the effluent limitations and prohibitions of this permit. The permittee shall promptly notify the Water Quality Section of DEM in writing of each such diversion or bypass.

6. Removed Substances

Solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of wastewaters shall be disposed of in a manner such as to prevent any pollutant from such materials from entering waters of the State or navigable waters of the United States.

7. Power Failures

In order to maintain compliance with the effluent limitations and prohibitions of this permit, the permittee shall either:

a. In accordance with the Schedule of Compliance contained in Part I, provide an alternative power source sufficient to operate the wastewater control facilities;

or, if such alternative power source is not in existence, and no date for its implementation appears in Part I,

b. Halt, reduce or otherwise control production and/or all discharges from wastewater control facilities upon the reduction, loss, or failure of the primary source of power to said wastewater control facilities.

8. Onshore or Offshore Construction

This permit does not authorize or approve the construction of any onshore or offshore physical structures or facilities or the undertaking of any work in any navigable waters.

B. RESPONSIBILITIES

1. Right of Entry

The permittee shall allow the Director of the Division of Environmental Management, the Regional Administrator, and/or their authorized representatives, upon the presentations of credentials:

a. The enter upon the permittee's premises where an effluent source is located or in which any records are required to be kept under the terms and conditions of this permit; and

b. At reasonable times to have access to and copy any records required to be kept under the terms and conditions of this permit; to inspect any monitoring equipment or monitoring method required in this permit; and to sample any discharge of pollutants.

2. Transfer of Ownership or Control

This permit is <u>not</u> transferable. In the event of any change in control or ownership of facilities from which the authorized discharge emanates or is contemplated, the permittee shall notify the prospective owner or controller by letter of the existence of this permit and of the need to obtain a permit in the name of the prospective owner. A copy of the letter shall be forwarded to the Division of Environmental Management.

3. Availability of Reports

Except for data determined to be confidential under N. C. G. S. 143-215. 3(a)(2) or Section 308 of the Federal Act, 33 USC 1318, all reports prepared in accordance with the terms shall be available for public inspection at the offices of the Division of Environmental Management. As required by the Act, effluent data shall not be considered confidential. Knowingly making any false statement on any such report may result in the imposition of criminal penalties as provided for in N. C. G. S. 143-215.6(b)(2) or in Section 309 of the Federal Act.

4. Permit Modification

After notice and opportunity for a hearing pursuant to N. C. G. S. 143-215.1(b)(2) and G. S. 143-215.1(e) respectively, this permit may be modified, suspended, or revoked in whole or in part during its term for cause including, but not limited to, the following:

a. Violation of any terms or conditions of this permit;

b. Obtaining this permit by misrepresentation or failure to disclose fully all relevant facts; or

c. A change in any condition that requires either a temporary or permanent reduction or elimination of the authorized discharge.

5. Toxic Pollutants

Notwithstanding Part II, B-4 above, if a toxic effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is established under Section 307(a) of the Act for a toxic pollutant which is present in the discharge and such standard or prohibition is more stringent than any limitation for such pollutant in this permit, this permit shall be revised or modified in accordance with the toxic effluent standard or prohibition and the permittee so notified.

6. Civil and Criminal Liability

Except as provided in permit conditions on "Bypassing" (Part II, A-5) and "Power Failures" (Part II, A-7), nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance pursuant to N. C. G. S. 143-215.6 or Section 309 of the Federal Act, 33 USC 1319.

7. Oil and Hazardous Substance Liability

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under N. C. G. S. 143-215.75 et seq. or Section 311 of the Federal [illegible], 33 USC 1321.

8. Property Rights

The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of Federal,State or local laws or regulations.

9. Severability

The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit shall not be affected thereby.

10. Expiration of Permit

Permittee is not authorized to discharge after the expiration date. In order to receive authorization to discharge beyond the expiration date, the permittee shall submit such information, forms, and fees as are required by the agency authorized to issue permits no later than 180 days prior to the expiration date. Except as provided in N.C.G.S. 150A, any discharge without a permit after the expiration will subject the permittee to enforcement procedures as provided in N.C.G.S. 143-215.6 and 33 USC 1251 et seq..

B. Previous Permits

All previous State water quality permits issued to this facility, whether for construction or operation or discharge, are hereby revoked by issuance of this permit. The conditions, requirements, terms, and provisions of this permit authorizing discharge under the National Pollutant Discharge Elimination System governs discharges from this facility.

C. Construction

No construction of wastewater treatment facilities or additions thereto shall be begun until Final Plans and Specifications have been submitted to the Division of Environmental Management and written approval and Authorization to Construct has been issued. If no objections to Final Plans and Specifications has been made by the DEM after 30 days following receipt of the plans or issuance of this permit, whichever is latter, the plans may be considered approved and construction authorized.

D. Certified Operator

Pursuant to Chapter 90A of North Carolina General Statutes, the permittee shall employ a certified wastewater treatment plant operator in responsible charge of the wastewater treatment facilities. Such operator must hold a certification of the grade equivalent to the classification assigned to the wastewater treatment facilities.

E. Heated Water Discharge to Auxillary Reservoir

In order to insure that the auxillary reservoir is available for its' designed use at all times, the permittee may circulate heated water through the auxillary reservoir to prevent ice formation at any time that the surface water temperature is below 35°F provided that the surface water temperature in the auxillary reservoir is not raised more 5°F above ambient temperature and in no case is raised to more than 40°F.

F. There shall be no discharge of polychlorinated biphenyls (PCB's) from this facility to the extent that this compound is not present in the facility's intake waters.

G. Withdrawal from the Cape Fear River

Withdrawals from the Cape Fear River, shall be limited to 25% of the flow in the river except that no withdrawals shall be made from the river when the flow is 600 cfs or less nor which will reduce the flow in the river to less than 600 cfs as measured at the USGS Lillington Gauge. The withdrawals shall be monitored and reported monthly on the monthly monitoring report.

H. Nothing contained in this Permit shall be construed as a waiver by the Permittee of any right to a hearing it may have pursuant to State or Federal law or regulations.

I. Water discharged as backwash from intake screens is permitted without limitations or monitoring requirements.

J. The Permittee shall submit information relative to the design, location, construction and capacity of the cooling water intake structures to demonstrate application of best technology available for minimizing adverse environmental impact in accordance with the adopt guidelines for cooling water intake structures. This information must be submitted on or before December 31, 1982.

K. If any applicable standard or limitation is promulgated under sections 301(b)(2)(C) and (D), 304(b)(2), and 307(a)(2) and that effluent standard is more stringent than any effluent limitation in this permit or controls a pollutant not limited in this permit, this permit shall be promptly modified, or revoked and reissued, to conform to that effluent standard or limitation.

L. Within one year after start-up of the first unit, the permittee shall analyze the discharges serial no.s 001,003, and 004 for the priority pollutants as required by 40 CFR 122.53(d)(7) to the extent that data is still required by regulation in effect at that times.

M. Should the guidelines and/or water quality standards upon which the limitations of this permit are based be revised to be less stringent, the permittee may request relaxation of the permit limits in keeping with the revised guidelines and/or standards.

APPENDIX B

TO FACILITY OPERATING LICENSE NO. _____.
SHEARON HARRIS NUCLEAR POWER PLANT
UNIT NOS. 1, and 2 3

CAROLINA POWER & LIGHT COMPANY

DOCKET NOS. 50-400, and 50-401

ENVIRONMENTAL TECHNICAL SPECIFICATIONS

(NON-RADIOLOGICAL)

SHEARON HARRIS NUCLEAR POWER PLANT

ENVIRONMENTAL SPECIFICATIONS

(NON-RADIOLOGICAL)

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TABLE OF CONTENTS

1.0 Definitions

Annually: As defined in the NPDES Permit.

Biweekly: As defined in the NPDES Permit.

CP&L: Carolina Power & Light Company.

Daily Average: As defined in the NPDES Permit.

Daily Maximum: As defined in the NPDES Permit.

EIS: Environmental Impact Statement.

ES: Environmental Specifications.

FES-OL: Final Environmental Statement - Operating License.

Instrument Maximum: As defined in the NPDES Permit.

Maximum Roving Average: As defined in the NPDES Permit.

Monthly: As defined in the NPDES Permit.

Normal Operation: Operation of any unit at the plant at greater than 5 percent of rated thermal power in other than a safety or power emergency situation.

NPDES Permit: NPDES permit is the current National Pollutant Discharge Elimination System Permit issued by United States Environmental Protection Agency or the North Carolina Department of Natural Resources and Community Development (NCDNRCD) to Carolina Power & Light Company as pertains to Shearon Harris Nuclear Power Plant (SHNPP) Units 1 and 2. This permit authorizes CP&L to discharge controlled waste waters from the SHNPP into the waters of the State of North Carolina. | 3

Site: On-site includes the area within the exclusion area boundary and the area encompassed by the 243.0 ft. contour of the Main Reservoir and the 260.0 ft. contour of the Auxiliary Reservoir as specifically described in FSAR Section 2.1.1. Off-site includes all other areas.

Plant: Plant refers to SHNPP Units 1 and 2. | 3

Twice Yearly: As defined in the NPDES Permit.

NEPA: National Environmental Policy Act.

USEPA: United States Environmental Protection Agency, an agency of the United States Government.

NRC: Nuclear Regulatory Commission.

Weekly: As defined in the NPDES Permit.

2.0 Limiting Conditions for Operation

2.1 Non-radiological Limits

Not Applicable

3.0 Environmental Monitoring

In compliance with the provisions of the Clean Water Act (33 USC Section 1251, et seq.) and in the interest of avoiding duplication of effort, the conditions and monitoring requirements related to water quality and aquatic biota are specified in the National Pollutant Discharge Elimination System (NPDES) Permit issued by the U. S. Environmental Protection Agency and/or North Carolina DNRCD to Carolina Power & Light Company. This permit authorizes CP&L to discharge controlled waste water from the SHNPP into specified waters of the State of North Carolina.

3.1 Nonradiological Monitoring

The Nuclear Regulatory Commission will be relying on the NPDES permit for protection of the aquatic environment from non-radiological effluents.

4.0 Special Studies and Requirements

4.1 Exceptional Occurrences

4.1.1 Unusual or Important Environmental Events

Requirements

The licensee shall record any occurrence of unusual or important events which are observed by management or other qualified personnel. In conjunction with any required monitoring program, the licensee shall document an occurrence of unusual or important events that could indicate potential environmental impact causally related with station operation. The following are examples: significant onsite flora or fauna disease outbreaks; unusual mortality of any species protected by the Endangered Species Act of 1973; significant fish kills according to the definition of the State of North Carolina near or downstream of the site.

This special requirement shall commence with the date of issuance of these environmental Technical Specifications and continue until approval for modification or termination is obtained from the NRC in accordance with Subsection 5.6.1.

Action

Copies of the biological monitoring reports filed with NCDNRCD shall be concurrently submitted to NRC.

Bases

Providing reports to the NRC of extraordinary or significant events as described above is necessary for responsible and orderly regulation of the nation's system of nuclear power reactors. Notification to NRC may serve to alleviate the magnitude of the environmental impact or to place it into a perspective broader than that available to the licensee. The information thus provided may be useful or necessary to others concerned with the same environmental resources. NRC also has an obligation to be responsive to inquiries from the public and the news media concerning potentially significant environmental events at nuclear power plants.

4.1.2 Exceeding Limits of Other Relevant Permits

Requirements

The licensee shall notify the NRC of occurrences exceeding the limits specified in relevant permits and certificates issued by other federal, state and local agencies by providing to the NRC a copy of the notice as submitted to the relevant agency.

This special requirement shall commence with the date of issuance of these environmental specifications contained herein and continue until approval for modification or termination is obtained from the NRC in accordance with Subsection 5.6.

Action

The licensee shall provide the NRC copies of reports to NPDES cognizant agencies in the event of excursion beyond a limit specified in a permit or certificate issued by another federal, state or local agency.

Bases

NRC is required under NEPA to maintain an awareness of environmental impacts causally related with the construction and opertions of facilities licensed under its authority.

4.2 Biological Monitoring Program

Requirements

The licensee shall provide the results of biological studies when the results of such studies are required by the NPDES permit issuing agency.

Action

The licensee shall submit informational copies of biological studies in accordance with the schedule required by the NPDES Permit.

Bases

The preoperational non-radiological (biological) monitoring program required in the Revised Final Environmental Statement will be conducted until one year after all units are in commercial operation. This monitoring program will span the period of both operation and construction phases of all four units. Future monitoring programs beyond that described above will be governed by the NPDES permit.

The submittal of results from the programs required by the NPDES Permit will allow the staff to follow the consequences of the NRC licensing action.

5.0 Administrative Controls

5.1 Responsibility

The Plant General Manager has the responsibility for operating the plant in compliance with these Specifications. Management responsibilities for the biological monitoring programs referenced in the Environmental Specifications rests with the Manager of Environmental Technology who reports to the Vice President, Technical Services Department.

5.2 Review and Audit

5.2.1 Independent Review

Independent review and audit of plant operations and specifications for environmental matters will be performed by Corporate Nuclear Safety & Quality Assurance Audit. Corporate Nuclear Safety & Quality Assurance Audit report through the Vice President of Nuclear Safety & Research to the Chief Operating Officer.

5.3 Procedures

5.3.1 Normal Operating Procedures

Written procedures shall be prepared and followed to implement the Environmental Specifications. They shall be subject to audit. These procedures will be reviewed and approved by appropriate supervisors.

5.3.4 Changes in Practices, Plant Design or Operation

Changes in practices, plant design or operation may be made subject to conditions described below:

a) The licensee may (1) make changes in the plant design and operation, (2) make changes in the environmental programs described in the NPDES Permit and (3) conduct tests and experiments not described in the NPDES Permit without prior Commission approval, unless the proposed change, test or experiment involves an unreviewed environmental question as defined in B below.

b) A proposed change, test or experiment shall be deemed to involve an unreviewed environmental question if it concerns (1) a matter which may result in a significant increase in any adverse environmental impact previously evaluated in the final environmental impact statement as modified by staff's testimony to the Atomic Safety and Licensing Board, supplements thereto, environmental impact appraisals, or in initial or final adjudicatory decisions; or (2) a significant change in effluents or power level as specified in 51.5(b) of 10 CFR 51; or (3) a matter not previously reviewed and evaluated in the documents specified in (1) of this section which may have a significant adverse environmental impact. The Plant General Manager shall decide if a proposed change, test or experiment constitutes an unreviewed environmental question.

c) The licensee shall maintain records of changes in procedures and in facility design or operation made pursuant to these specifications. The licensee shall also maintain records of tests and experiments carried out pursuant to paragraph "A" of this subsection.

d) Changes in the NPDES shall be governed by NCDNRCD.

5.4 Plant Reporting Requirments

Reports will be made as required in sections 4.1.1, 4.1.2 and 4.2.

5.5 Changes in Environmental Specifications and Permits

Changes and additions to required Federal (other than NRC), State, local and regional authority permits and certificates for the protection of the environment that pertain to the requirements of these Environmental Specifications shall be reported to the NRC. In the event that the licensee initiates or becomes aware of a request for changes to any of the water quality requirements, limits or values stipulated in any certification or permit issued pursuant to Section 401 or 402 of the Clean Water Act which is also the subject of an Environmental Specifications reporting requirement, NRC shall be notified.

If a permit or certification, in part or in its entirety, is appealed and stayed, and if this causes water quality requirements of Sections 401 or 402 of the Clean Water Act to become nonapplicable, NRC shall be notified as described above. If, as a result of the appeal process, the 401 and 402 requirements are changed, the change shall be dealt with as described in the previous paragraph of this section.

5.6 Records Retention

Records and logs relative to plant operation shall be made and retained in a manner convenient for review and inspection. These records and logs shall be made available to NRC on request.

5.6.1 The following records shall be retained for three years.

a) Records of changes to the Environmental Program including, when applicable, records of NRC approval of such changes.

b) Records of modifications to plant structures, systems and components determined to potentially affect the continued protection of the environment.

c) Records of changes to permits and certifications required by federal (other than NRC), state, local and regional authorities for the protection of the environment.

d) Routine reports submitted to the NRC.

e) Records of review and audit activities.

f) Events, and the reports thereon, which are the subject of nonroutine reports to the NRC.