LIMERICK GENERATING STATION UNITS 1 & 2

ENVIRONMENTAL REPORT - OPERATING LICENSE STAGE

REVISION 14 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.

After the revised pages are inserted, place the page that follows these instructions in the front of Volume 1.

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THIS EROL SET HAS BEEN UPDATED TO INCLUDE REVISIONS THROUGH 14 DATED 07/83.

CHAPTER 1

PURPOSE OF LIMERICK GENERATING STATION AND ASSOCIATED TRANSMISSION

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CHAPTER 1

PURPOSE OF LIMERICK GENERATING STATION AND ASSOCIATED TRANSMISSION

1.1 SYSTEM DEMAND AND RELIABILITY

1.1.1 LOAD CHARACTERISTICS

The Applicant, Philadelphia Electric Company, serves customers in the southeastern portion of the Commonwealth of Pennsylvania, and in a small northeastern portion of the state of Maryland. In 1982, the Applicant's system served 1,331,729 electric customers in an area of 2340 square miles, with a population of approximately 3.7 million people. The customers located in the Pennsylvania portion of the territory used 98.3% of the total kilowatt-hours sold.

The Applicant's customer load has similar characteristics to other metropolitan power systems in the northeastern U.S. Table 1.1-1 lists by customer class the 1982 actual energy sales and the estimated energy sales for 1983 through 1992. In 1982, the percentage split between major classes of customers was residential 30%; small commercial and industrial 12%; large commercial and industrial 54%; and other 4%. Large commercial and industrial customers include such heavy industries as steel production, single-point-metered apartment buildings, and department stores.

The Applicant is the largest electric power system, in terms of both peak demand and kilowatt-hour sales, in the Commonwealth of Pennsylvania. The Applicant serves Philadelphia, the largest city in the state, and the fourth largest city in the country. The maximum system demand of 6095 MW occurred on July 21, 1980. At the time of the peak, 5577 MW of the Applicant's 7698 MW of installed generating capacity were available to meet this demand.

The deficit was supplied by the Pennsylvania-New Jersey-Maryland Interconnection (PJM).

In 1927, the Applicant became one of the three original members of the Pennsylvania-New Jersey-Maryland (PJM) Interconnection. The present PJM pool members are: Public Service Electric and Gas Company, Philadelphia Electric Company, Atlantic Electric Company, Delmarva Power & Light Company, Pennsylvania Power & Light Company Group (Pennsylvania Power & Light Company, UGI Corporation), Baltimore Gas and Electric Company, General Public Utilities Corporation (Jersey Central Power & Light Company,

Metropolitan Edison Company, Pennsylvania Electric Company), and the Potomac Electric Power Company.

This power pool serves a population of about 21 million people in a 50,000-square-mile area including three-quarters of Pennsylvania, almost all of New Jersey, more than half of Maryland, all of Delaware and the District of Columbia, and a small part of Virginia. The maximum PJM system demand of 34,420 megawatts occurred July 21, 1980. At the time of the peak 35,419 megawatts of the power pools 45,030 megawatts of installed generating capacity were available to meet this demand. The pool operates under a written agreement that provides for operating the bulk power supply (generation and transmission) of each company as an integral part of the total PJM system. The pool operates as a single control area with minute-to-minute economic dispatch of generation, and free flow of power between the companies.

The Applicant is also a party to the Mid-Atlantic Area Council (MAAC) which provides for the coordinated planning of generation and transmission facilities by the companies included in the PJM Interconnection. Since the service territories of the signatories to the MAAC agreement are the same as those included in the PJM Interconnection, all references to the PJM Interconnection will also apply to the MAAC reliability council.

1.1.1.1 Load Analysis

The Applicant's past and projected system annual energy output, peak demand, installed generating capacity, and installed reserve capacity from 1970 to 1992 are shown in Table 1.1-2. The energy output and peak demand projections are based upon the Applicant's customers continuing to conserve energy. Information on the Applicant's activities to promote the conservation of energy is detailed in Ref. 1.1-4, which is submitted annually to the Pennsylvania Public Utility Commission in compliance with Legistative Act 216.

The projected PJM Interconnection system's annual energy output, peak demand, installed generating capacity, and installed reserve capacity from 1970 to 1992 are shown in Table 1.1-3.

The projected load duration curves for the Applicant's system for the year 1982 and the years 1985 through 1990 are shown in Figures 1.1-1 through 1.1-7.

1.1.1.2 Demand Projections

The Applicant's baseline annual peak demand projections are listed in Table 1.1-2. The high and low range annual peak demand projections are shown in Table 1.1-4. The Applicant has an ongoing program for reviewing the methodology for forecasting the annual peak demand. The current method was adopted in 1975 after

extensive testing showed that it was superior to the method then in use. The current method for forecasting peak demand is outlined in Appendix C.

The uncertainty of the effects of energy policies and laws being formulated at the national level, and the uncertainty of the effects of the amount of economic activity in the Applicant's service area, have prompted the Applicant to develop a range of peak demand forecasts. As with any forecast, the accuracy of the basic assumptions directly affects the accuracy of the forecast. If there is an upsurge of economic activity in the Applicant's service territory, then the annual peak demands will approach the high range demand projections. From past experience, unforeseen and unforeseeable events can substantially alter actual levels from those that are forecasted. Energy projections that correspond to these peak demand projections are found in Table 1.1-4. The methodology and the assumptions underlying these demand and energy forecasts are described in Appendix 1.1B.

Monthly data for actual peak demand and total kWh sales from October 1972 through December 1982 are shown in Table 1.1-5.

1.1.1.3 Power Exchanges

Large long-term capacity purchases have been investigated and are not feasible to meet the Applicant's requirements. Therefore, the Applicant must carry out its responsibility and provide generating capacity to meet future system demands.

The Applicant's only past capacity purchase occurred when the Applicant temporarily purchased 200 MW of generating capacity from Delmarva Power & Light Company from August 1973 to April 1975.

The Applicant owns a 42.59% undivided interest in the 1115-MW Unit 2 at Salem Nuclear Generating Station, which was placed in service in October 1981. An agreement between the Applicant and Jersey Central Power & Light Company provides for the sale by the Applicant of energy and capacity to Jersey Central Power & Light Company during an initial period beginning with the date of the first electric output from Salem Unit 2 to January 1, 1985, and, upon mutual agreement of the parties, during additional successive periods of 1 year each.

Under the agreement, Jersey Central Power & Light Company will purchase energy and operating capacity from the Applicant in an amount equal to the Applicant's share of the output of Salem Unit 2. Jersey Central Power & Light Company will also purchase installed capacity whenever it needs additional capacity to meet its requirements, provided the amount of such purchase does not exceed either the Applicant's share of Salem Unit 2 capacity, or the Applicant's capacity in excess of its own requirements. Such

capacity requirements will be determined in accordance with the PJM Agreement.

This agreement will have no effect on the Applicant's reserve calculations as presented in this report.

There are no other planned capacity exchanges.

1.1.2 SYSTEM CAPACITY

The object of the Applicant's planning process is to plan an electric system that will reliably supply electricity at a minimum cost to customers.

A list of all installed generating units, with their respective fuel types and capacity as of January 1, 1983, is shown in Table 1.1-6. Capacity additions and retirements for 1983 through 1992 are listed in Table 1.1-7.

Generation planning begins with the forecast of annual sales and peak demands. At least once a year, the annual sales and peak demands are estimated for a minimum of 10 years. In addition, the generation reserves necessary to reliably supply these forecast annual peak demands are calculated. The total generation required, peak demand plus reserve, is compared to the installed generation minus scheduled retirements plus committed new generating capacity. When this total forecast generation requirement exceeds the forecast supply, additional generating capacity is planned.

Historically, the Applicant has planned generating capacity additions using the baseline annual demand forecast to determine need. In the late 1960s, demand forecasts fell short of actual peaks, resulting in a decrease in reserve levels. In the early 1970s, when the available reserve generating capacity was lower than anticipated, the option to install short lead time oil-fired generating units was available. Because of current Federal government policies, short lead time oil-fired generating units can no longer be used to bridge the gap if installed generating capacity shortages occur.

If the annual peak demand grows at a more rapid rate than expected, the installation of large generating units cannot be expedited. If installed generating capacity should be inadequate to supply annual peak demand, nothing can be done but reduce, or eliminate, service to selected customers. (See Section 1.3.1, Effect of Delay on Reliability.)

The program of planned generation additions and retirements is reviewed annually. It is modified on a timely basis as changes in peak demand forecasts, and slippages in the service dates of committed generating units warrant. The type of generating unit

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	Actual 1982	1983	
Residential	6,639	6,683	
House Heating	1,238	1,357	
Small Comm. and Ind.	3,142	3,244	
Large Comm. and Ind.	14,178	14,587	1
Street Lighting	194	186	
Railroads & Railways	651	639	
Sales for Resale	107	112	
Interdepartment	61	58	
Total	26,210	26,866	2

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TABLE 1.?-1

TED ELECTRIC SALES BY CUSTOMER CLASS
PHILADELPHIA ELECTRIC COMPANY

MILLION kWh

4	1985	1986	1987	1988	1989	1990	1991	1992
53	6,599	6,538	6,477	6,414	6,327	6,238	6,146	6,057
70	1,600	1,733	1,870	2,008	2,142	2,275	2,409	2,542
13	3,356	3,405	3,447	3,491	3,537	3,584	3,631	3,677
95	14,999	15,213	15,418	15,575	15,722	15,874	16,023	16,181
87	189	191	193	194	195	196	197	198
39	639	639	639	639	639	639	639	639
13	114	115	116	117	118	119	120	121
58	59	60	60	61	62	62	63	63
28	27,555	27,894	28,220	28,499	28,742	28,987	29,228	29,478

ANNUAL SALES,

YEAR	ANNUAL SALES (10^6 kWh)	APPLICANT PREDICTED ANNUAL SALES (10^6 kWh)	PEAK DEMAND[1] (MW)
1970	22,813	-	4,712
1971	23,458	-	4,922
1972	24,506	-	5,313
1973	26,301	-	5,760
1974	25,556	-	5,431
1975	25,335	-	5,530
1976	26,273	-	5,346
1977	27,197	-	5,888
1978	27,394	-	5,667
1979	27,601	-	5,641
1980	27,621	-	6,095
1981	27,050	-	5,731
1982	26,272	-	5,691
1983	-	26,866	-
1984	-	27,229	-
1985	-	27,555	-
1986	-	27,894	-
1987	-	28,226	-
1988	-	28,499	-
1989	-	28,742	-
1990	-	28,987	-
1991	-	29,228	-
1992	-	29,475	-

(1) Peak demand is not adjusted for temperatu
(2) This is the baseline annual peak demand f

TABLE 1.1-2

YSTEM PEAK DEMAND, GENERATION, AND RESERVES
HILADELPHIA ELECTRIC COMPANY

APPLICANT PREDICTED DEMAND(2) (MW)	TOTAL SYSTEM CAPACITY AT TIME OF PEAK (MW)		RESERVE CAPACITY (MW)	
	AVAILABLE	INSTALLED	AVAILABLE	INSTALLED
-	4,475	5,357	-237	645
-	4,780	5,928	-142	1,006
-	4,851	6,136	-462	823
-	5,660	5,377	-100	617
-	6,110	6,967	679	1,536
-	5,826	7,214	296	1,684
-	6,711	7,167	1,365	1,821
-	6,121	8,202	233	2,314
-	6,643	7,727	976	2,060
-	6,388	7,727	746	2,086
-	5,577	7,698	-518	1,603
-	7,246	7,574	1,515	1,843
-	7,122	8,006	1,431	2,315
5,600	-	7,957	-	2,357
5,650	-	7,957	-	2,307
5,700	-	8,370	-	2,670
5,750	-	8,370	-	2,620
5,800	-	8,370	-	2,570
5,850	-	8,012	-	2,162
5,900	-	8,795	-	2,895
5,950	-	8,795	-	2,845
5,980	-	8,795	-	2,815
6,010	-	8,795	-	2,785

variations, voltage reductions, or other curtailments.
ecast.

ANNUAL
PENNSY

YEAR	ANNUAL OUTPUT (10⁶ kWh)	PJM PREDICTED OUTPUT (10⁶ kWh)	PEAK DEMA (MW
1970	130,504	-	23,
1971	136,208	-	25,
1972	145,158	-	27,
1973	148,950	-	30,
1974	155,362	-	29,
1975	151,274	-	28,
1976	159,679	-	29,
1977	163,363	-	32,
1978	169,766	-	31,
1979	172,540	-	31,
1980	176,920	-	34,
1981	175,760	-	33,
1982	172,818	-	33,
1983	-	173,819	-
1984	-	179,253	-
1985	-	183,655	-
1986	-	187,690	-
1987	-	191,421	-
1988	-	195,723	-
1989	-	197,951	-
1990	-	204,002	-
1991	-	207,785	-
1992	-	211,488	-

TABLE 1.1-3

PUT, PEAK DEMAND, GENERATION, AND RESERVES
ANIA, NEW JERSEY, MARYLAND INTERCONNECTION

	PJM PREDICTED DEMAND (MW)	TOTAL SYSTEM CAPACITY (MW) AVAILABLE	TOTAL SYSTEM CAPACITY (MW) INSTALLED	RESERVE CAPACITY (MW) AVAILABLE	RESERVE CAPACITY (MW) INSTALLED
8	-	24,316	28,235	478	4,397
9	-	27,001	31,116	1,472	5,587
2	-	28,793	33,864	941	6,012
3	-	30,981	35,879	-12	4,886
5	-	31,160	37,215	2,095	8,150
9	-	34,770	40,425	5,801	11,276
4	-	34,969	41,636	5,705	12,372
0	-	34,410	44,362	5,146	12,182
6	-	38,038	44,026	6,352	12,340
4	-	36,524	44,891	4,870	13,237
0	-	35,419	45,030	999	10,660
8	-	34,651	44,855	1,123	11,327
1	-	36,511	45,796	2,770	12,055
	34,080	-	48,137	-	14,057
	34,730	-	48,913	-	14,183
	35,340	-	50,313	-	14,973
	35,890	-	50,506	-	14,616
	36,440	-	51,514	-	15,074
	37,110	-	51,777	-	14,667
	37,800	-	52,560	-	14,760
	38,450	-	52,385	-	13,935
	39,050	-	51,340	-	12,290
	39,630	-	52,203	-	12,573

1.2 OTHER OBJECTIVES

The primary objective of installing Limerick Generating Station is to supply economical and reliable electric power to the customers of the Applicant.

Another objective is to reduce the amount of oil used to produce electricity.

The following table demonstrates the Applicant's reliance on oil-fired generation in 1990 to supply the forecast baseline demand, and the high and low range demands.

1990 INSTALLED CAPACITY BY FUEL AS A PERCENTAGE OF FORECAST PEAK DEMAND

	Percentage of Forecast Peak Demand		
Fuel	High Range (6550 MW)	Baseline (5950 MW)	Low Range (5400 MW)
Coal	22	25	27
Hydro	21	23	26
Nuclear (without Limerick)	28	31	34
Total A*	71	79	87
Limerick Units 1 and 2	32	35	39
Total B*	103	114	126
Oil	31	32	37
Total C*	134	146	163

* Total A excludes Limerick Units 1 and 2 oil-fired generation.
Total B excludes oil-fired generation.
Total C includes all units.

From the above table, the oil-fired installed generating capacity is approximately one-third of the estimated peak demand regardless of the forecast peak demand used. In all cases, total B is greater than 100%. This means that all oil-fired generation will be used for peaking and reserve capacity. Because of the continuing uncertainty in supply, and consistent with current Federal government policy the Applicant desires to decrease its dependence on oil. The installation of the Limerick nuclear units will accomplish this objective regardless of the peak demand.

1.3 CONSEQUENCES OF DELAY

The consequences of delay to the Applicant and the customers served by the Applicant are threefold: decreased reliability, economic loss, and increased adverse environmental impact. Since the Applicant is required by Section 401 of the Public Utility Law of the Commonwealth of Pennsylvania (66 PS 1171) to furnish and maintain adequate, safe, efficient, and reasonable service to its customers, the Applicant cannot consider not serving the anticipated demand as an alternative. The law further states that service shall be reasonably continuous and without unreasonable interruption or delay. The following discussion is based upon meeting the system demand and assessing the consequences of the absence of the Limerick generation.

1.3.1 EFFECT OF DELAY ON RELIABILITY

The effect of delaying the Limerick units on reliability is demonstrated by the following table. In calculating the reserves, the high peak demand from Table 1.1-4 was used; this represents the worst case.

The Applicant's and PJM's planning year is from June 1 to May 31 of the following year. Limerick Unit 1 is scheduled for service in April 1985, and will therefore be available for the 1985 summer peak. Limerick Unit 2 is scheduled for service in October 1988 and therfore will not be available for the summer peak until 1989.

EFFECT OF DELAY OF SERVICE DATES ON INSTALLED RESERVES

	SUMMER RESERVES (%)						
Service Dates	1985	1986	1987	1988	1989	1990	1991
1985-88	42.6	39.7	36.8	28.0	37.4	35.3	31.5
1986-89	24.6	39.7	36.8	28.0	20.9	35.3	31.5
1987-90	24.6	22.1	36.8	28.0	20.9	19.1	31.5
1988-91	24.6	22.1	19.5	28.0	20.9	19.1	15.7

However, if the Limerick units are delayed, the planned retirement of the obsolete oil-fired generation would also, in all probability, be delayed to maintain system reliability.

If the national oil supply is interrupted the effect of delaying the Limerick units on reliability would be profound. When the Limerick units are placed in service they will be capable of producing 50 million kilowatt-hours of electricity daily. To produce this much electricity with the oil fired units would require 100,000 barrels of oil daily. Therefore, without Limerick, if a severe oil shortage would occur the 50 million

kilowatt-hours would be unavailable. This 50 million kilowatt-hours is capable of supplying the daily needs of 3 million average residential customers under normal circumstances and even more customers under adverse conditions.

The increased used of obsolete oil fired generation with normal oil supply will also adversely effect reliability. Increased forced outage rates of the oil units will increase required reserve margins. For further discussion see Section 1.1.3.

1.3.2 ENVIRONMENTAL CONSEQUENCES OF DELAY

If Limerick generation is not installed, increased operation of fossil-fueled generation will be required. The increased oil consumption will increase competition for house-heating and industrial use for available oil. The increased operation of fossil generation will increase air pollutants. The estimated increases based upon the unavailability of Limerick generation, and with no replacement for this generation from 1985 through 1990 are indicated below:

INCREASED FOSSIL FUEL CONSUMPTION AND AIR POLLUTANTS WITHOUT LIMERICK GENERATION

	1985	1986	1987	1988	1989	1990
Oil, millions of barrels	2.9	3.7	3.9	7.2	6.1	7.4
Coal, millions of tons	1.2	1.6	2.0	2.3	3.8	3.4
SO_2, thousands of tons	67.3	89.2	109.1	134.3	202.9	188.0
NOx, thousands of tons	14.5	19.1	22.9	29.8	41.9	39.9
Particulates, thousands of tons	2.3	3.1	3.7	4.9	6.6	6.4

1.3.3 ECONOMIC CONSEQUENCES OF DELAY

The delay of Limerick generation for one or two years will require the operation of higher cost generation to serve energy requirements. In addition, a delay in the service dates will increase the ultimate plant cost due to escalation of total capital and AFUDC. The effects are summarized below:

ECONOMIC CONSEQUENCES OF DELAY
OF LIMERICK GENERATION SERVICE DATES ($ MILLIONS)

	One-Year Delay (1986 - 1989)	Two-Year Delay (1987 - 1990)
Energy penalty	400	830
Capital penalty	650	1375

1.4 REFERENCES

Ref. No.

1.1-1 "Reliability Principles and Standards for Planning Bulk Electric Supply System of MAAC Group."

1.1-2 The 1970 National Power Survey, Federal Power Commission, Washington, D.C., Part II, Chapter 5.

1.1-3 Billington, R., Power System Reliability Evaluation, Gordon and Breach, Sciences Publishers, Inc., New York, NY (1970) Chapter III.

1.1-4 Philadelphia Electric Company, Energy Management and Conservation Report for 1982, submitted to the Pennsylvania Public Utility Commission, April 30, 1983.

APPENDIX 1.1A

DELETED

APPENDIX 1.1B

ENERGY FORECASTING METHODOLOGY

The Applicant utilizes most of the known forecasting methods to some degree in estimating future system annual energy requirements. These methods include trend analysis, correlation analysis with regressions, economic projections, technological forecasting of changes in energy-using equipment, and data derived from a regional econometric model. Models of sensitive parts of the forecast, such as air conditioning loads and population analysis, have been programmed for a computer. An econometric model has been developed by Wharton Econometric Forecasting Associates (WEFA).

The forecast is produced by estimating energy sales for individual years for each rate class -- Residential, House Heating, Small Commercial and Industrial, Large Commercial and Industrial, Other Public Authorities, Railroads, Street Lighting, Resale, and Interdepartmental. In order to satisfy the need for special data to compute revenue, peaks, etc, energy sales for key months are forecast for each year along with numbers of customers and selected data on special uses such as air conditioning.

The forecast is prepared as a baseline forecast based upon assumptions considered most likely to occur. High and low ranges based upon variations of these assumptions are also forecast. If the forecast is seen to be deviating toward the high or low range, alternative futures can also be modeled and planned as changing conditions warrant.

The forecast is estimated by classes and then aggregated. Each class, in turn, consists of several parts. Because of the substantial amount of data collected from field forces, trade associations, and government agencies, estimating each component with its own correlations and data -- based upon uniform assumptions concerning the region and economy -- produces a more precise forecast than a general forecast driven by a national econometric model. This is especially true of local large manufacturing customers whose use and plans often bear little resemblance to the national performance of their industries.

Residential

The residential energy sales forecast is based primarily upon the number of customers and the average use per customer. There is a long history of the correlation between the number of customers and the area population derived from census material. Correlations are made between dwelling units and various demographic factors, such as women over 19 years of age, total

population, and total women. Sociological material is reviewed to determine the effects of expected changes in life-style and marriage rates on population per household, and the mix of apartments and various types of houses.

A computer program is used to test the effects of different migration, fertility, and mortality rates on the population.

Before analyzing average use, new construction must be estimated as this is a significant factor in such uses as electric space and water heating.

Construction data have been collected for more than 12 years from our field representatives. Trends are established based upon various demographic factors and existing housing. Information on new construction covering the next few years is obtained from local builders, builders' associations, and national statistical services in the construction field.

New construction is forecast by single homes, townhouses, individually-metered and common-metered apartments. Single-point-metered apartments billed in the Large Commercial and Industrial class are estimated along with the general residential class.

Demolitions and abandonments are estimated based upon past experience and data compiled by Philadelphia County.

Space heating for new construction is estimated based upon past saturation results and builders' plans, with consideration given to fuel prices and the future availability of gas. Electric space heating is separated into resistance heating and heat pumps, taking into account the expected improvements in heat pump efficiency.

Records on air conditioning have been kept since 1945. These data are collected from distributors and manufacturers through the Electrical Association of Philadelphia. These data cover unit sales and the sizes of units sold.

Since 1972, annual residential surveys have been used to update and check the air conditioning data base. The forecast of air conditioning energy sales is based upon saturation of the market -- defined as full dwelling-unit air conditioning in the equivalent of 63% of the space.

The air conditioning forecast is adjusted for new units, considering the cooling capacity and wattage, a replacement rate, and expected strong acceptance of high-efficiency air conditioning program.

Other appliances are forecast separately. The annual survey provides saturation data and the acquisition rate. Monthly sales statistics are also received from the Electrical Association, but these must be adjusted for anticipated replacements.

Annual use of appliances is obtained from test data and industry average data (EEI and other utilities).

The consumption for each appliance and application is summed to obtain the class totals for Residential House Heating, and the single-point-metered apartment component of Large Commercial and Industrial sales.

Small Commercial and Industrial Sales

These sales are obtained in much the same manner as large commercial sales.

Large Commercial and Industrial Sales

This class is broken down into the largest 8 manufacturing customers, all other manufacturing, single-point-metered apartments, and other nonmanufacturing (commercial, education, government, utilities) users.

The largest 8 manufacturers' sales forecasts -- which make up over 40% of manufacturing sales -- are based upon frequent interviews with these customers concerning their plans. These manufacturers' estimates are often modified, based on analysis of conditions in the industry, since in the past the customer's projections have been generally optimistic.

Forecasts of other manufacturing sales are based upon a historical correlation with GNP, GRP, the Industrial Production Index (IPI), and kWh per manhour for two-digit SICs.

Unusually large increases or decreases in energy sales are usually known ahead of time. Whether or not to treat these changes individually, or to include them in the general growth rate, is a matter of judgment.

Space heating, air conditioning, and environmental energy sales are forecast individually. Field reports on each change in usage provide data on square footage (new or additional) and changes in usage of lighting, space conditioning, process heating, and power. This establishes a large data base. These reports are factored into the energy sales estimates.

The commercial energy sales growth is based upon GNP, GRP, real disposable income, commercial employment and commercial square footage.

Other Classes

The forecasts for other classes are based upon close discussions with the limited numbers of customers involved, time-series analysis, and technological changes expected (as in street lighting sources).

Price Elasticity

Projections of energy prices are prepared by the Applicant. These prices are applied to various types of heating systems as a basis for estimating saturation percentages for each fuel. Because the cost of electricity in the Applicant's territory is not expected to rise faster than the Consumer Price Index, no specific coefficient of elasticity is applied. Past studies here and elsewhere were inconclusive as to values for the price elasticity of electricity. However, the forecast does assume that energy conservation will continue for several reasons. Two of the reasons are increasing energy prices and consumer efforts to use energy more efficiently. When forecasting energy sales for each component, whatever is applicable in optimizing energy use, such as full insulation, ASHRAE-90 standards, Pennsylvania House Bill 222, high-efficiency (high EER) air conditioning, accelerating acceptance of heat pumps with continually improving COPs, solid-state appliances, microwave cooking, high-efficiency light resources, and others are assumed. A strong restrictive effect is thus derived because of the high value of electricity, without relying on a fixed coefficient of elasticity with its necessary estimate of future prices. Forecasts of technological changes and data on future improvements are obtained from following a large number of publications including Futurist, Technology Review, Spectrum, Electrical World, Electrical Week, Business Week, Energy Review, Energy User News and the U.S. Information Service energy materials, etc. These are used in judging future efficiencies, and new uses such as solar energy.

Weather and Business Cycles

The energy sales forecasts are based upon normal weather and normal economic conditions. Whether the economy is in a recession or at a peak will cause sales to swing considerably from the base forecast trend line.

Other Forecasts

Meetings with other forecasters from PJM utilities are held several times a year. Forecast data and techniques are exchanged. Members of the group also participate in the Electric Utility Market Research Council, Wharton Regional Model meetings, and special conferences, meetings, and seminars on energy forecasting as available. A file is maintained on the forecasts of national forecasters (such as McGraw-Hill, EPRI, FEA, FPC, A.

9. BUSINESS CYCLES - The three forecasts assume the currently expected economy in 1983, and are based upon a normal peacetime economy through 1992.

   Based on historical analysis of sales, whether the economy is in a recession or at the peak of a boom can cause a -4% to +4% deviation from the probable trend which is based upon a smooth growth rate.

   In addition, recognized economists offer different projections of national economic growth, some of which are given in Table 1.1B-1. If the high and low projections shown are imposed on the business-cycle effect described in the above paragraph, deviations from these two causes could cause an increase in sales of 15% or a decrease of 8% in the later years of this forecast. Most of the listed assumptions would still be applicable.

10. WEATHER - Average weather conditions are projected, affecting heating and cooling loads. Normal weather for each calendar day of the year is determined by averaging actual weather data over a historic period. For the heating season, this average is computed over a 50-year period from 1930 to 1979. For the summer cooling season, the historic data covers a 34-year period from 1946 to 1980. Monthly and seasonal normal weather are the sum of normal weather for individual days. A new normal is calculated every 5 years.

    To correct actual sales for normal weather conditions in any given year, the difference between actual weather and normal weather for the heating and cooling season is computed. These differences are then multiplied by either a summer or winter weather electric usage factor. These factors are developed using linear and multiple regression techniques, and are a measure of the relationship between the changes in electrical usage and changes in weather. The resulting product, when subtracted from, or added to, actual sales, gives kWh usage on a normal weather basis.

<u>ECONOMIC AND DEMOGRAPHIC ASSUMPTIONS</u>

<u>Base Case</u>

1. The annual Gross National Product growth rate for 1980-90 will be 2.5%.

2. The annual Gross Regional Product growth rate for 1980-90 will be less than 1%.

3. The probable case is based upon the Census Bureau's Series III fertility rates and current survival rate tables. Estimates from 1970-80 include the 323,800 net

out migration estimate made by the Bureau of Census for the Pennsylvania portion of the Philadelphia SMSA. All estimates and projections for the Conowingo Power Company's service area assume a neutral net migration over the entire period from 1980-2000.

4. Fertility rate is based upon the U.S. Bureau of Census Series-III rate of below replacement level fertility on a national level.

5. The number of people per household is expected to decrease to 2.3 in 1995.

6. The number of households per female over 19 is expected to increase slightly from 0.97 in 1980 to 1.00 in 1991, due to the increasing number of single females per household.

7. "Other" manufacturing sales growth will lag behind the growth in the Industrial Production Index by approximately 2.6%. The Industrial Production Index is projected to grow at about 3.6%/year from 1982 to 1992.

   "Other" manufacturing sales equal total manufacturing sales minus the 8 largest industrial customers' sales.

8. The decreased birthrates of the sixties will cause a fall in growth of the potential labor force during the forecast period which will result in reduced demand and supply for some products.

9. FOSSIL FUEL CONVERSION - Some electrification of manufacturing processes -- existing or potential -- is expected to occur if the price of industrial electricity rises in line with the increase in the price of goods generally -- as is assumed here -- then the cost of fossil fuels will rise at a faster rate that should further stimulate conversion.

   Opportunities for increased power use include metal holding furnaces, electric boilers, induction heaters, high-temperature furnaces, high-temperature heat pumps, and microwave drying.

10. COGENERATION - There are 16 customers on the system using private generation. Of these, 15 are connected to the Applicant's system, while 1 major refiner operates independently.

   Estimated demand of private generation is 170 MW with approximate annual consumption of 1 billion kWh. The forecast, being based upon factors and growth rates that

apply equally to all kWh -- purchased or self-generated -- allows for an increase in private generation of about 300 million kWh by 1989, consistent with past forecast assumptions.

Future plans for generation by these customers, and nongenerating customers, are continuously monitored. There are no identified large customers committed to adding independent generation, although several have been studying the cost-benefits.

Because of the uncertainties existing in the areas of regulation, financing, costs, and government incentives no change in the existing ratio of self-generated to purchased power has been factored into this, or previous, forecasts. Future forecasts will be adjusted by specific changes, if any.

11. CONSERVATION (existing commercial buildings) - Reductions in the use of electricity that can be made without capital improvements have been largely accomplished. Customer billing records indicate that these customers have reduced electric usage by 17% since 1973. Because most space is rented and not owner-occupied, there is little incentive for building owners to make investments in energy-saving equipment.

12. CONSERVATION (new commercial buildings) - ASHRAE 90-80 has been adopted by the state for use in commercial buildings under Pennsylvania House Bill 222.

13. ELECTRIC SPACE HEATING (Commercial) - 75% of new large commercial space and 40% of new small commercial customers are currently installing electric heat. Among new small commercial electric heat customers, 40% are now installing heat pumps. This percentage is expected to rise to 60% by 1992.

14. AIR CONDITIONING - 95% of the current new commercial space is being air conditioned, and this percentage is expected to continue. The connected air conditioning watts per square foot is expected to remain level at 3.4 watts per square foot during the forecast period.

15. SOLAR ENEGRY - During the forecast period, solar energy will be used by a small but increasing number of small commercial and industrial customers for water and space heating. As of 1982, there were 25 small commercial and industrial customers with solar heating systems either installed or being installed. By 1989, this number is projected to increase to approximately 250 customers.

The impact of solar energy on the class is, therefore, expected to be negligible.

16. ELECTRIC VEHICLES - Commercial electric vehicles are expected to contribute little to electric consumption during the 1982-92 forecast period. Significant acceptance of commercial electric vehicles is not expected to occur until after 1992, if then.

17. COMPUTER LOADS - Studies by the NECA and FEA revealed that the single most influential factor on the amount of energy used in an office building is computer load. As the use of computers increases, the additional energy used will offset some of the reduction caused by conservation efforts.

Low Range Case

1. Gross National Product 1980/90 is expected to grow by 1.6%/year.

2. Gross Regional Product 1980/90 will show little growth.

3. Net out-migration will continue at the 1970-1980 rate.

4. "Other" manufacturing sales will lag behind the GNP and the Industrial Production Index (IPI), which is approximately 3.6%, by 3.6%.

High Range Case

1. Gross National Product 1980/90 is expected to grow by 4.0% a year.

2. Gross Regional Product 1980/90 is expected to grow by 2.0% a year.

3. Net migration will slow down after the 1970-80 period.

4. "Other" manufacturing sales will lag the Industrial Product Index by about 2.6%. The IPI is approximately 4.6%.

TABLE 1.1C-2

STANDARD DEMAND FACTOR

	Demand at 102.7 DWF	Net Actual Peak Demand	Corrected Peak Demand	Corrected Demand Divided by Demand at 102.7 DWF
1968	4316	4375	(4445)	1.030
1969	4661	4592	(4746)	1.018
1970	4750	4712	(4954)	1.043
1971	4878	4922	(5034)	1.032
1972	5162	5313	5313	1.029
1973	5448	5760	5760	1.057
1974	5434	5431	(5492)	1.011
1975	5344	5530	(5545)	1.038
1976	5462	5346	5346	.979
1977	5397	5888	5888	1.091
1978	5445	5667	5667	1.041
1979	5562	5641	5641	1.014
1980	5598	6095	6145	1.098
1981	5522	5731	5731	1.038
1982	5407	5691	5691	1.053
		Average Standard Demand Factor		1.038[1]

[1] 15 year average

TABLE 1.1C-3

ACTUAL AVERAGE OF APRIL AND OCTOBER OUTPUTS
-- PHILADELPHIA ELECTRIC COMPANY SYSTEM

	Base Output GW Hrs	Base Demand MW	Demand Divided by Output
1968	1734	2998	1.729
1969	1840	3142	1.708
1970	1906	3255	1.707
1971	1939	3326	1.716
1972	2060	3493	1.696
1973	2169	3668	1.691
1974	2138	3612	1.689
1975	2127	3632	1.708
1976	2210	3723	1.685
1977	2196	3763	1.713
1978	2246	3813	1.698
1979	2312	3830	1.657
1980	2246	3732	1.662
1981	2210	3697	1.673
1982	2190	3644	1.664

TABLE 3.5-1

ASSUMPTIONS AND PARAMETERS USED FOR EVALUATION OF RADIOACTIVE RELEASES

PARAMETER	VALUE
I. General	
1. Maximum core thermal power	3458 MWt
2. The methods and parameters of NUREG 0016 Rev. 0 are used to calculate the source terms in the primary coolant:	
a. Plant capacity factor	0.8
b. Isotopic release rates of noble gases to the reactor coolant at 30-minute decay (μCi/sec)	60,000
c. Concentration of fission, corrosion, and activation products in the reactor coolant	Table 3.5-2
3. The quantity of tritium released in liquid and gaseous effluents (Ci/yr, 2 units)	Liquid - 11 Gaseous - 144
II. Nuclear Steam Supply System	
1. Total steam flow rate for valve wide open condition	$1.48\times10^{+7}$ lb/hr
2. Mass of reactor coolant and steam in the reactor vessel at full power	$5.5\times10^{+5}$ lb $2.1\times10^{+4}$ lb
III. Reactor Water Cleanup System	
1. Average flow rate for 2 vessels	$1.33\times10^{+5}$ lb/hr
2. Demineralizer type	Powdex
3. Number of demineralizers	2
4. Backwash frequency	3.4 days (6.8-day run for each demineralizer)
5. Backwash volume	
IV. Condensate Demineralizers	

TABLE 3.5-1 (Cont'd) (Page 2 of 4)

PARAMETER		VALUE
1.	Average flow rate for 7 vessels (valve wide open condition)	$1.5x10^{+7}$ lb/hr
2.	Demineralizer type	Powdex
3.	Number of demineralizers and size	7 plus 1 standby 1300 ft^2
4.	Backwash frequency	1.43 days (10-day run for each demineralizer)
5.	Ultrasonic resin cleaning	Not used
6.	Backwash volume	9000 gal/backwash
V.	Liquid Waste Processing Systems	
1.	For each liquid waste subsystem, provide in tabular form the following information:	
a.	Sources, flow rates (gpd), and expected activities (fraction of primary coolant activity, PCA) all inputs to each system	Table 3.5-7
b.	Holdup times associated with collection, processing, and discharge of all liquid streams	Table 3.5-8
c.	Capacities of all tanks (gal) and processing equipment (gpd) considered in calculating holdup times	Table 3.5-9
d.	Decontamination factors for each processing step	Table 3.5-10
e.	Stream fraction discharged	
	Equipment drain subsystem	0.01
	Floor drain subsystem	0.1
	Chemical waste subsystem	0.1
	Laundry drain subsystem	1.00
f.	For waste demineralizer regeneration, time between regenerations, regenerant volumes and activities,	Spent resins from the radwaste demineralizer are sluiced to

3.9 TRANSMISSION FACILITIES

3.9.1 DESCRIPTION OF TRANSMISSION FACILITIES

As described in Section 3.2 of the Environmental Report-Construction Permit Stage and 3.7 of the Final Environmental Statement, five outlets for generation will be provided as shown schematically in Figures 3.9-1 and 3.9-8. The existing Peach Bottom to Whitpain 500-kV line will be routed through the Limerick 500-kV substation where the line will be cut and reconnected to provide two generation outlets. A 500-kV Limerick to Whitpain line will be constructed entirely on existing rights-of-way (ROW). This line is referred to in Sections 3.9.1.1 and 3.9.2.1. Two 230-kV Limerick to Cromby lines will be constructed along two existing railroad ROWs. These lines are referred to in Sections 3.9.1.2 and 3.9.2.2.

In addition to these previously described transmission facilities, two new 230-kV lines are required. A new 230-kV line from Cromby to North Wales will be constructed on existing ROW. This line is discussed in greater detail in Sections 3.9.1.3 and 3.9.2.3. A new 230-kV line from Cromby to Plymouth Meeting will be constructed using a combination of existing and railroad ROW. This is discussed in greater detail in Sections 3.9.1.4 and 3.9.2.4.

Figure 3.9-2 provides a detailed illustration of the transmission facilities associated with the Limerick Generating Station.

3.9.1.1 Limerick to Whitpain 500-kV Line

The Limerick to Whitpain 500-kV line was discussed in Section 3.2 of the Environmental Report-Construction Permit Stage and Section 3.7 of the Final Environmental Statement. In accordance with NRC Regulatory Guide 4.2 and 10 CFR 51, no further discussion is necessary.

3.9.1.2 Two Limerick to Cromby 230-kV Lines

The two Limerick to Cromby lines were discussed in Section 3.2 of the Environmental Report-Construction Permit Stage and Section 3.7 of the Final Environmental Statement. In accordance with NRC Regulatory Guide 4.2 and 10 CFR 51, no further discussion is necessary.

3.9.1.3 Cromby to North Wales 230-kV Line

The proposed Cromby to North Wales 230-kV transmission line will be approximately 16 miles in length. Philadelphia Electric Company owns, or has easement for, 100% of the proposed ROW for this line. The ROW varies between 150 and 300 feet in width. At the present time, this ROW contains a 138-kV lattice tower

transmission line. Most properties adjacent to the ROW are farms and much of the ROW is farmed. For this reason, tree trimming for the Cromby-North Wales line will be minimal. Less than 5% of the ROW is wooded. No changes in land usage are anticipated. The new line will cross the Schuylkill River, Perkiomen Creek, and the northeast extension of the Pennsylvania Turnpike.

The route selection for this line was based upon using an existing ROW. The existence of this ROW makes further consideration of alternative routes for this line impractical, as discussed in Section 10.9.

The new line will be supported on gray, single-circuit, triangular configuration, tubular steel structures (Figure 3.9-4) for a distance of approximately 15 miles from Cromby to West Point Pike in Upper Gwynedd Township. The conductor configuration will change from triangular to vertical where sharp turns in the ROW are encountered.

The last mile of the line requires installation of double-circuit vertical tubular structures (Figure 3.9-5). These structures will carry the new line and the existing Whitpain-North Wales line, which must be relocated, to new bus takeoff positions at North Wales Substation. The double-circuit vertical structures are needed because of the narrowness of the ROW in this area. These structures will also be painted gray.

The Cromby-North Wales line will be a high-capacity, 230-kV line with two 1590-kcmil (1.545 inches in diameter) ACSR conductors per phase. This line will have a summer normal rating of 1200 mVA and an emergency rating of 1400 mVA. The ruling span for this line will vary between 600 and 1200 feet depending upon terrain. All clearances will meet or exceed the minimum requirements of National Electric Safety Code (NESC) Section 23. The line will be designed to maintain a minimum vertical clearance to the ground of 25 feet at a maximum conductor temperature of 140°C, (284°F). This temperature is the conductor temperature used to establish clearances for ACSR conductors. The maximum electric field strengths anticipated for typical spans are indicated on the ROW cross sections (Figure 3.9-2).

The visual impact of the new line will be minimized by locating the new structures next to the existing line towers. This procedure takes full advantage of existing foliage which now shields the line towers from view and ensures that no structures will be placed where the general public has become accustomed to seeing only the conductors.

3.9.1.4 Cromby to Plymouth Meeting 230-kV Line

The proposed Cromby to Plymouth Meeting 230-kV transmission line will be approximately 13.5 miles long and will be constructed on

existing Conrail and Philadelphia Electric Company ROW. The existence of the ROW makes further consideration of alternative routes for this line impractical, as discussed in Section 10.9.

The new line will exit Cromby Substation to the east, cross the Schuylkill River, and join the existing Cromby-Barbadoes ROW crossing over the Schuylkill River and Perkiomen Creek near Oaks, Pennsylvania. Additional width for swingout clearances may be required in this section. From Oaks to Plymouth Meeting Substation, the line will follow Conrail (formerly Penn Central Transportation Company) ROW.

The section of line between Cromby and Haws Avenue in Norristown, a distance of approximately 10.5 miles, will be constructed with gray tubular steel structures (Figure 3.9-4). The conductors will vary from horizontal, to vertical, to triangular configurations. The exact configuration will depend upon ROW width restrictions. The ruling span will vary between 300 and 950 feet for these structures. River crossing spans will be 1000 feet or more.

From Haws Avenue to Plymouth Meeting Substation, the proposed line will utilize either tubular steel structures or the wide flange (WF) type of steel structure (Figures 3.9-6 and 3.9-7). WF structures are normally used by the railroad to support catenaries and railroad transmission lines. The existing WF structures between Haws Avenue and the Pennsylvania Turnpike will be reinforced to provide adequate structural strength to support the additional loading. Tubular steel poles will be used from the Pennsylvania Turnpike to Plymouth Meeting.

The conductors on the WF portion of the proposed line will vary from horizontal, to vertical, to triangular configurations. The structures will be made of steel with either steel or aluminum crossarms. These structures will be similar to other railroad structures existing in this area. Between the turnpike and Plymouth Meeting Substation, the railroad ROW parallels an existing 315-foot-wide Philadelphia Electric Company ROW containing five transmission lines. The cost to build this portion of the proposed line on Applicant's ROW would be prohibitive due to the need to relocate the existing lines.

The proposed line will use two 1590-kcmil (1.545 inches in diameter) ACSR conductors per phase and will have a summer normal and emergency rating of 1200 mVA and 1400 mVA, respectively.

Design maximum loading conditions for this voltage level is 1-inch-radial ice and an 8-pound-per-square-foot wind at -17.80°C (0°F). The minimum clearances at conductor operating temperature

of (140°C) 284°F will be equal to or greater than the NESC requirements.

3.9.2 ENVIRONMENTAL IMPACT

The overall impact of transmission line installations associated with Limerick Generating Station on the terrestrial ecology of the area will be minimal due to the routing of the new lines along existing ROW and through areas that are not sensitive to additional disturbance. Environmental impacts of new transmission lines are addressed in this section.

3.9.2.1 Limerick to Whitpain 500-kV Line

The Limerick to Whitpain 500-kV line is discussed in Section 3.2 of the Environmental Report-Construction Permit Stage and Section 3.7 of the Final Environmental Statement. In accordance with NRC Regulatory Guide 4.2 and 10 CFR 51, no further discussion is necessary.

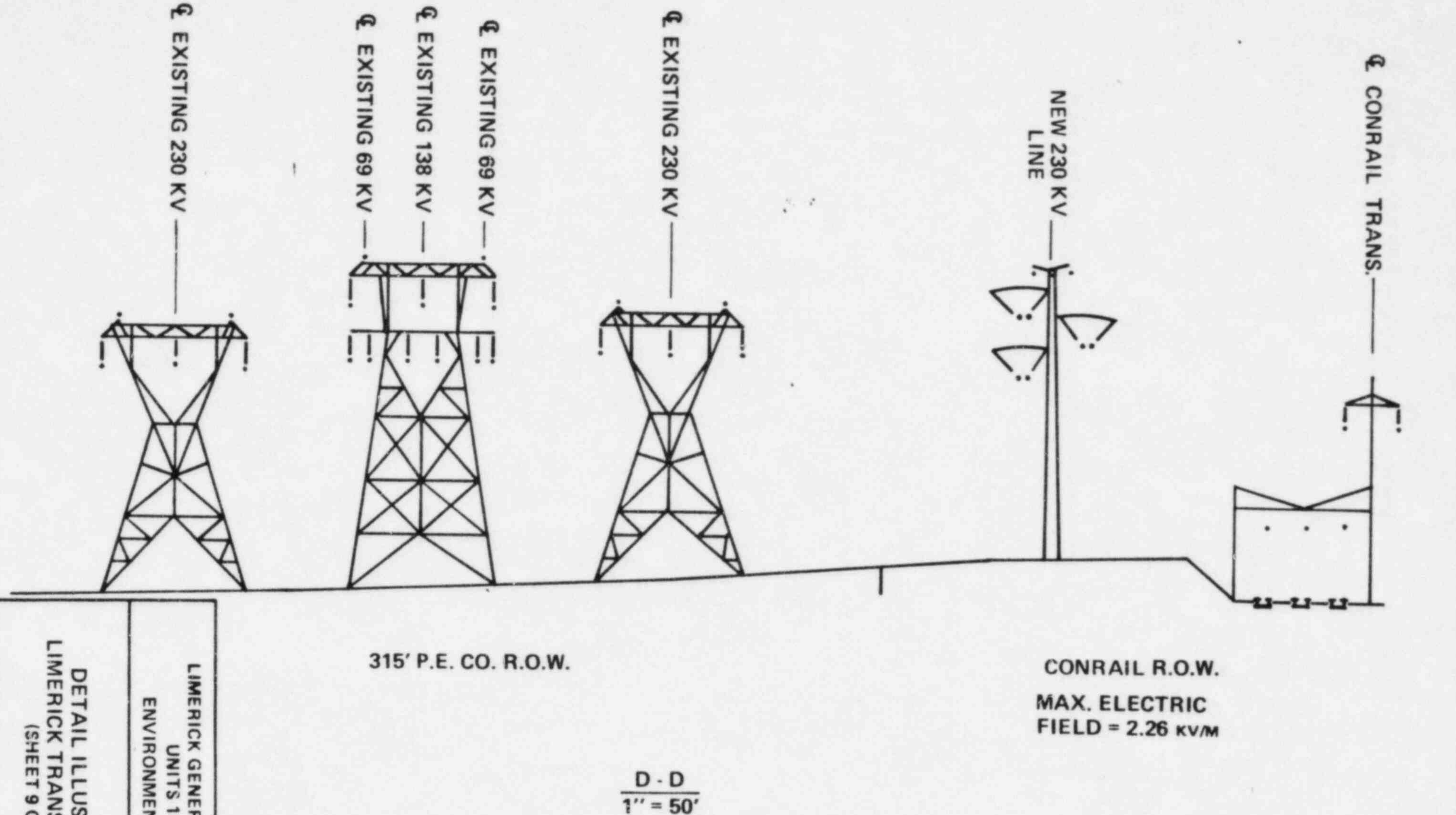
3.9.2.2 Two Limerick to Cromby 230-kV Lines

The two Limerick to Cromby 230-kV lines are discussed in Section 3.2 of the Environmental Report-Construction Permit Stage and Section 3.7 of the Final Environmental Statement. In accordance with NRC Regulatory Guide 4.2 and 10 CFR 51, no further discussion is necessary.

3.9.2.3 Cromby to North Wales 230-kV Line

This new line will leave Cromby toward the east and follow the existing Cromby to North Wales 138-kV transmission ROW. This route has been cleared to the boundary lines of the ROW and no additional clearing will be necessary. Current land use inside this ROW is mostly agricultural (corn, wheat, soybeans, and pasture) with the remainder in various successional stages similar to an old-field community. The ground cover on ROW land that is not used for agricultural purposes is a mixture of composites (asters, goldenrods, and grasses) which in places is covered with a well-developed vine layer composed primarily of Japanese honeysuckle and blackberry. Some areas also exhibit a sparse tree layer (red cedar, black locust, white ash, sassafras, and other early successional tree species). This layer is not permitted to develop to maturity and must be cleared periodically.

The environmental impact of this transmission line would be primarily due to the small loss of agricultural land under the tower bases.



LIMERICK GENERATING STATION
UNITS 1 AND 2
ENVIRONMENTAL REPORT

DETAIL ILLUSTRATION OF
LIMERICK TRANSMISSION LINES
(SHEET 9 OF 16)

FIGURE 3.9-2 REV. 14, 07/83

CHAPTER 8

ECONOMIC AND SOCIAL EFFECTS OF STATION CONSTRUCTION AND OPERATION

Construction and operation of the Limerick Station affects both the social and economic conditions of residents of Montgomery, Berks and Chester counties, Pennsylvania, and to a lesser degree the entire nation. This chapter assesses both the beneficial and adverse effects of operation of the Limerick Station, and where possible, places a monetary value upon them. All monetary values are expressed in 1990 dollar values unless otherwise noted.

8.1 BENEFITS

8.1.1 PRIMARY BENEFITS

Limerick Station is a nominal 2110 MWe (net) two-unit station. Unit 1 is scheduled for commercial operation in 1985 and Unit 2 in 1988. The net average annual energy generation of the station, calculated at a 70% capacity factor, is 12.9 billion kWh.

The energy delivered by the station is divided into four categories--residential, small commercial and industrial, large commercial and industrial, and other. System losses reduce the net annual energy delivered to customers to 12 billion kWh. The 1990 demand for electrical energy is expected to be distributed to the Applicant's customers as shown on the following summary:

	Million kWh
Small Commercial and Industrial	1440
Large Commercial and Industrial	6480
Residential	3600
Other	480
Total	12000

The price of electricity is the basis used to determine the station output's value to society since it reflects the value that users place on electricity. However, this market price provides only the minimum value of the output, since many customers are prepared to pay more for electricity than they are actually being charged. The average price for electricity in 1990 is estimated to be approximately 12.9 cents per kWh for all users described above.

The value of station output in its first full year of two-unit operation is therefore $1.55 billion. This aggregate value is based on the value of sales to all users: residential, commercial, and industrial.

It would be impractical to enumerate the specific uses of electricity and evaluate how these contribute to a rising quality of life at home and at work. One illustration which may be worth noting in this context is the use of household appliances. The Applicant's projections show that between 1982 and 1992, the saturation ratio (number of appliances as percent of total residential customers) of clothes dryers will rise from 44% to 50%; dishwashers from 37% to 39%; and freezers from 30% to 35%. Clearly, many families that do not use these and other appliances can be expected to acquire them as they seek to improve their living standards. An analysis of the sources of growth in electricity usage reveals that the rate of growth of residential usage is substantially faster in low income sections of the City of Philadelphia than the higher income sections of the City and in the suburban areas served by the Applicant.

The importance of Limerick Station in providing an adequate and reliable power supply for the Applicant and for the Pennsylvania-New Jersey-Maryland (PJM) Interconnection is discussed in Chapter 1. That discussion describes capacity reserve conditions based on current demand projections. Chapter 1 indicates that benefits from the Limerick Station capacity are substantial. For example, if Limerick Station were delayed one year, to 1986-89, the Applicant's energy costs will increase $400 million. If delayed two years, to 1987-90, energy costs would increase $830 million.

Operation of Limerick Station will provide substantial savings of oil. The value of nuclear capacity has become increasingly evident in the recent past as a result of imported oil price increases, embargoes, natural gas shortages and coal strikes.

No sale of steam or other products or services from the station is currently anticipated.

8.1.2 OTHER SOCIAL AND ECONOMIC BENEFITS

8.1.2.1 Tax Revenues

When completed and operational, the station will provide added tax revenues to state, federal and local governments. While tax revenues are treated as benefits in this discussion, it is recognized that such revenues are essentially transfer payments. For this analysis, taxes are apportioned on the basis of current rates and corporate financing plans and reflect the values of: (a) stock allocated to finance the station, (b) projected net income allocated to the station, (c) anticipated gross receipts allocated to the energy sales, made possible by station output, and (d) the value of that portion of the station applicable to realty taxes. All monetary values are expressed in 1990 dollars and assume two unit operation. It is of course recognized that these values are, at best, only estimates of what may actually

8.1.2.3 Incremental Increase in Regional Product

The incremental increase in regional product due to operation of Limerick Station is the value of the electric energy produced by the station less the personal income that would have been produced by the family units that previously resided in the area required for station construction and operation. The value of this personal income is estimated to be less than $1 million annually. This loss in regional product is considered to be negligible compared to the value of the electrical energy. The incremental increase in regional product is therefore, equal to the value of the electrical energy produced.

8.1.2.4 Public Parks and/or Recreational Areas

Recreation potential of the floodplain area adjacent to the station site is determined by its physical features, together with planned station uses on the site and existing industrial activity in the surrounding community.

The river is relatively shallow at the site and the use of motorboats is dependent on the river level. Canoes and other similar craft are more likely to be used under the existing conditions.

8.1.2.5 Improvement of Local Roads and Transportation Facilities

Two existing township roads were rehabilitated by the Applicant in connection with plant construction. A 2-1/2 mile section of Longview Road was relocated and repaved. Evergreen Road, the main access to the plant, was upgraded for approximately one mile.

8.1.2.6 Research and Environmental Monitoring

A number of environmental baseline studies and monitoring programs are being conducted by the Applicant. These include the water chemistry, thermal data, and aquatic and terrestrial biological monitoring programs. These efforts provide meaningful information for use in assessing environmental changes imposed on the local area by operation of the Limerick Station. To the extent these programs contribute to a better understanding and prediction of environmental interrelationships, they are considered research efforts. In addition, since the detailed documentation developed on the species and abundance of local terrestrial and aquatic organisms serves to strengthen the store of scientific information concerning the area, the programs under which this information was developed can also be defined as research. The Applicant has estimated that in excess of $5.5 million has been spent for research at the Limerick Station as of December 31, 1982.

8.1.2.7 Educational Center

The Applicant constructed an "Energy Information Center" as part of the overall nuclear education program. Located on Longview Road just southeast of Limerick Station, the center offers formal programs and provides exhibit material for visitors. The center includes energy conservation information in addition to current information relevant to nuclear issues.

8.1.2.8 Annual Savings of Oil for Power Generation

Operation of Limerick Station provides a substantial contribution to the national interest by reducing the need for consuming large amounts of oil. Operation of the Limerick Station is expected to replace fossil fuel equivalent to about 20 million barrels of oil per year on the PJM interconnection.

CHAPTER 9

ALTERNATE ENERGY SOURCES AND SITES

Alternate Energy Sources and Sites were discussed in Section 8.1 and 8.2 of the Environmental Report - Construction Permit Stage and Chapter 10 of the Final Environmental Statement. The subject of alternate sites is not discussed further, in accordance with 10 CFR 51 and Regulatory Guide 4.2. In early 1983, construction of Unit 1 and common was 83% complete; Unit 2 was 30% complete. The only alternative to completing construction of Units 1 and 2, with commercial operation scheduled for 1985 and 1988, respectively, considered worthy of examination at this time is to cease construction and restore site to pre-construction appearance.

9.1 TERMINATE CONSTRUCTION AND RESTORE SITE

9.1.1 REPLACEMENT OF REQUIRED CAPACITY

As stated in Chapter 1 long term capacity purchases are not feasible to meet the Applicant's requirements.

When Limerick 1 and 2 are placed in service 1272 MW of oil fired capacity will be retired. This will reduce the Applicant's oil consumption in accordance with current national energy policy. The Applicant estimates that retirement of these oil fired units will save 7.4 million barrels of oil per year and air pollution will be reduced by 24,420 tons SOx and 9,320 tons NOx per year.

Delaying the retirement of older oil-fired units is not considered practical. When the Limerick units are placed in service 796 MWe of oil-fired intermediate steam capacity will be retired. The average age of this equipment will be 40 years in 1988. This equipment is old and ready for retirement. Maintenance problems compounded by metal fatigue problems would increase the forced outage rates of these units such that they would not be capable of being base loaded units.

When Limerick Unit 1 is placed in service, 476 MWe of oil-fired peaking combustion turbine capacity will be retired. This equipment was installed in the late 1960's. The combustion turbines to be retired are characterized by high heat rates, high fuel costs, and abnormally high maintenance costs. These units were not designed for base load operation and their high forced outage rates preclude their use as base load units.

9.1.2 COSTS ASSOCIATED WITH TERMINATING LIMERICK GENERATING STATION

The following costs are associated with terminating the construction of the Limerick Generating Station:

a. As of March 1983, the sunk capital cost of the Limerick project was about $2.7 billion. The annual revenue requirement associated with amortizing this investment over a 20 year period would amount to about $540 million per year. This annual amount assumes the accounting for the sunk capital would be treated as an in-service plant in all aspects, including return of capital on a straight line basis, return on capital not recovered, taxes based on tax depreciation at a normal 1.5% Declining Balance/Straight Line (DB/SL) basis over an Accelerated Cost Recovery System (ACRS) life of 16 years and retention of the investment tax credit. The Applicant's projected lack of taxable income in the near future would preclude it from using any potential tax loss that might result from such a termination.

b. The estimated capital cost to restore the site to its pre-construction appearances is about $200 million. The annual revenue requirement associated with amortizing this investment over a 20 year period would amount to about $40 million per year. This annual amount assumes the accounting for the sunk capital would be treated as an in-service plant in all aspects, including return of capital on a straight line basis, return on capital not recovered, taxes based on tax depreciation at a normal 1.5 DB/SL basis over an ACRS life of 16 years and retention of the investment tax credit. The Applicant's projected lack of taxable income in the near future would preclude it from using any potential tax loss that might result from such a termination.

CHAPTER 11

SUMMARY BENEFIT-COST ANALYSIS

The importance of the Limerick Generating Station (LGS) in providing an economic and reliable power supply for the Applicant and the PJM Interconnection was demonstrated in Chapter 1. The economic and social effects of station construction and operation were discussed in Chapter 8. Other benefit-cost information has been provided throughout this report. It is the purpose of this chapter to summarize and weigh the overall benefits and costs of operating the completed station. This final balancing must, of necessity, be qualitative, since it is not possible to quantify all of the station's benefits and costs in comparable units of measure. All monetary values are expressed in 1990 dollar values unless otherwise noted.

11.1 BENEFITS

11.1.1 DIRECT BENEFITS

The primary benefits resulting from operation of LGS are those inherent in the value of the generated electricity which will be delivered to meet customer needs. The station will provide an average annual generation of 12.9 billion kWh based on a 70% capacity factor for the 2110 MWe station. Distribution of the energy based on projected 1990 demand is: 3.6 billion kWh - Residential, 7.92 billion kWh - Commercial and Industrial, 0.48 billion kWh - Other and 0.9 billion kWh - System Use and Losses. As noted previously, the actual value of this energy cannot be readily monetized, since its true worth relates to customer needs, safety, convenience, etc., that it provides. Based on an average $0.129 per kWh for all users, the value of station output in its first full year of two-unit operation is $1.55 billion.

As discussed in Chapter 1, delays from current in-service schedules for the station are likely to add substantially to the Applicant's overall cost of service. For example, if both the units were delayed one year, the Applicant's cost of energy is estimated to increase by about $320 million, and plant cost is estimated to increase by about $650 million. Furthermore, it has also been noted that station operation will conserve oil.

11.1.2 INDIRECT BENEFITS

The indirect benefits to be realized from the construction of LGS include over $460 million paid annually in taxes (essentially transfer payments) to the state and federal governments.

Operating staff for LGS is projected to about 724 persons with an expected average annual payroll of $44 million. The bulk of these employees will be drawn from the local area thus enhancing the local economy.

TABLE 11.3-1

SUMMARY BENEFITS-COSTS; LIMERICK GENERATING STATION

	Item	Benefits[1]	Reference
1.	Expected Average Annual Generation and Approximate Value	12.9 billion kWh $1.5 billion[2]	Section 8.1
2.	Proportional Distribution of Electric Energy (1990)	66% Industrial and Commercial 30% Residential 4% Other 100% Total	Section 8.1
3.	Average Annual Federal and State Taxes	$460 million	Section 8.1
4.	Direct Station Employment	724	Section 8.1
5.	Public Facilities	An Energy Information Center is provided	Sections 2.1, 8.1
6.	Annual Savings of Equivalent Oil for Power Generation	20 million barrels	Section 8.1
7.	Average Annual Federal and State Taxes	$460 million	Section 8.1

	Item	Costs	Reference
1.	Total Capital Cost (Land and Station)	$5,820 million	Section 8.2
2.	Capital Cost to Complete	$2,200 million	Section 8.2
3.	Capital Cost (Associated Transmission System)	$91 million	Section 8.2
4.	Decommissioning Cost[3]	$160 million	Section 8.2
5.	10-Year Levelized Annual Fuel Cost	$130 million	Section 8.2
6.	Annual Operation and Maintenance Cost	$140 million	Section 8.2
7.	Annual Low Flow Augmentation Cost	$13 million	Section 8.2

QUESTION E450.5

The staff intends to use the five year (1972 - 1976) period of meteorological data records in the PRA. In Section 2.8.2.1.4 of the FSAR and ER-OL monthly and annual precipitation totals at Limerick for the five year period are compared to Philadelphia and Allentown for the same five year period. The comparison shows that at least 20% more precipitation was measured at Limerick than at either of the other locations. Provide an analysis and discussion of the causes of these differences.

RESPONSE

The precipitation records of the Limerick, Philadelphia, and Allentown stations have been reviewed, and it would appear that Limerick often has significantly more precipitation than the other two locations. This is probably associated with Limerick's position on slightly higher ground just inland of the extremely flat coastal plain, and that a number of convective storms have affected Limerick more severely than either Allentown or Philadelphia. Precipitation amounts often vary substantially over small distances, especially during the summer. Precipitation is also known to be quite sensitive to the topography of a region.

Examination of the monthly records for each of the five years, 1972 through 1976, shown in Tables E450.5-1 through E450.5-5, indicates that the excessive precipitation at Limerick was generally associated with particular storms, and that the remainder of the monthly records are fairly similar at each of the three measuring sites.

As precipitation is influenced by elevation, it should be noted that Limerick precipitation instrumentation is at elevation 255 ft MSL, while the Philadelphia NWS gauge is at 64 ft MSL and the Allentown gage is at 391 ft MSL. For the years 1974-1976, total precipitation at Limerick is within ±3% of that received at Allentown on an annual basis.

There is one procedural technique that tended to augment the Limerick precipitation in Tables 2.3.2-66 and 2.3.2-67. To try to take reasonable account of the influence of missing data at Limerick, the total amount of measured precipitation during the five-year period was divided by the actual number of hours of observation to obtain a mean hourly precipitation rate. This rate was then multiplied by the total number of hours in the five-year period. Therefore, the assumption was made that the missing hours were as likely to have precipitation at the typical rate as any of the other hours. This adjustment, however, could

have accounted for no more that approximately a 10 percent discrepancy.

The data recovery for the Limerick precipitation instrumentation on an annual basis is shown in Table E450.5-6. This instrumentation is calibrated and maintained as described in FSAR Section 2.3.3.3. This includes weekly inspection. Component checks and adjustments are made as required. Calibration is performed at least semi-annually in accordance with Regulatory Guide 1.23. The instrument is recalibrated immediately after any maintenance work is performed that would affect its accuracy.

TABLE E450.5-6

PRECIPITATION INSTRUMENTATION DATA RECOVERY

Year	Percent
1972	99.9
1973	95.8
1974	93.6
1975	81.8
1976	88.5