LIMERICK GENERATING STATION UNITS 1 & 2

ENVIRONMENTAL REPORT - OPERATING LICENSE STAGE

REVISION 6 PAGE CHANGES

The attached pages, tables, and figures are considered part of a controlled copy of the Limerick Generating Station EROL. This material should be incorporated into the EROL by following the instructions below.

REMOVE	INSERT
VOLUME 1	
Pages 2.1-1 thru 2.1-6	Pages 2.1-1 thru 2.1-6
Table 2.1-2	Table 2.1-2
Table 2.1-9	Table 2.1-9
Table 2.1-12	Table 2.1-12
Table 2.1-15	Table 2.1-15
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CHAPTER 2

THE SITE AND ENVIRONMENTAL INTERFACES

2.1 GEOGRAPHY AND DEMOGRAPHY

2.1.1 SITE LOCATION AND DESCRIPTION

2.1.1.1 Specification of Location

Limerick Generating Station is located in southeastern Pennsylvania on the Schuylkill River, about 1.7 miles southeast of the limits of the Borough of Pottstown, and about 20.7 miles northwest of the Philadelphia city limits. The Schuylkill River passes through the site, separating the western portion, located in East Coventry Township, Chester County, from the eastern portion, located in Limerick Township and Pottsgrove Township, Montgomery County, Pennsylvania. Figure 2.1-1 identifies the general location of the Limerick site, and Figure 2.1-2 shows the immediate environs, within 5 miles of the site.

The Universal Transverse Mercator coordinates of the Limerick Unit 1 reactor are 4,452,582.462 meters north and 449,984.170 meters east, Zone 18T. The corresponding Greenwich coordinates for Unit 1 are 40°13'26.67" north latitude and 75°35'16.27" west longitude. The Unit 2 reactor is located at 4,452,582.462 meters north and 450,033.548 meters east, Zone 18T of the Transverse Mercator Coordinate System, with corresponding 40°13'26.64" north latitude and 75°35'14.15" west longitude coordinates.

2.1.1.2 Site Area

The land portion of the site consists of 595 acres, as shown in Figure 2.1-3. The property within the site boundary is owned by Philadelphia Electric Company except as noted below. The site boundary is shown in Figure 2.1-3. As shown in Figure 2.1-3, the site is traversed by several public roads, a ConRail right-of-way, and the Schuylkill River. These areas, including the island in the river, are considered public passageways and not part of the site property.

The site is located in gently rolling countryside, traversed by numerous valleys containing small streams that empty into the Schuylkill River. On the eastern bank of the Schuylkill River, the terrain rises from just under el 110 MSL, at the river, to approximately el 300 MSL toward the east, which is the highest ground on the site boundary. Two parallel streams, Possum Hollow Run and Brooke Evans Creek, cut through the site in wooded valleys, running southwest into the Schuylkill River. Grade in the area of the reactor and turbine enclosures is about el 217

MSL. On the western bank of the river the terrain is relatively flat, rising only about 50 feet from the shore to the western edge of the site. One small stream flows southeastward through the site to the Schuylkill River.

The exclusion area for Limerick Generating Station, shown in Figure 2.1-3, is defined as the area encompassed by a radius of 2500 feet from the center of each reactor unit. The property within the exclusion area is owned by Philadelphia Electric Company, except as noted below. As shown in Figure 2.1-3, the exclusion area is traversed by several public roads, a ConRail right-of-way, and the Schuylkill River. These areas, including the island in the river, are considered public passageways and not part of the site property. Arrangements for control of public access to these areas in the event of an emergency have been made with the Pennsylvania State Police and with ConRail, as described in the Emergency Plan.

There are no outstanding mineral rights within the exclusion area.

The locations of principal station structures are shown in Figure 2.1-4. In addition, the Limerick Atomic Information Center is located on the site property. The information center, owned and operated by Philadelphia Electric Company, is open to the public during specified hours. Admission to the information center is controlled by Philadelphia Electric Company.

A power plant simulator, used for training operating personnel, is adjacent to the site. This facility is operated by General Physics Corporation. Use of the facility is controlled by Philadelphia Electric Company.

2.1.1.3 Boundaries for Establishing Effluent Release Limits

The boundary line of the restricted area, as defined in 10 CFR Part 20, is identical to the site boundary line shown in Figure 2.1-3. The land area within the boundary lines is owned by Philadelphia Electric Company. Control of public passageways is discussed in Section 2.1.1.2.

There are no permanent residences within the restricted area.

Station effluent release points are shown in Figure 3.1-2.

2.1.2 POPULATION DISTRIBUTION

2.1.2.1 Population Within 10 Miles

The population distribution within 10 miles, as a function of distance and direction, for the decades 1970 through 2020 and for 1983, is listed in Tables 2.1-1 through 2.1-7. The 1970 and 1980 data are taken from actual census data and the other years are taken from projections (Table 2.1-15). The 1983 projections are considered to be representative of population near the year of initial station operation, and the 2020 projections represent population near the end of station operation. These projections are based on 1970 census data and have not been revised based on 1980 census data. The 1980 data shows that population has decreased. A map, keyed to Tables 2.1-1 through 2.1-7, is provided in Figure 2.1-5.

The population distribution within 10 miles is based upon the number of households, obtained from a 1980 meter count of Philadelphia Electric Company's residential customer billing file, and a 1980 meter count of Metropolitan Edison Company's billing file. A factor of 2.88 persons per residential meter in Philadelphia Electric Company territory, and a factor of 2.70 persons per residential meter for the Metropolitan Edison Company territory were used to convert the meter count into population.

Projected populations were determined by using county projection factors obtained from state agencies. Where information was not available to the year 2020, Philadelphia Electric Company extended the available information through that year. Table 2.1-15 lists the sources of population information.

Population for the year 1983 was estimated by Philadelphia Electric Company by extrapolation of data between 1980 and 1990. Projections for the years 2010 and 2020 were made by increasing projections for the year 2000 at a rate of 20% per 10-year period.

2.1.2.2 Population Between 10 and 50 Miles

Population distribution between 10 and 50 miles for the decades between 1970 through 2020 and for the year 1983 is listed in Tables 2.1-8 through 2.1-14. 1980 population distributions are based on the assumption that the population of each civil division occurs at the centroid of that civil division. The location of the centroid of the civil division by ring and sector determines the sector into which the population of the civil division is assigned. A map, keyed to Tables 2.1-8 through 2.1-14, is provided in Figure 2.1-6.

Projected populations were determined by using county projection factors obtained from state agencies. Where information was not available to the year 2020, Philadelphia Electric Company extended the available information through that year. Table 2.1-15 lists the sources of population information.

Population changes for 1950 through 1980 in the counties within 50 miles of the station are indicated in Table 2.1-16.

2.1.2.3 Transient Population

The transient population in the site area is classified as daily or seasonal. The daily transients result from an influx of employees to local business and industrial facilities. Local industries, and their location and employment, are listed in Table 2.1-17. The only industries with a significant daily transient population are Mrs. Smith's Pie Company, Sircom Knitting Company, and Crouse Company.

Seasonal transients result from use of recreational areas, of which there is only the Countryside Swim Club, Inc., within 1.3 miles of the station. The maximum daily attendance at the swim club is estimated to be 800, with a daily average of 400 during the summer season.

A 1976 creel survey of people fishing the Schuylkill River within 5 km of the station showed that 96 percent lived within 10 km of the river and thus do not comprise a transient population. These data also projected 1980 fishing pressure within 5 km of the station at 8800 angler hours for the principal fishing months of May through September. The average time spent fishing was 3.5 hours from shore and 4.7 hours by boat. Less than 20 percent of the fishing pressure came from boats. Table 2.1-42 describes boating hours per year as cited by the Pennsylvania Fish Commission. Based on these data and data collected in a 1980 creel survey conducted as part of the Limerick preoperational program, an average of 1100 boaters per year could be expected to use the Schuylkill River within 10 miles of the station, most of which would occur below Vincent Dam (3.3 miles below the station).

2.1.2.4 Age Distribution

The age distribution in Montgomery County compared with the U.S. population in 1970 is shown below:

Age	Percent in Age Group	
	Montgomery County	United States
0-11	21.4	22.4
12-17	12.2	11.9
18 and over	66.4	65.7
Total	100.0	100.0

There is no reason to believe that there will be a significant difference in age distribution in the year 2000 between the United States and Montgomery County. The United States age distribution in 2000 is shown below:

Age	Percent in Age Group
0-11	17.3
12-17	9.2
18 and over	73.5

2.1.3 USE OF ADJACENT LANDS AND WATERS

The general land use character of the area within 5 miles of the Limerick site is rural and open, and contains one major forest, located in northern Limerick and Lower Pottsgrove Townships. A discussion of local land use was provided in Section 2.1.4 of the Limerick Generating Station Environmental Report - Construction Permit Stage (Revised). There have been no major changes in actual or projected land use patterns.

Present and projected land use within a 5-mile radial area of Limerick is presented in Tables 2.1-18 and 2.1-19. The urban development and population concentration near Limerick lies outside a 2-mile ring and, historically, has been oriented along the Schuylkill River, with recent suburban growth spilling out over municipal boundaries. About half of the 1970 population was located in the Boroughs of Pottstown, Royersford, Spring City, and unincorporated areas of South Pottstown and Kenilworth. Pottstown Borough, with a 1980 population of 22,729 people, is the largest local municipality. The borough's population declined from 1960 to 1970 and continued to decline from 1970 to 1980.

2.1.3.1 Industries

Industries with 10 or more employees within 5 miles of Limerick Generating Station are listed in Table 2.1-17. The number of employees, products, and locations is listed for each establishment.

The nearest industry to the site is the Pottstown Trap Rock Quarry, Inc. Operations of the quarry include the detonation of explosives in the process of quarrying stone. However, the use of explosives is infrequent and only enough explosives for one particular application are brought to the quarry. There are no explosives stored on the quarry site. Other industries located within 1.3 miles of the station include Hooker Chemical Company, Mahr Printing, Inc., Eastern Warehouses, Inc., Amerind-MacKissic, Inc., and Structural Foam, Inc. The location of these industries is shown in Figure 2.1-7. Hooker Chemical Company is the only establishment near the Limerick Generating Station that has significant quantities of hazardous materials stored onsite. These materials are listed in Table 2.1-20.

As shown in Figure 2.1-8, there is a natural gas pipeline adjacent to the site, consisting of two separate pipes, operated by the

Columbia Gas Transmission Company, and an oil pipeline operated by Atlantic Richfield Company within the site area. Other pipelines within 5 miles of the station are operated by Philadelphia Electric Co, Mobil Oil, Texas Eastern Transmission Corp, Transcontinental Gas Pipe Line Corp, and UGI Corp. Pipe sizes, age, operating pressure, etc., are listed in Table 2.1-21. At the present time, there are no plans to utilize these pipelines to transport products other than those currently transported.

2.1.3.2 Transportation Routes

The major transportation routes located within 5 miles of the site include the following:

a. U.S. Route 422, an east-west highway passing approximately 1-1/2 miles to the north of the site.

b. Pennsylvania (PA) Route 100, a north-south highway passing approximately 4 miles west of the site.

c. Pennsylvania (PA) Route 724, a southeast-northwest highway passing approximately 1 mile southwest of the site.

d. The Consolidated Rail Corporation line (formerly Reading Company), passing through the site along the north bank of the Schuylkill River. The line is comprised of three tracks and has a rail spur serving the station.

e. The Consolidated Rail Corporation line (formerly Pennsylvania Central Railroad), running in north-south direction, passing along the western boundary of the site.

These transportation routes are shown in Figure 2.1-8. Planned changes to local transportation routes include the extension of the Schuylkill Expressway, and Interstate Route No. 76 from Valley Forge to the terminus of the Pottstown bypass, U. S. Route 422. The proposed alignment follows the Schuylkill River, generally about a mile away, and passes near the northern boundary of Royersford Borough. About midway through Limerick Township, the expressway veers northward to join with U.S. Route 422. In the vicinity of the Limerick site, the expressway is located farther away from the Schuylkill River than in any other location.

Expressway interchanges now exist along the Pottstown Bypass at PA Route 100, Hanover Street, Keim Street, PA Route 724, Firestone Blvd., Township Line Road (presently labeled Evergreen Road on all street signs), and existing U.S. Route 422. The PA Route 100 interchanges are modified types, which necessitate turning movements across traffic flow to get onto and off the ramps. This turning movement tends to lower traffic capacity of the feeder streets, as well as the ramps.

TABLE 2.1-2

POPULATION DISTRIBUTION 0-10 MILES
1980
DISTANCE (MILES)

Sector	0-1	1-2	2-3	3-4	4-5	5-10	10-Mile Total
N	58	682	894	397	753	3,158	5,942
NNE	46	1,088	244	478	204	2,428	4,488
NE	46	40	202	334	276	3,732	4,630
ENE	12	58	199	380	228	5,139	6,016
E	20	150	271	389	418	5,120	6,368
ESE	29	179	297	268	579	9,223	10,575
SE	0	369	141	4,844	4,055	6,830	16,239
SSE	6	190	285	2,664	1,587	20,992	25,724
S	3	343	331	164	340	3,864	5,045
SSW	12	611	308	513	268	1,848	3,560
SW	69	181	204	311	300	1,783	2,848
WSW	46	179	533	458	1,596	1,899	4,711
W	35	118	1,754	1,515	1,054	2,239	6,715
WNW	60	320	2,992	11,076	3,545	9,791	27,784
NW	0	288	1,872	6,667	1,309	4,004	14,140
NNW	0	711	1,727	1,237	1,304	6,555	11,534
Total	442	5,507	12,254	31,695	17,816	88,605	156,319

TABLE 2.1-9

POPULATION DISTRIBUTION 10-50 MILES
1980
DISTANCE (MILES)

Sector	0-10	10-20	20-30	30-40	40-50	50-Mile Total
N	5,942	7,884	53,061	55,728	24,830	147,445
NNE	4,488	24,323	185,370	175,555	38,751	428,487
NE	4,630	18,810	19,791	25,253	49,483	117,967
ENE	6,016	54,025	52,445	19,874	36,108	168,468
E	6,368	60,790	88,479	178,907	331,487	666,031
ESE	10,575	124,311	654,399	609,017	105,734	1,504,036
SE	16,239	84,571	1,042,915	509,968	182,225	1,835,918
SSE	25,724	24,010	260,063	31,240	22,748	363,785
S	5,045	71,662	37,832	329,479	23,712	467,730
SSW	3,560	41,678	25,473	47,226	48,771	166,708
SW	2,848	7,171	34,583	11,577	18,878	75,057
WSW	4,711	9,298	24,662	72,930	133,537	245,138
W	6,715	4,729	17,437	49,786	74,846	153,513
WNW	27,784	120,554	72,875	25,831	29,043	276,087
NW	14,140	9,026	17,164	17,026	63,480	120,836
NNW	11,534	12,706	16,031	7,502	34,491	82,264
Total	156,319	675,548	2,602,580	2,166,899	1,218,124	6,819,470

TABLE 2.1-12

POPULATION DISTRIBUTION 10-50 MILES
2000
DISTANCE (MILES)

Sector	0-10	10-20	20-30	30-40	40-50	50-Mile Total
N	11,927	6,829	46,286	46,773	25,174	136,989
NNE	5,381	25,272	215,644	183,280	37,574	467,151
NE	5,026	32,778	23,802	31,732	52,752	146,090
ENE	3,526	52,418	61,837	25,372	39,811	182,964
E	16,987	66,515	140,102	263,769	476,933	964,306
ESE	19,812	168,561	747,667	699,313	105,747	1,741,100
SE	13,336	116,919	1,252,024	724,448	143,256	2,249,983
SSE	51,068	38,367	269,704	35,137	29,640	423,916
S	8,090	95,506	39,132	436,266	24,908	603,902
SSW	5,268	44,671	37,951	52,662	68,035	208,587
SW	6,591	6,461	52,976	13,528	20,704	100,260
WSW	5,069	11,030	23,711	74,921	152,049	266,780
W	6,268	3,932	17,805	49,845	79,117	156,967
WNW	36,978	132,836	76,946	20,317	26,559	293,636
NW	15,742	8,414	18,249	14,247	51,353	108,005
NNW	11,216	10,593	15,770	5,735	29,634	75,190
Total	222,281	821,102	3,039,606	2,677,345	1,363,246	8,125,826

TABLE 2.1-15

SOURCES OF PROJECTED POPULATIONS

State	1970	1980	1983	1990	2000	2010	2020
Delaware	1	7	8	2	6	6	6
Maryland	1	7	8	3	6	6	6
New Jersey	1	7	8	4	4	6	6
Pennsylvania	1	7	8	5	5	6	6

		Year of Estimate
1	U.S. Census	1970
2	Division of Urban Affairs, University of Delaware	1975
3	Maryland Department of State Planning	1975
4	New Jersey Department of Labor and Industry, Division of Planning and Research, Office of Business Economics	1975
5	Pennsylvania Department of Education	1975
6	Philadelphia Electric Company	1977
7.	U.S. Census	1980
8.	Philadelphia Electric Company, based on State-supplied data	1977

TABLE 2.1-16

BUREAU OF CENSUS POPULATIONS OF COUNTIES WITHIN 50 MILES OF THE SITE

COUNTY	STATE	1950	1960	1970	1980
New Castle	DE	218,879	307,446	385,856	399,002
Cecil	MD	33,356	48,408	53,291	60,430
Burlington	NJ	135,910	224,499	323,132	362,542
Camden	NJ	300,743	392,035	456,291	471,650
Gloucester	NJ	91,727	134,840	172,681	199,917
Hunterdon	NJ	42,736	54,107	69,718	87,361
Mercer	NJ	229,781	266,392	303,968	307,863
Salem	NJ	49,508	59,711	60,346	64,676
Somerset	NJ	99,052	143,913	198,372	203,129
Warren	NJ	54,374	63,220	73,879	84,429
Berks	PA	255,740	275,414	296,382	312,509
Bucks	PA	144,620	308,567	415,056	479,211
Carbon	PA	57,558	52,889	50,573	52,285
Chester	PA	159,141	210,606	278,311	316,660
Delaware	PA	414,234	553,154	600,035	555,007
Lancaster	PA	234,717	278,359	319,693	362,346
Lebanon	PA	78,905	90,853	99,665	109,829
Lehigh	PA	198,207	227,536	255,304	273,582
Monroe	PA	33,803	39,567	45,422	69,409
Montgomery	PA	353,068	516,682	623,799	643,621
Northampton	PA	185,243	201,412	214,368	225,418
Philadelphia	PA	2,071,605	2,002,517	1,948,609	1,688,210
Schuylkill	PA	200,577	173,027	160,089	160,630
York	PA	202,737	238,336	272,603	312,963

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Salem	NJ	49,508	59,711	60,346	64,676
Somerset	NJ	99,052	143,913	198,372	203,129
Warren	NJ	54,374	63,220	73,879	84,429
Berks	PA	255,740	275,414	296,382	312,509
Bucks	PA	144,620	308,567	415,056	479,211
Carbon	PA	57,558	52,889	50,573	52,285
Chester	PA	159,141	210,608	278,311	316,660
Delaware	PA	414,234	553,154	600,035	555,007
Lancaster	PA	234,717	278,359	319,693	362,346
Lebanon	PA	78,905	90,853	99,665	109,829
Lehigh	PA	198,207	227,536	255,304	273,582
Monroe	PA	33,803	39,567	45,422	69,409
Montgomery	PA	353,068	516,682	623,799	643,621
Northampton	PA	185,243	201,412	214,368	225,418
Philadelphia	PA	2,071,605	2,002,517	1,948,609	1,688,210
Schuylkill	PA	200,577	173,027	160,089	160,630
York	PA	202,737	238,336	272,603	312,963

METEOROLOGICAL SENSOR A

PARAMETER	COMPONENT	MANUFACTURER/ MODEL NO.
Aerovane Wind Speed	Impeller Generator and	Bendix/120
	Recorder	Bendix/141
Combination of Components		
Aerovane Wind Direction	Wind Vane and Recorder	Bendix/120 Bendix/141
Combination of Components		
Satellite Wind Speed	3-cup Anemometer and	Bendix/241691
	Recorder	Bendix/141
Combination of Components		
Satellite Wind Direction	Wind Vane and Recorder	Bendix/241697 Bendix/141
Combination of Components		
Temperature (Ambient)	Sensor	L&N/8197
	Constant Current Power Source	L&N/445372
	Recorder	Speedomax W
Combination of Components(1)		
Temperature (Difference)	Sensor	L&N/8197
	Constant Current Power Source	L&N/445372

TABLE 6.1-32

ND SYSTEM SPECIFICATIONS AND ACCURACIES

COMPONENT ACCURACY	SYSTEM(1) ACCURACY	REGULATORY GUIDE 1.23	COMMENTS/ SPECIFICATIONS
±.5 mph (0-10 mph) ± 1 mph (> 10 mph)			Starting Speed of 1.8 mph Stopping Speed of 0.7 mph 2 element recorder
	±.5 mph	±.5 mph accuracy/starting speed 1 mph	
±2°			2 element recorder
	±2°	±5°	
±.5 mph (.5-50 mph)			Starting Speed <.5 mph 2 element recorder
	±.5 mph	±.5 mph accuracy/starting speed <1 mph	
±2°			2 element recorder
	±2°	±5°	
±.2°F			40°F-120°F, 1 ma ±.03%
±.06°F			6 points, 10 seconds/ point
±.36°F			Dual range recorder
	±.416°F	±.5°C (±.9°F)	±.9°F=±.5°C
±0.1°F			Matched Pairs ±0.07°F
Negligible			40-120°F 1 ma ± 0.03%

METEOROLOGICAL SENSOR A

PARAMETER	COMPONENT	MANUFACTURER/ MODEL NO.
	Recorder	L&N/Speedomax

(1) Total system accuracy from the square root of the

Regulatory Guide 1.23: ±0.15°C (0.27°F)

TABLE 6.1-32 (Page 2 of 2)

ND SYSTEM SPECIFICATIONS AND ACCURACIES

COMPONENT ACCURACY	SYSTEM(1) ACCURACY	REGULATORY GUIDE 1.23	COMMENTS/ SPECIFICATIONS
W ±0.072°F			6 Points 10 Seconds/Point

sum of the squares = ±0.12°F

QUESTION E310.3 (Section 2.1)

Please revise the demographic data and projections using data from the 1980 Census. (EROL Section 2.1.)

RESPONSE

Section 2.1 has been changed to provide data from the 1980 census. Projections based on the 1980 census information are developed by state and federal agencies.

QUESTION E310.10 (Section 2.6)

Identify any impacts to cultural resources in the vicinity of the plant property and transmission line corridors which could potentially result from the operation and maintenance of the plant. Provide copies of any correspondence with the State Historic Preservation Officer on this subject. (EROL Section 2.6)

RESPONSE

There will be little or no impact to cultural resources in the vicinity of the transmission lines resulting from the operation and maintenance of these lines. As noted in the response to Question 290.12, all lines will be built on existing transmission and railroad rights-of-way and will not require new access roads.

An archeological survey was made by John Milner Associates, Inc., 309 North Matlack Street, West Chester, PA 19380. This report was submitted to the Pennsylvania PUC on August 23, 1982 in response to their request. A copy of PECo's letter of notification to Pennsylvania Historical and Museum Commission and a reply from Brenda Barrett, Director of Bureau for Historic Preservation, are included with the response to Question E310.10.

PHILADELPHIA ELECTRIC COMPANY
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ENGINEERING AND RESEARCH DEPARTMENT

January 13, 1982

Pennsylvania Historical and Museum Commission
Mrs. Frank Piasecki, Chairperson
Box 1026
Harrisburg, PA 17120

To: Administrative Officer in Charge

This is to advise you that on December 9, 1981, a petition was filed by Philadelphia Electric Company before the Pennsylvania Public Utility Commission as of Docket No. P-810309, seeking a declaratory order determining that certain proposed transmission lines are excluded from siting review requirements, or, in the alternative, for a waiver of such requirements. This notice is being sent to you in accordance with and in compliance with instructions of the Commission.

The lines in question are as follows:

1. A proposed 230 kV line from the proposed Limerick Generating Station in Limerick Township, Montgomery County, to Cromby Generating Station in East Pikeland Township, Chester County, on the westerly side of the Schuylkill River, along right-of-way owned in part by Philadelphia Electric Compnay and, in part, by Conrail (formerly, the Pennsylvania Railroad). This proposed line will be approximately 8.63 miles long.

2. A proposed 230 kV line from the proposed Limerick Generating Station in Limerick Township, Montgomery County, to Cromby Generating Station in East Pikeland Twonship, Chester County, on the easterly side of the Schuylkill River along right-of-way owned in part by the Philadelphia Electric Company and, in part, by Conrail (formerly, the Reading Company). This proposed line will be approximately 8 miles long.

3. A proposed 230 kV line from Cromby Generating Station in East Pikeland Township, Chester County, to the Plymouth Meeting Substation of Philadelphia Electric Company in Plymouth Township, Montgomery County, along right-of-way in part presently owned and used by Philadelphia Electric Company and, in part, owned by Conrail. The portion presently owned by Philadelphia Electric Company contains a 66 kV line on lattice type structures which will be replaced by the proposed line. This proposed line will be approximately 13.5 miles long.

4. A proposed 230 kV line from Cromby Generating Station in East Pikeland Township, Chester County, to the North Wales Substation of Philadelphia Electric Company in Upper Gwynedd Township, Montgomery County, along right-of-way presently owned by or subject to an easement in favor of Philadelphia Electric Company and containing along its entirety a 138 kV line. This proposed line will be approximately 16 miles long.

5. A proposed 500 kV line from the proposed Limerick Generating Station in Limerick Township, Montgomery County, to the Whitpain Substation of Philadelphia Electric Company in Whitpain Township, Montgomery County, along right-of-way presently owned by Philadelphia Electric Company and containing several transmission lines along all or part of this right-of-way, including a 500 kV line. This proposed line will be approximately 16.5 miles long.

A copy of the application is available without cost upon written request to:

Philadelphia Electric Company
2301 Market Street,N3-1
Philadelphia, PA 19101

Attention: George N. DeCowsky
Chief Electrical Engineer

Very truly yours,

George N. DeCowsky

George N. DeCowsky
Chief Electrical Engineer
Philadelphia Electric Company

January 22, 1982

Pennsylvania Historical and Museum Commission
Mrs. Frank Piasecki, Chairperson
Box 1026
Harrisburg, PA 17120

Dear Mrs. Piasecki:

Enclosed is a copy of Docket P-810309, a petition by the Philadelphia Electric Company to the PA PUC. This docket was inadvertently omitted in our earlier letter to you dated January 13, 1982.

Very truly yours,

A. L. Milone

A. L. Milone
Philadelphia Electric Company

ALM:LCY
Enclosure

COMMONWEALTH OF PENNSYLVANIA
PENNSYLVANIA HISTORICAL AND MUSEUM COMMISSION
WILLIAM PENN MEMORIAL MUSEUM AND ARCHIVES BUILDING
BOX 1026
HARRISBURG, PENNSYLVANIA 17120

January 26, 1982

Mr. George N. DeCowsky
Chief Electrical Engineer
Philadelphia Electric Company
2301 Market Street
P.O. Box 8699
Philadelphia, PA 19101

Re: Proposed 230 kV line from proposed Limerick Generating Station to Cromby Generating Station, Montgomery & Chester Counties, File No. ER 82 042M 0047

Dear Mr. DeCowsky:

The above named application has been reviewed by the Bureau for Historic Preservation in accordance with Section 106 of the National Historic Preservation Act of 1966, Executive Order 11593 and the regulations of the Advisory Council on Historic Preservation (36 CFR 800).

There is a high probability that archeological resources may be affected by this project. A survey or limited testing of the area should be undertaken to locate potentially significant archeological resources. Guidelines and instructions for this phase are available from this office. If you have any questions, please call Kurt Carr at (717) 783-5216.

Sincerely,

Brenda Barrett
Director
Bureau for Historic Preservation
(717) 783-8947

QUESTION E320.1

Provide the following:

A production cost analysis which shows the difference in system production costs associated with the availability vs unavailability of the proposed nuclear addition. Note, the resulting cost differential should be limited solely to the variable or incremental costs associated with generating electricity from the proposed nuclear addition and the sources of replacement energy. If, in your analysis, other factors influence the cost differential, explain in detail.

a. The analysis should provide results on an annual basis covering the period from initial operation of the first unit through five full years of operation of the last unit.

b. Where more than one utility shares ownership in the proposed nuclear addition or where the proposed facility is centrally dispatched as part of an interconnected pool, the results of the analysis may be aggregated for all participating systems.

c. The analysis should assume electrical energy requirements grow at (1) the system's latest official forecasted growth rate, and (2) zero growth from the latest actual annual energy requirement.

d. All underlying assumptions should be explicitly identified and explained.

e. For each year (and for each growth rate scenario) the following results should be clearly stated: (1) system production costs with the proposed nuclear addition available as scheduled; (2) system production costs without the proposed nuclear addition available; (3) the capacity factor assumed for the nuclear addition; (4) the average fuel cost and variable O & M for the nuclear addition and the sources of replacement energy (by fuel type) - both expressed in mills per kWh; and (5) the proportion of replacement energy assumed to be provided by coal, oil, gas, etc. (The base year for all costs should be identified).

RESPONSE

The requested information will be provided in the first quarter of 1983.

QUESTION E320.2

Provide 30 yr levelized fuel and O & M costs (fixed and variable). Provide escalation, discount rates and all other variables assumed in calculating these costs.

RESPONSE

The requested information will be provided in the first quarter of 1983.

QUESTION E451.5 (Section 2.3)

Much of the information presented in the discussion of severe weather phenomena is not up to date. For example, the frequency of hurricanes is based on a period of record ending in 1963 and the tornado statistics are based on a period of record that ended in 1976.

a. Identify all hurricanes that have affected the site area since 1963 and update the number of storms (winds exceeding 74 mph) for those which have occurred since 1967.

b. Identify tornadoes that have occurred in the vicinity of the site since 1976, and provide revised estimates of mean path area, annual frequency and strike probability of tornadoes resulting from this change in data base.

c. Similarly, update the occurrence of thunderstorms, hail, ice storms and freezing rains, and peak winds.

RESPONSE

The requested information will be provided in October 1982.

QUESTION E451.6 (Section 2.3)

Section 2.3.1 of the ER provides a description of air quality in the vicinity of the site. Describe station sources of criteria air pollutants as defined by the Environmental Protection Agency, including estimated emissions, and compare these emissions to the DeMinimus criteria established by the Environmental Protection Agency (EPA). If station emissions are above the DeMinimus levels, provide a quantitative assessment of the impact of station emissions on local air quality using current EPA guidelines on atmospheric dispersion modeling.

RESPONSE

The requested information will be provided in the fourth quarter of 1982.

QUESTION E451.7 (Section 2.3.2)

Tables 2.3.2-26 through 2.3.2-31 present wind direction frequency distributions and Tables 2.3-2 through 2.3.2-25 present joint frequency distributions of wind direction and wind speed by atmospheric stability class. In both of these sets of distributions, calms are distributed by wind direction.

(1) Provide the definition of calm wind conditions, based on data reduction procedures, used to produce the frequency of calms in the tables.

(2) Provide a description of how the calm conditions were distributed according to the joint frequency of wind direction, wind speed and atmospheric stability class (vertical temperature difference method) in the tables and provide the actual frequencies of calm distributed by wind direction and atmospheric stability.

(3) Provide the basis for any departure from the definitions of calm in Regulatory Guide 1.111. Regulatory Guide 1.111 states that calms should be defined as hourly average wind speeds below the starting speed of the vane and anemometer, whichever is higher, and that calms, in joint frequency distributions should be assigned, as a separate wind speed class, to wind directions in proportion to the directional distribution, within an atmospheric stability class, of the lowest noncalm wind speed class.

RESPONSE

(1) Meteorological Evaluation Services, Inc. (MES) is the meteorological consultant for Philadelphia Electric. MES chart reading procedures state that wind speed shall be read as an hourly average. In the case of calm winds, this would be an hourly average of zero mph.

(2) During the five-year period (1972-1976) of record, chart reading procedures for wind directions during calm hours changed. Calm hours during the period 1972-1975 were assigned a direction of 777, indicating the trace was uninterpretable. However, examination of the charts from this period indicated that in most cases a direction could be obtained, and that despite the

limitations of such a procedure, it was preferable to an arbitrary assignment of direction for a given calm hour. Accordingly, the chart reading procedures were changed, and beginning January 1, 1976, a direction was read for each calm hour.

When calm hours were entered into the joint frequency distributions, those calm hours with uninterpretable directions were distributed uniformly among the directional sectors. Those calm hours with valid directions were put into the sector indicated by that direction. All calm hours were arbitrarily classified as stable and were entered into Class F in the lapse rate distributions.

Tables E451.7-1 through E451.7-7 contain distributions of calm hours from Tower 1, Tower 2, and the Satellite Tower. In each case the distribution of calm hours which were included in the Class F, 0-3 mph category of each wind rose are compared with the distribution of calms according to the Regulatory Guide 1.111 technique.

Because calm hours were arbitrarily placed in Class F in the earlier wind roses, it was possible for a calm hour with a missing delta temperature to be entered into the distribution. For this reason, the total number of calms in the Regulatory Guide 1.111 type distribution does not match the earlier totals.

(3) Regulatory Guide 1.111 states that calms should be defined as hourly average wind speeds below the starting speed of the vane or anemometer. The starting threshold of the Bendix six-bladed Aerovane is 1.8 mph. However, it is a well-known fact that once a propeller is set in motion, it can operate at speeds below the starting threshold. Unpublished tests conducted by Brookhaven National Laboratory at the New York University wind tunnel during the 1950s showed that the stopping threshold of the six-bladed Aerovane was roughly 1 ft/sec (0.7 mph) lower than the starting threshold. This indicates that hourly averages of 1 mph are possible.

In addition, MES chart readers are trained to distinguish a calm wind trace from a 1 mph trace based on an analysis of both the speed and direction traces. Figure E451.7-1 shows typical light wind speed traces, and an example of the differentiation between calm and 1 mph wind speeds. The hours ending at 6 and 7 a.m. are calm wind traces, evidenced not only by a 0 mph wind speed, but also by a "boxy" directional trace. However, during the hour ending at 8 a.m. and continuing into the following hour, both the speed and direction traces have become active, with speeds fluctuating between 0 and 2 mph. Both of these hours would be read as 1 mph.

The primary reason that calm hours were included in a 0-3 mph wind rose grouping rather than a separate class was to provide compatibility with MES dispersion models. However, it should be noted that Regulatory Guide 1.111 does not specifically say that calms should be assigned "as a separate wind speed class."

TABLE E451.7-1

LIMERICK GENERATING STATION

WEATHER STATION No. 1

JOINT FREQUENCY DISTRIBUTION OF CALM HOURS

1972-1976

30-FT. LEVEL

Directional Sector	Class F	Regulatory Guide 1.111 Technique Stability Class						
		A	B	C	D	E	F	G
NNE	247	0.04	0.19	0.41	13.76	42.01	52.40	32.45
NE	242	0.04	0.19	0.41	16.46	44.96	61.76	45.20
ENE	261	0.05	0.38	0.36	28.69	66.82	82.35	70.70
E	273	0.04	0.14	0.63	29.40	98.51	155.33	93.89
ESE	240	0.03	0.05	0.50	13.41	66.33	86.71	47.52
SE	240	0.01	0.19	0.54	13.76	74.93	77.36	41.73
SSE	244	0.05	0.38	1.04	21.29	71.00	61.76	16.23
S	254	0.10	0.47	1.49	27.52	88.93	79.23	15.07
SSW	241	0.10	0.28	1.13	21.05	62.64	40.55	20.86
SW	265	0.08	0.33	0.99	12.35	57.24	49.91	17.39
WSW	235	0.09	0.66	1.40	14.94	55.27	47.41	32.45
W	242	0.12	0.76	0.99	18.58	82.79	94.82	83.45
WNW	249	0.06	0.38	0.81	17.76	88.19	146.60	125.18
NW	247	0.05	0.24	0.45	12.82	74.44	126.60	88.01
NNW	240	0.05	0.24	0.32	12.82	54.78	54.90	47.52
N	254	0.07	0.14	0.54	15.41	47.17	54.27	38.25
Total	3974	1	5	12	290	1076	1272	816

Source: Meteorological Evaluation Services, Inc.

TABLE E451.7-2

LIMERICK GENERATING STATION
WEATHER STATION No. 1
JOINT FREQUENCY DISTRIBUTION OF CALM HOURS
1972-1976
175-FT. LEVEL

Directional Sector	Class F	Regulatory Guide 1.111 Technique Stability Class A	B	C	D	E	F	G
NNE	39	0.09	0.11	0.24	5.54	7.92	5.81	3.40
NE	40	0.09	0.27	0.15	3.69	8.44	6.37	1.59
ENE	38	0.09	0.16	0.12	7.46	11.19	4.87	2.72
E	43	0.04	0.11	0.15	8.31	17.56	10.11	5.21
ESE	44	0.09	0.00	0.24	4.85	11.02	5.62	2.04
SE	43	0.13	0.16	0.15	3.77	7.75	9.18	8.61
SSE	42	0.17	0.27	0.36	6.62	11.02	10.49	4.08
S	48	0.09	0.32	0.74	10.62	17.73	13.11	8.38
SSW	48	0.57	0.48	0.59	8.15	16.87	10.30	6.80
SW	42	0.30	0.32	0.44	4.54	13.26	9.74	7.93
WSW	41	0.17	0.37	0.41	6.23	11.36	11.24	6.57
W	39	0.43	0.48	0.38	5.77	18.25	20.98	11.56
WNW	43	0.13	0.16	0.47	5.46	18.08	21.73	17.90
NW	40	0.09	0.32	0.18	4.08	17.90	15.92	12.69
NNW	38	0.22	0.05	0.18	4.46	10.50	12.17	3.85
N	45	0.30	0.43	0.21	5.46	10.16	9.37	5.67
Total	673	3	4	5	95	209	177	109

Source: Meteorological Evaluation Services, Inc.

TABLE E451.7-3

LIMERICK GENERATING STATION

WEATHER STATION No. 1

JOINT FREQUENCY DISTRIBUTION OF CALM HOURS

1972-1976

270-FT. LEVEL

Directional Sector	Class F	Regulatory Guide 1.111 Technique Stability Class A	B	C	D	E	F	G
NNE	34	0.16	0.07	0.22	4.06	6.93	7.40	2.89
NE	33	0.05	0.09	0.13	3.04	8.26	3.70	3.37
ENE	28	0.05	0.16	0.16	5.45	8.26	5.88	3.85
E	35	0.07	0.12	0.16	6.40	8.59	8.27	4.58
ESE	26	0.05	0.09	0.19	4.44	6.44	3.70	1.45
SE	35	0.07	0.12	0.22	3.17	5.78	8.05	3.13
SSE	29	0.09	0.05	0.35	4.69	7.59	5.22	2.89
S	28	0.09	0.28	0.62	6.85	11.23	10.44	7.23
SSW	32	0.30	0.16	0.62	5.45	11.56	9.36	7.23
SW	30	0.23	0.14	0.43	4.69	8.75	10.66	6.75
WSW	31	0.16	0.09	0.43	3.93	8.26	11.53	8.19
W	32	0.26	0.21	0.38	4.25	12.55	14.36	5.78
WNW	32	0.12	0.09	0.32	4.56	12.22	12.62	8.91
NW	27	0.14	0.16	0.22	3.99	10.73	11.97	9.15
NNW	31	0.07	0.07	0.24	3.42	6.11	5.66	6.02
N	27	0.09	0.09	0.32	3.61	7.76	7.18	4.58
Total	490	2	2	5	72	141	136	86

Source: Meteorological Evaluation Services, Inc.

TABLE E451.7-4

LIMERICK GENERATING STATION

WEATHER STATION No. 2

JOINT FREQUENCY DISTRIBUTION OF CALM HOURS

4/72-3/73

30-FT. LEVEL

Directional Sector	Class F	Regulatory Guide 1.111 Technique Stability Class A	B	C	D	E	F	G
NNE	113	0.00	0.00	0.00	2.39	18.22	0.00	3.55
NE	113	0.00	0.00	0.00	0.30	5.20	3.56	0.00
ENE	113	0.00	0.00	0.00	2.17	19.70	3.56	0.00
E	113	0.00	0.00	0.00	5.09	29.37	1.78	0.00
ESE	113	0.00	0.00	0.00	3.66	45.73	19.58	10.64
SE	113	0.00	0.00	0.00	1.57	37.55	33.83	39.02
SSE	113	0.00	0.00	0.00	3.96	81.42	215.42	205.72
S	113	0.00	0.00	0.00	4.04	45.36	67.65	31.92
SSW	113	0.00	0.00	0.00	2.69	18.59	24.93	10.64
SW	113	0.00	0.00	0.00	0.37	5.58	3.56	0.00
WSW	113	0.00	0.00	0.00	1.94	12.27	8.90	3.55
W	113	0.00	0.00	0.00	3.89	27.51	30.27	10.64
WNW	113	0.00	0.00	0.00	3.22	45.73	51.63	14.19
NW	112	0.00	0.00	0.00	1.12	30.86	56.97	35.47
NNW	112	0.00	0.00	0.00	3.14	52.05	138.87	78.03
N	112	0.00	0.00	0.00	3.44	30.86	28.49	10.64
Total	1805	0	0	0	43	506	689	454

Source: Meteorological Evaluation Services, Inc.

TABLE E451.7-5

LIMERICK GENERATING STATION
WEATHER STATION No. 2
JOINT FREQUENCY DISTRIBUTION OF CALM HOURS
4/72-3/73
159-FT. LEVEL

Directional Sector	Class F	Regulatory Guide 1.111 Technique Stability Class A	B	C	D	E	F	G
NNE	45	0.00	0.00	0.00	0.82	8.08	7.77	6.01
NE	45	0.00	0.00	0.00	0.44	6.97	4.78	1.72
ENE	45	0.00	0.00	0.00	1.53	9.47	6.57	2.58
E	45	0.00	0.00	0.00	1.64	15.88	7.77	5.15
ESE	45	0.00	0.00	0.00	1.64	22.29	27.49	12.03
SE	45	0.00	0.00	0.00	1.26	16.72	20.92	13.74
SSE	45	0.00	0.00	0.00	1.64	16.16	25.10	27.49
S	45	0.00	0.00	0.00	1.31	13.93	17.93	12.03
SSW	45	0.00	0.00	0.00	1.26	9.20	11.95	12.89
SW	45	0.00	0.00	0.00	0.22	6.69	12.55	5.15
WSW	44	0.00	0.00	0.00	0.87	6.69	14.94	7.73
W	44	0.00	0.00	0.00	1.80	10.87	28.69	13.74
WNW	44	0.00	0.00	0.00	1.04	12.54	22.11	22.33
NW	44	0.00	0.00	0.00	0.49	13.65	21.52	28.35
NNW	44	0.00	0.00	0.00	1.31	13.37	20.92	16.32
N	44	0.00	0.00	0.00	1.75	14.49	8.97	7.73
Total	714	0	0	0	19	197	260	195

Source: Meteorological Evaluation Services, Inc.

TABLE E451.7-6

LIMERICK GENERATING STATION
WEATHER STATION No. 2
JOINT FREQUENCY DISTRIBUTION OF CALM HOURS
4/72-3/73
304-FT. LEVEL

Directional Sector	Class F	Regulatory Guide 1.111 Technique Stability Class						
		A	B	C	D	E	F	G
NNE	11	0.00	0.00	0.00	0.41	3.88	1.15	1.07
NE	11	0.00	0.00	0.00	0.23	2.26	1.73	0.53
ENE	11	0.00	0.00	0.00	0.52	5.17	2.31	1.33
E	11	0.00	0.00	0.00	0.52	4.68	1.15	1.07
ESE	11	0.00	0.00	0.00	0.52	7.11	2.60	0.80
SE	11	0.00	0.00	0.00	0.36	2.75	2.31	1.87
SSE	10	0.00	0.00	0.00	0.67	5.01	6.35	1.33
S	10	0.00	0.00	0.00	0.59	5.65	4.91	3,47
SSW	10	0.00	0.00	0.00	0.23	3.55	2.89	0.80
SW	10	0.00	0.00	0.00	0.10	1.78	2.60	1.33
WSW	10	0.00	0.00	0.00	0.39	1.78	2.02	2.67
W	10	0.00	0.00	0.00	0.62	3.55	4.62	3.73
WNW	10	0.00	0.00	0.00	0.49	5.01	5.48	4.27
NW	10	0.00	0.00	0.00	0.13	3.88	10.10	4.00
NNW	10	0.00	0.00	0.00	0.52	3.72	4.91	1.60
N	10	0.00	0.00	0.00	0.70	3.23	2.89	2.13
Total	161	0	0	0	7	63	58	32

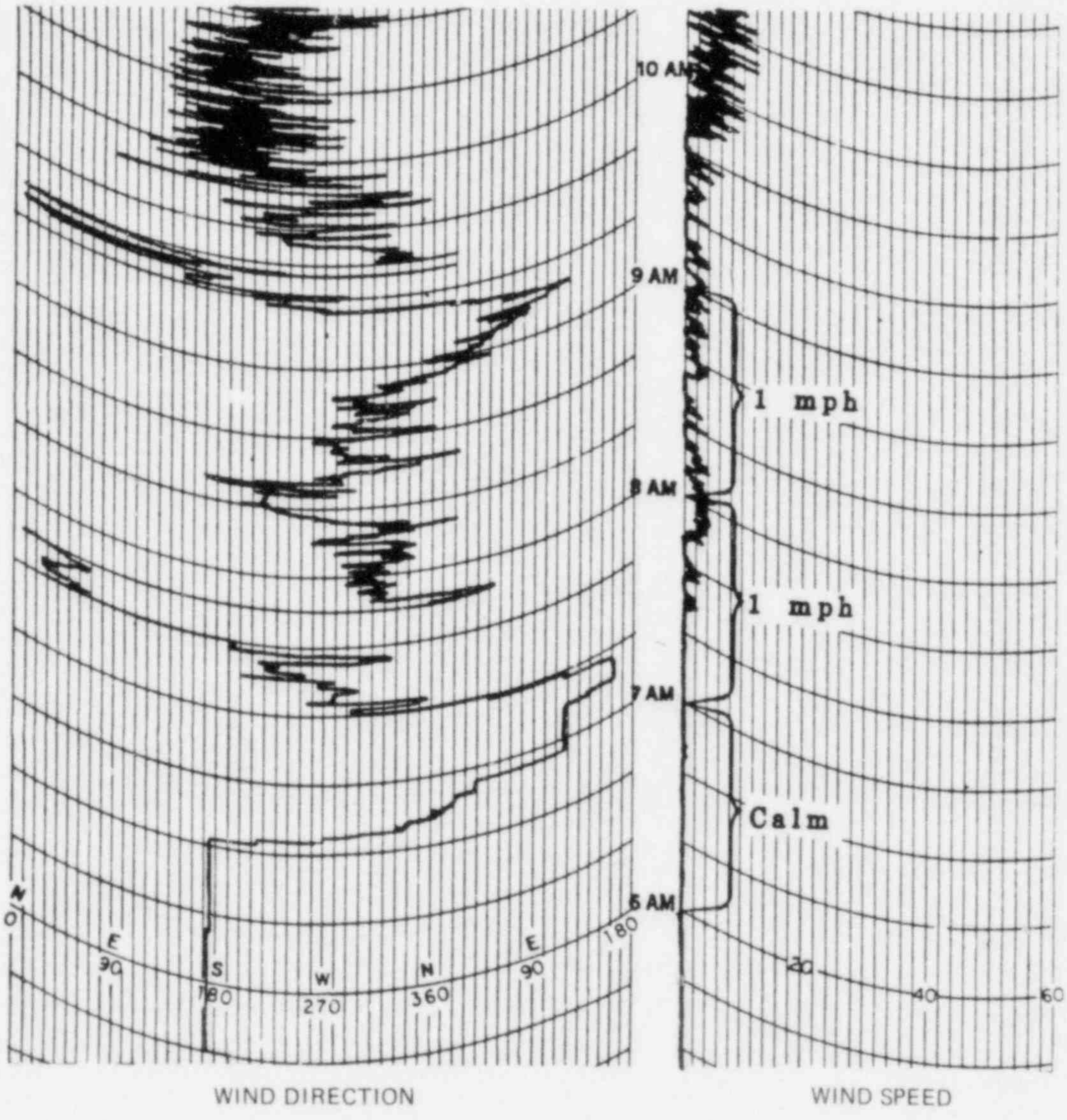
Source: Meteorological Evaluation Services, Inc.

TABLE E451.7-7

LIMERICK GENERATING STATION
SATELLITE TOWER
JOINT FREQUENCY DISTRIBUTION OF CALM HOURS
1/75-12/76
32-FT. LEVEL

Directional Sector	Class F	Regulatory Guide 1.111 Technique Stability Class A	B	C	D	E	F	G
NNE	95	0.00	0.00	0.19	4.00	9.07	6.55	7.28
NE	92	0.00	0.00	0.00	3.77	11.08	2.62	4.85
ENE	95	0.00	0.00	0.00	7.30	11.59	7.86	12.13
E	129	0.00	0.00	0.00	16.48	69.52	32.73	14.56
ESE	182	0.00	0.00	0.38	8.00	86.15	70.70	41.26
SE	183	0.00	0.00	0.19	8.47	97.74	75.94	19.42
SSE	149	0.00	0.00	0.95	10.59	86.15	57.94	9.71
S	93	0.00	0.91	2.08	11.06	44.33	57.61	4.85
SSW	78	0.00	0.91	1.32	5.53	13.10	14.14	0.00
SW	78	0.00	0.23	0.00	3.18	9.57	5.24	2.43
WSW	78	0.00	0.69	1.51	4.94	16.63	2.62	2.43
W	80	0.00	1.60	2.46	6.71	39.80	2.62	7.28
WNW	116	0.00	1.14	1.51	6.94	53.91	15.71	19.42
NW	120	0.00	0.91	1.14	7.53	70.03	23.57	24.27
NNW	143	0.00	0.91	1.70	9.42	68.52	61.54	33.98
N	106	0.00	0.69	0.57	7.06	41.82	51.06	12.13
Total	1817	0	8	14	121	729	508	216

Source: Meteorological Evaluation Services, Inc.



LIMERICK GENERATING STATION
UNITS 1 AND 2
ENVIRONMENTAL REPORT

TYPICAL LIGHT WIND TRACES

FIGURE E 451.7-1 REV. 6, 09/82

QUESTION E451.8 (Section 2.3)

Five years (1972-1976) of data record have been submitted in joint frequency distribution form. Regulatory Guide 4.2 (Revision 2) states that the data set should include the most recent one year period for an operating license application. Provide the joint frequency distributions of wind direction and wind speed by atmospheric stability class (as defined by vertical temperature difference) for the most recent annual cycle of meteorological data (1980 or later) for all levels of wind and vertical temperature difference measurements based on data from tower 1 and, if available, from the other towers. The data year selected should represent conditions which were unobstructed by temporary terrain modifications. Provide the frequency (hours and percent) of calms (as defined in question E451.7 from Regulatory Guide 1.111) by stability class and do not include calms in the joint frequency distribution tables by wind direction.

RESPONSE

Both items 1 and 2 have been transmitted to the NRC by letter from J. S. Kemper to A. Schwencer dated September 1, 1982. One copy of the magnetic tape and five copies of the joint frequency distributions were included with the letter. As required by Regulatory Guide 1.70, section 2.3.3, this material represents the most recent one-year period of record currently available.

QUESTION E451.9 (Section 6.1.3)

Table 6.1-32 provides meteorological system specifications and accuracies. This table does not include the accuracies for temperature difference measurements. Provide the component and system accuracies for these measurements.

RESPONSE

Table 6.1-32 has been changed to provided the requested information.

QUESTION E451.10

In Section 5.2B 2.2 of Appendix 5.2B, it is stated that annual average concentration of noble gases are decayed using the average wind speed in each section. Provide the basis for using simple arithmetic averages of wind speed rather than geometric means, since the decay process is an exponential function.

RESPONSE

A comparison was made between the arithmetic mean wind speed by sector and the geometric mean wind speed by sector for meteorological data collected between 1972 and 1976 at Limerick Tower 1, El. 175 ft. The results indicate that the geometric mean wind speeds in each case were slightly lower, by approximately 1 to 2 mph, than the arithmetic mean wind speeds. Thus, by using arithmetic mean wind speeds to account for radionuclide decay during transit to a receptor location, our results were slightly more conservative. Although it may be more technically appropriate to use geometric means, use of arithmetic means resulted in doses that were insignificantly higher.

QUESTION E451.11

Since the long term diffusion estimates are based on wind measured at the 175-foot level and atmospheric stability is based on the Brookhaven Turbulence Class System and the Smith-Singer vertical dispersion coefficients,

(1) provide the basis for utilization of these parameters, because they differ from those primarily recommended in Regulatory Guide 1.111, and

(2) provide a comparison of these diffusion estimates with diffusion estimates based on wind measured at the 30-foot level and vertical temperature difference as the stability indicator with vertical dispersion curves as indicated in Regulatory Guide 1.111.

RESPONSE

(1) The long-term diffusion estimates for the Limerick Plant were based upon the Smith-Singer vertical dispersion parameters and the Brookhaven Turbulence Class system because we believe that this system is more appropriate for the release and terrain characteristics of the Limerick site than the Regulatory Guide 1.111 parameters.

A. Vertical Dispersion Curves

Regulatory Guide 1.111 specifies that the Pasquill-Gifford or P-G dispersion coefficients be used for long--term dispersion estimates. However, there are several sound reasons for using the Brookhaven (Smith-Singer) coefficients instead:

1. Surface Roughness

The P-G dispersion coefficients were developed primarily from the Prairie Grass diffusion experiments at O'Neill, Nebraska. The Prairie Grass data were collected in extremely flat, smooth terrain with a roughness length, z_0, of 3 cm. In contrast, the Brookhaven coefficients were developed in an area of scrub pines and oaks, with a roughness length of 1 meter. The Limerick region, characterized by a combination of buildings, open fields and trees, is much more similar to Brookhaven than to O'Neill, Nebraska.

2. Release Elevation

The Prairie Grass experiments consisted of a series of ground level SO_2 releases, with concentrations measured at downwind distances of up to 800 meters. Extrapolation of these curves to distances beyond one kilometer is based on limited observations. The Brookhaven dispersion coefficients, on the other hand, are based on both elevated and low level releases. The standard curves published by Smith (Ref. E451.11-1) in the ASME Guide were derived from plumes released at 108 meters and tracked for more than 50 km. In addition, a second set of unpublished dispersion coefficients were developed from low level releases, as shown in FSAR Section 2.3.5.3.4.

The entrainment coefficients from Regulatory Guide 1.111 specify that the Limerick plume will be elevated 84 percent of the time. In these cases, the standard Brookhaven coefficients were used. For the remaining 16 percent of the time, the low level coefficients were used.

The 1977 AMS workshop on stability classification schemes and sigma curves (Ref 5.2-8) clearly supported the use of the Brookhaven curves in preference to the P-G curves where elevated sources in rolling terrain are involved:

> "For elevated sources, the "Brookhaven" curves (M.E. Smith, 1968) are an appropriate choice when σz is less than the effective source height. These curves are based on average concentration measurements from a passive source at an elevation of 108 m. They differ from the Pasquill-Gifford and Turner curves both because the source was elevated and because the measurement site was surrounded by a much rougher surface, mostly forests,

from which Z_0 equals approximately 1 m."

3. Averaging Time

The Prairie Grass project consisted of short duration field experiments, with the P-G horizontal coefficient representing 3 minute averages, and the vertical coefficients 10 minute averages. In contrast, all of the Brookhaven data from which the dispersion curves were derived were hourly averages.

4. Validation

While model validation is a somewhat nebulous and controversial area, attempts have been made to verify the appropriateness of the more commonly used dispersion coefficients with field data. A recent study by Weil (Ref. E451.11-2) at the coal-fired Dickerson power plant in Maryland found that when using the Gaussian plume model with the Brookhaven dispersion coefficients, predicted concentrations were within a factor of two during 73 percent of the cases analyzed. Conversely, the P-G coefficients at times resulted in orders of magnitude disagreement between predicted and measured concentrations.

The Dickerson Plant releases a buoyant plume from stacks approximately 400-feet tall, so the analogy with Limerick is not clearcut. However, the results indicate that the Brookhaven curves are preferable.

B. Stability Class Determination

Because the Brookhaven dispersion coefficients are used in the Limerick analysis, it is reasonable and consistent to use the Brookhaven stability classification system as well. The two were developed together and are part of a cohesive system.

Furthermore, although the classification system based on delta temperature is recommended by NRC, the ΔT method has been criticized by the scientific community. It seems clear that the system produces an inordinately high percentage of neutral hours, and several recent workshops and publications have recommended that the system be changed. Several of these suggestions are worth reiterating:

1. Weber et al. (Ref E451.11-3) conducted a regression analysis comparing several stability classification schemes with vertical dispersion data from the Prairie Grass, Green Glow, and National Reactor Testing Station experiments. The results from this study showed that during unstable conditions, delta temperature did not correlate at all with the measured concentrations. In stable conditions, delta temperature compared favorably with the other stability classification systems, but the authors cautioned that a strict correlation should only be found for delta temperature measured in the surface layer (<10 meters) and that there was no reason to expect correlation at higher levels.

2. AMS Workshop - At the 1977 American Meteorological Society workshop on stability classification schemes and sigma curves, there were lengthy discussions of the various methods available to classify stability. The workshop recommended that the standard deviation of the horizontal wind direction fluctuations, sigma theta, be used to estimate horizontal diffusion rates, and that dimensionless ratios of temperature lapse rate and wind speed be used to specify vertical turbulence. The workshop also said that there is little physical justification for the current practice of estimating vertical diffusion based on temperature lapse rate data alone.

   It seems contradictory that the NRC has referenced the report from this workshop in the proposed Revision 1 of Regulatory Guide 1.23, yet ignored some of these fundamental recommendations.

3. Gifford (Ref E451.11-4), in a memo to the Advisory Committee on Reactor Safeguards (ACRS) regarding the proposed Revision 1 of Regulatory Guide 1.23,

reiterates his objection to the use of delta temperature. Gifford states:

> "My main objection (a long-standing one) to the draft is that it continues to recommend the so called ΔT-method (or Δθ method as the primary means of determining σy and σz (p 6, lines 12 & 13). The problems involved, and limitations of this methodology are clearly set out in the American Meteorological Society workshop report on the subject, Ref. 1 in the proposed revision. This reference (Bulletin AMS, 58, p 1306) states "There is little physical justification for the currently widespread practice of approximating S'" (the stability factor) "by - Δθ alone....in stable conditions the effects of topography....may equally invalidate - Δθ and S' as determinants of σz". The reference goes on to stress problems of determining σz in other types of conditions (i.e. unstable, daytime) and stresses the poor state of our observational knowledge at present. Finally, problems of the Δθ method (p 1309) are discussed in detail, pointing out the desirability of a more physically based indicator such as the bulk Richardson number S'; and also the problem of measuring Δθ/ΔZ in a meaningfully shallow layer with present requirements for siting the upper temperature sensor (60 m) is pointed out."

Clearly, the ΔT method is not entirely palatable to the scientific community, and there is little doubt that the Brookhaven system is at least as good an indicator of stability. Particularly for the Limerick site and source elevations, the Brookhaven system offers some distinct advantages. The Brookhaven classes are based on the "gustiness" or short-term fluctuations of wind direction trace averaged over an hour and are a physical representation of the horizontal turbulence of the wind flow. In addition, the Brookhaven system determines the atmospheric stability in the region of the actual effluent release, which was another of the AMS Workshop recommendations.

(2) Regulatory Guide 1.111 states that wind speeds representative of the vent release elevation should be used for long-term dispersion estimates. Accordingly, wind data from the 175-ft level of Tower 1 were used for the Limerick annual X/Q calculations. This instrument is within 9 ft MSL of the Limerick vent elevation. For the elevation portion of the mixed mode release, wind speeds were not corrected for source elevation. However, for the low level portion of the mixed mode release, speeds were adjusted by standard power law techniques to the 10 meter level.

Figure E451.11-1 shows a comparison of the annual X/Q values from EROL Table 5.2-4, which were computed using Brookhaven dispersion coefficients. These values represented by the dashed line are from a similar calculation with ΔT stability and the P-G dispersion coefficients of Regulatory Guide 1.111. The comparison shows that the Brookhaven coefficients were more sensitive to terrain elevation because the lower portion of the mixed mode release is set at 10 meters in the BNL model, as compared to a ground level release in the Regulatory Guide 1.111 model. Otherwise, the values are quite similar.

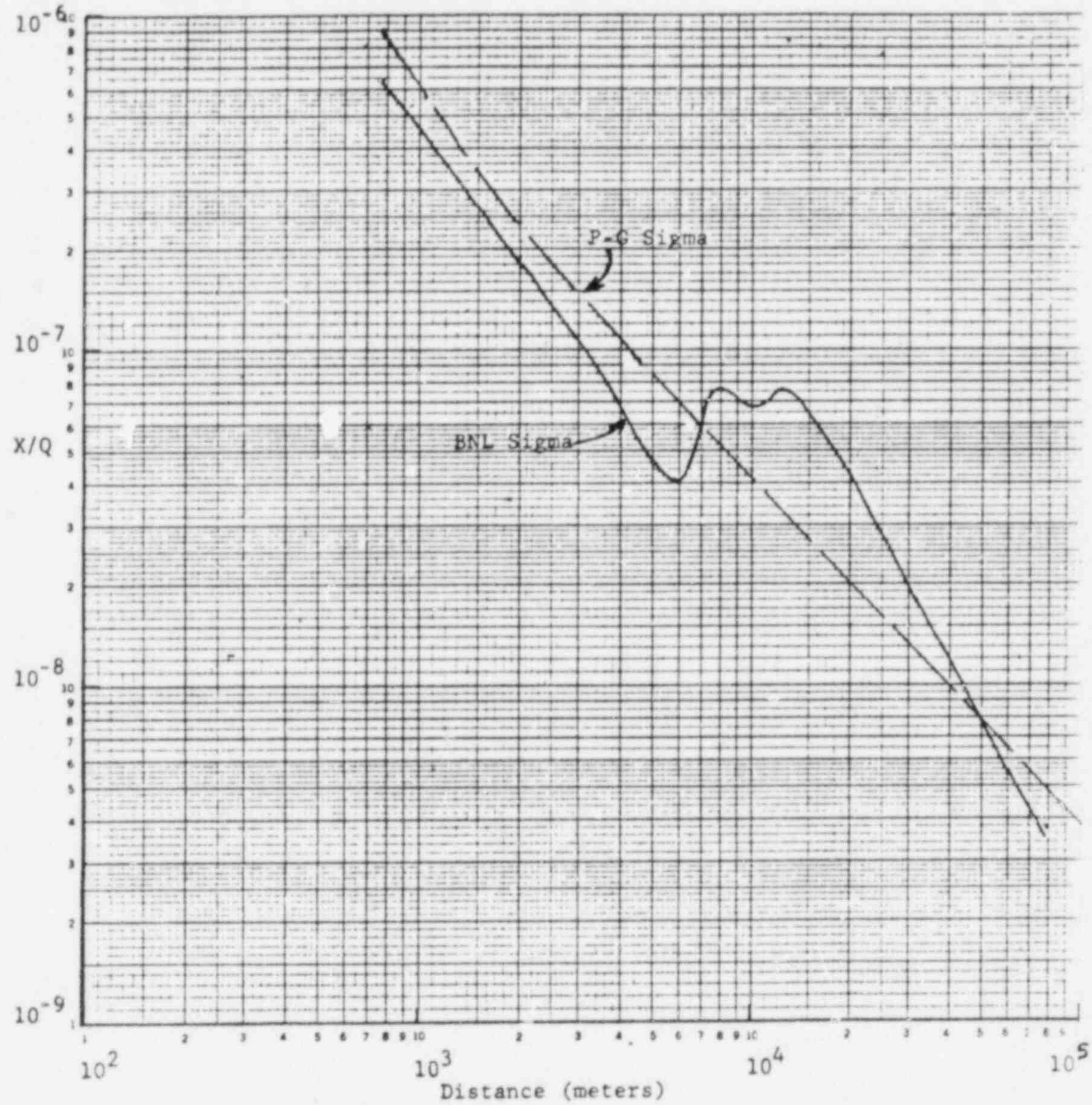
References

E451.11-1 Smith, M.E., Ed.: Recommended Guide for the Prediction of the Dispersion of Airborne Effluents, ASME, 1968.

E451.11-2 Weil, J.C. and A.F. Jepsen: Evaluation of the Gaussian Plume Model at the Dickerson Power Plant, Atmos. Environ., Vol. 11, pp. 901-910, 1977.

E451.11-3 Weber, A.H., et al.: Turbulence Classification Schemes for Stable and Unstable Conditions, in preprints of the First Joint Conference on Applications of Air Pollution Meteorology, American Meteorological Society, November 1977, pp. 96-102.

E451.11-4 Gifford, F. A.: Memo to Advisory Committee on Reactor Safeguards Regarding the Proposed Revision 1 of Regulatory Guide 1.23, May 26, 1980.



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COMPARISON OF ANNUAL
X/Q VALUES USING 175' LEVEL
WITH ESE SECTION WIND

FIGURE E 451.11-1

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