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Robinson Nuclear Plant
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H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2
DOCKET NO. 50-261/LICENSE NO. DPR-23
1997 ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT

Sir or Madam:

The purpose of this letter is to transmit the 1997 Annual Radioactive Effluent Release Report for the period of January 1, 1997, through December 31, 1997, for the H. B. Robinson Steam Electric Plant (HBRSEP), Unit No. 2. This report is submitted in accordance with 10 CFR 50.36a(a)(2), and the HBRSEP, Unit No. 2 Technical Specifications, Section 5.6.3.

If you have any questions concerning this report, please contact Mr. H. K. Chernoff of my staff.

Very truly yours,

for T. M. Wilkerson

T. M. Wilkerson
Manager - Regulatory Affairs

Attachment
c: Mr. L. A. Reyes, USNRC Region II
Mr. J. W. Shea, USNRC
USNRC Resident Inspector, HBRSEP

1/1
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EFFLUENT AND WASTE DISPOSAL

ANNUAL REPORT

January 1, 1997 - December 31, 1997

CAROLINA POWER & LIGHT COMPANY

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2

FACILITY OPERATING LICENSE NO. DPR-23

DOCKET NO. 50-261

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I. EXECUTIVE SUMMARY

A. Discussion

1. Protection Standards

The main objective in the control of radiation is to ensure that any exposure is kept not only within regulatory limits, but As Low As Reasonably Achievable (ALARA). The ALARA concept applies to reducing radiation exposure both to workers at H. B. Robinson Steam Electric Plant (HBRSEP), Unit No. 2 and to the general public. "Reasonably achievable" means that radiation exposure reduction is based on sound environmental practices, economic decisions, and operating practices. By practicing ALARA, HBRSEP and Carolina Power & Light (CP&L) Company minimizes health risk and environmental detriment, and ensures that exposures are maintained well below regulatory limits.

2. Sources of Radioactivity Released

During normal operations of a nuclear power station, most of the fission products are retained within the fuel and fuel cladding. However, small quantities of radioactive fission and activation products are present in the reactor coolant water. The types of radioactive material released are noble gases, iodines and particulates, and tritium.

The noble gas fission products in the reactor coolant water are released as a gas when the coolant is depressurized. These gases are collected by a system designed for collection and storage for radioactive decay prior to release to the environment.

Small releases of radioactivity in liquids may occur from equipment associated with the reactor coolant system. These liquids are collected, processed for radioactivity removal, prior to and during release.

3. Noble Gas

Some of the fission products released in airborne effluents are radioactive isotopes of noble gases, such as krypton, argon, and xenon. Noble gases are by nature inert and do not concentrate in humans or other organisms. Noble gases contribute to human radiation exposure as external exposure. The major isotopes released are Argon-41, Xenon-133, and Xenon-135 with half-lives of approximately two hours, five days, and nine hours, respectively. Half-life is defined as the time required for a radioactive isotope to lose 50 percent of its radioactivity by decay. Noble gases are readily dispersed in the atmosphere.

4. Iodines and Particulates

Annual releases of iodines, and those particulates with half-lives greater than eight days are small. Factors such as chemical reactivity and solubility in water, combined with high processing efficiencies, minimize their discharge. The main contribution of radioactive iodine to human exposure is to the thyroid gland, where the body concentrates iodine. The principal radioactive particulates are Cobalt-58 and Cobalt-60 which contribute to internal exposure of tissues such as the muscle, liver, and intestines. These particulates can also be a source of exposure if deposited on the ground.

5. Tritium

Tritium, a radioactive isotope of hydrogen, is the predominate radionuclide in liquid and gaseous effluents. Tritium is produced in the reactor coolant as a result of neutron interaction with deuterium (also a hydrogen isotope) and boron, both of which are present in the reactor coolant. Tritium is a weak beta particle emmitter and contributes very little radiation exposure to the human body, and when tritium is inhaled or ingested it is dispersed throughout the body until eliminated.

6. Processing and Monitoring

Effluents are strictly controlled and monitored to ensure that radioactivity released to the environment is minimal and within regulatory limits. Effluent controls include the operation of radiation monitoring systems, in-plant and environmental sampling and analyses, quality assurance programs for both in-plant and environmental sampling and analyses, and procedures that address effluent and environmental monitoring.

The plant radiation monitoring system provides monitors that are designed to ensure that all releases are below regulatory limits. Each instrument provides indication of the amount of radioactivity present and is equipped with alarms and indicators in the control room. The alarm setpoints are set below the regulatory limits, i.e., typically at less than 50 percent of the regulatory limit, to ensure that the limits are not exceeded. If a monitor alarms, a release to the environment from a tank is automatically suspended. Additionally, releases are sampled and analyzed in the laboratory prior to discharge to the environment. The sampling and analysis done in the laboratory provides a more sensitive and precise method of determining pre-effluent composition than in-plant monitoring instruments.

The plant has a meteorological tower which is linked to computers that record the meteorological data. The meteorological data and the release data is used to calculate dose to the public.

In addition to in-plant equipment the company maintains a Radiological Environmental Monitoring Program which consists of devices used to sample the air and water in the environment. The samples collected from the surrounding environment are analyzed to determine the presence of radioactive material in the environment.

7. Exposure Pathways

Radiological exposure pathways are the methods by which people may become exposed to radioactive material. The major pathways of concern are those which could cause the highest calculated radiation dose. The projected pathways are determined from the type and amount of radioactive material that may have been released, the environmental transport mechanism, and the use of the environment.

Environmental transport mechanisms include, but are not limited to, hydrological (i.e.,water) and meteorological (i.e.,weather) characteristics of the area. Information on water flow, wind speed and direction, dietary intake of residents, recreational use of the area and location of homes and farms in the area are some of the many factors used to calculate the potential exposure to offsite personnel.

The release of radioactive gaseous effluents includes pathways such as external whole body exposure, deposition on plants and soils, and human inhalation. The release of radioactive material in liquid effluents includes pathways such as drinking water, fish consumption, and direct exposure from the lake at the shoreline and while swimming.

Even though radionuclides can reach humans by many different pathways, some radionuclides result in more exposure than others. The critical pathway is the exposure which will provide, for a specific radionuclide, the greatest exposure to a population, or a specific group of the population, called the critical group. The critical group may vary depending on the radionuclides involved, the age and diet of the group, and other cultural factors. The exposure may be received by the whole body or to a specific organ, with the organ receiving the largest fraction of the exposure called the critical organ.

The exposures to the general public in the area surrounding HBRSEP, Unit No. 2 are calculated for gaseous and liquid releases. The exposure due to radioactive material released in gaseous effluents is calculated using factors such as the amount of radioactive material released, the concentration beyond the site boundary, weather conditions at the time of release, locations of exposure pathways, and usage factors. The exposures calculated due to radioactive materials released in liquid effluents are calculated using factors such as the total volume of liquid, the total volume of dilution water, field irrigation, and usage factors.

8. Results

The Radioactive Effluent Release Report is a detailed listing of the radioactivity released from the HBRSEP, Unit No. 2 during the period from January 1, 1997, through December 31, 1997.

During the period of January 1, 1997, through December 31, 1997, the estimated maximum individual offsite dose due to radioactivity released in effluents was:

Liquid Effluents:

- Total Body Dose 0.00400 millirem
- Critical Organ Dose 0.00464 millirem, liver

Gaseous Effluents:

- Beta Air Dose 0.00728 millirad
- Gamma Air Dose 0.01840 millirad
- Critical Organ Dose 0.19300 millirem, lung

B. Significant Variances

The following are explanations of significant variances in this Annual Report:

1. The 10 CFR 50, Appendix I, doses were calculated from the last posted release for the period indicated using the Canberra (Offsite Dose Calculation Manual (ODCM)

meteorology) Effluent Management System (EMS). The following is a summary of the comparison of the annual dose commitment of the ODCM and LADTAP/GASPAR dose programs.

GASEOUS	UNITS	EMS(ODCM)	LADTAP/GASPAR
Annual Beta Air Dose	mrad	7.28E-03	2.73E-03
Annual Gamma Air Dose	mrad	1.84E-02	6.88E-03
I-131, I-133, Tritium & Part. >8 Day Half-Lives Dose	mrem	1.93E-01	5.00E-02
LIQUID			
Total Body Dose	mrem	4.00E-03	1.89E-03
Critical Organ Dose	mrem	4.64E-03	2.13E-03

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 (EMS Software) provides day-by-day dose estimates that are higher because all releases are assigned to the limiting receptor, using the continuous ground level dispersion factors calculated from 1978 meteorology.

The annual liquid dose commitment is lower with LADTAP because total annual dilution flow is used. Day-by-day dose estimates provided by the ODCM using EMS software utilizes dilution flow during actual release periods from HBRSEP, Unit No. 2 or Unit No. 1 only; not both.

2. HBRSEP Unit No. 2 ran at steady-state power operations for the entire year of 1997 with the exception of one shutdown. On November 16, 1997, the unit tripped from full power due to the failure of the shaft on "B" Condensate Pump. The Unit was returned to service on November 20 and remained on line for the remainder of 1997. The high capacity factor combined with continued good fuel and reactor coolant system integrity kept gaseous and liquid effluent totals relatively low in 1997. Some of the gaseous and liquid release parameters for this reporting period are summarized below:

GASEOUS EFFLUENTS	Units	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr
Fission & Act. Gas	Ci	2.96E-02	1.95E-02	8.80E-01	1.17E-01
I-131	Ci	8.24E-08	7.41E-08	1.18E-07	6.17E-08
Part. >8 Day Half-Lives	Ci	1.70E-05	<LLD	<LLD	<LLD
Tritium	Ci	2.61E+00	2.54E+00	4.66E+00	4.13E+00

3. Virtually all parameters associated with liquid effluents remained constant throughout the year. The fourth quarter tritium release curies are noticeably higher due to the unit shutdown in November. The shutdown and subsequent dilution to power operation so late in core life produced a large volume of reactor coolant letdown to be processed for release. The high waste volume in the third quarter is the result of the long unit run causing tritium to build up in the steam generator blowdown to the point that it became detectable. This produces a large volume of very low activity water when the blowdown is released (for chemistry considerations)

instead of being recovered. Some of the liquid release parameters for this reporting period are shown below:

LIQUID EFFLUENTS

	Units	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr
Fission & Act. Products	Ci	8.58E-03	1.31E-02	3.23E-03	1.81E-03
Tritium	Ci	8.80E+01	1.23E+02	1.63E+02	5.32E+02
Dilution Volume	Liters	2.68E+11	2.71E+11	2.80E+11	2.77E+11
Waste Volume	Liters	6.13E+06	8.78E+06	2.47E+07	6.11E+06

C. Regulatory Compliance

1. When projected on a day-by-day basis utilizing conservative meteorological conditions, the dose commitment from gaseous and liquid effluents is a small fraction of the 10 CFR 50, Appendix I limits. The direct radiation assessment to the most likely exposed member of the public is reported in the Annual Radiological Environmental Operating Report. During 1997 the results of the direct radiation assessment demonstrated no measurable effect above background for plant operations.

2. There were changes to the waste solidification Process Control Program (PCP) during this reporting period. See page 64.

3. There were no changes to the Radioactive Waste Systems (i.e.,liquid, gaseous, or solid) during this reporting period.

4. There were no reportable instrumentation inoperability events during this reporting period.

   The Radiation Monitor designated R-16 monitors service water from the containment fan coolers for radiation indicative of a leak from the containment atmosphere into the Service Water System. This monitor experienced intermittent periods of noise primarily during outages and during periods of high environmental humidity and low environmental temperature. No single inoperability exceeded the time limits in the ODCM for a reportable occurrence. The noise has been attributed to degraded shielding of the detector cable. By modification to the detector, the signal to noise ratio has been improved without impacting detector performance, and the noise problems have not reappeared since the modification was installed.

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

6. There were no Waste Gas Decay Tanks that exceeded the 1.9E+04 curie limit during this reporting period.

7. There was a revision to the ODCM during this reporting period. See page 61.

II. SUPPLEMENTAL INFORMATION

A. Regulatory Limits

1. Fission and Activation Gases:
   - 10 CFR 20 Limits (Instantaneous Release Rate)
     - Total Body Dose ≤500 mrem/yr
     - Skin Dose ≤3000 mrem/yr
   - 10 CFR 50, 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:
   - 10 CFR 20 Limits (Instantaneous Release Rate)
     - Dose from Inhalation (only) to a child to any organ ≤1500 mrem/yr
   - 10 CFR 50, Appendix I (Organ Doses)
     - For Calendar Quarter ≤7.5 mrem
     - For Calendar Year ≤15 mrem

3. Liquids:
   Concentrations are specified in 10 CFR 20, Appendix B, Table 2, 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.
   - 10 CFR 50, 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 radioactive gas is determined by the fraction of that radioactive gas 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 mixed mode batch releases are included in the iodine determination from the mixed mode continuous Reactor Auxiliary Building release.

   c. Particulates - The particulates from mixed mode batch releases are included in the particulate determination from the mixed mode continuous Reactor Auxiliary Building release. Ground level batch particulates are reported in the batch mode accountability.

   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 release 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

	Jan - June 1997	July - Dec 1997
Number of batch releases	3.90E+01	7.90E+01
Total time period for batch releases	1.70E+04 min	2.58E+04 min
Maximum time period for a batch release	1.75E+03 min	2.23E+03 min
Average time period for a batch release	4.37E+02 min	3.27E+02 min
Minimum time period for a batch release	1.30E+01 min	1.10E+01 min

B. Abnormal Releases

	Jan - June 1997	July - Dec 1997
Number of releases	0.00E+00	0.00E+00
Total activity released	0.00E+00 Ci	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	Typical Lower Limits of Detection for Gaseous Effluents

TABLE III-A
EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT - 1997
GASEOUS EFFLUENTS - SUMMATION OF ALL RELEASES

	Unit	Quarter 1	Quarter 2	Est. Total Error %
A. Fission and Activation Gases				
1. Total release	Ci	2.96E-02	1.95E-02	3.63E+01
2. Average release rate for period	µCi/sec	3.80E-03	2.48E-03	
B. Iodines				
1. Total Iodine-131	Ci	8.24E-08	7.41E-08	1.74E+01
2. Average release rate for period	µCi/sec	1.06E-08	9.43E-09	
C. Particulates				
1. Particulates with half-lives >8 days	Ci	1.70E-05	<LLD	1.05E+01
2. Average release rate for period	µCi/sec	2.18E-06	<LLD	
3. Gross alpha radioactivity	Ci	<LLD	<LLD	
D. Tritium				
1. Total release	Ci	2.61E+00	2.54E+00	2.31E+01
2. Average release rate for period	µCi/sec	3.36E-01	3.22E-01	
E. Percent of 10 CFR 50, Appendix I				
1. Quarterly limit				
Gamma air	%	8.52E-03	8.24E-03	
Beta air	%	1.79E-03	1.51E-03	
Organ: Lung	%	4.95E-01	---	
Organ: Thyroid	%	---	4.65E-01	
2. Annual limit				
Gamma air	%	4.26E-03*	8.38E-03*	
Beta air	%	8.95E-04*	1.65E-03*	
Organ: Lung	%	2.47E-01*	4.80E-01*	

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

TABLE III-A
(Continued)
EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT - 1997
GASEOUS EFFLUENTS - SUMMATION OF ALL RELEASES

	Unit	Quarter 3	Quarter 4	Est. Total Error %
A. Fission and Activation Gases				
1. Total release	Ci	8.80E-01	1.17E-01	3.63E+01
2. Average release rate for period	µCi/sec	1.11E-01	1.47E-02	
B. Iodines				
1. Total Iodine-131	Ci	1.18E-07	6.17E-08	1.74E+01
2. Average release rate for period	µCi/sec	1.49E-08	7.76E-09	
C. Particulates				
1. Particulates with half-lives >8 days	Ci	<LLD	<LLD	1.05E+01
2. Average release rate for period	µCi/sec	<LLD	<LLD	
3. Gross alpha radioactivity	Ci	<LLD	<LLD	
D. Tritium				
1. Total release	Ci	4.66E+00	4.13E+00	2.31E+01
2. Average release rate for period	µCi/sec	5.87E-01	5.19E-01	
E. Percent of 10 CFR 50, Appendix I				
1. Quarterly limit				
Gamma air	%	3.39E-01	1.29E-02	
Beta air	%	6.48E-02	4.72E-03	
Organ: Lung	%	8.55E-01	7.56E-01	
2. Annual limit				
Gamma air	%	1.77E-01*	1.84E-01*	
Beta air	%	3.41E-02*	3.64E-02*	
Organ: Lung	%	9.07E-01*	1.29E+00*	

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

TABLE III-B
EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT - 1997
GASEOUS EFFLUENTS - GROUND LEVEL AND MIXED MODE RELEASES

		Continuous Mode		Batch Mode	
Nuclides Released	Unit	Quarter 1	Quarter 2	Quarter 1	Quarter 2
1. Fission Gases					
Ar-41	Ci	<LLD	<LLD	1.74E-02	1.72E-02
Xe-131m	Ci	<LLD	<LLD	7.99E-06	9.04E-04
Xe-133	Ci	9.91E-03	<LLD	2.19E-03	1.32E-03
Xe-133m	Ci	<LLD	<LLD	2.06E-05	<LLD
Xe-135	Ci	<LLD	<LLD	2.26E-05	8.79E-08
Total for Period	Ci	9.91E-03	<LLD	1.97E-02	1.95E-02
2. Iodines[1]					
I-131	Ci	8.24E-08	7.41E-08	<LLD	<LLD
I-133	Ci	<LLD	9.11E-07	<LLD	<LLD
Total for Period	Ci	8.24E-08	9.85E-07	<LLD	<LLD
3. Particulates[1]					
Co-60	Ci	<LLD	<LLD	1.70E-05	<LLD
Total for Period	Ci	<LLD	<LLD	1.70E-05	<LLD

[1]Mixed mode continuous accountability includes mixed mode batch accountability (excludes tritium).

TABLE III-B
(Continued)
EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT - 1997
GASEOUS EFFLUENTS - GROUND LEVEL AND MIXED MODE RELEASES

		Continuous Mode		Batch Mode	
Nuclides Released	Unit	Quarter 3	Quarter 4	Quarter 3	Quarter 4
1. Fission Gases					
Ar-41	Ci	<LLD	<LLD	7.05E-01	2.30E-02
Kr-85	Ci	<LLD	<LLD	3.21E-02	3.32E-03
Kr-85m	Ci	<LLD	<LLD	1.65E-05	2.40E-04
Kr-87	Ci	<LLD	<LLD	1.63E-06	7.06E-05
Xe-131m	Ci	<LLD	<LLD	8.98E-04	6.58E-04
Xe-133	Ci	<LLD	<LLD	1.38E-01	8.43E-02
Xe-133m	Ci	<LLD	<LLD	1.78E-03	1.17E-03
Xe-135	Ci	<LLD	<LLD	1.72E-03	4.13E-03
Total for Period	Ci	<LLD	<LLD	8.79E-01	1.17E-01
2. Iodines[1]					
I-131	Ci	1.18E-07	6.17E-08	<LLD	<LLD
I-133	Ci	<LLD	1.16E-06	<LLD	<LLD
Total for Period	Ci	1.18E-07	1.22E-06	<LLD	<LLD
3. Particulates[1]					
Total for Period	Ci	<LLD	<LLD	<LLD	<LLD

[1]Mixed mode continuous accountability includes mixed mode batch accountability (excludes tritium).

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

Nuclide	LLD (μCi/cc)
H-3	1.00E-06
Ar-41	6.15E-09
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-85	2.35E-06
Kr-85m	6.36E-09
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	2.45E-07
I-133	1.00E-10
Xe-133	1.00E-04
Xe-133m	1.00E-04
Cs-134	1.00E-11
I-135	3.21E-10
Xe-135	1.00E-04
Xe-135m	1.85E-07
Cs-137	1.00E-11
Xe-138	1.00E-04
Ba-140	3.23E-14
La-140	8.55E-14
Ce-141	1.00E-11
Ce-144	1.00E-11
Gross Alpha	1.00E-11

IV. LIQUID EFFLUENTS

A. Batch Releases

	Jan - June 1997	July - Dec 1997
Number of batch releases	1.70E+01	3.40E+01
Total time period for batch releases	3.64E+03 min	6.93E+03 min
Maximum time period for a batch release	4.84E+02 min	3.18E+02 min
Average time period for a batch release	2.14E+02 min	2.04E+02 min
Minimum time period for a batch release	1.40E+02 min	1.90E+01 min
Average stream flow during release periods	5.46E+05 gpm	5.55E+05 gpm

B. Abnormal Releases

	Jan - June 1997	July - Dec 1997
Number of releases	0.00E+00	0.00E+00
Total activity released	0.00E+00 Ci	0.00E+00 Ci

C. Data Tables

The following tables provide the details of gaseous releases:

Table IV-A	Summation of all Releases
Table IV-B	Continuous and Batch Mode Releases
Table IV-C	Typical Lower Limits of Detection for Liquid Effluents

TABLE IV-A
EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT - 1997
LIQUID EFFLUENTS - SUMMATION OF ALL RELEASES

	Unit	Quarter 1	Quarter 2	Est. Total Error %
A. Fission and Activation Products				
1. Total release (not including tritium, gases, alpha)	Ci	8.58E-03	1.31E-02	1.07E+01
2. Average diluted concentration during period	µCi/ml	3.20E-11	4.84E-11	
B. Tritium				
1. Total release	Ci	8.80E+01	1.23E+02	9.20E+00
2. Average diluted concentration during period	µCi/ml	3.28E-07	4.53E-07	
C. Dissolved and entrained gases				
1. Total release	Ci	2.67E-04	3.95E-04	9.60E+00
2. Average diluted concentration during period	µCi/ml	9.95E-13	1.46E-12	
3. Percent of applicable limit	%	4.98E-07	7.30E-07	
D. Gross alpha radioactivity				
1. Total release	Ci	<LLD	<LLD	1.83E+01
E. Volume of waste released prior to dilution	Liters	6.13E+06	8.78E+06	
F. Volume of dilution water used during period	Liters	2.68E+11	2.71E+11	
G. Percent of 10CFR50, Appendix I				
1. Quarterly Limit Organ: Liver Total body	 % %	 2.83E-02 7.90E-02	 2.43E-02 6.86E-02	
2. Annual Limit Organ: Liver Total body	 % %	 1.41E-02* 3.97E-02*	 2.63E-02* 7.38E-02*	

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

TABLE IV-A
(Continued)
EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT - 1997
LIQUID EFFLUENTS - SUMMATION OF ALL RELEASES

	Unit	Quarter 3	Quarter 4	Est. Total Error %
A. Fission and Activation Products				
1. Total release (not including tritium, gases, alpha)	Ci	3.23E-03	1.81E-03	1.07E+01
2. Average diluted concentration during period	µCi/ml	1.15E-11	6.53E-12	
B. Tritium				
1. Total release	Ci	1.63E+02	5.32E+02	9.20E+00
2. Average diluted concentration during period	µCi/ml	5.82E-07	1.92E-06	
C. Dissolved and entrained gases				
1. Total release	Ci	3.14E-04	2.04E-02	9.60E+00
2. Average diluted concentration during period	µCi/ml	1.12E-12	7.36E-11	
3. Percent of applicable limit	%	5.60E-07	3.68E-05	
D. Gross alpha radioactivity				
1. Total release	Ci	<LLD	<LLD	1.83E+01
E. Volume of waste released prior to dilution	Liters	2.47E+07	6.11E+06	
F. Volume of dilution water used during period	Liters	2.80E+11	2.77E+11	
G. Percent of 10CFR50, Appendix I				
1. Quarterly Limit Organ: Liver Total body	 % %	 2.74E-02 7.91E-02	 1.28E-02 4.02E-02	
2. Annual Limit Organ: Liver Total body	 % %	 4.00E-02* 1.13E-01*	 4.64E-02* 1.33E-01*	

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

TABLE IV-B
EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT - 1997
LIQUID EFFLUENTS - CONTINUOUS MODE AND BATCH MODE RELEASES

		Continuous Mode		Batch Mode	
Nuclides Released	Unit	Quarter 1	Quarter 2	Quarter 1	Quarter 2
H-3	Ci	1.52E-02	2.62E-02	8.80E+01	1.23E+02
Cr-51	Ci	<LLD	<LLD	6.67E-05	<LLD
Mn-54	Ci	<LLD	<LLD	1.38E-05	<LLD
Fe-55	Ci	<LLD	<LLD	5.98E-04	1.10E-02
Co-57	Ci	<LLD	<LLD	3.66E-06	5.65E-06
Co-58	Ci	<LLD	<LLD	2.02E-03	5.66E-04
Co-60	Ci	<LLD	<LLD	4.45E-03	5.77E-04
Ag-110m	Ci	<LLD	<LLD	7.20E-04	1.22E-04
Sb-125	Ci	<LLD	<LLD	6.51E-04	8.67E-04
Cs-137	Ci	<LLD	<LLD	5.99E-05	1.66E-05
Total for Period	Ci	<LLD	<LLD	8.58E-03	1.31E-02
Xe-133	Ci	<LLD	<LLD	2.67E-04	3.95E-04
Total for Period	Ci	<LLD	<LLD	2.67E-04	3.95E-04

TABLE IV-B
(Continued)
EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT - 1997
LIQUID EFFLUENTS - CONTINUOUS MODE AND BATCH MODE RELEASES

		Continuous Mode		Batch Mode	
Nuclides Released	Unit	Quarter 3	Quarter 4	Quarter 3	Quarter 4
H-3	Ci	2.38E-02	5.33E-03	1.63E+02	5.32E+02
Fe-55	Ci	<LLD	<LLD	1.91E-03	7.07E-04
Co-58	Ci	<LLD	<LLD	4.49E-05	<LLD
Co-60	Ci	<LLD	<LLD	1.01E-03	1.01E-03
Nb-95m	Ci	<LLD	<LLD	<LLD	1.54E-05
Ag-110m	Ci	<LLD	<LLD	6.45E-06	2.89E-06
Sn-117m	Ci	<LLD	<LLD	<LLD	1.35E-06
Sb-125	Ci	<LLD	<LLD	1.89E-04	4.01E-05
Cs-134	Ci	<LLD	<LLD	<LLD	2.64E-07
Cs-137	Ci	<LLD	<LLD	7.21E-05	3.02E-05
Total for Period	Ci	<LLD	<LLD	3.23E-03	1.81E-03
Xe-131m	Ci	<LLD	<LLD	1.38E-05	2.12E-04
Xe-133	Ci	<LLD	<LLD	2.89E-04	2.00E-02
Xe-133m	Ci	<LLD	<LLD	<LLD	1.41E-04
Xe-135	Ci	<LLD	<LLD	1.05E-05	3.88E-05
Total for Period	Ci	<LLD	<LLD	3.14E-04	2.03E-02

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

Nuclide	LLD (μCi/ml)
H-3	1.00E-05
Cr-51	8.96E-08
Mn-54	5.00E-07
Fe-55	1.00E-06
Co-57	7.19E-09
Co-58	5.00E-07
Fe-59	5.00E-07
Co-60	5.00E-07
Zn-65	5.00E-07
Sr-89	5.00E-08
Sr-90	5.00E-08
Nb-95	1.86E-08
Nb-95m	2.98E-08
Zr-95	3.34E-08
Mo-99	5.00E-07
Tc-99m	1.64E-08
Ag-110m	1.71E-08
Sn-117m	6.84E-09
Sb-125	3.81E-08
I-131	1.00E-06
Xe-131m	1.00E-05
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-140	5.79E-08
La-140	4.23E-08
Ce-141	5.00E-07
Ce-144	5.00E-07
Gross Alpha	1.00E-07

V. SOLID WASTE AND IRRADIATED FUEL SHIPMENTS
Report Time Period January 1, 1997, Through December 31, 1997

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

Waste Class A

Type of Waste	Unit	Period Total	Est. Total Error (%)	Solid. Agent	Cont. Type	Form	No. Ship.
a. Spent resins, filter sludges, evaporator bottoms, etc.	m^3 Ci	1.76E-01 3.76E-01	2.20E+01 2.20E+01	None	HIC	Dewatered resin	1
b. Dry compressible waste, contaminated equipment, etc.	m^3 Ci	9.55E+00 1.96E-01	2.20E+01 2.20E+01	None	STP	Compacted/ Incinerable	29
c. Irradiated components, control rods, etc.	m^3 Ci	NA	NA	NA	NA	NA	NA
d. Other (describe)	m^3 Ci	NA	NA	NA	NA	NA	NA

HIC = High Integrity Container
STP = Strong Tight Package

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

	%	Ci
a. H-3	8.85E+00	3.33E-02
Fe-55	2.16E+01	8.12E-02
Co-58	7.84E+00	2.95E-02
Co-60	3.14E+01	1.18E-01
Ni-63	1.97E+01	7.42E-02
Cs-137	4.97E+00	1.87E-02
* Others	5.69E+00	2.14E-02

b. H-3	8.72E+00	1.71E-02
Fe-55	3.58E+01	7.03E-02
Co-58	3.12E+00	6.12E-03
Co-60	1.89E+01	3.70E-02
Ni-63	1.64E+01	3.21E-02
Cs-137	1.19E+01	2.34E-02
** Others	5.15E+00	1.01E-02

3. Solid Waste Disposition

Number of Shipments 30
Mode of Transportation Sole Use Vehicle
Destination Barnwell, S.C.

* Others include: C-14, Mn-54, Sr-90, Cs-134, Pu-238.

** Others include: C-14, Cr-51, Mn-54, Co-57, Kr-85, Sr-85, Nb-95, Zr-95, Tc-99, Cd-109, Ag-110m, Sn-113, I-129, Cs-134, Ce-139,Ce-144, Hg-205,
Am-241.

Total Curie Quantity and Principle Radionuclides were determined by Estimate.

V. SOLID WASTE AND IRRADIATED FUEL SHIPMENTS
Report Time Period January 1, 1997, Through December 31, 1997

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

Waste Class C

Type of Waste	Unit	Period Total	Est. Total Error (%)	Solid. Agent	Cont. Type	Form	No. Ship.
a. Spent resins, filter sludges, evaporator bottoms, etc.	m^3 Ci	5.92E+00 2.29E+01	2.20E+01 2.20E+01	None	HIC	Dewatered filters	2
b. Dry compressible waste, contaminated equipment, etc.	m^3 Ci	NA	NA	NA	NA	NA	NA
c. Irradiated components, control rods, etc.	m^3 Ci	NA	NA	NA	NA	NA	NA
d. Other (describe)	m^3 Ci	NA	NA	NA	NA	NA	NA

HIC = High Integrity Container

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

	%	Ci
a. H-3	9.18E+00	2.10E+00
C-14	2.02E+00	4.63E-01
Fe-55	3.31E+01	7.56E+00
Co-60	4.81E+01	1.10E+01
Ni-63	4.94E+00	1.13E+00
Ag-110m	7.70E-01	1.76E-01
Ce-144	1.65E+00	3.78E-01
* Others	2.68E-01	6.14E-02

3. Solid Waste Disposition

Number of Shipments 2
Mode of Transportation Sole Use Vehicle
Destination Barnwell, S.C.

* Others include: Ni-59, Sr-90, Cs-137, Pu-238, Np-237, Pu-239/240, Am-241, Pu-241, Cm-242, Cm-243/244.

C. IRRADIATED FUEL SHIPMENTS
Number of Shipments 3
Mode of Transportation Exclusive Use
Destination Shearon Harris Nuclear Plant
New Hill, North Carolina

Total Curie Quantity and Principle Radionuclides were determined by Estimate.

VI. ANNUAL GASEOUS DOSE ASSESSMENTS

A. Population Distribution

The population distribution was taken from the Updated Final Safety Analysis Report (UFSAR) Section 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 Shearon Harris Energy and Environmental Center.

C. Food Production Totals

The total quantity of vegetable products within a 50 mile radius of the HBRSEP, Unit No. 2 is 1.81E+07 kilograms per year.

The total quantity of meat and egg production within a 50 mile radius of the plant is 4.23E+08 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 annual source terms were segregated by modes of release (mixed mode batch, mixed mode continuous, ground level continuous, and ground level batch) for dose calculations.

The concurrent meteorology calculations were performed using the XOQDOQ program with open terrain/recirculation factors, derived from 1978 Dames and Moore study, 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 batch releases are not random.

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.

E. Maximum Individual Doses

To demonstrate conformance with 10 CFR 50, 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 HBRSEP site based on 1985 through 1997 land use census reports.

Doses for the Hypothetical Maximum Individual at the site boundary are summarized in 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.

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

F. Integrated Population Doses

Since there is no known milk production within the five mile radius of the HBRSEP, 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 1997.

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 assess the onsite total integrated and recreational population doses from gaseous effluents during 1997:

Activity	Location	Usage
Spouses in parking lot	East lot	6 people/day, 15 min/day, 240 days/yr
Spouses in parking lot	West lot	2 people/day, 15 min/day, 240 days/yr
Picnicking	Picnic area	10 picnics/yr, 100 people/picnic, 4 hrs/picnic
Occupational	Darlington County Plant	17 employees, 240 days/yr, 8 hrs/day
Occupational	Visitor Center	1 employee, 240 days/yr, 8 hrs/day
Visits	Visitor Center	4000 visits/yr, 2 hrs/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 exposure pathways were used for the dose assessment based on the activities listed below:

Activity	Exposure Pathway
Spouses in parking lot	Ground plane, inhalation, plume
Picnicking	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

3. The assumptions below were used for the dose assessment of the maximum onsite individual:

a. The maximum onsite individual is an adult.
b. The exposure pathways are the same as in 2 above.
c. The site usage assumptions are as follows:

Activity or Location	Distance (meters)	Sector	Total Hours
Swimming	803	E	68
	803	ENE	68
	803	NE	68
	2414	NNE	68
	3219	N	68
Boating	803	E	38
	803	ENE	38
	803	NE	38
	2414	NNE	38
	3219	N	38
Fishing	803	E	80
	803	ENE	80
	803	NE	80
	2414	NNE	80
	3219	N	80
Shoreline	1303	ENE	170
	2529	NE	170
Visitor Center	302	S	2
Darlington County Plant	1062	NNW	1920
Picnic area	402	SE	40
West parking lot	402	SW	60
East parking lot	201	SE	60

4. The following data was used in assessing integrated onsite dose:

Lake Robinson

Distance (meters)	Sector	Total hours	% of lake surface	=	Hours	Person-yrs
3219	N	1.25E+06	71	=	8.875E+05	101
2414	NNE	1.25E+06	13	=	1.625E+05	19
803	NE	1.25E+06	8	=	1.000E+05	11
803	ENE	1.25E+06	6	=	7.500E+04	9
803	E	1.25E+06	2	=	2.500E+04	3
			TOTAL	=	1.250E+06	143

Occupational

Meters	Location	Sector	Total hours	Person-yrs
1062	Darlington County Plant	NNW	3.26E+04	4
302	Visitor Center	S	1.92E+03	1

Other

Meters	Location	Sector	Total Hours	Person-yrs
201	East Lot	SE	3.60E+02	0.1
402	West Lot	SW	1.20E+02	1
402	Picnic Area	SE	4.00E+03	0.9
302	Visitor Center	S	8.00E+03	1
2529	Easterling's/ Atkinson's Landing	NE	3.63E+05	42
1303	Johnson's Landing	ENE	3.63E+05	41

H. DATA TABLES

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

Table VI-A Hypothetical Site Boundary Maximum Individual Doses for 1997
Table VI-B True Offsite Maximum Individual Doses for 1997
Table VI-C Onsite Hypothetical Maximum Individual Doses for 1997
Table VI-D Offsite Annual Integrated Population Dose Summary for 1997
Table VI-E Onsite Annual Integrated and Recreational Population Doses for 1997

TABLE VI-A
GASEOUS PATHWAY
HYPOTHETICAL SITE BOUNDARY MAXIMUM INDIVIDUAL DOSES FOR 1997
(millirem)

Annual Beta Air Dose = 2.87E-03 millirads
Annual Gamma Air Dose = 7.22E-03 millirads

Sector: South-Southwest
Distance: 467.0 meters

Adult	Total body	GI-tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
Plume	4.80E-03	4.80E-03	4.80E-03	4.80E-03	4.80E-03	4.80E-03	4.80E-03	7.81E-03
Ground plane	3.44E-03	3.44E-03	3.44E-03	3.44E-03	3.44E-03	3.44E-03	3.44E-03	4.05E-03
Inhalation	1.06E-02	1.06E-02	1.18E-08	1.06E-02	1.06E-02	1.06E-02	1.07E-02	1.06E-02
Vegetation	1.92E-02	1.96E-02	3.76E-08	1.92E-02	1.92E-02	1.92E-02	1.92E-02	1.92E-02
Meat & Poultry	2.77E-03	2.90E-03	3.19E-09	2.76E-03	2.76E-03	2.76E-03	2.76E-03	2.76E-03
Total	4.09E-02	4.14E-02	8.24E-03	4.08E-02	4.08E-02	4.08E-02	4.09E-02	4.44E-02

Teenager	Total body	GI-tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
Plume	4.80E-03	4.80E-03	4.80E-03	4.80E-03	4.80E-03	4.80E-03	4.80E-03	7.81E-03
Ground plane	3.44E-03	3.44E-03	3.44E-03	3.44E-03	3.44E-03	3.44E-03	3.44E-03	4.05E-03
Inhalation	1.07E-02	1.07E-02	1.66E-08	1.07E-02	1.07E-02	1.07E-02	1.08E-02	1.07E-02
Vegetation	2.20E-02	2.24E-02	3.57E-08	2.20E-02	2.20E-02	2.20E-02	2.20E-02	2.20E-02
Meat & poultry	1.66E-03	1.72E-03	2.65E-09	1.65E-03	1.64E-03	1.65E-03	1.64E-03	1.64E-03
Total	4.26E-02	4.31E-02	8.24E-03	4.26E-02	4.25E-02	4.25E-02	4.27E-02	4.61E-02

TABLE VI-A
(Continued)
GASEOUS PATHWAY
HYPOTHETICAL SITE BOUNDARY MAXIMUM INDIVIDUAL DOSES FOR 1997
(millirem)

Child	Total body	GI-tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
Plume	4.80E-03	4.80E-03	4.80E-03	4.80E-03	4.80E-03	4.80E-03	4.80E-03	7.81E-03
Ground plane	3.44E-03	3.44E-03	3.44E-03	3.44E-03	3.44E-03	3.44E-03	3.44E-03	4.05E-03
Inhalation	9.45E-03	9.45E-03	2.26E-08	9.45E-03	9.45E-03	9.46E-03	9.56E-03	9.45E-03
Vegetation	3.42E-02	3.43E-02	6.62E-08	3.41E-02	3.40E-02	3.40E-02	3.40E-02	3.40E-02
Meat & poultry	2.01E-03	2.03E-03	4.92E-09	1.99E-03	1.99E-03	1.99E-03	1.99E-03	1.99E-03
Total	5.39E-02	5.40E-02	8.24E-03	5.37E-02	5.37E-02	5.37E-02	5.38E-02	5.73E-02

Infant	Total body	GI-tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
Plume	4.80E-03	4.80E-03	4.80E-03	4.80E-03	4.80E-03	4.80E-03	4.80E-03	7.81E-03
Ground plane	3.44E-03	3.44E-03	3.44E-03	3.44E-03	3.44E-03	3.44E-03	3.44E-03	4.05E-03
Inhalation	5.44E-03	5.44E-03	1.80E-08	5.44E-03	5.44E-03	5.44E-03	5.50E-03	5.44E-03
Total	1.37E-02	1.37E-02	8.24E-03	1.37E-02	1.37E-02	1.37E-02	1.37E-02	1.73E-02

TABLE VI-B
GASEOUS PATHWAY
TRUE OFFSITE MAXIMUM INDIVIDUAL DOSES FOR 1997
(millirem)

Annual Beta Air Dose = 2.73E-03 millirads
Annual Gamma Air Dose = 6.88E-03 millirads

Sector: South-southwest
Distance: 482.8 Meters

Adult	Total body	GI-tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
Plume	4.57E-03	4.57E-03	4.57E-03	4.57E-03	4.57E-03	4.57E-03	4.57E-03	7.44E-03
Ground plane	3.25E-03	3.25E-03	3.25E-03	3.25E-03	3.25E-03	3.25E-03	3.25E-03	3.82E-03
Inhalation	1.02E-02	1.03E-02	1.12E-08	1.02E-02	1.02E-02	1.03E-02	1.03E-02	1.02E-02
Total	3.66E-02	3.70E-02	7.82E-03	3.66E-02	3.66E-02	3.66E-02	3.66E-02	4.00E-02

Teenager	Total body	GI-tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
Plume	4.57E-03	4.57E-03	4.57E-03	4.57E-03	4.57E-03	4.57E-03	4.57E-03	7.44E-03
Ground plane	3.25E-03	3.25E-03	3.25E-03	3.25E-03	3.25E-03	3.25E-03	3.25E-03	3.82E-03
Inhalation	1.03E-02	1.03E-02	1.57E-08	1.03E-02	1.03E-02	1.03E-02	1.04E-02	1.03E-02
Total	3.94E-02	3.98E-02	7.82E-03	3.93E-02	3.93E-02	3.93E-02	3.94E-02	4.28E-02

TABLE VI-B
(Continued)
GASEOUS PATHWAY
TRUE OFFSITE MAXIMUM INDIVIDUAL DOSES FOR 1997
(millirem)

Child	Total body	GI-tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
Plume	4.57E-03	4.57E-03	4.57E-03	4.57E-03	4.57E-03	4.57E-03	4.57E-03	7.44E-03
Ground plane	3.25E-03	3.25E-03	3.25E-03	3.25E-03	3.25E-03	3.25E-03	3.25E-03	3.82E-03
Inhalation	9.12E-03	9.12E-03	2.14E-08	9.12E-03	9.12E-03	9.12E-03	9.22E-03	9.12E-03
Total	4.99E-02	5.00E-02	7.82E-03	4.98E-02	4.97E-02	4.98E-02	4.98E-02	5.32E-02

Infant	Total body	GI-tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
Plume	4.57E-03	4.57E-03	4.57E-03	4.57E-03	4.57E-03	4.57E-03	4.57E-03	7.44E-03
Ground plane	3.25E-03	3.25E-03	3.25E-03	3.25E-03	3.25E-03	3.25E-03	3.25E-03	3.82E-03
Inhalation	5.24E-03	5.24E-03	1.71E-08	5.24E-03	5.24E-03	5.25E-03	5.31E-03	5.24E-03
Total	1.31E-02	1.31E-02	7.82E-03	1.31E-02	1.31E-02	1.31E-02	1.31E-02	1.65E-02

TABLE VI-C
GASEOUS PATHWAY
ONSITE HYPOTHETICAL MAXIMUM INDIVIDUAL DOSES FOR 1997
(millirem)

Annual Beta Air Dose = 5.29E-05 millirads
Annual Gamma Air Dose = 1.31E-04 millirads

Sector: North-northwest
Distance: 1062.0 Meters

Adult	Total body	GI-tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
Plume	8.73E-05	8.73E-05	8.73E-05	8.73E-05	8.73E-05	8.73E-05	8.74E-05	1.42E-04
Ground plane	1.99E-04	1.99E-04	1.99E-04	1.99E-04	1.99E-04	1.99E-04	1.99E-04	2.34E-04
Inhalation	3.81E-04	3.82E-04	4.52E-10	3.81E-04	3.81E-04	3.82E-04	3.93E-04	3.81E-04
Total	6.67E-04	6.68E-04	2.86E-04	6.67E-04	6.67E-04	6.68E-04	6.79E-04	7.57E-04

TABLE VI-D
GASEOUS PATHWAY
OFFSITE ANNUAL INTEGRATED POPULATION DOSE SUMMARY FOR 1997
(person-rem)

Pathway	Total body	GI-tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
Plume	3.75E-04	3.75E-04	3.75E-04	3.75E-04	3.75E-04	3.75E-04	3.77E-04	7.11E-04
Ground plane	8.76E-05	8.76E-05	8.76E-05	8.76E-05	8.76E-05	8.76E-05	8.76E-05	1.03E-04
Inhalation	7.00E-03	7.00E-03	8.52E-09	7.00E-03	7.00E-03	7.00E-03	7.01E-03	7.00E-03
Vegetation	7.30E-04	7.31E-04	9.58E-10	7.30E-04	7.30E-04	7.30E-04	7.30E-04	7.30E-04
Cow milk	5.40E-04	5.40E-04	2.45E-10	5.40E-04	5.40E-04	5.40E-04	5.40E-04	5.40E-04
Meat & poultry	6.59E-04	6.60E-04	2.15E-10	6.58E-04	6.58E-04	6.58E-04	6.58E-04	6.58E-04
Total	9.39E-03	9.39E-03	4.63E-04	9.39E-03	9.39E-03	9.39E-03	9.41E-03	9.74E-03

TABLE VI-E
GASEOUS PATHWAY
ONSITE ANNUAL INTEGRATED AND RECREATIONAL POPULATION DOSES FOR 1997
(person-rem)

Pathway	Total body	GI-tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
Plume	5.87E-05	5.87E-05	5.87E-05	5.87E-05	5.87E-05	5.87E-05	5.87E-05	1.07E-04
Ground plane	1.91E-05	1.91E-05	1.91E-05	1.91E-05	1.91E-05	1.91E-05	1.91E-05	2.25E-05
Inhalation	3.99E-04	3.99E-04	5.43E-10	3.99E-04	3.99E-04	3.99E-04	4.02E-04	3.99E-04
Total	4.77E-04	4.77E-04	7.78E-05	4.77E-04	4.77E-04	4.77E-04	4.79E-04	5.28E-04

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, "Calculation of Annual Doses to Man From Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance With 10 CFR Part 50, Appendix I," 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

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

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

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

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

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

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 Lake 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:

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

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

For Lake 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

$$\frac{f_2}{v} = \frac{2.15E8m^3/yr}{5.06E7m^3} = 4.24 \text{ per year.}$$

Thus, ignoring normal 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 HBRSEP liquid discharge. Therefore, no pathways involving potable water are evaluated.

3. Irrigated Foods

Located ten miles east of the HBRSEP site, the Auburndale Plantation uses water from Black Creek for irrigating during dry seasons. 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 = 4.80E+02 hours
3. Irrigation Rate = 1.00E+02 liter/m^2/month
4. Non-irrigated Feed Fraction = 9.00E-01
5. Total 50 Mile Production = 4.23E+08 kg/yr
6. Total Meat Irrigated = 1.26E+06 kg/yr
7. Food Process Time = 4.80E+02 hours

b. Produce

1. Irrigation rate = 1.00E+02 liters/m^2/month
2. Total 50 mile production = 1.81E+07 kg/yr
3. Total crop irrigation = 4.40E+03 kg/yr

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 = 2.33E+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 HBRSEP, 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 assessing doses from each of the swimming, boating, and shoreline recreational pathways. These assumptions are summarized as follows:

Activity	Age	Usage
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	1 boat/day, 2 people/boat, 180 days/yr, 5.6 hrs/day
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 of 10 CFR 50, 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 Specification. 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 HBRSEP site (inclusive of the onsite doses) are summarized in Table VII-C.

F. Data Tables

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

Table VII-A	Hypothetical Maximum Individual Doses for 1997
Table VII-B	Lake Robinson (onsite) Annual Integrated and Recreational Population Doses for 1997
Table VII-C	Annual Integrated Population Dose Summary for 1997

TABLE VII-A
LIQUID PATHWAY
HYPOTHETICAL MAXIMUM INDIVIDUAL DOSES FOR 1997
(millirem)

Adult Doses

Pathway	Skin	Bone	Liver	Total body	Thyroid	Kidney	Lung	Gi-lli
Fish	0.00E+00	5.19E-04	2.05E-03	1.82E-03	1.37E-03	1.58E-03	1.46E-03	1.67E-03
Shoreline	7.31E-05	6.22E-05	6.22E-05	6.22E-05	6.22E-05	6.22E-05	6.22E-05	6.22E-05
Swimming	0.00E+00	5.88E-06	5.88E-06	5.88E-06	5.88E-06	5.88E-06	5.88E-06	5.88E-06
Boating	0.00E+00	3.92E-06	3.92E-06	3.92E-06	3.92E-06	3.92E-06	3.92E-06	3.92E-06
Total	7.31E-05	5.91E-04	2.12E-03	1.89E-03	1.44E-03	1.65E-03	1.54E-03	1.74E-03

	Usage (kg/yr, hr/yr)	Dilution	Time(hr)	Shore width factor = 0.3
Fish	21.0	1.2	24.0	
Shoreline	12.0	1.2	0.0	
Swimming	180.0	1.2	0.0	
Boating	240.0	1.2	0.0	

TABLE VII-A
(Continued)
LIQUID PATHWAY
HYPOTHETICAL MAXIMUM INDIVIDUAL DOSES FOR 1997
(millirem)

Teenager Doses

Pathway	Skin	Bone	Liver	Total body	Thyroid	Kidney	Lung	Gi-lli
Fish	0.00E+00	5.54E-04	1.76E-03	1.32E-03	1.05E-03	1.27E-03	1.17E-03	1.26E-03
Shoreline	4.08E-04	3.48E-04	3.48E-04	3.48E-04	3.48E-04	3.48E-04	3.48E-04	3.48E-04
Swimming	0.00E+00	1.18E-05	1.18E-05	1.18E-05	1.18E-05	1.18E-05	1.18E-05	1.18E-05
Boating	0.00E+00	5.88E-06	5.88E-06	5.88E-06	5.88E-06	5.88E-06	5.88E-06	5.88E-06
Total	4.08E-04	9.19E-04	2.13E-03	1.69E-03	1.42E-03	1.64E-03	1.53E-03	1.63E-03

	Usage (kg/yr, hr/yr)	Dilution	Time(hr)	Shore width factor = 0.3
Fish	16.0	1.2	24.0	
Shoreline	67.0	1.2	0.0	
Swimming	360.0	1.2	0.0	
Boating	360.0	1.2	0.0	

TABLE VII-A
(Continued)
LIQUID PATHWAY
HYPOTHETICAL MAXIMUM INDIVIDUAL DOSES FOR 1997
(millirem)

Child Doses

Pathway	Skin	Bone	Liver	Total body	Thyroid	Kidney	Lung	Gi-lli
Fish	0.00E+00	7.01E-04	1.52E-03	1.00E-03	8.70E-04	1.06E-03	9.64E-04	9.44E-04
Shoreline	8.53E-05	7.26E-05	7.26E-05	7.26E-05	7.26E-05	7.26E-05	7.26E-05	7.26E-05
Swimming	0.00E+00	8.82E-06	8.82E-06	8.82E-06	8.82E-06	8.82E-06	8.82E-06	8.82E-06
Boating	0.00E+00	2.94E-06	2.94E-06	2.94E-06	2.94E-06	2.94E-06	2.94E-06	2.94E-06
Total	8.53E-05	7.85E-04	1.60E-03	1.09E-03	9.54E-04	1.15E-03	1.05E-03	1.03E-03

	Usage (kg/yr, hr/yr)	Dilution	Time(hr)	Shore width factor = 0.3
Fish	6.9	1.2	24.0	
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 1997
(person-rem)

Pathway	Bone	Liver	Total body	Thyroid	Kidney	Lung	Gi-lli	Skin
Fish	2.47E-04	8.56E-04	7.21E-04	5.54E-04	6.48E-04	5.97E-04	6.64E-04	0.00E+00
Shoreline	3.73E-03	3.73E-03	3.73E-03	3.73E-03	3.73E-03	3.73E-03	3.73E-03	4.39E-03
Swimming	1.18E-05	1.18E-05	1.18E-05	1.18E-05	1.18E-05	1.18E-05	1.18E-05	0.00E+00
Boating	4.77E-06	4.77E-06	4.77E-06	4.77E-06	4.77E-06	4.77E-06	4.77E-06	0.00E+00
Total	3.99E-03	4.60E-03	4.47E-03	4.30E-03	4.39E-03	4.34E-03	4.41E-03	4.39E-03

TABLE VII-C
LIQUID PATHWAY
ANNUAL INTEGRATED POPULATION DOSE SUMMARY FOR 1997
(person-rem)

Pathway	Bone	Liver	Total body	Thyroid	Kidney	Lung	Gi-lli	Skin
Fish	5.12E-04	1.78E-03	1.50E-03	1.1E-03	1.34E-03	1.24E-03	1.38E-03	0.00E+00
Shoreline	6.5E-03	6.57E-03	6.57E-03	6.57E-03	6.57E-03	6.57E-03	6.57E-03	7.72E-03
Swimming	1.86E-05	1.86E-05	1.86E-05	1.86E-05	1.86E-05	1.86E-05	1.86E-05	0.00E+00
Boating	5.27E-06	5.27E-06	5.27E-06	5.27E-06	5.27E-06	5.27E-06	5.27E-06	0.00E+00
Irri. Veg.	1.72E-06	3.22E-04	3.22E-04	3.21E-04	3.21E-04	3.21E-04	3.28E-04	0.00E+00
Irri. Leafy veg.	7.33E-06	1.57E-03	1.57E-03	1.56E-03	1.56E-03	1.57E-03	1.61E-03	0.00E+00
Irri. Meat	1.16E-05	3.20E-04	3.16E-04	3.11E-04	3.11E-04	3.15E-04	3.41E-04	0.00E+00
Total	7.13E-03	1.06E-02	1.03E-02	9.94E-03	1.01E-02	1.00E-02	1.03E-02	7.72E-03

VIII. 40 CFR 190 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. Since no 10 CFR 50, Appendix I, limits have been exceeded and the evaluation of the Independent Spent Fuel Storage Installation indicates only a small fraction of the total dose to the environs, this demonstrates conformance with 40 CFR 190, "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, 1997, through December 31, 1997.

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
0.8	1.7	3.7	35.5	38.2	11.9	8.2

2. Wind Speed — 10 Meter

Average Speed (mph)	4.67
Percent Calm	0.02
Percent Less than 3.5 mph	40.46

3. Wind Direction — 10 Meter

Prevailing	SSW
Percent Occurrence	11.20

TABLE IX-A JOINT OCCURRENCE FREQUENCIES FOR LOWNDDEG AND LOWNDSPD - CONTINUOUS RELEASES

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION ATMOSPHERIC STABILITY CLASS A

UMAX (M/S)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
0.34	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1.56	0.000	0.000	0.000	0.000	0.000	0.013	0.013	0.000	0.000	0.013	0.013	0.000	0.000	0.000	0.000	0.000	0.052
3.35	0.039	0.065	0.039	0.092	0.065	0.013	0.078	0.039	0.000	0.000	0.013	0.013	0.013	0.000	0.000	0.000	0.471
5.59	0.052	0.078	0.026	0.013	0.000	0.000	0.000	0.026	0.026	0.000	0.000	0.000	0.000	0.013	0.013	0.000	0.249
8.27	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11.18	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
24.59	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	0.09	0.14	0.07	0.10	0.07	0.03	0.09	0.07	0.03	0.01	0.03	0.01	0.01	0.01	0.01	0.00	0.77

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION ATMOSPHERIC STABILITY CLASS B

UMAX (M/S)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
0.34	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1.56	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.013	0.000	0.000	0.000	0.000	0.013	0.013	0.000	0.039
3.35	0.105	0.052	0.065	0.157	0.078	0.078	0.157	0.092	0.052	0.052	0.092	0.105	0.052	0.052	0.013	0.013	1.217
5.59	0.039	0.065	0.039	0.013	0.000	0.000	0.000	0.000	0.013	0.013	0.052	0.039	0.000	0.052	0.026	0.052	0.406
8.27	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11.18	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
24.59	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	0.14	0.12	0.10	0.17	0.08	0.08	0.16	0.09	0.08	0.07	0.14	0.14	0.05	0.12	0.05	0.07	1.66

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION ATMOSPHERIC STABILITY CLASS C

UMAX (M/S)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
0.34	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1.56	0.000	0.013	0.000	0.000	0.013	0.013	0.039	0.026	0.026	0.000	0.065	0.013	0.000	0.000	0.000	0.000	0.209
3.35	0.209	0.314	0.327	0.183	0.170	0.105	0.183	0.118	0.092	0.196	0.209	0.196	0.105	0.092	0.039	0.065	2.603
5.59	0.144	0.170	0.026	0.000	0.000	0.000	0.026	0.039	0.026	0.118	0.118	0.065	0.000	0.013	0.078	0.052	0.877
8.27	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.013
11.18	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
24.59	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	0.37	0.50	0.35	0.18	0.18	0.12	0.25	0.18	0.14	0.31	0.39	0.27	0.10	0.10	0.12	0.12	3.70

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION ATMOSPHERIC STABILITY CLASS D

UMAX (M/S)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
0.34	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1.56	0.183	0.340	0.484	0.288	0.536	0.549	0.628	0.301	0.183	0.314	0.353	0.523	0.249	0.301	0.131	0.092	5.455
3.35	2.002	3.519	2.460	1.596	0.968	0.641	0.903	1.308	1.269	1.805	1.975	1.688	1.047	0.419	0.877	1.007	23.483
5.59	0.942	1.491	0.183	0.144	0.026	0.000	0.013	0.222	0.288	0.863	0.641	0.497	0.314	0.144	0.366	0.157	6.293
8.27	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.078	0.092	0.013	0.000	0.092	0.013	0.000	0.288
11.18	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
24.59	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	3.13	5.35	3.13	2.03	1.53	1.19	1.54	1.83	1.74	3.06	3.06	2.72	1.61	0.96	1.39	1.26	35.52

TABLE IX-A JOINT OCCURRENCE FREQUENCIES FOR LOWNDDEG AND LOWNDSPD - CONTINUOUS RELEASES

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION ATMOSPHERIC STABILITY CLASS E

UMAX (M/S)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
0.34	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1.56	0.628	0.903	0.536	0.981	0.746	0.628	0.706	0.824	2.564	2.577	1.609	1.020	0.824	0.589	0.837	0.720	16.693
3.35	1.321	1.334	1.243	0.916	0.445	0.314	0.379	1.164	2.512	2.630	2.002	0.903	0.288	0.445	0.981	1.439	18.315
5.59	0.196	0.379	0.052	0.013	0.013	0.000	0.000	0.078	0.288	0.523	0.144	0.196	0.157	0.249	0.288	0.458	3.035
8.27	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.039	0.000	0.000	0.000	0.026	0.026	0.065	0.157
11.18	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
24.59	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	2.15	2.62	1.83	1.91	1.20	0.94	1.09	2.07	5.36	5.77	3.75	2.12	1.27	1.31	2.13	2.68	38.20

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION ATMOSPHERIC STABILITY CLASS F

UMAX (M/S)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
0.34	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1.56	0.301	0.170	0.196	0.366	0.144	0.039	0.157	0.314	1.060	1.191	1.426	1.073	0.837	0.968	0.968	0.680	9.890
3.35	0.026	0.039	0.065	0.327	0.314	0.039	0.000	0.000	0.065	0.039	0.078	0.118	0.026	0.078	0.406	0.327	1.949
5.59	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8.27	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.013
11.18	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
24.59	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	0.33	0.21	0.26	0.69	0.46	0.08	0.16	0.31	1.14	1.23	1.50	1.19	0.86	1.05	1.37	1.01	11.85

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION ATMOSPHERIC STABILITY CLASS G

UMAX (M/S)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
0.34	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.003	0.003	0.003	0.003	0.004	0.005	0.003	0.024
1.56	0.118	0.092	0.052	0.065	0.039	0.026	0.105	0.105	0.366	0.720	0.863	0.863	0.863	1.374	1.596	0.850	8.098
3.35	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.052	0.013	0.000	0.000	0.026	0.078	0.170
5.59	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8.27	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11.18	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
24.59	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	0.12	0.09	0.05	0.07	0.04	0.03	0.10	0.10	0.37	0.72	0.92	0.88	0.87	1.38	1.63	0.93	8.29

TOTAL HOURS CONSIDERED ARE 7644.

WIND MEASURED AT 11.0 METERS.

OVERALL WIND DIRECTION FREQUENCY

WIND DIRECTION:	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
FREQUENCY:	6.3	9.0	5.8	5.2	3.6	2.5	3.4	4.7	8.9	11.2	9.8	7.3	4.8	4.9	6.7	6.1	100.0

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, 1997, through December 31, 1997.

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-B JOINT OCCURRENCE FREQUENCIES FOR LOWNDDEG AND LOWNDSPD - MIXED MODE BATCH RELEASES

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION ATMOSPHERIC STABILITY CLASS A

UMAX (M/S)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
0.34	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1.56	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3.35	0.320	0.160	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.160	0.000	0.000	0.000	0.000	0.640
5.59	0.160	0.320	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.480
8.27	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11.18	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
24.59	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	0.48	0.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.00	0.00	0.00	0.00	1.12

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION ATMOSPHERIC STABILITY CLASS B

UMAX (M/S)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
0.34	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1.56	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3.35	0.320	0.320	0.000	0.160	0.000	0.160	0.320	0.000	0.000	0.000	0.000	0.160	0.000	0.000	0.160	0.000	1.600
5.59	0.160	0.000	0.160	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.160	0.000	0.000	0.000	0.000	0.480
8.27	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11.18	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
24.59	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	0.48	0.32	0.16	0.16	0.00	0.16	0.32	0.00	0.00	0.00	0.00	0.32	0.00	0.00	0.16	0.00	2.08

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION ATMOSPHERIC STABILITY CLASS C

UMAX (M/S)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
0.34	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1.56	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3.35	0.320	0.000	0.000	0.000	0.000	0.320	0.000	0.000	0.000	0.320	0.160	0.000	0.000	0.160	0.000	0.000	1.280
5.59	0.000	0.160	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.160
8.27	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11.18	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
24.59	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	0.32	0.16	0.00	0.00	0.00	0.32	0.00	0.00	0.00	0.32	0.16	0.00	0.00	0.16	0.00	0.00	1.44

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION ATMOSPHERIC STABILITY CLASS D

UMAX (M/S)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
0.34	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1.56	0.320	0.160	0.800	0.480	0.480	0.640	0.640	0.000	0.160	0.000	0.000	0.640	0.800	0.960	0.000	0.320	6.400
3.35	1.120	1.920	0.800	0.320	0.320	0.320	0.800	0.800	2.400	1.760	2.880	1.440	0.800	0.640	0.640	0.320	17.280
5.59	0.960	1.120	0.000	0.000	0.000	0.000	0.000	0.000	0.160	0.000	0.800	0.160	0.160	0.000	0.000	0.320	3.680
8.27	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.160	0.000	0.000	0.000	0.000	0.000	0.160
11.18	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
24.59	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL .	2.40	3.20	1.60	0.80	0.80	0.96	1.44	0.80	2.72	1.76	3.84	2.24	1.76	1.60	0.64	0.96	27.52

TABLE IX-B JOINT OCCURRENCE FREQUENCIES FOR LOWNDDEG AND LOWNDSPD - MIXED MODE BATCH RELEASES

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION ATMOSPHERIC STABILITY CLASS E

UMAX (M/S)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
0.34	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1.56	1.280	1.440	0.640	2.080	2.080	1.600	1.280	1.440	3.040	4.320	1.280	0.960	0.480	0.800	0.800	1.440	24.960
3.35	1.120	1.920	1.120	1.120	1.440	0.320	0.160	0.960	2.080	3.680	2.240	0.960	0.320	1.120	0.000	0.800	19.360
5.59	0.480	0.160	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.160	0.160	1.120	0.160	0.000	0.160	0.320	2.720
8.27	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.160	0.160
11.18	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
24.59	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	2.88	3.52	1.76	3.20	3.52	1.92	1.44	2.40	5.12	8.16	3.68	3.04	0.96	1.92	0.96	2.72	47.20

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION ATMOSPHERIC STABILITY CLASS F

UMAX (M/S)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
0.34	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1.56	0.480	0.000	0.640	0.960	0.640	0.000	0.320	0.160	0.640	0.800	2.400	1.120	0.480	0.800	0.960	1.120	11.520
3.35	0.000	0.000	0.000	0.800	2.400	0.320	0.000	0.000	0.160	0.160	0.000	0.000	0.000	0.000	0.320	0.160	4.320
5.59	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8.27	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11.18	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
24.59	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	0.48	0.00	0.64	1.76	3.04	0.32	0.32	0.16	0.80	0.96	2.40	1.12	0.48	0.80	1.28	1.28	15.84

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION ATMOSPHERIC STABILITY CLASS G

UMAX (M/S)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
0.34	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1.56	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.320	0.640	0.000	0.640	0.480	1.600	1.120	4.800
3.35	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5.59	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8.27	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11.18	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
24.59	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.32	0.64	0.00	0.64	0.48	1.60	1.12	4.80

TOTAL HOURS CONSIDERED ARE 625.

WIND MEASURED AT 11.0 METERS.

OVERALL WIND DIRECTION FREQUENCY

WIND DIRECTION:	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
FREQUENCY:	7.0	7.7	4.2	5.9	7.4	3.7	3.5	3.4	8.6	11.5	10.7	6.9	3.8	5.0	4.6	6.1	100.0

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, 1997, through December 31, 1997.

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 JOINT OCCURRENCE FREQUENCIES FOR LOWNDDEG AND LOWNDSPD - GROUND LEVEL BATCH RELEASES

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION ATMOSPHERIC STABILITY CLASS A

UMAX (M/S)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
0.34	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1.56	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3.35	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5.59	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8.27	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11.18	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
24.59	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION ATMOSPHERIC STABILITY CLASS B

UMAX (M/S)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
0.34	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1.56	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3.35	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5.59	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8.27	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11.18	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
24.59	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION ATMOSPHERIC STABILITY CLASS C

UMAX (M/S)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
0.34	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1.56	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3.35	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5.59	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8.27	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11.18	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
24.59	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION ATMOSPHERIC STABILITY CLASS D

UMAX (M/S)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
0.34	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1.56	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.149	0.000	0.000	0.000	0.000	1.149	0.000	0.000	0.000	2.299
3.35	0.000	3.448	3.448	1.149	0.000	0.000	0.000	4.598	1.149	1.149	3.448	3.448	0.000	0.000	0.000	0.000	21.839
5.59	1.149	8.046	0.000	0.000	0.000	0.000	0.000	1.149	0.000	0.000	0.000	1.149	0.000	0.000	0.000	0.000	11.494
8.27	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11.18	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
24.59	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	1.15	11.49	3.45	1.15	0.00	0.00	0.00	6.90	1.15	1.15	3.45	4.60	1.15	0.00	0.00	0.00	35.63

TABLE IX-C JOINT OCCURRENCE FREQUENCIES FOR LOWNDDEG AND LOWNDSPD - GROUND LEVEL BATCH RELEASES

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION ATMOSPHERIC STABILITY CLASS E

UMAX (M/S)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
0.34	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1.56	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.299	4.598	3.448	9.195	3.448	1.149	0.000	0.000	0.000	24.138
3.35	0.000	2.299	3.448	0.000	0.000	0.000	0.000	3.448	0.000	1.149	9.195	4.598	0.000	0.000	0.000	1.149	25.287
5.59	1.149	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.149	1.149	0.000	0.000	0.000	0.000	3.448
8.27	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11.18	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
24.59	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	1.15	2.30	3.45	0.00	0.00	0.00	0.00	5.75	4.60	4.60	19.54	9.20	1.15	0.00	0.00	1.15	52.87

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION ATMOSPHERIC STABILITY CLASS F

UMAX (M/S)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
0.34	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1.56	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.299	1.149	3.448
3.35	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.299	0.000	2.299
5.59	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8.27	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11.18	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
24.59	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.60	1.15	5.75

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION ATMOSPHERIC STABILITY CLASS G

UMAX (M/S)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
0.34	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1.56	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.149	2.299	0.000	1.149	0.000	1.149	0.000	5.747
3.35	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5.59	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8.27	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11.18	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
24.59	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.15	2.30	0.00	1.15	0.00	1.15	0.00	5.75

TOTAL HOURS CONSIDERED ARE 87.

WIND MEASURED AT 11.0 METERS.

OVERALL WIND DIRECTION FREQUENCY

WIND DIRECTION:	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
FREQUENCY:	2.3	13.8	6.9	1.1	0.0	0.0	0.0	12.6	5.7	6.9	25.3	13.8	3.4	0.0	5.7	2.3	100.0

CHANGES TO ODCM, PCP, AND RADIOACTIVE WASTE SYSTEMS

TABLE OF CONTENTS
Enclosure 2

I. CHANGES TO THE OFFSITE DOSE CALCULATION MANUAL (ODCM)

There was a change to the ODCM during this reporting period. Several of the H. B. RobinsonSteam Electric Plant (HBRSEP), Unit No. 2 Technical Specifications requirements were relocated to the H. B. Robinson Steam Electric Plant Offsite Dose Calculation Manual (ODCM) during the conversion of HBRSEP, Unit No. 2 Technical Specifications to NUREG-1431, "Standard Technical Specifications for Westinghouse Plants."

Technical Specifications were relocated to the ODCM, in accordance with the license condition in Appendix B to the Final Operating License, Amendment No. 176, dated October 24, 1997.

The ODCM Relocation Log on the following pages details the changes that have been made. A complete copy of the updated ODCM is being forwarded under separate letter.

ODCM RELOCATION LOG

Specification	Relocated to ODCM Specification
3.9	2.2
3.9.2	2.4
3.5.2	2.6
Table 3.5-6	Table 2.6-1
4.19	2.7
Table 4.19-1	Table 2.7-1
4.10	2.8
3.16	2.9
4.20	2.9.3
3.9.3	3.2
3.9.4	3.4
3.9.5	3.5.2
3.5.3	3.10
TABLE 3.5-7	TABLE 3.10-1
4.19.2	3.11
TABLE 4.19-2	Table 3.11-1
4.10.2	3.12
TABLE 4.10-2	TABLE 3.12-1
4.10.3	3.13
4.10.4	3.14
3.16.3	3.15
3.17	4.1
3.17.2	4.2
TABLE 3.17-1	TABLE 4.1-1
TABLE 3.17-2	TABLE 4.1-2
TABLE 3.17-3	TABLE 4.1-3

Specification	Relocated to ODCM Specification
4.21	4.3
4.21.2	4.4
3.17.3	5.0
4.21.3	5.0
3.9.6	6.1
4.10.5	6.6
6.9.1.3	9.1
6.9.3.2	9.3
APPENDIX B to the Technical Specifications	10.0
1.0	7.0
1.1	7.1
none	7.2 MODE
1.3	7.3
1.6	7.4
1.11	7.5
1.12	7.6
1.13	7.7
DOSE EQUIVALENT I-131	7.8
1.17	7.9
1.18	7.10
1.19	7.11
1.20	7.12
1.21	7.13
Figure 1.1-1	Figure 7-1
LCO 3.0.1 thru 3.0.5	Control 8.1.1 thru 8.1.5
SR 3.0.1 thru 3.0.4	SR 8.2.1 thru 8.2.4

II. CHANGES TO THE RADIOACTIVE WASTE SYSTEMS

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

III. CHANGES TO THE PROCESS CONTROL PROGRAM (PCP)

There was a change to the PCP during this reporting period. The PCP was changed effective September 30, 1997, to add appropriate references to the Technical Requirements Manual (TRM).

The following pages show a complete copy of the updated PCP.

CAROLINA POWER & LIGHT COMPANY

H.B. ROBINSON - UNIT 2

PROCESS CONTROL PROGRAM

(P C P)

REVISION 4

DOCKET NO. 50-261

EFFECTIVE DATE: 9/30/97

REVIEWED BY PNSC: _____ DATE 9/29/97
PNSC CHAIRMAN

APPROVED BY PNSC: _____ DATE 9/29/97
PNSC CHAIRMAN

LIST OF EFFECTIVE PAGES

EFFECTIVE PAGES	REVISION
Cover Sheet	4
LEP	4
3 through 5	4

SUMMARY OF CHANGES

1. Added Technical Requirement Manual references after current Technical Specification references. (3.1.2)

H. B. ROBINSON

PROCESS CONTROL PROGRAM

1.0 SCOPE

This program establishes the management system and controls that the H. B. Robinson Steam Electric Plant (HBR) uses to ensure safe and effective solidification and dewatering of various low-level radioactive waste liquids and slurries for offsite disposal.

2.0 OBJECTIVES

It is the objective of this program that the solidification and/or dewatering of various low-level radioactive waste liquids and slurries (including oily wastes) for offsite disposal will be performed by qualified vendors. The quality of the solidified and/or dewatered product shall meet or exceed regulatory requirements and the disposal site criteria prior to release from the H. B. Robinson site for shallow disposal.

3.0 MANAGEMENT PROGRAM

3.1 Responsibilities

3.1.1 The Plant General Manager is responsible for ensuring that waste is shipped in accordance with the appropriate state and federal regulations.

3.1.2 The Manager - E&RC or designee is responsible for:

a. Advising the Plant General Manager on the appropriate technical standards, regulations, and requirements as related to solidification, dewatering, and shipping.

b. Ensuring changes to the vendor's process control program, operating procedures, and proposed contractual agreements are reviewed and advising the Plant General Manager as to their adequacy.

c. Retaining vendor-supplied documentation for NRC inspection and review.

3.1 Responsibilities (continued)

d. Ensuring vendor operations are monitored for compliance with:

1. Section 3.16.6.1 HBR Technical Specifications (TRMS 3.22). The Solid Radwaste System shall be used in accordance with a process control program (PCP) to process wet radioactive waste to meet shipping and burial ground requirements.
2. Section 3.16.6.2 HBR Technical Specifications (TRMS 3.22.A). With the provisions of the PCP not satisfied, suspend shipments of defectively processed or defectively packaged solid radioactive waste from the site.
3. Section 3.16.6.3 HBR Technical Specifications (TRMS 3.22.B). If any test specimen, as required by the PCP, fails to verify solidification, the solidification of the batch under test shall be suspended until such time as additional test specimens can be obtained, alternative solidification parameters can be determined in accordance with Section 6.15 of the Technical Specifications (TRMS 5.5.17), and solidification of the batch may then be resumed using alternative solidification parameters as determined by the PCP.
4. Section 4.20.6 HBR Technical Specifications (TRMS 3.22.1, 3.22.2). The PCP shall be used to verify the solidification of one representative test specimen from every tenth batch of wet radioactive waste.

3.1.3 The Superintendent - Radiation Control is responsible for advising the Manager - E&RC on:

a. The appropriate technical standards, regulations, and requirements as related to solidification, dewatering, and shipping.

b. The adequacy of the vendor's process control program, operating procedures, and proposed contractual agreements.

3.2 Specification for Vendors

The qualified solidification vendor will:

3.2.1 Provide a qualified process control program or a program approved by:

a. NRC

b. Disposal site licensee

3.2.2 The vendor will perform the tests described in the process control program.

3.3.3 The vendor will supply the Manager - E&RC with all documentation required to demonstrate compliance with dewatering and/or solidification requirements.

3.3.4 The Manager - E&RC will retain documentation required to demonstrate compliance with solidification requirements and standards.

4.0 MANAGEMENT/CONTRACTOR INTERACTIONS

4.1 The vendor is accountable to the Manager - E&RC for the solidification and/or dewatering of liquid wastes.

4.2 The Radiation Control Supervisor responsible for radwaste shipping handles the shipping of solidified and dewatered wastes and maintains required documentation. The vendor and the Radiation Control Supervisor responsible for radwaste shipping may communicate on these matters as necessary.

5.0 ATTACHMENTS

5.1 None Applicable

IV. CHANGES TO THE LAND USE CENSUS

There were no changes to the environmental sampling program as a result of the Land Use Census performed in 1997.

V. INSTRUMENT INOPERABILITY

There were no reportable instrumentation inoperability events during this reporting period.

VI. LIQUID HOLDUP TANK CURIE LIMIT

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

VII. WASTE GAS DECAY TANK CURIE LIMIT

There were no waste gas decay tanks with a curie content that exceeded the 1.90E+04 curie limit during this reporting period.

SUPPLEMENTS TO PREVIOUS
REPORTS

TABLE OF CONTENTS
Enclosure 3

I. DISCUSSION

There were no changes to previous reports during this reporting period.