CHAPTER 2 - SITE CHARACTERISTICS

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CHAPTER 2 - SITE CHARACTERISTICS

2.1 GEOGRAPHY AND DEMOGRAPHY

2.1.1 Site Location and Description

The Oyster Creek Nuclear Generating Station (OCNGS) is located on the coastal pine barrens of New Jersey in Lacey and Ocean Townships, Ocean County. The station site owned by AmerGen Energy Company, LLC. U.S. Route 9 divides the property. There are 152 acres west of Route 9 and 708 acres to the east. The plant site is located to the west of Route 9, and is bounded on the north by the South Branch of Forked River and on the south by Oyster Creek. Barnegat Bay forms the eastern site boundary and the Garden State Parkway the western site boundary. Figure 2.1-1 is an aerial photograph of the OCNGS site and environs.

The power island of the OCNGS is situated approximately midway between Oyster Creek and the South Branch of Forked River and about 1400 feet west of Route 9. Route 9 provides access to the site.

Approximately 352 acres of land onsite were used during station construction. This includes 22 acres for the generating station and auxiliary facilities, 8.5 acres for the emergency fire pond, and 33.5 acres for railroad, transmission right-of-way, and spoil areas due to dredging of the South Branch of Forked River and Oyster Creek.

The site is approximately 35 miles north of Atlantic City, New Jersey and 45 miles east of Philadelphia, Pennsylvania. Approximately 9.5 miles north of the site are several small residential communities; Toms River, South Toms River, Beachwood, Pine Beach, Ocean Gate, Island Heights and Gilford Park.

West of the Garden State Parkway the land is undeveloped woodland, and wooded wetlands are found along the banks of small creeks to the north, south, and west of the site. East of the station along the shoreline of Barnegat Bay, the land is residentially developed for year round and seasonal use. The terrain surrounding the site is relatively flat along the shoreline to gently rolling inland. About 4 miles inland just west of the Garden State Parkway, the terrain rises to heights in the range of 65 to 90 feet above mean sea level.

A state game farm on which quail and pheasant are raised is located approximately 2.25 miles northeast of the station.

Effluent Release Limits

Some radioactive material is released from the plant under controlled conditions as part of the normal operation of the facility. Other radioactive material not normally intended for release could be inadvertently released in the event of an accident. Therefore, limits have been placed on the above types of radioactive materials to ensure that the limits of 10CFR20 which apply to releases during normal operation, and the limits of 10CFR100 which apply to accidental releases, are not exceeded. This applies to the restricted area, exclusion area boundary and low population zone. Effluent release limits are established in the Technical Specifications.

Radiation dose from liquid effluents may be received through the ingestion of fish, shellfish, and from direct exposure. Personal radiation exposure via other aqueous pathways is negligible.

Barnegat Bay, which is approximately 2.5 miles east of station, is not a source for drinking water supplies. Radioactive material in liquid effluents are kept as low as is reasonably achievable, in compliance with 10CFR50, Appendix I.

2.1.2 Exclusion Area Authority and Control

The reactor (centerline) is located 1358 feet (approximately 0.25 mile) west of the eastern boundary of Route 9. The exclusion area boundary for the OCNGS is defined as a 1358 foot (414 meter) radius extending from the reactor centerline as illustrated in Figure 2.1-7. A perimeter security fence encompasses the area immediately around the plant. Access to this area is controlled by a security force, in accordance with the requirements of 10 CFR 73. On December 29, 1981 the NRC issued Amendment 59 to the POL-DPR-16 for this facility, pursuant to which GPU Nuclear Inc. was added as a licensee authorized to possess, use and operate Oyster Creek, and Jersey Central Power and Light d/b/a GPU Energy remained as a licensee, authorized to possess the facility. This area meets the requirements of 10CFR100 for exclusion area determination.

2.1.3 Population Distribution

The 1980 final census figures were used to determine the permanent population residing in the region surrounding the OCNGS. The population within the Emergency Planning Zone (within 10 miles of the OCNGS) was updated based on the 1990 census. The population figures were developed for concentric circles 1,2,3,4,5,10,20,30,40, and 50 miles around the station. Each circle is divided into 22 1/2 degree segments with each segment centered on one of the 16 compass points.

2.1.3.1 Population Within 10 Miles

There are 764 individuals permanently residing within a mile of the OCNGS according to the 1990 Census. This population is located east of Route 9, clustered north of the intake and south of the discharge canals. Table 2.1-1 and Figure 2.1-2 provide the population distribution by sector.

At the time of filing the Facility Description and Safety Analysis Report (FDSAR) in 1967, the estimated permanent population living within a mile radius of the station was 198. The 1990 Census shows that over the 24 year period 1967-1990, the population increased by a factor of 3.86. However, this increase is approximately what was projected for the year 1986. The projected 1986 population (1967) (Reference 2) was estimated to be 738.

The permanent population within a 5 mile radius of the station has also increased since the filing of the FDSAR. At the time of filing, the population was estimated at 4637. The 1990 Census figure reports 34,380 residents living in this area, or a population that has increased by a factor of 7.41. Table 2.1-1 and Figure 2.1-2 show the 5 mile permanent population distribution. Figure 2.1-3 is a bar chart based on the distribution of the 5 mile population by sector. As can be observed from this figure, the population is not evenly distributed. There are no residents living in the heavily wooded and wetland areas to the W, WNW, and NW of OCNGS. A sizeable percentage of the population resides north of the station along Deer Head Lake and Lake Barnegat, 2 to 3 miles from the site, and south, in Barnegat. Together, these four sectors (N, NNE, NE, and S) represent 63 percent of the total 5 mile permanent population.

Within 5 to 10 miles of the OCNGS, there are 64,840 permanent residents. Again the population is heavily concentrated in only four sectors. Over 74 percent of the total permanent population, 5 to 10 miles from the station is located in the N, NNE, SW and SSW sectors.

2.1.3.2 Population Between 10 and 50 Miles

The total population based on the 1980 Census and transient population estimates, 10 to 50 miles from the station, are listed on Table 2.1-2 and shown in Figure 2.1-4.

About 80 percent of the total population between 10 and 50 miles resides in the 30 to 50 mile rings. This distribution is influenced by Atlantic City, Trenton, the densely populated land in northern New Jersey, and a portion of the Philadelphia metropolitan area.

2.1.3.3 Transient Population

The transient population surrounding the station was determined for an area approximately 10 miles in all directions of the station. This area corresponds to the OCNGS Emergency Planning Zone (EPZ).

The transient population could encompass individuals visiting an area for recreational, employment, or business purposes, and it could be seasonal or daily in duration. The transient population for the OCNGS is primarily a summer (June, July and August) seasonal population. The Barnegat Bay region of New Jersey is a well known summer resort area.

No significant transient population due to employment within the EPZ was identified. Besides the OCNGS, the only other major employer in the EPZ is the Ocean County Administrative Complex which is situated 9.5 miles from the station near the EPZ boundary. Approximately 75 percent of the EPZ labor force is employed outside of the EPZ, and the number of people living outside the EPZ but commuting to seasonal jobs within the EPZ is about equal to the number of seasonal residents living in the EPZ and commuting elsewhere to work.

The determination of the transient seasonal population on an average day for the OCNGS considers the following:

- Seasonal residents - Those who own or rent a dwelling but maintain a permanent residence elsewhere
- Short term visitors - Those visiting for two days to several weeks in a hotel, motel, or rooming house
- Day Visitors

The most recent seasonal population estimates were obtained from a December 1991 report on EPZ evacuation time estimates prepared by Dresdner, Robin & Associates (Reference 3). Assuming all the seasonal transient population lives east of the Garden State Parkway, the transient population, on an average summer day, was estimated by sector and ring (Table 2.1-3 and Figure 2.1-5).

Within a mile of OCNGS, the seasonal population more than doubles the permanent population figure to a total summer population of 1618. Seasonal population distribution by sector follows the same pattern as for the permanent population.

The distribution of the total transient population 0 to 5 miles from the station, by sector, is shown on Figure 2.1-3 and has a somewhat different distribution than the permanent population. The greatest percentage of the total transient population is found 3 to 4 miles NE of the station in Murray Grove and Lanoka Harbor.

Within the 10 mile distance ring (Figure 2.1-5), seven sectors experience seasonal population increases. However, the majority of this seasonal population resides in the N and NNE sectors within about 9.5 miles from the station in the communities of Toms River, South Toms River, Beachwood, Pine Beach, Ocean Gate, and Gilford Park. These communities also account for the distribution of permanent population. Sixty six percent of the permanent population living 5 to 10 miles from the station lives in the N and NNE sectors.

In summary, the majority (70 percent) of the transient population lives 5 to 10 miles from OCNGS. For both permanent and transient populations, the greatest percentage of residents are located in the N and NNE sectors.

2.1.3.4 Low Population Zone

A Low Population Zone is defined in 10CFR100 as "the area immediately surrounding the exclusion area which contains residents, the total number and density of which are such that there is a reasonable probability that appropriate protective measures could be taken in their behalf in the event of a serious accident". The regulation does not specify a permissible population density or total population due to the variations on the number of people who can be evacuated from a specific area or instructed to take shelter on a timely basis based on the number and size of highways, extent of advanced planning, and actual distribution of residents. The Low Population Zone (LPZ) for the OCNGS is defined as a 2 mile (3218 meter) radius extending from the reactor centerline.

The Emergency Plan and Emergency Plan Implementing Document for the OCNGS Emergency Planning Zone (EPZ) reasonably assure that adequate protective measures can and will be taken in the event of a radiological emergency and hence fulfill the requirements for a Low Population Zone.

The OCNGS EPZ is an area having a radial distance of approximately 10 miles from the site and is identified as the "Plume Exposure Pathway"*, shown on Figure 2.1-6.

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* The means by which a radioactive plume can expose the population at risk and/or onsite personnel to radiation. The time of potential exposure could range from hours to days. The principal exposure sources from this pathway are: (1) whole body external exposure to gamma radiation from radioactive plume and from deposited material and (2) inhalation exposure from the passing radioactive plume.

The Emergency Plan assures that emergency situations, including those which involve radiation or radioactive material, are handled logically and efficiently. It covers the entire spectrum of emergencies from minor, localized emergencies to major emergencies involving actions by offsite emergency response agencies and organizations. The Emergency Plan includes a scheme for classifying emergencies that meet the current Nuclear Regulatory Guidelines. In addition to the Emergency Plan, there is an Emergency Plan Implementing Document which provides a single source document for significant information used to assess conditions, classify the emergency, make required notifications and request assistance, and provide step by step instructions for initiating protective and corrective actions.

EPZ Description

The EPZ is an area approximately 10 miles in all directions from the station. It is bounded on the north by Davenport Creek and Route 37, on the south and southwest by Route 72 and Micajas Road, on the east by the Atlantic Ocean, and on the west by Route 539.

Special facilities within the EPZ consist of hospitals, nursing homes, correctional facilities and schools. The population of each special facility is listed in Table 2.1-4 and summarized below. (Reference 3):

Facility	Population
Hospitals	847
Nursing Homes	706
Correctional Facilities	350
Schools	20,901
Total	22,804

Of the total persons in special facilities, 740 are located more than 10 miles from OCNGS and another 3,945 persons or 17 percent are located 9 to 10 miles from the station. The majority of this population (91.7 percent) is school children.

2.1.3.5 Population Center

The nearest population center is Dover Township, which is 9.5 miles north of the site. Dover Township is made up of the communities of Toms River, Island Heights and several smaller communities. The 1990 Census for the permanent population was approximately 76,371. (Reference 1)

2.1.3.6 Population Density

The cumulative population within 30 miles of the station is 592,485. This population figure includes both permanent and transient individuals. Assuming a uniform distribution of the population in all directions from the station out to 30 miles, the population density is below the 500 people/square mile density.

2.1.4 References

(1) OCNGS Emergency Plan for Oyster Creek Nuclear Generating Stations, (latest revision).

(2) Jersey Central Power and Light Company; Oyster Creek Nuclear Generating Station, Facility Description Safety Analysis Report, Amendment II, August 30, 1967.

(3) Evacuation Time Estimates for OCNGS, prepared by Dresdner, Robin & Associates, Inc., December 1991.

(4) Ocean County Databook Fourth Edition, prepared by Ocean County Planning Board, November 1993.

(5) Population and Development Trends in Ocean County, prepared by Ocean County Planning Department, August 1992.

TABLE 2.1-1
(Sheet 1 of 1)

PERMANENT POPULATION (WINTER NIGHT POPULATION)
0 TO 10 MILES OF OCNGS

SECTOR	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	0-10 TOTAL
N	0	896	3149	1161	142	1100	328	3799	10411	7589	28575
NNE	212	733	2449	2674	1182	2539	1899	4991	5797	4527	27003
NE	141	755	548	1049	2617	808	183	0	155	1050	7306
ENE	100	920	292	594	0	0	0	0	0	0	1906
E	0	487	389	0	0	0	0	0	0	0	876
ESE	104	622	0	0	0	0	68	0	0	0	794
SE	207	933	81	0	0	25	731	196	0	0	2173
SSE	0	370	569	86	0	0	0	183	290	330	1828
S	0	81	940	2302	673	79	0	0	91	2146	6312
SSW	0	81	0	988	2762	3695	319	727	1428	964	10964
SW	0	0	0	256	726	840	3753	1333	0	0	6908
WSW	0	0	0	0	0	743	174	174	0	84	1175
W	0	0	0	0	0	0	0	0	87	0	87
WNW	0	0	0	0	0	0	0	0	0	0	0
NW	0	0	0	0	0	0	0	92	92	0	184
NNW	0	256	1853	0	0	0	0	0	0	1020	3129
TOTAL	764	6134	10270	9110	8102	9829	7455	11495	18351	17710	99220

SOURCE: Dresdner, Robin & Associates, Inc., 1991. Derived from 1990 U.S. Census Data.

TABLE 2.1-2
(Sheet 1 of 1)

PERMANENT AND TRANSIENT POPULATION
10 TO 50 MILES OF OCNGS

ZONE	MILES	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
10	0-10	41064	28391	9360	3146	1210	1260	3564	3610	6675	11375	5857	705	43	0	441	985	117686
20	10-20	75784	62724	3667	0	0	0	0	1928	5828	8084	2678	830	914	14573	12024	21594	210628
30	20-30	50559	95423	0	0	0	0	0	0	172	10297	7819	5717	9656	39432	20064	25032	264171
40	30-40	113587	100327	0	0	0	0	0	0	0	99807	12843	28266	95368	143369	150586	82463	826616
50	40-50	298541	7789	0	0	0	0	0	0	0	30754	13684	71829	352656	666452	234558	233102	1909365
TOTAL	0-50	579535	294654	13027	3146	1210	1260	3564	5538	12675	160317	42881	107347	458637	863826	417673	363176	3328466

TABLE 2.1-3
(Sheet 1 of 1)

TRANSIENT POPULATION (SUMMER DAY POPULATION)

RING (in miles)

SECTOR	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	0-10 TOTAL
N	0	1105	4185	1511	186	1394	419	5009	12978	9985	36772
NNE	267	989	3390	3491	1658	3423	2717	7310	8586	7080	38911
NE	180	996	898	1526	3663	1521	286	0	402	4115	13587
ENE	700	1246	400	877	0	0	5105	2553	0	0	10881
E	0	667	534	0	0	61	61	0	0	0	1323
ESE	157	944	0	0	0	60	123	0	0	0	1284
SE	314	1414	120	0	0	261	6765	2120	0	0	10994
SSE	0	549	812	120	0	0	0	2127	4365	3725	11698
S	0	114	1306	3229	987	130	0	0	227	2468	8462
SSW	0	113	0	1225	3802	5205	333	810	2575	1780	15956
SW	0	0	0	260	1460	846	3817	1280	0	0	7663
WSW	0	0	0	50	0	704	180	160	0	77	1171
W	0	0	0	0	0	0	0	0	80	0	80
WNW	0	0	0	0	0	0	0	0	0	0	0
NW	0	0	0	0	0	0	0	85	605	0	690
NNW	0	318	2222	0	0	0	0	0	0	939	3479
TOTAL	1618	8569	13867	12289	11756	13605	19806	21454	29818	30169	162951

SOURCE: Dresdner, Robin & Associates, Inc., 1991. Derived from 1990 U.S. Census Data.

TABLE 2.1-4
(Sheet 1 of 3)

SPECIAL FACILITIES IN THE VICINITY OF
THE OYSTER CREEK NUCLEAR GENERATING STATION

Hospitals

Community Medical Center
Southern Ocean County Hospital
Garden State Rehabilitation Hospital

Nursing Homes

Barnegat Nursing Center
Bayview Convalescent Center
Berkeley Home for the Aged
Lacey Nursing and Rehabilitation Center
Manahawkin Convalescent Center

Correctional Facilities

Ocean County Jail

Schools

District	School
Barnegat Township	Elizabeth V. Edwards Elementary Cecil S. Collins Elementary Lillian M. Dunfee Elementary Russell O. Brackman Middle
Berkeley Township	Bayville Elementary Clara B. Worth Elementary
Clara B. Worth Elementary	H and M Potter Elementary
Central Regional	Central Regional High School Central Regional Middle
Island Heights Borough	Island Heights Elementary

TABLE 2.1-4
(Sheet 2 of 3)

SPECIAL FACILITIES IN THE VICINITY OF
THE OYSTER CREEK NUCLEAR GENERATING STATION

District	School
Lacey Township	Cedar Creek Elementary
	Forked River Elementary
	Lanoka Harbor Elementary
	Lacey Township Middle
	Lacey Township High
Ocean Township	Frederic A. Priff Elementary
	Waretown Elementary
Ocean Gate	Ocean Gate Elementary
Southern Regional	Southern Regional High
	Southern Regional Middle
Stafford Township	McKinley Avenue School
	Oxycocus Elementary
	Stafford Intermediate
Toms River Regional	Beachwood Elementary
	Pine Beach Elementary
	South Toms River Elementary
	Washington Street School
	Toms River High School South

TABLE 2.1-4
(Sheet 3 of 3)

SPECIAL FACILITIES IN THE VICINITY OF
THE OYSTER CREEK NUCLEAR GENERATING STATION

Vocational Schools	Ocean County Vocational-Technical School, Waretown Center
Private & Parochial Schools	Ambassador Christian Academy, Toms River
	Lighthouse Christian Academy, Manahawkin
	Saint Josephs Grammar School, Toms River
Pre-Schools, Kindegartens, & Day Care Centers	Barnegat Head Start, Barnegat Beachwood Nursery School, Beachwood
	Berkeley Head Start, Berkeley
	The Education Academy, Lanoka Harbor
	First Adventure Nursery School, Forked River
	Forever Young Nursery School, Lanoka Harbor
	Hilltop II Nursery School, Bayville
	Kids of the Kingdom Christian Day School, Bayville
	Land of Oz Pre-School, Forked River
	Noah’s Ark Day School, Waretown
	Pigwiggen School, Lanoka Harbor
	Tots R Us, Manahawkin
	Unicorn University, Island Heights

2.2 NEARBY INDUSTRIAL, TRANSPORTATION, AND MILITARY FACILITIES

2.2.1 Industrial Locations

Within 10 miles of the Oyster Creek Nuclear Generating Station (OCNGS), there are over 35 industrial facilities. An estimated 1,800 individuals were employed there. The list of industries and their locations are shown on Table 2.2-1 and Figure 2.2-1.

2.2.2 Other Facilities

2.2.2.1 Waterways

The nearest navigable waterway to the OCNGS is Barnegat Bay. This body of water is relatively shallow. The average depth is less than 5 feet with a range of less than 1 foot to 20 feet at mean low tide. The U.S. Army Corps of Engineers maintains the Intracoastal Waterway, which crosses Barnegat Bay at a depth of 6 feet, mean water line. The Intracoastal Waterway is used by pleasure craft and commercial fishing boats.

2.2.2.2 Airports

There are 10 airport facilities within 20 miles of the OCNGS (Table 2.2-2 and Figure 2.2-2). The closest of these is a seaplane base some seven miles southeast.

Two Restricted Areas are within 20 miles, but none within 10 miles. These and air lanes and military air routes are listed on Table 2.2-2 and shown in Figure 2.2-2.

2.2.3 Evaluation of Potential Accidents

2.2.3.1 Aircraft Accidents

Aircraft strike probabilities were estimated for three size categories including small general aviation, medium sized commercial, and large (heavy) commercial or military aircraft. The nearest airports of significance are at Lakehurst, 16 miles north-northwest and McGuire Air Force Base about 24 miles northwest. At these distances there is no significant hazard due to landing and takeoff activities. Low level military training routes in the area must be kept more than five miles from the plant by agreement between the military and the NRC. There is little traffic along these routes, and at this distance they represent an extremely low hazard to the plant.

Based on evaluation of the available information on air traffic conditions at the site, it was concluded that the only significant hazard is from the traffic along the V312 airway, as shown on Figure 2.2-2, and general aviation in the area. Probabilities for a strike on the plant were developed for three sizes of aircraft based on available traffic information for each size. The largest mean frequency is from general aviation at 4.0×10^{-7}.

2.2.3.2 Explosions

Possible sources of explosions are essentially limited to transportation accidents. Explosion of chemicals being transported along Route 9 or the Parkway (the railroad along Route 9 is no longer in use) would present the only significant hazard in this regard. Route 9 is located about

400 meters east at its closest approach and the Parkway is located more than 1,000 meters west. Portions of the Parkway are closed to trucks; therefore, little through truck traffic passes the plant. There are no shipping channels near the plant.

Based on NRC Regulatory Guide 1.91 and information received from the New Jersey Department of Highways, the probability of explosions was estimated at 1.5×10^{-8} (mean frequency).

A commitment has been obtained from the New Jersey State Police (NJ State Police Interoffice Memo, April 13, 1992) which requires their duty officer or hazardous material emergency response personnel to promptly notify the OCNGS Group Shift Supervisor (GSS) or OCNGS Control Room with the characteristics of an incident involving hazardous material in Lacey or Ocean Township and provide further information on any significant changes. Upon receiving the call from the New Jersey State Police Duty Officer, the GSS will reference OCNGS Procedure 2000-ABN-3200.33, "Toxic Material/Flammable Gas Release -- No Radiation Involved" for appropriate actions.

An explosion of the Hydrogen Water Chemistry System hydrogen storage facility located adjacent to the southeast corner of the South Parking Lot is evaluated in accordance with Appendix B to the EPRI Guidelines for Permanent BWR Hydrogen Water Chemistry Installations, 1987 Revision; "Separation Distances Recommended for Hydrogen Storage to Prevent Damage to Nuclear Power Plant Structures from Hydrogen Explosion", by R. P. Kennedy, as approved by the NRC. The evaluation concludes that the hydrogen facility is sufficiently separated from the nearest safety related structure to avoid damage. In addition, an explosion of the total hydrogen supply of one delivery truck at its closest distance to a safety related structure is acceptable.

In 1990, two natural gas pipelines were installed in the vicinity of Oyster Creek Nuclear Generating Station (OCNGS). One pipeline is a 16 inch diameter line which runs parallel to Route 9 on the east side of the plant. This pipeline is outside the plant exclusion zone except where it crosses the intake and discharge canals. The other pipeline is a 16 inch line that branches off the main line at a point North of the plant. The branch line runs roughly adjacent to the north side of the intake canal to the combustion turbines dispatched by FirstEnergy.

USNRC Systematic Evaluation Program (SEP) Topic II-1C for Oyster Creek evaluated the impact of a 6 inch and 8 inch diameter natural gas pipeline also located along Route 9 at one quarter mile from the plant and concluded that the pipelines do not pose a significant hazard to the plant due to the distance involved. While the newly installed gas lines are larger in diameter and were pressurized to higher pressures than those analyzed by NRC, it is reasonable to conclude that the primary factors which influenced NRC's conclusion of no hazard (i.e., distance from the plant and low probability of failure) would result in a similar conclusion for the new installation.

Also, NUREG 0014 comprising the USNRC safety assessment for the Construction of TVA Hartsville Nuclear Plants concluded that the existence of a pipeline in the vicinity represents no undue threat to the safe operation of the proposed facility and that accidents occurring to that pipeline need not be considered in the design of the plant.

This conclusion was based on the extensive research study performed for TVA, "Mechanic's Research Inc. Nuclear Power Plant Risks from a Natural Gas Pipeline, a Research Study Performed for TVA, August 1974".

The differences between the gasline at the TVA plant and the one at Oyster Creek are as follows:

- The distance from the gas line to the plant is approximately one half mile versus approximately one quarter mile at Oyster Creek.
- The diameter of the pipeline is 22 inches versus 16 inches at Oyster Creek.
- The working pressure is 720 psi versus 350 psi (up to 550 psi in the future, in the main line) at Oyster Creek.

As shown in "Mechanic's Research Inc. Nuclear Power Plant Risks from a Natural Gas Pipeline, a Research Study Performed for TVA, August 1974", (Risk Assessment Summary Table) the probability of a pipeline accident affecting the TVA facilities is of an order of magnitude of 10^{-7} or less. Taking the above differences into consideration, a qualitative judgement can be made that the USNRC conclusions listed in NUREG-0014 are applicable for the Oyster Creek facility.

TABLE 2.2-1
(Sheet 1 of 2)

INDUSTRIES WITHIN 10 MILES OF OCNGS

Name	Location	Town	Reference Number (a)
Abex Corp.	Pinewald Road	Bayville	34
Atlantic Gravel Co.	Lacey Road	Lacey Twp.	31
Bay Construction	W. Bay Ave.	Barnegat	25
Brick-Wall Corp.	Lacey Road	Lacey Twp.	30
Ciba-Geigy Corp.	Hwy. 37 West	Toms River	14
DeMott & Aldrich Trucking Co.	U.S. Route 9	Toms River	17
Denzer & Schafer X-Ray Co.	Hickory Lane	Bayville	16
Dover Oil Co.	Dover Road	S. Toms River	6
Dunwin Press Printers	Lakehurst Road	Toms River	11
E & D Recycling	Off U.S. Rt. 9	Forked River	35
Fisher Brothers Sand & Gravel	Hickory Lane	Bayville	2
Francis M. Moon Inc.	Hwy. 72	Barnegat	26
Island Oil Co, Inc.	Stafford Ave.	Manahawkin	23
L & H Plumbing & Heating Supplies, Inc.	Rt. 9 North	Forked River	36
Laursen Sheet Metal	Flint Road	S. Toms River	7

[a] Reference numbers are keyed to Figure 2.2-1

TABLE 2.2-1
(Sheet 2 of 2)

INDUSTRIES WITHIN 10 MILES OF OCNGS

Name	Location	Town	Reference Number (a)
Micro-Industrial Corp.	Hickory Ln.	Bayville	16
Modern Gas Service Corp.	Hwy. 72	Barnegat	28
New Jersey Pulverizing	Hickory Ln.	Bayville	3
Nor-Dan Manufacturing	Irons St.	Toms River	8
Ocean County Observer	Robbins St.	Toms River	9
Ocean County Sewerage Authority	Hickory Ln.	Bayville	
Park Iron Works	Irons St.	Toms River	8
Quarry Operation	Off Hwy. 9	Bayville	4
Quarry Operation	Lacey Rd	Lacey Twp	32
Quarry Operation	Lacey Rd	Lacey Twp	33
S P Sheet Metal Co, Inc.	Hwy 37 East	Toms River	13
Sun Printing Inc.	Hyers St	Toms River	10
Times-Beacon Co.	Bay Ave	Manahawkin	24
Towne Custom Decorating	Lowell Ave	Toms River	12
Urner Barry Publication	Double Trouble Road	Beachwood	5
Vogue Construction	W. Bay Ave	Barnegat	27
Woodhaven Lumber & Millwork	Off Rt. 9	Bayville	18

(a) Reference numbers are keyed to Figure 2.2-1

TABLE 2.2-2
(Sheet 1 of 1)

AIRPORTS, RESTRICTED AREAS AND AIR LANES WITHIN
APPROXIMATELY 20 MILES OF OCNGS

Airport/Heliport/Seaplane Base*		Latitude	Longitude
1.	Lakewood Airport	40° 04' 00"	74° 10' 40"
2.	Mantoloking Sea-plane Base	40 02 00	74 03 30
3.	Pinelli Seaplane Base	39 45 00	74 07 00
4.	WJRZ Helistop	9 42 00	74 15 00
5.	Manahawkin Airport	39 42 00	74 16 45
6.	Eagles Nest Airport	39 40 00	74 18 30
7.	Lentine South PAF	39 47 05	74 22 36
8.	Coyle Field	39 48 45	74 25 30
9.	Ocean County Airpark (Miller Airport)	39 55 30	74 17 30
10.	Lakehurst Naval Air Facility (Multiple Runway)	40 01 45	74 20 00
Restricted Areas			
	McGuire/Lakehurst Restricted Area	40° 00’ 00”	74 30 00
	Warren Grove Restricted Area	39 42 30	74 23 00

Air Lanes

Victor Air Lane 16
Victor Air Lane 229
Victor Air Lane 44
Victor Air Lane 312
New York Air Route 838 (Military Training Route)

Source: NJ Dept. of Transportation, Div. of Aeronautics

* Numbers correspond to those in Figure 2.2-2

2.3 METEOROLOGY

2.3.1 Regional Climatology

2.3.1.1 General Climate

The Oyster Creek site is on the Central Atlantic Coast and has a basically continental climate somewhat modified by its immediate coastal location. The characteristics of the climate in the region of the site, as represented by more than 30 years of record at the Atlantic City National Weather Service (NWS) Station located on the coast 35 miles south-southwest of the site, are illustrated on Figure 2.3-1. The data represent monthly averages of temperature, prevailing winds, maximum wind speeds, precipitation and sky cover.

During winter there is a predominance of winds from the northwest. During summer, however, prevailing winds are from the southwest. Often during the summer, the "sea breeze" phenomenon results in onshore circulation during late morning through early afternoon.

The site is subject to some heavy winter storms and in the summer, to tropical storms which move up the coast, usually offshore. Figure 2.3-1 indicates that the prevailing direction of winds above 40 mph is from the ENE at Atlantic City. The Atlantic City NWS Station reported its fastest speed as 91 mph from the northeast during the month of September, 1944. In general, during periods of precipitation, there appears to be a higher frequency of northeasterly winds. The existence of coastal low type storms which travel along the Atlantic Coast towards New England account for a good percentage of these northeast winds, as well as precipitation.

The average annual precipitation is about 42 inches in the region of the site, with monthly averages between three and five inches. Maximum precipitation in 24 hours was about 9 inches for Atlantic City.

2.3.1.2 Regional Meteorological Conditions for Design and Operating Bases

2.3.1.2.1 Hurricanes

Historic accounts of early American hurricanes affecting the New Jersey - New York area date back to the 17th Century. More than 80 tropical hurricanes or their remnants have affected the coastal area of New Jersey since 1889. In recent years, some of the more severe storms which have passed over or near the area have been hurricanes "Hazel" in October, 1954, "Connie" and "Diane" in August, 1955, and "Donna" in September 1960. The "Great Atlantic Hurricane" of September, 1944 passed directly over the New Jersey shoreline in its northward movement.

The relative hurricane frequency for the area is roughly one occurrence every 1.8 years. In general, record hurricanes passing over the site study area have had central pressures of from 27.8 to 28.5 inches and peak wind speeds over the ocean approaching 100 mph. The forward speed of the more severe hurricanes, following recurvature in the middle latitudes, has ranged from 15 to 40 knots.

Hurricanes which, at some stage of their development, caused major damage and passed with centers closer than 100 miles to the site during the period from 1935 to 1967, inclusive, were as follows. (Reference 1)

Hurricane Name	Date	Approximate Closest Approach of Hurricane Center to Oyster Creek Site
None	September 14-15, 1944	30 miles SE
None	October 21, 1944	60 miles SE*
None	September 18-19, 1945	70 miles NW*
None	August 29, 1948	100 miles NW*
Carol	August 31, 1954	50 miles E
Edna	September 11, 1954	100 miles SE
Diane	August 19, 1955	40 miles N*
Donna	September 12, 1960	40 miles SE
Alma	June 13, 1966	100 miles E

The Atlantic City NWS recorded its highest wind velocity of 91 mph during the September 1944 storm.

The ASCE Task Committee Report No. 3269 "Wind Forces on Structures", shows the site area as having potentially a fastest mile wind of 100 mph for a 100 year period of recurrence.

Analysis of the Probable Maximum Flood level as a result of Probable Maximum Hurricane for the site is provided in Appendix 2.4A, with results summarized in Subsection 2.4.5.

2.3.1.2.2 Tornadoes

National Weather Service records indicate that 33 tornadoes occurred in New Jersey between 1920 and 1967. Four of these tornadoes were in Ocean County. Two of these passed across the northern corner of the county about 25 miles northwest of the site. The other two occurred at the northern end of Barnegat Bay, near Mantoloking, in June 1958 and July 1960. They are described as follows:

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*Post hurricane stage when near site.

At 4 PM on July 1, 1960, a waterspout developed over Barnegat Bay. It moved across the bridge on State Highway 528 at Mantoloking, then continued across the Bay, passing northward over Bay Head and into the Atlantic Ocean. Two buildings were unroofed, several boats overturned and power lines damaged. The path length was about 2 miles and the width 50 yards. The tornado affected an area of about 0.06 square miles, 16 miles north of the site.

At 5:45 PM on June 13, 1958, five funnel clouds were observed moving eastward over Barnegat Bay near Mantoloking. They joined and hit the narrow strip of land on which Mantoloking is located. There was damage to the windows, roofs and television antennas of a number of buildings. The path length was about one half mile and a width of about 150 yards. The tornado affected an area of about 0.04 square miles, about 16 miles north of the site. (Reference 2)

A total of 25 tornadoes were reported during 23 separate days of the period 1916-1958 (Reference 3). The following is taken from the same reference and represents the occurrence of tornadoes for each month during 1916-1958.

Month:	J	F	M	A	M	J	J	A	S	O	ND
Total Tornadoes	0	0	1	4	3	4	6	4	1	1	10
Tornado Days	0	0	1	4	3	3	5	4	1	1	10

Appendix 2.3A provides an analysis of Oyster Creek tornado hazard probabilities for the site, based on New Jersey and neighboring state tornadoes of the eight year period 1971 through 1978; then it compares these results to previous other more generalized estimates which have been made for the site.

2.3.2 Local Meteorology

This section provides information on the local meteorological conditions which exist at and near the site. These include wind, temperature and temperature inversion data summaries.

2.3.2.1 Winds

2.3.2.1.1 Frequency of Recurrence by Speed and Direction

Figure 2.3-2 shows a five year average annual wind rose for the 33 ft level of the Forked River meteorological tower. Over the five year period, 1977 through 1981, SSW through NNW wind directions occurred about 50 percent of the time. Calm winds (i.e., winds with speeds less than 3.5 mph) occurred 11 percent of the time. All other wind directions occurred about 30 percent of the time. Note that NE through S winds (i.e., onshore winds) occurred about 25 percent of the time.

Figure 2.3-3 shows the five year average annual wind rose for the 380 ft level. The 380 ft level wind rose shows a similar distribution of winds to the 33 ft level annual wind rose. As may be expected, calm winds occur much less often at the 380 ft level (only 1.2 percent of the time).

Forked River Tower wind roses for the most recent available years of data collection are presented in Section 2.2.3.

Wind roses for 1968 data taken at the 75 ft level and the 400 ft level of the former Oyster Creek onsite tower are presented in Figures 2.3-4 and 2.3-5, respectively. Very similar distributions to those for the Forked River tower given above are seen.

2.3.2.1.2 Wind Persistence

The duration of time over which the wind continuously blows in a given direction (22 1/2 degree sector) for various wind speed ranges is given in Table 2.3-1. The table includes durations of 10 hours and more, as taken from a one year Oyster Creek tower data base, February 1966-February 1967. (Data from the 400 ft tower level were utilized here, since the elevated release point is about the same height above ground).

There were 127 cases where the wind stayed within a 22 1/2 degree sector for at least 10 hours. The maximum duration of 28 consecutive hours occurred with an average wind speed of over 25 mph. There were no cases with speeds less than 3 mph. In fact, only two cases occurred in the 4-7 mph range, one of 12 hours duration and one of 14 hours duration. Most of the occurrences were in the 19-24 mph range.

2.3.2.1.3 Sea Breeze

The sea breeze is a local circulation induced by density and pressure differences associated with differences in thermal characteristics between land and water surfaces. The sea breeze is also affected by topographical features such as terrain and the shape of the coastline. It is a phenomenon that is strongly influenced by transient weather systems which may entirely negate or amplify its existence. The sea breeze, represented as a mass of marine air (air which takes on the characteristics of air over the ocean), may be only 100-300 feet in depth or possibly as much as about 3,000 feet.

There usually is a seasonal preference for the summer months since the temperature difference between land and water surfaces is at its greatest at this time.

By virtue of its coastal location, the Oyster Creek Site is subject to this sea breeze phenomenon. An analysis of the character of the sea breeze as it occurs at the Oyster Creek Nuclear Generating Station, based on five years (1977-1981) of Forked River meteorological tower data, is provided in Appendix 2.3B.

2.3.2.2 Temperature

Table 2.3-2 presents temperature data from the New Jersey Agricultural Station at Pleasantville, New Jersey, located 33 miles south-southwest down the coastline from the Oyster Creek site.

Ambient temperature in the immediate vicinity of the site is continuously monitored at the 33 ft level of the Forked River meteorological tower. Table 2.3-3 provides mean monthly and extreme hourly temperatures observed during the period, January 1982 through December 1983. Data recovery percentages are also included. Table 2.3-4 describes the diurnal

temperature variation, averaged by month, as well as annually over the entire 1982 through 1983 period. Table 2.3-5 provides a gross distribution of the occurrence frequency of temperatures at the site during the two year period.

Table 2.3-6 provides mean monthly and extreme hourly dew point temperatures and dew point data recovery rates for 1982 through 1983. The months of lower recovery percentages were, in large measure, due to an occasionally malfunctioning dew point sensor and the self cleaning mechanism of the dew point system. Since late 1982, intensified maintenance has improved the dewpoint recovery rate. Table 2.3-7 displays the month to month diurnal variation in dew point. Occurrence frequencies of dew point temperatures measured during the two year period appear in Table 2.3-8.

Dew point temperature sensors, originally installed in 1974, remained in full service until December 1989. At that time, the dew point temperature sensing monitors failed and because replacement parts were no longer available, dew point temperature monitoring was discontinued. Ambient temperatures from each sensor, however, continued to be monitored.

In June, 1994, the ambient temperature monitoring section of both sensors failed. Because dew point temperature data are neither required nor useful and replacement parts for the instrumentation are out of production and stock, the dew point temperature systems remained out of service and the instrumentation is retired.

2.3.2.3 Fog

A five year record from the Atlantic City NWS Station, approximately 35 miles south-southwest of the site, indicates the annual average number of hours in which dense fog occurred was 155 hours. Dense fog is defined as a fog which restricts visibility to less than three eighths of a mile.

2.3.2.4 Temperature Inversion Conditions

2.3.2.4.1 Inversion Frequency

During nighttime hours, the ground cools more rapidly than the overriding air, forming a nocturnal temperature inversion with its base at the ground.

Inversion frequencies for the coast of New Jersey for each season, as well as annually, have been determined by Hosler (Reference 4). They are as follows:

	Winter	Spring	Summer	Fall	Annual
Frequency:	20%	20%	18%	24%	21%

These represent the percentage of total hours in each season. At the site, however, inversion frequencies are higher than those of Hosler. In fact, based on a one year period of data taken between February 1966 and February 1967 at the former Oyster Creek tower, about 64 percent of the time very stable (i.e.,vertical temperature lapse rate greater than 0.8°F per 100 ft) and moderately stable (i.e., vertical temperature lapse rate between -0.3 and 0.8°F per 100 ft) classifications were observed between 12 and 400 feet. This compares with 21 percent for Hosler. Actually, part of this difference is that Hosler defines an inversion as an increase in

temperature within 500 feet elevation above the ground. The moderately stable category used above to classify the Oyster Creek data actually includes some data that were in the neutral (slight decrease in temperature with height) category defined by Hosler. This results in a higher frequency of stable cases than that determined by Hosler.

Figure 2.3-6 shows the cumulative percent probability of inversion duration for February 1966 through February 1967. The cases considered inversion durations up to 24 hours. Only one case occurs in a day, so that the total cases actually represent the number of inversion days. Vertical temperature gradients of 0, 5, 10, 15, 20, and 25°F in the 12 to 400 ft layer were used to classify inversions with respect to strength. There were 315 days during which an inversion occurred. The inversion with the greatest strength occurred on October 28, 1966 and had a vertical temperature gradient of 26.1°F over the 388 ft layer.

There were four occurrences during the year which had inversion durations longer than 24 hours. One occurred during the fall and lasted 36 hours. The remainder occurred during winter and lasted 46, 45 and 42 hours each. Inversion in this case is defined as any positive temperature difference in the 12 to 400 ft layer but includes isothermal conditions.

Figures 2.3-7 through 2.3-10 also show cumulative percent probabilities of inversion duration but broken down for each season. Such illustrations are useful to determine the probability of an inversion of a particular strength occurring for a given duration. Table 2.3-9 presents this in tabular form for inversion durations of 5, 10 and 15 hours. For example, an inversion of 5°F during spring has a 65 percent probability of lasting at least 5 hours, 42 percent at 10 hours and less than 1 percent for a 15 hour duration.

Table 2.3-9 also shows that inversions persist longer during the fall and winter. This is to be expected since, during the warmer months, the air becomes more unstable due to surface heating and vertical mixing.

2.3.2.4.2 Inversion Breakdown

Definition

A stack release into an inversion results in a plume with little or no vertical displacement, but some horizontal meandering. That is, the plume often stays aloft, not reaching ground level for many miles. After sunrise, the ground is heated rapidly with the result that the layer of air near the surface becomes unstable. This unstable layer deepens such that the once surface based inversion has its base lifted.

The condition known as "fumigation" starts when the convection eddies within the mixing layer cause the lower part of the plume to rapidly mix downward. At this point the upper part of the plume is relatively undisturbed. Fumigation ends when the top of the mixing layer (this is actually the base of the old inversion) passes through the upper side of the plume.

The inversion breakdown occurs over an extensive area due to the solar radiation warming the land surface. Therefore, the conditions necessary for fumigation occur over this same area. The entire plume, which has drifted downwind in the stable air before sunrise, will be subjected to fumigation at about the same time, even when a considerable distance from the stack.

Duration and Frequency

The duration of fumigation depends upon the rate that the mixing layer deepens as the nocturnal inversion is dissipated. The more rapid the rise of the mixing layer, the shorter will be the duration of possible fumigation.

The Oyster Creek site data exhibit conditions that are necessary for fumigation to take place. Existing knowledge on this phenomenon indicates that fumigation may last a few minutes to about 15 minutes.

Prior to determination of fumigation frequency of occurrence, meteorological criteria were determined. Stability change over a certain time period is the most important indicator of fumigation. Once the vertical temperature difference within a layer goes from stable to lapse (unstable), fumigation can occur. But the inversion breakdown must proceed from the ground upward. Table 2.3-10 shows the seasonal occurrences of inversion breakdown: surface up, top down, and both surface up and top down.

Another factor to consider is the time that the atmosphere takes to switch from very stable to very unstable. The more rapid this change or "crossover", the more significant would be the effect due to fumigation. There were 226 days during the year when an inversion of at least 5°F existed. On 11 of these days, the inversion dissipated very slowly so as to mitigate a possible occurrence of fumigation.

A total of 76 days had an inversion breaking from the surface upwards. Assuming that fumigation lasts for about 15 minutes or less, a total of 19 hours in the year could possibly experience fumigation. Most of these hours occurred during the spring and summer. A seasonal breakdown is as follows:

	Winter	Spring	Summer	Fall
Hours	2.25	6.5	8.25	2.0

Wind Direction During Inversion Breakdown

The wind direction during inversion breakdown was offshore with the predominant direction being WNW. This offshore (land toward sea) wind direction during the inversion breakdown is typical of nocturnal surface based inversions at seacoast locations. However, once the inversion is weakened or broken down, the wind direction is then subject to thermal and pressure gradients consistent with daytime differential heating of land and water surfaces. In the cases examined from the site data, wind direction did not change significantly until after the breakdown period. Of course, this local air circulation is complicated greatly when transient weather systems travel across the area, and, in fact, they usually mask out this effect entirely.

Example of Breakdown of Nocturnal Inversion

Figure 2.3-11 represents a time history of meteorological data taken at the 400 foot tower on May 4 and 5, 1966. It includes wind speed and direction at 75 and 400 feet, surface temperature (12 feet) and temperature differences from surface to 75, 200 and 400 feet, respectively.

Several noteworthy features should be pointed out. Looking at the temperature difference traces, the air appears very stable during the nighttime hours followed by instability after sunrise and continuing through the day. The diurnal effect of the vertical temperature structure from the surface to 400 feet is quite apparent.

The vertical wind profile also exhibits a diurnal effect, although not as evident as the diurnal temperature change. During early morning on May 4, the wind at 400 feet attains a speed more than double that at 75 feet. At sunrise, however, the speeds at the two levels approach the same value and stay about the same during the daylight hours. Then near sunset, the speeds become similar to those that were observed before sunrise.

These diurnal differences can be explained by a brief discussion of turbulence. During the daytime, the energy due to moving air is transported downwards through the process of convection or turbulent exchange. Usually this results in a decrease of wind speed at the upper level and an increase at the lower level so that the speeds are quite similar. At night, however, the turbulence due to convection (eddy motions of various sizes) diminishes as the air stratifies thermally. This sets up the difference in speeds (wind shear) between the upper and lower levels.

Wind speed during the night of May 4 was typical of very stable air and fairly low wind speeds, which were due to a change in the pressure pattern in the area as a weather system approached. Even though the winds were influenced by the changing pressure pattern during the night of May 4, the thermal stability apparently was not affected very much until early evening on May 5 when the daytime instability approached isothermal stratification. During May 5, the wind speed increased at both 75 and 400 feet as the weather system approached.

The wind direction on May 4 was predominantly northwesterly. On the morning of May 5, the direction backed (moved counterclockwise) to a south-southwest direction with the approach of the transient weather system.

2.3.3 Onsite Meteorological Measurements Program

2.3.3.1 Meteorological Towers

The Oyster Creek Nuclear Generating Station is currently served by the meteorological tower located on the nearby Forked River Plant site. Prior to this, during licensing, construction and the early years of operation, meteorological data were obtained from an onsite tower.

2.3.3.1.1 Forked River

The Oyster Creek Nuclear Generating Station has obtained meteorological data from the Forked River meteorological tower since July 1976. The tower is 400 feet tall and located west-northwest of the site at a distance of 2529 feet from the Oyster Creek stack.

The meteorological tower is instrumented at three levels: 380 ft, 150 ft and 33 ft above ground. The instrumentation and meteorological variables measured at each level during the 1977-1981 period are shown in Table 2.3-11. The variables are measured every 10 seconds and are averaged for 15 minute periods before being archived.

There are redundant wind speed, wind direction, and temperature sensors at all three tower levels to ensure efficient data recovery and to comply with U.S. Nuclear Regulatory Commission Regulatory Guide 1.23, Revision 1 requirements. In addition, a processor calculates vertical temperature differentials between the 150 and 33 ft, and the 380 and 33 ft levels. All readings are continuously recorded. In addition, all data are processed via the Plant Process Computer, which is routinely accessed by the Control Room.

The meteorological tower sensors, recorders, and processors are calibrated at least semi-annually as per Regulatory Guide 1.23, Revision 1. Periodic tower inspections are made to insure maximum data integrity. A schematic of the meteorological data collection system is provided in Figure 2.3-12. In addition, all data are processed via the Plant Process Computer, which is routinely accessed by the Control Room.

2.3.3.1.2 Oyster Creek

From February 1966 through June 1976, data were continuously recorded from instruments mounted on a 400 foot tower, located in relatively flat terrain in a cleared area approximately 1200 feet west-southwest of the Oyster Creek Nuclear Generating Station Reactor Building. There were no trees for a radius of at least 300 feet and the nearest large structures were about 1000 feet to the east-northeast. Measurements may have been slightly affected by the proximity of structures in the east-northeast direction sector, however, no pronounced effect on speed or direction range measurements were found by inspection of the data.

Table 2.3-12 gives the type of instrument, the instrument accuracy, the instrument location, and the data recorded on the previous meteorological tower (1966 – 1976).

2.3.3.2 Onsite Joint Wind Stability Frequencies

Joint frequency distributions of wind and stability conditions measured on both the Forked River and Oyster Creek meteorological towers are provided. Atmospheric stability is classified as A through G, according to the NRC Regulatory Guide 1.23, Revision 1 method given in Table 2.3-13.

2.3.3.2.1 Forked River

A summary of annual results of an analysis of wind and stability data taken on the Forked River meteorological tower during 1982 and 1983 is provided in Tables 2.3-14, 2.3-16, 2.3-18, 2.3-20, 2.3-22, and 2.3.23.

Table 2.3-14 provides 1990 annual joint wind stability distributions for each stability class (A through G), utilizing 33 ft measurement level wind data, and 150 to 33 ft temperature difference stability data. Table 2.3-16 gives the 33 ft level wind distributions for all stability classes combined for 1990.

Tables 2.3-22 and 2.3-23 present the combined 1987-1990 monthly and annual occurrence frequency distributions of each stability class as derived from the 150 to 33 ft and 380 to 33 ft temperature difference data sets, respectively.

2.3.3.2.2 Oyster Creek

Joint wind stability frequency distributions using the Oyster Creek meteorological tower data for January 1968 through December 1968 are shown in Tables 2.3-24 through 2.3-26.

Table 2.3-24 provides joint frequency distributions of wind speed, wind direction and stability for wind data taken at 75 ft and vertical temperature difference between 75 ft and 12 ft. Table 2.3-25 provides the distribution for wind at 75 ft and vertical temperature difference between 200 and 75 ft. Table 2.3-26 provides the distribution for wind at 400 ft and vertical temperature difference between 400 and 12 ft.

Joint data recovery rates for wind and stability data provided in Tables 2.3-24 through 2.3-26 are 84 percent, 84 percent and 92 percent, respectively.

The measured wind speeds have been corrected according to the calibration curves measured for a typical three bladed Aerovane. Wind tunnel tests with this type of anemometer have shown that the indicated speed is lower than the true wind speed when the true wind speed is below 4 miles per hour. The corrections are as follows:

Indicated Wind Speed (mph)	True Wind Speed (mph)
0.0	0.00
0.5	2.25
1.0	2.40
1.5	2.50
2.0	2.70
2.5	3.00
3.0	3.30
3.5	3.75
4.0	4.00

2.3.4 Short Term (Accident) Diffusion Estimates

Conservative estimates of short term relative concentration factors (X/Q)* have been derived for the plant for the purpose of assessing the potential offsite radiological consequences of postulated accidental releases of radiological material to the atmosphere.

2.3.4.1 AEC Generated Augmented Offgas System X/Q

Relative concentrations (X/Q)* at the exclusion area boundary associated with an accidental release due to failure of the Augmented Offgas (AOG) System, including the Delay Pipe and the Condenser Steam Jet Air Ejectors (SJAE) were formerly calculated by the Atomic Energy Commission (AEC). These X/Q values are presented in Table 2.3-27. (The X/Q value for the AOG building represents a subsequent modification to allow for a relocation of the AOG building closer to the site boundary). The 1968 period of Oyster Creek onsite meteorological tower wind and vertical temperature difference data was used by the AEC for this analysis.

2.3.4.2 Other Design Basis Accident X/Q

Relative concentration factors (X/Q) for other design basis accidents were determined by several methods as documented in the respective accident evaluation.

For the loss of coolant accident, relative concentration factors were determined directly from Safety Guide 3 for distances of 600 meters and 3218 meters (Low Population Zone). Figures 1(A), 1(B), 1(C), 1(D) and 1(E) of the guide were used for determining X/Q values. Site specific meteorology was not used for the determination of X/Q values at these distances. Fumigation conditions were assumed to exist for this event as documented in Amendment 68 of reference 9.

For the main steam line break accident, X/Q values at 414 meters (EAB) and 3218 meters (LPZ) were determined directly from Figure 1 of Safety Guide 5 as documented in Amendment 68 of reference 9.

For the fuel handling accident and control rod drop accident, relative dispersion coefficients were determined utilizing generic methods developed by J. J. Fuquay, C. L. Simpson and W. T. Hinds based upon Hanford experimental data (reference 10). The assumptions used with these generic methods, as described in Appendix 15A, were confirmed with site specific meteorological data from February 1966 through February 1967 as documented in Amendment 13 of reference 9. Site specific data was not used for the direct determination of X/Q for these events.

2.3.4.2.1 Deleted

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[*] X/Q is the ambient concentration (X) of plume material relative to source strength (Q), in units of seconds/meter^3.

2.3.4.2.2 Deleted

2.3.5 Long Term (Routine Release) Diffusion Estimates

Routine release diffusion factors have been calculated with data from both the former Oyster Creek meteorological tower and the Forked River meteorological tower. NRC Regulatory Guide 1.111 (Rev. 1) methodology for "constant mean wind direction" modeling was employed in each analysis.

2.3.5.1 Estimates Using Oyster Creek Tower Data

Appendix 2.3D provides a detailed diffusion analysis utilizing data previously recorded at the Oyster Creek meteorological tower. Computations were performed, using 1968 tower data, for both elevated stack releases and ground level releases from the radwaste and turbine buildings. The following diffusion factors were computed; undepleted relative concentration (X/Q), depleted relative concentration (X/Q_d), and relative deposition (D/Q)*. Receptors were located at 10 distances out to 90 km in each direction, as well as at several critical discrete points.

Less detailed computations were performed for comparative purposes on a February, 1966 through December, 1968 data base. Additionally, wind data taken over the 10 year data collection period, 1966 through 1975, were used to demonstrate the representativeness of the diffusion analysis data base.

Tables 2.3-31 and 2.3-32 present the 1968 annual average values of (X/Q), (X/Q_d), and (D/Q) for ground level release and elevated release, respectively, as computed for each receptor in the radial grid. (See Appendix 2.3D for all results in detail).

2.3.5.2 Estimates Using Forked River Tower Data

X/Q and D/Q Dispersion parameters were computed using 1989 and 1990 Forked River Meteorological Tower Data. Tables 2.3-33 and 2.3-34 provide X/Q and D/Q values for ground level and elevated releases, respectively, at 10 distances out to 50 miles in each direction.

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* D/Q is the deposition rate (D) of plume material relative to source strength (Q), in units of meter^{-2}.

2.3.6 References

(1) U.S. Weather Bureau; Some Devastating North Atlantic Hurricanes of the 20th Century; pub. LS 6303; January 1963.

(2) U.S. Weather Bureau; Storm Data-1959 through 1962.

(3) Tornadoes; AIA Technical Reference Guide 13-2.

(4) Hosler, C.R.; "Low Level Inversion Frequency in the Contiguous United States", Monthly Weather Review, 89(9): 319-339; 1961.

(5) Deleted

(6) U.S. Nuclear Regulatory Commission Regulatory Guide 1.23, Revision 1, Meteorological Monitoring Programs for Nuclear Power Plants.

(7) U.S. Nuclear Regulatory Commission Regulatory Guide 1.111, Revision 1, Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors.

(8) Deleted

(9) Oyster Creek Nuclear Power Plant, Facility Description and Safety Analysis Report, and Amendments.

(10) Fuquay, JJ, Simpson, C. L., and Hinds, W.T., “Prediction of Environmental Exposures from Sources Near the Ground, Based on Harford Environmental Data”, Journal of Applied Meteorology, Volume 3, No. 6 (December 1964).

TABLE 2.3-1
(Sheet 1 of 1)

TOTAL OCCURRENCES OF WIND DIRECTION WITHIN A
22 1/2 DEGREE DIRECTION SECTOR FOR VARIOUS WIND SPEED
RANGES, BASED ON THE OYSTER CREEK METEOROLOGICAL
TOWER DATA FOR FEBRUARY 1966 - FEBRUARY 1967

Duration	Wind Speed Range (mph)						
(hours)	0-3	4-7	8-12	13-18	19-24	25	Totals
10	-	-	6	9	11	1	27
11	-	-	5	5	11	6	27
12	-	1	1	5	9	5	21
13	-	-	-	1	6	2	9
14	-	1	-	3	8	3	15
15	-	-	1	2	4	2	9
16	-	-	-	1	3	2	6
17	-	-	1	1	2	-	4
18	-	-	-	-	2	-	2
19	-	-	-	-	-	1	1
20	-	-	-	-	1	-	1
21	-	-	-	-	1	1	2
22	-	-	-	-	1	-	1
23	-	-	-	-	-	-	-
24	-	-	-	-	-	-	-
25	-	-	-	-	-	-	-
26	-	-	-	-	1	-	1
27	-	-	-	-	-	-	
28	-	-	-	-	-	1	1
Totals	0	2	14	27	60	24	127

TABLE 2.3-2
(Sheet 1 of 1)

TEMPERATURE DATA AT PLEASANTVILLE, NEW JERSEY (1926-1955)

MEAN DAILY HIGHEST AND LOWEST TEMPERATURES (°F) EXPECTED ON A MONTHLY BASIS

Month	Mean Daily Maximum	Mean Daily Minimum
Jan	43.5	23.7
Feb	44.9	24.8
March	51.2	31.1
April	60.5	39.7
May	71.4	50.8
June	80.1	59.9
July	84.0	64.7
Aug	82.3	62.1
Sept	75.7	54.0
Oct	67.1	44.4
Nov	55.7	33.5
Dec	45.3	25.0

HIGHEST AND LOWEST HOURLY TEMPERATURES (°F) EVER RECORDED ON A MONTHLY BASIS DURING THE PERIOD OF RECORD*

Month	Hourly Maximum	Hourly Minimum
Jan	76	-23
Feb	80	-11
March	87	2
April	93	19
May	96	28
June	101	37
July	106	42
Aug	102	41
Sept	99	30
Oct	94	20
Nov	85	1
Dec	70	-4

* Absolute maximum of 106°F in 1936 and absolute minimum of -23°F in 1942.

TABLE 2.3-3
(Sheet 1 of 1)

MEAN MONTHLY AND EXTREME HOURLY TEMPERATURES
BASED ON FORKED RIVER METEOROLOGICAL TOWER DATA
FOR THE PERIOD 1987-1990: 33 FT LEVEL

Temperature (°F)

Month	Mean	Maximum	Minimum	Data Recovery (Percentage)
Jan	33.8	68.9	1.7	99.4
Feb	34.4	80.2	3.9	95.3
March	41.3	83.2	14.0	99.5
April	48.5	82.7	26.1	92.3
May	59.4	91.7	33.5	94.0
June	69.6	94.2	42.6	97.9
July	73.8	96.9	45.4	95.8
Aug	73.1	99.0	46.2	99.5
Sept	65.0	91.6	32.2	98.7
Oct	53.8	85.1	23.4	98.6
Nov	46.8	86.0	11.0	98.7
Dec	34.7	70.6	0.0	97.6
1987-1990	52.9	85.8	23.3	97.3

TABLE 2.3-4
(Sheet 1 of 1)

DIURNAL VARIATION OF MEAN HOURLY TEMPERATURE BY MONTH
BASED ON FORKED RIVER METEOROLOGICAL TOWER DATA
FOR THE PERIOD 1987-1990: 33 FT. LEVEL

Local Standard Time	Temperature (°F) Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
0100	31.1	31.9	37.2	44.8	55.3	65.0	69.4	68.9	60.7	49.2	43.5	32.3	49.1
0200	30.6	31.3	37.0	44.2	54.6	64.1	68.7	68.2	60.0	48.7	43.2	31.6	48.0
0300	30.4	30.9	36.4	43.6	53.7	63.7	68.2	67.6	59.4	48.0	42.9	31.3	48.0
0400	30.3	30.5	36.0	43.0	53.3	63.1	67.8	67.1	59.3	47.3	42.7	31.0	47.6
0500	29.9	30.1	35.6	42.4	52.8	62.5	67.3	66.5	58.8	47.0	42.4	30.6	47.2
0600	29.6	29.5	35.3	42.1	52.6	62.2	67.1	66.3	58.2	46.7	41.9	30.1	46.8
0700	29.3	29.2	34.9	42.6	54.0	64.0	68.6	67.2	57.9	46.4	41.6	30.3	47.2
0800	29.2	29.0	36.0	46.0	57.3	67.3	71.7	70.1	61.0	47.8	41.4	29.9	48.9
0900	30.2	31.3	39.8	48.9	60.2	70.3	74.5	73.6	65.5	53.2	44.6	31.0	51.9
1000	32.9	34.2	42.9	50.9	62.1	72.4	76.6	75.7	68.2	57.3	48.5	34.5	54.7
1100	35.6	36.5	44.4	52.4	63.9	74.3	78.3	77.4	69.7	59.9	50.7	36.8	56.7
1200	37.8	38.0	45.5	53.4	64.8	75.5	79.3	78.3	70.3	61.1	52.4	38.6	57.9
1300	39.1	39.2	47.3	53.9	64.9	75.6	79.8	79.0	71.2	62.0	53.2	40.0	58.8
1400	39.8	40.1	47.8	54.3	65.0	76.0	79.9	79.4	71.8	62.2	53.8	41.1	59.3
1500	40.0	40.4	47.9	54.7	65.1	76.1	79.9	79.4	72.0	62.4	53.8	41.2	59.4
1600	39.8	40.6	47.9	54.2	64.5	76.0	79.6	79.3	71.8	61.8	53.1	40.8	59.1
1700	38.9	39.9	47.8	53.6	64.7	75.4	78.9	78.7	71.0	60.6	51.7	39.6	58.4
1800	37.1	38.7	46.4	52.7	64.0	74.4	78.0	77.8	69.5	58.3	49.4	37.7	57.0
1900	35.6	36.7	44.4	51.3	62.7	73.1	76.6	76.1	67.5	55.6	47.8	36.4	55.3
2000	34.1	35.2	42.5	49.3	61.0	71.1	74.8	73.9	65.4	53.5	46.3	34.7	53.5
2100	33.2	34.2	41.2	48.0	59.3	69.1	73.1	72.3	63.9	52.0	45.5	33.9	52.1
2200	32.6	33.5	40.4	47.0	58.0	67.6	72.0	71.1	62.9	50.8	44.9	33.2	51.2
2300	32.1	32.8	39.4	46.2	57.1	66.5	71.1	70.2	62.2	49.9	44.2	33.0	50.4
2400	31.8	32.3	38.4	45.6	56.5	65.7	70.2	69.4	61.2	49.4	43.8	32.9	49.8

TABLE 2.3-5
(Sheet 1 of 1)

FREQUENCY DISTRIBUTION OF TEMPERATURES
BASED ON FORKED RIVER METEOROLOGICAL TOWER DATA
FOR THE PERIOD 1987-1990: 33 FT LEVEL

Interval (°F)	Occurrences	Percentage
0	2	0.0001
0.1 - 9.9	180	0.5133
10 - 19.9	858	2.45
20 - 29.9	2668	7.61
30 - 39.9	5167	14.74
40 - 49.9	6118	17.45
50 - 59.9	6163	17.58
60 - 69.9	5963	17.01
70 - 79.9	5297	15.11
80 - 89.9	1571	4.48
90 - 99.9	111	0.317
Missing	3946	2.76

TABLE 2.3-6
(Sheet 1 of 1)

MEAN MONTHLY AND EXTREME HOURLY DEW POINT TEMPERATURES
BASED ON FORKED RIVER METEOROLOGICAL TOWER DATA
FOR THE PERIOD 1982-1983: 33 FT LEVEL

Dew Point (°F)

Month	Mean	Maximum	Minimum	Data Recovery (Percentage)
Jan	20.2	54.2	-14.8	91.9
Feb	23.1	54.2	-8.6	98.7
March	27.3	53.4	-4.1	85.5
April	32.7	58.3	-0.5	96.8
May	47.7	66.7	10.9	91.2
June	57.7	74.4	9.1	90.8
July	62.9	76.1	40.6	65.1
Aug	62.1	75.2	33.0	86.8
Sept	56.1	74.5	29.3	86.9
Oct	45.8	69.5	21.3	89.4
Nov	38.3	66.1	6.0	87.4
Dec	28.8	61.9	-10.2	92.3
1982-1983	41.9	76.1	-14.8	88.6

TABLE 2.3-7
(Sheet 1 of 1)

DIURNAL VARIATION OF MEAN HOURLY TEMPERATURE BY MONTH
BASED ON FORKED RIVER METEOROLOGICAL TOWER DATA
FOR THE PERIOD 1982-1983: 33 FT. LEVEL

Local Standard Time	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
	Dew Points (°F)												
0100	17.9	23.0	26.4	32.9	47.3	57.4	62.6	61.6	55.8	45.9	39.0	28.6	41.0
0200	18.9	23.1	26.1	32.7	47.3	57.1	62.3	61.5	55.4	45.8	39.0	28.6	41.1
0300	18.1	22.9	26.0	32.2	47.2	56.9	62.0	61.3	55.3	45.6	38.9	28.8	40.9
0400	18.9	22.7	26.5	31.7	47.6	56.9	61.9	61.3	55.2	46.5	38.7	27.6	41.2
0500	19.1	22.8	26.4	31.5	47.4	58.2	62.8	61.1	55.3	45.4	38.7	29.4	40.3
0600	19.2	22.8	26.4	31.6	47.6	57.7	62.7	61.4	54.9	45.1	38.4	29.3	41.0
0700	19.2	22.6	26.7	32.4	49.1	58.4	64.2	63.2	56.7	45.4	38.2	29.4	41.6
0800	20.1	23.0	27.2	31.8	49.1	58.1	64.0	65.6	57.8	46.8	38.8	29.6	41.1
0900	21.1	23.2	27.6	31.5	48.5	57.5	62.8	62.3	56.3	44.3	39.3	29.9	41.0
1000	21.1	23.2	27.2	31.7	47.5	57.3	61.1	61.9	56.3	48.3	38.2	26.9	41.3
1100	20.8	22.3	27.3	31.9	47.2	57.0	61.0	61.8	55.5	45.3	38.7	29.9	41.1
1200	21.1	21.7	28.2	32.3	47.0	57.3	61.6	61.3	55.8	45.5	38.2	29.5	41.0
1300	21.7	22.8	28.3	32.6	47.2	57.1	62.1	61.4	55.0	45.5	37.9	29.9	41.4
1400	22.2	23.3	27.5	32.7	47.3	56.9	61.9	61.8	55.7	45.9	37.7	29.3	41.5
1500	21.7	23.5	27.7	32.8	47.4	56.5	62.5	61.9	56.2	46.1	37.7	29.4	41.5
1600	20.8	23.4	27.4	32.3	46.8	57.2	62.3	61.8	55.9	47.7	38.2	28.4	41.3
1700	21.2	23.5	28.0	32.7	47.1	59.1	63.6	61.7	57.1	45.8	38.4	29.1	40.7
1800	21.0	23.9	28.1	33.5	47.2	58.3	63.6	62.5	57.1	46.1	38.2	29.3	41.7
1900	21.4	24.0	27.9	34.6	48.2	59.2	64.4	62.7	57.2	45.7	38.1	29.0	42.0
2000	20.7	23.7	28.3	34.1	48.6	59.0	64.7	65.4	57.4	46.3	37.5	27.7	41.4
2100	20.2	23.6	28.2	33.9	48.7	58.8	64.6	63.1	56.8	43.9	37.6	28.2	41.3
2200	19.8	23.2	28.3	33.8	48.6	58.4	64.3	62.7	56.6	47.2	37.4	25.3	41.7
2300	19.1	22.7	27.7	33.4	47.8	57.9	63.9	62.1	56.2	45.8	37.4	27.9	41.2
2400	19.1	22.3	26.9	33.4	48.1	56.8	63.3	61.8	56.0	45.5	38.5	28.7	41.1

TABLE 2.3-8
(Sheet 1 of 1)

FREQUENCY DISTRIBUTION OF DEW POINT TEMPERATURE
BASED ON FORKED RIVER METEOROLOGICAL TOWER DATA
FOR THE PERIOD 1982-1983: 33 FT LEVEL

Interval (°F)	Occurrences	Percentage
-10	32	0.18
-9 – 0	207	1.18
0.1 – 9	692	3.95
10 – 19	1467	8.37
20 – 29	2221	12.68
30 – 39	2447	13.97
40 – 49	2379	13.58
50 – 59	3207	18.31
60 – 69	2270	12.96
70 – 79	575	3.28
Missing	2023	11.55

Table 2.3-9
(Sheet 1 of 1)

PERCENT PROBABILITIES OF INVERSION
DURATION FOR EACH SEASON, BASED ON THE
FORKED RIVER METEOROLOGICAL TOWER
DATA FOR JANUARY 1990 - DECEMBER 1990*

Inversion Strength T (380-33 Ft.)** (deg F)	INVERSION DURATION (HOURS) Winter 5	10	15	Spring 5	10	15	Summer 5	10	15	Fall 5	10	15
0-4.99 5.6	45.6 2.2	10.0	*	33.7	7.6	*	43.0	6.5	*	46.0	15.6	2.2
5-9.99	10.0	1.1	*	6.5	1.1	*	26.9	5.4	*	20.0	4.4	*
10-14.99	8.9	*	*	4.4	*	*	8.6	*	*	14.4	2.2	*
15-19.99	*	*	*	1.1	*	*	1.1	*	*	5.6	*	*
>20	*	*	*	*	*	*	*	*	*	*	*	*

* For example, an inversion between 0 degrees F and 4.99 degrees F between 33 and 380 feet during the spring has a 33.7 percent probability of lasting at least 5 hours, 7.6 percent chance of lasting at least 10 hours, and less than 1 percent for a 15 hour duration.

** Vertical temperature difference between tower 380 foot level minus 33 foot level.

TABLE 2.3-10
(Sheet 1 of 1)

SEASONAL OCCURRENCES OF INVERSION* BREAKDOWN**
BASED ON THE FORKED RIVER METEOROLOGICAL TOWER DATA
FOR JANUARY 1990 - DECEMBER 1990

	Total	Inversion Breakdown Occurs (Days)		
Season	Inversion (Days)	Surface Up	Top Down	Both at Once
Winter	50	14	17	19
Spring	42	17	19	6
Summer	40	18	7	15
Autumn	58	8	28	22
Total	190	57	71	62

* A temperature inversion is defined here as the 380 foot temperature minus the 33 foot temperature of greater than or equal to 4.47 degrees F before the breakdown occurs. This value is normalized from inversion criteria set forth in the previous version for the defunct Oyster Creek Meteorological Tower.

** This total represents 190 days when a complex vertical temperature profile occurred due to an inversion breakdown within 380 feet. A complex stability is where a stable layer exists over (or under) an unstable profile, or the inversion is breaking down from the bottom (top) or even both. Criteria for a stable and unstable layer were also normalized from those set with reference to the Forked River Meteorological Tower.

Note: There were 55 inversion days in which no breakdown trend could be deciphered due to long term inversion, hence, little fumigation possibility.

TABLE 2.3-11
(Sheet 1 of 1)

FORKED RIVER METEOROLOGICAL TOWER:

PARAMETERS RECORDED DURING THE YEARS 1977-1981

Approximate Height Above Tower Base (ft.)	Parameter	Instrumentation
380	Wind speed*	Teledyne Geotech 50.1/52.2
	Wind direction*	Teledyne Geotech 50.2/53.2
	Temperature*	Rosemount 104 MB/78-39
	Delta T 380 to 33 ft.*	Rosemount 104 MB/78-39
	Dew point temperature**	EG&G 110S (M)
150	Wind speed	Teledyne Geotech 50.1/52.2
	Wind direction	Teledyne Geotech 50.2/53.2
	Temperature	Rosemount 104 MB/78-39
	Delta T 150 to 33 ft.	Rosemount 104 MB/78-39
33	Wind speed*	Teledyne Geotech 50.1/52.2
	Wind direction*	Teledyne Geotech 50.2/53.2
	Temperature*	Rosemount 104 MB/78-39
	Dew point temperature**	EG&G 110S (M)
Ground Level	Rainfall	Belfort 5-405 HA

* Redundant system installed in 1981.

** Dew point temperature no longer measured.

TABLE 2.3-12
(Sheet 1 of 2)

INSTRUMENTATION FOR OYSTER CREEK METEOROLOGICAL TOWER
(February 1966 – June 1976)

Wind Speed and Direction

Anemometers

Number	2
Location (Elevation), Feet	75 and 400
Make	Bendix Aerovane
Model	120

Recorders

Number	2
Make	Bendix Friez
Model	141

System Accuracy

Wind Speed, mph	3 to 45 ±1.75, 45 to 100 ±3.0
Wind Direction, Degrees	±3.0

Temperature

Ambient

Number	1
Location (Elevation), Feet	12
Sensor Make	Bristol Resis. Thermometer Bulb
Sensor Model	7NA
Sensor Range, °F	-50 to +265
Sensor Accuracy, Percent	±0.18 from -50°F to 110°F
Recorder Number	1
Recorder Make	Bristol Wide Strip Dynamaster
Recorder Model	560 Multipoint
Recorder Chart Scale, °F	-28 to +120
Recorder Chart Divisions, °F	1.0
Recorder Accuracy, Percent	±0.25% of Full Scale
Recorder Accuracy, °F	0.37

TABLE 2.3-12
(Sheet 2 of 2)

INSTRUMENTATION FOR OYSTER CREEK METEOROLOGICAL TOWER
(February 1966 – June 1976)

Difference

Number of Points	3
Location (Elevation), Feet	12 - 75 12 - 200 12 - 400
Sensor and Recorder “Ambient	See above under Temperature"
Recorder Chart Scale, °F	-7 to +30
Recorder Chart Divisions, °F	0.25
Recorder Accuracy, Percent	±0.25
Recorder Accuracy, °F	±0.09

TABLE 2.3-13
(Sheet 1 of 1)

METEOROLOGICAL CLASSIFICATION OF ATMOSPHERIC STABILITY

Stability Classification	Pasquill Categories	Standard Deviation* (degrees)	With Height (F/100 ft)
Extremely Unstable	A	25.0	-1.0
Moderately Unstable	B	20.0	-1.0 to -0.9
Slightly Unstable	C	15.0	-0.9 to -0.8
Neutral	D	10.0	-0.8 to -0.3
Slightly Stable	E	5.0	-0.3 to 0.8
Moderately Stable	F	2.5	0.8 to 2.2
Extremely Stable	G	1.7	2.2

* Standard deviation of horizontal wind direction fluctuation over a period of 15 minutes to 1 hour. The values shown are average for each stability classification. Source: Reference 6

TABLE 2.3-14
(Sheet 1 of 7)

JOINT FREQUENCY OF WIND BY STABILITY CLASS (1990 DATA)
FORKED RIVER METEOROLOGICAL TOWER
LOWER MEASUREMENT LEVEL (33 FT)

(HOURS AT EACH WIND SPEED AND DIRECTION)
STABILITY CLASS: A
ELEVATION
SPEED: 33 FT
DIRECTION: 33 FT
LAPSE: 150 to 33 FT

		WIND SPEED (MPH)						
SECTOR TO	WINDS FROM	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	S	0	13	75	36	3	0	127
NNE	SSW	3	16	42	58	9	0	128
NE	SW	1	24	40	5	0	0	70
ENE	WSW	6	43	51	7	0	0	107
E	W	5	56	69	17	0	2	149
ESE	WNW	2	45	111	42	2	2	204
SE	NW	7	57	106	25	1	0	196
SSE	NNW	1	45	51	5	0	0	102
S	N	2	22	17	0	0	0	41
SSW	NNE	0	20	12	0	0	0	32
SW	NE	3	37	41	0	0	0	81
WSW	ENE	2	47	68	1	0	0	118
W	E	2	42	25	0	0	0	69
WNW	ESE	4	31	19	0	0	0	54
NW	SE	0	44	61	11	0	0	116
NNW	SSE	0	20	57	13	0	0	90
TOTAL		38	562	845	220	15	4	1684

HOURS OF MISSING DATA: 67

TABLE 2.3-14
(Sheet 2 of 7)

JOINT FREQUENCY OF WIND BY STABILITY CLASS (1990 DATA)
FORKED RIVER METEOROLOGICAL TOWER
LOWER MEASUREMENT LEVEL (33 FT)

(HOURS AT EACH WIND SPEED AND DIRECTION)
STABILITY CLASS: B
ELEVATION
SPEED: 33 FT
DIRECTION: 33 FT
LAPSE: 150 to 33 FT

SECTOR TO	WINDS FROM	WIND SPEED (MPH) 1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	S	3	9	15	6	1	0	34
NNE	SSW	1	10	19	21	5	0	56
NE	SW	2	9	7	3	0	0	21
ENE	WSW	3	11	13	3	0	0	30
E	W	5	13	12	5	0	0	35
ESE	WNW	2	19	24	6	0	0	51
SE	NW	1	20	22	8	0	0	51
SSE	NNW	5	7	7	0	0	0	19
S	N	3	5	3	0	0	0	11
SSW	NNE	2	4	2	0	0	0	8
SW	NE	1	15	12	1	0	0	29
WSW	ENE	1	14	8	0	0	0	23
W	E	2	8	5	0	0	0	15
WNW	ESE	0	5	2	0	0	0	7
NW	SE	3	6	5	1	0	0	15
NNW	SSE	1	11	9	1	0	0	22
TOTAL		35	166	165	55	6	0	427

HOURS OF MISSING DATA: 67

TABLE 2.3-14
(Sheet 3 of 7)

JOINT FREQUENCY OF WIND BY STABILITY CLASS (1990 DATA)
FORKED RIVER METEOROLOGICAL TOWER
LOWER MEASUREMENT LEVEL (33 FT)

(HOURS AT EACH WIND SPEED AND DIRECTION)

STABILITY CLASS: C
ELEVATION
SPEED: 33 FT.
DIRECTION: 33 FT
LAPSE: 150 to 33 FT

SECTOR TO	WINDS FROM	WIND SPEED (MPH) 1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	S	2	5	12	2	0	0	21
NNE	SSW	2	3	17	6	2	0	30
NE	SW	2	8	5	0	0	0	15
ENE	WSW	0	11	4	1	0	0	16
E	W	3	9	9	1	0	0	22
ESE	WNW	4	9	9	5	0	0	27
SE	NW	1	8	9	1	0	0	19
SSE	NNW	2	7	3	0	0	0	12
S	N	3	4	3	0	0	0	10
SSW	NNE	0	3	4	0	0	0	7
SW	NE	0	11	5	0	0	0	16
WSW	ENE	2	8	6	1	0	0	17
W	E	1	4	2	0	0	0	7
WNW	ESE	1	3	0	1	0	0	5
NW	SE	0	4	3	0	0	0	7
NNW	SSE	2	5	5	0	0	0	12
TOTAL		25	102	96	18	2	0	243

HOURS OF MISSING DATA: 67

TABLE 2.3-14
(Sheet 4 of 7)

JOINT FREQUENCY OF WIND BY STABILITY CLASS (1990 DATA)
FORKED RIVER METEOROLOGICAL TOWER
LOWER MEASUREMENT LEVEL (33 FT)

(HOURS AT EACH WIND SPEED AND DIRECTION)

STABILITY CLASS: D
ELEVATION
SPEED: 33 FT
DIRECTION: 33 FT
LAPSE: 150 to 33 FT

		WIND SPEED (MPH)						
SECTOR TO	WINDS FROM	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	S	8	30	41	9	5	1	94
NNE	SSW	12	55	99	50	8	2	226
NE	SW	7	40	33	7	0	0	87
ENE	WSW	13	45	37	2	0	0	97
E	W	12	36	30	4	0	0	82
ESE	WNW	15	37	36	18	0	0	106
SE	NW	12	57	56	6	0	0	131
SSE	NNW	11	31	32	1	0	0	75
S	N	11	28	16	6	0	0	61
SSW	NNE	16	48	14	0	0	0	78
SW	NE	11	96	60	1	0	0	168
WSW	ENE	19	43	43	5	0	0	110
W	E	4	41	19	6	0	0	70
WNW	ESE	4	33	16	2	0	0	55
NW	SE	6	36	16	0	0	0	58
NNW	SSE	5	45	22	4	0	0	76
TOTAL		166	701	570	121	13	3	1574

HOURS OF MISSING DATA: 67

TABLE 2.3-14
(Sheet 5 of 7)

JOINT FREQUENCY OF WIND BY STABILITY CLASS (1990 DATA)
FORKED RIVER METEOROLOGICAL TOWER
LOWER MEASUREMENT LEVEL (33 FT)

(HOURS AT EACH WIND SPEED AND DIRECTION)
STABILITY CLASS: E
ELEVATION
SPEED: 33 FT
DIRECTION: 33 FT
LAPSE: 150 to 3 FT

SECTOR TO	WINDS FROM	WIND SPEED (MPH) 1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	S	25	80	40	8	5	1	159
NNE	SSW	36	184	184	50	7	0	461
NE	SW	33	188	84	17	0	0	322
ENE	WSW	38	127	54	3	0	0	222
E	W	31	105	40	6	0	0	182
ESE	WNW	35	95	84	15	1	0	230
SE	NW	38	96	48	4	0	0	186
SSE	NNW	19	72	43	0	0	0	134
S	N	22	37	17	0	0	0	76
SSW	NNE	21	33	11	0	0	0	65
SW	NE	28	47	40	1	0	0	116
WSW	ENE	24	47	28	4	0	0	103
W	E	17	40	9	0	0	0	66
WNW	ESE	12	31	4	3	0	0	50
NW	SE	10	53	23	4	1	0	91
NNW	SSE	21	47	28	3	0	0	99
TOTAL		410	1282	737	118	14	1	2562

HOURS OF MISSING DATA: 67

TABLE 2.3-14
(Sheet 6 of 7)

JOINT FREQUENCY OF WIND BY STABILITY CLASS (1990 DATA)
FORKED RIVER METEOROLOGICAL TOWER
LOWER MEASUREMENT LEVEL (33 FT)

(HOURS AT EACH WIND SPEED AND DIRECTION)

STABILITY CLASS: F
ELEVATION
SPEED: 33 FT
DIRECTION: 33 FT
LAPSE: 150 to 33 FT

SECTOR TO	WINDS FROM	WIND SPEED (MPH) 1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	S	22	19	2	0	0	0	43
NNE	SSW	35	53	3	2	0	0	93
NE	SW	44	95	6	1	0	0	146
ENE	WSW	39	93	3	0	0	0	135
E	W	42	68	0	0	0	0	110
ESE	WNW	27	43	5	2	0	0	77
SE	NW	45	49	6	0	0	0	100
SSE	NNW	41	36	3	0	0	0	80
S	N	19	17	1	0	0	0	37
SSW	NNE	12	11	0	0	0	0	23
SW	NE	14	4	2	0	0	0	20
WSW	ENE	10	1	2	0	0	0	13
W	E	9	4	0	0	0	0	13
WNW	ESE	8	4	0	0	0	0	12
NW	SE	11	5	0	0	0	0	16
NNW	SSE	7	0	0	0	0	0	7
TOTAL		385	502	33	5	0	0	925

HOURS OF MISSING DATA: 67

TABLE 2.3-14
(Sheet 7 of 7)

JOINT FREQUENCY OF WIND BY STABILITY CLASS (1990 DATA)
FORKED RIVER METEOROLOGICAL TOWER
LOWER MEASUREMENT LEVEL (33 FT)

(HOURS AT EACH WIND SPEED AND DIRECTION)

STABILITY CLASS: G
ELEVATION
SPEED: 33 FT
DIRECTION: 33 FT
LAPSE: 150 to 33 FT

		WIND SPEED (MPH)						
SECTOR TO	WINDS FROM	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	S	60	4	0	0	0	0	64
NNE	SSW	82	14	0	0	0	0	96
NE	SW	85	20	0	0	0	0	105
ENE	WSW	75	50	0	0	0	0	125
E	W	63	79	1	1	0	0	144
ESE	WNW	59	89	1	0	0	0	149
SE	NW	77	61	0	0	0	0	138
SSE	NNW	91	53	0	0	0	0	144
S	N	74	23	0	0	0	0	97
SSW	NNE	34	5	0	0	0	0	39
SW	NE	34	6	0	0	0	0	40
WSW	ENE	18	0	0	0	0	0	18
W	E	18	1	0	0	0	0	19
WNW	ESE	33	2	0	0	0	0	35
NW	SE	30	0	0	0	0	0	30
NNW	SSE	34	1	0	0	0	0	35
TOTAL		867	408	2	1	0	0	1278

HOURS OF MISSING DATA: 67

TABLE 2.3-16
(Sheet 1 of 1)

JOINT FREQUENCY OF WIND SPEED AND DIRECTION (1990 DATA)
FORKED RIVER METEOROLOGICAL TOWER
LOWER MEASUREMENT LEVEL (33 FT)

(HOURS AT EACH WIND SPEED AND DIRECTION)
STABILITY CLASS: All
ELEVATION
SPEED: 33 FT
DIRECTION: 33 FT

		WIND SPEED (MPH)						
SECTOR TO	WINDS FROM	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	S	120	160	185	61	14	2	542
NNE	SSW	171	335	364	187	31	2	1090
NE	SW	174	384	175	33	0	0	766
ENE	WSW	174	380	162	16	0	0	732
E	W	161	366	161	34	0	2	724
ESE	WNW	144	337	270	88	3	2	844
SE	NW	181	348	247	44	1	0	821
SSE	NNW	170	251	139	6	0	0	566
S	N	134	136	57	6	0	0	333
SSW	NNE	85	124	43	0	0	0	252
SW	NE	91	216	160	3	0	0	470
WSW	ENE	76	160	155	11	0	0	402
W	E	53	140	60	6	0	0	259
WNW	ESE	62	109	41	6	0	0	218
NW	SE	60	148	108	16	1	0	333
NNW	SSE	70	129	121	21	0	0	341
TOTAL		1926	3723	2448	538	50	8	8693

HOURS OF MISSING DATA:67

TABLE 2.3-18
(Sheet 1 of 7)

JOINT FREQUENCY OF WIND BY STABILITY CLASS (1990 DATA)
FORKED RIVER METEOROLOGICAL TOWER
UPPER MEASUREMENT LEVEL (380 FT)

(HOURS AT EACH WIND SPEED AND DIRECTION)

STABILITY CLASS: A
ELEVATION
SPEED: 380 FT
DIRECTION: 380 FT
LAPSE: 380 to 33 FT

SECTOR WINDS		WIND SPEED (MPH)						
TO	FROM	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	S	0	0	4	2	4	0	10
NNE	SSW	0	1	2	2	1	4	10
NE	SW	0	0	2	1	2	0	5
ENE	WSW	0	0	5	7	1	0	13
E	W	0	2	1	6	7	4	20
ESE	WNW	0	0	3	14	13	11	41
SE	NW	1	1	9	21	13	7	52
SSE	NNW	0	3	7	8	1	3	22
S	N	0	0	2	0	0	0	2
SSW	NNE	0	1	3	1	0	0	5
SW	NE	0	1	7	8	1	0	17
WSW	ENE	0	3	8	10	6	0	27
W	E	0	0	5	6	0	0	11
WNW	ESE	0	3	2	1	0	0	6
NW	SE	0	2	4	2	0	0	8
NNW	SSE	0	1	3	2	0	0	6
TOTAL		1	18	67	91	49	29	255

HOURS OF MISSING DATA: 63

TABLE 2.3-18
(Sheet 2 of 7)

JOINT FREQUENCY OF WIND BY STABILITY CLASS (1990 DATA)
FORKED RIVER METEOROLOGICAL TOWER
UPPER MEASUREMENT LEVEL (380 FT)

(HOURS AT EACH WIND SPEED AND DIRECTION)
STABILITY CLASS: B
ELEVATION
SPEED: 380 FT
DIRECTION: 380 FT
LAPSE: 380 to 33 FT

SECTOR	WINDS	WIND SPEED (MPH)						
TO	FROM	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	S	0	0	3	16	7	1	27
NNE	SSW	1	0	2	6	14	4	27
NE	SW	0	1	4	9	0	0	14
ENE	WSW	0	1	8	17	3	4	33
E	W	0	0	12	9	8	8	37
ESE	WNW	0	0	11	21	14	20	66
SE	NW	0	0	12	18	8	13	51
SSE	NNW	0	1	16	12	7	3	39
S	N	0	1	3	5	2	0	11
SSW	NNE	0	1	3	5	0	0	9
SW	NE	0	1	6	16	2	0	25
WSW	ENE	0	2	12	15	0	0	29
W	E	0	1	6	6	0	0	13
WNW	ESE	0	0	13	1	0	0	14
NW	SE	0	0	19	5	2	1	27
NNW	SSE	0	0	5	11	4	0	20
TOTAL		1	9	135	172	71	54	442

HOURS OF MISSING DATA: 63

TABLE 2.3-18
(Sheet 3 of 7)

JOINT FREQUENCY OF WIND BY STABILITY CLASS (1990 DATA)
FORKED RIVER METEOROLOGICAL TOWER
UPPER MEASUREMENT LEVEL (380 FT)

(HOURS AT EACH WIND SPEED AND DIRECTION)
STABILITY CLASS: C
ELEVATION
SPEED: 380 FT
DIRECTION: 380 FT
LAPSE: 380 to 33 FT

SECTOR	WINDS	WIND SPEED (MPH)						
TO	FROM	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	S	0	0	11	29	6	6	52
NNE	SSW	1	4	8	12	10	13	48
NE	SW	0	6	11	8	2	0	27
ENE	WSW	0	2	18	11	6	2	39
E	W	0	3	20	19	13	8	63
ESE	WNW	0	4	20	23	14	14	75
SE	NW	1	3	16	27	11	13	71
SSE	NNW	0	4	11	13	2	1	31
S	N	0	3	7	4	1	0	15
SSW	NNE	0	5	3	2	0	0	10
SW	NE	0	3	13	7	4	0	27
WSW	ENE	0	4	18	13	4	0	39
W	E	1	5	16	3	1	0	26
WNW	ESE	1	6	8	2	0	0	17
NW	SE	0	6	18	12	5	1	42
NNW	SSE	1	4	11	18	1	0	35
TOTAL		5	62	209	203	80	58	617

HOURS OF MISSING DATA: 63

TABLE 2.3-18
(Sheet 4 of 7)

JOINT FREQUENCY OF WIND BY STABILITY CLASS 1990 DATA)
FORKED RIVER METEOROLOGICAL TOWER
UPPER MEASUREMENT LEVEL (380 FT)

(HOURS AT EACH WIND SPEED AND DIRECTION)
STABILITY CLASS: D
ELEVATION
SPEED: 380 FT
DIRECTION: 380 FT
LAPSE: 380 to 33 FT

SECTOR	WINDS	WIND SPEED (MPH)						
TO	FROM	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	S	4	18	71	67	27	18	205
NNE	SSW	4	16	60	121	124	76	401
NE	SW	3	25	31	53	27	15	154
ENE	WSW	3	24	52	52	50	10	191
E	W	0	26	50	42	40	27	185
ESE	WNW	3	24	40	57	72	68	264
SE	NW	2	23	43	76	75	43	262
SSE	NNW	3	15	21	40	47	18	144
S	N	5	17	26	32	15	11	106
SSW	NNE	7	16	41	43	5	0	112
SW	NE	3	20	66	90	54	30	263
WSW	ENE	3	25	49	58	44	36	215
W	E	5	21	45	34	16	13	134
WNW	ESE	3	20	55	21	6	6	111
NW	SE	5	28	67	21	8	8	137
NNW	SSE	1	20	72	41	4	5	143
TOTAL		54	338	789	848	614	384	3027

HOURS OF MISSING DATA: 63

TABLE 2.3-18
(Sheet 5 of 7)

JOINT FREQUENCY OF WIND BY STABILITY CLASS (1990 DATA)
FORKED RIVER METEOROLOGICAL TOWER
UPPER MEASUREMENT LEVEL (380 FT)

(HOURS AT EACH WIND SPEED AND DIRECTION)
STABILITY CLASS: E
ELEVATION
SPEED: 380 FT
DIRECTION: 380 FT
LAPSE: 380 to 33 FT

SECTOR TO	WINDS FROM	WIND SPEED (MPH) 1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	S	1	14	36	64	33	11	159
NNE	SSW	2	11	34	151	175	78	451
NE	SW	4	8	30	108	139	51	340
ENE	WSW	2	12	26	39	76	33	188
E	W	3	9	28	44	68	19	171
ESE	WNW	0	8	26	49	87	25	195
SE	NW	3	10	17	70	66	23	189
SSE	NNW	2	12	12	50	64	9	149
S	N	5	7	21	37	18	1	89
SSW	NNE	6	10	31	18	1	0	66
SW	NE	4	9	21	20	20	19	93
WSW	ENE	0	19	16	22	6	8	71
W	E	3	14	13	14	5	3	52
WNW	ESE	1	5	12	4	8	2	32
NW	SE	1	15	21	24	21	9	91
NNW	SSE	1	14	17	24	31	11	98
TOTAL		38	177	361	738	818	302	2434

HOURS OF MISSING DATA: 63

TABLE 2.3-18
(Sheet 6 of 7)

JOINT FREQUENCY OF WIND BY STABILITY CLASS (1990 DATA)
FORKED RIVER METEOROLOGICAL TOWER
UPPER MEASUREMENT LEVEL (380 FT)

(HOURS AT EACH WIND SPEED AND DIRECTION)
STABILITY CLASS: F
ELEVATION
SPEED: 380 FT
DIRECTION: 380 FT
LAPSE: 380 to 33 FT

SECTOR	WINDS	WIND SPEED (MPH)						
TO	FROM	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	S	4	6	14	20	5	2	51
NNE	SSW	1	3	13	32	27	9	85
NE	SW	2	6	17	43	49	30	147
ENE	WSW	0	7	17	44	59	44	171
E	W	0	5	15	51	40	16	127
ESE	WNW	1	2	16	27	42	13	101
SE	NW	1	4	9	36	48	22	120
SSE	NNW	1	1	6	23	47	14	92
S	N	2	3	6	20	17	1	49
SSW	NNE	0	6	10	12	0	0	28
SW	NE	2	5	16	1	1	0	25
WSW	ENE	3	4	4	0	1	0	12
W	E	2	5	5	3	0	0	15
WNW	ESE	4	7	13	1	0	0	25
NW	SE	2	5	4	0	0	0	11
NNW	SSE	2	1	6	1	1	0	11
TOTAL		27	70	171	314	337	151	1070

HOURS OF MISSING DATA:63

TABLE 2.3-18
(Sheet 7 of 7)

JOINT FREQUENCY OF WIND BY STABILITY CLASS (1990 DATA)
FORKED RIVER METEOROLOGICAL TOWER
UPPER MEASUREMENT LEVEL (380 FT)

(HOURS AT EACH WIND SPEED AND DIRECTION)
STABILITY CLASS: G
ELEVATION
SPEED: 380 FT
DIRECTION: 380 FT
LAPSE: 380 to 33 FT

SECTOR TO	WINDS FROM	WIND SPEED (MPH) 1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	S	2	9	11	15	0	0	37
NNE	SSW	5	10	19	25	5	4	68
NE	SW	2	13	11	24	20	9	79
ENE	WSW	3	1	14	36	26	17	97
E	W	6	8	23	28	39	17	121
ESE	WNW	2	7	21	31	33	8	102
SE	NW	1	10	15	17	26	8	77
SSE	NNW	4	11	21	29	18	7	90
S	N	1	8	12	23	16	1	61
SSW	NNE	0	4	10	7	2	0	23
SW	NE	3	4	12	3	0	0	22
WSW	ENE	0	3	5	1	0	0	9
W	E	2	4	2	1	0	0	9
WNW	ESE	0	9	3	0	0	0	12
NW	SE	1	8	7	1	0	0	17
NNW	SSE	2	14	10	1	1	0	28
TOTAL		34	123	196	242	186	71	852

HOURS OF MISSING DATA:63

TABLE 2.3-20
(Sheet 1 of 1)

JOINT FREQUENCY OF WIND SPEED AND DIRECTION (1990 DATA)
FORKED RIVER METEOROLOGICAL TOWER
UPPER MEASUREMENT LEVEL (380 FT)

(HOURS AT EACH WIND SPEED AND DIRECTION)
STABILITY CLASS: All
ELEVATION
SPEED: 380 FT
DIRECTION: 380 FT

SECTOR	WINDS	WIND SPEED (MPH)						
TO	FROM	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	S	11	47	150	213	82	38	541
NNE	SSW	14	45	138	349	356	188	1090
NE	SW	11	59	106	246	239	105	766
ENE	WSW	8	47	140	206	221	110	732
E	W	9	53	149	199	215	99	724
ESE	WNW	6	45	137	222	275	159	844
SE	NW	9	51	121	265	247	129	822
SSE	NNW	10	47	94	175	186	55	567
S	N	13	39	77	121	69	14	333
SSW	NNE	13	43	101	88	8	0	253
SW	NE	12	43	141	145	82	49	472
WSW	ENE	6	60	112	119	61	44	402
W	E	13	50	92	67	22	16	260
WNW	ESE	9	50	106	30	14	8	217
NW	SE	9	64	140	65	36	19	333
NNW	SSE	7	54	124	98	42	16	341
TOTAL		160	797	1928	2608	2155	1049	8697

HOURS OF MISSING DATA:63

TABLE 2.3-22
(Sheet 1 of 1)

PERCENTAGE FREQUENCY DISTRIBUTION OF LOWER
DELTA T STABILITY CLASS BY MONTH
FORKED RIVER METEOROLOGICAL TOWER DATA
FOR THE PERIOD 1987-1990

Month	Stability Class A	B	C	D	E	F	G	Total Hours Good Data	Missing
Jan	15.0	4.9	2.0	23.8	26.9	10.8	16.6	2958	0.6
Feb	2.3	5.6	2.9	26.1	20.9	8.0	14.1	2661	1.9
March	26.8	4.6	3.1	24.3	18.3	6.6	16.3	2941	1.2
April	31.0	5.0	2.6	25.8	16.7	6.8	12.1	2711	5.9
May	30.9	5.8	3.5	22.4	19.4	7.1	10.8	2834	4.8
June	31.4	4.7	2.5	20.9	21.1	7.9	11.4	2660	7.6
July	28.4	4.9	3.0	19.5	23.2	10.1	11.0	2863	3.8
Aug	23.1	5.4	2.4	17.8	24.9	9.9	16.5	2955	0.7
Sep	23.2	5.0	2.4	17.0	21.1	9.5	21.7	2818	2.2
Oct	22.2	4.3	1.6	13.4	22.6	9.3	26.6	2937	1.3
Nov	16.0	4.7	2.2	17.8	27.6	12.0	19.6	2850	1.0
Dec	11.9	4.8	2.2	18.6	32.5	12.7	17.2	2909	2.3
Annual	23.5	5.0	2.5	20.6	23.0	9.2	16.2	2841.4	2.8

Data Source: 150 ft to 33 ft measurement level temperature difference

TABLE 2.3-23
(Sheet 1 of 1)

PERCENTAGE FREQUENCY DISTRIBUTION OF UPPER
DELTA T STABILITY CLASS BY MONTH
FORKED RIVER METEOROLOGICAL TOWER DATA
FOR THE PERIOD 1987-1990

Month	Stability Class							Total Hours	
	A	B	C	D	E	F	G	Good Data	Missing
Jan	0.7	3.0	5.2	36.6	30.0	14.1	10.3	2898	2.6
Feb	2.2	4.7	7.6	39.8	25.1	11.7	8.9	2601	4.1
March	6.8	7.4	6.9	36.0	21.0	12.4	9.6	2882	3.2
April	9.4	7.1	6.3	40.8	19.2	8.8	8.4	2807	2.5
May	7.1	7.9	7.2	40.0	19.2	11.2	7.4	2845	4.4
June	6.4	7.9	8.3	35.3	22.4	11.1	8.5	2772	3.8
July	4.3	7.3	9.4	35.9	23.2	13.4	6.5	2858	4.0
Aug	4.0	6.4	7.5	34.6	24.8	13.5	9.3	2951	0.8
Sep	3.9	5.4	7.7	33.6	21.3	13.7	14.4	2793	3.0
Oct	2.5	6.9	8.2	25.8	23.6	12.8	20.2	2888	3.0
Nov	0.5	3.8	6.9	32.8	27.7	15.4	13.0	2854	0.9
Dec	0.2	2.8	5.5	33.2	32.1	16.7	9.4	2915	2.0
Annual	4.0	5.9	7.2	35.4	24.1	12.9	10.5	2838.7	2.9

Data Source: 380 ft to 33 ft measurement level temperature difference

TABLE 2.3-24
(Sheet 1 of 7)

JOINT FREQUENCY OF WIND BY VERTICAL TEMPERATURE DIFFERENCE
OYSTER CREEK METEOROLOGICAL TOWER DATA
LOWER MEASUREMENT LEVEL
FOR THE YEAR 1968

PASQUILL STABILITY CLASS: A
LAPSE RATE (F/100 FT): LESS THAN OR EQUAL TO - 1.0
MEASUREMENT LEVELS: WIND - 75 FT; DELTA T-75 TO 12 FT

SPEED	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	PERCENT
0 MPH	2	2	1	1	3	0	3	0	0	1	0	0	1	2	2	3	21	.8
1 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
2 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
3 MPH	4	8	7	5	5	5	0	1	5	6	8	3	11	7	11	8	94	3.8
4 MPH	21	16	8	9	12	7	16	12	12	12	11	3	10	4	9	19	181	7.3
5 MPH	9	11	13	15	10	18	12	9	8	8	3	8	6	17	12	6	165	6.7
6 MPH	9	9	8	10	10	15	13	7	5	3	10	11	9	6	5	8	138	5.6
7 MPH	10	0	8	17	20	30	24	11	12	14	8	7	16	18	15	21	231	9.3
8 MPH	7	1	9	11	14	22	26	12	17	9	6	5	11	9	13	14	186	7.5
12 MPH	12	2	20	81	103	62	82	69	72	33	22	32	42	86	75	41	834	33.7
18 MPH	2	0	1	25	25	17	8	23	52	18	9	19	67	121	91	14	492	19.9
24 MPH	0	0	0	9	2	0	0	1	6	5	0	4	15	35	27	1	105	4.2
32 MPH	0	0	1	4	0	0	0	0	0	0	0	1	2	17	2	0	27	1.1
32 MPH	0	0	0	3	0	0	0	0	0	0	0	0	0	1	0	0	4	0.2
TOTAL	76	49	76	190	204	176	184	145	189	109	77	93	190	323	262	135	2478	100.0
PERCENT	3.1	2.0	3.1	7.7	8.2	7.1	7.4	5.9	7.6	4.4	3.1	3.8	7.7	13.0	10.6	5.4	100.0	
AVG SPD	6.1	4.8	5.9	9.0	9.2	9.0	9.3	10.4	11.0	8.5	7.6	8.6	10.1	12.3	12.3	8.1		

AVERAGE SPEED FOR THIS TABLE EQUALS 9.9 MPH

TABLE 2.3-24
(Sheet 2 of 7)

JOINT FREQUENCY OF WIND BY VERTICAL TEMPERATURE DIFFERENCE
OYSTER CREEK METEOROLOGICAL TOWER DATA
LOWER MEASUREMENT LEVEL
FOR THE YEAR 1968

PASQUILL STABILITY CLASS: B
LAPSE RATE (F/100 FT): LESS THAN OR EQUAL TO - 1.0
MEASUREMENT LEVELS: WIND - 75 FT; DELTA T-75 TO 12 FT

SPEED	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	PERCENT
0 MPH	2	2	0	0	0	0	0	1	0	0	0	0	0	1	0	0	6	2.9
1 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
2 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
3 MPH	1	2	2	0	0	0	1	0	0	1	0	0	0	0	0	1	8	3.8
4 MPH	2	1	3	2	6	2	0	1	0	3	2	1	1	0	2	3	29	13.9
5 MPH	0	2	1	0	0	1	1	0	1	0	0	1	1	0	5	1	14	6.6
6 MPH	1	1	1	0	0	1	0	2	0	2	0	3	3	0	0	0	14	6.7
7 MPH	0	1	3	1	3	1	2	1	2	3	2	1	2	0	1	0	23	11.0
8 MPH	0	0	0	3	1	0	0	1	2	1	0	1	2	2	0	0	13	6.2
12 MPH	2	0	5	7	5	2	4	1	5	5	1	4	5	6	2	0	54	25.8
18 MPH	0	0	1	2	1	5	0	5	4	3	0	0	3	9	1	3	37	17.7
24 MPH	0	0	0	1	1	0	0	1	0	0	1	0	0	0	2	0	6	2.9
32 MPH	0	0	0	2	0	0	0	0	0	0	0	0	1	1	0	0	4	1.9
32 MPH	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0.5
TOTAL	8	9	16	19	17	12	8	13	14	18	6	11	18	19	13	8	209	100.0
PERCENT	3.8	4.3	7.7	9.1	8.1	5.7	3.8	6.2	6.7	8.6	2.9	5.3	8.6	9.1	6.2	3.8	100.0	
AVG SPD	7.4	5.3	6.3	8.8	9.7	9.2	8.1	9.8	10.9	9.5	8.0	10.8	11.6	11.5	10.6	9.0		

AVERAGE SPEED FOR THIS TABLE EQUALS 9.3 MPH

TABLE 2.3-24
(Sheet 3 of 7)

JOINT FREQUENCY OF WIND BY VERTICAL TEMPERATURE DIFFERENCE
OYSTER CREEK METEOROLOGICAL TOWER DATA
LOWER MEASUREMENT LEVEL
FOR THE YEAR 1968

PASQUILL STABILITY CLASS: C
LAPSE RATE (F/100 FT): LESS THAN OR EQUAL TO - 1.0
MEASUREMENT LEVELS: WIND - 75 FT; DELTA T-75 TO 12 FT

SPEED	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	PERCENT
0 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
1 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
2 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
3 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
4 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
5 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
6 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
7 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
8 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
12 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
18 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
24 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
32 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
32 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
PERCENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AVG SPD	5.4	4.4	3.0	10.9	9.2	7.5	8.3	9.1	11.9	11.9	7.7	10.3	10.9	15.3	12.1	8.2		

AVERAGE SPEED FOR THIS TABLE EQUALS 0.0

TABLE 2.3-24
(Sheet 4 of 7)

JOINT FREQUENCY OF WIND BY VERTICAL TEMPERATURE DIFFERENCE
OYSTER CREEK METEOROLOGICAL TOWER DATA
LOWER MEASUREMENT LEVEL
FOR THE YEAR 1968

PASQUILL STABILITY CLASS: D
LAPSE RATE (F/100 FT): LESS THAN OR EQUAL TO - 1.0
MEASUREMENT LEVELS: WIND - 75 FT; DELTA T-75 TO 12 FT

SPEED	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	PERCENT
0 MPH	2	0	1	0	0	0	1	0	0	3	1	1	1	2	3	3	18	2.1
1 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
2 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
3 MPH	5	3	4	3	3	0	4	1	4	1	1	4	0	2	4	6	45	5.3
4 MPH	6	8	9	5	8	3	7	7	5	4	8	4	4	5	10	5	98	11.6
5 MPH	3	3	3	9	8	2	4	4	6	5	4	5	9	3	3	5	76	9.0
6 MPH	2	6	4	5	5	3	1	3	1	3	8	5	8	2	4	2	62	7.3
7 MPH	4	2	13	13	8	3	4	7	6	7	6	9	6	5	5	4	102	12.0
8 MPH	2	4	5	5	4	3	2	12	3	4	2	6	2	8	2	1	65	7.7
12 MPH	6	2	11	26	8	9	7	13	22	17	10	14	11	15	10	11	192	22.7
18 MPH	2	1	9	9	9	5	9	0	6	15	1	9	18	17	9	4	123	14.5
24 MPH	2	0	0	12	5	1	0	1	5	2	2	2	4	6	4	1	47	5.5
32 MPH	0	0	0	0	0	0	0	0	0	0	0	1	3	6	3	3	16	1.9
32 MPH	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0	3	0.4
TOTAL	34	29	60	87	58	29	39	48	58	61	43	60	67	72	57	45	847	100.0
PERCENT	4.0	3.4	7.1	10.3	6.8	3.4	4.6	4.7	6.8	7.2	5.1	7.1	7.9	8.5	6.7	5.3	100.0	
AVG SPD	5.8	3.9	3.7	9.8	6.8	6.5	8.6	9.1	10.3	9.7	7.3	9.3	14.5	14.1	11.0	13.3		

AVERAGE SPEED FOR THIS TABLE EQUALS 9.2 MPH

TABLE 2.3-24
(Sheet 5 of 7)

JOINT FREQUENCY OF WIND BY VERTICAL TEMPERATURE DIFFERENCE
OYSTER CREEK METEOROLOGICAL TOWER DATA
LOWER MEASUREMENT LEVEL
FOR THE YEAR 1968

PASQUILL STABILITY CLASS: E
LAPSE RATE (F/100 FT): LESS THAN OR EQUAL TO - 1.0
MEASUREMENT LEVELS: WIND - 75 FT; DELTA T-75 TO 12 FT

SPEED	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	PERCENT
0 MPH	2	0	2	1	2	2	0	0	1	0	2	1	1	4	4	1	23	1.3
1 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
2 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
3 MPH	3	3	5	6	6	3	2	2	1	6	12	11	3	1	5	1	70	3.8
4 MPH	11	4	9	14	9	5	3	7	11	10	13	13	16	13	15	7	160	8.8
5 MPH	5	2	4	7	8	3	7	11	10	22	13	9	13	17	13	11	155	8.5
6 MPH	3	2	5	2	5	1	6	12	14	19	3	14	12	14	13	11	136	7.4
7 MPH	2	4	2	11	9	8	4	9	17	22	11	8	20	21	16	16	180	9.8
8 MPH	6	1	6	5	8	7	2	6	8	12	12	20	29	22	17	9	170	9.3
12 MPH	10	4	18	17	16	9	14	19	20	35	32	68	72	64	73	31	502	27.5
18 MPH	7	6	10	10	24	3	1	4	12	12	8	30	52	59	46	13	297	16.2
24 MPH	0	0	1	7	14	6	0	0	2	12	0	8	23	30	7	0	110	6.0
32 MPH	0	0	0	1	7	0	0	0	0	1	0	3	5	6	1	0	24	1.3
32 MPH	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.1
TOTAL	49	26	63	81	108	47	39	70	96	151	106	185	246	251	210	100	1828	100.0
PERCENT	2.7	1.4	3.4	4.4	5.9	2.6	2.1	3.8	5.3	8.3	5.8	10.1	13.5	13.7	11.5	5.5	100.0	
AVG SPD	6.0	4.5	9.8	12.1	8.3	7.7	6.9	8.4	9.7	9.5	8.4	10.2	11.8	15.2	12.7	7.0		

AVERAGE SPEED FOR THIS TABLE EQUALS 9.6 MPH

TABLE 2.3-24
(Sheet 6 of 7)

JOINT FREQUENCY OF WIND BY VERTICAL TEMPERATURE DIFFERENCE
OYSTER CREEK METEOROLOGICAL TOWER DATA
LOWER MEASUREMENT LEVEL
FOR THE YEAR 1968

PASQUILL STABILITY CLASS: F
LAPSE RATE (F/100 FT): LESS THAN OR EQUAL TO - 1.0
MEASUREMENT LEVELS: WIND - 75 FT; DELTA T-75 TO 12 FT

SPEED	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	PERCENT
0 MPH	0	2	0	0	0	0	0	0	0	2	1	1	1	1	2	1	11	1.5
1 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
2 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
3 MPH	2	2	0	1	5	3	3	0	0	2	1	4	2	0	4	3	32	4.5
4 MPH	3	1	1	2	1	2	3	4	9	8	6	8	9	11	8	6	82	11.5
5 MPH	3	0	1	3	2	2	2	8	8	12	11	11	11	6	8	11	99	13.9
6 MPH	2	0	1	1	0	2	4	1	12	3	3	8	7	11	4	4	63	8.8
7 MPH	0	2	0	1	2	2	1	4	2	10	7	9	14	14	11	10	89	12.5
8 MPH	2	0	1	1	2	2	1	1	3	3	8	13	10	8	11	10	76	10.7
12 MPH	0	5	4	1	3	3	4	2	17	11	16	26	36	29	26	11	194	27.2
18 MPH	0	0	0	0	1	0	0	0	3	5	1	8	12	17	8	0	55	7.7
24 MPH	0	0	0	0	0	0	0	0	1	0	0	0	5	5	0	0	11	1.5
32 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
32 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
TOTAL	12	12	8	10	16	16	18	20	55	56	54	88	107	102	82	56	712	100.0
PERCENT	1.7	1.7	1.1	1.4	2.2	2.2	2.5	2.8	7.7	7.9	7.6	12.4	15.0	14.3	11.5	7.9	100.0	
AVG SPD	4.4	3.0	7.2	10.8	9.2	7.3	6.7	9.1	10.5	7.9	6.9	11.9	13.0	14.7	13.4	6.3		

AVERAGE SPEED FOR THIS TABLE EQUALS 7.6 MPH

TABLE 2.3-24
(Sheet 7 of 7)

JOINT FREQUENCY OF WIND BY VERTICAL TEMPERATURE DIFFERENCE
OYSTER CREEK METEOROLOGICAL TOWER DATA
LOWER MEASUREMENT LEVEL
FOR THE YEAR 1968

PASQUILL STABILITY CLASS: G
LAPSE RATE (F/100 FT): LESS THAN OR EQUAL TO - 1.0
MEASUREMENT LEVELS: WIND - 75 FT; DELTA T-75 TO 12 FT

SPEED	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	PERCENT
0 MPH	2	2	2	1	2	2	4	5	1	0	4	5	2	5	6	3	46	3.7
1 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
2 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
3 MPH	14	9	8	4	10	5	10	12	6	12	15	12	8	11	19	10	166	13.3
4 MPH	21	9	5	6	3	5	10	6	14	21	25	19	25	40	36	37	282	22.5
5 MPH	2	1	0	3	1	5	4	6	7	21	19	31	20	16	48	17	201	16.1
6 MPH	1	0	3	0	0	3	1	2	3	5	18	18	18	17	18	21	128	10.2
7 MPH	1	0	1	2	2	1	1	7	6	6	16	35	32	18	21	6	155	12.4
8 MPH	0	0	0	0	0	1	2	1	1	2	12	42	27	12	9	9	118	9.4
12 MPH	0	0	0	0	2	3	0	3	3	3	9	45	30	23	17	9	147	11.8
18 MPH	0	0	0	0	0	0	1	0	1	0	2	0	1	1	1	0	7	0.6
24 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
32 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0.1
32 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
TOTAL	41	21	19	17	20	25	33	42	42	70	120	207	163	144	175	112	1251	100.0
PERCENT	3.3	1.7	1.5	1.4	1.6	2.0	2.6	3.4	3.4	5.6	9.6	16.5	13.0	11.5	14.0	9.0	100.0	
AVERAGE SPEED	6.4	8.9	7.5	10.9	10.9	9.1	6.1	8.3	9.0	8.7	6.9	9.2	12.0	13.5	9.2	6.9		

AVERAGE SPEED FOR THIS TABLE EQUALS 5.4 MPH

TABLE 2.3-25
(Sheet 1 of 7)

JOINT FREQUENCY OF WIND BY VERTICAL TEMPERATURE DIFFERENCE
OYSTER CREEK METEOROLOGICAL TOWER DATA
MIDDLE MEASUREMENT LEVEL
FOR THE YEAR 1968

PASQUILL STABILITY CLASS: A
LAPSE RATE (F/100 FT): LESS THAN OR EQUAL TO - 1.0
MEASUREMENT LEVELS: WIND - 75 FT; DELTA T-200 TO 75 FT

SPEED	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	PERCENT
0 MPH	1	0	2	0	0	0	0	0	0	0	0	1	0	0	0	1	5	1.5
1 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
2 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
3 MPH	1	0	1	3	1	0	0	0	1	0	3	0	1	1	1	0	13	4.0
4 MPH	0	2	5	1	1	1	2	1	1	4	3	0	2	2	0	2	27	8.3
5 MPH	1	0	5	1	0	3	0	0	0	0	1	0	2	3	0	1	17	5.2
6 MPH	2	2	0	1	0	5	2	0	2	0	1	2	4	0	0	0	21	6.4
7 MPH	0	0	0	0	0	2	6	1	2	1	1	0	3	2	0	0	18	5.5
8 MPH	0	1	2	1	0	1	5	2	0	0	2	1	2	3	1	1	22	6.7
12 MPH	3	0	1	5	7	9	9	6	2	1	5	4	7	10	10	5	84	25.8
18 MPH	0	0	0	0	6	3	3	5	9	3	2	4	8	18	11	1	73	22.4
24 MPH	0	0	0	8	9	2	0	2	5	0	0	0	3	3	2	1	35	10.7
32 MPH	0	0	0	2	6	0	0	0	0	0	0	0	1	2	0	0	11	3.4
32 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
TOTAL	8	5	16	22	30	26	27	17	22	9	18	12	33	44	25	12	326	100.0
PERCENT	2.5	1.5	4.9	6.7	9.2	8.0	8.3	5.2	6.7	2.8	5.5	3.7	10.1	13.5	7.7	3.7	100.0	
AVG SPD	0.0	0.0	5.0	14.5	15.9	8.2	6.6	13.3	18.8	10.1	7.0	9.0	6.0	11.2	0.0	9.0		

AVERAGE SPEED FOR THIS TABLE EQUALS 11.1 MPH

TABLE 2.3-25
(Sheet 2 of 7)

JOINT FREQUENCY OF WIND BY VERTICAL TEMPERATURE DIFFERENCE
OYSTER CREEK METEOROLOGICAL TOWER DATA
MIDDLE MEASUREMENT LEVEL
FOR THE YEAR 1968

PASQUILL STABILITY CLASS: B
LAPSE RATE (F/100 FT): LESS THAN OR EQUAL TO - 1.0
MEASUREMENT LEVELS: WIND - 75 FT; DELTA T-200 TO 75 FT

SPEED	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	PERCENT
0 MPH	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1.1
1 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
2 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
3 MPH	0	0	1	0	0	0	0	0	0	1	0	0	1	0	0	0	3	3.4
4 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
5 MPH	2	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	5	5.6
6 MPH	0	1	1	0	0	0	0	0	0	0	0	0	0	0	2	0	4	4.5
7 MPH	1	0	1	0	0	0	0	0	1	0	0	2	0	1	1	0	7	7.9
8 MPH	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	4	4.5
12 MPH	0	0	0	5	4	0	3	2	0	3	1	2	2	6	3	2	33	37.1
18 MPH	0	0	1	2	0	1	0	0	3	0	1	1	2	9	3	2	25	28.1
24 MPH	0	0	0	2	0	0	1	0	0	0	0	0	1	4	0	0	7	7.9
32 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
32 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
TOTAL	3	1	5	10	5	2	5	3	4	4	2	5	6	20	10	4	89	100.0
PERCENT	3.4	1.1	5.6	11.2	5.6	2.2	5.6	3.4	4.5	4.5	2.2	5.6	6.7	22.5	11.2	4.5	100.0	
AVG SPD	0.0	0.0	0.0	13.1	22.0	0.0	0.0	22.0	17.0	0.0	2.7	14.0	0.0	0.0	0.0	0.0		

AVERAGE SPEED FOR THIS TABLE EQUALS 11.3 MPH

TABLE 2.3-25
(Sheet 3 of 7)

JOINT FREQUENCY OF WIND BY VERTICAL TEMPERATURE DIFFERENCE
OYSTER CREEK METEOROLOGICAL TOWER DATA
MIDDLE MEASUREMENT LEVEL
FOR THE YEAR 1968

PASQUILL STABILITY CLASS: C
LAPSE RATE (F/100 FT): LESS THAN OR EQUAL TO - 1.0
MEASUREMENT LEVELS: WIND - 75 FT; DELTA T-200 TO 75 FT

SPEED	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	PERCENT
0 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
1 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
2 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
3 MPH	0	0	1	0	0	0	0	0	0	0	1	0	0	1	0	0	3	2.3
4 MPH	2	0	0	1	0	1	0	0	0	0	2	0	0	0	0	0	6	4.6
5 MPH	1	0	0	1	1	1	1	0	0	0	0	0	0	0	1	0	6	4.6
6 MPH	2	0	0	0	1	0	0	0	0	0	0	1	0	0	0	2	6	4.6
7 MPH	1	0	0	1	2	0	1	0	0	0	1	0	0	2	0	3	11	8.5
8 MPH	0	0	0	0	0	1	1	1	0	1	0	1	0	0	1	0	6	4.6
12 MPH	0	0	0	6	6	7	3	4	3	1	0	4	3	5	4	1	47	36.2
18 MPH	0	0	0	3	1	0	0	4	3	2	0	1	5	10	6	1	36	27.7
24 MPH	0	0	0	0	0	0	0	0	0	0	0	1	1	0	2	0	4	3.1
32 MPH	0	0	0	0	1	0	0	0	0	0	0	1	0	3	0	0	5	3.8
32 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
TOTAL	6	0	1	12	12	10	6	9	6	4	4	9	9	21	14	7	130	100.0
PERCENT	4.6	0.0	0.8	9.2	9.2	7.7	4.6	6.9	4.6	3.1	3.1	6.9	6.9	16.2	10.8	5.4	100.0	
AVG SPD	0.0	0.0	0.0	22.0	27.0	12.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		

AVERAGE SPEED FOR THIS TABLE EQUALS 11.2 MPH

TABLE 2.3-25
(Sheet 4 of 7)

JOINT FREQUENCY OF WIND BY VERTICAL TEMPERATURE DIFFERENCE
OYSTER CREEK METEOROLOGICAL TOWER DATA
MIDDLE MEASUREMENT LEVEL
FOR THE YEAR 1968

PASQUILL STABILITY CLASS: D
LAPSE RATE (F/100 FT): LESS THAN OR EQUAL TO - 1.0
MEASUREMENT LEVELS: WIND - 75 FT; DELTA T-200 TO 75 FT

SPEED	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	PERCENT
0 MPH	1	1	0	1	0	0	3	1	0	0	0	0	0	0	2	1	10	0.5
1 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
2 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
3 MPH	2	6	3	1	5	2	2	0	3	3	1	3	2	1	1	3	38	1.9
4 MPH	11	11	13	13	12	5	4	6	5	7	4	4	4	7	2	5	113	5.7
5 MPH	5	9	9	16	9	8	11	5	5	5	2	6	3	7	7	4	111	5.6
6 MPH	5	10	9	11	9	8	6	7	5	4	5	5	3	2	2	8	99	5.0
7 MPH	10	6	13	25	21	13	23	8	7	13	6	7	8	8	10	11	189	9.6
8 MPH	11	3	9	11	12	13	15	13	13	7	5	5	7	7	7	8	146	7.4
12 MPH	19	5	34	76	67	36	58	55	71	32	16	29	35	63	58	33	687	34.8
18 MPH	6	3	13	32	24	20	8	14	42	22	8	23	62	88	68	11	444	22.5
24 MPH	2	0	1	14	7	0	0	0	5	4	2	6	13	26	18	1	99	5.0
32 MPH	0	0	0	3	0	0	0	0	0	0	0	4	4	15	5	3	34	1.7
32 MPH	0	0	1	2	0	0	0	0	0	0	0	0	1	2	0	0	6	0.3
TOTAL	72	54	105	205	166	105	130	109	156	97	49	92	142	226	180	88	1976	100.0
PERCENT	3.6	2.7	5.3	10.4	8.4	5.3	6.6	5.5	7.9	4.9	2.5	4.7	7.2	11.4	9.1	4.5	100.0	
AVG SPD	0.0	0.0	0.0	25.0	25.4	0.0	8.0	0.0	9.0	0.0	0.0	6.0	2.4	0.0	0.0	8.0		

AVERAGE SPEED FOR THIS TABLE EQUALS 10.6 MPH

TABLE 2.3-25
(Sheet 5 of 7)

JOINT FREQUENCY OF WIND BY VERTICAL TEMPERATURE DIFFERENCE
OYSTER CREEK METEOROLOGICAL TOWER DATA
MIDDLE MEASUREMENT LEVEL
FOR THE YEAR 1968

PASQUILL STABILITY CLASS: E
LAPSE RATE (F/100 FT): LESS THAN OR EQUAL TO - 1.0
MEASUREMENT LEVELS: WIND - 75 FT; DELTA T-200 TO 75 FT

SPEED	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	PERCENT
0 MPH	2	5	3	2	1	1	0	0	1	4	4	2	1	7	4	4	45	1.5
1 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
2 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
3 MPH	9	9	12	9	12	6	8	4	6	9	15	15	6	2	8	7	117	4.6
4 MPH	24	17	13	14	20	14	23	25	21	22	29	14	19	25	23	20	323	10.9
5 MPH	5	8	5	15	13	14	14	23	22	27	16	20	26	24	26	19	277	9.4
6 MPH	5	5	8	5	10	8	15	20	15	14	15	23	26	20	14	7	210	7.1
7 MPH	3	3	12	17	19	28	5	20	27	34	19	14	33	33	25	21	313	10.6
8 MPH	6	2	8	13	16	18	10	14	18	21	16	18	32	31	26	12	263	8.9
12 MPH	8	8	22	40	52	34	12	17	57	63	48	68	76	112	96	46	799	27.0
18 MPH	5	4	7	9	29	6	7	8	21	26	10	37	76	99	68	19	431	14.6
24 MPH	0	0	0	5	6	5	0	1	4	15	1	7	29	43	18	0	134	4.5
32 MPH	0	0	1	2	0	0	0	0	0	1	0	0	6	10	1	0	215	0.7
32 MPH	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0.1
TOTAL	67	61	93	133	178	137	114	152	192	236	173	218	332	406	309	155	2956	100.0
PERCENT	2.3	2.1	3.1	4.5	6.0	4.6	3.9	5.1	6.5	8.0	5.9	7.4	11.2	13.7	10.5	5.2	100.0	
AVG SPD	0.0	6.0	5.2	5.0	20.5	14.0	0.0	8.0	0.0	7.0	4.1	0.0	12.0	0.0	5.0			

AVERAGE SPEED FOR THIS TABLE EQUALS 8.0 MPH

TABLE 2.3-25
(Sheet 6 of 7)

JOINT FREQUENCY OF WIND BY VERTICAL TEMPERATURE DIFFERENCE
OYSTER CREEK METEOROLOGICAL TOWER DATA
MIDDLE MEASUREMENT LEVEL
FOR THE YEAR 1968

PASQUILL STABILITY CLASS: F
LAPSE RATE (F/100 FT): LESS THAN OR EQUAL TO - 1.0
MEASUREMENT LEVELS: WIND - 75 FT; DELTA T-200 TO 75 FT

SPEED	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	PERCENT
0 MPH	2	1	0	0	2	1	2	3	1	1	0	3	0	1	2	2	21	2.6
1 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
2 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
3 MPH	5	6	2	3	6	4	5	5	2	10	8	5	6	5	4	4	80	9.9
4 MPH	4	2	2	6	4	2	6	4	12	7	9	15	12	7	8	6	106	13.1
5 MPH	6	1	0	2	5	4	2	6	10	26	18	21	18	13	10	5	147	18.1
6 MPH	1	0	2	1	0	1	2	0	11	13	11	17	10	15	13	4	101	12.4
7 MPH	0	0	1	1	2	2	1	8	5	12	16	21	17	15	16	5	122	15.0
8 MPH	0	0	0	0	0	0	1	2	2	2	11	26	18	7	10	10	89	11.0
12 MPH	0	0	0	0	0	1	4	2	6	3	13	44	35	10	19	7	144	17.7
18 MPH	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0.1
24 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
32 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0.1
32 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
TOTAL	18	10	7	13	19	15	23	31	49	74	86	152	116	74	82	43	812	100.0
PERCENT	2.2	1.2	0.9	1.6	2.3	1.8	2.8	3.8	6.0	9.1	10.6	18.7	14.3	9.1	10.1	5.3	100.0	
AVG SPD	6.0	0.0	3.3	6.2	18.0	10.0	8.2	10.0	2.4	9.0	8.4	10.2	7.0	9.7	11.7	4.0		

AVERAGE SPEED FOR THIS TABLE EQUALS 6.1 MPH

TABLE 2.3-25
(Sheet 7 of 7)

JOINT FREQUENCY OF WIND BY VERTICAL TEMPERATURE DIFFERENCE
OYSTER CREEK METEOROLOGICAL TOWER DATA
MIDDLE MEASUREMENT LEVEL
FOR THE YEAR 1968

PASQUILL STABILITY CLASS: G
LAPSE RATE (F/100 FT): LESS THAN OR EQUAL TO - 1.0
MEASUREMENT LEVELS: WIND - 75 FT; DELTA T-200 TO 75 FT

SPEED	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	PERCENT
0 MPH	4	1	1	0	4	0	2	2	0	1	4	2	3	7	9	3	43	4.2
1 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
2 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
3 MPH	12	6	6	4	5	4	5	7	4	5	9	11	8	11	29	15	141	13.6
4 MPH	23	7	2	3	2	1	4	1	12	18	18	15	28	32	47	44	257	24.8
5 MPH	2	1	2	1	1	1	2	4	3	10	13	18	11	12	44	22	147	14.2
6 MPH	3	0	2	0	0	3	0	0	2	4	10	11	14	13	13	25	100	9.7
7 MPH	2	0	0	1	0	0	0	2	3	2	7	25	29	15	17	17	120	11.6
8 MPH	0	0	1	0	0	0	0	0	1	0	6	36	22	13	7	12	98	9.5
12 MPH	0	0	1	0	1	1	2	1	0	1	7	38	38	17	13	9	129	12.5
18 MPH	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0.1
24 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
32 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
32 MPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
TOTAL	46	15	15	9	13	10	16	17	25	41	74	156	153	120	179	147	1036	100.0
PERCENT	4.4	1.4	1.4	0.9	1.3	1.0	1.5	1.6	2.4	4.0	7.1	15.1	14.8	11.6	17.3	14.2	100.0	
AVG SPD	6.2	4.6	4.9	13.3	11.3	7.7	10.1	11.8	11.6	3.3	7.7	9.2	12.0	13.9	13.0	11.5		

AVERAGE SPEED FOR THIS TABLE EQUALS 5.3 MPH

TABLE 2.3-26
(Sheet 1 of 7)

JOINT FREQUENCY OF WIND BY VERTICAL TEMPERATURE DIFFERENCE
OYSTER CREEK METEOROLOGICAL TOWER DATA
UPPER MEASUREMENT LEVEL
FOR THE YEAR 1968

PASQUILL STABILITY CLASS: A
LAPSE RATE (F/100 FT): LESS THAN OR EQUAL TO - 1.0
MEASUREMENT LEVELS: WIND - 400 FT; DELTA T-400 TO 12 FT

SPEED	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	PERCENT
LE 0.0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	3	5	0.7
LE 3.5	5	5	2	0	3	7	1	1	0	1	0	1	4	5	2	2	39	5.5
LE 7.5	14	7	0	11	10	17	10	2	2	5	5	7	15	10	15	13	159	22.5
LE 12.5	5	5	4	12	20	10	48	24	7	4	7	17	30	37	27	13	270	33.2
LE 18.5	1	0	3	4	0	6	1	13	13	2	8	3	24	35	36	0	162	22.9
LE 24.5	0	0	0	0	0	1	0	0	2	1	0	4	9	17	10	1	45	6.4
LE 32.5	0	0	0	0	0	0	0	0	4	1	5	2	1	3	6	0	22	3.1
GT 32.5	0	0	0	3	0	0	0	0	0	0	0	0	1	1	0	0	5	0.7
TOTAL	25	17	9	30	33	41	18	40	28	16	27	39	34	116	96	40	707	100.0
PERCENT	3.5	2.4	1.3	4.2	4.7	5.5	9.6	5.7	4.0	2.0	3.8	5.3	11.9	16.4	13.6	5.7	100.0	
AVG SPD	6.1	5.6	10.7	12.2	7.6	6.0	0.6	11.2	15.6	10.9	12.9	12.1	12.4	12.6	13.2	0.3		

AVERAGE SPEED FOR THIS TABLE EQUALS 11.1 MPH

TABLE 2.3-26

(Sheet 2 of 7)

JOINT FREQUENCY OF WIND BY VERTICAL TEMPERATURE DIFFERENCE

OYSTER CREEK METEOROLOGICAL TOWER DATA

UPPER MEASUREMENT LEVEL

FOR THE YEAR 1968

PASQUILL STABILITY CLASS: B

LAPSE RATE (F/100 FT): LESS THAN OR EQUAL TO - 1.0

MEASUREMENT LEVELS: WIND - 400 FT; DELTA T-400 TO 12 FT

SPEED	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	PERCENT
LE 0.0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0.6
LE 3.5	1	3	0	0	2	1	0	0	0	1	2	1	0	1	0	0	12	3.8
LE 7.5	5	0	3	6	8	5	11	2	1	4	3	4	3	5	1	2	63	13.7
LE 12.5	2	0	8	17	9	9	11	15	12	1	2	4	8	10	9	5	122	38.2
LE 18.5	0	0	0	2	2	1	2	14	7	2	1	4	11	15	9	4	74	23.2
LE 24.5	0	0	1	0	0	0	0	1	4	3	1	0	6	10	5	0	31	9.7
LE 32.5	0	0	0	1	0	0	0	0	2	1	0	0	3	2	5	0	14	4.4
GT 32.5	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0.3
TOTAL	8	3	13	26	21	17	24	32	26	12	9	13	32	43	29	11	319	100.0
PERCENT	2.5	0.9	4.1	8.2	6.6	5.3	7.5	10.0	3.2	3.6	2.8	4.1	10.0	13.5	9.1	3.4	100.0	
AVG SPD	5.8	3.0	8.8	9.9	7.8	7.9	8.5	11.7	14.6	12.5	8.2	9.3	15.7	14.8	16.7	11.4		

AVERAGE SPEED FOR THIS TABLE EQUALS 11.8 MPH

TABLE 2.3-26

(Sheet 3 of 7)

JOINT FREQUENCY OF WIND BY VERTICAL TEMPERATURE DIFFERENCE
OYSTER CREEK METEOROLOGICAL TOWER DATA
UPPER MEASUREMENT LEVEL
FOR THE YEAR 1968

PASQUILL STABILITY CLASS: C
LAPSE RATE (F/100 FT): LESS THAN OR EQUAL TO - 1.0
MEASUREMENT LEVELS: WIND - 400 FT; DELTA T-400 TO 12 FT

SPEED	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	PERCENT
LE 0.0	0	0	1	0	0	0	0	1	0	1	0	3	0	0	0	0	3	1.2
LE 3.5	2	1	1	0	1	4	2	2	4	2	0	2	1	0	0	0	22	9.0
LE 7.5	0	1	3	3	8	1	12	3	3	2	1	1	3	1	2	2	46	18.8
LE 12.5	2	0	4	8	5	4	7	7	8	2	2	2	7	8	5	0	71	29.0
LE 18.5	0	0	1	7	0	0	2	3	11	0	0	6	5	11	11	1	58	23.7
LE 24.5	0	0	0	1	0	1	0	0	7	1	0	3	5	3	0	1	22	9.0
LE 32.5	0	0	1	3	0	0	0	1	2	1	0	0	6	3	3	1	21	3.6
GT 32.5	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0.8
TOTAL	4	2	12	23	14	10	23	17	35	9	3	14	27	26	21	5	245	100.0
PERCENT	1.6	0.8	4.9	9.4	5.7	4.1	9.4	6.9	14.3	3.7	1.2	5.7	11.0	10.6	8.6	2.0	100.0	
AVG SPD	6.4	3.8	14.3	14.6	6.7	7.4	7.8	9.9	13.9	9.8	9.0	13.4	16.4	15.4	15.0	14.0		

AVERAGE SPEED FOR THIS TABLE EQUALS 12.5 MPH

TABLE 2.3-26

(Sheet 4 of 7)

JOINT FREQUENCY OF WIND BY VERTICAL TEMPERATURE DIFFERENCE

OYSTER CREEK METEOROLOGICAL TOWER DATA

UPPER MEASUREMENT LEVEL

FOR THE YEAR 1968

PASQUILL STABILITY CLASS: D

LAPSE RATE (F/100 FT): LESS THAN OR EQUAL TO - 1.0

MEASUREMENT LEVELS: WIND - 400 FT; DELTA T-400 TO 12 FT

SPEED	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	PERCENT
LE 0.0	0	1	1	0	2	0	1	4	1	2	1	0	1	3	1	2	20	0.9
LE 3.5	4	12	11	11	10	13	10	12	4	8	11	4	8	6	2	4	133	5.9
LE 7.5	16	29	35	36	49	31	17	29	21	16	22	18	17	21	10	12	399	17.6
LE 12.5	22	25	66	74	45	26	43	47	68	33	18	32	38	38	32	33	640	23.2
LE 18.5	14	7	39	62	24	15	7	32	72	38	19	40	47	71	38	28	559	24.6
LE 24.5	3	13	11	28	21	10	6	10	25	16	17	13	57	54	30	14	328	14.4
LE 32.5	1	6	23	13	4	4	2	4	11	6	2	2	19	27	19	5	146	6.4
GT 32.5	2	0	3	14	2	0	1	2	1	1	0	1	3	9	7	0	46	2.0
TOTAL	62	93	189	235	157	134	107	140	203	118	90	115	188	229	139	98	2271	100.0
PERCENT	2.7	4.1	8.3	10.5	6.9	4.5	4.7	6.2	8.9	5.2	4.0	5.1	8.3	10.1	6.1	4.3	100.0	
AVG SPD	11.3	10.6	13.4	14.5	11.1	9.5	9.3	10.9	13.7	12.6	11.5	13.0	16.4	16.9	17.2	12.9		

AVERAGE SPEED FOR THIS TABLE EQUALS 13.4 MPH

TABLE 2.3-26

(Sheet 5 of 7)

JOINT FREQUENCY OF WIND BY VERTICAL TEMPERATURE DIFFERENCE

OYSTER CREEK METEOROLOGICAL TOWER DATA

UPPER MEASUREMENT LEVEL

FOR THE YEAR 1968

PASQUILL STABILITY CLASS: E

LAPSE RATE (F/100 FT): LESS THAN OR EQUAL TO - 1.0

MEASUREMENT LEVELS: WIND - 400 FT; DELTA T-400 TO 12 FT

SPEED	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	PERCENT
LE 0.0	2	3	1	2	3	3	1	2	4	2	2	2	0	3	2	3	35	1.4
LE 3.5	6	6	5	11	10	12	7	4	7	8	6	2	4	6	2	3	99	4.0
LE 7.5	16	21	22	5	23	15	21	16	10	22	8	11	9	15	9	11	234	3.4
LE 12.5	32	13	12	20	38	31	28	33	31	39	25	34	27	39	26	18	446	17.9
LE 18.5	27	5	20	19	16	13	18	38	91	92	48	55	87	112	88	55	789	31.7
LE 24.5	7	7	5	14	8	4	7	27	41	76	43	81	91	111	104	42	668	26.9
LE 32.5	0	1	0	7	5	2	1	1	8	23	11	7	19	54	39	3	181	7.3
GT 32.5	0	0	0	0	8	2	1	1	4	6	0	2	0	4	3	3	34	1.4
TOTAL	90	60	65	78	111	82	84	122	196	268	143	195	237	344	273	138	2486	100.0
PERCENT	3.6	2.4	2.6	3.1	4.5	3.3	3.4	4.9	7.9	10.8	5.8	7.3	9.5	13.8	11.0	5.6	100.0	
AVG SPD	10.9	9.4	10.2	13.0	13.2	10.0	10.3	13.6	15.3	16.8	15.8	16.3	17.4	18.2	13.6	16.0		

AVERAGE SPEED FOR THIS TABLE EQUALS 15.6 MPH

TABLE 2.3-26

(Sheet 6 of 7)

JOINT FREQUENCY OF WIND BY VERTICAL TEMPERATURE DIFFERENCE

OYSTER CREEK METEOROLOGICAL TOWER DATA

UPPER MEASUREMENT LEVEL

FOR THE YEAR 1968

PASQUILL STABILITY CLASS: F

LAPSE RATE (F/100 FT): LESS THAN OR EQUAL TO - 1.0

MEASUREMENT LEVELS: WIND - 400 FT; DELTA T-400 TO 12 FT

SPEED	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	PERCENT
LE 0.0	2	1	1	1	3	1	2	2	0	2	0	1	3	1	1	1	22	1.8
LE 3.5	3	2	3	6	4	2	4	5	6	4	6	4	2	1	0	3	55	4.8
LE 7.5	6	10	3	12	2	14	14	11	14	7	15	3	3	7	8	1	140	11.6
LE 12.5	22	13	9	4	5	8	4	18	16	26	17	19	18	17	16	10	214	17.8
LE 18.5	34	2	6	1	2	0	5	15	27	33	30	33	58	58	41	26	371	30.8
LE 24.5	9	0	1	2	0	0	0	3	14	33	28	43	64	54	43	32	320	27.2
LE 32.5	1	0	0	0	0	0	0	0	0	4	16	17	15	12	5	4	74	6.1
GT 32.5	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0.1
TOTAL	77	28	28	26	16	17	28	54	77	109	112	123	163	151	114	77	1205	100.0
PERCENT	6.4	2.3	2.3	2.2	1.3	1.4	2.3	4.5	6.4	9.0	9.3	10.6	13.5	12.5	9.5	6.4	100.0	
AVG SPD	13.2	3.1	8.7	6.7	8.7	4.5	7.0	10.0	12.8	14.7	15.7	17.0	17.8	17.4	16.7	17.2		

AVERAGE SPEED FOR THIS TABLE EQUALS 14.8 MPH

TABLE 2.3-26

(Sheet 7 of 7)

JOINT FREQUENCY OF WIND BY VERTICAL TEMPERATURE DIFFERENCE

OYSTER CREEK METEOROLOGICAL TOWER DATA

UPPER MEASUREMENT LEVEL

FOR THE YEAR 1968

PASQUILL STABILITY CLASS: G

LAPSE RATE (F/100 FT): LESS THAN OR EQUAL TO - 1.0

MEASUREMENT LEVELS: WIND - 400 FT; DELTA T-400 TO 12 FT

SPEED	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	PERCENT
LE 0.0	1	5	3	1	3	4	2	3	1	2	1	2	0	3	1	2	34	4.1
LE 3.5	3	5	9	6	2	8	6	6	6	7	5	1	3	3	3	5	73	9.5
LE 7.5	20	10	5	8	10	7	11	8	5	10	11	4	11	10	6	7	149	13.1
LE 12.5	26	11	13	17	2	3	4	6	12	12	16	15	15	18	28	19	217	26.3
LE 18.5	12	2	14	7	1	0	0	4	9	14	21	36	31	21	29	23	224	27.2
LE 24.5	1	0	1	2	0	0	0	0	3	2	11	13	14	18	17	9	93	11.3
LE 32.5	0	0	0	0	0	0	0	0	0	0	1	9	8	6	2	1	27	3.3
GT 32.5	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	0.2
TOTAL	63	33	45	41	18	22	23	27	36	47	68	86	82	81	86	66	124	100.1
PERCENT	7.6	4.0	5.5	5.0	2.2	2.7	2.8	3.3	4.4	5.7	8.3	10.4	10.0	9.8	10.4	8.0	100.0	
AVG SPD	9.2	6.1	9.3	9.1	5.1	3.7	5.1	6.6	9.6	9.4	12.4	13.4	16.8	14.4	13.7	12.6		

AVERAGE SPEED FOR THIS TABLE EQUALS 11.4 MPH

TABLE 2.3-27
(Sheet 1 of 1)

DISPERSION FACTORS AT THE EXLUSION AREA BOUNDARY (EAB)
DURING 0-2 HOURS FOLLOWING A POSTULATED
ACCIDENTAL RELEASE FROM THE
AUGMENTED OFFGAS SYSTEM
(1968 Meteorological Data Used)

Release Location	X/Q (sec/m^3)
Augmented Offgas Building	7.0×10^{-3}
Delay Pipe	4.6×10^{-3}
Stream Jet Air Ejectors	2.3×10^{-3}

TABLE 2.3-31
(Sheet 1 of 3)

ANNUAL ROUTINE GROUND LEVEL RELEASE DIFFUSION FACTORS
OYSTER CREEK METEOROLOGICAL TOWER DATA
FOR THE YEAR 1968
(UNDEPLETED X/Q IN S/M^3)

Direction Sector	804	2413	4022	5631	7240	12067	24135	40225	56315	72405
N	1.41E-5	1.90E-6	4.95E-7	2.50E-7	1.67E-7	7.13E-8	2.21E-8	9.64E-9	8.23E-9	4.48E-9
NNE	1.85E-5	2.56E-6	6.74E-7	3.42E-7	2.29E-7	9.87E-8	3.10E-8	1.36E-8	8.85E-9	6.41E-9
NE	2.02E-5	7.87E-6	7.67E-7	3.92E-7	2.64F-7	1.15E-7	3.69E-8	1.64E-8	1.07E-9	7.85E-9
ENE	2.81E-5	4.02E-6	1.08E-6	5.51E-7	3.71E-7	1.62E-7	5.21E-8	2.31E-8	1.52E-8	1.11E-8
E	2.85E-5	4.06E-6	1.08E-6	5.54E-7	3.73E-7	1.63E-7	5.23E-8	2.32E-8	1.52E-8	1.11E-8
ESE	2.74E-5	3.86E-6	1.03E-6	5.24E-7	3.52E-7	1.53E-7	4.92E-8	2.17E-8	1.42E-8	1.04E-8
SE	3.22E-5	4.68E-6	1.25E-6	6.42E-7	4.32E-7	1.90E-7	6.19E-8	2.75E-8	1.81E-8	1.33E-8
SSE	2.22E-5	3.22E-6	6.68E-7	4.47F-7	3.01E-7	1.33E-7	4.33E-8	1.93E-8	1.27E-8	9.34E-9
S	1.18E-5	1.60E-6	4.27E-7	2.19E-7	1.47E-7	6.42E-8	2.07E-8	9.15E-9	6.00E-9	4.39E-9
SSW	7.07E-6	9.61E-7	2.52E-7	1.27E-7	8.51E-8	3.64E-8	1.14E-8	4.98E-9	3.22E-9	2.32E-9
SW	8.47E-6	1.14E-6	2.47E-7	1.49E-7	9.96E-8	4.26E-8	1.32E-8	5.76E-9	3.71E-9	2.66E-9
WSW	1.02E-5	1.33E-6	3.43E-7	1.71E-7	1.14E-7	4.80E-8	1.47E-8	6.32E-9	4.03E-9	2.86E-9
W	1.13E-5	1.49E-6	3.86E-7	1.94E-7	1.29E-7	5.47E-8	1.69E-8	7.30E-9	4.68E-9	3.33E-9
WNW	8.05E-6	1.07E-6	2.76E-7	1.39E-7	9.27E-8	3.95E-8	1.22E-8	5.31E-9	3.42E-9	2.45E-9
NW	9.73E-6	1.31E-6	3.41E-7	1.72E-7	1.15E-7	4.94E-8	1.55E-8	6.75E-9	4.36E-9	3.14E-9
NNW	1.11E-5	1.52E-6	3.96E-7	2.00E-7	1.34E-7	5.74E-8	1.80E-8	7.85E-9	5.09E-9	3.67E-9

TABLE 2.3-31
(Sheet 2 of 3)

ANNUAL ROUTINE GROUND LEVEL RELEASE DIFFUSION FACTORS
OYSTER CREEK METEOROLOGICAL TOWER DATA
FOR THE YEAR 1968
(DEPLETED X/Q IN S/M^3)

Direction Sector	804	2413	4022	5631	7240	12067	24135	40225	56315	72405
N	1.20E-5	1.44E-6	3.51E-7	1.67E-7	1.02E-7	4.15E-8	1.07E-8	3.92E-9	2.21E-9	1.42E-9
NNE	1.57E-5	1.94E-6	4.77E-7	2.28E-7	1.47E-7	5.74E-8	1.50E-8	5.53E-9	3.14E-9	2.04E-9
NE	1.72E-5	2.18E-6	5.48E-7	2.62E-7	1.69E-7	6.70E-8	1.79E-8	6.64E-9	3.80E-9	2.49E-9
ENE	2.39E-5	3.05E-6	7.61E-7	3.68E-7	2.37E-7	9.43E-8	2.52E-8	9.39E-9	5.38E-9	3.53E-9
E	2.43E-5	3.08E-6	7.67E-7	3.07E-7	2.38E-7	9.47E-8	2.53E-8	9.41E-9	5.38E-9	3.53E-9
ESE	2.33E-5	2.93E-6	7.27E-7	3.50E-7	2.25E-7	8.93E-8	2.38E-8	8.83E-9	5.04E-9	3.29E-9
SE	2.75E-5	3.35E-6	8.85E-7	4.29E-7	2.77E-7	1.11E-7	2.99E-8	1.12E-9	6.42E-9	2.42E-9
SSE	1.89E-5	2.44E-6	6.14E-7	2.98F-7	1.92E-7	7.72E-8	2.09E-8	7.83E-9	4.50E-9	2.96E-9
S	9.63E-6	1.22E-6	3.03E-7	1.46E-7	9.39E-8	3.74E-8	1.00E-8	3.72E-9	2.13E-9	1.39E-9
SSW	6.02E-6	7.29E-7	1.78E-7	8.49E-8	5.44E-8	2.12E-8	5.51E-9	2.02E-9	1.14E-9	7.37E-10
SW	7.22E-6	8.64E-7	2.10E-7	9.97E-8	6.37E-8	2.48E-8	6.41E-9	2.34E-9	1.31E-9	8.43E-10
WSW	8.68E-6	1.01E-6	2.43E-7	1.14E-7	7.29E-8	2.79E-8	7.10E-9	2.57E-9	1.43E-9	9.07E-10
W	9.59E-6	1.13E-6	2.73E-7	1.29E-7	8.24E-8	3.18E-8	8.16E-9	2.97E-9	1.66E-9	1.06E-9
WNW	6.86E-6	8.09E-7	1.96E-7	9.28E-8	5.93E-8	2.30E-8	5.91E-9	2.16E-9	1.21E-9	7.76E-10
NW	8.28E-6	9.92E-7	2.42E-7	1.15E-7	7.36E-8	2.82E-8	7.48E-9	2.74E-9	1.55E-9	9.96E-10
NNW	9.49E-6	1.15E-6	2.80E-7	1.34E-7	8.56E-8	3.34E-8	8.68E-9	3.19E-9	1.80E-9	1.16E-9

TABLE 2.3-31
(Sheet 3 of 3)

ANNUAL ROUTINE GROUND LEVEL RELEASE DIFFUSION FACTORS
OYSTER CREEK ME--TEOROLOGICAL TOWER DATA
FOR THE YEAR 1968
(DEPOSITION D/Q IN M-2)

Direction Sector	804	2413	4022	5631	7240	12067	24135	40225	56315	72405
N	7.36E-8	8.30E-9	1.88E-9	8.69E-10	5.26E-10	1.99E-10	4.55E-11	1.48E-11	7.53E-12	4.68E-12
NNE	7.54E-8	8.50E-9	1.93E-9	8.00E-10	5.39E-10	2.04E-10	4.66E-11	1.52E-11	7.71E-12	4.79E-12
NE	6.58E-8	7.42E-9	1.68E-9	7.27E-10	4.70E-10	1.78E-10	4.07E-11	1.33E-11	6.37E-11	4.18E-12
ENE	1.04E-7	1.18E-8	2.67E-9	1.23E-9	7.46E-10	2.38E-10	6.45E-11	2.11E-11	1.07E-11	6.63E-12
E	1.28E-7	1.45E-8	3.28E-9	1.51E-9	9.16E-10	3.47E-10	7.92E-11	2.59E-11	1.31E-11	8.15E-12
ESE	1.48E-7	1.66E-8	3.77E-9	1.74E-9	1.06E-9	4.00E-10	9.12E-11	2.98E-11	1.51E-11	9.38E-12
SE	1.29E-7	1.46E-8	3.31E-9	1.53E-9	9.25E-10	3.51E-10	8.00E-11	2.61E-11	1.33E-11	8.23E-12
SSE	7.39E-9	8.33E-9	1.89E-9	8.72E-10	5.28E-10	2.00E-10	4.57E-11	1.49E-11	7.56E-12	4.70E-12
S	8.57E-8	4.02E-9	9.11E-10	4.21E-10	2.55E-10	9.65E-11	2.20E-11	7.19E-12	3.65E-12	2.27E-12
SSW	2.37E-8	2.67E-9	6.05E-10	2.79E-10	1.69E-10	6.41E-11	1.46E-11	4.77E-12	2.42E-12	1.50E-12
SW	3.92E-8	4.42E-9	1.00E-9	4.63E-10	2.80E-10	1.06E-10	2.42E-11	7.91E-12	4.01E-12	2.49E-12
WSW	6.55E-8	7.38E-9	1.67E-9	7.73E-10	4.68E-10	1.77E-10	4.05E-11	1.32E-11	6.70E-12	4.16E-12
W	6.85E-8	7.73E-9	1.75E-9	8.09E-10	4.90E-10	1.86E-10	4.24E-11	1.38E-11	7.02E-12	4.36E-12
WNW	4.94E-8	5.57E-9	1.26E-9	5.83E-10	3.53E-10	1.34E-10	3.05E-11	9.97E-12	5.06E-12	3.14E-12
NW	5.20E-8	5.87E-9	1.33E-9	6.14E-18	3.72E-10	1.41E-10	3.21E-11	1.05E-11	5.32E-12	3.31E-12
NNW	5.45E-8	6.16E-9	1.40E-9	6.45E-10	3.90E-10	1.48E-10	3.37E-11	1.10E-11	5.59E-12	3.47E-12

TABLE 2.3-32
(Sheet 1 of 3)

ANNUAL ROUTINE ELEVATED RELEASE DIFFUSION FACTORS
OYSTER CREEK METEOROLOGICAL TOWER DATA
FOR THE YEAR 1968
(UNDEPLETED X/Q IN S/M^3)

Direction Sector	804	2413	4022	5631	7240	12067	24135	40225	56315	72405
N	7.06E-9	2.39E-8	2.58E-8	2.43E-8	2.15E-8	1.45E-8	6.13E-9	3.07E-9	2.06E-9	1.51E-9
NNE	4.34E-9	1.51E-8	1.76E-8	1.83E-8	1.83E-8	1.35E-8	6.15E-9	3.19E-9	2.19E-9	1.62E-9
NE	1.82E-8	1.57E-8	1.39E-8	1.27E-8	1.19E-8	8.72E-9	4.23E-9	2.29E-9	1.60E-9	1.20E-9
ENE	1.40E-8	1.80E-8	1.63E-8	1.48E-8	1.37E-8	9.83E-9	4.65E-9	2.47E-9	1.72E-9	1.28E-9
E	3.94E-9	3.05E-8	2.37E-8	2.07E-8	1.88E-8	1.31E-8	5.92E-9	3.07E-9	2.10E-9	1.55E-9
ESE	7.48E-8	3.89E-8	2.97E-8	2.36E-8	2.36E-8	1.63E-8	7.28E-9	3.74E-9	2.55E-9	1.87E-9
SE	5.57E-8	2.56E-8	1.91E-8	1.68E-8	1.58E-8	1.09E-9	5.00E-9	2.60E-9	1.79E-9	1.33E-9
SSE	5.54E-8	1.74E-8	1.25E-8	1.12F-8	1.04E-8	7.60E-9	3.62E-9	1.93E-9	1.34E-9	1.00E-9
S	3.00E-8	1.38E-8	1.15E-8	1.05E-8	9.71E-9	7.07E-9	3.44E-9	1.67E-9	1.32E-9	9.94E-10
SSW	1.42E-8	1.55E-9	1.73E-8	1.79E-8	1.69E-8	1.06E-8	4.37E-9	2.20E-9	1.49E-9	1.10E-9
SW	1.01E-8	1.97E-8	2.61E-8	2.56E-8	2.39E-8	1.44E-8	5.46E-9	2.68E-9	1.80E-9	1.31E-9
WSW	1.25E-8	3.09E-8	3.10E-8	2.77E-8	2.46E-8	1.71E-8	6.30E-9	3.00E-9	1.97E-9	1.42E-9
W	1.23E-8	3.08E-8	2.85E-8	2.78E-8	1.85E-8	1.85E-8	7.10E-9	3.37E-9	2.22E-9	1.60E-9
WNW	2.12E-9	2.76E-8	2.76E-8	2.52E-8	2.49E-8	1.64E-8	6.53E-9	3.17E-9	2.11E-9	1.53E-9
NW	4.33E-8	3.08E-8	2.73E-8	2.61E-8	2.29E-8	1.37E-8	5.64E-9	2.72E-9	1.81E-9	1.31E-9
NNW	7.73E-9	2.52E-8	2.83E-8	2.59E-8	2.21E-8	1.37E-8	5.90E-9	2.93E-9	1.97E-9	1.43E-9

TABLE 2.3-32
(Sheet 2 of 3)

ANNUAL ROUTINE ELEVATED RELEASE DIFFUSION FACTORS
OYSTER CREEK METEOROLOGICAL TOWER DATA
FOR THE YEAR 1968
(DEPLETED X/Q IN S/M^3)

Direction Sector	804	2413	4022	5631	7240	12067	24135	40225	56315	72405
N	6.92E-9	2.36E-8	2.53E-8	2.35E-8	2.06E-8	1.37E-8	5.66E-9	2.79E-9	1.86E-9	1.35E-9
NNE	4.27E-9	1.49E-8	1.74E-8	1.80E-8	1.30E-8	1.30E-8	5.88E-9	3.00E-9	2.05E-9	1.51E-9
NE	1.80E-8	1.54E-8	1.35E-8	1.24E-8	1.15E-8	8.37E-9	4.00E-9	2.14E-9	1.49E-9	1.12E-9
ENE	1.38E-8	1.76E-8	1.60E-8	1.44E-8	1.33E-8	9.42E-9	4.38E-9	2.31E-9	1.59E-9	1.19E-9
E	3.88E-8	2.97E-8	2.32E-8	2.00E-8	1.81E-8	1.24E-8	5.53E-9	2.83E-9	1.92E-9	1.41E-9
ESE	7.35E-8	3.78E-8	2.89E-8	2.51E-8	2.27E-8	1.55E-8	6.79E-9	3.43E-9	2.32E-9	1.70E-9
SE	5.47E-8	2.48E-8	1.66E-8	1.63E-8	1.49E-8	1.04E-8	4.71E-9	2.42E-9	1.65E-9	1.22E-9
SSE	5.47E-8	1.69E-8	1.22E-8	1.09F-8	1.01E-8	7.27E-8	3.40E-9	1.80E-9	1.24E-9	9.26E-9
S	2.95E-8	1.34E-8	1.12E-8	1.02E-8	9.38E-9	6.78E-9	3.26E-9	1.76E-9	1.23E-9	9.30E-10
SSW	1.40E-8	1.52E-8	1.69E-8	1.72E-8	1.61E-9	1.00E-9	4.05E-9	2.01E-9	1.36E-9	1.00E-9
SW	9.92E-8	1.96E-8	2.55E-8	2.44E-8	2.24E-8	1.32E-8	4.89E-9	2.36E-9	1.57E-9	1.15E-9
WSW	1.22E-8	3.05E-8	3.02E-8	2.64E-8	2.31E-8	1.57E-8	5.60E-9	2.61E-9	1.70E-9	1.22E-9
W	1.20E-8	3.02E-8	2.78E-8	2.66E-8	2.57E-8	1.71E-8	6.42E-9	3.01E-9	1.97E-9	1.41E-9
WNW	2.09E-8	2.70E-8	2.71E-8	2.41E-8	2.34E-8	1.51E-8	5.90E-9	2.83E-9	1.87E-9	1.35E-9
NW	4.25E-8	2.99E-8	2.65E-8	2.48E-8	2.14E-8	1.26E-8	5.03E-9	2.38E-9	1.56E-9	1.12E-9
NNW	7.59E-8	2.48E-8	2.78E-8	2.50E-8	2.11E-8	1.27E-8	5.33E-9	2.60E-9	1.72E-9	1.25E-9

TABLE 2.3-32
(Sheet 3 of 3)

ANNUAL ROUTINE ELEVATED RELEASE DIFFUSION FACTORS
OYSTER CREEK METEOROLOGICAL TOWER DATA
FOR THE YEAR 1968
(DEPOSITION D/Q IN M-2)

Direction Sector	804	2413	4022	5631	7240	12067	24135	40225	56315	72405
N	1.59E-9	1.36E-9	5.70E-10	3.22E-10	2.14E-10	9.65E-11	2.35E-11	8.22E-12	4.39E-12	2.76E-12
NNE	7.02E-10	6.17E-10	2.57E-10	1.47E-10	9.89E-11	4.52E-11	1.11E-11	3.87E-12	2.07E-12	1.30E-12
NE	1.32E-9	6.14E-10	2.34E-10	1.30E-10	8.58E-11	3.93E-11	9.81E-12	3.53E-12	1.93E-12	1.22E-12
ENE	1.86E-9	9.10E-10	3.48E-10	1.93E-10	1.28E-11	5.84E-11	1.46E-11	5.22E-12	2.84E-12	1.80E-12
E	4.43E-9	1.85E-9	6.77E-10	3.68E-10	2.43E-10	1.10E-10	2.74E-11	9.93E-12	5.47E-12	3.49E-12
ESE	7.23E-9	2.56E-9	9.01E-10	4.85E-10	3.18E-10	1.42E-10	3.58E-11	1.32E-11	7.34E-12	4.72E-12
SE	5.75E-9	1.82E-9	6.22E-10	3.31E-10	2.16E-10	9.62E-11	2.43E-11	9.06E-12	5.09E-12	3.29E-12
SSE	2.68E-9	8.51E-10	2.94E-10	1.57F-10	1.03E-10	4.59E-11	1.16E-11	4.34E-12	2.45E-12	1.58E-12
S	1.53E-9	5.01E-10	1.80E-10	9.66E-10	6.32E-11	2.83E-11	7.14E-12	2.65E-12	1.48E-12	9.56E-13
SSW	9.14E-10	4.48E-10	1.80E-10	1.02E-10	6.84E-11	2.96E-11	7.25E-12	2.59E-12	1.41E-12	8.94E-13
SW	5.87E-10	9.12E-10	4.16E-10	2.39E-10	1.63E-10	6.84E-11	1.62E-11	5.57E-12	2.96E-12	1.85E-12
WSW	1.45E-9	1.46E-9	6.22E-10	3.51E-10	2.36E-10	1.02E-10	2.43E-11	8.39E-12	4.49E-12	2.83E-12
W	1.63E-9	1.05E-9	4.23E-10	2.40E-10	1.63E-10	6.98E-11	1.67E-11	5.86E-12	3.19E-12	2.04E-12
WNW	1.73E-9	9.08E-10	3.69E-10	2.04E-10	1.38E-10	5.88E-11	1.41E-11	5.00E-12	2.73E-12	1.73E-12
NW	3.78E-9	1.35E-9	5.07E-10	2.79E-10	1.84E-10	7.93E-11	1.95E-11	7.09E-12	3.91E-12	2.49E-12
NNW	1.52E-8	1.10E-9	4.62E-10	2.60E-10	1.72E-10	7.69E-11	1.87E-11	6.55E-12	3.51E-12	2.21E-12

Table 2.3-33
(Sheet 1 of 2)
STACK DISPERSION PARAMETERS FOR GROUND RELEASES
FORKED RIVER METEOROLOGICAL TOWER DATA
FOR THE YEARS 1989, 1990
(X/Q IN S/M^3)

Sector	805m 0.5 miles	3218m 2 miles	4827m 3 miles	6436m 4 miles	8045m 5 miles	16090m 10 miles	38120m 20 miles	48270m 30 miles	64360m 40 miles	80450m 50 miles
N	1.07E-05	9.75E-07	5.87E-07	4.03E-07	2.84E-07	1.13E-07	4.09E-08	3.09E-08	2.17E-08	1.74E-08
NNE	1.35E-05	1.28E-06	7.65E-07	5.25E-07	3.64E-07	1.44E-07	5.12E-08	3.83E-08	2.68E-08	2.14E-08
NE	1.46E-05	1.40E-06	8.38E-07	5.76E-07	4.01E-07	1.59E-07	5.68E-08	4.24E-08	2.96E-08	2.37E-08
ENE	1.32E-05	1.24E-06	7.44E-07	5.12E-07	3.57E-07	1.42E-07	5.07E-08	3.80E-08	2.66E-08	2.12E-08
E	1.36E-05	1.27E-06	7.62E-07	5.25E-07	3.68E-07	1.47E-07	5.28E-08	3.95E-08	2.77E-08	2.21E-08
ESE	1.28E-05	1.17E-06	7.02E-07	4.83E-07	3.38E-07	1.35E-07	4.85E-08	3.64E-08	2.56E-08	2.05E-08
SE	1.39E-05	1.27E-06	7.63E-07	5.26E-07	3.70E-07	1.48E-07	5.36E-08	4.03E-08	2.84E-08	2.27E-08
SSE	1.17E-05	1.06E-06	6.41E-07	4.42E-07	3.13E-07	1.25E-07	4.55E-08	3.43E-08	2.41E-08	1.93E-08
S	1.03E-05	9.29E-07	5.62E-07	3.88E-07	2.75E-07	1.10E-07	4.02E-08	3.05E-08	2.15E-08	1.72E-08
SSW	6.20E-06	5.66E-07	3.39E-07	2.32E-07	1.62E-07	6.39E-08	2.30E-08	1.73E-08	1.21E-08	9.71E-09
SW	7.64E-06	6.95E-07	4.15E-07	2.84E-07	1.95E-07	7.68E-08	2.75E-08	2.06E-08	1.44E-08	1.15E-08
WSW	5.64E-06	5.29E-07	3.13E-07	2.13E-07	1.45E-07	5.65E-08	1.99E-08	1.48E-08	1.03E-08	8.20E-09
W	5.14E-06	4.66E-07	2.80E-07	1.92E-07	1.34E-07	5.30E-08	1.91E-08	1.44E-08	1.01E-08	8.09E-09
WNW	4.47E-06	4.02E-07	2.41E-07	1.66E-07	1.16E-07	4.60E-08	1.66E-08	1.25E-08	8.82E-09	7.05E-09
NW	5.46E-06	4.93E-07	2.95E-07	2.03E-07	1.41E-07	5.59E-08	2.02E-08	1.52E-08	1.07E-08	8.54E-09
NNW	7.92E-06	7.14E-07	4.29E-07	2.95E-07	2.07E-07	8.23E-08	2.99E-08	2.26E-08	1.59E-08	1.28E-08

Table 2.3-33
(Sheet 2 of 2)
STACK DISPERSION PARAMETERS FOR GROUND RELEASES
FORKED RIVER METEOROLOGICAL TOWER DATA
FOR THE YEARS 1989, 1990
(D/Q IN M-2)

Sector	805m 0.5 miles	3218m 2 miles	4827m 3 miles	6436m 4 miles	8045m 5 miles	16090m 10 miles	38120m 20 miles	48270m 30 miles	64360m 40 miles	80450m 50 miles
N	1.23E-08	1.12E-09	5.10E-10	3.27E-10	2.29E-10	6.75E-11	1.54E-11	9.98E-12	5.74E-12	3.74E-12
NNE	1.98E-08	1.80E-09	8.23E-10	5.28E-10	3.70E-10	1.06E-10	2.48E-11	1.61E-11	9.26E-12	6.03E-12
NE	1.67E-08	1.52E-09	6.95E-10	4.45E-10	3.12E-10	8.94E-11	2.09E-11	1.36E-11	7.82E-12	5.09E-12
ENE	1.59E-08	1.45E-09	6.64E-10	4.26E-10	2.98E-10	8.54E-11	2.00E-11	1.30E-11	7.47E-12	4.86E-12
E	1.60E-08	1.46E-09	6.66E-10	4.27E-10	2.99E-10	8.57E-11	2.00E-11	1.30E-11	7.49E-12	4.88E-12
ESE	1.97E-08	1.80E-09	8.22E-10	5.27E-10	3.70E-10	1.06E-10	2.47E-11	1.61E-11	9.25E-12	6.03E-12
SE	1.89E-08	1.72E-09	7.88E-10	5.05E-10	3.54E-10	1.01E-10	2.37E-11	1.54E-11	8.87E-12	5.77E-12
SSE	1.25E-08	1.14E-09	5.22E-10	3.35E-10	2.35E-10	6.71E-11	1.57E-11	1.02E-11	5.87E-12	3.82E-12
S	9.02E-09	8.21E-10	3.76E-10	2.41E-10	1.69E-10	4.83E-11	1.13E-11	7.35E-12	4.23E-12	2.75E-12
SSW	6.80E-09	6.20E-10	2.83E-10	1.82E-10	1.27E-10	3.65E-11	8.52E-12	5.54E-12	3.19E-12	2.08E-12
SW	1.08E-08	9.80E-10	4.48E-10	2.87E-10	2.02E-10	5.77E-11	1.35E-11	8.77E-12	5.04E-12	3.28E-12
WSW	9.66E-09	8.80E-10	4.02E-10	2.58E-10	1.81E-10	5.18E-11	1.21E-11	7.87E-12	4.53E-12	2.95E-12
W	6.53E-09	5.94E-10	2.72E-10	1.74E-10	1.22E-10	3.50E-11	8.18E-12	5.32E-12	3.06E-12	1.99E-12
WNW	5.30E-09	4.83E-10	2.21E-10	1.42E-10	9.93E-11	2.84E-11	6.64E-12	4.32E-12	2.48E-12	1.62E-12
NW	7.76E-09	7.06E-10	3.23E-10	2.07E-10	1.45E-10	4.16E-11	9.72E-12	6.32E-12	3.63E-12	2.37E-12
NNW	8.63E-09	7.86E-10	3.59E-10	2.30E-10	1.62E-10	4.62E-11	1.08E-11	7.03E-12	4.04E-12	2.63E-12

Table 2.3-34
(Sheet 1 of 2)
STACK DISPERSION PARAMETERS FOR ELEVATED RELEASES
FORKED RIVER METEOROLOGICAL TOWER DATA
FOR THE YEARS 1989, 1990
(X/Q IN S/M^3)

Sector	805m 0.5 miles	3218m 2 miles	4827m 3 miles	6436m 4 miles	8045m 5 miles	16090m 10 miles	38120m 20 miles	48270m 30 miles	64360m 40 miles	80450m 50 miles
N	1.01E-08	2.05E-08	1.77E-08	1.45E-08	1.18E-08	5.88E-09	2.27E-09	1.73E-09	1.24E-09	9.52E-10
NNE	9.69E-09	2.51E-08	2.28E-08	2.08E-08	1.69E-08	8.32E-09	3.13E-09	2.37E-09	1.69E-09	1.29E-09
NE	7.52E-09	1.38E-08	1.40E-08	1.26E-08	1.09E-08	6.07E-09	2.54E-09	1.97E-09	1.44E-09	1.13E-09
ENE	1.42E-08	1.42E-08	1.34E-08	1.16E-08	9.91E-09	5.34E-09	2.22E-09	1.72E-09	1.26E-09	9.86E-10
E	1.53E-08	1.51E-08	1.38E-08	1.19E-08	1.00E-08	5.36E-09	2.23E-09	1.74E-09	1.28E-09	1.00E-09
ESE	2.27E-08	1.85E-08	1.61E-08	1.35E-08	1.12E-08	5.65E-09	2.25E-09	1.73E-09	1.26E-09	9.77E-10
SE	2.56E-09	1.87E-08	1.64E-08	1.38E-08	1.14E-08	5.89E-09	2.37E-09	1.83E-09	1.34E-09	1.04E-09
SSE	1.35E-08	1.29E-08	1.18E-08	1.01E-08	8.44E-08	4.42E-09	1.79E-09	1.39E-09	1.01E-09	7.90E-10
S	5.36E-09	1.27E-08	1.13E-08	9.44E-09	7.83E-09	4.05E-09	1.65E-09	1.27E-09	9.33E-10	7.27E-10
SSW	5.44E-09	1.85E-08	2.04E-08	1.51E-08	1.18E-08	5.50E-09	2.03E-09	1.53E-09	1.09E-09	8.35E-10
SW	1.19E-08	2.48E-08	2.45E-08	1.78E-08	1.36E-08	6.27E-09	2.25E-09	1.69E-09	1.20E-09	9.09E-10
WSW	1.56E-08	1.91E-08	1.93E-08	1.44E-08	1.12E-08	5.66E-09	1.97E-09	1.47E-09	1.03E-09	7.80E-10
W	1.30E-08	1.58E-08	1.59E-08	1.33E-08	1.03E-08	5.38E-09	1.88E-09	1.40E-09	9.90E-10	7.50E-10
WNW	1.13E-08	1.89E-08	1.51E-08	1.27E-08	9.76E-09	5.04E-09	1.78E-09	1.34E-09	9.44E-10	7.16E-10
NW	1.30E-08	2.39E-08	1.92E-08	1.44E-08	1.13E-09	5.74E-09	2.01E-09	1.50E-09	1.06E-09	8.02E-10
NNW	9.43E-09	1.82E-08	1.75E-08	1.36E-08	1.08E-08	5.06E-09	1.87E-09	1.41E-09	1.01E-09	7.67E-10

Table 2.3-34
(Sheet 2 of 2)
STACK DISPERSION PARAMETERS FOR ELEVATED RELEASES
FORKED RIVER METEOROLOGICAL TOWER DATA
FOR THE YEARS 1989, 1990
(D/Q IN M-2)

Sector	805m 0.5 miles	3218m 2 miles	4827m 3 miles	6436m 4 miles	8045m 5 miles	16090m 10 miles	38120m 20 miles	48270m 30 miles	64360m 40 miles	80450m 50 miles
N	5.18E-09	5.54E-10	2.78E-10	1.86E-10	1.39E-10	6.81E-11	2.06E-11	1.31E-11	7.62E-12	4.86E-12
NNE	7.06E-09	7.90E-10	3.99E-10	2.76E-10	2.13E-10	1.14E-10	3.50E-11	2.21E-11	1.26E-11	7.87E-12
NE	3.80E-09	4.19E-10	2.25E-10	1.78E-10	1.56E-10	1.05E-10	3.36E-11	2.10E-11	1.18E-11	7.25E-12
ENE	4.80E-09	4.98E-10	2.61E-10	1.93E-10	1.60E-10	9.70E-11	3.07E-11	1.94E-11	1.10E-11	6.90E-12
E	5.40E-09	5.52E-10	2.87E-10	2.06E-10	1.65E-10	9.53E-11	2.99E-11	1.90E-11	1.09E-11	6.88E-12
ESE	8.52E-09	8.56E-10	4.35E-10	2.94E-10	2.22E-10	1.11E-10	3.42E-11	2.20E-11	1.29E-11	8.28E-12
SE	8.25E-09	8.26E-10	4.20E-10	2.83E-10	2.13E-10	1.06E-10	3.26E-11	2.10E-11	1.23E-11	7.94E-12
SSE	4.26E-09	4.45E-10	2.30E-10	1.64E-10	1.31E-10	7.43E-11	2.32E-11	1.47E-11	8.43E-12	5.31E-12
S	2.90E-09	3.23E-10	1.65E-10	1.18E-10	9.38E-11	5.35E-11	1.66E-11	1.04E-11	5.91E-12	3.68E-12
SSW	2.98E-09	3.38E-10	1.67E-10	1.09E-10	7.96E-11	3.70E-11	1.09E-11	6.94E-12	3.99E-12	2.53E-12
SW	5.83E-09	6.45E-10	3.15E-10	1.98E-10	1.37E-10	5.45E-11	1.56E-11	1.00E-11	5.91E-12	3.84E-12
WSW	5.65E-09	6.01E-10	2.94E-10	1.83E-10	1.26E-10	4.79E-11	1.37E-11	8.90E-12	5.35E-12	3.53E-12
W	3.59E-09	3.75E-10	1.85E-10	1.17E-10	8.20E-11	3.35E-11	9.78E-12	6.36E-12	3.80E-12	2.50E-12
WNW	2.88E-09	3.05E-10	1.50E-10	9.52E-11	6.66E-11	2.72E-11	7.90E-12	5.12E-12	3.05E-12	1.99E-12
NW	4.07E-09	4.24E-10	2.10E-10	1.35E-10	9.56E-11	4.07E-11	1.20E-11	7.78E-12	4.63E-12	3.02E-12
NNW	4.07E-09	4.34E-10	2.16E-10	1.41E-10	1.02E-10	4.67E-11	1.39E-11	8.93E-12	5.23E-12	3.37E-12

2.4 HYDROLOGIC ENGINEERING

The design criteria for controlling water levels at the Oyster Creek Nuclear Generating Station (OCNGS) were based on hurricane storm and tidal action. The stream flow from either the Oyster Creek or the South Branch of the Forked River was considered to be relatively insignificant in terms of the flooding potential of the plant site.

The design basis high water level for the plant was established from a storm which struck New Jersey in 1962 (Reference 1). This storm was the worst ever recorded at the plant site. Flood marks from this storm showed a high tide elevation of 4.5 feet above Mean Sea Level (MSL). The deck elevation of the circulating water intake structure was therefore set at elevation 6.0 ft MSL providing 1.5 feet of free board.

A study conducted in 1970 to establish the Probable Maximum Hurricane flood level east of US Route 9 (Reference 1) determined that a hurricane storm with a 250 year return frequency would produce a flood elevation of about 5.3 ft MSL at the plant site. This 250 year return period is the criterion used by the US Army Corps of Engineers for determining design basis flood levels of waterfront structures. In the absence of specific nuclear regulatory criteria, the OCNGS service water pumps installed at the same deck along with circulating water pumps, are considered safe against the 250 year hurricane flood.

2.4.1 Hydrologic Descriptions

2.4.1.1 Site and Facilities

The Oyster Creek site is located at approximate latitude 39° 49' North and longitude 74° 12' West, on the eastern coastline of New Jersey (Figure 2.4-1), about two miles inland from the shore of Barnegat Bay and about seven miles WNW of Barnegat Light. It is approximately nine miles south of Toms River, New Jersey, 50 miles east of Philadelphia, Pennsylvania, and 60 miles south of Newark, New Jersey.

The site, in plan view, is shown in (Drawing JC-19702). Building arrangements, dimensions and elevations are shown in Section 1.2. Site grade elevation is 23' MSL (datum in Section 2.4 is MSL unless noted otherwise). The Turbine Building and Intake/Discharge Area plan view and cross section are shown in Figure 2.4-4. The Intake Structure is depicted in Figures 2.4-5 and 2.4-6.

2.4.1.2 Hydrosphere

Barnegat Bay is located along the middle New Jersey coast, extending approximately 30 miles from Point Pleasant on the north to Manahawkin Causeway on the south (Figure 2.4-1). The Bay is enclosed by a barrier beach and is a narrow, shallow tidal basin, generally typical in hydrologic characteristics of mid Atlantic estuarine bays. It is interconnected with Little Egg Harbor and Great Bay to the south, and through Barnegat Inlet to the Atlantic Ocean.

The only break in the barrier beach in this stretch is the one at Barnegat Inlet, opposite Waretown, about 20 miles south of Point Pleasant.

The barrier beach does not stop at Manahawkin Causeway but extends another nine miles south to Beach Haven Inlet. However, the basin south of Manahawkin Causeway is considered to be the northward extension of Little Egg Harbor.

The Bay is about 30 miles long; its width varies from about 1.2 to 4.6 miles with a mean width of about 2.4 miles. The average depth of the Bay is less than 5 feet with a range of less than 1 foot to 20 feet at mean low tide. Large areas of the Bay have depths of 1 foot or less; these areas are located mainly in the eastern portions. The surface area of the Bay is estimated to be over 1.8 billion square feet (16,725 hectares) and the volume is about 8.5 billion cubic feet.

The Bay receives input from freshwater creeks which border on the western shore as well as from the Atlantic Ocean via Barnegat Inlet, the Point Pleasant Canal and Manahawkin Bay (Figure 2.4-1). Freshwater runoff averages 200 cubic feet per second (CFS) from Toms River, 108 CFS from Cedar Creek and 4 and 25 CFS for the South Branch of the Forked River and the Oyster Creek, respectively.

The salinity of the bay varies from 12 parts per thousand (ppt) in the upper reaches to 32 ppt at Barnegat Inlet and lower sections of the Bay; average monthly water temperatures range from 2.8°C (37°F) in winter to 26.7°C (80°F) in summer. Due to low flow and velocity from the freshwater creeks and the limited saltwater inflow, the forces governing water circulation in the Bay are primarily winds and secondarily tidal action.

Depending on meteorological conditions, evaporation from the surface of Barnegat Bay may approach the volume of freshwater entering the Bay.

Tide Effects

Water levels in Barnegat Bay are influenced primarily by winds and tidal actions. Effluents discharged into Barnegat Bay ultimately are mixed with ocean water, with the extent of mixing dependent on the tidal forces, local winds, rainfall runoff, and temperature and salinity gradients. The barrier beach and the shallowness of the bay minimize tidal fluctuations by attenuating the tidal energy.

With the exception of those at Barnegat Inlet, tidal fluctuations in Barnegat Bay are less than 1 foot; at the mouth of Oyster Creek, the tidal range is 0.5 feet. The tidal cycle is 12.7 hr, and the tidal flow is 18,000 acre-feet.

Tide magnitude diminishes progressively north and south from Barnegat Inlet. The intertidal volume, or tidal prism, has been calculated (Reference 2) to be 790 million cubic feet, most of which enters and leaves the Bay via Barnegat Inlet. The tidal currents in the Bay thus are weak and the inflow of fresh water from coastal streams and storms further complicates the weak current system. Tidal changes during storms may be greater than 3.1 feet.

Ground Water Inflow

The surface inflow of fresh water is relatively small, about 2 percent of the intertidal volume (tidal prism) of 790 million cubic feet (Reference 3). The major source is the Toms River drainage basin. The component of ground water seepage has not been determined, but based on salinity measurements of the water in Barnegat Bay (the average salinity in the bay is about 25 ppt which is 30 percent less than normal sea water), it appears that it is a significant part of total fresh water inflow.

Ocean Water Inflow

Ocean derived saline water enters Barnegat Bay by tidal flushing through Barnegat Inlet, and the saline water disperses northward through the Bay. Salinity throughout the Bay varies seasonally, but high salinities always characterize the vicinity of the OCNGS discharge canal and Barnegat Inlet. By contrast, salinities in the vicinity of Toms River, even during low flow periods of high salinity, are near 12 to 16 parts per thousand. To the south of Barnegat Inlet the Bay is constricted by a series of islands, south of which lies Manahawkin Bay where salinities are as high as the ocean salinity. In the Bay's shallower areas, strong local heating and evaporation result in warmer temperatures and higher salinities in these areas than in the rest of the Bay during warm summer days.

Oyster Creek-Forked River

The Oyster Creek and the Forked River are contributing streams to Barnegat Bay. They are situated on the western side of the Bay between the towns of Waretown and Forked River. The Oyster Creek is the more southerly of the two (Figure 2.4-1).

The Oyster Creek has a drainage area of approximately 12.4 square miles, consisting primarily of pine barrens. The US Geological Survey flow records of 1961 - 1974 reflect a mean daily flow of approximately 28.3 CFS (11,200 gpm) near Brookville, with a maximum discharge of 122 CFS and a minimum of 12 CFS. At least 70 percent of the flow, as well as the others in the vicinity of the site, is ground water base flow derived from the water in the aquifer.

The Forked River is comprised of three branches. Of interest is the South Branch of the Forked River which joins the Middle and North branches at a point approximately 7500 feet east of Route 9. The South Branch has a drainage area of approximately 2.7 square miles, consisting primarily of pine barrens. Definitive flow records for the South Branch are not available, but a sample series between 1968 and 1973 by the US Geological Survey indicated an average discharge of 3.7 CFS (1350 gpm), with a maximum of 5.4 CFS and a minimum of 1.3 CFS.

The intake canal along the South Branch of the Forked River measures approximately 10,500 feet in length, 120 feet at the narrowest cross section, 280 feet at the widest section, and 7 to 12 feet in depth. The discharge canal measures about 11,500 feet in length, 110 feet at the narrowest width, 1000 feet at the broadest width, and 8 to 12 feet in depth.

Under present conditions, there is a tidal fluctuation of between three and six inches west of Route 9 in both the intake and discharge canals. Currents are unidirectional and may vary from less than 1 fps to almost 2 fps depending on the number of dilution pumps in operation. As a consequence, the lower regions of the South Branch of the Forked River and Oyster Creek are more closely related to Bay water. Because the Bay has an average depth of five feet and the discharge canal was dredged to an average depth of 10 feet, turbulence takes place at the canal mouth. The velocity increase produces momentum jet mixing which substantially increases mixing in the Bay.

2.4.2 Floods

2.4.2.1 Flood History

In March 1962, high tides accompanied by a storm which is considered to have been the most severe ever to strike New Jersey, left water marks which were recorded by the United States Geological Survey immediately north of the Oyster Creek site at Forked River. These water marks showed a high flood elevation of 4.5 feet.

In October 2012, a new high flood elevation was experienced due to post-tropical cyclone Sandy (Reference 15). Oyster Creek reported a peak flood/surge elevation of 7.4 feet from Sandy; there were no wind-generated wave heights recorded. The local precipitation from Hurricane Sandy did not produce major flooding (ponding of a few inches in some areas). The most intense 1-hour period during Sandy was only approximately 0.6 inch in 1 hour; total was about 4.2 inches for the whole (24-hour) day (National Weather service, River Forecast Center, Hourly Precipitation Analysis for 10/29/12). The local precipitation from Sandy was well below current licensing bases IPEEE (Ref 16), which states that the Local Intense Precipitation (LIP) value is 18.00 inches in 1 hour.

2.4.2.2 Flood Design Considerations

Hurricane storm surge analysis performed after the completion of the OCNGS has concluded that a Probable Maximum Hurricane (PMH) still water level of +22 feet MSL could occur at the site (Reference 3). During such an event, the safety related buildings and structures at the plant island remain above flood levels. However, the Circulating Water Intake Structure deck, which is at an elevation of 6 ft., will become flooded and the pumps installed on this deck will have to be shutdown, leading to the shutdown of the reactor. The impact of this flooding is discussed in Subsection 2.4.5.

The plant site is bounded on the south and north by the Oyster Creek and the South Branch of the Forked River, respectively. The catchment areas drainage characteristics are dominated by typical pine barren surface cover and a composite slope which is steep in the upper one third reach and relatively flat in the lower two thirds. The small size of the drainage area of the streams, along with the site topography, preclude the possibility of their flooding any part of the plant site during floods of 100 or even 250 year return frequency.

2.4.2.3 Effects of Local Intense Precipitation

The plant site, which is about 10 acres in area and at a grade elevation of 23 feet, is mostly covered with plant buildings, roads, and other structures. Runoff resulting from local intense precipitation partly drains off the site through the existing storm water sewers and partly drains away as overland flow towards the outer periphery of the plant site.

Topography of the plant site, as shown on the site plan presented in Figure 2.4-3, is such that the surface drainage flows from the high point in the center of the island towards the intake canal to the north and west, the discharge canal to the south and west, and Route 9 to the east.

Due to the time lag between the runoff and rainfall, some local site ponding occurs but it does not result in flooding of the site. This issue was reviewed during the Systematic Evaluation

Program (SEP) assessment; the SEP is summarized in Section 1.10. The flood elevation for the Probable Maximum Precipitation (PMP) was established at 23.5 ft. MSL.

2.4.3 Probable Maximum Flood (PMF) on Streams and Rivers

The potential for flooding due to stream flow was evaluated for the OCNGS as part of the SEP, summarized in Section 1.10. No flooding that would affect safety related structures has been postulated for the site.

2.4.4 Potential Dam Failures

Two small dams are located on the Oyster Creek. Incremental flood flows were calculated based on their breaching by any unspecified cause as part of the SEP. Refer to Section 1.10 for a summary of this program. No flooding which would affect safety related structures is postulated for the site.

2.4.5 Probable Maximum Flood From Hurricanes (PMH)

Due to the proximity of the site to Barnegat Bay and the Atlantic Coast, and the relatively small size of the onsite freshwater streams, it was noted in the design stage that storm and tidal flooding should be used as the design basis in establishing the elevations of various plant components.

Several detailed studies of flooding potential due to probable maximum surges and wind wave action have been performed. The two more important were conducted by Eaton and Haeussner, Consulting Engineers, and Dames and Moore Inc. (References 1 and 3). Results of the Dames and Moore report are summarized in Subsections 2.4.5.1 through 2.4.5.4.

2.4.5.1 Maximum Water Levels - General

Water levels in Barnegat Bay and at the plant site are influenced solely by storm and tidal action. There is no significant stream flow in either the Oyster Creek or the Forked River. Floods or droughts in these streams will not have a measurable effect on the water levels at the plant.

Extreme high water levels are based on the Probable Maximum Hurricane tide condition. This was established by maximizing the combination of estimated worst possible conditions influencing storm and tide heights. These conditions are as follows for the OCNGS site:

a. Rate of forward movement: A forward translational speed of 12 and 23 knots. Stopping (hovering) the storm resulted in lower flooding values.

    b. Direction of storm: Selected so that the wind direction of the maximum isovel would be oriented normal to shore and the offshore depth contours in order to produce:

        1. Greatest possible erosion on the barrier beach separating Barnegat Bay from the Atlantic Ocean.

        2. Greatest possible pile up of water in Barnegat Bay,along the mainland shore, due to wind stress acting on the free water surface.

c. Central barometric pressure, which fixes the wind intensity: Estimated to have an extreme low value of 27.1 inches Hg. This low pressure results in a maximum wind speed of 133 mph occurring 39 nautical miles from the center of the storm.

d. A bottom friction factor of 0.008.

e. An initial rise in water level of 1.1 feet.

f. An astronomical high spring tide of 4.2 feet above Mean Low Water (MLW), or 2.7 ft MSL.

2.4.5.2 Maximum Tide and Storm Height at the Ocean Shore of Barnegat Inlet

Based on the applicable factors presented in Subsection 2.4.5.1, the Probable Maximum Hurricane water level was calculated to be 22.0 feet MSL.

2.4.5.3 Maximum Tide and Storm Height at the West Shore of Barnegat Bay

The Probable Maximum Hurricane water level at the entrance to Forked River will be 22.0 feet MSL including effects of wind and wave runup.

2.4.5.4 Maximum Tide and Storm Height at the Plant Site

The Probable Maximum Hurricane still water level at the plant site was calculated to be 22.0 feet MSL. An additional height of less than 1.0 feet represents the maximum wave runup at the plant site.

2.4.5.5 Maximum Water Levels for One-in-250-Year Storm

Maximum high water elevation has been determined by consultants Eaton and Haeussner (Reference 1) to be 5.3 feet MSL both in Barnegat Bay and at the makeup water pump structure, based on a one-in-250-year high tide. The maximum recorded high tide along the Barnegat Bay beachfront is approximately 7 feet MSL, which occurred during the March 1962 storm.

2.4.6 Probable Maximum Tsunami

Tsunami events are not typical of the eastern coast of the United States and have not, therefore, been addressed.

2.4.7 Icing Effects

Icing effects have been considered during the SEP assessment. During normal plant operation, icing has been limited to the canal area outside of the steel trash grates. The area in close proximity to the intake, where the suction of the pumps is taken, is kept from freezing by the thermal dilution gates, which recirculate discharge water through the intake bay, and by the turbulence induced by the circulating water pumps. The discharge canal remains free of ice during normal operation due to the plant heated effluent.

It is unlikely that ice blockage would cause problems to any safety related systems as the emergency service water flow utilizes approximately only 3 percent of the design capacity of the 6 screens on the intake structure.

2.4.8 Flooding Protection Requirements

The plant site has a general grade elevation of 23 ft MSL as shown in Figure 2.4-3. The land slopes down gradually towards the north, south, and east.

On the west, the grade meets the top of the intake and discharge canals at an elevation of 23 ft and then drops sharply into the canal bottom elevation of (-)10 ft MSL. The slope at the canal bank is 1:1-1/2. The capability of the plant to cope with the design basis flooding has been reviewed as part of the SEP, which is discussed in Section 1.10.

As reported in Subsection 2.4.5, the maximum flood level due to PMH will be at elevation 22 ft MSL. The plant grade, elevation 23 ft MSL, is one foot above the PMH flood level. Therefore, the flood will not find its way into the plant buildings, the floor levels of which are generally six inches above grade at elevation 23'-6". The circulating water intake structure with its deck at elevation 6 ft will be under water. This deck supports, apart from the other equipment, the circulating water pumps and the emergency service water pumps. During a PMH flood, the circulating water and service water pumps will become inoperable and thus emergency plant procedures have been instituted which require the plant to be shutdown when flood waters reach a predetermined level as to ensure the capability for safe shutdown under either normal or abnormal conditions.

The two entrances to the emergency diesel generator building are at elevation 23 ft. MSL, which is 6 inches below the flooding level which would be caused by local Probable Maximum Precipitation (PMP) at elevation 23.5 ft. MSL (Reference 17). A 6 inch high asphalt dike is provided at these entrances to mitigate the entry of surface water into the emergency diesel generator building during a PMP. Flowing water will still have the ability to impinge the dikes and some overflow of water into the EDG is expected. In this case, the building is designed with an internal drain system to port water into the discharge canal.

2.4.9 Low Water Considerations

2.4.9.1 Low Water Levels - Tides and Storm Waters

The extreme low tide elevation to be expected on the west shore of Barnegat Bay was calculated to be (-)3.4 feet MSL (Reference 3). With water levels in the Bay this low, the intake canal would be unable to fully support the flow requirements of the plant (Reference 10). Plant operating procedures have been instituted which require the plant to be shut down when intake water levels decline to a predetermined level as to ensure the capability for safe shutdown under either normal or abnormal conditions.

2.4.9.2 Historical Low Water Elevation

On December 4-5, 1980, the water level in the intake canal dropped to a point where the screen wash pumps lost suction. The screen wash pumps were restored by turning off the station's dilution pumps. It was found that this unusual event was due to an extreme low water level at the intake of approximately (-)2.0 feet MSL, which corresponded to a water level of (-)0.7 feet

MSL on the west shore of the Bay. The probable cause was strong and persistent westerly winds which occurred for several days prior to the incident (Reference 10).

GPU has committed to the New Jersey Board of Public Utilities to maintain navigability in these waterways. Portions of both the Oyster Creek and the main branch of the Forked River are dredged periodically for this purpose.

Shoaling problems in both waterways have not been severe and dredging is mostly confined to the lagoons and the access channels from the lagoon mouths to the center of the main channel. Soundings to define the intake and discharge canal bathymetry are performed, east of U. S. Route 9 to Barnegat Bay.

2.4.9.3 Low Water Levels-Failure of Structures

The potential for low water levels at the intake structure for the OCNGS as a result of failure of structures (such as bridges) crossing the canal has been investigated as discussed below.

Bridge Failure

The intake canal for the plant was originally designed to serve as an intake waterway for as many as four nuclear generating stations. The design capacity of 1,260,000 gallons per minute (gpm) is attained at a very low velocity (2.25 feet per second).

The requirement for postaccident cooling water for OCNGS is 14,000 gpm. This amounts to 1.1 percent of the capacity of the canal. If however, a partial blockage should occur, as the water in the forebay drops, the velocity past the blockage will pick up. Therefore, some lesser percentage of the total canal area could supply the cooling water requirement.

Collapse mechanisms, due to a seismic event, of the three bridges which cross the intake were investigated in order to determine the potential effects on the supply of cooling water for emergency shutdown.

The continuous flow of water which is required for the emergency shutdown of the OCNGS is 14,000 gpm. Under the most critical situation resulting from the analysis of all postulated bridge collapse mechanisms which were investigated, the least available flow in the intake canal was found to be 304,000 gpm, at a Mean Low Water elevation of (-)1.3 feet, with a maximum velocity of 3 feet per second. The most critical situation analyzed resulted from the complete collapse of the Route 9 Bridge.

The three bridge crossings over the intake canal are all supported on timber piles. The Railroad Bridge has an extremely low profile; should the collapsed structure remain entirely below the free water level, there would still be sufficient sectional canal area remaining to allow a flow of 570,000 gpm. The postulated collapse mechanism for the Railroad Bridge was extremely conservative as it neglects the bouyant nature of the component materials. Should a more realistic collapse mechanism be postulated for this bridge, it would certainly result in an even larger available flow.

The three bridges are all of articulated construction being of precast, prestressed elements or of timbers; it would be reasonable to assume that severe collapse mechanisms would result in the breaking up of the bridge into smaller units such as timber and precast concrete sections. The smaller sections would thus produce a smaller final blockage than those analyzed.

As discussed above, complete blockage of the canal is not possible; however, postulating such an occurrence at the western most bridge, sufficient water would be available in the resulting "pond" to operate the shutdown pumps for a period of time in excess of twelve hours. This time appears reasonable to clear the blockage, at least to an extent sufficient to permit the required flow to operate the service water pumps, or to open the gates in the berm between the intake and discharge canals, permitting alternate intake from the Oyster Creek discharge canal.

<u>Embankment Failure</u>

The following failure modes that could contribute to blockage of the canal by bank slides were examined (Reference 1):

a. Earthquake induced slope failures

b. Mass earth slides due to soil liquefaction below the water table

For these analyses, the canal was divided into three sections:

a. Section 1: from Route 9 west to a point approximately 700 feet north of the intake structure. In this section the canal was dredged to elevation (-)10 ft and the adjacent banks vary between approximately elevation 23 and 9 ft.

b. Section 2: from Route 9 east to the Beach Boulevard Bridge. In this section the canal was dredged to elevation (-)6 ft and adjacent banks are at about elevation 6 ft.

c. Section 3: from the Beach Boulevard Bridge east to Barnegat Bay. In this section the canal was dredged to between elevations (-)7 ft and (-)10 ft for a distance of some 500 feet. From that point on, the combined streams (Middle and South Branches of Forked River) maintain an adequate channel.

Insofar as bank slides are concerned, Section 1 (from Route 9 west approaching the intake structure) is the most critical.

The canal banks are dredged to a slope of 1 on 1. These slopes have exhibited no lack of stability. There has been erosion and ravelling along the banks due to surface water runoff and the difficulty of establishing vegetation cover. However, there was no evidence of shear failures along the banks even where they have been over steepened. Nevertheless, since the original evaluation was performed, additional canal stabilization measures have been undertaken, thus precluding the possibility of bank slides.

Under earthquake forces, and prior to bank stabilization, some flattening of the slopes could have been expected. Analysis indicates that under earthquake conditions slopes at 1 on 3 exhibit factors of safety above unity.

Through most of the area the "upper clay" occurs near the base of the slope. Locally, this clay, which outcrops to the northwest, is absent. Therefore, evaluations were made for sections with the clay seam both present and absent.

A study of earthquake induced slope failure (prior to stabilization) in the canal bank of the more critical section is shown on Figure 2.4-7. This figure shows the condition in which the clay seam is absent. A quasi static analysis was made assuming a sliding wedge driven by its own weight plus a 22 percent horizontal acceleration. The results are summarized below:

a. It is assumed that all soil above the failure plane moves into the canal and comes to rest below the water level. Under this most conservative assumption, using a factor of safety greater than 1 on the failure wedge, over 56 percent of the canal remains unblocked.

b. An examination of more probable failure modes, i.e., modes involving movements of a few feet on the failure plane, indicates that the resulting canal blockage would be insignificant.

Another earthquake induced slope failure study was made within the most critical part of the canal (Section 1). This was concerned with slopes in which clay seams are present. The assumed failure mode was sliding along a circular arc. A quasi static analysis was again made assuming that the soil mass was being driven by its own weight plus a 22 percent horizontal acceleration. The results are summarized below.

a. Using a factor of safety greater than 2 on the failure wedge, and the conservative assumption that all the soil above the failure plane came to rest below water level, over 81 percent of the canal remained unblocked.

b. Examination of a more probable failure mode, i.e., modes involving movements of a few feet, indicated that the resulting canal blockage would be insignificant.

The potential for soil liquefaction in the intake canal was investigated by Dr. Arthur Casagrande of Casagrande Consultants (Reference 4). Ten exploratory trenches which extended from the top of the slope down to the water surface were excavated in the canal banks.

Penetration tests in sand were made by means of a core penetrometer; a pocket penetrometer was used to measure the insitu strength of typical clay. The tests were supplemented with visual inspection within the trenches and comparison of observations and tests to standard penetration borings previously made in the area.

The consultants found that the sand overlying the clay or peat layers along the canal banks is dense to very dense, with the exception of a surface layer not exceeding three feet in thickness. This surface layer was described as between medium loose to medium dense.

The consultants concluded that there is no possibility that the banks could experience liquefication slides. The worst that could happen during a severe earthquake, they explained, would be slumping of oversteep slopes. Most of the slumped material would collect on the flat beachlike berm which has formed within the range of normal tidal fluctuations. The volume of material that might move into the canal prism below elevation 0 ft., they continued, would be of no consequence.

<u>Combination of Natural Phenomena</u>

The intake canal banks were analyzed under the following combination of natural phenomena: PMH, the resulting high water; and an earthquake having a horizontal acceleration of 0.11g (Reference 1).

It is not expected that the hurricane itself will have any appreciable effect on the canal banks. Using time/water level relationships (Reference 3), the following conclusions were drawn:

a. The rise in water will, in itself, have a stabilizing effect on the canal banks.

b. Wave action will be minor in the critical areas of the canal, west of Route 9. The substructures of the highway and railroad bridges near Route 9 will cause any significant waves to dissipate and lose form.

c. Wave action on a sand bank, as along a sea shore, erodes by undermining small slip surfaces over long periods of time. Within the short time span postulated, about symmetrical tide cycle, the volume of eroded material will be very small.

The maximum flood water will tend to saturate the canal banks, laterally during the rise cycle and vertically during the period when flooding overtops the banks. The results of this occurrence have been examined (Reference 1). The findings are summarized as follows:

a. Transient water levels resulting from wave action will not affect the infiltration rate.

b. The rapid infiltration will result in less than full saturation. Some 20% of the voids will be filled with entrapped air.

c. Within the time span of the PMH, the banks will not be partially saturated to their full extent. During the drawdown cycle drainage will be bidirectional; i.e., toward the canal and into the unsaturated zone inland of the canal simultaneously.

d. Assuming the worst possible failure mode, the analysis indicated that the drawdown of the intake canal could block no more than 25% percent of the total canal flow volume.

The examination of the canal banks assuming full saturation and an 0.11 g earthquake reveals the following:

a. The smaller earthquake acting on saturated soils will produce slump zones no greater than the earthquake used in our previous analysis acting on drained soils.

b. The evaluation of the liquefaction potential of the soils in the canal bank considered insitu soil properties only. The analysis is independent of the size of the earthquake or the degree of saturation. Therefore, the occurrence of an earthquake contemporaneously with the hurricane and flood does not alter the conclusions with respect to the safety of the banks with respect to liquefaction.

In considering the effects of combined phenomena on the stability of earth banks it should be recognized that any adjustments in bank configuration are in the direction of increasing stability. Therefore, the effects are not additive. At some point the bank configuration attains a degree of stability that permits it to withstand additional disruptive forces without further alteration.

Miscellaneous Causes

Seaweed has clogged the intake trash racks and screens in the past and has caused plant shutdown. Tripping of the circulating water pumps immediately relieves the flow restriction problem through the screens and provides sufficient relief to permit the small flow of the service water pumps to pass. In recent years a floating boom across the canal has reduced the seaweed loading to such an extent that it can be managed without cutting off the circulating water pumps. With the circulating water pumps shut down, the rate of seaweed accumulation is very slow and can be easily managed by operation of the trash rake and the traveling screens.

Silt

Modest silt accumulation has been experienced within the pump bays, especially when some circulating water pumps are idle. The accumulation results from settling out sediment in water eddies. This poses no threat to the operation of any of the pumps. Accumulation of silt in front of the intake screens is pumped out as necessary.

2.4.10 Dispersion, Dilution, and Travel Times of Accidental Releases of Liquid Effluents in Surface Waters

In 1963 and 1964, Dr. James H. Carpenter conducted tracer experiments in Barnegat Bay and also studied recirculation and effluent distribution for the OCNGS site (References 2, 5). In 1979, GPUN conducted a hydrographic survey of Barnegat Bay (Reference 6).

Results of the first studies showed that a mean density gradient existed across the Bay, west to east. This gradient, in combination with Coriolis forces and hydraulic head associated with runoff accumulation in basins to the north, produce a current to the south. In southern areas, a combination of southerly winds and runoff flowing north produced a well flushed area.

Rates of horizontal turbulent diffusion in the Bay were estimated and found to be much slower than rates which have been observed in deeper waters.

Dr. Carpenter described the general distribution of material flushed from Oyster Creek, as follows:

> "Materials discharged near Oyster Creek drift to the south into an area off the Barnegat inlet channel which is rapidly flushed by tidal action. The northward drift of waters in the southern portion of the Bay under the influence of the prevailing winds minimizes the accumulation of material in the southern portion of the Bay. The low rate of turbulent diffusion in the shallow waters of the Bay permits the circulation pattern to efficiently transport the material to the ocean." (Reference 2)

The report concluded that factors influencing the distribution will change with season (other than August) to produce more rapid dispersion of material and increase the rate of exchange of Bay waters with the ocean.

From results of the studies, a recirculation analysis was performed based on tracer results. It was found that the increased concentration in the discharge canal due to recirculation is estimated to be 1.8 times the steady state single pass concentration.

The GPUN study (Reference 6) complimented those of Carpenter. This later study concluded that the northernmost sections of the Bay, near Toms River and above have limited tidal flushing. The dividing line between that area which is dominated by the tidal flushing of Barnegat Inlet and that area which is dominated by Manasquan Inlet is between the outlets to Kettle Creek and Toms River.

The area of the Bay within two to three miles of Barnegat Inlet is a maze of shoals and islands which delays and suppresses tidal flushing through the Inlet, but flows do occur under the influence of pressure head created by meteorological and tidal forces.

The portion of the Bay south of Barnegat Inlet is more conducive to tidal flushing. Despite heavy shoaling around the Inlet and eelgrass in the southern end of the Bay, the close proximity of Barnegat Inlet and the tidal exchanges through Beach Haven Inlet allows for better tidal flushing than the northern half of the Bay.

Dispersion of the discharge plume of OCNGS was mathematically modeled (Reference 7). This study considered dye studies performed by Carpenter in 1963 and 1964 (References 2 and 5) and several other thermal plume studies conducted subsequently. The study showed that the wind induced, vertically averaged net flow in the Bay was 1.85 percent of the prevailing wind speed. Longitudinal and lateral dispersion coefficients were verified against dye distribution (Reference 5). Using this method it was concluded that:

a. In the upper Bay north of Oyster Creek, the longitudinal dispersion coefficients have a constant value of 2.0 square miles per day.

b. In the lower Bay from Oyster Creek to Manahawkin Bay, the longitudinal dispersion coefficients gradually increase from 2.0 to 3.5 square miles per day.

c. Lateral dispersion coefficients of 0.1 square miles per day can be used in Barnegat Bay.

d. Longitudinal dispersion coefficients in Oyster Creek channel and Double Creek channel varied from 3 square miles per day at the Bay end to 25 square miles per day at the junction of Barnegat Inlet with the ocean.

2.4.11 Ground Water

Numerous geological and ground water related studies have been conducted on or near the OCNGS. These studies included the collection and evaluation of site-specific hydrogeologic data and the installation of a groundwater monitoring system on site (Reference 9).

2.4.11.1 Regional Hydrogeology

The regional stratigraphy includes beds of sand, gravel, clay, and marl dipping gently to the southeast. These tertiary coastal plain deposits are overlain by more recent sands and gravels. Of direct interest in the Oyster Creek region are three stratigraphic units: the Cape May

(Pleistocene), Cohansey (Miocene), and Kirkwood (Miocene) Formations. Figure 2.4-10 is based on average depths from a number of boring logs in the site area and shows generalized boundaries of these geologic formations at the OCNGS site.

> Cape May Formation - This is the youngest formation in the Oyster Creek region. Its average thickness is 40 feet and it is comprised of a light gray to tan, medium to fine sand, trace silt, coarse sand. It is poorly compacted and commonly contains a thin, shallow black clay bed in coastal areas.
>
> Cohansey Formation - The Cohansey lies beneath the Cape May Formation. Its average thickness is 60 feet and it is primarily composed of a red-brown and tan, medium to fine sand, trace silt, coarse sand, and some coarse to fine gravel. Lenticular beds of clay are sometimes found and the lower portions are densely compacted.
>
> Kirkwood Formation - Lying below the Cohansey is the Kirkwood consisting of a light gray to yellow-brown micaceous ilmenitic, lignitic very fine to fine grained quartz sand, and some coarse to fine gravel. It is densely compacted and extends from a depth of about 100 feet to at least 250 feet below the surface.

A plan view of geologic formations in the area is shown in Figure 2.4-8. The strike of the bedding of the formations is generally in a northeast direction with a dip to the southeast. Water levels of the various formations are shown in Figure 2.4-9.

Another aquifer that exists in the area is the Raritan - Magothy which occurs at depths of about 1800 feet near the site. Due to the greater depths of this aquifer and the possibility that it is within the zone of salt water intrusion, it is not widely used in this area.

Regional Ground Water Replenishment

The unconfined Recent and Cape May Formations are replenished directly by precipitation. The topography and the porous nature of the sediments exposed in the area are such that most of the precipitation infiltrates into the ground water body with relatively small amounts of surface runoff. Part of the water that sinks into the ground is discharged by evapotranspiration to the atmosphere. Most of the remainder percolates down to the water table and moves in the general direction of the slope of the land surface - from the higher ground in the west toward Barnegat Bay. The upper ground water body intersects the eastward flowing streams in the area (including Oyster Creek and Forked River) and is the source of base flow of these streams. In addition, the unconfined aquifer is in contact with, and discharges directly into Barnegat Bay. Approximately one half of the average annual precipitation (42 inches) is surface stream flow, and the remainder is evapotranspiration, recharge to deeper aquifers and direct discharge to the Bay.

The outcrop areas of the confined aquifers (Lower Cape May Formation, Cohansey Sand and Kirkwood Formations) are generally to the west of the site at higher elevations (Figures 2.4-8 and 2.4-10). The recharge to the confined aquifers occurs primarily from direct rainfall penetration on the outcrops, and from vertical leakage downward from the unconfined aquifer through the confining layers (aquitards) of silt and clay. Recharge of the confined aquifers from areas of higher elevation to the west has resulted in artesian pressures sufficient to cause the water in wells penetrating the aquifers to rise above the elevation at which the aquifers are encountered.

Information on piezometric surfaces of the different aquifer zones at the site was obtained from test borings for foundation investigation and from the deep well used for water supply at the plant. The observed piezometric surfaces for the various pressure aquifers are shown in Table 2.4-1.

Based on test drilling performed at the Oyster Creek, Forked River and other sites in the area, it appears that the clay-silt layers that act as confining layers between the upper aquifers are extensive lenses rather than continuous layers. Thus, at some locations where pumping tests were made in various aquifers there was no apparent hydraulic connection between upper unconfined and upper artesian aquifers, but at other locations there were indications of some degree of hydraulic connection.

Regional Sources of Well Water

Most water supplies in the area surrounding the site are derived from wells (Reference 8). The wells are reported to range in depth from 34 feet to 350 feet and are used for municipal, industrial, irrigation and domestic purposes. In the past, many wells less than 30 feet deep were used for domestic and irrigation purposes but, due to water quality problems caused by septic tank contamination, the water became unfit for use as a potable water supply. In some cases it was possible to obtain water of satisfactory quality by deepening the wells to about 60 feet in order to tap aquifers of better quality underlying impermeable confining layers.

It is estimated that one million gallons per day (MGD) per square mile is potentially available from the ground water aquifers in the region. Although this amount of water could probably be obtained from the aquifers in the site area under present geohydrologic conditions, it should be revised downward (to about one half MGD per square mile) for a more conservative estimate of long term yield. This conservative estimate depends in part on the proximity of the salt water canals which could be a potential source of salt water intrusion, but principally on the anticipated future public pumpage of ground water from the area which will cause a significant decrease in head on the aquifers.

The locations of some of the wells being used within a radius of about five miles of the site are shown on Figure 2.4-11 and listed in Table 2.4-2. The quantity of water being used in Ocean and Lacey Township is about 2.25 million gallons/day. A conservative estimate of the potential for ground water development for aquifers in this 80 square mile area would be on the order of 40 million gallons per day (using the factor of one half million gallons of ground water potential per square mile).

Quality of Ground Water

As water flows across and under the ground, quantities of mineral matter are dissolved. The amount and nature of the material dissolved are directly related to:

a. Initial character of the water

b. Length of time the water is in contact with the sediments

c. Solubility of the materials composing the sediments

The temperature of ground water below a depth of about ten feet is equal approximately to the mean annual air temperature, which is about 56°F. There is a normal increase in temperature with depth of about 2°F for each 100 feet of depth.

The wells being used at the OCNGS obtain water from the Kirkwood Formation. The typical characteristics of water from these wells are shown on Table 2.4-3.

The base flow of streams in the area is from effluent ground water seepage, mostly from the uppermost unconfined aquifer, and it can be expected that the water quality characteristics of the streams would most closely resemble the quality characteristics of this aquifer.

2.4.11.2 Site Specific Hydrogeology

During construction of the OCNGS much of the site was excavated and the ground surface recontoured. Installation of foundations for the Reactor Building and Turbine Building required excavations of 40 feet and the water intake and discharge canals required excavations of 30 feet. These, as well as other excavations at the plant, have profoundly affected the ground water flow regime at the site.

The principal cause for these ground water alterations has been the removal of sections of the upper clay layer and overlying strata resulting in altered gradients around the deeper foundations and a decrease in water table levels across the site.

The high potentiometric elevations observed in the Kirkwood wells (as high as elevation 22 feet), along with the presence of sandy seams and lenses suggests the presence of an upward gradient between the Kirkwood to the Cohansey and the potential for leakage between the two formations.

Effects of Construction on Ground Water Conditions

Some mixing of waters between the Cohansey and Cape May aquifers may occur due to penetration of the upper clay by foundations. Such penetration of clay layers is a common occurrence when constructing deep foundations. Where deep foundations penetrate the upper clay, waters from the Cohansey aquifer and the Cape May water table, once isolated from each other by the clay, now are connected through pervious fill surrounding the foundations. Because the present potentiometric head of the Cohansey aquifer is generally lower than the level of the water table in the vicinity of deeper building foundations, there should be a downward flow of water from the water table aquifer to the underlying Cohansey aquifer. This gradient will vary as the potentiometric levels in the aquifer and the water table fluctuate. If the water table should fall below the level of the potentiometric head of the underlying aquifer, flow direction would reverse.

Water levels dropped as a result of construction of water canals for the power plant. These canals, which surround the site in a U, are in trenches cut through topography ranging from elevation 10 to elevation 20 feet. Water level in the canals is roughly at sea level and the canal bottom lies at about (-)10 feet. Here, again, the upper clay layer was breached. Since the water table at the banks of the canal can be assumed to be at sea level, and since it lies above sea level elsewhere across the site, a water table gradient exists on either side of the canal. As a result, the surrounding site area was dewatered after construction and present ground water levels are lower. Before construction, the water level averaged less than six feet below the

surface, at about elevation 20 feet; currently, water table levels average 12 feet below the surface at about elevation 12 feet.

The Flow Regime

Direction of flow in the water table aquifer is governed by differences in hydrostatic head which results in gradients. These gradients can be visualized on a contour map of the hydrostatic head of the body of water, in this case the unconfined water table aquifer of the Cape May Formation. The contours connect points of equal hydrostatic levels. The map is interpreted much like a topographic map, i.e., water flows down hill. On a hydrostatic head map the "hills" are water levels in the subsurface, and the slopes of these hills are the ground water gradients. An important consideration with such maps is the time elapsed between measurements of each data point. Unless measurements at all data points are made at the same time, the map of the water levels will only approximate the actual conditions because water table levels fluctuate day to day.

Figures 2.4-12A and 2.4-12B show the inferred water level contours and flow lines in the Cape May and Cohansey formations based on water level data obtained in December 1983. The contours, gradients and flow lines can be expected to locally shift somewhat in response to precipitation and future construction activities. However, the overall pattern would not be expected to change appreciably.

The water surface in the canals themselves remains at or near sea level. The canal trenches drain ground water from the surrounding upper aquifers. They act as discharge points and barriers to ground water flow across the site. The canals, therefore, are the largest single factor controlling local ground water conditions on the site.

The general flow direction of ground water is from the higher area of the plant itself toward the canal. As shown in Figure 2.4-12A, the pierced upper clay layer in the vicinity of the Turbine and Reactor Buildings has distorted the ground water flow paths. The water level where the clay has been pierced (W-8) is considerably lower than the surrounding water levels when the clay layer is intact (W-7, 9, 15, 12, & 5) and more closely approximates hydraulic head levels in the Cohansey wells near the Turbine and Reactor Buildings. The ground water gradients in the upper Cape May formation are locally in the direction of the Turbine Building.

The ground water flow in the Cohansey formation is also controlled by the canals on the site as evidenced by the direction of ground water flow near wells W-2, -3, & -6. Review of construction drawings indicate that the canal excavation has pierced the upper layer at least at some points. However, as the distance from the canal increases, the generally easterly regional gradient begins to deflect the flow paths away from the canal.

Ground Water Flow Rates

Sodium chloride (NaCl) trace tests were conducted in four closely spaced, shallow (20 foot) test wells in October and December 1976. The tests provide data for computing ground water flow rates in the unconfined Cape May aquifer under natural as well as pumping conditions (Reference 9).

<u>Ground Water Velocity</u>

Flow velocities in ground water may be estimated using the seepage velocity equation:

V = KI/n, where
V = Velocity in ft/day
K = Hydraulic Conductivity in ft/day
I = Hydraulic Gradient
n = Porosity of Soil Material

Assuming:

K = 2.0×10^{-4} ft/sec for Cape May formation
= 2.7×10^{-4} ft/sec for Cohansey formation
I = .02 ft/ft for Cape May formation
= .01 ft/ft for Cohansey formation
n = 25% for both formations

the computed mean velocity is 1.4 and 0.9 ft/day for the Cape May and Cohansey formations respectively. The 1.4 ft/day compares favorably with the 2.6 ft/day computed in a 1977 study of dispersion, dilution and travel time for a hypothetical radionuclides spill performed at the Oyster Creek Site (Reference 9).

<u>Hydraulic Conductivity</u>

During the course of a tracer test conducted in 1976 water levels were also monitored in the four test wells. Standard analyses of the water level decline and recovery data allowed estimates to be made of the aquifer transmissivity, which is given as the product of the hydraulic conductivity and the saturated thickness. The resultant average transmissivity was approximately 6000 gpd/foot, with a saturated aquifer thickness of 12 feet, giving a hydraulic conductivity of 500 gpd/foot^2 or 66.8 feet/day.

The pump and tracer test sites were located 1250 feet from the nearest point of the OCNGS discharge canal. The ground water level was approximately at elevation 12 feet based on a land surface elevation of 21 feet. The average ground water gradient, between the test site and the canal was, therefore, 12/1250 = 0.0096. According to Darcy's Law the specific discharge between the test site and the canal, under natural flow conditions, is given as the product of the hydraulic conductivity and the ground water gradient. Assuming a porosity of 25 percent, this results in an estimated flow velocity of 2.56 feet/day.

A 1977 pump test performed on the Kirkwood aquifer at the Forked River site indicated an average transmissivity of 60,000 gpd/foot and a storage coefficient on the order of 10^{-4}. A storage coefficient in this range is typical for an aquifer that is confined. Using a saturated thickness of 250 feet the hydraulic conductivity of the Kirkwood is 240 gpd/ft^2 or 32 feet/day.

The ground water gradient in the Kirkwood at the OCNGS (calculated from water levels in salt water intrusion wells) is 0.00033. Again applying Darcy's Law, the specific discharge is 0.011 feet/day. Using an assumed porosity of 20 percent this results in a flow velocity of 0.055 feet/day.

<u>Dispersion Coefficient</u>

The physical process of contaminant dispersion in ground water can be modeled mathematically. A key parameter for modeling the amount of dispersion is the dispersion coefficient. Dispersion coefficients for near surface conditions were calculated based on data obtained from the field tracer test. The longitudinal and transverse coefficients are 0.235 feet and 0.0211 feet respectively. Using the natural flow velocity of 2.86 feet/day the calculated dispersion coefficients are 0.672 ft^2/day and 0.0603 ft^2/day.

2.4.11.3 <u>Dispersion, Dilution and Travel Time for Hypothetical Radionuclides Spill</u>

An analysis of dispersion, dilution and travel time for a hypothetical radionuclides spill has been performed (Reference 9). The analysis was carried out using analytical methods which were verified by use of a field testing program using a tracer substance. Results of the analysis were reported as relative to a nonspecific initial concentration. The results of the analysis could be applied, therefore, to any desired concentration of radionuclide.

It was hypothesized that liquid radwaste, stored in a 30,000 gallon nonseismic category I tank, is accidentally released instantaneously at the land surface. Radionuclides could enter the hydrologic environment by infiltration into the local aquifer or by overland runoff into the discharge canal.

This evaluation used representative conservative pathways; the calculated factors and parameters which determine the concentration distributions of the released radwaste were chosen to yield maximum concentrations. Thus, it was assumed that the released liquid in its entirety will reach either the surface water or ground water. To be conservative, losses of radionuclides due to evaporation or adsorption by clay materials were not considered in the computations. Travel distances were minimized and the migration velocities maximized.

Although concentration distributions can be generated at any time or distance along the liquid radwaste hydrologic pathway, the locations shown in Figure 2.4-13 were chosen for presentation and analysis. These points represent:

a. <u>Ground water</u>

   1. Nearest point of seepage into discharge canal, representing the worst case for seepage into surface waters.

b. <u>Surface Water</u>

   1. Nearest point of surface entry into discharge canal, representing the worst case for surface runoff to surface waters.

   2. The discharge canal at the Route 9 crossing, representing the point at which discharge waters leave the OCNGS site.

   3. The discharge canal at the former marinas, representing a near point of concentrated human activity.

Based on the results of the field testing program, the analysis was carried out by determining concentration distributions and peak concentrations (normalized as percentages of initial

concentrations) for a mixture of radionuclides representative of typical liquid radwaste and for selected individual radionuclides at the locations of interest as a function of time.

Ground Water Results

As a result of a hypothetical spill of liquid containing radionuclides at the OCNGS Radwaste Building, any liquid wastes which might enter the shallow Cape May ground water aquifer would be transported down gradient to the OCNGS discharge canal within about 245 days.

Maximum relative radionuclide concentrations at the point of entry into the discharge canal are expected to range from 0.25 to 0.493 for the nine longest lived isotopes (Cs-137, Sr-90, Co-60, Cs-134, Ru-106, Mn-54, Ce-144, Ag-110m, and Zn-65).

This analysis did not include the retardation of radionuclides motion in groundwater flow due to ion exchange effects. This phenomenon would result in lower predicated concentrations at the point of entry into the discharge canal since the effective radionuclide velocity will be lower and, thus, the travel time will be longer and additional radioactive decay will occur.

Concentrations of radionuclides will be further reduced once the groundwater has entered the discharge canal. The effects of dispersion in the OCNGS discharge canal were considered and a summary of results is presented below.

Surface Water Results

The maximum relative concentration of a single radionuclide is expected to be less than 0.001 at the Route 9 bridge, and less than 0.0005 within the marina area downstream. Under normal and dilution flow conditions in the canal, dispersion is much more significant than radioactive decay in reducing radionuclide concentrations, so that all the radionuclides considered exhibit relative concentrations of the same order of magnitude.

Under shutdown flow conditions, the travel time within the OCNGS discharge canal is long enough that radioactive decay becomes significant, so that the shorter lived radionuclides exhibit peak concentrations as much as four to five orders of magnitude less than the longest-lived radionuclides.

2.4.11.4 Ground Water Monitoring

A ground water monitoring network for the OCNGS has been installed (Reference 9, 12 and 13). The system design (number, location and depth of wells) was based on the following criteria: 1) potential spill locations, 2) site stratigraphy, and 3) probable ground water flow directions. Pertinent soil and water tests were performed to obtain the necessary data to define the hydrogeologic model. Also considered in the final design was subsurface obstructions, vehicular accessibility, and recent site development activity (i.e., paving of the Radiologically Controlled Area).

The initial ground water monitoring system consisted of 16 wells; Figure 2.4-14 shows their locations. Numerical identification of wells was established during the preliminary investigation stage and remains unchanged; this accounts for the inconsistency in the numbering of the final installations. Of the 16 wells initially installed, 8 are shallow wells which serve to sample water from the Cape May formation (see Subsection 2.4.11.1); 7 are intermediate depth wells

designed to sample water from the Cohansey formation; and one deep well extends down to the Kirkwood formation. Table 2.4-4 provides the completion depths and elevations of each of the 16 wells that comprised the initial groundwater monitoring system. The initial monitoring system also included lysimeters, whose purpose was to provide early detection of contaminent transport before it reaches the ground water table. The lysimeters were installed adjacent to the Condensate Storage Tank, Torus Water Storage Tank and Offgas Building at depths of 5 to 7 feet below the ground surface. Most of these lysimeters were subsequently removed because they were found to be ineffective sampling devices or they were displaced as a result of construction activity.

The extent of the ground water monitoring capabilities at the OCNGS increased substantially during the years following the installation of the above-described initial monitoring network. Numerous additional monitoring wells were installed, primarily as part of an investigation of a leak from an underground diesel fuel pipeline (Reference 11), the Site Investigation-Remedial Investigation conducted in support of the sale of the OCNGS in 2000 (Reference 12), and the Site Investigation associated with tritium leaks in 2009 (Reference 14). As a result of these investigations, there are more than 100 monitoring wells located on the OCNGS site and adjacent properties. These wells were utilized to conduct hydrogeologic investigations of the site in 2006, as part of an Exelon fleet-wide program to determine whether groundwater at and in the vicinity of its nuclear power generating facilities had been adversely impacted by any releases of radionuclides (Reference 13) and in 2009, as part of the investigation of tritium leaks at the facility.

Periodic monitoring of site groundwater is performed on an ongoing basis in order to provide for timely detection and effective response to any radiological impacts to groundwater.

2.4.11.5 Ground Water - Hydrostatic Pressures

Based on test borings at the site (Reference 3), the ground water levels were found to be less than 10 feet below grade elevation. This means that the ground water table exists at elevation 13 feet. The safety related buildings and some other major structures were designed to withstand the hydrostatic and uplift pressure due to ground water table corresponding to the levels shown in 2.4-5.

The ground water table will rise with rising surface water levels. The highest flood water level which can be expected to develop on the plant site is elevation 22 ft MSL. This will happen during the occurrence of a Probable Maximum Hurricane (Subsection 2.4.5). Flood water levels and their corresponding durations, as extracted from the Hurricane Surge Hydrograph of Reference 7, are shown in Table 2.4-6.

The ground water table rise which is expected to occur during PMH floods has been estimated assuming seepage from the flooded canal at the west end of the plant. This postulation is considered to give most severe ground water levels under the plant foundations. The estimated values of the highest ground water level that would occur during PMH are listed in Table 2.4-7.

This assessment was based on the assumption of initial ground water table at elevation 18 ft, extracted from pump test records. This value is very conservative. Due to the massive weight of the Turbine and Reactor Buildings, these increased uplift and hydrostatic pressure loads would have marginal effect on the stability of these buildings. Most of the other buildings are at grade level, and are not affected by this ground water table rise (Reference 3). The floatation

potential of safety related buildings has been assessed under the Systematic Evaluation Program, summarized in Section 1.10.

2.4.12 Technical Specifications and Emergency Operation Requirements

2.4.12.1 Safety Related Water Supply - Ultimate Heat Sink (UHS)

The primary UHS source is the open canal leading from Barnegat Bay to a pump structure adjacent to the plant. Discharge is returned via the discharge canal leading back to Barnaget Bay. System descriptions are found in Subsection 9.2.5 and Section 10.4.

2.4.12.2 Vulnerability of Canal System Ultimate Heat Sink (UHS)

The canal and pumping system are subject to several natural and potentially disrupting phenomena, which can be put in four categories as follows:

a. Hurricane flooding resulting from Atlantic Ocean storms.

b. PMF flooding due to a PMF over the drainage area west of the power plant, which feeds into the Oyster Creek and the South Branch of Forked River streams, that pass the plant on two sides.

c. Cutoff of the water supply to the pumps due to:

    1. Route 9 or railroad bridge collapse which might block the water way

    2. Failure of the canal banks due to a seismic event

    3. Ice, seaweed and silt which might block the pump intakes

d. Damage to the pumps caused by missiles.

2.4.12.3 Hurricane Flooding from Atlantic Ocean Storms

Flood level in the plant and canal area can reach elevation 22 ft. (Reference 7). At this elevation, the service water pumps deriving water from the canal will be submerged and inoperative. An orderly procedure for shutdown has been developed for this event (Subsection 2.4.8).

The fire pumps at the Fire Pond will also be submerged, inoperable and therefore, unable to supply supplemental water to the Isolation Condensers. A redundant fire pump and tank are installed above the flood elevation level (see Section 9.5) which ensures the availability of this backup service for decay heat removal.

2.4.12.4 Flooding Due to PMF of Oyster Creek and the South Branch of Forked River

The maximum flood elevations in the OCNGS intake canal under PMF conditions have been determined and are discussed in Subsection 2.4.3.

Results of these studies show that the PMF flood does not constitute a threat to the operation of the service water pumps at the intake structure.

2.4.13 References

(1) Jersey Central Power and Light Co., 1972 Preliminary Safety Analysis Report. Forked River Nuclear Generating Station Docket No. 50-363.

(2) Carpenter, J. H., "Concentration Distribution for Material Discharged into Barnegat Bay," Pritchard-Carpenter Consultants, Baltimore, MD. 1963

(3) "Probable Maximum Hurricane Flood Analysis, Oyster Creek Nuclear Unit No. 1," Dames and Moore Inc., Cranford, NJ. 1972

(4) Casagrande, A., Forked River Nuclear Station, Investigations of Stability Characteristics of Soils in the Canal Banks. Casagrande Consultants, Arlington, MA. 1972

(5) Carpenter, J. H., "Recirculation and Effluent Distribution for Oyster Creek Site," Pritchard-Carpenter Consultants, Baltimore, MD. 1964

(6) GPU Nuclear, "Hydrographic Study of Barnegat Bay, NJ," Parsippany, NJ. 1979

(7) Lawler, Matusky, Skelly Engineers, "Simulation of the Effluent Plumes from the Oyster Creek Nuclear Generating Station," Pearl River, NY. 1978

(8) Jersey Central Power and Light Co., Oyster Creek Nuclear Generating Station, Docket No. 50-219. Environmental Report

(9) Woodward Clyde Consultants, "Phase II Report Groundwater Monitoring System," Wayne, NJ. 1984

(10) GPU Nuclear, "Forked River Water Surface Profiles", Parsippany, NJ. 1987

(11) Woodward-Clyde Consultants, “Ground Water Contamination Assessment, Oyster Creek Nuclear Generating Station,” Wayne, NJ, 1988

(12) URS Greiner Woodward Clyde, “Final Report, Site Investigation/Remedial Investigation – Non-Radiological, Volumes 1–19, GPU Nuclear, Inc., Oyster Creek Generating Station,” Wayne, NJ, 2000

(13) Conestoga-Rovers & Associates, “Hydrogeologic Investigation Report, Fleetwide Assessment, Oyster Creek Generating Station, Forked River, New Jersey,” Waterloo, Ontario Canada, 2006

(14) Conestoga-Rovers & Associates, “Site Investigation Report, Oyster Creek Generating Station, Forked River, New Jersey,” Prepared For: Exelon Generation Company, LLC, 2009

(15) Tropical Cyclone Report Hurricane Sandy (AL182012) 22 - 29 October 2012; National Hurricane Center 12 February 2013.

(16) OCNGS Reply to RAI on IPEEE 1940-00-20206, 8/17/2000 (ML003743533)

(17) OCNGS Response Letter SEP Topic No. II-3-C Flooding Potential and Protection Requirements, 06/06/1983

Table 2.4-1
(Sheet 1 of 1)

OBSERVED PIEZOMETRIC SURFACES

Aquifer	Approximate Depth Range (feet)	Elevation (MSL of Piezometric Surface
Upper confined*	10 to 30±	+ 8 feet at Oyster Creek
Cohansey Sand	10 to 90±	+14 feet at Forked River Site +10 feet at Oyster Creek Site + 4 feet at Barnegat Bay
Kirkwood Formation	90 to 300±	+20 feet at Oyster Creek Site

* See Subsection 2.4.11.1

TABLE 2.4-2
(Sheet 1 of 1)

DATA[a] FOR WELLS IN OYSTER CREEK GENERATING STATION AREA[b]

Number	Owner	Depth (Ft.)	Yield (GPM)	Use
1.	Lacey Materials	120	325	Industrial
2.	Lacey Township Municiple Utilities Authority	235-265’	C	Community Water Supply (2 wells)
3.	Lacey Township Municiple Utilities Authority	235-265’	C	Community Water Supply (3 wells)
4.	Lacey Township Municple Utilities Authority	235-265’	C	Community Water Supply (2 wells)
5.	Ocean Township Utilities Authority	160’	D	Community Water Supply (3 wells)
6.	Ocean Township Utilities Authority	350’	D	Community Water Supply (1 well)
7.	Barnegat Water Co.	148	--	Community Water Supply
8.	Oyster Creek/Forked River Plant	100-350	E	Industrial (9 wells)

Notes:

(a) Reference 8
(b) Refer to Figure 2.4-9
(c) Average use of 1.5-2.0 million gallons/day (Total system yield)
(d) Average use of 0.75 million gallons/day (Total system yield)
(e) Average use of 0.022 million gallons/day

TABLE 2.4-3
(Sheet 1 of 1)

OYSTER CREEK TYPICAL WELL WATER ANALYSIS

Constituent	Parts per Million
Calcium	5.82
Magnesium	1.30
Sodium and Potassium (by difference)	16.56
Chloride	19.00
Sulfate	7.50
Nitrate	0.25
Phosphate	1.95
Bicarbonate	0.00
Silica	10.80
Iron (Total)	3.75
Manganese	.01
Total Residue	96.0
Suspended Matter	.0
Volatile Residue	36.0
Hardness as Calcium Carbonate ($CaCO_3$)	26.6 (Ca, Mg & Fe)
Phenolphthalein Alkalinity ($CaCO_3$)	0.0
Methyl Orange Alkalinity ($CaCO_3$)	18.0
PH	6.35
Biochemical Oxygen Demand	0

TABLE 2.4-4
(Sheet 1 of 1)

INITIAL GROUNDWATER MONITORING NETWORK
MONITOR WELL COMPLETION DATA

Well #	Completion Depth (in Feet)	Elevation * (Feet above MSL)
W-1	50	22.49
W-2	55	22.69
W-3	24	20.49
W-4	52	20.34
W-5	20.5	22.57
W-6	52.0	23.63
W-7	20.0	22.86
[(a)] W-8	27.5	23.09
W-9	20.0	23.72
W-10	60.0	23.04
W-12	20.0	23.98
W-13	50.0	24.10
W-14	53.0	23.34
W-15	20.0	23.26
W-16	20.0	23.08
W-17	150.0	20.14

* Highest point on PVC pipe

[(a)] Monitoring Well W-8 was subsequently removed during construction activity.

TABLE 2.4-5
(Sheet 1 of 1)

DESIGN BASIS OF WATER TABLE ELEVATIONS
FOR SAFETY RELATED BUILDINGS/STRUCTURES

Building/Structures	Water Table Elevation Used for Design (Feet above MSL)
Reactor Building	15.0
Turbine Building	15.0
Radwaste Buildings (Both Old & New)	No Hydrostatic Loads Applied
Circulating Water Intake Structure Foundation	3.0
Pipe Tunnels Connecting the Old & New Radwaste Buildings	22.0
For Structures with Foundation Mat at Grade Elecation 23 ft., e.g., New Radwaste Building, OffGas Building, Boiler House, etc.	No Hydrostatic Pressure

TABLE 2.4-6
(Sheet 1 of 1)

FLOOD LEVELS VERSUS DURATION

Flood Level (Ft. Above MSL)	Duration (Hour)
22	0
21	1.2
20	1.5
19	1.8
18	2.1
17	2.4
16	2.7
15	3.1
14	3.4
13	3.7
12	4.0

Source: Reference 3

TABLE 2.4-7
(Sheet 1 of 1)

GROUND WATER ELEVATIONS DURING
PROBABLE MAXIMUM HURRICANE

Distance East of Canal Bank Near Seal Well Structure (Ft.)	Ground Water Table Elevation (Feet above MSL)
50	22
150	21
300	20
600	19

2.5 GEOLOGY, SEISMOLOGY, AND GEOTECHNICAL ENGINEERING

2.5.1 Basic Geologic and Seismic Information

2.5.1.1 Regional Geology

The OCNGS site lies far out on the New Jersey Coastal Plain (Figure 2.5-1). The Coastal Plain is underlain by a thick wedge of unconsolidated sediments ranging from Cretaceous to Recent in age. It is an area of low relief extending from the Fall Zone some forty miles west of the site to the Continental Shelf east of the site. The thickness of the Coastal Plain sediments varies from a feather edge at the Fall Zone to as much as 3500 feet at the edge of the Continental Shelf.

The Fall Zone, which forms the northern and western border of the Coastal Plain, follows a northeast-southwest trend, running just west of Wilmington, Delaware, and Philadelphia, Pennsylvania, thence passing between Trenton and Princeton, New Jersey, and terminating just south of New York City. Long Island and Cape Cod represent discontinuous northern extensions of the Coastal Plain.

To the south, the Coastal Plain extends along the Atlantic Coast to Florida and westward along the Gulf Coast. The Plain is interrupted by deep embayments such as the Delaware and Chesapeake Bays. Through this broad range, the relationship of the Coastal Plain sediments with the underlying bedrock is quite variable.

West of the Fall Zone, the Coastal Plain is bordered by rocks of the Piedmont Province, the Trenton Prong, from Trenton, New Jersey, southward through Philadelphia, Baltimore and Washington, DC. The Piedmont is an eroded plateau of Precambrian and early Paleozoic rocks. These strata extend below the Coastal Plain to form the bedrock below the unconsolidated sediments.

North of Trenton, and extending northeast to the tip of the Manhattan Prong, the Coastal Plain sediments are bounded on the northwest by shales, sandstones and diabase dikes and sills deposited in fault bordered troughs of Triassic age. The Triassic deposits in Eastern North America occur in six major and several minor elongate basins found from Nova Scotia to North Carolina. The longest of these extends from the Hudson River near Stony Point, New York, through northwestern New Jersey, Eastern Pennsylvania and Central Virginia. The Triassic trough deposits typically include a basal sandstone sequence, a shale sequence, and diabase or basalt intrusions, and, particularly in the northern occurrences, some basalt extrusions.

Similar deposits occur in a separate basin, in the Connecticut Valley Lowland, some 75 miles north of the OCNGS site.

The development of the Triassic troughs represents the last major tectonic and igneous event in Eastern North America. The forces which caused the faulting and vulcanism have been quiescent for a period in excess of 140 million years.

West of the Triassic Lowlands lies a belt of Precambrian Uplands (the New Jersey Highlands), trending northeast from south of Reading, Pennsylvania, to Danbury, Connecticut. Farther north, similar uplands form the Housatonic-Berkshire Highlands of Western Connecticut and Massachusetts and the Green Mountains of Vermont. These Precambrian Uplands range in width from ten miles to a few tens of miles. Through upstate New York and the New England

states to the east, the Precambrian Highlands are bordered by the New England Upland, made up of sediments and meta-sediments of early Paleozoic age. Acidic intrusives are common, especially in Connecticut.

To the west of the Precambrian in New Jersey and the New England Upland to the north, lies the Valley and Ridge Province. This area contains the lower courses of the Lehigh and Delaware Rivers and most of the valley of the Hudson River. The rocks in this area are Paleozoic sediments ranging in age from Cambrian to Devonian. Intense folding and faulting are common throughout.

Still farther to the west are the Middle and Upper Paleozoic beds of the Appalachian Plateau. These beds show only moderate folding, with the intensity of folding dying out to the east and west of the Appalachian Front.

2.5.1.2 Stratigraphy

The New Jersey Coastal Plain is underlain by a sequence of unconsolidated to semi consolidated deposits of Quaternary, Tertiary and Cretaceous age. These sediments lie unconformably on a basement complex consisting of crystalline Precambrian, early Paleozoic rock, and Triassic rocks. The stratigraphic sequence, lithologic descriptions, and general thickness of formations in the New Jersey Coastal Plain are shown on Figure 2.5-2.

Coastal Plain sediments were deposited in a northwest trending coastal plain "basement depression" which extends from the vicinity of Raritan Bay, New Jersey, to Virginia and westward to the Fall Zone. The center of the broad depression is located in the vicinity of Chesapeake Bay. In the New Jersey Coastal Plain, sediments thicken seaward of the Fall Zone, and southward along the coastline, increasing from 800 feet at Sandy Hook, to 6000 feet at Cape May. In the vicinity of the site, sediment thickness is approximately 3700 feet.

2.5.1.3 Geologic History

The sediments which were consolidated to form the basement rock in the area were deposited during the Precambrian and early Paleozoic eras. Before the beginning of the Paleozoic era, the Precambrian sediments were subjected to magmatic intrusion, metamorphism and erosion.

At the onset of the Cambrian period, the region was covered by a shallow inland sea which received sediments primarily from highlands to the east. The materials which form the Chickies Quartzite and the Wissahickon Formation were deposited during early Paleozoic time. The sediments which were to form the Baltimore Gneiss were deposited during the Precambrian period.

Regional metamorphism of these sediments took place during the Taconic Orogeny, which occurred during middle and late Ordovician time. The region was uplifted during this orogeny and provided the sediments which were deposited farther to the west during the remainder of the Paleozoic era.

The Tectonic events that took place during the latter part of the Paleozoic era in the Eastern United States have been grouped into what is known as the Appalachian Revolution. This orogeny occurred as a series of local tectonic disturbances which extended progressively farther southward from Newfoundland to Alabama. In the region west of the site, initial crustal

uplift took place in late Ordovician time and again during the Devonian period. The disturbance reached its peak during Permian or early Triassic time, 240 to 200 million years ago. As a result of the Appalachian Revolution the entire region was uplifted, folded and faulted. Faulting associated with the Cream Valley-Huntingdon Valley fault zone post dates the folding and regional metamorphism, and represents a final episode of the orogeny.

During the following Triassic Period, an interval of relative crustal quiescence occurred. The newly formed Appalachian Mountains were greatly reduced in elevation with the erosional products spreading onto the Continental shelf. By middle to late Triassic time the mountains were rejuvenated and a series of depressed basins developed along their eastern flanks through a area of Eastern North America extending from Nova Scotia to North Carolina.

Great thicknesses of sediments were poured into these basins first from the east and later (or contemporaneously) from the west. As the deposition continued, the compressive forces which produced the thrust faulting associated with the Appalachian Revolution relaxed, and normal (tension) faults developed along the borders of the basins. Thick sedimentary prisms were developed along the faulted edges, up to 20,000 feet along the northwest side of the New Jersey Basin and as much as 15,000 feet along the east side of the Connecticut River Lowland.

Late in the period a series of at least three episodes of volcanic activity occurred. Thick flows of basalt form the Watchung Mountains of New Jersey and thick diabase sills form the Palisades marking the western bank of the Hudson River opposite New York City. These events represent the last volcanic activity recorded in the eastern portion of the United States.

The following period, the Jurassic, is described as "missing evidence - the Jurassic (185 to 140 million years ago)". In Northeastern North America, no deposits of this age have been identified. The nearest Jurassic deposits are found in deep drillings for oil in Alabama. Obviously, this was a period of profound erosion with the erosional products being carried far out to sea, possibly to be covered by later Coastal Plain deposits.

During the Lower Cretaceous epoch, marine sediments were deposited on the eroded basement rock in the outer portion of the Coastal Plain. At the beginning of the Upper Cretaceous epoch, the streams draining from the Piedmont deposited broad alluvial fans in the vicinity of the Fall Zone.

Farther to the southeast, marine sediments were deposited on the eroded basement rock in the outer portion of the Coastal Plain. At the beginning of the Upper Cretaceous epoch, the streams draining from the Piedmont deposited broad alluvial fans in the vicinity of the Fall Zone.

Farther to the southeast in the Coastal Plain, thick sequences of sand, clay and marl were deposited throughout the remainder of the Cretaceous period. Similar deposits were formed during Tertiary time.

There is no record in the Eastern United States of any major tectonic event in the interval between Cretaceous and present time. This time span is characterized by periodic broad upwarping and regional downwarping of the surface, as evidenced in the stratigraphic record of repeated transgressions and regressions of the sea. Beginning in early late Cretaceous time the strata were subjected to differential subsidence. Downwarping of the southern portion of the New Jersey Coastal Plain, accompanied by differential uplift in the northern part of the Coastal Plain, resulted in

progressively easterly shift in strike of the younger formations. Downwarping during deposition caused the strata to thicken to the south and southeast.

During the Pleistocene epoch, the region was subjected to the influence of the multiple advance and retreat of continental glaciers. The maximum advance of the continental ice sheets in this area extended across North Central Jersey some 40 miles north of the site.

During repeated glacial stages, sea level was lowered by as much as 300 feet below its present level, and the region was subject to erosion. During periods of glacial melting, the major streams were choked with large quantities of glacial outwash consisting of sand and gravel. These sediments were deposited along the major streams and their tributaries, and remain today as terrace deposits along valley walls.

During the final interglacial stage, sea level was some 30 to 50 feet higher than present. The resulting estuarine deposits cover islands and many of the lowland regions along the Delaware River and to the east. These deposits are known as the Cape May Formation. After deposition of the Cape May Formation, the sea withdrew and erosion began again. A net rise in sea level during the last 10,000 years, since the shrinkage of the latest continental glaciers, is estimated to be 150 to 300 feet. As a result, the outer part of the Coastal Plain and the lower reaches of streams have been inundated. Recent measurements indicate that sea level had been rising at the rate of 1/100 of a foot per year before 1939 and 2/100 of a foot per year since that time.

2.5.1.4 Site Geology

Several geological investigations have been performed on and near the OCNGS site. They include a preliminary study made in 1960, prior to acquisition of the property, investigations for construction of OCNGS, investigations for a potential additional unit immediately north of OCNGS, and to the east and west. Additionally, borings were made along the route of the circulating water canals. Prior to initiation of investigations for Forked River Unit 1, west of OCNGS, 182 test borings had been performed in the site area. Fifty two additional borings were made for the Forked River project.

The discussions below are excerpted from results of both the OCNGS and Forked River Projects (References 1 and 2).

Ninety seven test borings were made in the site area prior to or during construction of OCNGS. These holes generally covered the plant property and the routes of the intake and discharge canals. The soils to the depth investigated consisted of five distinct strata varying considerably in depth over the area investigated but quite consistent in the area where plant buildings and structures are located (Figure 2.5-3). The following is a summary of the information obtained from borings (Reference 1).

The first stratum (Cape May Formation), starting at the surface in the area of the plant buildings and structures (elevation 23 ft. MSL), consisted of approximately 17 feet of generally yellow, fine to medium textured, sand of medium density.

The second stratum (Upper Clay) started at elevation plus 6 feet MSL, and consisted of alternating layers or lenses of clay, silt and dark gray, fine sand which extended approximately 17 feet to an elevation of minus 11 feet MSL. Samples of the clay silt were analyzed for particle size; approximately 50 percent of the material fell in the clay or colloid range. This stratum

varied in thickness over the area investigated and sloped generally downward toward Barnegat Bay to the east and upward to the north so that the stratum generally thins out and disappears along the South Branch of Forked River, which forms the northern boundary of the site. This stratum was found to vary in thickness along a line of borings from the west of the plant southward and eastward to and along Oyster Creek to the Bay. The lower extremity of the clay-silt layer or lense along this line of borings was well below the bottom of the discharge canal dredging (elevation minus 10 ft. MSL).

The third stratum (Cohansey Formation) at the plant location is a dense sand stratum about 65 feet in thickness and generally yellow sand of medium to course texture.

The fourth stratum (Lower Clay) at the plant location was another stratum of layers or lenses of clay, silt and dark gray, fine sand. This stratum started at minus 76 feet MSL and was 8 feet thick at the plant location. The particle size analysis of this material again indicated about 50 percent clay or colloids. This stratum appears to underlie all of the area investigated varying in thickness from 6 feet to 30 feet and starting at elevations from minus 63 feet to minus 98 feet below MSL. There does not appear to be any distinct sloping of this stratum in the area investigated.

The fifth stratum (Kirkwood Formation) from minus 84 feet MSL down is a dense fine to coarse textured sand of a uniformly gray color. The borings showed some local areas with fine and medium to coarse gravel intermingled with the sand.

The two clay-silt strata appear to act as aquicludes and separate the soil below the surface into three water bearing sand aquifers, although there may be some interconnection of these aquifers in local areas.

At the Forked River site (Reference 2), test borings were extended to depths as great as 250 feet. The lowest stratum penetrated can be correlated with the Kirkwood Formation (Figure 2.5-3). The Kirkwood at this locality is essentially a fine sand extending from a depth of about 100 feet downward to the limits of the exploration. At the Forked River site the Kirkwood is overlain by sands of Cohansey age.

The Kirkwood-Cohansey contact is marked by a persistent clay seam about ten feet thick. This seam is made up of interbedded sands and dark gray to black clay. The total thickness of the clay laminae is no more than one third of the interval. A very similar clay stratum, the "deep clay," was encountered 1500 feet northwest of OCNGS at 243 feet below grade.

The Cohansey sands extend from the top of the Kirkwood upward to a depth of about forty feet. The Cohansey Formation is primarily sand, slightly coarser than the underlying Kirkwood.

The upper stratum at the site has been correlated with the Cape May Formation of Pleistocene age. The Cape May beds were deposited on an eroded surface of the Cohansey sands. Their thickness, therefore, is variable, averaging about forty feet over the site. Local thickening of the Cape May beds was encountered in the borings in the form of erosion channels as much as sixty feet in depth. The sands in the upper forty feet and in the channels are coarser than the sands below and are slightly less dense. A significant increase in the shear modulus at a depth of forty feet reported by Weston Geophysical Engineers, Inc., tends to confirm a stratum change at this depth.

Locally peats and beach sands of Holocene age are encountered. The principal area of Holocene deposits is found along the intake canal northeast of the plant site. These deposits were the subject of a field investigation conducted in April of 1972. The results of this investigation are reported in a letter from A. Casagrande (Appendix 2.5-A).

At the sites explored to the west of OCNGS, the Cape May-Cohansey contact is marked by a persistent clay seam which is exposed in the circulating water canals just west of the Oyster Creek plant. In the western site area, this marker bed becomes discontinuous.

The clay beds apparently thicken below Barnegat Bay. At Island Beach, the entire Cohansey interval was classified as silty, lignitic clay and it extends to depths of 120 to 150 feet.

2.5.2 Vibratory Ground Motion

2.5.2.1 Structural Geology

Coastal Plain

Little is known of the structural relationships of the bedrock surface below the Coastal Plain. Figure 2.5-4 indicates the Pre-Cretaceous surface below the Coastal Plain, in the site vicinity, and indicates the paucity of data points. There is some evidence that the dip on the bedrock surface steepens southeast of Toms River.

The assumption that the early Paleozoic or Precambrian rocks of the Piedmont form the bedrock floor of the Coastal Plain was reinforced by the core of biotite gneiss, typical of the Piedmont, taken in a test well at the Island Beach State Park, some nine miles southwest of the OCNGS site. This would suggest that the macro structural characteristics of the rocks in the Piedmont exist below the Coastal Plain.

The structure of the Coastal Plain formations is essentially homoclinal with gentle dips to the southwest. Studies east of Trenton reveal local reversals of dip and the possibility of domelike structures in the Coastal Plain formations. The local structures may be related to depositional conditions rather than post depositional deformation. It would be surprising if so thick a sequence of sediments could be deposited without the development of some structure from differential compaction.

Faulting Near the Fall Zone

In New Jersey, the Fall Zone represents an erosion and depositional boundary, rather than a tectonic feature (Section 2.5.1.1). Structures in Precambrian and Paleozoic rocks that occur in the vicinity of the Fall Zone west of the site are complex. These strata are extensively folded. Fold axes strike between North 50° East to North 70° East. The most prevalent type of folding is flexural slip folding, in which competent layers have been bent while incompetent layers have yielded by slippage. The amplitudes of folds that may be noted in the field range from small crenulations of about one inch to larger folds of about 100 feet. Most of the faults along the Fall Zone are relatively shallow, low angle thrust faults associated with the Appalachian Orogenies of the late Paleozoic time. A major thrust fault is believed to occur in the southern position of the New Jersey Highlands where the Precambrian rocks have been interpreted as resting on the younger rocks as an eroded nappe. This very old thrust cannot be regarded as a potential source of a modern tectonic event. The same can be said of the other low angle faults in the

area. None of the Paleozoic thrust faults involves Mesozoic or younger strata. They have been inactive for over 200 million years.

The Cream Valley-Huntingdon Valley fault extending northwest from West Chester, Pennsylvania, to Trenton, New Jersey is the closest known fault to the site. This fault marks the contact between the Chickies Quartzite and the Wissahickon Formation. Numerous small drag folds are encountered along the fault suggesting that it is a high angle reverse fault. However, the evidence of direction of movement based on these drag folds is not conclusive. The nearest approach of the Cream Valley-Huntingdon Valley fault to the site is some 45 miles.

The extensive thrust faulting in the Valley and Ridge Province to the west is even more remote from the site. These faults also are of late Paleozoic age and have not affected post Permian deposits (Figure 2.5-5).

Faults in the Triassic

Widmer (Reference 3) describes the Triassic border fault as a "nearly straight fault line valley extending southwestward from the Hudson at Stony Point to the vicinity of Boonton and Morristown. South of Morristown the boundary is again abrupt and marked by a fault valley extending to the vicinity of Far Hills and Bedminster." Smith (Reference 4) describes the Triassic border fault as a "relatively deep seated fault zone of substantial displacement and continuity."

Numerous normal faults are encountered in the Triassic beds. None of these faults involves younger strata; they have been inactive for 140 million years or more.

The most significant of these faults are the Hopewell and Flemington faults which cross the Delaware River within a few miles of each other in the vicinity of Lambertville, New Jersey. The Flemington fault continues to the northwest through Central New Jersey to the edge of the Triassic basin, while the Hopewell fault extends northeast to near the south branch of the Raritan River. Westward, the two faults join south of Doylestown, Pennsylvania, where they become the Chalfont fault. Vertical displacement of the faults varies between 5000 to 15,000 feet. Right lateral strike slip displacement of 12 miles has been measured on the Hopewell fault in New Jersey. Unknown amounts of the lateral displacements have occurred on the Flemington and Chalfont faults. The movement along these faults is believed to have occurred during late Triassic or possibly early Jurassic times. The closest approach of these faults to the site is greater than 50 miles.

The Cornwall-Kelvin Wrench Fault

A postulated major east-west fault zone known as the Cornwall-Kelvin wrench fault has been mapped on the basis of subsea topography and geophysical surveys, and has been inferred to extend through the Triassic Lowland of Southeastern Pennsylvania. It has been suggested that this fault may be part of a major east-west continental fault which extends from the mid United States to 300 miles beyond the Atlantic shoreline. A 94 mile, right lateral offset of sedimentary basins and belts of magnetic anomalies has been determined by oceanographic surveys near the 40th parallel in the ocean basin and onto the Continental Shelf and slope.

King (Reference 2) describes the geological and geophysical evidence of a continuation of this feature onto the continent as "seemingly tenuous." He suggests a Pre-Eocene date for the suboceanic portion of the trend. Since the most persuasive evidence for a continuation of this

feature onto the continent is the right-lateral displacement in the Triassic troughs in Pennsylvania, the zone of weakness permitting the displacement must have resulted from middle to late Triassic movements, or older.

From the above, even if the reality of this most ambiguous feature is assumed, the dating of the observed phenomena are such as to suggest that this "Tectonic Trend" has not been active for 140 million years, as a minimum.

2.5.2.2 Seismology

General

Based on more than 200 years of historic record and some 40 years of instrumental data, New Jersey and the surrounding areas are shown to be relatively inactive seismically. As compared to the more active Pacific Coast area, the events on the East Coast are few in number and, for the most part, are too low in magnitude and/or intensity to cause damage to well designed structures.

The epicentral location and Modified Mercalli intensities of all reported earthquakes greater than Intensity V within 250 miles of the site in relation to the major tectonics of the region are shown in Figure 2.5-5. A generalized relationship for earthquake intensity attenuation in the Northeastern United States is shown in Figure 2.5-6. Epicentral and intensity data for the earthquakes shown on Figure 2.5-5 are listed in Table 2.5-1.

Remote Major Earthquakes in Eastern United States

Major earthquakes, Intensity VIII and over, are rare in the Eastern United States, limited to a large degree to the St. Lawrence Valley and to the vicinity of Charleston, South Carolina.

The seismic activity in the St. Lawrence Region can be related to very old structural features, a rift valley northeast of the Adirondack Dome, and instabilities marginal to the Canadian Shield from the Adirondacks southwest toward Lake Ontario. Major earthquakes in this area include the following:

a. St. Lawrence River (47.6°N, 70.1°W) February 5, 1663. Few details are available on this early event. However, it was sharply felt throughout New England. The epicentral intensity was probably X.

b. St. Lawrence River, near Montreal (45.5°N, 73.6°W) February 10, 1732. This was a violent earthquake, but somewhat limited in extent. Felt from Boston, Massachusetts, to Annapolis, Maryland. Intensity IX.

c. Massena, New York - Cornwall, Ontario (44.9°N, 74.9°W) September 4, 1944. This event caused considerable damage to the two cities and was felt through Pennsylvania and Maryland. Intensity VIII. It was also nearest to the OCNGS site, and was felt at the site with an intensity of about III.

The region surrounding Charleston, South Carolina, has been the locus of no less than twelve reported earthquakes, including the major earthquake of August 31, 1886.

King and Johnson (Reference 2) describe a "transverse spur of epicenters extending southwestward from the Appalachian Belt to the coast of South Carolina, which includes the major Charleston earthquake." On the tectonic map (Figure 2.5-5) a transverse arch with about the same trend is shown to extend southeastward from the Appalachian across the Continental Shelf into the ocean, but the spur of epicenters lies on the southwestern flank of this feature rather than on its crest. The conditions described by King (Reference 2) serve to differentiate the Charleston, South Carolina area tectonically from the rest of the Coastal Plain.

The Charleston Earthquake (32.9°N, 80.0°W), August 31, 1886, was probably the largest well documented seismic event in the Eastern United States. Felt over an area of some 2,000,000 square miles, its epicentral intensity was X. It occurred as a series of shocks starting at 21:15 on August 31, and extending to 20:00 September 1. A series of aftershocks with the same epicenter occurred on October 22 and November 5.

The Charleston Earthquake was probably felt at the Forked River site with an intensity of III or, as a maximum, IV (Figure 2.5-6).

Major Earthquakes Within 250 Miles of the Site

Two earthquakes of Intensity VIII have been recorded in the vicinity of Boston in a cluster of epicenters along the coast to the north. For completeness, the Cape Ann, Massachusetts event, which occurred just outside the 250 mile limit is also cited.

a. Newbury, Massachusetts (42.8°N, 70.8°W) November 9, 1727. Intensity VIII.

b. Woburn, Massachusetts (42.5°N, 72.2°W), Intensity VII-VIII.

c. East of Cape Ann, Massachusetts (42.5°N, 70.0°W). A series between November 18 and December 19, 1755. Maximum Intensity VIII. This event is classed as a major earthquake.

The Tectonic Map (Figure 2.5-5) indicates major faulting concentrated in the Boston area. The above events could be related to the northernmost of the faults shown.

Closer to the site is the Intensity VIII (Number 25 on Figure 2.5-5) shock reported at East Haddam, Connecticut (41.5°N, 72.5°W). This occurrence may be related to the eastern border fault of the Connecticut Valley Triassic Basin. By reference to Figure 2.5-5, this event (the nearest Intensity VIII earthquake to the site) was probably felt at Forked River with an intensity of no more than IV.

Local Seismicity

Some of the earthquakes in Western New Jersey, north of Latitude 40°, shown on Figure 2.5-5 and Table 2.5-1 (Numbers 36, 11, 16, 15 and 20) had their epicenters near the borders of the Triassic Lowland. Numbers 36, 15 and 20 of these epicenters seem to be directly related to the border fault. The maximum intensity reported along this trend is VI. Other zones of minor seismicity appear bordering the New Jersey Highlands and farther west, along the Appalachian axis. In no case, however, are epicentral intensities in excess of VI reported along these trends within fifty miles of the site.

The largest recorded earthquakes within 50 miles of the site are two Intensity VII events which have occurred to the north:

a. Near New York City (40.6°N, 74.0°W) August 10, 1884. Intensity VII. (Number 12, Figure 2.5-5). This earthquake was felt over an estimated 70,000 square miles and had its epicentral location in New York Harbor, between Staten Island and Manhattan. Its location suggests a relationship to an instability marginal to the Manhattan Prong, Cambro-Ordovician or older in age. The greatest damage occurred in Jamaica and Amityville on Western Long Island. It was felt as far south as Atlantic City, New Jersey.

b. Sandy Hook to Toms River, New Jersey (three shocks), 40.3°N, 74.0°W), June 1, 1927. Intensity VII. (Number 3, Figure 2.5-5).

The reported felt area for the last of the Intensity VII events was 3000 square miles. This is notably smaller than the felt area for any other Intensity VII event reported. This may be explained in part by the epicentral location proximate to the Atlantic Coast. If the oceanic area were included, the actual felt area would have approached 6000 square miles. This is still a small felt area for an Intensity VII event. For comparison, the two closest events, definitely on the Coastal Plain, are listed in Table 2.5-1 as event Numbers 5 and 19.

This comparison suggests that, based on felt area, the 1927 Toms River event was an atypical Intensity VII event. Very probably, its actual energy release was more typical of an Intensity V or VI event.

2.5.2.3 Basis for Seismic Design Criteria

The basis for the seismic design criteria at the OCNGS is presented in Section 3.7. The historical seismicity of the site as described in the U.S. Coast and Geodetic Survey publication "Earthquake History of the United States, Part I" and the "Seismic Probability Map of the United States" (U.S. Coast and Geodetic Survey) were examined by Professor George W. Housner of the California Institute of Technology. The results of the study are as follows:

a. Small earthquakes have occurred in the general New Jersey area and others can be expected to occur there in the future.

b. The nearest large earthquakes were centered approximately 500 miles from the site. These were the Charleston, South Carolina shock of August 31, 1886, centered approximately 500 miles southwest of the site and the earthquake of February 28, 1925, near Quebec at 47.6°N, 70.1°W centered approximately 500 miles north of the site.

c. The seismic probability map assigns New Jersey to Zone 1 with zones being classified as follows:

Zone 0 - no damage
Zone 1 - minor damage
Zone 2 - moderate damage
Zone 3 - major damage

d. The nearest known fault is approximately 40 miles from the site at Morrisville, Pennsylvania, and there is no evidence of faulting near the site. It is concluded that the probability of fault displacements occurring in the vicinity of the reactor structure is negligibly small.

e. The seismicity of the general region of the Oyster Creek Site is so low that it would be expected to have a low intensity of ground motion. The shocks in this region are too small to be listed in "Seismicity of the Earth" by Gutenberg and Richter, and the U.S. Coast and Geodetic survey publication does not give information on the magnitudes of the shocks.

The response spectra, discussed in Section 3.7, are based upon a ground acceleration of 0.11g or 3.54 feet per second. The derivation of this ground acceleration is as follows: The spectrum intensity for California Zone 3 is assumed to be $I_{0.2}$ = 2.7. Reference can be made to AEC publication TID-7024, Table 1.6.

The corresponding spectrum intensities for other zones may be taken to be:

	$I_{0.2}$
Zone 0	0.33
Zone 1	0.67
Zone 2	1.35
Zone 3	2.70

The seismic probability map (Figure 1.10 of TID-7024) assigns New Jersey to Zone 1.

Professor Housner recommended using an intensity $I_{0.2}$ = 0.67 x 1.40 = 0.94 as the probable maximum intensity to be expected at the site during the life of the plant.

Table 1.6 in TID-7024 gives the maximum ground acceleration for the May 18, 1940, El Centro earthquake as 0.33g with a spectrum intensity of $I_{0.2}$. = 2.7. This has been assumed to be equivalent to a California Zone 3 earthquake.

Reducing the acceleration by the factor 0.94/2.70 gives a ground acceleration of 0.11g. The OCNGS response spectrum, corresponds to a spectrum intensity of $I_{0.2}$ = 0.94 or an intensity of approximately one third that of Zone 3. The application of this spectrum to design was set forth in G.W. Housner's "Design of Nuclear Power Reactors Against Earthquake." A detailed explanation is given in the AEC publication TID-7024. Refer to Section 3.7 for further detail.

In 1992, Weston Geophysical developed a new site specific design input response spectra generated from a suite of 67 horizontal earthquake time history records and the corresponding 34 vertical records. The peak ground accelerations associated with the Safe Shutdown Earthquake (SSE) are obtained from the 84% non-exceedance probability of the data and are equal to 0.184g. horizontal and 0.0952g. vertical. The operating basis earthquake accelerations are one-half the SSE accelerations and are, therefore, equal to 0.092g. horizontal and 0.0476g. vertical. The SSE Site Specific Response Spectra (SSRS) are contained in Reference 6 and are approved by the US NRC in March, 1992, as shown in Reference 5.

2.5.3 Stability of Subsurface Materials and Foundations

2.5.3.1 Building and Structure Foundations

Buildings and structures are founded generally in the third stratum (Cohansey sand) described in Subsection 2.5.1.4. After excavation, backfilling and rolling, soil compression tests were made in the Reactor Building and Turbine Building areas, using loads up to 80,000 pounds on a four square foot plate. In the Reactor Building area a loading of 20,000 pounds per square foot gave a deflection of 0.003 inches in eight hours, and in the Turbine Building area the deflection from this loading was 0.009 to 0.14 inches in eight hours. These results were highly satisfactory from the standpoint of safety against overstressing the subsoil, for the 8000 pounds per square foot loadings used and even for the 13,000 pounds per square foot loadings used for the earthquake criteria. So far as settlements are concerned, the increased stresses during earthquakes would have no measurable effects upon the settlements in this type of highly compacted soils.

Observed settlements of the Reactor Building from the start of construction until May 1968 range between 2/3 inch and 3/4 inch.

All available information and test results confirm that the Cohansey sand has a dense to very dense relative density. Results also indicate a marked increase in standard penetration resistance (N-values) at about elevation (-)30 feet. The direct determination of relative densities from undisturbed samples indicated that the relative density of the Cohansey sand is greater than 70 percent.

2.5.4 References

(1) Jersey Central Power and Light Co. 1967. Oyster Creek Nuclear Generating Station, Docket No. 50-219. Facility Description Safety Analysis Report.

(2) Jersey Central Power and Light Co. 1972. Forked River Nuclear Generating Station, Docket No. 363. Preliminary Safety Analysis Report.

(3) Widmer, K. 1964. The Geology and Geography of New Jersey. D. Van Nostrand Company Inc., Princeton, NJ.

(4) Smith, B.L., Personal Communication.

(5) Letter, A. Dromerick, NRC, to J. J. Barton, GPUN, Review and Evaluation of the Site Specific Response Spectra - Oyster Creek Nuclear Generating Station (M68217), October 14, 1992.

(6) Letter, G. C. Klimkiewicz, Weston Geophysical Corp. To A. O. Asfura, EQE, "Site Specific Response Spectra, Oyster Creek Nuclear Generatin Station," October 14, 1992.

TABLE 2.5-1
(Sheet 1 of 4)

LIST OF EARTHQUAKES (INTENSITY IV OR GREATER) WITHIN
250-MILE RADIUS OF SITE

Distance From Site (Miles)	No.	Date	Time	Locality	North Latitude	West Longitude	Area (mi^2)	Intensity (M.M.)	Reference (See Shts. 3&4)
0-50	1	3/10/1877	09:59	Delaware Valley	40.3	74.9	300	IV-V	2-76, 12
	2	1/21/1921	18:40	New Jersey	40	75	150	V	4
	3	6/1/1927	07:20	New Jersey	40.3	74.0	3000	VII	7
	4	1/24/1933	21:00	ear Trenton, NJ	40.2	74.7	600	V	10
	5	8/22/1938	22:36	Central NJ	40.1	74.5	5000	V	10
50-100	6	12/18/1737	23:00	Near New York City	40.8	74.0	-	VII	1, 12, 13
	7	10/9/1871	09:40	Wilmington, Del	39.7	75.5	-	VII	5, 15
	8	7/11/1872	05:25	Westchester Co., NY	40.9	73.8	100	V	2-73
	9	12/10/1874	22:25	Westchester, NY	40.9	73.8	5000	VI	2-75
	10	3/25/1879	19:30	Delaware River	39.2	75.5	600	IV-V	2-80, 5, 11
	11	5/31/1884	-	Allentown, PA	40.6	75.5	Local	V	5, 12
	12	8/10/1884	14:07	Near New York City, felt to south	40.6	74.0	70,000	VII	-
	13	3/8/1889	18:40	Pennsylvania	40	76	4000	V	9-89, 12
	14	3/9/1893	00:30	New York City, NY	40.6	74.0	Local	V	5
	15	9/1/1895	06:09	New Jersey felt to Northeast	40.7	74.8	35000	VI	-
	16	5/31/1908	12:42	Allentown, PA	40.6	75.5	Local	VI	5, 12
	17	6/8/1916	16:15	Near New York City, NY	41.0	73.8	Local	IV-V	4
	18	5/11/1926	22:30	New Rochelle, NY	40.9	73.9	150	V	7
	19	11/14/1939	21:54	Salem Co., NJ	39.6	75.2	6000	V	10
	20	9/3/1951	20:26	New York, felt in NJ	41.2	74.1	5500	V	-
	21	3/27/1953	03:50	Stamford, CT	41.1	73.5	-	V	10
	22	3/23/1957	14:03	West-Central, NJ	40-3/4	74-3/4	-	VI	10
	23	9/14/1961	21:17	Lehigh Valley, PA	40-3/4	75-1/2	Local	V	10
	24	12/27/1961	12:06	Pennsylvania - NJ Border	10-1/4	74-3/4	-	V	10
	25	5/18/1791	22:00	Connecticut, felt in PA	41.5	72.5	35000	VIII	-
100-150	26	8/23/1827	-	New London, CT	41.4	72.7	-	IV-V	1
	27	4/12/1837	-	Hartford, CT	41.7	72.7	-	V	1
	28	6/30/1858	22:45	New Haven, CT	41.3	73.0	1000	V	1
	29	8/9/1840	15:30	South Connecticut	41.5	72.9	7500	V	1, 13

TABLE 2.5-1
(Sheet 2 of 4)

LIST OF EARTHQUAKES (INTENSITY IV OR GREATER) WITHIN
250-MILE RADIUS OF SITE

Distance From Site (Miles)	No.	Date	Time	Locality	North Latitude	West Longitude	Area (mi^2)	Intensity (M.M.)	Reference (See Shts. 3&4)
100-150	30	7/28/1875	04:10	Connecticut	41.8	73.2	2000	V	2-76
(Cont'd)	31	10/4/1878	02:30	Hudson River, NY	41.5	74.0	600	V	2-79
	32	3/11/1883	18:57	Hartford Co., MD	39.5	76.4	Local	IV-V	2-84
	33	5/8/1906	12:41	Delaware	38.7	75.7	400	V	5
	34	11/14/1925	08:04	Near Hartford, CT	41.5	72.5	850	VI	7
	35	10/8/1952	16:40	Poughkeepsie, NY	41.7	74.0	-	V	10
	36	1/7/1954	02:25	Sinking Spring, PA	40.3	76.0	-	VI	10
	37	2/21/1954	15:00	Wilkes-Barre, PA	41.2	75.9	Local	VII	10
	38	2/23/1954	22:55	Wilkes-Barre, PA	41.2	75.9	Local	VI	10
150-200	39	2/27/1883	22:30	Rhode Island	41.5	71.5	-	V	4
	40	1/2/1885	21:16	Maryland & Virginia	39.2	77.5	3500	V	2-86, 4, 9-85, 14
200-250	41	10/5/1817	11:45	Woburn, MA	42.5	71.2	-	VII-VIII	1, 13
	42	9/21/1876	23:30	Southeast MA	41.8	71.0	2000	V	4
	43	12/18/1897	18:45	Ashland, VA	37.7	77.5	7500	V	4, 14
	44	4/24/1903	07:30	Northeastern, MA	42.7	71.0	350	V	5
	45	1/21/1903	A.M.	East Massachusetts	42.1	70.9	500	V	5
	46	1/24/1907	06:30	Schenectady, NY	42.8	74.0	Local	IV-V	4
	47	4/2/1909	02:25	VA, W. VA, MD, PA	39.4	78.0	2500	V-Vi	5, 6, 14
	48	2/2/1916	23:26	Mohawk Valley, NY	43	74	8000	V	4
	49	11/1/1916	21:32	Glens Falls, NY	43.3	73.7	300	V	8
	50	4/9/1918	21:09	Virginia	38.7	78.4	60000	VI	3-8, 4, 5,
	51	9/5/1919	21:46	Virginia	38.8	78.2	-	VI	3-9
	52	4/24/1925	02:56	Southeast MA	41.8	70.8	1600	V	7, 8
	53	3/18/1926	16:09	New Ipswich, NH	42.6	71.8	800	VI	7
	54	4/20/1931	14:54	Lake George, NY	43.4	73.7	60000	VII	10
	55	7/15/1938	17:45	Southern Blair County, Pa	40.4	78.2	100	VI	10, 12
	56	1/28/1940	18:12	Buzzards Bay, MA	41.6	70.8	2000	V	10
	57	8/24/1952	19:07	Mohawk Valley, NY	43.0	74.5	400	V	10
	58	10/16/1963	10:31	Near Coast of Maine	42.5	70.8	5800	VI	10

TABLE 2.5-1
(Sheet 3 of 4)

LIST OF EARTHQUAKES (INTENSITY IV OR GREATER) WITHIN
250-MILE RADIUS OF SITE

References for Table 2.5-1

1. Memoirs of Boston Society of Natural History, Volume 2, 1871-1878. Volcanic Manifestations in New England, Being an Enumeration of the Principal Earthquakes from 1638 to 1969 by William T. Brigham, pages 1-28.

2. American Journal of Science and Arts (known also as Silliman's Journal of Science), 1819-1886. Inasmuch as all of the references used are in the nineteenth century, only the last two digits of the year are given. Thus 2-86 refers to the volume for the year 1886. This reference contains the important catalogue of C. G. Rockwood which continued from 1872 to 1877.

3. Bulletin of the Seismological Society of America. Since this started in 1911 and annual volumes have followed, the year may be obtained by adding 10 to the number of volume. Reference is by volume number.

4. Monthly Weather Review of the United States Weather Bureau. The earthquakes are always described in the issue for the month in which they occurred and in rare cases in that for the following month so that the general reference to this source is sufficient. In earlier years the amount of earthquake information varies greatly being quite complete for some periods and at other entirely lacking. However, from 1915 to June 1924, during which period the Weather Bureau was charged with seismological investigation, the information is very complete.

5. Unpublished records of Harry Fielding Reid, Johns Hopkins University, Baltimore, MD. These include a card index and volumes of newspaper clippings, as well as special correspondence. In many cases where quite complete information is available from other sources, valuable supplementary information regarding area and intensity is given by Reid.

6. Unpublished records of J.B. Woodworth, Harvard University, through the courtesy of Francis A. Tondorf, S. J., Georgetown University, Washington, DC.

7. Quarterly Seismological Report of the Coast and Geodetic Survey, which began in 1925. The last report for that year also contains information for the second half of 1924 to connect with Weather Bureau publication. Earthquakes are described under the month in which they occurred.

8. The Registration of Earthquakes and Press Dispatches on Earthquakes. Georgetown University publication by Francis A. Tondorf, S. J., Chief Seismologist. Earthquakes found under year and date. Also monthly Seismological Dispatches which give in advance of publication the same information in more detail.

9. Science. References as in case of reference number 2.

TABLE 2.5-1
(Sheet 4 of 4)

LIST OF EARTHQUAKES (INTENSITY IV OR GREATER) WITHIN
250-MILE RADIUS OF SITE

References for Table 2.5-1

10. Annual publication United States Earthquakes, 1928-1963. Coast and Geodetic Survey.

11. An Annotated List of North Carolina Earthquakes, by Gerald R. MacCarthy, Journal of Elisha Mitchell Scientific Society, Volume 73, Number 1, May 1957.

12. Earthquake, September 5, 1944. Felt in Pennsylvania by Dr. R. W. Stone, Commonwealth of Pennsylvania, Department of Internal Affairs, Volume 12, Number 11. Also contains a list of earthquakes felt in Pennsylvania.

13. Earthquakes of Eastern Canada and Adjacent Areas, 1534-1927 and 1954-1959, by W.E.T. Smith, Publications of Dominion Observatory, Ottawa, Volume XXVI, Numbers 5 (1962) and 1963-2 (1964).

14. A Descriptive List of Virginia Earthquakes through 1960 by Gerald R. MacCarthy, Journal of the Elisha Mitchell Scientific Society, Volume 80, Number 2, December 1964.

15. Wilmington News, Wilmington, DEL, September 4, 1965.