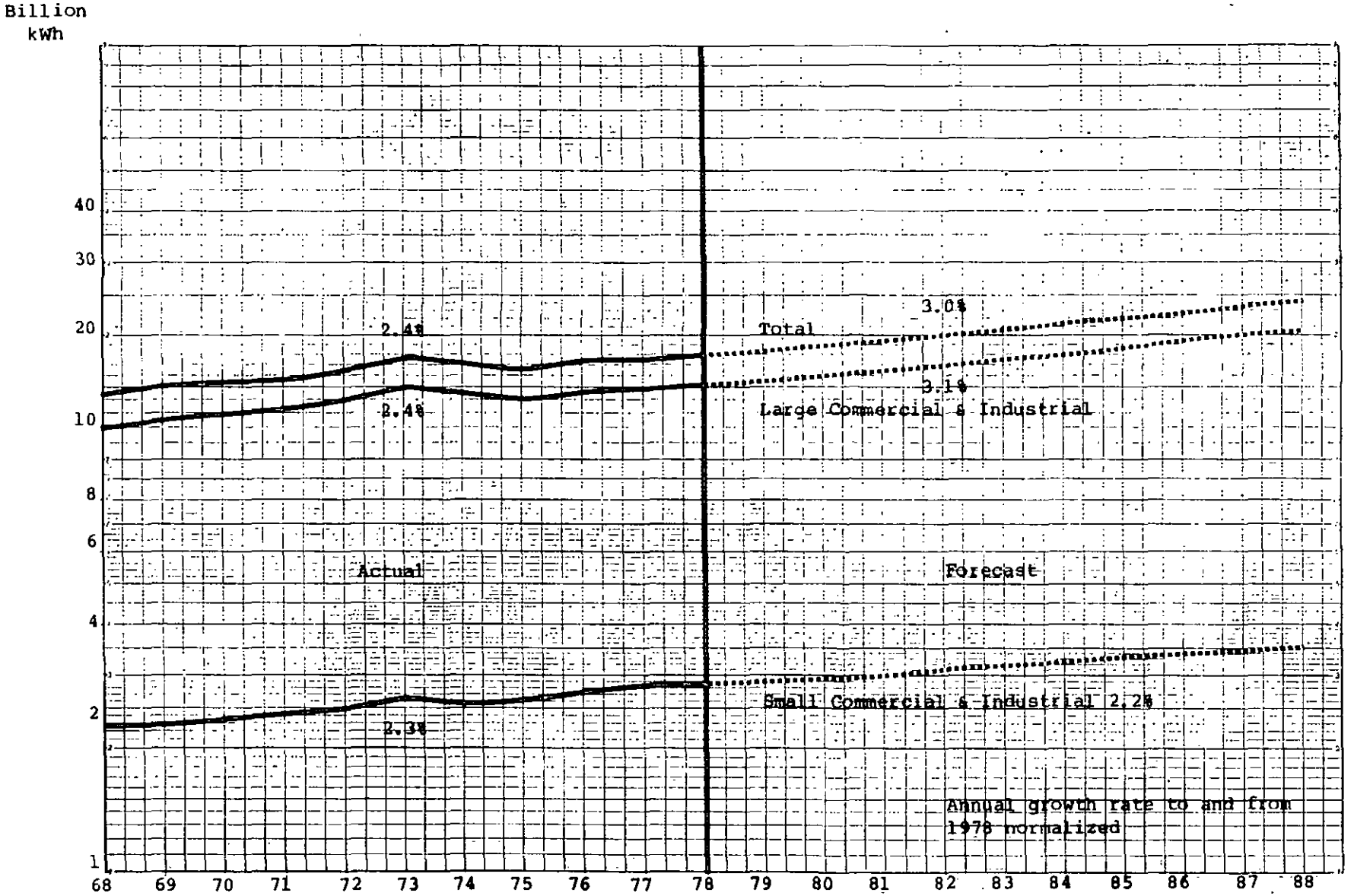
PHILADELPHIA ELECTRIC COMPANY SYSTEM
1978-88 FORECAST
SMALL AND LARGE COMMERCIAL AND INDUSTRIAL
ELECTRIC

Base Case



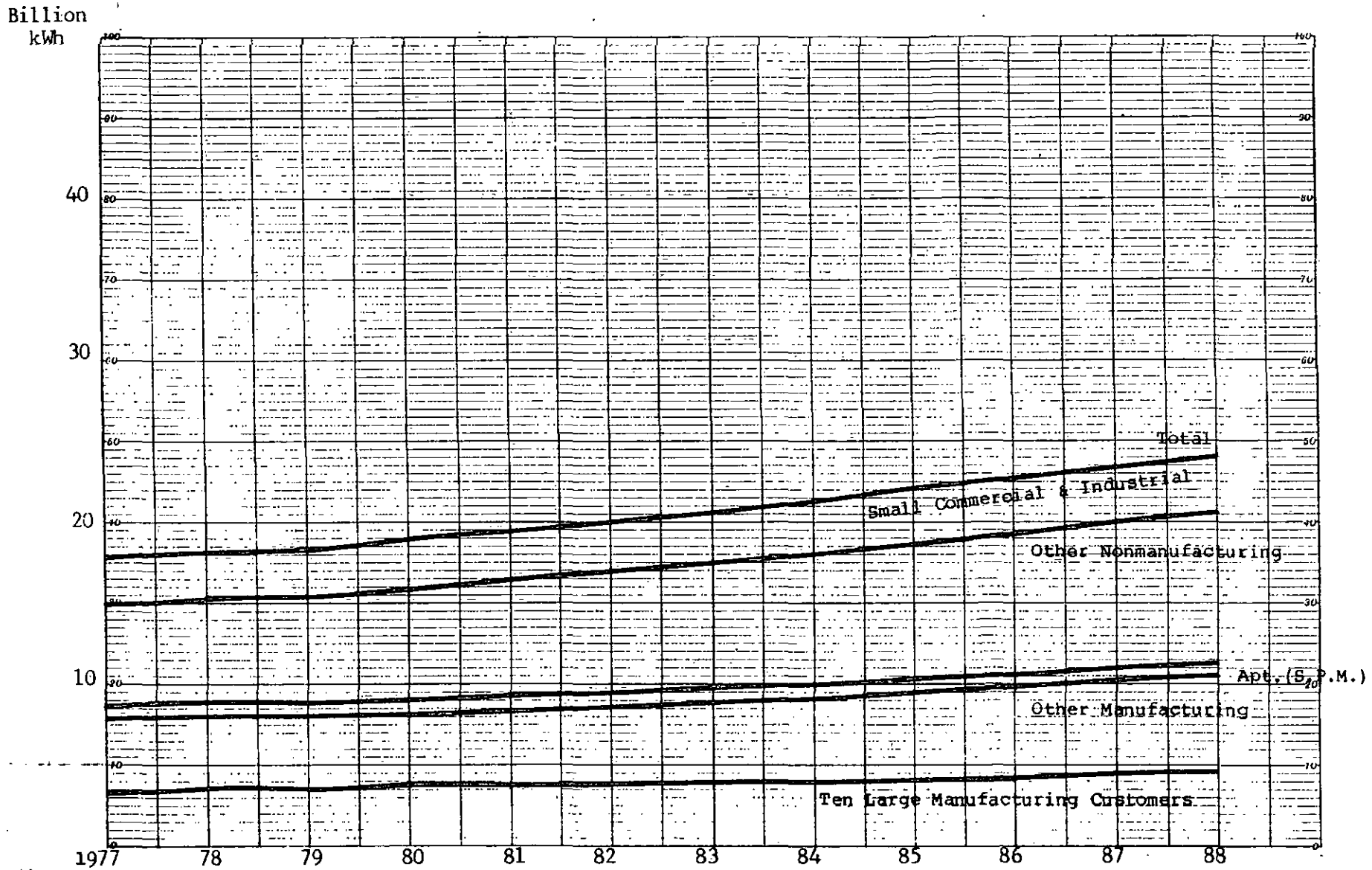
NOTE: Semilog scale
Curves are noncumulative

Chart C-2

R & F Dept.
December 1978

PHILADELPHIA ELECTRIC COMPANY SYSTEM
SMALL AND LARGE COMMERCIAL AND INDUSTRIAL
1978-88 FORECAST

Base Case



Note: This chart is cumulative. Sales in each class are represented by space between curves.

R & F Dept.
December 1978

Chart C-3

PHILADELPHIA ELECTRIC COMPANY SYSTEM

INDUSTRIAL AND COMMERCIAL NEW CONSTRUCTION SPACE HEATING

BASE CASE

THOUSAND SQUARE FEET

	ACTUAL 1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
SUBURBAN*												
ELECTRIC:												
GS, MLP AND FLP	1769	1160	1180	1330	1330	1380	1590	1590	1590	1550	1480	1330
PD AND HT	1654	1378	1945	2680	2830	2820	2810	2810	2810	2825	2910	2990
TOTAL	3423	2538	3125	4010	4160	4200	4400	4400	4400	4375	4390	4320
GAS OR OIL	1582	1547	2675	4255	4785	4915	5300	5305	5315	5225	5205	5095
TOTAL SUBURBAN	5005	4085	5800	8265	8945	9115	9700	9705	9715	9600	9595	9415
PHILADELPHIA												
ELECTRIC:												
GS, MLP AND FLP	528	370	440	490	490	500	510	560	560	510	490	470
PD AND HT	520	520	530	1170	1295	1305	1315	1315	1315	1300	1215	1135
TOTAL	1048	890	970	1660	1785	1805	1825	1875	1875	1810	1705	1605
GAS OR OIL	692	425	530	905	1190	1810	1875	1920	1910	1790	1600	1480
STEAM	500	1000	1000	1000	1000	500	500	500	500	500	500	500
TOTAL PHILADELPHIA	2240	2315	2500	3645	3975	4115	4200	4295	4285	4100	3805	3585
TOTAL PHILADELPHIA AND SUBURBAN												
ELECTRIC:												
GS, MLP AND FLP	2297	1530	1620	1820	1820	1880	2100	2150	2150	2060	1970	1800
PD AND HT	2174	1898	2475	3850	4125	4125	4125	4125	4125	4125	4125	4125
TOTAL	4471	3428	4095	5670	5945	6005	6225	6275	6275	6185	6095	5925
GAS OR OIL	2274	1972	3205	5240	5975	6725	7175	7225	7225	7015	6805	6575
STEAM	500	1000	1000	1000	1000	500	500	500	500	500	500	500
TOTAL PHILADELPHIA AND SUBURBAN	7245	6400	8300	11910	12920	13230	13900	14000	14000	13700	13400	13000

* ALL SUBURBAN FIGURES INCLUDE CONOWINGO POWER COMPANY.

Table C-VII

R & E DEPT.
NOVEMBER 1978

PHILADELPHIA ELECTRIC COMPANY SYSTEM

LARGE COMMERCIAL AND INDUSTRIAL AIR CONDITIONING

BASE CASE

482a

RATES PD AND HT

	ACTUAL 1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
TOTAL SQUARE FEET (1,000'S)												
COMMERCIAL AND INDUSTRIAL TOTAL	3655	3780	5020	7860	8440	8420	8540	8500	8500	8450	8370	8410
COMMERCIAL	3311	3450	4500	7000	7500	7500	7500	7500	7500	7500	7500	7500
INDUSTRIAL	344	330	520	860	940	920	1040	1000	1000	950	870	910
PERCENT OF SQUARE FEET - AIR CONDITIONED												
PERCENT OF TOTAL	67	68	65	65	65	65	65	65	65	65	65	65
PERCENT OF COMMERCIAL	67	65	65	65	65	65	65	65	65	65	65	65
PERCENT OF INDUSTRIAL	70	98	65	65	65	65	65	65	65	65	65	65
A/C SQUARE FEET (1,000'S)												
COMMERCIAL SQUARE FEET (1,000'S)	2213	2243	2925	4550	4875	4875	4875	4875	4875	4875	4875	4875
INDUSTRIAL SQUARE FEET (1,000'S)	242	323	338	559	611	598	676	650	650	618	566	592
TOTAL SQUARE FEET (1,000'S)	2455	2566	3263	5109	5486	5473	5551	5525	5525	5493	5441	5467
WATTS PER SQUARE FOOT	4.4	4.4	4.2	4.0	3.8	3.6	3.5	3.5	3.5	3.5	3.5	3.5
TOTAL NEW CONSTRUCTION - KW	10800	11300	13700	20400	20800	19700	19400	19300	19300	19200	19000	19100
CONVERSION - KW	1206	7935	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000
TOTAL ADDITIONS - KW	12006	19235	16700	23400	23800	22700	22400	22300	22300	22200	22000	22100
TOTAL ON LINES - KW	1083270	1102505	1119205	1142605	1166405	1189105	1211505	1233805	1256105	1278305	1300305	1322405
HOURS USE	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200
KILOWATTHOURS (MILLIONS)	1300	1323	1343	1371	1400	1427	1454	1481	1507	1534	1560	1587

Table C-VIII

R & F DEPT.
NOVEMBER 1978

PHILADELPHIA ELECTRIC COMPANY SYSTEM

SMALL COMMERCIAL AND INDUSTRIAL AIR CONDITIONING

BASE CASE

RATES GLP AND GS

	ACTUAL 1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
TOTAL SQUARE FEET (1,000'S)												
COMMERCIAL AND INDUSTRIAL TOTAL	3590	2620	3280	4050	4480	4810	5360	5500	5500	5250	5030	4590
COMMERCIAL	3318	2400	3000	3710	4100	4400	4900	5000	5000	4800	4600	4200
INDUSTRIAL	272	220	280	340	380	410	460	500	500	450	430	390
PERCENT OF SQUARE FEET - AIR CONDITIONED												
PERCENT OF TOTAL	64	63	63	63	63	63	63	63	63	63	63	63
PERCENT OF COMMERCIAL	66	65	65	65	65	65	65	65	65	65	65	65
PERCENT OF INDUSTRIAL	44	45	45	45	45	45	45	45	45	45	45	45
A/C SQUARE FEET (1,000'S)												
COMMERCIAL SQUARE FEET (1,000'S)	2190	1560	1950	2410	2670	2860	3190	3250	3250	3120	2990	2730
INDUSTRIAL SQUARE FEET (1,000'S)	120	100	130	150	170	180	210	230	230	200	190	180
TOTAL SQUARE FEET (1,000'S)	2310	1660	2080	2560	2840	3040	3400	3480	3480	3320	3180	2910
WATTS PER SQUARE FOOT	4.50	4.40	4.20	4.00	3.80	3.60	3.50	3.50	3.50	3.50	3.50	3.50
TOTAL NEW CONSTRUCTION - KW	10400	7300	8740	10240	10790	10940	11900	12180	12180	11620	11130	10190
CONVERSION - KW	500	500	500	500	500	500	500	500	500	500	500	500
TOTAL ADDITIONS - KW	10900	7800	9240	10740	11290	11440	12400	12680	12680	12120	11630	10690
DEMOLITIONS AND REMOVALS - KW	600	600	600	600	600	600	600	600	600	600	600	600
NET ADDITIONS - KW	10300	7200	8640	10140	10690	10840	11800	12080	12080	11520	11030	10090
TOTAL ON LINE - KW	357900	365100	373740	383880	394570	405410	417210	429290	441370	452890	463920	474010
TOTAL SALES - KWH (MILLIONS)*	304	313	296	309	322	335	350	364	379	393	407	419

* THE FIRST TWO YEARS REFLECT ACTUAL WEATHER.

GROSS PRODUCT PROJECTIONS

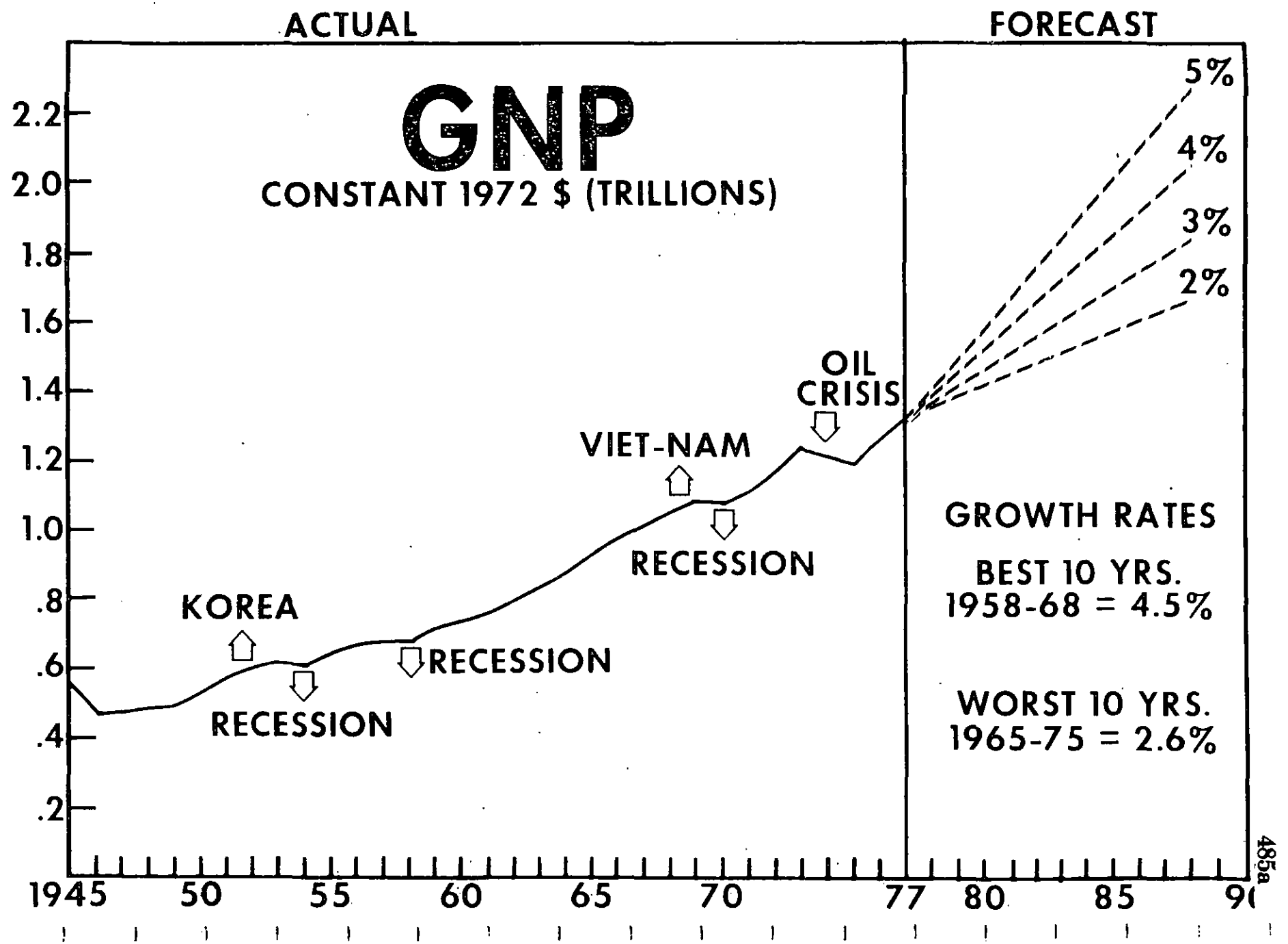
1972 Billion $

Actual 1976 GNP $1271.0 Actual 1976 GRP $26.7
Actual 1977 GNP 1332.7 Actual 1977 GRP 27.4

Previous Forecast:	Year Made	1980	1985	1990	1995	2000
NATIONAL PRODUCT						
Wharton EFA	1977	1,518	1,788	2,088	2,413	X
EEI Task Group 20	1976	X	X	2,200	X	2,925
Merrill Lynch Economics	1976	1,496	1,782	X	X	X
Council of Economic Advisors	1977	1,562	X	X	X	X
Data Resources, Inc.	1976	1,534	1,796	2,073	X	X
Mc Graw-Hill	1977	1,508	1,761	2,061	2,388	X
P. E. Co. (D. F. King)	1977	1,530	1,789	2,080	2,388	X
REGIONAL PRODUCT						
Wharton EFA	1977	34.7	X	X	X	X
Present Forecast:						
NATIONAL PRODUCT						
Council of Economic Advisors	1978	1,537	X	X	X	X
Joint Economic Committee	1978	1,532	X	X	X	X
Wharton EFA	1978	1,509	1,744	1,985	2,288	2,662
Data Resources	1978	1,517	1,815	2,105	X	X
McGraw-Hill	1978	1,498	1,794	2,099	2,458	X
Bell Telephone	1978	1,442	X	X	X	X
P. E. Co. (D. F. King)	1978	1,505	1,761	2,061	2,338	2,662
REGIONAL PRODUCT						
Wharton EFA	1978	30.0	32.3	X	X	X

Table C-X

R&F Dept.
October 1978


ACTUAL
FORECAST
GNP
CONSTANT 1972 $ (TRILLIONS)
2.2
2.0
1.8
1.6
1.4
1.2
1.0
.8
.6
.4
.2
KOREA
RECESSION
RECESSION
VIET-NAM
RECESSION
OIL
CRISIS
5%
4%
3%
2%
GROWTH RATES
BEST 10 YRS.
1958-68 = 4.5%
WORST 10 YRS.
1965-75 = 2.6%
1945
50
55
60
65
70
77
80
85
90
485a

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1988-98 FORECAST

The projections of estimated sales in this section cover the second decade of the forecast period and are provided as a guide to long-term company and interconnection planning. This part of the forecast provides data for each class of service in a form similar to that of the first ten years but without the depth of detail possible in near term forecasting.

ASSUMPTIONS

1. GROSS NATIONAL PRODUCT - Real GNP for the base case will grow at an average rate of 3.1%. For the low case, GNP growth of 2.0% is assumed, while a rate of 4.0% is assumed for the high case.

2. REGIONAL OUTPUT - Regional output growth will lag national growth rates by 1% because of the built-up character of the area, the age distribution of the population, and the limited new industrial and commercial construction now foreseen.

3. POPULATION - The population model for the PECo. System service area was used to project population and total dwelling units through 1998. The assumptions for fertility, mortality and migrations were discussed in the first ten year forecast section. The base case population in 1998 is projected to be 4,050,000.

4. FERTILITY - The base, high and low forecasts use the Bureau of Census Series II fertility rates which ultimately leads to replacement level fertility.

5. WORK FORCE - The growth in the labor force is expected to drop from 3.8% in the 1978/88 period to approximately 2.3% in the latter ten years, or a reduction of 40% in the growth rate. This is based on the population model.

6. FOSSIL FUEL CONVERSION - The conversion of fossil to electric energy will have the effect of increasing the growth rate of other manufacturing sales by 0.5% for the base case and 1.0% for the high case.

7. COSTS OF ENERGY - The price of gas and oil will continue to increase faster than the price of electricity as more nuclear generation is provided for all three cases. The price of electricity is assumed to increase at the same rate as the Consumer Price Index. Price elasticity will not have a predictable effect, most long-term effects of price changes having had an impact in the first ten years.

8. CONSERVATION - Market forces reinforced by legislation will continue to exert a pressure to improve efficiencies of electric energy use resulting in high efficiency appliances, heavily insulated construction, energy monitoring of large buildings, and the general adoption of the most efficient heating and cooling systems, including a continuing swing to heat pumps and ASHRAE 90-75 type construction.

9. COGENERATION - Cogeneration kilowatt-hours will continue to expand at the same growth rate as purchased electric energy.

10. GAS - For the base and low forecasts it is assumed gas will be available to new and existing customers. For the high forecast, it is assumed that gas will be unavailable for additional uses, resulting in higher electric sales.

11. DWELLING UNITS - Dwelling units were developed in two ways--first, by projecting the number of people per household; and, second, by projecting the number of dwelling units per female over 19 years of age.

In the first method (people per household), the historical trend decreased from 3.6 persons per living unit in 1950 to 2.97 in 1975. This forecast estimates the decreasing trend to continue but at a slower rate--down to 2.68 in 1998.

The second method (household per female over 19), was projected from 0.95 realized in 1975 to .98 in 1998. This is due to more single heads of households, both male and female.

The effects of these changes and the population estimates on new construction are shown on Table R-XXXVI which is located in the first ten year forecast section.

The average demolition and abandonment rate was estimated to be 6,000 per year from 1989 to 1998, up from the 4,200 level of 1979-88.

In the low range, 9,400 demolitions and abandonments were estimated annually while the high range estimated 4,900 units/year.

12. RESIDENTIAL NEW CONSTRUCTION - For the forecast period 1989-98, 51% of all new residential construction was projected to be in the multi-unit market, up from the 43% level for the 1978-88 period. A decrease of single-point metered apartments was projected due to demolitions and conversions to individually metered apartments.

For the low forecast it was generally assumed that the trend to smaller living units and apartments would continue while the high forecast continued to maintain the movement toward single detached houses.

13. RESIDENTIAL SPACE HEATING - The following conditions were applied to the residential space heating market:

A. Long-term penetration rates of electric space heating in the new housing market will increase from the 51% level of 1988 to 62% in 1998 as the availability of oil decreases for house heating and the cost of natural gas increases.

The base forecast projects that 57% of all new construction during the period 1989-98 will have electric space heating while the low forecast estimated 38% and the high range 74%.

B. Annual heating kWh per dwelling unit continue to decrease based on less single home construction, greater percentage of townhouses and IMA's, an increase in building insulation, and an increase

in the penetration of heat pumps and solar assisted heating systems.

In 1998, 77% of the new construction electric heating installations were estimated to be heat pumps, while 95% of the electric space heating conversions were projected to be heat pumps. These values are equivalent to a combined saturation of 88% of the electric space heating connections.

By 1998, in the low forecast, 78% of all electric space heating additions (new and conversion) were estimated to have heat pumps compared to 87% for the high range.

14. RESIDENTIAL APPLIANCES - Residential appliances were grouped in the same manner as the first ten year forecast.

A. Major Appliances

The individual penetration of major brown and white goods (refrigerators, freezers, ranges, clothes dryers, washers, dishwashers, televisions, dehumidifiers) were generally increased but normally at a slower rate than for the period 1978-88. The average use per customer per appliance was generally reduced due to increased appliance efficiency. Table R-XVII in the 1978-88 section lists the individual appliance penetrations for all three forecasts, and Table VII in this section indicates the energy use of each appliance.

B. Water Heating

It was projected that electric water heating on Rates RH, and R would continue to obtain new customers. Customers on Rate WHU would peak in 1989 and then decrease about one percent a year due to conversions to Rate RH. Customers on Rate WHR would continue to decrease by about one percent a year due to demolitions and conversions to WHU and RH. By 1998, 27% of all residential customers on line are projected to have electric water heating, an increase from 1988's penetration of 20%.

In the low range, the water heating penetration increased slightly from 19% in 1988 to 23% in 1998 while for the high range the penetration increased from 25% to 36%.

C. Air Conditioning (All Rates)

(1) For the period 1989 to 1998, the penetration of air conditioning is projected to increase to 70%. The forecast anticipates an increase in the penetration of central air conditioning from the 1988 level of 30% to 34% in 1998, while the room cooler penetration will only increase from 35% to 36% in

1992 and then decline to 35% by 1998.

In the low range, the total air conditioning penetration is projected to grow to 55% compared to 53% in 1988. Room coolers would increase from 31% in 1988 to 32% in 1998 while central plant units would increase from 25% to 26%.

In the high range, the total air conditioning penetration is estimated to increase to 90% compared to 73% in 1988. Room coolers increase from 40% to 45% while central plants would rise from 33% in 1988 to 45% in 1998.

(2) In 1998, room coolers are estimated to have an average size of 9,500 Btu/hour with an EER of 8.6. Hourly use is estimated to remain constant at 150 through 1998.

In the low range, the average on line EER is estimated to rise to 11.5 in 1998 while the high range rises to the 1998 level of 8.3. Hourly use for the low range was decreased from 200 hours in 1988 to 140 hours in 1998. The high range was maintained at 200 hours per unit.

(3) Central plant air conditioners are projected to average 31,000 Btu/hour with an EER of 9.0 and an hourly use of 450 hours in 1998.

In the low range the average on line EER was estimated to rise to 9.5 in 1998 and the hours of use to drop from 395 in 1988 to 345 in 1998.

In the high range the EER increased to 8.0 in 1998 while hours of use showed an increase from 482 in 1988 to 502 in 1997.

D. Transportation - Electric Vehicles

Electric cars are projected to increase from 43,000 automobiles and vans in 1988 to 183,000 or 13% of residential Rate R and RH customers.

This particular "appliance" category has the largest opportunity for decreased or increased energy sales. The major handicaps to expanded sales are the need for a vastly improved battery and a significant commitment from major automobile manufacturers. In the low range the penetration was estimated to be 6% which is equivalent to 72,000 electric automobiles, while the high range is projected at 21% or 319,000 automobiles.

492a E. Lighting

The use of lighting is decreased from 525 kWh/unit in 1988 to 500 kWh/unit in 1998 as the use of higher efficacy light bulbs are accepted in the residential market.

In the low forecast the lighting was decreased to 460 kWh/customer, while the high range increased to 660 kWh/customer in 1998.

F. Miscellaneous Appliances

805 kWh/customer in 1988, increasing gradually each year to a maximum of 1,100 in 1998. This growth is attributable to the introduction of new appliances and the increased market penetration of small appliances.

In the low forecast the growth rate per customer was 2.7% per year, while the high range was 2.9%.

15. LARGE MANUFACTURING - For the base case, the 1978/88 growth rate was lowered by 40% to reflect the impact of the lower growth rate of the work force. 0.5% was then added for the effects of increased electrification due to fossil fuel shortages to produce a growth rate of 2.1%.

16. OTHER NONMANUFACTURING - As in the large manufacturing class, the 1978/88 growth rate was lowered by 40% because of the lower growth rate of the work force. 0.5% was then added to allow for increased computer loads, greater use of existing buildings, and the impact of electric vehicles. This produced a 1988/98 growth rate of 2.7%.

17. COMMERCIAL CONSTRUCTION - In the base case forecast, new construction is forecast to decline from the 1988 level of 11.7 million square feet per year to 6 million square feet per year by 1998. In the low range, new construction in 1998 is expected to drop to 3 million square feet per year from 6 million square feet in the 1988 low case. The high range forecasts annual construction to decline from the 1988 level of 14 million square feet to 8 million square feet in 1998.

18. ELECTRIC SPACE HEATING IN COMMERCIAL AND INDUSTRIAL MARKETS - The saturations of electric space heating and heat pumps are expected to be the same as those discussed in the 1978/88 forecast.

19. COMMERCIAL ELECTRIC VEHICLES - This load is not included in the base and high case tables because it is assumed that battery charging will be off-peak and will not affect demands. In the low case, it is assumed that there will be no significant use of electric vehicles. In the base case, it is assumed that 10% of the local delivery vehicles will be electric and in the high case 25% by 1998. This would add 68 million kWh and 170 million kWh respectively by the end of the forecast period.

PHILADELPHIA ELECTRIC COMPANY SYSTEM

ELECTRIC

BASE CASE

1988-98 FORECAST

MILLION KWH

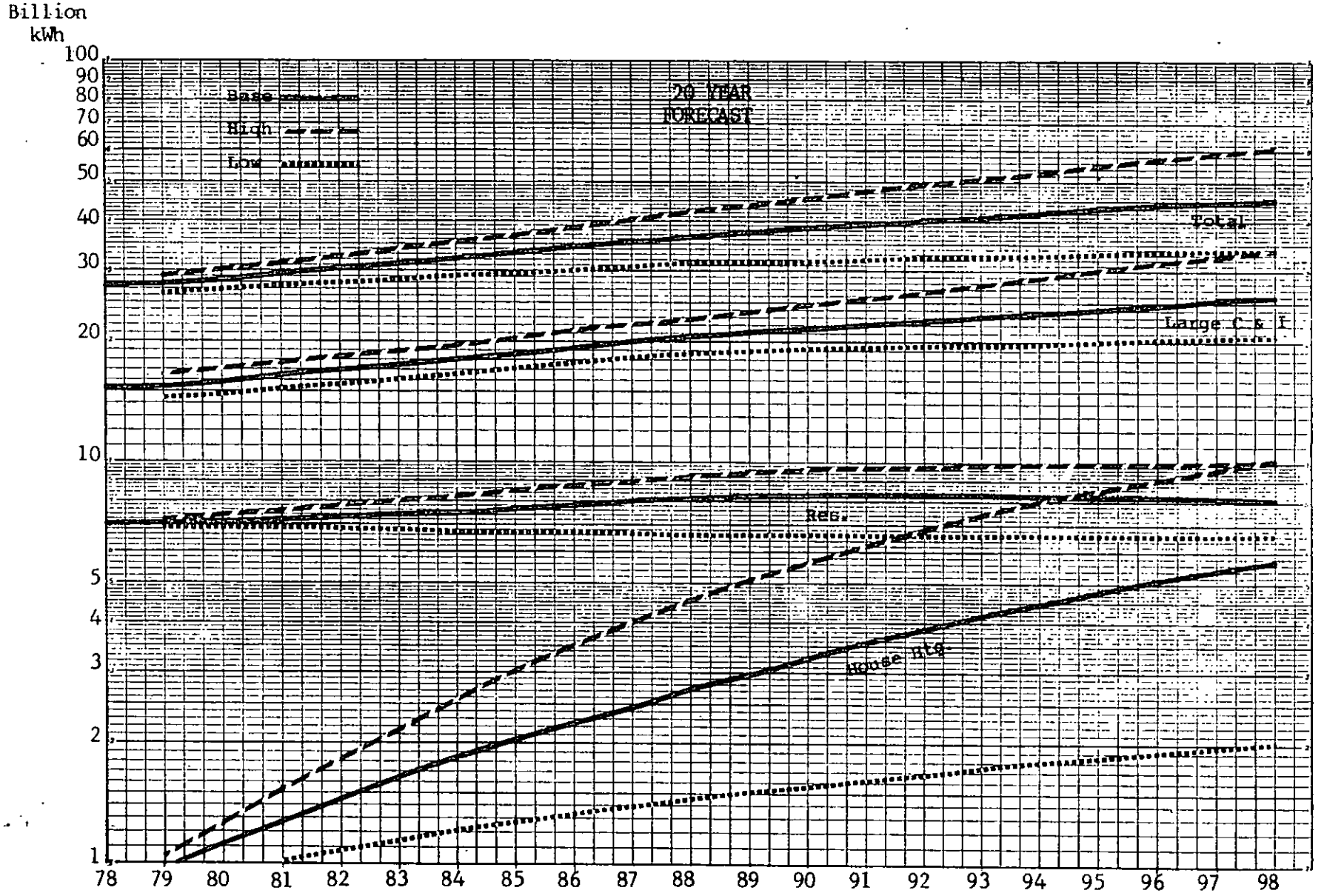
	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
RESIDENTIAL	8090.0	8188.0	8256.0	8295.0	8313.0	8306.0	8294.0	8255.0	8213.0	8154.0	8081.0
PERCENT CHANGE	1.6	1.2	0.8	0.5	0.2	-0.1	-0.1	-0.5	-0.5	-0.7	-0.9
HOUSE HEATING	2720.0	2982.0	3249.0	3531.0	3826.0	4138.0	4461.0	4780.0	5095.0	5411.0	5733.0
PERCENT CHANGE	10.1	9.6	9.0	8.7	8.4	8.2	7.8	7.2	6.6	6.2	6.0
SMALL COM. & IND.	3520.0	3570.0	3610.0	3660.0	3690.0	3730.0	3760.0	3780.0	3810.0	3830.0	3850.0
PERCENT CHANGE	1.7	1.4	1.1	1.4	0.8	1.1	0.8	0.5	0.8	0.5	0.5
LARGE COM. & IND.	20610.0	21075.0	21550.0	22045.0	22540.0	23065.0	23600.0	24115.0	24600.0	25255.0	25820.0
PERCENT CHANGE	3.2	2.3	2.3	2.3	2.2	2.3	2.3	2.2	2.3	2.3	2.2
STREET LIGHTING	184.0	186.0	188.0	190.0	192.0	194.0	195.0	196.0	197.0	198.0	199.0
PERCENT CHANGE	0.5	1.1	1.1	1.1	1.1	1.0	0.5	0.5	0.5	0.5	0.5
OTHER PUBLIC AUTH.	161.0	163.0	165.0	167.0	169.0	170.0	171.0	172.0	173.0	174.0	175.0
PERCENT CHANGE	0.6	1.2	1.2	1.2	1.2	0.6	0.6	0.6	0.6	0.6	0.6
RAILROADS & RAILWAYS	1055.0	1070.0	1080.0	1100.0	1110.0	1125.0	1140.0	1155.0	1170.0	1185.0	1200.0
PERCENT CHANGE	2.4	1.4	0.9	1.9	0.9	1.4	1.3	1.3	1.3	1.3	1.3
SALES FOR RESALE	120.0	121.0	122.0	123.0	124.0	125.0	126.0	127.0	128.0	129.0	130.0
PERCENT CHANGE	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
INTERDEPARTMENTAL	70.0	71.0	72.0	73.0	74.0	75.0	76.0	77.0	78.0	79.0	80.0
PERCENT CHANGE	2.9	1.4	1.4	1.4	1.4	1.4	1.3	1.3	1.3	1.3	1.3
TOTAL	36530	37426	38292	39184	40038	40928	41823	42657	43544	44415	45260
PERCENT CHANGE	3.1	2.5	2.3	2.3	2.2	2.2	2.2	2.0	2.1	2.0	1.9
BREAKDOWN OF SEASONAL AND ENVIRONMENTAL LOADS											
SPACE HEATING	2767	2922	3075	3231	3389	3550	3714	3874	4030	4186	4345
AIR CONDITIONING	3092	3149	3201	3248	3292	3331	3369	3404	3437	3469	3501
ENVIRONMENTAL	4622	4743	4885	5032	5183	5339	5499	5664	5834	6009	6189
ALL OTHER LOAD	26049	26612	27131	27673	28174	28708	29241	29715	30243	30751	31233

Table I (Long Range)

R & F DEPT.
DECEMBER 1978

1978-98 FORECAST

ELECTRIC



NOTE: Semilog scale
Curves are noncumulative

Chart 1 (Long Range)

R & F Dept.
December 1978

ELECTRIC

1988-98 FORECAST

HIGH AND LOW RANGES

MILLION KWH

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
RESIDENTIAL											
HIGH	9240	9431	9580	9700	9794	9868	9909	9950	9976	9990	9983
LOW	6613	6608	6600	6590	6578	6575	6561	6576	6581	6586	6593
HOUSE HEATING											
HIGH	4537	5081	5630	6192	6766	7358	7952	8523	9078	9632	10192
LOW	1451	1508	1565	1623	1682	1740	1799	1855	1911	1966	2021
SMALL COM. & IND.											
HIGH	3763	3833	3900	3961	4018	4072	4118	4168	4206	4242	4287
LOW	3102	3120	3137	3157	3173	3200	3208	3235	3252	3270	3299
LARGE COM. & IND.											
HIGH	22840	23760	24710	25700	26730	27800	28920	30080	31290	32540	33850
LOW	18730	18910	19090	19270	19460	19640	19830	20020	20210	20400	20600
STREET LIGHTING											
HIGH	193	196	199	202	205	208	210	212	214	216	218
LOW	173	174	175	176	177	177	177	177	177	177	177
OTHER PUBLIC AUTHORITIES											
HIGH	172	175	178	181	184	187	188	190	191	193	194
LOW	154	155	156	157	158	159	159	159	159	159	159
RAILROADS & RAILWAYS											
HIGH	1150	1200	1250	1315	1390	1480	1565	1655	1770	1940	2110
LOW	925	935	940	945	950	955	960	965	970	975	980
SALES FOR RESALE											
HIGH	126	127	129	130	131	133	134	136	137	139	140
LOW	106	107	107	107	108	108	108	109	109	109	110
INTERDEPARTMENTAL											
HIGH	72	74	75	77	79	80	82	84	86	88	90
LOW	68	68	68	68	68	69	69	69	69	70	70
TOTAL											
HIGH	42093	43877	45651	47458	49297	51186	53078	54998	56948	58980	61064
PERCENT CHANGE	4.2	4.2	4.0	4.0	3.9	3.8	3.7	3.6	3.5	3.6	3.5
LOW	31322	31585	31838	32093	32354	32623	32871	33165	33438	33712	34009
PERCENT CHANGE	1.9	0.8	0.8	0.8	0.8	0.8	0.8	0.9	0.8	0.8	0.9

Table II (Long Range)

R & F DEPT.,
DECEMBER 1978

PHILADELPHIA ELECTRIC COMPANY SYSTEM

LARGE COMMERCIAL AND INDUSTRIAL

1988-98 FORECAST

MILLION KWH

BASE CASE

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
TEN LARGE MANUFACTURING*	4570	4650	4720	4800	4870	4960	5040	5130	5210	5300	5370
OTHER MANUFACTURING	5880	6020	6170	6320	6480	6640	6810	6950	7130	7310	7490
TOTAL MANUFACTURING	10450	10670	10890	11120	11350	11600	11850	12080	12340	12610	12860
SINGLE-POINT METERED APTS.	820	815	810	805	800	795	790	785	780	775	770
OTHER NONMANUFACTURING	9340	9590	9850	10120	10390	10670	10960	11250	11560	11870	12190
TOTAL NONMANUFACTURING	10160	10405	10660	10925	11190	11465	11750	12035	12340	12645	12960
TOTAL LARGE C & I	20610	21075	21550	22045	22540	23065	23600	24115	24680	25255	25820
CONOWINGO LARGE C & I	206	211	216	220	225	231	236	241	247	253	258
BREAKDOWN OF SEASONAL AND ENVIRONMENTAL LOADS											
SPACE HEATING	905	933	961	989	1017	1045	1073	1101	1129	1157	1185
AIR CONDITIONING	1719	1744	1770	1796	1822	1848	1875	1901	1928	1954	1981
ENVIRONMENTAL**	3387	3541	3642	3748	3822	3944	4036	4148	4270	4394	4493
ALL OTHER LOAD	14599	14857	15177	15512	15879	16228	16616	16965	17343	17750	18161

* ATLANTIC RICHFIELD, BP OIL, SUN OIL, SCOTT PAPER, LUKENS STEEL, U.S. STEEL, BUDD CO., FIRESTONE, LINDE AIR PRODUCTS, MERCK.

** INCLUDES ELECTRIC STEEL MELTING.

Table III (Long Range)

R & F DEPT.
DECEMBER 1978

PHILADELPHIA ELECTRIC COMPANY SYSTEM

LARGE COMMERCIAL AND INDUSTRIAL

1988-98 FORECAST

HIGH AND LOW RANGES

MILLION KWH

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
TOTAL MANUFACTURING											
HIGH	11500	11975	12470	12985	13520	14070	14650	15250	15880	16520	17200
LOW	9500	9485	9470	9450	9440	9415	9400	9375	9350	9320	9300
SINGLE-POINT METERED APTS.											
HIGH	840	835	830	825	820	815	810	805	800	795	790
LOW	810	805	800	795	790	785	780	775	770	765	760
OTHER NONMANUFACTURING											
HIGH	10500	10950	11410	11890	12390	12915	13460	14025	14610	15225	15860
LOW	8420	8620	8820	9025	9230	9440	9650	9870	10090	10315	10540
TOTAL NONMANUFACTURING											
HIGH	11340	11785	12240	12715	13210	13730	14270	14830	15410	16020	16650
LOW	9230	9425	9620	9820	10020	10225	10430	10645	10860	11080	11300
TOTAL LARGE C & I											
HIGH	22840	23760	24710	25700	26730	27800	28920	30080	31290	32540	33850
LOW	18730	18910	19090	19270	19460	19640	19830	20020	20210	20400	20600
BREAKDOWN OF SEASONAL LOADS											
SPACE HEATING											
HIGH	979	1008	1038	1069	1101	1134	1168	1203	1239	1276	1314
LOW	848	865	882	900	918	936	955	974	993	1013	1033
AIR CONDITIONING											
HIGH	2026	2067	2108	2150	2193	2237	2282	2328	2375	2423	2471
LOW	1544	1559	1575	1591	1607	1623	1639	1655	1672	1689	1706

* ATLANTIC RICHFIELD, BP OIL, SUN OIL, SCOTT PAPER, LUKENS STEEL, U.S. STEEL, BUDD CO., FIRESTONE, LINDE AIR PRODUCTS, MERCK.

Table IV (Long Range)

R & F DEPT.
DECEMBER 1978

PHILADELPHIA ELECTRIC COMPANY SYSTEM

RESIDENTIAL SALES - RATES R, RM, WH

1989-1998 FORECAST

BASE CASE

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
ADDITIONS TO RH	13700	14600	15300	16000	17300	17200	16820	16990	17490	17590
RATE RH										
CUSTOMERS - DECEMBER (1,000'S)	158.4	173.0	188.3	204.3	221.6	238.8	255.6	272.6	290.1	307.7
CUSTOMERS - AVG. (1,000'S)	151.5	165.7	180.6	196.3	212.9	230.2	247.2	264.1	281.4	298.9
ANNUAL AVG. USE - KWH	19677	19608	19547	19491	19432	19379	19336	19291	19232	19181
SALES - KWH (MILLIONS)	2982	3249	3531	3826	4138	4461	4780	5095	5411	5733
RATES R AND RM - INCLUDES WH										
NET CHANGE IN CUSTOMERS	-4300	-5700	-6300	-7000	-7300	-8200	-9420	-10490	-10990	-11590
CUSTOMERS - DECEMBER (1,000'S)	1142.8	1137.1	1130.8	1123.8	1116.5	1108.3	1098.9	1088.4	1077.4	1065.8
CUSTOMERS - AVG. (1,000'S)	1145.0	1140.0	1134.0	1127.3	1120.2	1112.4	1103.6	1093.6	1082.9	1071.6
ANNUAL AVG. USE - KWH	7152	7242	7315	7374	7415	7455	7480	7509	7529	7541
ANNUAL AVG. KWH INC.	108	90	73	59	40	41	25	29	20	12
SALES - KWH (MILLIONS)	8188	8256	8295	8313	8306	8294	8255	8213	8154	8081
TOTAL RESIDENTIAL										
ADDITIONS - NEW CONSTR.	14900	14400	14400	14400	15400	14400	12800	11800	11800	11300
OTHER CUSTOMER CHANGES(1)	-5500	-5500	-5400	-5400	-5400	-5400	-5400	-5300	-5300	-5390
NET CHANGE IN CUSTOMERS	9400	8900	9000	9000	10000	9000	7400	6500	6500	6000
CUSTOMERS - DECEMBER (1,000'S)	1301.2	1310.1	1319.1	1328.1	1338.1	1347.1	1354.5	1361.0	1367.5	1373.5
CUSTOMERS - AVG. (1,000'S)	1296.5	1305.7	1314.6	1323.6	1333.1	1342.6	1350.8	1357.8	1364.3	1370.5
ANNUAL AVG. USE - KWH	8616	8811	8996	9171	9334	9500	9650	9801	9943	10080
ANNUAL AVG. KWH INC.	213	196	184	176	163	166	150	151	142	137
SALES - KWH (MILLIONS)	11170	11505	11826	12139	12444	12755	13035	13308	13565	13814
RATE WH - INCLUDED IN R & RM (CUSTOMERS IN 1,000'S)										
UNRESTRICTED CUSTOMERS - AVG.	17.6	17.6	17.5	17.4	17.3	17.1	16.9	16.7	16.5	16.2
OFF-PEAK CUSTOMERS - AVG.	98.4	97.7	97.0	96.3	95.5	94.8	94.0	93.1	92.3	91.4
SALES - KWH (MILLIONS)	469	461	453	447	440	431	423	416	408	402
BREAKDOWN OF SEASONAL LOADS - KWH (MILLIONS)										
ELECTRIC SPACE HEATING(2)	1515	1623	1736	1852	1972	2097	2218	2335	2453	2575
AIR CONDITIONING(3)	946	962	974	984	990	997	1001	1004	1006	1008
ALL OTHER LOAD	8710	8919	9116	9304	9481	9661	9817	9968	10105	10231

(1)OTHER CUSTOMER CHANGES REFLECTS THE NET NUMBER OF REINTRODUCTIONS, DEMOLITIONS AND SEPARATIONS OF WIRING.
(2)INCLUDES BASE AND SUPPLEMENTAL. (3)INCLUDES ROOM COOLERS AND CENTRAL AIR ONLY.
TOTALS MAY NOT EQUAL THE SUM OF INDIVIDUAL FIGURES DUE TO ROUNDING.

Table V (Long Range)

R & F DEPT.
NOVEMBER 1978

PHILADELPHIA ELECTRIC COMPANY SYSTEM
RESIDENTIAL SALES - RATES R, RH, RM, WH
HIGH AND LOW RANGES 1989-98

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
RATE RH										
Customers - Avg. (1,000's) - High	225.7	249.5	274.1	299.3	325.7	353.1	379.9	406.2	432.8	459.7
Customers - Avg. (1,000's) - Low	79.8	83.1	86.6	90.0	93.4	96.9	100.1	103.4	106.5	109.6
Avg. Annual Use (kWh) - High	22,510	22,560	22,590	22,610	22,590	22,520	22,440	22,350	22,260	22,170
Avg. Annual Use (kWh) - Low	18,910	18,820	18,750	18,700	18,630	18,570	18,520	18,490	18,460	18,440
Sales - kWh (millions) - High	5,081	5,630	6,192	6,766	7,358	7,952	8,523	9,078	9,632	10,192
Sales - kWh (millions) - Low	1,508	1,565	1,623	1,682	1,740	1,799	1,855	1,911	1,966	2,021
RATES R + RM (INCLUDING WH)										
Customers - Avg. (1,000's) - High	1,115.1	1,103.5	1,090.8	1,077.4	1,063.2	1,048.3	1,032.5	1,015.6	998.0	979.9
Customers - Avg. (1,000's) - Low	1,061.7	1,055.8	1,049.8	1,043.6	1,037.5	1,031.2	1,024.7	1,017.9	1,011.0	1,003.9
Avg. Annual Use (kWh) - High	8,460	8,680	8,890	9,090	9,280	9,450	9,640	9,820	10,010	10,190
Avg. Annual Use (kWh) - Low	6,220	6,250	6,280	6,300	6,340	6,360	6,420	6,470	6,510	6,570
Sales - kWh (millions) - High	9,431	9,580	9,700	9,794	9,868	9,909	9,950	9,976	9,990	9,983
Sales - kWh (millions) - Low	6,608	6,600	6,590	6,578	6,575	6,561	6,576	6,581	6,586	6,593
TOTAL RESIDENTIAL (R,RH,RM,WH)										
Customers - Avg. (1,000's) - High	1,340.8	1,353.0	1,364.9	1,376.7	1,388.9	1,401.4	1,412.4	1,421.8	1,430.8	1,439.6
Customers - Avg. (1,000's) - Low	1,141.5	1,138.9	1,136.4	1,133.6	1,130.9	1,128.1	1,124.8	1,121.3	1,117.5	1,113.5
Avg. Annual Use (kWh) - High	10,820	11,240	11,630	12,030	12,400	12,750	13,080	13,400	13,710	14,010
Avg. Annual Use (kWh) - Low	7,110	7,170	7,230	7,290	7,350	7,410	7,500	7,570	7,650	7,740
Sales - kWh (millions) - High	14,512	15,210	15,892	16,560	17,226	17,861	18,473	19,054	19,622	20,175
Sales - kWh (millions) - Low	8,116	8,165	8,213	8,260	8,315	8,360	8,431	8,492	8,552	8,614
BREAKDOWN OF SEASONAL LOADS kWh (millions)										
Electric Space Heating - High(1)	2,242	2,442	2,647	2,852	3,063	3,279	3,487	3,688	3,888	4,089
Electric Space Heating - Low(1)	862	888	914	938	963	988	1,010	1,032	1,052	1,074
Air Conditioning - High(2)	1,372	1,441	1,506	1,563	1,615	1,662	1,702	1,737	1,763	1,787
Air Conditioning - Low(2)	524	517	511	503	497	493	487	483	478	475
All Other Load - High	10,898	11,327	11,739	12,145	12,548	12,920	13,284	13,629	13,971	14,299
All Other Load - Low	6,730	6,760	6,788	6,819	6,855	6,879	6,934	6,977	7,022	7,065

(1) Base and supplemental.

(2) Room coolers and central air conditioning only.

PHILADELPHIA ELECTRIC COMPANY SYSTEM

RESIDENTIAL USE BY APPLIANCE CATEGORY (RATES R,RH WH)

BASE CASE

ALL UNITS ARE AVERAGE IN USE IN THOUSANDS - ANNUAL KWH IS IN MILLIONS

		1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
DWELLING UNITS (R,RH,RM)		1309	1318	1327	1336	1346	1355	1363	1370	1377	1383
REFRIGERATORS	- UNITS	1712	1735	1751	1760	1766	1769	1772	1773	1774	1774
	KWH	2706	2722	2729	2734	2740	2751	2764	2779	2788	2795
FREEZERS	- UNITS	534	548	560	570	578	584	589	592	595	596
	KWH	602	608	612	614	612	604	596	592	591	590
RANGES	- UNITS	584	598	611	624	635	645	654	661	667	672
	KWH	409	418	428	437	444	451	456	460	463	466
CLOTHES DRYERS	- UNITS	632	647	660	671	680	686	690	693	694	694
	KWH	605	618	629	638	646	652	656	658	659	659
CLOTHES WASHERS	- UNITS	1094	1105	1112	1117	1120	1121	1121	1121	1121	1121
	KWH	113	114	115	115	115	115	115	115	115	115
DISHWASHERS	- UNITS	652	671	689	705	721	735	747	757	765	771
	KWH	202	205	210	215	220	224	228	231	233	235
WATER HEATERS	- UNITS	269	279	290	301	313	325	337	348	359	371
	KWH	1078	1108	1141	1177	1215	1255	1289	1325	1361	1397
TELEVISIONS	- UNITS	2349	2367	2384	2400	2415	2431	2446	2460	2474	2486
	KWH	395	400	405	410	415	420	426	431	433	435
ROOM COOLERS	- UNITS	1382	1407	1427	1443	1455	1463	1467	1468	1467	1467
	KWH	246	248	248	250	249	249	248	247	245	243
CENTRAL AIR	- UNITS	404	417	427	435	443	450	456	462	468	473
	KWH	700	714	726	734	742	748	753	758	761	765
DEHUMIDIFIERS	- UNITS	253	258	262	266	269	273	275	278	280	282
	KWH	84	84	85	85	85	86	87	88	89	89
ELEC. HT. (RH)	- UNITS	151	166	181	196	213	230	247	264	281	299
	KWH	1381	1489	1600	1717	1838	1963	2086	2206	2326	2448
HTG AUXILIARIES	- UNITS	1158	1153	1147	1140	1133	1125	1116	1106	1096	1084
	KWH	461	456	452	447	442	437	431	425	419	413
SUPPLEMENTARY HT.	- UNITS	234	240	246	250	254	256	258	259	260	261
	KWH	133	134	135	135	134	133	131	129	127	126
TRANSPORTATION	- UNITS	57	71	85	99	113	127	141	155	169	183
	KWH	257	320	383	446	509	572	635	698	761	824
SUB TOTAL	- KWH	9370	21144	9897	10154	22851	23416	10902	24449	11371	11601
LIGHTING	- KWH	687	692	694	696	697	698	695	693	693	692
OTHER APPLIANCES	- KWH	1113	1173	1234	1289	1339	1396	1438	1473	1501	1521
ANNUAL TOTAL	- KWH	11170	23009	11826	12139	24887	25509	13035	26615	13565	13814

TOTALS MAY NOT EQUAL SUM OF INDIVIDUAL APPLIANCE M-MKWH DUE TO ROUNDING.

PHILADELPHIA ELECTRIC COMPANY SYSTEM

BASE CASE

CENTRAL PLANT - RESIDENTIAL - ALL RATES

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
CENTRAL PLANT ADDITIONS (1,000'S)	18	14	11	9	8	8	7	7	6	6	6
CENTRAL PLANT REPLACEMENT MARKET (1,000'S)	21	19	16	15	17	20	23	26	30	33	36
CENTRAL PLANT REPLACEMENTS (1,000'S)	21	19	16	15	16	19	23	26	29	33	35
CENTRAL PLANT NET CHANGE IN UNITS (1,000'S)	18	14	11	9	8	7	7	6	6	6	6
CENTRAL PLANT UNITS ON LINE (1,000'S)	412	428	440	450	458	466	473	479	485	491	497
TOTAL D.U.'S WITH CENTRAL PLANT OR LARGE TONNAGE SYSTEMS (1,000'S)	426	442	454	464	472	480	487	493	499	505	511
E.E.R. - AVERAGE UNIT SOLD	8.50	8.55	8.60	8.65	8.70	8.75	8.80	8.85	8.90	8.95	9.00
BTU - AVERAGE UNIT ADDED	29000	28900	28900	28900	28800	28800	28800	28800	28800	28700	28700
KW - AVERAGE UNIT ADDED	3.41	3.38	3.36	3.34	3.31	3.29	3.27	3.25	3.24	3.21	3.19
E.E.R. - AVERAGE UNIT IN USE	8.06	8.14	8.21	8.26	8.32	8.37	8.42	8.48	8.53	8.58	8.64
BTU - AVERAGE UNIT IN USE	31413	31335	31276	31230	31189	31151	31117	31087	31059	31031	31004
KW - AVERAGE UNIT IN USE	3.90	3.85	3.81	3.78	3.75	3.72	3.69	3.67	3.64	3.62	3.59
TOTAL MW CONNECTED - CP & LT	1660	1700	1730	1753	1771	1785	1798	1809	1818	1826	1832

TOTAL RESIDENTIAL AIR CONDITIONING MW - ALL RATES

CENTRAL PLANT (INCLUDES LARGE TONNAGE)	1660	1700	1730	1753	1771	1785	1798	1809	1818	1826	1832
ROOM COOLERS	1727	1747	1759	1765	1768	1768	1767	1762	1753	1741	1730
TOTAL MW - RESIDENTIAL	3387	3447	3489	3518	3538	3553	3565	3571	3571	3566	3563

NOTES: SPM AND LANSDALE ARE INCLUDED IN ALL FIGURES ON THIS PAGE.
UNITS ARE AVERAGE UNITS IN USE DURING THE YEAR.
TOTALS MAY NOT EQUAL THE SUM OF INDIVIDUAL FIGURES DUE TO ROUNDING.
CENTRAL PLANT -- REFERS TO INDIVIDUAL AIR CONDITIONING UNITS, EACH COOLING ONE DWELLING UNIT.
CENTRAL PLANT -- E.E.R.'S, KW/UNIT AND TOTAL MW HAVE ALL BEEN ESTIMATED TO INCLUDE FAN LOADS IN ACCORDANCE WITH A.R.I. STANDARDS ADOPTED JANUARY 1975.

PHILADELPHIA ELECTRIC COMPANY SYSTEM

ROOM COOLERS - RESIDENTIAL - ALL RATES

BASE CASE

502a

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
ROOM COOLER ADDITIONS (1,000'S)	34	31	28	24	20	16	13	10	8	7	6
ROOM COOLER REPLACEMENT MARKET (1,000'S)	47	67	95	124	130	127	111	130	141	145	123
ROOM COOLER REPLACEMENTS (1,000'S)	45	63	91	118	123	120	105	124	134	138	117
ROOM COOLER NET CHANGE IN UNITS (1,000'S)	32	28	23	18	14	10	7	3	1	-0	-0
ROOM COOLER UNITS ON LINE (1,000'S)	1444	1473	1499	1519	1535	1547	1555	1561	1563	1563	1563
E.E.R. - AVERAGE UNIT SOLD	8.40	8.45	8.50	8.55	8.60	8.65	8.70	8.75	8.80	8.85	8.90
BTU - AVERAGE UNIT ADDED	9500	9500	9500	9500	9500	9500	9500	9500	9500	9500	9500
KW - AVERAGE UNIT ADDED	1.13	1.12	1.12	1.11	1.10	1.10	1.09	1.09	1.08	1.07	1.07
E.E.R. - AVERAGE UNIT IN USE	7.98	8.05	8.13	8.22	8.29	8.35	8.40	8.45	8.51	8.57	8.62
BTU - AVERAGE UNIT IN USE	9551	9550	9548	9546	9544	9543	9542	9542	9543	9544	9545
KW - AVERAGE UNIT IN USE	1.20	1.19	1.17	1.16	1.15	1.14	1.14	1.13	1.12	1.11	1.11
TOTAL MW CONNECTED - ROOM COOLERS	1727	1747	1759	1765	1768	1768	1767	1762	1753	1741	1730

NOTES: SPM AND LANSDALE ARE INCLUDED IN ALL FIGURES ON THIS PAGE.
UNITS ARE AVERAGE UNITS IN USE DURING THE YEAR.
TOTALS MAY NOT EQUAL THE SUM OF INDIVIDUAL FIGURES DUE TO ROUNDING.

PHILADELPHIA ELECTRIC COMPANY SYSTEM

RESIDENTIAL AIR CONDITIONING ON RATES R,RH,RM

BASE CASE

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
AVERAGE DWELLING UNITS (1,000'S)	1299	1309	1318	1327	1336	1346	1355	1363	1370	1377	1383
CENTRAL PLANT NET CHANGE IN UNITS (1,000'S)	19	16	12	10	8	8	7	7	6	6	6
CENTRAL PLANT UNITS IN USE (1,000'S)	387	403	416	425	434	441	448	455	461	467	472
KW - AVERAGE UNIT IN USE	3.90	3.85	3.81	3.78	3.75	3.72	3.69	3.67	3.64	3.62	3.59
HOURS USE - AVERAGE UNIT IN USE	450	450	450	450	450	450	450	450	450	450	450
KWH - AVERAGE UNIT IN USE	1754	1732	1715	1701	1688	1675	1662	1650	1639	1627	1615
TOTAL MW CONNECTED - CENTRAL PLANT	1510	1552	1584	1608	1626	1642	1656	1668	1670	1687	1695
ROOM COOLER NET CHANGE IN UNITS (1,000'S)	32	29	25	20	15	11	8	5	2	-0	-1
ROOM COOLER UNITS IN USE (1,000'S)	1350	1379	1404	1423	1438	1449	1457	1462	1464	1463	1463
KW - AVERAGE UNIT IN USE	1.20	1.19	1.17	1.16	1.15	1.14	1.14	1.13	1.12	1.11	1.11
HOURS USE - AVERAGE UNIT IN USE	150	150	150	150	150	150	150	150	150	150	150
KWH - AVERAGE UNIT IN USE	179	178	176	174	173	171	170	169	168	167	166
TOTAL MW CONNECTED - ROOM COOLERS	1616	1635	1648	1654	1656	1656	1656	1651	1641	1630	1619
TOTAL MW CONNECTED - CP & RC	3126	3187	3232	3262	3283	3299	3312	3319	3320	3316	3314

NOTES: SPM AND LANSDALE ARE EXCLUDED FROM ALL FIGURES ON THIS PAGE.
UNITS ARE AVERAGE UNITS IN USE DURING THE YEAR.
TOTALS MAY NOT EQUAL THE SUM OF INDIVIDUAL FIGURES DUE TO ROUNDING.
CENTRAL PLANT -- E.E.R.'S, KW/UNIT AND TOTAL MW HAVE ALL BEEN ESTIMATED TO INCLUDE FAN LOADS IN ACCORDANCE WITH A.R.I. STANDARDS ADOPTED JANUARY 1975.

Table X (Long Range)

R & F DEPT.
AUGUST 1978

PHILADELPHIA ELECTRIC COMPANY SYSTEM

SUMMARY OF RESIDENTIAL MARKET PROJECTIONS

BASE CASE

1988-1998

TOTAL AND ELECTRIC HEAT DWELLING UNITS

RATES --)	TOTAL DWELLING UNITS (ALL)	HOUSES (R,RH,RM)	APARTMENTS		TOTAL (R,RH,RM)
			INDIVIDUALLY METERED (R,RH,RM)	SINGLE-POINT METERED (GS,PD,HT)	
TOTAL					
DECEMBER 31, 1988	1436600	1034250	270150	132200	1304400
NEW CONSTRUCTION 1989-98 INCLUSIVE	135600	67100	68500	0	135600
DEMOLITIONS AND ABANDONMENTS	60000	44500	9400	6100	53900
DECEMBER 31, 1998	1512200	1056850	329250	126100	1386100
NET INCREASE 1988-98 (10 YEARS)	75600	22600	59100	-6100	81700
ELECTRIC HEAT					
DECEMBER 31, 1988	167170	94400	47470	25300	141870
PERCENT PENETRATION 1988	11.6%	9.1%	17.6%	19.1%	10.9%
NEW CONSTRUCTION 1989-98 INCLUSIVE	77610	42720	34890	0	77610
PERCENT PENETRATION NEW CONSTRUCTION	57.2%	63.7%	50.9%	0.0%	57.2%
CONVERSIONS FROM OTHER FUELS 1989-98	85380	70670	14710	0	85380
DECEMBER 31, 1998	330160	207790	97070	25300	304860
PERCENT PENETRATION 1998	21.8%	19.7%	29.5%	20.1%	22.0%

NOTE: LANSDALE IS EXCLUDED FROM ALL FIGURES ON THIS PAGE.

Table XI (Long Range)

R & F DEPT.
DECEMBER 1978

1979-88 BUDGET FORECAST
ANNUAL PEAK DEMAND

PREPARED BY SYSTEM PLANNING DIVISION
ENGINEERING & RESEARCH DEPARTMENT

TEN YEAR PEAK DEMAND FORECAST

The peak demand (maximum annual MW hourly load) is derived from the energy and connected air conditioning forecast developed by the Commercial Operations Department.

Historical and projected demands, annual output (sales plus losses) and load factors are given in Exhibit 1.

Plots of summer and winter peak demand and base (Average April and October) demands are shown in Exhibit 2. Compound annual growth rates (percent) over specified periods of years are as follows:

	Standardized Summer	Actual Winter	Actual Base
1960-68	7.5	5.2	
1968-73	4.8	2.9	4.1
1973-75	-0.9	2.5	-0.5
1975-78	0.6	2.9	1.6
1978-88 Projected	2.5	3.6	2.8

Historically, the 1960 to 1973 period can be characterized as rapid with summer growth exceeding winter growth by 50%. For the 1973-78 period, there has been essentially no summer growth. Winter and base growths have continued in the 1973-78 period but at a decreased pace.

Projected growths assume resumption of summer growths, but at only half the rate of the 1968 to 1973 experience. Winter growths are twenty percent higher than the 1968 to 1973 period due to increased use of electric heat. Base growths are 30% lower than the 1968 to 1973 pre-oil embargo pre-recession period reflecting the long term trend of increased use of electricity modified by conservation.

In summary, projected growths are conservative. They are less than would be indicated by long term trends, but greater than those experienced during the past 5 years of accelerated prices, conservation, and depressed economy. The 2.5% growth for PECO annual peak load compares to a 5.1% growth estimate for all U. S. utilities as estimated in the 1978 Annual Electrical Industry Forecast of the Electrical World.

Following is a comparison of this year's forecast with last year's, a description of the method used in its preparation and the maximum, minimum and 20 year forecast.

Exhibit 1

PHILADELPHIA ELECTRIC CO. SYSTEM

	Standard Demand - MW	Annual Output - GWH	Annual Load Factor
1968	4460	22109	56.4
1969	4820	23469	55.6
1970	4910	24441	56.8
1971	5040	25045	56.7
1972	5340	26351	56.2
1973	5630	28095	57.0
1974	5620	27408	55.7
1975	5530	27243	56.2
1976	5650	28437	57.3
1977	5580	28805	58.9
1978	5630	*29479	59.8
		FORECAST DATA	
1979	5700	29619	59.3
1980	5850	30541	59.4
1981	6000	31399	59.7
1982	6150	32342	60.0
1983	6300	33361	60.4
1984	6450	34433	60.8
1985	6600	35537	61.5
1986	6800	36727	61.7
1987	7000	37981	61.9
1988	7200	39160	61.9

*Sum of Daily Territorial Electric Outputs

System Planning Division
1-11-79

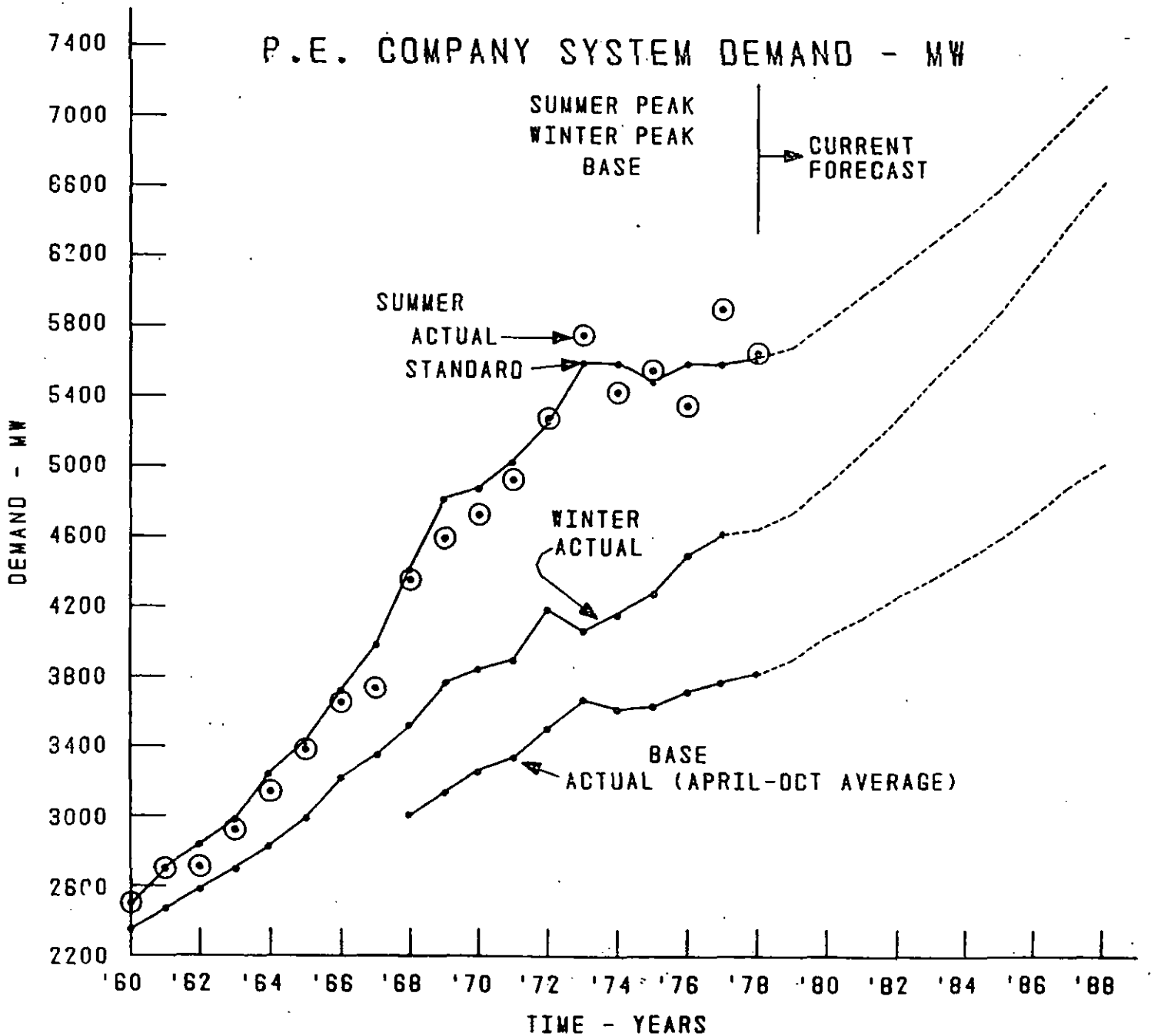

P.E. COMPANY SYSTEM DEMAND - MW
SUMMER PEAK
WINTER PEAK
BASE
CURRENT FORECAST
SUMMER ACTUAL
STANDARD
WINTER ACTUAL
BASE
ACTUAL (APRIL-OCT AVERAGE)
DEMAND - MW
7400
7000
6600
6200
5800
5400
5000
4600
4200
3800
3400
3000
2600
2200
'60 '62 '64 '66 '68 '70 '72 '74 '76 '78 '80 '82 '84 '86 '88
TIME - YEARS

Exhibit 2

COMPARISON WITH LAST YEAR'S ESTIMATE

The demand forecast for the year 1987 has been lowered 550 MW relative to the previous forecast prepared in December 1977. A comparison for all years is given in Exhibit 3.

A modification in the peak demand forecast method caused 70 MW of the 550 MW reduction in 1987. The 480 MW balance of the reduction was caused by a reduced energy and connected air conditioning forecast. The 480 MW decrease consists of a 320 MW decrease in base demand and 160 MW decrease in coincident weather sensitive demand. The base demand is the daily peak load when weather is such that both air conditioning and electric heat are at a minimum total value. This base demand has decreased due to a 15 percent decrease in base energy estimates for the residential class and a 9 percent decrease for the small commercial and industrial class. The coincident weather sensitive (air conditioning) demand has decreased primarily from lowered estimates of connected air conditioning load for the residential class (11 percent) and the small commercial and industrial class (15 percent). The large commercial and industrial class was lowered 1.7 percent.

These decreases result in a compound annual growth rate (1978-1988) for peak demand of 2.5 percent. The compound annual growth rate for the previous forecast was 3.1 percent.

PHILADELPHIA ELECTRIC CO. ANNUAL DEMAND FORECAST - MW

	Estimate Prepared in December 1978			Estimate Prepared in December 1977			Difference 1978-1977		
	Peak	Base	AC	Peak	Base	AC	Peak	Base	AC
1978	*5630	3813	1817	5700	3830	1870	-70	-17	-53
1979	5700	3900	1800	5850	3950	1900	-150	-50	-100
1980	5850	4040	1810	6050	4090	1960	-200	-50	-150
1981	6000	4140	1860	6250	4240	2010	-250	-100	-150
1982	6150	4260	1890	6480	4410	2070	-330	-150	-180
1983	6300	4360	1940	6710	4580	2130	-410	-220	-190
1984	6450	4480	1970	6940	4750	2190	-490	-270	-220
1985	6600	4600	2000	7150	4920	2230	-550	-320	-230
1986	6800	4740	2060	7350	5090	2260	-550	-350	-200
1987	7000	4890	2110	7550	5260	2290	-550	-370	-180
1988	7200	5030	2170						

*Weather Adjusted Peak Demand. Actual Peak was 5667 MW

ANNUAL PEAK DEMAND FORECASTING METHOD

DESCRIPTION OF DAILY WEATHER FACTOR (DWF) FORMULA

Prior to estimating future peak demands, historical peak demands are adjusted to a standard weather condition. In this way actual peak demand growth rates are determined.

Analyses to date indicate that the weather variable most highly correlated with daily peak demands consists of 29 hours of weighted dry bulb temperatures and one hour of weighted wet bulb temperature. The formula for this weather variable, called the daily weather factor (DWF), is as follows:

$$DWF = \left[\frac{1}{29} \sum_{n=1}^{29} T_{(n)DB} \left(\frac{n + 27}{56} \right) \right] + 0.5\, T_{(29)WB}$$

$T_{(29)DB}$ = Dry Bulb Temp. @ Hour of peak weather

$T_{(1)DB}$ = Dry Bulb Temp. 28 Hours prior

$T_{(29)WB}$ = Wet Bulb Temp. @ Hour of Peak Weather

Generally, during hot weather, the higher the DWF, the higher will be the daily peak demand.

USE OF DAILY WEATHER FACTOR (DWF) FORMULA IN ANALYZING HISTORICAL PEAKS

Exhibit A is a computer output plot of peak demand vs. daily weather factor for all weekdays (excluding holidays) from April through October 1978. Examination of similar plots for past years indicates that there is a constant demand value for daily weather factors between 64 and 77 and a uniformly rising trend for all daily weather factors above 86. The sloping line of Exhibit A is the linear regression for all daily peak demands occuring above 86 DWF. The sloping line is, of course, a "mid-point" line with actual demands lying both above and below it. Demand-weather characteristic lines as calculated from actual data for all years 1968 through 1978 are shown in Exhibit B.

The standard DWF is defined as the historical average of the maximum DWF which occurs between 10:00 a.m. and the time of the peak demand on the day that the annual peak demand occurs. Calculation of the standard DWF is shown in Exhibit C. The regression demand is the demand located on the linear regression line (shown in Exhibit A) at the standard DWF. However, the most probable peak demand for a year occurs at a value slightly above the regression demand.

Exhibit D is a tabulation of the relationships between the regression demands and historical peak demands. The last column shows the ratio between the actual peak demand that occurred in each year and the regression demand at the standard DWF. The actual peak demand averages 3.4% higher than the regression demand. The most probable peak demand for a year is therefore determined by increasing the regression demand by 3.4% and is defined as the standard demand.

The inter-relationships of the regression demand, standard demand and standard DWF are shown in Exhibit E. The solid sloping line is the linear regression line of actual daily peak demands for 1978. Its intersection with the standard DWF line gives a regression demand of 5445 MW. The standard demand for 1978 is 3.4% above this, or 5630 MW. The actual peak demand for 1978 was 5667 MW.

1978 DAILY PEAK LOAD VS DAILY WEATHER FACTOR

(APRIL THRU OCTOBER)

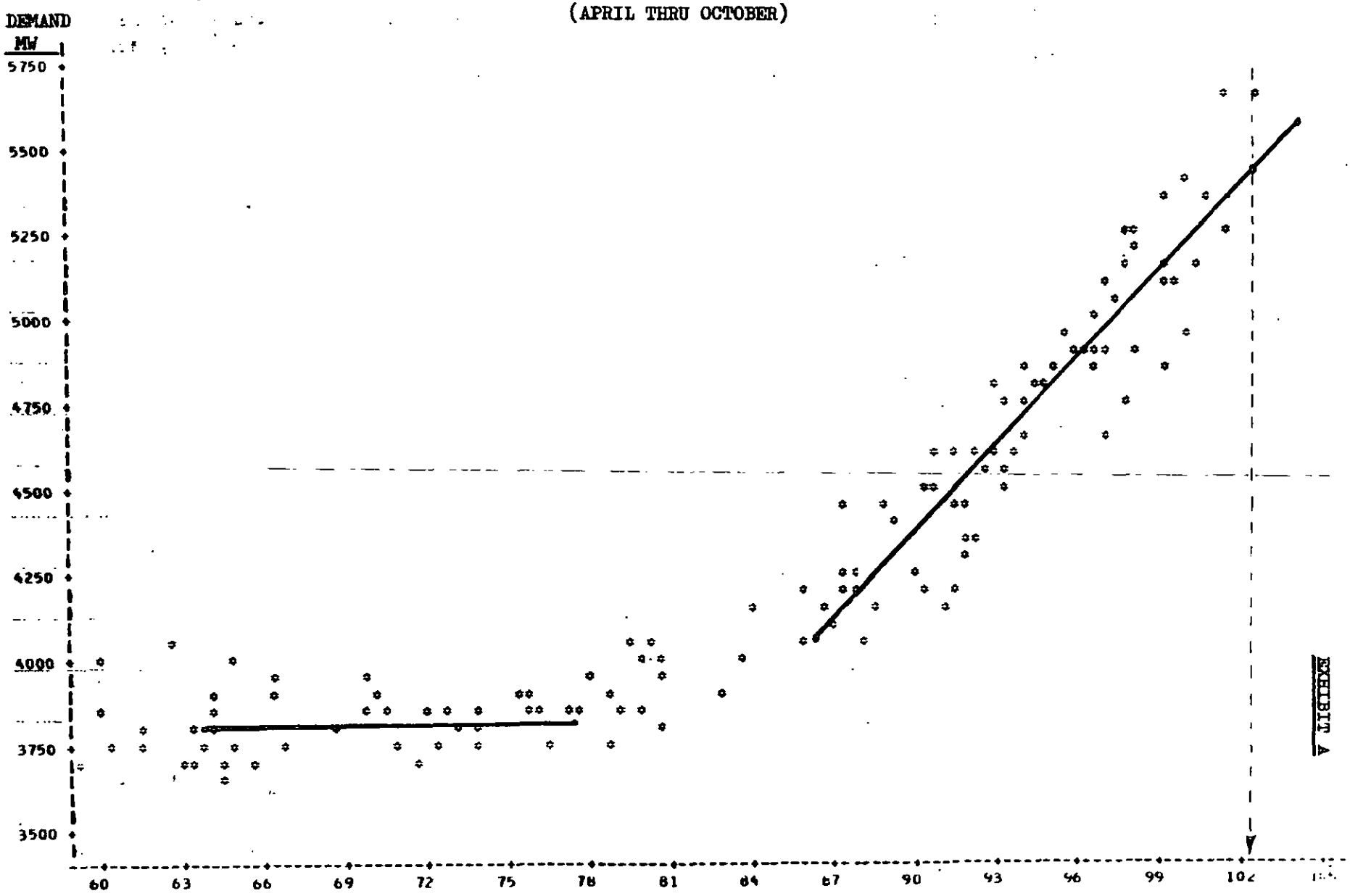


EXHIBIT A

WEATHER FACTOR VS. HISTORICAL LOAD

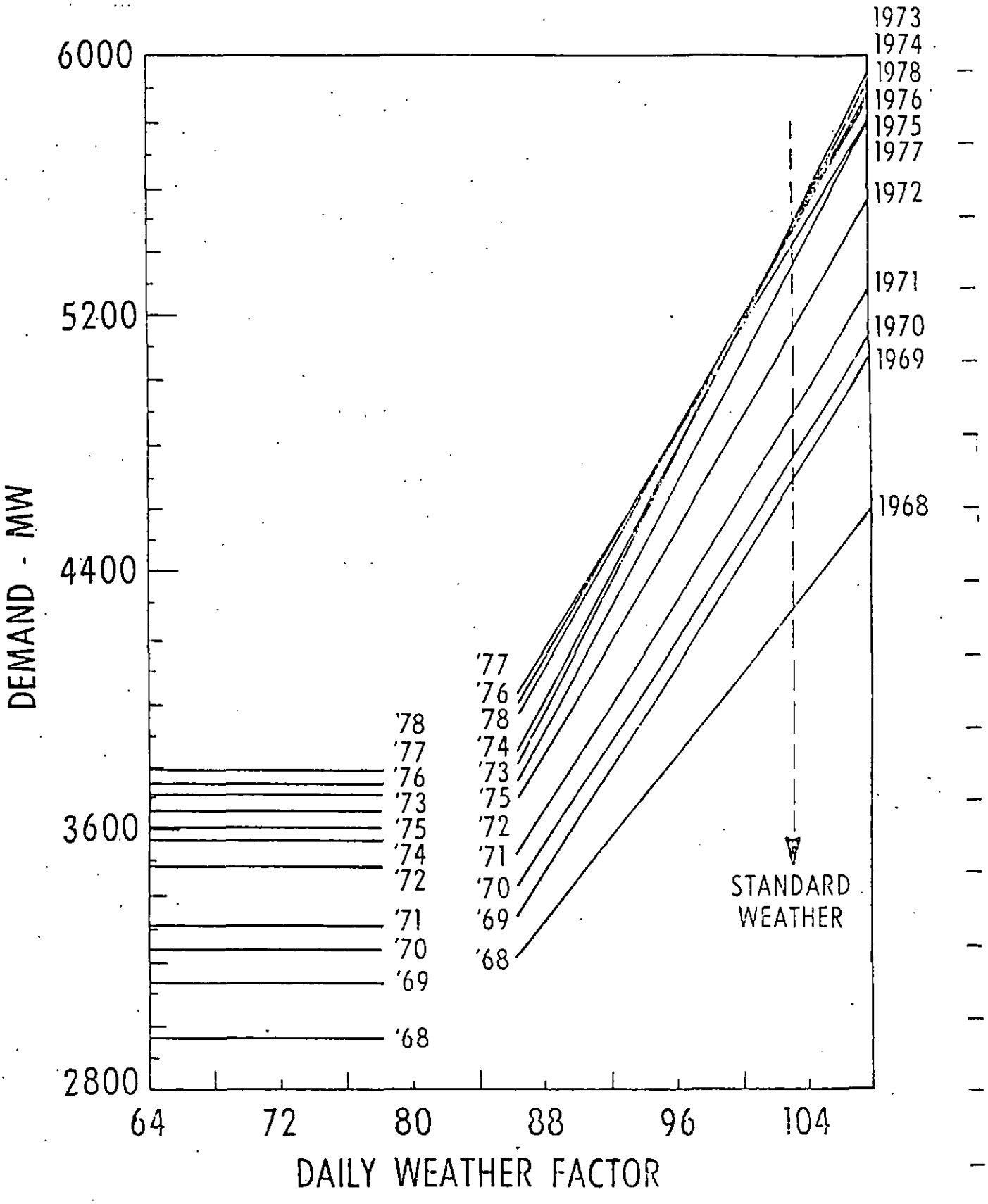


Exhibit C

MAXIMUM DWF BETWEEN 10 A.M. & TIME OF PEAK DEMAND

	DWF	Date
1968	102.7	7-18
1969	104.0	7-17
1970	102.8	9-23
1971	100.7	7-1
1972	104.3	7-20
1973	104.7	8-30
1974	101.6	7-9
1975	104.5	8-4
1976	96.9	6-28
1977	106.3	7-21
1978	101.6	8-17

(Standard DWF) 102.7

Exhibit D

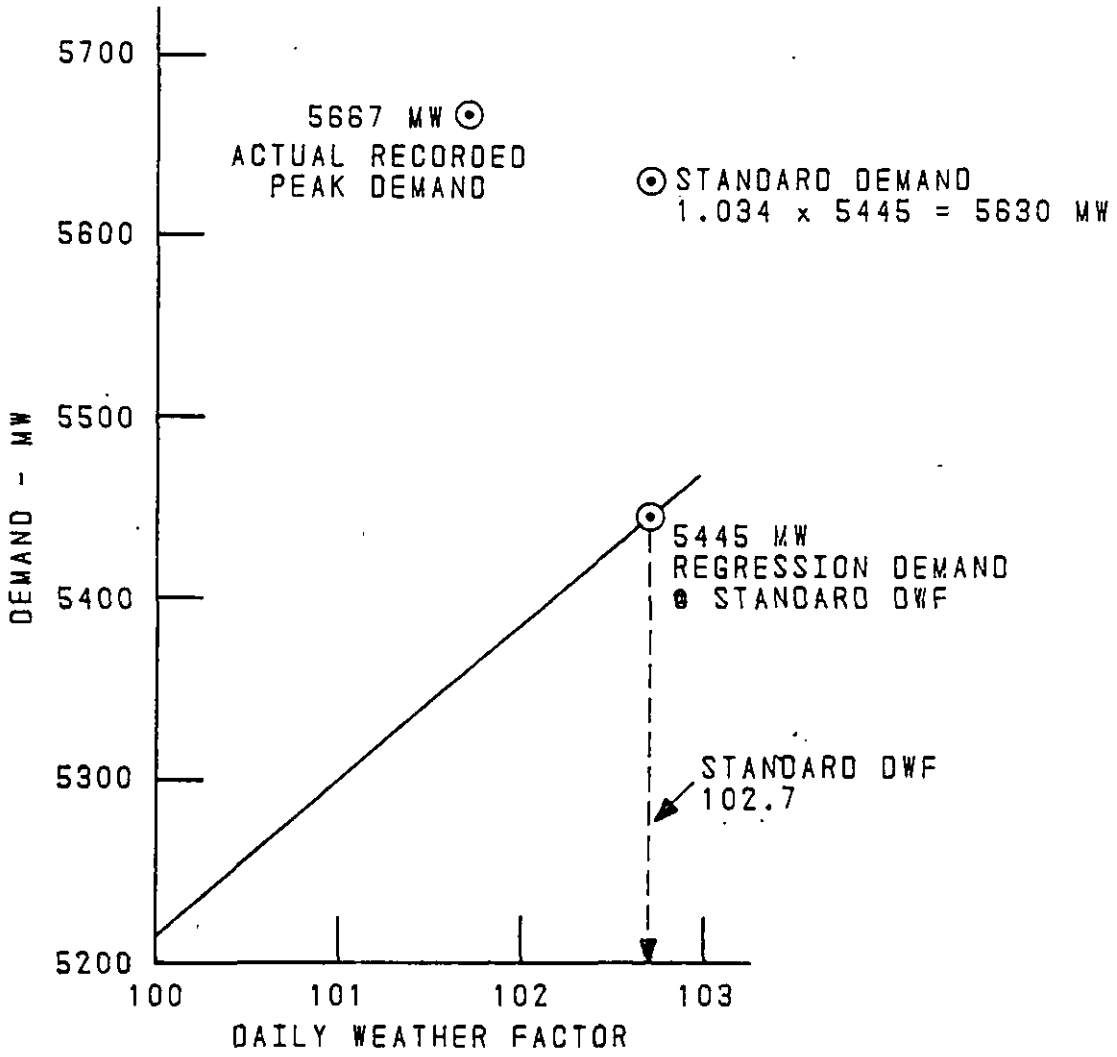
STANDARD DEMAND FACTOR

	Regression Demand @ 102.7 DWF	Net Actual Peak Demand	Corrected Peak Demand	Corrected Demand ÷ Demand @ 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
		Average Standard Demand Factor		1.034

( ) Corrected for voltage reduction and load curtailment.

Note: The recommended Standard Demand Factor of 1.034 and Standard DWF of 102.7 vary slightly from those recommended in previous reports. This is due to more data now being available plus a different method for calculating maximum DWF.

Exhibit E


5700
5600
5500
5400
5300
5200
DEMAND - MW
5667 MW ⊙
ACTUAL RECORDED
PEAK DEMAND
⊙ STANDARD DEMAND
1.034 x 5445 = 5630 MW
5445 MW
REGRESSION DEMAND
@ STANDARD DWF
STANDARD DWF
102.7
100
101
102
103
DAILY WEATHER FACTOR

USE OF DWF APPROACH IN ESTIMATING FUTURE PEAK DEMANDS

The basis for the procedure to forecast demand is shown in Exhibit F. This graph is the demand-weather characteristic line for 1978 shown in Exhibit C. The horizontal segment is defined as the base demand. The sloping segment shows the relationship between the weather sensitive demand and the weather.

The base demand has been found to have a high correlation with the average April and October output and sales. Since monthly outputs are not subject to variation due to a change of billing cycles and/or estimated readings which affect monthly sales figures, the output values are now used instead of sales values as in previous years.

The first column of Exhibit G is a tabulation of the historical average total monthly outputs of April and October. The second column is a tabulation of the corresponding base demands. In the last column the ratio of base demand to base output has been calculated. These historical ratios and an extrapolation into the future are plotted in Exhibit H. (A horizontal segment of the plotted curve would indicate a constant base load factor). The extrapolated base demand factors are applied to the forecast of base output to compute the base demand forecast. The base output forecasts do not include any off-peak sales which result from new, non-typical loads such as off-peak electric car charging.

The coincident weather sensitive demand is derived by subtracting the base demand from the value of weather sensitive demand at the standard DWF. Historically, the coincident weather sensitive demand has been found to have a good correlation with the estimates of actual MW's of connected air conditioning.

Exhibit I shows the historical coincident weather sensitive demand and estimates of connected air conditioning for the years 1968 through 1978. The estimates of connected air conditioning are year-end values and are obtained from the Commercial Operations Department.

Exhibit J is a plot of the relationship between coincident weather sensitive demand and connected air conditioning load for the years 1968-1988. The coincident demand increased linearly with increasing connected load in the 1968-1974 period and decreased with increasing connected load in the 1975-1978 period. The 1975-1978 period decrease is the result of the impact of "conservation of energy." This impact is assumed to reach a maximum in the 1979-1980 period. The subsequent coincident weather sensitive demand versus connected air conditioning load relationship is expected to parallel the 1968-1974 period relationship.

The mathematical expression for the 1980-1988 coincident weather sensitive demand versus connected air conditioning load relationship is determined by computing the linear regression of the 1968-1974 period relationship and adjusting the intercept to account for the energy conservation impact. This expression is applied to the forecast of connected air conditioning load to compute the coincident weather sensitive demand forecast.

A different method of forecasting the relationship between connected air conditioning and weather sensitive load was used for last year's forecast. In that method described in the "1977-87 Budget Forecast Annual Peak Demand" report of November 1977, relationships were more a function of the year rather than the amount of connected air conditioning.

The sum of the base and weather sensitive components of the demand forecast produces a forecast of the regression demands (value of demand on the regression line at the standard DWF). The regression demands must be increased by 3.4% (Standard Demand Factor) to obtain a forecast of the most probable peak demands (standard demands).

Exhibit F

DEMAND - WEATHER CHARACTERISTIC

1978

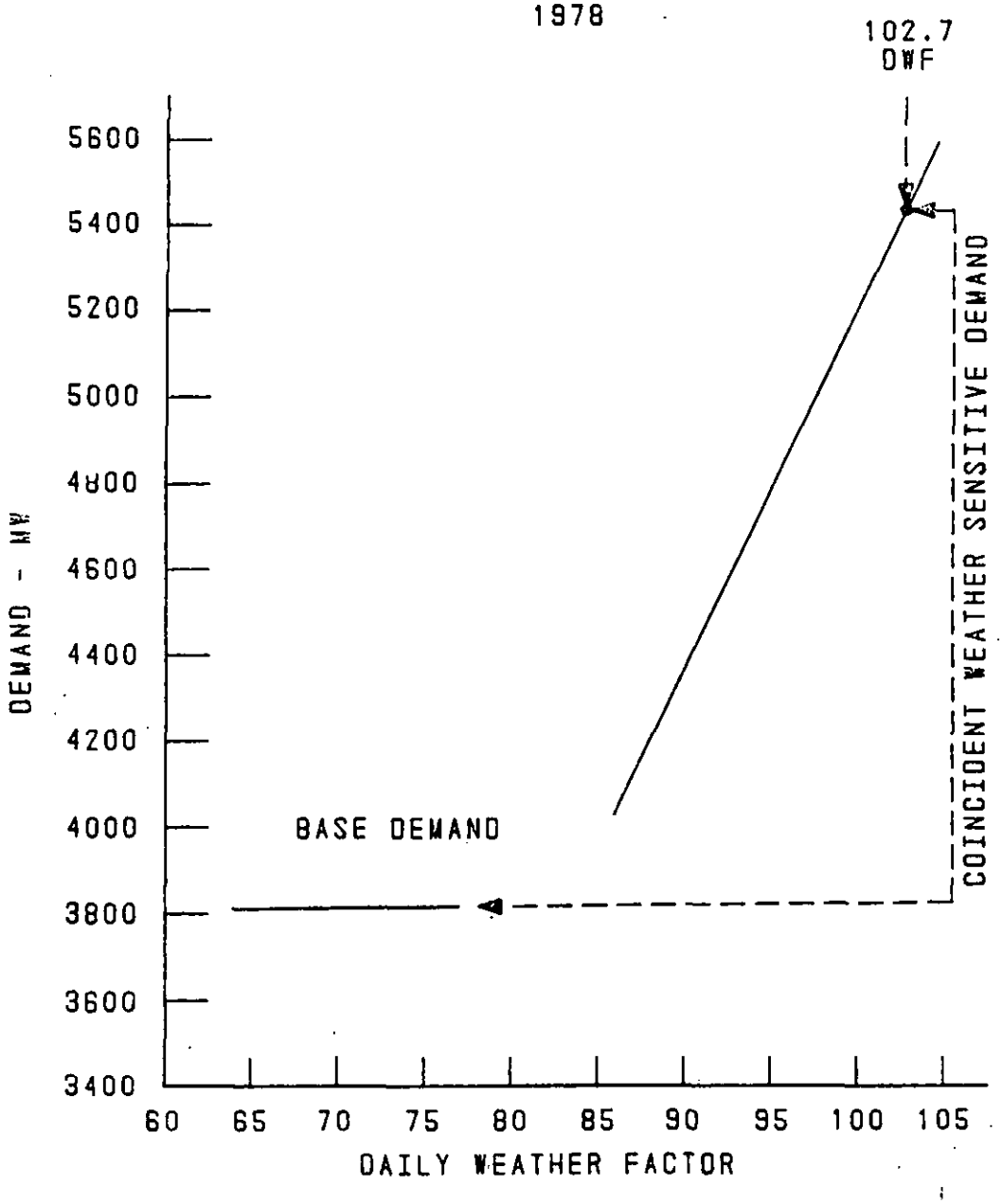


Exhibit G

ACTUAL AVERAGE OF APRIL & OCTOBER OUTPUTS

PHILADELPHIA ELECTRIC COMPANY SYSTEM

	Base Output-GWHrs	Base Demand-MW	Demand / Output
1968	1734.2	2998	1.729
1969	1840.1	3142	1.708
1970	1906.3	3255	1.707
1971	1938.5	3326	1.716
1972	2059.6	3493	1.696
1973	2168.8	3668	1.691
1974	2138.4	3612	1.689
1975	2126.7	3632	1.708
1976	2209.9	3723	1.685
1977	2196.2	3763	1.713
1978	2246.2	3813	1.698

BASE DEMAND FACTOR

BASE DEMAND = BASE DEMAND FACTOR x MONTHLY OUTPUT
MW GEHR

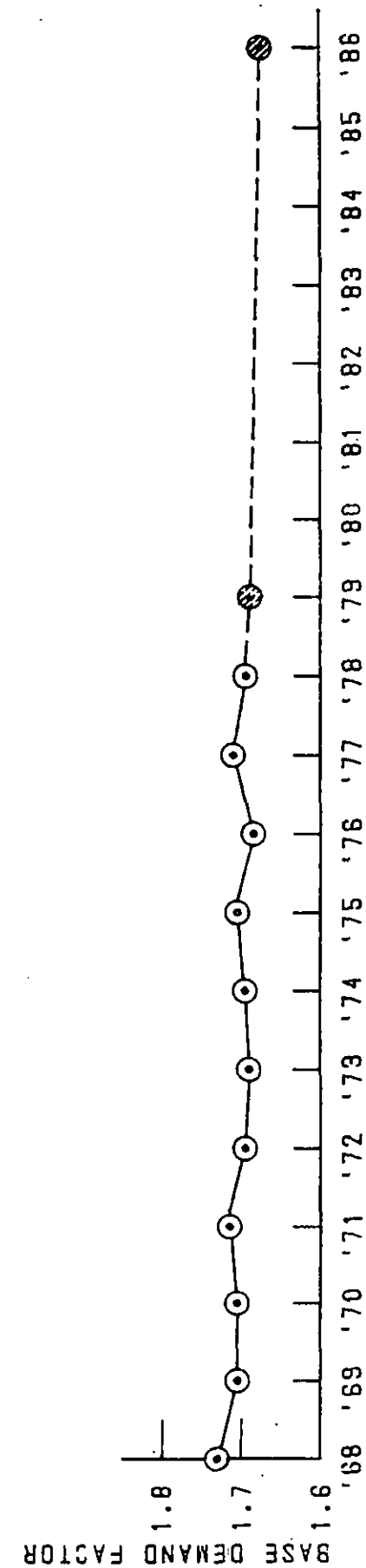
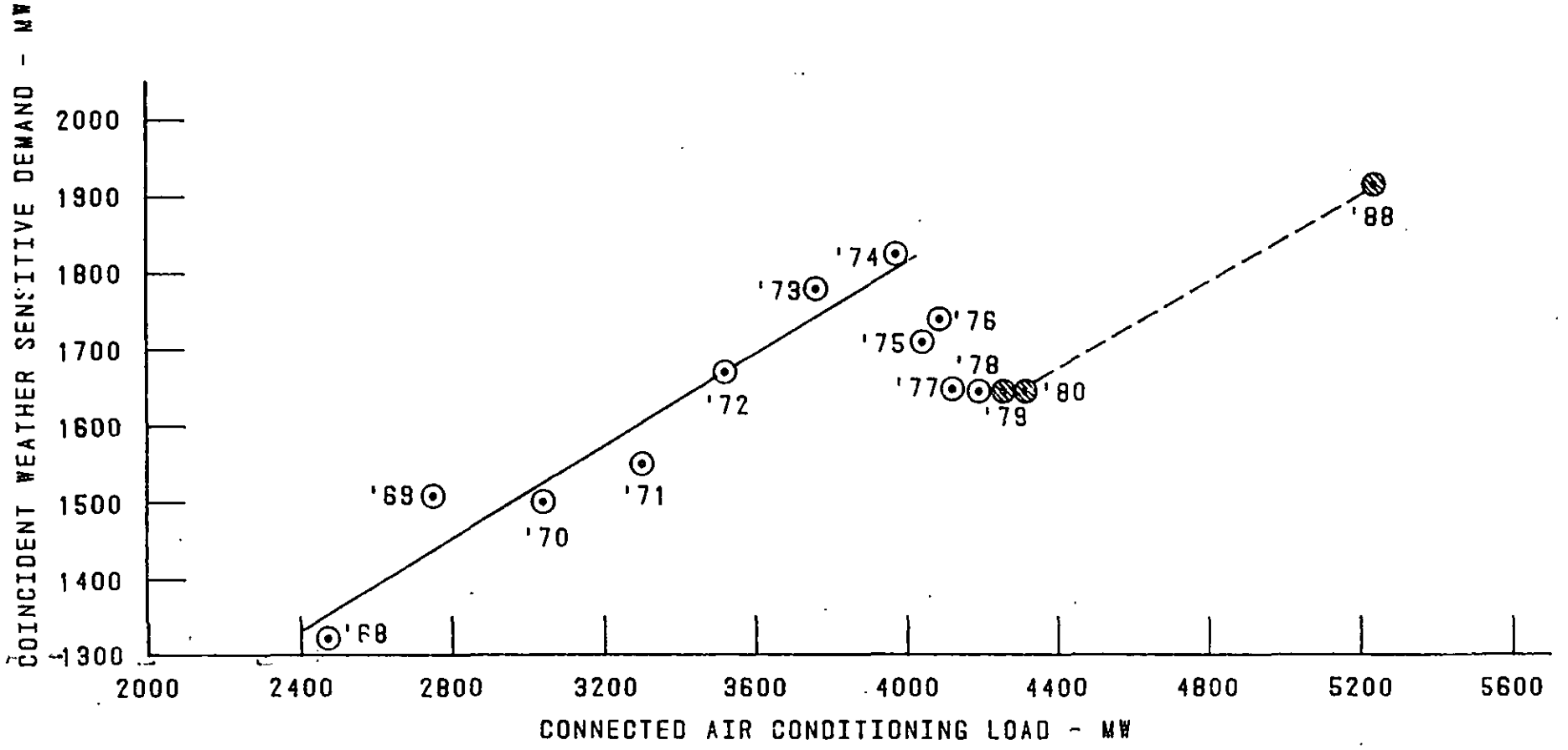


Exhibit I

WEATHER SENSITIVE DEMAND - MW

	Regression Demand @ 102.7DWF	- Base Demand	= Coincident Weather Sensitive Demand	Connected Air Cond.
1968	4316	2998	1318	2470
1969	4661	3142	1519	2755
1970	4750	3255	1495	3041
1971	4878	3326	1552	3298
1972	5162	3493	1669	3524
1973	5448	3668	1780	3758
1974	5434	3612	1822	3966
1975	5344	3632	1712	4050
1976	5462	3723	1739	4085
1977	5397	3763	1634	4124
1978	5445	3813	1632	4186

COINCIDENT WEATHER SENSITIVE DEMAND RESPONSE



SAMPLE CALCULATION OF 1980 PEAK DEMAND FORECAST

Base Demand

Base Monthly Output	2395 GWHRS	(Based on energy estimate of
Base Demand Factor	x 1.689	December 1978)
Base Demand	4045 MW	

Coincident Weather Sensitive Demand

Connected Air Conditioning Load = 4327 MW

Coincident Weather Sensitive Demand Obtained from Exhibit J = 1632 MW

Base Demand + Weather Sensitive Demand = Regression Demand

4045 + 1632 = 5677 MW

Regression Demand x Standard Demand Factor = Standard Demand

5677 x 1.034 = 5870 MW

5850 MW (rounded)

The demand forecast was also calculated using the method described above with the exception that the estimated effects of electric heat were removed from both historical observations and forecasts of base output and demand. The results were compared with the recommended demand forecast and found to be within a 30-70 mw range over the 10 year forecast period. The historical effects of electric heat can only be estimated. They are not measured as are the actual total outputs and demands. Also, the effect of electric heat is relatively small during the April and October periods since normally there is little need for heat during these months. For these reasons the method described on the preceeding pages was used for the present forecast.

MAXIMUM, MINIMUM AND TWENTY YEAR DEMAND FORECAST

The twenty year most probable forecast in exhibit K was computed using the same procedure as described for the ten year forecast. The reduced annual growths after the first ten years are a direct result of the reduction in the growth rates of base kWh output and connected air conditioning load.

The maximum and minimum demand forecasts were computed by observing the ratios of maximum and minimum annual energy forecasts to the most probable annual energy forecast and applying these ratios to the most probable demand forecast.

The twenty year projections are more approximate than the ten year and are presented merely to indicate present thinking as to the range in load demand that could occur in the mid-nineties.

PHILADELPHIA ELECTRIC CO. SYSTEM
ANNUAL PEAK DEMAND
20 YEAR FORECAST

	Maximum	Minimum	Probable
1979	5950	5450	5700
1980	6200	5550	5850
1981	6400	5600	6000
1982	6650	5700	6150
1983	6900	5750	6300
1984	7100	5800	6450
1985	7350	5850	6600
1986	7650	5950	6800
1987	8000	6050	7000
1988	8300	6150	7200
1989	8600	6200	7350
1990	8900	6200	7500
1991	9200	6200	7600
1992	9500	6200	7700
1993	9750	6200	7800
1994	10050	6200	7900
1995	10300	6200	8000
1996	10600	6200	8100
1997	10900	6200	8200
1998	11200	6200	8300

System Planning Division
1-11-79

Stat. No. 11

TESTIMONY OF

STEPHEN A. MALLARD

Q. Please state your name and business address.

A. My name is Stephen A. Mallard and my business address is 80 Park Place, Newark, New Jersey.

Q. By whom are you employed and in what position?

A. I am employed by Public Service Electric and Gas Company as Vice President-System Planning.

Q. What is the purpose of your testimony?

A. The purpose of this testimony is to comment on the report "Construction Management Audit of Salem Nuclear Generation Station Unit No. 1" prepared by Theodore Barry & Associates (TB&A). This report was prepared for the State of New Jersey Department of Public Advocate and the Commonwealth of Pennsylvania Office of Consumer Advocate. This report was submitted as Consumer Advocate Exhibit No. 5 in the Pennsylvania Public Utility Commission Docket No. R.I.D. 438, et al. (Philadelphia Electric rate case).

Q. Please describe your qualifications as a witness.

A. Schedule 1 describes my qualifications as a witness in these proceedings.

Q. Please give a brief history of Salem Nuclear Generator Station, Unit No. 1.

A. Salem No. 1 is part of a two unit station located on Artificial Island in Lower Alloways Creek Township, Salem County, New Jersey. These units were originally planned for location at Burlington, New Jersey for service in 1971 and 1973. In 1967, it was necessary to relocate the units to Salem because the Atomic Energy Commission indicated an unwillingness

to issue a license for construction at the Burlington site. Construction began at Salem in January 1968. The relocation and escalation of regulatory requirements caused delays in the Salem project.

Salem No. 1 was successfully completed and placed in commercial service on June 30, 1977. The unit, a pressurized water reactor (PWR) with a summer capacity rating of 1079 MW, was designed by Public Service Electric and Gas (PSE&G) Company personnel and constructed by United Engineers & Constructors Inc. of Philadelphia, Pennsylvania. PSE&G personnel operate the unit.

Salem No. 1 is jointly owned by the following utilities:

Joint Owners	% Ownership
Public Service Electric & Gas Co.	42.59
Philadelphia Electric Co.	42.59
Delmarva Power & Light Co.	7.41
Atlantic Electric Co.	7.41

Under the joint ownership agreement executed on November 24, 1971, and amended by a supplemental agreement dated January 26, 1977, joint owners are entitled to shares of the installed capacity, available capacity, operating capacity and hourly energy generation of the unit in proportion to their ownership. The joint owners share in the cost of site preparation, land, cost of engineering, design, construction, operation and maintenance in proportion to their ownership.

Under the conditions of the joint ownership agreement, PSE&G was responsible for the detailed engineering, design and

construction of a complete and operable station. As members of the Engineering Task Force of the Joint Generation Project and the Owners Committee, the joint owners were kept appraised of and were able to contribute to significant project developments. In addition, monthly progress reports were submitted to the joint owners and their representatives attended project management meetings. These programs enabled the joint owners to knowledgeably participate in the design and construction efforts.

PSE&G was also responsible for the accounting and billing of all project costs. Under the agreement PSE&G provided monthly reports summarizing the construction costs and provided annual estimates of the monthly construction expenditures.

In summary, through the joint owners agreement, PSE&G had the responsibility to design and construct Salem in the most prudent and efficient method possible on behalf of and in cooperation with the joint owners.

Q. Please provide a background on construction management audits.

A. Construction of Salem No. 1 was successfully completed despite the many problems inherent in a complex construction project of this magnitude. In the case of Salem these were compounded by additional external pressures, namely the relocation to a second-choice site, continual changes in regulations by the Nuclear Regulatory Commission, labor practices unique to New Jersey, and double digit inflation during much of the construction period.

A general critique of the TB&A or any other retrospective

analysis of such a complex, long duration project of this type has two primary points.

The first point is that the determination of alleged hypothetical savings during a postmortem review by its very nature has to be based on assumptions, generalizations, speculations and conjecture. There is no way of determining what techniques PSE&G could have implemented, at what time and at what cost. Nor is there any way of determining which techniques could have saved a specific amount of money.

The second point is that postmortem review of a ten-year project cannot serve as a substitute or a replacement for judgments which are based on and tempered by practical, timely and on-the spot decision-making conducted in a fluid and changing environment. During the construction period, problems were recognized and new and innovative procedures were adopted to resolve them. Examples are cited in the TB&A report. With hindsight, we can now recognize that if certain procedures had been found to be cost effective and had been implemented earlier, then improved performance might have been achieved.

As also pointed out in the TB&A report, improved procedures developed during construction of Salem No. 1 were used in the construction of Salem No. 2. Some of these are state of the-art methods which were applied as they were developed by the industry. We feel that construction performance for Salem No. 2 was better than it was for Salem No. 1.

PSE&G management of the Salem project has been diligent

and responsible. All of the costs associated with this project were reasonable and proper expenditures and should be included in rate base.

Q. Please describe the specific rate base impact on the TB&A report.

A. TB&A identifies projected savings if certain "preferred management practices" had been practiced throughout the construction of Salem Unit No. 1. These savings were categorized by TB&A as "hard" or minimum cost savings and "soft" or maximum cost savings which could have been attained. This classification of the projected savings serves as nothing more than an arbitrary range which proves to have no underlying support. In short, the so called "hard" savings are themselves very soft and the "soft" savings are effervescent.

Page 20, TB&A text as corrected by TB&A at the Docket No. R.I.D. 438, et al. hearing on June 29, 1978 on transcript Page 8664:

Potential Rate Base Impact Table
(000,000)

Area of Improvement	Salem Project Impact Hard	Salem Project Impact Soft	% Attributable to Salem No. 1	Salem No. 1 Project Impact Hard	Salem No. 1 Project Impact Soft
Cost Control (Project Management)	--	$12.0	60%	--	$ 7.2
Rework	$ 5.0	20.0	75%	$ 3.75	15.0
Work Force Utilization	16.0	35.0	60%	9.6	21.0
Material Management	0.8	1.7	75%	0.6	1.2
Construction Equipment	--	1.6	50%	--	0.8
Totals	$21.8	$70.3		$13.95	$45.2

Since the basis for calculating these savings is not explained in the report, TB&A was requested to provide the workpapers behind all of the figures in the table above as well as workpapers setting forth the costs of implementation. In response to this request TB&A provided an explanation which is provided in Schedule 2.

This explanation failed to show specifically how the amounts were calculated other than to state some general assumptions based on judgement alone, often expressed as assumed, rounded, undocumented percentages. There was no task-by-task analysis of how the proposed improvements would produce specific savings. There is no evidence in the TB&A report (Consumer Advocate Exhibit No. 5), in Schedule 2 or in any of the cross examination of TB&A June 29, 1978 in Docket No. R.I.D. 438, et al. that develops concrete, specific relationships between the tables of data throughout the TB&A report and the Rate Base Impact table on page 20 of the TB&A report. Also, TB&A did not estimate the timing of the savings based on these data. Furthermore, TB&A did not provide any documentation on the cost of implementing the proposed management practices in response to a request for such data.

In the following sections I will examine each of the five "Areas of Improvement" shown on the previous table and show that the alleged savings have not been substantiated.

Q. Please describe the Cost Control (Project Management) area of improvement.

A. TB&A makes favorable and correct comments about a number of project management techniques used by PSE&G for the Salem Project.

Page 169, TB&A text:

> "PSE&G Uses an Unusual and Effective Grid Approach To Identifying and Locating Activities On Its Planning And Scheduling Sheets."

Page 172, TB&A text:

> "A Computerized Critical Path Method (CPM) Planning And Scheduling Technique Was Used Beginning Early In The Salem Project and Enhancements Were Made to Suit Salem Requirements."

Page 175, TB&A text:

> "The Mating of Construction and Engineering/Design Schedules Into A Single Master Schedule For Salem Activities Is Innovative and Effective.

Another statement concerning project management techniques includes an incorrect conclusion.

Page 174, TB&A text:

> "Resource Levelling Was Used to Evaluate Cost Impacts Of Alternative Strategies For Salem Schedule, Although A Search For the Lowest Cost Schedule Was Not Formally Conducted."

A search for the lowest cost schedule was formally conducted by PSE&G at the time the project was originally authorized, and at various times throughout the construction phase of the

project as schedule changes were required.

To establish the lowest cost schedule, PSE&G evaluated and optimized, in addition to resource leveling, the following factors:

. Alternative forms of generation and siting.

. PJM reserve requirements

. System reliability requirements.

. System load projections and projection uncertainty.

. State Board of Public Utilities requirements.

. Economic conditions affecting service area.

. Cost and availability of construction capital.

. Labor availability for alternative construction schedules.

. Production cost of replacement energy.

. Co-owner requirements.

Analytical and subjective techniques utilized by PSE&G, considering the above factors, resulted in an optimized minimum cost schedule for both Salem units.

The statements above indicate that PSE&G has followed sound project management practices.

Q. Please describe the rework area of improvement.

A. The second item in the Table on page 5 of this testimony (page 20, TB&A text) indicates that the amount of rework could have been reduced with a claimed savings of $5 million minimum to $20 million maximum. Neither of these amounts have been justified by the data presented in the report.

The estimate of the maximum rework impact ($20 million)

assumes that the extra material costs would be equal to the labor costs. This assumption is unreasonable. In many cases, rework involved only limited procurement of new material since basic system equipment was reusable.

Rework cannot be completely avoided on a project of this magnitude. By diligent efforts, rework expenditures were held within normal reasonable levels. There is no evidence that the rework could have been reduced by any of the amounts shown as Rework in the Rate Base Impact Table on page 5 (page 20, TB&A text).

Q. Please describe work force utilization.

A. The third item in the Table on page 5 of this testimony (page 20, TB&A text) indicates project savings of $16 million to $35 million from improved work force utilization. This estimate appears to be at least partially based on the following conclusions from the TB&A report.

Pages 137, 139, TB&A text:

> "Work Force Management Functions Were Performed Well At the Project Level. However, Opportunities Existed To Improve The Performance Of Work Force Management Evaluation and Control Functions At The Supervisory Level."
>
> "Exhibit VII-2 is an appraisal of how the aforementioned work force management practices were performed at Salem. Information systems existed throughout the project to measure unit costs and identify causes of project delay. This information was primarily used for reestimating costs

> and rescheduling tasks, that is, project level management tasks. Our review indicated that supervisory personnel could have used the data to a greater extent to control work hours of individual craft workers."

The information described in the paragraph above was in fact used for manhour control by supervisors. Weekly Look Ahead schedules which detailed activities, their duration, quantities to be installed and manpower requirements were used by each supervisor to plan work activities. These were used to control work hours of individual craft workers and detailed work tasks on a daily basis. Supervisors also received Bi-weekly Manhour Unit Cost Reports and Performance Curves which compare actual manhours per unit with the targets.

Meetings were held at least weekly between PSE&G and the Project Superintendent to analyze problem areas revealed by reports and the corrective actions to be implemented. Also on a weekly basis, planning and scheduling meetings were held by the Project Superintendent with his supervisors to pinpoint the problems and determine necessary adjustments to personnel and work methods. Supervisors met daily with foremen to deploy manpower and arrange the daily tasks.

The work management techniques used in the Salem project were comparable to those used in other nuclear power plant construction projects.

Q. Please describe material management.

A. In Schedule 2 TB&A claims that certain materials manage-

ment procedures could have reduced the inventory between 10% (hard) and 20% (soft). However, no evidence is presented to show that the project managers could have foreseen that such reductions were possible without delaying the construction. A materials inventory somewhat above the calculated theoretically desired level can be a good investment if it protects against the much greater penalties of construction delays.

Q. Please describe construction equipment.

A. In Schedule 2 TB&A estimates that operation and maintenance expenses for construction equipment should have been 15% less than they were. The findings and conclusions on pages 26-41 or anywhere else in the TB&A report do not include any statements about how operating and maintenance costs for construction equipment could have been reduced. We do not feel that there has been any demonstration of savings or the need to adjust rate base for construction equipment.

Q. What are your conclusions of the TB&A report?

A. PSE&G candidly acknowledges, as would any prudent management, that if improved management techniques which were developed and implemented during a project had been used from the project's inception, then total costs for the project might have been different. We readily acknowledge that we did initiate what we consider to be (and TB&A has found to be) improved management techniques during the course of the Salem construction. We would also expect that five or ten years from now additional progress would also be made in terms of improved management

techniques. When we, as a company and a management, think that perfection has been obtained and there is no room or need for improvement, then that is the time that regulators should become concerned with our performance. The TB&A report demonstrates that we are leaders in the utility industry in many very important respects. We have and will continue to strive to maintain that status. We believe that in its totality the TB&A report is testimony supporting the position that PSE&G managed the Salem Project in a reasonable and prudent manner, consistent with its tradition of high quality and progressive and conscientious service.

I conclude that there is no basis for the $45.2 million cited as a potential rate base impact for Salem No. 1.

Q. Please describe the findings of the New Jersey Board of Public Utilities concerning the TB&A report.

A. In Docket Nos. 7711-1107 and 776-492, the New Jersey Board of Public Utilities (NJ BPU) examined the issue of what cost of the Salem project should be included in PSE&G's rate base. Based on the evidence submitted in the proceedings the NJBPU rejected the rate base reductions proposed by TB&A.

In its Order, dated March 28, 1979, the NJBPU concluded:

> ...."that PSE&G managed the construction of the Salem Nuclear generating station in a reasonable and prudent manner and that PSE&G exercised due diligence in implementing sophisticated management techniques in an effort to reduce costs and improve performance."

Schedule 1
Page 1 of 3

S. A. MALLARD

VICE PRESIDENT - SYSTEM PLANNING

PUBLIC SERVICE ELECTRIC & GAS COMPANY

QUALIFICATIONS

I received the degree of Mechanical Engineer from Stevens Institute of Technology in June of 1948. I received the degree of Master of Science, majoring in electrical engineering, from Stevens Institute of Technology, in June of 1951. I served in the U.S. Navy as an electronics technician between 1944 and 1946. I was an instructor in the Electrical Engineering Department of Stevens Institute of Technology between 1948 and 1951.

I was employed by PSE&G in June of 1951. Between 1951 and 1953, I was assigned to the Company's General Office in Newark, working on various engineering projects involving electric substation installations and electic system planning. From 1953 until 1960, I was assigned to Essex Division where I worked on various engineering projects involving the construction and operation of electric distribution facilities, and the installation of customer electric service entrance facilities.

In June 1960, I was transferred to the System Planning and Development Department located in the General Office in Newark. I was responsible for making both short-range and long-range plans for additions to the bulk power electric

system. I became Transmission Planning Engineer in January 1964, responsible for preparing plans for expanding and reinforcing the PSE&G electric transmission system. I became Assistant System Planning and Development Engineer, the assistant department head of the System Planning and Development Department in January 1968. I became Manager of System Planning, responsible for all electric system planning, in January 1971. I was appointed General Manager - Planning and Research for electric and gas in July 1974 and Vice-President-System Planning in July 1977.

Currently, I represent PSE&G on the System Planning Committee of the Edison Electric Institute (EEI); I serve on the Executive Group of the EEI System Planning Committee and am Chairman of its R&D Task Force; I also serve on its Load Management Task Force.

I am an industry advisor to the Electric Power Research Institute (EPRI) Electric Utility Rate Design Study.

I have served as the PSE&G's representative on the Planning and Engineering Committee of the Pennsylvania-New Jersey-Maryland (PJM) Interconnection, and on the Area Coordination Committee of the Mid-Atlantic Area Council (MAAC).

I am a member of CIGRE (Conference Internationale des Grands Reseaux Electriques - International Conference on Large High Voltage Electric Systems). I am a Senior Member of the Institute of Electrical and Electronics Engineers

(IEEE), and have served as Chairman of the North Jersey Section. I am a member of the National and New Jersey Society of Professional Engineers, the Montclair Society of Engineers, Tau Beta Pi, and Eta Kappa Nu. In addition, I serve on the Awards Organization Committee of Eta Kappa Nu.

I have been a Licensed Professional Engineer in New Jersey since 1953.

I have testified before the New Jersey Board of Public Utility Commissioners on behalf of PSE&G as the Electric Planning witness in connection with a petition filed for eminent domain for the New Jersey portion of the Branchburg-Holland and the Branchburg-Ramapo 500-kV transmission circuits.

I also testified on behalf of PSE&G before the N. J. BPU in connection with the Company's petitions for increases in electric and gas rates in Docket Nos. 703-105, 726-562/ 7211-964, 744-355, 761-8 and 7711-1107.

I testified before the N. J. BPU on the energy crisis hearing held in 1973 (Docket No. 733-177). In addition, I testified in 1973 before the New Jersey Senate's Immediate Energy Needs Subcommittee on the energy crisis.

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TELEPHONE 359 20 57

June 13, 1978

Martha Bush, Esquire
Office of the Consumer Advocate
100 Chestnut Street
Suite 102
Harrisburg, Pa. 17101

Re: Pennsylvania Public Utility Commission
v.
Philadelphia Electric Company

Dear Martha:

Confirming our telephone conversation of Monday, please have your consultant, Theodore Barry & Associates, provide me with the following information with regard to their report on the construction of the Salem nuclear generating station:

- At page 19 of their Summary report, TB&A identifies projected savings if certain "preferred management practices" had been practiced throughout the construction of Salem Unit No. 1. Please provide the work papers behind all of the figures shown on the table on page 20.

- Again at page 19 of their Summary report, TB&A states that the savings are net of implementation costs. Please provide the work papers setting forth the development of the implementation costs.

- Again at page 19 of their Summary report, TB&A states that an "arbitrary allocation" of the savings has been made to Salem Unit No. 1. Provide the basis of this allocation, if any.

- State the names, job titles and hours worked of TB&A personnel who assisted in the preparation of the report. Also state separately the number of equivalent work days (i.e. 8 hour days) and/or hours spent visiting the Salem plant site, interviewing Public Service and United Engineers personnel, reviewing Public Service and United Engineers documentation, preparing the PECO project monitoring chapter and other.

Sincerely yours,

Walter R. Hall, II

pam
cc: All Parties of Record
bcc: R. H. Young, Esq.; J. Paquette; T. Robb; M.F. Friedrichs

Theodore Barry & Associates · Management Consultants

TB&A
Telephone 212-986-5995
245 Park Avenue
New York, New York 10017

June 13, 1978

Walter R. Hall, Esq.
Morgan, Lewis & Bockius
123 South Broad Street
Philadelphia, Pennsylvania 91909

Dear Mr. Hall:

Enclosed are workpapers (typed) of calculations used in developing figures and costs included in our report. I believe this responds appropriately to Mr. Codey's request of June 1, 1978.

Sincerely,

Perry L. Wheaton
Principal

PLW:br
Enclosure

cc: Ms. Martha Bush
Office of Consumer Advocate
Commonwealth of Pennsylvania

With enclosure.

SALEM PROJECT REPORT

Basis For Calculations

Cost Control - Soft: Net savings of 1 per cent of total project costs of $1.2 billion due to use of improved project management techniques.

About 60 per cent of projected savings attributable to Salem Unit No. 1.

Rework - Hard: 1.2 million craft hours at $10 per manhour equals $12 million of labor costs due to rework. Assume that 50 per cent or $6 million was correctable less implementation costs of $1 million for a net reduction of $5 million.

About 75 per cent attributable to Salem Unit No. 1.

Rework - Soft: Assume all $12 million of labor costs were correctable, add engineering labor costs of $1.2 million for total of $13.2 million. Double labor costs to reflect material costs for a total of $26.4 million of labor and materials. Assume estimated implementation costs of $6.4 million for a net reduction of $20 million.

About 75 per cent attributable to Salem Unit No. 1.

Work Force Utilization - Hard: Reduction of 5 per cent of 43.5 million labor hours at $10 per hour or $21.8 million less estimated implementation costs of $5.8 million for a net reduction of $16 million.

About 60 per cent attributable to Salem Unit No. 1.

Work Force Utilization - Soft: Reduction of 10 per cent of 43.5 million labor hours at $10 per hour or $43.5 million less estimated implementation costs of $8.5 million for a net reduction of $35 million.

About 60 per cent attributable to Salem Unit No. 1.

Materials Management - Hard: Reduction of 10 per cent of stock items inventory of $8 million or $800,000 per year, resulting in reduction of carrying costs of 20 per cent or $160,000 per year. Seven years savings at $160,000 per year equals $1.12 million less estimated implementation costs of $320,000 for net reduction of $0.8 million.

About 75 per cent attributable to Salem Unit No. 1.

Materials Management - Soft: Reduction of 20 per cent of stock items inventory of $8 million or $1.6 million per year, resulting in reduction of carrying costs of 20 per cent or $320,000 per year or $2.24 million for seven years less estimated implementation costs of $540,000 for net reduction of $1.7 million.

About 75 per cent attributable to Salem Unit No. 1.

Construction Equipment - Soft: 15 per cent reduction in operations and maintenance expenses of $14.3 million or $2.1 million less estimated implementation costs of $500,000 for a net reduction of $1.6 million.

About 50 per cent attributable to Salem Unit No. 1.

Theodore Barry & Associates · Management Consultants

TB&A

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New York, New York 10017

Schedule 2
Page 5 of 6

June 19, 1978

Mr. Walter R. Hall
Morgan, Lewis & Bockius
123 South Broad Street
Philadelphia, Pennsylvania 91909

Dear Mr. Hall:

At Ms. Martha Bush's request, I am enclosing certain data which you have requested with regard to our testimony on Salem Nuclear Generating Station Unit No. 1.

Sincerely,

Perry L. Wheaton

Perry L. Wheaton

PLW:lch

Attachment
cc: Ms. Martha Bush

BASIS OF ALLOCATION TO SALEM UNIT NO. 1

Costs for the Salem project were not accumulated in a manner that facilitates allocation of costs to the respective units in the manner outlined on Page 20 of TB&A's testimony. More complete cost data will be available when unitization of the project is completed sometime after Salem Unit No. 2 is placed in commercial operation. TB&A's allocation of the projected impact of net savings was therefore based on its understanding of the time period over which costs were incurred, approximate dollars expended on Salem Unit No. 1, where known, and the timing of the implementation of improved management practices during the course of the project. The allocations were developed as the result of the review of available documentation and interviews which were conducted through the conduct of the construction management audit.

TB&A Staffing

Name	Title	Equivalent Man Days
P. Wheaton	Principal	34
J. Love	Managing Associate	44
Others	Various	72
		150

Allocation of TB&A Staff Time

Activity	
Salem Site Visits	10
PECO Monitoring Review	15-20
Other	120-125
	150

THE ADMINISTRATIVE LAW JUDGE: I prefer to entertain it as I told Mr. Bock earlier in this proceeding, when counsel for the company moved for admission of all this.

MR. HERSHEY: Very well.

THE ADMINISTRATIVE LAW JUDGE: Without objection, it will be so identified.

(Philadelphia Electric Statement No. 11, Direct Testimony of Stephen A. Mallard, was produced and marked for identification.)

THE ADMINISTRATIVE LAW JUDGE: Mr. Sayre, do you have any questions of this witness?

MR. SAYRE: Not at this time, Your Honor.

THE ADMINISTRATIVE LAW JUDGE: Ms. Bush?

MS. BUSH: Yes, Your Honor. Good morning, Mr. Mallard. I am Martha Bush. I am with the Office of Consumer Advocate.

THE WITNESS: Good morning.

CROSS EXAMINATION

BY MS. BUSH:

Q I understand from your testimony and statement of qualifications that you are a registered engineer. Is that correct?

A That is correct.

Q And you have been involved in the construction and operation in your employment in the utility field over the past few decades in the construction and operation of

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the electric distribution facilities and customer electric service entrance facilities and transmission systems, is that correct?

A. That's correct.

Q. During your period of employment in this area, have you had experience in the actual construction process as contrasted to generation planning of a production, electric production generation facility?

A. My experience has been in the planning of generation facilities.

Q. I take it - -

A. My direct experience. But I have been appointed as a spokesman for the company in our last rate case and in this rate case as the overall spokesman for the company on all aspects of electric and gas operations.

Q. So that although you haven't been involved in the actual construction process of generation facilities, you have assumed the role of being a witness in various proceedings with regard to this question?

A. That's correct. I am a member of the operating committee of the company.

Q. And is it - - do I understand correctly from your statement of qualifications that you have testified in is that six rate proceedings, both electric and gas in New Jersey?

A. In many. I have lost track. But it has been a great number.

Q. So perhaps you might -- you have, in fact, testified in more cases than the ones you have listed in your statement of qualifications or is that an exhaustive list?

A. That's probably an exhaustive list. We attempted to make it exhaustive. And exhausting.

Q. And in addition to your testimony in rate cases, you have testified, as I understand, in an eminent domain proceeding in New Jersey?

A. That's correct.

Q. And you have testified on two occasions with regard to the energy crisis?

A. At least two occasions, that's right. I have also presented non-sworn testimony in Trenton at various times on various aspects of the company's business involving the on-going energy crisis.

Q. Now, you have listed on the chart on page 5 of your testimony the excerpt from the audit report of the different area where there were financial impacts stated by the auditors, and I would like to -- I've made a calculation as to the midpoint in that column, the last column on the right, that's on page 5 of statement 11, Salem No. 1 project impact and I have just made a mathematical calculation and I wonder if you would accept those numbers subject to check

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for purposes of cross examination today and those are for the first area, cost control project management, 3.6 million.

For the rework area, 9.375 million.

A. Well, I have a problem with that number because the Theodore Barry number is incorrect. And has been corrected. They have a figure of 19.5 million as the soft number for Salem No. 1 impact and that number should in fact be $15 million and that number was corrected in the Public Service rate case and Theodore Barry accepted that correction.

Q So that it is 15 million as you list here on page 5?

A My 15 million is correct and Theodore Barry's arithmetic was incorrect in that they took 75 percent of $20 million and came up with 19.5 million. They had a weak battery on their little electronic calculator, apparently.

Q So that the midpoint between the numbers you have listed there on line 23 is 9.375?

A The midpoint between what and what?

Q 3.75 and 15.0.

A If one were to add 15 and 3.75, one would reach 18.75 and then you took half of that, is that correct?

Q Well, what I did actually was I subtracted 3.75 from 15.0 and divided that by 2 and came up with 3.75.

A I think it would come out the same. What was your result, please?

Q 9.375.

A. That would be my result by my different method.

Q And on the next area, work force utilization, the midpoint was 15.3; materials management, .9 and construction equipment, .3.

A. Without making a detailed check of the arithmetic, what you have just described sounds about right.

Q Now, the total cost of both projects was $1.21 billion, is that correct?

A. Yes. The project is not completed, however. We are - - we have not yet placed Salem No. 2 in commercial service and as a matter of fact, we are continuing to do work at Salem No. 2.

Q And it is continuing to accrue AFDC?

A. Both construction costs and AFDC, yes. That's right.

Q Do you have available to you, there, the figure in terms of the total cost of Salem 1?

A. I have the Public Service cost for Salem No. 1, which includes our AFDC. This is what we currently have Salem No. 1 on our books for. And it is - -

Q All right. Could I have them?

A. It is $367,661,000.00.

Q 367 - -

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A. 367,661,000.

Q. And that's just PSE&G's portion of Salem 1?

A. That's our portion of the capital cost of Salem No. 1 including our AFDC.

Q. So that, and your ownership portion is 42.59 percent?

A. It is the same as Philadelphia Electric's portion and that's in my testimony. It is some 42 percent. I don't recall the decimal places.

(Transcript continues on next page)

As I recall our portion and Philadelphia Electric's portion are identical.

Q Yes, I think that is correct.

A I have it, it is 42.59 percent.

Q Yes. Now with regard to the area of project management which you discussed beginning on page 7 and into page 8, as I understand it, you have stated here that a search for the lowest cost schedule was formally conducted by PSE&G at the time the project was originally authorized, and you are presenting that in contradiction to the statement blocked out right prior to that excerpted from the Theodore Barry report atpage 174, which stated: Resource leveling was used to evaluate cost impacts of alternative stra agies for Salem schedule, although a search for the lowest cost schedule was not formallyconducted.

Now do you recollect during the course of the audit having some discussions with Mr. Love with regard to a definition of what is appropriate or in your professional opinion what is a definition of what is a search for the lowest cost schedule on a formal level?

A I recall having many discussions with Mr. Love and at times we were on the same wavelength and at times we were not.

Q Do you recall with regard to this particular question whether you had a difference of professional opinion

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as to what would be a formal search for the lowest cost?

A It was more than a difference of professional opinion. I attempted to educate Mr. Love and I was unsuccessful.

Q So not only did you differ, but in your opinion you were correct and he was incorrect and you tried to persuade him to your point of view?

A Of course.

Q If I could direct your attention to page 174 of the audit, and particularly the last paragraph there, the last full sentence in that paragraph, which states: TB&A is defining the search for the lowest cost schedule as an integrated process which requires the evaluation of alternative schedules, enough alternatives to permit interpolating an optimum using an analytic technique like PSE&G's PWAFRR to determine minimum cost.

Are you familiar with that particular statement in the audit?

A Yes, I am.

Q Does that sentence to you imply or does it express to you the difference, or a discussion of the difference that you had extensively with Mr. Love as to what would be a search for the lowest cost schedule?

A That sentence makes sense to me. I have no problem with the sentence. The problem was that Mr. Love did

not recognize that we were doing what this sentence says.

Q I see, even though you told him repeatedly that you were doing it, he would not accept that you had done it or he would not accept that what you did reached the level that he thought was appropriate to be done?

A I guess I am a poor communicator. I tried my best, like a Christian missionary in Africa.

Q So Mr. Love was the uneducated heathen that you were trying to persuade of your views?

A Unwashed.

Q I am sure he will be interested to read that in the transcript, Mr. Mallard.

A I hope he does because I like Mr. Love. He is an affable gentleman. I spent a good deal of time with him and told him where the better restaurants were in Newark.

Q But apparently that did not persuade him of your point of view in other areas.

A Oh, no, it was an arm's length relationship which we had, the sum of his arm and my arm.

Q And from the results of the audit, you were pretty far apart with both of you arms together?

A My testimony speaks for itself. If Theodore Barry submitted that report in Public Service, I would have thought about either discharging him or transferring him to some other department which was not as sensitive in the

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operation of Public Service, such as street maintenance.

Q I can understand, given the results of the audit, that you had that opinion. Could you define for the record what PWAFRR is? What does those stand for?

A Present worth of all future revenue requirements.

Q Is that a computer model that PSE&G has?

A It is a Welsh word, Pwafrr.

Q Are you serious, Mr. Mallard.

A No, I am being facetious, and I won't waste your time with facetiousness. I apologize.

It is not a computer model. It is a well-known economic methodology, which simply takes a string of expenses that are made over a period of time, and using the appropriate discount rate, expresses them as one equivalent dollar figure.

For instance, if I have an expense of $10 a year for 10 years, if I added that up that would be $100, but on a present worth basis I could buy an annuity, for instance, perhaps for $70, so that the $70 then would be an economic surrogate for a series of expenses over a period of time and that is what that means.

Q During the course of the construction of Salem-1 when PSE&G realized that the plant was not on the original time schedule target, did PSE&G make extensive

attempts to get the construction schedule back on target and in line with the critical path originally scheduled?

A We did, after we assessed what our various needs were, in terms of the shopping list which I have indicated on page 8 of my testimony.

In other words, we did not direct ourselves exclusively to a come-hell-or-high-water attempt to keep the construction schedule on target no matter what; but we went back and assessed all of the factors we could think of, as shown on my page 8.

Q So you assessed the cost impact of these various factors listed here on page 8?

A On a regular routine and continuing basis, that is correct.

Q In coming to their conclusion in the final report of the audit, you had informed the auditors, you did not withhold information from the auditors that you had done this kind of analysis in your project management?

A Absolutely not. I can recall sitting down and practically grabbing Mr. Love by the lapels and saying to him: Jim, here is what we do. I told him, I did the best that I could.

Q The next area that you address in your testimony is rework. Do I understand correctly that your position is that not that PSE&G avoided all unnecessary rework,

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but that they avoided what in your opinion could be reasonably expected of a construction manager to avoid?

A That is right. As a matter of fact, Theodore Barry in January of 1978 prepared a report for the Virginia State Corporation Commission involving a review of the Virginia Electric and Power Company's management of power station engineering and construction programs, and in this report --

Q Is this relevant?

A Oh, it is, extremely.

Q To what --

A To your question.

MR. HALL: Your Honor, I would ask that the witness be given the opportunity to respond to the question in the manner he feels is appropriate.

MS. BUSH: Well, Your Honor, it appears to me the witness is going off into an extraneous matter. If Mr. Hall would like the witness to be able to say this in redirect, I have no problem with that.

I have asked a specific question and the witness has answered it. My concern is what he meant when he said by diligent effort rework expenditures were held to a normal and reasonable level, that is what I --

MR. HALL: Your Honor, Ms. Bush is quite simply trying to prevent the witness from giving an answer which she doesn't want to hear. I have not heard an answer

to the question. She merely does not want to hear it.

MS. BUSH: I don't mind hearing it, but I don't want to hear it on my cross-examination.

THE ADMINISTRATIVE LAW JUDGE: I have allowed a great deal of latitude on the part of witnesses in answering questions. The witness will be able to answer as fully as he wishes.

THE WITNESS: Thank you. In the report to which I have just referred, which is the Theodore Barry report dated January 1978 --

BY MS. BUSH:

Q Excuse me, could I have an opportunity to look at the report as you are testifying?

MS. BUSH: Do you have a copy, counselor?

MR. HALL: I don't have a copy, no.

THE WITNESS: I don't have an extra copy, but I would be happy to walk over to the table and sit down with you.

MR. HALL: Ms. Bush can walk over and look with the witness --

THE WITNESS: Either way.

MR. HERSHEY: Why don't we take a two-minute recess so that Ms. Bush can have an adequate opportunity to look at it?

THE ADMINISTRATIVE LAW JUDGE: If Ms. Bush

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wishes, we will be glad to. Let's take a five-minute break.

(Short recess.)

STEPHEN A. MALLARD, resumed.

MS. BUSH: Your Honor, I would like to move to strike the answer that we have just received from the witness. I believe that he has had a full opportunity to incorporate whatever references he would like to to reports and give the other parties an opportunity to review the reports prior to cross-examination.

Rate cases are not like criminal trials or personal injury where the witness is allowed to bring up new matters on the stand.

Of course, if he did not have the report available to him when he was preparing his direct testimony, I would understand, but this is information that he has and he had the opportunity to put in his direct testimony.

MR. HALL: Your Honor, I have never heard of that principle at all. This is a matter which Mr. Mallard believes is relevant to the question, which Your Honor has not heard yet, and I think he should be permitted to state his answer, then perhaps Your Honor can evalute it and in light of the objection we can have argument on it.

THE ADMINISTRATIVE LAW JUDGE: I will defer any ruling on the motion to strike right now. If you wish

to renew your motion after the witness gives his answer, you may, Ms. Bush. Of course, as we all know, this is all subject to -- I don't know exactly what I can call the status of the motion to strike now -- but -- but it will be governed by that motion, too.

So if the witness would like to answer --

THE WITNESS: Thank you, Your Honor. In response to Ms. Bush's question, I was responding to the question of rework in the Theodore Barry report and my response involves a standard which Theodore Barry has expressed for an appropriate amount of rework in a report dated January 1978 concerning the Virginia Electric Power Company, which they prepared for the Virginia State Corporation Commission.

In this report on page IV-22 Theodore Barry states that about 8½ percent of total manual labor as an amount of rework does not appear to be abnormal. In the case of Salem No. 1 the amount of rework was approximately 2 percent.

BY MS. BUSH:

Q Is that a direct quote from the report?

A I paraphrased it. The direct quote is as follows: Thus, about 8.5 percent of the total manual labor cost has been for rework. Although data for comparison with other similar projects is limited, this amount of rework does

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not appear to be abnormal.

MS. BUSH: I would move to strike the response, Your Honor.

MR. HALL: If Your Honor will entertain argument on it, the matter becomes relevant because of the question. As a result of the question, Mr. Mallard offers this as his response to the question. I think that is a perfectly appropriate response in timing sequence.

MS. BUSH: However I don't know whether it is taken out of context, I don't know anything else about the plants, I don't know whether that is engineering or labor. It is a meaningless figure as far as I know.

To determine the value of it would take a review of the report and understanding of the entire audit of that plant, any distinctions from that plant to this plant, the timing of that plant and various other factors that I don't think we can go into in this proceeding.

MR. HERSHEY: If I might add, Your Honor, one of the very reasons for prefiled testimony in this kind of case is the technical nature of the testimony and the need to adequately prepare to cross-examine, and that is particularly important in a case where we have a seven-month suspension period, and the trial period is very limited.

Ms. Bush could have had the opportunity had she had this information in the prefiled testimony to consult

with either Mr. Wheaton or Mr. Love on that report. She has not had that opportunity and it would be very difficult for her now to raise those issues and that is why I think it should be stricken.

MR. HALL: Your Honor, I just note that Ms. Bush has plenty of opportunity through the remainder of this proceeding to consult with Mr. Love and employ whatever rebuttal she wishes to respond to this particular reference.

MR. HERSHEY: That is not the same as cross-examination.

THE ADMINISTRATIVE LAW JUDGE: I will deny the motion. However, I would like this report entered into the record.

MR. HALL: The Virginia Electric and Power Company report?

THE ADMINISTRATIVE LAW JUDGE: Yes.

MR. HALL: We will do that.

MS. BUSH: And I would like a copy of the report as soon as possible.

MR. HERSHEY: In fact, to all parties, please.

MR. HALL: Your Honor, I would note that this is not some unusual report that we have uncovered in arcane places. This is a report that was known at the time of the company's last case. I obtained a copy of this report by asking Barry what else they had done.

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It seems to me this is part of the opposing parties' professional obligations to obtain this material and be familiar with it.

MS. BUSH: I never saw a copy of the report. I don't recall you asking through me. I recall you asking information that is attached to Mr. Mallard's testimony. I have not been aware of the report and have not seen it before today.

MR. HALL: We will make a copy available.

BY MS. BUSH:

Q Mr. Mallard, do I understand correctly, then, your position to be that at times you agree with Theodore Barry and at times you don't in terms of what standards they set for construction management practices?

A Yes.

Q So that you respect their professional judgments in some areas and you do not respect their professional judgments in other areas, and which areas happen to be the areas you disagree with them?

A I am not enthusiastic about their professional judgment at all except that I am not going to call somebody wrong simply because I am on the other side from them; and in fact their entire report turns out to have been a ringing endorsement of Public Service's efficacious prosecution of this project in that in their hard figures they came up with

about a 98 percent endorsement of all our costs.

Q So you in fact think that they did judge you and they judged you to have performed well and you agree with that, but there are particular points on which you disagree with them?

A I think you could characterize my relation to them is that I don't quarrel with them when I don't agree with them, but I don't enthusiastically welcome their support because they did not do that good a job.

Q I see. Mr. Mallard, with regard to the data acquisition system that PSE&G has instituted in their Construction and Engineering Department, would you say it is accurate to say that a better data acquisition system has been set up and was used at Salem-2 than was used at Salem-1?

A Oh, absolutely. All of our management procedures have been evolutionary, and as time goes on we have improved.

Q Thank you. Do you recall the Theodore Barry auditors repeatedly asking personnel from PSE&G over the course of the audit for material and information and data with regard to labor and materials that were expended for rework?

A During the course of the audit our relationship with Theodore Barry was on a continuing basis and I recall that they made thousands of requests for data and we used many thousands of man-hours in complying and attempting to

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comply with their requests. I have recollection of that in total.

As far as specifics go, these things occurred over a year ago and I may be a little fuzzy on some of the particulars.

Q So you do not recall specifically with regard to labor and materials for rework that quantification or data related to that, you do not recall the information requests or the discussions in that regard over the course of the audit?

A Of that subject I do remember, oh yes, I remember the subject, but I can't give you names, dates and so on.

I also recall that in our judgment many of the requests for data by Theodore Barry were trivial.

MS. BUSH: Your Honor, I would ask that that response be stricken as irrelevant and judgmental and argumentative and not responsive to or relevant to any issue in this proceeding.

MR. HALL: Your Honor, rate making is judgmental. Secondly, I would note that Mr. Mallard is testifying, not Ms. Bush. He is seeking to respond to her questions in what he believes to be an appropriate manner. That is the purpose of testimony. It is not to obtain whatever Ms. Bush wishes.

MS. BUSH: A characterization on the record of the auditors' requests for information as trivial I think

is totally irrelevant to the rate proceeding and does not rise to the level of something that should be on the record.

THE ADMINISTRATIVE LAW JUDGE: We will take it for what it is worth.

BY MS. BUSH:

Q So you do not recall, or do you recall, Mr. Mallard, several requests over the course of the audit by the auditors for data with regard to quantification of the labor and material that went into rework in the construction of Salem-1 and 2?

A I do recall that there were many requests, and that was among them, yes.

Q You don't seem to have understood my question, Mr. Mallard. Let me see if I can rephrase it.

A Well, perhaps it would help if you had a document. Is there a written request that you can refer me to?

Q No, there is not a written request which I can refer you to. My question simply is, if you recall one way or the other, what is your recollection as to whether the auditors inquired of PSE&G on several occasions during the course of the audit for information and data with regard to the labor and materials expended for rework.

A I do so recall.

Q I would like to clarify with you exactly what

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you mean by a sentence you have on page 10 of Statement No. 11, lines 5 and 6.

A Forgive me while I locate that.

Q Certainly.

A You are talking about page 10, lines 5 and 6 of my direct testimony?

Q That is right. If I might quote a sentence: The information described in the paragraph above was in fact used for man-hour control by supervisors.

My question to you is: Do I correctly interpret that sentence to mean that you under-stand the audit to be and you are rebutting that understanding which is that the auditors' information from you and conclusion in their report was based on a view of what happened at the construction project that supervisory personnel did not at all use the data described to control work hours of individual craft workers?

A That appears to be the case.

Q Now with regard to that paragraph and the next paragraph in your testimony, in which you discuss the various activities that were undertaken by the supervisors and other personnel at the office, do I understand correctly by your testimony here that you are stating that the auditors were not aware of these activities that you describe here, or that they were aware of them and you do not think they properly

took them into account?

A It is difficult for me to answer that question, but I will attempt if you will permit me.

Q Certainly. I would appreciate a response to the question.

A I read English as well as I can and I read the conclusions of the Theodore Barry team in this particular area, and it baffles me.

I did not spend time with them 100 percent. I spent a good deal of time with them during this period, however, and I was present at many of the interviews that Theodore Barry had with the relevant Public Service construction people, and I visited the Salem project with them and saw through their eyes, as well as I could, how our systems were progressing and what our methods were; but I was not with them 100 percent so therefore I cannot vouch for everything that they heard and perceived and I cannot go through their mental process.

But I shared with them the investigation to a great extent. Since I work for Public Service I probably had more opportunity to speak with some of these people at other times when Theodore Barry was not present, because I work with them in the normal course of activities.

But my conclusion, and this is my sworn testimony, is based on my personal knowledge and investigation

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and discussion with our construction people, and I reached a conclusion which is opposite to Theodore Barry's. That is why it baffles me.

Q Do I understand correctly your response that with regard to these activities that you list on page 10, lines 5 through 21, you don't have a specific recollection of whether the PSE&G people conveyed these activities to the auditors?

A No, except I can answer in a general way, if I may be permitted.

Q Yes.

A And that is that the attitude of Public Service Electric and Gas during this audit was one of absolute candor and being forthcoming with Theodore Barry. We spent thousands of man-hours. We allowed them to go through our records, to parade through our offices, to go through our project plant to their heart's content.

On the other hand, we were not writing their report for them and we could not go through their thinking processes.

So we did our best at communicating and if this is what they came up with, as I say, I am baffled.

Q You know that PSE&G people gave the Theodore Barry people as much information as they had and were very open and opened their records, but you do not specifically

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recollect one way or the other whether they gave them this information on lines 5 through 21, or could you say that you reasonably assume that they gave them this information?

A Well, they had every opportunity to have seen this information among thousands of other documents. Now whether they did or not, I cannot say, and whether they identified this material appropriately I cannot say.

We were not spoon feeding them. We were responding to them. Even though we were being candid, there was still an arm's length relationship to them. There is not that arm's length relationship when I ask people things. So their could be some problem in communication there.

If they had a problem in phrasing a question in a certain way, I did not say to them, well, gee, Jim, you should have asked it this way. I would answer him to the extent that he had asked the question, and if he had a problem with understanding, well, that was unfortunate.

Q So your answer is you don't know?

A I have forgotten what the question was.

Q The question is and has been: do you know if this specific information regarding the description of the various activities listed on lines 5 through 21 on page 10, if that information was -- you don't have a specific knowledge of whether that information was conveyed to the auditors although you have described at great length the audit process?

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A I can't be sure that is correct.

Q Now the next area you discuss is materials management and I am also trying to understand the English language, Mr. Mallard, and the entire context of your sworn testimony here, and you have a statement: However, no evidence --

A Excuse me, would you give me the reference?

Q Yes, page 11.

A What line?

Q Lines 2, 3 and 4. However, no evidence is presented to show that the project managers could have foreseen that such reductions were possible without delaying the construction. And you go on to say: A materials inventory somewhat above the calculated theoretically desired level can be a good investment if it protects against the much greater penalties of construction delays.

Now, do I understand from this sentence as well as how you have approached the other areas that with regard to any particular descriptions of various materials management practices, and whether or not they were adopted by PSE&G, and to what extent, that were listed rather extensively at the audit, the chapter having to do with materials management, you do not have a factual disagreement with those descriptions in that chapter as you have with the other chapters in which you specifically noted a difference of

opinion or factual difference, but you are rather saying the standard that you think, of reasonably could have foreseen it, was met by the management constructors?

A I would like to respond to that in terms of information which Theodore Barry provided to me, if I may be permitted.

Q Yes.

A And that is, I was curious when I read this Theodore Barry report, which had the wrong date on the cover, which disturbed me, because when Public Service publishes reports we try to get the correct date. This report was dated May 1977 although they began their audit in January 1978.

But aside from that, I asked Theodore Barry for their work sheets, how they came to the conclusions on page 20 of their report, which are serious conclusions, accusing Public Service of having been imprudent, and they provided me with a work sheet which I thought was embarrassing. It was one and a half pages of very skimpy notes that I would characterize as a back-of-an-envelope study which could have been done before they wrote this report.

It simply said, I take 1 percent of this number and I add 2 percent of that number, I take a pinch of salt and a pat of butter, and I produce this thing.

In that content they talk about materials

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management, which was your question, and they say that -- and I am quoting Theodore Barry now -- that the soft figure was arrived at simply by taking a reduction of 20 percent of stock items inventory of $8 million or $1.6 million per year, resulting in a reduction of carrying costs of 20 percent or $320,000 per year or $2.24 million for seven years less estimated implementation costs of $540,000 for a net reduction of $1.7 million.

And then they say about 75 percent of this is attributable to Salem Unit No. 1.

Well, that is pitiable, and that is the context of my evaluation of Theodore Barry's numbers. They are absolutely groundless, unquantified, and it is the sort of thing that is just not acceptable in a company like Public Service Electric and Gas Company.

MS. BUSH: Your Honor, I would request that you direct the witness to answer my question. I would be happy to have my question reread.

THE ADMINISTRATIVE LAW JUDGE: The question will please be reread.

(The following was read by the reporter:

Question: Now the next area you discuss is materials management and I am also trying to understand the English language, Mr. Mallard, and the entire context of your

sworn testimony here, and you have a statement: However, no evidence --

Answer: Excuse me, would you give me the reference?

Question: Yes, page 11.

Answer: What line?

Question: Lines 2, 3 and 4. However, no evidence is presented to show that the project managers could have foreseen that such recutions were possible without delaying the construction. And you go on to say: A materials inventory somewhat above the calculated theoretically desired level can be a good investment if it protects against the much greater penalties of construction delays.

Now, do I understand from this sentence as well as how you have approached the other areas that with regard to any particular descriptions of various materials management practices, and whether or not they were adopted by PSE&G, and to what extent, that were listed rather extensively at the audit, the chapter having to do with materials management, you do not have a factual disagreement with those descriptions in that chapter as you have with the other chapters in which you specifically noted a difference of opinion or factual difference, but you are rather saying the standard that you think, of reasonably could have foreseen it, was met by the management constructors?)

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MR. HALL: Your Honor, the question seems rather long and involved. As I understand it, it merely requests the basis of Mr. Mallard's statement on page 11 and I think the answer fully responds to that. I have no problem with him giving a further answer.

MS. BUSH: If the witness would like to answer it, would you mind letting him answer it?

MR. HALL: That would be fine, if you can frame the question.

BY MS. BUSH:

Q Do you understand my question to be something different than what you responded to?

A I would stand on my answer to the extent that no evidence was in fact presented by Theodore Barry, but that in the area of materials management I do not have a basic disagreement with the need for materials management, and in fact Public Service does practice materials management.

Q Let me take you through the chapter with specific areas that were discussed by the auditors and see if you agree with the factual statements here.

A Would you give me a page reference, please?

Q I certainly will. I was about to do that. Page 51. The area discussed in the last paragraph on that page, to correct the problem during the completion of Unit 2, PSE&G has requested that UE&C establish a material coordinator,

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to coordinate the scheduling and expediting of critical materials to support the construction schedule.

Is that a true statement of fact, yes or no?

A Yes.

Q On page 55, is it true or not, to your knowledge, that as a result of the Theodore Barry review at the site they found lack of identification of bin location on the commodity cards in the conventional piping warehouses, do you factually contest that?

A I have no basis for factually contesting it.

Q With regard to the electrical storeroom, do you factually contest that the auditors found lack of commodity cards/other system to designate locations in the warehouse?

A I want to agree with you but I don't know whether to answer yes or no, depending upon how your question is phrased, but I agree with you.

Q You don't have any information that would lead you to factually disagree with what the auditors found?

A That is correct.

Q If I went through any other statement in this chapter, which I take it you have reviewed --

A Indeed I have.

Q You would not factually disagree with their descriptions of what they found?

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A That is correct.

Q Rather you are disagreeing with the standard that they established as to whether that could have foreseen installing such techniques to reduce materials without delaying the construction?

A Yes, my problem is that they gave a laundry list of motherhood and apple pie items and somehow or other on page 20 arrived at a soft figure of $1.6 and there is no basis for that. If you can show me in this report a basis for that I would be happy to discuss that with you.

Q I am directing the cross-examination, Mr. Mallard, and I have another area in which I am cross-examining you. If you would like with your attorney to explore those other areas further than you have in your direct testimony on redirect, you are welcome to do that.

But the way the rate proceeding goes is that I do cross-examination and I determine what areas I would like to cross-examine you on.

A And I am the most cooperative person trying to help you do that.

Q Thank you. I appreciate your cooperation. If I could direct your attention to page 34 of the audit, the middle paragraph there states that PSE&G will implement a formal maintenance management system for the Hope Creek Park project. PSE&G was unable to provide the cost benefits which

it expects to receive from implementation of such a system.

Can I assume from the PSE&G's decision to implement this formal maintenance management system at the Hope Creek project that the company made some cost benefit analysis and determined that the savings that would be accrued as a result of implementing this formal procedure outweighed the cost of implementing the procedure?

A The company assesses all its decisions in terms of cost effectiveness. It does not always make a formal study on every little aspect of its operations.

Q So you did do some kind of cost benefit analysis before you decided to institute this procedure?

A We made a management assessment and made a decision which we believed to be cost effective, yes.

Q Was that one of the formal or one of the informal cost benefit analyses?

A Informal.

Q Do you have a quantification for me of what the cost benefit analysis was?

A I do not.

Q Does the company have that information available?

A We may have.

MS. BUSH: I would like to have that provided, please.

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MR. HALL: Could you state what the information is, again, so that we are clear as to what your request is?

MS. BUSH: You can have the last question re-read.

(The following was read by the reporter:
Question: Do you have a quantification for me of what the cost benefit analysis was?)

MR. HALL: Of what?

MS. BUSH: Of the implementation of the formal maintenance management system for the Hope Creek project as referenced on page 34 of the audit.

MR. HALL: Your Honor, I would object to that question. I don't see its relevance whatsoever. This is another generating station that we are now talking about of Public Service Electric and Gas as to which Philadelphia Electric has no relationship whatsoever.

I don't see the relevance of this particular calculation or judgment of the Public Service management to this proceeding or to the construction of Salem.

MS. BUSH: If we could sequester the witness I would be glad to respond to that.

THE ADMINISTRATIVE LAW JUDGE: Would you like a cup of coffee?

THE WITNESS: I missed what Ms. Bush said.

MS. BUSH: I would be glad to argue the relevance of this point but with you out of the room.

THE WITNESS: Oh, I see. That is unusual, but I would be very happy.

THE ADMINISTRATIVE LAW JUDGE: Off the record.

(Discussion off the record.)

THE ADMINISTRATIVE LAW JUDGE: I am going to sustain Mr. Hall's objection. Let's take a ten-minute recess.

(Short recess.)

(Transcript continues on Page 1878.)

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THE ADMINISTRATIVE LAW JUDGE: Let's go back on the record. Ms. Bush?

MS. BUSH: Your Honor, I don't know whether my specific data request was on the record, but I would like to state for the record in the eventuality that it was not, that I have requested a description or a copy of any informal cost benefit analysis done by PSE&G in making its determination as to whether it would implement the formal maintenance management systems that it eventually used or will use at the Hope Creek project.

I wonder if I could have your ruling on Mr. - -

THE ADMINISTRATIVE LAW JUDGE: Let's first have Mr. Hall's objection.

MR. HALL: Your Honor, I objected on several grounds, the first of which is that a prospective determination as such as the Hope Creek determination is much different than the retrospective audit and therefore, has no relevance to an analysis or retrospective audit.

I secondly objected on the grounds that this particular determination involved a generating station of Public Service Electric and Gas which is used only in its own operations to serve New Jersey customers, and as to which Philadelphia Electric Company has no relationship whatsoever.

For those reasons, it is the company's position

that the request is irrelevant.

MR. HERSHEY: It should also be noted on the record that I joined in the data request.

MS. BUSH: And I will state for the record my reasons for considering that a relevant data request and that being that one of the major thrusts of PSE&G's testimony that they have presented here for the Commission to consider in making their determination is that the level of - - the basis of the quantification done by the auditors was insufficient and it is my opinion that this informal analysis done by PSE&G and a provision of that for the parties to inspect would have some probative and relevant value with regard to PSE&G's own construction management practices in terms of what level of analysis and quantification they, themselves, do in making decisions as to the costs and the benefits of implementing various management practices.

THE ADMINISTRATIVE LAW JUDGE: I will sustain Mr. Hall's objection.

I have just received word that the Commission has ruled on the petition of CEPA for the admission of Mr. Scobbo and the Commission has allowed for Mr. Scobbo's participation in cross examination.

MS. BUSH: Might I have for the record the reasons for your ruling?

THE ADMINISTRATIVE LAW JUDGE: I will file a

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written decision on it. You will have to wait in line.

MS. BUSH: Thank you.

MR. HERSHEY: I would ask, Your Honor, that if possible, that this matter be given some expeditious treatment because if we are to be allowed to effectively deal with Mr. Mallard's testimony, this may be an issue which we will want to move for certification and time is running short.

THE ADMINISTRATIVE LAW JUDGE: The Administrative Law Judge is well aware of the time limitations in this case.

MR. HERSHEY: Thank you, Your Honor.

BY MS. BUSH:

Q Mr. Mallard, you testified earlier that you went to many of the meetings between the auditors and the PSE&G personnel. Do you have before you available today dates in terms of when you received the original draft or the revised draft chapters of the audit?

A. No, I didn't keep such records. I do recall, however, that we went through a verification process whereby Theodore Barry gave us many of the chapters in a very rough draft form, and asked us to look at it, to ascertain correctness and we saw that material sometime before May of 1978. I don't have specific dates.

Q Did you then get back from the auditors' a revised draft of the audit that was - - or of the chapters as

they were finalized in the bluebook?

A I believe that we did, yes. My recollection is that they fed us those chapters on a piecemeal basis as they come out of the typewriter and there were still some typos at that point, but what was finally printed was essentially what we had seen on either the second or third go-round in the process.

Q Do you have specifically the date that you received the summary chapter?

A That we didn't see in the draft form. We saw the summary chapter only in the final version and that was sometime in May of 1978, as I recollect. I have some notes that go back to that period and some of my back-up material, if I may consult that.

Q Please do.

A The information I have here is that sometime in May, 1978, we received the summary chapter from Theodore Barry. On June 29, 1978, here in Pennsylvania, there were corrections made by Mr Nelk on the transcript at transcript pages 8663 and 8664 of certain of the additional mistakes that were found on the report. Particularly on page 20. These corrections were made in New Jersey on July 11, 1978 at the Board of Public Utility Hearing and then my testimony in the Public Service case, my rebuttal testimony was completed sometime before October, 1978 and filed with the New Jersey

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BPU on October 30, 1978. These are the dates in my notes. I can't be any more precise than that.

Q That's very interesting, Mr. Mallard.

Do you have the specific date in May in which you received the final chapter?

A No, I don't. I am not even sure it was made. But I received it. It could have been early June. I'm going by the report which says May, 1977.

Q Did you receive the final chapter at the same time you received the bluebook or did you receive the final chapter before you received the bluebook?

A My recollection is that I received it in the final form, the printed form. That's the first time I saw the final chapter. It is my recollection, but I don't have any independent way to ascertain that. That's just my recollection of something that happened a year and a half ago. I don't remember reviewing for correctness or factuality, their summary chapter. I do remember their other chapters, though, as I mentioned before, seeing them in draft versions.

Q Who was the project manager of the Salem project?

A Dennis Yagi.

Q Who were the PSE&G personnel who were at the hearing in Philadelphia when the auditors examined? Mr. Kistner, Mr. Whetca and Mr. Love?

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MR. HALL: Objection. I think we are going pretty far afield of the relevance of the substantive nature of this audit.

THE ADMINISTRATIVE LAW JUDGE: I will overrule the objection.

THE WITNESS: I wasn't aware that anybody from Public Service was at that hearing. There may have been somebody there. I'm not aware of who, if anyone. I won't say no one was there.

BY MS. BUSH:

Q So you don't recall if anybody was there or you don't remember or you didn't know at all that someone was there?

A I have no recollection.

Q One way or the other?

A I knew that there was a hearing and I had been discussing it with the Philadelphia Electric people back in June or so. I imagine it was June, because the hearing was June 29. But I have no independent recollection.

Q Is my understanding correct that you were not able to prepare your testimony in time for that proceeding?

A What happened was that in the Public Service case, the Theodore Barry report was part of the main case up until a certain point. Some time after their testimony was filed, I believe, or about the same time, there was a

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stipulation made between the Public Advocate in New Jersey and Public Service and other parties that our case would be bifurcated into phases one and two and phase one was designated as the main case and we got a ruling on that in terms of what rate increase we would get, and phase two was designated as the continuing investigation of the Salem Construction Management, which was essentially the Theodore Barry Report.

Once the Theodore Barry report went into phase two of the Public Service case, it went on the back burner, my review of it, and working and so forth involved with it went on the back burner as far as I was concerned. Because I was concerned with addressing the other issues in rebuttal and preparation of briefs and so on, assisting our attorneys on phase one.

So as I indicated, I didn't get around to filing my rebuttal to Theodore Barry until October 30, 1978.

Q To your knowledge, did anyone from Philadelphia Electric Company request anyone from PSE&G to prepare testimony for the Philadelphia Electric rate proceeding?

A. They talked to us, yes. And my recollection is that it was not possible for me to meet a date of June, 1978 to be properly prepared or to be prepared at all, as a matter of fact, because of the press of other work that I had with both the phase one part of the Public Service report as

well as my other duties.

Q. With regard to the substance of your response to the audit which you have formulated in Statement No. 11, were those positions that you had and developed over the course of the audit or were those positions that you developed sometime after you received the statement, the bluebook, the formalized copy of the audit?

A. You will have to help me with that. I don't understand what you mean by Statement No. 11.

Q. Your testimony that you filed today, here.

A. Oh, I see. May I ask the court reporter to read that question back, please?

(The question was read by the reporter)

THE WITNESS: I would characterize my testimony here as a commentary on the Theodore Barry report.

BY MS. BUSH:

Q. Any of the positions that you expressed in your commentary of the Theodore Barry report as formalized in your direct testimony, did you develop any of those positions over the course of the audit in the process in which you described you were involved?

A. That's really a difficult question and I apologize, because I am not trying to be difficult. But I'm having problems with that question just in terms of what your intent is. Perhaps you could give me some examples of what

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you mean by positions. I really don't grasp it.

Q Well, what I'm trying to get at, quite frankly, Mr. Mallard, is aside from your other pressing duties in terms of representing your direct employer of PSE&G in their regulatory proceedings, were these positions in terms of the substance of the positions that you have expressed in your direct testimony, were they positions that you developed in the time frame over the course of the audit or were they positions that you developed after you had seen the audit and when you then sat down, I suppose, for example, to do the testimony for your employer?

A. Okay. I can only go on recollection, now, but my recollection is that I did not begin to do anything on the testimony which I submitted in the New Jersey case which was quite similar to what I have submitted here. I did not begin to do anything in way of preparation for that until sometime after the Theodore Barry report was available to me and I did not begin on it immediately, because of other duties to which I had to attend.

Q When did you begin to prepare your testimony that you filed on October 11?

A. I would have to guess.

Q Okay.

A. Ms. Bush, I can only give you a time frame. It was probably in the late summer or early fall of 1978.

Q August or September?

A Sometime in there. That's an absolute guess.

Q Any of the substantive criticisms that you have of the audit here in your testimony, were any of those opinions formulated, though perhaps not formalized, during the course of the audit?

A The only one that I could give you an affirmative answer on that would be this question that you discussed before of the lack of agreement between Jim Love and myself.

MS. BUSH: That's all the questions I have.

THE ADMINISTRATIVE LAW JUDGE: Mr. Hershey?

BY MR. HERSHEY:

Q Mr. Mallard, my name is Steven Hershey.

A As in Hershey, Pennsylvania?

Q Yes. And Steven with a V. I represent CEPA and other community organizations in Philadelphia.

A And what is the acronym CEPA?

Q Consumers Education and Protective Association.

A Thank you.

Q Isn't it true, Mr. Mallard, that you have been with PSE&G since 1951?

A That's correct.

Q And during that time, as your experience and abilities increased, your abilities were recognized, you were gradually promoted with the company, isn't that correct?

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A. Yes, that is correct.

Q. During that period of time, have you worked for anyone else?

A. Yes.

Q. As a consultant?

A. No.

Q. You worked for someone - - you interrupted your service with PSE&G?

A. No.

Q. Would you explain that, please?

A. I taught an evening school at Stevens Institute of Technology.

Q. Were you employed anyplace else during that period?

A. No.

Q. And would it be fair to say that as a result of your experience, your judgment today is probably better than it was in 1951 when you graduated from school?

A. I guess that would be fair for any of us, as a general rule, unless we are declining with age.

Q. I see no evidence of that here today.

And isn't it true that that judgment becomes important in work such as yours because there are areas where one cannot reduce decision making to mere application of formulas?

A. Yes.

Q Did you participate in the planning of the Salem project?

A. Yes.

Q Would you describe your role, please?

A. It may be somewhat lengthy. I hope I don't disturb you, but I will attempt to summarize it.

Q Please do.

A. My overall responsibility is for the expansion of the electric and gas system facilities, including an assessment of the proper level of reliability, with service to the customers, determining what the level should be and then examining projections of load forecasts to determine for future years on a simulated basis, taking into account variations in load growth, in weather, in performance of equipment, what reinforcements and expansion of the electric and gas systems might be required.

In the conduct of these duties, my department and I identified or regularly identify the need for additional electric generating capacity and transmission facilities. We do this work both within Public Service and in terms of PJM, Pennsylvania, New Jersey, Maryland interconnection and also working with other utilities such as Consolidated Edison, which is our neighbor and not a member of PJM.

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Once the need is identified, we then address various ways of satisfying that need on an integrated basis, in terms of cost reliability and environmental impact. In doing this work, we identified, working with Philadelphia Electric, a need for new capacity, which we jointly recognized through our studies ought to be nuclear back in the mid 1960's,

This led to the evolution of the plan called the Lower Delaware Valley Project, which was pursued jointly by Public Service, Philadelphia Electric, Delmarva Power & Light and Atlantic City Electric Company, which involved four nominal 1100 megawatt nuclear units, which eventually were located at Salem and Peach Bottom. Plus the transmission, the 500,000 volt transmission that is associated with these power plants.

And my job, in Public Service, was to do the planning for this entire project.

Q And did that planning deal with the details of the actual construction project?

A No. Only to the extent that they were reflected in costs and in schedule, because it was necessary for us to identify the appropriate lead times and the costs in our planning studies, both our initial planning studies and our continuing planning studies as the project progressed.

Q Have you participated in the planning for other plants other than what eventually became the Salem plant?

A Yes. I have been doing that continuously for many years.

Q In New Jersey?

A In New Jersey and Pennsylvania and New York.

Q Mr. Mallard, I would ask you to turn to page 8 of your testimony. The last sentence - - do you have that, sir?

A On page 8, I'm looking at it, yes.

Q The last sentence on that page which continues on page 9, and I quote "The estimate of the maximum rework impact ($20 million) assumes that the extra material costs would be equal to the labor costs." End quotation.

Do you see that sentence?

A I do.

Q That sentence refers, does it not, to the TB&A table on page 20 of the TB&A report.

A In my understanding, it refers to that and to the one and a half page so-called work sheet that TB&A provided to me as I mentioned to Ms. Bush.

Q And is that contained in Schedule 2 attached to your testimony?

A That's correct.

Q And isn't it true, Mr. Mallard, that while the

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maximum rework impact assumes material costs, the hard or minimum rework cost does not?

A. Would you restate that question for me, please, sir?

(The question was read by the reporter)

THE WITNESS: I think that's correct, yes.

BY MR. HERSHEY:

Q Mr. Mallard - -

A - - except that, if you will forgive me, to the extent that, are you identifying hard and soft, now, in terms of Theodore Barry's definitions? Is that your intent?

Q Yes.

A I'm not sure what their definitions are. My interpretation of their definitions were spelled out here where I felt their hard is soft and their soft is effervescent, as I indicated.

Q Yes. I understand that. But referring both to your own testimony on pages 8 and 9 and to schedule 2, attached to your testimony, isn't it true that in the hard rework section, which could also be identified as minimum rework, there's no reference whatever to material costs?

A Theodore Barry makes some other assumptions in there, but I would agree with what you said.

Q Mr. Mallard, prior to the location of the

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plant at Salem, was any work done at the Burlington site?

A Yes.

Q Would you describe the work that was done, please?

A There was engineering, there was some site preparation and there was work done in connection with obtaining the Atomic Energy Commission license.

Q And would you please describe for us the sequence of these events which you have just described? And if you can, attach some dates.

A Well, the work was done, to some extent, on parallel tracks. The engineering, some of the engineering work preceded the other two activities, but then there was parallel activities and their work started, my recollection is that it began sometime in the mid 1960's.

Q Which work are you referring to? Engineering work?

A The engineering work and then the site preparation began shortly thereafter. In fact, I can tell you that I have one date here that construction at Salem began in January, 1968, which means that the site work began sometime before 1968 at Burlington. I don't have the precise date on that.

Q So your testimony is that the engineering work at the Burlington site began in the 1960's. Sometime after that, the site preparation work began and also the attempt to license through the Atomic Energy Commission, is

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that correct?

A. Yes.

Q. And do you know the cost of the engineering work that was performed at the Burlington site?

A. I don't have that with me in the material which I brought here. But that is a matter of record on our books of account and could be readily provided.

Q. Would you do so, please?

A. Surely.

Q. Do you know the cost of the site preparation work that was done?

A. The answer is the same. It is a matter of record, but I don't have the information with me.

Q. Could you also provide that?

A. We would be happy to, yes. As well as the licensing. There may be some problems in terms of the way the dollars are allocated, in other words, however they are allocated, we will provide the information to you. It may be in toto rather than the precise breakdown that you are requesting, but however we have it available, we will make it available to you.

Q. If you can allocate them, I would appreciate that.

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A. It may be/is an approximate allocation or engineering as opposed to accounting or regulatory allocation.

Q If that is the best you can do, I will accept that.

A Surely.

Q How long did the attempt to obtain Atomic Energy Commission permission for the Burlington site take?

A I do have information here that would be helpful. We filed our original application on December 13, 1966 with the Atomic Energy Commission. On Docket No. 50-272. So we were in the process of having an application pending for a Burlington location until 1967. August 17, 1967, there was a letter from Mr. Harold Preis, who was the director of regulation of the Atomic Energy Commission, to the Commission concerning a meeting on Friday, August 11, between Public Service and the ACRS, which is the Advisory Committee on Reactor Safety, I believe, of the Atomic Energy Commission, where the question of the Burlington site was discussed.

And then the company wrote a letter to Mr. Harold Preis on August 14, 1967, indicating that we would amend our December 13, 1966 application for a change in site from Burlington, and in that letter, we did not indicate where the new site would be, but it eventually became what we call Artificial Island, which is the present location of Salem. So I hope those dates are helpful.

We are talking from December, '66 to August,

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'77, where our application was pending for the Burlington site.

Q Do you know, Mr. Mallard, whether or not the costs incurred during that period are a part of rate base in this case?

A I do know that much of the preliminary plant design that was developed for Burlington was used at Salem and therefore, was capitalized in connection with Salem and I can give you -- -- we do have on our books of account precise information to that question which I don't have with me today.

Q And would that information include information about the engineering work and the site preparation work for the Burlington site?

A Oh, yes. The site preparation work for the Burlington site was not useful at Salem. But some of the engineering work, in fact much of the engineering work and much of the licensing activity was appropriately and properly transferable to Salem.

Q Could you provide that information, please?

A Yes, surely.

Q Now, isn't it true, Mr. Mallard, that there were frequent meetings between -- -- among representatives of the Joint owners of the Salem project during the construction period and in fact prior to the construction period?

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A. Yes.

Q And during those meetings, weren't the joint owners supplied with information by PSE&G concerning the construction?

A. Yes.

Q And in fact, they were even supplied with information/writing in between meetings?

A. They had access to any information that they wanted as co-owners.

Q And would you say that each owner played approximately the same role in those meetings?

A. No. I would say Philadelphia Electric played a more dominant role than Atlantic City Electric and Delmarva. Fitting with their role or their experience as the builders of Peach Bottom.

Q Now, Mr. Mallard, I'm referring you to page 7 of your testimony, beginning on line 24 of that page, where you indicate that, and I quote, "A search for the lowest cost schedule is formally conducted by PSE&G at the time that project was originally authorized and at various times throughout the construction phase of the project as schedule changes were required." End quotation marks.

Do you see that sentence?

A. Yes, I do.

Q Now, I would also like to refer you to the

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answer to interrogatory IR-3, number 157.

A. I'm looking at that, yes.

Q. Do you have that?

A. Yes.

Q. Now, the response to that interrogatory contains a section of a submission to the United States Atomic Energy Commission, does it not?

A. That's correct.

Q. Did you participate in the preparation of that document?

A. Yes.

Q. Was it prepared under your supervision?

A. No.

Q. Did you participate in the preparation of Section 4 of that document, that section 4 being the response to interrogatory 157?

A. Section 4 is alternates to Salem Nuclear Generating Station.

Q. That's correct.

A. And indeed, I did.

In fact, I was one of the principals in the preparation of that section.

Q. And can you tell us when that was prepared?

A. I have a photostatic copy of that section in front of me and I don't see a date on it. I do see some

footnotes, though, referencing 1971, so evidently, it was prepared after 1971. In 1971 or later.

And that is a matter of record and could be easily ascertained as to what date that was filed, but I don't know.

Q Would you please let us know when it was prepared?

A Surely.

Q Now, is this document, the formal search referred to in your testimony on page 7 and 8? That is the formal search for the lowest cost schedule?

A It is illustrative of it. There is much more.

Q What was the purpose for which this document was submitted to the Atomic Energy Commission?

A It was part of our application for a construction permit for nuclear power plant.

Q Which nuclear power plant?

A Depending on when it was submitted, it would have either been the original Burlington location or Salem.

Q Is it true that construction of Salem began in January of 1968?

A That's correct.

Q And we have identified that this is probably written sometime after 1971?

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A. That was section 4 that we were discussing.

Q. So what was the purpose for which this section 4 was submitted?

A. Section 4 was related to Salem. At least this particular version of section 4 that we are discussing.

Q. Were there earlier versions?

A. There may have been.

Q. Were there later versions?

A. There may have been, although I doubt that there were later versions. I think that this is probably the latest version. But a licensing procedure, as you can understand, is quite complex and it goes on for a long period of time and there are revisions as events unfold. Some of the revisions merely build on an original submission. I can't say with any certainty that section 4 hasn't been amended since. But I - - whatever it is, it is, in terms of NRC files.

Q. Would it be fair to say that this was submitted as part of the National Environmental Protection Policies Act requirement related to construction of the Salem project?

A. I think that's the case. It is. The Calvert Cliffs decision.

Q. And that's a decision of the Circuit Court of the District of Columbia in the early 1970's, is it not?

Or late '60's? Relating to construction of nuclear plants?

A Right. It is related to other than radiation issues. Environmental impact of nuclear plants. My recollection was that it was sometime around 1970. This is section 4 that you are talking about.

Q Yes. I wonder if you might supply us with the earlier and if any, later versions of this section 4?

A Well, that could - - yes, I will see what I - - I will endeavor to do that. There would be a problem of duplicating it for all parties, because these things are extremely voluminous.

Q I'm asking only for section 4.

MR. HALL: We will review that and how many parties are interested in it? I know you are. Is there any other party that has an interest in receiving that material?

MS. DUFOUR: I do.

MR. HALL: We will supply those two parties with copies.

THE ADMINISTRATIVE LAW JUDGE: I would assume that all the parties would like to have copies. Just a general output.

MR. HALL: Fine.

MR. HERSHEY: If I may take a moment, Your Honor.

(Pause)

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MR. HERSHEY: I have no further questions.

THE ADMINISTRATIVE LAW JUDGE: Does any other party have questions for this witness?

(No response)

THE ADMINISTRATIVE LAW JUDGE: Mr. Hall?

MR. HALL: Your Honor, I don't know that I have any redirect at this time. Perhaps it would be appropriate to stop for lunch and if I do, we will go forward afterwards.

THE ADMINISTRATIVE LAW JUDGE: Will Mr. Waddington be available?

MR. HALL: Mr. Waddington will be available at 1:00 o'clock.

THE ADMINISTRATIVE LAW JUDGE: Let's take a recess until 1:00 o'clock.

(Whereupon at 11:47 a.m. the hearing recessed to reconvene at 1:00 o'clock the same day.)

(Transcript continues on next page)

B-800062683

IN THE

Commonwealth Court of Pennsylvania

No. 1415 C. D. 1980

PHILADELPHIA ELECTRIC COMPANY,
Petitioner,

vs.

PENNSYLVANIA PUBLIC UTILITY COMMISSION.

REPRODUCED RECORD
Volume II — Pages 611a-1255a

Petition for Review of the Order of the Pennsylvania Public Utility Commission, Entered May 9, 1980 at Docket No. R-79060865.

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TESTIMONY AND WITNESS' EXHIBITS.

PREPARED TESTIMONY
OF
EMIL KASUM

Q. Please state your name and business address for the record.

A. Emil Kasum, 2301 Market Street, Philadelphia, Pennsylvania.

Q. Please state your employer, present position, and how long you have held that position.

A. I am employed by the Philadelphia Electric Company as the Chief System Planning Engineer, System Planning Division, Engineering and Research Department. I have held this position since March 1, 1971.

Q. Please describe your educational and professional background.

A. I received a Bachelor of Science degree in Electrical Engineering from the University of Wisconsin in 1948 and a Master of Science degree in Electrical Engineering from the University of Pennsylvania in 1955. I am a registered professional engineer in the Commonwealth of Pennsylvania.

I am a senior member of the Institute of Electrical and Electronic Engineers, a member of the Committee on Power System Planning and Dispatching of the US/USSR Technology and Engineering Program, a member of the System Planning Committee of the Edison Electric Institute and Chairman of its Generation Subcommittee. I am also a member of the Electric Industry Technical Committee to aid and advise DOE on the Power System

Reliability Study mandated by PURPA, and a member of the National Power Grid Study Task Force of the National Electric Reliability Council. My past affiliations include member and past chairman of the Planning and Engineering Committee of PJM, and member and past chairman of the Area Coordination Committee of the Mid-Atlantic Area Council.

Q. What is your experience in system planning for electrical utilities?

A. During the 29 years in which I have been employed in PECO's System Planning Division, I have participated in all phases of system planning activities and held, at different times, all supervisory positions in the Division. Among the activities in which I have participated are peak demand forecasting, use of probability analysis to determine generation reserves, timing, location, type and sizing of new electric facilities, preparation of capital budget forecasts and economic evaluation of alternative facilities. Under my supervision, PECO developed a system planning package of digital computer programs which are now used by other utilities world-wide. As a representative of PECO in PJM planning acitivities, I participated in such landmark activities as the Keystone-Conemaugh jointly owned mine mouth generating plants and the development of a 600 mile grid of 500 kv transmission lines that has greatly enhanced the reliability of electric service in Pennsylvania and the PJM area.

Q. Have you reviewed the testimony of Dr. Shakow?

A. Yes.

Q. Please summarize your major findings on Dr. Shakow's testimony.

A. 1. The Electrical Systems Generation Expansion model (ESGEM) that Dr. Shakow used in his analysis is simplistic and inappropriate for differentiating the true dollar cost between alternate generation planning schemes. It also has an inherent bias against base load generation.

2. The Loss-of-Load-Probability (LOLP) indices calculated by Dr. Shakow pertain to much lower levels of system reliability than are currently employed by PECO and the industry.

3. Dr. Shakow's assumed data has many inaccuracies that would lead to erroneous conclusions irrespective of the methodologies used.

4. Because of the deficiencies in his methodology and data the major conclusions reached by Dr. Shakow are in error. Specifically we believe and can illustrate that the PECO generation expansion program will have a lower net cost to the consumer than Dr. Shakor's "optimum" generation expansion plan for PECO.

Q. Why do you believe that ESGEM methodology is inappropriate for measuring cost differentials between alternate plans?

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A. The Optimal Generation Expansion Planning portion of the ESGEM Model is a misapplication of an outdated, simplistic approach. The techniques used are similar to those developed by PECO 18 years ago. This simplistic approach should only be used for the purposes of quickly screening a variety of generating alternatives. The optimum choice among a few selected alternatives should only be determined through a more rigorous analysis, such as that done by PECO.

PECO calculates annual production costs with a sophisticated computer program which performs calculations for the PECO and PJM Interconnection simultaneously. Purchases and sales by PECO with the PJM Interconnection are correctly represented by considering the load levels, machine availabilities, machines-on-line and operating costs for both the PECO and the remaining systems on a bihourly basis. This approach has been previously reviewed by the PUC. The ESGEM uses an annual load duration curve which completely misrepresents the economics (e.g. it ignores start-up costs) of dispatching units for the daily load cycle. It also uses a single machine to represent the economic generation in the complex PJM Interconnection without any regard to its own load cycle. This feature distorts the energy bought and sold by PECO and the cost of such energy. This is an important discrepancy as the interchange cost is over 20% of the costs in Dr. Shakow's optimum plan.

Q. Do the procedures used by Dr. Shakow contain bias against base load generation?

A. Yes. There are several reasons.

Dr. Shakow does not correctly model the PECO Muddy Run 880 mw pumped storage plant's pumping load and resultant generation cost. This plant allows PECO to take advantage of available low cost base load generation at light load for use as pumping energy. The production cost program used by PECO correctly costs the Muddy Run generation based on the pumping cost. The ESGEM program completely ignores pumping load. It assumes the resultant generation cost is zero, rather than being a function of the load and generation mix within both PECO and PJM. More importantly, ESGEM fails to recognize the additional economic use on the PECO system for base load plant to provide this pumping energy.

Another significant error in the ESGEM approach is Dr. Shakow's reliance upon but three yearly calculations (1981, 1987, 1992) which are then interpolated to the remaining years of his 1980-1992 analysis period to obtain a total period "social cost." Generation mixes which are optimal for individual years, do not generally yield an optimal expansion plan for a period of years. Moreover, the judicious decision to install a particular type of generating unit in a particular year must consider the economic impact of the decision over the entire lifetime of the plant, not just the initial fifteen years analyzed by Dr. Shakow. Considering two alternative

unit additions one may be optimal for the initial years of service, while the other is optimal for the remaining years of service. The overall optimal choice must be based on the sum of the present worth of annual cost differentials (between competing alternatives) over the lifetime of the alternatives.

Q. Does the ESGEM model properly calculate system reliability levels?

A. No. The ESGEM Model uses a rather simplistic method to evaluate system reliability. It uses a Monte Carlo simulation technique in which the accuracy of its results depends on the number of random samples taken. In contrast, PECO uses an exact analytical technique (LOLP) which has no inherent sampling error.

There is indication that the 25 samples taken in the ESGEM Model is insufficient. Sheets 16 and 18 of Exhibit DS-C show that (given the ESRG construction program, ESRG demand forecast and ESRG low cost and full plant estimates) when the 1987 reserve margin is increased from 22% to 30% the incidence of voltage reductions <u>increases</u> from 0.2 to 2.3 hours per year. This <u>tenfold</u> change is obviously in the wrong direction (system reliability should not <u>decrease</u> as reserves <u>increase</u>) and can only be due to an inadequate number of samples.

Perhaps the greatest simplification in the ESGEM Models reliability evaluation is the assumption that PECO's reliability can be evaluated via a single area analysis, i.e. without

detailed modeling of the PJM system. Dr. Shakow has assumed that PECO's benefits of being a member of the PJM Interconnection can adequately be modeled by two dummy generating units; a 913 mw unit with a 90% availability, and a 500 mw unit with a 50% availability. These values are arbitrary. The 913 mw unit is developed by assuming that our net import of energy from PJM will come from units with 50% capacity factors. Dr. Shakow has neglected to consider the fact that the vast majority of PECO imports occur during non-peak hours. This affects both the costs of this energy and its availability to meet peak loads. It is incorrect to assume, as does Dr. Shakow, that the units from which we purchase energy will be available for use in times of capacity shortages which occur predominantly during peak hours. In contrast PECO models all the generators in the PJM Interconnection in its calculation of reserve requirements.

Dr. Shakow incorrectly assumes that PECO's benefits from interconnections should remain constant at an average available capacity of 1072 mw (913 x .9 + 500 x .5) regardless of PECO's level of installed reserves. It is obviously incorrect to presume that as PECO drops its installed reserve to a 14% level that the remaining interconnection members would provide the same support as they do at the existing 35% interconnection reserve margin. Each company in an interconnection

cannot individually be analyzed to prove its reserve levels should be lowered while presuming the remaining companies are maintaining their reserve levels and their emergency support to that company. The proper assumption would be to lower the interconnection's percent reserve along with that of the analyzed company.

Q. Please explain why Dr. Shakow's calculated reliability indices are not equivalent to the industrial standard.

A. 1. Dr. Shakow calculates the hours that load curtailment occur and translates them into a loss-of-load probability (LOLP) index by assuming that 24 hours of curtailment equate to one day of curtailment. Actually 24 hours of curtailment equate to a number of days in which curtailment durations of 1 hour and higher have occurred. The accepted definition of LOLP refers to days per year in which curtailment has occurred without regard to the length of time within those days that the curtailment occurred. If we assume, for an example, that the average duration of load curtailment during a day was four hours, then Dr. Shakow's calculated reliability levels would be overstated about six time those of the traditional index used by the electric utility industry. Or put another way, Dr. Shakow's reliability index is poorer by a factor of 6.

2. The ESGEM model assumes that when a capacity deficiency occurs, load will only be curtailed to reduce the load to exactly equal the currently available capacity. This means the system would be operating with no spinning reserve and would be vulnerable, in the event of the sudden outage of a major generating unit or transmission facility, to cascading system-wide interruptions. Table EK-1 illustrates that using the ESRG low cost estimates, the additional costs of such system-wide interruptions change the optimum reserve levels (as defined by ESRG) from a range of 14% to 22% to a range of 22% to 30%. PECO's calculated reserve requirements are contained within this interval.

   The depletion of spinning reserve is contrary to acceptable operating procedures where voltage reductions will be taken to maintain spinning reserves. In contrast, PECO in its planning correctly assumes that voltage reductions will be taken to maintain spinning reserve. Additional load will be shed to maintain spinning reserve should the capacity deficit increase.

TABLE EK-1

Unaccounted for Costs of Additional Blackouts caused by the Depletion of Spinning Reserve (*)

Reserve Margin		1981 (10^6 $)	1987 (10^6 $)	1992 (10^6 $)
6%	ESRG Cost	601.4	596.6	566.8
	Additional Blackout Cost	+30.2	+37.4	+29.8
	Adjusted Cost	631.6	634.0	596.6
14%	ESRG Cost	595.1 (**)	588.6	542.9 (**)
	Additional Blackout Cost	+ 7.4	+ 9.7	+13.3
	Adjusted Cost	602.5	598.3	556.2
22%	ESRG Cost	598.5	577.7 (**)	547.8
	Additional Blackout Cost	+ 0.8	+ 0.7	+ 0.6
	Adjusted Cost	599.3	578.4 (***)	548.4
30%	ESRG Cost	597.9	578.9	550.9
	Additional Blackout Cost	+ 0.1	+ 1.0	+ 0.0
	Adjusted Cost	598.0 (***)	579.9	550.9 (***)

(*) Based on the ESRG demand, ESRG low cost, ESRG construction plan case.

(**) Optimum reserve level with ESRG costs.

(***) Optimum reserve level with adjusted costs.

3. Several assumptions are implicit in the ESGEM models representation of "soft" and "hard" curtailment: 621a

a. The first is that these various emergency procedures will be implemented for only the duration required. This is not a sound assumption. To accomplish this in the "real world" would require perfect forecast capability and zero implementation time. Also, it assumes that the magnitude of curtailment can be varied in order to exactly follow the required magnitude of curtailment. This assumption cannot be followed in actual practice and will lead to underestimating actual curtailment.

b. Another assumption is that the magnitude of curtailment capability is inelastic with regard to the frequency of its use. This is an unrealistic assumption. The public response to voluntary load curtailment appeals diminishes as the number of appeals per year increase. Frequent use of voltage reductions can also result in businesses and others installing equipment to nullify their effect.

Q. Are Dr. Shakow's concepts for system reliability consistent with utility practice?

A. No. Dr. Shakow states that the major focus in the ESGEM model is on economic rather than technical reliability.

PECO along with other PJM companies and most companies nationwide plans its system to meet a fixed reliability criterion--load demand should not exceed available generating capacity

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no more than an average of one day every ten years. The key word here is PLAN. The planner realizes that unforeseeable events (such as variations in load growth, oil embargos, coal strikes, construction delays) may occur which will result in operating reliabilities considerably lower or higher than the planning standard.

PECO is at present bound by the PJM contract, which has been accepted by FERC, to have reserves to meet a reserve requirement based on the one day in ten year LOLP or pay substantial penalties. PECO cannot arbitrarily move unilaterally to plan its capacity on an alternative basis.

The concept of reliability applied to electric power systems is undergoing a constant evolutionary change. The US Department of Energy currently funds a research program that is attempting to define and improve present reliability measures. DOE is spending about two million dollars over three years on this effort. Philadelphia Electric Company in conjunction with Econ, Inc. of Princeton, NJ has one of the five contracts to work on this project.

In the absence of a demonstrably better standard, it is my opinion that utilities should continue to use the traditional LOLP Standard. Upon completion of the DOE and other presently ongoing research projects and depending upon the results of those analyses, it may be appropriate to consider an alternative standard. Indeed, the congressional report, "Are The Electric Utilities Gold Plated," cited by Dr. Shakow and other witnesses

on capacity requirements, states: "The suitable reliability level, under the economic view as opposed to the engineering view, depends on the relative costs and benefits. These are difficult to assess, but several studies have been published. All indicate the 1 day 10 year reliability criterion is too high, but none evaluate the use of reserves as a buffer against uncertainty. These studies also have other disabilities which make the results difficult to accept. As a consequence, the current reliability criterion should be accepted until such time as a more definitive methodology evolves."

Q. Are there any further discrepancies in the methods used by Dr. Shakow to calculate his optimum plan?

A. Dr. Shakow's optimum plan has existing PECO units moving into and out of his cost calculation as he needs them. For example, he has one Southwark 178 mw unit in service in 1981, none in 1987 and two unites in 1992. Units cannot be mothballed and reinstalled without considerable expenditures which would be comparable to fixed O&M costs. Such costs have apparently not been considered in ESGEM.

Dr. Shakow's optimum plan keeps old units in service past their estimated life expectency, and further at unreasonably high capacity factors. Eight units, totalling 1521 mw, are beyond their planned retirement dates by 1992 and yet are included in Dr. Shakow's "Optimum" mix (see Exhibit DS-C sheet 20). One of these units, Richmond No. 9, will be seven

624a years past its planned retirement date by 1992. Yet the testimony predicts this unit will have a capacity factor of 63%. Similarly, Delaware units 7 and 8 show capacity factors of 75.1% and 81.2% respectively, even though they will be four years beyond their planned retirement dates. Although in the past, units have been kept in service past 40 years, at reduced capacity factors, they usually have been small, low pressure and low temperature units which operated very few hours. It is expected that similar retention will not be feasible for the larger, higher pressure and higher temperature units without extensive capital improvements for these units. Dr. Shakow does not consider the costs of such improvements in his analysis.

Q. Dr. Shakow in his prepared testimony states that a 14 to 22% reserve level is optimum for PECO. Do you consider that level consistent with his other testimony?

A. No. Under cross-examination, Dr. Shakow stated that the overall optimum reserve level is determined by calculating the interpolated 1981-1992 cumulative total cost for each of the four reserve levels. The optimum reserve level is presumably the one with the lowest cumulative total costs.

We have calculated 1981-1992 cumulative total costs using Dr. Shakow's results with two alternative interpolation methods -- piece-wise linear and quadratic. The results, shown in Table EK-2, indicate that, for both interpolation methods, the 22% reserve margin has the lowest total cost and 30% has the next

lowest. Presumably the optimum reserve margin resides somewhere in the 22% to 30% range.

TABLE EK-2

1981-1992 Interpolated Cumulative Total Costs by Reserve Margin Level(*)

Reserve Margin (%)	Real 1979 Cost: Piece-wise Linear Method (10^6 $)	Real 1979 Cost: Quadratic Method (10^6 $)
6	7,086.6	7,112.0
14	6,948.8	6,989.1
22	6,915.5	6,928.1
30	6,929.3	6,941.5

(*) For the ESRG demand, ESRG-low cost, ESRG Construction Plan Case

Q. Do the formulas used by Dr. Shakow correctly calculate the capital costs of coal and nuclear units?

A. No. Dr. Shakow's equations based on regression analysis of the historical costs of a limited selection of existing units are not appropriate for forecasting future power plant costs. The defects in such equations are basic. For example, our analysis shows that the 0.303 constant in the coal cost equation (pp. 44 line 20 Dr. Shakow's testimony) has a 90% confidence interval; i.e. under standard statistical techniques, the correct value for this constant could range from 0.01685 to 5.448 and still accurately describe the underlying plant cost data. Accordingly, coal plant costs as predicted by the equation could vary by the order of 10 or more and still be representative of that data.

Dr. Shakow's equations are too superficial to estimate accurate future costs and have a strong bias for underestimating the cost of coal plants relative to nuclear plants. Dr. Shakow's use of regression equations and his own procedures for arriving at actual capital costs has produced cost estimates which are much higher than NRC and architecture-engineer estimates. His costs are also extremely prejudicial to nuclear units. Table EK-3 compares Dr. Shakow's actual cost estimates with those from architect-engineers. His capital cost estimates for nuclear are triple those of the average costs from these other

sources. His nuclear unit costs are also 2.48 to 2.60 times coal unit costs compared to an average of 1.3 from the other sources.

An example of the superficiality of the regression equations is that there is no recognition of economy of scale in unit construction. This has led to Dr. Shakow's unlikely results of having the $/kw cost of units decrease as the unit size decreases. Figure EK-1 compares Dr. Shakow's relative actual cost by size with other estimates. Dr. Shakow's actual cost in $/kw for 300 mw units is appreciably lower than 1000 mw units while the other sources show that such units would cost about fifty percent more.

An example of the equations' prejudice toward nuclear units is the inclusion of a factor for including cooling towers in the regression equation for nuclear unit costs but not in his equation for coal unit costs. Cooling towers are required for new coal plant facilities also.

TABLE EK-3

ECONOMIC COMPARISONS
LARGE COAL UNIT VS. LARGE NUCLEAR UNITS
1990 SERVICE DATE

Source	Actual Capital Cost $/kw		Ratio of Nuclear to Coal Costs
	Coal	Nuclear	
Donald M. Shakow	2032-2367 (A)	5030-6152 (B)	2.48-2.6(
NRC (C)	1047	1320	1.26
Westinghouse (D)			
Bechtel	1183	1482	1.25
Ebasco	1367	1780	1.30
Sargent & Lundy	1165	1777	1.53
Stone & Webster	1509	1937	1.28
UE&C	1413	1679	1.19
Average (does not include Shakow)	1280	1663	1.30
Limerick (E)			
Donald M. Shakow		1994-2322	
PECO		1478	

(A) 1-1000 Mw unit 1988 S.D.

(B) 1-1200 mw unit

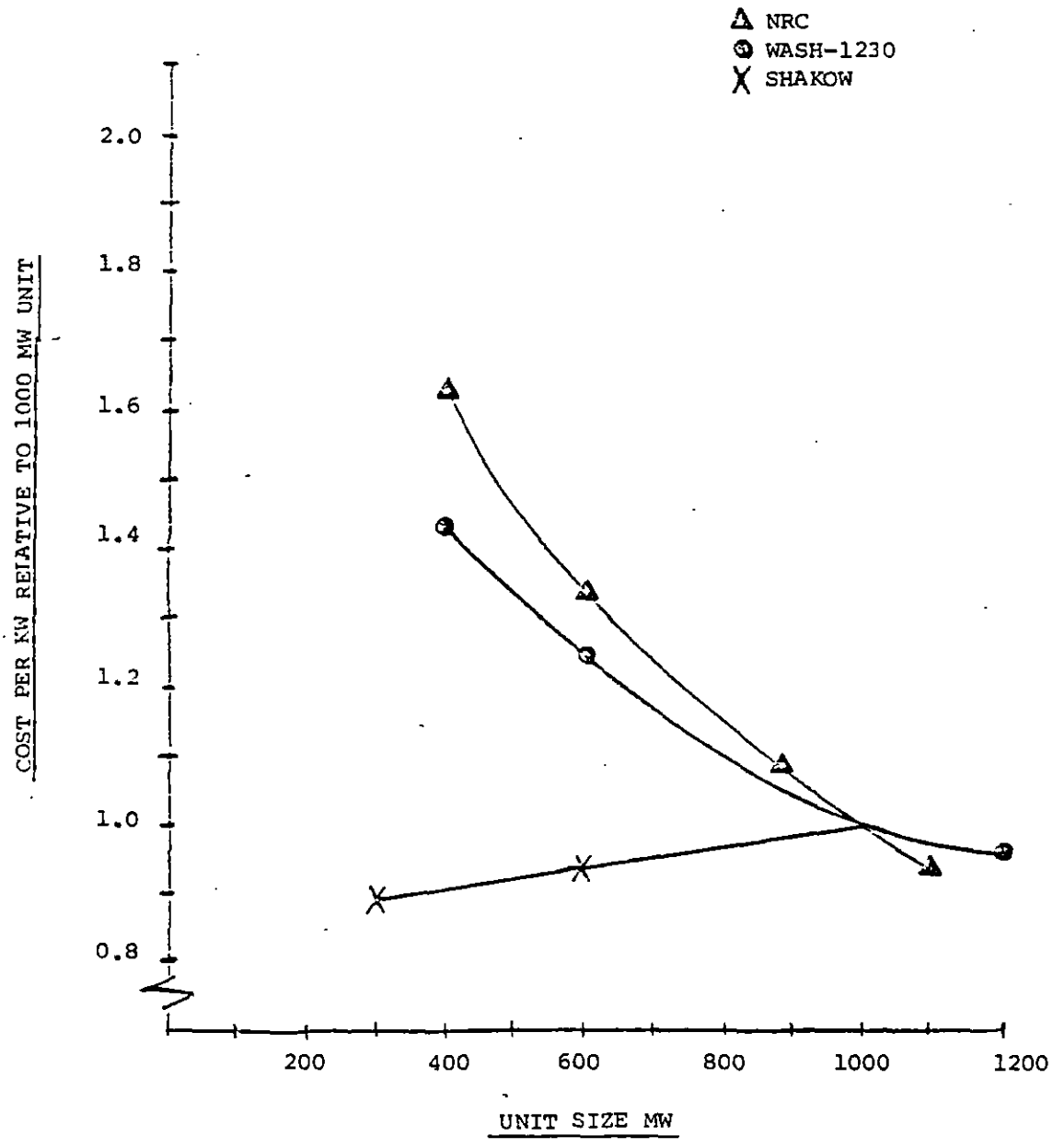
(C) Coal and Nuclear: A Comparison of Cost of Generating Baseload Electricity by Region, NRC, December 1978, p.25, Middle Atlantic Region.

(D) Nuclear and Coal Power Generation Economics, Westinghouse, 6/79, p.2 and 4.

(E) 2-1055 MW units, 1985-87 S.D.

FIGURE EK-1

ECONOMY OF SCALE FOR POWER PLANTS



References: 1. John H. Crowley, Power Plant Cost Estimates Put to the Test, Nuclear News International, July 1978.

2. D. Shakow, Testimony before the PA PUC, Nov. 13, 1979, Exhibit A, Tables E-1, E-2, E-3, Columns 2 and 3, Adjusted to Common Year Using Dr. Shakow's Inflation Rates.

Q. Have you compared the Limerick costs as estimated by Dr. Shakow with Philadelphia Electric Company's estimated costs for Limerick?

A. Yes. PECO's Limerick costs estimate is based on a careful plant specific analysis of anticipated labor, major material and other component costs.

Q. Have you found any errors in his calculations?

A. Yes. There are two major errors which inflate his costs. The first is his application of the allowance for funds under construction (AFUDC) to the first Limerick unit after it goes into service. The accounting method that is accepted by the PUC stops AFUDC on plant under construction at the time it is put in service. In a two unit station, such as Limerick, the costs associated with Unit #1 do not accrue AFUDC after the unit is put in service (known as commercial operation).

Dr. Shakow's calculations use a 12/31/87 in service date for both units. The present official projected in service for the Limerick units are dates April 1, 1985 and April 1, 1987. Because Dr. Shakor does not separate the costs by unit and account for a 4/1 service date, his estimated AFUDC charges are $654 million in excess of the proper level (See Table EK-4).

The second is in the AFUDC rates that he uses in 1979 and 1980. Dr. Shakow's AFUDC rate estimates for 1979 and 1980 have a discontinuity, jumping from 7.2% in 1978 to 11.2% in 1979, and 10.5% in 1980. This is a mathematical impossibility under the PUC mandated method of PFUDC rate computation due to the large

amount of embedded costs contained in the computation. PECO's AFUDC rates are calculated on an embedded cost basis for review by the PUC. On such a basis they are not influenced by variations in inflation rates except as additional securities are issued. Changing the 1979 and 1980 AFUDC rate in the ESRG-LOW calculation to 7.5%, 1979's actual level, and leaving the remaining years at 9.5%, an interest savings of $156 million results. (See Table EK-5) 631a

Summary of cost differentials between PECO estimate and ESRG-LOW estimate.

Reason	Differential (Millions)	Reference
Direct capital costs	$146	
AFUDC calculation errors	654	EK-4
AFUDC rate calculation errors	156	EK-5
	$956	

After correcting these errors, Dr. Shakow's total Limerick investment costs are reduced to $3.251 billion. This compares to his original estimate of $4.207 billion, and the plant's expected cost of approximately $3.118 billion.

Q. Are there any inconsistencies in Dr. Shakow's calculations of Limerick costs?

A. Yes. The cost estimate of $1002/kw for Limerick as stated on lines 14 through 26 on Page 49 by Dr. Shakow is based on the regression equation.

On line 21, Page 49, Dr. Shakow states that the cost assumptions include the factor for common siting; yet on line 27, Page 49 Dr. Shakow says that the cost economies for common site are not included. To try to determine which statement is correct the costs were calculated using the regression equation.

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(See Table EK-6). Without common site economies the cost works out to be $1044/kw, with it the cost is $950/kw. Neither figure agrees with the $1002/kw (line 26 Page 49). Had Dr. Shakow employed the $950/kw value, as implied in his cross-examination, his estimated Limerick cost would be reduced by about $200 million.

TABLE EK-4

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Calculation of AFUDC Using Actual Limerick Service Dates

AFUDC calculations using split service date of 4/1/85 and 4/1/87 instead of 12/31/87(1) for both units. Because of the associative property, all costs were left in Shakow's format of $/kw without affecting the accuracy of calculations.

Assumptions: Shakow costs and AFUDC rate

$1416.31/kw - spent prior to 1985 - split $850/kw Unit #1, $567/kw Unit #2

		Total Expenditures Unit #1	Total Expenditures Unit #2	AFUDC Rate	AFUDC Expenditures Unit #1	AFUDC Expenditures Unit #2	
	Prior	$850/kw	$567/kw	9.5%	$80.8/kw	$53.9/kw	
1985	Current	40	27		1.9	1.3	1985
	Total	890	594		82.7	55.2	Total =76
		21	55		÷4 (4/1/85 SD) (2)		
		911 Total	649		21		
	Prior	$649/kw		9.5%		$61.7/kw	1986
1986	Current	32.5				1.5	Total =63
	Total	681.5				63.2	
	AFUDC	63.2					
	Total	744.7					
	Prior	$744.7		9.5%		$70.7	1987
1987	Current	12.9				.6	Total =18
	Total	757.6				71.3	
	AFUDC	18				÷4 (4/1/87 SD) (2)	
	Total	77.5%				18	

(1) The AFUDC calculations if done correctly by ESRG indicate a 12/31 service date; however, this is not indicated in the text.

(2) Effect of 4/1 service date.

Comparison of AFUDC Costs

Shakow (from Table E-4)	PE (from above)
$138/kw	$76/kw
156	63
173	18
467	157
-157 (PE)	
310	

Convert to millions of dollars

x 2.11

654 million

TABLE EK-5

Additional AFUDC Costs Due to
Inconsistent AFUDC Rates

Changing 1979 AFUDC rate to 7.5% (PE) from 11.2 (Shakow-Low)

$474.72/kw* x .075 + $55.11/kw* x .075/2 = $ 37.67/kw

-56.26	Shakow-Low AFUDC
18.59	
x1.105	1980 int.+ addl.from 1979
x1.095^{7}**	1981 thru 1987
38.77	
x 2.11	x 10^6 kw
$ 81.8	million higher than PE

Changing 1980 AFUDC rate to 7.5% (PE) from 10.5 (Shakow-Low)

$586.09/kw* x .075 + $65.64/kw* x .075/2 = $ 46.42/kw

-64.99	Shakow-Low AFUDC
18.57	
x1.095^{7}**	1981 through 1987
35.05	
x 2.11	x 10^6 kw
$74.0	million higher than PE

TOTAL Additional Cost 82 + 74 = $156 million

* From Exhibit DS-E Sheets 4 and 5

** AFUDC rate assumed by Dr. Shakow for 1985-87

TABLE EK-6

Limerick cost estimate using Dr. Shakow's regression equation (Page 45)

	Data	Intermediate Results ($/Kw - 1979 Dollars)
6.46 x		6.46
$(NC)^{.575}$ x	NC=78789	4223.8
$(MW)^{-.208}$ x	MW=1055	992.8
$(AE)^{-1.02}$ x	AE=38	685.1
1.27 if Northeast	Yes	870.0
1.20 if Tower	Yes	1044.0
.91 if Common Site	Yes	950.0
1.35 if Dangling	No	-

Q. Do you have any comment concerning the financial assumptions made by Dr Shakow in his direct testimony?

A. Yes. In the financial area there are major differences in assumptions regarding inflation, escalation rates and discount rates.

Q. What are the differences concerning inflation assumptions between Dr. Shakow and PECO?

A. Dr. Shakow's assumption on inflation is apparently based on analysis of recent Consumer Price Indes (CPI) change. Changes in the CPI are not an appropriate measure of inflation for purposes of a capital cost study since that index is sensitive to the prices of many consumer items such as food, housing, and clothing whose rate of cost increase is unrelated to the capital costs under analysis. For its measure of inflation, PECO uses the GNP Price Index (GNP deflator) which is a much broader measure than the CPI and is more appropriately applied to the capital costs here under consideration. From 1976 to August 1979 the GNP Price Index has increased 6.8% per year which is a rate significantly lower than that for the CPI.

Q. Does the assumed rate of inflation make a difference in view of Dr. Shakow's statement on Page 42, line 25 that "..the main results of my analysis are not very sensitive to the inflation rate assumptions"?

A. Although Dr. Shakow assumes a higher escalation rate for capital expenditures and a higher discount rate, his fuel cost escalation rates (excluding natural gas) are the same in both the PE and ESRG-LOW case. However, the higher discount rates

assumed in the ESRG-LOW case result in much lower fuel costs when discounted back to 1979 dollars. For example, in 1987 the discounted cost of nuclear, coal and oil fuels in the ESRG-LOW case would be only 83.3% of the respective fuel costs in the PECO case. Since fuel costs in the ESRG-LOW case are typically almost half of total costs, the use of higher discount rates results in a significant decrease in total cost. For the 1987, 22% case this is a decrease of $55.3 million in 1979 discounted dollars.

Q. Please explain how the model is not correct in its handling of AFUDC.

A. On Page 47 line 16, Dr. Shakow states that "interest during construction was assumed to be 2 percent above inflation in the ESRG Low Case, and 1.5 percent above inflation in 1980 and 3.0 percent above inflation thereafter in the ESRG High Case." Actually PECO's interest during construction rates are calculated on an embedded cost basis pursuant to a PUC established methodology. Therefore the ESRG model overstates AFDC and incorrectly penalizes capital intensive projects such as Limerick since the assumed rates are much higher than those allowed by the PUC.

Q. What are the differences in cost escalation?

A. Dr. Shakow escalates the various costs at the assumed inflation rate plus a real cost increase (i.e. after excluding the effects of inflation) which are appropriately different for certain items. The difference in those rates is, however, strongly biased against nuclear power plant construction. The 8.65% real

638a cost rate employed to escalate nuclear construction costs, which is derived from an unexplained analysis, greatly exceed the 4% rate assumed for coal plants. The rationale for this difference is not explained.

Q. Do you agree with Dr. Shakow's estimates for unit capacity factors?

A. No, I do not. Dr. Shakow states that the 70% capacity factor assumed by PECO for nuclear units is "an insupportably optimistic assumption." To the contrary the PECO 2-1000 mw Peach Bottom BWR nuclear units had a 75% capacity factor in 1978 and so far in 1979 have an 80% capacity factor. The Limerick units are generically similar to the Peach Bottom units and with the PECO operating expertise would be expected to have similar availability. We believe that the 80% capacity factor Dr. Shakow uses for a 300 mw coal unit is optimistic in light of existing and expanding use of pollution control equipment which adversely effects availability.

Q. Do you agree with Dr. Shakow's comparison of his cost results for the PECO generation expansion plan and his optimum plan?

A. No. Aside from my objections on his methodology and data assumptions, Dr. Shakow in the development of his optimum plan has disregarded the embedded costs for Limerick, which are currently over a billion dollars, by assuming that they can be recovered either as the result of the unit's sale or through tax write-offs. At this time such recovery is not a realistic possibility.

Further, Dr. Shakow has included in his social cost analysis as a part of PECO's construction program a 600 mw coal plant whose construction is not in fact planned. Accordingly, his

social cost estimates for the PECO construction program are overstated.

Dr. Shakow has incorrectly handled the capital costs of Salem No. 2 in comparing total costs of the PECO and ESRG cases shown in Table I. The capital costs of Salem No. 2 are included in the PECO case, but not included in the ESRG-LOW case. We recognize that the treatment of embedded costs may vary from case to case in modeling the decision making process. However, once the decision whether or not to include Salem No. 2 in the generation mix has been made, its associated capital costs must be included in all cases in which it is assumed to be in the rate base. Thus total costs for the ESRG construction plan cases, the third and fourth cases shown in Table I, should be increased to include these costs. The necessary adjustment ranges from an annual level of $17 million to $53 million for the various years of the ESRG study period.

Q. How does PE perform economic comparisons of alternative generation plans, and how do its methods differ from those of Dr. Shakow?

A. We determine the annual revenue requirements (these are the actual costs to the customer) of each alternative over its life, and then compare the present worth of annual revenue requirements to determine the plan which would result in the

minimum effective customer cost over the plant life. For this purpose the revenue requirements of capital, system fuel requirements, and system operation and maintenance are determined.

The annual revenue requirements of capital are the sum of:

1) The annual cost of money required to construct the project.
2) The annual depreciation cost required to recover the initial investment.
3) All income taxes associated with this revenue including such effects as investment tax credit.

The resulting "carrying charge" when multiplied by the initial capital investment results in the annual revenue requirements of capital.

Fixed operation and maintenance costs and fuel and interchange costs are expense items and are added to the revenue requirements of capital to obtain the total annual revenue requirement.

Fuel and interchange costs are determined by means of a production cost digital computer program. This program models every generator in the PJM interconnection, including those of PECO, schedules maintenance and games forced outages on a PJM wide basis, for each year of the study period. The PE and PJM hourly loads are represented in chronological order, and

generation is dispatched, as on the actual interconnection, on a PJM economy basis, recognizing startup costs, to supply the daily peaks and hourly loads at minimum cost. The program determines the annual cost for each year of the study period for each alternative plan, taking into account an accurate determination of the effect of power imports and exports to PECO. In my opinion, this approach is far more detailed and accurate than that of Dr. Shakow.

Q. Have you made any cost comparisons of the PECO expansion plan and Dr. Shakow's coal unit expansion plan employing the above approach?

A. Yes, we have made cost comparisons between the PECO generation expansion and Dr. Shakow's coal unit expansion plans. Such comparisons were the result of yearly calculations without interpolations.

Table EK-7 compares Dr. Shakow's optimum plan with the PECO expansion plan with the utilization of Dr. Shakow's low energy forecast. The first four years properly show no difference in cost. Except for these years and 1985 and 1986 the PECO plan is more economic. The cumulative saving with the PECO plan in 1979 dollars is $509,000,000.

Table EK-8 compares a plan which adds 300 mw coal units as needed to maintain a 14% reserve with the PECO expansion plan based on the PECO energy forecast. Here every year

642a after the common years the PECO plan is more economic. The cumulative saving with the PECO plan in 1979 dollars is $1,297,000,000.

There was no attempt in this analysis to penalize Dr. Shakow's plans for the unreliability present with his lower reserves. Using Dr. Shakow's energy forecast the approximate half billion dollar difference between the PECO Plan and Dr. Shakow's optimum plan would be my "lower bound" benefit for the PECO expansion plan.

TABLE EK-7

Comparison of PECO Generation Plan Costs
Relative to Dr. Shakow's Optimum
Generation Expansion Plan (1) - PECO Cost Estimates
Dr. Shakow's Low Growth Forecast

Differential Costs (2) of PECO Plan in Millions of 1979 Dollars Relative to Dr. Shakow's Optimum Expansion Plan

	Capital	Fuel	O&M	Total
1981	0	0	0	0
82	0	0	0	0
83	0	0	0	0
84	0	0	0	0
85	175	-187	25	13
86	160	-128	23	55
87	147	-225	21	-57
88	134	-206	19	-53
89	123	-224	18	-83
90	112	-257	16	-129
91	103	-228	15	-110
92	94	-253	14	-145
Total	$1048	$-1708	$151	$-509

(1) Based on Dr. Shakow's optimum plan of adding 2-300 mw units.

(2) Negative values indicate PECO Plan is less costly.

TABLE EK-8

Comparison of PECO Generation Plan Costs
Relative to Adding 300 MW Coal Units to
Maintain 14% Reserve (1) - PECO Cost Estimates
PECO Growth Forecasts

Differential Costs (2) of PECO Plan in Millions of 1979 Dollars Relative to the 300 MW Coal Unit Expansion Plan

	Capital	Fuel	O&M	Total
1981	0	0	0	0
82	0	0	0	0
83	0	0	0	0
84	0	0	0	0
85	105	-216	23	-88
86	96	-202	21	-85
87	88	-363	19	-256
88	80	-279	17	-182
89	74	-289	16	-199
90	67	-278	15	-196
91	62	-223	13	-148
92	57	-212	12	-143
Total	$629	$-2062	$136	$-1297

(1) Based on adding 300 mw coal units in 1987, 1988, 1990 and 1992.

(2) Negative values indicate PECO Plan is less costly.

ADDITIONAL REBUTTAL TESTIMONY
OF
EMIL KASUM

Q. Mr. Kasum, please describe the actions taken by Philadelphia Electric Company in recent years with respect to its generating capacity reserve levels?

A. During the twenty years preceding 1973, PECO had an approximate annual compound growth rate of about 6%. In the period 1966 to 1969, this growth rate increased to an average annual rate of almost 10.0%. If even the 6% growth rate had continued to the present day, PECO's average annual peak for 1979-1981 would have been 8670 mw, or almost 1000 mw in excess of its currently expected average capacity during this period. Because of the 8 to 12 year planning period required for the construction of large base load generating units, it is not surprising that plans for capacity additions and retirements developed at the time such growth rates were being experienced have produced generating capacity reserves which exceed planning levels given the experience of no demand growth during the period 1973 to the present.

As explained more fully in Exhibit VSB-2, when demand growth rates moderated beginning in the early 1970's, PECO moved to reflect this change in its capacity planning. No additional generating plant was planned for construction after the Croydon units in 1972.

The Fulton plant, a large nuclear facility, was eliminated from the Company's capacity plans and was not replaced. Moreover, in recent years, as minimal demand growth has continued, the Company has retired older generating units where economic to do so. Such retirements have included Barbadoes Nos. 3 & 4, Richmond 12 and Chester 5 & 6 as soon as permitted by the Westinghouse contract (total 425 mw). Periodically, the Company makes retirement studies to determine whether it would be economic to retire additional facilities. These studies indicate that, at the present time, additional retirements beyond those scheduled would not be economically beneficial to either the customer or the Company. I should also note, as testified to by Mr. Paquette, that the Company has sold the generation of the Salem No. 2 unit.

Q. Please discuss briefly the nature of the economic penalty which can arise upon the retirement of generating plant even though such plant may not be needed for capacity reasons?

A. Retirement of a generating unit results in several specific cost increases which must be borne by ratepayers. First, the kilowatt hours generated by the unit must be obtained from some other generating unit. Where additional generation is not being installed, this will mean replacement by more expensive generation. Second, even though a

generating unit may not actually be producing kilowatt-hours, it may be reducing energy costs through the PJM contractual split saving pricing mechanism to price purchased energy. With the unit retired, a more expensive unit must be employed in this pricing analysis, resulting in greater costs to be borne by ratepayers. Finally, generating facilities perform a local area reliability function, as well as a total electric system reliability function. Additional transmission facilities to a local area are often required upon the retirement of generating plant in a given location in order to avoid possible interruptions of service due to transmission limitations and/or outages. Where these costs exceed the savings which can be obtained by a unit's retirement, clearly the retirement of the unit benefits neither the Company nor the ratepayer.

Q. Can you give us an indication of the nature of these costs?

A. Yes, I can. Referring to Richmond 9 and Southwark Units 1 & 2, whose elimination from rate base is recommended by Mr. Weiss, the retirement of these units would require additional transmission reinforcements to assure local area reliability in an amount greater than $16,000,000. Southwark Units 1 & 2 oil-fired steam units generated 394,325 mwh in 1978 and 344,068 mwh in the first ten months of 1979. This energy would need to be generated from higher cost sources should the units be retired. These additional

costs would be passed on to ratepayers through PECO's energy clause. Assuming that the cost increment would be as little as $5/mwh, this additional energy cost for 1979 (10 months) would equal approximately $1.7 million. In addition, during the first ten months of 1979, Southwark 1 & 2 generation costs were used in computing split savings energy purchases for a total of 608,595 mwh. If Southwark had not been available, combustion turbines would have probably been used to compute PECO's avoided cost. Southwark's generation cost is about $50/mwh compared to about $72/mwh. Therefore, the cost of purchased energy could increase $11/mwh if the Southwark units were not available. PECO's cost of purchased energy would have increased by $6.7 million in the first ten months of 1979. This increase would have been passed on to ratepayers through PECO's Energy Clause. These costs exceed the cost savings which could be obtained as the result of the units' retirement. Accordingly, that retirement would not be in the customers interest. A similar analysis could be made for Richmond 9.

Q. Mr. Kasum, please discuss whether it would be possible for the Company to sell or lease any of its present generating capacity to another utility.

A. Such sales, with the exception of Salem 2, have not been possible in the past and are not an available option in the foreseeable future. There is no market for generating

capacity within PJM as can be seen from Table 1 of VSB-2. Other PJM companies have higher than normal reserve generating capacity (i.e., with the exception of GPU). In fact, the entire Eastern U.S. and Canada have more than enough generating capacity for the years 1980 and 1981. The calculated average reserves for this two-year period by reliability council are as follows:

MAAC (less PECO)	32.6%
NPCC	44.8%
ECAR	32.8%
SERC	26%

For these reasons, and based upon our contacts with other companies, I see no reasonable possibility that future sales or leases of capacity can be made.

I should like to note that PJM considers reserve generating capacity to have a value of $25.55 only where there is a market for such generating capacity. If there is no market, there is no value.

Q. Even assuming it were economical, Mr. Kasum, how much generating capacity could Philadelphia Electric Company retire over the next two years without the imposition of a capacity charge under the PJM agreement?

A. Under the PJM Agreement, PE's generating capacity obligation is determined three years into the future based upon the Company's forecast peak load, historic forced outage rates

and other data. As a consequence, PE's capacity obligation has been determined for the next two planning periods and is shown in the following table:

Planning Year	Installed Capacity (MW)	Capacity Obligation	Capacity In Excess c Obligation
1980-81	7689	7483	206
1981-82	7689	7476	213

If the Company were to reduce its installed generating capacity by more than 206 mw in 1980-81 or 213 mw in 1981-82, then PECO would have to buy additional generating capacity from the PJM companies at the contract rate of $25.55 to meet its forecast obligation. The Company's average excess over the 1979-1981 period is even less being 136 mw. If ratemaking is to reflect the actual operating limitations placed upon a utility, then clearly proposals that from 500 to 850 mw of capacity should be eliminated from the Company's rate base are unreasonable and must be rejected.

Q. If additional generating units were to be retired early, what units would the Company choose to retire?

A. We would retire combustion turbines which have had poor operating records and are not needed for local reliability. Two combustion turbines which we have considered for retirement are Barbadoes 6 & 7 (38 mw). These are our oldest combustion turbines. If those units were retired, annual capital costs would be reduced by about $5.00/kw, or a total of about $325,000 in revenues including operation and maintenance

expense. Additional combustion turbine capacity of approximately 200 mw would be retired at about the same revenue savings per kw. This is not to say that there would not be offsetting costs associated with those retirements. I should add that employment of the PJM installed capacity charge, as proposed by witnesses Boonin & Barrett, is unreasonable as this charge reflects the cost of recently installed units who, because of lesser operating cost, would not be retired.

Q. Mr. Kasum, do you have any comment upon witnesses Boonin and Barrett's employment of a 20% generating reserve requirement?

A. Yes. These witnesses reject the Company's planning reserve requirement of 25-29% because of their belief that the one-day in ten-year loss-of-load probability criterion provides too high a level of reliability. They further believe it to be artifically inflated as the result of high-forced outage rates and because it fails to consider transmission and distribution outages. Mr. Boyer addresses the question of the appropriate reliability standard. Accordingly, I will address only the witnesses' latter two reasons.

PECO's claimed reserve margins have not be inflated by high-forced outage rates resulting from extended maintenance periods on units not immediately required for system reliability or economic generation. As the witnesses assert, certain units, principally peaking units, are maintained only during

normal working hours to reduce maintenance costs which must be borne by ratepayers.

The level of required generating reserves is in part dependent upon forced outage rates. However, the outage rates employed by PJM to calculate the required reserve margin have been adjusted to eliminate the effects of maintenance periods which have been extended for economic reasons. When repairs to generating units are deferred to avoid overtime costs, the outage time in excess of the time needed for expeditious repairs is excluded from PE's forced outage rate used in determining future reserve margin requirements. In addition, an estimated one-fifth across the board reduction in the forced outage rates of marginal and peaking units was used in the reliability calculations. This results in a further 1% reduction in reserve requirement. The indicated reserve requirements tabulated in Appendix A of Exhibit VSB-2 include these reductions.

I should also like to note in response to these witnesses' testimony, that the Company's forced outage rate has improved in recent months. Twelve-month average forced outage rates for PE and PJM as a whole over the past two-year period are stated below:

	PE	PJM
June 1978	22.2	17.2
June 1979	15.5	14.5

I would also like to comment briefly on witness Barrett's understanding of the basis of the 20%'s reserve margin employed in the mid-1960's. Ms. Barrett's hypothesis is that the 20% margin was that which would be required, based upon the 1965 PJM system installed capacity, to provide a reserve margin against loss of the Keystone or Conemaugh plants due to transmission limitations. In the first place, the transmission line corridor referred to by Ms. Barrett included the normal redundant transmission line capacity which standards of that period required to assure system reliability. Second, as the western units were only beginning to be placed in service in the late 1960's, with Conemaugh 1 & 2 having service dates of May 1970 and May 1971, it is doubtful that they were the focus of system reliability in 1966. . .

Q. Please comment on the use of a fixed percentage generating reserve margin as an appropriate reliability criterion.

A. PECO and the other members of PJM have not employed a fixed percentage generating reserve margin standard for planning purposes for more than 15 years. We plan our system to have enough generating capacity installed in order to meet the reliability criterion of loss-of-load probability of one day in ten years. As stated in the publication by the Congressional Research Service cited by these witnesses, "Are the Electric Utilities Gold Plated": "The loss-of-load probability approach

is coming into wide usage and represents a significant improvement in methodology for reliability calculations." As stated in the Report, the LOLP approach is greatly preferred over a fixed percentage approach.

Q. Please address the witnesses' criticism of the LOLP criterion's failure to consider transmission and distribution outages.

A. The LOLP method does not consider the quality of the transmission and distribution systems. These systems, however, are designed separately to appropriate reliability levels. Transmission outages are primarily caused by the weather-lightning or heavy snow and ice - not equipment failure due to the lack of maintenance. PE builds redundancy into the transmission system to handle up to two simultaneous outages without cascading the system into a partial or total shutdown. Having sufficient installed generating capacity wisely located provides added assurance that a transmission system built to meet the double contingency reliability criterion will not cause major service interruptions.

Q. Please comment on Mr. Weiss' calculation of a 49% actual reserve margin for the Company during 1978 and his assertion that the MAAC planning criterion is 22%.

A. Mr. Weiss' calculation of a 49% reserve capacity margin is incorrect as shown on Exhibit VSB-2, p. 6. Mr. Weiss has apparently employed incorrectly data contained in the

Company's 1978 FERC Form 12. Mr. Weiss' calculation as compared to the Company's actual 1978 reserve margin is as follows:

	Mr. Weiss	Actual
Installed Capacity	7926	7727
Peak Load	5318	5667
Installed Reserve (mw)	2608	2060
Installed Reserve (%)	49	36

The installed capacity number of 7926 mw employed by Mr. Weiss is the "manufacturer's maximum nameplate rating of generators" as shown on page 4A of FERC Form 12. Nameplate capacity is not available to the Company at the time of its summer peak for two reasons: use within the station of a portion of its output and production limitations due to higher cooling water temperatures during the summer and as the result of other equipment limitations not considered in nameplate ratings. Mr. Weiss has also understated the Company's 1978 peak load. On an actual basis this equalled 5667 mw's. Mr. Weiss employs the FERC Form 12 indicated 5318 mw generated on PE generators at the time of the system peak. An additional 349 mw was required to meet customer load at that time and was obtained through net power imports from other companies. The correct reserve margin, as shown in Exhibit VSB-2, is 36% for 1978.

Mr. Weiss asserts that the MAAC reserve margin planning goal is 22%. This is also in error. As stated in "Reliability

Principles and Standards for Planning Bulk Electric Supply System of MAAC Group," each MAAC company is required to install sufficient generating capacity "to ensure that in each year for the MAAC system the probability of occurrence of load exceeding the available generating capacity shall not be greater, on the average, than one day in ten years." As calculated in Exhibit VSB-2, the necessary reserve margin is 25-29% in future years.

Q. Under cross-examination, Dr. Birx referred to the extent of construction at Eddystone 3 & 4 at the time of the Arab oil embargo in 1973. Do you have any comment?

A. At December 31, 1973, shortly following the Arab oil embargo and at about the time oil prices first started to rise, expenditures plus commitments at the Eddystone 3 & 4 facilities equalled $166 million. Commitments, which were not recognized by Dr. Birx, represent the purchase of equipment which the Company is obligated to accept and pay for even should the unit be cancelled. Moreover, it must be remembered that the significance of the Arab oil embargo was not immediately realized upon its occurrence. Time was required to assess and measure through changing patterns of customer electric usage, the effect of this event. Total Eddystone 3 & 4 plant cost at completion was $252 million. I think it is also pertinent to note that the installation of oil burning facilities such as Eddystone in the early 1970's was necessitated for environmental reasons.

examination.

(PECO Statement 15-A, a document entitled Additional Rebuttal Testimony of Emil Kasum, was produced and marked for identification.)

THE ADMINISTRATIVE LAW JUDGE: Mr. Sayre?

CROSS EXAMINATION

BY MR. SAYRE:

Q Mr. Kasum, PECO's contractual PJM capacity requirement is based in part on PECO's planned forecast peak, is that correct?

A Yes.

Q And is it also correct that PECO's forecast peak for the last few years hasbeen high compared to the actual peak?

A Yes.

Q Is it also correct that PECO's historic forced outage rate also contributes to the PJM contractual requirement?

A Yes.

Q And that PECO's forced outage rate is higher than the overall PJM forced outage rate?

A That I am not so sure of. There are times when it is and times when it isn't.

Q I gather right now it certainly is, is it not?

A I am not that certain of it, frankly.

Q Do you have any figures more recently than

way to put it, have contributed to forced outage rates.

Q. Getting back to PECO's PJM contractual requirement, is it correct that PECO's contractual requirement is also affected by what the other PJM utilities forecast for their peaks?

A. Yes.

Q. Do you know whether or not their forecasts in the last few years have been high, low or right on?

A. They have suffered the same problems that we have. As have utilities all across the country.

Q. That is they, too, have been forecasting higher rates than have occurred?

A. Right.

Q. On page 7, you give a figure of 25 to 29 percent planning reserve requirement?

A. We are still on the same - - the additional testimony?

Q. Yes.

A. Yes.

Q. This is to maintain a loss of load probability of one day in ten years?

A. Right.

Q. Does the range of 4 percent mean that the plans are that unspecific or is this a percentage that's more specific but increasing over the next few years?

Q. Maybe to cut things short, perhaps I could ask you to add that particular debt issue to the schedule on II-6-A, which includes premiums, discounts, issue expenses, net proceeds and a few other items. Can you do that?

A. Yes. I'm sure we can.

Q. Did that debt issue mean a reduction of some of your short term debt outstanding at the time?

A. Yes. We made settlement on that issue about a week later, around I think it was the 17th or 18th of October, and the hundred million dollar proceeds were used to pay down outstanding short term debt which, as I recall, was about $135 million, as of that morning.

Q. Did all the proceeds go to eliminate a portion of short term debt?

A. As I can recall, they did, yes.

Q. That short term debt was refinanced. Was it being used in construction projects?

A. Well, partly. And also, as I indicated earlier, partly used to finance the unanticipated deferred fuel that we had experienced this year.

Q. Was any of it used for the normal operations of the company, apart from those two items?

A. Well, our short term debt is used as an interim financing between permanent security issues and it is,

Trial Staff Statement No. DLB-1
Witness: D. L. Birx

PENNSYLVANIA PUBLIC UTILITY COMMISSION

v.

PHILADELPHIA ELECTRIC COMPANY

Docket No. R-79060865

Direct Testimony

of

Donald L. Birx

Concerning

Valuation

claimed measures of value and operating expenses?

A. These adjustments were derived from data provided by the respondent, Appendix E. The change to a 40-year life span will result in an increase to the O.C. measure of value of $45,114,000 and a decrease in depreciation expense of $5,432,000.

Q. Do you believe that the customers of Philadelphia Electric Co. should be charged for a reasonable amount of reserve capacity?

A. Yes, reserve capacity is necessary to provide for reliability of service when units are down for either scheduled or forced outage.

Q. How much reserve is necessary to provide for such outages?

A. At the present time utilities have excellent statistical tools available for determining the loss of load probability based on installed capacity limitations. As shown in Schedule 5, a utility can determine from historical outage data and planned maintenance schedules a probability distribution of available capacity at any given time. In like manner a probability distribution of system load can be determined. The cross hatched overlapping area represents a finite probability, which is readily calculated, for the capacity not being sufficient to meet the demand. The larger this cross-hatched area, the greater is the probability of the system capacity not being able to meet demand. Many utilities have standardized on limiting this overlap so that loss of load probability does not exceed 1 day in 10 years.

Q. How can this cross-hatched area be controlled or managed?

A. If one does not undertake to manage the load and capacity distributions, the only way to reduce the overlapping area is to increase the separation of the curves. This can only be accomplished by installing more capacity. This is the primary reason that we have witnessed claims on the part of some utilities for increasingly larger reserve margins to maintain the same loss of load probability.

Q. What other factors affect the loss of load probability?

A. The primary factors influencing the loss of load probability are the size of the installed units, the forced outage experience, and the peak load probabilities.

Q. Can these factors be controlled?

A. Yes. A variety of load management techniques such as controlled water heating, off-peak incentives, interruptible provisions and demand metering are available which can be employed in controlling the shape of the load probability function. Also forced outage rates and durations could be managed much more effectively than they are through better maintenance procedures. Finally, the reliability could be improved by installing smaller plants.

Q. Do you feel that it is important to employ these alternate routes to reliability at the present time?

A. I feel that we have already exceeded the limit so far as relying on reserve capacity to solve our reliability problem. North Carolina has recently

determined[2] that a 15% reserve capacity is adequate for their system. New York State [3] has determined that a 20% reserve is adequate to maintain a loss of load probability of 1 day in 10 years for their system. We should be moving in a similar direction.

Q. What is the present reserve margin for Philadelphia Electric Co.?

A. One may obtain different values for reserve margin depending upon how one calculates installed capacity. According to Company figures (Exhibit VSB-2, Table I, p. 8) the present reserves for Philadelphia Electric amount to 36%.

Q. What do you feel is a proper reserve requirement for the Philadelphia Electric System?

A. If all known load management techniques were employed, optimum maintenance procedures instituted and detailed analysis performed to determine optimum sizes for future capacity additions it should be possible to achieve a significant decrease in reserve requirements while maintaining the same reliability. To my knowledge, no studies have been performed by Philadelphia Electric or any other utility in the state to examine these areas.

In a recent Penelec rate case (R.I.D. 599), I asked Mr. E. Newton, Jr., Vice President--System Operations of a General Public Utilities Service Corporation what factors were contributing to the need for higher reserve requirements, and he listed three (TR 336-342):

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(2) "Analysis of Long Range Needs for Electric Generating Facilities in North Carolina," 1978, State of North Carolina Utilities Commission, Public Staff Report

(3) "Reliability Criteria--A Cost Benefit Analysis," August 1975, New York State Public Service Commission.

1. Narrowing of the differential between summer and winter peaks.

2. Higher maintenance times that are being experienced.

3. Increased generating capacity of units currently being installed.

As a means of countering the rise in reserve requirements, Mr. Newton stated, (TR 339):

> "The only way it could be done would be by installing units considerably smaller than we have, more reliable, and in so doing, this, of course, sustaining the tremendously increased installed cost that relates to the lower units, giving up the advantages of size which we have achieved, giving up the efficiencies of scale."

When asked where the increased cost of smaller units would be offset by saving the additional cost of increased reserves, Mr. Newton replied,

> "I really couldn't say where the cross-over point is, ". . . and he agreed that a study to determine this cross-over point ..." would be a very valuable thing."

So, without the necessary analysis, it is impossible to predict how large a saving could be made in reserves without sacrificing reliability. It should be pointed out, however, that the provision for 20% reserves for $3 billion of plant in service amounts to $600,000,000. Just a 10% reduction in the reserve requirement would amount to a saving of $60 million.

Q. What does PJM recommend as a reserve requirement?

A. The PJM reserve requirement at the present time is 22%.

A. In the light of this would you recommend any adjustment to be made to Philadelphia Electric Company's installed capacity?

A. Yes. Philadelphia Electric presently has reserves of 36 percent. The difference between this and the PJM requirement of 22% amounts to 773 megawatts excess. Referring to Table I, VSB-2, p. 8, it will be

noted that the Respondent has a number of retirements and deratings amounting to 185 MW planned for the near future. Giving a credit for these brings the excess down to 588 MW. Rounding this off, I would suggest the removal of 500 MW of plant in service.

Q. Do you have any suggestion as to which equipment should be eliminated?

A. I originally felt that the leased CT's would be plant that could readily be eliminated. Leasing arrangements are usually beneficial on two counts. First of all, they free capital for other uses and secondly, when properly formulated, they permit a high degree of flexibility.

As an example of the latter, the General Electric Space Division at Valley Forge at the peak of the space effort was housed in one permanently owned building and nine leased buildings in a neighboring industrial park. In 1967, a severe drop in the space effort required a corresponding cut-back at G.E. Less than a year later, G.E. had rid itself of all its leased buildings with the resulting saving of all the expenses associated therewith.

Unfortunately, the lease that Philadelphia Electric has negotiated does not afford this kind of flexibility. Philadelphia Electric is locked into this lease for 25 years regardless of whether or not the equipment is needed or useful.

Q. In light of the above, what do you suggest?

A. I feel that an adjustment should be made to rate base to account for 500 MW of excess capacity. The basis for the adjustment is explained in Schedule 6.

In this schedule, I have endeavored to derive a value for rate base in $/MW for Philadelphia Electric's peaking capacity. It's really an excess of peaking capacity that the company is saddled with (Sched. 7) Even Eddystone 3 and 4, the cost of which equalled that of a base load unit, is presently used only for peaking.

Using Eddystone 3 and 4, Muddy Run, and Croydon as typical of PECO's peaking capacity we find the net O.C. amount in rate base for these plants is $344,497,000 which amounts to $169,487 per megawatt of installed capacity. To remove 500 MW of excess at this dollar amount would require an adjustment of 500 x $169,487 = $84,743,356. Rounding this figure, I have made an adjustment to rate base of $85,000,000 in original cost and pro-rated amounts in the trended Measures of Value as shown in Table A.

Q. Have you read Mr. Boyer's testimony as to how this excess capacity came into being?

A. Yes. Mr. Boyer did an excellent job of presenting the difficulties inherent in forecasting. However, in the 60's, a period when load growth was relatively stable, Philadelphia Electric had permitted their reserves to drop to such a dangerously low level that this Commission had to strongly urge a prompt increase in installed capacity. Today, with the situation reversed, there is still evidence of lack of response to changing load growth conditions. Although there has been no growth in peak load for six years Philadelphia Electric has been following an attitude of doing no more than maintaining a holding pattern until some day in the future load hopefully will grow again to meet installed capacity. Furthermore, Philadelphia Electric is in the embarassing position of

having an over-abundance of oil-fired capacity with heat rates so high as to limit their usefulness severely. Even with all its excess of capacity Philadelphia finds it more economical to purchase from PJM. In a typical off-peak period, company data show 33% of the energy being purchased at a system load level of only 3000 MW.

Mr. Boyer states that "factors such as wars, rapid changes in conservation and curtailment of usage, population migration, and recessions are very powerful forces which are without control and impossible to forecast accurately." This may be true for utilities, but all these events plus more were found in all long range planning documents I was familiar with in industry, and contingency plans were developed accordingly. Planning in unregulated industry is very extensive and comprehensive because the future of your company and your income depend upon it.

Q. Have you examined the effect that your recommended reduction in capacity would have on the projected future reserve capacity of Philadelphia Electric?

A. First of all, it would be Philadelphia Electric's decision as to whether or not to retire plants because of excess capacity. My suggestion is to remove the excess from rate base until such time as it could be justified as being used and useful. Depreciation expense would continue and a return sufficient to cover the fixed capital obligations of the respondent would be allowed.

If physical retirement of 500 MW actually occurred, one would find according to PECO's forecast (VSB-2, Table I, p. 8) that the reserves

would hit a low point in 1984. In fact, if the load growth Mr. Boyer is predicting actually materialized, the reserves would be 9% with the removal of the suggested 500 MW.

Q. Could Philadelphia Electric tolerate such low reserves?

A. I would not recommend allowing the reserves to drop to this level. There are at least two alternatives for achieving an adequate reserve level in 1984 even with a 500 MW reduction now.

1. It would be a very reasonable management goal to shave 9% off the projected peak load for 1984. Such a goal is fully in accord with the conservation measures being urged upon us and this one factor alone would restore the reserves to 20%. Appendix F provides a good example of a conservation program which is working well in the Northwest.

2. Eliminate the recent two-year delay announced for Limerick. Bringing Limerick on line in the 1983-1985 period rather than in 1985-1987 would raise the 1984 reserves to 25% even with the projected load growth and save the customers the high cost of this delay.

Q. Would you please explain the Salem Audit adjustment?

A. This adjustment was ordered by the Commission in R.I.D. 438 and disputed by the Respondent in this rate case. The Administrative Law Judge on October 29, 1979 granted the motion to strike the Respondent's testimony on this issue. The $10.5 M adjustment sustains the previous Commission order.

Trial Staff Statement No. DMB/EMB-1
Witness: David M. Boonin
Eileen M. Barrett

PENNSYVANIA PUBLIC UTILITY COMMISSION
V.
PHILADELPHIA ELECTRIC COMPANY
DOCKET NO. R-79060865

Direct Testimony
of
David M. Boonin
Eileen M. Barrett

Concerning: Excess Capacity

Summary of Testimony

Between 1979 and 1981, the Philadelphia Electric Company will have an average installed generating capacity of 7701 MW (Staff Exhibit DMB/EMB-1-A, Schedule 1). In that same period, the Company will have an average peak load of 5850 MW (Staff Exhibit DMB/EMB-1-A, Schedule 1). The average reserve of generating capacity within the PECO system will be 1851 MW or 31.6% above peak demand. PECO is a member of the PJM Interconnection and the benefits of interconnection reduce the Company's actual peak demand by 2.4% to 5709 MW (Staff Exhibit DMB/EMB-1-A, Schedule 2) which is called the diversified peak. The average reserve margin of generating capacity over the diversified peak is 35%. (Staff Exhibit DMB/EMB-1-A, Schedule 2).

An acceptable level of reserve generating capacity for the Company is 20% above the diversified peak or 6851 MW. The difference between installed generating capacity and 6851 MW is 850 MW (Staff Exhibit DMB/EMB-1-A, Schedule 3) and is in excess of the needs of the Company's ratepayers. Regardless of whether this capacity was prudent when planned and installed, it is not necessary to the Company for the three year period 1979-1981. If this capacity has a value, it is to the other members of the PJM Interconnection or to other utilities. The value to be assigned to it is, therefore, $25.55 per KW, the average cost of capacity as outlined in the PJM Agreement in Schedule 4.01 (Staff Exhibit DMB/EMB-1-A, Schedule 4).

We recommend that an upward adjustment to the Company's total revenues be made to recognize that the value of PECO's excess capacity is to other utilities and not to the Company's ratepayers. It would be imprudent for the Commission to establish rates which discourage a company from minimizing the burden to ratepayers and the company associated with ownership of capacity that is not needed to serve its ratepayers. We therefore recommend that an adjustment of $25.55 per KW (the PJM rate for accounting for capacity obligations) be applied to the three year average excess capacity of 850 MW.

The total adjustment should be $21,717,500. The effects on taxes and on the income available for return are as follows:

Increase Revenues	State Income Tax[1]	Federal Income Tax[2]	Income Available For Return
$21,717,500	$1,515,165	$9,293,074	$10,909,261

1/ State income tax rate - .069767

2/ Federal income tax rate - .046

Q. Mr. Boonin would you please state your name and business address?

A. My name is David M. Boonin. My business address is the Pennsylvania Public Utility Commission, P.O. Box 3265, Harrisburg, PA 17120.

Q. By whom are you employed and in what capacity?

A. I am the Chief of the Economics Division in the Bureau of Conservation, Economics and Energy Planning of the Pennsylvania Public Utility Commission.

Q. What is your educational and professional background?

A. See Appendix A.

Q. Ms. Barrett would you please state your name and business address?

A. My name is Eileen M. Barrett. My business address is the Pennsylvania Public Utility Commission, P.O. Box 3265, Harrisburg, PA 17120.

Q. By whom are you employed and in what capacity?

A. I am an economist in the Bureau of Conservation, Economics and Energy Planning of the Pennsylvania Public Utility Commission.

Q. What is your educational and professional background?

A. See Appendix A.

Q. What is the purpose of your testimony?

A. The purpose of our testimony is threefold. First, we will identify an amount of installed generating capacity which is not necessary for service to the Company's ratepayers. By the Company's own admission, it presently has more generating capacity than needed for adequate service to its ratepayers. (Tr. 693) The amount of excess capacity will be determined on the basis of the Company's projected peak loads and a suitable reserve margin above peak demand.

Second, we will assign a dollar value to the unnecessary capacity. Regardless of whether the capacity was prudent when planned and installed, it is not needed by the Company to serve its customers for the three year study period; therefore, this capacity must be of benefit to ratepayers served by other utilities (an example of the benefit of PECO's excess capacity to other utilities occurred during the 1978 UMW strike, when PECO sold power to the coal dependent utilities). The value that will be assigned to the capacity will be a value that is officially recognized by the member companies of the PJM Interconnection. This value, expressed in dollars per KW of capacity, is a rate which provides the supplier of short-term capacity in the PJM system with a fair and equitable return on investment and provides the prospective buyer of short-term capacity with a reasonable alternative to new installations.

Finally, we will establish the ratemaking premise that the fixed costs of unnecessary generating capacity represent a burden to the ratepayer and to the utility. It should be the objective of a regulated utility such as PECO to minimize the burden associated with unnecessary capacity by selling, leasing or retiring this capacity, even if all the costs are not fully recovered. Apparently, the Company's present strategy is to retain all capacity ever installed until it is eligible for retirement, (i.e. fully depreciated) hoping that demand will grow to meet the capacity in place and make it needed. This year the Company has considered the sale of unnecessary capacity (Salem 2), but not without Commission's staff prodding.

If it is the Commission's desire to influence the Company to minimize costs, and we believe it is, an adjustment to rates is necessary to further induce the Company to minimize the burdens of capacity not needed to serve its customers. This adjustment is such an inducement.

Q. How did you determine that there was an excess?

A. We examined the Company's projections of installed generating capacity and estimated peak load as listed in Table 1 (p. 8) of Exhibit VSB-2, "Explanation of Load Forecasting and of Present and Future Generating Reserve Capacity." For the three year period 1979-1981, we calculated the average installed generating capacity and the average peak load for the Company. (Staff Exhibit DMB/EMB-1-A, Schedule 1) The average installed generating capacity is 7701 MW. The average peak load is 5850 MW. We then reduced the average peak load for the three year period by approximately 2.4%, (Staff Exhibit DMB/EMB-1-A, Schedule 2) which is the benefit from the diversity of PJM peak loads that the Company will receive in the planning period 1981-82 by virtue of its membership in the PJM Interconnection. This lower number, 5709 MW, is called the diversified planning peak. The 2.4% was calculated in the following manner: The forecast peak load of the Company for the summer of 1981 is 6000 MW (Exhibit VSB-2, P. 8). The diversified planning peak for the Company for the period 1981-82, which encompasses the 1981 summer peak, is 5855 MW (IR-1, informal CEEP 3). The difference is 2.4%. Diversified planning peaks and capacity obligations are assigned to the PJM member systems by the PJM Management Committee three years in advance of the actual obligation. The planning period 1981-82 is the period farthest into the future

for which assignments have been made. Assignments therefore were based upon the Company's most recent estimates of future peak load. A review of the past relationships between the Company's forecast peak and its diversified planning peak reveals that the historical benefit of diversity has ranged from 3.4% to 4.4%. Information obtained from exhibits from the official record of the last rate case, R.I.D. 438, (Rx-A-1 and PTX 64, p. 4) included the following values:

Table 1

Planning Period	1976-77	1977-78	1979-80
PECO forecast peak	6430 MW	6820 MW	6600 MW
PECO diversified peak	6211 MW	6572 MW	6308 MW
Difference	3.4%	3.6%	4.4%

We believe that a diversified planning peak that is 2.4% below forecast peak load is a conservative estimate of the benefits of diversity for the period 1979-1981.

The difference between the average total installed capacity and the average diversified peak is 1992 MW or a reserve margin of 35%. We determined that a reserve margin of 20% above peak is adequate for the Company's system, considering its membership in an interconnected power pool; hence, only 6851 MW are needed to serve the PECO ratepayers. The excess generating capacity is therefore 850 MW (Staff Exhibit DMB/EMB-1-A, Schedule 3).

Q. Why did you use the projected 1979 peak load rather than the actual peak load?

A. It should be noted that the 5850 MW average load figure for 1979-81 uses the Company's 1979 load forecast for each of these three

years. The 1979 projected peak load was 5700 MW. However, the peak that was actually realized was only 5641 MW. (Tr. 697) If we had incorporated this number into our analysis it would have reduced the average peak load to 5830 MW, which would have led to an additional revenue increase of $511,000. We have, however, chosen to remain with the projected figure in order to more closely track the PJM capacity obligation calculation. The use of the forecasted 1979 peak load further reinforces the conservative nature of this proposed adjustment.

Q. Why did you select a three year period for your analysis?

A. We selected a three year period because the PJM Agreement establishes capacity obligations three years in advance of the peak of each system. The PJM member companies consider three years to be a period long enough for a member company to make short-term adjustments in its total installed capacity in order to meet its PJM obligation. The three years we selected, 1979-81, includes the future test year of this rate case.

Q. How did you determine what was an adequate reserve margin?

A. The issue of an adequate reserve margin in Pennsylvania was raised in 1966, in response to the northeastern U.S. blackout of 1965. In a joint meeting of the public utility commissions of Pennsylvania, Delaware, the District of Columbia, Maryland and New Jersey, the decision was made to inform the member companies of the PJM Interconnection that immediate preparations should be made to increase installed generating capacity until a reliable reserve margin of 20% above forecasted loads was reached (Company's Exhibit VSB-2, p. App-D2). The selection of the reserve margin of 20% was not

related to a loss of load probability of one day in ten years but to the spatial distribution of the 1966 PJM generating system. Approximately 20% of the generating capacity of the PJM system was installed or under construction in western Pennsylvania, tied by a single transmission line corridor to the electric loads in the eastern portion of the PJM territory. It was the impact of the loss of this generating capacity that prompted the regulatory commissions within the PJM system to recommend a 20% reserve margin, a reserve margin that applied to the PJM system as a whole rather than to any individual company.

Since the blackouts of the late 1960's, the 20% reserve margin and the design parameters for a generating system of a loss of load probability of one day in ten years have been used as reliability guidelines. In 1975 the New York Public Service Commission concluded that for the New York State Power Pool, a 20% reserve margin was equal to a loss of load probability of one day in ten years[1]. In recent rate cases, however, Pennsylvania electric utilities have argued that the same loss of load probability now requires a reserve margin greater than 20%. On page App-A5 of the Company's Exhibit VSB-2, Mr. Boyer states that a reserve margin of 25%-29% is necessary for reliability of service, while 22% is required by PJM for accounting purposes.

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1 "Reliability Criteria - A Cost Benefit Analysis", New York State Department of Public Service, 1975.

Many other utility companies claim that, in order to maintain a loss of load probability of one day in ten years, a reserve margin larger than 20% is needed to counter the adverse effects on system reliability of higher forced outage rates and larger generating stations. This claim has been disputed in two recent reports on generation reliability prepared by the Congressional Research Service[2] and the North Carolina Utilities Commission[3]. Both reports conclude that a standard percent reserve margin of 15%-20% would provide adequate and reliable service to utility customers. The discrepancy between the claims of the utility companies and the reports prepared by governmental agencies can be attributed in part to the definition of the one day in ten years reliability criterion and the manner in which reserve margins are calculated.

The reliability standard of a one day in the ten years loss of load probability (LOLP) has received much criticism for overstating the true meaning of loss of load. A loss of load is defined as any occurrence of any duration which results from the failure of the operating generating capacity to deliver power to all customers who demand it. Regardless of whether this failure results in a voltage reduction, a brownout, a public appeal to reduce air conditioning

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2 "Are the Electric Utilities Gold Plated? A Perspective on Electric Utility Reliability", Congressional Research Service, Library of Congress 1979.

3 "Analysis of Long Range Needs for Electric Generating Facilities in North Carolina", State of North Carolina Utilities Commission, 1978.

use, a shedding of load or a complete blackout, all results are given equal weight and are equally guarded against. This LOLP criterion is not defined as a 24 hr. blackout once every 10 years but as the probability of any disruption once every 10 years. The failure to recognize that not all losses of load have the same impact on the customer leads to the conclusion that all load losses are to be avoided, and that any outage must be more expensive than the cost of an additional generating station. Further, PECO has not produced any evidence to demonstrate that the economic and social costs of any outage are greater than the costs of additional reserve capacity.

One of the most critical drawbacks of the LOLP criterion for establishing reliable service is that it calculates reliability exclusively for the generating system, while ignoring the quality of the transmission and distribution systems. Yet, the overwhelming majority of outages experienced by any electric utility's customers are related to the transmission and distribution system. Under cross-examination, Mr. Boyer reviewed PECO's record of disruptions related to generation problems. The most recent disruption in the PECO system which was the result of deficiencies in the PECO generation system occurred in 1970 (Tr. 701). Subsequent disruptions in 1974 occurred as the PJM system attempted to respond to high PJM forced outages and these disruptions were only voltage reductions. The prolonged blackout of 1977 in New York City was attributed to several factors including a vulnerable transmission line corridor, improper maintenance of circuit breakers, inadequate operator

training, improper load shedding techniques, and failure to automatically operate combustion turbines. It was not the result of insufficient generating capacity.

In short, the PJM member companies insist that higher reserve margins and additional capacity are necessary to maintain a reliability criterion that excludes consideration of the major sources of outages - the transmission and distribution systems. The ambitious capacity construction programs of the early 1970's have left many companies with cash-flow problems in the late 1970's, as a result of the general rate of inflation and extraordinary construction costs. A common method of improving cash flow is to cut expenses. Maintenance expenses, particularly for transmission and distribution, is usually one of the first accounts to be reduced. The Philadelphia Electric Company is no exception. There is a direct relationship between reduced transmission expenses and higher outage rates experienced by customers in the years following maintenance cutbacks. Witnesses from this Commission's rates staff are prepared to testify that PECO's proposed expenditures for the maintenance of its transmission system are at less than normal historical levels. As the PJM member companies complete new generating stations in the future, which allegedly yield more reliability, their customers may witness less reliability in the transmission and distribution systems because of reduced spending in these areas. The LOLP criterion alone will not therefore assure a utility that it is delivering reliable service.

The loss of load probability criterion of one day in ten years is used to generate a system-wide reserve margin for the PJM system, for both planning and contractual purposes. Once the contractual reserve margin is decided by the PJM Management Committee, the forecast obligation for each member company is determined by an equation, as outlined in Company Exhibit VSB-2, Appendix E. A critical variable in this equation is the forced outage rate of each company. The forced outage rate of each company is expressed as a percentage above or below the average for the entire PJM system. PECO's forced outage rate has been consistently higher than the PJM average, as is demonstrated in Table 2 (IR-1, Informal. CEEP 3). A value of zero would mean that the Company's forced outage rate did not vary from the system average. The fact is that between 1974 and 1977, the forced outage rate adjustment for PECO almost doubled and from 1977 through 1981 the adjustment grows at a compounded annual rate of 44%.

Table 2

Planning Period	1974-1975	1975-1976	1976-1977	1977-1978	1978-1979	1979-1980	1980-1981	1981-1982
F(%)	.758	.937	.845	1.399	2.062	3.149	4.543	5.990

Under cross-examination, Mr. Boyer acknowledged that a company-wide cutback of expenses during 1974-1976 reduced maintenance expenditures for the generating stations (Tr. 720). He also acknowleged that the higher forced outage rates experienced by PECO since 1973 are a result of both equipment problems and a tendency not to repair

generating units as fast as possible, since an adequate reserve margin exists to permit generating stations to be repaired during normal working hours (Tr. 718). When higher forced outage rates are the result of unhurried repair and more-than-adequate current reserve margins, and these same high forced outage rates are used to justify a still higher reserve margin, a self-perpetuating circle of justification has been created. It is bad regulation to condone such circular reasoning. The circle must be broken. On p. APP-A5 of Exhibit VSB-2, Mr. Boyer states that "the overall trend of increasing required reserve levels indicated in the table on page APP-A4 is due predominately to the system wide decrease in unit availability." The member companies of the PJM system have little incentive to be concerned about higher forced outage rates because the PJM system had a comfortable reserve margin of 35% in 1979 (Exhibit VSB-2 p. 8).

Because the present definition of loss of load probability pessimistically describes the impact of customer losses of load: because this reliability criterion fails to consider explicitly transmission and distribution reliability; and because artificially high forced outage rates are being used to justify still higher reserve margins, we reject the Company's claim that an adequate reserve margin must exceed the 20% goal which the Commission outlined in 1966. We have used a 20% reserve margin of generating capacity above peak demand in our adjustment as a conservative measure for PECO in the interconnected PJM system. Further improvements in

reliability of service for the Company should come from improvements in generation, transmission, and distribution maintenance.

Q. How did you select the value to be assigned to the excess capacity?

A. The value we selected is taken from Schedule 4.01 of the PJM Agreement entitled "Rates and Payments For Contract Capacity". (Staff Exhibit DMB/EMB-1-A, Schedule 4). The rate of $25.55 per kilowatt became effective on June 1, 1979, subject to approval by the Federal Energy Regulatory Commission. This rate is applied to companies which require planned purchases in order to meet their PJM capacity obligation under Schedule 2.01 and allocated according to Schedule 2.21 of the PJM Agreement. This provision allows a PJM member utility which anticipates that it will be unable to meet its forecast obligation to the PJM system to purchase sufficient power from other PJM members rather than installing new capacity to meet its obligation.

The purpose of accounting for and valuing capacity in excess or deficiency of a contract obligation is to protect any utility from carrying the reserves for the system without compensation. This is a bookkeeping adjustment for PJM since the ownership of the capacity doesn't change. If, however, a company's capacity is truly in excess of the PJM system's needs, no compensation is awarded. The rate used in Schedule 4.01 is representative of the net annual cost of combustion turbine generating capacity based on current costs of installation in PJM member systems. The net cost is the levelized annual cost of plant investment less the benefit of

economical energy generated by the plant, because that benefit is retained by the owner. The rate of $25.55 per kilowatt is therefore the net annual cost of the least expensive type of generating capacity in the PJM system. Its purpose is to coordinate capacity installations by giving the prospective buyer of capacity a reasonable, short-term alternative to a new installation, while giving to the supplier a fair and equitable return on investment.

A higher rate, such as the average carrying charge of all installed capacity or the carrying charges associated with the most recent capacity put into service, could have been used for the adjustment. The rate of $25.55/KW which we chose assesses PECO with what we believe to be the lowest reasonable cost per KW of excess capacity - capacity not needed to serve its customers.

Q. What kind of adjustment for excess capacity do you recommend?

A. We recommend an upward adjustment to the total revenues of the company to recognize that if there is a value to this excess capacity, it is to other utilities rather than to the Company's ratepayers. The fixed costs of unnecessary generating capacity represent a burden to the ratepayers and to the Company. It should be the objective of a regulated utility to minimize the burden associated with unnecessary capacity by selling, leasing, or retiring such capacity even if all the costs are not fully recovered. An analogy may be drawn to a competitive business burdened with excessive inventory or capital assets. The business minimizes its losses by

obtaining whatever it can for the inventory or capital assets that would otherwise go unsold or be unused. PECO's present strategy apparently is to retain all capacity ever installed, at the expense of the ratepayer, hoping that demand for power will grow to meet the capacity in place. While we recognize that generating capacity is constructed in discrete units of multiple megawatts rather than by individual megawatts, the fact is that unnecessary capacity can be leased or sold or retired by individual megawatts.

We have identified an amount of excess capacity in megawatts rather than identifying individual generating stations whose capacity is excess because we believe that the selection of plants to be sold, leased, or retired should be left to the Company. Such decisions should be reviewed by the Commission to assure that they are in the public interest.

We assert that 850 MW of PECO's installed capacity is not necessary for serving the Company's ratepayers. If it has a purpose and a value, it is to other utilities and their customers. We have therefore assigned a revenue level which is based upon a rate found reasonable by PJM. This rate represents the least cost capacity in the PJM system (i.e. combustion turbines) and therefore places the most reasonable obligation on the Company if it is not able to rid itself of the burden of the excess capacity.

By valuing the excess capacity at a rate which equals the net annual cost of combustion turbine generating capacity, we have created an inducement for the Company to remove capacity whose

annual costs at least equal $25.55 per kilowatt. If the Company is able to sell or lease capacity for a higher rate, clearly the stockholders of the Company will benefit. If the capacity is sold or leased for less than $25.55 per kilowatt, the loss will also belong to the Company's stockholders but the burden is still lessened. The Company has declined to make sufficient adjustments in its installed capacity without Commission prodding.

I recommend an upward adjustment to total revenues of $21,717,500, which is the product of 850 MW of excess capacity valued at $25.55 per KW. Our choice of a rate per kilowatt which represents the least cost capacity in the PJM system should not preclude the Commission from using rates which more directly reflect the costs of capacity in individual utility companies.

This revenue adjustment increases the Company's adjusted test year revenues by $21,717,500 and therefore reduces the Company's proposed rate increase by the same amount. The Company rather than the ratepayer is made responsibile for this amount of costs associated with excess capacity. Using regulatory accounting, the Company may reduce or eliminate its burden of excess capacity or even possibly profit by selling, leasing or retiring these megawatts. These are the type of cost minimizing actions we hope to induce through this adjustment.

APPENDIX A Statement of Educational and Professional Background

Eileen M. Barrett

Current Employment	Economist, Pennsylvania Public Utility Commission, Bureau of Conservation, Economics, and Energy Palnning, January 1978 to the present. Continuing responsibility for economic analysis of special topics in the electric utility industry. Have prepared reports to the Chairman on the reserve generating capacity of Pennsylvania under several scenarios, including removal of major coal-burning stations for environmental reasons and removal of all nuclear stations for safety reasons. Special advisor to Staff Counsel on environmental impacts of high-voltage transmission lines.
Education	M.A. Regional Science, 1974 University of Pennsylvania, Philadelphia, PA B.A. Geography, minor in Economics, 1973 George Washington University, Washington, D.C.
Previous Employment	Economist, Governor's Office of State Planning and Development, Harrisburg, 1977-1978. Directed and participated in projects relating to state energy planning, state coal development, analysis of National Energy Plan. Planner, U.S. Department of the Interior, Bureau of Outdoor Recreation, Philadelphia, 1974-1977.

David M. Boonin is head of the Economics Division within the Bureau of Conservation, Economics and Energy Planning of the Pennsylvania Public Utility Commission. Responsible for the management and administration of the Division and supervises the activities of the Division's technical staff. Directs the establishment of project teams and designates project managers. As the Division Chief, he determines priorities of internally initiated projects and confers with Bureau Director and/or the Chairman on the Division's goals, objectives and priorities. Coordinates interdisciplinary analytical project teams, which address policy issues and perform research on energy and utility regulatory topics. Also performs duties outlined in next section.

Previous Experience

- Chief of the Energy Impact Analysis Section, Pa. PUC. Managed interdisciplinary projects concerning energy and fixed utilities, with the objective of developing policy recommendations for the Commission's approval. Serve as an in-house consultant to the Commission. Specific areas of study have included: developing policies to cope with energy shortages and promote conservation; improving the environment for cogeneration; defining capacity requirements; developing rate case policies and recommendations; creating policies to induce the improvement of electric utilities' operating efficiencies; and studying interstate power supply agreements. Testify as expert witness in Commission rate proceedings.

- Economic advisor to the Chairman of the Pennsylvania Public Utility Commission and to the other Commissioners. Analyzed problems and recommended policies concerning issues within the entire spectrum of economic, financial, energy and fixed utility regulation under the Commission's jurisdiction. Reviewed rate cases and recommended specific decisions and policies including total revenue requirements, rate structures and treatment of all related underlying considerations.

- Staff economist for the Government Division, U.S. Department of Commerce. Revised data concerning state and local governments' contribution to the Gross National Product. Researched and developed a method for lagging tax activity indicators from the period in which the taxes were accrued to when the activity occurred. Also developed indices.

- Economist on the Nuclear Technical Staff, United Engineers and Constructors. Analyzed issues relating to the licensing, design and safety of nuclear power plants. Contributed economic, demographic, statistical and engineering analyses to conceptual design reports, siting studies, environmental impact statements and safety analysis reports. Researched the economics of various modes of electric power generation, long run energy supply and demand, and comparative energy input-output options.

Education

M.A, Economics
Brown University, Providence, R.I.

BS, Economics
Wharton School, University of Pennsylvania, Philadelphia, Pa.

Certificates of Completion

Utility Rate Regulation, Michigan State University, East Lansing, Michigan, 1978.

Regulation of Water Utilities, University of South Florida, St. Petersburg, Florida, 1976.

Environmental Impact Statements, George Washington University, Washington, D.C., 1974

Publications and Presentations

Decommissioning, A State's Perspective, Decontamination and Decommissioning of Nuclear Facilities, American Nuclear Society, September 1979.

Return on Effectiveness, ERRI Cogeneration Workshop, San Antonio, Texas, April 1979.

Return on Effectiveness, Sixth Energy Technology Conference, Washington, D.C., February 1979.

Economics and the Public Interest, Ursinus Economists' Club, Collegeville, Pennsylvania, February 1978.

Supplemental Comments on Marginal Cost Pricing Theory, Co-author, Louis J. Carter, National Gas Survey on Rate Design, Federal Power Commission, 1977.

An Aircraft Accident Distribution Function, Transactions, American Nuclear Society, Volume 18, June 1974.

Trial Staff Statement No. GFM-1
Witness: G. F. Markovci

PENNSYLVANIA PUBLIC UTILITY COMMISSION

v.

PHILADELPHIA ELECTRIC COMPANY

Docket No. R-79060865

Direct Testimony

of

George F. Markovci

Concerning:

Cash Working Capital

Summary

The following adjustments to Respondent's Cash Working Capital Requirement (Exhibit DPS-2, page C-25) of $52,276,000 are recommended:

Semi-Annual Interest Payments	$27,071,000
Preferred Dividend Payments	3,121,000
Cash Required to Finance O&M Expenses	25,368,000
Total Adjustments to Cash Working Capital	$55,560,000

Trial Staff Statement No. GFM-1
Witness: George F. Markovci

Q. State your name and the name and address of your employer.

A. George F. Markovci. I am employed by the Pennsylvania Public Utility Commission, P. O. Box 3265, Harrisburg, Pennsylvania 17120.

Q. What is your position with the Pennsylvania Public Utility Commission and how long have you held this position?

A. I am an Analyst for the Energy Division - Electric Finance Section, Bureau of Rates and I have held this position since October 1977. Prior to that I was employed as an Analyst for the Financial Section - Bureau of Rates and Research from February 1976 to October 1977.

Q. What is your educational and professional background?

A. See Appendix A.

Q. What is the purpose of your testimony in this case?

A. My testimony is intended to recommend the following necessary downward adjustments to Respondent's Cash Working Capital Requirement (Exhibit DPS-2, page C-25)

Semi-Annual Interest Payments	$27,071,000
Preferred Dividend Payments	3,121,000
Cash Requirement to Finance O&M Expenses	25,368,000
Total Adjustments to Cash Working Capital	$55,560,000

Q. Please comment on your reasons for disagreeing with the Company's methodology used to determine the cash working capital requirement?

A. The purpose of a cash working capital allowance is to allow the equity holder a fair return on funds required by a utility to conduct normal opera-

tions and to cover any gap between cash expenditures required for the production and delivery of service and the collection of revenues associated with these services.

The rates paid by PECO customers include a revenue requirement to service debt and preferred obligations. These rates are collected on a continuous basis throughout the year. In the case of bonds, the interest is paid semi-annually and preferred dividends are paid quarterly. If revenues collected from customers but not yet paid to bondholders and preferred stockholders are not recognized as a source of working capital contributed by the rate payer and correspondingly offset against the cash working capital requirement, the equity holders will earn on capital not supplied by them and receive a supplemental return or windfall profit. PECO recognizes this principal in its revenue-expense lag study for tax revenues received in advance of payment. There is no valid basis for ignoring the same principal and application to funds collected to service debt and preferred instruments.

I believe that an adjustment should be made on the basis that the mid-point of semi-annual interest payments and quarterly preferred dividend payments are proper in determining the adjustment to cash working capital requirement for debt service and preferred obligations.

Q. Have you prepared an exhibit outlining the Staff's position in regard to your adjustments to the cash working capital requirement for semi-annual interest payments and quarterly preferred dividend payments for the test year March 31, 1980?

A. Yes, I have attached Trial Staff Exhibit No.'s GFM-1A and 1B: Exhibit No.

GFM-1A supports a downward adjustment in cash working capital of $27,071,000 for semi-annual interest payments. Exhibit No. GFM-1B indicates a downward adjustment of $3,121,000 for quarterly preferred dividend payments. The total downward adjustment for debt service and preferred obligations is $30,192,000 and should be applied as a reduction to the Cash Working Capital Requirement.

Q. Please comment on your reasons for disagreeing with the Company's treatment of arriving at the Cash Requirement of $71,876,000 to finance Operation and Maintenance Expenses (Exh. DPS-2, Page C-25).

A. The Company was selective in arriving at its Average Lag in Receipt of Revenues of 57 days. Respondent has used a combination of a lag methodology and a balance sheet approach to determine this requirement of 57 days. PECO's claim is based on 15 days from the mid-point of the month, four days for bill preparation and 38 days for the time average bill is outstanding (Exh. DPS-1, page C-25A).

Witness Rimmerman (TR-403) characterized the 38-day period for the average time bill is outstanding as strictly a lag in receipt of payment. Staff does not agree with this statement. The method of arriving at the 38-day period was the result of the sum of twelve monthly total accounts receivable balances divided by the sum of twelve average daily revenue balances for the twelve months ended March 31, 1979 (TR-378). Staff characterizes this as a the balance sheet approach as this method utilizes twelve "snapshot" pictures of the Company's balances at the end of each month of the test year.

I believe that a Revenue Lag Day study should be made utilizing Total

Electric Revenues for the test period. The lag day study should include both Electric Revenues by Rate Classes and Other Operating Revenues, including late payment penalties.

Q. Have you prepared a Revenue Lag Day Study for the test period?

A. Yes, attached is Trial Staff Exhibit GFM-1C (Three Sheets).

Q. Do you have any additional comments to make on Trial Staff Exhibit GFM-1C?

A. Yes. The source of Total Revenue and resultant Revenues Dollar Days utilized was Exhibit DPS-1, Page A-5, which is the historic test year ended March 31, 1979. I could not use the future test year revenues as the Company information regarding a breakdown of forfeited discounts for the future test year was not available (TR-1, Q. and A. 15).

I, also could have assumed the mid-point of the 54-calendar days after due date when a delinquent account is referred to an outside collection agency or becomes delinquent (Footnotes D, E. & F). I did not use the mid-point of 54-calendar days or 27 days in the interest of conservatism.

Q. How did you make your revenue lag study as outlined on Trial Staff Exhibit GFM-1C?

A. First, I took the electric revenues received by each individual rate class and multiplied it by the lag days indicated and explained on Footnotes A, B and C which resulted in revenue dollar days for each individual rate class. This resulted in a Total Revenue of $1,196,846,493 and Revenue Dollar Days $49,094,581,519 for the test period.

Then the Other Operating Revenues excluding late payment penalties were lagged in the same manner to arrive at Total Electric Operating Revenues of $1,208,836,493 and Revenue Dollar Days of $49,456,279,519 which resulted in 41 days revenue lag before application of Late Payment Penalties. The 30 and 57-lag days used for Other Operating Revenue items were conservatively estimated in the absence of specific information.

The 95-lag days used for late penalty payments are explained in Footnotes D, E and F. The principle involved to arrive at penalty revenue dollars was to capitalize the associated penalties at an annual or monthly interest rate to derive the revenues associated with these late penalty payments. This was then multiplied times the 95-lag days to arrive at the Revenue Dollar Days of $5,014,765,000 associated with late penalty payments.

The overall result was $1,213,526,493 of Total Revenue divided by $54,471,044,519 Revenue Dollar Days which resulted in an overall 45 dollar days revenue lag.

The difference between the Company's Dollar Days Revenue Lag of 57 days and Staff's 45 days results in an reduction of 12 days to Respondent's claim for cash required to finance O&M expenses. This results in a cash working capital requirement of $46,508,000 (22 days @ $2,114,000). A $25,368,000 reduction (12 days x $2,114,000) to Respondent's cash working capital claim of $71,876,000 to finance O&M expenses is recommended.

Trial Staff Statement No. GFM-1
Witness: George F. Markovci

Appendix A

Educational and Professional Background

I graduated in February 1950 with a B.A. degree from Pennsylvania State University, majoring in Commerce and Finance. After graduation, I was employed by the Blue Mountain Consolidated Water Co. of Nazareth, Pa. (1950-1965). I was hired as an accountant, promoted to office manager and ultimately to Manager. Served as Manager for an eight-year period. In 1965, I was employed by General Waterworks Management and Service Corporation as Division Accountant of their Delaware Division. My duties included supervision of office personnel and formulation of office and accounting procedures for seven operating utility companies in Delaware, Pennsylvania and Maryland. I was transferred in June of 1966 to Pennsylvania Utilities Investment Corporation as their Controller and Assistant Secretary-Treasurer. My duties consisted of preparation of consolidated financial reports, operating budgets, cash flow and other financial reports for the parent and four operating steam heat utilities. I served in this capacity until June of 1967 when I entered the public accounting profession. I remained in public accounting until February 1970. During this time I was employed by the firms of Timpson, Boyle and Wolverton of Oakland, California and J. D. Yerger Company of Reading, Pennsylvania. In February 1970, I was hired as Accounting Manager of the Birdsboro Corporation, Birdsboro, Pa. I became Treasurer of Barbey Electronics of Reading, Pennsylvania in April 1971 and served in this capacity until December 1973 when I accepted the position of Controller with Herr & Company of Lancaster, Pennsylvania and remained in that capacity until

Trial Staff Statement No. GFM-1
Witness: George F. Markovci

Appendix A

Educational and Professional Background (continued)

May 1975 when I became the accountant for the Reading Area Community College. I served as their accountant until February 1976 when I joined the staff of the Pennsylvania Public Utility Commission.

Trial Staff Exhibit No. GFM-1A
Witness: George F. Markovci

PENNSYLVANIA PUBLIC UTILITY COMMISSION

v.

PHILADELPHIA ELECTRIC COMPANY

Docket No. R-79060865

Exhibit to Accompany The

Direct Testimony

of

George F. Markovci

Concerning:

Cash Working Capital

Trial Staff Exhibit GFM-1A

PHILADELPHIA ELECTRIC COMPANY

Commission Staff Adjustment to Cash Working Capital Requirement for Semi-Annual Interest Payments for Year Ended March 31, 1980

Exh. DPS-2 Page A-2	Net Electric Plant--3/31/80	$2,501,021,000
Attachment II-A-1A	1979 Budget Capitalization Ratio Long-Term Debt	52.1%
Exh. DPS-2 Page D-9	Amount of Net Electric Plant Allocated to Long Term Debt ($2,501,021,000 x 52.1%)	$1,303,032,000
Exh. DPS-2 B-19	Pro Forma Long Term Interest Charges Allocable to Electric (Embedded Debt Cost of 8.31% x $1,303,032,000 Electric Plant)	$108,282,000
	Semi-Annual Interest Payments $108,282,000 ÷ 2 payments	$54,141,000
Staff Assumes Mid-Point of Semi-Annual Long Term Debt Payments of $54,141,000		2
Staff recommended adjustment to cash working capital requirement for long term interest payments		$27,071,000

Trial Staff Exhibit No. GFM-1B
Witness: George F. Markovci.

PENNSYLVANIA PUBLIC UTILITY COMMISSION

v.

PHILADELPHIA ELECTRIC COMPANY

Docket No. R-79060865

Exhibit to Accompany The

Direct Testimony

of

George F. Markovci

Concerning:

Cash Working Capital

Trial Staff Exhibit GFM-1B

PHILADELPHIA ELECTRIC COMPANY

Commission Staff Adjustment to Cash Working Capital Requirement for Preferred Dividend Payments for Year Ended March 31, 1980

Exh. DPS-2 Page A-2	Net Electric Plant--3/31/80	$2,501,021,000
Attachment II-A-1A	1979 Budget Capitalization Ratio Preferred Stock	12.8%
	Amount of Net Electric Plant Financed by Preferred Stock (12.8% x $2,501,021,000)	$320,130,688
Exh. DPS-2 Page B-20	Embedded Cost of Preferred Stock	7.80%
	Amount of Preferred Stock Dividends Allocated to Electric Plant (7.80% x $320,130,688)	$24,970,194
	Average Quarterly Dividend Payments Allocated to Electric Plant ($24,970,194 ÷ 4 Quarterly Payments)	$6,242,549
Staff assumes Mid-Point of Quarterly Preferred Dividend Payments of $6,242,549		2
Staff recommended adjustment to cash working capital requirement for quarterly preferred dividend payments		$3,121,000

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pay these rising costs and does so? Is that not correct?

A. That's correct, Mr. Hall.

Q. However, is it not true, Mr. Markovci, that the company is not compensated through its rates, for the increase in these costs?

A. That is correct to the extent of not being compensated due to regulatory lag.

Q. Would it also be true to the extent that the company had experienced an increase in its debt or preferred costs, which increase had been since the time of the company's last rate order, with no subsequent filing having been made? Is that not correct?

A. That is substantially correct, Mr. Hall.

MR. HALL: That is all the questions that I have, Your Honor.

THE ADMINISTRATIVE LAW JUDGE: Thank you. Do any other parties have any questions of this witness?

(No response)

MR. SAYRE: No redirect.

THE ADMINISTRATIVE LAW JUDGE: The witness is excused.

MR. HALL: Your Honor, at this time, we have Mr. Carroll for additional cross examination as to his rebuttal testimony. Mr. Carroll has been previously sworn.

BEFORE THE

PENNSYLVANIA PUBLIC UTILITY COMMISSION

*** *** ***

PENNSYLVANIA PUBLIC UTILITY COMMISSION

VS.

PHILADELPHIA ELECTRIC COMPANY

R.I.D. R-79060865

*** *** ***

Direct Testimony of

John K. Stutz

as to

Long Range Load Forecasting

November 2, 1979

E S R G

Q. Please state your name and business address.

A. My name is John K. Stutz. My business address is Energy Systems Research Group, Inc. (ESRG), 120 Milk Street, Boston, MA 02109.

Q. Please describe your background and qualifications.

A. I am currently a senior research scientist at Energy Systems Research Group. At ESRG I have specialized in the area of mathematical modeling and its application to energy related problems. I have had extensive experience in the areas of long range electric utility load forecasting. I have testified on matters related to load forecasting in the states of Massachusetts, Connecticut, New York, Pennsylvania and Michigan. A complete description of my background and qualifications is contained in the attached Vita, Exhibit ___ (JS-1)

Q. What is the purpose of your testimony in this case?

A. I will address three areas in this portion of my testimony:

1. I will present the results of an independent Base Case long range load forecast for the Philadelphia Electric Company system (PECO) prepared by ESRG. The Base Case modelling methodology, data sources, forecasting assumptions, and detailed results are described fully in Exhibit (JS-4);
2. The ESRG Base Case results are compared to PECO's long range load forecast, points of contrast identified, and a critique offered of aspects of the Company's forecast submission;

3. I will present the results of a Conservation Policy Forecast developed by ESRG. Again, detailed explication is summarized at the end of the testimony in Exhibit ___ (JS-5). Finally, in a supplementary submission, I will discuss the aspects of the "essential human needs" question raised for consideration in this case by Chairman Goode in a memorandum to Judge Shane dated August 9, 1979.

Q. Why are you presenting a "Conservation Policy scenario analysis" in this case?

A. Currently, long range forecasts are prepared under "business-as-usual" assumptions. This characterizes both the Company's forecast and ESRG's Base Case forecast in this case. These assume only evolutionary changes in the economics and regulatory environment. Recent actions by the federal government and the state governments in New York and California suggest that there can be discontinuous shifts in regulatory policy--shifts which lead to a much more aggressive promotion of conservation than would normally be expected. The primary purpose of the Conservation scenario is to show the potential effects of such a shift in state policy upon the Base Case forecast of local growth in the PECO service area prepared by ESRG. Since the future direction of state policy is unknown at this time, the results of the Conservation Policy scenario analysis form a useful compliment to the Base Case forecast in describing the structure of peak demand and energy consumption which PECO may experience in the future.

Q. What are your major findings in this case?

A. Based upon the results of the long range Base Case load forecast prepared by ESRG I find that the estimates of growth in energy consumption and peak power developed in-house by PECO and contained in Exhibit ___ (WCH-1) are substantially in excess of what is likely to occur. A summary of the PECO and ESRG Base Case results appears in Table 1 below. Through a point-by-point comparison of the Company forecast with that prepared by ESRG, I find that the general overestimate of future electric load and energy growth can for the most part be traced to the following primary sources:

- Overestimates of likely residential customer growth,
- Inadequate treatment of certain residential end-uses,
- Overestimate of the addition of new loads in the commercial sector,
- Failure to adequately account for changes in energy intensity and self-generation within the industrial sector.

Based upon the results of the Conservation Policy scenario analysis in Exhibit ___ (JS-5), I find that if the State pursues a policy of vigorous promotion of conservation, the future load growth experienced by PECO may be substantially below that shown in the ESRG Base Case (see Table 1.1 of Exhibit ___ (JS-5)).

TABLE 1

Comparison of Annual Base Case Growth Rates:
1977-1988

	ESRG	PECO
Residential Energy[1]	1.6%	3.0%
Commercial Energy	.5	3.2[2]
Industrial Energy	1.9	2.7[3]
Total Energy[4]	1.4	2.9
Summer Peak	1.1	2.3

[1] Corrected for billing adjustments and 1977 weather normalization, and includes single point metered (SPM) apartments.

[2] Includes "Other Non-manufacturing" and 90% small "C & I" based on Exhibit ___ (WCH-1), Sec. 3.

[3] Includes manufacturing and 10% small "C & I."

[4] Excludes Sales for Resale.

Q. How are the results of the ESRG forecast related to the issues of capacity planning and utilization?

A. I share the view expressed by company witness Boyer that "Generation planning begins with the forecast of future annual sales and peak demand" (Exhibit ___(VSB-2), p. 1). Given that the forecast which I am sponsoring is significantly lower than that proposed by the Company, I would expect that it would lead to the need for substantially less additional capacity than currently planned. However, the issues involved in generation planning extend far beyond the area of load forecasting. For that reason I

will simply point out that the forecast which I am sponsoring has been used as one of the inputs for the analysis of the need for and economics of generation planning and system reliability presented by Dr. Don Shakow of our firm. One may consult Dr. Shakow's testimony to determine the impact of the ESRG forecast in the area of generation planning. The ESRG forecast is also relevant to certain of the financial issues in this case. Here one may consult the testimony of Mr. Robert Towers. Mr. Towers has utilized the ESRG forecast as one of the inputs in the preparation of his testimony.

Q. Before beginning your comparison of the ESRG and Company forecasts, please explain the relationship between your subsequent testimony and the information contained in Exhibit ___(JS-4).

A. Exhibit ___ (JS-4) contains a complete description of the assumptions, methodology, and results of the ESRG forecast. It is the primary source of information concerning my forecast. Below I will present a general discussion of the ESRG forecast with the aim of highlighting the points of difference between it and that prepared by the Company. For details concerning the latter forecast, the reader may refer to Mr. Hoch's Exhibit ___ (WCH-1).

Q. Please begin your comparative analysis of the ESRG and PECO forecasts by discussing the future number of residential customers.

A. The two forecasts are similar in methodology. Both first obtain estimates of future population growth, convert this to growth in the number of households (dwelling units), and then apportion the growth among different types of housing units. For 1988, ESRG forecasts 1.426 million households for the service area, while the Company forecasts 1.475 million households. ESRG divides new construction into 48% single family, 52% multifamily, while the Company has the split at 55% single family and 45% multifamily.

There are three major components to the forecasts of residential customer growth prepared by ESRG and the Company: population growth, trend in the number of persons per household, and split between single family and multifamily dwellings. On each point, PECO has taken a decidedly optimistic view. The PECO population growth rate is compared to the forecasts of the Census or the Pennsylvania Office of State Planning and Development in Exhibit ___ (JS-4), p. 66, and seen to be relatively high. However, this is offset by relatively high projections of the number of persons per household, which tends to decrease customer growth but raises the number of single family dwellings added. This latter point is significant because of lower consumption of multifamily units. Focusing on the single family/multifamily split for a moment, we note that the Company stresses what customers may want, not what they are likely to be able to afford. For example, the fact that the price of single family housing is expected to run 2 to 4% above inflation is seen as part of the "compelling case" for home ownership among young couples. (Exhibit ___ (WCH-1, p. 48). Nowhere in its discussion does PECO mention that real household income

has been stagnant since 1974, nor does it even suggest that escalating real housing prices, together with high mortgage rates and large down payments, may cut into the ability to afford "... the best single investment available to a young family or anyone else in this country." Based upon current and likely future economic conditions I regard the ESRG forecast as optimistic concerning both customer growth and addition of single family dwellings.

Q. Please discuss the difference between the ESRG and Company forecasts of residential consumption.

A. In my previous answer, I explained the difference between the two forecasts of the number of residential customers. Here I will focus on the difference in per customer usage. In order to facilitate the discussion I have prepared Schedule A of Exhibit ___ (JS-2). This schedule shows the difference between PECO and ESRG forecast 1987 per customer usage in four categories: refrigerators and freezers, heating, miscellaneous, and the remaining end-uses in the ESRG forecast. I have arranged the data in this way because it highlights the major difference in per customer consumption between the two forecasts. Notice that the first three categories cover the bulk of the difference. The end-uses lumped in the fourth category show small individual differences, the bulk of which cancel when added.

Q. Please explain the difference in refrigerator and freezer consumption.

A. This is due to much greater saturation assumptions in the Company forecast (unit usage is actually higher in the ESRG forecast). In the case of refrigerators, the base year (1977) saturation (average number of units per household) for single family dwellings is 1.2, while for multifamily dwellings it is 1.04. In both the ESRG and Company forecasts, the number of persons per household is falling and the share of multifamily dwellings is growing. It seems obvious that both these trends would argue for smaller saturation. In the ESRG forecast we have taken the very conservative assumption that the saturation of refrigerators in single family and multifamily units will remain at their current levels. This is also supported by the econometrically-based saturation growth analysis referred to in Exhibit ___ (JS-4), Sec. 8.1.2. The Company simply asserts , without explanation, that historic refrigerator saturation growth to 1.3 by 1988 averaged over single and multifamily units will continue. A similar set of comments apply to freezers. In addition to the demographic and housing type trends, the assumed penetration of larger refrigerators with their own freezer space point to a moderation in saturation growth for this appliance. Nevertheless, to be conservative I have allowed some saturation growth per the analysis in Exhibit ___ (JS-4) of about 25% overall between 1977 and 1987. The Company forecasts a 56% growth in freezer saturation growth between 1977 and 1987. I find that, given the underlying demographic and housing construction trends assumed by both ESRG and the Company, the refrigerator and freezer saturation forecasts made by the Company are unrealistically high.

Q. Please discuss the difference in electric space heating and heating auxiliary consumption.

A. Both forecasts assume rapid penetration of electric space heating among new customers. Historic penetration rates have been dependent on a complex mix of factors: construction practices, gas curtailment policy, economic promotion, etc. From 1970 to 1973, penetration rates in the PECO service area fluctuated, ranging from .13 to .34, then increased rapidly to over .50 in the gas curtailment years of 1974 and 1975. Given the recent rebound of the gas market, bans on new master-metered units, and the continuing economic inferiority of direct electric heating, the shared penetration rate assumptions of 30 to 70% over the forecast period (compare Exhibit ___ (JS-4), p. 69, and Exhibit ___ (WCH-1), p. 170) may be sources of over-estimation in both forecasts. The main source of divergence between the forecasts is traced to the differences of customer growth forecasts discussed earlier. Since penetration multiplied by new customers gives new electric space heated units, the resultant forecasts are sensitive to household growth assumptions. The difference in household forecasts accounts for over 70% of the 220 KWH/Year/Customer difference in Exhibit ___ (JS-2), Schedule A. The remainder of the difference is a composite effect. We assume a larger fraction of multi- to single family construction than does the Company with concommitant lower usage per household. Furthermore, based on our prototypical building shell analysis (Exhibit ___ (JS-4), Sec. 8.1.4 and Exhibit ___ (JS-5), Sec. 3.2, we have included thermal integrity improvements in new electric space heat construction reducing electricity requirements from

5 to 10 percent. For all of these reasons, but especially the differences in demographic assumptions and the shared high penetration projections, the ESRG electric heat estimate is, in my judgement, considerably more reliable.

Q. Please discuss the difference in miscellaneous consumption.

A. The Company miscellaneous forecast consists of three individually forecast components: dehumidifiers, supplementary heating, and transportation (electric vehicles), as well as general increases in the areas of cooking appliances, entertainment, and "personal comfort" uses. I will show that, for each of the categories the growth is highly speculative and where any applicable information exists it tends to suggest decreased rather than increased growth. I will deal with each end-use separately.

- Dehumidifiers. This is a curious case. The Company provides specific reasons why the use of this appliance should decline, related to the operating characteristics of central air-conditioning, and none whatever why it might increase. Yet saturation is assumed to increase from 15% in 1979 to 19% in 1988. A decrease here would be at least as plausible.
- Supplementary Heat. Here only the base year saturation is based upon hard data; usage is based upon an estimate of wattage and hours of use. Saturation is forecast to increase from .115 in 1977 to .195 in 1988 for rate R customers, with slightly smaller increases overall. Unit usage is expected to fall from 600 KWH to 575. No specific

explanation of either change is given. In fact, the pattern projected is extremely implausable. These units are equivalent to baseboard electric units, and as such are more expensive sources of heat than either the gas or oil units. The only logical reason for using them in a bathroom or bedroom, as PECO reports the majority are used, is to save money by heating only a limited area. If indeed this is the motive, then the use of such units for 1000 hours per year in both bedrooms and bathrooms as assumed by the Company in its forecast seems unlikely. Similarly, one might expect some decrease in the wattage of the average size of the units in use. The Company in making its forecast has assumed a large increase in the saturations of such units, 70% increase between 1978 and 1988, but only a 4.2% reduction in consumption. I feel this forecast to be extremely speculative, in view of the absence of data, as well as optimistic in its effect.

- Transportation (the "electric" car). This potential end-use has yet to come on line. Looking back over previous Company forecasts, we find that in 1976 it was expected in 1978, in 1977 it had slipped to 1979 and now, in the 1978-88 forecast, it makes its first appearance in 1982. In my view, this record is indicative of the actual state of affairs with the electric car: outside of DOE sponsored acquisition programs, no one knows if, when, or what numbers such vehicles will appear. Progress continues in such areas as battery design, but even if all technical obstacles

were overcome, there would still be the question of public acceptance of an electric vehicle with limited range and speed. In sum, I find its use extremely speculative.

- Miscellaneous Cooking Appliances. Here we find mention of the microwave range. Microwave ovens, a closely-related appliance, have already been discussed in the section of the forecast dealing with the electric range, Exhibit ___ (WCH-1), p. 100. There it is assumed that a microwave oven will consume 190 KWH per year while reducing range consumption by 35%, or 245 KWH. This means in effect that microwave ovens consume 78% of the energy that would have been consumed by electric ranges to cook the equivalent items. This is simply false. In Exhibit ___ (JS-2), Schedule B, I have reproduced data showing the energy consumption in cooking a variety of foods using different appliances. As is clear from the data, microwave ovens use about 25% of the energy of ranges, depending on the food. Just as an illustration, let us accept the Company forecast assumption of 43% saturation for electric ranges in 1987. If <u>all</u> PECO customers used microwave ranges, forecast energy consumption would decrease. With respect to other cooking appliances, they too, as indicated in the exhibit, exhibit analogous "substitution" effects and will tend also to decrease overall usage, an effect which increases with increasing electric range saturation. In short, the likely effects of growing use of miscellaneous cooking appliances is to decrease overall use.

- Entertainment. Here, the Company discusses only variants of the television. Currently, they forecast two conventional televisions per customer in 1987. I find no reason to assume that these "new" end-uses would not simply supplant usage of one or more of the conventional sets. With the use of solid-state equipment, I see no reason to assume significant additional consumption for these devices.
- "Personal Comfort and Convenience." Here the only new load suggested by the Company is the home computer. Beyond the level of the hand-held calculator now in common use, I find this load extremely speculative. However, if it were to come into common use, it would presumably be a small solid-state unit with negligible usage. Any other assumption would fly in the face of current developments in computer technology.

Overall, the Company forecast usage in the miscellaneous category grows from 610 KWH per customer in 1978 to 1016 in 1987, an annual growth of 5.9% per year. As my discussion above has indicated, such a forecast of miscellaneous usage in 1987 is simply far beyond what one could reasonably expect.

Q. Please summarize your findings concerning the Company's residential forecast.

A. In most areas the Company residential forecast is reasonable. Population and single family housing growth potential are somewhat overstated. End-use consumption, due in part to the demographic

assumptions, for refrigeration, space heating, and miscellaneous consumption, is seriously overestimated. These problemmatic areas lead to a general overstatement of probable residential load growth over the forecast period.

Q. Please begin your discussion of the ESRG and the Company commercial forecasts.

A. The methods used by ESRG and the Company for its Base Case forecast are similar in approach. Both consider three basic factors as part of their forecasting methodology: changes in total commercial square footage to which service is provided, changes in the mix of end-uses serviced, and changes in the intensity of usage. The major difference between the two forecasts is in the degree of disaggregation. The ESRG forecast, as described in Section 4 of Exhibit ___ (JS-4), presents an extremely disaggregated approach to each of the three aspects of the forecast mentioned above. The Company forecast, on the other hand, as shown in Exhibit ___ (WCW-1), is aggregate in approach.

Q. Why does ESRG use such a disaggregated approach in forecasting commercial energy consumption?

A. We at ESRG find that to produce an adequate, accurate forecast, one must tie the forecasting methodology as closely as possible to the actual energy consuming end-uses. In the residential sector this leads to the end-use by end-use analysis both ESRG and the Company employ. We have continued this pattern of end-use analysis in our commercial forecast. For each of five building

types we identify four separate end-uses. Each building type/ end-use combination is forecast separately. For each such combination, the effects of growth in demand and changes in intensity of use are modeled separately, and then combined to provide the forecast for that combination. Based upon our knowledge and experience in this area, we believe that our forecasting approach represents the greatest degree of end-use disaggregation which can be achieved given the current availability of data in commercial sector consumption.

Q. Does the Company provide a comparable analysis?

A. No, it does not. As shown in Exhibit ___(WCH-2), pp. 220 and 221, with the exception of employment forecasts obtained from Wharton Econometric Forecasting Associates, all of the data is in aggregate form. Even the Wharton data is reduced to aggregate form before it is utilized. In the first paragraph on page 221, we find two key variables presented in an extremely aggregate form. These variables are square feet per commercial employee and electrical consumption per square foot in new commercial buildings. This second factor is in turn linked to other aggregate assumptions concerning conservation and the addition of new types of loads.

Q. How does the Company use of this aggregate data affect their forecast?

A. As I will show through a detailed analysis of each of the two items mentioned above, the Company's use of aggregate data accounts for the bulk of the difference with the ESRG commercial energy forecast.

Q. Please begin your discussion of the Company's use of its aggregate figure for square feet per commercial employee.

A. Wharton Econometric Forecasting Associates have supplied the Company with estimates of employment growth for the years 1975 to 1987. This information is disaggregated by type of business. From this information, PECO has derived an estimate of the total commercial square footage added in the 1978/88 period. This estimate was made by taking the total forecast employment growth and, assuming that there will be 465 square feet per employee, multiplying to obtain the square footage estimate. The PECO estimate is 121 million square feet. This represents a 22.3 percent increase over PECO's estimate of 1978 total commercial square footage.

The use of single estimates of the square footage per commercial employee represents a monumental simplification of the actual state of affairs. In Table 4.3 of Exhibit ___ (JS-4), I show detailed information concerning the number of square feet per employee. Because of the extreme variation shown in Table 4.3, the ESRG forecast of growth in commercial square footage is developed in the detail suggested by Table 4.3. The procedure is discussed in Exhibit ___ (JS-4). In Exhibit ___ (JS-2), Schedule C, I have developed an estimate of 1985 commercial floor space beginning with the disaggregated 1975 commercial floor space as developed by ESRG (and consistent with PECO total existing commercial floor space estimates) and applying the appropriate growth rates from the data developed by Wharton Associates. This computation makes exactly the same assumption of proportionality

between growth in employment and square footage as was made in the Company forecast, only the level of aggregation is different. Despite this similarity in method, the growth shown is strikingly different from that found by PECO. Instead of the addition of 121 million square feet in the 1978/88 period we find only 56 million in the 1975/85 period.

Q. Can you explain how such a difference is possible?

A. Yes, a simple example will make it clear. Suppose one had two types of business, the first with 200 square feet per employee and the second with 400. Then the average would be 300 square feet per employee. Now suppose the first business added 15 employees and the second 5. Using the average, one would expect $300 \times (15 + 5) = 6000$ square feet of additional floor space corresponding to these 20 employees. In fact, what we would find would be $200 \times 15 + 400 \times 5 = 3000 + 2000 = 5000$, or 20% less than the use of an average figure for square feet per employee would suggest.

Q. Can you estimate the effect of an overestimate of commercial square footage growth on the Company base forecast for the commercial sector?

A. Yes, I can. Using the growth rate in square feet per year developed in Schedule C of Exhibit ___ (JS-2) and the 1975 ESRG estimate of commercial floor space, I calculate that there would be 63 million square feet of commercial floor space added in the 1978/88 period. Following PECO's forecast procedure, I multiply by 34 KWH

per square foot and deduct 20% for conservation to obtain an additional 1850 million KWH of consumption in 1988. The corresponding figure in the PECO forecast is 3260 million KWH. The substitution of the estimate of floor space growth made on the basis of disaggregated input data thus reduces the Company's forecast of commercial energy consumption in 1988 from 12,320 to 10,754. This accounts for over half of the difference between the Company and ESRG forecasts.

Q. Is your use of ESRG data for 1975 commercial consumption consistent with PECO's commercial forecast assumptions?

A. Yes, it is. PECO presents its forecast of floor space growth from a base of 543 million square feet in 1978. Use of the above procedure produces an estimate of 541 million square feet for 1978.

Q. Please begin your discussion of the use by the Company of an aggregate figure for electrical consumption per square foot as a basis for forecasting the consumption in new commercial buildings.

A. It is simply not possible to reduce all of the information on the intensity of commercial energy consumption to a single number without collapsing a great number of essential distinctions and introducing the potential for substantial errors. In the ESRG forecast, the corresponding information is developed separately for each building and end-use as shown in Table 8.12 of Exhibit___ (JS-4). As explained in the text accompanying Table 8.12, the data on intensity of consumption per square foot is based upon an

updated version of the well-known information developed by A. D. Little, Inc. in its analysis of the ASHRAE 90-75 building standards. PECO has relied upon this A. D. Little analysis in determining its commercial conservation effects. The use of a single intensity figure is particularly troubling in light of the data presented by the Company on the extent of variation in the intensity of energy consumption in the commerical sector. As shown in Exhibit ___ (WCH-1), p. 210, among office buildings alone, the intensity of energy consumption differs by a factor of more than two. In addition to the single intensity figure itself, I have a great deal of difficulty with the Company's separation of basic intensity from conservation and saturation effects.

As I mentioned earlier, the question of intensity of energy consumption is interwoven with changes in the saturation of heating and cooling loads and the application of conservation. All of these factors are separated and treated as individual aggregate effects by the Company when in fact they are each specific to a particular building type/end-use combination and their results are inextricably linked.

Faced with all of these methodological shortcomings, I am forced to conclude that the treatment of the intensity of electric consumption in the Company base forecast of commercial energy consumption is so flawed that it places the adequacy and accuracy of the entire portion of the forecast in question.

FILE CONTINUED