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EFFECTS OF ACCELERATING THE CONSTRUCTION OF NUCLEAR POWER PLANTS ON OIL AND GAS USE

by

Charles D. Kolstad

ABSTRACT

The acceleration of construction schedules for nuclear power plants in the US raises new implications for oil and gas use by electric utilities during the 1980s. Announced utility plans are used for a base case. Results of this study show that accelerating construction schedules by up to 2 years could save an average of nearly 150 thousand barrels per day of oil equivalent over the next decade.

I. INTRODUCTION

The energy problem in the US is principally one of reliance on high-priced energy, particularly foreign oil. If oil consumption could be reduced significantly, pressures associated with oil prices and imports would also be reduced. If gas consumption could be reduced or if it could replace oil use, economic pressures from energy consumption also would be eased. The largest single consumer of primary energy in the US is the electric utility sector. In 1980, 26% of the electricity produced in the US was produced with oil and gas; this was 13% of all oil and gas used during that year.[1] These statistics suggest the purpose of this study: to examine the potential levels of oil and gas use in the electric utility industry during the coming decade.

Because coal and nuclear generation are alternate sources of electricity, the significance of oil and gas use in the electric utility sector is not only in their overall consumption level, but also in the industry's unnecessary dependence on oil and gas. With the recent increases in the price of oil, it is usually now more economical to build a coal or nuclear power plant than to continue operating an existing oil-fired generation facility. However, the situation is not nearly so simple because many electric utilities find themselves in the difficult financial position of being unable to finance the large outlays of capital necessary to build the coal or nuclear units that could replace oil and gas generation. Uncertainty in the future electricity demand, potential construction delays, and, in some cases, working with state utility commissions that have different goals have made it difficult for some utilities to raise the necessary capital to pursue construction programs that would benefit their rate-payers while reducing oil and gas use. Difficulties also have arisen with construction schedules of fully approved facilities, particularly nuclear power plants. Not all utility systems share these difficulties, but they are the major reasons that oil and gas use by utilities may continue to be higher than would be justified on the basis of economics alone.

This analysis examines the effects of accelerating the completion of nuclear power plants currently planned or under construction. Our concern is not how acceleration might be achieved but rather what the effects of such an acceleration might be on overall levels of oil and gas consumption in the electric utility sector.

Many of the data assumptions used in this study are presented in the Appendix; Sec. II discusses the problem of reduction of oil and gas use by utilities in more detail; Sec. III describes the approach to this analysis; and Sec. IV presents the results of the analysis.

II. BACKGROUND

For many years, coal was the fuel of choice for generating electricity. It has only been in the past few decades that a movement to oil and natural gas for electricity generation has been significant. This has occurred because of the relatively low price of oil and gas, particularly in the 1960s, and the concern over pollution from uncontrolled coal-fired power plants. As a result, a large number of new oil- and gas-fired stations were constructed and a number of coal-fired facilities were converted to oil and gas use. Simultaneously, nuclear power became a commercial alternative to coal for supplying baseload electricity that was cheap and clean. The situation, of course, changed dramatically in recent years as oil and gas became very expensive. Nuclear and coal power involve very large capital outlays although they are still much cheaper than oil and gas power for baseload generation.

Oil and gas use by utilities is determined by both the nature and level of electricity demand as well as the mix of generating capacity to supply that demand. As the fuels of last resort, oil and gas fill the gap between demand for electricity and the capability of coal, nuclear, and hydroelectric facilities to meet that demand. Oil and gas use can be reduced, therefore, either by reducing demand or by increasing the use of non-oil and gas capacity. Utilities are pursuing each of these alternatives. Reduction of demand growth through conservation programs is being pursued by many utilities that view utility investment in customer conservation as easier or more profitable than investment in new generating capacity. For utilities not generating baseload power with oil or gas, load management can also reduce oil and gas use.

Most strategies for the reduction of utility oil and gas use focus on power supply rather than demand management, either increasing the use of existing facilities or constructing new coal, nuclear, or hydroelectric facilities. Figure 1 shows typical load duration curves where coal and nuclear generation are available for some power production with oil and gas generation making up the residual. In Fig. 1a, the stippled area represents the potential additional generation that could come from operating coal and nuclear facilities at full capacity rather than following load. The demand

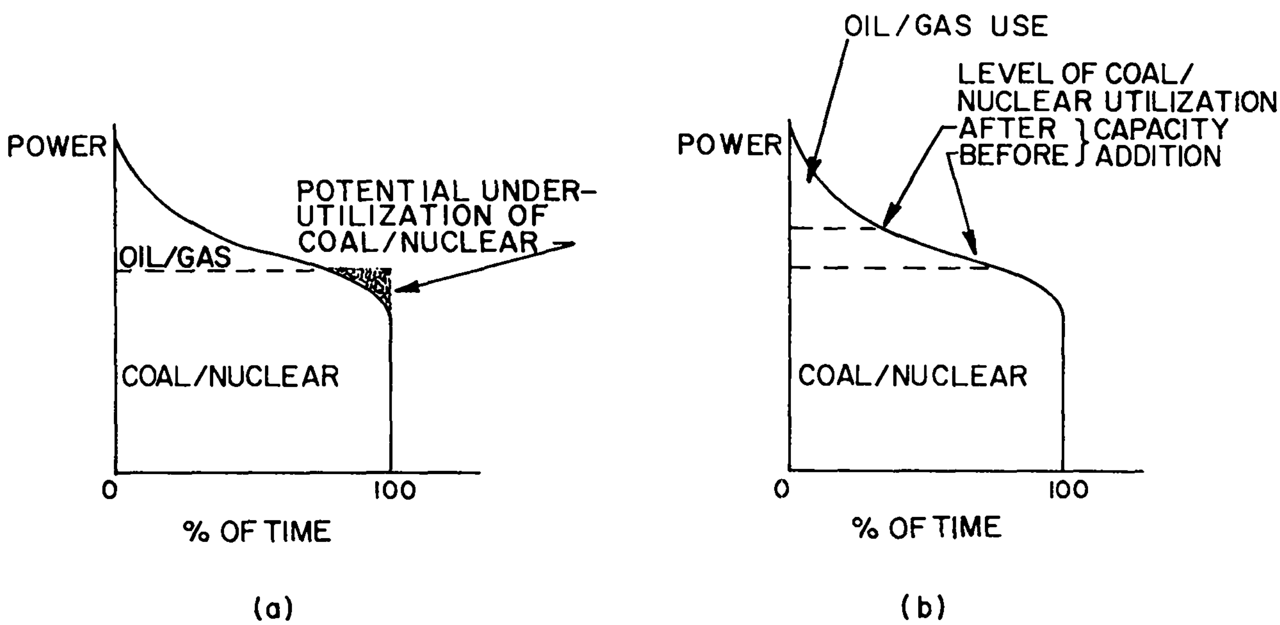

Fig. 1. Typical load duration curves.

does not exist for such operation; however, by either load management or sales of power to a neighboring utility (probably a more oil-and-gas-dependent neighbor), the coal/nuclear capacity could be operated at a higher level, thus presumably replacing a comparable amount of oil/gas capacity.

Figure 1b illustrates the effect of adding coal/nuclear capacity to a system. Because fuel use is proportional to the area under the load duration curve, it is the intermediate load and baseload (as opposed to peaking) oil and gas use that is of most concern. Adding non-oil and non-gas capacity drives a wedge under oil and gas use and results in dramatic savings.

It is, therefore, highly desirable to increase construction of new coal and nuclear facilities accompanied by a phase-out of oil- and gas-fired facilities. Indeed, Fig. 2 indicates that the cost of electricity from a new nuclear power plant is less than the variable cost alone of power from an existing oil-fired plant for capacity factors as low as 35%, given current oil prices. Many

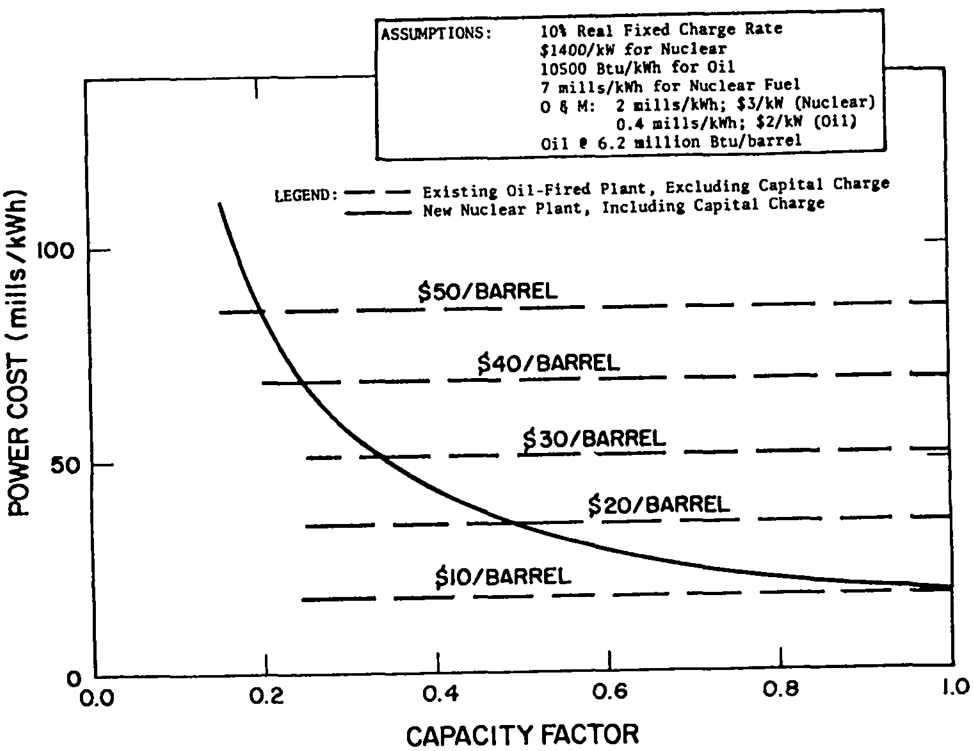

Fig. 2. Comparison of generating costs as a function of capacity utilization.

systems use oil and gas at much higher capacity factors. Why, then, have utilities failed to replace oil and gas capacity rapidly with alternate generating sources? The answer lies in three areas: problems with capital formation, regulatory biases, and unanticipated construction delays.

Any massive replacement of oil/gas capacity obviously requires large amounts of capital. To replace all of the ~145 GW(e) of oil and gas steam capacity at $1400/kW would require approximately $200 billion, or half of the total US gross domestic investment in 1980. Although this would not seem an impossible task over a period of several years, many electric utilities find their financial condition so weak that they cannot raise this capital in addition to other capital needs in private capital markets. A major reason for this financial bind is that utilities generally cannot include such investments in their rate base until the facility is operational, which can take as much as ten years from the initial project conception. The problem is exacerbated by the fact that oil and gas capacity is concentrated in a few regions--the East, West, and Gulf Coasts. Most state utility commissions have approved methods for easily passing fuel costs on to consumers while asking utilities to shoulder more of the risks associated with new capital investments. Other aspects of utility regulations inhibit early retirement of oil and gas capacity.[2,3]

Even for utilities that have been able to finance new construction of coal or nuclear facilities, many factors have caused completion dates to slip. This has been a particular problem for nuclear power facilities and is caused, in part, by overly optimistic construction schedules as well as by regulatory redirection during planning or construction. This analysis examines the effects on utility fuel use if this trend for nuclear facilities is reversed.

III. APPROACH

Our approach to assessing the effects of accelerating nuclear facility construction schedules has included investigating two scenarios for the coming decade: a base case and a case where completion dates for nuclear power plants have been moved forward. The base-case scenario corresponds to levels of energy demand and planned capacity additions expected by each utility in the US and reported in the Regional Reliability Council annual reports (latest is April 1, 1981) to the Economic Regulatory Administration (ERA) of the Department of Energy (DOE). The accelerated nuclear facility completion scenario involves advancing completion dates of nuclear power plants 2 years for plants planned or less than 50% complete, 1 year for plants over 50% but less than 80% complete, and 6 months for plants over 80% complete. Further information on plant status is presented in the Appendix. Construction schedule changes are purely arbitrary and we make no assumptions as to how the advanced schedules might be achieved or even if it is possible to achieve them. Similarly, the accuracy of utility supply or demand forecasts is unknown. In some cases, the scheduled completion dates as reported by utilities are clearly overly optimistic. The analysis examines the effects of a hypothetical policy in an approximately realistic setting to determine if the potential gains are large enough to warrant further investigation of the problem.

Rather than examine each of these two scenarios for each US utility, we have grouped utilities into operating regions and treat all utilities within a region as one regional utility. These regions have been defined by the ERA (Fig. 3) and represent an attempt to define groupings of operating utilities. Within some regions, utilities actually do operate as if they were a single regional system. We assume that there are no power transfers among regions

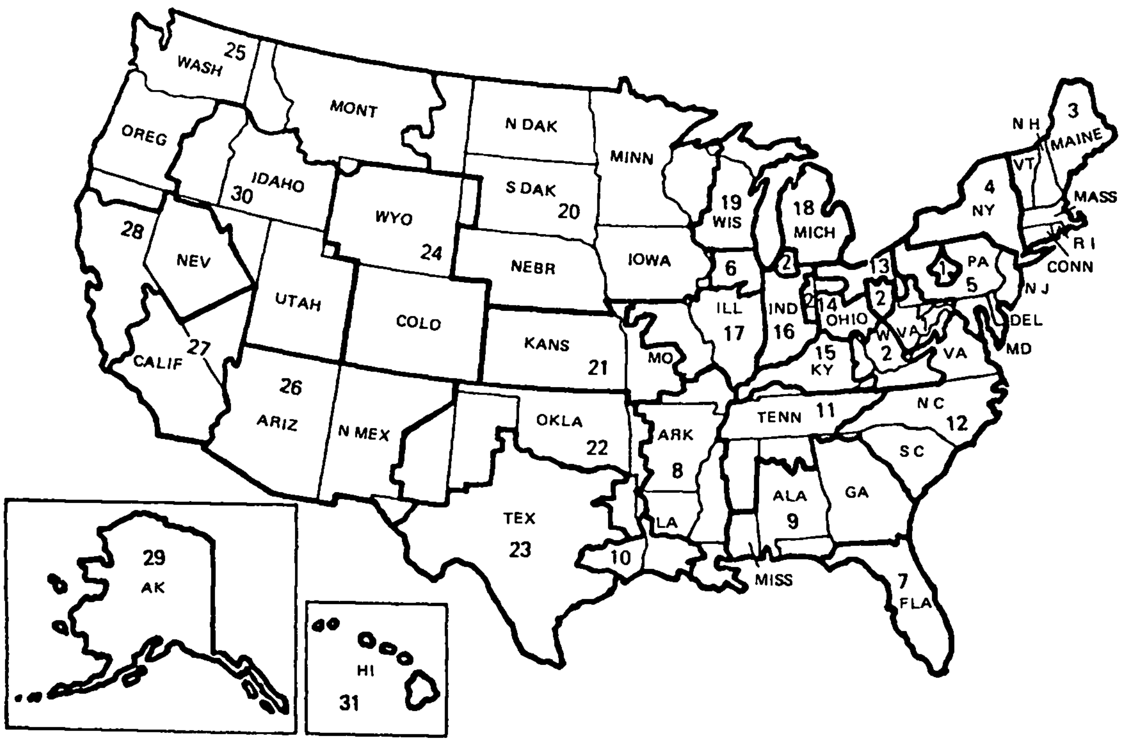

Fig. 3. Electric regions in the United States, June 1, 1980 (Economic Regulatory Administration, Department of Energy).

except those committed through joint ownership of generating capacity. This assumption is necessary because of the difficulty in estimating power transfer capability between regions. Our approach is to use a regional model of the national electricity system (the Electric Utility Fuel Use Model--EUFUM) to simulate operation of these regional utility systems. This model has been used in many studies, including a more in-depth analysis of oil and gas use by electric utilities.[4] Using this model, we simulate the regional capacity dispatch decisions to meet regional load for the years 1982, 1984, 1986, 1988, and 1991. A more detailed description of the assumptions of the analysis can be found in the Appendix.

IV. RESULTS

Figure 4 summarizes our projections of oil and gas use over the coming decade for the two scenarios. As can be seen, accelerated completion of nuclear facilities reduces oil and gas use significantly. Because the base-case scenario considered utility plans only through 1990, the two scenarios come together at that point. In the 9-year period from 1982 through 1990,

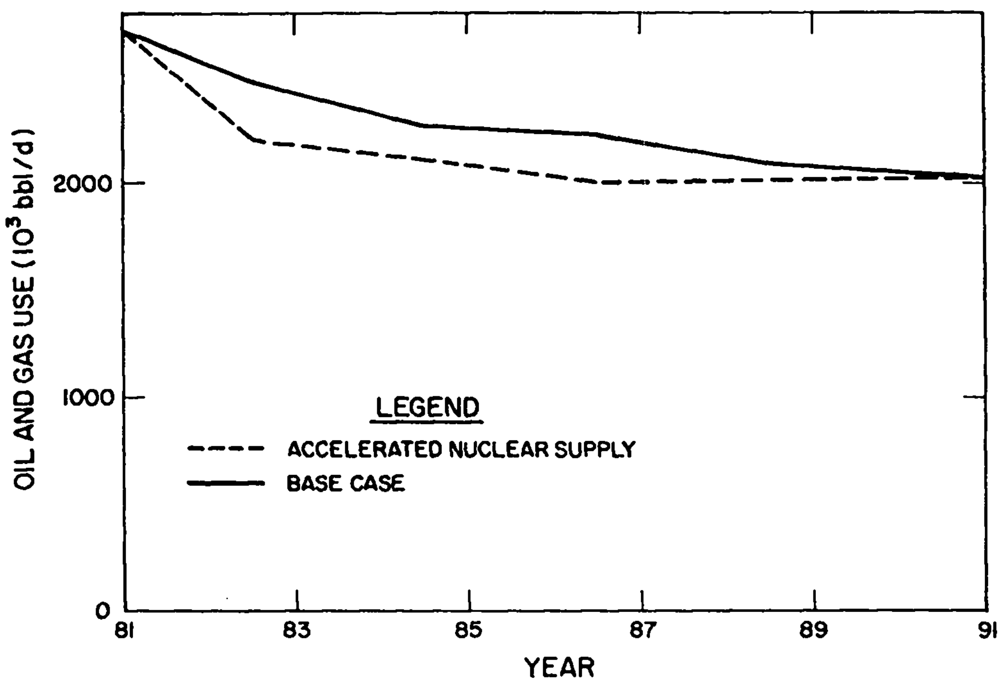

Fig. 4. Projected oil and gas use from 1981 through 1991 for the accelerated nuclear supply case and the base case.

approximately 450 million barrels of oil are saved in the accelerated supply case, relative to the base case. At $30/barrel and assuming a 4% real discount rate, this amounts to about $12 billion in 1980 terms. Although this is a significant savings, it must be balanced against the other costs or benefits from accelerating nuclear facility construction. These would include the added cost of implementing a program to accelerate construction, the cost of providing capital up to two years earlier, as well as savings on interest charges during plant construction.

It is more difficult to project the amount of oil and gas capacity that can be retired as a result of the accelerated nuclear scenario. There is an average reduction in oil and gas generation of approximately 30 trillion kWh/year, which is equivalent to approximately 5000 MW(e) of oil capacity operating at a 70% capacity factor. Because capacity factors vary considerably, and the decision to retire a plant is complex and involves a slow reduction in use of the facility, it is difficult to project just how much additional oil and gas capacity actually will be retired under the accelerated scenario. This may not be particularly important because it is fuel use rather than the mere existence of oil and gas capacity that is important.

Table I presents detailed regional oil and gas use for the two scenarios. As expected, the effects of accelerating nuclear facility construction are uneven. In California, oil and gas dependence is almost unaffected by the policy, whereas in New England, significant savings are achieved. A reason for this is that regions that are heavily expanding nuclear capacity are not always the same regions that are heavily oil and gas dependent. Table II presents nuclear capacity plans for the two scenarios. Note, for example, that the Tennessee Valley Authority and the Virginia-Carolinas have nearly a quarter of the US nuclear capacity by 1990, but neither is particularly dependent on oil or gas.

V. VALIDITY OF RESULTS

It is difficult to validate our results. An examination of our methods suggests that there may be small inaccuracies in our oil and gas use forecasts. Forecasting fuel use based on derating capacity and use of load duration curves may result in errors of a few per cent. Furthermore, neglecting some interregional transfers of power can result in additional inaccuracies. Results of

TABLE I

PROJECTED OIL AND GAS USE BY UTILITIES
(10^3 bbl/day)

NOTE: Top number is for accelerated nuclear construction case; bottom number is for base case.

Analysis Region	1982	1984	1986	1988	1990
Allegheny Power	1	3	2	4	2
	1	3	2	4	2
American Electric Power	1	4	10	11	14
	1	4	10	11	15
New England	220	94	87	95	109
	250	152	115	95	109
New York	236	208	186	128	147
	259	208	215	128	147
Pa.-N.J.-Md. (PJM)	118	94	94	89	118
	145	116	136	107	116
Commonwealth Edison	25	8	8	9	13
	38	13	8	9	13
Florida	279	271	247	239	248
	298	271	247	239	249
Middle South/Gulf States	260	266	219	216	202
	316	266	252	216	202
Southern Company Group	5	6	7	8	16
	5	6	7	8	16
Tennessee Valley Authority	5	5	5	5	8
	10	5	9	13	8
Virginia-Carolinas	10	12	13	15	19
	20	15	14	15	19
Central Area (Ohio)	3	3	2	3	7
	7	6	5	3	7
Cincinnati, Dayton	2	4	3	3	3
	2	4	3	3	3
Kentucky	0	2	3	3	4
	0	2	3	3	4
Indiana	1	1	1	1	1
	1	1	2	1	1
Illinois-Missouri	2	3	4	4	8
	2	3	4	4	8
Michigan	35	8	9	11	21
	35	20	9	11	22
Wisconsin-Upper Michigan	2	3	3	5	8
	2	3	3	5	8
Midcontinent (MARCA)	5	11	12	15	27
	5	11	12	14	27
Missouri-Kansas	6	7	8	13	17
	6	7	8	13	17
Oklahoma	82	107	81	96	98
	83	107	81	96	98
Texas (ERCOT)	402	431	457	438	403
	463	463	457	468	403
Rocky Mountain	2	2	4	5	5
	2	2	5	5	5
Northwest	73	91	58	77	94
	73	117	125	77	94
Arizona-New Mexico	10	11	15	17	18
	20	13	15	17	18
Southern California	246	247	261	223	212
	260	254	261	221	220
Northern California	174	201	213	297	202
	174	201	213	297	195
TOTAL CONTINENTAL US	2205	2104	2014	2030	2027
	2477	2273	2222	2083	2027

TABLE II

ASSUMED NUCLEAR GENERATING CAPACITY
(10^3 MW)

NOTE: Top number is for accelerated nuclear construction case; bottom number is for base case.

Analysis Region	1982	1984	1986	1988	1990
Allegheny Power	0	0	0	0	0
	0	0	0	0	0
American Electric Power	2.38	2.38	2.38	2.38	2.38
	2.38	2.38	2.38	2.38	2.38
New England	5.40	7.70	8.85	8.85	8.85
	4.25	5.40	7.70	8.85	8.85
New York	4.77	4.77	5.85	5.85	5.85
	3.96	4.77	4.77	5.85	5.85
Pa.-N.J.-Md. (PJM)	10.42	11.53	13.65	14.71	14.71
	9.37	10.42	11.53	13.65	14.71
Commonwealth Edison	6.88	9.12	11.30	11.30	11.30
	5.83	8.00	10.21	11.30	11.30
Florida	3.57	3.61	3.61	3.61	3.61
	2.84	3.61	3.61	3.61	3.61
Middle South/Gulf States	5.08	5.08	6.33	6.33	6.33
	2.94	5.08	5.08	6.33	6.33
Southern Company Group	3.16	3.16	4.32	5.48	5.48
	3.16	3.16	4.32	5.48	5.48
Tennessee Valley Authority	6.67	7.85	11.56	15.26	15.26
	4.35	7.85	9.06	11.56	15.26
Virginia-Carolinas	12.53	14.57	15.47	15.47	16.38
	10.20	12.53	14.57	15.47	16.38
Central Area (Ohio)	2.79	3.57	4.76	4.76	4.76
	1.60	2.79	3.57	4.76	4.76
Cincinnati, Dayton	0.56	0.56	0.56	0.56	0.56
	0.56	0.56	0.56	0.56	0.56
Kentucky	0	0	0	0	0
	0	0	0	0	0
Indiana	0	0	2.26	2.90	2.90
	0	0	0	2.26	2.90
Illinois-Missouri	1.15	2.10	3.25	3.25	3.25
	0	2.10	2.10	3.25	3.25
Michigan	0.70	3.08	3.08	3.08	3.09
	0.70	2.58	3.08	3.08	3.09
Wisconsin-Upper Michigan	1.51	1.51	1.51	1.51	1.51
	1.51	1.51	1.51	1.51	1.51
Midcontinent (MARCA)	3.18	3.18	3.18	3.18	3.18
	3.18	3.18	3.18	3.18	3.18
Missouri-Kansas	1.16	1.16	1.16	1.16	1.16
	0	1.16	1.16	1.16	1.16
Oklahoma	0	0	0	0	0
	0	0	0	0	0
Texas (ERCOT)	3.55	4.80	4.80	5.93	5.93
	1.15	3.55	4.80	4.80	5.93
Rocky Mountain	0.20	0.20	0.20	0.20	0.20
	0.20	0.20	0.20	0.20	0.20
Northwest	1.92	3.43	7.16	7.16	7.16
	1.92	2.18	3.43	7.16	7.16
Arizona-New Mexico	1.98	2.97	2.97	2.97	2.97
	0	1.98	2.97	2.97	2.97
Southern California	3.20	3.48	3.48	3.48	3.48
	2.64	3.20	3.48	3.48	3.48
Northern California	3.07	3.07	3.07	3.07	3.07
	3.07	3.07	3.07	3.07	3.07
TOTAL CONTINENTAL US	85.80	102.84	124.72	132.42	133.33
	65.79	91.22	106.30	125.88	133.33

the analysis are also highly sensitive to several parameters used in the analysis, particularly availability factors for coal and nuclear facilities. For instance, the National Electric Reliability Council forecast oil and gas use in 1990, projecting use at the level of 1895 million barrels per day, 7% lower than our base forecast. In large part, this can be accounted for by their assumption of availability for nuclear facilities of approximately 70% versus the 65% assumption used in our analysis. If we had assumed a higher availability, then our results might have shown even greater oil and gas savings from the accelerated nuclear scenario.

Although the forecasts presented here are subject to some uncertainty, their usefulness is not severely diminished. They can be used as relative measures (rather than absolute forecasts) of oil and gas use under the two assumptions about construction schedules in the future.

VI. CONCLUSIONS

We have shown that there could be significant savings in oil and gas by accelerating the completion of nuclear power plants. This very positive result must be tempered by several considerations. First, it is not clear how such an acceleration in construction could be achieved and with what cost savings or penalties. Furthermore, it is not clear that investing in reducing the construction time for nuclear plants is the best use of resources; for example, reducing the construction time for coal-fired facilities may achieve similar results. Nevertheless, the potential savings warrant further examination of the issue.

APPENDIX
ASSUMPTIONS USED IN THE ANALYSIS

The analysis presented in this report was done using the Electric Utility Fuel Use Model (EUFUM), which is solved using the Los Alamos Coal and Utility Modeling System (LACUMS) model software. The EUFUM model was developed specifically to examine oil and gas use by electric utilities and is documented in detail in Ref. 4. The LACUMS software is documented in Ref. 5. Rather than duplicate this documentation here, we refer the interested reader to the appropriate references. We present in this Appendix some critical data assumptions as well as nuclear capacity information used for this specific analysis.

An integral part of this analysis is a computer data base on the status of nearly all generating units in the US. The data base (GURF) contains information on capacity, historic availability, and heat rates among other things. Using this file, we compile the generating equipment characteristics used in the EUFUM analysis. Additional characteristics are required for the analysis, some of which are displayed in Table A-I.

Annual energy demand levels are reported in Table A-II. Capacity additions, as reported by the Regional Reliability Councils, are midyear forecasts for each analysis year except 1990 where an end-of-year forecast was used. Table A-III presents assumptions regarding nuclear plant operating dates.

TABLE A-I

VALUES OF KEY PARAMETERS
(1980 dollars)

Fuel Costs ($/$10^6$ Btu)[a]	1985	1990
Natural Gas	6.37	6.99
Residual Oil	6.07	7.12
Distillate Oil	6.76	7.97

Technology	Default Equivalent Availability (%)	Capital Cost ($/kW)[c]	O&M Costs[b] Fixed ($/kW/yr)	Variable (mills/kWh)	Default Heat Rate (Btu/kWh)
Coal w/o scrubber	70	d	26	0.35	9 500
Coal w/scrubber	70	1 050	28	1.8	10 200
Nuclear	65	1 250	3.5	13	--
Oil-fired steam	80	550	3.5	0.6	9 500
Gas-fired steam	80	550	3.0	0.6	9 500
Oil-fired turbine	90	200	0.3	2.8	14 000
Gas-fired turbine	90	200	0.15	2.1	14 000
Hydroelectric	95	700	1.4	0.15	--
Other steam	80	650	3.3	2.4	9 500
Other peakers	90	200	0.2	2.4	14 000

[a]Coal costs computed endogenously in the model.

[b]Excluding fuel costs, except in the case of nuclear.

[c]Capital costs for plants under construction were arbitrarily assumed to be half of figures listed here. Existing plants incur no additional capital costs. Costs reported here are averages of the regionally varying costs used in the analysis.

[d]All new coal plants were assumed to have scrubbers.

TABLE A-II

ENERGY DEMAND FORECASTS BY REGIONAL RELIABILITY COUNCIL MEMBERS
(10^9 kWh/yr)

Analysis Region	1982	1984	1986	1988	1990
Allegheny Power	34	37	40	43	46
American Electric Power	109	117	125	137	148
New England	90	95	100	106	112
New York	117	121	126	131	135
Pa.-N.J.-Md. (PJM)	183	195	206	218	231
Commonwealth Edison	71	76	81	86	92
Florida	102	111	119	127	136
Middle South/Gulf States	111	120	130	141	153
Southern Company Group	112	120	129	138	147
Tennessee Valley Authority	126	132	146	161	170
Virginia-Carolinas	161	177	191	207	224
Central Area (Ohio)	69	74	76	80	84
Cincinnati, Dayton	29	30	32	35	36
Kentucky	34	37	40	43	46
Indiana	52	56	61	66	70
Illinois-Missouri	62	67	72	78	83
Michigan	70	78	82	88	92
Wisconsin-Upper Michigan	42	45	47	50	52
Midcontinent (MARCA)	107	116	127	136	146
Missouri-Kansas	46	49	54	59	63
Oklahoma	68	74	80	87	95
Texas (ERCOT)	177	194	213	233	254
Rocky Mountain	34	39	43	47	52
Northwest	200	220	236	253	270
Arizona-New Mexico	49	53	61	68	73
Southern California	105	109	115	121	137
Northern California	86	93	98	120	105
TOTAL CONTINENTAL US	2446	2635	2830	3059	3252

TABLE A-III

ASSUMPTIONS REGARDING COMPLETION DATES FOR NUCLEAR PLANTS

Reactor	State	Capacity (MWe)	Per Cent Complete (1980)	Date of Commercial Operation	
				Base	Accelerated
Millstone #3	Connecticut	1150	30	May 1986	May 1984
Seabrook #1	New Hampshire	1194	37	April 1983	April 1981
Shoreham	New York	813	83	December 1982	June 1982
Nine Mile Point #2	New York	1080	32	November 1986	November 1984
Salem #2	New Jersey	1115	99	April 1981	April 1981
Hope Creek #1	New Jersey	1066	18	December 1986	December 1984
Hope Creek #2	New Jersey	1066	18	December 1989	December 1987
Beaver Valley #2	Pennsylvania	820	33	May 1986	May 1984
Three Mile Island #2	Pennsylvania	880	100	May 1978	May 1978
Susquehanna #1	Pennsylvania	1050	94	March 1982	September 1981
Susquehanna #2	Pennsylvania	1050	57	January 1983	January 1982
Limerick #1	Pennsylvania	1055	55	April 1985	April 1984
Limerick #2	Pennsylvania	1055	35	October 1987	October 1985
North Anna #2	Virginia	870	100	July 1980	July 1980
Farley #2	Alabama	807	76	July 1981	July 1980
Harris #1	North Carolina	900	22	September 1985	September 1983
McGuire #1	North Carolina	1180	95	July 1981	July 1981
McGuire #2	North Carolina	1180	60	June 1983	June 1982
Catawba #1	South Carolina	1145	45	March 1984	March 1982
Catawba #2	South Carolina	1145	35	September 1985	September 1983
St. Lucie #2	Florida	729	20	April 1983	April 1981
Grand Gulf #1	Mississippi	1250	86	June 1982	December 1981
Summer	South Carolina	900	81	June 1982	December 1981
Sequoyah #1	Tennessee	1148	100	March 1981	March 1981
Sequoyah #2	Tennessee	1148	83	July 1982	January 1982
Watts Bar #1	Tennessee	1177	86	November 1982	May 1982
Watts Bar #2	Tennessee	1177	75	August 1983	August 1982
Bellefonte #1	Alabama	1213	67	December 1985	December 1984
Bellefonte #2	Alabama	1213	47	September 1986	September 1984
Hartsville A1	Tennessee	1233	23	July 1988	July 1986
Hartsville B1	Tennessee	1233	19	June 1989	June 1987
Zimmer	Ohio	792	93	June 1982	December 1981
Perry #1	Ohio	1179	45	May 1984	May 1982
Perry #2	Ohio	1179	30	May 1988	May 1986
Midland #2	Michigan	783	61	December 1983	December 1982
Midland #1	Michigan	505	54	July 1984	July 1983
LaSalle #1	Illinois	1048	91	April 1982	October 1981
LaSalle #2	Illinois	1048	71	October 1982	October 1981
Braidwood #1	Illinois	1090	54	October 1985	October 1984
Braidwood #2	Illinois	1090	43	October 1986	October 1984
Byron #1	Illinois	1120	63	October 1983	October 1982
Byron #2	Illinois	1120	46	October 1984	October 1982
Fermi	Michigan	1093	84	December 1983	June 1983
Clinton #1	Illinois	948	53	August 1983	August 1982
Marble Hill #1	Indiana	1130	29	December 1986	December 1984
South Texas Project #1	Texas	1250	39	February 1984	February 1982
South Texas Project #2	Texas	1250	11	February 1986	February 1984
Waterford #3	Louisiana	1104	68	March 1983	March 1982
Comanche Peak #1	Texas	1150	76	June 1981	June 1980
Comanche Peak #2	Texas	1150	23	March 1984	March 1982
Wolf Creek	Kansas	1150	37	April 1984	April 1982
Callaway #1	Missouri	1150	48	April 1983	April 1981
Palo Verde #1	Arizona	1270	47	May 1983	May 1981
Palo Verde #2	Arizona	1270	21	May 1984	May 1982
Diablo Canyon #1	California	1084	99	July 1981	July 1981
Diablo Canyon #2	California	1106	98	March 1982	March 1982
San Onofre #2	California	1100	80	December 1981	June 1981
San Onofre #3	California	1100	60	March 1982	March 1981
WNP #2	Washington	1100	72	September 1983	September 1982
WNP #1	Washington	1250	23	February 1986	February 1984

TABLE A-III (cont)

Reactor	State	Capacity (MWe)	Per Cent Complete (1980)	Date of Commercial Operation Base	Date of Commercial Operation Accelerated
WNP #3	Washington	1240	15	September 1986	September 1984
WNP #4	Washington	1250	10	February 1987	February 1985
Seabrook #2	New Hampshire	1150	7	February 1985	February 1983
Forked River	New Jersey	1120	5	May 1986	May 1984
Harris #2	North Carolina	900	3	March 1988	March 1986
Harris #4	North Carolina	900	1	March 1989	March 1987
Cherokee #1	South Carolina	1280	14	1987	1985
Cherokee #2	South Carolina	1280	12	1989	1987
Grand Gulf #2	Mississippi	1250	13	April 1988	April 1986
Hartsville A2	Tennessee	1233	12	April 1989	April 1987
Hartsville B2	Tennessee	1233	9	June 1990	June 1988
Phipps Bend #1	Tennessee	1233	6	February 1989	February 1987
Yellow Creek #1	Mississippi	1285	8	April 1988	April 1986
Clinton #2	Illinois	950	2	1988	1986
Bailly	Indiana	644	1	June 1989	June 1987
Marble Hill #2	Indiana	1130	6	December 1987	December 1985
River Bend #1	Louisiana	940	7	April 1984	April 1982
River Bend #2	Louisiana	940	5	1984	1982
Callaway #2	Missouri	1150	1	April 1988	April 1986
Palo Verde #3	Arizona	1270	2	May 1986	May 1984
WNP #5	Washington	1240	8	September 1987	September 1985
Pilgram #2	Massachusetts	1150	0	November 1987	November 1985
Harris #3	North Carolina	900	0	March 1990	March 1988
Phipps Bend #2	Tennessee	1233	0	August 1989	August 1987
Yellow Creek #2	Mississippi	1285	2	April 1988	April 1986
Carroll County #1	Illinois	1120	0	1990	1988
Allens Creek	Texas	1130	0	November 1988	November 1986
Black Fox #1	Oklahoma	1150	0	March 1985	March 1983
Black Fox #2	Oklahoma	1150	0	March 1988	March 1986
Skagit #1	Washington	1288	0	1987	1985

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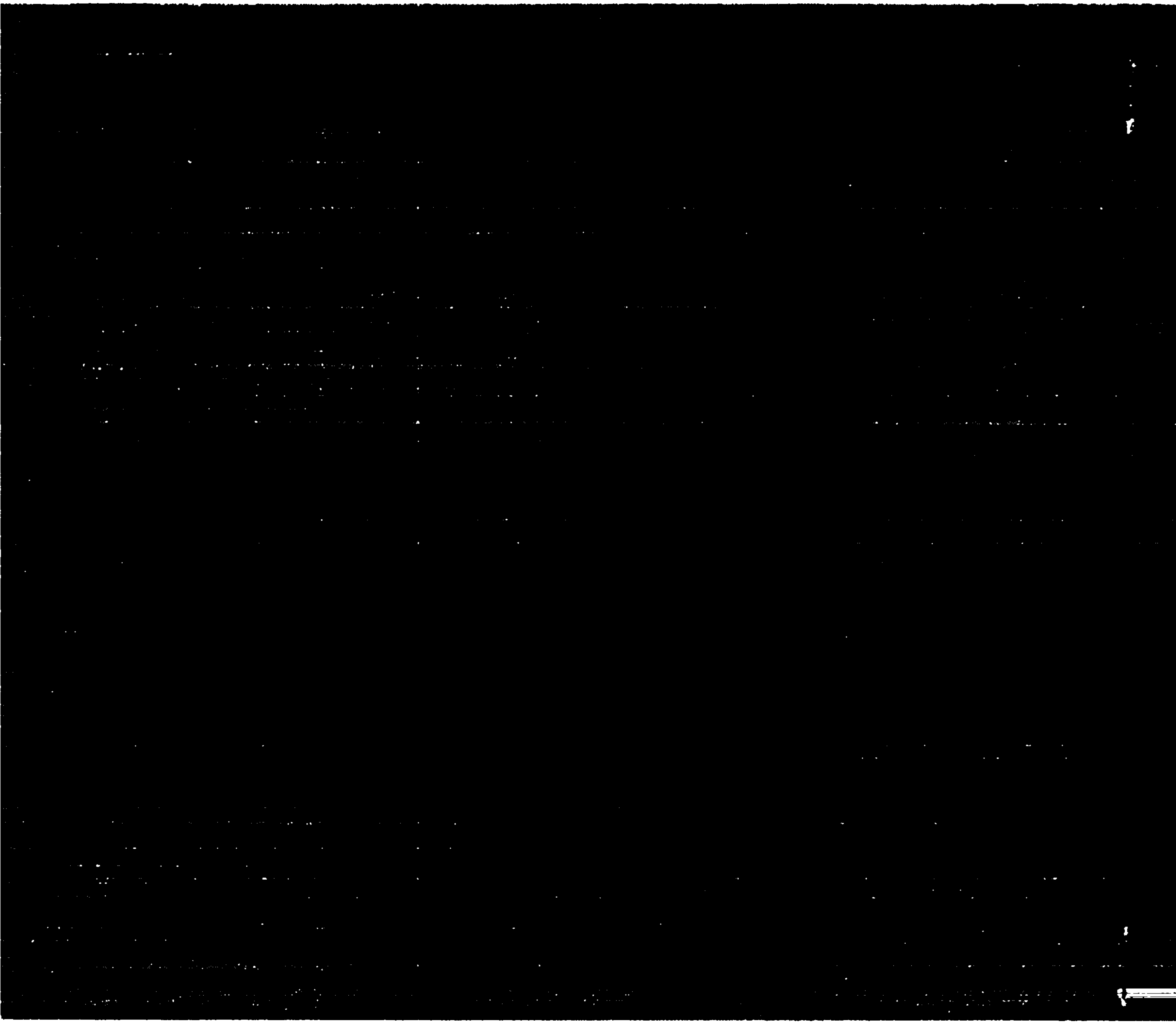

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