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Serial: RNPD/88-0540
(10CFR50.36a)

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D. C. 20555

SUBJECT: Effluent and Waste Disposal Semiannual Report

Dear Sir:

The enclosed Semiannual Radioactive Effluent Release Report for the period of July 1 through December 31, 1987, is submitted pursuant to 10CFR50.36a(a)(2). The Report specifies the quantity of each of the principal radionuclides released to unrestricted areas in liquid and in gaseous effluents during the second six months of operation in 1987. This Report is to provide the NRC with information to estimate maximum potential annual radiation doses to the public resulting from effluent releases at Robinson Unit 2.

Should you require additional or other information, please contact my staff.

Very truly yours,

R. E. Morgan
General Manager
H. B. Robinson S. E. Plant

JMH:jch

Enclosures

cc: Mr. L. W. Garner
Dr. J. N. Grace

IE48
1/1

EFFLUENT AND WASTE DISPOSAL

SEMIANNUAL REPORT

7/1/87 - 12/31/87

CAROLINA POWER AND LIGHT COMPANY

H. B. ROBINSON SEG PLANT - UNIT 2

FACILITY OPERATING LICENSE NO. DPR-23

DOCKET NO. 50-261

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I. EXECUTIVE SUMMARY

Significant Variances

A. The following are explanations of significant variances in this Semiannual Report:

1. The 10CFR50 Appendix I, Percent of Limits, were calculated from the last posted release for the period indicated using the Nuclear Data LRW/GRW (ODCM methodology) release permit generating system. The following is a summary of the comparison of the annual dose commitment of the ODCM and LADTAP/GASPAR dose programs:

GASEOUS	UNITS	LRW/GRW	LADTAP/GASPAR
Annual Beta Air Dose	mrad	2.31E+00	2.82E-01
Annual Gamma Air Dose	mrad	1.00E+00	1.11E-01
I-131, 133, Tritium & Part. >8 Day Dose	mrad	3.80E+00	4.69E-01
LIQUID			
Total Body Dose	mrem	2.09E-01	1.11E-01
Critical Organ Dose	mrem	3.04E-01	1.57E-01

The annual gaseous dose commitment was calculated with GASPAR using batch mixed mode, continuous mixed mode, batch ground level mode, and continuous ground level concurrent meteorology. The ODCM (GRW software) provides day-by-day dose estimates that are higher because all releases are assigned to the limiting receptor, using the continuous ground level annual average meteorology from 1978.

The annual liquid dose commitment is lower with LADTAP because total annual dilution flow is used. Day-by-day dose estimates provided by ODCM (LRW software) utilize dilution flow during actual release periods.

2. The total release time for batch gaseous releases reported in the first six months of 1987 was 2.61E+04 minutes versus 4.55E+04 minutes reported in this report, a factor of 1.7 increase. This increase was due to 7 batch containment purges during this reporting period versus only 2 batch containment purges in the first six months report for 1987. Also during this reporting period, there was an increased number of containment pressure reliefs which were due to a leaking air operated valve causing approximately four releases per week in the month of August.

3. A minimum time of 17 minutes was reported for gaseous batch releases. This release was for calibration of the Plant Vent Stack Radiation Monitor.

4. The total curies of fission and activation gases reported in the second quarter 1987 was 1.10E+01 versus 1.04E+02 curies reported in the third quarter 1987, a factor of 9.4 increase. This was due to the unit's power transients in the third quarter causing an increase fission product inventory in gaseous effluents. This also resulted in an increase in 10CFR50, Appendix I, percent of limits for nobles gases. In addition, the Unit was in a refueling outage during most of the second quarter.

10CFR50, Appendix I Compliance

	2nd QTR	3rd QTR	% Change
% QTR Limit (Gamma Air)	2.66E-01	3.46E+00	1.30E+03%
% QTR Limit (Beta Air)	6.00E-03	3.20E+00	5.33E+04%

The significant increase in the third quarter beta air dose was due to the noble gas source inventory having a greater affect on the skin dose.

5. The total curies of tritium released in gaseous effluents in the second quarter 1987 was 6.68E-01 versus 1.07E+01 curies in the third quarter a factor of 16 increase. This increased our quarterly organ dose limit to a factor of 6. This again was due to the units power transients and normal power operations in the third quarter.

6. The average stream flow of dilution water for liquid effluents reported in the first six months of 1987 was 2.37E+05 GPM versus 3.83E+05 GPM in this reporting period, a factor of 1.6 increase. This increase was due to continuous operation of the circulating water pumps in the third quarter while the unit was in a refueling outage in the second quarter of 1987 and the circulating water pumps were not operating.

7. The number of batch liquid release reported in the first six months report was 138 versus 66 batch liquid releases in this report, a factor of 2.1 decrease. The unit was in a refueling outage and an extended start-up period in the second quarter of 1987 which resulted in processing a larger volume of water.

8. The total curies released in liquid fission and activation products in the third quarter was 2.44E-01 versus 2.53E-02 curies in the fourth quarter. This decrease was due to fourth quarter Fe-55, Sr-89, and Sr-90 composite results approximately 50% lower than third quarter results. Also, the total volume in this report period was significantly lower than the first six months report for 1987.

9. The total curies of tritium in liquid effluent reported in the second quarter of 1987 was 1.40E+02 versus 4.74E+01 curies in the third quarter, a factor of 2.95 lower. The higher quantity in the second quarter was due to the unit being at the end of core life while the third quarter quantities were after a refueling outage. The fourth quarter tritium curies total was 5.88E+01, a factor of 1.2 increase which is a normal tritium inventory increase following continued power operation.

10. The total curies of dissolved and entrained noble gases reported in the second quarter was 6.62E-02 versus 8.76E-01 curies in the third quarter 1987, a factor of 13 increase. This again was due to the unit's power transients during the third quarter of 1987.

11. The total volume of liquid waste reported in the third quarter was 1.38E+07 liters versus 6.62E+05 liters in the fourth quarter 1987, a factor of 20.8 decrease. Third quarter continuous liquid effluent composite analysis results showed detectable activity while the fourth quarter continuous liquid effluent composite analysis results all showing less than minimum detectable activity, thus, a smaller volume was reported.

12. The total volume of dilution for the second quarter 1987 was 1.08E+11 liters versus 2.67E+11 liters for the third quarter 1987, a factor of 2.5 increase. The unit was in a refueling outage during the second quarter with fewer circulating water pumps running.

B. Regulatory Compliance

Whether projected on a day-by-day basis utilizing conservative meteorological conditions or estimated with concurrent meteorological conditions, the dose commitment from gaseous and liquid effluents is a small fraction of the 10CFR50, Appendix I limits. The direct radiation assessment to the likely most exposed member of the public is reported in the Annual Radiological Environmental Operating Report. The results of the assessment demonstrate no measurable affect above background for Plant operations, and since no 10CFR50 Appendix I limits have been exceeded, and there are no other nearby uranium fuel cycle sources to be considered, this demonstrates conformance with 40CFR190, Environmental Radiation Protection Standards for Nuclear Power Operation.

There were no changes to the waste solidification process control program (PCP) during the second six months of 1987.

There were no changes to the Radioactive Waste Systems (liquid, gaseous, or solid) during the second six months of 1987.

There was a reportable instrumentation inoperability event during 1987. See Enclosure II.

Revision 4 of the Offsite Dose Calculation Manual (ODCM) was reviewed and approved by the Plant Nuclear Safety Committee (PNSC) on September 16, 1987. These changes do not reduce the accuracy or reliability of the dose calculations or setpoint determinations.

There were no outside liquid holdup tanks that exceeded the 10 curie limit during this reporting period.

There were no waste gas decay tanks that exceeded the 1.9E+04 curie limit during this reporting period.

Technical Specification Table 4.10-2 specifies a continuous gas monitor having a lower limit of detection of 2.0E-05 uCi/cc on continuous gaseous vents. The radiation monitor (R-15) for the condenser air ejector vent does not meet this requirement for the reporting period. See Enclosure 1, Table III-C.

II. SUPPLEMENTAL INFORMATION

A. Regulatory Limits

1. Fission and Activation Gases:

10CFR20 Limits (Instantaneous Release Rate)

Total Body Dose ≤500 mrem/yr

Skin Dose ≤3000 mrem/yr

10CFR50, Appendix I

For Calendar Quarter

Gamma Dose ≤5 mrad

Beta Dose ≤10 mrad

For Calendar Year

Gamma Dose ≤10 mrad

Beta Dose ≤20 mrad

2. Iodine - 131 and 133, Tritium, and Particulates ≥8 day half-lives:

10CFR20 Limits (Instantaneous Release Rate)

Dose from Inhalation (only) to a child to any organ ≤1500 mrem/yr

10CRF50, Appendix I (Organ Doses)

For Calendar Quarter ≤7.5 mrem

For Calendar Year ≤15 mrem

3. Liquids:

Concentrations are specified in 10CFR20, Appendix B, Table II, Column 2 for radionuclides other than dissolved or entrained noble gases. For dissolved or entrained noble gases, the concentration shall be limited to 2.00E-04 μCi/ml total activity.

10CFR50, Appendix I

For Calendar Quarter

Total Body Dose ≤1.5 mrem

Any Organ Dose ≤5 mrem

For Calendar Year

Total Body Dose ≤3 mrem

Any Organ Dose ≤10 mrem

B. Measurements and Approximations of Total Radioactivity

1. Continuous Gaseous Releases

a. Fission and Activation Gases - The total activity released is determined from the net count rate of the gaseous monitor, its calibration factor, and the total exhaust flow. The activity of radiogas is determined by the fraction of that radiogas in the isotopic analysis for that period.

b. Iodines - The activity released as iodine-131, 133, and 135 is based on isotopic analysis of the charcoal cartridge and particulate filter and the total vent flow.

c. Particulates - The activity released via particulates with half-lives greater than eight days is determined by isotopic analysis of particulate filters and the total vent flow.

d. Tritium - The activity released as tritium is based on weekly grab sample analysis and total vent flow.

2. Batch Gaseous Releases

a. Fission and Activation Gases - The activity released is based on the volume released and the activity of the individual nuclides obtained from an isotopic analysis of the grab sample taken prior to the release.

b. Iodines - The iodines from batch releases are included in the iodine determination from the continuous Auxiliary Building release.

c. Particulates - The particulates from batch releases are included in the particulate determination from the continuous Auxiliary Building release.

d. Tritium - The activity released as tritium is based on the grab sample analysis of each batch and the batch volume.

3. Liquid Releases

a. Fission and Activation Products - The total release values (not including tritium, strontium, iron-55, and alpha) are comprised of the sum of the individual radionuclide activities in each batch released to the discharge canal for the respective quarter. These values represent the activity known to be present in the liquid radwaste effluent.

b. Tritium & Alpha - The measured tritium and alpha concentrations in a monthly composite sample are used to calculate the total release and average diluted concentration during each period.

c. Strontium-89, 90, and Iron-55 - The total release values are measured quarterly from composite samples.

C. Estimated Total Errors

1. Estimated total errors for gaseous effluents are based on uncertainties in counting equipment calibration, counting statistics, vent flow rates, vent sample flow rates, non-steady release rates, chemical yield factors, and sample losses for such items as charcoal cartridges.

2. Estimated total errors for liquid effluents are based on uncertainties in counting equipment calibration, counting statistics, non-steady release flow rate, sampling and mixing losses, and volume determinations.

3. Estimated total errors for solid waste are based on uncertainties in equipment calibration, dose rate measurements, geometry, and volume determinations.

III. GASEOUS EFFLUENTS

A. Batch Releases

1.	Number of Batch Releases	8.80E+01	
2.	Total Time Period for Batch Releases	4.55E+04	Min
3.	Maximum Time Period for a Batch Release	2.85E+03	Min
4.	Average Time Period for Batch Releases	5.17E+02	Min
5.	Minimum Time Period for a Batch Release	1.70E+01	Min

B. Abnormal Releases

1.	Number of Releases	0.00E+00	
2.	Total Activity Released	0.00E+00	Ci

C. Data Tables

The following tables provide the details of gaseous releases:

Table III-A	Summation of all Releases
Table III-B	Ground Level and Mixed Mode Releases
Table III-C	Lower Limits of Detection

TABLE III-A
EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT - 1987
GASEOUS EFFLUENTS - SUMMATION OF ALL RELEASES

		UNITS	3RD QUARTER	4TH QUARTER
A.	Fission and Activation Gases:			
1.	Total Release	Ci	1.04E+02	5.90E+01
2.	Estimated Total Error	%	6.00E+01	6.00E+01
3.	Average Release Rate for Period	µCi/sec	1.31E+01	7.42E+00
4.	Percent of 10CFR50, Appendix I			
	Quarterly Limit			
	Gamma Air	%	3.46E+00	1.77E+00
	Beta Air	%	3.20E+00	1.81E+00
	Yearly Limit			
	Gamma Air	%	9.15E+00*	1.00E+01*
	Beta Air	%	1.06E+01*	1.15E+01*
B.	Iodines, Particulates, and Tritium:			
	Iodines			
1.	Total Iodine - 131	Ci	1.12E-04	1.64E-04
2.	Estimated Total Error	%	4.00E+01	4.00E+01
3.	Average Release Rate	µCi/sec	1.41E-05	2.06E-05
	Particulates			
1.	Particulates with Half-Lives >8 days	Ci	1.22E-07	2.72E-07
2.	Estimated Total Error	%	4.00E+01	4.00E+01
3.	Average Release Rate for Period	µCi/sec	1.53E-08	3.42E-08
4.	Gross Alpha Radioactivity	Ci	<LLD	<LLD
	Tritium			
1.	Total Release	Ci	1.07E+01	1.51E+00
2.	Estimated Total Error	%	3.00E+01	3.00E+01
3.	Average Release Rate for Period	µCi/sec	1.35E+00	1.90E-01
	Percent of 10CFR50, Appendix I			
	Quarterly Limit			
	Organ Thyroid	%	2.22E+00	7.01E-01
	Yearly Limit			
	Organ Thyroid	%	2.50E+01*	2.53E+01*

*Cumulative total for the year-to-date using the methodology in the ODCM.

TABLE III-B
EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT - 1987
GASEOUS EFFLUENTS - GROUND LEVEL AND MIXED MODE RELEASES

	UNITS	CONTINUOUS MODE 3RD QUARTER	CONTINUOUS MODE 4TH QUARTER	BATCH MODE 3RD QUARTER	BATCH MODE 4TH QUARTER
1. FISSION GASES					
Ar-41	Ci	2.11E+00	6.54E-01	3.09E-01	4.51E-01
Kr-85	Ci	1.33E+00	7.34E-01	4.16E-02	5.30E-02
Kr-85m	Ci	<LLD	<LLD	4.22E-03	2.16E-03
Kr-87	Ci	<LLD	<LLD	<LLD	3.46E-04
Kr-88	Ci	<LLD	<LLD	<LLD	6.66E-04
Xe-131m	Ci	<LLD	<LLD	6.25E-02	4.11E-01
Xe-133	Ci	8.76E+01	3.99E+01	5.96E+00	1.46E+01
Xe-133m	Ci	<LLD	<LLD	3.99E-02	8.73E-02
Xe-135	Ci	6.08E+00	2.09E+00	9.82E-02	9.00E-02
Total for Period	Ci	9.71E+01	4.33E+01	6.52E+00	1.57E+01
2. IODINES[1]					
I-131	Ci	1.12E-04	1.64E-04	<LLD	<LLD
I-133	Ci	5.76E-05	2.91E-04	<LLD	<LLD
Total for Period	Ci	1.69E-04	4.54E-04	<LLD	<LLD
3. PARTICULATES[1]					
H-3	Ci	1.01E+01	7.29E-01	5.85E-01	7.81E-01
CO-58	Ci	1.22E-07	2.72E-07	<LLD	<LLD
Total for Period	Ci	1.01E+01	7.29E-01	5.85E-01	7.81E-01

[1]Continuous Accountability includes Batch Accountability (excludes H-3).

TABLE III-C
TYPICAL LOWER LIMITS OF DETECTION FOR GASEOUS EFFLUENTS

GRAB SAMPLE ANALYSIS

Nuclide	LLD (μCi/cc)
Mn-54	1.00E-11
Co-58	1.00E-11
Fe-59	1.00E-11
Co-60	1.00E-11
Zn-65	1.00E-11
Kr-85m	3.50E-04
Kr-87	1.00E-04
Kr-88	1.00E-04
Sr-89	1.00E-11
Sr-90	1.00E-11
Mo-99	1.00E-11
I-131	1.00E-12
Xe-131m	1.20E-06
I-133	1.00E-10
Xe-133m	1.00E-04
Cs-134	1.00E-11
I-135	1.60E-09
Xe-135m	9.30E-05
Cs-137	1.00E-11
Xe-138	1.00E-04
Ba/La-140	1.00E-13
Ce-141	1.00E-11
Ce-144	1.00E-11
Gross Alpha	1.00E-11

RADIATION GAS MONITORS

Description	LLD (uCi/cc)
Continuous Noble Gas Monitor	2.00E-05*

*Technical Specifications, Table 4.10-2, specifies a noble gas monitor on gaseous continuous release pathways with a sensitivity (LLD) of 2.0E-05 uCi/cc. Radiation monitor (R-15) which monitors gaseous effluents discharged via the condenser air ejector vent does not meet this sensitivity. This monitor does, however, satisfy the requirement to automatically divert its effluents to the Plant Vent Stack in the event the monitor exceeds its alarm setpoint (calculated per ODCM). The condenser air ejector vent is also diverted by Chemistry procedural control to the Plant Vent Stack if steam generator activity is greater than 1.0E-04 uCi/ml. This ensures proper effluent accountability in the case of primary to secondary leakage. A Plant Improvement Request has been approved which will assure resolution. Grab sampling is also conducted to ensure accountability.

IV. LIQUID EFFLUENTS

A. Batch Releases

1. Number of Batch Releases	6.60E+01	
2. Total Time Period for Batch Releases	1.17E+04	Min
3. Maximum Time Period for a Batch Release	5.60E+02	Min
4. Average Time Period for Batch Releases	1.78E+02	Min
5. Minimum Time Period for a Batch Release	2.10E+01	Min
6. Average Stream Flow During Release Periods	3.83E+05	GPM

B. Abnormal Releases

1. Number of Releases	0.00E+00	
2. Total Activity Released	0.00E+00	Ci

C. Data Tables

The following tables provide the details of liquid releases:

Table IV-A	Summation of all Releases
Table IV-B	Liquid Effluents
Table IV-C	Lower Limits of Detection

TABLE IV-A
EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT - 1987
LIQUID EFFLUENTS - SUMMATION OF ALL RELEASES

		UNITS	3rd QUARTER	4th QUARTER
A.	FISSION AND ACTIVATION PRODUCTS			
	1. Total Releases	Ci	2.44E-01	2.53E-02
	2. Estimated Total Error	%	2.00E+01	2.00E+01
	3. Average Diluted Concentration	µCi/ml	9.14E-10	1.03E-10
B.	TRITIUM			
	1. Total Release	Ci	4.74E+01	5.88E+01
	2. Estimated Total Error	%	1.00E+01	1.00E+01
	3. Average Diluted Concentration	µCi/ml	1.78E-07	2.39E-07
C.	DISSOLVED AND ENTRAINED GASES			
	1. Total Release	Ci	8.76E-01	7.65E-01
	2. Estimated Total Error	%	2.00E+01	2.00E+01
	3. Average Diluted Concentration	µCi/ml	3.28E-09	3.11E-09
	4. Percent of Applicable Limit	%	1.64E-03	1.55E-03
D.	GROSS ALPHA RADIOACTIVITY			
	1. Total Release	Ci	<LLD	<LLD
	2. Estimated Total Error	%	6.00E+01	6.00E+01
E.	VOLUME OF WASTE RELEASED	Liters	1.38E+07	6.62E+05
F.	VOLUME OF DILUTION WATER	Liters	2.67E+11	2.46E+11
G.	PERCENT OF 10CFR50 APPENDIX I*			
	Quarterly Limit			
	Organ Liver	%	9.05E-01	4.35E-02
	Total Body	%	2.14E+00	1.00E-01
	Yearly Limit			
	Organ Liver	%	3.02E+00*	3.04E+00*
	Total Body	%	6.93E+00*	6.98E+00*

*Cumulative total for the year-to-date using the methology in the ODCM.

TABLE IV-B
EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT - 1987
LIQUID EFFLUENTS

		CONTINUOUS MODE		BATCH MODE	
1. PARTICULATES					
	UNITS	3rd QUARTER	4th QUARTER	3rd QUARTER	4th QUARTER
Cr-51	Ci	<LLD	<LLD	9.95E-04	<LLD
Mn-54	Ci	<LLD	<LLD	4.25E-03	3.94E-04
Fe-55	Ci	3.90E-03	9.88E-05	4.83E-02	8.22E-03
Fe-59	Ci	<LLD	<LLD	8.72E-04	9.58E-06
Co-57	Ci	<LLD	<LLD	3.86E-04	4.81E-05
Co-58	Ci	<LLD	<LLD	6.23E-02	7.69E-03
Co-60	Ci	<LLD	<LLD	1.32E-02	3.80E-03
Sr-89	Ci	<LLD	<LLD	8.93E-06	1.06E-06
Sr-90	Ci	<LLD	<LLD	4.65E-06	9.50E-07
Zr-95	Ci	<LLD	<LLD	8.48E-05	<LLD
Nb-95	Ci	<LLD	<LLD	3.95E-04	1.63E-05
Ag-110m	Ci	<LLD	<LLD	2.94E-03	4.10E-04
I-131	Ci	5.10E-05	1.78E-07	<LLD	2.82E-05
I-133	Ci	3.93E-05	<LLD	<LLD	<LLD
Cs-134	Ci	<LLD	<LLD	1.98E-03	1.67E-05
Cs-137	Ci	<LLD	<LLD	5.16E-03	2.98E-04
Ce-141	Ci	<LLD	<LLD	1.71E-06	<LLD
Sn-113	Ci	<LLD	<LLD	2.29E-05	<LLD
Sb-124	Ci	<LLD	<LLD	8.22E-02	3.00E-03
Sb-125	Ci	<LLD	<LLD	1.68E-02	1.25E-03
Total for Period	Ci	3.99E-03	9.90E-05	2.40E-01	2.52E-02
2. Gases					
Kr-85	Ci	<LLD	<LLD	1.06E-02	2.87E-02
Xe-131m	Ci	<LLD	<LLD	1.79E-02	2.30E-02
Xe-133m	Ci	<LLD	<LLD	1.52E-03	2.13E-03
Xe-133	Ci	1.39E-04	2.17E-07	8.46E-01	7.11E-01
Xe-135	Ci	7.41E-06	<LLD	3.97E-06	<LLD
Total for Period	Ci	1.46E-04	2.17E-07	8.76E-01	7.65E-01

TABLE IV-C
TYPICAL LOWER LIMITS OF DETECTION FOR LIQUID EFFLUENTS

NUCLIDE	LLD (μCi/ml)
H-3	1.00E-05
Cr-51	7.10E-06
Mn-54	5.00E-07
Co-57	1.20E-07
Co-58	5.00E-07
Fe-59	5.00E-07
Co-60	5.00E-07
Zn-65	5.00E-07
Kr-85m	3.00E-08
Kr-85	4.10E-06
Sr-89	5.00E-08
Sr-90	5.00E-08
Nb-95	1.10E-07
Zr-95	2.00E-07
Mo-99	5.00E-07
Tc-99m	6.60E-08
Ag-110m	2.40E-08
Sn-113	2.10E-08
Sb-124	1.20E-07
Sb-125	5.10E-08
I-131	1.00E-06
I-133	2.70E-08
Xe-131m	4.00E-07
Xe-133	1.00E-05
Xe-133m	1.00E-05
Cs-134	5.00E-07
Xe-135	1.00E-05
Cs-137	5.00E-07
Ba-139	1.70E-06
Ba/La-140	2.40E-07
Ce-141	5.00E-07
Ce-144	5.00E-07
Gross Alpha	1.00E-07

2. Estimate of major nuclide composition (by type of waste)

		%	Ci
a.	Fe-55	87.23%	1.32E+02
	Co-58	3.20%	4.85E+00
	Co-60	4.64%	7.05E+00
	Ni-63	2.22%	3.37E+00
	Cs-134	1.12%	1.70E+00
	Cs-137	1.44%	2.19E+00
	Others*	0.16%	2.34E-01
b.	Mn-54	6.45%	3.96E-01
	Fe-55	16.60%	1.02E+00
	Co-58	48.18%	2.96E+00
	Co-60	13.95%	8.57E-01
	Ni-63	2.91%	1.79E-01
	Cs-134	2.17%	1.33E-01
	Cs-137	5.34%	3.28E-01
	H-3	2.69%	1.65E-01
	Others**	1.71%	1.05E-01

3. Solid Waste Disposition

Number of Shipments	23
Mode of Transportation	Sole Use Vehicle
Destination	Barnwell, S. C.

* Others include: C-14, H-3, Mn-54

** Others include: Cr-51, Fe-59, Co-57, Zr-95, Nb-95, Ag-110m, Sb-124, C-14

B. IRRADIATED FUEL SHIPMENTS (Disposition)

Number of Shipments	0
Mode of Transportation	NA
Destination	NA

V. SOLID WASTE AND IRRADIATED FUEL SHIPMENTS
REPORT TIME PERIOD JULY 1 TO DECEMBER 31 YEAR 1987

A. SOLID WASTE SHIPPED OFFSITE FOR BURIAL OR DISPOSAL (not irradiated fuel)

WASTE CLASS A

1. Type of waste	Unit	6-month Period	Est. Total Error %	Solid. Agent	Cont. Type	Form	No. Ship.
a. Spent resins, filter sludges, evaporator bottoms, etc.	m^3 Ci	9.13E+00 1.52E+02	2.00E+01	NA	HIC STP	Dewatered Filters & Resin	2
b. Dry compressible waste, contaminated equip., etc.	m^3 Ci	3.67E+01 6.14E+00	2.00E+01	NA	STP	Compacted Uncompacted	21
c. Irradiated components, control rods, etc.	m^3 Ci	0.00E+00 0.00E+00	NA	NA	NA	NA	NA
d. Other (describe)	m^3 Ci	0.00E+00 0.00E+00	NA	NA	NA	NA	NA

HIC - High Integrity Container
STP - Strong Tight Package

VI. ANNUAL GASEOUS DOSE ASSESSMENTS

A. Population Distribution

The population distribution was taken from the updated FSAR 2.1.3 based on the 1980 U. S. Bureau of the Census data projected for the year 1986.

B. Food Production Distribution

Food yields of agricultural commodities were calculated with the aid of factors published by the USDA[1]. The input parameters for commodities were based on a demographic study performed in September 1987 by the Operations Training and Technical Services Department at the Shearron Harris Energy and Environmental Center.

[1] USDA:ERS, "Conversion Factors and Weights and Measures for Agricultural Commodities and Their Products," Statistical Bulletin No. 362 (June 1963).

C. Food Production Totals

The total quantity of vegetable products within a 50 mile radius of the Robinson Plant is 1.793E+08 kilograms per year.

The total quantity of meat and egg production within a 50 mile radius of the Plant is 9.45E+07 kilograms per year.

The total quantity of milk production within a 50 mile radius of the Plant is 3.56E+07 liters per year.

D. Source Terms and Meteorological Inputs

The source terms were segregated by modes of release (mixed mode batch, mixed mode continuous, ground level continuous, and ground level batch) for the year for dose calculations.

The dissolved and entrained noble gas source terms of liquid effluents were included with the gaseous source term of ground level continuous airborne effluents for dose assessments.

The concurrent meteorology calculations were performed using the XOQDOQ program to compliment the above modes of releases. The mixed mode batch release meteorology used the appropriate X/Q probability level to adjust for more adverse diffusion conditions since our batch releases are not random.

E. Maximum Individual Doses

To demonstrate conformance with 10CFR50, Appendix I, doses were calculated for all sectors for the hypothetical maximum individual at the site boundary, the hypothetical maximum onsite member of the public and the True Offsite Maximum Individual with nearest resident, garden and meat pathways. The doses from the cow-goat-milk-man pathways were excluded since there is no known milk production within a five mile radius of the H. B. Robinson site based on 1985, 1986, and 1987 land use census reports.

The hypothetical maximum individual at the site boundary (SSE Sector) used for Technical Specification compliance has the highest doses (Table VI-A). The true offsite maximum individual doses, are summarized in Table VI-B. The onsite hypothetical maximum member of the public doses are summarized in Table VI-C.

F. Integrated Population Doses

Since is no known milk production within the five mile radius of the H. B. Robinson site, the milk productions, listed in Section C (Food Production Totals), were used beyond the five mile radius for the integrated population doses. The offsite annual integrated population doses are summarized in Table VI-D.

G. Onsite Integrated and Recreational Population Doses for 1987.

1. The assessment of the radiation doses from radioactive gaseous effluents to members of the public due to their activities inside the site boundary are listed in Table VI-E.

The following assumptions/site specific data were used to determine the onsite total integrated and recreational populaton doses from gaseous effluents during 1987.

SITE USAGE DATA

ACTIVITY	LOCATION	USAGE
Spouses in Parking Lot	East Lot	6 people/day, 15 min./day, 240 days/yr
	West Lot	2 people/day, 15 min./day, 240 days/yr
Picnicing	Picnic Area	10 picnics/yr, 100 people/picnic, 4 hrs/picnic
Occupational	Darlington Co. Plant	17 employees, 240 days/yr, 8 hrs/day
	Visitor Ctr.	1 employee, 240 days/yr, 8 hrs/day
Visits	Visitor Ctr.	4000 visitors, 2 hr/visit
Swimming	Lake Robinson	1000 people/day, 180 days/yr, 2 hrs/day
Boating	Lake Robinson	100 boats/day, 4 people/boat, 365 days/yr
Shoreline	Lake Robinson	1000 people/day, 180 days/yr, 4 hrs/day
Fishing	Lake Robinson	14 people/day, 365 days/yr, 6 hrs/day

2. The following consumption pathways were used for the dose assessment based on the activities listed below:

ACTIVITY	CONSUMPTION PATHWAY
Spouses in Parking Lot	Ground Plane, Inhalation, Plume
Picnicing	Ground Plane, Inhalation, Plume
Occupational	Ground Plane, Inhalation, Plume
Visits	Ground Plane, Inhalation, Plume
Swimming	Inhalation, Plume
Boating	Inhalation, Plume
Shoreline	Ground Plane, Inhalation, Plume
Fishing*	Inhalation, Plume

*The assumption that 20% of the fishing activity was from the shoreline and is included in the ground plane pathway.

3. The following data was used to determine dose assessment and meteorological conditions during periods of releases:

LAKE ROBINSON

DISTANCE METERS	SECTOR	(TOTAL HRS)	(% LAKE SURFACE)	=	HOURS
3219	N	1.25E+06	0.71	=	8.875E+05
2414	NNE	1.25E+06	0.13	=	1.625E+05
803	NE	1.25E+06	0.08	=	1.000E+05
803	ENE	1.25E+06	0.06	=	7.500E+04
803	E	1.25E+06	0.02	=	2.500E+04
			TOTAL	=	1.250E+06

OCCUPATIONAL

DISTANCE METERS	LOCATION	SECTOR	TOTAL HOURS
1062	Darlington Co. Plant	NNW	3.264E+04
302	Visitor Center	S	1.92E+03

OTHER

DISTANCE METERS	LOCATION	SECTOR	TOTAL HOURS
201	East Lot	SE	3.60E+02
402	West Lot	SW	1.20E+02
402	Picnic Area	SE	4.00E+03
302	Visitor Center	S	8.00E+03
2529	Easterlings/ Atkinsons	NE	3.63E+05
1303	Johnson	ENE	3.63E+05

H. The following tables provide the details of the Annual Gaseous Dose Assessments:

Table VI-A Hypothetical Offsite Maximum Individual Doses for 1987
Table VI-B True Offsite Maximum Individual Doses for 1987
Table VI-C Onsite Hypothetical Maximum Individual Doses for 1987
Table VI-D Offsite Annual Integrated Population Dose Summary for 1987
Table VI-E Onsite Annual Integrated and Recreational Population Doses for 1987

TABLE VI-A

GASEOUS PATHWAY
HYPOTHETICAL OFFSITE MAXIMUM INDIVIDUAL DOSES FOR 1987*
(MILLIREM)

ADULT DOSES

PATHWAY	TOTAL BODY	GI-LLI	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
Plume	6.70E-02	6.70E-02	6.70E-02	6.70E-02	6.70E-02	6.70E-02	6.98E-02	1.86E-01
Ground Plane	6.67E-04	6.67E-04	6.67E-04	6.67E-04	6.67E-04	6.67E-04	6.67E-04	7.85E-04
Inhalation	3.57E-03	3.52E-03	8.21E-05	3.62E-03	3.68E-03	3.66E-02	3.50E-03	3.50E-03
Vegetation	7.26E-03	6.57E-03	9.87E-04	7.81E-03	8.08E-03	3.08E-01	6.38E-03	6.31E-03
Meat & Poultry	9.93E-04	9.31E-04	8.92E-05	1.04E-03	1.07E-03	2.85E-02	9.13E-04	9.07E-04
Total	7.95E-02	7.87E-02	6.89E-02	8.02E-02	8.05E-02	4.41E-01	8.13E-02	1.98E-01

TEENAGER DOSES (MILLIREM)

PATHWAY	TOTAL BODY	GI-LLI	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
Plume	6.70E-02	6.70E-02	6.70E-02	6.70E-02	6.70E-02	6.70E-02	6.98E-02	1.86E-01
Ground Plane	6.67E-04	6.67E-04	6.67E-04	6.67E-04	6.67E-04	6.67E-04	6.67E-04	7.85E-04
Inhalation	3.60E-03	3.54E-03	1.15E-04	3.68E-03	3.76E-03	4.42E-02	3.52E-03	3.52E-03
Vegetation	8.04E-03	7.41E-03	1.15E-03	8.97E-03	9.00E-03	2.57E-01	7.34E-03	7.23E-03
Meat & Poultry	5.95E-05	5.56E-04	7.37E-05	6.51E-04	6.73E-04	2.06E-02	5.46E-04	5.41E-04
Total	8.00E-02	7.92E-02	6.91E-02	8.10E-02	8.11E-02	3.90E-01	8.19E-02	1.98E-01

TABLE VI-A (Continued)

GASEOUS PATHWAY
HYPOTHETICAL OFFSITE MAXIMUM INDIVIDUAL DOSES FOR 1987*
(MILLIREM)

CHILD DOSES

PATHWAY	TOTAL BODY	GI-LLI	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
Plume	6.70E-02	6.70E-02	6.70E-02	6.70E-02	6.70E-02	6.70E-02	6.98E-02	1.86E-01
Ground Plane	6.67E-04	6.67E-04	6.67E-04	6.67E-04	6.67E-04	6.67E-04	6.67E-04	7.85E-04
Inhalation	3.19E-03	3.12E-03	1.56E-04	3.27E-03	3.34E-03	4.83E-02	3.12E-03	3.11E-03
Vegetation	1.21E-02	1.13E-02	2.40E-03	1.38E-02	1.35E-02	3.90E-01	1.14E-02	1.12E-02
Meat & Poultry	7.15E-04	6.62E-04	1.36E-04	7.98E-04	8.20E-04	3.09E-02	6.60E-04	6.54E-04
Total	8.37E-02	8.28E-02	7.04E-02	8.56E-02	8.54E-02	5.37E-01	8.56E-02	2.02E-01

INFANT DOSES (MILLIREM)

PATHWAY	TOTAL BODY	GI-LLI	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
Plume	6.70E-02	6.70E-02	6.70E-02	6.70E-02	6.70E-02	6.70E-02	6.98E-02	1.86E-01
Ground Plane	6.67E-04	6.67E-04	6.67E-04	6.67E-04	6.67E-04	6.67E-04	6.67E-04	7.85E-04
Inhalation	1.85E-03	1.79E-03	1.19E-04	1.93E-03	1.94E-03	4.31E-02	1.79E-04	1.79E-03
Total	6.96E-02	6.95E-02	6.78E-02	6.96E-02	6.97E-02	1.11E-01	7.23E-02	1.89E-01

*There are no milk production within a 5 mile radius of the Plant site.

MAXIMUM INDIVIDUAL AIR DOSE FOR 1987 FROM RADIONOBLE GASES
(MILLIRADS)

Annual Beta Air Dose	2.82E-01
Annual Gamma Air Dose	1.11E-01

TABLE VI-B

GASEOUS PATHWAY

TRUE OFFSITE MAXIMUM INDIVIDUAL DOSES FOR 1987
(MILLIREM)

PATHWAY	TOTAL BODY	GI-LLI	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
Adult								
Plume	6.40E-02	6.40E-02	6.40E-02	6.40E-02	6.40E-02	6.40E-02	6.66E-02	1.77E-01
Ground Plane	5.99E-04	5.99E-04	5.99E-04	5.99E-04	5.99E-04	5.99E-04	5.99E-04	7.04E-04
Inhalation	3.49E-03	3.44E-03	8.12E-05	3.54E-03	3.60E-03	3.67E-02	3.42E-03	3.42E-03
Total Adult	6.81E-02	6.80E-02	6.47E-02	6.81E-02	6.82E-02	1.01E-01	7.06E-02	1.81E-01
Teenager								
Plume	6.40E-02	6.40E-02	6.40E-02	6.40E-02	6.40E-02	6.40E-02	6.66E-02	1.77E-01
Ground Plane	5.99E-04	5.99E-04	5.99E-04	5.99E-04	5.99E-04	5.99E-04	5.99E-04	7.04E-04
Inhalation	3.52E-03	3.46E-03	1.14E-04	3.60E-03	3.69E-03	4.43E-02	3.45E-03	3.44E-03
Total Teenager	6.81E-02	6.81E-02	6.47E-02	6.82E-02	6.83E-02	1.09E-01	7.06E-02	1.81E-01
Child								
Plume	6.40E-02	6.40E-02	6.40E-02	6.40E-02	6.40E-02	6.40E-02	6.66E-02	1.77E-01
Ground Plane	5.99E-04	5.99E-04	5.99E-04	5.99E-04	5.99E-04	5.99E-04	5.99E-04	7.04E-04
Inhalation	3.12E-03	3.05E-03	1.54E-04	3.20E-03	3.27E-03	4.85E-02	3.05E-03	3.04E-03
Total Child	6.77E-02	6.76E-02	6.48E-02	6.78E-02	6.79E-02	1.13E-01	7.02E-02	1.81E-01
Infant								
Plume	6.40E-02	6.40E-02	6.40E-02	6.40E-02	6.40E-02	6.40E-02	6.66E-02	1.77E-01
Ground Plane	5.99E-04	5.99E-04	5.99E-04	5.99E-04	5.99E-04	5.99E-04	5.99E-04	7.04E-04
Inhalation	1.81E-03	1.75E-03	1.18E-04	1.89E-03	1.90E-03	4.33E-02	1.75E-03	1.75E-03
Total Infant	6.64E-02	6.63E-02	6.47E-02	6.65E-02	6.65E-02	1.08E-01	6.89E-02	1.79E-01

TRUE OFFSITE MAXIMUM INDIVIDUAL AIR DOSE FOR 1987 FROM RADIONOBLE GASES
(MILLIRADS)

Annual Beta Air Dose	2.67E-01
Annual Gamma Air Dose	1.06E-01

TABLE VI-C

GASEOUS PATHWAY

ONSITE HYPOTHETICAL MAXIMUM INDIVIDUAL DOSES FOR 1987
(MILLIREM)

PATHWAY	TOTAL BODY	GI-LLI	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
Plume	4.38E-03	4.38E-03	4.38E-03	4.38E-03	4.38E-03	4.38E-03	4.54E-03	1.18E-02
Ground Plane	4.99E-05	4.99E-05	4.99E-05	4.99E-05	4.99E-05	4.99E-05	4.99E-05	5.86E-05
Inhalation	3.54E-04	3.47E-04	1.12E-05	3.61E-04	3.69E-04	4.89E-03	3.45E-04	3.45E-04
Total	4.78E-03	4.78E-03	4.44E-03	4.79E-03	4.80E-03	9.32E-03	4.93E-03	1.22E-02

ONSITE HYPOTHETICAL MAXIMUM INDIVIDUAL AIR DOSE FOR 1987 FROM RADIONOBLE GASES
(MILLIRADS)

Annual Beta Air Dose	1.70E-02
Annual Gamma Air Dose	7.19E-03

Location: Darlington County Electric Plant (NNW Sector)

TABLE VI-D

GASEOUS PATHWAY

OFFSITE ANNUAL INTEGRATED POPULATION DOSE SUMMARY FOR 1987
(PERSON-REM)

PATHWAY	TOTAL BODY	GI-LLI	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
Plume	7.60E-02 73.08%	7.60E-02 73.79%	7.60E-02 97.81%	7.60E-02 72.38%	7.60E-02 71.70%	7.60E-02 11.00%	8.09E-02 74.91%	2.63E-01 90.69%
Ground Plane	1.47E-04 0.14%	1.47E-04 0.14%	1.47E-04 0.19%	1.47E-04 0.14%	1.47E-04 0.14%	1.47E-04 0.02%	1.47E-04 0.14%	1.76E-04 0.06%
Inhalation	1.26E-02 12.12%	1.24E-02 12.04%	3.72E-04 0.48%	1.28E-02 12.19%	1.31E-02 12.36%	1.69E-01 24.46%	1.23E-02 11.39%	1.23E-02 4.24%
Vegetation	1.14E-02 10.96%	1.10E-02 10.68%	7.95E-04 1.02%	1.18E-02 11.24%	1.25E-02 11.79%	3.15E-01 45.59%	1.09E-02 10.09%	1.09E-02 3.76%
Cow Milk	1.46E-03 1.40%	1.32E-03 1.28%	2.88E-04 0.37%	1.61E-03 1.53%	1.83E-03 1.73%	1.09E-01 15.77%	1.26E-03 1.17%	1.26E-03 0.43%
Meat & Poultry	2.27E-03 2.18%	2.25E-03 2.18%	4.89E-05 0.06%	2.30E-03 2.19%	2.34E-03 2.21%	2.16E-02 3.13%	2.23E-03 2.06%	2.23E-03 0.77%
Total	1.04E-01	1.03E-01	7.77E-02	1.05E-01	1.06E-01	6.91E-01	1.08E-01	2.90E-01

TABLE VI-E

GASEOUS PATHWAY

ONSITE ANNUAL INTEGRATED AND RECREATIONAL POPULATION DOSES FOR 1987
(PERSON-REM)

PATHWAY	TOTAL BODY	GI-LLI	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
Plume	3.56E-03	3.56E-03	3.56E-03	3.56E-03	3.56E-03	3.56E-03	3.70E-03	9.14E-03
Ground Plane	1.35E-05	1.35E-05	1.35E-05	1.35E-05	1.35E-05	1.35E-05	1.35E-05	1.59E-05
Inhalation	2.72E-04	2.67E-04	2.40E-06	2.76E-04	2.83E-04	3.54E-03	2.66E-04	8.50E-04
Total	3.85E-03	3.84E-03	3.58E-03	3.85E-03	3.86E-03	7.11E-03	3.98E-03	1.00E-02

VII. ANNUAL LIQUID DOSE ASSESSMENTS

A. Environmental Inputs and Assumptions

In this section, parameters which are used in making dose calculations to individuals and populations are described. Extensive use has been made of the parameters outlined in NRC Regulatory Guide 1.109, but these have been supplemented, particularly in the case of population doses, with the site specific information. In the calculation of population doses considerable reliance has been placed on the selection of clearly conservative assumptions.

1. Mixing Ratios

For all calculations, the mixing ratios used to determine concentrations of isotopes at the point of exposure have been conservatively estimated. For calculation of doses to individuals, the mixing ratio of 0.835 was used to account for dilution by the discharge flow, initial dilution in the lake, and accumulation in the lake. For calculation of population doses, a mixing ratio of 0.817 was used. The method of estimating concentrations of radionuclides in Lake Robinson and downstream of the lake are given below.

Lake Robinson is supplied by surface runoff in several creeks and discharges as a continuance of Black Creek. Condenser cooling water is drawn from the lower end of the lake and is returned near the upper end. Liquid waste enters the lake via the condenser cooling water; since the cooling water flow exceeds the flow through the lake, complete mixing may be assumed.

Assuming zero initial concentration and complete mixing, the time dependent concentration of each radionuclide in the lake due to Plant releases will be

$$C_1 = C_1 = \frac{Q(1 - e^{-\Lambda t})}{V_\Lambda}$$

where: C_1 = Average concentration of each radionuclide in the lake (Ci/m^3)

Q = Rate of addition of each radionuclide into cooling water (Ci/yr)

V = Volume of water in lake (m^3)

Λ = Effective loss rate constant of each radionuclide from the lake

t = Time in years

After equilibrium is reached, the average concentration of each radionuclide in the lake will be $C_1 = \frac{Q}{V \Lambda}$

Assuming removal of radioactivity from the lake by outflow, but not by radioactive decay, the effective loss rate constant is

$$\Lambda = \frac{f_2}{V}$$

where: f_2 = average volumetric flow from lake (m^3/yr)

After equilibrium is reached, the concentration of each radionuclide in Lake Robinson is represented by $C_1 = \frac{Q}{V \Lambda} = \frac{Q}{f_2}$

The concentration of each radionuclide in the discharge canal is determined by: $C_d = C_1 + C_a = C_1 + \frac{Q}{f_1} = \frac{Q}{f_2} + \frac{Q}{f_1}$

where: C_d is the concentration in the discharge canal (Ci/m^3)

C_1 is the equilibrium concentration in the lake (Ci/m^3)

C_a is the concentration added to the water while passing through the plant = Q/f_1 (Ci/m^3)

f_1 is the cooling water flow rate (m^3/yr)

Assuming each gallon of water from discharge canal is diluted with 9 gallons of lake water, the concentration at the edge of the mixing zone C_m is

$$C_m = (C_d + 9C_1) \div 10$$

$$= (\frac{Q}{f_1} + \frac{Q}{f_2} + \frac{9Q}{f_2}) \div 10$$

$$= \frac{Q}{f_2} + \frac{Q}{10f_1}$$

The mixing ratio at the edge of the mixing zone M_m is the ratio:

$$M_m = \frac{\text{concentration at edge of mixing zone}}{\text{concentration in discharge canal}} = \frac{C_m}{C_d}$$

$$= \frac{\frac{Q}{f_2} + \frac{Q}{10f_1}}{\frac{Q}{f_2} + \frac{Q}{f_1}}$$

$$= \frac{10f_1 + f_2}{10\ (f_1 + f_2)}$$

For Robinson f_1 = 9.59E8 m^3/yr

and f_2 = 2.15E8 m^3/yr

thus M_m = 0.835

The mixing ratio for the lake in general M_1 is the ratio

$$\frac{\text{Equilibrium lake concentration}}{\text{Concentration in discharge canal}} = \frac{C_1}{C_d}$$

$$= \frac{\frac{Q}{f_2}}{\frac{Q}{f_1} + \frac{Q}{f_2}} = \frac{f_1}{f_1 + f_2}$$

For Robinson M_1 = 0.817

The validity of ignoring radioactive decay was checked by determining which isotopes were the most significant dose contributors. They were Co^{60}, Cs^{134}, and Cs^{137}. All of these isotopes have decay constants which are at least 12 times smaller than the loss rate constant of the lake

$\frac{f_2}{v} = \frac{2.15E8\ m^3/yr}{5.06E7\ m3} = 4.24$ per year. Thus, ignoring decay should have little effect.

For Auburndale Plantation the equation for mixing ratio is $e^{-.02}$ (distance downstream [Km]). Equation was derived from EPA-520/5-76-005 study.

2. Potable Water Use

There is no potable water use of any water resource which is affected by the Robinson liquid discharge. Therefore, no pathways involving potable water are evaluated.

3. Irrigated Foods

Located ten miles east of Robinson Site, the Auburndale Plantation uses water from Black Creek for irrigating. Based on observation, the following are conservative assumptions that were used for dose calculations:

a. Meat (beef)

1. No drinking water for cattle from creek,
2. Transit time = 1.00E+01 hours,
3. Irrigation rate = 1.00E+02 liter/m^2/month
4. Non-irrigated feed fraction = 9.00E-01
5. Total 50 mile production 1.96E+08 kg/yr
6. Total meat irrigated 1.00E+06 kg/yr
7. Food process time = 4.80E+00 hours

b. Produce

1. Irrigation rate = 1.00E+02 liters/m^2/month
2. Total 50 mile production = 6.10E+06 kg/yr
3. Total crop irrigation = 4.00E+03 kg

c. Leafy Vegetables

1. Irrigation rate = 1.00E+02 liter/m^2/month
2. Total 50 mile production = 2.59E+08 kg/yr
3. Total crop irrigated = 2.00E+03 kg/yr

4. Other Pathways

No other pathways which would be likely to produce 10% of the dose calculated by these pathways described above were identified for the liquid discharge for H. B. Robinson Unit No. 2.

B. Recreational Activities

1. Seasonal Population Variations

Within the 10-mile area surrounding the Plant, there are no major seasonal population variations. During the entire year, Lake Robinson is used for fishing, boating, picnicking, and other recreational activities. Based on a 1975 creek and recreational survey, the daily summer peak transient population is approximately 550-650 people. This figure would include people who are boating on Lake Robinson, as well as those using shore facilities. Also, during the winter months, Lake Prestwood, located on the north side of Hartsville, is utilized by local residents for recreation. Lake Prestwood is a comparatively small body of water, and it is estimated that 50-100 people would be using the area on a peak day. Based on this survey, the seasonal variation did not warrant any special dose assessments.

2. Water Recreation for Maximum Individual Doses

Because suitable statistics are unavailable, assumptions were made for purposes of evaluating doses from each of the swimming, boating, and shoreline recreational pathways. These assumptions are summarized as follows:

Boating

Adult - 120 days/yr x 2 hrs/day = 240 hrs/yr
Teen - 180 days/yr x 2 hrs/day = 360 hrs/yr
Child - 90 days/yr x 2 hrs/day = 180 hrs/yr

Swimming

Adult - 90 days/yr x 2 hrs/day = 180 hrs/yr
Teen - 180 days/yr x 2 hrs/day = 360 hrs/yr
Child - 90 days/yr x 3 hrs/day = 270 hrs/yr

Fresh water fish and shoreline exposure: default to NRC Regulatory Guide 1.109 values.

3. Population Doses

The following assumptions/site specifics are listed:

Water Recreation Data

Activity	Location	Usage
Swimming	Lake Robinson	1000 people/day, 180 days/yr, 2 hr/day
	Lake Prestwood	100 people/day, 180 days/yr, 2 hr/day
	Black Creek	10 people/mile, 50 miles, 180 days/yr, 2 hr/day
Boating	Lake Robinson	100 boats/day, 4 people/boat, 365 days/yr, 2 hr/day
	Lake Prestwood	10 boats/day, 4 people/boat, 365 days/yr, 2 hr/day
	Black Creek	none
Shoreline	Lake Robinson	1000 people/day, 180 days/yr, 4 hr/day
	Lake Prestwood	100 people/day, 180 days/yr, 4 hr/day
	Black Creek	10 people/mile, 50 miles, 365 days/yr, 4 hr/day

4. Aquatic Foods (Fish)

There are no shellfish or aquatic plants harvested in Lake Robinson or within 50 miles downstream of the site. Assuming approximately 8000 fish are taken from the lake each year and an edible yield of 1 kg per fish, this amounts to 8000 kg per year. An additional 800 kg per year are assumed to come from Lake Prestwood and another 8000 kg from the Black Creek downstream of Lake Robinson.

C. Maximum Individual Dose

To demonstrate conformance with 10CFR50, Appendix I, doses were calculated for all the age groups for the total body and all organs using the fish, shoreline, swimming, and boating pathways. The hypothetical maximum individual doses for the liquid pathway was calculated to show compliance with Technical Specifications. These doses were onsite at the end of the discharge canal in the North sector and are summarized in Table VII-A.

D. Onsite Integrated Population Doses

The assessment of the radiation doses from radioactive liquid effluents to members of the public due to their activities inside the site boundary are listed in Table VII-B.

E. Annual Integrated Population Doses

The assessment of the annual radiation doses from radioactive liquid effluents within the 50 mile radius of the H. B. Robinson site (inclusive of the onsite doses) are summarized in Table VII-C.

F. Data Tables

The following tables provides the details of the Annual Liquid Dose Assessment:

Table VII-A Hypothetical Maximum Individual Doses for 1987
Table VII-B Lake Robinson (onsite) Annual Integrated and Recreational Population Doses for 1987
Table VII-C Annual Integrated Population Dose Summary for 1987

TABLE VII-A
LIQUID PATHWAY
HYPOTHETICAL MAXIMUM INDIVIDUAL DOSES FOR 1987
(MILLIREM)

A D U L T D O S E S

PATHWAY	SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
Fish		9.79E-02	1.54E-01	1.09E-01	1.42E-03	5.17E-02	1.77E-02	4.91E-02
Drinking		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Shoreline	2.52E-03	2.15E-03	2.15E-03	2.15E-03	2.15E-03	2.15E-03	2.15E-03	2.15E-03
Swimming		2.95E-04	2.95E-04	2.95E-04	2.95E-04	2.95E-04	2.95E-04	2.95E-04
Boating		1.97E-04	1.97E-04	1.97E-04	1.97E-04	1.97E-04	1.97E-04	1.97E-04
Total	2.52E-03	1.00E-01	1.57E-01	1.11E-01	4.06E-03	5.43E-02	2.04E-02	5.17E-02

	USAGE (KG/YR, HR/YR)	DILUTION	TIME(HR)	SHORE WIDTH FACTOR = 0.5
Fish	21.0	1.2	24.00	
Shoreline	12.0	1.2	0.0	
Swimming	180.0	1.2	0.0	
Boating	240.0	1.2	0.0	

T E E N A G E R D O S E S

(MILLIREM)

PATHWAY	SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
Fish		1.04E-01	1.59E-01	6.16E-02	1.24E-03	5.31E-02	2.10E-02	3.47E-02
Drinking		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Shoreline	1.41E-02	1.20E-02	1.20E-02	1.20E-02	1.20E-02	1.20E-02	1.20E-02	1.20E-02
Swimming		5.90E-04	5.90E-04	5.90E-04	5.90E-04	5.90E-04	5.90E-04	5.90E-04
Boating		2.95E-04	2.95E-04	2.95E-04	2.95E-04	2.95E-04	2.95E-04	2.95E-04
Total	1.41E-02	1.17E-01	1.72E-01	7.45E-02	1.41E-02	6.60E-02	3.39E-02	4.76E-02

	USAGE (KG/YR, HR/YR)	DILUTION	TIME(HR)	SHORE WIDTH FACTOR = 0.5
Fish	16.0	1.2	24.00	
Shoreline	67.0	1.2	0.0	
Swimming	360.0	1.2	0.0	
Boating	360.0	1.2	0.0	

TABLE VII-A (Cont.)

C H I L D D O S E S

(MILLIREM)

PATHWAY	SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
Fish		1.30E-01	1.41E-01	2.46E-02	1.19E-03	4.53E-02	1.68E-02	1.26E-02
Drinking		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Shoreline	2.94E-03	2.51E-03	2.51E-03	2.51E-03	2.51E-03	2.51E-03	2.51E-03	2.51E-03
Swimming		4.42E-04	4.42E-04	4.42E-04	4.42E-04	4.42E-04	4.42E-04	4.42E-04
Boating		1.47E-04	1.47E-04	1.47E-04	1.47E-04	1.47E-04	1.47E-04	1.47E-04
Total	2.94E-03	1.33E-01	1.44E-01	2.77E-02	4.29E-03	4.84E-02	1.98E-02	1.57E-02

	USAGE (KG/YR, HR/YR)	DILUTION	TIME(HR)	SHORE WIDTH FACTOR = 0.5
Fish	6.9	1.2	24.00	
Shoreline	14.0	1.2	0.0	
Swimming	270.0	1.2	0.0	
Boating	180.0	1.2	0.0	

TABLE VII-B

LIQUID PATHWAY
LAKE ROBINSON (ONSITE) ANNUAL INTEGRATED AND RECREATIONAL POPULATION DOSES FOR 1987
(PERSON-REM)

	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI	SKIN
Fish	4.53E-02	6.63E-02	3.87E-02	4.37E-04	2.21E-02	7.80E-03	1.63E-02	0.00E+00
Shoreline	7.69E-02	7.69E-02	7.69E-02	7.69E-02	7.69E-02	7.69E-02	7.69E-02	9.01E-02
Swimming	5.86E-04	5.86E-04	5.86E-04	5.86E-04	5.86E-04	5.86E-04	5.86E-04	0.00E+00
Boating	2.38E-04	2.38E-04	2.38E-04	2.38E-04	2.38E-04	2.38E-04	2.38E-04	0.00E+00
Total	1.17E-01	1.38E-01	1.10E-01	7.20E-02	9.36E-02	7.93E-02	8.78E-02	9.01E-02

TABLE VII-C

LIQUID PATHWAY
ANNUAL INTEGRATED POPULATION DOSE SUMMARY FOR 1987
(PERSON-REM)

PATHWAY	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI	SKIN
Fish	9.55E-02	1.40E-01	8.13E-02	9.19E-04	4.65E-02	1.64E-02	3.44E-02	0.00E+00
Shoreline	1.35E-01	1.35E-01	1.35E-01	1.35E-01	1.35E-01	1.35E-01	1.35E-01	1.59E-01
Swimming	9.30E-04	9.30E-04	9.30E-04	9.30E-04	9.30E-04	9.30E-04	9.30E-04	0.00E+00
Boating	2.61E-04	2.61E-04	2.61E-04	2.61E-04	2.61E-04	2.61E-04	2.61E-04	0.00E+00
Irr. Produce	8.04E-02	1.39E-01	9.67E-02	5.85E-02	7.72E-02	7.10E-02	2.55E-01	0.00E+00
Irr. Leafy Veg.	5.63E-03	9.81E-03	7.30E-03	5.15E-03	5.52E-03	5.14E-03	1.23E-02	0.00E+00
Irr. Meat	7.20E-04	1.03E-03	7.82E-04	3.25E-04	4.58E-04	5.25E-04	3.39E-03	0.00E+00
Hydrosphere H-3	0.00E+00	3.67E-03	3.67E-03	3.67E-03	3.67E-03	3.67E-03	3.67E-03	3.67E-03
Total	3.18E-01	4.30E-01	2.94E-01	1.73E-01	2.38E-01	2.01E-01	4.13E-01	1.63E-01

VIII. 40CFR190 DOSE CONFORMANCE

The direct radiation assessment to the most likely exposed member of the public is reported in the Annual Radiological Environmental Operating Report. The results of the assessment demonstrate no measurable affect above background from Plant Operations, and since no 10CFR50 Appendix I limits have been exceeded, and there are no other nearby uranium fuel cycle sources to be considered, this demonstrates conformance with 40CFR190, Environmental Radiation Protection Standards for Nuclear Power Operation.

IX. METEOROLOGICAL DATA

A. Continuous Release Diffusion Analysis

Table IX-A presents the number and frequency of wind direction occurrences by wind speed class as recorded at the onsite meteorological system during the period January 1 through December 31, 1987.

The frequencies are presented as a percent of total occurrences for each stability class as well as a summary for all classes for the lower (10 meter) sensor elevation.

Pertinent information available from the tables is as follows:

1. Stability

Percent occurrence Pasquill Stability categories based on lower level (10m) wind distribution:

A	B	C	D	E	F	G
8.3	6.0	8.2	33.5	22.7	10.2	11.1

2. Wind Speed

Wind Speed	10 Meter
Average Speed (mph)	4.9
Percent Calm	1.9
Percent Less than 3.5 mph	34.9

3. Wind Direction

Wind Direction	10 Meter
Prevailing Direction	SSW
Percent Occurrence	10.2

4. Data Recovery

Data Recovery	10 Meter
Percent Good Hours	97.8

TABLE IX-A

ENVIRONMENTAL MONITORING SYSTE[redacted]AROLINA POWER & LIGHT COMPANY
PROGRAM IEM24#32 ([redacted]Q) - 22 JAN 1988 9:59 THURSDAY, FEBRUARY [redacted]88
JOINT OCCURRENCE FREQUENCIES FOR LOWNDDEG AND LOWNDSPD
RANGES INCLUDE LOWER END POINT, EXCLUDE UPPER END POINT

SITE=ROBN PERIOD=YRC1987 SUMMARY OVER ALL STAB

LOWNDDEG= \ LOWNDSPD	CALM	.75-3.5	3.5-7.5	7.5-12.5	12.5-18.5	18.5-25	>= 25	TOTAL	AVERAGE LOWNDSPD
N	8.2/ 0.10	144/ 1.68	318/ 3.71	173/ 2.02	12/ 0.14	/	/	655.2/ 7.64	5.83530
NNE	6.2/ 0.07	108/ 1.26	443/ 5.17	267/ 3.12	28/ 0.33	/	/	852.2/ 9.94	6.62975
NE	4.7/ 0.05	82/ 0.96	342/ 3.99	108/ 1.26	1/ 0.01	/	/	537.7/ 6.27	5.59750
ENE	3.6/ 0.04	63/ 0.74	245/ 2.86	28/ 0.33	/	/	/	339.6/ 3.96	4.91678
E	2.9/ 0.03	50/ 0.58	168/ 1.96	10/ 0.12	/	/	/	230.9/ 2.69	4.58354
ESE	3.3/ 0.04	58/ 0.68	126/ 1.47	10/ 0.12	/	/	/	197.3/ 2.30	4.42168
SE	4.0/ 0.05	69/ 0.81	177/ 2.07	32/ 0.37	/	/	/	282.0/ 3.29	4.89860
SSE	9.8/ 0.11	171/ 2.00	275/ 3.21	35/ 0.41	2/ 0.02	/	/	492.8/ 5.75	4.36140
S	16.9/ 0.20	295/ 3.44	327/ 3.82	88/ 1.03	14/ 0.16	/	/	740.9/ 8.64	4.55632
SSW	18.7/ 0.22	326/ 3.80	388/ 4.53	125/ 1.46	13/ 0.15	/	/	870.7/10.16	4.73136
SW	12.5/ 0.15	218/ 2.54	330/ 3.85	101/ 1.18	9/ 0.11	/	/	670.5/ 7.82	4.89727
WSW	11.1/ 0.13	194/ 2.26	241/ 2.81	49/ 0.57	5/ 0.06	/	/	500.1/ 5.83	4.45536
W	10.4/ 0.12	181/ 2.11	180/ 2.10	40/ 0.47	3/ 0.04	/	/	414.4/ 4.83	4.19200
WNW	12.1/ 0.14	212/ 2.47	127/ 1.48	56/ 0.65	2/ 0.02	/	/	409.1/ 4.77	4.06067
NW	16.0/ 0.19	280/ 3.27	177/ 2.07	58/ 0.68	25/ 0.29	/	/	556.0/ 6.49	4.27862
NNW	21.6/ 0.25	377/ 4.40	326/ 3.80	88/ 1.03	9/ 0.11	/	/	821.6/ 9.59	4.17366
TOTAL	162.0/ 1.89	2828/32.99	4190/48.89	1268/14.79	123/ 1.44	/	/	8571/ 100	4.88013

NUMBER OF BAD RECORDS: 189

TABLE IX-A (Continued)

ENVIRONMENTAL MONITORING SYSTE[redacted]AROLINA POWER & LIGHT COMPANY
PROGRAM IEM24#32 ([redacted]Q) - 22 JAN 1988 9:59 THURSDAY, FEBRUARY [redacted]88
JOINT OCCURRENCE FREQUENCIES FOR LOWNDDEG AND LOWNDSPD
RANGES INCLUDE LOWER END POINT, EXCLUDE UPPER END POINT

SITE=ROBN PERIOD=YRC1987 STAB=A

LOWNDDEG= / LOWNDSPD	CALM	.75-3.5	3.5-7.5	7.5-12.5	12.5-18.5	18.5-25	>= 25	TOTAL	AVERAGE LOWNDSPD
N	/	/	17/ 0.20	56/ 0.65	1/ 0.01	/	/	74.0/ 0.86	8.87493
NNE	/	1/ 0.01	21/ 0.25	34/ 0.40	4/ 0.05	/	/	60.0/ 0.70	8.6068Q
NE	/	1/ 0.01	29/ 0.34	26/ 0.30	/	/	/	56.0/ 0.65	7.16906
ENE	/	1/ 0.01	21/ 0.25	7/ 0.08	/	/	/	29.0/ 0.34	6.46300
E	/	1/ 0.01	25/ 0.29	6/ 0.07	/	/	/	32.0/ 0.37	5.96392
ESE	/	5/ 0.06	16/ 0.19	4/ 0.05	/	/	/	25.0/ 0.29	5.09588
SE	/	1/ 0.01	37/ 0.43	4/ 0.05	/	/	/	42.0/ 0.49	5.38563
SSE	/	3/ 0.04	39/ 0.46	5/ 0.06	/	/	/	47.0/ 0.55	5.70391
S	/	1/ 0.01	20/ 0.23	19/ 0.22	3/ 0.04	/	/	43.0/ 0.50	7.58402
SSW	/	/	33/ 0.39	46/ 0.54	11/ 0.13	/	/	90.0/ 1.05	8.71269
SW	/	1/ 0.01	24/ 0.28	34/ 0.40	4/ 0.05	/	/	63.0/ 0.74	8.19334
WSW	/	2/ 0.02	22/ 0.26	16/ 0.19	1/ 0.01	/	/	41.0/ 0.48	7.31924
W	/	/	12/ 0.14	18/ 0.21	2/ 0.02	/	/	32.0/ 0.37	8.63035
WNW	/	/	7/ 0.08	15/ 0.18	/	/	/	22.0/ 0.26	8.20486
NW	/	/	3/ 0.04	17/ 0.20	8/ 0.09	/	/	28.0/ 0.33	10.52312
NNW	/	/	6/ 0.07	17/ 0.20	3/ 0.04	/	/	26.0/ 0.30	9.28926
TOTAL	/	17/ 0.20	332/ 3.87	324/ 3.78	37/ 0.43	/	/	710.0/ 8.28	7.73794

NUMBER OF BAD RECORDS: 0

TABLE IX-A (Continued)

ENVIRONMENTAL MONITORING SYSTE[redacted]AROLINA POWER & LIGHT COMPANY
PROGRAM IEM24#32 ([redacted]Q) - 22 JAN 1988 9:59 THURSDAY, FEBRUARY [redacted]88
JOINT OCCURRENCE FREQUENCIES FOR LOWNDDEG AND LOWNDSPD
RANGES INCLUDE LOWER END POINT, EXCLUDE UPPER END POINT

SITE=ROBN PERIOD=YRC1987 STAB=B

LOWNDDEG=	LOWNDSPD								AVERAGE
	CALM	.75-3.5	3.5-7.5	7.5-12.5	12.5-18.5	18.5-25	>= 25	TOTAL	LOWNDSPD
N	/	1/ 0.01	35/ 0.41	31/ 0.36	4/ 0.05	/	/	71.0/ 0.83	7.53217
NNE	/	3/ 0.04	33/ 0.39	31/ 0.36	7/ 0.08	/	/	74.0/ 0.86	7.80871
NE	/	3/ 0.04	27/ 0.32	9/ 0.11	/	/	/	39.0/ 0.46	6.01127
ENE	/	1/ 0.01	19/ 0.22	8/ 0.09	/	/	/	28.0/ 0.33	6.07804
E	/	1/ 0.01	25/ 0.29	1/ 0.01	/	/	/	27.0/ 0.32	5.21248
ESE	/	3/ 0.04	17/ 0.20	1/ 0.01	/	/	/	21.0/ 0.25	4.65947
SE	/	5/ 0.06	19/ 0.22	2/ 0.02	/	/	/	26.0/ 0.30	4.94093
SSE	/	1/ 0.01	16/ 0.19	1/ 0.01	/	/	/	18.0/ 0.21	5.60651
S	/	/	11/ 0.13	7/ 0.08	3/ 0.04	/	/	21.0/ 0.25	8.01194
SSW	/	1/ 0.01	20/ 0.23	18/ 0.21	2/ 0.02	/	/	41.0/ 0.48	7.74981
SW	/	/	35/ 0.41	14/ 0.16	3/ 0.04	/	/	52.0/ 0.61	7.12888
WSW	/	/	18/ 0.21	7/ 0.08	/	/	/	25.0/ 0.29	6.84942
W	/	/	16/ 0.19	6/ 0.07	/	/	/	22.0/ 0.26	6.49264
WNW	/	2/ 0.02	7/ 0.08	6/ 0.07	/	/	/	15.0/ 0.18	7.08799
NW	/	/	11/ 0.13	5/ 0.06	1/ 0.01	/	/	17.0/ 0.20	7.32719
NNW	/	1/ 0.01	13/ 0.15	4/ 0.05	2/ 0.02	/	/	20.0/ 0.23	6.82508
TOTAL	/	22/ 0.26	322/ 3.76	151/ 1.76	22/ 0.26	/	/	517.0/ 6.03	6.81503

NUMBER OF BAD RECORDS: 4

TABLE IX-A (Continued)

ENVIRONMENTAL MONITORING SYSTE[redacted]AROLINA POWER & LIGHT COMPANY
PROGRAM IEM24#32 ([redacted]Q) - 22 JAN 1988 9:59 THURSDAY, FEBRUARY [redacted]88
JOINT OCCURRENCE FREQUENCIES FOR LOWNDDEG AND LOWNDSPD
RANGES INCLUDE LOWER END POINT, EXCLUDE UPPER END POINT

SITE=ROBN PERIOD=YRC1987 STAB=C

LOWNDDEG= \ LOWNDSPD	CALM	.75-3.5	3.5-7.5	7.5-12.5	12.5-18.5	18.5-25	>= 25	TOTAL	AVERAGE LOWNDSPD
N	/	3/ 0.04	49/ 0.57	26/ 0.30	2/ 0.02	/	/	80.0/ 0.93	7.04790
NNE	/	7/ 0.08	52/ 0.61	62/ 0.72	8/ 0.09	/	/	129.0/ 1.51	7.93278
NE	/	5/ 0.06	48/ 0.56	28/ 0.33	/	/	/	81.0/ 0.95	6.43923
ENE	/	7/ 0.08	32/ 0.37	4/ 0.05	/	/	/	43.0/ 0.50	5.20842
E	/	9/ 0.11	18/ 0.21	/	/	/	/	27.0/ 0.32	4.44975
ESE	/	4/ 0.05	20/ 0.23	/	/	/	/	24.0/ 0.28	4.46751
SE	/	4/ 0.05	18/ 0.21	1/ 0.01	/	/	/	23.0/ 0.27	5.05252
SSE	/	1/ 0.01	19/ 0.22	1/ 0.01	/	/	/	21.0/ 0.25	5.43843
S	/	2/ 0.02	23/ 0.27	6/ 0.07	2/ 0.02	/	/	33.0/ 0.39	6.77662
SSW	/	4/ 0.05	29/ 0.34	12/ 0.14	/	/	/	45.0/ 0.53	6.30648
SW	/	3/ 0.04	45/ 0.53	14/ 0.16	1/ 0.01	/	/	63.0/ 0.74	6.45296
WSW	/	2/ 0.02	33/ 0.39	6/ 0.07	1/ 0.01	/	/	42.0/ 0.49	6.02364
W	/	2/ 0.02	19/ 0.22	3/ 0.04	1/ 0.01	/	/	25.0/ 0.29	6.09238
WNW	/	1/ 0.01	10/ 0.12	12/ 0.14	/	/	/	23.0/ 0.27	7.11587
NW	/	/	9/ 0.11	4/ 0.05	4/ 0.05	/	/	17.0/ 0.20	8.56735
NNW	/	1/ 0.01	18/ 0.21	8/ 0.09	1/ 0.01	/	/	28.0/ 0.33	6.83556
TOTAL	/	55/ 0.64	442/ 5.16	187/ 2.18	20/ 0.23	/	/	704.0/ 8.21	6.54892

NUMBER OF BAD RECORDS: 21

TABLE IX-A (Continued)

ENVIRONMENTAL MONITORING SYSTE[redacted]AROLINA POWER & LIGHT COMPANY
PROGRAM IEM24#32 ([redacted]Q) - 22 JAN 1988 9:59 THURSDAY, FEBRUARY 1[redacted]88
JOINT OCCURRENCE FREQUENCIES FOR LOWNDDEG AND LOWNDSPD
RANGES INCLUDE LOWER END POINT, EXCLUDE UPPER END POINT

SITE=ROBN PERIOD=YRC1987 STAB=D

LOWNDDEG=	LOWNDSPD								AVERAGE
	CALM	.75-3.5	3.5-7.5	7.5-12.5	12.5-18.5	18.5-25	>= 25	TOTAL	LOWNDSPD
N	0.1/ 0.00	18/ 0.21	138/ 1.61	50/ 0.58	5/ 0.06	/	/	211.1/ 2.46	6.35506
NNE	0.1/ 0.00	29/ 0.34	271/ 3.16	133/ 1.55	9/ 0.11	/	/	442.1/ 5.16	6.76810
NE	0.2/ 0.00	37/ 0.43	186/ 2.17	44/ 0.51	1/ 0.01	/	/	268.2/ 3.13	5.63377
ENE	0.1/ 0.00	33/ 0.39	140/ 1.63	8/ 0.09	/	/	/	181.1/ 2.11	4.83361
E	0.1/ 0.00	23/ 0.27	87/ 1.02	3/ 0.04	/	/	/	113.1/ 1.32	4.54733
ESE	0.1/ 0.00	25/ 0.29	68/ 0.79	5/ 0.06	/	/	/	98.1/ 1.14	4.77264
SE	0.1/ 0.00	25/ 0.29	82/ 0.96	25/ 0.29	/	/	/	132.1/ 1.54	5.47962
SSE	0.1/ 0.00	33/ 0.39	104/ 1.21	18/ 0.21	2/ 0.02	/	/	157.1/ 1.83	5.14993
S	0.1/ 0.00	19/ 0.22	121/ 1.41	41/ 0.48	3/ 0.04	/	/	184.1/ 2.15	6.10435
SSW	0.2/ 0.00	44/ 0.51	142/ 1.66	39/ 0.46	/	/	/	225.2/ 2.63	5.54758
SW	0.1/ 0.00	35/ 0.41	122/ 1.42	30/ 0.35	1/ 0.01	/	/	188.1/ 2.19	5.39876
WSW	0.2/ 0.00	39/ 0.46	119/ 1.39	17/ 0.20	3/ 0.04	/	/	178.2/ 2.08	5.15952
W	0.1/ 0.00	34/ 0.40	90/ 1.05	13/ 0.15	/	/	/	137.1/ 1.60	4.74912
WNW	0.2/ 0.00	38/ 0.44	53/ 0.62	20/ 0.23	2/ 0.02	/	/	113.2/ 1.32	5.43204
NW	0.1/ 0.00	22/ 0.26	48/ 0.56	26/ 0.30	12/ 0.14	/	/	108.1/ 1.26	6.89367
NNW	0.1/ 0.00	19/ 0.22	77/ 0.90	31/ 0.36	3/ 0.04	/	/	130.1/ 1.52	6.15821
TOTAL	2.0/ 0.02	473/ 5.52	1848/21.56	503/ 5.87	41/ 0.48	/	/	2867/33.45	5.70490

NUMBER OF BAD RECORDS: 20

TABLE IX-A (Continued)

ENVIRONMENTAL MONITORING SYSTE[redacted]AROLINA POWER & LIGHT COMPANY
PROGRAM IEM24#32 ([redacted]Q) - 22 JAN 1988 9:59 THURSDAY, FEBRUARY [redacted]88
JOINT OCCURRENCE FREQUENCIES FOR LOWNDDEG AND LOWNDSPD
RANGES INCLUDE LOWER END POINT, EXCLUDE UPPER END POINT

SITE=ROBN PERIOD=YRC1987 STAB=E

LOWNDDEG=	LOWNDSPD								AVERAGE
	CALM	.75-3.5	3.5-7.5	7.5-12.5	12.5-18.5	18.5-25	>= 25	TOTAL	LOWNDSPD
N	0.5/ 0.01	35/ 0.41	71/ 0.83	8/ 0.09	/	/	/	114.5/ 1.34	4.53891
NNE	0.6/ 0.01	39/ 0.46	63/ 0.74	7/ 0.08	/	/	/	109.6/ 1.28	4.34059
NE	0.4/ 0.00	27/ 0.32	48/ 0.56	1/ 0.01	/	/	/	76.4/ 0.89	3.96249
ENE	0.2/ 0.00	16/ 0.19	33/ 0.39	1/ 0.01	/	/	/	50.2/ 0.59	4.00128
E	0.2/ 0.00	13/ 0.15	13/ 0.15	/	/	/	/	26.2/ 0.31	3.28917
ESE	0.3/ 0.00	17/ 0.20	4/ 0.05	/	/	/	/	21.3/ 0.25	2.66604
SE	0.4/ 0.00	24/ 0.28	21/ 0.25	/	/	/	/	45.4/ 0.53	3.68760
SSE	1.0/ 0.01	67/ 0.78	92/ 1.07	7/ 0.08	/	/	/	167.0/ 1.95	4.01992
S	1.8/ 0.02	116/ 1.35	137/ 1.60	11/ 0.13	1/ 0.01	/	/	266.8/ 3.11	4.03458
SSW	1.9/ 0.02	123/ 1.44	142/ 1.66	8/ 0.09	/	/	/	274.9/ 3.21	3.79280
SW	1.4/ 0.02	90/ 1.05	93/ 1.09	9/ 0.11	/	/	/	193.4/ 2.26	3.86331
WSW	1.1/ 0.01	69/ 0.81	37/ 0.43	2/ 0.02	/	/	/	109.1/ 1.27	3.24195
W	0.9/ 0.01	60/ 0.70	32/ 0.37	/	/	/	/	92.9/ 1.08	3.14650
WNW	0.7/ 0.01	46/ 0.54	38/ 0.44	2/ 0.02	/	/	/	86.7/ 1.01	3.53083
NW	0.7/ 0.01	48/ 0.56	71/ 0.83	6/ 0.07	/	/	/	125.7/ 1.47	4.14901
NNW	0.8/ 0.01	55/ 0.64	100/ 1.17	28/ 0.33	/	/	/	183.8/ 2.14	4.85580
TOTAL	13.0/ 0.15	845/ 9.86	995/11.61	90/ 1.05	1/ 0.01	/	/	1944/22.68	3.96766

NUMBER OF BAD RECORDS: 1

TABLE IX-A (Continued)

ENVIRONMENTAL MONITORING SYSTE[redacted]AROLINA POWER & LIGHT COMPANY
PROGRAM IEM24#32 ([redacted]Q) - 22 JAN 1988 9:59 THURSDAY, FEBRUARY [redacted]88
JOINT OCCURRENCE FREQUENCIES FOR LOWNDDEG AND LOWNDSPD
RANGES INCLUDE LOWER END POINT, EXCLUDE UPPER END POINT

SITE=ROBN PERIOD=YRC1987 STAB=F

LOWNDDEG=	LOWNDSPD								AVERAGE
	CALM	.75-3.5	3.5-7.5	7.5-12.5	12.5-18.5	18.5-25	>= 25	TOTAL	LOWNDSPD
N	1.4/ 0.02	31/ 0.36	3/ 0.04	/	/	/	/	35.4/ 0.41	2.02878
NNE	0.6/ 0.01	13/ 0.15	2/ 0.02	/	/	/	/	15.6/ 0.18	2.14101
NE	0.4/ 0.00	8/ 0.09	2/ 0.02	/	/	/	/	10.4/ 0.12	2.20301
ENE	0.2/ 0.00	4/ 0.05	/	/	/	/	/	4.2/ 0.05	1.66948
E	0.0/ 0.00	1/ 0.01	/	/	/	/	/	1.0/ 0.01	1.20060
ESE	0.1/ 0.00	3/ 0.04	1/ 0.01	/	/	/	/	4.1/ 0.05	2.58055
SE	0.3/ 0.00	6/ 0.07	/	/	/	/	/	6.3/ 0.07	1.60860
SSE	1.4/ 0.02	32/ 0.37	5/ 0.06	3/ 0.04	/	/	/	41.4/ 0.48	2.97027
S	3.7/ 0.04	85/ 0.99	15/ 0.18	4/ 0.05	2/ 0.02	/	/	109.7/ 1.28	2.88656
SSW	4.7/ 0.05	108/ 1.26	19/ 0.22	2/ 0.02	/	/	/	133.7/ 1.56	2.53581
SW	2.6/ 0.03	60/ 0.70	10/ 0.12	/	/	/	/	72.6/ 0.85	2.27867
WSW	2.1/ 0.02	47/ 0.55	11/ 0.13	1/ 0.01	/	/	/	61.1/ 0.71	2.61333
W	2.2/ 0.03	50/ 0.58	11/ 0.13	/	/	/	/	63.2/ 0.74	2.45427
WNW	2.2/ 0.03	51/ 0.60	10/ 0.12	1/ 0.01	/	/	/	64.2/ 0.75	2.38552
NW	3.0/ 0.04	68/ 0.79	31/ 0.36	/	/	/	/	102.0/ 1.19	2.81545
NNW	4.2/ 0.05	95/ 1.11	52/ 0.61	/	/	/	/	151.2/ 1.76	3.07781
TOTAL	29.0/ 0.34	662/ 7.72	172/ 2.01	11/ 0.13	2/ 0.02	/	/	876.0/10.22	2.65026

NUMBER OF BAD RECORDS: 1

TABLE IX-A (Continued)
ENVIRONMENTAL MONITORING SYSTE[redacted]ROLINA POWER & LIGHT COMPANY
PROGRAM IEM24#32 ([redacted]) - 22 JAN 1988 9:59 THURSDAY, FEBRUARY 1[redacted]88
JOINT OCCURRENCE FREQUENCIES FOR LOWNDDEG AND LOWNDSPD
RANGES INCLUDE LOWER END POINT, EXCLUDE UPPER END POINT

SITE=ROBN PERIOD=YRC1987 STAB=G

LOWNDDEG=	LOWNDSPD								AVERAGE
	CALM	.75-3.5	3.5-7.5	7.5-12.5	12.5-18.5	18.5-25	>= 25	TOTAL	LOWNDSPD
N	8.8/ 0.10	56/ 0.65	5/ 0.06	2/ 0.02	/	/	/	71.8/ 0.84	1.86925
NNE	2.5/ 0.03	16/ 0.19	1/ 0.01	/	/	/	/	19.5/ 0.23	1.27367
NE	0.2/ 0.00	1/ 0.01	2/ 0.02	/	/	/	/	3.2/ 0.04	3.06922
ENE	0.2/ 0.00	1/ 0.01	/	/	/	/	/	1.2/ 0.01	1.13248
E	0.3/ 0.00	2/ 0.02	/	/	/	/	/	2.3/ 0.03	0.88991
ESE	0.2/ 0.00	1/ 0.01	/	/	/	/	/	1.2/ 0.01	0.95183
SE	0.6/ 0.01	4/ 0.05	/	/	/	/	/	4.6/ 0.05	1.16904
SSE	5.3/ 0.06	34/ 0.40	/	/	/	/	/	39.3/ 0.46	1.34554
S	11.3/ 0.13	72/ 0.84	/	/	/	/	/	83.3/ 0.97	1.53881
SSW	7.2/ 0.08	46/ 0.54	3/ 0.04	/	/	/	/	56.2/ 0.66	1.56449
SW	4.5/ 0.05	29/ 0.34	1/ 0.01	/	/	/	/	34.5/ 0.40	1.46083
WSW	5.5/ 0.06	35/ 0.41	1/ 0.01	/	/	/	/	41.5/ 0.48	1.50331
W	5.5/ 0.06	35/ 0.41	/	/	/	/	/	40.5/ 0.47	1.38822
WNW	11.6/ 0.14	74/ 0.86	2/ 0.02	/	/	/	/	87.6/ 1.02	1.49156
NW	22.2/ 0.26	142/ 1.66	4/ 0.05	/	/	/	/	168.2/ 1.96	1.52192
NNW	32.2/ 0.38	206/ 2.40	60/ 0.70	/	/	/	/	298.2/ 3.48	2.33591
TOTAL	118.0/ 1.38	754/ 8.80	79/ 0.92	2/ 0.02	/	/	/	953.0/11.12	1.78385

NUMBER OF BAD RECORDS: 1

IX. METEOROLOGICAL DATA

B. Mixed Mode Batch Release Diffusion Analysis

Table IX-B presents the number and frequency of wind direction occurrences by wind speed class as recorded at the onsite meteorological system during mixed mode batch releases for the period January 1 through December 31, 1987.

The frequencies are presented as a percent of total occurrences for each stability class as well as a summary for all classes for the lower (10 meter) sensor evaluation.

TABLE IX-B

ENVIRONMENTAL MONITORING SYSTE[redacted]AROLINA POWER & LIGHT COMPANY
PROGRAM IEM24#32 ([redacted]Q) - 22 JAN 1988 10:16 THURSDAY, FEBRUARY [redacted]88
JOINT OCCURRENCE FREQUENCIES FOR LOWNDDEG AND LOWNDSPD
RANGES INCLUDE LOWER END POINT, EXCLUDE UPPER END POINT

SITE=ROBN PERIOD=YRMB1987 SUMMARY OVER ALL STAB

LOWNDDEG=	LOWNDSPD CALM	.75-3.5	3.5-7.5	7.5-12.5	12.5-18.5	18.5-25	>= 25	TOTAL	AVERAGE LOWNDSPD
N	0.8/ 0.06	19/ 1.50	58/ 4.58	27/ 2.13	2/ 0.16	/	/	106.8/ 8.44	5.89885
NNE	0.6/ 0.05	15/ 1.18	76/ 6.00	60/ 4.74	9/ 0.71	/	/	160.6/12.69	7.34087
NE	0.5/ 0.04	13/ 1.03	49/ 3.87	18/ 1.42	/	/	/	80.5/ 6.36	5.88653
ENE	0.6/ 0.05	14/ 1.11	37/ 2.92	8/ 0.63	/	/	/	59.6/ 4.71	5.10643
E	0.3/ 0.02	8/ 0.63	28/ 2.21	3/ 0.24	/	/	/	39.3/ 3.10	4.55666
ESE	0.5/ 0.04	11/ 0.87	16/ 1.26	2/ 0.16	/	/	/	29.5/ 2.33	4.24378
SE	0.2/ 0.02	4/ 0.32	14/ 1.11	1/ 0.08	/	/	/	19.2/ 1.52	5.15405
SSE	0.7/ 0.06	18/ 1.42	28/ 2.21	4/ 0.32	/	/	/	50.7/ 4.00	4.67598
S	1.2/ 0.09	28/ 2.21	54/ 4.27	21/ 1.66	3/ 0.24	/	/	107.2/ 8.47	5.50959
SSW	1.2/ 0.09	29/ 2.29	60/ 4.74	17/ 1.34	4/ 0.32	/	/	111.2/ 8.78	5.40437
SW	1.2/ 0.09	28/ 2.21	44/ 3.48	14/ 1.11	1/ 0.08	/	/	88.2/ 6.97	4.99304
WSW	1.4/ 0.11	34/ 2.69	27/ 2.13	8/ 0.63	/	/	/	70.4/ 5.56	4.20423
W	1.4/ 0.11	33/ 2.61	22/ 1.74	1/ 0.08	/	/	/	57.4/ 4.53	3.25786
WNW	1.2/ 0.09	29/ 2.29	21/ 1.66	4/ 0.32	/	/	/	55.2/ 4.36	3.74763
NW	1.7/ 0.13	41/ 3.24	35/ 2.76	13/ 1.03	3/ 0.24	/	/	93.7/ 7.40	4.70315
NNW	2.6/ 0.21	62/ 4.90	52/ 4.11	15/ 1.18	5/ 0.39	/	/	136.6/10.79	4.27970
TOTAL	16.0/ 1.26	386/30.49	621/49.05	216/17.06	27/ 2.13	/	/	1266/ 100	5.19318

NUMBER OF BAD RECORDS: 57

TABLE IX-B (Continued)

ENVIRONMENTAL MONITORING SYSTE[redacted]ROLINA POWER & LIGHT COMPANY
PROGRAM IEM24#32 ([redacted]) - 22 JAN 1988 10:16 THURSDAY, FEBRUARY 1[redacted]88
JOINT OCCURRENCE FREQUENCIES FOR LOWNDDEG AND LOWNDSPD
RANGES INCLUDE LOWER END POINT, EXCLUDE UPPER END POINT

SITE=ROBN PERIOD=YRMB1987 STAB=A

LOWNDDEG=	LOWNDSPD								
	CALM	.75-3.5	3.5-7.5	7.5-12.5	12.5-18.5	18.5-25	>= 25	TOTAL	AVERAGE LOWNDSPD
N	/	/	3/ 0.24	8/ 0.63	/	/	/	11.0/ 0.87	8.02825
NNE	/	/	3/ 0.24	4/ 0.32	/	/	/	7.0/ 0.55	8.56142
NE	/	/	4/ 0.32	4/ 0.32	/	/	/	8.0/ 0.63	7.48916
ENE	/	/	4/ 0.32	3/ 0.24	/	/	/	7.0/ 0.55	8.02067
E	/	/	5/ 0.39	2/ 0.16	/	/	/	7.0/ 0.55	6.16022
ESE	/	/	3/ 0.24	/	/	/	/	3.0/ 0.24	4.55227
SE	/	/	4/ 0.32	/	/	/	/	4.0/ 0.32	4.97749
SSE	/	1/ 0.08	5/ 0.39	3/ 0.24	/	/	/	9.0/ 0.71	6.64221
S	/	1/ 0.08	5/ 0.39	4/ 0.32	/	/	/	10.0/ 0.79	6.64999
SSW	/	/	5/ 0.39	5/ 0.39	2/ 0.16	/	/	12.0/ 0.95	8.63487
SW	/	/	3/ 0.24	4/ 0.32	/	/	/	7.0/ 0.55	7.54901
WSW	/	1/ 0.08	5/ 0.39	4/ 0.32	/	/	/	10.0/ 0.79	7.82947
W	/	/	/	1/ 0.08	/	/	/	1.0/ 0.08	10.63865
WNW	/	/	1/ 0.08	1/ 0.08	/	/	/	2.0/ 0.16	6.51992
NW	/	/	1/ 0.08	5/ 0.39	3/ 0.24	/	/	9.0/ 0.71	10.63494
NNW	/	/	/	2/ 0.16	1/ 0.08	/	/	3.0/ 0.24	10.52748
TOTAL	/	3/ 0.24	51/ 4.03	50/ 3.95	6/ 0.47	/	/	110.0/ 8.69	7.75453

NUMBER OF BAD RECORDS: 0

TABLE IX-B (Continued)

ENVIRONMENTAL MONITORING SYSTE[redacted]AROLINA POWER & LIGHT COMPANY
PROGRAM IEM24#32 ([redacted]Q) - 22 JAN 1988 10:16 THURSDAY, FEBRUARY 1[redacted]88
JOINT OCCURRENCE FREQUENCIES FOR LOWNDDEG AND LOWNDSPD
RANGES INCLUDE LOWER END POINT, EXCLUDE UPPER END POINT

SITE=ROBN PERIOD=YRMB1987 STAB=B

LOWNDDEG=	LOWNDSPD								AVERAGE
	CALM	.75-3.5	3.5-7.5	7.5-12.5	12.5-18.5	18.5-25	>= 25	TOTAL	LOWNDSPD
N	/	/	5/ 0.39	2/ 0.16	1/ 0.08	/	/	8.0/ 0.63	7.81224
NNE	/	1/ 0.08	4/ 0.32	3/ 0.24	2/ 0.16	/	/	10.0/ 0.79	7.95786
NE	/	/	4/ 0.32	1/ 0.08	/	/	/	5.0/ 0.39	7.22027
ENE	/	/	1/ 0.08	1/ 0.08	/	/	/	2.0/ 0.16	8.08737
E	/	/	4/ 0.32	1/ 0.08	/	/	/	5.0/ 0.39	5.67617
ESE	/	/	1/ 0.08	/	/	/	/	1.0/ 0.08	3.66850
SE	/	1/ 0.08	/	/	/	/	/	1.0/ 0.08	2.06770
SSE	/	/	1/ 0.08	/	/	/	/	1.0/ 0.08	5.70285
S	/	/	1/ 0.08	/	/	/	/	1.0/ 0.08	7.33700
SSW	/	1/ 0.08	2/ 0.16	2/ 0.16	2/ 0.16	/	/	7.0/ 0.55	8.80916
SW	/	/	5/ 0.39	1/ 0.08	/	/	/	6.0/ 0.47	5.36101
WSW	/	/	4/ 0.32	2/ 0.16	/	/	/	6.0/ 0.47	7.10633
W	/	/	3/ 0.24	/	/	/	/	3.0/ 0.24	4.65788
WNW	/	/	/	/	/	/	/	/	
NW	/	/	4/ 0.32	3/ 0.24	/	/	/	7.0/ 0.55	6.57710
NNW	/	/	2/ 0.16	1/ 0.08	1/ 0.08	/	/	4.0/ 0.32	7.59546
TOTAL	/	3/ 0.24	41/ 3.24	17/ 1.34	6/ 0.47	/	/	67.0/ 5.29	6.99064

NUMBER OF BAD RECORDS: 0

TABLE IX-B (Continued)

ENVIRONMENTAL MONITORING SYSTE[redacted]AROLINA POWER & LIGHT COMPANY
PROGRAM IEM24#32 ([redacted]Q) - 22 JAN 1988 10:16 THURSDAY, FEBRUARY [redacted]988
JOINT OCCURRENCE FREQUENCIES FOR LOWNDDEG AND LOWNDSPD
RANGES INCLUDE LOWER END POINT, EXCLUDE UPPER END POINT

SITE=ROBN PERIOD=YRMB1987 STAB=C

LOWNDDEG=	LOWNDSPD								
	CALM	.75-3.5	3.5-7.5	7.5-12.5	12.5-18.5	18.5-25	>= 25	TOTAL	AVERAGE LOWNDSPD
N	/	/	10/ 0.79	2/ 0.16	1/ 0.08	/	/	13.0/ 1.03	6.48529
NNE	/	2/ 0.16	9/ 0.71	24/ 1.90	5/ 0.39	/	/	40.0/ 3.16	9.27505
NE	/	1/ 0.08	10/ 0.79	6/ 0.47	/	/	/	17.0/ 1.34	6.37573
ENE	/	1/ 0.08	4/ 0.32	1/ 0.08	/	/	/	6.0/ 0.47	5.68340
E	/	1/ 0.08	5/ 0.39	/	/	/	/	6.0/ 0.47	4.67456
ESE	/	/	/	/	/	/	/	/	
SE	/	/	1/ 0.08	/	/	/	/	1.0/ 0.08	5.16925
SSE	/	/	3/ 0.24	/	/	/	/	3.0/ 0.24	5.73620
S	/	/	3/ 0.24	/	/	/	/	3.0/ 0.24	6.98682
SSW	/	1/ 0.08	2/ 0.16	3/ 0.24	/	/	/	6.0/ 0.47	6.29481
SW	/	/	6/ 0.47	5/ 0.39	1/ 0.08	/	/	12.0/ 0.95	8.32221
WSW	/	/	3/ 0.24	1/ 0.08	/	/	/	4.0/ 0.32	6.34484
W	/	1/ 0.08	4/ 0.32	/	/	/	/	5.0/ 0.39	4.68234
WNW	/	/	/	/	/	/	/	/	
NW	/	/	3/ 0.24	/	/	/	/	3.0/ 0.24	6.44767
NNW	/	/	4/ 0.32	/	1/ 0.08	/	/	5.0/ 0.39	7.48707
TOTAL	/	7/ 0.55	67/ 5.29	42/ 3.32	8/ 0.63	/	/	124.0/ 9.79	7.35798

NUMBER OF BAD RECORDS: 0

TABLE IX-B (Continued)

ENVIRONMENTAL MONITORING SYST[redacted]AROLINA POWER & LIGHT COMPANY
PROGRAM IEM24#32 ([redacted]Q) - 22 JAN 1988 10:16 THURSDAY, FEBRUARY [redacted]988
JOINT OCCURRENCE FREQUENCIES FOR LOWNDDEG AND LOWNDSPD
RANGES INCLUDE LOWER END POINT, EXCLUDE UPPER END POINT

SITE=ROBN PERIOD=YRMB1987 STAB=D

LOWNDDEG=	LOWNDSPD CALM	.75-3.5	3.5-7.5	7.5-12.5	12.5-18.5	18.5-25	>= 25	TOTAL	AVERAGE LOWNDSPD
N	0.1/ 0.01	4/ 0.32	26/ 2.05	13/ 1.03	/	/	/	43.1/ 3.40	6.43699
NNE	0.0/ 0.00	2/ 0.16	53/ 4.19	26/ 2.05	2/ 0.16	/	/	83.0/ 6.56	7.16000
NE	0.1/ 0.01	4/ 0.32	24/ 1.90	7/ 0.55	/	/	/	35.1/ 2.77	6.03518
ENE	0.1/ 0.01	5/ 0.39	24/ 1.90	3/ 0.24	/	/	/	32.1/ 2.54	5.03250
E	0.1/ 0.01	3/ 0.24	12/ 0.95	/	/	/	/	15.1/ 1.19	4.11629
ESE	0.1/ 0.01	4/ 0.32	10/ 0.79	2/ 0.16	/	/	/	16.1/ 1.27	5.27670
SE	/	/	8/ 0.63	1/ 0.08	/	/	/	9.0/ 0.71	6.36244
SSE	0.1/ 0.01	4/ 0.32	8/ 0.63	/	/	/	/	12.1/ 0.96	4.57046
S	0.0/ 0.00	1/ 0.08	21/ 1.66	10/ 0.79	/	/	/	32.0/ 2.53	6.57516
SSW	0.1/ 0.01	5/ 0.39	24/ 1.90	2/ 0.16	/	/	/	31.1/ 2.46	5.52513
SW	0.0/ 0.00	2/ 0.16	17/ 1.34	3/ 0.24	/	/	/	22.0/ 1.74	5.54747
WSW	0.1/ 0.01	6/ 0.47	8/ 0.63	1/ 0.08	/	/	/	15.1/ 1.19	3.84270
W	0.1/ 0.01	4/ 0.32	7/ 0.55	/	/	/	/	11.1/ 0.88	3.42588
WNW	0.1/ 0.01	3/ 0.24	7/ 0.55	2/ 0.16	/	/	/	12.1/ 0.96	5.49138
NW	0.1/ 0.01	5/ 0.39	8/ 0.63	3/ 0.24	/	/	/	16.1/ 1.27	5.47556
NNW	0.1/ 0.01	4/ 0.32	10/ 0.79	11/ 0.87	2/ 0.16	/	/	27.1/ 2.14	6.99919
TOTAL	1.0/ 0.08	56/ 4.42	267/21.09	84/ 6.64	4/ 0.32	/	/	412.0/32.54	5.94510

NUMBER OF BAD RECORDS: 2

TABLE IX-B (Continued)

ENVIRONMENTAL MONITORING SYSTE[redacted]AROLINA POWER & LIGHT COMPANY
PROGRAM IEM24#32 ([redacted]Q) - 22 JAN 1988 10:16 THURSDAY, FEBRUARY [redacted]88
JOINT OCCURRENCE FREQUENCIES FOR LOWNDDEG AND LOWNDSPD
RANGES INCLUDE LOWER END POINT, EXCLUDE UPPER END POINT

SITE=ROBN PERIOD=YRMB1987 STAB=E

LOWNDDEG=	LOWNDSPD							AVERAGE
	CALM	.75-3.5	3.5-7.5	7.5-12.5	12.5-18.5	18.5-25	>= 25	TOTAL	LOWNDSPD
N	/	4/ 0.32	12/ 0.95	2/ 0.16	/	/	/	18.0/ 1.42	5.13775
NNE	/	6/ 0.47	5/ 0.39	3/ 0.24	/	/	/	14.0/ 1.11	4.29143
NE	/	5/ 0.39	6/ 0.47	/	/	/	/	11.0/ 0.87	4.41433
ENE	/	6/ 0.47	4/ 0.32	/	/	/	/	10.0/ 0.79	3.15491
E	/	4/ 0.32	2/ 0.16	/	/	/	/	6.0/ 0.47	2.85142
ESE	/	6/ 0.47	2/ 0.16	/	/	/	/	8.0/ 0.63	2.57629
SE	/	3/ 0.24	1/ 0.08	/	/	/	/	4.0/ 0.32	3.58096
SSE	/	12/ 0.95	11/ 0.87	1/ 0.08	/	/	/	24.0/ 1.90	4.04091
S	/	10/ 0.79	23/ 1.82	5/ 0.39	1/ 0.08	/	/	39.0/ 3.08	5.18678
SSW	/	10/ 0.79	25/ 1.97	3/ 0.24	/	/	/	38.0/ 3.00	4.52989
SW	/	16/ 1.26	12/ 0.95	1/ 0.08	/	/	/	29.0/ 2.29	3.69725
WSW	/	14/ 1.11	4/ 0.32	/	/	/	/	18.0/ 1.42	2.79584
W	/	8/ 0.63	4/ 0.32	/	/	/	/	12.0/ 0.95	3.50870
WNW	/	5/ 0.39	11/ 0.87	1/ 0.08	/	/	/	17.0/ 1.34	4.55718
NW	/	4/ 0.32	10/ 0.79	2/ 0.16	/	/	/	16.0/ 1.26	5.21615
NNW	/	10/ 0.79	12/ 0.95	1/ 0.08	/	/	/	23.0/ 1.82	3.95197
TOTAL	/	123/ 9.72	144/11.37	19/ 1.50	1/ 0.08	/	/	287.0/22.67	4.20762

NUMBER OF BAD RECORDS: 0

TABLE IX-B (Continued)

ENVIRONMENTAL MONITORING SYSTE[redacted]ROLINA POWER & LIGHT COMPANY
PROGRAM IEM24#32 ([redacted]Q) - 22 JAN 1988 10:16 THURSDAY, FEBRUARY 1[redacted]88
JOINT OCCURRENCE FREQUENCIES FOR LOWNDDEG AND LOWNDSPD
RANGES INCLUDE LOWER END POINT, EXCLUDE UPPER END POINT

SITE=ROBN PERIOD=YRMB1987 STAB=F

LOWNDDEG=	LOWNDSPD								
	CALM	.75-3.5	3.5-7.5	7.5-12.5	12.5-18.5	18.5-25	>= 25	TOTAL	AVERAGE LOWNDSPD
N	0.0/ 0.00	1/ 0.08	1/ 0.08	/	/	/	/	2.0/ 0.16	3.01817
NNE	/	/	2/ 0.16	/	/	/	/	2.0/ 0.16	4.11872
NE	0.0/ 0.00	2/ 0.16	1/ 0.08	/	/	/	/	3.0/ 0.24	2.60130
ENE	0.0/ 0.00	2/ 0.16	/	/	/	/	/	2.0/ 0.16	2.13440
E	/	/	/	/	/	/	/	/	
ESE	0.0/ 0.00	1/ 0.08	/	/	/	/	/	1.0/ 0.08	1.85092
SE	/	/	/	/	/	/	/	0.0/ 0.00	
SSE	0.0/ 0.00	1/ 0.08	/	/	/	/	/	1.0/ 0.08	1.38402
S	0.2/ 0.02	7/ 0.55	1/ 0.08	2/ 0.16	2/ 0.16	/	/	12.2/ 0.96	5.53144
SSW	0.2/ 0.02	10/ 0.79	2/ 0.16	2/ 0.16	/	/	/	14.2/ 1.12	3.40956
SW	0.2/ 0.02	7/ 0.55	1/ 0.08	/	/	/	/	8.2/ 0.65	2.38533
WSW	0.1/ 0.01	6/ 0.47	2/ 0.16	/	/	/	/	8.1/ 0.64	2.67726
W	0.3/ 0.02	12/ 0.95	4/ 0.32	/	/	/	/	16.3/ 1.29	2.61633
WNW	0.2/ 0.02	11/ 0.87	2/ 0.16	/	/	/	/	13.2/ 1.04	2.30039
NW	0.3/ 0.02	14/ 1.11	9/ 0.71	/	/	/	/	23.3/ 1.84	3.15644
NNW	0.4/ 0.03	18/ 1.42	17/ 1.34	/	/	/	/	35.4/ 2.80	3.37974
TOTAL	2.0/ 0.16	92/ 7.27	42/ 3.32	4/ 0.32	2/ 0.16	/	/	142.0/11.22	3.18962

NUMBER OF BAD RECORDS: 0

TABLE IX-B (Continued)

ENVIRONMENTAL MONITORING SYSTE[redacted]ROLINA POWER & LIGHT COMPANY
PROGRAM IEM24#32 ([redacted]Q) - 22 JAN 1988 10:16 THURSDAY, FEBRUARY 1[redacted]8
JOINT OCCURRENCE FREQUENCIES FOR LOWNDDEG AND LOWNDSPD
RANGES INCLUDE LOWER END POINT, EXCLUDE UPPER END POINT

SITE=ROBN PERIOD=YRMB1987 STAB=G

LOWNDDEG= \ LOWNDSPD	CALM	.75-3.5	3.5-7.5	7.5-12.5	12.5-18.5	18.5-25	>= 25	TOTAL	AVERAGE LOWNDSPD
N	1.3/ 0.10	10/ 0.79	1/ 0.08	/	/	/	/	12.3/ 0.97	1.52986
NNE	0.5/ 0.04	4/ 0.32	/	/	/	/	/	4.5/ 0.36	1.13851
NE	0.1/ 0.01	1/ 0.08	/	/	/	/	/	1.1/ 0.09	0.77689
ENE	/	/	/	/	/	/	/	/	
E	/	/	/	/	/	/	/	/	
ESE	/	/	/	/	/	/	/	/	
SE	/	/	/	/	/	/	/	/	
SSE	/	/	/	/	/	/	/	/	
S	1.1/ 0.09	9/ 0.71	/	/	/	/	/	10.1/ 0.80	1.44253
SSW	0.3/ 0.02	2/ 0.16	/	/	/	/	/	2.3/ 0.18	1.81791
SW	0.4/ 0.03	3/ 0.24	/	/	/	/	/	3.4/ 0.27	1.52525
WSW	0.9/ 0.07	7/ 0.55	1/ 0.08	/	/	/	/	8.9/ 0.70	2.12556
W	1.0/ 0.08	8/ 0.63	/	/	/	/	/	9.0/ 0.71	1.69990
WNW	1.3/ 0.10	10/ 0.79	/	/	/	/	/	11.3/ 0.89	1.67670
NW	2.3/ 0.18	18/ 1.42	/	/	/	/	/	20.3/ 1.60	1.62949
NNW	3.8/ 0.30	30/ 2.37	7/ 0.55	/	/	/	/	40.8/ 3.22	2.06840
TOTAL	13.0/ 1.03	102/ 8.06	9/ 0.71	/	/	/	/	124.0/ 9.79	1.76907

NUMBER OF BAD RECORDS: 0

IX. METEOROLOGICAL DATA

C. Ground Level Batch Release Diffusion Analysis

Table IX-C presents the number and frequency of wind direction occurrences by wind speed class as recorded at the onsite meteorological system during ground level batch releases for the period January 1 through December 31, 1987.

The frequencies are presented as a percent of total occurrences for each stability class as well as a summary for all classes for the lower (10 meter) sensor elevation.

TABLE IX-C

ENVIRONMENTAL MONITORING SYSTE[redacted]ROLINA POWER & LIGHT COMPANY
PROGRAM IEM24#32 ([redacted]Q) - 22 JAN 1988 10:09 THURSDAY, FEBRUARY 1[redacted]88
JOINT OCCURRENCE FREQUENCIES FOR LOWNDDEG AND LOWNDSPD
RANGES INCLUDE LOWER END POINT, EXCLUDE UPPER END POINT

SITE=ROBN PERIOD=YRGB1987 SUMMARY OVER ALL STAB

LOWNDDEG= \ LOWNDSPD	CALM	.75-3.5	3.5-7.5	7.5-12.5	12.5-18.5	18.5-25	>= 25	TOTAL	AVERAGE LOWNDSPD
N	/	1/ 4.76	/	/	/	/	/	1.0/ 4.76	2.73470
NNE	/	/	/	/	/	/	/	/	
NE	/	/	/	/	/	/	/	/	
ENE	/	/	/	/	/	/	/	/	
E	/	/	/	/	/	/	/	/	
ESE	/	/	/	/	/	/	/	/	
SE	/	/	1/ 4.76	/	/	/	/	1.0/ 4.76	4.33550
SSE	/	1/ 4.76	/	/	/	/	/	1.0/ 4.76	0.98382
S	/	/	/	/	/	/	/	/	
SSW	/	1/ 4.76	/	/	/	/	/	1.0/ 4.76	2.40120
SW	/	/	/	/	/	/	/	/	
WSW	/	1/ 4.76	/	/	/	/	/	1.0/ 4.76	2.30115
W	/	1/ 4.76	/	/	/	/	/	1.0/ 4.76	2.33450
WNW	/	3/14.29	/	1/ 4.76	/	/	/	4.0/19.05	3.36418
NW	/	2/ 9.52	4/19.05	2/ 9.52	/	/	/	8.0/38.10	5.66950
NNW	/	1/ 4.76	2/ 9.52	/	/	/	/	3.0/14.29	4.06870
TOTAL	/	11/52.38	7/33.33	3/14.29	/	/	/	21.0/ 100	4.10046

NUMBER OF BAD RECORDS: 0

TABLE IX-C (Continued)

ENVIRONMENTAL MONITORING SYSTE[redacted]ROLINA POWER & LIGHT COMPANY
PROGRAM IEM24#32 ([redacted]) - 22 JAN 1988 10:09 THURSDAY, FEBRUARY 1[redacted]88
JOINT OCCURRENCE FREQUENCIES FOR LOWNDDEG AND LOWNDSPD
RANGES INCLUDE LOWER END POINT, EXCLUDE UPPER END POINT

SITE=ROBN PERIOD=YRGB1987 STAB=A

LOWNDDEG=	LOWNDSPD								
	CALM	.75-3.5	3.5-7.5	7.5-12.5	12.5-18.5	18.5-25	>= 25	TOTAL	AVERAGE LOWNDSPD
N	/	/	/	/	/	/	/	/	
NNE	/	/	/	/	/	/	/	/	
NE	/	/	/	/	/	/	/	/	
ENE	/	/	/	/	/	/	/	/	
E	/	/	/	/	/	/	/	/	
ESE	/	/	/	/	/	/	/	/	
SE	/	/	1/ 4.76	/	/	/	/	1.0/ 4.76	4.33550
SSE	/	/	/	/	/	/	/	/	
S	/	/	/	/	/	/	/	/	
SSW	/	/	/	/	/	/	/	/	
SW	/	/	/	/	/	/	/	/	
WSW	/	/	/	/	/	/	/	/	
W	/	/	/	/	/	/	/	/	
WNW	/	/	/	1/ 4.76	/	/	/	1.0/ 4.76	7.87060
NW	/	/	/	1/ 4.76	/	/	/	1.0/ 4.76	7.92062
NNW	/	/	/	/	/	/	/	/	
TOTAL	/	/	1/ 4.76	2/ 9.52	/	/	/	3.0/14.29	6.70891

NUMBER OF BAD RECORDS: 0

TABLE IX-C (Continued)

ENVIRONMENTAL MONITORING SYSTE[redacted]AROLINA POWER & LIGHT COMPANY
PROGRAM IEM24#32 ([redacted]Q) - 22 JAN 1988 10:09 THURSDAY, FEBRUARY [redacted]88
JOINT OCCURRENCE FREQUENCIES FOR LOWNDDEG AND LOWNDSPD
RANGES INCLUDE LOWER END POINT, EXCLUDE UPPER END POINT

SITE=ROBN PERIOD=YRGB1987 STAB=B

LOWNDDEG=	LOWNDSPD								
	CALM	.75-3.5	3.5-7.5	7.5-12.5	12.5-18.5	18.5-25	>= 25	TOTAL	AVERAGE LOWNDSPD
N	/	/	/	/	/	/	/	/	
NNE	/	/	/	/	/	/	/	/	
NE	/	/	/	/	/	/	/	/	
ENE	/	/	/	/	/	/	/	/	
E	/	/	/	/	/	/	/	/	
ESE	/	/	/	/	/	/	/	/	
SE	/	/	/	/	/	/	/	/	
SSE	/	/	/	/	/	/	/	/	
S	/	/	/	/	/	/	/	/	
SSW	/	/	/	/	/	/	/	/	
SW	/	/	/	/	/	/	/	/	
WSW	/	/	/	/	/	/	/	/	
W	/	/	/	/	/	/	/	/	
WNW	/	/	/	/	/	/	/	/	
NW	/	/	2/ 9.52	1/ 4.76	/	/	/	3.0/14.29	7.20916
NNW	/	/	/	/	/	/	/	/	
TOTAL	/	/	2/ 9.52	1/ 4.76	/	/	/	3.0/14.29	7.20916

NUMBER OF BAD RECORDS: 0

TABLE IX-C (Continued)

ENVIRONMENTAL MONITORING SYSTE[redacted]ROLINA POWER & LIGHT COMPANY
PROGRAM IEM24#32 ([redacted]) - 22 JAN 1988 10:09 THURSDAY, FEBRUARY 1[redacted]88
JOINT OCCURRENCE FREQUENCIES FOR LOWNDDEG AND LOWNDSPD
RANGES INCLUDE LOWER END POINT, EXCLUDE UPPER END POINT

SITE=ROBN PERIOD=YRGB1987 STAB=C

LOWNDDEG=	LOWNDSPD								
	CALM	.75-3.5	3.5-7.5	7.5-12.5	12.5-18.5	18.5-25	>= 25	TOTAL	AVERAGE LOWNDSPD
N	/	/	/	/	/	/	/	/	
NNE	/	/	/	/	/	/	/	/	
NE	/	/	/	/	/	/	/	/	
ENE	/	/	/	/	/	/	/	/	
E	/	/	/	/	/	/	/	/	
ESE	/	/	/	/	/	/	/	/	
SE	/	/	/	/	/	/	/	/	
SSE	/	/	/	/	/	/	/	/	
S	/	/	/	/	/	/	/	/	
SSW	/	/	/	/	/	/	/	/	
SW	/	/	/	/	/	/	/	/	
WSW	/	/	/	/	/	/	/	/	
W	/	/	/	/	/	/	/	/	
WNW	/	/	/	/	/	/	/	/	
NW	/	/	1/ 4.76	/	/	/	/	1.0/ 4.76	6.06970
NNW	/	/	2/ 9.52	/	/	/	/	2.0/ 9.52	5.50275
TOTAL	/	/	3/14.29	/	/	/	/	3.0/14.29	5.69173

NUMBER OF BAD RECORDS: 0

TABLE IX-C (Continued)

ENVIRONMENTAL MONITORING SYSTEM [redacted]ROLINA POWER & LIGHT COMPANY
PROGRAM IEM24#32 (E[redacted]) - 22 JAN 1988 10:09 THURSDAY, FEBRUARY 1[redacted]8
JOINT OCCURRENCE FREQUENCIES FOR LOWNDDEG AND LOWNDSPD
RANGES INCLUDE LOWER END POINT, EXCLUDE UPPER END POINT

SITE=ROBN PERIOD=YRGB1987 STAB=D

LOWNDDEG=	LOWNDSPD								
	CALM	.75-3.5	3.5-7.5	7.5-12.5	12.5-18.5	18.5-25	>= 25	TOTAL	AVERAGE LOWNDSPD
N	/	/	/	/	/	/	/	/	
NNE	/	/	/	/	/	/	/	/	
NE	/	/	/	/	/	/	/	/	
ENE	/	/	/	/	/	/	/	/	
E	/	/	/	/	/	/	/	/	
ESE	/	/	/	/	/	/	/	/	
SE	/	/	/	/	/	/	/	/	
SSE	/	/	/	/	/	/	/	/	
S	/	/	/	/	/	/	/	/	
SSW	/	/	/	/	/	/	/	/	
SW	/	/	/	/	/	/	/	/	
WSW	/	/	/	/	/	/	/	/	
W	/	/	/	/	/	/	/	/	
WNW	/	/	/	/	/	/	/	/	
NW	/	1/ 4.76	1/ 4.76	/	/	/	/	2.0/ 9.52	4.34384
NNW	/	/	/	/	/	/	/	/	
TOTAL	/	1/ 4.76	1/ 4.76	/	/	/	/	2.0/ 9.52	4.34384

NUMBER OF BAD RECORDS: 0

TABLE IX-C (Continued)

ENVIRONMENTAL MONITORING SYSTE[redacted]ROLINA POWER & LIGHT COMPANY
PROGRAM IEM24#32 ([redacted]Q) - 22 JAN 1988 10:09 THURSDAY, FEBRUARY 1[redacted]88
JOINT OCCURRENCE FREQUENCIES FOR LOWNDDEG AND LOWNDSPD
RANGES INCLUDE LOWER END POINT, EXCLUDE UPPER END POINT

SITE=ROBN PERIOD=YRGB1987 STAB=E

LOWNDDEG=	LOWNDSPD								
	CALM	.75-3.5	3.5-7.5	7.5-12.5	12.5-18.5	18.5-25	>= 25	TOTAL	AVERAGE LOWNDSPD
N	/	1/ 4.76	/	/	/	/	/	1.0/ 4.76	2.73470
NNE	/	/	/	/	/	/	/	/	
NE	/	/	/	/	/	/	/	/	
ENE	/	/	/	/	/	/	/	/	
E	/	/	/	/	/	/	/	/	
ESE	/	/	/	/	/	/	/	/	
SE	/	/	/	/	/	/	/	/	
SSE	/	/	/	/	/	/	/	/	
S	/	/	/	/	/	/	/	/	
SSW	/	/	/	/	/	/	/	/	
SW	/	/	/	/	/	/	/	/	
WSW	/	/	/	/	/	/	/	/	
W	/	/	/	/	/	/	/	/	
WNW	/	1/ 4.76	/	/	/	/	/	1.0/ 4.76	0.91712
NW	/	/	/	/	/	/	/	/	
NNW	/	/	/	/	/	/	/	/	
TOTAL	/	2/ 9.52	/	/	/	/	/	2.0/ 9.52	1.82591

NUMBER OF BAD RECORDS: 0

TABLE IX-C (Continued)

ENVIRONMENTAL MONITORING SYSTE[redacted]AROLINA POWER & LIGHT COMPANY
PROGRAM IEM24#32 ([redacted]Q) - 22 JAN 1988 10:09 THURSDAY, FEBRUARY [redacted]88
JOINT OCCURRENCE FREQUENCIES FOR LOWNDDEG AND LOWNDSPD
RANGES INCLUDE LOWER END POINT, EXCLUDE UPPER END POINT

SITE=ROBN PERIOD=YRGB1987 STAB=F

LOWNDDEG=	LOWNDSPD								AVERAGE
	CALM	.75-3.5	3.5-7.5	7.5-12.5	12.5-18.5	18.5-25	>= 25	TOTAL	LOWNDSPD
N	/	/	/	/	/	/	/	/	
NNE	/	/	/	/	/	/	/	/	
NE	/	/	/	/	/	/	/	/	
ENE	/	/	/	/	/	/	/	/	
E	/	/	/	/	/	/	/	/	
ESE	/	/	/	/	/	/	/	/	
SE	/	/	/	/	/	/	/	/	
SSE	/	/	/	/	/	/	/	/	
S	/	/	/	/	/	/	/	/	
SSW	/	1/ 4.76	/	/	/	/	/	1.0/ 4.76	2.40120
SW	/	/	/	/	/	/	/	/	
WSW	/	1/ 4.76	/	/	/	/	/	1.0/ 4.76	2.30115
W	/	1/ 4.76	/	/	/	/	/	1.0/ 4.76	2.33450
WNW	/	2/ 9.52	/	/	/	/	/	2.0/ 9.52	2.33450
NW	/	/	/	/	/	/	/	/	
NNW	/	/	/	/	/	/	/	/	
TOTAL	/	5/23.81	/	/	/	/	/	5.0/23.81	2.34117

NUMBER OF BAD RECORDS: 0

TABLE IX-C (Continued)

ENVIRONMENTAL MONITORING SYSTE[redacted]ROLINA POWER & LIGHT COMPANY
PROGRAM IEM24#32 ([redacted]Q) - 22 JAN 1988 10:09 THURSDAY, FEBRUARY 1[redacted]88
JOINT OCCURRENCE FREQUENCIES FOR LOWNDDEG AND LOWNDSPD
RANGES INCLUDE LOWER END POINT, EXCLUDE UPPER END POINT

SITE=ROBN PERIOD=YRGB1987 STAB=G

LOWNDDEG=	LOWNDSPD								AVERAGE
	CALM	.75-3.5	3.5-7.5	7.5-12.5	12.5-18.5	18.5-25	>= 25	TOTAL	LOWNDSPD
N	/	/	/	/	/	/	/	/	
NNE	/	/	/	/	/	/	/	/	
NE	/	/	/	/	/	/	/	/	
ENE	/	/	/	/	/	/	/	/	
E	/	/	/	/	/	/	/	/	
ESE	/	/	/	/	/	/	/	/	
SE	/	/	/	/	/	/	/	/	
SSE	/	1/ 4.76	/	/	/	/	/	1.0/ 4.76	0.98382
S	/	/	/	/	/	/	/	/	
SSW	/	/	/	/	/	/	/	/	
SW	/	/	/	/	/	/	/	/	
WSW	/	/	/	/	/	/	/	/	
W	/	/	/	/	/	/	/	/	
WNW	/	/	/	/	/	/	/	/	
NW	/	1/ 4.76	/	/	/	/	/	1.0/ 4.76	1.05052
NNW	/	1/ 4.76	/	/	/	/	/	1.0/ 4.76	1.20060
TOTAL	/	3/14.29	/	/	/	/	/	3.0/14.29	1.07832

NUMBER OF BAD RECORDS: 0

CHANGES TO ODCM, PCP, AND RADIOACTIVE WASTE SYSTEMS

TABLE OF CONTENTS
Enclosure 2

I. CHANGES TO THE ODCM

JUSTIFICATION FOR CHANGE IN ODCM REVISION 4

A. To minimize frequent future revisions to the ODCM, site specific parameters (example; vent fractions, discharge flow rates, and dilution flow rates) are considered as typical system values for the purpose of illustrations in this document. These parameters are variable with Plant conditions and are controlled by approved procedures. The approval by the PNSC is not needed for variable Plant parameters.

B. Annually the assessment of radiation doses from liquid and gaseous effluents will be calculated using the NRC software (LADTAP & GASPAR). The methodology used are contained in the computer codes and documented in their respective NUREGS/Users Manual.

C. Safety factor of 0.5 has been added to the liquid setpoint calculation based on Iodine-131. This safety factor is used as a conservatism to assure that the radionuclide concentrations are less than the limits specified in 10CFR20, Appendix B, at the point of discharge.

D. The methodology for compositing Steam Generator blowdown has been revised to accommodate compositing requirements when blowdown recovery is in operation.

E. Editorial changes have been made for the purpose of distinguishing batch and continuous release points.

F. The maximum flow rate for Steam Generators has been changed from 750 gpm to 480 gpm to be consistent Paragraph 2.1.1.1 which was changed in Rev. 3.

G. The A_{i_τ} values for Co-57, Sb-124, and Sb-125 have been included in Table 2.3-1. These radionuclides became more significant when liquid waste processing was changed from evaporators to ion exchange.

H. Additional potential release points have been included in the event that a release is made.

I. Technical Specification paragraph numbers have been deleted. Each time paragraph numbers change in Technical Specifications an ODCM change by PNSC is required. Reference to Technical Specifications is adequate in the ODCM.

J. The methodology for calculating a weighted average source term has been corrected for setpoint determination on the air particulate monitor for the Containment Building when sampling is from the Plant vent. Decontamination factors have been added for iodine and air particulate removal.

K. The TLD sample point descriptions have been changed to be brief but specific in terms of distance and sector. Approved Plant procedures are more descriptive and detailed for each location.

L. Food sample station (#58) within three miles of site based on highest deposition rate has been removed to be consistent with Technical Specifications.

M. The methodology for calculating Lower Limits of Detection has been expanded to include environmental samples, effluent samples, and gaseous effluent monitor equations.

Page No.	Comments for Changes in ODCM Revision 4
Title Page	Changed Revision 3 to Revision 4 and changed date.
1-1	See justifications A and B.
1-2	See justification B.
2-2	See justification C.
2-3	See justification C.
2-4	Changed Typo C_A to C_s.
2-11	See justification D.
2-14	See justifications E and F.
2-15	Repagination of last paragraph from Page 2-14 to Page 2-15.
2-17	Editorial change of units for consistency.
2-22	See justification G.
2-23	See justification G.
3-6	See justification H and minor editorial change for clarification.
3-7	Minor editorial change.
3-8	Added the flow rate for containment vessel pressure relief.
3-13	Minor editorial change.
3-15	See justification H and minor editorial change for consistency.
3-18	Minor editorial change for consistency.
3-26	See justification I.
3-27	Minor editorial change for consistency and clarification.
3-32	See justification I.
3-63	See justification J.
3-64	See justification J.
3-65	See justification J.
3-66	See justification J.
Page 4-3 thru 4-6	See justification K.
4-7	See justification L.
6-1	See justification I.
Page C-1 thru C-4	See justification M.

H.B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2
OFF-SITE DOSE CALCULATIONAL MANUAL
(ODCM)

Revision 4

DOCKET NO. 50-261

PNSC Review R E Morgan DATE 9/16/87
PNSC Chairman

CAROLINA POWER & LIGHT COMPANY
September 16, 1987

CONTROLLED COPY # N/A

MPO:HBRODCO

1.0 INTRODUCTION

The Off-Site Dose Calculation Manual (ODCM) provides the information and methodologies to be used by H. B. Robinson Steam Electric Plant Unit 2 (HBR) to assure compliance with Specifications 3.9.1, 3.9.2, 3.9.3, 3.9.4, 3.9.5, and 3.9.6 of the H. B. Robinson Technical Specification. These portions are those related to liquid and gaseous radiological effluents. They are intended to show compliance with 10CFR20, Appendix I of 10CFR50, and 40CFR190.

The ODCM is based on "Radiological Effluent Technical Specifications for PWRs (NUREG 0472, Rev. 3, Draft 7), "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants" (NUREG 0133), and guidance from the United States Nuclear Regulatory Commission (NRC). Specific plant procedures for implementation of this manual are presented in H. B. Robinson Unit 2 Plant Operating Manual. These procedures will be utilized by the operating staff of HBR to assure compliance with technical specifications.

Changes to the ODCM which affect the methodologies showing compliance with 10CFR20, Appendix I of 10CFR50, and 40CFR190 will be properly reviewed and approved as indicated in the Administrative Control Section of Plant Technical Specifications. Site specific parameters such as vent fractions, dilution water flow rates (gpm), and liquid/gaseous discharge flow rates are listed in this document as typical system values. Actual values derived from actual operating Plant conditions should be used in lieu of these typical values. Specific Plant procedures controls the values of the above parameters; therefore, minimizing the need for frequent revisions to the O.D.C.M.

The Semiannual Radioactive Effluent Release Report prepared after July 1 and January 1, of each year will be complied on the Nuclear Data data acquisition and processing system using the Radioactive Release Report Generating System (RRRGS) software. This report will be prepared as outlined in Regulatory Guide 1.21, "Measuring, Evaluating, and Reporting Radioactivity in Solid Waste and Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants" (Revision 1, June 1974) with data summarized on a quarterly basis following the format of Appendix B thereof.

The Semiannual Radioactive Effluent Release Report prepared after January 1 of each year will include an assessment of the radiation doses from radioactive liquid and gaseous effluents using LADTAP and GASPAR software using concurrent meteorology obtained during the report period. This report will be inclusive of the requirements as outlined in the HBR Technical Specifications.

c = The setpoint, in μCi/ml, of the radioactivity monitor measuring the radioactivity concentration in the effluent line prior to dilution and subsequent release; the setpoint represents a value which, if exceeded, would result in concentrations exceeding the limits of 10CFR20 in the unrestricted area.

f = The waste effluent flow rate in gpm.

F = The dilution water flow rate in gpm.

2.1.1.1 Determine c (the effluent monitor setpoint) in [μCi/ml] for each of the dilution water flow rates.

where: $c = \frac{C(F+f)}{f}$ (S)

C = 3×10^{-7} μCi/ml, the effluent concentration limit based on 10CFR20, Appendix B, for I-131.

F = Dilution water flow rate (gpm).

= 160,000 gpm from one circulating water pump[1], Unit 2.
= 250,000 gpm from two circulating water pumps[1], Unit 2.
= 400,000 gpm from three circulating water pumps[1], Unit 2.

or

= 50,000 gpm from one circulating water pump[2], Unit 1.
= 80,000 gpm from two circulating water pumps[2], Unit 1.

f = The maximum acceptable discharge flow rate prior to dilution (gpm).

= 60 gpm for the Waste Disposal System Liquid Effluent Monitor[3].

= 480 gpm for the Steam Generator Blowdown Monitor.

= 450 gpm for the Steam Generator Blowdown Monitor while draining a steam generator.

= 390 gpm for the Condensate Polisher Liquid Waste Monitor.

S = 0.5, safety factor used as a conservatism to assure that the radionuclide concentrations are less than the limits specified in 10CFR20, Appendix B, at the point of discharge.

2.1.1.2 Determine CR (calculated monitor count rate in corrected counts per minute [ccpm]) attributed to the radionuclides for each of the dilution water flow rates.

$CR = (c)(E)$

E = The applicable effluent monitor efficiency located in the Plant Operating Manual, Volume 15, Curve Book. Use the radioactivity concentration "c" to find CR.

2.1.1.3 Determine SP (the monitor alarm/trip setpoint including background [cpm] for each of the dilution water flow rates.

$$SP = (T_m)(CR) + Bkg + 3.3\sqrt{\frac{Bkg}{2\tau}}$$

where: T_m = Fraction of the radioactivity from the site that may be released via the monitored pathway to ensure that the site boundary limit is not exceeded due to simultaneous releases from several pathways.

= .50 for the Steam Generator Blowdown Monitor (RMS-19).

= .25 for the Condensate Polisher Liquid Waste (RMC-37).

Bkg = the monitor background.

3.3 $\frac{Bkg}{2\tau}$ = statistical variance on the background (Bkg) count rate (CPM) at a 99.95% confidence level at a RC time constant τ (minutes). This is included to prevent inadvertent high/trip alarms due to random counts on the monitor.

2.1.2 Setpoint Based on an Analysis of Liquid Prior to Discharge

The following method applies to liquid releases via the discharge canal when determining the alarm setpoint for the Waste Disposal System Liquid Effluent Monitor (RMS-18), the Steam Generator Blowdown Monitor (RMS-19), and the Condensate Polisher Liquid Waste Monitor (RMS-37) when an analysis of the activity of the principal gamma emitters has been made prior to or during the release.

2.1.2.1 Determine D (the minimum acceptable dilution factor):

$$D = S\sum_i \frac{Ci}{MPC_i} \quad \text{or}$$

$$D = S[\Sigma g \frac{C_g}{MPC_g} + \frac{C_a}{MPC_a} + \frac{C_s}{MPC_s} + \frac{C_t}{MPC_t} + \frac{C_{Fe-55}}{MPC_{Fe-55}}]$$

C_i = Radioactivity concentration of radionuclide "i" in the liquid effluent prior to dilution (μCi/ml) from analysis of the liquid effluent to be released.

C_g = The concentration of each measured gamma-emitting radionuclide observed by gamma spectroscopy including noble gases.

C_a = The measured concentration of alpha-emitting radionuclides observed by gross alpha analysis of the monthly composite sample.

C_s = The measured concentration of Sr-89 and Sr-90 in liquid waste as determined by analysis of the quarterly composite sample.

2.2 COMPLIANCE WITH 10CFR20 (LIQUIDS)

Liquid effluents from H.B. Robinson Unit 2 (HBR) will occur both continuously and on a batch basis. The following sections discuss the methodology which will be utilized by the HBR to show compliance with 10CFR20.

2.2.1 Continuous Releases

Steam generator blowdown may be a continuous release from HBR. During release periods grab samples will be taken of steam generator blowdown and analyzed for I-131, fission, activation, and corrosion products as outlined in Table 4.10-1 of the Technical Specification for HBR. These samples are then composited at a rate using the following equation:

$$Vup = Vcp\ [Va/Vt]$$

where: Vup = Volume to be replaced/updated (milliliters)
Vcp = Volume of the composite (milliliters)
Va = Actual volume released from grab sample (gallons)
Vt = Total waste volume (gallons) released to date, including volume Va, within the compositing period.

Compliance with 10CFR20 during actual release is established through the steam generator blowdown effluent monitor alarm setpoint. This setpoint is based upon I-131 as noted in Section 2.1. However, if a continuous release should occur in which the effluent monitor alarm setpoint is exceeded, then actual compliance with 10CFR20 may be determined utilizing the actual radionuclide mix and the following equation:

$$Conc_i = \frac{C_{ic}\ V_c}{V_{dc}} \qquad (2.2\text{-}1)$$

where:

$Conc_i$ = Concentration of radionuclide "i" at the unrestricted area, μCi/ml;

The mixture of radionuclides released must be of such concentrations that Equation 2.2-3 must be met.

For HBR, the liquid radwaste effluent line discharges to the circulating water system. Therefore, the dilution flow rate (D_{fr}) is a function of the number of circulating water pumps operating. Unit 2 of the H.B. Robinson Steam Electric Plant has three circulating water pumps. Pump curves show that with three pumps operating, the circulating water flow is 400,000 gpm, with two pumps--250,000 gpm, and with one pump--160,000 gpm. Unit 1 of the H.B. Robinson Steam Electric Plant has two circulating water pumps. The circulating water flow is 50,000 gpm with one pump and 80,000 gpm with two pumps. At least one circulating water pump must be operating during any liquid waste discharge.

Batch releases from the HBR liquid radwaste system may occur from the waste condensate tanks, the monitor tanks, and the steam generators (during drainage). Continuous release may occur from Steam Generator Blowdown and the Condensate Polisher Liquid Waste. The maximum administrative release rate (R_b) is 480 gpm for the steam generators, 60 gpm from the monitor and waste condensate tanks, and 390 gpm for the Condensate Polisher Liquid Wastes, and 450 for the steam generators during drainage.

2.2.2.2 Postrelease

The Steam Generation Blowdown Monitor (RMS-19), the Waste Disposal System Liquid Monitor (RMS-18), and the Condensate Polisher Liquid Waste Monitor (RMS-37) setpoint will each be limited to 50 percent of the 10CFR20 limits. These setpoints will ensure that 10CFR20 limits are met. However, because they are based upon a given mix, the possibility exists that the alarm trip setpoints may be exceeded, while 10CFR20 limits are not exceeded. The following methodology is provided to determine whether actual releases exceeded 10CFR20 limits.

The concentration of each radionuclide in the unrestricted area following release from a batch tank will be calculated in the following manner:

For the case where only batch releases are occurring, the total activity of radionuclide "i" released is divided by the actual dilution flow to obtain the concentration in the unrestricted area. This calculation is shown in the following equation:

$$Conc_{ik} = \frac{C_{ikb} V_{kb}}{V_{kd}} \qquad (2.2\text{-}5)$$

where:

$Conc_{ik}$ = The concentration of radionuclide "i" at the unrestricted area during release k, μCi/ml;

C_{ikb} = Concentration of radionuclide "i" in the batch release k, μCi/ml;

V_{kb} = Volume of batch release k, gal;

V_{kd} = Actual volume of dilution flow during release k, gal.

To show compliance with 10CFR20, the following relationship must hold:

$$\sum_i (Conc_{ik}/MPC_i) \leq 1 \qquad (2.2\text{-}6)$$

The actual dilution volume during release k (V_{kd}) is calculated by the following equation:

$$V_{kd} = 60 \sum_k (D_{fr})t_k \qquad (2.2\text{-}7)$$

where:

60 = Conversion factor, min/hr;

t_k = Duration of release k, hr;

where:

$D_{\tau b}$ = The cumulative dose commitment to the total body or any organ τ, from batch liquid effluents, mrem;

t_{kb} = The length of time of batch release k over which C_{ikb} and F_{kb} are averaged for each batch liquid release, hours;

C_{ikb} = The average concentration of radionuclide "i" in undiluted batch liquid effluent during batch release k, µCi/ml;

$A_{i\tau}$ = The site-related ingestion dose commitment factor to the total body or any organ τ for each identified principal gamma and beta emitter, mrem/hr per µCi/ml;

F_{kb} = The near-field average dilution factor for C_{ikb} during any batch liquid effluent release k. Defined as the ratio of the volume of undiluted liquid waste released to the product of the dilution volume from the site discharge structure to unrestricted receiving waters times 1.0. (1.0 is the site-specific applicable factor for the mixing effect of the HBR discharge structure as defined in NUREG-0133, October 1978).

$$= \frac{V_{kb}}{V_{kd} \times 1.0}$$

Where V_{kb} and V_{kd} are as defined in Equation 2.2-5.

The dose factor $A_{i\tau}$ was calculated for an adult for each isotope using the following equation:

$$A_{i\tau} = 1.14 \times 10^5 \, (21BF_i) \, DF_{i\tau} \qquad (2.3\text{-}2)$$

where:

$$1.14 \times 10^5 = 10^6 \, \frac{pCi}{\mu Ci} \times 10^3 \, \frac{ml}{l} \times \frac{1 \text{ yr}}{8760 \text{ hr}}$$

TABLE 2.3-1

A_{i_τ} VALUES FOR THE ADULT FOR THE H.B. ROBINSON STEAM ELECTRIC PLANT

(MREM/HR PER MICRO-Ci/ML)

Nuclide	Bone	LiverT.Body	Thyroid	Kidney	Lung	GI-LLI	
H-3	0.00E-01	2.26E 01	2.26E-01	2.26E-01	2.26E-01	2.26E-01	2.26E-01
C-14	3.13E+04	6.26E 03	6.26E+03	6.26E+03	6.26E+03	6.26E+03	6.26E+03
Na-24	4.07E+02	4.07E 02	4.07E+02	4.07E+02	4.07E+02	4.07E+02	4.07E+02
P-32	4.62E+07	2.87E 06	1.79E 06	0.00E-01	0.00E-01	0.00E-01	5.19E 06
Cr-51	0.00E-01	0.00E+01	1.27E 00	7.61E-01	2.81E-01	1.69E 00	3.20E 02
Mn-54	0.00E-01	4.38E 03	8.35E 02	0.00E-01	1.30E 03	0.00E-01	1.34E 04
Mn-56	0.00E-01	1.10E 02	1.95E 01	0.00E-01	1.40E 02	0.00E-01	3.51E 03
Fe-55	6.58E 02	4.55E 02	1.06E 02	0.00E-01	0.00E-01	2.54E 02	2.61E 02
Fe-59	1.04E 03	2.44E 03	9.36E 02	0.00E-01	0.00E-01	6.82E 02	8.14E 03
Co-57	0.00E+00	2.09E+01	3.48E+01	0.00E+00	0.00E+00	0.00E+00	5.31E+02
Co-58	0.00E-01	8.92E 01	2.00E 02	0.00E-01	0.00E-01	0.00E-01	1.81E 03
Co-60	0.00E-01	2.56E 02	5.65E 02	0.00E-01	0.00E-01	0.00E-01	4.81E 03
Ni-63	3.11E 04	2.16E 03	1.04E 03	0.00E-01	0.00E-01	0.00E-01	4.50E 02
Ni-65	1.26E 02	1.64E 01	7.49E 00	0.00E-01	0.00E-01	0.00E-01	4.17E 02
Cu-64	0.00E-01	9.97E 00	4.68E 00	0.00E-01	2.51E 01	0.00E-01	8.50E 02
Zn-65	2.32E 04	7.37E 04	3.33E 04	0.00E-01	4.93E 04	0.00E-01	4.64E 04
Zn-69	4.93E 01	9.43E 01	6.56E 00	0.00E-01	6.13E 01	0.00E-01	1.42E 01
Br-83	0.00E-01	0.00E-01	4.04E 01	0.00E-01	0.00E-01	0.00E-01	5.82E 01
Br-84	0.00E-01	0.00E-01	5.24E 01	0.00E-01	0.00E-01	0.00E-01	4.11E-04
Br-85	0.00E-01	0.00E-01	2.15E 00	0.00E-01	0.00E-01	0.00E-01	1.01E-15
Rb-86	0.00E-01	1.01E 05	4.71E 04	0.00E-01	0.00E-01	0.00E-01	1.99E 04
Rb-88	0.00E-01	2.90E 02	1.54E 02	0.00E-01	0.00E-01	0.00E-01	4.00E-09
Rb-89	0.00E-01	1.92E 02	1.35E 02	0.00E-01	0.00E-01	0.00E-01	1.12E-11
Sr-89	2.21E 04	0.00E-01	6.35E 02	0.00E-01	0.00E-01	0.00E-01	3.55E 03
Sr-90	5.44E 05	0.00E-01	1.34E 05	0.00E-01	0.00E-01	0.00E-01	1.57E 04
Sr-91	4.07E 02	0.00E-01	1.64E 01	0.00E-01	0.00E-01	0.00E-01	1.94E 03
Sr-92	1.54E 02	0.00E-01	6.68E 00	0.00E-01	0.00E-01	0.00E-01	3.06E 03
Y-90	5.76E-01	0.00E-01	1.54E-02	0.00E-01	0.00E-01	0.00E-01	6.10E 03
Y-91M	5.44E-03	0.00E-01	2.11E-04	0.00E-01	0.00E-01	0.00E-01	1.60E-02
Y-91	8.44E 00	0.00E-01	2.26E-01	0.00E-01	0.00E-01	0.00E-01	4.64E 03
Y-92	5.06E-02	0.00E-01	1.48E-03	0.00E-01	0.00E-01	0.00E-01	8.86E 02
Y-93	1.60E-01	0.00E-01	4.43E-03	0.00E-01	0.00E-01	0.00E-01	5.09E 03
Zr-95	2.40E-01	7.70E-02	5.21E-02	0.00E-01	1.21E-01	0.00E-01	2.44E 02
Zr-97	1.33E-02	2.68E-03	1.22E-03	0.00E-01	4.04E-03	0.00E-01	8.30E 02
Nb-95	4.47E 02	2.48E 02	1.34E 02	0.00E-01	2.46E 02	0.00E-01	1.51E 06
Mo-99	0.00E-01	1.03E 02	1.96E 01	0.00E-01	2.34E 02	0.00E-01	2.39E 02
Tc-99M	8.87E-03	2.51E-02	3.19E-01	0.00E-01	3.81E-01	1.23E-02	1.48E+01

TABLE 2.3-1 (continued)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
Tc-101	9.12E-03	1.31E-02	1.29E-01	0.00E-01	2.37E-01	6.72E-03	3.95E-14
Ru-103	4.43E+00	0.00E-01	1.91E+00	0.00E-01	1.69E+01	0.00E-01	5.17E-02
Ru-105	3.69E-01	0.00E-01	1.46E-01	0.00E-01	4.76E+00	0.00E-01	2.26E+02
Ru-106	6.58E+01	0.00E-01	3.33E+00	0.00E-01	1.27E+02	0.00E-01	4.26E+03
Ag-110M	8.81E-01	8.15E-01	4.84E-01	0.00E-01	1.60E 00	0.00E-01	3.33E 02
Sb-124	6.70E+00	1.27E-01	2.66E+00	1.63E-02	0.00E+00	5.22E+00	1.90E+02
Sb-125	4.29E+00	4.79E-02	1.03E+00	4.36E-03	0.00E+00	3.30E+00	4.72E+01
Te-125M	2.57E 03	9.30E 02	3.44E 02	7.72E 02	1.04E 04	0.00E-01	1.02E 04
Te-127M	6.48E 03	2.32E 03	7.90E 02	1.66E 03	2.63E 04	0.00E-01	2.17E 04
Te-127	1.05E 02	3.78E+01	2.28E 01	7.80E 01	4.29E 02	0.00E-01	8.31E 03
Te-129M	1.10E 04	4.11E 03	1.74E 03	3.78E 03	4.60E 04	0.00E-01	5.54E 04
Te-129	3.01E 01	1.13E 01	7.33E 00	2.31E 01	1.26E 02	0.00E-01	2.27E 01
Te-131M	1.66E 03	8.10E 02	6.75E 02	1.28E 03	8.21E 03	0.00E-01	8.04E 04
Te-131	1.89E 01	7.88E 00	5.96E 00	1.55E 01	8.26E 01	0.00E-01	2.67E 00
Te-132	2.41E 03	1.56E 03	1.47E 03	1.72E 03	1.50E 04	0.00E-01	7.38E 04
I-130	2.71E 01	8.01E 01	3.16E 01	6.79E 03	1.25E 02	0.00E-01	6.89E 01
I-131	1.49E 02	2.14E 02	1.22E 02	7.00E 04	3.66E 02	0.00E-01	5.64E 01
I-132	7.29E 00	1.95E 01	6.82E 00	6.82E 02	3.11E 01	0.00E-01	3.66E 00
I-133	5.10E 01	8.87E 01	2.70E 01	1.30E 04	1.55E 02	0.00E-01	7.97E 01
I-134	3.81E 00	1.03E 01	3.70E 00	1.79E 02	1.64E 01	0.00E-01	9.01E-03
I-135	1.59E 01	4.17E 01	1.54E 01	2.75E 03	6.68E 01	0.00E-01	4.70E 01
Cs-134	2.98E 05	7.09E 05	5.79E 05	0.00E-01	2.29E 05	7.61E 04	1.24E 04
Cs-136	3.12E 04	1.23E 05	8.86E 04	0.00E-01	6.85E 04	9.38E 03	1.40E 04
Cs-137	3.82E 05	5.22E 05	3.42E 05	0.00E-01	1.77E 05	5.89E 04	1.01E 04
Cs-138	2.64E 02	5.22E 02	2.59E 02	0.00E-01	3.84E 02	3.79E+01	2.23E-03
Ba-139	9.29E-01	6.62E-04	2.72E-02	0.00E-01	6.19E-04	3.75E-04	1.65E 00
Ba-140	1.94E 02	2.44E-01	1.27E 01	0.00E-01	8.30E-02	1.40E-01	4.00E 02
Ba-141	4.51E-01	3.41E-04	1.52E-02	0.00E-01	3.17E-04	1.93E-04	2.13E-10
Ba-142	2.04E-01	2.10E-04	1.28E-02	0.00E-01	1.77E-04	1.19E-04	2.87E-19
La-140	1.50E-01	7.54E-02	1.99E-02	0.00E-01	0.00E-01	0.00E-01	5.54E 03
La-142	7.66E-03	3.48E-03	8.68E-04	0.00E-01	0.00E-01	0.00E-01	2.54E 01
Ce-141	2.24E-02	1.52E-02	1.72E-03	0.00E-01	7.04E-03	0.00E-01	5.79E 01
Ce-143	3.95E-03	2.92E 00	3.23E-04	0.00E-01	1.29E-03	0.00E-01	1.09E 02
Ce-144	1.17E 00	4.88E-01	6.27E-02	0.00E-01	2.90E-01	0.00E-01	3.95E 02
Pr-143	5.51E-01	2.21E-01	2.73E-02	0.00E-01	1.27E-01	0.00E-01	2.41E 03
Pr-144	1.80E-03	7.48E-04	9.16E-05	0.00E-01	4.22E-04	0.00E-01	2.59E-10
Nd-147	3.76E-01	4.35E-01	2.60E-02	0.00E-01	2.54E-01	0.00E-01	2.09E 03
W-187	2.96E 02	2.47E 02	8.65E 01	0.00E-01	0.00E-01	0.00E-01	8.10E 04
Np-239	2.85E-02	2.80E-03	1.54E-03	0.00E-01	8.74E-03	0.00E-01	5.75E 02

3.1.2.1 Determine R_i, the noble gas release rate [μCi/sec] for radionuclide "i":

$$R_i = 472\ (C_i)\ (F). \qquad (3.1\text{-}7)$$

where:

472 = A conversion factor to convert cfm to cc/sec.

C_i = The radioactivity concentration of noble gas radionuclide "i" from analysis of gaseous effluent (μCi/cc) from the Condenser Vacuum Pump Vent, Plant Vent (stack), Fuel Handling Basement Exhaust, Environmental & Radiation Control (E&RC) Building Hood Exhaust, and the Containment Vessel when RMS-12 is sampling from the Containment. If there are no isotopes identified in the sample, the LLD's for Xe-133 and Kr-85 may be used as actual values for the purpose of the setpoint calculation.

Containment Purge--

($\mu Ci/cc_i$ from analysis of Containment Vent) (0.368) +
($\mu Ci/cc_i$ from analysis of Plant Vent) (0.632)

Containment Pressure Relief--

($\mu Ci/cc_i$ from analysis of Containment Vent) (0.040) +
($\mu Ci/cc_i$ from analysis of Plant Vent) (0.960)

Waste Gas Decay Tanks--

($\mu Ci/cc_i$ from analysis of WGDT) (0.0017) +
($\mu Ci/cc_i$ from analysis of Plant Vent) (0.9983)

Waste Gas Decay Tanks during Containment Purge--
($\mu Ci/cc_i$ from analysis of WGDT) (0.0011) +
($\mu Ci/cc_i$ from analysis of Plant Vent) (0.631) +
($\mu Ci/cc_i$ from analysis of C.V.) (0.368)

0.368 = Dilution correction factor for C.V. Purge = $\frac{35{,}000 \text{ CFM}}{(60{,}000 + 35{,}000) \text{ CFM}}$

0.632 = Dilution correction factor for Plant Vent during C.V. Purge = $\frac{60{,}000 \text{ CFM}}{(60{,}000 + 35{,}000) \text{ CFM}}$

0.040 = Dilution correction factor for C.V. Pressure Relief = $\frac{2500^* \text{ CFM}}{(60{,}000 + 2500^*) \text{ CFM}}$

0.960 = Dilution correction factor for Plant Vent during C.V. Pressure Relief = $\frac{60{,}000 \text{ CFM}}{(60{,}000 + 2500^*) \text{ CFM}}$

0.0017 = Dilution correction factor for Waste Gas Decay Tank = $\frac{100 \text{ CFM}}{(60{,}000 + 100) \text{ CFM}}$

0.9983 = Dilution correction factor for Plant Vent during WGDT Release = $\frac{60{,}000 \text{ CFM}}{(60{,}000 + 100) \text{ CFM}}$

0.0011 = Dilution correction factor for Waste Gas Decay Tank during a Continuous C.V. Purge and Plant Vent Release = $\frac{100 \text{ CFM}}{(60{,}000 + 35{,}000 + 100) \text{ CFM}}$

0.631 = Dilution correction factor for Plant Vent during a Continuous C.V. Purge and Plant Vent Release = $\frac{60{,}000 \text{ CFM}}{(60{,}000 + 35{,}000 + 100) \text{ CFM}}$

0.368 = Dilution correction factor for Continuous C.V. Purge during WGDT Release = $\frac{35{,}000 \text{ CFM}}{(60{,}000 + 35{,}000 + 100) \text{ CFM}}$

F = The maximum acceptable effluent flow rate at the point of release (CFM)

= 200 CFM for the condenser

= 60,000 CFM for the plant vent

= 10,200 CFM for the fuel handling basement exhaust

= 11,500 CFM for the E&RC building hood exhaust

= 95,000 CFM for the containment vessel purge plus plant vent

= 62,500 CFM for the containment vessel pressure relief

= 60,100 CFM for the waste gas decay tank

= 95,100 CFM for the waste gas decay tank during a continuous containment vessel purge

= 35,000 CFM for containment vessel purge or continuous release

= 2500 CFM for containment vessel pressure relief releases

*2500 CFM--Refer to Appendix B.4 for additional information

TABLE 3.1-1

GASEOUS SOURCE TERMS*

Radionuclide	Plant Vent Release[1]		Condenser Vacuum Pump Vent[2]		Containment Purge or Pressure Relief		Gas Decay Tanks[3]	
	A_i (Ci/yr)	S_i	A_i (Ci/yr)	S_i	A_i (Ci/yr)	S_i	A_i (Ci/yr)	S_i
Kr-85m	2.0E0	5.26E-2	1.0E0	4.35E-2	0.00	0.00	0.00	0.00
Kr-85	0.00	0.00	0.00	0.00	0.00	0.00	1.6E2	8.00E-1
Kr-87	1.0E0	2.63E-2	0.00	0.00	0.00	0.00	0.00	0.00
Kr-88	3.0E0	7.89E-2	2.0E0	8.70E-2	1.0E0	2.90E-3	0.00	0.00
Xe-131m	0.00	0.00	0.00	0.00	1.0E0	2.90E-3	9.0E0	4.50E-2
Xe-133m	0.00	0.00	0.00	0.00	4.0E0	1.16E-2	0.00	0.00
Xe-133	2.8E1	7.37E-1	1.8E+1	7.83E-1	3.1E2	8.99E-1	3.1E1	1.55E-1
Xe-135	4.0E0	1.05E-1	2.0E0	8.70E-2	4.0E0	1.16E-2	0.00	0.00
Ar-41	0.00	0.00	0.00	0.00	2.5E1	7.25E-2	0.00	0.00
TOTAL	3.8E1		2.3E1		3.45E2		2.0E2	

*Source terms are based upon GALE Code (not actual releases) from the evaluation of H.B. Robinson Unit 2 to demonstrate conformance to the design objectives of 10CFR50, Appendix I, Table 2-4. These values are only for routine releases and not for a complete inventory of gases in an emergency.

[1]These values are used to determine the monitor alarm setpoints for the Plant Vent Gas Monitor (RMS-14).

[2]These values are used to determine the monitor alarm setpoint for the Condenser Vacuum Pump Vent Monitor (RMS-15).

[3]These values are used to determine the monitor alarm setpoint for the Fuel Handling Basement Exhaust Monitor (RMS-20).

3.2 COMPLIANCE WITH 10CFR20 (GASEOUS)

3.2.1 Noble Gases

The gaseous effluent monitors setpoints are utilized to show compliance with 10CFR20 for noble gases. However, because they are based upon a conservative mix of radionuclides, the possibility exists that the setpoints could be exceeded and yet 10CFR20 limits may actually be met. Therefore, the following methodology has been provided in the event that if the alarm trip setpoints are exceeded, a determination may be made as to whether the actual releases have exceeded 10CFR20.

The dose rate in unrestricted areas resulting from noble gas effluents is limited to 500 mrem/year to the total body and 3000 mrem/year to the skin. Based upon NUREG 0133, the following are used to show compliance with 10CFR20.

$$\sum_i K_i [(\overline{X/Q})_v \dot{Q}_{iv} + (\overline{X/Q})_e \dot{Q}_{ie}] \leq 500 \text{ mrem/yr} \qquad (3.2\text{-}1)$$

$$\sum_i (L_i + 1.1 M_i) [(\overline{X/Q})_v \dot{Q}_{iv} + (\overline{X/Q})_e \dot{Q}_{ie}] \leq 3000 \text{ mrem/yr} \qquad (3.2\text{-}2)$$

where:

$(\overline{X/Q})_v$ = Annual average relative dilution for plant vent releases at the site boundary, sec/m^3.

= From Table A-1 for ground level releases.

= From Table A-10 for elevated mode releases only with upper wind speed of $\leq$ 9 mph.

$(\overline{X/Q})_e$ = Annual average relative dilution for Condenser Vacuum Pump, Fuel Handling Basement Exhaust, and the Environmental and Radiation Control Building Exhaust releases at the site boundary, sec/m^3.

= From Table A-1 for ground level releases.

$\dot{Q}_{iv}$ = Release rate of radionuclide "i" from the plant vent, µCi/sec.

$\dot{Q}_{ie}$ = Release rate of radionuclide "i" from the condenser vacuum pump vent, fuel handling building basement exhaust, and environmental and radiation control building exhaust µCi/sec.

$(\overline{X/Q})_v$ = Annual average relative dilution for plant vent releases at the site boundary, sec/m^3.

$(\overline{X/Q})_e$ = Annual average relative dilution for condenser vacuum pump vent releases at the site boundary, sec/m^3.

P_{i_I} = The dose parameter for Iodine-131, Iodine-133, tritium, and all radionuclides in particulate form with half-lives greater than 8 days for the inhalation pathway only in the most restrictive sector in mrem/yr per $\mu Ci/m^3$. The dose factor is based on the most restrictive group (child) and most restrictive organ at the SITE BOUNDARY (see Table 3.3-4).

where:

In the calculation to show compliance with 10CFR20, only the inhalation is considered. A description of the methodology used in calculating the Pi values is presented in Appendix B. Compliance with 10CFR20 is achieved if the dose rate via inhalation pathway to a child is $\leq$ 1500 mrem/year.

For the calendar year:

$$D_{\gamma} \leq 10 \text{ mrad} \qquad (3.3\text{-}5)$$

$$D_{\beta} \leq 20 \text{ mrad} \qquad (3.3\text{-}6)$$

The quarterly limits given above represent one-half of the annual design objectives of Section II.B.1 of Appendix I of 10CFR50. If any of the limits of Equations 3.3-3 through 3.3-6 are exceeded, a special report pursuant to Technical Specification must be filed with the NRC. This report complies with Section IV.A of Appendix I of 10CFR50.

3.3.1.2 Projection of Doses

Doses resulting from the release of gaseous effluents will be projected once per 31 days. These projections will include a safety margin based upon expected operational conditions which will take into consideration both planned and unplanned releases.

Projected dose will be calculated as follows:

$$PD = \frac{31\ (DA + DB)}{(TE)} + M \qquad (3.3\text{-}7)$$

where:

PD = Projected doses in mrem.

DA = Dose accumulated during current quarter in mrem.

DB = Projected dose from this release.

TE = Time elapsed in quarter in days.

M = Safety margin in mrem.

If the projected doses exceed 0.6 mrad for gamma radiation or 1.3 mrad for beta radiation when averaged over a calendar quarter, the ventilation exhaust treatment system will be operated to reduce releases of radioactive materials.

3.3.2 Radioiodine, Particulates and Tritium

3.3.2.1 Cumulation of Doses

Section II.C of Appendix I of 10CFR50 limits the release of radioiodines and radioactive material in particulate form from each reactor such that estimated dose or dose commitment to an individual in an unrestricted area from all pathways of exposure is not in excess of 15 mrem to any organ. Based upon NUREG 0133, the dose to an organ of an individual from radioiodines, tritium, and particulates with half-lives ≥ 8 days in gaseous effluents released to unrestricted areas can be determined by the following equation:

$$D_\tau = 3.17 \times 10^{-8} \sum_i R_{i_I} \left[(\overline{X/Q})_v Q_{iv} + (\overline{X/Q})_e Q_{ie} \right] +$$

$$\left(R_{i_B} + R_{i_M} + R_{i_V} + R_{i_G}\right) \left[(\overline{D/Q})_v Q_{iv} + (\overline{D/q})_v q_{iv} + (\overline{D/Q})_e Q_{ie}\right] + \qquad (3.3\text{-}8)$$

$$\left(R_{T_M} + R_{T_B} + R_{T_I} + R_{T_V}\right) \left[(\overline{X/Q})_v Q_{TV} + (\overline{X/q})_v q_{TV} + (\overline{X/Q})_e Q_{Te}\right]$$

where:

D_τ = Dose to any organ τ from I-131, I-133, particulates with ≥ 8 day half-lives, and Tritium in mrem.

For the calendar quarter:

$$D_T \leq 7.5 \text{ mrem} \qquad (3.3\text{-}9)$$

For the calendar year:

$$D_T \leq 15 \text{ mrem} \qquad (3.3\text{-}10)$$

The quarterly limits given above represent one-half the annual design objectives of Section II.C of Appendix I of 10CFR50. If any of the limits of Equations 3.3-9 or 3.3-10 are exceeded, a special report pursuant to Technical Specification must be filed with the NRC. This report complies with Section IV.A of Appendix I of 10CFR50.

3.3.2.2 Projection of Doses

Doses resulting from release of radioiodines and particulate effluents will be projected once per 31 days. These projections will include a safety margin based upon expected operational conditions which will take into consideration both planned and unplanned releases.

Projected dose will be calculated as follows:

$$PD = \frac{31\ (DA + DB)}{(TE)} + M \qquad (3.3\text{-}11)$$

where:

PD = Projected doses in mrem.

DA = Dose accumulated during current quarter in mrem.

DB = Projected dose from this release.

TE = Time elapsed in quarter in days.

M = Safety margin in mrem.

3.4 METHODOLOGY FOR RMS-11 SETPOINT (Air Particulate)

Determine the Monitor Alarm Setpoint based on the inhalation pathway to the child. The most restrictive organ "j" will be determined from the following methodology.

3.4.1 Determine dose rate for organ "j" (mrem/yr).

$$DR_j = \overline{X/Q} \; \Sigma_i \; R_{i_j} \; Q_i \qquad (3.4\text{-}1)$$

where:

$\overline{X/Q}$ = the highest calculated annual average relative dispersion factor for any area at or beyond the unrestricted area boundary for all sectors (sec/m^3) from Appendix A.

= 8.1E-3 sec/m^3 (continuous ground release) from Table A-1, Appendix A.

R_{i_j} = the organ "j" dose factor due to gamma emissions from particulates greater than or equal to 8 day half-life, I-133, I-131, and H-3.

Q_i = the particulate release rate (μCi/sec) for radionuclide "i".

= 472 $(C_i)(F)$

where:

472 = conversion factor to convert CFM to cc/sec.

C_i = ($\mu Ci/cc_i$ from analysis of containment vessel) (0.368) ÷(DF) + (μCi/cc, from analysis of Plant Vent) (0.632) when RMS-11 is sampling the Plant Vent for CV purges.

= ($\mu Ci/cc_i$ from analysis of CV) (0.04) ÷(DF) + ($\mu Ci/cc_i$ from analysis of Plant Vent) (0.960) when RMS-11 sampling from Plant Vent for CV pressure relief.

= ($\mu Ci/cc_i$ from analysis of CV) ÷(DF) when RMS-11 is sampling CV.

F = 95,000 cfm for CV purge when RMS-11 is sampling from Plant Vent.

= 35,000 cfm for CV purge when RMS-11 is sampling from CV.

= 2,500 cfm for CV pressure relief when RMS-11 is sampling from CV.

= 62,500 cfm for CV pressure relief when RMS-11 is sampling Plant Vent.

DF = 1.0 for Tritium

= 10 for Iodines when using charcoal filters

= 100 for Particulates ≥ 8 day half-lives when using HEPA Filters.

3.4.2 Determine the particulate emission Projected Dose Rate Ratio (PDRR) for the most critical organ "j".

$$PDRR_j = DR_j/1500 \qquad (3.4\text{-}2)$$

1500 = the allowable organ dose rate due to particulates with > 8 day half-life, I-131, I-133, H-3 (mrem/year).

3.4.3 Determine the maximum monitor setpoint concentration (μCi/cc) for most critical organ "j".

Maximum Monitor Setpoint for Organ "j" =

$$[(\Sigma_i C_i) / (PDRR_j)] \quad (SF) \; (T_m) \; (TL)$$

where:

SF = an engineering factor used to provide a margin of safety for cumulative measurement uncertainties = 0.50.

T_m = fraction of the radioactivity from the site that may be released via the monitored pathway to ensure that the site boundary limit is not exceeded due to simultaneous releases from several pathways.

= 0.81 for RMS-11 particulate monitor.

TL = total activity/ $\Sigma_i C_i$ where the total activity is the sum of all detectable particulates from analysis of particulate filter divided by the detectable particulates of ≥ 8 day half-lives. If this ratio is not known, use 1.0.

= 1.0 when RMS-11 sampling from Plant Vent.

3.4.4 Determine the maximum monitor setpoint (cpm) for the most critical organ "j".

Setpoint = (Maximum organ setpoint in μCi/cc) (monitor

$$\text{eff}) + \text{Bkg} + 3.3\sqrt{\frac{\text{Bkg}}{2\tau}} \qquad (3.4\text{-}3)$$

Monitor efficiency = obtained from the applicable effluent monitor efficiency curve located in the POM, Volume 15, Curve Book. Use the radioactivity concentration (μCi/cc) to find cpm.

Bkg = the monitor background (cpm)

$3.3\sqrt{\frac{\text{Bkg}}{2\tau}}$ = statistical variance on the background (Bkg) count rate (cpm) at a 99.95% confidence level at a time constant τ (minutes). This factor is included to prevent inadvertent high/trip alarms due to random counts on the monitor.

Table 4.0-1 (continued)

Exposure Pathway and/or Sample	Sample Point	Sample Point Description, Distance, and Direction	Sampling and Collection Frequency	Analysis[1] Frequency	Analysis[1]
2. Direct Radiation (continued)	2.	Information Center 0.2 mile S @ 180°	Continuous measurement with readout at least once per quarter (TLDs)	Quarterly	Gamma Dose[5]
	3.	Microwave tower 0.7 mile N @ 5°			
	4.	Spillway 0.4 mile ESE @ 110°			
	5.	East shore of lake across from plant intake Johnson's landing 0.9 mile ENE @ 73°			
	6.	Information Center 0.3 mile SW @ 214°			
	7.	CP&L Hartsville substation 6.3 miles ESE @ 109°			
	8.	Transmission tower 0.8 mile SSE.			
	9.	Transmission tower 1.0 mile S.			
	10.	The Church of God cemetary 1.0 mile WSW.			
	11.	Old Camden Road 1.0 mile SW.			
	12.	Tree 1.2 miles SSW.			

Table 4.0-1 (continued)

Exposure Pathway and/or Sample	Sample Point	Sample Point Description, Distance, and Direction	Sampling and Collection Frequency	Analysis[1] Frequency	Analysis[1]
2. Direct Radiation (continued)	13.	Tree 1.0 mile W.	Continuous measurement with readout at least once per quarter (TLDs)	Quarterly	Gamma Dose[5]
	14.	Highway 151 at Pine Ridge Church 0.9 mile WNW.			
	15.	Tree directly directly adjacent to ash pond on CP&L property 1.0 miles NW.			
	16.	Darlington County I.C. Turbine Plant 1.0 mile NNW.			
	17.	1.0 mile down Discharge Canal road at Old Unit One Weir 1.1 miles N.			
	18.	Black Creek 0.7 mile SE.			
	19.	Road #S-16-23 1.0 mile E.			
	20.	Road #S-16-39 1.3 miles ENE.			
	21.	Atkinson's landing 1.4 miles NE.			
	22.	Shady Rest Club 1.9 miles NNE.			
	23.	Road #S-16-39 1.2 miles ESE.			
	24.	Road #S-13-711 5.0 miles NW.			

Table 4.0-1 (continued)

Exposure Pathway and/or Sample	Sample Point	Sample Point Description, Distance, and Direction	Sampling and Collection Frequency	Analysis[1] Frequency	Analysis[1]
2. Direct Radiation (continued)	25.	Road #S-13-346 4.6 miles NNW.	Continuous measurement with readout at least once per quarter (TLDs)	Quarterly	Gamma Dose[5]
	26.	Road #S-13-346 5.0 miles N.			
	27.	Road #S-13-763 5.0 miles NNE.			
	28.	Road #S-13-39 4.8 miles NE.			
	29.	Road #S-16-20 4.1 mile ENE.			
	30.	Road #S-16-20 4.6 miles E.			
	31.	Lakeshore Drive 4.6 miles ESE.			
	32.	Transmission 4.5 miles SE.			
	33.	Road #S-16-493 4.6 miles SSE.			
	34.	Transmission pole on Road #S-16-772 4.6 miles S.			

Table 4.0-1 (continued)

Exposure Pathway and/or Sample	Sample Point	Sample Point Description, Distance, and Direction	Sampling and Collection Frequency	Analysis[1] Frequency	Analysis[1]
2. Direct Radiation (continued)	35.	Power pole on Road #S-31-51 4.4 miles SSW.	Continuous measurement with readout at least once per quarter (TLDs)	Quarterly	Gamma Dose[5]
	36.	Power pole ~3/4 mile down paved road off Road #S-16-85. 4.7 miles SW.			
	37.	Transmission tower 5.0 miles WSW.			
	38.	Road S-16-231 next to Union Church 4.9 miles W.			
	39.	Power pole 5.0 miles WNW.			
3. Waterborne a. Surface Water	40.	Black Creek at Road 1623 0.6 mile ESE (Indicator).	Composite sample[6] over one-month period	Monthly	Gamma Scan[4] H-3
	41.	Black Creek (Control Station[2] 7.2 miles NNW.			
b. Groundwater	40.	Artesian well 0.6 mile ESE.	Grab Sample	Monthly	Gamma Scan[4] H-3
	42.	Unit 1 deep well			
	43.	Unit 2 deep well			
c. Drinking Water		Not required[7].			
d. Shoreline Sediment	44.	East Shore of Lake, Shady Rest Club 1.9 miles NNE.	Semiannually	Semiannually	Gamma Scan[4]

Table 4.0-1 (continued)

Exposure Pathway and/or Sample	Sample Point	Sample Point Description, Distance, and Direction	Sampling and Collection Frequency	Analysis[1] Frequency	Analysis[1]
4. Ingestion a. Milk	53.	Lyndale Farm 9.0 miles SW (Control Station for milk).	Semimonthly when animals are on pasture; monthly @ other times	Semimonthly when animals are on pasture; monthly @ other times	Gamma Scan[4] and I-131 analysis semi-monthly when animals are on pasture; monthly @ other times
	50.	Indicator Milk Sample Location (There are no milk samples available within 8 Km of Plant. The following broad-leaf vegetation are to sampled and analyzed.)			
	51.	0.25 mile SSE CP&L property[9].	Monthly when available (3 different kinds of broad-leaf vegetation)	Each sample	Gamma Scan[4] I-131
	52.	0.25 NNE CP&L property[9].			
	53.	10 miles W Bethune (Control Station for Broad-Leaf Vegetation).			
b. Fish	45.	Site varies within Lake Robinson.	Semiannually (collect comparable species at all three locations)	Each sample	Gamma Scan[4] Edible portion
	46.	Prestwood Lake 4.9 miles ESE.			
	47.	Bee Lake (Control Station)[2] 13 miles NNW or May Lake 12.5 miles NW.			
c. Food Products leafy vege-tables	54.	Auburndale Plantation[8] 10.1 miles E. (One sample of each principal class of irrigated food products.)	Annual at harvest	Each sample	Gamma Scan[4]

6.0 TOTAL DOSE (40CFR190 CONFORMANCE)

6.1 COMPLIANCE WITH 40CFR190

Compliance with 40CFR190 as prescribed by Specification 3.9.6 is to be demonstrated only when one or more of Specifications 3.9.2.1.a, 3.9.2.1.b, 3.9.4.1a, 3.9.4.1.b, 3.9.5.1.a, and 3.9.5.1.b is exceeded by a factor of 2. Once this occurs the Company has 30 days to submit this report in accordance with Technical Specification.

6.2 CALCULATIONS EVALUATING CONFORMANCE WITH 40CFR190

To perform the calculations to evaluate conformance with 40CFR190, an effort is made to develop doses that are realistic by removing assumptions that lead to overestimates of dose to a MEMBER OF THE PUBLIC (i.e., calculations for compliance with 10CFR50, App. I). To accomplish this the following calculational rules are used:

(1) Doses to a MEMBER OF THE PUBLIC via the liquid release pathway will be calculated.

(2) Doses to a MEMBER OF THE PUBLIC due to a milk pathway will be evaluated only as can be shown to exist. Otherwise, doses via this pathway will be estimated as <1 mrem/yr.

(3) Environmental sampling data which demonstrate that no pathway exists may be used to delete a pathway to man from a calculation.

(4) To sum numbers represented as "less than" (<), use the value of the largest number in the group.

(i.e. <5 + <1 + <1 + <3 = 5)

(5) When doses via direct radiation are added to doses via inhalation pathway, they will be calculated for the same distance in the same sector.

APPENDIX C

LOWER LIMIT OF DETECTABILITY

C.1 Radiological Environmental Monitoring Program

The LLD[1,2] is defined 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:

$$LLD = \frac{4.66\ s_b}{E \cdot V \cdot 2.22 \cdot Y \cdot \exp(-\lambda\ \Delta t)}$$

where:

LLD = "A" priori" lower limit of detection as defined above, as picocuries per unit mass or volume;

s_b = standard deviation of the background counting rate or of the counting rate of a blank sample, as appropriate, as counts per minute;

E = counting efficiency, as counts per disintegration;

V = sample size in units of mass or volume;

2.22 = number of disintegrations per minute per picocurie;

Y = fractional radiochemical yield, when applicable;

λ = radioactive decay constant for the particular radionuclide; and

Δt = the elapsed time between sample collection or end of the sample collection period and time of counting;

Typical values of efficiency, volume/mass, chemical yield, and radionuclide decay corrections are to 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 an a posteriori (after the fact) limit for a particular measurement. Analyses shall be performed in such a manner that the stated LLDs will be achieved under routine conditions. Occasionally background fluctuations, unadvoidable small sample sizes, the presence of interfering nuclides, or other uncontrollable circumstances may render these LLDs unachievable. In such cases, the contributing factors shall be identified and described in the Annual Radiological Environmental Operating Report pursuant to Specification 6.9.1.e.[3]

C. 2 Radiocative Waste Sampling and Analysis Program

The LLD is defined 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:

$$LD = \frac{4.66\ s_b}{E \cdot V \cdot 2.22 \times 10^6 \cdot Y \cdot \exp(-\lambda\ \Delta t)}$$

where:

LLD = "A" priori" lower limit of detection as defined above, as microcuries per unit mass or volume;

s_b = standard deviation of the background counting rate or of the counting rate of a blank sample, as appropriate, as counts per minute;

E = counting efficiency, as counts per disintegration;

V = sample size in units of mass or volume;

2.22×10^6 = number of disintegrations per minute per microcurie;

Y = fractional radiochemical yield, when applicable;

λ = radioactive decay constant for the particular radionuclide; and

Δt = the elapsed time between the midpint of sample collection and time of counting.

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 an a posteriori (after the fact) limit for a particular measurement.

C. 3 Radioactive Gaseous Waste Monitoring System

The LLD is defined 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[4].

$$LLD = \frac{4.66 \sqrt{\frac{Bkg}{2\tau}}}{E}$$

where:

LLD = "A" priori" lower limit of detection as defined above, as microcuries per cubit centimeter,

Bkg = the background counting rate as counts per minute,

E = counting efficiency, as $\frac{\text{counts per minute}}{\text{microcurie per cubic centimeter}}$

τ = the time constant for the particular measurement system.

Typical values of E, and Bkg 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 an a posteriori (after the fact) limit for a particular measurement.

References

1. HASL-300 (Suppl. 4), HASL Procedures Manual, (1972).

2. NBS SP456 "The Minimum Detectable Activity Concept," J. C. Lockamy (1976).

3. Technical Specifications for H. B. Robinson Unit 2.

4. NUREG/CR-4007, Lower Limit of Detection: Definition and Elaboration of a Proposed Position for Radiological Effluent and Environmental Measurements, (September 1984).

II. CHANGES TO RADIOACTIVE WASTE SYSTEMS

There were no changes to the Radioactive Waste Systems during this reporting period.

III. CHANGES TO PCP

There were no changes to the Process Control Program during this reporting period.

IV. CHANGES TO LAND USE CENSUS

There were no changes to the environmental sampling program as a result of the Land Use Census during this reporting period.

V. INSTRUMENT INOPERABILITY

On November 9, 1987, the Waste Gas Holdup System Explosive Gas Monitoring System was removed from service to allow replacement of existing watertaps and recorders for improved reliability. On January 14, 1988, the system was returned to operable status. The inoperability beyond 14 days was due to the confined space restricting work progression and the time required by the vendor representative. Throughout the duration, daily grab samples were taken and analyzed in accordance with Plant Technical Specifications, Table 3.5-7, Item Number 2.

VI. LIQUID HOLDUP TANK CURIE LIMIT

There were no outside liquid holdup tanks that exceeded the ten curie limit during this reporting period.

VII. WGDT CURIE LIMIT

There were no waste gas decay tank curie content that exceeded the 1.9E+04 curie limit.

SUPPLEMENTS TO PREVIOUS SEMIANNUAL REPORTS

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Enclosure 3

LIST OF TABLES
Enclosure 3

I. DISCUSSION

Supplements to the Effluent and Waste Disposal Semiannual Report are as follows:

Report Period	Affected Pages
January - June 1987	Enclosure 1, Pages 9-10
January - June 1987	Enclosure 1, Pages 13-14

Supplements are provided as replacement pages with change bars indicating new information. Corrections were made to the First Six Months 1987 Semiannual Report to correct curie totals and average release rates for Fission and Activation Gases and Iodines, Particulates and Tritium of Gaseous Effluents. These corrections were due to the inclusion of minimum detectable activities in curie totals for each quarterly period. Similarly, the percent of 10CFR50 Appendix I Quarterly and Annual Limits were also corrected.

The First Six Months 1987 Semiannual Report were also corrected for curie totals in the first quarter for Fission and Activation Products and Average Diluted Concentration on liquid effluents. This was due to a quarterly Steam Generator Drainage Fe-55, Sr-89, and Sr-90 results which were omitted. The 10CFR50, Appendix I, reported doses for liquid effluents are correct as originally submitted.

II. DATA TABLES

The corrected data tables are as follows:

TABLE III-A	Gaseous Effluents - Summation of All Releases
TABLE III-B	Gaseous Effluents Ground Level Releases
TABLE IV-A	Liquid Effluents - Summation of All Releases
TABLE IV-B	Liquid Effluents - Continuous Mode and Batch Mode Releases

TABLE III-A
EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT - 1987
GASEOUS EFFLUENTS - SUMMATION OF ALL RELEASES

		UNITS	1ST QUARTER	2ND QUARTER
A.	Fission and Activation Gases:			
1.	Total Release	Ci	5.25E+02	1.10E+01
2.	Estimated Total Error	%	6.00E+01	6.00E+01
3.	Average Release Rate for Period	µCi/sec	6.75E+01	1.40E+00
4.	Percent of 10CFR50 Appendix I			
	Quarterly Limit			
	Gamma Air	%	1.25E+01	2.66E-01
	Beta Air	%	1.58E+01	6.00E-03
	Annual Limit			
	Gamma Air	%	6.27E+00*	7.30E+00*
	Beta Air	%	7.90E+00*	8.84E+00*
B.	Iodines, Particulates, and Tritium:			
	Iodines			
1.	Total Iodine - 131	Ci	2.02E-02	1.97E-04
2.	Estimated Total Error	%	4.00E+01	4.00E+01
3.	Average Release Rate	µCi/sec	2.60E-03	2.51E-05
	Particulates			
1.	Particulates with Half-Lives >8 days	Ci	3.01E-06	1.22E-05
2.	Estimated Total Error	%	4.00E+01	4.00E+01
3.	Average Release Rate for Period	µCi/sec	3.87E-07	1.55E-06
4.	Gross Alpha Radioactivity	Ci	<LLD	<LLD
	Tritium			
1.	Total Release	Ci	9.74E-01	6.68E-01
2.	Estimated Total Error	%	3.00E+01	3.00E+01
3.	Average Release Rate for Period	µCi/sec	1.25E-01	8.50E-02
	Percent of 10CFR50 Appendix I			
	Quarterly Limit			
	Organ Thyroid	%	4.71E+01	3.71E-01
	Annual Limit			
	Organ Thyroid	%	2.35E+01*	2.38E+01*

*Cumulative total for the year-to-date.

TABLE III-B
EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT - 1987
GASEOUS EFFLUENTS GROUND LEVEL RELEASES

		CONTINUOUS MODE		BATCH MODE	
	UNITS	1ST QUARTER	2ND QUARTER	1ST QUARTER	2ND QUARTER
1. FISSION GASES					
Ar-41	Ci	<LLD	6.86E-01	1.17E-01	6.03E-06
Kr-85	Ci	<LLD	6.44E-02	2.56E+00	6.75E-01
Kr-85m	Ci	1.93E+00	<LLD	2.40E-01	<LLD
Kr-87	Ci	<LLD	<LLD	1.77E-02	<LLD
Kr-88	Ci	<LLD	<LLD	8.73E-02	<LLD
Xe-131m	Ci	<LLD	<LLD	2.61E+00	2.25E-01
Xe-133	Ci	2.99E+02	2.80E+00	1.81E+02	6.53E+00
Xe-133m	Ci	1.08E+00	<LLD	2.56E+00	5.64E-02
Xe-135	Ci	2.62E+01	<LLD	7.83E+00	1.41E-03
Total for Period	Ci	3.28E+02	3.55E+00	1.97E+02	7.49E+00
2. IODINES[1]					
I-131	Ci	2.02E-02	1.97E-04	<LLD	<LLD
I-133	Ci	4.12E-04	1.53E-06	<LLD	<LLD
I-135	Ci	<LLD	<LLD	<LLD	<LLD
Total for Period	Ci	2.06E-02	1.98E-04	<LLD	<LLD
3. PARTICULATES[1]					
H-3	Ci	9.25E-01	6.66E-01	4.88E-02	1.79E-03
Co-58	Ci	3.48E-07	2.85E-06	<LLD	<LLD
Cs-134	Ci	1.09E-07	<LLD	<LLD	3.69E-06
Cs-137	Ci	2.55E-06	6.74E-07	<LLD	4.96E-06
Total for Period	Ci	9.25E-01	6.66E-01	4.88E-02	1.80E-03

[1]Continuous Accountability includes Batch Accountability (excludes H-3) for Mixed Mode Releases

TABLE IV-A
EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT - 1987
LIQUID EFFLUENTS - SUMMATION OF ALL RELEASES

		UNITS	1ST QUARTER	2ND QUARTER
A.	FISSION AND ACTIVATION PRODUCTS			
1.	Total Releases	Ci	1.42E-01	3.26E-01
2.	Total Estimated Error	%	2.00E+01	2.00E+01
3.	Average Diluted Concentration	µCi/ml	5.77E-10	3.02E-09
B.	TRITIUM			
1.	Total Release	Ci	1.54E+02	1.40E+01
2.	Estimated Total Error	%	1.00E+01	1.00E+01
3.	Average Diluted Concentration	µCi/ml	6.26E-07	1.30E-07
C.	DISSOLVED AND ENTRAINED GASES			
1.	Total Release	Ci	2.10E+01	6.62E-02
2.	Estimated Total Error	%	2.00E+01	2.00E+01
3.	Average Diluted Concentration	µCi/ml	8.54E-08	6.11E-10
4.	Percent of Applicable Limit	%	4.27E-02	3.06E-04
	GROSS ALPHA RADIOACTIVITY			
1.	Total Release	Ci	<LLD	<LLD
2.	Estimated Total Error	%	6.00E+01	6.00E+01
E.	VOLUME OF WASTE RELEASED	Liters	5.73E+07	1.06E+07
F.	VOLUME OF DILUTION WATER	Liters	2.46E+11	1.08E+11
G.	PERCENT OF 10CFR50 APPENDIX I			
	Quarterly Limit			
	Organ Liver	%	2.47E+00	2.68E+00
	Total Body	%	5.89E+00	5.88E+00
	Organ GI-LLI	%	1.20E-01	3.72E+00
	Annual Limit			
	Organ Liver	%	1.24E+00*	2.58E+00*
	Total Body	%	2.95E+00*	5.88E+00*
	Organ GI-LLI	%	6.02E-02*	1.92E+00*

*Cumulative total for the year-to-date.

TABLE IV-B
EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT - 1987
LIQUID EFFLUENTS

		CONTINUOUS MODE		BATCH MODE	
1. PARTICULATES	UNITS	1ST QUARTER	2ND QUARTER	1ST QUARTER	2ND QUARTER
Cr-51	Ci	<LLD	<LLD	2.69E-05	1.15E-02
Mn-54	Ci	<LLD	<LLD	9.98E-04	1.18E-02
Fe-55	Ci	4.80E-02	5.97E-04	2.31E-03	2.45E-03
Fe-59	Ci	<LLD	<LLD	<LLD	4.68E-03
Co-57	Ci	<LLD	<LLD	5.36E-05	3.69E-04
Co-58	Ci	<LLD	<LLD	6.31E-03	1.24E-01
Co-60	Ci	<LLD	<LLD	4.59E-02	2.71E-02
Sr-89	Ci	<LLD	<LLD	2.86E-07	7.09E-06
Sr-90	Ci	<LLD	<LLD	7.33E-08	6.31E-06
Zr-95	Ci	<LLD	<LLD	5.25E-06	3.32E-04
Nb-95	Ci	<LLD	<LLD	2.22E-05	2.43E-03
Ru-106	Ci	<LLD	<LLD	<LLD	5.13E-04
Ag-110m	Ci	<LLD	<LLD	2.51E-03	9.11E-03
Sn-113	Ci	<LLD	<LLD	1.10E-05	1.77E-04
Sb-124	Ci	<LLD	<LLD	4.58E-03	1.09E-01
Sb-125	Ci	<LLD	<LLD	9.89E-03	1.63E-02
I-131	Ci	<LLD	<LLD	1.27E-03	2.71E-04
I-133	Ci	<LLD	<LLD	4.98E-05	<LLD
Cs-134	Ci	<LLD	<LLD	5.57E-03	2.40E-05
Cs-137	Ci	<LLD	<LLD	1.37E-02	4.86E-03
Ba-139	Ci	<LLD	<LLD	6.34E-04	<LLD
Ba/La-140	Ci	<LLD	<LLD	<LLD	2.14E-04
Total for Period	Ci	4.80E-02	5.97E-04	9.38E-02	3.25E-01
2. GASES					
Kr-85m	Ci	<LLD	<LLD	1.59E-05	<LLD
Kr-85	Ci	<LLD	<LLD	1.83E-01	7.58E-03
Xe-131m	Ci	<LLD	<LLD	3.21E-01	4.90E-03
Xe-133m	Ci	<LLD	<LLD	1.67E-01	5.25E-03
Xe-133	Ci	<LLD	<LLD	2.03E+01	4.67E-02
Xe-135	Ci	<LLD	<LLD	2.81E-02	1.57E-03
Total for Period	Ci	<LLD	<LLD	2.10E+01	6.60E-02