PRELIMINARY UNION ELECTRIC COMPANY
PEAK DEMAND PROJECTION

A REPORT TO THE CALLAWAY PROJECT TASK FORCE

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SUMMARY AND CONCLUSIONS

The Staff has prepared a tentative projection of Union Electric's (UE) future peak loads as an aid to studying the need for the Callaway nuclear units. The peak load is the maximum kilowatt demand which an electric utility must be prepared to meet with its generating capacity. Due to the long lead time (10 to 12 years) to construct a nuclear power plant, it is extremely important to have a good forecast of future needs if the consumer is to avoid paying excessive rates. This problem has been magnified in the last decade by a reduction in the rate at which consumer demand has been growing, implying that if a company does build too much generating capacity it will be longer before this excess capacity can be absorbed by increased demand.

The Staff's projection of UE's peak load is based on trend analysis. Trend analysis is a statistical technique which allows the researcher to study how the value of a variable (for instance, peak load) changes through time. It is then possible to project the probable values of this variable into the future. In order to have a high degree of confidence in these projections it is necessary that they are found to be accurate and that they remain relatively stable as new data becomes available.

For the purposes of projecting peak load, both the Staff and UE have divided peak into base and temperature sensitive components. Base load represents that component of peak electricity demand which does not depend on temperature. Examples of base load would be the use of lights or an electric range in the home, refrigeration units in a grocery store and machinery driven by electric motors in a manufacturing concern. Temperature sensitive load is that portion of peak demand which is due to the use of air conditioners (A/C) in the summer and electric heating in the winter. Temperature sensitive load was further divided into that due to residential customers and that due to commercial enterprises. These three components of peak demand (base load and residential and commercial temperature sensitive load) were each projected and the results added together to arrive at projected system peak demand.

In order to make a forecast, the statistician must build a mathematical model which involves the choice of what variables to use and how these variables are related. The quality of the forecast depends on the appropriateness of these choices. Once these decisions are made, the statistician uses a computer to estimate the model and other values which, in part, help to determine the appropriateness of these decisions.

To project the future values of base load, UE decided base load depended on the sales of electricity to large commercial and industrial customers and on the passage of time. One problem in this is that sales to large users is more sensitive to economic conditions than the base load it is supposed to predict. This is an inappropriate statistical procedure which will tend to make projections unstable. In addition, UE chose a relationship between its variables which will tend to project values of base load which grow rapidly. The Staff found UE's forecast of base load has been too high in the past and that it has consistenly had to be revised downward as new data became available.

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The Staff's model used only time to explain the movement of base load and chose a relationship between base load and time which seemed to reflect the actual growth in base load much more accurately. Besides providing projections which were more accurate and stable, the Staff's projections of base load are much lower than UE's. It is shown in the text that a high level of confidence can be attached to the Staff's projections.

The projection of commercial A/C demand by UE grows at an annual rate of 5%. The Staff estimated the trend of commercial A/C demand and projected this trend. Once again, these projections were lower than UE's and were found to be more accurate and more stable over time. This would, again, imply that more confidence can be attached to the Staff's projections.

The Staff checked UE's projections of residential A/C demand carefully and found these to be both accurate and stable and, therefore, accepted these results.

The Staff's analysis has demonstrated two important results. One, UE's peak forecast has required downward revision every year since the Arab oil embargo and that these downward revisions have been approaching the relatively stable values forecast by the Staff. Second, the accuracy and stability of the Staff's projections demonstrate that it is possible to provide estimates to future peak demand to which a high degree of confidence can be attached.

The results of this study are summarized in Figure A following this section. Shown on the graph are the Staff's projection and UE's forecast of the load. As indicated on the Figure for 1987, the Staff model projects a load requirement of approximately 7,800 megawatts while the UE model forecasts approximately 8,830 megawatts.

Also shown on the graph is the planned plant capacity to be installed by UE. In 1982 and 1987 UE plans to add the generating capacity of Callaway Units 1 and 2 respectively. When comparing the available capacity after Callaway Unit 1 is generating power in 1982 with the estimated load requirements as projected by the Staff model, the graphs clearly show that there is excess system capacity available from Unit 1 through 1988.

While Unit 2 is planned for completion in 1987, the graph shows that it is not needed until after 1988. If Unit 2 were finished as UE plans, there will be approximately 1,350 megawatts of excess capacity in 1987 above that which is projected by the Staff model.

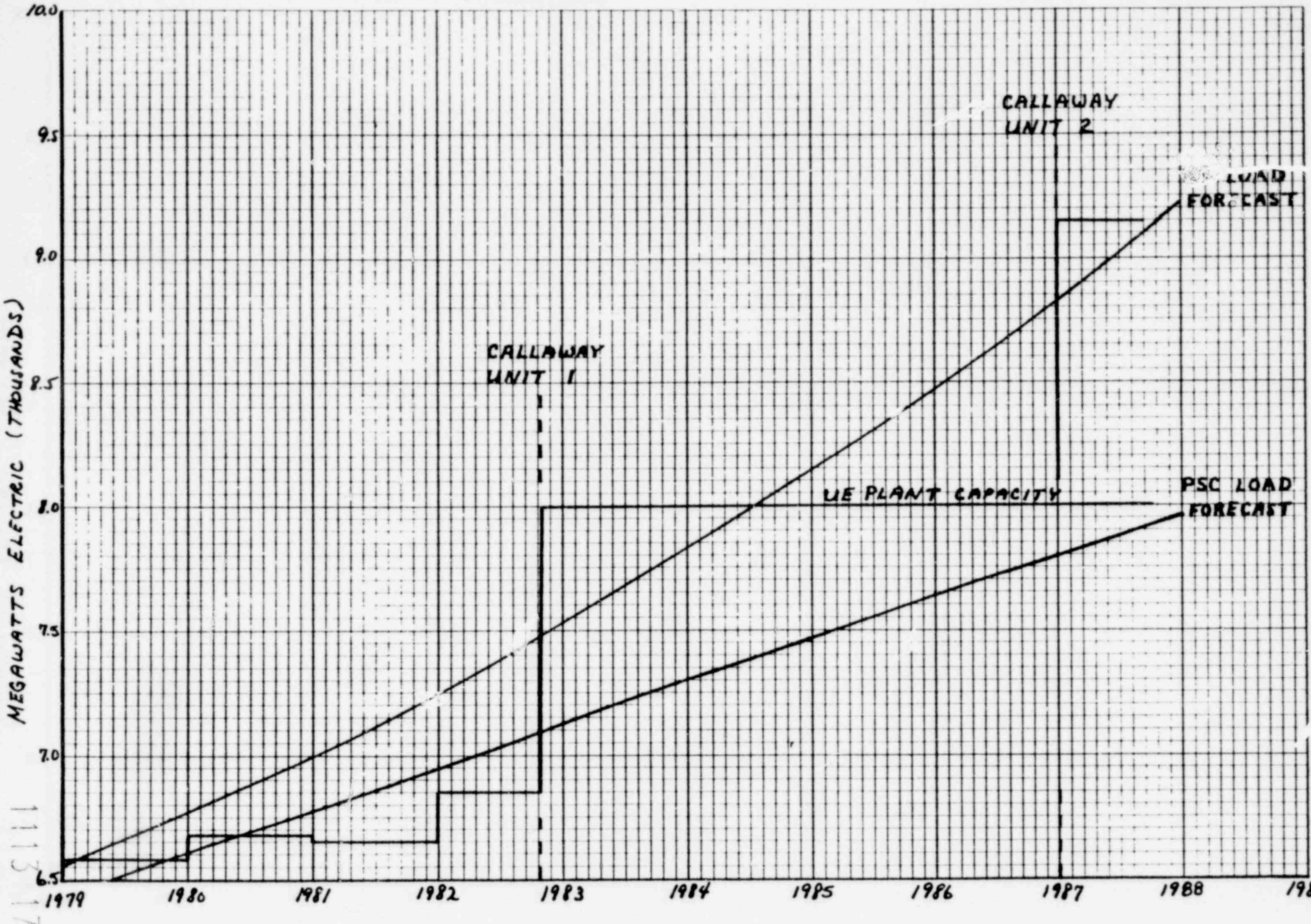

FIGURE A

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PEAK DEMAND PROJECTION

-DETAILS-

I. BASE LOAD

Base load represents that component of peak demand which is independent of occurring weather. Union Electric uses large power sales (LPS) and time (t) to project base load ($BASE_{mw}$). LPS is defined as annual billed GWH sales to large commercial (purchases of more than 300,000 KWH/year) and industrial customers. Since LPS is the driver in this model, it must be forecast. As far as can be determined, UE primarily uses judgment to project LPS rather than a quantitative model. Time is a proxy variable to account for the growth in base load caused by variables not include in the equation.

The functional forms used by UE and the PSC Staff are the following:

UE: $\ln(BASE_{mw}) = a + b_1[\ln(LPS)] + b_2(t) + u$

PSC: $BASE_{mw} = a + b[\ln(t)] + v$

with the associated computer runs including 1979-1998 projections being found as Schedules 1(UE) and 2(PSC) in the Appendix. The statistics associated with both models are quite encouraging except that positive serial correlation is indicated for the Staff's model while its presence is indeterminant in UE's model. Since this is a possible sign that the wrong functional form has been fit to the data, a check was made of model residuals for the years 1964-78. No serial correlation was found to exist in these latter years which are the most important for forecasting purposes.

The summer base load projections based on UE's and the Staff's models can be seen graphically in Figure 1 and numerically in Table 1.[2] The Staff felt discrepancies of this magnitude should

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[2] In addition to the model projections, the base load projection for UE includes an "other base" component which UE uses to reflect expected growth in base load from conversions of other energy sources to electricity.

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COMPARISON OF PROJECTED SUMMER BASE LOADS, 1979-1998

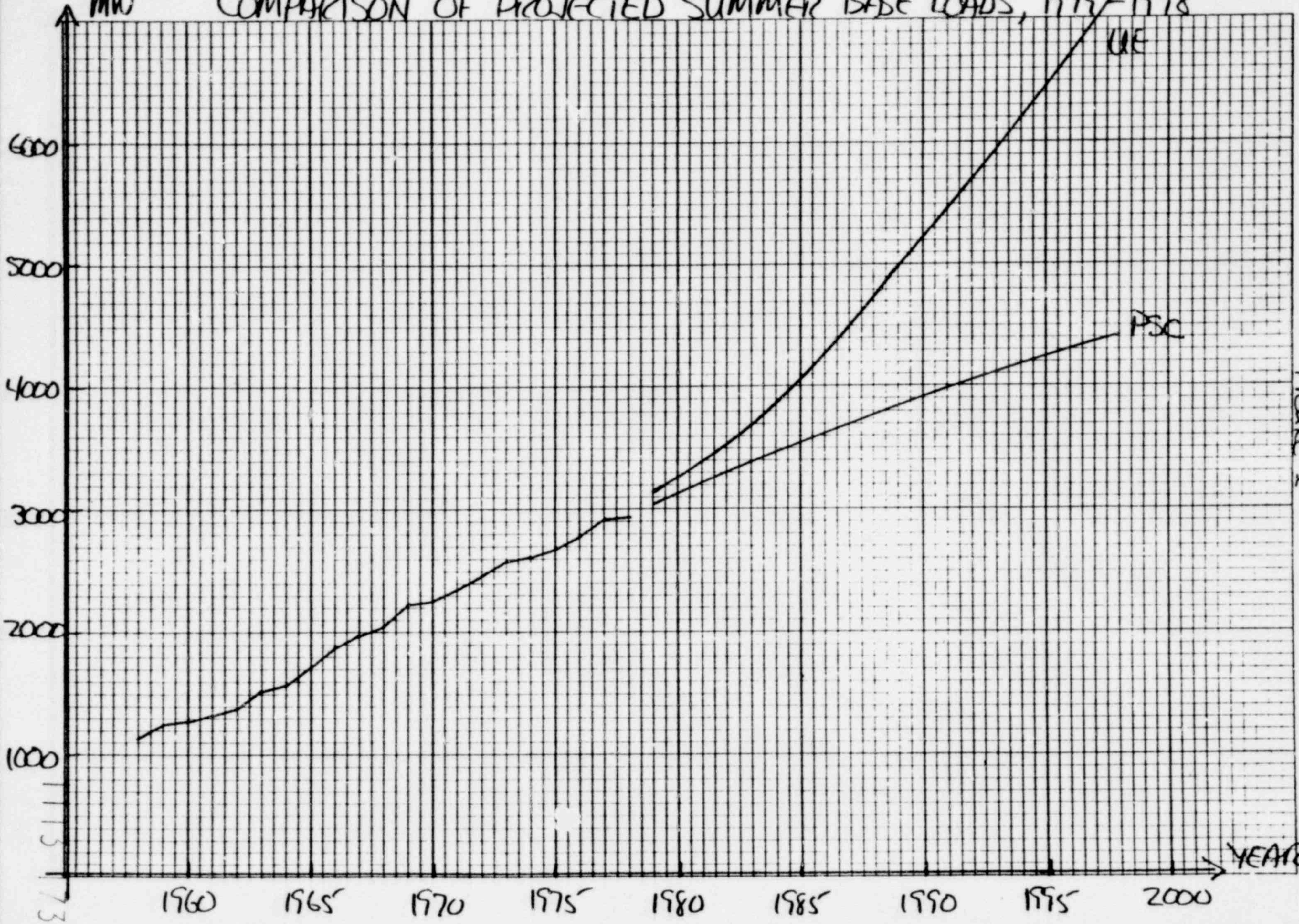

FIGURE 1

TABLE 1

COMPARISON OF PROJECTED BASE LOAD

YEAR	PROJECTED PEAK PSC	UE	GROWTH RATES PSC	UE
1965	1724	1724	8.50	8.50
1966	1886	1886	9.40	9.40
1967	1981	1981	5.04	5.04
1968	2047	2047	3.33	3.33
1969	2224	2224	8.65	8.65
1970	2256	2256	1.44	1.44
1971	2354	2354	4.34	4.34
1972	2469	2469	4.89	4.89
1973	2592	2592	4.98	4.98
1974	2612	2612	0.77	0.77
1975	2679	2679	2.57	2.57
1976	2793	2793	4.26	4.26
1977	2917	2917	4.44	4.44
1978	2933	2933	0.55	0.55
1979	3042	3130	3.72	6.71
1980	3124	3250	2.70	3.84
1981	3204	3376	2.56	3.87
1982	3284	3527	2.50	4.49
1983	3362	3690	2.38	4.61
1984	3440	3864	2.32	4.72
1985	3516	4055	2.21	4.94
1986	3592	4268	2.16	5.25
1987	3667	4494	2.09	5.29
1988	3741	4733	2.02	5.31
1989	3814	4974	1.95	5.11
1990	3887	5210	1.91	4.74
1991	3958	5450	1.83	4.61
1992	4029	5695	1.79	4.49
1993	4099	5940	1.74	4.30
1994	4168	6193	1.68	4.26
1995	4237	6453	1.66	4.19
1996	4305	6720	1.60	4.13
1997	4372	6998	1.56	4.15
1998	4439	7265	1.53	4.10

be checked very carefully, especially since both projections are based on models with "good statistics".

It is desirable to check both the accuracy and the stability provided by the two models. Both of these checks were made on the basis of sequential model estimates. To accomplish this, the historical data series were truncated to 1971 and both models estimated for the years 1958-71 with projections being made through 1998. The same estimation procedure was carried out for the years 1958-72, then 1958-73, etc. so that a total of 8 years' forecasting "experience" could be gained for each model. It was then possible to check the accuracy of the models by comparing the forecasts through 1978 with the values which actually occurred and to check the stability over the forecast period by comparing the sequence of forecast values for a particular year, say 1988, generated by the set of truncated models.

The comparative accuracy of UE's and the Staff's models can be seen by looking at Table 2. The row headings in Table 2 indicate the year of the last observation included in the truncated model while the entries are the forecasts given by that model for the year designated in the column heading. For example, the value 2870 found in the top half of Table 2 in the row labeled 1973 and column labeled 1976 means that UE's model projected 1976 summer base load to be 2870 MW when the forecast was made from data available through 1973. The number beneath 2870 in parenthesis (2.76) is the percentage error between the forecast and the value actually occurring in that year.

Two interesting comparisons of the models are revealed in Table 2. First, using the sequential forecasts for 1978 (see the

TABLE 2

ACCURACY OF BASE LOAD MODELS

YEAR OF FORECAST	FORECASTED VALUE 1972	1973	1974	1975	1976	1977	1978
UE MODEL							
1971	2451 (0.73)	2567 (0.96)	263[illegible] (0.88)	2688 (0.34)	2838 (1.61)	3005 (3.02)	3097 (5.59)
1972		2582 (0.39)	2655 (1.65)	2715 (1.34)	2868 (2.69)	3037 (4.11)	3135 (6.89)
1973			2654 (1.61)	2716 (1.38)	2870 (2.76)	3039 (4.18)	3140 (7.06)
1974				2694 (0.56)	2845 (1.86)	3013 (3.29)	3106 (5.90)
1975					2841 (1.72)	3008 (3.12)	3100 (5.69)
1976						2975 (1.99)	3063 (4.43)
1977							3055 (4.16)
PSC MODEL							
1971	2419 (2.03)	2506 (3.32)	2593 (0.73)	2678 (0.04)	2761 (1.15)	2844 (2.50)	2926 (0.24)
1972		2519 (2.82)	2606 (0.23)	2692 (0.49)	2777 (0.57)	2861 (1.92)	2944 (0.38)
1973			2623 (0.42)	2711 (1.19)	2797 (0.14)	2882 (1.20)	2966 (1.13)
1974				2708 (1.08)	2794 (0.04)	2879 (1.30)	2963 (1.02)
1975					2788 (0.18)	2872 (1.54)	2956 (0.78)
1976						2873 (1.51)	2957 (0.82)
1977							2965 (1.09)
ACTUAL VALUE:	2469	2592	2612	2679	2793	2917	2933

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column labeled 1978) as an example, the UE model has shown a reduction in the forecasted value for 1978 for every year since 1973. The Staff model 1978 forecast has remained much more stable. In addition, the UE 1977 forecast of 1978 base load was still substantially above the realized value while the 1977 Staff forecast, although higher, was much closer. The important point here is that the UE model requires regular downward revision of forecasts yet is still well above the realized value.

The second point of note in Table 2 is that the percentage errors associated with UE's forecasts are substantially higher than those associated with the Staff's forecasts. Hence, the Staff's model appears to provide ex post forecasts which are more accurate and more stable than UE's model.

Table 3 provides a comparison of the ex ante forecasts of the two models. A row reports the forecast for that year made by each of the 8 sequential model estimates. A column reports the forecasts made by the associated truncated model for each of the 20 years 1979-98. To study forecast stability for a particular year, say 1988, find the row labeled 1988 and study the change in values as years are added to the estimation period. If UE and Staff forecasts are compared for any year, it is seen that the instability associated with UE's forecasts (and mentioned with regard to Table 2) is still present with a tendency for downward revision after 1973. The seriousness of this downward revision becomes very obvious when the forecasts for 1998 are studied.

TABLE 3

COMPARISON OF SEQUENTIAL BASE LOAD FORECASTS BASED ON UE'S MODEL

FORECAST BASED ON DATA ENDING IN THE FOLLOWING YEARS

YEAR	1971	1972	1973	1974	1975	1976	1977	1978
1979	3209	3252	3273	3227	3217	3194	3168	3130
1980	3341	3389	3414	3360	3349	3324	3294	3250
1981	3480	3533	3561	3501	3488	3459	3426	3376
1982	3624	3684	3716	3648	3633	3601	3564	3507
1983	3776	3843	3878	3802	3786	3750	3708	3645
1984	3935	4009	4048	3964	3946	3905	3859	3789
1985	4102	4183	4226	4133	4113	4069	4018	3940
1986	4276	4366	4413	4311	4289	4240	4184	4098
1987	4460	4558	4610	4497	4473	4419	4357	4264
1988	4652	4760	4816	4693	4666	4607	4540	4438
1989	4854	4971	5033	4898	4869	4805	4731	4619
1990	5066	5193	5261	5114	5082	5012	4932	4810
1991	5288	5426	5500	5340	5306	5229	5142	5010
1992	5521	5672	5751	5578	5541	5458	5363	5220
1993	5766	5929	6015	5827	5787	5697	5595	5440
1994	6021	6197	6291	6087	6044	5946	5836	5668
1995	6289	6479	6580	6360	6313	6208	6089	5908
1996	6570	6776	6885	6647	6596	6483	6354	6160
1997	6866	7087	7204	6948	6894	6772	6633	6423
1998	7176	7414	7541	7265	7206	7075	6926	6700

COMPARISON OF SEQUENTIAL BASE LOAD FORECASTS BASED ON PSC'S MODEL

FORECAST BASED ON DATA ENDING IN THE FOLLOWING YEARS

YEAR	1971	1972	1973	1974	1975	1976	1977	1978
1979	3006	3025	3049	3045	3038	3039	3048	3042
1980	3086	3106	3131	3127	3119	3121	3130	3124
1981	3165	3185	3212	3208	3200	3201	3210	3204
1982	3242	3264	3291	3288	3279	3280	3290	3284
1983	3319	3342	3370	3366	3357	3359	3369	3362
1984	3395	3418	3448	3444	3435	3436	3447	3440
1985	3470	3494	3525	3521	3511	3513	3524	3516
1986	3544	3569	3601	3597	3587	3588	3600	3592
1987	3617	3643	3677	3672	3662	3663	3675	3667
1988	3689	3717	3751	3746	3735	3737	3750	3741
1989	3761	3789	3825	3820	3808	3810	3823	3814
1990	3832	3861	3897	3892	3881	3882	3896	3887
1991	3902	3931	3969	3964	3952	3954	3968	3958
1992	3971	4001	4040	4035	4023	4024	4039	4029
1993	4039	4071	4111	4105	4092	4094	4109	4099
1994	4107	4139	4180	4175	4162	4163	4179	4168
1995	4174	4207	4249	4243	4230	4232	4248	4237
1996	4240	4274	4317	4311	4298	4299	4316	4305
1997	4306	4341	4385	4379	4365	4366	4383	4372
1998	4371	4406	4452	4445	4431	4433	4450	4439

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II. COMMERCIAL A/C DEMAND

The commercial A/C demand at temperature corrected peak has been projected by UE at an annual growth rate of 5%. Although conversations with UE's forecasting personnel indicate that the process used by the Company is much more complex than this (and will be reviewed in detail when the necessary data is received), the projections currently in hand, however they were arrived at, show this constant growth rate.

The Staff tried several models of commercial A/C demand and found a simple linear function of time to provide the best overall performance, see Schedule 3 in the Appendix. This model projects growth as a constant absolute amount each year as opposed to UE's constant rate of growth which implies a larger absolute amount of growth each year.

A comparison of the projections made by both models can be found graphically in Figure 2 and numerically in Table 4. Again a relatively large divergence between UE and Staff projections can be seen and, as a result, it was felt desirable to study the accuracy and stability of the two models. Table 5 was developed to compare accuracy and should be read in the same manner as Table 2 while Table 6 shows the sequential commercial A/C demand projections and is similar to Table 3.

Examination of Table 5 shows the Staff model to have a marked tendency to greater accuracy than UE's model and Table 6 shows greater stability in the Staff's sequential forecasts although in neither case is the difference as dramatic as in the case of base load. Looking at Figure 2, the Staff's extension of the historical data series would seem to be a more natural one than that provided

COMPARISON OF PROJECTED COMMERCIAL A/C DEMAND, 1977-1998

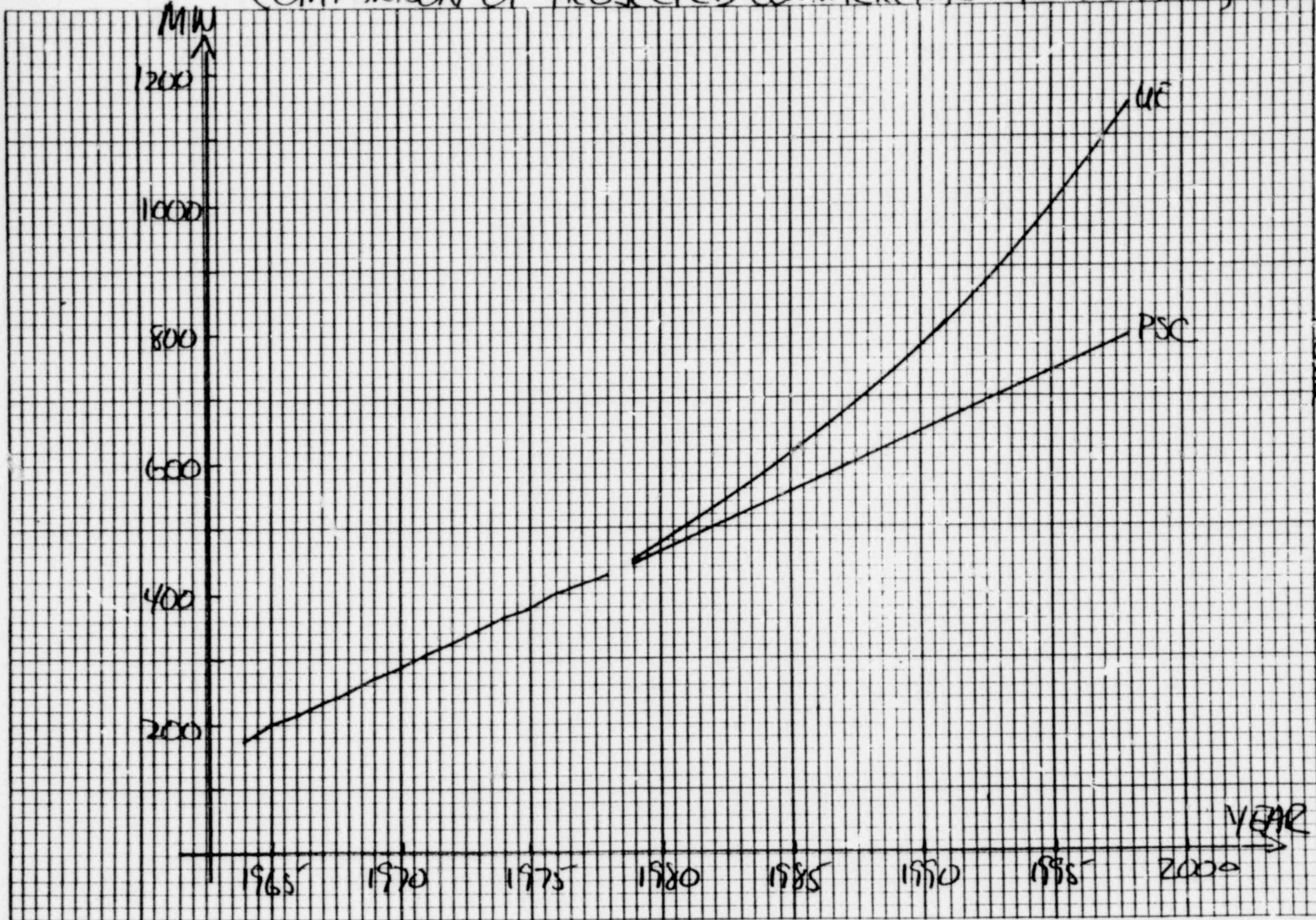

FIGURE 2

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TABLE 4

COMPARISON OF PROJECTED COMMERCIAL A/C PEAK LOADS

YEAR	PROJECTED PEAK PSC	PROJECTED PEAK UE	GROWTH RATES PSC	GROWTH RATES UE
1965	200	200	7.62	7.62
1966	215	215	7.30	7.30
1967	233	233	8.30	8.30
1968	251	251	7.97	7.97
1969	272	272	8.13	8.13
1970	289	289	6.23	6.23
1971	307	307	6.27	6.27
1972	324	324	5.60	5.60
1973	345	345	6.35	6.35
1974	365	365	5.83	5.83
1975	380	380	4.10	4.10
1976	401	401	5.70	5.70
1977	417	417	4.00	4.00
1978	431	431	3.29	3.29
1979	452	453	4.90	5.00
1980	470	475	3.99	5.00
1981	488	499	3.84	5.00
1982	507	524	3.70	5.00
1983	525	550	3.57	5.00
1984	543	578	3.44	5.00
1985	561	607	3.33	5.00
1986	579	637	3.22	5.00
1987	597	669	3.12	5.00
1988	615	702	3.03	5.00
1989	633	738	2.94	5.00
1990	651	774	2.85	5.00
1991	669	813	2.77	5.00
1992	687	854	2.70	5.00
1993	705	896	2.63	5.00
1994	723	941	2.56	5.00
1995	741	988	2.50	5.00
1996	759	1038	2.44	5.00
1997	777	1090	2.38	5.00
1998	796	1144	2.32	5.00

TABLE 5

ACCURACY OF COMMERCIAL A/C DEMAND MODELS

YEAR OF FORECAST	FORECASTED VALUE 1972	1973	1974	1975	1976	1977	1978
UE MODEL							
1971	322 (0.62)	338 (2.03)	355 (2.74)	373 (1.84)	392 (2.24)	411 (1.44)	432 (0.23)
1972		340 (1.45)	357 (2.19)	375 (1.32)	394 (1.75)	414 (0.72)	434 (0.70)
1973			362 (0.82)	380 (-)	399 (0.50)	419 (0.48)	440 (2.09)
1974				383 (0.79)	402 (0.25)	422 (1.20)	443 (2.78)
1975					399 (0.50)	419 (0.48)	440 (2.09)
1976						422 (1.20)	443 (2.78)
1977							438 (1.62)
PSC MODEL							
1971	323 (0.31)	341 (1.16)	358 (1.92)	376 (1.05)	394 (1.75)	411 (1.44)	429 (0.46)
1972		341 (1.16)	359 (1.64)	377 (0.79)	394 (1.75)	412 (1.20)	429 (0.46)
1973			360 (1.37)	378 (0.53)	396 (1.25)	414 (0.72)	432 (0.23)
1974				380 (-)	398 (0.75)	416 (0.24)	434 (0.70)
1975					398 (0.75)	416 (0.24)	434 (0.70)
1976						417 (-)	435 (0.93)
1977							435 (0.93)
ACTUAL VALUE:	324	345	365	380	401	417	431

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TABLE 6

COMPARISON OF SEQUENTIAL COMMERCIAL A/C FORECASTS BASED ON UE'S MODEL

FORECAST BASED ON DATA ENDING IN THE FOLLOWING YEARS

YEAR	1971	1972	1973	1974	1975	1976	1977	1978
1979	454	456	462	466	462	465	460	453
1980	476	479	485	489	485	488	483	475
1981	500	503	509	513	509	512	507	499
1982	525	528	535	539	534	538	533	524
1983	551	554	562	566	561	565	559	550
1984	579	582	590	594	589	593	587	578
1985	608	611	619	624	619	623	617	607
1986	638	642	650	655	650	654	648	637
1987	670	674	683	688	682	687	680	669
1988	704	708	717	722	716	721	714	702
1989	739	743	753	758	752	757	750	738
1990	776	780	790	796	790	795	787	774
1991	814	819	830	836	829	835	827	813
1992	855	860	871	878	870	876	868	854
1993	898	903	915	922	914	920	911	896
1994	943	948	960	968	960	966	957	941
1995	990	996	1008	1016	1008	1014	1005	988
1996	1040	1045	1059	1067	1058	1065	1055	1038
1997	1091	1098	1112	1121	1111	1118	1108	1090
1998	1146	1153	1167	1177	1167	1174	1163	1144

COMPARISON OF SEQUENTIAL COMMERCIAL A/C FORECASTS BASED ON PSC'S MODEL

FORECAST BASED ON DATA ENDING IN THE FOLLOWING YEARS

YEAR	1971	1972	1973	1974	1975	1976	1977	1978
1979	446	447	449	452	452	453	453	452
1980	464	465	467	470	470	471	472	470
1981	482	482	485	488	488	490	490	488
1982	499	500	503	506	506	508	508	507
1983	517	518	521	524	524	526	526	525
1984	534	535	538	542	542	544	544	543
1985	552	553	556	560	560	562	562	561
1986	569	570	574	578	578	580	581	579
1987	587	588	592	596	596	598	599	597
1988	605	606	610	614	614	617	617	615
1989	622	623	628	632	632	635	635	633
1990	640	641	645	650	650	653	653	651
1991	657	659	663	668	668	671	671	669
1992	675	676	681	686	686	689	690	687
1993	692	694	699	704	704	707	708	705
1994	710	712	717	722	722	725	726	723
1995	728	729	735	740	740	744	744	741
1996	745	747	752	758	758	762	762	759
1997	763	764	770	776	776	780	780	777
1998	780	782	788	794	794	798	799	796

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by UE's constant rate of growth. In fact, the actual rate of growth in commercial A/C demand has shown a downward trend since the beginning of the 1970's, see Table 4.

It should be noted that at this time there is a substantial difficulty associated with the data series representing commercial A/C demand and also residential A/C demand which is defined as the difference between system temperature sensitive demand and commercial A/C demand. The problem is that commercial A/C demand is derived from a diversity factor applied to installed commercial A/C capacity. The diversity factor is of primary importance since it determines how temperature sensitive demand is broken into its commercial and residential components. This separation is important because, as will be seen in the next section, the two components seem to be following different growth patterns. UE is currently developing a new methodology for estimating the diversity factor and the Staff will also study this whole problem carefully in the future. The point is that a revision in both Company and Staff projections of the two components of temperature sensitive demand is likely although conversations with the Company's personnel indicate they expect the impact on system peak to be small.

III. RESIDENTIAL A/C DEMAND

As was mentioned in Section II, UE uses a residual series to represent residential A/C demand at temperature corrected peak. This component's projection is based on a regression of the residual variable against DEMAND (the product of number of customers, KW demand at temperature corrected peak and percent A/C saturation) and DUMMY (to account for the conservation effect showing up after the OPEC oil embargo). This dummy variable allows a gradual adjustment in the 1974-77 period. The functional form of the model is the following:

$$RES_{mw} = a + b_1 \text{ DEMAND} + b_2 \text{ DUMMY} + u$$

The model computer run can be found as Schedule 4 in the Appendix and the projections can be found graphically in Figure 3 and numerically in Table 7.

This circuitous approach was adopted by UE because the residual nature makes their residential variable depend on the diversity factor adopted for commercial A/C. It might be thought that DEMAND could be used to represent the residential component leaving commercial A/C as a meaningful residual, however, the only component of DEMAND known with any confidence is number of customers. As a result, the absolute value of DEMAND is not dependable.

The UE model is somewhat unconventional and very difficult to interpret although its projections seem very reasonable compared to historical growth and no alternative model could be found, given the data which the Staff currently has, which provided projections as accurate and stable as UE's. However, the same caveat should

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PROJECTED RESIDENTIAL A/C DEMAND, 1979-1998

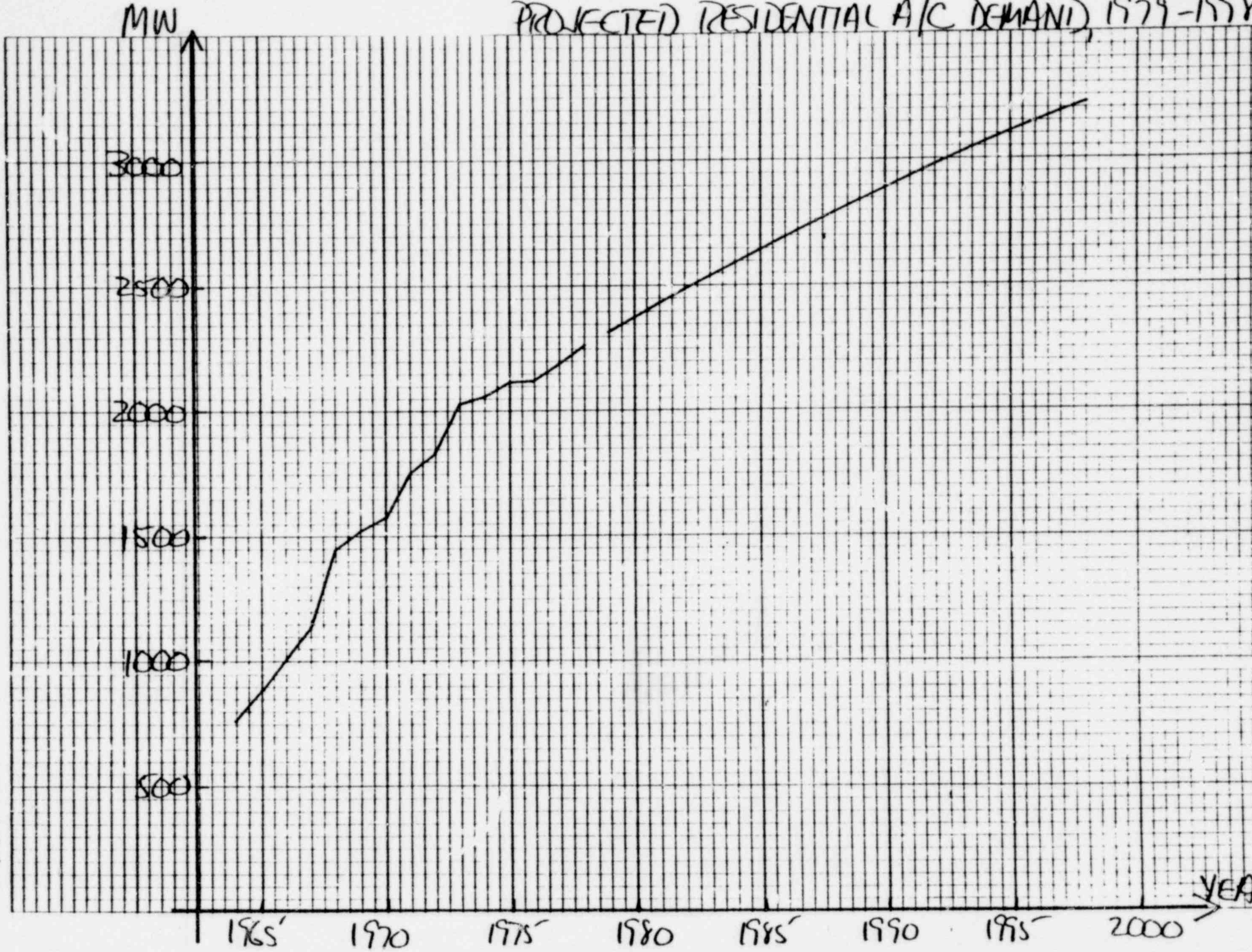

FIGURE 3

TABLE 7

PROJECTED RESIDENTIAL A/C PEAK LOADS

YEAR	PROJECTED PEAK	GROWTH RATES
1965	891	15.84
1966	1019	14.41
1967	1146	12.48
1968	1452	26.65
1969	1524	5.00
1970	1585	4.01
1971	1759	10.97
1972	1837	4.42
1973	2033	10.69
1974	2053	0.98
1975	2121	3.31
1976	2126	0.21
1977	2196	3.29
1978	2266	3.20
1979	2321	2.44
1980	2374	2.27
1981	2432	2.45
1982	2491	2.42
1983	2547	2.28
1984	2605	2.25
1985	2659	2.10
1986	2714	2.07
1987	2766	1.91
1988	2811	1.62
1989	2852	1.48
1990	2894	1.47
1991	2937	1.47
1992	2980	1.46
1993	3023	1.46
1994	3064	1.34
1995	3105	1.34
1996	3150	1.45
1997	3191	1.33
1998	3230	1.21

TABLE 8

ACCURACY OF RESIDENTIAL A/C DEMAND MODEL

YEAR OF FORECAST	FORECASTED VALUE 1972	1973	1974	1975	1976	1977	1978
1971	1915 (4.25)	2051 (0.89)	2163 (5.36)	2250 (6.08)	2340 (10.07)	2408 (9.65)	2466 (8.83)
1972		2017 (0.79)	2125 (3.51)	2209 (4.15)	2269 (6.73)	2361 (7.51)	2418 (6.71)
1973			2131 (3.80)	2216 (4.48)	2303 (8.33)	2369 (7.88)	2426 (7.06)
1974				2059 (2.92)	2067 (2.78)	2133 (2.87)	2190 (3.35)
1975					2147 (0.99)	2212 (0.73)	2269 (0.13)
1976						2198 (0.09)	2255 (0.49)
1977							2254 (0.53)
ACTUAL VALUE:	1837	2033	2053	2121	2126	2196	2266

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TABLE 9

COMPARISON OF SEQUENTIAL RESIDENTIAL A/C FORECASTS BASED ON UE'S MODEL

FORECAST BASED ON DATA ENDING IN THE FOLLOWING YEARS

YEAR	1971	1972	1973	1974	1975	1976	1977	1978
1979	2532	2481	2490	2254	2333	2319	2318	2321
1980	2587	2534	2543	2307	2385	2371	2370	2374
1981	2647	2592	2601	2365	2443	2429	2428	2432
1982	2708	2650	2660	2424	2502	2488	2487	2491
1983	2766	2707	2717	2481	2558	2545	2544	2547
1984	2825	2764	2774	2538	2616	2602	2601	2605
1985	2882	2818	2829	2593	2670	2657	2656	2659
1986	2939	2873	2884	2648	2725	2712	2711	2714
1987	2992	2925	2936	2700	2777	2764	2763	2766
1988	3038	2969	2981	2745	2821	2809	2808	2811
1989	3081	3011	3023	2787	2863	2850	2849	2852
1990	3125	3053	3065	2829	2905	2892	2891	2894
1991	3169	3095	3107	2871	2947	2934	2934	2937
1992	3213	3138	3150	2914	2990	2977	2976	2980
1993	3258	3181	3194	2958	3033	3021	3020	3023
1994	3300	3221	3234	2999	3074	3061	3060	3064
1995	3342	3262	3275	3040	3115	3102	3101	3105
1996	3388	3307	3320	3085	3159	3147	3146	3150
1997	3431	3348	3362	3126	3201	3189	3188	3191
1998	3471	3387	3401	3165	3240	3228	3227	3230

be made here as at the end of Section II. It is realized that much more research has to be done before a high degree of confidence can be placed on these results.

Although no comparisons are being made, Tables 8 and 9 are offered as an indication of the overall performance of UE's model.

IV. SYSTEM PEAK DEMAND

A comparison of projected system peak based on UE's and the Staff's models can be found graphically in Figure 4 and numerically in Table 10. Of particular interest is how these forecasts translate into capacity deficits if Callaway I is not brought on line. Tables 11 and 12 provide this information through 1988 based on the UE and Staff forecasts, respectively, including the 15% capacity reserve required by UE's power pool agreement.

The base load component is the major contributor to difference between UE's and the Staff's projections. UE's model does not seem consistent with the changes in electricity consumption which have occurred since the OPEC oil embargo. In fact, in November, 1977 UE forecast 1978 summer base to be 3040 while the actual value which occurred was 2933, a drop of 107 mw. The explanation given for this unexpected drop was the coal strike in early 1978 which caused a downward shift in consumption due to user adjustment to the conservation required during the strike. This was similar in type to the effect of the OPEC oil embargo. The unstable energy supply situation we are currently experiencing testifies to the possibility of recurring "conservation effects" in the future.

Again it should be emphasized that the Staff's projections are tenative and that a major modeling effort is currently being undertaken by the Staff to improve its forecasts. UE is currently working on the temperature sensitive component of demand and has recently retained consultants to help them with their model of the base component of peak load.

POOR ORIGINAL

COMPARISON OF PROJECTED SYSTEM PEAKS, 1979 – 1998

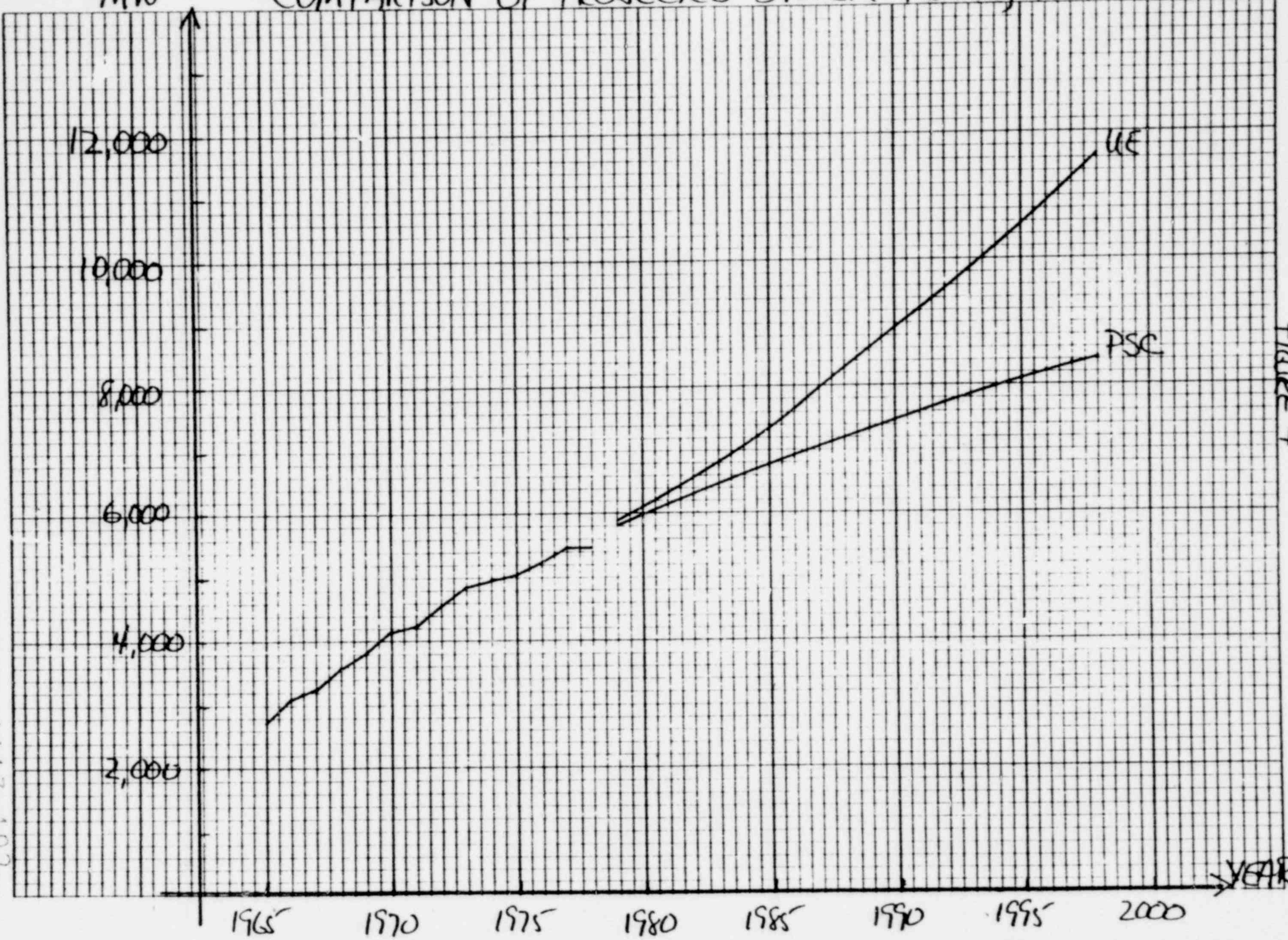

FIGURE 4

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TABLE 10

COMPARISON OF PROJECTED SYSTEM PEAKS

YEAR	PROJECTED PEAK PSC	PROJECTED PEAK UE	GROWTH RATES PSC	GROWTH RATES UE
1965	2761	2761	0.00	0.00
1966	3125	3125	13.18	13.18
1967	3249	3249	3.97	3.97
1968	3586	3586	10.37	10.37
1969	3834	3834	6.92	6.92
1970	4160	4160	8.50	8.50
1971	4249	4249	2.14	2.14
1972	4592	4592	8.07	8.07
1973	4846	4846	5.53	5.53
1974	4963	4963	2.41	2.41
1975	5037	5037	1.49	1.49
1976	5236	5236	3.95	3.95
1977	5476	5476	4.58	4.58
1978	5474	5474	-0.04	-0.04
1979	5812	5900	6.18	7.79
1980	5965	6096	2.63	3.31
1981	6121	6304	2.62	3.41
1982	6278	6539	2.56	3.73
1983	6431	6784	2.43	3.76
1984	6584	7043	2.38	3.82
1985	6733	7318	2.26	3.90
1986	6882	7616	2.21	4.08
1987	7027	7926	2.11	4.06
1988	7164	8243	1.95	4.00
1989	7296	8561	1.85	3.87
1990	7429	8876	1.82	3.67
1991	7561	9197	1.77	3.62
1992	7693	9525	1.75	3.57
1993	7824	9857	1.71	3.48
1994	7952	10195	1.63	3.44
1995	8080	10543	1.61	3.41
1996	8211	10904	1.62	3.42
1997	8338	11276	1.55	3.42
1998	8461	11656	1.48	3.37

TABLE 11

CAPACITY BALANCE SHEET*
UE FORECAST

YEAR	1 BASE LOAD	2 COMM A/C	3 RES A/C	4 FORECAST LOAD	5 LOAD ADJ'T	6 ADJ'D LOAD	7 W/15% RESERVE	8 PLANT CAPACITY	9 CAPACITY DEFICIT	 SURPLUS
1979	3130	453	2321	5904	220	5684	6537	6573		36
1980	3250	475	2374	6099	223	5876	6757	6675	-82	
1981	3376	499	2432	6307	226	6081	6993	6654	-339	
1982	3527	524	2491	6542	229	6313	7260	6854	-406	
1983	3690	550	2547	6788	232	6556	7539	6854	-685	
1984	3864	578	2605	7047	235	6812	7834	6854	-980	
1985	4055	607	2659	7321	238	7083	8145	6854	-1291	
1986	4268	637	2714	7620	241	7379	8486	6854	-1632	
1987	4494	669	2766	7929	244	7685	8838	6854	-1984	
1988	4733	702	2811	8246	247	7999	9199	6854	-2345	

*Without Callaway 1

TABLE 12

CAPACITY BALANCE SHEET*
PSC PROJECTION

YEAR	1 BASE LOAD	2 COMM A/C	3 RES A/C	4 FORECAST LOAD	5 LOAD ADJ'T	6 ADJ'D LOAD	7 W/15% RESERVE	8 PLANT CAPACITY	9 CAPACITY DEFICIT	SURPLUS
1979	3042	452	2321	5815	220	5595	6434	6573		139
1980	3124	470	2374	5968	223	5745	6607	6675		68
1981	3204	488	2432	6124	226	5898	6783	6654	-129	
1982	3284	507	2491	6281	229	6052	6960	6854	-106	
1983	3362	525	2547	6434	232	6202	7132	6854	-278	
1984	3440	543	2605	6587	235	6352	7305	6854	-451	
1985	3516	561	2659	6736	238	6498	7473	6854	-619	
1986	3592	579	2714	6885	241	6644	7641	6854	-787	
1987	3667	597	2766	7030	244	6786	7804	6854	-950	
1988	3741	615	2811	7167	247	6920	7958	6854	-1104	

*Without Callaway 1

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APPENDIX

SCHEDULE 1

SUMMER BASE LOAD: LN(BASEJL)=A+B[LN(LPS)]+C*T, 1958-78

DEGREES OF FREEDOM 18
STANDARD ERROR OF THE ESTIMATE 32.64040386
R SQUARE 0.9982251803
CORRECTED R SQUARE 0.9980280404
ERROR SUM OF SQUARES 19177.12735
DURBIN-WATSON D-STATISTIC 1.454528754
DEPENDENT VARIABLE MEAN IS 2044.714286

INDEPENDENT VARIABLES

VARIABLE MEAN	REGRESSION COEFFICIENT	COEFFICIENT STANDARD ERROR	T-STATISTIC
1.0065	1.5783	0.1861	8.4831
7285.6476	0.4997	0.0346	14.4289
68.0000	0.0233	0.0019	12.3744

OBSERVED Y	ESTIMATED Y	RESIDUAL
1123.5000	1126.2288	-2.7288
1238.0000	1237.5929	0.4071
1276.0000	1277.0508	-1.0508
1333.5000	1307.8711	25.6289
1393.0000	1403.7256	-10.7256
1522.5000	1511.6020	10.8980
1588.5000	1618.5993	-30.0993
1724.0000	1750.3270	-26.3270
1885.5000	1895.6674	-10.1674
1981.0000	1977.6937	3.3063
2047.0000	2069.8398	-22.8398
2224.0000	2187.6202	36.3798
2256.0000	2268.9586	-12.9586
2353.5000	2354.1358	-0.6358
2469.0000	2432.0775	36.9225
2591.5000	2542.0923	49.4077
2611.5000	2597.1503	14.3497
2679.0000	2634.5794	44.4206
2792.5000	2780.4170	12.0830
2916.5000	2943.3667	-26.8667
2933.0000	3020.7473	-87.7473

YEAR	PROJECTION
1979	3129.884
1980	3250.059
1981	3375.836
1982	3507.347
1983	3645.049
1984	3789.301
1985	3940.211
1986	4098.312
1987	4263.896
1988	4437.505
1989	4619.468
1990	4810.190
1991	5010.278
1992	5220.094
1993	5440.174
1994	5668.487
1995	5908.197
1996	6159.569
1997	6423.338
1998	6700.190

SCHEDULE 2

SUMMER BASE LOAD: BASEJL=A+B[LN(TIME)], 1958-78

DEGREES OF FREEDOM 19
STANDARD ERROR OF THE ESTIMATE 50.12763147
R SQUARE 0.9932916755
CORRECTED R SQUARE 0.9929386057
ERROR SUM OF SQUARES 47742.8093
DURBIN-WATSON D-STATISTIC 0.8743264028
DEPENDENT VARIABLE MEAN IS 2044.714286

INDEPENDENT VARIABLES

VARIABLE MEAN	REGRESSION COEFFICIENT	COEFFICIENT STANDARD ERROR	T-STATISTIC
1.0000	¯25268.7540	515.0705	¯49.0588
4.2155	6479.2730	122.1569	53.0406

OBSERVED Y	ESTIMATED Y	RESIDUAL
1123.5000	1039.9647	83.5353
1238.0000	1150.7242	87.2758
1276.0000	1259.6221	16.3779
1333.5000	1366.7200	¯33.2200
1393.0000	1472.0764	¯79.0764
1522.5000	1575.7469	¯53.2469
1588.5000	1677.7848	¯89.2848
1724.0000	1778.2407	¯54.2407
1885.5000	1877.1628	8.3372
1981.0000	1974.5973	6.4027
2047.0000	2070.5883	¯23.5883
2224.0000	2165.1779	58.8221
2256.0000	2258.4065	¯2.4065
2353.5000	2350.3126	3.1874
2469.0000	2440.9333	28.0667
2591.5000	2530.3040	61.1960
2611.5000	2618.4587	¯6.9587
2679.0000	2705.4301	¯26.4301
2792.5000	2791.2496	1.2504
2916.5000	2875.9472	40.5528
2933.0000	2959.5518	¯26.5518

YEAR	PROJECTION
1979	3042.091
1980	3123.593
1981	3204.082
1982	3283.583
1983	3362.121
1984	3439.718
1985	3516.396
1986	3592.178
1987	3667.084
1988	3741.133
1989	3814.346
1990	3886.741
1991	3958.336
1992	4029.149
1993	4099.195
1994	4168.493
1995	4237.058
1996	4304.904
1997	4372.047
1998	4438.502

SCHEDULE 3

COMMERCIAL A/C DEMAND: TSCOMDS=A+B(TIME), 1964-78

DEGREES OF FREEDOM 13
STANDARD ERROR OF THE ESTIMATE 2.436278637
R SQUARE 0.9991560598
CORRECTED R SQUARE 0.9990911413
ERROR SUM OF SQUARES 77.16089679
DURBIN-WATSON D-STATISTIC 1.171024846
DEPENDENT VARIABLE MEAN IS 307.83

INDEPENDENT VARIABLES

VARIABLE MEAN	REGRESSION COEFFICIENT	COEFFICIENT STANDARD ERROR	T-STATISTIC
1.0000	¯974.6151	10.3564	¯94.1075
71.0000	18.0626	0.1456	124.0602

OBSERVED Y	ESTIMATED Y	RESIDUAL
186.2300	181.3918	4.8382
200.4300	199.4544	0.9756
215.0600	217.5170	¯2.4570
232.9100	235.5796	¯2.6696
251.4700	253.6422	¯2.1722
271.9100	271.7048	0.2052
288.8500	289.7674	¯0.9174
306.9700	307.8300	¯0.8600
324.1600	325.8926	¯1.7326
344.7300	343.9552	0.7748
364.8300	362.0178	2.8122
379.7800	380.0804	¯0.3004
401.4300	398.1430	3.2870
417.4700	416.2056	1.2644
431.2200	434.2682	¯3.0482

YEAR	PROJECTION
1979	452.331
1980	470.393
1981	488.456
1982	506.519
1983	524.581
1984	542.644
1985	560.706
1986	578.769
1987	596.832
1988	614.894
1989	632.957
1990	651.020
1991	669.082
1992	687.145
1993	705.207
1994	723.270
1995	741.333
1996	759.395
1997	777.458
1998	795.520

SCHEDULE 4

RESIDENTIAL A/C DEMAND: DUMMY INTERCEPT, 1964-78

DEGREES OF FREEDOM 12
STANDARD ERROR OF THE ESTIMATE 45.34434865
R SQUARE 0.9930421443
CORRECTED R SQUARE 0.9918825017
ERROR SUM OF SQUARES 24673.31945
DURBIN-WATSON D-STATISTIC 2.59350591
DEPENDENT VARIABLE MEAN IS 1651.703333

INDEPENDENT VARIABLES

VARIABLE MEAN	REGRESSION COEFFICIENT	COEFFICIENT STANDARD ERROR	T-STATISTIC
1.0000	72.8250	48.0924	1.5143
1754.9080	0.9248	0.0314	29.4781
0.2667	¯165.1800	44.4457	¯3.7164

OBSERVED Y	ESTIMATED Y	RESIDUAL
768.7700	778.6731	¯9.9031
890.5700	897.6292	¯7.0592
1018.9400	1016.5391	2.4009
1146.0900	1229.1397	¯83.0497
1451.5300	1347.0416	104.4884
1524.0900	1476.7160	47.3740
1585.1500	1606.8344	¯21.6844
1759.0300	1745.6642	13.3658
1836.8400	1888.4523	¯51.6123
2033.2700	2019.9948	13.2752
2053.1700	2073.8434	¯20.6734
2121.2200	2102.2637	18.9563
2125.5700	2135.0085	¯9.4385
2195.5300	2200.4284	¯4.8984
2265.7800	2257.3216	8.4584

YEAR	PROJECTION
1979	2321.068
1980	2373.661
1981	2431.802
1982	2490.712
1983	2547.392
1984	2604.609
1985	2659.292
1986	2714.262
1987	2766.180
1988	2810.921
1989	2852.407
1990	2894.384
1991	2936.841
1992	2979.788
1993	3023.226
1994	3063.722
1995	3104.635
1996	3149.515
1997	3191.335
1998	3229.991