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A STATISTICAL ANALYSIS OF REGIONAL CAPITAL AND OPERATING COSTS FOR ELECTRIC POWER GENERATION

LUIS R. SANCHEZ, MYRON G. MYERS,
JAMES A. HERRMAN, AND ANTHONY J. PROVANZANO

MASTER

October 1977

PREPARED BY THE
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WASHINGTON, DC 20016

For the
OFFICE OF ENVIRONMENTAL POLICY
NATIONAL CENTER FOR ANALYSIS OF ENERGY SYSTEMS
DEPARTMENT OF ENERGY AND ENVIRONMENT

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ABSTRACT

This report presents the results of a three and one-half-month study conducted for Brookhaven National Laboratory to develop capital and operating cost relationships for seven electric power generating technologies: oil-, coal-, gas-, and nuclear-fired steam-electric plants, hydroelectric plants, and gas turbine plants. The methodology is based primarily on statistical analysis of Federal Power Commission data for plant construction and annual operating costs. The development of cost-output relationships for electric power generation is emphasized, considering the effects of scale, technology, and location on each of the generating processes investigated. The regional effects on cost are measured at the Census Region level to be consistent with the Brookhaven Multi-Regional Energy and Interindustry Regional Model of the United States.

Preliminary cost relationships for system-wide costs - transmission, distribution and general expenses - were also derived. These preliminary results cover the demand for transmission and distribution capacity and operating and maintenance costs in terms of system service characteristics. They have been forwarded to Brookhaven National Laboratory under separate cover.

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I. INTRODUCTION

A. Scope and Purpose

This study was undertaken to develop parametric cost relationships for electric power generation. These cost-estimating relationships are for initial investment costs for generating capacity and for annual operating expenses, including those associated with fuel, operations, and station maintenance. Primary consideration was given to the effects of technology, scale, and location on each of these cost categories.

The generating technologies discussed are: conventional coal-, oil-, and gas-fired steam-electric stations, gas turbine generators, conventional hydroelectric stations, pumped storage facilities, and nuclear light water reactor (LWR) stations. For each generating technology and cost category, cost-estimating relationships were developed to reflect differences across regions. To be consistent with the level of detail contemplated for the Brookhaven National Laboratory's (BNL) Multi-Regional Energy and Interindustry Model of the United States, regional analysis was conducted by U.S. Census Region. State identification was retained in the data base, however, to facilitate more detailed regional analysis in the future should this prove desirable.

Capital and operating cost relationships will be incorporated into the BNL Regional Energy Model while fuel prices and demands are specified within the model. Consequently, no attempt was made in this report to integrate the various cost components so as to determine total electric power generation costs. All relationships required for both average and marginal cost determination are available here, however.

B. Methodology

The study began with the compilation of a statistical data base describing capital costs, station characteristics, and operating expenses for each generating technology. Plant-level data were collected from annual reports filed by utilities with the Federal Power Commission (FPC), starting as early as 1938. Use of statistical data for a period of significant technological advances, fluctuations in general price levels, and variations in plant design and operating characteristics required a substantial data base.

In general, plants were observed in the initial year of operation and their capital costs and physical characteristics recorded. Operating cost data were observed in the most recent year for those plants that remained unchanged from the data of initial operations. Thus, plants incurring capacity expansion, major modification, or backfitting subsequent to initial operations were excluded from the operating cost sample. This required tracking each plant from initial operation to the year(s) for which operating data were recorded.

Capital costs recorded at the inception of commercial operations were normalized to constant 1975 dollars, using region-specific price deflators developed from the Handy-Whitman Index of Public Utility Construction Costs. Price indices that reflected the pricing behavior for the various categories of structures and equipment comprising the overall generating plant were developed for each generating technology. In addition, information about the phasing of actual cash outlays over the plant construction period was used to develop the price deflators used in this report.

Three broad categories of costs were analyzed: capital costs, fuel input (Btu) and non-fuel operating and maintenance (O&M) expenditures. In some cases, engineering design parameters reflecting plant efficiency or design characteristics were used in the analysis of capital costs to explain cost differences among otherwise similar plants. In others, construction time proved to be a significant cost-determining variable, since interest on funds employed during construction is included in reported investment costs.

Our usual practice was to use separate or component variables for the specification of independent variables—plant capacity and utilization (plant factor)—instead of the composite variable, net generation (kilowatt hours). Although cost relationships were specified and computed in both linear and exponential form, whenever possible we attempted to select the exponential form

as preferable because of the following desirable features:

- Marginal costs vary with the level of output or capacity and other independent variables.
- Cost elasticities are constant.
- The error term is proportional to output or capacity.

Liberal use was made of dummy variables for location (Census Regions) and other qualitative independent variables, such as plant type, operating mode, type of cooling, etc. Dummy variables for location and plant characteristics often were found to be significant and indicated substantial cost differences depending on station location and design characteristics.

C. Summary of Statistical Results

1. Capital Costs. All generating technologies evidenced (static) economies of scale in the capital cost of physical plant, with the greatest economies present in nuclear steam-electric plants, followed by hydroelectric, conventional steam technologies and gas turbines. The partial cost elasticity was estimated to be in the neighborhood of 0.75 to 0.80 for each of the base load technologies and 0.95 for gas turbine plants. Additionally, significant dynamic improvements were noted for all technologies except nuclear-fired steam stations. Technological improvement was on the order of 2 to 3% per year in the early 1950's and dropped to 1 to 2% by the early 1970's. The relatively recent gas turbine technology evidenced greater dynamic improvements of 4 to 4.5% per year. A general tendency was noted for Census Regions 5, 6, 7, and 8 (South Atlantic, East and West South Central, and Mountain States) to experience lower costs per unit of installed capacity in comparison to the rest of the country. For specific technologies, regional cost differences were sometimes of substantial magnitude. Exceptions to these general conclusions were noted for gas turbine stations, where units are often shipped preassembled and site preparation and structures are minimal.

2. Fuel. Overall, economies of scale for fuel consumption were noted: large plants consume less fuel at a given utilization rate than smaller plants. Furthermore, fuel consumption increases less than in proportion to increases in plant output. Several exceptions were noted. Gas turbines evidenced constant returns to scale, with no advantage gained by increasing plant size or unit capacity. Nuclear stations showed the largest economies of scale and improvements in fuel efficiency with increased utilization, but the results were clouded by the apparent proration of Btu consumption based on estimated fuel life and capacity.

3. Non-Fuel Operating and Maintenance Costs. These costs displayed a remarkably similar pattern across all generating technologies. A high fixed cost component was observed, with substantial economies of scale as plant size increased. The degree of plant utilization generally had a significant impact on contemporaneous O&M costs, although the magnitude of the impact was rather small. Estimates indicated that O&M costs were around 20% variable with output. The impact of age was generally found to be significant. Regional cost differences arise chiefly on account of wage and material price differentials. The Middle Atlantic and East North Central Regions generally exhibited higher than average O&M cost levels, while the West North and South Central Regions displayed consistently lower than average costs. The South (Atlantic and East South Central) and Mountain States evidenced lower than average cost levels for certain technologies.

D. Report Organization

The balance of this report is organized so that the reader is first introduced to pertinent concepts of technology, functional activities, and cost elements in Chapter II, where results of preliminary analysis of the effects of scale, time, and location are presented. Chapter III formally presents the statistical methodology and results by cost category within each generating technology.

Three technical appendices are included. Appendix A documents the data sources and procedures undertaken to compile each data base. Appendix B

describes the procedure used to develop the construction cost indices for each generating technology analyzed. Appendix C documents the variables used and presents the actual data bases.

II. PRELIMINARY ANALYSIS OF ELECTRIC POWER GENERATION COST AND TECHNICAL VARIABLES

A. Introduction

This chapter discusses the attempt to identify the effects of time, scale, technology, and regional differences on capital, O&M costs, and fuel use for different types of electric power generation systems, and analyzes technical variables that may reflect such effects in the cost functions. Electric power generation systems are discussed in terms of power generation and pollution control processes and costs. Approaches to incorporate the effects of vintage, size, technological, and regional characteristics on the cost functions are investigated.

The estimation of electric power generation system costs requires some background knowledge of the pertinent technologies, functional activities, and cost elements involved. Accordingly this chapter introduces the basic cost elements, functional activities, and technical parameters of electric power generation systems and analyzes the possible cost effects of system scale, technology, and regional location that these parameters represent.

B. Cost Elements

The basic purpose of the electric power generation regional cost model developed in this study is to relate resource requirements (costs) to system characteristics and outputs, so that investment and production costs for alternative systems or configurations may be derived. The structure of the model provides a logical representation of the total electric power generation system and of system operation within a region; it relates costs to capacity

(thousands of kilowatts - MW_e) and to final measures of output (kilowatt-hours-kWh), and to the system processes that achieve these outputs.

The analytical structure of the cost model defines the cost elements that must be considered for each major process in the system, and determines the system variables to which cost-estimating relationships or cost functions must be sensitive if the estimates are to measure the cost impacts of alternative systems adequately. The latter requires an understanding of the underlying physical properties of the system, how the values of the selected variables are generated, and the interactions between the variables themselves. For example, the knowledge that boiler pressure is a cost-sensitive variable in estimating the investment cost of electric power generating capacity must be supplemented with an understanding of both the metallurgical state-of-the-art problems involved in achieving a given increment in boiler pressure and the impact of boiler pressure on plant capital costs, heat rates, and fuel use.

Investment costs for generating capacity are divided into three major categories: land, structures and improvements, and equipment. Land accounts for a very small proportion of investment costs and varies widely in physical and dollar terms across plants of similar capacity and vintage. This cost element was therefore dropped from the cost sample and estimated as a ratio of other initial investment costs for a particular generating plant.

The investment cost data for the various plants in the sample showed more variability between interplant structures and improvements and equipment cost categories than between combined interplant capital cost categories. The greater variability between component capital costs is understandable, because construction costs and equipment installation costs are closely related. This is especially true of nuclear power plants where, if an item of heavy equipment is improperly installed or malfunctions in operation, the cost of dismantling and reassembling the unit may be charged to either of the two accounts. In addition, the utility could either purchase the equipment separately and have it installed by the construction contractor, which would be reflected in the structure cost account, or have the equipment contractor include the installation cost in his contract. For these reasons, both accounts were

combined into a single plant capital cost account for all activities as the dependent variable in the investment equations. Costs of various vintage plants were deflated to 1975 dollars by use of the Handy-Whitman Construction Index, modified to reflect average construction time and outlay profiles for different technologies.

Production costs are broken down by the FPC into three major accounts: operation, maintenance, and fuel. Additional detail is shown under the O&M accounts, but time and funding limitations precluded derivation of cost functions at that level of detail. Besides, the reason behind the aggregation of investment costs into a single capital cost variable for each system activity is also applicable to O&M cost categories. Thus, a single value for O&M costs and physical measures of fuel usage were used in all the production expense equations.

Operation and maintenance costs for the various plant types and activities used in the study are in current year dollars. No index for deflating O&M costs was considered appropriate for several reasons. The labor and material dollar values for each functional activity are not broken down in the FPC reports. Regional wage rates and material cost price levels are not available on an annual basis even if the composition of labor and material impacts is known.¹

Fuel costs in the fuel cost equations are presented in physical units: British thermal units (Btu). Physical rather than monetary values are used for a number of reasons, including: regional variations in both type and price of primary fuel used, which tend to distort the true fuel consumption relationship, variations in Btu content of different fuels used, and the advantage of estimating fuel consumption in Btu for each plant type and then applying constant regional prices to arrive at total costs comparable between fuel types and regions. Since the cost relationships are to be used in conjunction with a regional energy model, endogeneous regional prices can then be applied to the physical fuel impacts to determine regional costs.

Interest and escalation costs during construction are not reported separately in the FPC reports. Alternate data sources provide estimates of these costs for future plants, but because they are embedded in the

construction costs of the plants in our sample, we were not able to develop separate equations for this cost element. The estimates gathered from other sources may provide the basis for development of an adjustment factor tied to plant construction time, which is one of the independent variables in some of our capital cost equations.

C. Electric Power Generation Systems

Electric power systems generate, transmit, and distribute electric power to meet varying demands with an adequate amount of reserves. An electric power system consists of power generation (production) facilities, transmission lines to link production facilities to consumption centers, and distribution networks to carry electric power to individual customers. Only cost-output relationships and related air and water pollution control costs for generating activities are considered in this report.

1. Generation Costs. The largest components of capital equipment in an electric generating activity are the steam generator (boiler) and the turbine generator units that produce electric power. The capacity of the system which is usually prescribed by the manufacturer on the name plate rating is measured in MW_e . The bulk of U.S. electric power is produced by generators with turbines driven by steam from fossil fuel or light water reactor (LWR) nuclear power derived heat. The balance is primarily generated by hydroelectric, gas turbine, and combined cycle power plants. The output of the system is measured in kWh, a composite variable reflecting electricity generated (instantaneous output times duration).

New technologies such as breeder and fusion reactions, magneto-hydrodynamics (MHD), solar energy, geothermal energy, and fuel cells are under development, but are not far enough advanced to be included in this study. The technologies considered available—fossil-fueled plants, LWR nuclear-fueled plants, gas-driven turbines, and hydroelectric (especially, pumped storage) plants—were used to develop the cost functions in this study. Combined cycle plants, although already in operation, were excluded, as too few were

operational in 1974 for reliable statistical coefficients for either their capital or their operating costs to be derived.

Electric power generation requires land for the site, structures and buildings, methods of heat rejection, fuel supply and handling, and O&M personnel and materials. Fuel and cool water are fed into a plant and electric current, combustion residuals, and warm water are produced. Pollution abatement equipment to recycle the cooling water and to capture fuel residuals is considered part of the generation plant.

The "heat rate" of a thermal generation unit (one or more units per plant) is the average amount of Btu of fuel input energy per kWh of electricity output produced. Since fuel is the single most important operating input, this ratio is considered the most important measure of plant generating efficiency. A combination of technical innovation and scale effects has resulted in a gradual reduction of heat rate over time.

The best heat rates are usually attained by larger units with higher steam pressures and temperatures. However, the plant factor, the kind and grade of fuel burned, turbine start and stops, outages for maintenance, circulatory water conditions, the age of the plant, and the overall operating condition of all its equipment have a direct effect on a unit's annual heat rate.

By definition, the generating activity stops at the generation "bus" a term used for the contact point between the generator and the switchyard, where voltage is increased for more economical transmission to demand centers. Generation costs account for roughly half the average total cost of electric service and appear to be rising rapidly, owing to increases in new plant construction costs, fuel costs, and interest rates. The fixed-cost component of average electricity generation depends not only on the initial construction costs of generating facilities, but also on the plant factor (ratio of actual output to potential output) and the fixed-charge (or gross profit) rate required to yield an acceptable rate of return to investors.

Fuel costs account for more than 80% of operation costs for generating facilities. Fuel costs for nuclear plants are lower than those for large conventional units. For fossil-fueled plants, unit fuel cost is easily

computed from the average price paid for the fuel and the thermal heat rate of the plant (Btu/kWh generated). The latter is largely a function of plant design. Currently, the heat rate averages around 10,500 Btu/kWh, but some plants do notably better; in 1974, the most efficient plant had a rate of 8,915 Btu/kWh. The statistical results reported in Chapter III show how fuel consumption is affected by plant size, utilization and age.

2. Cost and Plant Characteristics. Prior to application of formal statistical methods, a preliminary analysis was conducted to select appropriate cost and system technical variables for the development of electric power generation system cost functions. Table II-1 displays the electric power generating plants in the capital cost sample, showing number of plants by fuel type and region and the range of values of capital costs and plant characteristics selected as explanatory variables for the cost functions. Table II-2 presents a similar tabulation of the operation and maintenance cost sample. Appendix A describes the criteria used to select the sample.

These samples show a wide variation in the range of both cost and plant characteristics and adequate regional representation for all technologies, which should allow for both the development of significant and stable cost relationships for each type of plant by region, and the measurement of technology and scale impacts on the costs of the plants in the sample.

The data base for this study includes fossil-fueled steam-electric, hydroelectric, and gas turbine plants built through 1974 and nuclear power plants in operation by the end of 1975. The sample thus includes enough large plants of the most recent vintage to test an hypothesis about capital cost economies of scale for plants larger than 400 MW_e.

Most previous studies have assumed that vintage alone captures the effect of dynamic technological change and that size reflects the effect of static economies in steam-electric generating plants. A strong correlation between size and vintage can obscure the separate effects of time and scale on costs. An attempt was made to use technological design parameters, such as system pressures and temperatures, as variables to separate the effects of dynamic and static technological changes on capital cost. A number of technical design

Table II-1
Capital Costs Data - Electric Power Plants

Values of sample variables										Regional representation (No. of plants per region)								
	Number of Plants	Vintage	Plant capacity (MW _e)	Construction time (months)	Number of generating units	Capacity per unit	Heat rate	Boiler pressure (psi)	Capital cost \$10 ⁶	R ₁	R ₂	R ₃	R ₄	R ₅	R ₆	R ₇	R ₈	R ₉
<u>Steam- electric</u>																		
Oil	73	1928	11.5		1	11.0	8962		4.9									
		1974	1827.7		4	913.0	17913		436.3	7	7	0	2	10	0	19	8	20
Coal	214	1920	8.0		1	4.0	8486		5.2									
		1974	2932.6		10	1460.0	18921		628.0	7	38	49	30	44	24	0	20	2
Gas	37	1928	15.0		1	7.0	8918		4.6									
		1974	892.8		3	781.0	14179		111.5	0	0	1	5	0	6	23	2	0
Nuclear	31	1962	75.0	41	1	75.0		570	41.6									
		1975	2660.1	86	3	1152.0		2485	806.5	6	4	7	5	5	1	1	0	2
<u>Hydro- electric</u>																		
	177	1948	11.0						4.9									
		1974	2430.0						756.4	11	9	6	7	21	18	19	3	83
<u>Gas- turbines</u>																		
	215	1967	14.2		1	14.0			1.5									
		1973	821.5		24	167.0			80.9	25	48	49	18	43	12	2	9	9

Table II-2
Non-Fuel Operation and Maintenance Costs - Electric Power Plants

Range of Values of Sample Variables															
Values of sample variables						Regional representation (No. of plants per region)									
Number of plants	Vintage	Plant capacity	Net generation	Plant factor	O&M cost \$10 ³	R ₁	R ₂	R ₃	R ₄	R ₅	R ₆	R ₇	R ₈	R ₉	
<u>Steam-</u> <u>electric</u>															
Oil															
Coal	131	1947 1974	22.0 2932.0		6.3 113.2	216 20652	4	16	17	16	20	15	16	21	6
Gas															
Nuclear	39	1962 1975													
<u>Hydro-</u> <u>electric</u>															
	151	1948 1974	11.0 2430.0	27.9 17366.5		31 19447	7	4	6	7	18	16	17	11	65
<u>Gas-</u> <u>Turbines</u>															
	234	1961 1972	11.2 821.5			4 3521	30	55	46	15	54	9	10	5	10

variables and plant and unit scale measures were analyzed for the 31 nuclear power plants in our sample, which show large variations in design characteristics between observations.

Three technical variables intuitively presumed to affect construction costs were considered as explanatory variables for the nuclear power plant capital cost equations. The first variable represents the number of first units of multi-unit plants completed during the year. This variable should reflect the embedded expenditures for future unit extensions, such as general site improvements, circulating water, fuel storage and handling facilities, system control equipment, etc., which would properly be reallocated when the new units are added. Some engineering studies conducted by the Atomic Energy Commission (AEC) estimate the cost of the first unit of a two-unit plant to be 10% higher than the cost of the second unit.

The second technical variable is boiler pressure measured in psi. This variable is a key determinant of the generating unit's thermal efficiency and fuel use. Given escalating costs for both fossil and nuclear fuels worldwide, it seems logical that the utilities would be willing to invest to increase the thermal efficiency of their new plants. This assumption has already been borne out for plants becoming operational in 1974 and 1975.

The third technical variable included in our analysis is the average construction time in months for plant completions in a given year. The average construction time for the two plants completed in 1962 was 56 months. The averaging construction time for the four plants completed in 1975 was 78 months, an increase of nearly 40%.

Construction delays are costly. Interest and escalation of costs during construction, both reflected in the construction time variable, are estimated by the AEC to account for more than 40% of the cost of a two-unit 2600-MW_e plant completed in the early 1980's. Some delays are due to safety and environmental requirements and should thus be considered as policy variables in the development of capital cost functions.

Table II-3 presents average costs in 1975 dollars for 31 plants and 41 nuclear power generating units completed between 1962 and 1975. The table shows average cost per plant and per generating unit for the number of plants and units which became operational in any given year. Average capacity per plant and per generating unit are similarly computed and a cost per kW_e of capacity in constant 1975 dollars is derived. Values for the three technical design parameters - number of first units, average boiler pressure, and average construction time - are then listed.

Figure II-1 presents the data in Table II-3 graphically. It seems clear that, when measured in constant dollars, a large part of the escalation in average capital cost per kW_e of installed capacity since 1970 can be explained by changes in system technical and operational variables. From cursory observation of the trends, it appears that some real cost increases were experienced during the period, probably due to more stringent safety and environmental standards, but that the downward trend in cost per kW_e observed from 1962 through 1970 might have started again in 1975.

Table II-4 presents the same information classified into size and vintage groupings. The size and vintage groups were selected so that they contained a reasonable number of observations, the size groups represented real trends in plant and unit capacity growth, and the vintage groups reflected trends in technological change.

Figures II-2 and II-3 present the information in Table II-4 graphically. Figure II-2 shows again the underlying relationship between capital cost per kW_e and boiler pressure and construction time. Also, except for the 800 to 900-MW_e group, which includes a large number of first unit plants, the underlying economies of scale in plant capital cost are reflected. Figure II-3 shows the upward trend in cost and the corresponding increases in boiler pressure and construction time.

The impact of technological effects and the existence of scale effects in capital costs with the nuclear power plant sample are difficult to discern for three reasons. First, many of the plants in the sample are experimental, and design standardization has not yet been achieved. Even though a wide range of

Table II-3
Sample Data for Analysis of Nuclear Power Plant Scale and Vintage Effects

Year	No. plants	No. units	Average cost per plant 1975\$ x 10 ⁶	Average cost per generating unit 1975\$ x 10 ⁶	Average capacity per plant MW _e	Average capacity per unit MW _e	Average cost per MW _e 1975\$ ^e	First unit plants no.	Average boiler pressure (psi)	Average constr. time (months)
1962	2	2	\$ 52.6	\$ 52.6	130	130	405	0	785	56
1968	3	3	155.5	155.5	564	564	276	2	790	50
1970	3	4	140.2	105.1	742	557	189	1	865	48
1971	3	3	137.5	137.5	716	716	192	0	848	61
1972	5	8	284.7	177.9	1218	761	234	2	914	61
1973	5	9	412.1	228.9	1471	839	280	1	842	60
1974	6	7	380.9	326.5	1002	859	380	2	1156	71
1975	4	5	454.5	363.6	1310	1048	347	2	1698	78
	31	41

Figure II-1. Nuclear power plants. Trend values of capacity cost and technical parameters. Cost in 1975 dollars

Figure II-2. Trend values of average investment cost and technical parameters of nuclear plants as function of plant capacity

Figure II-3. Trend values of average cost and technical parameters of nuclear plants as function of plant vintage

Table II-4
Nuclear Power Plant Grouping According to Size and Vintage

Plant capacity range MW _e	No. plants and units plants units		Total plant capacity MW _e	Total plant cost \$10 ⁶	Av. plant capacity MW _e	Av. cost per kW _e \$/kW _e	Boiler pressure (psi)	Construction time (months)
<u>Size groups</u>								
0 - 550	6	6	2243.1	749.5	373	334	747	57
551 - 800	8	8	5025.6	1375.8	628	274	942	55
801 - 1100	9	10	8233.5	2870.3	914	327	1373	68
1101 - 2700	8	17	15521.7	3901.4	1940	251	901	67
<u>Vintage groups</u>								
1962-1969	5	5	-	-	390	293	788	52
1970-1971	6	7	-	-	729	190	856	54
1972-1973	10	17	-	-	790	244	878	61
1974-1975	10	12	-	-	938	356	1373	74

plant and unit sizes was observed in the sample, the fact that each plant is almost one of a kind precludes any learning effect in equipment manufacturing and plant construction costs as additional units are built. Second, concern about the environment has led to the imposition of increasingly stringent standards by Federal and state regulatory commissions, which have increased the real cost of building a unit of nuclear power capacity. Also, uncertainty about future demand and tight capital markets has forced utilities to postpone, and in some cases extend, construction of new nuclear capacity. The resultant increase in real cost over time is reflected in Figure II-3.

To study trend behavior and regional differences in the capital costs of fossil-fueled plants and units, we selected a sample of all the plants in three regions—Northeast Regions 1 and 2 and West South Central Region 7. Regions 1 and 2 were combined into a single sample because our preliminary analysis showed no difference in the equipment unit costs between them. Plants in these regions are predominantly coal and oil fired. Plants in Region 7 are predominantly gas and oil fired.

The costs analyzed are for equipment, instead of the combined structures and equipment. Most of the technology and scale-related capital cost savings in fossil-fueled systems which we wish to discern in the preliminary analysis are achieved through improvements in steam and electric generating equipment. This might not be true of nuclear systems where structures and equipment are difficult to separate. Also, we are interested in testing for regional differences between the high-cost Northeast and the low-cost West South Central regions that are caused by technical requirements rather than price difference.

Table II-5 presents average equipment costs for five vintage and four capacity groupings of fossil-fueled steam-electric plants in the Northeast region. Table II-6 presents similar data for plants in the West South Central region. Examination of these tabulations shows that average equipment costs per kW_e of capacity decline for each vintage group within a capacity group and for each vintage group as capacity per unit is increased. Figures II-4 and II-5 present trend lines showing decreasing costs per unit of capacity as both average vintage and average capacity increase.

Table II-5

Northeast Regions 1 and 2 Average Equipment Costs for Fossil-Fueled
Plants for Various Vintage and Capacity Groupings

	No. of plants	No. of units	Total capacity (MW _e)	Total cost 1975\$x10 ⁶	Av. MW _e per unit	Cost per MW _e 1975\$
<u>100 MW_e</u>						
1920-1940	16	81	4019	3755	50	934
1941-1950	10	32	1876	936	59	499
1951-1960	5	16	926	335	58	362
1961-1969	1	1	28	6	28	221
1970-1974(cc)	2	11	562	126	51	224
<u>101 to 200 MW_e</u>						
1920-1940	5	22	2585	1831	118	708
1941-1950	7	26	3560	1965	137	552
1951-1960	9	24	3566	1212	149	340
1961-1969	1	3	475	175	158	368
1970-1974	-	-	-	-	-	-
<u>201 to 400 MW_e</u>						
1920-1940	-	-	-	-	-	-
1941-1950	0	-	-	-	-	-
1951-1960	9	26	6460	2318	248	359
1961-1969	3	9	3479	987	389	284
1970-1974	-	-	-	-	-	-
<u>> 400 MW_e</u>						
1961-1968	7	16	9963	2372	623	238
1970-1974	6	11	6977	1473	634	211

Table II-6
West South Central Region 7
Average Equipment Cost for Fossil-Fueled Plants
For Various Vintage and Capacity Groupings

	No. of plants	No. of units	Total capacity MW _e	Total cost 1975\$ \$10 ⁶	Av. capacity MW _e per unit	Av. cost 1975\$
<u>< 100 MW_e</u>						
1920-1940	8	33	1564	971	47	\$620
1941-1950	8	31	1935	415	62	214
1951-1960	9	21	1211	232	58	192
1961-1969	6	14	1024	131	73	128
1970-1974	1	3	290	32	97	110
<u>100 to 200 MW_e</u>						
1920-1940	1	8	945	424	118	449
1941-1950	4	18	1484	610	138	245
1951-1960	7	25	3507	578	140	165
1961-1969	1	1	120	13	120	109
1970-1974	2	3	387	54	129	140
<u>200 to 400 MW_e</u>						
1920-1940	0	-	-	-	-	-
1941-1950	0	-	-	-	-	-
1951-1960	4	16	5444	889	340	163
1961-1969	5	15	4575	482	297	105
1970-1974	4	6	1669	203	278	122
<u>> 400 MW_e</u>						
1961-1969	2	5	2155	244	431	113
1970-1974	3	5	2523	241	505	96

Figures II-4 and II-5 also show significant differences between average equipment cost per unit capacity (kW_e) for the Northeast and South West Central regions, but the slopes of the two curves are very similar. This indicates that the effects of technological improvement and economies of scale are not significantly affected by regional differences and that both technological improvements and generating unit size have been increasing at a similar rate for all fossil-fueled generating units, i.e., coal, oil, and gas.

The regional differences observed in Figures II-4 and II-5 can be explained by a number of factors. First, the Northeast region's generating capacity consists primarily of residual oil- and coal-fired power plants which are more polluting than gas-fired plants. There is not a single gas-fired steam-electric plant in the Northeast region, while they predominate in Region 7. Second, the Northeast region is heavily congested and afflicted by severe air and water pollution problems that require heavy investment in pollution abatement equipment. Region 7 is more sparsely populated and its plants burn low-sulfur oil and clean gas, thus requiring lower investment in air pollution equipment. Third, coal and oil plants require more fuel-handling equipment and burners and are thus more expensive than gas-fired plants. There may be other reasons for the large differences in average plant equipment costs between the two regions, which we will try to measure by the use of appropriate variables in the regression equation.

D. Pollution Abatement

The principal emissions from electric generation plants are sulfur dioxide (SO_2), nitrogen oxides (NO_x), particulates, and thermal pollution. Methods and costs for abatement of each pollutant are discussed below.

1. Air Pollution Control. Electrostatic precipitators are generally recognized as providing the cheapest, most reliable process for fly-ash (particulates) removal rates of up to the 99% required to meet both the particulate and SO_2 standards established by EPA. They are usually used with pulverized coal furnaces. Most new base load coal plants use electrostatic precipitators, and this study considers them only for fly-ash and SO_2 abatement in coal-fired power plants.

Figure II-4. Average equipment cost for fossil-fueled steam-electric power plants as a function of vintage. Northeast regions 1 and 2 and WSC region 7

Figure II-5. Average equipment cost per kW_e for fossil-fueled steam-electric power plants as a function of scale. Northeast regions 1 and 2 and WSC region 7

Scherer questioned a number of electric utilities about fly-ash precipitation and removal and found that the average cost of air pollution control equipment for existing plants was approximately 2.5% of initial capital costs for 1970 vintage plants.² Additional information gathered for his study showed fly-ash removal equipment capital costs for four pre-1970 plants amounting to \$1.73 million against initial capital costs of \$84.1 million. The ratio of fly-ash removal equipment cost to total plant cost was 2%. This finding gives credibility to the utilities' 2.5% estimate for post-1970 plants.

The later ratio could be used as an adjustment factor to estimate fly-ash removal equipment costs in existing plants if the regression analysis does not provide an adequate estimation for total pollution control capital and O&M costs.

SO₂ abatement by stack removal has not been completely proven, although several methods had been tested by 1973. The abatement of SO₂ emissions from fossil-fueled plants is accomplished either by removing SO₂ from stack gases or by using a low-sulfur fuel.

The SO₂ stack removal processes under development may be categorized as either "throwaway," or "by-product recovery." The throwaway processes include limestone injection, dry removal, and wet removal. In the dry process, lime or limestone is blown into the boiler, reacts with the SO₂ to form calcium sulfite, and is then collected in the electrostatic precipitator from which it is removed and discarded. In the wet process, lime or limestone is injected into the boiler, and then removed along with the particulates by wet scrubbers.

The recovery processes are also divided into "wet" and "dry" systems.

Table II-7 reproduces a tabulation from the FPC Form S-253 listing pollution control systems with SO₂ removal capability installed through 1973. Quick calculations from the cost data in the table result in cost ranges for fly-ash and SO₂ removal systems operating at 80 to 90% efficiency of between \$20-30/kW_e for oil-fired plants and \$60-90/kW_e for coal-fired plants.

Table II-8 reproduces Cat-Ox SO₂ removal cost estimates published by Mansanto Eviro-Chem Systems, Inc., in 1972.³ The table shows estimates (1972 dollars) of both capital and operating costs to retrofit existing plants and

Table II-7
Pollution Control Systems With SO₂ Removal
Capability Installed Through 1973

Utility (plant)	Year FGD placed in service	FGD capacity served (MW)	Fuel burned	Design SO ₂ removal efficiency (%) ^a	Installed cost (\$1000)	Type of FGD system
Dairyland Power Co. (Alma)	1971	81.6	Coal	70.0	300	Dry lime injection
Illinois Power Co. (Wood River)	1972	112.5	Coal	85.0	6,800	Catalytic oxidation
Commonwealth Edison (Will County)	1972	167.0	Coal	76.0	15,000	Wet limestone scrubber
Boston Edison (Mystic)	1972	137.5	Residual oil	90.0	4,000	Magnesium oxide scrubber ^b
Potomac Electric Power Co. (Dickerson)	1973	100.0	Coal	90.0	6,307	Magnesium oxide scrubber ^b
Louisville Gas & Electric (Paddy's Run)	1973	65.0	Coal	85.0	3,760	Wet lime scrubber
Key West Utility Board (Stock Island)	1973	37.0	Residual oil	85.0	800	Dry limestone injection
Arizona Public Service Co. (Cholla)	1973	57.5	Coal	80.0	6,553	Wet limestone scrubber

^a To be distinguished from total system efficiency which includes system availability in addition to SO₂ removal efficiency.

^b Regenerative type which produces a salable product.

Table II-8
Cat-Ox SO₂ Removal Costs*

Plant size	Capital costs				Operating costs			
	New plant		Existing plant		New plant		Existing plant	
	Av. total (\$/kW)	Av. annual (\$/kW) ^b	Av. total (\$/kW)	Av. annual (\$/kW) ^b	(¢/MBtu)	(\$/kW-yr) ^c	(¢/MBtu)	\$/kW-yr
100	-	-	(60)				(8)	
			54.5	7.52	-	-	10.4	
250	(36)		(39)		(4)		(7)	Varies
	32.8	4.53	35.5	4.90	5.2	4.62	9.1	with
500	(35)		(38)		(4)		(7)	plant
	31.8	4.38	34.6	4.76	5.2	4.58	9.1	heat
1,000	(34)		-	-	(4)			rate
	31.0	4.28			5.2	4.47		
1,500 ^d	33.5		-	-	(4)		-	
	30.5	4.21			5.2	4.38		
2,000 ^d	33		-	-	(4)		-	
	30.0	4.14			5.2	4.28		

^aData in parentheses taken from Monsanto Enviro-Chem Systems, Inc., Air Pollution Control for Electric Utilities -

^bCat-Ox Systems, Air Pollution Control Department, 800 Lindbergh Blvd., St. Louis, Mo. 63166, 1972.

^cFCF = 13.8% for existing and new plants.

^dHeat rates from table 6.8; heat rate for Y MW plant is heat rate for unit of Y/2 MW.

^eExtrapolated.

install the system at new plants of various sizes. Capital cost estimates average approximately \$35/kW_e for new plants and \$40-60/kW_e for retrofits. O&M costs range from approximately \$5/kW-yr. for new plants to \$10 for existing plants.

Estimates of future costs for pollution abatement are given by the AEC in current and 1974 dollars for coal- and oil-fired plants going into service in 1983, with and without SO₂ removal equipment.⁴ The capital cost of air pollution abatement per MW_e of installed capacity is shown as \$47 for coal-fired plants and \$26 for oil-fired plants in 1974 dollars. The same source estimates the cost of safety and pollution control for a 1000-MW_e nuclear LWR to be \$60/kW_e in current dollars by 1983. This source does not show estimates of O&M costs.

O&M cost estimates for particulate and SO₂ removal and disposal are given in a 1975 ERDA study, based on engineering estimates for coal- and oil-fired power plants.⁵ The estimate assumes limestone slurry scrubbers for the flue-gas desulfurization, and a 2-unit, 1,000-MW_e per unit plant, operating at a 78% plant factor with mechanical draft evaporate cooling towers.

The results show a cost of 2.13 mills/kWh for SO₂ removal and disposal for the coal plant and 0.83 mills/kWh for the oil plant. These costs translate into \$14.55/kW-yr for the coal plant and \$5.67/kW-yr. for the oil plant. The SO₂ abatement costs for the coal plant represent 70% of the total O&M cost and 53% for the oil plant.

2. Water Pollution Control. Water pollution from power plants occurs chiefly in the form of hot water discharges into streams and other bodies of water. Modern fossil-fueled plants emit 75% of their waste heat in this manner, and nuclear plants, 94%. The stated goals of the Federal Water Pollution Control Act Amendments of 1972 and the 1977 guidelines enacted by the states to implement the act are the virtual elimination of water pollution discharges by 1985.

As of 1973, a majority of the nation's generating capacity were using simple once-through cooling systems. Such systems will clearly fail to meet

the 1977 EPA guidelines. The principal alternatives are cooling ponds or cooling towers. With these systems, the excess heat in the discharge water is transferred to the atmosphere before release to natural water bodies.

Four main sources of information were used to gather water pollution costs. The first source presents estimates of the initial investment costs for cooling systems as of 1970.⁶ According to this report, the incremental capital costs for water pollution control range from 2 to \$6/kW_e at fossil-fueled plants and from 3 to \$9/kW_e at nuclear plants, depending on the type of system installed — once-through, ponds, or mechanical and natural draft cooling towers. The report also gives estimates for dry-cooling towers of 25 to \$28/kW_e for mechanical draft and 27 to \$30/kW_e for natural draft cooling systems.

The FPC estimates unit capital costs per kW capacity in 1973 dollars as follows:

Once-through fresh water	- \$4.39/kW _e
Once-through saline water	- 5.38/kW _e
Cooling ponds	- 5.29/kW _e
Cooling towers	- 6.95/kW _e

These estimates are based on cooling systems installed as of the end of 1973 and fall within the range of the 1970 Joint Economic Committee estimates.

Scherer, using equations developed by Dickey and Cates,⁷ estimates forced draft cooling tower costs of \$5.50/kW_e for fossil-fueled plants and \$7.50 for nuclear plants. Natural draft tower costs are estimated at \$4.20/kW_e for fossil-fueled plants and \$5.70/kW_e for nuclear plants. The cost data uncovered for once-through cooling ponds and wet-cooling towers are in close agreement after adjustment for differences in the years the estimates were made.

Petruschell and Salter estimated incremental cooling system capital costs for wet and dry cooling towers.⁸ For wet towers, the estimates were (1970 dollars): \$3.70/kW_e for coal-fired plants and \$4.80 for nuclear plants for mechanical draft towers, and \$7.48/kW_e for oil plants and \$9.60/kW_e for nuclear plants for natural draft systems. For dry towers, they estimated \$23/kW_e for coal plants and \$30/kW_e for nuclear plants for mechanical draft systems, and

\$30/kW_e for coal plants and \$46/kW_e for nuclear plants for natural draft systems. These numbers are essentially in agreement with the estimates prepared by the Joint Economic Committee.

Tables II-9 and II-10 show a summary of capital costs per kW_e and O&M cost per kW-yr collected from the various sources mentioned, and converts the estimates to 1975 dollars for ease of comparison. The averages of the various estimates in 1975 dollars could be used as adjustment factors in the regression equations developed in this study for projection of future costs. Appropriate escalation factors are available in the literature if current dollar estimates are desired.

REFERENCES

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7. Dickey, J.B., and Cates, R.E., Managing Waste Heat with the Water Cooling Tower, report to the Marley Corp., Kansas City, Mo., 1972.
8. Petruschell, R.L., and Salter, R.G., Electricity Generating Cost Model for Comparison of California Power Plant Siting Alternatives, The RAND Corp., R-1087-RF/CSA, January 1973.

Table II-9
Air Pollution Control Costs

SO ₂ control	Source ^a	Capital costs (\$/kW _e)				O&M cost (\$/kW-yr)			
		Current \$		1975 \$		Current \$		1975 \$	
		New	Retrofit	New	Retrofit	New	Retrofit	New	Retrofit
Watson	(Ref 2)	33-45	-	46-63	-	4.29-7.98	-	5.36-9.98	-
McSorley	(Ref 3)	25	75	33	100	3.06	9.18	4.08	12.24
Tarquin	(Ref 4)	35	45-60	44	56-75	-	-	-	-
Gakner	(Ref 5)	57	77	71	96	8.58	11.67	10.73	14.59
Myers	(Ref 6)	36	-	50	-	6.13	-	8.51	-
FPC	(Ref 1)								
Oil		20-30	-	27-38	-	-	-		
Coal		60-90	-	80-113	-	-	-		
Cat-Ox	(Ref 9)	15	40-60	44	50-75	5.00	10.00	6.33	13.00
AEC	(Ref 10)								
Oil		26	-	28	-	-	-	-	-
Coal		47	-	51	-	-	-	-	-
ERDA	(Ref 11)								
Oil		-	-	-	-	5.67	-	5.67	-
Coal		-	-	-	-	14.34	-	14.34	-

^aSources listed in References at the end of Appendix A.

Table II-10
Water Pollution Control Costs

	Source ^a	Capital costs (\$/kW _e)		O&M costs (\$/kW-yr)
		Current	1975\$	
JEC	(Ref 12)			
Wet cooling towers				
Fossil fuel		\$ 2.00- 6.00	\$ 2.80- 8.30	
Nuclear		3.00- 9.00	4.20-12.50	
Dry cooling towers		25.00-30.00	34.70-42.00	
EPC	(Ref 1)			
Once through		4.39- 5.38	5.50- 6.75	
Cooling ponds		5.29- -	6.65- -	
Cooling towers		6.95- -	8.75- -	
Scherer	(Ref 9)			
Fossil fuel		4.20- 5.50	5.80- 7.60	
Nuclear		5.70- 7.50	7.90-10.40	
Petruschell	(Ref 13)			
Wet towers				
Fossil fuel		3.40- 7.48	5.10-10.40	
Nuclear		4.80- 9.60	6.70-13.30	
Dry towers				
Fossil fuel		23.00-30.00	32.00-42.00	
Nuclear		30.00-46.00	42.00-64.00	
Anderson	(Ref 14)			O&M costs of 1 to 2% of cooling system investment cost plus capacity penalty of 1% of generating plant investment.

^aSources listed in References at the end of Appendix A.

III. STATISTICAL ANALYSIS OF ELECTRIC POWER GENERATION COSTS

A. Overview of Cost-Estimating Methodology

1. Introduction. This study focuses primarily on developing capital and operating cost-estimating relationships for a number of generating technologies, based on historic plant-level data published annually by the FPC. Cost-estimating relationships are for initial investment costs and annual operating expenses at the Census Region level. The generating technologies covered are: conventional coal, oil, and gas steam-electric, nuclear LWR, gas turbine generators, and conventional hydroelectric and pumped storage facilities.

These generating technologies lend themselves to a statistically based cost determination approach, since a great deal of historic information covering a large number of plants in each Census Region is available. Use of statistical data for a period of significant technological advances, fluctuations in general price levels, and variations in plant design and operating characteristics requires a substantial effort. For conventional steam technologies, plant-level data are available from reports filed with the FPC and published annually since 1938. Data are available for individual plants from the year of initial commercial operation for capacity, construction costs, and engineering characteristics, and for annual production expenses in subsequent years.

Plants were generally observed in the initial year of operation, and their capital costs and physical characteristics recorded. Operating cost data for those plants that remained unchanged from the date of initial operations were observed in the most recent year available. Thus, plants undergoing capacity expansion, major modification, or back-fitting subsequent to initial operations were excluded from the sample. This procedure required tracking each plant from initial operation to the year(s) for which operating data were recorded.

Capital costs recorded at the inception of commercial operations were normalized to constant 1975 dollars, using region-specific price deflators

developed from the Handy-Whitman Index of Public Utility Construction Costs. A procedure which reflected pricing behavior for various categories of structures and equipment comprising the overall generating plant was used to develop price indices for each generating technology. In addition, information about the phasing of actual cash outlays over the plant construction period was utilized to develop the price deflators used here. Thus, a price deflator was developed by weighting the Handy-Whitman annual or semiannual series to account for the typical timing of outlays and length of construction period. (See Appendix B for a complete description of the procedure employed.)

Although the Handy-Whitman price index is compiled separately on a six-region geographical basis, it is critical to note that all regions were assigned an index value of 100 in the base period (1947), and rates of change from this common base value are recorded subsequently. Only regional rates of change in costs can be determined from this source, not relative differences in the level of costs between regions. Relative differences in the level of capital and operating costs were therefore determined by statistical analysis.

Operating costs are composed of fuel and non-fuel labor and material expenditures. Fuel input data at the plant level of detail are available on both a monetary and physical (Btu) basis. Non-fuel expenditures are grouped into separate O&M cost accounts, which we have treated as aggregate total production expenses exclusive of fuel. Fuel input was measured in physical terms (Btu) and estimating equations were developed on a Btu basis.¹ O&M costs, however, are measured in dollars and, in the absence of a regional or national cost index, cannot be expressed on a constant dollar basis over time.

To avoid this difficulty, two options are possible: use average annual employees per plant as a proxy for total O&M costs, or take a cross section of plants in the latest year for which data are available and determine costs in constant dollars for the year observed. The first option was rejected because: 1) regional wage levels needed to derive costs for utility employees were only available for 1972²; 2) no data for the mix of skill categories or quality differences were available; 3) available statistical studies indicated reasonably good, but not outstanding, results using the number of employees, since O&M costs can vary without variation in the number of assigned

employees.³ Consequently, cross-section O&M expenditure data for the most years available were pooled and deflated through the use of dummy variables. In instances where a large sample was available from a single cross section, pooling was avoided.

2. Model Specification: General. Model specification involves the determination of the level of disaggregation for the cost categories to be estimated, the selection of independent variables, and the use of functional form(s). Each of these topics is discussed below.

As previously mentioned, three broad categories of costs were analyzed: capital costs, fuel input, and non-fuel O&M expenditures. Capital expenditures for each plant comprise structures and improvements, equipment, and land and land rights. As prescribed in the FPC Uniform System of Accounts, these costs cover accounts 311 through 316, and include direct and overhead construction costs, structures, equipment, and an allowance for funds used during construction, but exclude the step-up transmission substation associated with the plant. Interest and escalation costs during construction have assumed increasing importance as the period required for construction has lengthened in recent years. Note that land and land rights were excluded from the capital costs used in this study, since wide variability in this item unrelated to technical requirements was observed. Further investigation of land costs in the "19th Steam Station Cost Survey" published by Electric World revealed enormous variability in site acreage for plants with similar generating capacity.⁴ Plants ranging in size from 500 to 1,000 MW of capacity were, for example, observed to "require" sites from as small as 187 acres to nearly 8,000 acres. Some utilities are able to include additional land beyond the amount strictly required for the plant site as part of the investment cost base.

Fuel expenses are by far the largest production expense category for steam plants and gas turbine generators. Utilities report to the FPC the amount, cost per unit, Btu per unit, and cost per million Btu for each plant and type of fuel used. In general, cost per unit, and to some extent Btu per unit and consequently cost per Btu differed appreciably even for plants burning the same fuel and belonging to the same utility system. Accordingly, we have chosen to

use as the dependent variable the physical input of fuel measured in Btu. For multi-fuel plants, data recorded were Btu consumed for each fuel type and in total.⁵ To eventually compute total generating costs, the fuel input relationship will have to be converted from physical to monetary terms. For this purpose, the regional price for each fuel type at future points in time will be provided as an endogeneous variable from the BNL Multi-Regional Energy and Interindustry Model.

Non-fuel O&M costs for labor and materials are the third cost category. The available FPC accounts are not broken out by cost category (i.e., labor, water, maintenance supplies, and materials) but rather by activities such as supervision and engineering, steam expenses, maintenance of boilers, etc. Because accounting treatment of operating as opposed to maintenance activity is somewhat arbitrary, we have chosen to combine both categories into total production expenses (exclusive of fuel).

As we examined the data in detail, it became apparent that regulated utilities prefer to treat modification or backfitting activities as expenses when such activities are really of a capital nature. Unfortunately, little can be done to separate such costs from O&M costs. We have, however, excluded from the sample the partial year of operating data for a new plant beginning commercial operations. Apparently, many pre-operating expenses are spread over into operating costs after the plant begins commercial generation.

3. Model Specification: Regional Analysis. Prior to presenting the results of the analysis undertaken to derive regression equations for estimating capital and operating costs for each generating technology, the theoretical basis and statistical principles of our techniques should be explained. We have developed estimating equations in both additive (linear) and exponential (log-linear) forms. Our a priori preference is for the exponential form, on account of its greater consistency with the technical features of modeling productive relationships and its preferable statistical properties. The selection of potential explanatory variables includes output unit parameters and characteristics of generating plant logically related to

the costs being estimated. Whenever possible, we have avoided the use of composite variables, such as total capacity and kWh of output, which tend to mask the specific structure of the underlying independent variables. Instead, independent variables are broken down into several separate component variables, depending on whether the cost category is a capital or an operating variable.

$$\text{Capacity(MW}_e\text{)} = \frac{\text{installed capacity}}{\text{turbine generator unit}} \times \text{number of T-G units,}$$

$$\text{Net generation(kWh)} = \text{installed capacity} \times \text{plant factor,}$$

where

$$\text{Plant factor} = \frac{\text{net generation(kWh)}}{8760 \text{ hours per year} \times \text{installed capacity}} .$$

An additional feature of the regression analysis is the liberal use of dummy variables, especially to measure regional effects, and also to represent qualitative variables that may affect costs.

Equations. The exponential equation form has many desirable statistical properties that make it more appropriate than the additive form for regression analysis of costs. The most important of these are:

- The marginal cost per unit of output (or capacity) can vary with the level of output (capacity) and other plant characteristics.
- The cost elasticity is constant.

The error term is proportional to the magnitude of out (or capacity).

Consider the advantages of the exponential form with regard to marginal cost and cost elasticity. If we attempted to estimate O&M costs (C) with a linear equation in terms of, say, a size variable (S) and output (O), the equation would be as follows:

$$C = a + b_1S + b_2O.$$

Regression coefficient b_2 is equal to the estimated marginal costs per unit output. In this model, a given increase in output will increase costs by a fixed number of dollars, b_2 , regardless of level of output or plant size. The exponential form relates a percentage change in cost to a percentage change in output (or size). That is, if we have an exponential equation to

$$C = AS^{b_1} O^{b_2},$$

then differentiating it with respect to output and dividing both sides by C , we get

$$\frac{DC}{C} = b_2 \frac{dO}{O},$$

which means that a 10% change in output implies a change in costs of $b_2 \times 10\%$. Furthermore, the size of the coefficient b_2 immediately signifies whether the cost relationship is of increasing ($b_2 > 1$), decreasing ($b_2 < 1$), or constant costs ($b_2 = 1$). The cost elasticity coefficient b_1 is constant over all levels of output.

With the exponential equation form, the marginal cost per unit output will also vary with size or any other variables included in the equation. Taking the derivation of cost with respect to output gives the following expression for marginal cost:

$$MC = \frac{dC}{dO} = AS^{b_1} b_2 O^{b_2-1}.$$

Thus we see that the marginal cost is related to both the level of output and the size variable.

The nature of the error term is another desirable feature of the exponential model. Because the regression equation for the exponential model

is developed in log-linear form, the estimating error is proportional to the size of the dependent variable. This assumes that the error which perturbs costs for small plants will be no worse than that for large plants on a relative basis. The log linear regression equation has the following form:

$$\log C = \log a + b_1 \log S + b_2 \log O + \epsilon,$$

where ϵ is the regression error. When transformed into exponential form, the cost equation is as follows:

$$C = AS^{b_1} O^{b_2} \epsilon,$$

where $A = e^a$ and $\epsilon e = e$. We see, therefore, that the error term associated with the estimated cost is proportional to C . Contrast this result with the linear model which has a constant error for all values of C :

$$C = a + bS + b_2 O + \epsilon.$$

A comparison of the two models is illustrated below in Figure III-1 for a simple regression of cost and output.

Figure III-1. Confidence limits ($\pm$ two standards error) for linear and exponential models

Another advantage of the exponential model, which follows from the error term being proportional to the size of the dependent variable, involves unequal variance of residuals along the axis of the independent variable. The problem of heteroscedasticity or unequal variance of the residuals can arise when the dependent variable displays a great deal of variability. While resulting regression coefficients are unbiased with heteroscedasticity, the estimates do not have minimum variance. The exponential model is usually adequate to avoid the problem of heteroscedasticity.

Use of Dummy Variables. Dummy regional variables were included in the preliminary specification of all regression equations. The regional dummies were defined for each of the nine Census Regions to correspond to the level of geographical detail in the BNL Multi-Regional Model. Thus, plant location, although available by state, was aggregated into Census Regions. We realized that this level of aggregation could create regions too homogeneous to differ as to wage and material prices, physical and load characteristics, environmental constraints, and other factors that might cause regional cost variations. Nevertheless, the regression results reported in the next section do demonstrate significant differences among Census Regions for a number of cost categories and technologies.

Both regional dummy variables and the others introduced to capture the effects of additional qualitative independent variables were treated as shift parameters. Many of the non-regional dummies were related to engineering or physical characteristics, such as building type, operating type (manual, automatic), type of cooling, etc. They were usually unique to the particular technology being investigated—for example, hydroelectric facilities operated by the Corps of Engineers were distinguished from privately owned plants, while cooling technologies (towers, reservoirs, etc.) were distinguished by dummy variables for nuclear generating plants.

For a regression equation containing sets of dummy variables for regional and other factors, the dummy variable was tested to verify if it deviated significantly from the constant term of the regression. Since the regions

were defined as the nine Census Regions, eight dummy variables were used to designate regions and the ninth region was assigned as the intercept. The significance tests on the coefficients of the dummy variables then applied to the hypothesis of whether or not the intercept term for the i^{th} region was the same as the region defined to be the intercept. Dummy variables representing non-regional factors are defined when introduced in the discussion of results later in this chapter.

When dummy variables are used in the linear model, the estimated coefficient for the dummy term is added to or subtracted from the estimated intercept, thus shifting the linear equation upward or downward by a constant amount depending on the coefficient sign. For the exponential model, the estimated coefficient of the dummy term becomes a shift parameter over the entire range of the function:

$$C = AS^{b_1} 10^{b_2 d} e^{b_3}.$$

Thus, when $d = 1$, costs for every value of S and 0 are e^{b_3} more or less than costs when $d = 0$. For example, an estimated value of $b_3 = 0.2$ gives $e^{b_3} = 1.22$, so that costs are 22% higher for the case represented by $d = 1$.

4. Use of Price Indices and Measurements of Technological Change. It is helpful to state at the outset of the analysis, the assumptions, limitations, and possible sources of bias and misinterpretation that are possible with the historic statistical adopted in this study.

Improvements in Capital. The selection by utilities of plant size, operating characteristics, and configuration is a complex decision; load projection and the future course of input prices are primary considerations. It can be expected that for a given state of the art, expectations of higher operating costs will cause utilities to select more capital-intensive plants to reduce the need for operating inputs (labor, fuel, material).

Technological change for capital equipment, per se, means that a plant representing a given level of capacity and the same level of operating efficiency can be purchased at a lower real price. Technological change may, of course, be achieved in the form of improved operating efficiency, but this can be distinguished from technical improvement for capital equipment. Technical change for capital equipment is what we are trying to measure in the capital cost regressions. Since at a given point in time a plant with greater operating efficiency is more costly, the technique to identify technical change for capital equipment is to include measures of operating characteristics as independent variables in the capital cost regression equation.

Prices indices used to achieve constant dollar prices at different points in time should only reflect inflationary price increases. Price increases caused by increased plant efficiency (i.e., quality change) should in principle be netted out from the price index. Thus an increase in plant efficiency without inflation should be reflected as an increase in real unit cost of capital equipment. By the same token, if manufacturers of electric plants and equipment can generate greater operating efficiency at no additional manufacturing cost, they may be able to increase equipment prices to reflect the increased efficiency. Under competitive conditions, without adjustment lags, and with perfect and costless information transfer, however, it can be expected that the price charged a utility for a plant will reflect only the extra cost of resources (R&D, equipment, etc.) required to achieve greater operating efficiency.

A second important consideration in measuring technological change in capital is the possibility that economies of scale are the real cause of observed reductions in plant costs per unit of capacity. Increasing trends towards larger plants will tend to reduce unit capital costs when economies of scale are present, regardless of technological improvements. Thus, it is important to differentiate between decreasing costs over time versus static decreasing costs from scale economies. Capital cost equations should be specified to include time and capacity as independent variables. Otherwise, economies of scale and technological change are inseparable.

Improvements in Operating Efficiency. In principle, the identification of technical improvements in operating efficiency (fuel, labor, material inputs) requires measurement of shifts in the estimated operating function over plants of different vintages. However, the design of plant to achieve lower operating costs through substitution of capital for operating inputs is not the same as technological change. Similarly, operating economies achieved as a result of scale (i.e., a larger plant) are not technological improvements. Theoretically, if the operating cost regression equations contain all the factors affecting demand for input, including relative prices or design characteristics at the time of plant design, then substitution effects can be separated from technological change—i.e., shifts of the isoquant can be distinguished from movements along the isoquant.

A second, more fundamental consideration, given the data limitation inherent in our sample, is the separation of technological shifts in operating functions from the impact of plant age on costs. It can be expected that technological improvements will reduce the O&M requirements (after adjustment for inflation), so that newer plants will display lower real O&M costs. But newer plants observed at a fixed point in time (i.e., data cross section) are also younger plants. Are the reduced O&M costs observed under these conditions attributable to technological change or to age? The only way to quantify the two effects separately is to pool cross sections so that plants of a given vintage are observed in their first, second, and subsequent years of operation. Use of a single cross section to identify either vintage or age leads to an overstated estimate of technological change and an understated estimate of the impact of age. It is, of course, not possible to include both age and vintage as independent variables when data points come from a single cross section, since vintage is merely a linear transformation of age.

B. Regression Results

The estimated regression equations for each cost category and technology are presented in this section. These results are organized by technology: fossil-fueled steam-electric plants, gas turbine plants, hydroelectric plants,

and nuclear plants. Within each technology, capital cost equations are presented first, followed by fuel and non-fuel O&M cost relationships. For fossil-fueled steam-electric plants, separate capital cost equations are developed for coal-, gas-, and oil-fired plants. For the other technologies and cost categories, generic plant differences, such as those between oil- and gas-fired gas turbine units are treated through dummy variables.

The format for the presentation of each regression result indicates sample characteristics, discusses the analysis conducted, including the selection of variables, preliminary findings, and statistical results, and interprets the final estimates in terms of the economic and technical meaning of the coefficients. Except where otherwise noted, all equations are for the logarithm of the dependent variable. Significant independent variables are listed together with the estimated regression coefficient and t-value. A single asterisk denotes that the variable is significantly different from zero at the 1% level of significance, a double asterisk denotes a 5% level of significance, and a triple asterisk denotes a 10% level of significance. A list of sample characteristics for the dependent and the more important explanatory variables can be found in Tables II-1 and II-2 in Chapter II.

1. Fossil-Fueled Steam-Electric Plants

a) Capital Costs

Coal-, Coal/Gas-, Coal/Oil-Fired Plants. The sample for estimating capital costs for these facilities consists of 214 plants, ranging in size from 8 MW_e to 2,932.6 MW_e and representing vintages as old as 1920 and as recent as 1974. All Census Regions except Region 7 are represented by at least 2 and as many as 49 plants. Most of the plants (154) burn coal exclusively, and 60 have the capability of burning coal and another fuel. Thirty-one plants were put in service in 1970 or later and can be expected to have included in their capital costs the pollution abatement equipment required to comply with environmental standards for new units.

At the outset of the analysis, caution was required in specifying the independent variables because of reasonably strong pairwise correlations. High correlation coefficients between pairs of potential explanatory variables were:

Vintage and unit capacity; 0.70.

Vintage and design heat rate; -0.69.

Vintage and reheat capacity; 0.62.

Reheat capacity and capacity per unit; -0.48

Over time these coal-fired plants have become larger, with more reheat capacity and lower design heat rates. The joint use of these variables may lead to insignificant coefficients for one of the pairs due to high collinearity. This phenomenon did occur when reheat capacity and design heat rate were both included as independent variables. Design heat rate became insignificant and the estimated regression coefficient was incorrectly signed. Both variables were significant, however, and correctly signed when vintage was excluded — either vintage or design heat rate captured the same effect.

Both linear and exponential models were run, with no appreciable differences found in signs, significance levels, or overall explanatory capability. In no case could a difference between coal-burning plants and those able to burn a second fuel be found. Dummy variables for Census Regions 1, 2, and 3 were found to be insignificant and were therefore combined with the intercept term (Census Region 9). The remaining regions were found to be from 15 to about 30% less expensive than the other locations. Finally, plants coming into service after 1970 were found to exhibit higher real costs than those of earlier vintages. Table III-1 shows the final regression equation.

Capacity. The coefficients for the capacity per unit of the component variables and the number of units indicate the presence of substantial economies of scale in the capital costs of coal-fired plants. The coefficients are significantly different from both zero and unity. The use of two-component variables to present composite capacity means that the elasticity

Table III-1

Results of Coal-Fired Steam Electric Coal/Mixed
Capital Cost Regression
(Logarithm of Thousands of 1975 Dollars)

Independent variables	Coefficient	t-Value
Intercept	9.723300	16.183*
Ln vintage	-0.677824	-4.057*
Ln capacity per unit (MW) _e	0.790713	20.406*
Ln number of units	0.799367	16.708*
Reheat capacity (%)	-0.180619	-2.360**
Dummy for Census Region 4	-0.189221	2.518**
Dummy for Census Region 5	-0.226532	-3.685*
Dummy for Census Region 6	-0.344571	-4.456*
Dummy for Census Region 8	-0.184726	-2.143**
Dummy for post-1969 plants	0.250906	3.143*

R^2 raw = 0.8820

R^2 corrected = 0.8768

of costs with respect to total capacity lies between the estimated coefficients for the two explanatory variables. Where the elasticity lies depends on how capacity increases - additional units, greater capacity per unit, or some combination of the two. Increasing capacity by equal increases in unit capacity and number of units gives an elasticity equal to the average of the two coefficients. As the coefficients are nearly identical, the magnitude of the cost coefficient is nearly identical, regardless of how capacity is increased.

Vintage and Post-1970 Shift Parameter. The coefficient for the vintage term indicates continuous downward shifting of the cost function due to technology. Real costs declines at an annual rate of 1.2% in the early 1950's, and decreased to about 1% by 1960 and 0.865% by the early 1970's. Note that superimposed on these shifts is an upward shift of about 28% for plants introduced after 1970, primarily because of pollution abatement costs, longer construction times, and higher interest rates.

Reheat Capacity. The coefficient for percentage of reheat capacity indicates that for otherwise identical plants, those having a higher percentage of reheat capacity are less costly. Increasing reheat capacity by 10% reduces total capital costs by 1.8%. This effect explains why newer plants in the sample tend to have higher reheat capacities—the simple correlation coefficient between percentage reheat capacity and vintage is 0.62.

Regional Effects. Capital costs for plants in Census Regions 4, 5, and 6 were found to range from 15 to about 30% less costly than the remaining regions, with Census Region 6 (the TVA region) having the lowest absolute costs. This result is not affected by undue concentration of either coal or mixed-fuel plants in any one region, since the dummy variable for fuel type proved highly insignificant.

Oil- and Oil/Gas-Fired Plants. The sample for oil- and oil/gas-fired plants consisted of 73 plants representing all Census Regions except Region 3 (East North Central) and Region 6 (East South Central). Of the total 73 plants in the sample, 58 are capable of burning both oil and gas. Their vintages range from 1928 to 1974; the smallest has a name plant rating of 11.5 MW_e and the largest 1827.7 MW_e. Plants with from one to four turbogenerator units were observed with unit capacity ranging from 11 MW_e to 913 MW_e.

Linear and exponential equation forms were run, using the composite capacity variable and the component variables, capacity per unit, and number of units. The exponential form with the two-component variables proved superior and was selected.

In addition to vintage, two engineering design parameters, reheat capacity and heat rate, were included as explanatory variables. However, relatively

high correlation between vintage and heat rate reduced the statistical significance of the latter and it was dropped. Dummy variables for mixed-fuel plants and for plants going on line beyond 1970 were also used. Mixed-fuel plants were significantly more costly than pure oil plants. The impact of pollution abatement and lengthened construction time, as measured by the dummy variable for 1970 and later years, proved insignificant. Apparently the plants in our sample either were built too early for pollution abatement costs to be captured or were switched to low sulfur fuel oil instead of investing in pollution abatement equipment.

Table III-2

Results of Oil-Fired Steam-Electric
Capital Cost Regression
(Logarithm of Thousands of 1975 Dollars)

Independent variables	Coefficient	t-Value
Intercept	10.386900	9.515*
Ln vintage	-0.934040	-3.232*
Ln capacity per unit (MW) _e	0.815272	14.965*
Ln number of units	0.828328	10.833*
Reheat capacity (%)	-0.185504	-1.966*
Dummy for mixed fuels	0.214370	2.264**
Dummy for Census Region 2	0.257360	2.155**
Dummy for Census Region 7	-0.508460	-5.822*
Dummy for Census Region 8	-0.513360	-4.293*
R ² raw = .9208		
R ² corrected = .9109		

Capacity. Estimation results again evidence considerable economies of scale, about the same as those found for coal plants. Increases in capacity lead to less than proportional increases in plant costs. The coefficients for capacity per unit and number of units indicate that a 100% increase in capacity from a 50% increase in unit capacity and number of units (i.e., from two to three) causes an 82.15% increase in costs, $0.5(0.828) + 0.5(0.815)$. Note that the coefficients for component capacity terms are significantly different from unity (constant returns to scale.)

Vintage. The effect of vintage is to shift the total cost curve downward at a decreasing rate over time. The exponential form and coefficient estimated in the regression equation indicate technological change at a rate of nearly 2% per year in the early 1950's, 1.33% in the 1960's, and 1.25% by the early 1970's. Note that the dummy variable used to distinguish plants beginning operations after 1969 proved very insignificant, indicating that pollution abatement requirements had little effect on our sample.

Mixed-Fuel Plant. Plants capable of burning either oil or gas are significantly more expensive than otherwise comparable plants that can burn only oil. The coefficient for the mixed-plant dummy variable is surprisingly high, indicating capital costs nearly 24% higher for this capability.

Regional Effects. Cost differences among Census Regions are statistically significant and of relatively large magnitude. Census Regions included in the intercept term are Regions 1, 4, 5, and 9. (No plants were found in Regions 3 and 6.) Relative to the intercept, Census Region 2 (Mid-Atlantic) was found to have 29% higher costs, while Census Regions 7 and 8 (West South Central and Mountain) were 40% less costly. These variations in relative costs arise from differences in construction and materials prices, in pollution control requirements, in design requirements for burning fuels with different characteristics, and in configuration and equipment requirements related to climate and site characteristics.

Gas-Fired Plants. Gas-fired plants tend to be smaller than coal or oil units. The average station capacity in our sample is 175 MW_e, compared to

301 MW_e for oil-fired stations and 446 MW_e for coal-fired stations. Gas-fired plants are also more highly concentrated in a limited number of Census Regions, primarily the West South Central Region (Region 7). A limited number of sample observations are available for Regions 3, 4, 6, and 8, however.

The sample consists of 37 gas-fired plants, ranging in vintage from 1928 to 1974. Variables considered were: location, capacity, design heat rate, and reheat capacity. Both linear and exponential equation forms were tested, using both composite and component capacity variables. This technology was the only one of those analyzed, in which the linear forms proved superior. With the linear forms, the estimated coefficients do not immediately indicate the cost elasticities and the consequent degree of returns to scale. Elasticity terms can be computed at a specific value; usually the mean value of the independent variable is more meaningful. That is,

$$C = a + bX,$$

$$\text{Elasticity} = \text{marginal cost/average cost} = \frac{bX}{a + bX}.$$

The regression results presented in Table III-3 include the value of the partial cost elasticity computed at a mean for each relevant independent variable.

Capacity. The coefficient for the unit capacity term indicates a (constant) marginal capital cost of \$147 per kW_e of capacity in 1975 dollars for a plant with a given number of units. The computed elasticity coefficients for both units and unit capacity indicate substantial scale economies - more so than with the other technologies. Of course, with the linear form, the elasticity value approaches unity as the capacity expands, so that the computed value is only applicable for values around the sample mean (1.29 unit stations of 147-MW_e unit capacity). The computed elasticities indicate that a 10% increase in total capacity through capacity through equal increases in number of units and unit capacity increases costs about 6.7%.

Table III-3

Results of Gas-Fired Steam-Electric
Capital Cost Regression
(Capital Costs in Thousands of 1975 Dollars)

Independent variables	Coefficient	Elasticity at means	t-Value
Intercept	68552.3000	-	2.465**
Vintage	-727.3500	-1.485	-3.106*
Number of units	13099.7000	0.585	5.501*
Capacity per unit (MW _e)	147.3740	0.749	14.579*
Design heat rate	-3.3577	-1.257	-2.138**
Dummy for Census Region 3	52547.9000	-	6.335*
R ² raw = 0.928			
R ² corrected = 0.9166			

Vintage. The coefficient for the vintage term indicates annual costs reduction of \$727,000 through technological changes, regardless of station size, location, etc. The computed elasticity indicates that for stations of sample-average characteristics, the downward shift in costs amounted to nearly 3% in the early 1950's, 2 to 3% in the early 1960's, and slightly more than 2% in 1970.

Design Heat Rate. The design parameter for the fuel efficiency of gas-fired plants is both significant and of the correct sign. The coefficient indicates that an investment of \$3,357 is required to reduce the design heat rate by 1 Btu per kWh. The elasticity coefficient indicates that a 10%

reduction in heat rates adds about 12.5% to initial capital costs. To judge the reasonableness of the design heat rate coefficient, a rough calculation was made to compare the additional investment in capital with the annual value of fuel savings. The cost coefficient can be considered reasonable if it indicates a rate of return on extra investment consistent with utility discount rates for investment decision-making (i.e., perhaps 8 to 15%). Higher or lower rates of return would indicate disequilibrium and thus an unreasonable coefficient. To reduce the station heat rate by 1,000 Btu/kWh requires an investment of \$3,357,700 in 1975 dollars. A 200-MW_e plant operating at a 57% plant factor produced 1,000 million kWh per year and saves $1,000,000 \times 10^6$ Btu per year by investing the additional \$3,357,700. Fuel prices for 1974 in Census Region 7, where most gas-fired plants are located, was about 50¢ per 10^6 Btu, yielding an annual fuel cost savings of \$500,000. Thus, the investment implies an undiscounted payback period of six to seven years or an internal rate of return of 13.7 to 14.4% for plants with useful lives of 20 and 25 years, respectively.

Regional Effects. A significant upward shift in the intercept of \$52 million was found for Census Region 3, the East North Central, when compared with Regions 4, 6, 7, and 8. This represents a 78% upward shift at the origin, but because of the nature of the linear form, the importance of the cost difference declines as plant size increases.

b) Fuel Costs

The estimated fuel relationship is for the physical input of fuel measured in Btu. Cross-section data at two points in time were compiled to apply a pooled cross section regression. Data on Btu consumed for plants of various types, locations, capacities, and utilization rates were gathered for 1969 and 1974. Only plants tracked as unchanged from the initial year of operation to the year observed were included. Thus, plants that were modified, expanded, or otherwise altered before 1969 and 1974 were eliminated. These years were selected to obtain contrasting cross sections of data: pre-oil embargo, high economic activity and plant utilization (1969), and post-oil-embargo, low economic activity and plant utilization (1974).

With such a multiyear cross section, the effects of both vintage and age can be modeled, as well. A plant of vintage 1960, observed in 1969 and again in 1974, can be recorded first with vintage 1960 and age 9 and then with vintage 1960 but age 14 (1974-1960). A pooled cross section in theory allows vintage effects to be separated from depreciation effects. The pooled sample consists of a total of 234 plants, ranging in vintage from 1950 to 1974 and in capacity from 22 MW_e to 2932.6 MW_e. The plants are reasonably well distributed across fuel types and regions.

Several preliminary regression runs were attempted to test for differences in the fuel efficiencies of plants burning various types of fuel and located in different regions. First, regressions with plant capacity, plant factor, vintage (to measure trends in technology), and age (to measure the degradation effect of age) were combined with regional and fuel-type dummies. Both regional and fuel dummies were included to test whether differences in fuel types or fuel sources influenced fuel efficiency. Is there a difference between the thermal conversion efficiency of Btu equivalent gas, oil, and coal, or between, say, eastern and western coal, perhaps on account of ash, moisture, or sulfur content? None of the regional or fuel-type dummies proved significant in either the combined regional and fuel-type runs or subsequent runs using first only regional dummies and then only fuel-type dummies.

A second result from these preliminary regressions was that when vintage and age were employed together, both were highly insignificant. A check showed an extremely high correlation (simple correlation coefficient of -0.094) between these variables accounting for the results. Using each variable separately showed vintage to be insignificant, while age (i.e., degradation effect) became significant at the 10% level.⁶

Table III-4 displays the regression results for the fuel consumption equation derived from the pooled cross section of 234 fossil-fueled steam-electric stations. The estimated equation is relatively uncomplicated, involving plant capacity, utilization, and age. A striking feature is its lack of a vintage term, indicating that the reduction in plant heat rate over time is a man-

ifestation of static economies of scale rather than dynamic changes in the quality of plant at every level of capacity. Note also that the estimating equation can be converted to the more familiar heat rate function showing Btu per kWh against plant factor.⁷

Table III-4

Results of Fossil-Fueled Steam-Electric
Fuel Consumption Regression
(Logarithm of Btu x 10⁹)

Independent variables	Coefficient	t-Value
Intercept	0.551969	5.954*
Ln capacity (MW _e)	0.934769	107.689*
Ln plant factor (%)	0.925549	47.758*
Age (years)	0.002333	1.676*
R ² raw = 0.9926		
R ² corrected = 0.9851		

Capacity and Utilization. The partial elasticity of fuel consumption with respect to plant size indicates economies of scale—larger plants require less fuel at a given plant factor. However, a larger plant does not necessarily consume less fuel for a given level of output (net generation), since the larger plant operates at a lower plant factor. Larger and smaller plants will consume the same fuel per unit of output when the coefficients for capacity and plant factor are equal. Larger plants will consume less fuel per unit of output when the regression coefficient for capacity is less than the coefficient

for plant factor, and conversely. Our results indicate nearly equivalent regression coefficients so that the 200-MW_e plant producing at a 25% plant factor consumes as much fuel as the 100-MW_e plant operating at a 50% plant factor.

Age. The age coefficient is measured in years, rather than the logarithm of years, and indicates that fuel efficiency declines as plants age. The rate of fuel degradation is slight at 0.23% per year (exp. 0.002333).

c) Non-Fuel O&M Costs

The analysis of non-fuel O&M costs presents many of the same problems associated with estimation of fuel consumption relationships, with the additional problem of inflation when pooled cross sections are used. No suitable method of normalizing costs to a constant dollar basis exists for the many types and combinations of inputs that comprise O&M costs. Pooling cross sections is desirable for these costs, as both age and vintage can be influential.

A pooled sample of 235 plants was compiled, consisting of 131 plants observed in 1974 (a recession year) and 105 plants observed in 1969 (a year of high economic activity). Rather than applying an arbitrary deflator to the current dollar O&M costs observed in the sample, a dummy variable was introduced to distinguish 1969 observations from 1974 observations. The sample had good regional representation, with no single Census Region having fewer than 9 or more than 35 plants. Included were 17 oil plants, 36 gas plants, 25 coal/oil or coal/gas plants, 25 oil/gas plants, and 134 coal plants.

A preliminary examination of the correlation matrix of potential explanatory variables was next conducted to gauge the ability of the sample to separate age/vintage and regional/fuel-type effects. A high correlation (-0.94) was found between age and vintage in our two-year cross section and between gas plants and the dummy variable for Census Region 7 (0.67). Later regression results confirmed what had been found with the fuel analysis: vintage and age effects cannot be separated. Preliminary analysis indicated very little cost difference between plants burning different fuels, except for gas plants, which exhibited an O&M cost advantage.

The desirability of using component variables (capacity and plant factor) in place of the composite variable (net generation) was confirmed, since vastly different coefficients were estimated for capacity and plant factor. A high fixed-cost component accounts for this result, although costs do vary significantly with activity. Recall that when similar coefficients are estimated, no advantage is gained by using the single composite variable in place of the several component variables. We found that the vintage effect captured much of the age effect in regression estimates. However, when age was used instead of vintage, the latter's effect was to a large extent captured in the intercept. The reason for this is that when a plant appears in both cross sections, there is no difference in the vintage variable in the 1969 and 1974 cross sections. When age is used, the plant appears at a certain age in 1969 and then as five years older in the 1974 cross section. The regression results are shown in Table III-5 below.

Table III-5
Results of Fossil-Fueled Steam-Electric
Non-Fuel O&M Cost Regression
(Logarithm of Thousands of 1974 Dollars)

Independent variables	Coefficient	t-Value
Intercept	1.053670	3.341*
Ln capacity (MW_e)	0.875129	27.870*
Ln plant factor (%)	0.274883	4.445*
Age (years)	0.038800	8.208*
Dummy for Census Region 3	-0.167596	-1.842***
Dummy for Census Region 5	-0.327123	-3.703*
Dummy for Census Region 6	-0.304537	-3.140*
Dummy for Census Region 7	-0.465342	-3.891*
Dummy for gas-fired plants	-0.192726	-1.679***
Dummy for 1969	-0.364272	-6.024*
R^2 raw = 0.8441		
R^2 corrected = 0.8372		

Capacity and Utilization. The inclusion of a significant capacity variable with a coefficient significantly less than unity suggests two important conclusions: (1) O&M costs have a high fixed element, and (2) there are economies of scale in O&M costs. The plant factor variable, although small in absolute value, is significant, indicating that changes in the rate of output do drive some portion of these costs. The coefficient for capacity indicates that a 10% increase in capacity induces a less than proportional 8.7% increase in fixed O&M costs. An increase in plant activity of say 10% causes a relatively small 2.7% increase in these costs; O&M costs are 27% variable with output.

Age. The coefficient for the age variable is highly significant and indicates an increase in O&M costs (most likely maintenance) as the plant ages. These costs appear to increase in absolute terms, growing at a constant percentage rate of about 4% (exp. 0.0388) per year.

Plant Type. Only gas-burning steam-electric stations were found to have O&M costs different from those of the other plant types. This variable was barely significant and represents an 18% cost difference in comparison to the other fossil steam technologies. It should be recalled that gas plants are concentrated in Census Region 7, so that the effects of real cost differences for gas plants and regional price differences were difficult to separate. (The correlation between the dummy variables for gas and for Region 7 was .67.) Still, both dummies were significant.

Regional Effects. Census Regions 3, 5, 6, and 7 were found to have from 16 to 37% lower O&M costs in comparison to the rest of the country. These results are consistent with Bureau of Labor Statistics 1972 Industry Wage Survey which showed a trend for the Border, Southeastern, and Southwestern states to have lower wage levels for electric systems workers.

Inflation Dummy. This variable is reported for completeness and is not intended for use in costing or projection. The regression results are constant 1974 dollars, with the dummy for 1969 observation included to distinguish

the impact of inflation. The coefficient shows a 30% increase in prices between 1969 and 1974. This variable should be suppressed when using the regression equation, and the resultant cost estimation should be interpreted as constant 1974 dollars.

2. Gas Turbine Plants

a) Capital Costs

Gas turbine technology is unique in that units tend to be relatively standard and often are shipped already assembled from the manufacturer to the plant site. The site itself requires minimum preparation and the structure is often no more than a concrete slab. Widespread use of this technology is relatively recent, with the oldest observations in our sample dating back only to 1967. It is therefore not surprising to find nearly constant returns to scale and extremely small (though statistically significant) regional cost differences. These differences amounted to about 90 to 95% of the average value and were detected for three out of the nine Census Regions.

The gas turbine sample consisted of 215 plants brought on line between 1967 and 1973. Unit capacity ranged from 14 to 167 MW_e, while plant capacity ranged from 14 to 821.5 MW_e. The high plant capacity was achieved by combining many individual units; some plants in the sample consisted of as many as 24 units. Plants were observed in all Census Regions, although Regions 2, 3, and 5 had the most observations - 48, 49, and 43, respectively. The fuel burned by the plants varied, with 19 plants capable of burning only gas, 125 burned oil exclusively, and 71 burned oil and/or gas.

Because of the rapid growth in gas turbine capacity in the past decade, considerable care was taken in the analysis. However, despite its growth rate, this technology still contributes but a small fraction of overall capacity and an even smaller fraction of output. Our procedure was to regress capital costs against vintage, capacity per unit and number of units, first with dummies for all Census Regions, fuel types, and operating types. Insignificant dummy variables were then eliminated in subsequent runs. A tendency for gas-fired units to be less costly than oil-fired or mixed units was evidenced. However, the

dummy for gas-fired units proved to be only marginally significant and was eventually dropped from the regression equation. The final regression equation presented below in Table III-6 contains three regional dummies in addition to vintage, capacity per unit and number of units, and has extremely high explanatory power overall.

Capacity. Gas turbines evidenced nearly constant returns to scale, with coefficients for capacity per unit and number of units estimated as 0.967 and 0.952, respectively. The coefficient for unit capacity is not significantly different from unity (constant returns to scale), while that for number of units is significantly different from unity and evidences returns to scale.

Table III-6

Results of Gas Turbine
Capital Cost Regression
(Logarithm of Thousands of 1975 Dollars)

Independent variables	Coefficient	t-Value
Intercept	17.5350000	8.071*
Ln vintage	-2.9958300	-5.724*
Ln capacity per unit	0.9674000	34.803*
Ln number of units	0.9517270	63.690*
Dummy for Census Region 1	-0.0997838	-2.755*
Dummy for Census Region 3	-0.0572437	-2.023**
Dummy for Census Region 5	-0.0521320	-1.772***
$R^2 = 0.968$		
R^2 corrected = 0.9671		

Vintage. The effect of technology has been rather dramatic, considering the short six-year span represented by the sample. To a considerable extent, the rapid growth of installed turbine capacity probably explains a good deal of the reduction in the real price of capacity. Cost improvements in manufacturing these units due to the large number produced and the concomitant reduction in real price to purchasers is no doubt reflected in this coefficient. The rate of technological change at the beginning of the sample period was about 4.5% per year and tapered down to slightly more than 4% per year by 1974.

Regional Variables. Regional differences were observed for Census Regions 1, 3, and 5, which achieved lower cost than the other regions. The calculated regional differences were, however, no more than 10% below the cost level for the rest of the country. The nature of the technology — preassembled standard units and minimal site preparation and structures — suggests that the regional cost differences may well be attributable to transportation charges.

b) Fuel Costs

A sample of 232 gas turbine stations observed in 1973 (latest available year) was compiled for analysis of the fuel consumption relationship. The plants in the sample varied in vintage from 1961 to 1972, with most plants coming on line in the late 1960's. Most, but not all, stations are intended to meet peaking requirements, as evidenced by the very low observed plant factor—mean of 6.34% and standard deviation of 2.73. All regions are well represented in the sample with no fewer than five plants nor more than 55. Out of the total sample of 232 plants, 28 burn gas, 134 burn oil, and 70 burn oil and/or gas.

The same general model was used here for the fuel relationship as was previously developed for conventional steam generating stations. The Btu consumption was estimated in exponential form, using capacity, plant factor, and vintage with regional and fuel-type dummies. Regional and fuel-type dummy variables were employed first jointly and then separately. The use of capacity and plant factor instead of net generation was justified since estimated coef-

efficients were different. Preliminary regression results indicated in fuel consumption due to regional effects or fuel type burned. These results held when regional and then fuel-type dummies were employed separately in the regression equation. This was, of course, anticipated from the preceding analysis conducted for the steam technologies.

In contrast to the steam technologies, however, vintage was not found to be significant. Since the data are from a cross-section sample of plants in 1973, vintage is equivalent in a statistical sense to age (age = 1973 vintage). Advances in technology may improve the fuel efficiency of a plant while the impact of age (depreciation) may reduce fuel efficiency. Older plants are expected to be less fuel efficient since they represent an older technology and because age degrades the plant efficiency. However, a single cross section is not sufficient to untangle the separate effects of technology and age. Neither effect could be separately detected in the analysis. The final estimated fuel consumption equation is presented in Table III-7.

Table III-7

Results of Gas Turbine Fuel
Consumption Regression
(Logarithm of Btu x 10⁹)

Independent variables	Coefficient	t-Value
Intercept	0.477010	5.856*
Ln capacity (MW _e)	1.000520	47.437*
Ln plant factor (%)	0.929752	47.175*
R ² = 0.9608		
R ² corrected = 0.9605		

Capacity. The regression coefficient for capacity indicates constant returns to scale for fuel use as plant capacity increases. Thus, no gain ensues in terms of fuel efficiency as larger capacity plants are built. To verify this result, a second equation with capacity per unit, number of units, and plant factor was estimated. It was anticipated that the original specification using capacity and plant factor was masking differences in efficiency between plants with a single large unit versus one with several smaller units but of equivalent overall size. Coefficient estimates for capacity per unit and number of units were both virtually unity, indicating results equivalent to the first specification.

Output. The coefficient estimated for the plant factor variable indicates that fuel consumption increases less than in proportion to increases in plant output. This coefficient has nearly the same value as was found for steam-electric plants and confirms the prevalent engineering concept of optimal heat rate at highest plant utilization. Combining the results for the capacity and utilization variables indicates that a smaller plant will burn less fuel than a larger plant when both plants achieve the same annual output. Of course, these plants are installed to meet peaking requirements and are sized to meet maximum instantaneous load requirements. However, reduction of absolute maximum peaking requirements and spreading the load over longer durations will save fuel even if gas turbines are used to supply the load.

c) Non-Fuel O&M Costs

Estimation of the non-fuel O&M cost relationship for gas turbine stations proved the least satisfactory of all estimates attempted. The primary reason for the relatively poor results arises from the fact that these plants are often co-located or otherwise associated with a larger base load station and often rely on personnel assigned to the base load plant for O&M resources. Consequently, it can be expected that inconsistent attribution of costs is likely depending on specifics of the plant. Inconsistent or improper attribution of costs may be for supplies and materials as well as for manpower.

The sample employed to estimate this cost relationship was relatively large—234 plants observed in 1973 with from as few as 5 to as many as 55 plants in a region. The sample is essentially similar to the one used for estimating gas turbine fuel consumption. The estimation procedure employed was to estimate an equation in capacity, plant factor, regional, and fuel-type dummies plus an age variable. Age rather than vintage was used, since we were reasonably confident that the short technological cycle represented by the sample embodied essentially the same technology with respect to operating characteristics and maintenance reliability. However, we did not wish to preclude the possibility that increased costs (especially maintenance) occur as the plant ages. The sample is a cross section of 1973 plants, so it is impossible to differentiate the effect that technological advance and age each have on O&M costs. Three regional dummies proved significantly different (less costly) in comparison to the other regions. Gas-burning units are also slightly less costly to operate and maintain than oil-burning units. However, gas units tend to be concentrated in Census Region 7, so to some extent there is a mingling of regional price and fuel-type effects. Note that the dummy variable for Census Region 7 was not significant. The estimated operating and maintenance cost relationship is presented in Table III-8.

Utilization and Capacity. The estimated coefficients for capacity and plant factor display much the same pattern as conventional steam plants. There is a high fixed-cost component for these expenditures which decreases on a relative basis as station size increases. A plant with double the generating capacity of another requires only 92% more fixed O&M resources. Secondly, changes in plant utilization have a statistically significant impact on O&M costs, but these expenditures are only "27% variable" with output. That is, a 100% increase in output causes O&M costs to increase by 27%.

Age. As the unit ages, O&M costs are seen to increase. The estimated impact from Table III-8 is approximately 6% per year.

Table III-8

Results of Gas Turbine O&M
Cost Regression
(Logarithm of Thousands of 1973 Dollars)

Independent variables	Coefficient	t-Value
Intercept	0.2378330	Insignificant
Ln capacity (MW _e)	0.9226550	12.515*
Ln plant factor (%)	0.2746370	4.471*
Age (years)	0.0592533	1.977**
Dummy for gas-burning unit	-0.0628956	-3.235*
Dummy for Census Region 4	-0.4526400	-1.857***
Dummy for Census Region 6	-0.5172130	-1.641***
Dummy for Census Region 8	-0.8794910	-2.121**
R ² raw = 0.5426		
R ² corrected = 0.5283		

Fuel Type and Region Effects. There is a minor cost difference between gas- and oil-burning units, the former being about 6% less costly to operate and maintain. Some of this effect represents the impact of price levels in Census Region 7 where many of these gas units are located. Substantial regional cost differences were found for Census Regions 4, 6, and 8. It is possible that these differences arise from the accounting attribution between the base load unit and the associated gas turbine plant. Utility systems in these regions may systematically under-report (attribute) O&M costs. This seems very likely for Census Region 8, since the dummy coefficient value shows a 60% cost difference.

3. Hydroelectric Plants

a. Capital Costs

The hydroelectric plant sample consists of 177 plants built between 1948 and 1974. The sample includes stations that are privately owned, plus those built and operated by the Corps of Engineers (52 plants). Although Census Region 9 dominates the sample with 83 plants, all others are represented, with as few as 3 or as many as 21 plants. The sample covers both conventional and pumped storage units which were differentiated in the analysis by a dummy variable. Conventional plants were further subdivided into automatic, manual and semiautomatic units depending on their operating mode.

Capital costs for the 177 hydroplants in our sample, normalized to 1975 dollars, were regressed against capacity, vintage, and dummy variables representing Census Region, plant type, and a dummy for whether the plant was privately built or constructed by the Corps of Engineers. Preliminary results indicated significant capital costs differences depending on plant type, location, and for privately built versus Corps of Engineers built plants. Substantial costs differences were indicated between pumped storage and conventional facilities and between Census Regions 1, 3, 4, and 9 and the remaining regions of the country. Corps of Engineers plants are of the order of 30% more costly than private plants. Examination of simple correlation coefficients included a tendency for the high cost Corps of Engineers plants to be concentrated in Census Region 7. However, Census Region 7 was shown to be a significantly lower cost region than the average. Both the dummy for Corps of Engineers plants and for Census Region 7 remained significant despite correlation between the variables.

Following the appraisal of the preliminary results, Census Regions that proved insignificant were dropped, while manual and automatic pumped storage plants were combined into a single dummy variable since their separate impacts on cost were indistinguishable. The final estimated equation for hydroelectric capital costs involves vintage, capacity, and 9 dummy variables for regional, plant-type, and Corps of Engineers plants. Substantial difference between

regions and between regular and pumped storage plants were found. The final relationship had an overall explanatory power of 89% and is presented in Table III-9, where it should be noted that costs for pumped storage facilities are found by suppressing dummies for plant type.

Table III-9
Results of Hydro-Electric
Capital Cost Regression
(Logarithm of Millions of 1975 Dollars)

Independent variables	Coefficient	t-Value
Intercept	6.307730	6.675*
Ln vintage	-1.561490	-6.640*
Ln capacity (MW _e)	0.766554	30.099*
Dummy for Census Region 2	-0.212504	-1.871***
Dummy for Census Region 5	-0.157455	-2.021**
Dummy for Census Region 6	-0.216165	-2.578**
Dummy for Census Region 7	-0.349935	-3.872*
Dummy for Census Region 8	-0.166494	-1.750***
Dummy for Corps of Engineers	0.267552	4.221*
Dummy for conventional/ automatic plants	0.458357	3.965*
Dummy for conventional/ manual plants	0.546912	4.717*
Dummy for conventional/ semi-automatic plants	0.475986	3.485*
R ² raw = 0.8971		
R ² adjusted = 0.8902		

Capacity. The regression results evidence substantial economies of scale—comparable to but even somewhat more substantial than those for the steam-electric technologies. The partial elasticity of cost with respect to size is 0.766. Unlike steam technologies, hydro capacity is limited mainly by site characteristics which dictate potential capacity. Consequently, utilities have been precluded from taking advantage of scale—the simple correlation between capacity and vintage was only 0.34 in our sample.

Vintage. Vintage effects were highly significant and relatively large for this technology. The estimated coefficient indicates about 3% annual reduction in real capital costs per unit of capacity in the early 1950's dropping to about 2.2% by the early 1970's.

Plant-Type Effects. As expected, pumped storage facilities evidenced much lower costs than conventional facilities of equivalent capacity, location, and vintage. Little difference was discerned between manual, automatic, and semi-automatic plants for conventional plants, which were around 60% more costly than pumped storage facilities.

Regional Effects. Census Regions 2, 5, 6, 7, and 8 were found to be significantly less costly than the other locations. Differences ranged from Census Region 5, which was about 14% less costly than the higher cost regions, to Census Region 7, which was nearly 30% less costly despite the high concentration of Corps of Engineers plants in the region.

Corps of Engineers. Plants built by the Corps were found to be significantly more expensive. A disproportionate number of Corps plants are in Census Region 7, which is the lowest cost location after adjustment is made for the Corps representation. The higher cost with Corps-built plants may to a large extent reflect accounting differences—Corps projects are multipurpose—so perhaps more of recreational and flood control costs are borne by users of electric power.

b) O&M Costs

Analysis of O&M costs was anticipated to be difficult for hydroelectric plants because they operate in many different ways. Some plants must purchase

water; pumped storage facilities may purchase off-peak electric power from within the system or as imports, others may have water available in plant reservoirs. Corps of Engineers plants may be subject to high charges for water from the associated multipower project. In addition to water and electric charges, these facilities have the usual O&M costs for turbine plant and associated pumping and electrical equipment.

The sample utilized for analysis of hydroelectric O&M costs consisted of 151 plants, representing all nine Census Regions. Again Census Region 9 dominated the sample, but the remaining regions had a minimum of four plants in the sample. Corps of Engineers plants accounted for 50 observations; seven plants were pumped storage facilities.

Preliminary regressions employed vintage, capacity, and plant factor as explanatory variables; and dummy variables for location, plant type, and Corps of Engineers plants. Significant differences were found between pumped storage and conventional plants, but not for operating-type characteristics among conventional facilities. Plants in Census Regions 2 and 3 and those operated by the Corps of Engineers were found to be significantly more costly to operate and maintain than plants located elsewhere or privately operated plants.

Vintage was not found to be significant variable, which leads to the conclusion that operating economies were achieved through static scale effects, not advances in technology. Recall that vintage was not found to be highly correlated with other explanatory variables, so the insignificance is real. Table III-10 presents the final O&M cost-estimating relationship.

Utilization and Capacity. Hydroelectric facilities exhibit the same O&M cost properties associated with the other generating technologies - economies of scale with respect to plant size and a high percentage of fixed O&M costs. A 10% increase in plant size utilization (output) has a small, but statistically significant impact on O&M costs: 1.8% for every 10% increase in plant utilization. Although utilization is a significant driver of costs, the low elasticity is the result of the high fixed costs.

Table III-10

Results of Hydroelectric
O&M Cost Regression

Independent variables	Coefficient	t-Value
Intercept	8.791640	11.463*
Ln capacity (MW _e)	0.650137	17.731*
Ln plant factor (%)	0.187778	2.477**
Dummy for conventional (non-pumped storage) plants	-2.027170	-8.113*
Dummy for Corps of Engineers	0.346264	3.946*
Dummy for Census Region 2	0.469580	1.717***
Dummy for Census Region 3	0.538182	2.595**
R ² raw = 0.8126		
R ² corrected = 0.8047		

Plant-Type Effects. Pumped storage facilities require purchased off-peak power and consequently have higher unit operating costs than conventional plants. The regression results show that conventional plants are a significant 87% less costly to operate for a given level of output than pumped storage facilities. Corps of Engineers plants are also more costly to operate and maintain, compared to otherwise similar privately operated facilities. This cost difference amounts to a substantial 41% and may to some extent reflect higher costs from user charges placed on power facilities.

Regional Effects. Census Regions 2 and 3 are indicated to be locations with substantial higher costs when compared to the rest of the country. Cost differences are high, on the order of 60% more. It is plausible that a concentration of high-cost pumped storage facilities in Regions 2 and 3 may account for some of the indicated higher cost. That is, the dummy coefficients for Census Regions 2 and 3 may be overestimated, while the coefficient for conventional plants may be underestimated. A check on this hypothesis revealed very little correlation between pumped storage facilities and Census Regions 2 and 3 (simple correlation coefficients of 0.36 and 0.11, respectively).

4. Nuclear Steam-Electric Plants

a) Capital Costs

The published FPC information available for nuclear-fired steam-electric generating plants is much more limited than that for the other, better established technologies. The capital cost sample consisted of 31 stations brought on line between 1962 and 1975, ranging in size from 75 MW_e to 2660 MW_e of rated generating capacity. The average total station size and unit capacity in the sample were quite large, nearly 1,000 MW_e and 717 MW_e, respectively.

Nuclear technology is evolving rapidly; capacity has grown quickly during a period of high price escalation; the period covered by our sample is short; and the size of the sample itself is limited. For these reasons, we endeavored to incorporate more cost-driving engineering design parameters into the analysis than we did for the other technologies. These variables should reflect technological impacts on capital costs that are explained by vintage in the other technologies examined.

In certain instances, sources other than the FPC annual publications were employed for engineering design characteristics and other variables. Annual 1975 FPC data that had yet to be published at the time of this study were also utilized. Of primary interest in this regard was capturing changes in engineering parameters, such as higher boiler pressures and temperatures, and accounting for the impact on costs of construction delays, safety, and

environmental protection standards. Among the variables compiled in the data base were boiler temperature and pressure, type of cooling, type of reactor container, reactor type (PWR,BWR), and total construction time. Recall that interest on funds used during construction is part of the reported plant investment costs.

Preliminary regression analysis began with the observation that boiler pressure and temperature are highly correlated with each other and with vintage. Boiler pressure and temperature were, therefore, not jointly used as independent variables. A regression equation was developed, using unit capacity, number of units, boiler pressure, construction time, reactor type, container type, and regional dummies. Dummy for Census Regions 1, 2, and 4 were marginally significant, as was vintage and boiler pressure. Container type was not significant. Additional runs were developed, retaining significant or nearly significant variables and adding dummies for cooling type and a new dummy to distinguish if reported sample costs were for the initial unit of a multiunit station. Regional dummies for Census Regions 1 and 2 were combined since the estimated coefficients for the regional dummies were identical. In the subsequent regressions, cooling type and vintage were found to be insignificant. Vintage had a positive but insignificant coefficient, which might be due to the inclusion of boiler pressure and construction time explanatory variables. The final cost estimating relationship that eventually evolved is presented in Table III-11.

Capacity. The coefficients for unit capacity and number of units evidence substantial economies of scale. This finding seems to be supported by the observed tendency for the size of new stations to increase quite rapidly (13% per annum) during the 14 years covered in the sample. The simple average for the two coefficients is 0.77, indicating that equal increases in unit capacity and number of units to produce a 100% increase in overall capacity results in 77% higher costs. However, the lower coefficient for unit capacity suggests that most of the economies come from increasing unit capacity.

Table III-11

Results of Nuclear Steam Plant
(Millions of 1975 Dollars)

Independent variables	Coefficient	t-Value
Intercept	1.099110	0.999
Ln number of units	0.920290	6.245*
Ln capacity per unit (MW _e)	0.622736	6.476*
Ln boiler pressure	0.317297	1.903***
Ln construction time (months)	1.149440	3.734*
Dummy for BWR (0 for PWE)	-0.259434	-2.699**
Dummy for first of two units	0.198409	2.004***
Dummy for Census Regions 1 & 2	0.314333	2.713**
Dummy for Census Region 4	0.379635	2.868*
R ² raw = 0.9120		
R ² corrected = 0.880		

Construction Time. Funds used during construction are an explicit component of reported total plant investment. Furthermore, delays for technical, environmental, and safety reasons have increased in recent years. The estimated impact of construction time on total costs is significant and quite substantial. The regression coefficient shows that an increase in construction time of 20% (for example, from 60 to 72 months) causes a 23% increase in total capital costs. This relatively large impact reflects the timing of the delay (cumulative effect if early) and the associated additional costs such as increased interest costs for capital funds embodied in the unfinished plant and construction overhead.

Plant Type/Boiler Pressure. The effect of plant type and design boiler pressure are of the expected sign and reflect the trade-off between higher plant first cost and lower operating costs. Boiler pressure is the key to increasing a plant's thermal efficiency and lowering fuel costs. Most of the dramatic increases in boiler pressure registered from 1973 to 1975 were incorporated in PWR-type plants, which explains their significant increase in cost per kW_e during this period. The coefficient for boiler pressure (a continuous variable) shows that an increase of 10% increases plant costs by 3.17%. The dummy for BWR indicates that BWR's are 23% less costly to build than comparable PWR plants.

Other Dummy Variables. The dummy variable for the first generating unit of a multi-unit plant shows that such units are 22% more costly than if the observation represents a complete plant. The higher costs associated with such first generating units reflect infrastructure and equipment costs procured with the first unit which are common to the additional units to be built at the site.

Significant regional differences were found for Census Regions 1, 2 and 4. Regions 1 and 2 were combined into a single dummy to increase the available degrees of freedom for the regression. Cost differences amount to a 46% increase for Census Region 4 and a 36.8% increase for Census Regions 1 and 2 as compared to the rest of the country. (No plants were observed in Region 8).

b) Fuel Costs

For nuclear-fueled plants, we again sought to determine a relationship for physical fuel usage in terms of numbers of Btu consumed and plant size, vintage, utilization, etc. The direct attribution of fuel consumed per period of time is not available and the physical measure of Btu consumption is an estimate based on attributed fuel cost per kWh of net generation and the heat rate. The attribution of costs per kWh is necessary since the fuel is purchased as a unit (usually with provision for refueling), not as divisible units of known Btu content. Furthermore, the station heat rate reported in our sample exhibited very little variation.

The estimating procedure to determine Btu consumption is not consistent from plant to plant. The general procedure seems to be to calculate the initial cost of fuel on the basis of the cost of uranium (net of residual value, plutonium buildup) and all other added costs such as fabrication and reprocessing, and to prorate this cost as an annual fuel charge based on an estimate of thermal unit of production rate (cents per million Btu). Estimates are then subject to adjustment when actual cost and output are determined. In some cases, the fuel charge is based on amounts payable to the supplier of leased fuel-actual lease carrying costs and amortization of investment.

As a consequence of this variation in allocation procedures, we really do not have data that accurately report units of fuel consumed and average Btu content per unit of fuel. Instead we are estimating an equation that represents the procedure used by the industry to determine the physical amount and value of fuel attributable to annual output. The annual estimate from this procedure is itself subject to revision once the actual useful life and associated costs of the fuel bundle are known.

The regression equation reported in Table III-12 explains 60% of the observed variability in reported station fuel consumption. Attempts to improve the overall explanatory power of the relationship using boiler pressure, reactor type, vintage, and other variables were unsuccessful. We have concluded that the regression equation is superior to a simple point estimate, and that because of the difficulty and inconsistency of the techniques used to estimate actual Btu consumption, it is the best estimate that can be developed with existing data.

Capacity. The estimated coefficient for plant capacity indicates substantial economies of scale in fuel consumption as plant size increases. Doubling plant size requires only 80% more fuel, if the utilization rate is held constant. However, a plant with twice the previous plant's capacity operating at the same plant factor produces twice the output with 20% less fuel. This suggests that as the price of nuclear fuel increases, economics will dictate the building of larger capacity plants. The extent of economies of scale appears to be greater for nuclear steam-electric plants than for conventionally fired units.

Table III-12

Results of Nuclear Fuel
Consumption Regression
(Logarithm of Btu x 10⁹)

Independent variables	Coefficient	t-Value
Intercept	2.745290	1.848***
Ln capacity (MW _e)	0.791846	7.871*
Ln plant factor (%)	0.681999	2.358**
R ² raw = 0.6264		
R ² corrected = 0.6062		

Utilization. Fuel consumption of nuclear plants appears to be less variable with changes in output than is the case with conventional steam plants. Conventional steam plants evidence growth in fuel consumption nearly in proportion to that of output. Nuclear-fired plants appear to provide substantial operating economies as utilization increases. A 10% increase in net generation requires less than a 7% increase in fuel consumption. This result is, of course, subject to the above stated reservations concerning determination of fuel consumption.

c) Non-Fuel O&M Costs

Non-fuel O&M costs of nuclear power plants were estimated from a sample of 40 plants obtained from pooled 1974 and 1975 cross sections. To account for inflation-induced price differences between the two years, a dummy variable for the year of observation was introduced. Plants beginning operation in either 1974 or 1975 were omitted from the sample for the initial year. This was done because of the fear that preoperating costs were charged to operating costs in the initial year of commercial operation, which would unduly bias the sample.

Regression equations were derived, with capacity, plant factor, vintage, dummy for year of observation, and regional dummies as explanatory variables. In contrast to similar formulations for other technologies, plant factor and vintage were both insignificant. Usually, plant factor proved statistically significant, although the estimated coefficient indicated high fixed costs compared to variable costs. O&M costs appear to be fixed by plant capacity and do not vary substantially with output.

Subsequent runs were made with regional dummies. The coefficients for all Census Regions, except Region 7, were insignificant and were eliminated. Reactor type and age, instead of vintage, were introduced as separate variables and capacity was replaced with capacity per unit and the number of units. Age became significant, but vintage did not, because the two-period cross section differentiates age, while vintage stays invariant from one cross section to the next. Table III-13 presents the final regression results for nuclear plant O&M costs.

Capacity. The coefficients of unit capacity and number of units evidence substantial economies of scale, more so as units are added to a station than as capacity per unit is increased. This result is the opposite of that obtained from the capital cost equations. Doubling capacity through equal 50% increases in units and unit capacity causes only a 49% increase in operating costs. Holding a station at say the traditional two-unit configuration and increasing unit capacity by 10% causes O&M costs to increase by only 7.6%. Note that utilization rate is not included as a significant explanatory variable, indicating that the manning of nuclear units is essentially fixed with capacity and that maintenance is periodic, regardless of output. Increasing plant output apparently has little impact on required operating or maintenance expenditures.

Age. This variable apparently captures much of the impact of output as a driver of O&M costs. It is significant and large - O&M costs increase at a proportionate rate of 5.7% per year, regardless of plant size or utilization. This effect is much more substantial than for other steam-electric technologies.

Table III-13

Results of Nuclear Non-Fuel
O&M Cost Regression
(Logarithm of Thousands of 1975 Dollars)

Independent variables	Coefficient	t-Value
Intercept	3.760270	3.948*
Ln capacity per unit (MW _e)	0.761578	5.536*
Ln number of units	0.226287	1.708***
Age (years)	0.057788	-2.438**
Dummy for year of observation (1974 = 1)	-0.180632	-2.000**
Dummy for Census Region 7	-0.679867	-2.405**
R ² raw = 0.6907		
R ² corrected = 0.6452		

Regional Effects. Census Region 7 was estimated to be a lower cost region in comparison to the rest of the country. Cost differences amount to a substantial 50% markdown from those of the rest of the country. This result should be viewed skeptically, as there is only one nuclear plant in Region 7, and the total sample contains only 40 observations.

Dummy for Year. This dummy variable is not to be used for projections, but was included to account for the impact of inflation between 1974 and 1975. The coefficient, incidentally, indicates that 1975 prices for O&M inputs were 17% higher than in 1974.

APPENDIX A

DATA BASE DOCUMENTATION

A. Introduction

For the results of this study to be credible, they must be reproducible by other analysts following the same procedures. To this end, every effort has been made to document the data base fully.

The sample selection and data collection efforts are described for fossil-fueled, nuclear, hydro, and gas turbine electric generation and pollution control facilities and equipment. The discussion under each electric power generation plant type covers capital and O&M costs and fuel consumption data.

The data for this study came primarily from FPC Form 1 reports. To establish a basis for cost function estimation, it was necessary to adjust the cost data to reflect constant 1975 dollars. The procedure for adjustment of capital costs is described in Appendix B.

B. Electric Power Generation

The FPC publishes annual capital and production costs separately for each electric power plant to reflect the cost of electric power generation. These reports are entitled: "Steam-Electric Plant Construction Cost and Annual Production Expenses", which contains data on fossil-fueled and nuclear power plants; Hydro-Electric Plant Construction Costs and Annual Production Expenses, and Gas Turbine-Electric Plant Construction Costs and Annual Production Expense. All the capital, O&M fuel cost, and plant characteristics data used in this study were extracted from these reports unless otherwise specified.

The data in the FPC reports do not include a separate account for the capital and O&M costs of pollution control equipment; therefore, it was necessary to use other sources to determine how much of the plant-reported costs were for pollution abatement. These data will be described in the section on "Pollution Control Costs" later in this appendix.

1. Plant Cost Data. The FPC reports aggregate capital costs of plant generating capacity in three accounts: land, structures and improvements, and equipment. Since land is on the average less than 2% of total plant cost, the amount of land varies widely between plants of similar type and capacity, and the cost per acre is independent of plant characteristics, the cost of land was excluded from the capital cost samples.

Plant production costs are reported in three major accounts: operating costs, maintenance costs, and fuel expense. For each plant, we calculated the aggregate operating cost (excluding rents and fuel). Our efforts to compare O&M and capital costs consistently necessitated the omission of rents from operating costs, because the corresponding capital account, land, was left out of capital costs. Total fuel dollar costs were likewise not considered in operating expenses, but fuel use, measured in Btu by fuel type, was calculated for each plant. The advantage of analyzing actual physical amounts of fuel burned is the removal of variability caused by regional and system price differences. Estimates of fuel costs can then be developed by applying regional prices to each type of fuel. These costs can finally be added to arrive at total plant operating costs.

Steam-Electric Plants. The data base for capital costs of steam-electric plants was selected from the 1974 and 1975 FPC reports, Steam-Electric Construction Cost and Annual Production Expenses. These reports have been published annually since 1947, and the first edition includes yearly data back to 1938 for fossil-fueled plants, and 1960 for nuclear plants. There are not published data for prior years.

The total fossil-fueled steam-electric plant population listed in the 1974 report, from which the sample was chosen, consisted of approximately 635 plants located in the continental U.S. Data on plant capital costs were obtained for 340 plants. The principal criterion for choosing plants for our capital cost sample was the ability to track back and capture initial investment cost and related plant characteristics for the year the plant became operational. Of the total 635 plants listed in the 1974 report, 135 were in operation prior to 1938 and 1947. Approximately two-thirds of the post-1938 plants were eligible according to our initial criterion.

Many of the older plants were excluded from the sample because of such reasons as: the absence of cost data, conflicting data, the mixing together of data for several plants operating within the same utility system, and unexplained time lapses between the first year of operation and the initial year of FPC reporting.

Data for the 340 plants included in the final sample were traced from the first year of FPC reporting through 1974. When the information was available, all changes in capacity and corresponding changes in capital investment were documented. The model uses only those cost and capacity data that reflect the initial period of a plant's operation. Initial operation was defined as the early years of a plant's existence when single or multiple units were being placed in service. Thus, the capacity and investment data include all units comprising the original plant. In many cases, plants had units that began operating one year after the other over a span of two to four years. In these situations, all units were judged to be part of the original plant, and their cost data were aggregated and expressed in constant 1975 dollars. The indices used to convert to constant dollars were based on the Handy-Whitman, Building Construction Cost Trend Tables from 1912 to January 2, 1977.*

Operations and maintenance and fuel consumption data for fossil-fueled steam-electric plants were gathered from the annual FPC reports for 1969 and 1974. The groups of plants sampled in those years were selected of plants sampled in those years were selected from the 340 plants from which capital costs were collected. Only 105 plants had usable 1969 data; 133 had usable 1974 data. The criterion for plant selection was the absence of major changes in equipment or structures from the period of initial operation to the year in which O&M and fuel data were collected. Information about plants that began

*The procedure for developing the weighted annual deflation factors took into consideration the average construction lead time for the different types of technologies, i.e., 10 years for nuclear and hydro, etc. Appendix B describes the procedure.

operations during 1969 or 1974 was omitted from one sample or the other, because it was felt that a partial year of operations would produce distorted information.

Capital cost data gathered for 33 nuclear-powered plants that began operations between 1960 and 1975. This sample comprised almost the entire population of plants operating in 1975. We attempted to include all nuclear plants in this sample, but had to exclude several because they were prototypes or had questionable cost data. The capital cost sample included four plants that began operations in 1975 for which there appeared to be sufficient information about costs and physical characteristics to make them eligible for the capital cost sample.

Unlike the data reported for fossil-fueled steam-electric plants, those for nuclear plants were clearly trackable. Most plants are of recent vintage and report requested information regularly. Also, most nuclear plants have a few large units that entered service in consecutive years; few plants have more than two units; none have reheat capacity; and few have changed the ratings of their generating capacity. All these factors simplified the sample selection process.

The sample used in the analysis of O&M costs and fuel consumption for nuclear-powered plants consisted of the same plants that made up the capital cost sample. Operations and maintenance and fuel consumption data were collected for the years 1974 and 1975 for all plants except those that began operations in each of these years.

The operations cost accounts for nuclear plants are the same as those for fossil-fueled plants, with the addition of the "Coolants and Water" account. The various categories of maintenance costs used by both types of plants are identical.

Hydroelectric Plants. Capital and O&M costs were collected for 177 of the 184 hydroelectric plants constructed since 1948. These data were reported in the 1974 edition of Hydro-Electric Plant Construction Cost and Annual Production Expenses, published by the FPC. Several plants were excluded from the sample because they reported insufficient or conflicting data.

Of the 177 plants in the sample, 52 were constructed by the Corps of Engineers. Such plants were identified as a separate subsample to be "dummied" for possible cost differences from privately built plants because their accounting system varies from that generally followed by private industry, and the reported costs were observed to be significantly higher than those for private plants.

A number of adjustments to the capital data for hydroelectric plants had to be made. Certain privately owned plants lack their own reservoir and purchase water from another utility to power their turbines. In such instances, plants purchasing water and reporting costs in excess of 50% of total operating cost were deleted from the sample. The assumption was that these plants (typically small) were auxiliary units operating downstream from a larger power plant and thus would not be representative of the hydroelectric plant population.

Another major adjustment involved the allocation of the investment and operating costs of central dams and reservoirs. Central facilities provide the water to a number of plants within a river basin and were allocated to those plants identified as part of the system. This had to be done to make these plants comparable to those owning their own dams and reservoirs.

Gas Turbine Plants. Capital and O&M costs and fuel consumption data for gas turbine facilities were taken exclusively from the FPC's publication, Gas Turbine-Electric Plant Construction Costs and Annual Production Expenses, First Annual and First Annual Supplement. The FPC publication began in 1972, following the increased use of this technology for peaking purposes. However, the initial 1972 publication lists all existing plants as of 1972 and compiles investment costs, O&M costs, and fuel consumption for units installed as far back as the late 1950's. This publication also recorded operating data for 1972.

The comparable 1973 publication (entitled First Annual Supplement) presents cost data, investment cost and physical characteristics for new plants added in 1972, and annual operating statistics for existing plants in a manner

similar to that for the steam-electric plant data. Since gas turbine plants represent a relatively small fraction of overall capacity and an even smaller fraction of net generation, low priority is placed on the timeliness of publication of data by the FPC. The latest data now available are for calendar 1973.

Since publication of construction costs began in 1972, it was not possible to separate construction costs into the amounts attributable to initial capacity or to subsequently added capacity. Consequently, plants were only considered for our sample if rated capacity and investment cost remained unchanged from the initial values. Secondly, multi-unit plants were included in the sample only if the units were of identical capacity.

Many recently acquired plants are leased to the utility, in which case no capital investment cost is recorded. Annual rental charges for the leased equipment appear in operating costs. Leased plants were therefore excluded from the capital cost data base, but when otherwise suitable were included in the operating cost data base. In the latter case, rental (lease) payments were excluded from non-fuel operating costs.

Capital costs were aggregated and inflated to constant 1975 dollars for structures and improvements, and equipment. Land costs usually are not attributed to the gas turbine unit since the plant is often co-located with a base plant. When land costs were reported, they were not included in investment costs.

Operating cost data were compiled for the two available years, 1972 and 1973. Plants were excluded from the operating cost data base when they operated for less than a full year, or when costs were shared with another plant.

2. Plant Characteristics. Collection of power plant capital and O&M cost data was accompanied by compilation of key physical and operational characteristics common to electric power generating plants. Of the available characteristics in the FPC reports, those thought to be most useful were: region, fuel

type, construction type, number and capacity of generating units, number and capacity of reheat units, the design heat rate and related technical variables, such as boiler pressure and temperature and the vintage of the plant.

Plant location in one of the nine energy regions considered in the study was assumed to be an important explanatory variable for both capital and O&M expenditures. The nine U.S. Census Regions were used as proxy energy regions for this study. These are: New England, Middle Atlantic, East North Central, West North Central, South Atlantic, East South Central, West South Central, Mountain, and Pacific.

Plants situated in regions with mild climates have, in many instances, constructed outdoor facilities. In other regions the climate has necessitated semi-outdoor or enclosed facilities, which are more costly to build. Differences in regional wage rates and materials prices also affect reported capital costs.

The availability of different fuels for electric power generation also varies by region and affects capital and production expenditures. There are four predominant types of steam-electric and gas turbine plant fuel: coal, oil, nuclear, and gas. Hydroelectric plants require no fuel, except that pumped storage plants require off-peak electricity to pump water to the upper reservoir. The fuel consumed by a plant determines what types of structures and equipment it will need. For example, a coal-burning plant requires coal handling and pulverizing, as well as ash removal equipment not used by plants fueled by oil or gas. In addition, coal plants must install costly scrubbers to meet environmental regulations and relatively greater storage facilities for bulk storage of coal.

Steam-Electric Plants. The most important design parameters for steam-electric plants were assumed to be the number of units and their generating capacity. For fossil-fueled plants, operating efficiency of the units is related to other characteristics, such as whether or not the unit is equipped to reheat the steam and power a secondary turbine. Therefore, information concerning reheat capacity was also collected and analyzed.

Another aggregate indicator of operating efficiency is the amount of fuel required to produce a kilowatt-hour of electricity, i.e., the heat rate. The lower the heat rate, the more efficient the plant. We attempted to incorporate this design characteristic using actual heat rates and capacity utilization information for each plant. Design heat rate was estimated using an engineering relationship for the design heat rate in terms of the actual heat rate and plant utilization as reported by S. Ling.¹⁵

Plant characteristics for nuclear-powered steam-electric stations were compiled from FPC reports and other sources. Some of these characteristics, such as vintage, region, number of units, and generating capacity, are identical to those collected for fossil-fueled plants. Relevant data were available in the nuclear section of Steam-Electric Plant Construction Cost and Annual Production Expenses.

Other design characteristics affecting investment costs in nuclear power plants reported by the FPC are boiler pressure and temperature, and reactor type. In addition, we included the type of cooling facility, length of construction, and type of reactor containment. These data are reported in Electric World's Annual Nuclear Plant Survey reported every 15th of October. Appendix C describes the various breakouts for type of cooling facility and reactor containment available in this survey.

Hydroelectric Plants. The plant characteristics compiled for hydroelectric plants generally are the same as those used in analyzing steam-electric plants, and the same justification exists for their selection. However, one of the physical factors, plant type, has a different meaning. Where applied to a hydroelectric facility, the plant type reflects the classification of the plant as a conventional or pumped storage plant. In the case of steam-electric plants, plant type indicated whether or not the facilities were outdoor, semi-outdoor, or conventional.

Two additional technical variables are available for hydroelectric facilities—head, and water flow (gpm). Data for these two technical factors were incomplete. Less than 50% of the reporting plants showed this information, and for this reason they were not included in the final data sample.

Combined Cycle Plants. Rising fuel prices, increasing environmental requirements, and greater flexibility for mid- and base-load applications as dictated by changing system load requirements have contributed to renewed interest in combined cycle electric generating plants. By the end of 1974, approximately 1372 MW_e of gas turbine capacity was in combined cycle plants, and many thousands of additional MW_e are on order for installation in the late 1970's and 1980's. Because cost and capacity data for combined cycle plants cannot be separated from that for the conventional plants they are usually a part of, combined cycle plants were deleted from our sample. Further data-gathering effort may be necessary to obtain a clean sample of combined cycle plants to develop cost functions for this type of generating plant.

C. Pollution Control Costs

The FPC does not include a separate account for the costs of pollution control at each plant. It was therefore necessary to use other data sources to determine how much of the total plant cost in each of the samples was for fly-ash, for SO₂ and NO_x control (air pollution), and for cooling towers and artificial lakes for water pollution control. The technology for control of SO₂ and NO_x emissions is still in the development stage, although a number of prototype SO₂ removal systems had been installed by 1973. The consensus among the various sources reviewed points to very low initial costs for NO_x abatement. The preferred technique for NO_x abatement is currently combustion modification, which would result in lower plant efficiencies and increased costs per unit of output.

Thus, the cost data and system characteristics discussed in the previous sections do not identify the cost of air and water pollution control facilities and equipment in existing plants. We therefore examined a number of previous studies for purposes of understanding the abatement technologies being developed, identifying pollution control costs in our sample data, and estimating the future cost of implementing these technologies in new plants.

The references below are the sources of the data used in the air pollution control cost analysis. Comparison and analysis of the various air pollution control cost data are presented in Chapter II. Table II-6 in that chapter shows the range of cost estimates for air pollution control, and attempts to normalize these costs by adjusting them to 1975 dollars.

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APPENDIX B

CONSTRUCTION COST INDICES

The observed cost of plants included in the data base reflects the level of prices prevailing at the time and place of construction. In order to normalize total capital costs associated with plants of varied vintages and locations, construction cost price indices were developed. The indices account for the timing of expenditures over the construction period and the length of the construction period of the original plant. This is accomplished by weighing semiannual indices for each period with semiannual expenditures expressed as a percentage of total cost. The indices are specific to the type of power plant and region. The generating station types are fossil-fueled, hydropowered, gas turbine and nuclear production plants. The regions are the North Atlantic, South Atlantic, North Central, South Central, Plateau and Pacific sectors of the U.S.

The annual construction cost indices used were those contained in the Handy-Whitman Index of Public Utility Construction Costs.¹ Specific indices used were the "Total Fossil Production Plant," "Total Hydraulic Production Plant," and the "Gas Turbo-Generator" categories of the Electric Utility Construction section of the Index for each of the six regional categories indicated above. Since an index for "Total Nuclear Production Plants" did not exist, one was developed from component categories available as explained below.

The Handy-Whitman Index does not identify the level of costs in a particular region for a particular generating technology but the rate of change in costs through changes in the price of requisite materials and labor. Consequently, the Handy-Whitman Index cannot be used to discern regional cost difference (all regions are normalized at an index value of 100 in 1949), only differential rates of change among regions at a point in time. Secondly, the index does not account for the fact that a plant is constructed over many periods. Price changes are in accordance with the index only for the period reported. To correct this deficiency, annual indices were weighted by annual outlays over a representative construction period. Outlays were expressed as

a percent of total construction expenses. These weights were obtained from the cumulative cash flow curves depicted in Figure B-1. It was assumed that construction expenditures for hydroelectric and gas turbine plants would follow the same distributive pattern as that for fossil-fueled plants. It was also assumed that fossil-fueled, hydroelectric, and gas turbine plants are constructed over 5-, 10-, and 2.5-year periods, respectively. While the construction period of nuclear power stations was estimated to be ten years, major expenditures were made only in the final six years of construction. Therefore, the latter time period was used in developing an index.

The construction period for each type of power plant was divided into semiannual segments and expressed as a percent of the overall construction period. Corresponding expenditure percentages were extracted from the cash flow curves. The incremental percent expenditures reported in Tables B-1 to B-4 were used as weights and applied to the appropriate annual construction index and then summed to obtain an index for the total construction costs of a plant for the year in which it was completed. A fossil-fueled production plant in the South Atlantic Region completed in 1973 with expenditures beginning in 1969 would have the following index:

<u>HANDY-WHITMAN INDEX</u>	<u>WEIGHT</u>	<u>WEIGHTED SEGMENT</u>
1973 - 255	0.014	3.57
247	0.016	3.95
1972 - 245	0.065	15.93
233	0.102	23.77
1971 - 222	0.216	47.95
212	0.174	36.89
1970 - 205	0.215	44.08
197	0.088	17.34
1969 - 192	0.096	18.43
188	0.014	2.63
Total		214.54 = expenditure weighted price index

Figure B-1. Typical cumulative cash flow curves for major direct cost accounts

Source: Concept A computer code for conceptual cost estimating of steam-electric power plants, U.S. energy research and development administration, June 1975

The Nuclear Index was constructed by weighting the indices for nuclear production plant structures and improvements and reactor plant equipment with the fossil production plant indices for turbogenerator units, accessory electrical equipment, and miscellaneous power plant equipment. The weights for these indices were taken from the cash flow curve power plants as depicted in Figure B-1. The weights are as follows:

Account #21 Structures & Facilities	0.21
Account #22 Reactor Plant Equipment	0.33
Account #23 Turbo-Generator Units	0.31
Account #24 Electrical Plant Equipment	0.125
Account #25 Miscellaneous Plant Equipment	0.025

Indices for nuclear production plants were not provided in Handy-Whitman for years prior to 1965. In order to construct the weighted index for total construction costs, these indices were estimated. The Nuclear Production Plant Structures and Improvements Index most closely parallel the Fossil Production Plant Structures & Improvements (Indoors) Index; there, the Nuclear Index for 1962-1964 was estimated using this trend. There also was a close correspondence between the Reactor Plant Equipment Index and the Accessory Electrical Equipment Index. Therefore, a Reactor Plant Equipment Index for 1962-1964 was estimated using the rates of change from the electrical equipment index as a guide.

Table B-1
Time-Phased Construction Expenditures
For Fossil-Fueled Power Plants
(5-year average construction period)

Time period	Cumulative percent	Percent expenditures	
		Cumulative	Incremental
1	0.10	0.014	0.014
2	0.20	0.110	0.096
3	0.30	0.198	0.088
4	0.40	0.413	0.251
5	0.50	0.587	0.174
6	0.60	0.803	0.216
7	0.70	0.905	0.102
8	0.80	0.970	0.065
9	0.90	0.986	0.016
10	1.00	1.000	0.014

Table B-2
Time-Phased Construction Expenditures
For Hydro Production Plants
(10-year average construction period)

Time period	Cumulative percent	Percent expenditures	
		Cumulative	Incremental
1	0.05	0.004	0.004
2	0.10	0.014	0.010
3	0.15	0.045	0.031
4	0.20	0.110	0.065
5	0.25	0.150	0.040
6	0.30	0.198	0.048
7	0.35	0.280	0.082
8	0.40	0.413	0.133
9	0.45	0.500	0.087
10	0.50	0.587	0.087
11	0.55	0.700	0.113
12	0.60	0.803	0.103
13	0.65	0.861	0.058
14	0.70	0.905	0.044
15	0.75	0.930	0.025
16	0.80	0.970	0.040
17	0.85	0.977	0.007
18	0.90	0.986	0.009
19	0.95	0.995	0.009
20	1.00	1.000	0.005

Table B-3
Time-Phased Construction Expenditures
Gas Turbo-Generator Production Plants
(2.5-year average construction period)

Time period	Cumulative percent	Percent expenditures	
		Cumulative	Incremental
1	0.20	0.110	0.110
2	0.40	0.413	0.303
3	0.60	0.803	0.390
4	0.80	0.970	0.167
5	1.00	1.000	0.030

Table B-4
Time-Phased Construction Expenditures
Nuclear Production Plants
(10-year average construction period*)

Time period	Cumulative percent	Percent expenditures		
		Cumulative	Incremental	Over last six years
1	0.05	0.000	0.000	-
2	0.10	0.004	0.004	-
3	0.15	0.009	0.005	-
4	0.20	0.015	0.006	-
5	0.25	0.023	0.008	-
6	0.30	0.042	0.019	-
7	0.35	0.100	0.058	-
8	0.40	0.172	0.072	-
9	0.45	0.258	0.086	0.103
10	0.50	0.411	0.153	0.184
11	0.55	0.490	0.079	0.095
12	0.60	0.681	0.191	0.230
13	0.65	0.820	0.139	0.167
14	0.70	0.869	0.049	0.059
15	0.75	0.900	0.031	0.037
16	0.80	0.932	0.032	0.038
17	0.85	0.952	0.020	0.024
18	0.90	0.970	0.018	0.021
19	0.95	0.991	0.021	0.025
20	1.00	1.000	0.009	0.017

*Major expenditures take place during last six years.

APPENDIX C

DATA AND DATA CODES

- C-1 OPERATION AND MAINTENANCE - FOSSIL-FUELED STEAM-ELECTRIC
- C-2 PLANT CHARACTERISTICS - FOSSIL-FUELED STEAM-ELECTRIC
- C-3 PLANT CHARACTERISTICS - GAS TURBINES
- C-4 OPERATION AND MAINTENANCE - GAS TURBINES
- C-5 PLANT CHARACTERISTICS/OPERATION AND MAINTENANCE-
HYDROELECTRIC PLANTS
- C-6 PLANT CHARACTERISTICS/OPERATION AND MAINTENANCE-
NUCLEAR-POWERED PLANTS
- C-7 ELECTRIC UTILITY SYSTEMS - ANNUAL EXPENSE AND PHYSICAL
CHARACTERISTICS DATA

OPERATION AND MAINTENANCE - FOSSIL-FUELED STEAM-ELECTRIC

Column A - Five-digit identification code

The first digit identifies the plant by the Census Region in which it is located.

The second and third digits are the state identification code. The state codes are numerically sequenced 01 to 50 and correspond to an alphabetical listing of the states. Code #51 indicates the District of Columbia.

The final two digits denote the specific plant within a state.

Column B - Two-digit vintage code

Year in which the plant observed was brought into initial operation.

Column C - Eight-digit region code

Regional code constructed for analytical purposes. This code for the nine Census Regions is as follows:

Region 1	1	0	0	0	0	0	0	0
Region 2	0	1	0	0	0	0	0	0
Region 3	0	0	1	0	0	0	0	0
Region 4	0	0	0	1	0	0	0	0
Region 5	0	0	0	0	1	0	0	0
Region 6	0	0	0	0	0	1	0	0
Region 7	0	0	0	0	0	0	1	0
Region 8	0	0	0	0	0	0	0	1
Region 9	0	0	0	0	0	0	0	0

Column D - Three-digit fuel type code

Identifies the types of fuel for which the boiler was designed.

Coal	0	0	0
Oil	1	0	0
Gas	0	1	0
Mixed	0	0	1

Column E - Three-digit building code.

Indicates the plant's construction type.

Conventional	0	0	0
Outdoor	1	0	0
Semi-Outdoor	0	1	0
Other	0	0	1

Column F - Number of units installed at the plant observed.

Column G - Total capacity of the plant in megawatts; the sum of the capacity of all units.

Column H - Number of units within the plant having reheat capability.

Column I - Total capacity of the reheat units within the plant.

Column J - Heat rate (Btu's/kWh of net generation).

Column K - Plant factor (net generation/(capacity x 8,760 hours)).

Column L - Average employment.

Column M - Construction cost in $\$(x 10^3)$. The cost has been adjusted to a base year of 1975.

Column N - Adjusted heat rate.

Column O - Internal code used for programming purposes only; indicates the number of years in which the plant was observed.

Column P - Net generation, in kWh ($x 10^6$), of the plant in the year observed.

Column Q - Total Btu's ($x 10^9$) of coal consumed by the plant in the year observed.

Column R - Total Btu's ($x 10^9$) of oil consumed by the plant in the year observed.

Column S - Total Btu's ($x 10^9$) of gas consumed by the plant in the year observed.

Column T - Operating expense, in $\$(x 10^3)$, of the plant for the observation year.

Column U - Annual maintenance expense, in $\$(x 10^3)$, of the plant for the observation year.

Column V - Year in which observation was made.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
60102	49	00000100	001	000	2	138.0	0	0.	11800	100	95	37424	11800	3	613.7	959	0	635	887	552	74
60103	65	00000100	000	000	2	568.5	0	568.5	9491	59	32	84164	9215	3	2750.3	27492	0	0	1360	2277	74
60104	74	00000100	000	000	1	952.0	1	952.0	9431	99	248	170143	9433	1	1986.7	18741	0	0	685	688	74
60105	60	00000100	000	000	4	1060.8	4	1060.8	9167	78	99	179936	9187	3	6325.8	62125	0	0	1761	1957	74
80301	62	00000001	000	100	1	113.6	1	113.6	9062	85	38	28043	9682	3	944.1	9063	0	0	552	650	74
80302	63	00000001	000	100	3	633.6	3	633.6	10277	76	58	121747	10277	1	3327.2	36971	0	0	639	6185	74
80303	69	00000001	801	100	2	1636.2	2	1636.2	10252	61	130	213053	10252	1	8449.8	84999	0	0	492	9755	74
80304	60	00000001	001	100	2	227.5	0	0.	9709	70	41	36674	9708	3	924.0	0	5182	5092	524	418	74
80306	52	00000001	001	100	2	90.0	0	0.	11366	89	19	23977	11366	3	330.5	0	0	2922	339	74	
70403	51	00000010	001	100	2	130.0	0	0.	11290	60	44	34543	11290	3	180.1	0	0	364	263	74	
70404	60	00000010	001	010	1	120.0	1	120.0	10463	49	16	16949	9965	3	138.1	0	0	0	146	74	
70405	63	00000010	001	010	1	59.8	0	0.	11915	40	16	10144	11136	3	86.7	0	0	68	153	74	
90504	58	00000000	001	000	2	326.4	2	326.4	9753	96	148	103945	9753	3	1588.4	6796	0	0	951	852	74
90505	54	00000000	001	100	2	545.6	1	545.6	10421	66	126	156599	10421	3	1499.7	4581	0	0	1588	7099	74
90514	61	00000000	001	100	2	146.9	2	146.9	9963	80	51	78102	9963	3	1102.9	10827	313	10827	579	260	74
90519	71	00000000	001	100	2	1612.8	2	1612.8	9410	52	51	204725	8962	1	4109.4	0	0	37597	1242	3113	74
90521	57	00000000	001	100	2	130.6	2	130.6	9800	93	32	30684	9800	3	660.5	0	2103	4846	529	237	74
80604	73	00000001	001	010	1	382.5	1	382.5	10288	60	15	109767	10288	1	2292.6	23513	57	1681	564	74	
80605	65	00000001	000	000	1	163.2	1	163.2	9954	86	36	60514	9954	3	975.6	9603	15	0	817	74	
80606	59	00000001	000	000	3	34.6	0	0.	14394	27	22	12703	12852	3	174.0	2537	0	0	494	812	74
50902	73	00001000	100	010	1	445.8	1	445.8	10050	42	99	99265	9993	1	1626.2	0	16251	768	479	74	
50902	66	00001000	000	000	2	964.3	2	964.3	9936	41	96	124596	9286	3	5675.4	0	0	1158	3241	74	
50906	67	00001000	001	100	2	804.1	2	804.1	9702	63	75	79527	9438	3	4832.5	0	31717	2091	3241	74	
50907	65	00001000	000	000	2	340.0	2	340.0	10019	75	43	60006	10019	3	1722.8	17940	35	0	2091	2726	74
51001	71	00001000	000	000	3	2546.6	3	2546.6	9410	49	277	342206	8962	1	6090.6	62919	877	0	2156	3188	74
51004	63	00001000	000	000	2	598.4	2	598.4	9576	67	77	103787	9576	3	2678.8	24453	42	4627	2812	74	
31305	67	00100000	000	000	2	1319.4	2	1319.4	10139	41	144	194907	9476	3	5241.0	50452	0	0	2056	4639	74
31310	55	00100000	000	010	2	182.3	2	182.3	10322	70	85	58187	10322	3	897.3	9927	0	0	756	548	74
31312	63	00100000	000	010	3	99.0	0	0.	12747	32	41	26812	11588	3	531.9	6509	0	0	375	407	74
31404	63	00100000	000	100	3	432.0	3	432.0	10003	79	99	86896	10003	3	2707.1	29739	0	0	746	1764	74
31405	55	00100000	000	000	6	1303.6	6	1303.6	9147	88	333	305499	9147	3	7223.9	65600	0	0	2408	3953	74
31409	60	00100000	000	010	1	495.6	1	495.6	8842	76	85	113428	9842	3	1909.5	17864	0	0	1319	2091	74
31409	70	00100000	000	000	2	1062.0	2	1062.0	9683	62	103	186397	9428	1	6077.5	59487	6	0	1164	2351	74
41501	64	00010000	001	000	1	148.8	1	148.8	10005	48	99	13101	9529	3	516.3	5154	0	0	373	400	74
41503	68	00010000	000	000	1	212.0	1	212.0	10163	57	26	36634	9772	3	867.6	9067	7	0	262	348	74
41505	60	00010000	001	000	1	37.5	0	0.	12543	44	13	10452	11333	3	174.7	894	0	0	197	113	74
41605	63	00010000	010	010	1	32.0	0	0.	8919	69	10	5264	8918	3	128.3	0	0	1553	90	74	
61701	65	00000100	000	010	1	81.6	1	81.6	11907	50	21	17075	11340	3	435.6	5297	17	0	375	74	
61707	74	00000100	000	000	1	556.9	1	556.9	9968	99	65	118839	9968	1	2779.8	27709	0	0	401	74	
61709	72	00000100	000	000	2	711.0	2	711.0	9840	44	104	133411	9283	1	2307.5	22264	0	0	838	1135	74
71803	50	00000010	001	000	3	175.0	0	0.	12325	61	99	45802	12325	3	1156.4	0	1103	36776	367	74	
52002	70	00001000	000	000	3	1251.0	2	1251.0	9162	63	67	251722	9162	1	6906.7	48654	0	0	1025	3172	74
12101	65	10000000	100	000	2	117.7	2	117.7	9034	79	96	106674	9034	3	3872.6	0	0	2549	2877	74	
12102	60	10000000	000	100	1	136.0	1	136.0	9885	95	42	37415	9885	3	997.3	3900	0	0	485	515	74
12103	66	10000000	100	000	1	28.3	0	0.	12483	55	20	6362	12003	3	115.2	0	0	281	2061	74	
32205	52	00100000	000	000	3	325.0	3	325.0	9574	91	100	70553	9574	3	2446.5	24400	0	0	1161	2152	74
32206	56	00100000	000	000	3	933.2	3	933.2	9170	69	132	240447	9170	3	3246.5	30431	121	0	1161	2152	74

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
42302	53	00010000	001	010	2	116.1	0	0.	115.11	46	42	29572	10859	3	437.9	5855	11	0	448	627	74
42304	68	00010000	000	000	1	598.4	1	590.4	9521	54	75	117386	9155	3	3268.0	31530	0	0	1263	1545	74
42306	69	00010000	001	000	1	75.0	0	0.	13965	24	33	22957	12469	1	128.5	0	445	1389	379	305	74
42307	48	00010000	001	000	2	25.0	0	0.	13265	62	24	12394	12916	3	103.1	521	0	1352	252	77	74
62401	74	00000100	010	010	1	781.5	1	781.5	10195	-9	41	111488	10395	1	44.2	0	459	0	-9	-9	74
62403	53	00000100	010	010	2	180.0	0	0.	10719	35	44	47481	9925	3	683.9	0	5921	2166	509	623	74
62404	51	00000100	010	010	1	66.0	0	0.	11374	65	26	4566	11874	3	139.3	0	1435	353	297	203	74
42503	73	00010000	001	100	2	893.4	1	873.0	14200	18	140	211357	12456	1	1453.6	19874	757	0	2157	3825	74
42505	72	00010000	000	000	1	650.0	1	650.0	10275	38	107	178703	9603	1	2173.1	22355	0	0	819	1454	74
42507	70	00010000	001	000	4	2482.0	4	2482.0	9724	49	316	471740	9621	1	10561.1	102067	635	0	3895	6931	74
42509	67	00010000	000	000	2	1099.6	2	1099.6	9499	51	141	179356	9047	3	3147.1	33567	93	0	2349	8753	74
82601	63	00000001	001	100	1	172.8	1	172.8	10000	46	-9	16051	9434	3	923.8	9121	0	503	251	309	74
42701	58	00010000	001	000	1	100.0	1	100.0	10200	47	25	24971	9623	3	629.9	0	1133	5305	285	143	74
82602	64	00000001	010	010	1	81.6	0	81.6	9967	59	24	17226	9677	3	496.4	0	1605	3622	590	223	74
82603	68	00000001	001	010	2	220.0	2	210.0	10254	71	31	43106	10254	1	1287.0	0	885	12434	560	107	74
12902	74	10000000	100	000	1	414.0	0	0.	11264	-9	54	87038	11964	1	299.2	0	3580	0	487	243	74
23002	74	01000000	100	000	4	205.2	0	0.	12229	-9	6	35438	12229	1	525.7	0	4775	0	115	101	74
23005	60	01000000	001	100	2	652.8	2	652.8	8874	69	131	178344	8874	3	2880.2	25759	0	2357	1833	3597	74
83102	73	00000001	001	000	1	328.7	1	328.7	10551	62	87	99526	10551	1	1778.5	18650	117	0	1159	2215	74
83103	67	00000001	010	010	1	113.6	1	113.6	10446	56	25	16009	10044	3	591.5	0	0	6096	295	107	74
23202	74	01000000	100	000	2	1242.0	2	1242.0	9311	-9	97	346047	9311	1	944.3	0	8785	0	2277	164	74
23203	72	01000000	001	000	1	621.0	1	621.0	9792	58	65	104289	9507	1	4277.4	0	42617	190	2234	2313	74
23206	63	01000000	001	000	2	1827.7	0	1827.7	9631	65	123	436291	9631	3	7343.5	0	71746	1540	3766	9511	74
23211	48	01000000	000	000	2	96.5	0	0.	12260	99	70	30549	12660	3	541.4	7977	0	0	637	295	74
23213	55	01000000	000	000	2	310.0	2	310.0	9504	87	69	68737	9504	3	2040.2	19512	0	0	775	790	74
53302	60	00001000	000	100	1	206.6	1	206.6	9317	68	42	41477	9817	3	935.1	7212	185	1857	299	722	74
53306	74	00001000	000	000	1	1080.0	1	1080.0	8904	-9	130	168292	8904	1	2646.5	23564	0	0	295	120	74
43402	66	00010000	000	000	1	240.0	1	240.0	10811	62	50	42061	10811	3	1544.2	17709	0	0	630	850	74
43403	70	00010000	001	000	1	256.5	1	256.5	11212	89	50	52613	11212	1	1936.9	22108	78	0	604	609	74
33506	70	00100000	001	000	4	2440.8	4	2440.8	9572	-9	196	432374	9572	1	9841.6	92696	205	0	1906	3965	74
33508	54	00100000	000	000	2	312.8	2	312.8	9627	76	62	74647	9627	3	1465.7	15328	11	0	682	1041	74
33512	55	00100000	000	000	5	1086.3	5	1086.3	9176	109	290	252193	9176	3	8045.0	76119	0	0	2159	3782	74
33514	74	00100000	001	000	1	1300.0	1	1300.0	9621	-9	272	351034	9621	1	1747.6	16663	152	0	371	349	74
73601	53	00000010	010	000	1	74.6	0	0.	11947	91	33	20043	11947	3	344.9	0	0	4249	295	112	74
73603	71	00000010	001	001	2	1157.6	2	1134.0	10056	58	54	98984	9763	1	5836.2	0	13	58617	665	715	74
73606	73	00000010	010	001	3	290.0	0	0.	10275	-9	19	32257	10275	1	740.0	0	3	7603	323	549	74
73607	74	00000100	010	000	1	472.5	1	472.5	9694	-9	40	53889	9694	1	1447.0	0	0	14034	536	540	74
23802	51	01000000	000	000	3	225.0	3	225.0	9840	93	62	81809	9840	3	1579.3	16223	234	0	1036	1727	74
23803	69	01000000	000	000	2	1319.4	2	1319.4	10263	42	105	252199	9592	3	4636.0	45686	264	0	3516	10257	74
23808	72	01000000	000	100	3	1641.7	2	1624.5	9696	57	143	319714	9323	1	8170.2	78052	1170	0	2618	5051	74
23809	70	01000000	000	100	2	1872.0	2	1872.0	9349	55	173	296086	9076	1	733.5	73237	589	0	3705	11972	74
23810	67	01000000	000	000	2	1872.0	2	1872.0	9652	51	114	267008	9192	3	7246.0	72691	386	0	3792	16860	74
23812	47	01000000	001	000	2	345.0	0	0.	11963	96	98	171047	11963	3	1101.5	0	14227	0	1555	2015	74
23813	70	01000000	000	000	1	565.3	1	565.3	9473	59	58	164550	9202	1	3131.2	29792	388	0	1314	2257	74
23817	58	01000000	000	010	2	326.4	2	326.4	9830	87	46	75470	9830	3	1263.9	14237	0	0	691	1160	74
23818	69	01000000	000	010	3	1728.0	3	1728.0	9440	58	100	329330	9165	1	6680.1	67569	0	0	1901	3465	74
23819	50	01000000	000	100	2	46.0	0	0.	12146	92	35	18933	12146	3	168.3	834	1445	0	446	264	74
54001	73	00001000	100	010	1	632.7	1	632.7	9765	52	56	109795	9319	1	2875.3	0	28134	0	883	792	74
54003	70	00001000	001	010	2	771.8	2	771.8	9073	56	62	67124	8729	1	2278.5	22932	201	0	693	2377	74
44101	60	00010000	000	010	1	22.0	0	0.	12055	52	22	8933	12243	3	142.2	1864	0	0	216	96	74

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V		
64201	58	000001	00	001	000	3	990.0	1	950.0	1	950.0	50	191	203140	8486	3	4668.4	35447	0	1642	2387	74	
64202	67	000001	00	000	000	1	950.0	1	950.0	1	950.0	50	191	203140	8486	3	6159.5	55503	0	1676	2006	74	
64203	65	000001	00	000	000	1	950.0	1	950.0	1	950.0	50	191	203140	8486	3	2214.3	21702	0	1011	2017	74	
64204	73	000001	00	000	000	2	2600.0	2	2600.0	2	2600.0	9420	9420	422530	9420	1	9491.4	88966	0	5413	5413	74	
64205	54	000001	00	000	000	9	1700.0	9	1700.0	9	1700.0	9420	9420	422530	9420	1	9491.4	88966	0	2983	5201	74	
74301	57	000000	01	010	100	2	184.7	0	113.7	1	184.7	57	34	31317	11430	3	760.5	0	14	400	236	74	
74302	71	000000	01	010	100	1	261.0	1	261.0	1	261.0	50	34	32562	9375	1	1091.0	0	455	10532	246	74	
74303	74	000000	01	010	100	1	352.8	1	352.8	1	352.8	50	35	10583	9867.8	1	9867.8	0	12	10441	246	74	
74306	72	000000	01	010	100	2	892.8	2	892.8	2	892.8	50	35	101459	8962	1	2326.7	0	455	10532	246	74	
74308	71	000000	01	010	000	1	247.5	1	247.5	1	247.5	50	28	32813	9669	1	1501.4	0	557	15073	544	74	
74311	62	000000	01	010	000	1	81.6	1	81.6	1	81.6	68	19	13415	10010	3	494.8	0	260	4817	236	74	
74313	66	000000	01	010	000	2	133.5	1	133.5	1	133.5	64	32	16507	9801	3	861.0	0	260	4817	236	74	
74314	74	000000	01	010	000	1	156.6	1	156.6	1	156.6	64	32	20491	10167	1	523.3	0	99	5225	123	74	
74319	70	000000	01	010	000	2	542.8	2	542.8	2	542.8	61	34	73015	10021	1	2992.8	0	47	29855	260	74	
84401	54	000000	01	010	000	1	75.0	0	0.	0	75.0	85	35	25113	11069	3	353.3	4131	0	284	321	74	
84402	57	000000	01	010	000	1	113.6	1	113.6	1	113.6	81	35	24534	10281	3	513.8	5427	0	274	680	74	
84403	55	000000	01	010	000	1	113.6	1	113.6	1	113.6	81	35	24534	10281	3	513.8	5427	0	274	680	74	
84404	70	000000	01	010	000	1	326.4	1	326.4	1	326.4	76	30	27078	10352	3	595.2	6042	0	274	680	74	
84405	74	000000	01	010	000	1	446.4	1	446.4	1	446.4	61	30	144658	10296	1	946.8	9688	10	1089	305	74	
84406	64	000000	01	010	000	1	163.2	1	163.2	1	163.2	57	30	49168	9779	3	918.9	9542	0	1089	305	74	
84407	68	000000	01	010	000	1	217.6	1	217.6	1	217.6	69	30	36994	10184	3	1301.4	13356	16	303	334	74	
84408	49	000000	00	000	000	1	34.5	0	0.	0	34.5	74	29	22595	13239	3	49.2	44646	279	5220	144	74	
94701	72	000000	00	010	000	1	1460.0	1	1460.0	1	1460.0	10554	33	106	37886	9772	1	4214.4	44646	2631	5220	144	74
94702	49	000000	00	000	000	0	0.	0	0.	0	0.	10554	33	106	37886	9772	1	4214.4	44646	2631	5220	144	74
94703	53	000000	00	000	000	2	439.4	2	439.4	2	439.4	98	123	118969	9113	3	3018.3	28185	19	1005	1179	74	
94704	54	000000	00	000	000	2	150.0	2	150.0	2	150.0	98	123	118969	9113	3	3018.3	28185	19	1005	1179	74	
94705	52	000000	00	010	000	3	278.3	3	278.3	3	278.3	98	123	118969	9113	3	3018.3	28185	19	1005	1179	74	
94706	72	000000	00	010	000	3	2052.0	3	2052.0	3	2052.0	98	123	118969	9113	3	3018.3	28185	19	1005	1179	74	
94707	67	000000	00	000	000	2	1152.0	2	1152.0	2	1152.0	98	123	118969	9113	3	3018.3	28185	19	1005	1179	74	
94708	71	000000	00	000	000	3	2932.6	3	2932.6	3	2932.6	98	123	118969	9113	3	3018.3	28185	19	1005	1179	74	
94709	71	000000	00	000	000	3	2932.6	3	2932.6	3	2932.6	98	123	118969	9113	3	3018.3	28185	19	1005	1179	74	
94710	71	000000	00	000	000	2	1632.6	2	1632.6	2	1632.6	98	123	118969	9113	3	3018.3	28185	19	1005	1179	74	
94711	69	000000	00	000	000	1	345.6	1	345.6	1	345.6	59	65	66664	8516	3	1973.1	25087	36	909	1769	74	
94712	59	000000	00	000	000	1	113.6	1	113.6	1	113.6	59	65	66664	8516	3	1973.1	25087	36	909	1769	74	
94713	54	000000	00	000	000	2	150.0	2	150.0	2	150.0	59	65	66664	8516	3	1973.1	25087	36	909	1769	74	
94714	54	000000	00	000	000	2	150.0	2	150.0	2	150.0	59	65	66664	8516	3	1973.1	25087	36	909	1769	74	
94715	54	000000	00	000	000	2	150.0	2	150.0	2	150.0	59	65	66664	8516	3	1973.1	25087	36	909	1769	74	
94716	54	000000	00	000	000	2	150.0	2	150.0	2	150.0	59	65	66664	8516	3	1973.1	25087	36	909	1769	74	
94717	54	000000	00	000	000	2	150.0	2	150.0	2	150.0	59	65	66664	8516	3	1973.1	25087	36	909	1769	74	
94718	54	000000	00	000	000	2	150.0	2	150.0	2	150.0	59	65	66664	8516	3	1973.1	25087	36	909	1769	74	
94719	54	000000	00	000	000	2	150.0	2	150.0	2	150.0	59	65	66664	8516	3	1973.1	25087	36	909	1769	74	
94720	54	000000	00	000	000	2	150.0	2	150.0	2	150.0	59	65	66664	8516	3	1973.1	25087	36	909	1769	74	
94721	54	000000	00	000	000	2	150.0	2	150.0	2	150.0	59	65	66664	8516	3	1973.1	25087	36	909	1769	74	
94722	54	000000	00	000	000	2	150.0	2	150.0	2	150.0	59	65	66664	8516	3	1973.1	25087	36	909	1769	74	
94723	54	000000	00	000	000	2	150.0	2	150.0	2	150.0	59	65	66664	8516	3	1973.1	25087	36	909	1769	74	
94724	54	000000	00	000	000	2	150.0	2	150.0	2	150.0	59	65	66664	8516	3	1973.1	25087	36	909	1769	74	
 																						

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	
43402	66	00010000	000	000	1	246.0	1	240.0	10411	62	50	42061	10811	3	1442.7	15972	0	0	0	445	302	
33502	53	00100000	000	000	2	375.5	2	375.5	9336	103	105	123967	9336	2	4296.2	42135	0	0	0	1316	1795	
33508	54	00100000	000	000	2	312.6	2	312.6	9627	76	62	74647	9627	3	1294.5	13278	0	0	0	528	642	
33512	55	00100000	000	000	5	1086.3	5	1086.3	9176	109	290	252193	9176	3	7553.4	68540	0	0	0	1966	69	
73601	53	00000010	010	000	1	74.6	0	0.	11947	91	33	20043	11947	3	299.6	0	0	0	0	445	302	
73604	61	00000010	001	001	1	170.0	1	170.0	10085	69	36	32316	10085	2	1253.4	0	0	0	3698	45	69	
23002	51	01000000	000	000	3	225.0	3	225.0	9840	93	62	81809	9840	3	1708.6	17493	0	0	0	637	619	
23003	69	01000000	000	000	2	1319.4	2	1319.4	10263	42	105	252199	9592	3	703.6	1350	0	0	0	398	328	
23010	67	01000000	000	000	2	1872.0	2	1872.0	9652	51	114	267008	9192	3	8403.4	80370	0	0	0	1579	5091	
23011	60	01000000	001	600	2	707.2	2	707.2	9760	65	50	239100	8760	2	4703.3	41274	357	0	0	1036	3124	
23012	47	01000000	001	000	2	345.0	0	0.	11963	98	98	171047	11963	3	2343.3	8061	21025	0	0	1251	2069	
23017	54	01000000	000	010	2	326.4	2	326.4	9830	87	46	75470	9830	3	2398.4	24563	0	0	0	387	714	
23019	50	01000000	000	100	2	46.0	0	0.	12146	92	35	18983	12146	3	263.2	3419	0	0	0	227	264	
44101	60	00010000	000	010	-1	22.0	0	0.	12855	52	22	8983	12243	3	116.2	-9	0	0	0	146	53	
64201	58	00000100	001	030	3	990.0	3	990.0	9500	46	170	21708	9048	3	5161.1	29010	0	0	0	1147	2120	
64202	67	00000100	000	000	1	950.0	1	950.0	8910	50	191	203140	8486	3	4139.5	36467	0	0	0	1277	1716	
64204	65	00000100	000	000	9	1550.0	9	1550.0	9560	50	-9	102694	9105	3	3274.9	30827	0	0	0	2178	2538	
74301	57	00000010	010	100	2	189.7	0	113.7	11887	57	34	31317	11430	3	1002.0	0	0	0	10982	294	152	
74304	66	00000010	010	100	1	225.0	1	225.0	9769	55	82	28390	7393	2	2226.3	0	0	0	21734	415	469	
74311	62	00000010	001	100	1	81.6	1	81.6	10010	88	19	13415	10010	3	498.3	0	0	0	21734	415	469	
74313	66	00000010	010	100	2	133.5	1	100.8	9801	64	32	16507	9801	3	895.9	0	0	0	5002	180	75	
74317	65	00000010	001	010	2	250.0	0	250.0	9718	72	40	36941	9718	2	1437.7	0	0	0	14319	239	203	
74321	64	00000010	010	100	1	179.5	1	179.5	9944	80	27	21734	9944	2	1401.4	0	0	0	13990	206	123	
84402	57	00000001	001	010	1	75.0	0	11069	11069	85	35	25113	11069	3	341.5	4083	0	0	0	210	154	69
84403	55	00000001	001	010	1	113.6	1	113.6	10352	76	30	27076	10352	3	561.1	0	0	0	185	553	69	
84406	64	00000001	001	010	1	163.2	1	163.2	10170	57	30	49168	9779	3	883.5	9137	3670	2432	205	253	69	
84407	68	00000001	001	010	1	217.6	1	217.6	10184	69	-9	36994	10184	3	1316.3	13397	0	0	0	198	121	69
54602	49	00001000	000	000	1	34.5	0	0.	13239	89	68	76598	9598	2	2219.8	22346	0	0	0	219	109	69
54606	57	00001000	001	100	2	345.5	2	345.5	9593	89	74	22595	13239	3	115.6	1602	0	0	0	109	69	69
54608	53	00001000	000	000	2	439.4	2	439.4	9113	98	123	118969	9113	3	3370.8	30657	0	0	0	669	656	69
54805	52	00001000	000	100	3	278.3	1	140.3	11511	128	49	75258	11511	3	2126.1	24196	0	0	0	388	922	69
54807	67	00001000	000	000	2	1152.0	2	1152.0	9179	58	89	211062	9179	3	7902.5	72535	0	0	0	743	1192	69
34901	69	00100000	000	000	1	345.6	1	345.6	8771	59	65	66664	8516	3	904.1	7846	0	0	0	729	3133	69
34903	59	00100000	000	000	1	113.6	1	113.6	9751	67	47	27396	9751	3	1454.9	14086	0	0	0	327	165	69
34904	54	00100000	000	000	2	150.0	2	150.0	9902	64	49	45964	9902	3	987.9	10106	0	0	0	250	69	69

PLANT CHARACTERISTICS - FOSSIL-FUELED STEAM-ELECTRIC

Column A - Five-digit identification code

The first digit identifies the plant by the Census Region in which it is located.

The second and third digits are the state identification code. The state codes are numerically sequenced 01 to 50 and correspond to an alphabetical listing of the states. Code #51 indicates the District of Columbia.

The final two digits denote the specific plant within a state.

Column B - Two-digit vintage code

Year in which the plant observed was brought into initial operation.

Column C - Eight-digit region code

Regional code constructed for analytical purposes. This code for the nine Census Regions is as follows:

Region 1	1	0	0	0	0	0	0	0
Region 2	0	1	0	0	0	0	0	0
Region 3	0	0	1	0	0	0	0	0
Region 4	0	0	0	1	0	0	0	0
Region 5	0	0	0	0	1	0	0	0
Region 6	0	0	0	0	0	1	0	0
Region 7	0	0	0	0	0	0	1	0
Region 8	0	0	0	0	0	0	0	1
Region 9	0	0	0	0	0	0	0	0

Column D - Three-digit fuel type code

Identifies the types of fuel for which the boiler was designed.

Coal	0	0	0
Oil	1	0	0
Gas	0	1	0
Mixed	0	0	1

Column E - Three-digit building code

Indicates the plant's construction type.

Conventional	0	0	0
Outdoor	1	0	0
Semi-Outdoor	0	1	0
Other	0	0	1

Column F - Number of units installed at the plant observed.

Column G - Total capacity of the plant in megawatts; the sum of the capacity of all units.

Column H - Number of units within the plant having reheat capability.

Column I - Total capacity of the reheat units within the plant.

Column J - Heat rate (Btu's/kWh of net generation).

Column K - Plant factor (net generation/(capacity x 8,760 hours)).

Column L - Average employment.

Column M - Construction cost in $\$(\times 10^3)$. The cost has been adjusted to a base year of 1975.

Column N - Adjusted heat rate.

Column O - Internal code used for programming purposes only; indicates the number of years in which the plant was observed.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
60101	54	00000100	000	000	2	250.0	0	0.	9551	77	75	69461	9551	0
60102	49	00000100	001	000	2	136.0	0	0.	11600	100	95	37424	11800	3
60103	65	00000100	000	000	2	568.5	2	568.5	9491	59	32	84164	9215	3
60104	74	00000100	003	000	1	952.0	1	952.0	9433	-9	248	170143	9433	1
60105	60	00000100	000	000	4	1060.8	4	1060.8	9187	78	-9	179936	9187	3
80301	62	00000001	000	100	1	113.6	1	113.6	9562	85	38	28843	9682	3
80302	63	00000001	000	100	3	633.6	3	633.6	10277	76	58	121747	10277	3
80303	69	00000001	001	100	2	1636.2	2	1636.2	10252	64	130	213053	10252	1
80304	60	00000001	001	100	2	227.5	0	0.	9703	78	41	36874	9703	3
80305	57	00000001	001	100	2	227.5	0	0.	9943	48	34	38556	9470	0
80306	52	00000001	001	100	2	90.0	0	0.	11366	89	19	23977	11366	3
80307	58	00000001	001	000	1	174.0	1	174.0	10014	40	-9	30671	9359	0
70401	47	00000010	010	100	1	25.0	0	0.	12291	97	28	12209	12291	0
70402	50	00000010	001	010	2	88.0	0	0.	11345	100	36	25179	11345	0
70403	51	00000010	001	100	2	133.0	0	0.	11290	68	44	34543	11290	3
70404	66	00000010	001	010	1	120.0	1	120.0	10463	49	16	16989	9965	3
70405	63	00000010	001	010	1	59.8	0	0.	11915	40	16	10144	11136	3
90501	59	00000000	001	000	1	44.0	0	0.	12314	78	-9	45615	12314	0
90502	43	00000000	000	000	1	65.0	0	0.	11830	90	96	43932	11830	0
90503	62	00000000	001	100	4	690.0	4	690.0	9639	69	106	137459	9639	0
90504	58	00000000	001	000	2	326.4	2	326.4	9753	96	148	103985	9753	3
90505	54	00000000	001	100	2	545.6	1	345.6	10421	66	126	156599	10421	3
90506	51	00000000	001	100	3	292.5	0	0.	13546	26	-9	98893	11882	0
90507	55	00000000	001	010	2	338.2	2	338.2	9765	45	-9	82927	9212	0
90508	50	00000000	001	100	3	264.0	0	0.	12575	-9	-9	131730	12575	0
90509	54	00000000	001	100	4	625.0	4	625.0	10142	77	-9	147504	10142	0
90510	49	00000000	001	000	1	20.0	0	0.	14969	36	17	12475	13860	0
90511	54	00000000	001	000	2	200.0	2	200.0	10442	63	75	57614	10442	0
90512	61	00000000	001	000	2	272.5	2	272.5	12966	78	44	53053	12966	0
90513	56	00000000	001	100	2	321.3	2	321.3	9609	67	25	66077	9609	0
90514	61	00000000	001	100	2	146.9	2	146.9	9963	80	51	78102	9963	3
90515	56	00000000	001	100	3	176.2	3	176.2	9467	86	5	32809	9467	0
90516	53	00000000	001	100	4	220.0	4	220.0	10003	95	24	76981	10003	0
90517	53	00000000	001	100	2	435.2	2	435.2	9436	74	27	84398	9436	0
90518	59	00000000	001	100	2	435.2	2	435.2	9224	80	43	75170	9224	2
90519	71	00000000	001	100	2	1612.8	2	1612.8	9410	52	61	204725	8962	1
90520	48	00000000	001	100	4	252.0	0	0.	12007	82	72	107170	12007	0
90521	57	00000000	001	100	2	130.6	2	130.6	9800	93	32	30684	9800	3
80601	50	00000001	001	010	3	132.0	0	0.	12441	66	26	52891	12441	0
80602	57	00000001	001	010	1	22.0	0	0.	13194	56	17	10692	12687	0
80603	57	00000001	001	010	1	100.0	0	0.	10736	82	29	34565	10736	0
80604	73	00000001	001	010	1	382.5	1	382.5	10288	68	15	109767	10288	1
80605	65	00000001	000	000	1	163.2	1	163.2	9954	86	36	60514	9954	3
80606	59	00000001	000	000	3	34.6	0	0.	14394	27	22	12703	12852	3
10701	60	10000000	000	000	1	163.0	0	0.	9511	82	43	46528	9511	0
10702	54	10000000	001	000	1	66.0	0	0.	10914	76	43	34011	10914	0
10703	57	10000000	001	100	1	75.0	1	75.0	9823	72	41	35158	9823	0
10704	29	10000000	001	000	6	75.0	0	0.	20300	26	130	47276	18125	0
50801	51	00001000	001	100	2	138.0	0	0.	10859	89	75	55171	10859	0
50802	73	00001000	100	010	1	445.8	1	445.8	10050	42	-9	89265	9393	1

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
50803	57	00001000	000	100	2	163.2	2	163.2	10159	77	64	48325	10159	0
50901	58	00001000	100	000	1	127.5	1	127.5	10364	71	53	37770	10364	0
50902	66	00001000	000	000	2	964.3	2	964.3	9936	41	96	124596	9286	3
50903	65	00001000	000	100	1	402.1	1	402.1	9461	58	43	44026	9185	0
50904	58	00001000	100	100	1	125.0	1	125.0	9271	57	43	28198	9588	0
50905	60	00001000	100	100	1	225.3	1	225.3	9459	71	44	39020	9459	0
50906	67	00001000	001	100	2	804.1	2	804.1	9702	63	75	79527	9438	3
50907	65	00001000	000	000	2	340.0	2	340.0	10019	75	43	60006	10019	3
50908	60	00001000	001	000	1	86.7	1	86.7	9944	61	55	24703	9654	0
50909	70	00001000	000	010	2	891.0	2	891.0	10155	55	104	153531	9764	1
50910	57	00001000	000	010	2	240.0	2	240.0	10450	60	-9	32667	10146	0
50911	28	00001000	100	000	1	15.0	0	0.	17913	77	-9	7599	17913	0
51001	71	00001000	000	000	3	2546.6	3	2546.6	9410	49	277	342206	8962	1
51002	65	00001000	001	000	4	1746.2	4	1746.2	9288	59	176	227013	9017	0
51003	54	00001000	000	000	3	300.0	3	300.0	9973	63	81	87784	9701	2
51004	63	00001000	000	000	2	598.4	2	598.4	9576	67	77	103787	9576	3
51005	52	00001000	100	000	1	40.0	0	0.	12061	53	55	20000	11597	0
51006	48	00001000	000	000	2	45.0	0	0.	11043	63	64	22621	11611	0
51007	50	00001000	001	000	2	200.0	0	0.	10986	88	99	78390	10986	0
31301	60	00100000	000	000	1	125.0	1	125.0	9760	74	38	43537	9760	0
31302	65	00100000	000	000	1	330.0	1	330.0	9871	75	56	66790	9871	2
31303	40	00100000	000	000	2	50.0	0	0.	12730	80	-9	19587	12730	0
31304	48	00100000	000	000	2	100.0	0	0.	11680	63	71	51440	11362	0
31305	67	00100000	000	000	2	1319.4	2	1319.4	10139	41	144	194907	9476	3
31306	50	00100000	001	000	2	345.0	0	0.	10751	81	195	171336	10751	0
31307	55	00100000	000	000	2	345.0	2	345.0	9568	78	117	126042	9568	0
31308	70	00100000	000	000	1	623.1	1	623.1	9760	62	88	158711	9503	0
31309	53	00100000	000	000	1	60.0	1	60.0	10173	85	70	41002	10173	0
31310	55	00100000	000	010	2	182.3	2	182.3	10322	70	85	58187	10322	3
31311	47	00100000	001	001	3	160.5	0	0.	11427	85	-9	91604	11427	0
31312	63	00100000	000	010	3	99.0	0	0.	12747	32	41	26812	11588	3
31313	22	00100000	000	000	2	50.0	0	0.	17289	57	-9	27897	16624	0
31401	25	00100000	000	000	2	80.0	0	0.	11825	68	135	59901	11825	0
31402	30	00100000	000	000	1	68.0	0	0.	13106	71	106	48576	13106	0
31403	70	00100000	000	100	1	380.0	1	380.0	9876	68	100	50139	9876	0
31404	63	00100000	000	100	3	432.0	3	432.0	10003	79	-9	86898	10003	3
31405	55	00100000	000	000	6	1303.6	6	1303.6	9147	88	333	305499	9147	3
31406	60	00100000	000	010	1	495.6	1	495.6	8842	76	85	113426	8842	3
31407	51	00100000	000	000	1	125.0	1	125.0	9329	86	82	54803	9329	0
31408	56	00100000	000	000	1	138.1	1	138.1	10724	74	86	44385	10724	2
31409	70	00100000	001	000	2	1062.0	2	1062.0	9683	62	103	186397	9428	1
31410	55	00100000	000	000	1	40.0	0	0.	10762	92	31	24333	10762	0
41501	68	00010000	001	000	1	148.8	1	148.8	10005	48	-9	31301	9529	3
41502	64	00010000	001	000	1	147.1	1	147.1	9722	60	23	31034	8838	2
41503	68	00010000	000	000	1	212.0	1	212.0	10163	57	26	36634	9772	3
41504	49	00010000	001	000	4	43.8	0	0.	14614	25	21	24449	13048	0
41505	60	00010000	001	000	1	37.5	0	0.	12543	44	13	10452	11833	3
41601	63	00010000	010	010	1	58.8	0	0.	11870	59	20	11109	11524	0
41602	53	00010000	010	010	1	19.0	0	0.	13089	61	16	12049	12708	0
41603	61	00010000	010	100	1	149.6	1	149.6	9916	37	31	25460	9181	0

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
41604	52	00010000	010	100	2	104.0	0	0.	11492	77	33	32137	11499	0
41605	63	00010000	010	010	1	32.0	0	0.	8913	69	10	5264	8918	3
41606	55	00010000	001	000	2	84.0	0	0.	11363	59	43	22391	11388	0
41607	66	00010000	001	001	1	81.6	0	0.	10632	47	12	22252	10632	2
61701	65	00000100	000	010	1	81.6	1	81.6	11907	50	21	17075	11340	3
61702	65	00000100	000	000	1	113.6	1	113.6	9972	60	40	26443	9631	0
61703	54	00000100	000	100	4	176.0	0	0.	11356	29	51	52594	10360	0
61704	63	00000100	000	000	1	265.0	1	265.0	8939	81	61	58005	8939	0
61705	57	00000100	000	000	1	100.0	1	100.0	10175	69	38	26861	10175	0
61706	50	00000100	000	000	2	60.0	0	0.	11964	108	60	27373	11964	0
61707	74	00000100	000	000	1	556.9	1	556.9	9963	-9	65	118829	9968	1
61708	54	00000100	000	000	1	90.0	0	0.	10605	74	91	35742	10685	0
61709	72	00000100	000	000	2	711.0	2	711.0	9840	44	104	133411	9283	1
61710	42	00000100	000	000	2	50.0	0	0.	12485	94	102	26364	12485	0
71801	48	00000010	010	100	2	15.0	0	0.	13633	-9	18	7785	13633	0
71802	53	00000010	010	100	1	20.0	0	0.	12952	47	-9	8211	12219	0
71803	50	00000010	001	000	3	175.0	0	0.	12325	81	-9	45802	12325	3
71804	59	00000010	001	100	3	390.5	3	390.5	10659	52	46	66043	10249	2
71805	60	00000010	001	100	1	163.2	1	163.2	10443	57	24	34187	10041	0
71806	61	00000010	001	100	1	247.0	1	247.0	9810	69	41	39853	9810	0
71807	51	00000010	010	100	1	66.0	0	0.	11514	76	27	17183	11514	0
71808	57	00000010	001	100	1	115.0	0	0.	10763	68	36	22587	10768	0
71809	47	00000010	010	100	1	25.0	0	0.	11326	97	22	12593	11326	0
11901	57	10000000	100	000	2	100.0	0	0.	10819	81	42	37760	10819	0
11902	54	10000000	100	000	1	11.5	0	0.	15560	56	-9	4906	15560	0
52001	59	00001000	000	000	3	586.5	3	586.5	9006	76	75	132607	9006	3
52002	70	00001000	000	000	2	1251.0	2	1251.0	9182	63	67	251722	9182	1
12101	65	10000000	100	000	2	717.7	2	717.7	9034	79	96	106674	9034	3
12102	60	10000000	000	100	1	136.0	1	136.0	9685	95	42	37415	9685	3
12103	66	10000000	100	000	1	28.3	0	0.	12483	55	20	6362	12003	3
12104	63	10000000	001	000	2	482.0	2	482.0	8810	91	91	109435	8810	0
12105	52	10000000	001	000	2	150.0	0	0.	9972	92	116	80215	9972	0
12106	49	10000000	001	000	2	96.0	0	0.	11155	71	64	40842	11155	0
32201	24	00100000	000	000	6	300.0	0	0.	14400	44	-9	168165	13585	0
32202	62	00100000	010	000	1	265.0	1	265.0	8918	69	68	98214	8918	0
32203	48	00100000	000	000	3	180.0	0	0.	11213	76	83	31719	11213	0
32204	59	00100000	000	000	2	530.0	2	530.0	8998	70	59	117233	8998	3
32205	52	00100000	000	000	3	325.0	3	325.0	9574	91	100	70553	9574	3
32206	56	00100000	000	000	3	933.2	3	933.2	9170	69	132	240447	9170	3
32207	53	00100000	000	000	4	500.0	4	500.0	9220	75	160	207758	9220	0
32208	55	00100000	000	000	1	22.0	0	0.	12412	63	19	9161	12074	0
42301	30	00010000	000	000	2	20.0	0	0.	16330	50	41	13951	15552	0
42302	53	00010000	001	010	2	116.1	0	0.	11511	46	42	29572	10359	3
42303	53	00010000	000	010	2	140.0	2	140.0	9951	63	37	35950	9680	2
42304	68	00010000	000	000	1	598.4	1	598.4	9521	54	73	117386	9155	3
42305	46	00010000	001	000	1	25.0	0	0.	14262	80	22	18071	14282	0
42306	69	00010000	001	000	1	75.0	0	0.	13965	24	33	22957	12469	1
42307	48	00010000	001	000	2	25.0	0	0.	13265	62	24	42394	12916	3
62401	74	00000100	010	010	1	781.5	1	781.5	10395	-9	41	111488	10395	1
62402	66	00000100	010	010	1	544.6	1	544.6	9664	62	31	68513	9400	2

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
62403	53	00000100	010	010	2	180.0	0	0.	10719	35	44	47431	9925	3
62404	51	00000100	010	010	1	66.0	0	0.	11874	65	26	4566	11874	3
62405	48	00000100	010	010	2	77.0	0	0.	11896	85	30	26452	11896	0
42501	51	00010000	001	001	2	132.0	0	0.	10361	71	60	52234	10861	0
42502	53	00010000	000	100	2	312.6	2	312.6	10221	77	67	60456	10221	0
42503	73	00010000	001	100	2	893.4	1	373.0	14200	18	140	211357	12456	1
42504	60	00010000	000	010	2	100.0	0	0.	11641	69	19	26712	11641	0
42505	72	00010000	000	000	1	650.0	1	650.0	10275	38	107	178703	9603	1
42506	54	00010000	000	010	2	67.7	0	0.	11487	90	33	27712	11487	0
42507	70	00010000	001	000	4	2482.0	4	2482.0	9724	49	316	471740	9621	1
42508	53	00010000	001	010	2	250.0	2	250.0	10137	90	118	107235	10137	0
42509	67	00010000	000	000	2	1099.6	2	1099.6	9499	51	141	179356	9017	3
42510	54	00010000	001	000	2	40.0	0	0.	12723	72	27	20084	12723	0
42511	57	00010000	001	010	2	44.0	0	0.	12734	50	36	17892	12128	0
82601	68	00000001	001	100	1	172.8	1	172.8	10000	46	-9	16051	9434	3
42701	54	00010000	001	000	1	100.0	1	100.0	10200	47	25	24971	9623	3
42702	54	00010000	001	000	3	275.0	3	275.0	10119	72	-9	70181	10119	0
82801	65	00000001	000	010	1	113.6	1	113.6	9461	58	32	25268	9191	0
82802	64	00000001	010	010	1	81.6	0	81.6	9967	59	24	17228	9677	3
82803	68	00000001	001	010	2	220.0	2	210.0	10254	71	31	43108	10254	1
82804	63	00000001	001	010	1	53.0	0	0.	11751	50	28	11106	11301	0
12901	49	10000000	001	000	3	43.0	0	0.	9379	87	33	35652	9379	0
12902	74	10000000	100	000	1	414.0	0	0.	11964	-9	54	87038	11964	1
23001	63	01000000	001	010	2	299.2	2	299.2	9620	68	63	68412	9620	2
23002	74	01000000	100	000	4	205.2	0	0.	12229	-9	6	35438	12229	1
23003	59	01000000	001	100	1	360.4	1	360.4	9419	67	114	112646	9419	0
23004	64	01000000	001	100	1	454.8	1	454.8	9339	64	120	114238	9339	0
23005	60	01000000	001	100	2	652.8	2	652.8	8874	69	131	178344	8874	3
23006	48	01000000	001	100	3	335.0	3	335.0	10369	83	112	149273	10369	0
23007	30	01000000	000	000	2	70.5	0	0.	14175	33	96	38187	13125	0
23008	30	01000000	000	000	1	55.0	0	0.	12500	72	78	28422	12500	0
83101	59	00000001	001	010	1	44.0	0	0.	10379	79	23	11862	10379	0
83102	73	00000001	001	000	1	328.7	1	328.7	10551	62	87	99526	10551	1
83103	67	00000001	010	010	1	113.6	1	113.6	10446	56	25	16009	10044	3
83104	62	00000001	001	010	1	56.5	0	0.	12766	53	15	11697	12275	0
23201	51	01000000	000	000	1	60.0	0	0.	9942	100	52	31861	9942	0
23202	74	01000000	100	000	2	1242.0	2	1242.0	9311	-9	97	346047	9311	1
23203	72	01000000	001	000	1	621.0	1	621.0	9792	58	65	104289	9507	1
23204	47	01000000	000	000	1	20.0	0	0.	12440	87	35	20291	12440	0
23205	53	01000000	001	000	1	180.0	1	180.0	9841	86	42	83674	9841	0
23206	63	01000000	001	000	2	1827.7	0	1827.7	9631	65	123	436291	9631	3
23207	56	01000000	000	100	1	187.5	1	187.5	9719	80	62	51403	9719	0
23208	67	01000000	100	000	2	774.2	2	774.2	9601	69	77	142400	9601	2
23209	48	01000000	001	100	2	83.0	0	0.	11116	82	78	51635	11116	0
23210	38	01000000	000	000	1	20.0	0	0.	12715	104	46	11649	12716	0
23211	48	01000000	000	000	2	96.5	0	0.	12260	99	70	30549	12660	3
23212	45	01000000	000	000	1	30.0	0	0.	13097	98	49	18616	13097	0
23213	55	01000000	000	000	2	310.0	2	310.0	9504	87	69	68737	9504	3
23214	52	01000000	000	000	4	400.0	4	400.0	9373	83	111	123350	9373	0
23215	50	01000000	000	000	2	160.0	0	0.	9430	99	83	71872	9430	0

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
23216	40	01000000	000	000	2	190.0	0	0.	11003	79	179	60805	11003	0
53391	64	00001000	000	100	1	206.6	1	206.6	9425	65	44	33773	9425	2
53392	60	00001000	000	100	1	206.6	1	206.6	9817	60	42	41477	9817	3
53393	60	00001000	000	100	1	410.9	1	410.9	9271	76	52	39378	9271	0
53394	54	00001000	000	100	2	225.0	1	112.5	10042	80	54	50032	10042	2
53395	57	00001000	000	000	2	330.0	2	330.0	9179	76	54	67462	9179	0
53396	74	00001000	000	000	1	1080.0	1	1080.0	8904	-9	130	168292	8904	1
53397	40	00001000	000	000	2	80.0	0	0.	11692	79	85	22158	11692	0
53398	49	00001000	000	000	2	140.0	0	0.	10642	97	74	44745	10642	0
53399	51	00001000	000	000	2	180.0	2	180.0	10300	100	65	45618	10300	0
53310	65	00001000	000	000	2	700.0	2	700.0	9682	98	79	115009	9682	0
43401	54	00010000	001	010	1	20.0	0	0.	17018	39	26	13694	15905	0
43402	66	00010000	000	000	1	240.0	1	240.0	10811	62	50	42061	10811	3
43403	70	00010000	001	000	1	256.5	1	256.5	11212	89	50	52613	11212	1
33501	52	00100000	000	000	1	100.0	1	100.0	10209	-9	60	55262	10209	0
33502	53	00100000	000	000	2	375.5	2	375.5	9336	103	105	123967	9336	2
33503	57	00100000	000	100	1	125.0	1	125.0	9953	63	61	43586	9953	0
33504	73	00100000	001	000	1	341.5	1	341.5	10022	59	-9	151356	9730	0
33505	49	00100000	000	100	2	80.0	0	0.	11692	73	53	48851	11692	0
33506	70	00100000	001	000	4	2440.8	4	2440.8	9572	-9	196	432374	9572	1
33507	46	00100000	001	100	2	120.0	0	0.	10708	-9	73	85165	10708	0
33508	54	00100000	000	000	2	312.8	2	312.8	9627	76	62	74647	9627	3
33509	67	00100000	000	010	2	1180.0	2	1180.0	9087	74	104	193675	9087	0
33510	53	00100000	000	000	2	351.5	2	351.5	9234	101	14	114196	9234	0
33511	45	00100000	000	000	1	100.0	0	0.	11190	92	85	45963	11190	0
33512	55	00100000	000	000	5	1086.3	5	1086.3	9176	109	290	252193	9176	3
33513	55	00100000	000	000	1	125.0	1	125.0	9282	90	43	61032	9282	0
33514	74	00100000	001	000	1	1300.0	1	1300.0	9621	-9	272	351034	9621	1
73601	53	00000010	010	000	1	74.6	0	0.	11947	91	33	20043	11947	3
73602	64	00000010	001	010	1	55.0	0	0.	10765	94	33	10737	10765	0
73603	71	00000010	001	001	2	1157.6	2	1134.0	10056	58	54	98984	9763	1
73604	61	00000010	001	001	1	170.0	1	170.0	10065	69	36	32316	10065	2
73605	52	00000010	010	001	1	90.3	0	0.	11567	72	18	20170	11567	0
73606	73	00000010	010	001	3	290.0	0	0.	10275	-9	19	32257	10275	1
73607	74	00000100	010	000	1	472.5	1	472.5	9694	-9	40	53889	9694	1
23801	56	01000000	000	100	1	150.0	1	150.0	9322	73	60	54910	9322	0
23802	51	01000000	000	000	3	225.0	3	225.0	9840	93	62	81809	9840	3
23803	69	01000000	000	000	2	1319.4	2	1319.4	10263	42	105	252199	9592	3
23804	54	01000000	000	000	2	265.0	2	265.0	9361	65	67	80323	9368	0
23805	48	01000000	000	000	2	69.0	0	0.	11970	99	55	41115	11970	0
23806	61	01000000	000	100	1	363.3	1	363.3	9279	73	75	69267	9279	0
23807	54	01000000	000	100	1	132.5	0	0.	10823	51	70	47529	10312	0
23808	72	01000000	000	100	3	1641.7	2	1624.5	9696	57	143	319714	9323	1
23809	70	01000000	000	100	2	1872.0	2	1872.0	9349	55	173	296016	9076	1
23810	67	01000000	000	000	2	1872.0	2	1872.0	9652	51	114	267006	9192	3
23811	60	01000000	001	000	2	707.2	2	707.2	8760	65	50	239100	8760	2
23812	47	01000000	001	000	2	345.0	0	0.	11963	98	98	171047	11963	3
23813	70	01000000	000	000	1	565.3	1	565.3	9478	59	58	164550	9202	1
23814	52	01000000	000	000	2	185.0	0	0.	10345	102	72	85074	10345	0
23815	42	01000000	000	000	1	66.0	0	66.0	12161	62	74	47246	12100	0

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
23816	39	01000000	000	000	1	35.0	0	0	11907	90	60	15726	11909	0
23817	56	01000000	000	010	2	326.4	2	326.4	9830	87	46	75470	9830	3
23818	69	01000000	000	010	3	1728.0	3	1728.0	9440	56	100	329330	9165	1
23819	50	01000000	000	100	2	46.0	0	0	12146	92	35	10983	12146	3
23820	40	01000000	000	000	2	149.5	0	0	11530	82	65	100475	11530	0
23821	20	01000000	000	000	6	116.8	0	0	18139	21	161	130860	16490	0
54001	73	00001000	100	010	1	632.7	1	632.7	9785	52	56	109795	9319	1
54002	62	00001000	001	010	2	272.0	2	272.0	8971	64	42	50172	8971	0
54100	70	00001000	001	010	2	771.8	2	771.8	9078	56	62	67124	8729	1
44101	40	00010000	000	010	1	22.0	0	0	12855	52	22	8983	12243	3
44102	40	00010000	000	000	2	24.0	0	0	14470	68	-9	10642	14470	0
64201	58	00000100	001	000	3	990.0	3	990.0	9500	48	170	21708	9048	3
64202	67	00000100	000	000	1	950.0	1	950.0	8910	50	191	203140	8486	3
64203	55	00000100	000	000	4	800.0	4	800.0	9490	85	260	19023	9490	0
64204	65	00000100	000	000	1	550.0	1	550.0	9560	50	-9	102694	9105	3
64205	73	00000100	000	000	2	2600.0	2	2600.0	9420	-9	402	422530	9420	1
64206	56	00000100	000	000	2	450.0	2	450.0	9530	73	170	141120	9530	0
64207	54	00000100	000	000	9	1700.0	9	1700.0	9590	93	529	360431	9590	3
64208	55	00000100	000	000	4	846.5	4	846.5	9390	66	217	166297	9390	0
64209	53	00000100	000	000	10	1750.4	10	1750.4	9840	95	531	374935	9840	0
74301	57	00000100	010	100	2	188.7	0	113.7	11867	57	34	31317	11430	3
74302	71	00000100	010	100	1	261.0	1	261.0	9844	50	34	32562	9375	1
74303	74	00000100	010	100	1	352.6	1	352.6	10583	-9	35	50048	10583	1
74304	66	00000100	010	100	1	225.0	1	225.0	9769	55	82	28390	9393	2
74305	49	00000100	010	100	1	30.0	0	0	12895	70	23	9824	12895	0
74306	72	00000100	010	100	2	892.8	2	892.8	9679	35	77	101459	8962	1
74307	54	00000100	010	100	1	60.0	0	0	11723	73	32	15485	11723	0
74308	71	00000100	010	000	1	247.5	1	247.5	10152	50	28	32813	9669	1
74309	52	00000100	010	100	1	100.0	1	100.0	10178	57	31	21327	9787	0
74310	60	00000100	001	100	1	40.0	0	0	11598	-9	36	15617	11598	0
74311	62	00000100	001	100	1	81.6	1	81.6	10010	68	19	13415	10010	3
74312	53	00000100	010	100	1	30.0	0	0	11759	66	22	9202	11759	0
74313	66	00000100	010	100	2	133.5	1	100.8	9801	64	32	16507	9801	3
74314	74	00000100	010	000	1	156.6	1	156.6	10169	-9	157	20491	10169	1
74315	64	00000100	001	100	1	75.0	0	0	12281	63	17	12281	11170	0
74316	58	00000100	001	100	3	81.6	0	0	12190	78	18	14641	12190	0
74317	65	00000100	001	010	2	250.0	0	250.0	9718	72	40	36941	9718	2
74318	61	00000100	010	100	3	75.0	0	0	13511	31	24	13315	12283	0
74319	70	00000100	001	100	2	542.8	2	542.8	10021	61	34	73015	10021	1
74320	62	00000100	001	100	2	478.7	2	478.7	10062	44	30	66890	9511	0
74321	64	00000100	010	100	1	179.5	1	179.5	9944	80	27	21734	9944	2
74322	28	00000100	010	000	1	15.0	0	0	14179	99	29	9924	14179	0
84401	54	00000001	001	010	1	75.0	0	0	11069	85	35	25113	11069	3
84402	57	00000001	001	010	1	113.6	1	113.6	10281	81	-9	24534	10281	3
84403	55	00000001	001	010	1	113.6	1	113.6	10352	76	30	27078	10352	3
84404	70	00000001	001	010	1	326.4	1	326.4	10318	29	-9	68888	9380	1
84405	74	00000001	001	010	1	446.4	1	446.4	10296	-9	61	144658	10296	1
84406	64	00000001	001	010	1	163.2	1	163.2	10170	57	30	49168	9779	3
84407	68	00000001	001	010	1	217.6	1	217.6	10184	69	-9	36994	10184	3
54601	49	00001000	000	000	2	160.0	0	0	10913	84	75	71720	10918	0

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
54602	49	00001000	000	000	1	34.5	0	0.	13239	74	28	22595	13239	3
54603	44	00001000	000	000	1	50.0	0	0.	11950	82	61	25380	11950	0
54604	53	00001000	000	000	2	180.0	2	180.0	9913	93	87	60713	9913	0
54605	43	00001000	000	000	2	138.0	0	0.	11616	90	80	54594	11616	0
54606	57	00001000	001	100	2	345.5	2	345.5	9598	89	68	76598	9598	2
54607	31	00001000	000	000	3	31.0	0	0.	14496	40	61	16439	13548	0
94701	72	00000000	001	010	1	1460.0	1	1460.0	10954	33	106	379886	9772	1
54801	71	00001000	000	100	3	2932.6	3	2932.6	8959	-9	338	620005	8959	1
54802	58	00001000	000	100	2	446.0	2	446.0	9011	88	131	108982	9011	0
54803	53	00001000	000	000	2	439.4	2	439.4	9113	98	123	110969	9113	3
54804	50	00001000	000	000	4	610.0	4	610.0	9378	-9	-9	180144	9378	0
54805	52	00001000	000	100	3	278.3	1	140.3	11511	128	49	75258	11511	3
54806	72	00001000	000	010	3	2052.0	3	2052.0	9544	-9	131	403951	9544	1
54807	67	00001000	000	000	2	1152.0	2	1152.0	9179	78	89	211062	9179	3
54808	49	00001000	000	000	1	50.0	0	0.	11365	101	42	36369	11365	0
54809	65	00001000	000	000	2	1140.0	2	1140.0	9405	54	87	198475	9405	2
54810	58	00001000	000	100	1	225.0	1	225.0	9203	-9	-9	55479	9203	0
54811	71	00001000	000	100	2	1632.6	2	1632.6	9461	48	110	283959	9461	1
34901	69	00100000	000	000	1	345.6	1	345.6	8771	59	65	66664	8516	3
34902	49	00100000	000	000	2	8.0	0	0.	18921	67	15	5253	18921	0
34903	59	00100000	000	000	1	113.6	1	113.6	9751	67	47	27396	9751	3
34904	54	00100000	000	000	2	150.0	2	150.0	9902	64	49	45964	9902	3
34905	54	00100000	000	000	1	60.0	0	0.	11744	53	32	22831	11292	0
85001	74	00000001	001	010	1	560.5	1	560.5	10353	-9	78	188219	10358	1

PLANT CHARACTERISTICS - GAS TURBINES

Column A - Five-digit identification code

The first digit identifies the plant by the Census Region in which it is located.

The second and third digits are the state identification code. The state codes are numerically sequenced 01 to 50 and correspond to an alphabetical listing of the states. Code #51 indicates the District of Columbia.

The final two digits in the identification code denote the specific plant within a state.

Column B - Two-digit vintage code

Year in which the plant observed was brought into initial operation.

Column C - Eight-digit region code

Regional code constructed for analytical purposes. This code for the nine Census Regions is as follows:

Region 1	1	0	0	0	0	0	0	0
Region 2	0	1	0	0	0	0	0	0
Region 3	0	0	1	0	0	0	0	0
Region 4	0	0	0	1	0	0	0	0
Region 5	0	0	0	0	1	0	0	0
Region 6	0	0	0	0	0	1	0	0
Region 7	0	0	0	0	0	0	1	0
Region 8	0	0	0	0	0	0	0	1
Region 9	0	0	0	0	0	0	0	0

Column D - Two-digit fuel type code

Identifies the types of fuel for which the turbine was designed.

Oil	0	0
Gas	1	0
Mixed	0	1

Column E - Two-digit building code

Indicates the plant's construction type.

Conventional	0	0
Outdoor	1	0
Other	0	1

Column F - Three-digit operating code

Indicates the four different types of operation possible in gas turbine plants.

Semi-automatic	0	0	0
Automatic	1	0	0
Manual	0	1	0
Other	0	0	1

Column G - Contains the number of gas turbine units installed at the plant observed.

Column H - Total capacity of the plant in megawatts; the sum of the capacity of all units.

Column I - Construction cost in $\$(x 10^3)$. The cost has been adjusted to a base year of 1975.

Column J - Internal code used for programming purposes only; indicates the number of years in which the plant was observed.

A	B	C	D	E	F	G	H	I	J
60101	12	00000100	00	00	100	2	59.5	6732.20	1
60102	09	00000100	00	00	100	2	47.6	5496.80	3
60103	10	00000100	00	00	000	1	21.3	1879.49	2
60104	12	00000100	00	00	100	3	470.0	43294.62	1
80301	12	00000001	00	00	100	1	23.6	2161.40	1
80302	13	00000001	01	00	100	2	106.2	11562.77	0
80303	13	00000001	01	00	100	2	106.2	11445.75	0
80304	13	00000001	01	00	100	2	106.2	11492.55	0
80305	11	00000001	01	00	100	2	47.2	4147.47	2
80306	10	00000001	01	10	100	4	75.6	6080.51	3
80307	10	00000001	01	10	100	1	18.9	1808.58	3
90501	13	00000000	01	00	000	2	46.3	5169.16	0
90502	08	00000000	00	10	100	1	18.0	2162.20	3
90503	08	00000000	01	10	100	1	18.0	2045.80	3
90504	08	00000000	01	10	100	1	18.0	4203.86	1
90505	12	00000000	01	10	100	2	39.1	2053.70	3
90506	09	00000000	01	10	100	1	18.0	2053.70	3
90507	12	00000000	00	10	100	2	39.1	4193.13	1
90508	06	00000000	00	10	100	1	18.6	2363.77	3
90509	07	00000000	01	00	000	1	16.3	3617.40	3
10701	09	10000000	00	10	100	1	18.6	2084.93	3
10702	09	10000000	00	10	100	3	63.8	6355.26	3
10703	06	10000000	00	10	100	1	16.3	2108.73	3
10704	09	10000000	00	10	100	1	18.6	1982.06	3
10705	06	10000000	00	10	100	1	16.3	2297.57	3
10706	08	10000000	00	10	100	1	16.0	2056.12	3
10707	08	10000000	00	10	100	1	18.6	2202.81	3
10708	06	10000000	00	10	100	1	18.6	2174.54	3
10709	07	10000000	00	10	100	1	18.6	2131.58	0
10709	07	10000000	00	00	100	1	18.6	2362.88	3
50801	08	00001000	00	01	000	1	18.6	1955.35	3
50802	03	00001000	01	01	000	1	15.0	1625.00	3
50803	07	00001000	00	10	000	1	18.6	1944.60	3
50804	04	00001000	00	10	100	1	14.0	1524.09	3
50804	02	00001000	00	01	000	1	11.7	1661.34	3
50805	04	00001000	01	01	000	1	20.2	1918.25	3
55101	09	00001000	00	00	100	16	238.0	27839.29	3
50901	08	00001000	01	00	100	2	67.0	6663.27	3
50902	12	00001000	00	00	100	4	222.6	20633.33	1
50903	13	00001000	00	00	100	4	226.8	17637.62	0
50904	10	00001000	00	00	100	1	19.3	1604.17	3
50905	10	00001000	00	00	100	1	19.3	1769.11	3
50906	10	00001000	00	00	100	2	638.6	3477.40	3
50907	11	00001000	01	00	000	24	621.5	60893.97	3
50908	12	00001000	01	00	000	12	410.7	41605.27	3
50909	11	00001000	00	00	100	1	41.9	4142.86	3
50910	09	00001000	00	10	000	1	18.0	2026.71	3
50911	09	00001000	00	10	000	1	18.0	2029.19	3
51001	09	00001000	01	01	000	2	32.6	3565.79	3
51002	10	00001000	01	01	000	2	33.7	7031.29	3

A	B	C	D	E	F	G	H	I	J
51003	71	00001000	00	01	000	1	41.9	3734.38	3
51004	71	00001000	01	01	000	2	33.7	7694.20	3
51005	72	00001000	00	01	100	9	498.6	41795.70	3
51006	71	00001000	00	01	000	3	125.6	11383.93	3
51007	73	00001000	00	01	000	5	318.8	32443.61	0
51008	71	00001000	01	00	000	3	46.8	-9.00	3
51009	69	00001000	01	00	000	1	18.6	2031.10	3
31301	67	00100000	10	00	000	1	32.0	6502.76	3
31302	71	00100000	01	10	000	8	152.0	15130.40	3
31303	70	00100000	01	10	100	16	297.1	27261.92	3
31304	63	00100000	01	10	100	12	207.6	21617.05	3
31305	71	00100000	01	10	100	16	304.0	29086.17	3
31306	63	00100000	01	10	100	8	304.0	33291.35	3
31307	69	00100000	01	10	100	3	147.4	13703.83	3
31308	69	00100000	01	10	100	6	132.9	12601.43	3
31309	70	00100000	01	10	100	3	149.7	14183.35	3
31310	63	00100000	00	10	100	4	152.0	13795.17	3
31311	70	00100000	00	00	100	4	70.2	7142.03	2
31312	70	00100000	00	00	100	4	95.2	11249.42	2
31313	67	00100000	00	00	100	1	15.0	1628.73	0
31314	70	00100000	01	00	100	4	67.8	6953.81	3
31315	67	00100000	00	00	100	1	29.6	4470.99	3
31401	63	00100000	00	01	000	1	15.3	1969.47	3
31402	63	00100000	00	01	000	1	15.3	1922.39	3
31403	63	00100000	00	01	000	1	15.3	1917.30	3
31404	63	00100000	01	00	100	1	33.9	3959.29	3
31405	67	00100000	01	00	100	3	52.2	6262.43	3
31406	72	00100000	00	00	000	2	102.0	7260.45	1
31407	63	00100000	00	00	000	6	104.0	10743.00	3
31408	71	00100000	01	01	100	1	53.1	5861.92	3
31409	64	00100000	10	10	100	2	22.2	3227.61	3
41501	70	00010000	01	00	100	4	67.8	-9.00	3
41502	63	00010000	10	00	100	4	67.8	6316.79	3
41503	67	00010000	01	00	100	8	124.0	14130.53	3
41506	69	00010000	01	10	000	2	38.0	3942.72	3
41601	73	00010000	01	10	100	1	65.5	5005.30	0
41602	69	00010000	10	00	100	1	17.7	2126.49	3
41603	70	00010000	01	00	000	1	16.3	1745.96	3
41604	72	00010000	01	00	010	2	53.3	5011.79	1
61701	70	00000100	01	10	100	3	63.0	5315.13	2
61702	66	00000100	10	00	100	1	16.3	1932.40	3
61703	69	00000100	10	00	100	1	18.0	1840.91	3
71801	71	00000010	01	00	010	1	22.8	1959.82	3
11901	70	10000000	00	00	000	2	35.1	3560.33	3
52001	67	00001000	00	10	100	1	16.0	2059.56	3
52002	69	00001000	10	10	100	8	144.0	14551.44	3
52003	72	00001000	00	10	100	4	212.5	23855.91	1
52004	70	00001000	00	10	100	4	72.0	7943.22	3
52005	67	00001000	00	10	100	1	16.0	2127.42	3
52006	69	00001000	00	00	100	1	121.5	15019.14	3

	A	B	C	D	E	F	G	H	I	J
52007	68	00001000	00	10	000	1	18.6	1946.43	3	
52008	67	00001000	00	00	100	1	16.2	2091.41	3	
52009	67	00001000	00	00	100	1	16.2	2139.89	3	
12101	69	10000000	00	00	100	2	28.4	2765.55	3	
12102	70	10000000	00	00	100	3	42.6	4499.71	3	
12103	68	10000000	00	00	100	1	18.6	2390.56	3	
12104	59	10000000	00	00	100	1	14.2	1468.90	3	
12105	71	10000000	00	00	100	2	46.6	3939.73	1	
12106	70	10000000	00	10	100	2	42.4	4024.33	3	
12107	71	10000000	00	10	100	2	39.1	3811.38	3	
12108	69	10000000	00	01	100	1	18.6	1922.25	3	
12109	67	10000000	00	01	100	1	16.0	2070.64	3	
12110	69	10000000	00	01	100	4	72.0	6511.95	3	
12111	68	10000000	00	01	100	1	18.6	1948.98	3	
12112	69	10000000	00	01	100	1	16.6	1912.68	3	
32201	68	00100000	00	00	100	1	20.6	2189.57	3	
32202	69	00100000	10	00	100	2	35.0	3844.83	3	
32203	69	00100000	10	00	100	1	25.0	2274.46	3	
32204	68	00100000	10	00	100	1	20.6	2141.22	3	
32205	68	00100000	00	00	100	1	20.6	2109.41	3	
32206	68	00100000	00	10	100	4	64.0	5921.54	3	
32207	68	00100000	01	10	100	1	13.6	2402.04	3	
32208	68	00100000	00	10	100	4	64.0	6067.05	3	
42301	67	00010000	00	01	000	2	36.0	4436.46	3	
42302	69	00010000	01	01	000	4	72.0	7495.23	3	
42303	72	00010000	00	01	000	6	326.4	30835.32	1	
42304	70	00010000	01	01	000	4	72.0	7098.15	3	
42305	65	00010000	01	01	000	3	48.5	7064.05	3	
62401	70	00000100	01	00	100	1	41.9	3741.60	3	
62402	67	00000100	10	00	000	2	33.2	6023.55	3	
62403	71	00000100	01	00	100	1	41.9	4081.47	3	
42501	72	00010000	00	10	100	2	100.8	9137.19	1	
42502	67	00010000	10	00	000	1	28.8	3455.80	3	
42503	73	00010000	00	10	100	1	45.5	3945.97	0	
42701	73	00010000	00	00	100	1	36.1	4872.88	0	
42702	73	00010000	00	00	100	1	38.1	4978.81	0	
42703	73	00010000	00	00	100	1	36.7	4661.02	0	
42704	72	00010000	01	00	100	2	110.8	10142.55	3	
62801	73	00000001	10	10	000	1	65.5	5361.70	0	
62802	70	00000001	10	00	100	1	16.3	1918.40	3	
12901	69	10000000	00	00	000	2	37.2	3714.81	3	
12902	69	10000000	00	00	000	1	13.0	1889.95	3	
12903	70	10000000	01	00	100	1	21.3	2028.97	3	
12904	68	10000000	00	00	000	1	16.6	1892.65	3	
23001	67	01000000	01	00	001	1	18.6	2393.35	3	
23002	69	01000000	00	00	010	3	55.8	6647.13	3	
23003	70	01000000	01	00	100	4	95.2	16609.50	3	
23004	71	01000000	00	00	100	8	156.8	15422.99	3	
23005	72	01000000	00	00	100	4	212.4	22910.75	0	
23006	72	01000000	00	00	100	4	212.4	22826.68	1	

	A	B	C	D	E	F	G	H	I	J
23007	70	01000000	00	10	100	2	42.5	4205.10	3	
23008	67	01000000	10	10	100	1	18.6	2012.12	3	
23009	71	01000000	01	10	100	3	502.2	40474.33	3	
23010	67	01000000	01	00	100	1	115.2	10370.12	3	
23011	67	01000000	01	00	100	1	115.2	15030.70	2	
23012	69	01000000	00	10	100	1	18.6	1759.57	3	
23013	65	01000000	01	00	100	1	115.2	15007.30	3	
23014	63	00000001	10	00	100	1	11.5	1657.74	3	
23015	70	01000000	00	00	100	1	21.3	1910.09	3	
23016	69	01000000	01	00	100	1	21.3	1909.23	3	
23017	70	01000000	00	00	100	1	16.3	-9.00	3	
23018	69	01000000	00	00	100	2	34.2	5053.03	3	
23019	71	01000000	00	01	100	32	600.0	-9.00	3	
23020	69	01000000	00	00	100	1	16.6	3290.67	3	
23021	69	01000000	00	00	000	2	20.0	4450.02	3	
23022	72	01000000	01	01	100	32	393.1	-9.00	1	
23023	63	01000000	00	00	100	2	37.2	6051.02	3	
23024	63	01000000	00	00	000	1	19.0	2794.64	3	
23025	70	01000000	00	10	001	1	21.3	2101.92	3	
23026	67	01000000	00	10	100	1	16.0	2236.04	3	
23027	67	01000000	00	10	100	1	16.0	1903.33	3	
23028	71	01000000	00	10	100	1	52.9	4400.94	3	
23029	63	01000000	00	10	100	1	11.5	1800.12	3	
23030	64	01000000	00	10	100	1	14.0	1751.02	3	
23031	70	01000000	00	00	100	4	155.6	13316.07	3	
23032	71	01000000	01	00	100	5	105.6	12159.44	2	
23033	69	01000000	00	00	100	1	19.0	2172.25	3	
23034	69	01000000	01	00	100	1	19.0	1949.76	3	
23035	72	01000000	00	00	100	2	53.2	4176.34	1	
23036	71	01000000	10	00	100	1	23.4	1742.19	3	
23037	72	01000000	00	00	100	1	53.1	5294.62	1	
23038	72	01000000	00	00	100	1	53.1	5721.74	1	
23039	67	01000000	00	00	100	4	64.0	6120.50	3	
23040	69	01000000	00	00	100	2	37.2	3723.63	3	
23041	67	01000000	00	00	100	4	64.0	6103.08	3	
23042	67	01000000	00	00	100	2	32.0	3484.76	3	
23043	67	01000000	00	00	100	2	32.0	3059.23	3	
23044	69	01000000	00	00	100	1	18.6	2094.50	3	
23045	71	01000000	00	00	100	4	94.3	-9.00	3	
23046	70	01000000	00	00	100	1	29.3	5749.71	3	
23047	71	01000000	00	00	100	2	47.2	-9.00	3	
23048	69	01000000	00	00	100	2	37.2	3745.22	3	
23049	67	01000000	00	00	100	2	32.0	3459.03	3	
23050	69	01000000	00	01	100	3	55.8	5777.51	3	
23051	70	01000000	00	01	100	4	77.1	7771.63	3	
23052	70	01000000	00	01	100	3	63.8	6345.31	3	
23053	70	01000000	00	01	100	3	63.8	6171.49	3	
23054	71	01000000	00	01	100	2	95.9	-9.00	3	
23055	71	01000000	01	00	100	10	190.0	-9.00	3	
23056	63	00000100	01	00	100	3	90.0	-9.00	3	

A	B	C	D	E	F	G	H	I	J
54003	09	00001000	01	00	100	2	10.0	3351.67	3
54004	02	00001000	01	01	100	3	35.0	5909.10	3
54005	03	00001000	01	01	100	1	10.5	1075.00	3
54006	09	00001000	01	01	100	2	39.2	4443.78	3
54007	01	00001000	10	01	100	1	11.2	1638.18	3
54008	08	00001000	00	01	100	1	16.1	1869.90	1
54009	72	00001000	01	01	100	2	00.0	-9.00	1
44101	01	00000000	01	00	010	1	12.5	2799.04	1
53301	71	00001000	00	00	000	4	70.0	6246.65	3
53302	09	00001000	00	00	000	4	72.0	7017.94	3
53303	08	00001000	00	00	000	1	16.3	1937.50	3
53304	08	00001000	00	00	000	1	16.3	1923.47	3
53305	08	00001000	01	00	000	1	16.3	2000.38	2
53306	09	00001000	01	00	000	3	91.3	7082.72	2
53307	71	00001000	01	00	000	4	175.7	13699.83	3
53308	71	00001000	00	00	100	2	47.6	-9.00	3
33501	72	00100000	00	00	000	4	221.6	21384.78	1
33502	00	00100000	00	00	100	1	18.6	2000.00	3
33503	03	00100000	01	00	010	1	32.0	3643.77	3
33504	70	00100000	01	00	010	7	126.0	13024.94	3
33505	73	00100000	00	00	000	2	50.2	5080.51	0
33506	72	00100000	00	00	000	2	70.0	6719.19	1
33507	72	00100000	00	00	000	1	35.0	2798.50	1
33508	73	00100000	00	00	000	2	139.4	13221.40	0
33509	07	00100000	00	10	000	1	16.0	1838.40	3
33510	00	00100000	01	10	000	3	45.0	5005.72	3
33511	08	00100000	00	10	000	1	19.0	2010.19	3
73601	05	00000010	10	00	100	4	60.0	6253.28	3
23801	71	01000000	00	00	100	1	19.6	2092.63	3
23802	71	01000000	00	00	100	3	58.8	5672.99	3
23803	72	01000000	00	00	100	2	53.2	4240.86	1
23804	71	01000000	00	00	100	1	19.6	1952.01	3
23805	72	01000000	00	00	100	1	19.6	2246.24	1
64201	71	00000100	01	00	100	16	382.4	30022.32	0
64202	72	00000100	01	00	100	20	620.8	58947.05	1
74301	05	00000010	10	00	000	6	90.0	-9.00	3
74302	07	00000010	10	00	000	1	16.3	-9.00	3
74303	07	00000010	10	00	000	1	16.3	-9.00	3
74304	07	00000010	10	00	000	1	16.3	-9.00	3
74305	03	00000010	01	01	000	2	22.5	-9.00	3
74306	03	00000010	10	00	000	3	49.0	5267.86	3
74307	05	00000010	10	00	010	1	13.3	1205.84	3
74308	05	00000010	10	00	000	1	32.6	4459.85	3
84401	71	00000000	01	10	000	1	16.0	3423.94	3
14501	71	10000000	00	00	100	1	24.0	2867.19	3
14502	01	10000000	00	10	100	1	13.2	1857.30	3
14503	72	10000000	00	10	100	1	48.6	3364.52	1
14504	05	10000000	00	10	100	1	17.0	1518.98	3
54601	72	00001000	00	10	100	1	27.0	-9.00	1
54602	71	00001000	00	00	100	4	32.8	-9.00	3

A	B	C	D	E	F	G	H	I	J
54603	71	00001000	00	00	100	4	82.8	-9.00	3
54604	63	00001000	00	00	100	6	96.0	-9.00	3
54801	67	00001000	00	00	000	1	18.6	2657.89	3
34901	69	00100000	10	00	001	1	21.2	2162.29	3
34902	64	00100000	01	00	000	1	13.5	2247.45	3
34903	68	00100000	01	00	100	2	36.0	3917.30	3
34904	69	00100000	00	00	100	1	19.6	2365.16	3
34905	63	00100000	01	00	100	1	19.6	2461.63	3
34906	67	00100000	10	00	100	1	57.5	3431.93	3
34907	68	00100000	10	00	100	1	13.0	1709.65	3
34908	73	00100000	01	00	010	2	102.0	9641.95	0
34909	71	00100000	01	00	100	1	46.5	3879.73	3
34910	72	00100000	01	00	100	2	83.7	7449.09	0
34911	71	00100000	01	00	100	1	41.9	3847.44	2
34912	69	00100000	01	00	100	1	21.5	2113.37	2

OPERATION AND MAINTENANCE - GAS TURBINES

Column A - Five-digit identification code

The first digit identifies the plant by the Census Region in which it is located.

The second and third digits are the state identification code. The state codes are numerically sequenced 01 to 50 and correspond to an alphabetical listing of the states. Code #51 indicates the District of Columbia.

The final two digits denote the specific plant within a state.

Column B - Two-digit vintage code

Year in which the plant observed was brought into initial operation.

Column C - Eight-digit region code

Regional code constructed for analytical purposes. This code for the nine Census Regions is as follows:

Region 1	1	0	0	0	0	0	0	0
Region 2	0	1	0	0	0	0	0	0
Region 3	0	0	1	0	0	0	0	0
Region 4	0	0	0	1	0	0	0	0
Region 5	0	0	0	0	1	0	0	0
Region 6	0	0	0	0	0	1	0	0
Region 7	0	0	0	0	0	0	1	0
Region 8	0	0	0	0	0	0	0	1
Region 9	0	0	0	0	0	0	0	0

Column D - Two-digit fuel type code

Identifies the types of fuel for which the turbine was designed.

Oil	0	0
Gas	1	0
Mixed	0	1

Column E - Two-digit building code

Indicates the plant's construction type.

Conventional	0	0
Outdoor	1	0
Other	0	1

Column F - Three-digit operating code

Indicates the four different types of operation possible in gas turbine plants.

Semi-Automatic	0	0	0
Automatic	1	0	0
Manual	0	1	0
Other	0	0	1

Column G - Contains the number of gas turbine units installed at the plants observed.

Column H - Indicates the total capacity of the plant in megawatts; the sum of the capacity of all units.

Column I - Construction cost in $$(x 10^3)$. The cost has been adjusted to a base year of 1975.

Column J - Internal code used for programming purposes only; indicates the number of years in which the plant was observed.

Column K - Net generation, in kWh $(x 10^6)$, of the plant in the year observed.

Column L - Total Btu's $(x 10^9)$ of oil consumed by the plant in the year observed.

Column M - Total Btu's $(x 10^9)$ of gas consumed by the plant in the year observed.

Column N - Operating expense, in $$(x 10^3)$, of the plant for the observation year.

Column O - Annual maintenance expense, in $$(x 10^3)$, of the plant for the observation year.

Column P - Year in which observation was made.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
60101	72	00000100	00	00	100	2	59.5	6732.26	1	66.1	1071.26	0.	21	46	73
60102	69	00000100	00	00	100	2	47.6	5493.80	3	44.7	794.13	0.	45	13	73
60104	72	00000100	00	00	100	0	476.0	43294.62	1	115.7	1554.35	0.	79	70	73
80301	72	00000001	00	00	100	1	23.6	2161.46	1	5.1	76.12	0.	2	10	73
80306	70	00000001	01	10	100	4	75.6	6980.51	3	15.1	75.31	184.23	2	44	73
80307	70	00000001	01	10	100	1	18.9	1308.53	3	5.1	5.34	76.35	1	15	73
90502	63	00000000	00	10	100	1	13.0	2162.20	3	2.5	45.87	0.	19	15	73
90503	68	00000000	01	10	100	1	18.0	2011.43	3	17.0	6.47	304.00	15	16	73
90504	68	00000000	01	10	100	1	18.0	2045.80	3	7.5	5.88	123.62	14	63	73
90505	72	00000000	01	10	100	2	39.1	4203.86	1	78.7	46.80	1246.36	27	45	73
90506	69	00000000	01	10	100	1	13.0	2053.70	3	121.8	72.91	2019.99	14	95	73
90507	72	00000000	00	10	100	2	39.1	4193.13	1	6.4	121.13	0.	26	31	73
90508	66	00000000	00	10	100	1	13.6	2363.77	3	0.0	4.50	0.	13	85	73
90509	67	00000000	01	00	000	1	16.3	3617.40	3	78.5	361.73	1442.18	93	50	73
10701	69	10000000	00	10	100	1	16.6	2084.93	3	11.5	168.97	0.	3	95	73
10702	69	10000000	00	10	100	3	63.8	6355.26	3	20.8	412.78	0.	1	219	73
10703	66	10000000	00	10	100	1	16.3	2104.73	3	5.3	92.90	0.	17	9	73
10704	69	10000000	00	10	100	1	18.6	1982.06	3	10.6	161.03	0.	4	10	73
10705	66	10000000	00	10	100	1	16.3	2297.57	3	4.6	86.44	0.	8	51	73
10706	68	10000000	00	10	100	1	16.0	2056.12	3	6.2	100.55	0.	4	39	73
10707	68	10000000	00	10	100	1	18.6	2202.81	3	13.1	195.62	0.	11	10	73
10708	66	10000000	00	10	100	1	18.6	2174.54	3	8.4	121.20	0.	17	46	73
10709	67	10000000	00	00	100	1	18.6	2362.88	3	6.1	91.38	0.	0	17	73
50801	63	00001000	00	01	000	1	18.6	1955.35	3	15.4	222.79	0.	2	19	73
50802	63	00001000	01	01	000	1	15.0	1625.00	3	6.9	107.60	0.	0	25	73
50803	67	00001000	00	10	000	1	18.6	1944.60	3	13.4	191.33	0.	0	29	73
50804	64	00001000	00	10	100	1	14.0	1524.09	3	4.5	76.60	0.	1	4	73
50804	62	00001000	00	01	000	1	11.7	1631.34	3	3.5	65.27	0.	0	24	73
50805	64	00001000	01	01	000	1	20.2	1918.25	3	16.0	225.97	0.	1	12	73
50901	63	00001000	00	00	100	16	288.0	27839.29	3	86.4	1464.57	0.	8	230	73
50901	68	00001000	01	00	100	2	67.6	6663.27	3	75.4	163.13	1131.45	7	306	73
50902	72	00001000	00	00	100	4	222.8	20633.33	1	353.2	4698.08	0.	34	107	73
50904	70	00001000	00	00	100	1	19.3	1804.17	3	15.8	265.34	0.	1	9	73
50905	70	00001000	00	00	100	1	19.3	1789.11	3	14.3	249.52	0.	0	10	73
50906	70	00001000	00	00	100	2	38.6	3477.40	3	32.9	634.90	0.	3	43	73
50907	71	00001000	01	00	000	24	821.5	80893.97	3	642.7	1523.50	8927.30	338	3183	73
50908	71	00001000	01	00	000	12	410.7	41685.27	3	299.9	1683.40	2960.20	171	2141	73
50909	71	00001000	00	00	100	1	41.9	4142.86	3	45.0	635.54	0.	16	170	73
50910	69	00001000	00	10	000	1	18.0	2026.71	3	2.4	41.18	0.	2	16	73
50911	69	00001000	00	10	000	1	18.0	2129.19	3	2.3	37.70	0.	3	75	73
51001	69	00001000	01	01	000	2	32.6	3565.79	3	45.3	135.95	649.81	12	393	73
51002	70	00001000	01	01	000	2	83.7	7031.29	3	117.5	19.42	1924.45	27	485	73
51003	71	00001000	00	01	000	1	41.9	3734.30	3	41.2	525.50	0.	21	73	73
51004	71	00001000	01	01	000	2	83.7	7694.20	3	118.4	33.99	1556.74	28	276	73
51005	72	00001000	00	01	100	9	493.6	41795.70	3	560.9	6903.52	0.	49	94	73
51006	71	00001000	00	01	000	3	125.6	11333.93	3	130.7	2510.42	0.	16	456	73
51008	71	00001000	01	00	000	3	46.8	-9.00	3	56.9	314.17	700.34	14	14	73
51009	69	00001000	01	00	000	1	18.6	2031.10	3	6.0	84.48	2.37	11	8	73
31301	67	00100000	10	00	000	1	32.0	6502.76	3	1.5	0.	27.87	3	44	73
31302	71	00100000	01	10	000	8	152.0	15160.40	3	259.9	1388.91	2677.62	54	439	73

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
31303	70	00100000	01	10	100	10	297.1	27261.92	3	325.9	5219.90	152.42	63	1052	73
31304	68	00100000	01	10	100	12	207.6	21617.05	3	260.0	3849.60	464.00	125	297	73
31305	71	00100000	01	10	100	16	304.0	29026.17	3	420.7	2593.89	4470.73	102	461	73
31306	68	00100000	01	10	100	6	304.0	33291.35	3	150.5	2199.25	286.46	100	120	73
31307	69	00100000	01	10	100	6	147.4	13703.43	3	137.2	1856.60	212.92	105	365	73
31308	69	00100000	01	10	100	6	132.9	12601.43	3	179.8	431.85	2195.30	105	365	73
31309	70	00100000	01	10	100	6	149.7	14188.35	3	124.4	1945.05	4.54	62	337	73
31310	68	00100000	00	10	100	4	152.0	13795.17	3	48.6	1763.83	0.	22	470	73
31314	70	00100000	01	00	100	4	67.8	6953.81	3	28.2	178.19	276.69	2	46	73
31315	67	00100000	00	00	100	1	29.6	4470.99	3	2.1	46.55	0.	1	09	73
31401	68	00100000	00	01	000	1	15.3	1969.47	3	0.0	92.59	0.	4	18	73
31402	68	00100000	00	01	000	1	15.3	1822.39	3	0.5	124.59	0.	4	9	73
31403	68	00100000	00	01	000	1	15.3	1917.30	3	22.1	32.54	0.	4	20	73
31404	68	00100000	01	00	100	1	33.9	3959.29	3	37.9	46.12	502.00	26	373	73
31405	67	00100000	01	00	100	3	52.2	6262.43	3	114.9	80.56	1685.50	52	63	73
31406	72	00100000	00	00	000	2	102.0	7260.45	1	13.2	10187.58	0.	4	40	73
31407	68	00100000	00	00	000	6	104.0	10743.00	3	7.9	150.18	0.	4	140	73
31408	71	00100000	01	01	100	1	53.1	5861.92	3	86.9	59.62	1285.04	8	24	73
31409	64	00100000	10	10	100	2	22.2	3227.61	3	7.2	0.	137.94	1	8	73
41501	70	00010000	01	00	100	4	67.8	-9.00	3	23.4	207.70	176.11	8	31	73
41502	68	00010000	10	00	100	4	67.8	6316.79	3	30.4	0.	505.16	3	12	73
41503	67	00010000	01	00	100	8	124.0	14130.53	3	61.6	61.14	947.45	16	148	73
41505	69	00010000	01	10	000	2	36.0	3942.72	3	12.7	70.25	118.13	6	18	73
41602	69	00010000	10	00	100	1	17.7	2126.19	3	3.5	0.	71.39	1	7	73
41603	72	00010000	01	00	000	1	16.3	1745.96	3	12.4	11.59	199.59	2	7	73
41604	72	00010000	01	00	010	2	53.3	5011.79	1	111.7	419.63	977.03	50	33	73
61702	68	00000100	10	00	100	1	16.3	1932.40	3	1.0	0.	12.40	18	2	73
61703	69	00000100	10	00	100	1	18.0	1840.91	3	1.3	0.	20.40	3	3	73
71801	71	00000010	01	00	010	1	22.8	1959.82	3	64.8	9.85	1010.05	7	20	73
11901	70	10000000	00	00	000	2	35.1	13560.83	3	20.8	332.58	0.	8	9	73
52001	67	00001000	10	10	100	8	144.0	14551.44	3	423.1	0.	6490.02	90	642	73
52003	72	00001000	00	10	100	4	212.5	23855.91	1	207.9	2955.90	0.	84	666	73
52004	70	00001000	00	10	100	4	72.0	7943.22	3	63.9	1076.37	0.	41	38	73
52005	67	00001000	00	10	100	1	16.0	2127.42	3	14.9	243.17	0.	21	10	73
52006	69	00001000	00	00	100	1	121.5	15019.14	3	34.7	565.33	3.65	78	18	73
52007	68	00001000	00	10	000	1	16.6	1946.43	3	12.1	169.48	0.	6	155	73
52008	67	00001000	00	00	100	1	16.2	2091.41	3	4.9	75.62	0.	1	196	73
52009	67	00001000	00	00	100	1	16.2	2091.41	3	4.9	75.62	0.	1	196	73
52010	69	00001000	00	00	100	1	16.2	2091.41	3	4.9	75.62	0.	1	196	73
12101	69	10000000	00	00	100	1	16.2	2765.55	3	5.5	103.36	0.	2	40	73
12102	70	10000000	00	00	100	3	42.6	4499.71	3	10.4	175.11	0.	22	46	73
12103	66	10000000	00	00	100	1	16.6	2390.56	3	6.7	94.23	0.	12	12	73
12104	69	10000000	00	00	100	1	14.2	1468.90	3	3.8	62.35	0.	2	12	73
12105	71	10000000	00	00	100	2	46.6	3939.73	1	25.0	350.91	0.	0	139	73
12106	70	10000000	00	10	100	2	42.4	4024.33	3	30.5	414.08	0.	8	18	73
12107	71	10000000	00	10	100	2	39.1	3811.33	3	28.1	407.07	0.	11	103	73
12108	69	10000000	00	01	100	1	18.6	1922.25	3	13.5	187.32	0.	1	17	73
12109	67	10000000	00	01	100	1	16.0	2070.64	3	19.0	146.94	0.	1	8	73
12110	69	10000000	00	01	100	4	72.0	6511.95	3	35.2	624.02	0.	1	37	73
12111	68	10000000	00	01	100	1	18.6	1946.94	3	7.5	113.31	0.	1	216	73

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
12112	69	10000000	00	01	100	1	18.6	1912.63	3	12.8	143.38	0.	1	18	73
32201	63	00100000	00	00	100	1	20.6	2189.57	3	24.2	346.63	0.	12	18	73
32202	69	00100000	10	00	100	2	35.0	3844.93	3	85.3	0.	1388.97	3	26	73
32203	69	00100000	10	00	100	1	25.0	2274.46	3	62.4	0.	1062.76	24	150	73
32204	63	00100000	10	00	100	1	20.6	2141.22	3	27.6	0.	389.04	10	22	73
32205	68	00100000	00	00	100	1	20.6	2109.41	3	27.9	392.88	0.	12	144	73
32206	65	00100000	00	10	100	4	64.0	5921.54	3	45.1	768.73	0.	18	232	73
32207	68	00100000	01	10	100	1	18.6	2402.04	3	11.5	172.04	1.01	1	31	73
32208	65	00100000	00	10	100	4	64.0	6067.05	3	40.8	706.59	0.	9	216	73
42301	67	00010000	00	01	000	2	36.0	4436.46	3	4.6	96.95	0.	27	53	73
42302	69	00010000	01	01	000	4	72.0	7495.23	3	124.9	255.89	1752.98	58	115	73
42303	72	00010000	00	01	000	6	326.4	30945.32	1	312.0	4140.23	0.	287	163	73
42304	70	00010000	01	01	000	4	72.0	7098.15	3	132.0	281.55	1949.80	55	201	73
42305	65	00010000	01	01	000	3	48.5	7064.05	3	56.3	149.69	704.61	41	385	73
62401	70	00000100	01	00	100	1	41.9	3741.60	3	32.0	25.38	479.80	25	60	73
62402	67	00000100	10	00	000	2	33.2	6023.55	3	252.3	0.	4011.73	63	27	73
62403	71	00000100	01	00	100	1	41.9	4081.47	3	35.0	290.85	225.94	26	34	73
42501	72	00010000	00	10	100	2	100.8	9137.19	1	47.4	601.41	0.	3	24	73
42502	67	00010000	10	00	000	1	28.8	3455.80	3	41.4	0.	658.51	3	18	73
42704	72	00010000	01	00	100	2	110.8	10142.55	3	77.1	71.34	969.58	45	75	73
82802	70	00000001	10	00	100	1	16.3	1988.40	3	42.4	0.	669.49	9	9	73
12901	69	10000000	00	00	000	2	37.2	3714.81	3	47.3	242.77	0.	6	100	73
12902	69	10000000	00	00	000	1	18.0	1839.95	3	10.5	174.80	0.	17	18	73
12903	70	10000000	01	00	100	1	21.3	2028.97	3	16.2	63.36	151.60	14	48	73
12904	68	10000000	00	00	000	1	18.6	1892.85	3	11.4	159.91	0.	13	117	73
23001	67	01000000	01	00	001	1	18.6	2393.35	3	16.7	15.81	247.82	10	25	73
23002	69	01000000	00	00	010	3	55.8	6647.13	3	19.8	287.69	0.	55	46	73
23003	70	01000000	01	00	100	4	95.2	10609.50	3	169.9	1921.61	712.04	46	660	73
23004	71	01000000	00	00	100	8	156.8	15422.99	3	324.3	4585.15	0.	65	263	73
23006	72	01000000	00	00	100	4	212.4	22826.88	1	453.7	6484.75	0.	21	332	73
23007	70	01000000	00	10	100	2	42.5	4205.10	3	21.0	291.53	0.	30	78	73
23008	67	01000000	10	10	100	1	18.6	2612.19	3	14.2	9.81	257.96	13	42	73
23009	71	01000000	01	10	100	3	502.2	48474.33	3	355.5	5053.49	90.01	233	2713	73
23010	67	01000000	01	00	100	1	115.2	18376.12	3	28.5	436.04	3.72	39	312	73
23012	69	01000000	00	10	100	1	18.6	1759.57	3	16.3	89.31	0.	8	20	73
23013	65	01000000	01	00	100	1	115.2	15807.30	3	32.8	586.30	21.82	27	644	73
83101	63	00000001	10	00	100	1	11.5	1657.74	3	5.8	0.	104.70	1	3	73
23201	70	01000000	00	00	100	1	21.3	1918.89	3	14.6	205.42	0.	9	121	73
23202	69	01000000	01	00	100	1	21.3	1989.23	3	27.6	14.39	361.89	7	35	73
23203	70	01000000	00	00	100	1	16.3	-9.00	3	16.2	286.31	0.	15	76	73
23204	69	01000000	00	00	100	2	34.2	5053.83	3	25.8	409.99	0.	19	112	73
23205	71	01000000	00	01	100	32	688.0	-9.00	3	1075.1	16288.42	0.	936	1693	73
23206	69	01000000	00	00	100	1	18.6	3290.67	3	16.3	299.95	0.	29	104	73
23207	69	01000000	00	00	000	2	23.0	4458.02	3	15.2	273.35	0.	33	108	73
23208	72	01000000	01	01	100	32	393.1	-9.00	1	723.9	10275.71	1587.13	404	410	73
23209	68	01000000	00	00	100	2	37.2	6051.02	3	34.0	523.85	0.	21	55	73
23210	63	01000000	00	00	000	1	19.0	2794.64	3	0.4	5.61	0.	1	116	73
23211	70	01000000	00	10	001	1	21.3	2181.92	3	16.4	246.23	0.	20	29	73
23212	67	01000000	00	10	100	1	16.0	2236.84	3	7.4	141.79	0.	8	74	73
23213	67	01000000	00	10	100	1	16.0	1983.33	3	7.5	130.71	0.	8	22	73

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
23214	71	01000000	00	10	100	1	52.0	4400.94	3	34.2	459.78	0.	35	88	73	
23215	63	01000000	00	10	100	1	11.5	1800.12	3	4.9	95.32	0.	12	56	73	
23216	64	01000000	00	10	100	1	14.0	1751.82	3	6.1	109.94	0.	13	45	73	
23217	70	01000000	00	00	100	4	155.6	1316.07	3	51.9	785.21	0.	35	010	73	
23219	69	01000000	00	00	100	1	19.0	2172.25	3	4.1	60.80	0.	0	8	73	
23220	69	01000000	01	00	100	1	19.0	1949.76	3	4.7	70.00	73.24	0	4	73	
23806	72	01000000	00	00	100	2	53.2	4170.34	1	43.6	621.32	0.	26	43	73	
23807	71	01000000	10	00	100	1	23.4	1742.19	3	54.3	0.	783.30	4	153	73	
23808	72	01000000	00	00	100	1	53.1	5294.62	1	47.5	662.83	0.	20	210	73	
23809	72	01000000	00	00	100	1	53.1	5721.74	1	54.7	754.93	0.	61	428	73	
23810	67	01000000	00	00	100	4	64.0	6120.50	3	41.5	644.45	0.	22	170	73	
23811	69	01000000	00	00	100	2	37.2	3723.68	3	15.4	228.76	0.	9	16	73	
23812	67	01000000	00	00	100	4	64.0	6103.80	3	37.6	588.04	0.	5	51	73	
23813	67	01000000	00	00	100	2	32.0	3404.76	3	7.6	115.24	0.	4	151	73	
23814	67	01000000	00	00	100	2	32.0	3659.23	3	13.8	223.76	0.	8	96	73	
23815	69	01000000	00	00	100	1	18.6	2094.50	3	1.8	27.21	0.	4	105	73	
23816	71	01000000	00	00	100	4	94.3	-9.00	3	85.2	1227.11	0.	10	156	73	
23817	70	01000000	00	00	100	1	29.3	5749.71	3	6.1	97.76	0.	19	10	73	
23818	71	01000000	00	00	100	2	47.2	-9.00	3	28.2	386.07	0.	1	24	73	
23819	69	01000000	00	00	100	2	37.2	3745.22	3	17.1	210.12	0.	12	74	73	
23820	67	01000000	00	00	100	2	32.0	3459.83	3	16.9	253.68	0.	7	32	73	
23821	69	01000000	00	01	100	3	55.8	5777.51	3	15.2	214.35	0.	23	165	73	
23822	70	01000000	00	01	100	4	77.1	7771.63	3	24.3	341.71	0.	60	197	73	
23823	70	01000000	00	01	100	3	63.8	6345.31	3	28.0	380.94	0.	3	130	73	
23824	70	01000000	00	01	100	3	63.8	6171.49	3	30.6	505.45	0.	55	326	73	
23825	71	01000000	00	01	100	2	35.9	-9.00	3	19.9	304.18	0.	21	64	73	
54001	71	00001000	01	00	100	10	196.0	-9.00	3	441.6	2322.66	4606.47	99	744	73	
54002	68	00001000	01	00	100	3	90.0	-9.00	3	105.4	708.34	1197.17	15	47	73	
54003	69	00001000	01	00	100	2	40.0	3851.67	3	11.0	194.33	1.13	20	174	73	
54004	62	00001000	01	01	100	3	35.0	5039.10	3	6.1	6.96	133.59	6	17	73	
54005	68	00001000	01	01	100	1	16.5	1875.00	3	2.9	6.96	41.82	4	186	73	
54006	69	00001000	01	01	100	2	39.2	4443.78	3	13.4	5.80	236.80	15	132	73	
54007	61	00001000	10	01	100	1	11.2	1638.18	3	1.3	0.	29.97	4	5	73	
54008	68	00001000	00	01	100	1	16.1	1869.90	1	0.2	5.80	0.	6	5	73	
54009	72	00001000	01	01	100	2	60.0	-9.00	1	38.0	104.91	504.08	6	36	73	
44101	61	00000000	01	00	010	1	12.5	2799.04	1	17.1	18.06	295.60	65	100	73	
53301	71	00001000	00	00	000	4	70.0	6246.65	3	22.6	361.73	0.	18	44	73	
53302	69	00001000	00	00	000	4	72.0	7017.94	3	23.7	402.22	0.	10	18	73	
53303	68	00001000	00	00	000	1	16.3	1937.50	3	1.0	16.17	0.	4	75	73	
53304	63	00001000	00	00	000	1	16.3	1923.47	3	1.2	20.46	0.	7	34	73	
53307	71	00001000	01	00	000	4	176.7	13699.33	3	33.7	484.39	38.67	31	145	73	
53308	71	00001000	00	00	100	2	47.6	-9.00	3	16.8	313.40	0.	3	266	73	
33501	72	00100000	00	00	000	4	221.6	21344.78	1	121.8	1504.64	0.	43	16	73	
33502	66	00100000	00	00	100	1	18.6	2000.00	3	2.2	32.46	0.	10	6	73	
33503	68	00100000	01	00	010	1	32.6	3643.77	3	23.5	373.56	13.27	4	64	73	
33504	70	00100000	01	00	010	7	126.0	13024.94	3	66.3	968.76	19.33	17	326	73	
33506	72	00100000	00	00	000	2	70.0	6719.19	1	47.8	694.95	0.	57	25	73	
33507	72	00100000	00	00	000	1	35.0	2798.50	1	19.9	253.85	0.	38	31	73	
33509	67	00100000	00	10	000	1	16.0	1836.40	3	2.3	39.84	0.	3	15	73	
33510	66	00100000	01	10	000	3	45.0	5005.72	3	14.1	118.30	147.06	10	16	73	

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
33511	68	00100000	00	10	000	1	19.0	2010.19	3	5.3	101.84	0.	3	7	73
73601	65	00000010	10	00	100	4	60.0	6253.28	3	233.5	35.94	4041.60	11	160	73
23801	71	01000000	00	00	100	1	19.6	2092.63	3	18.4	262.88	0.	19	35	73
23802	71	01000000	00	00	100	3	58.8	5672.99	3	56.5	325.93	0.	33	88	73
23803	72	01000000	00	00	100	2	53.2	4240.56	1	48.3	679.02	0.	24	35	73
23804	71	01000000	00	00	100	1	19.6	1952.01	3	17.1	241.67	0.	16	25	73
23805	72	01000000	00	00	100	1	19.6	2246.24	1	28.7	387.15	0.	10	36	73
64202	72	00000100	01	00	100	20	620.8	58947.05	1	138.2	1011.62	946.14	62	137	73
74301	68	00000010	10	00	000	6	96.0	-9.00	3	6.3	0.	115.88	0	14	73
74302	67	00000010	10	00	000	1	16.3	-9.00	3	1.1	0.	24.20	0	4	73
74303	67	00000010	10	00	000	1	16.3	-9.00	3	1.2	0.	24.20	0	154	73
74304	67	00000010	10	00	000	1	16.3	-9.00	3	1.1	0.	23.84	0	8	73
74305	63	00000010	01	01	000	2	22.5	-9.00	3	6.9	20.73	108.68	47	16	73
74306	68	00000010	10	00	000	3	49.0	5267.86	3	37.0	0.	630.82	2	16	73
74307	65	00000010	10	00	010	1	13.3	1295.84	3	100.9	0.	1658.80	34	17	73
74308	65	00000010	10	00	000	1	32.6	4459.85	3	204.4	0.	3541.34	72	153	73
84401	71	00000000	01	10	000	1	16.0	3423.94	3	67.2	298.12	949.35	68	78	73
14501	71	10000000	00	00	100	1	28.0	2867.19	3	9.0	148.05	0.	18	115	73
14502	61	10000000	00	10	100	1	13.2	1857.36	3	5.5	96.16	0.	17	25	73
14503	72	10000000	00	10	100	1	48.6	3364.52	1	42.8	583.37	0.	12	15	73
14504	65	10000000	00	10	100	1	17.0	1818.98	3	6.0	111.80	0.	9	11	73
54601	72	00001000	00	10	100	1	27.0	-9.00	1	23.3	336.01	0.	6	14	73
54602	71	00001000	00	00	100	4	82.8	-9.00	3	68.1	1078.98	0.	9	44	73
54603	71	00001000	00	00	100	4	82.8	-9.00	3	61.7	967.26	0.	4	45	73
54604	68	00001000	00	00	100	6	96.0	-9.00	3	98.5	1661.69	0.	6	68	73
54605	67	00001000	00	00	000	1	16.6	2657.89	3	6.4	97.02	0.	0	12	73
34901	69	00100000	10	00	001	1	21.2	2152.29	3	30.1	0.	519.73	16	11	73
34902	64	00100000	01	00	000	1	13.5	2247.45	3	2.3	2.09	42.46	9	12	73
34903	68	00100000	01	00	100	2	36.0	3917.30	3	24.3	16.18	368.07	12	45	73
34904	69	00100000	00	00	100	1	19.6	2365.16	3	3.1	49.65	0.	20	179	73
34905	68	00100000	01	00	100	1	19.6	2461.83	3	13.3	19.03	193.93	19	40	73
34906	67	00100000	10	00	100	1	57.5	3401.93	3	46.0	0.	874.04	3	14	73
34907	63	00100000	10	00	100	1	18.0	1708.65	3	25.7	0.	365.54	3	7	73
34909	71	00100000	01	00	100	1	46.5	3879.73	3	74.9	171.32	942.99	7	122	73
60102	69	00000100	00	00	100	2	47.6	5496.80	3	52.5	897.77	0.	33	36	72
60103	70	00000100	00	00	000	1	21.3	1879.49	2	29.1	394.36	0.	6	105	72
80305	71	00000001	01	00	100	2	47.2	4147.47	2	19.5	21.16	241.93	11	28	72
80306	70	00000001	01	10	100	4	75.6	6880.51	3	20.9	155.29	199.94	2	13	72
80307	70	00000001	01	10	100	1	18.9	1808.53	3	3.3	26.86	35.19	0	6	72
90502	68	00000000	00	10	100	1	18.0	2162.20	3	1.9	40.57	0.	12	8	72
90503	68	00000000	01	10	100	1	18.0	2011.45	3	7.1	11.76	136.44	10	9	72
90504	68	00000000	01	10	100	1	18.0	2045.80	3	6.0	7.05	111.51	11	10	72
90506	69	00000000	01	10	100	1	18.0	2053.70	3	111.6	143.47	1742.33	6	16	72
90508	66	00000000	00	10	100	1	18.6	2363.77	3	2.9	46.15	0.	9	12	72
90509	67	00000000	01	00	000	1	16.3	3617.40	3	81.2	210.17	1448.82	98	54	72
10701	69	10000000	00	10	100	1	18.6	2084.93	3	19.0	289.74	0.	0	7	72
10702	69	10000000	00	10	100	3	53.8	6335.26	3	48.6	721.23	0.	8	370	72
10703	66	10000000	00	10	100	1	16.3	2108.73	3	7.5	145.32	0.	16	25	72
10704	69	10000000	00	10	100	1	18.6	1932.06	3	16.3	1250.05	0.	0	2	72
10705	66	10000000	00	10	100	1	16.3	2297.57	3	8.6	157.00	0.	7	24	72

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
10706	63	10000000	00	10	100	1	16.0	2055.12	3	14.3	221.09	0.	1	16	72
10707	68	10000000	00	10	100	1	16.6	2202.81	3	17.1	260.02	0.	6	19	72
10708	66	10000000	00	10	100	1	16.6	2174.54	3	7.6	119.45	0.	21	162	72
10709	67	10000000	00	00	100	1	18.6	2362.38	3	7.7	118.24	0.	0	75	72
50801	63	00001000	00	01	000	1	15.6	1955.35	3	10.8	158.23	0.	2	19	72
50802	63	00001000	01	01	000	1	15.0	1625.00	3	9.6	0.	152.85	0	20	72
50803	67	00001000	00	10	000	1	18.6	1944.60	3	10.3	146.83	0.	2	142	72
50804	64	00001000	00	10	100	1	14.0	1524.09	3	4.1	69.95	0.	1	13	72
50804	62	00001000	00	01	000	1	11.7	1631.34	3	3.2	65.27	0.	1	51	72
50805	64	00001000	01	01	000	1	20.2	1918.25	3	12.5	0.	121.03	1	119	72
55101	68	00001000	00	00	100	16	238.0	27839.29	3	91.5	1572.67	0.	1	270	72
50901	68	00001000	01	00	100	2	67.6	5663.21	3	59.7	175.50	810.42	4	40	72
50904	70	00001000	00	00	100	1	19.3	1804.17	3	10.9	186.61	0.	2	9	72
50905	70	00001000	00	00	100	1	19.3	1789.11	3	8.7	142.61	0.	1	6	72
50906	70	00001000	00	00	100	2	38.6	3477.40	3	19.8	371.60	0.	2	32	72
50907	71	00001000	01	00	000	24	821.5	80893.97	3	871.8	6904.72	5280.60	167	566	72
50903	71	00001000	01	00	000	12	410.7	41685.27	3	518.6	5748.34	1808.90	161	384	72
50909	71	00001000	00	00	100	1	41.9	4142.86	3	35.0	498.16	0.	17	74	72
50910	69	00001000	00	10	000	1	18.0	2028.71	3	5.1	94.92	0.	20	20	72
50911	69	00001000	00	10	000	1	18.0	2129.79	3	5.2	93.77	0.	30	11	72
51001	69	00001000	01	01	000	2	32.6	3565.79	3	43.3	269.04	524.56	11	15	72
51002	70	00001000	01	01	000	2	33.7	7031.29	3	69.8	943.62	1.75	14	169	72
51003	71	00001000	00	01	000	1	41.9	3734.38	3	32.2	434.68	0.	8	35	72
51004	71	00001000	01	01	000	2	33.7	7694.20	3	86.2	15.42	1005.37	14	86	72
51005	72	00001000	00	01	100	9	498.6	41795.70	3	175.7	2138.00	0.	31	48	72
51006	71	00001000	00	01	000	3	125.6	11383.93	3	106.5	1446.28	0.	14	70	72
51008	71	00001000	01	00	000	3	46.8	-9.00	3	46.0	429.02	373.53	14	8	72
51009	69	00001000	01	00	000	1	14.6	2031.10	3	7.1	87.73	20.97	12	1	72
31301	67	00100000	10	00	000	1	32.0	6502.76	3	19.6	0.	162.00	3	20	72
31302	71	00100000	01	10	000	8	152.0	15180.40	3	322.4	2534.55	2451.39	44	264	72
31303	70	00100000	01	10	100	16	297.1	27261.92	3	443.2	7191.48	52.43	79	957	72
31304	68	00100000	01	10	100	12	207.6	21617.05	3	299.6	4424.92	344.43	152	786	72
31305	71	00100000	01	10	100	16	304.0	29086.17	3	590.6	5057.74	4333.63	111	450	72
31306	63	00100000	01	10	100	8	304.0	33291.35	3	177.7	2170.30	5.15	107	1350	72
31307	69	00100000	01	10	100	8	147.4	13706.83	3	193.8	2979.23	79.23	26	752	72
31308	69	00100000	01	10	100	6	132.9	12601.43	3	170.3	478.65	1937.71	233	993	72
31309	70	00100000	01	10	100	8	149.7	14188.35	3	168.6	2511.83	1.34	37	105	72
31310	68	00100000	00	10	100	4	152.0	13795.17	3	57.7	886.08	0.	29	451	72
31311	70	00100000	00	00	100	4	70.2	7142.03	2	136.4	1605.79	502.74	15	77	72
31312	70	00100000	00	00	100	4	95.2	11249.42	2	119.7	1485.29	319.40	41	331	72
31314	70	00100000	01	00	100	4	67.8	6953.81	3	92.3	768.93	705.32	3	18	72
31315	67	00100000	00	00	100	1	29.6	4470.99	3	18.4	321.07	0.	1	22	72
31401	68	00100000	00	01	000	1	15.3	1969.47	3	0.4	58.12	0.	6	107	72
31402	68	00100000	00	01	000	1	15.3	1922.39	3	10.6	150.64	0.	6	51	72
31403	63	00100000	00	01	000	1	15.3	1917.30	3	8.4	118.02	0.	7	32	72
31404	68	00100000	01	00	100	1	33.9	3959.29	3	58.0	19.27	903.40	12	55	72
31405	67	00100000	01	00	100	3	52.2	6262.43	3	114.5	129.02	1597.20	26	46	72
31407	68	00100000	00	00	000	6	104.0	10743.00	3	35.5	589.76	0.	7	353	72
31408	71	00100000	01	01	100	1	53.1	5811.92	3	50.3	18.55	682.65	2	72	72
31409	64	00100000	10	10	100	2	22.2	3227.61	3	8.1	0.	152.20	0	13	72

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
41501	70	00010000	01	00	100	4	67.8	-9.00	3	53.7	339.04	511.94	5	33	72
41502	68	00010000	10	00	100	4	67.8	5316.79	3	60.2	0.	971.57	3	33	72
41503	67	00010000	01	00	100	3	124.0	14130.51	3	171.9	473.30	2290.70	15	43	72
41504	69	00010000	01	10	000	2	36.0	3942.72	3	16.9	128.98	135.64	10	10	72
41602	69	00010000	10	00	100	1	17.7	2126.49	3	4.5	0.	87.32	1	6	72
41603	70	00010000	01	00	000	1	16.3	1745.96	3	15.0	11.84	244.49	3	16	72
61701	70	00000100	01	10	100	3	63.0	5315.13	2	14.1	89.32	145.40	31	11	72
61702	68	00000100	10	00	100	1	16.3	1932.46	3	1.6	0.	27.51	11	1	72
61703	69	00000100	10	00	100	1	16.0	1840.91	3	2.9	0.	46.33	15	3	72
71801	71	00000010	01	00	010	1	22.8	1939.82	3	72.0	5.44	1107.81	42	140	72
11901	70	10000000	00	00	000	2	35.1	3560.83	3	28.8	467.46	0.	0	81	72
52001	67	00001000	00	10	100	1	16.0	2059.56	3	26.5	420.61	0.	10	19	72
52002	69	00001000	10	10	100	3	144.0	14531.44	3	381.6	0.	5733.64	74	171	72
52004	70	00001000	00	10	100	4	72.0	7943.22	3	109.3	1746.27	0.	50	56	72
52005	67	00001000	00	10	100	1	16.0	2127.42	3	28.2	429.13	0.	17	32	72
52006	69	00001000	00	00	100	1	121.5	15019.14	3	95.0	1520.11	0.	120	254	72
52007	68	00001000	00	10	000	1	16.6	1946.43	3	18.1	250.35	0.	1	31	72
52008	67	00001000	00	00	100	1	16.2	2091.41	3	9.0	140.07	0.	2	13	72
52009	67	00001000	00	00	100	1	16.2	2139.89	3	3.5	54.01	0.	2	27	72
12101	69	10000000	00	00	100	2	29.4	2765.55	3	14.2	236.51	0.	67	126	72
12102	70	10000000	00	00	100	3	42.6	4499.71	3	12.2	190.16	0.	6	26	72
12103	66	10000000	00	00	100	1	13.6	2390.56	3	13.1	163.95	0.	48	105	72
12104	69	10000000	00	00	100	1	14.2	1468.90	3	8.6	138.10	0.	46	146	72
12106	70	10000000	00	10	100	2	42.4	4024.33	3	29.7	401.10	0.	21	64	72
12107	71	10000000	00	10	100	2	39.1	3811.38	3	61.7	669.08	0.	5	83	72
12108	69	10000000	00	01	100	1	16.6	1922.25	3	21.5	312.39	0.	1	108	72
12109	67	10000000	00	01	100	1	16.0	2070.64	3	16.5	263.88	0.	4	6	72
12110	69	10000000	00	01	100	4	72.0	6511.95	3	72.9	1278.52	0.	0	58	72
12111	68	10000000	00	01	100	1	18.6	1948.93	3	15.2	235.41	0.	4	5	72
12112	69	10000000	00	01	100	1	18.6	1912.68	3	22.1	312.17	0.	1	32	72
32201	68	00100000	00	00	100	1	20.6	2169.57	3	15.0	211.98	0.	9	116	72
32202	69	00100000	10	00	100	2	35.0	3844.83	3	79.3	0.	1252.97	9	34	72
32203	69	00100000	10	00	100	1	25.0	2274.46	3	63.5	0.	1058.70	27	127	72
32204	68	00100000	10	00	100	1	20.6	2141.22	3	28.4	0.	394.99	8	40	72
32205	68	00100000	00	00	100	1	20.6	2109.41	3	11.9	258.25	0.	9	81	72
32206	66	00100000	00	10	100	4	64.0	5921.54	3	78.6	1322.84	0.	14	57	72
32207	68	00100000	01	10	100	1	18.6	2402.04	3	17.1	215.20	25.05	1	161	72
32208	66	00100000	00	10	100	4	64.0	5067.05	3	94.3	1593.90	0.	12	62	72
42301	67	00010000	00	01	000	2	36.0	4436.46	3	7.5	155.93	0.	37	238	72
42302	69	00010000	01	01	000	4	72.0	7495.23	3	82.0	1153.24	297.88	75	103	72
42304	70	00010000	01	01	000	4	72.0	7098.15	3	139.9	965.86	1260.97	58	207	72
42305	65	00010000	01	01	000	3	48.5	7064.05	3	56.8	296.54	568.73	68	137	72
62401	70	00000100	01	00	100	1	41.9	3741.60	3	32.8	6.42	449.43	18	54	72
62402	67	00000100	10	00	000	2	33.2	6023.55	3	253.7	0.	3955.80	69	196	72
62403	71	00000100	01	00	100	1	41.9	4081.47	3	40.2	89.24	540.74	24	19	72
42502	67	00010000	10	00	000	1	23.8	3455.80	3	108.7	0.	1649.98	5	255	72
42704	72	00010000	01	00	100	2	110.8	10142.55	3	116.2	591.10	917.12	23	10	72
62802	70	00000001	10	00	100	1	16.3	1938.40	3	37.6	0.	632.15	10	15	72
12901	69	10000000	00	00	000	2	37.2	3714.81	3	32.8	454.71	0.	24	106	72
12902	69	10000000	00	00	000	1	18.0	1839.95	3	18.9	324.62	0.	17	17	72

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
12903	70	10000000	01	00	100	1	21.3	2028.97	3	20.5	153.95	114.90	25	77	72
12904	68	10000000	00	00	000	1	18.6	1892.86	3	25.6	352.74	0.	19	31	72
23001	67	01000000	01	00	001	1	18.6	2393.35	3	8.3	71.05	50.16	6	13	72
23002	69	01000000	00	00	010	3	55.8	6647.13	3	19.2	267.81	0.	60	240	72
23003	70	01000000	01	00	100	4	95.2	10609.50	3	254.5	2700.40	1207.53	31	757	72
23004	71	01000000	00	00	100	8	156.8	15422.99	3	338.5	5226.13	0.	59	197	72
23007	70	01000000	00	10	100	2	42.5	4205.10	3	42.3	572.63	0.	27	269	72
23008	67	01000000	10	10	100	1	18.6	2612.19	3	13.9	0.	2800.36	4	205	72
23009	71	01000000	01	10	100	3	502.2	48474.33	3	356.8	4996.55	181.55	150	702	72
23010	67	01000000	01	00	100	1	115.2	18378.12	3	23.2	360.18	46.50	17	704	72
23011	67	01000000	01	00	100	1	115.2	15038.78	2	25.0	417.23	36.63	26	377	72
23012	69	01000000	00	10	100	1	18.6	1759.57	3	15.6	219.07	0.	9	112	72
23013	65	01000000	01	00	100	1	115.2	15307.30	3	63.9	1118.42	11.39	24	717	72
83101	63	00000001	10	00	100	1	11.5	1657.74	3	3.4	0.	65.40	1	2	72
23201	70	01000000	00	00	100	1	21.3	1918.69	3	12.3	169.17	0.	5	33	72
23202	69	01000000	01	00	100	1	21.3	1939.23	3	25.3	0.04	343.27	5	41	72
23203	70	01000000	00	00	100	1	16.3	-9.00	3	22.7	411.15	0.	-9	78	72
23204	69	01000000	00	00	100	2	34.2	5053.83	3	36.7	505.55	0.	17	101	72
23205	71	01000000	00	01	100	32	638.0	-9.00	3	1636.0	24353.02	0.	697	1509	72
23206	69	01000000	00	00	100	1	18.6	3290.67	3	1.1	20.28	0.	8	298	72
23207	69	01000000	00	00	000	2	28.0	4458.02	3	29.2	475.70	0.	28	70	72
23209	68	01000000	00	00	100	2	37.2	6051.02	3	46.5	673.23	0.	15	760	72
23210	68	01000000	00	00	000	1	19.0	2794.64	3	10.6	170.90	0.	-9	144	72
23211	70	01000000	00	10	001	1	21.3	2181.92	3	14.6	220.95	0.	22	189	72
23212	67	01000000	00	10	100	1	16.0	2236.84	3	5.4	96.97	0.	7	100	72
23213	67	01000000	00	10	100	1	16.0	1983.38	3	7.1	116.22	0.	9	18	72
23214	71	01000000	00	10	100	1	52.9	4460.94	3	32.5	413.75	0.	28	91	72
23215	63	01000000	00	10	100	1	11.5	1860.12	3	3.0	61.34	0.	9	13	72
23216	64	01000000	00	10	100	1	14.0	1751.82	3	4.9	96.15	0.	27	30	72
23217	70	01000000	00	00	100	4	155.6	13316.07	3	99.8	1204.36	255.38	51	478	72
23218	71	01000000	01	00	100	8	165.6	12159.44	2	112.5	1405.97	444.13	63	60	72
23219	69	01000000	00	00	100	1	19.0	2172.25	3	2.0	40.30	0.	0	4	72
23220	69	01000000	01	00	100	1	19.0	1949.76	3	1.9	0.02	34.71	0	4	72
23807	71	01000000	10	00	100	1	23.4	1742.19	3	63.4	0.	862.40	6	58	72
23810	67	01000000	00	00	100	4	64.0	6120.50	3	76.5	1179.62	0.	25	366	72
23811	69	01000000	00	00	100	2	37.2	3723.68	3	40.2	631.25	0.	16	146	72
23812	67	01000000	00	00	100	4	64.0	6103.83	3	83.8	1297.63	0.	5	162	72
23813	67	01000000	00	00	100	2	32.0	3484.76	3	25.5	395.42	0.	4	28	72
23814	67	01000000	00	00	100	2	32.0	3659.28	3	40.2	627.66	0.	6	20	72
23815	69	01000000	00	00	100	1	18.6	2094.50	3	1.5	19.72	0.	5	466	72
23816	71	01000000	00	00	100	4	94.3	-9.00	3	94.3	2611.94	0.	9	94	72
23817	70	01000000	00	00	100	1	29.3	5749.71	3	7.5	109.46	0.	21	17	72
23818	71	01000000	00	00	100	2	47.2	-9.00	3	53.7	911.31	0.	1	35	72
23819	69	01000000	00	00	100	2	37.2	3745.22	3	47.0	664.13	0.	6	268	72
23820	67	01000000	00	00	100	2	32.0	3459.83	3	36.8	556.71	0.	2	36	72
23821	69	01000000	00	01	100	3	55.8	5777.51	3	46.2	647.24	0.	30	91	72
23822	70	01000000	00	01	100	4	77.1	7771.63	3	61.2	845.82	0.	46	249	72
23823	70	01000000	00	01	100	3	63.8	6345.31	3	74.4	1001.47	0.	3	348	72
23824	70	01000000	00	01	100	3	63.8	6171.49	3	51.4	597.60	0.	45	201	72
23825	71	01000000	00	01	100	2	45.9	-9.00	3	61.2	846.96	0.	27	66	72

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
54001	71	00001000	01	00	100	10	126.0	-9.00	3	521.2	2661.40	5294.33	96	317	72
54002	68	00001000	01	00	100	3	90.0	-9.00	3	190.1	1143.18	1996.12	16	636	72
54003	69	00001000	01	00	100	2	40.0	3851.67	3	13.4	78.25	148.86	8	23	72
54004	62	00001000	01	01	100	3	35.0	5009.10	3	7.1	23.18	123.86	8	161	72
54005	68	00001000	01	01	100	1	16.5	1875.00	3	2.9	14.49	39.81	3	46	72
54006	69	00001000	01	01	100	2	39.2	4443.78	3	27.3	119.98	330.35	13	4	72
54007	61	00001000	10	01	100	1	11.2	1688.13	3	1.7	0.	37.74	5	4	72
53301	71	00001000	00	00	000	4	70.0	6246.65	3	43.4	688.85	0.	16	36	72
53302	69	00001000	00	00	000	4	72.0	7017.94	3	26.0	425.96	0.	8	50	72
53303	68	00001000	00	00	000	1	16.3	1937.50	3	1.0	20.21	0.	2	107	72
53304	68	00001000	00	00	000	1	16.3	1923.47	3	1.6	30.48	0.	8	25	72
53305	68	00001000	01	00	000	1	16.3	2006.38	2	1.8	11.02	26.47	3	191	72
53306	69	00001000	01	00	000	3	91.3	7882.72	2	9.6	186.21	1.56	38	58	72
53307	71	00001000	01	00	000	4	176.7	13699.83	3	78.3	881.04	318.24	32	108	72
53308	71	00001000	00	00	100	2	47.6	-9.00	3	47.6	412.78	0.	2	25	72
33502	66	00100000	00	00	100	1	18.6	2000.00	3	8.2	127.35	0.	8	10	72
33503	68	00100000	01	00	010	1	32.6	3643.77	3	134.6	500.37	78.17	2	11	72
33504	70	00100000	01	00	010	7	126.0	13024.94	3	105.9	1350.32	206.70	19	89	72
33509	67	00100000	00	10	000	1	16.0	1838.40	3	3.7	65.43	0.	2	11	72
33510	65	00100000	01	10	000	3	45.0	5005.72	3	22.3	216.46	208.77	9	37	72
33511	68	00100000	00	10	000	1	19.0	2010.19	3	14.4	273.84	0.	4	13	72
73601	65	00000010	10	00	100	4	60.0	6253.28	3	132.3	0.	2528.00	11	186	72
23801	71	01000000	00	00	100	1	19.6	2092.63	3	30.2	452.29	0.	16	14	72
23802	71	01000000	00	00	100	3	58.8	5672.99	3	92.6	1367.22	0.	25	58	72
23804	71	01000000	00	00	100	1	19.6	1952.01	3	25.9	379.81	0.	20	22	72
74301	68	00000010	10	00	000	6	96.0	-9.00	3	19.3	0.	328.97	0	67	72
74302	67	00000010	10	00	000	1	16.3	-9.00	3	2.4	0.	47.10	0	15	72
74303	67	00000010	10	00	000	1	16.3	-9.00	3	2.6	0.	52.84	0	31	72
74304	67	00000010	10	00	000	1	16.3	-9.00	3	2.3	0.	96.18	0	25	72
74305	63	00000010	01	01	000	2	22.5	-9.00	3	6.1	2.16	129.68	46	17	72
74306	68	00000010	10	00	000	3	49.0	5267.86	3	62.9	0.	1004.13	3	24	72
74307	65	00000010	10	00	010	1	13.3	1205.84	3	101.2	0.	1651.70	34	17	72
74308	65	00000010	10	00	000	1	32.6	4459.85	3	208.3	0.	3497.60	70	199	72
84401	71	00000000	01	10	000	1	16.0	3423.94	3	28.2	186.78	509.95	76	37	72
14501	71	10000000	00	00	100	1	28.0	2867.19	3	19.6	323.48	0.	22	13	72
14502	61	10000000	00	10	100	1	13.2	1857.36	3	7.6	129.58	0.	16	26	72
14504	65	10000000	00	10	100	1	17.0	1818.98	3	5.5	102.07	0.	8	13	72
54602	71	00001000	00	00	100	4	82.8	-9.00	3	78.9	1224.22	0.	17	29	72
54603	71	00001000	00	00	100	4	82.8	-9.00	3	75.6	1135.41	0.	15	23	72
54604	63	00001000	00	00	100	6	96.0	-9.00	3	129.3	2180.89	0.	9	75	72
54801	67	00001000	00	00	000	1	16.6	2657.89	3	5.9	82.55	0.	0	11	72
34901	69	00100000	10	00	001	1	21.2	2162.29	3	37.0	54.22	559.81	17	14	72
34902	64	00100000	01	00	000	1	13.5	2247.45	3	2.7	11.51	38.37	9	10	72
34903	68	00100000	01	00	100	2	36.0	3917.30	3	15.7	16.65	247.34	14	27	72
34904	69	00100000	00	00	100	1	19.6	2365.16	3	6.4	101.18	0.	11	7	72
34905	68	00100000	01	00	100	1	19.6	2461.83	3	7.4	15.02	103.01	31	14	72
34906	67	00100000	10	00	100	1	57.5	3401.93	3	53.4	0.	1016.07	3	75	72
34907	63	00100000	10	00	100	1	18.0	1798.65	3	17.4	0.	244.22	2	4	72
34909	71	00100000	01	00	100	1	46.5	3879.73	3	54.5	176.17	605.35	5	30	72
34911	71	00100000	01	00	100	1	41.9	3647.44	2	45.6	19.59	620.31	12	99	72
34912	69	00100000	01	00	100	1	21.5	2113.37	2	12.0	31.17	156.10	1	20	72

PLANT CHARACTERISTICS/OPERATION AND MAINTENANCE
HYDRO-ELECTRIC PLANTS

Column A - Three-digit identification code

The first digit identifies the plant by the Census Region in which it is located.

The final two digits denote the specific plant within a state.

Column B - Two-digit vintage code

Year in which the plant observed was brought into initial operation.

Column C - Eight-digit region code

Regional code constructed for analytical purposes. This code for the nine Census Regions is as follows:

Region 1	1	0	0	0	0	0	0	0
Region 2	0	1	0	0	0	0	0	0
Region 3	0	0	1	0	0	0	0	0
Region 4	0	0	0	1	0	0	0	0
Region 5	0	0	0	0	1	0	0	0
Region 6	0	0	0	0	0	1	0	0
Region 7	0	0	0	0	0	0	1	0
Region 8	0	0	0	0	0	0	0	1
Region 9	0	0	0	0	0	0	0	0

Column D - One-digit construction code

Constructed by Corps of Engineers - 1
Other - 0

Column E - Four-digit operating type code

Automatic	1	0	0	0
Manual	0	1	0	0
Semi-Automatic	0	0	1	0
Automatic w/pump storage	0	0	0	1
Manual w/pump storage	0	0	0	0

Column F - Indicates the total capacity of the plant in megawatts; the sum of the capacity of all units.

Column G - Construction cost in $\$(x 10^6)$. The cost has been adjusted to a base year of 1975.

Column H - Average number of employees.

Column I - Net generation, in kWh $(x 10^6)$, of the plant in the year observed.

Column J - Total operating and maintenance expense, in $\$(x 10^3)$, of the plant for the observation year.

A	B	C					D	E			F	G	H	I	J
901	48	0	0	0	0	0	0	0	0	1	0	0	0	566.5	146
902	48	0	0	0	0	0	0	0	0	1	0	0	0	99.3	100
901	48	0	0	0	0	0	0	0	1	0	1	0	0	174.3	42
101	48	1	0	0	0	0	0	0	0	0	1	0	0	126.0	121
102	48	1	0	0	0	0	0	0	0	1	1	0	0	111.9	151
601	49	0	0	0	0	0	1	0	0	0	0	1	0	195.3	449
903	49	0	0	0	0	0	0	0	0	0	1	0	0	511.8	172
802	49	0	0	0	0	0	0	0	1	0	1	0	0	484.9	131
803	49	0	0	0	0	0	0	0	1	0	0	1	0	384.9	160
904	50	0	0	0	0	0	0	0	0	0	0	1	0	822.3	321
103	50	1	0	0	0	0	0	0	0	0	0	1	0	169.6	231
905	50	0	0	0	0	0	0	0	0	0	1	0	0	301.1	70
301	50	0	0	1	0	0	0	0	0	0	0	1	0	67.2	47
302	50	0	0	1	0	0	0	0	0	0	0	1	0	95.2	134
303	50	0	0	1	0	0	0	0	0	0	0	1	0	93.2	185
701	50	0	0	0	0	0	0	1	0	1	0	1	0	56.4	154
501	50	0	0	0	0	1	0	0	0	1	0	1	0	207.3	360
602	50	0	0	0	0	0	1	0	0	1	0	1	0	512.0	316
906	51	0	0	0	0	0	0	0	0	0	0	1	0	558.6	734
907	51	0	0	0	0	0	0	0	0	0	0	1	0	111.1	64
702	51	0	0	0	0	0	0	0	1	0	0	1	0	31.7	115
703	51	0	0	0	0	0	0	1	0	0	1	0	0	18.1	92
304	51	0	0	1	0	0	0	0	0	0	0	1	0	88.9	153
804	51	0	0	0	0	0	0	0	1	1	0	1	0	****	****
908	52	0	0	0	0	0	0	0	0	0	0	0	1	185.5	306
909	52	0	0	0	0	0	0	0	0	0	0	1	0	191.1	174
910	52	0	0	0	0	0	0	0	0	0	1	0	0	560.7	119
805	52	0	0	0	0	0	0	0	1	0	0	1	0	1109.8	303
104	52	1	0	0	0	0	0	0	0	0	1	0	0	121.3	73
911	52	0	0	0	0	0	0	0	0	0	1	0	0	63.7	96
912	52	0	0	0	0	0	0	0	0	0	1	0	0	79.8	55
913	52	0	0	0	0	0	0	0	0	0	0	1	0	1023.9	703
704	52	0	0	0	0	0	0	1	0	1	0	1	0	1413.2	518
603	52	0	0	0	0	0	1	0	0	1	0	1	0	1317.9	516
502	52	0	0	0	0	1	0	0	0	1	0	1	0	472.2	1053
914	53	0	0	0	0	0	0	0	0	0	1	0	0	177.5	197
105	53	1	0	0	0	0	0	0	0	0	0	1	0	117.5	261
915	53	0	0	0	0	0	0	0	0	0	1	0	0	72.1	41
916	53	0	0	0	0	0	0	0	0	0	1	0	0	98.0	90
917	53	0	0	0	0	0	0	0	0	0	0	1	0	724.0	218
604	53	0	0	0	0	0	1	0	0	0	1	0	0	156.4	195
503	53	0	0	0	0	1	0	0	0	1	0	1	0	784.9	484
705	53	0	0	0	0	0	1	0	1	0	1	0	0	360.0	250
706	53	0	0	0	0	0	0	1	0	1	1	0	0	189.5	127
918	53	0	0	0	0	0	0	0	1	0	1	0	0	649.6	431
919	53	0	0	0	0	0	0	0	0	1	0	1	0	7086.9	1634
706	53	0	0	0	0	0	1	0	1	0	1	0	0	39.6	205
504	53	0	0	0	0	1	0	0	0	1	0	1	0	27.9	129
105	54	1	0	0	0	0	0	0	0	0	1	0	0	268.5	167
920	54	0	0	0	0	0	0	0	1	0	0	1	0	588.7	364

A	B	C						D	E	F	G	H	I	J				
921	54	0	0	0	0	0	0	0	1	0	1	0	0	2160.0	561.5	54	11356.3	1510
401	54	0	0	0	1	0	0	0	0	1	0	1	0	320.0	287.3	29	1650.1	1153
922	55	0	0	0	0	0	0	0	0	0	1	0	0	90.0	60.3	0	614.1	283
106	55	1	0	0	0	0	0	0	0	0	1	0	0	37.2	35.9	2	134.4	78
201	55	0	1	0	0	0	0	0	0	0	1	0	0	22.5	11.1	****	117.7	34
505	55	0	0	0	0	1	0	0	0	0	0	0	1	100.1	66.4	13	387.8	399
923	55	0	0	0	0	0	0	0	0	0	1	0	0	29.0	21.4	4	210.5	94
924	55	0	0	0	0	0	0	0	0	0	0	1	0	60.0	44.7	14	365.7	391
707	55	0	0	0	0	0	0	1	0	1	0	1	0	75.0	50.1	11	292.7	239
806	55	0	0	0	0	0	0	0	1	1	0	1	0	42.6	61.2	15	169.7	582
925	55	0	0	0	0	0	0	0	0	1	0	1	0	1024.8	347.6	68	9076.1	1802
202	56	0	1	0	0	0	0	0	0	0	1	0	0	22.5	13.6	****	119.4	35
926	56	0	0	0	0	0	0	0	0	0	1	0	0	33.0	26.3	5	218.0	126
506	56	0	0	0	0	1	0	0	0	0	1	0	0	15.0	6.9	****	57.9	61
402	56	0	0	0	1	0	0	0	0	1	0	1	0	490.0	309.1	30	2429.1	1039
403	56	0	0	0	1	0	0	0	0	1	0	1	0	109.0	74.7	21	728.7	938
927	57	0	0	0	0	0	0	0	0	0	0	1	0	33.0	14.5	10	33.3	76
107	57	1	0	0	0	0	0	0	0	0	0	1	0	140.4	57.7	****	336.7	233
203	57	0	1	0	0	0	0	0	0	0	1	0	0	14.4	11.5	****	74.3	46
928	57	0	0	0	0	0	0	0	0	0	0	1	0	108.0	42.0	35	493.4	514
507	57	0	0	0	0	1	0	0	0	0	1	0	0	50.0	23.8	0	256.8	112
508	57	0	0	0	0	1	0	0	0	1	0	1	0	30.0	50.0	17	261.6	302
509	57	0	0	0	0	1	0	0	0	1	1	0	0	36.0	48.3	5	237.6	351
605	57	0	0	0	0	1	0	0	1	0	1	0	0	100.0	56.5	28	621.1	562
929	57	0	0	0	0	0	0	0	0	1	0	0	1	1125.0	467.2	52	8259.6	1311
930	58	0	0	0	0	0	0	0	0	0	1	0	0	36.0	16.6	0	301.3	143
931	58	0	0	0	0	0	0	0	0	0	1	0	0	109.8	54.0	0	801.5	132
932	58	0	0	0	0	0	0	0	0	0	1	0	0	124.2	71.2	0	879.2	295
933	58	0	0	0	0	0	0	0	0	0	0	1	0	97.2	32.7	0	580.7	166
934	58	0	0	0	0	0	0	0	0	0	1	0	0	135.0	83.2	0	590.6	217
807	58	0	0	0	0	0	0	1	0	0	1	0	0	360.4	130.7	11	2448.9	358
808	58	0	0	0	0	0	0	1	0	1	0	0	0	48.0	19.0	0	333.7	102
204	58	0	1	0	0	0	0	0	0	0	0	1	0	912.0	445.6	168	7595.7	1177
935	58	0	0	0	0	0	0	0	0	0	0	0	1	80.0	23.2	7	461.9	307
936	58	0	0	0	0	0	0	0	0	0	1	0	0	38.4	32.5	15	272.6	209
937	58	0	0	0	0	0	0	0	0	0	0	1	0	204.0	91.9	8	914.3	213
606	58	0	0	0	0	0	1	0	0	0	0	1	0	36.0	37.2	6	166.0	215
510	59	0	0	0	0	1	0	0	0	0	1	0	0	60.0	24.7	2	257.1	331
809	59	0	0	0	0	0	0	0	1	0	0	1	0	232.9	94.4	12	1756.8	385
205	59	0	1	0	0	0	0	0	0	0	1	0	0	17.3	10.0	****	87.1	30
938	59	0	0	0	0	0	0	0	0	0	1	0	0	70.0	34.9	****	****	****
939	59	0	0	0	0	0	0	0	0	0	0	1	0	94.4	81.7	8	424.1	173
404	59	0	0	0	1	0	0	0	0	1	0	1	0	201.4	77.4	17	880.3	502
940	60	0	0	0	0	0	0	0	0	0	1	0	0	135.0	32.2	0	****	****
941	60	0	0	0	0	0	0	0	0	0	1	0	0	129.4	45.9	0	712.6	426
942	60	0	0	0	0	0	0	0	0	0	0	1	0	733.5	229.2	33	5570.1	2122
943	60	0	0	0	0	0	0	0	0	0	0	0	1	270.0	126.2	14	2176.2	510
807	61	0	0	0	0	0	1	0	0	0	0	1	0	157.5	44.4	12	327.1	174
608	61	0	0	0	0	0	1	0	0	0	1	0	0	37.8	44.1	13	255.4	217
206	61	0	1	0	0	0	0	0	0	0	0	1	0	2430.0	756.4	258	17336.5	3768

A	B	C					D	E			F	G	H	I	J
944	61	0	0	0	0	0	0	0	0	1	0	0	0	1152.7	517
945	61	0	0	0	0	0	0	0	0	0	0	1	0	7106.1	1351
405	61	0	0	0	1	0	0	0	0	0	0	1	0	2518.0	930
946	62	0	0	0	0	0	0	0	0	1	0	0	0	217.0	104
947	62	0	0	0	0	0	0	0	0	1	0	0	0	354.1	161
948	62	0	0	0	0	0	0	0	0	1	0	0	0	239.2	177
949	62	0	0	0	0	0	0	0	0	1	0	0	0	134.4	242
511	62	0	0	0	0	1	0	0	0	1	0	0	0	198.0	64
950	62	0	0	0	0	0	0	0	0	0	0	1	0	6159.5	1470
512	62	0	0	0	0	1	0	0	0	1	0	1	0	588.7	768
951	62	0	0	0	0	0	0	0	0	1	1	0	0	204.2	77
609	62	0	0	0	0	0	1	0	0	0	0	1	0	195.3	219
513	62	0	0	0	0	1	0	0	0	0	1	0	0	154.4	213
406	62	0	0	0	1	0	0	0	0	0	0	0	1	67.0	1470
514	62	0	0	0	0	1	0	0	0	0	1	0	0	228.7	277
515	62	0	0	0	0	1	0	0	0	0	1	0	0	****	****
952	62	0	0	0	0	0	0	0	0	0	1	0	0	311.2	267
953	62	0	0	0	0	0	0	0	0	0	0	1	0	797.0	174
516	62	0	0	0	0	1	0	0	0	1	0	1	0	486.7	344
610	64	0	0	0	0	0	1	0	0	0	1	0	0	****	****
708	64	0	0	0	0	0	1	0	0	0	1	0	0	378.3	212
954	64	0	0	0	0	0	0	0	0	0	1	0	0	1139.2	718
517	64	0	0	0	0	1	0	0	0	0	1	0	0	54.1	115
709	64	0	0	0	0	0	1	0	1	0	0	1	0	331.8	428
710	64	0	0	0	0	0	1	0	1	1	0	0	0	347.7	150
955	64	0	0	0	0	0	0	0	1	0	1	0	0	163.7	129
810	64	0	0	0	0	0	0	1	1	0	1	0	0	****	****
956	65	0	0	0	0	0	0	0	0	0	1	0	0	941.3	277
957	65	0	0	0	0	0	0	0	0	1	0	0	0	457.9	148
958	65	0	0	0	0	0	0	0	0	0	1	0	0	659.1	246
959	65	0	0	0	0	0	0	0	0	1	0	0	0	2667.3	1948
207	65	0	1	0	0	0	0	0	0	0	0	0	1	538.1	2381
518	65	0	0	0	0	1	0	0	0	0	0	0	1	607.5	3146
711	65	0	0	0	0	0	1	0	1	1	0	0	0	288.6	254
712	65	0	0	0	0	0	1	0	1	0	0	1	0	845.0	511
811	65	0	0	0	0	0	0	1	1	0	1	0	0	933.6	1160
713	65	0	0	0	0	0	0	1	0	1	0	1	0	211.5	185
611	66	0	0	0	0	1	0	0	0	1	0	0	0	232.1	241
612	66	0	0	0	0	1	0	0	1	0	1	0	0	761.6	371
613	67	0	0	0	0	1	0	0	0	0	0	1	0	****	****
614	67	0	0	0	0	1	0	0	0	0	1	0	0	667.7	299
960	67	0	0	0	0	0	0	0	0	0	0	1	0	354.3	116
961	67	0	0	0	0	0	0	0	0	1	0	0	0	****	****
812	67	0	0	0	0	0	0	1	0	0	0	0	0	214.1	2795
305	67	0	0	1	0	0	0	0	0	1	0	0	0	354.6	530
962	67	0	0	0	0	0	0	0	0	0	0	1	0	2778.6	330
208	67	0	1	0	0	0	0	0	0	0	0	0	1	1074.6	15836
963	67	0	0	0	0	0	0	0	0	0	1	0	0	4580.0	2618
964	67	0	0	0	0	0	0	0	0	0	1	0	0	3584.1	1023
965	67	0	0	0	0	0	0	1	1	0	0	0	0	509.9	413

A	B	C				D				F	G	H	I	J
615	68	0	0	0	0	0	1	0	0	0	0	1	0	190
519	63	0	0	0	0	1	0	0	0	0	0	0	1	2378
966	68	0	0	0	0	0	0	0	0	0	1	0	0	265
714	68	0	0	0	0	0	0	1	0	1	1	0	0	145
967	69	0	0	0	0	0	0	0	0	1	0	0	0	****
968	69	0	0	0	0	0	0	0	0	0	1	0	0	****
715	69	0	0	0	0	0	0	1	0	1	0	1	0	****
969	69	0	0	0	0	0	0	0	0	1	0	1	0	170
209	70	0	1	0	0	0	0	0	0	0	0	0	1	544
616	70	0	0	0	0	0	1	0	0	1	0	1	0	19133
617	70	0	0	0	0	0	1	0	0	1	1	0	0	306
970	70	0	0	0	0	0	0	0	1	0	1	0	0	77
971	71	0	0	0	0	0	0	0	0	1	0	0	0	752
520	71	0	0	0	0	1	0	0	0	1	0	0	0	****
716	71	0	0	0	0	0	1	0	1	1	0	0	0	****
972	72	0	0	0	0	0	0	0	0	0	0	0	0	****
973	72	0	0	0	0	0	0	0	0	0	0	1	0	****
717	72	0	0	0	0	0	1	0	1	1	0	0	0	****
718	72	0	0	0	0	0	1	0	1	1	0	0	0	271
108	73	1	0	0	0	0	0	0	0	0	0	0	0	210
306	73	0	0	1	0	0	0	0	0	0	0	0	0	****
521	73	0	0	0	0	1	0	0	0	0	0	0	1	****
813	73	0	0	0	0	0	0	1	1	0	1	0	0	1438.5
401	73	0	0	0	1	0	0	0	1	1	0	0	0	19447
109	74	1	0	0	0	0	0	0	0	0	0	0	1	****
110	74	1	0	0	0	0	0	0	0	1	0	0	0	****
618	74	0	0	0	0	0	1	0	0	0	1	0	0	****

PLANT CHARACTERISTICS/OPERATION AND MAINTENANCE -
NUCLEAR-POWERED PLANTS

Column A - Five-digit identification code

The first digit identifies the plant by the Census Region in which it is located.

The second and third digits are the state identification code. The state codes are numerically sequenced 01 to 50 and correspond to an alphabetical listing of the states. Code #51 indicates the District of Columbia.

The final two digits denote the specific plant within a state.

Column B - Two-digit vintage code

Year in which the plant observed was brought into initial operation.

Column C - Eight-digit region code

Regional code constructed for analytical purposes. This code for the nine Census Regions is as follows:

Region 1	1	0	0	0	0	0	0	0
Region 2	0	1	0	0	0	0	0	0
Region 3	0	0	1	0	0	0	0	0
Region 4	0	0	0	1	0	0	0	0
Region 5	0	0	0	0	1	0	0	0
Region 6	0	0	0	0	0	1	0	0
Region 7	0	0	0	0	0	0	1	0
Region 8	0	0	0	0	0	0	0	1
Region 9	0	0	0	0	0	0	0	0

Column D - Reactor type code

Identifies the type of reactor for which the plant was designed.

Pressurized water reactor	0
Boiling water reactor	1

Column E - Four-digit container type code

Indicates the type of container used in the plant.

Steel sphere	1	0	0	0
Steel cylinder	0	1	0	0
Reinforced concrete				
w/steel liner	0	0	1	0
Steel drywell & wetwell	0	0	0	1
Reinforced concrete drywell				
& wetwell w/steel liner	0	0	0	0

Column F - Denotes whether or not the data observed are for the first unit of a planned multi-unit facility.

Yes	1
No	0

Column G - Cooling type code; denotes the cooling method used by the nuclear plant.

Column H - Contains the number of units installed at the plant observed.

Column I - Indicates the total capacity of the plant in megawatts; the sum of the capacity of all units.

Column J - Boiler pressure.

Column K - Boiler temperature.

Column L - Construction cost, in $\$(x 10^3)$. The cost has been adjusted to a base year of 1975.

Column M - Construction time (in months) to complete the facility.

Column N - Net generation, in kWh $(x 10^6)$, of the plant in the year observed.

Column O - Total Btu's $(x 10^9)$ of nuclear fuel consumed by the plant in the year observed.

Column P - Operating expense, in $\$(x 10^3)$, of the plant for the observation year.

Column Q - Annual maintenance expense, in $\$(x 10^3)$, of the plant for the observation year.

Column R - Average employment at the plant in the year observed.

Column S - Year in which observation was made.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S		
12101	62	1	0	0	0	0	0	0	1	185.0	570	481	05034	44	1200.4	13775	2966	1591	107	75
32201	62	0	0	0	0	0	0	0	1	75.0	1000	546	41649	67	290.5	31139	1604	978	59	75
10701	68	1	0	0	0	0	0	0	1	600.3	675	492	129782	43	4114.7	45769	4028	83	75	
90501	68	0	0	0	0	0	0	0	1	450.0	695	505	111986	51	3217.9	34145	4451	105	75	
23201	68	0	0	0	0	0	0	0	1	601.5	1035	546	128557	55	3044.9	3286	2524	160	75	
10702	70	1	0	0	0	0	0	0	1	661.5	1035	546	128557	55	3044.9	4133	433	101	75	
23202	70	0	0	0	0	0	0	0	1	517.1	755	514	110292	47	2079.5	22916	2194	95	74	
34901	70	0	0	0	0	0	0	0	1	1047.6	806	521	181719	41	6344.6	65459	2538	214	74	
32202	71	0	0	0	0	0	0	0	1	811.7	760	508	179268	75	78.3	1348	8641	120	74	
42301	71	0	0	0	0	0	0	0	1	508.8	1000	545	134379	48	2293.8	3387	2538	214	74	
50901	72	0	0	0	0	0	0	0	1	1520.0	770	510	260465	67	8677.3	86398	5521	100	74	
31301	72	0	0	0	0	0	0	0	1	1656.0	1000	540	243907	65	7905.1	89122	3338	235	74	
12102	72	1	0	0	0	0	0	0	1	655.4	1000	546	283923	59	1973.2	20460	5050	91	74	
14501	72	1	0	0	0	0	0	0	1	514.0	1020	547	157226	60	2490.0	23080	3970	106	74	
31402	73	0	0	0	0	0	0	0	1	1395.0	780	520	471651	54	5952.6	65211	4965	192	74	
11901	73	1	0	0	0	0	0	0	1	830.0	800	518	255543	49	3574.3	53034	3722	1510	74	
42302	73	0	0	0	0	0	0	0	1	1830.2	1000	518	255543	49	3574.3	53034	3722	1510	74	
54601	73	0	0	0	0	0	0	0	1	2196.2	705	544	633965	58	4724.7	57571	7038	2196	74	
14502	73	1	0	0	0	0	0	0	1	1395.0	780	520	471651	54	5952.6	65211	4965	192	74	
 						

A	B	C				D	E			F	G		H	I	J	K	L	M	N	O	P	Q	R	S						
42701	73	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	1	1	481.0	755	550	204171	64	2404.1	25879	2407	1006	34	74	
54002	73	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	1	0	3	2600.1	950	556	527698	67	5522.6	57987	4200	2782	305	74
70401	74	0	0	0	0	0	0	1	0	0	0	0	0	1	1	0	0	0	1	902.3	1050	570	250464	65	179.6	1770	****	****	122	74
41501	74	0	0	0	1	0	0	0	0	1	0	0	0	1	0	1	0	0	1	565.7	1020	560	216582	60	1391.4	15301	1174	311	103	74
42702	74	0	0	0	1	0	0	0	0	1	0	0	0	1	0	0	0	1	1	835.0	1005	545	265712	73	1740.5	21721	1652	1039	102	74
23801	74	0	1	0	0	0	0	0	0	1	0	0	1	0	0	1	0	0	2	2304.0	1000	543	405491	84	3717.3	40593	1077	714	440	74
23802	74	0	1	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	1	871.0	2155	604	432832	72	1977.9	21150	2063	1287	309	74
34902	74	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	535.0	705	505	217742	71	1528.6	17177	5019	2203	80	74

ELECTRICITY UTILITY SYSTEMS - ANNUAL EXPENSE AND PHYSICAL CHARACTERISTICS DATA

Column A - Five-digit identification code

The first digit identifies the system by the Census Region in which it is located.

The second and third digits are the state identification code. The state codes are numerically sequenced 01 to 50 and correspond to an alphabetical listing of the states. Code #51 indicates the District of Columbia.

The final two digits in the identification code denote the specific system within a state.

Column B - Eight-digit region code

Regional code constructed for analytical purposes. This code for the nine Census Regions is as follows:

Region 1	1	0	0	0	0	0	0	0
Region 2	0	1	0	0	0	0	0	0
Region 3	0	0	1	0	0	0	0	0
Region 4	0	0	0	1	0	0	0	0
Region 5	0	0	0	0	1	0	0	0
Region 6	0	0	0	0	0	1	0	0
Region 7	0	0	0	0	0	0	1	0
Region 8	0	0	0	0	0	0	0	1
Region 9	0	0	0	0	0	0	0	0

Column C - Transmission operation and maintenance expenses in $\$(x 10^3)$.

Column D - Distribution operation and maintenance expenses in $\$(x 10^3)$.

Column E - General and administrative expenses in $\$(x 10^3)$.

Column F - Number of residential and small light & power customers $(x 10^3)$.

Column G - Number of large light & power customers $(x 10^2)$.

Column H - Annual kWh sales to large light & power customers $(x 10^3)$.

Column I - Annual kWh sales to residential and small light & power customers $(x 10^3)$.

Column J - Total annual kWh sales to all ultimate users $(x 10^3)$.

Column K - Structure miles of transmission lines.

Column L - Total circuit miles.

Column M - Total underground and submarine circuit lines.

Column N - Capacity of transmission substation transformers in kilowatt-amperes ($\times 10^3$).

Column O - Capacity of distribution substation transformers in kilowatt-amperes ($\times 10^3$).

Column P - Number of distribution lines transformers ($\times 10^3$).

Column Q - Capacity of distribution line transformers in kilowatt-amperes ($\times 10^3$).

Column R - Number of meters.

A	B						C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
60141	0	0	0	0	0	0	5935	17503	43709	834	32	12355	10742	25650	8253	1271	0	20325	4546	370	9130	933
60381	0	0	0	0	0	0	3630	9310	13526	320	35	5374	2113	8893	3910	2635	14	8543	3553	105	4733	375
30342	0	0	0	0	0	0	2694	4155	7573	146	1	1706	1703	3609	1153	1217	0	2791	1108	49	2436	162
70431	0	0	0	0	0	0	480	1500	3201	55	3	507	648	1350	1115	299	0	923	175	22	527	72
70482	0	0	0	0	0	0	2692	11722	26736	413	11	5458	3851	13154	3633	1749	0	9714	5155	103	5499	470
90581	0	0	0	0	0	0	15004	22601	118236	2954	7	36674	11223	52668	13178	5953	0	26698	13657	734	21764	3076
90582	0	0	0	0	0	0	4775	10636	24903	604	16	4824	3245	8313	1023	545	0	5248	3256	96	4099	645
90583	0	0	0	0	0	0	34079	61438	124388	2713	19	28445	17008	51328	9102	4593	0	63162	13422	490	****	2639
80681	0	0	0	0	0	0	1637	16267	7625	630	62	7126	2413	11610	2228	828	18	5278	3302	108	4720	652
10731	1	0	0	0	0	0	4309	20618	34367	541	36	5914	2236	9175	929	215	10	7693	4175	152	5648	567
10782	1	0	0	0	0	0	3874	10306	20375	284	11	3629	1165	5066	338	95	16	4125	2172	51	2804	328
10783	1	0	0	0	0	0	2355	7809	13582	263	24	2999	1273	4333	41	5	14	3089	520	46	2405	275
50631	0	0	0	0	1	0	3639	7232	12253	153	5	2074	1881	4696	601	375	0	5729	2454	38	1427	139
52081	0	0	0	0	1	0	820	14256	39996	455	2	1033	2867	13897	364	630	76	11461	7548	79	6992	464
50931	0	0	0	0	1	0	3515	12293	26464	613	15	3599	2475	13944	3107	906	45	11724	5375	168	6613	711
50932	0	0	0	0	1	0	8936	59430	106450	1727	90	29163	2534	34111	3760	2987	52	27728	19319	364	17231	2070
50933	0	0	0	0	1	0	962	2703	9798	174	2	2929	1340	4788	1491	366	0	5155	239	61	1734	194
50934	0	0	0	0	1	0	1694	6705	15911	268	6	4673	3297	3469	973	432	8	5609	2123	77	3394	394
51081	0	0	0	0	1	0	9331	22379	73427	1073	33	18056	11654	39010	11951	2615	0	35612	15606	391	17115	1256
51082	0	0	0	0	1	0	16	1475	3100	78	1	1167	664	1920	89	38	0	25	2847	24	****	111
31281	0	0	0	0	0	0	1535	7514	12138	202	1	4744	2790	10512	4413	2823	0	5170	2467	112	3660	215
31381	0	0	1	0	0	0	487	4202	7432	167	4	2084	1946	4119	216	356	0	1880	1233	49	1862	178
31332	0	0	1	0	0	0	2543	8000	14190	287	1	3518	2107	7291	4174	1482	1	9230	2016	388	2911	333
31383	0	0	1	0	0	0	20899	64033	142116	2737	8	32887	16912	55972	2981	4055	221	52120	4912	388	21721	3032
31384	0	0	1	0	0	0	1675	12327	19233	473	13	4658	5759	11325	2485	1542	0	11234	6118	156	5088	518
31385	0	0	1	0	0	0	2	169	508	5	1	43	53	103	44	12	0	20	12	1	43	6
31386	0	0	1	0	0	0	4	173	151	43	0	46	0	118	9	0	0	0	20	1	45	5
31481	0	0	1	0	0	0	4739	10793	15751	412	24	6289	3835	17643	3542	3718	0	16260	1837	129	4352	450
31482	0	0	1	0	0	0	1612	7612	12644	301	12	3815	3730	7675	768	543	0	5335	2194	57	2833	323
31433	0	0	1	0	0	0	4190	10431	12736	329	77	2637	7528	10938	2222	701	0	10524	1444	37	3169	370
31434	0	0	1	0	0	0	2753	13341	24662	586	25	6992	4602	14404	5486	2525	0	12120	3615	150	4774	521
31485	0	0	1	0	0	0	344	1803	3486	91	2	1266	1738	3376	665	251	0	1334	844	32	1065	108
41581	0	0	0	1	0	0	1228	5005	6079	141	5	1558	1136	2883	2534	653	0	2126	645	40	1093	136
41532	0	0	0	1	0	0	1020	3682	9015	182	5	2115	921	3287	3003	262	0	3049	936	57	1540	212
41583	0	0	0	1	0	0	1094	4261	6803	154	1	1913	1150	3233	754	501	1	3976	298	38	1729	159
41584	0	0	0	1	0	0	1520	7000	8971	206	3	2317	1229	3659	14820	629	3	3018	1353	72	2514	228
41585	0	0	0	1	0	0	1128	3612	7723	143	6	1573	607	2441	2445	663	0	2173	801	43	1556	179
41586	0	0	0	1	0	0	262	1777	3432	87	5	789	433	1312	647	174	0	1296	417	29	708	98
41681	0	0	0	1	0	0	163	383	845	16	0	282	0	491	627	0	0	285	212	8	164	18
41632	0	0	0	1	0	0	554	3010	5288	121	4	1192	518	2510	2724	216	0	1607	699	39	1109	130
41683	0	0	0	1	0	0	849	4515	10234	197	25	2840	2268	5102	2043	1029	0	3747	1457	68	2826	216
41684	0	0	0	1	0	0	1055	5375	7448	245	13	3432	1371	5637	3424	562	0	4340	1717	97	2695	261
61781	0	0	0	0	1	0	1050	3030	4505	120	14	1392	1416	3528	591	349	0	4017	136	50	1172	132
61732	0	0	0	0	1	0	1265	6210	17758	290	15	3381	2105	9577	3612	1289	0	5253	2094	104	2766	381
61733	0	0	0	0	1	0	1464	5264	8449	278	3	3586	2473	6915	488	416	0	5567	2681	57	2666	388
61784	0	0	0	0	1	0	198	1860	2649	33	3	916	333	1404	139	67	0	313	341	18	692	91
71881	0	0	0	0	0	1	580	4751	5192	140	6	1600	1152	3539	958	1412	0	4276	1141	76	1615	157
71832	0	0	0	0	0	1	4493	12282	15780	403	56	6954	10530	20373	3695	2497	0	21278	4193	172	5706	458
71883	0	0	0	0	0	1	2064	10273	23569	397	55	6198	6600	19157	2232	1005	0	4005	6201	128	5246	442
71884	0	0	0	0	0	1	995	6448	10673	185	11	2788	769	4396	117	72	0	3570	2879	31	2237	205

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
11941	10257	1739	10257	11120	343	6	2940	1703	4809	2079	177	29	2901	1129	125	2449	371
11932	10000	281	666	1476	29	0	235	0	430	420	0	0	83	99	10	161	34
55203	0	0	0	0	0	0	12	7265	13657	735	491	101	6730	7432	124	5659	611
52034	0	0	0	0	0	0	26	3265	2862	6994	132	0	60	75	8	2430	322
52085	0	0	0	0	0	0	3	218	237	1452	439	119	0	400	26	950	81
12181	10000	4525	21312	36623	583	15	6366	1679	10334	275	164	123	5722	6743	53	3729	614
12183	10000	798	2289	2479	92	0	1093	0	1320	7	0	0	465	127	18	744	120
12184	10000	56	22965	26203	714	26	3081	2605	9831	137	0	12	52	2455	0	5	29
12185	10000	0	286	104	4	0	40	0	40	0	0	0	0	0	0	0	0
12186	10000	3701	5665	10671	205	4	1452	303	1908	303	76	0	0	381	295	42	1313
32281	0	0	0	0	0	0	16	12714	9296	810	6437	10	20151	4506	364	6349	1280
32282	0	0	0	0	0	0	19	13599	15036	32419	847	1737	23564	6192	250	9886	1871
32283	0	0	0	0	0	0	26	264	164	493	196	0	142	0	12	330	28
42332	0	0	0	0	0	0	5	1002	2849	17932	1634	344	0	2195	26	576	96
42333	0	0	0	0	0	0	36	7713	1761	19935	899	6	12782	7973	159	6929	914
62432	0	0	0	0	0	0	33	3698	1751	604	1907	0	5715	3563	106	3305	295
62433	0	0	0	0	0	0	3	947	604	1907	1025	0	5715	3563	106	3305	295
62434	0	0	0	0	0	0	20	5146	1763	7247	1489	0	1053	548	39	850	97
42582	0	0	0	0	0	0	0	356	0	637	372	13	4326	3798	70	2858	353
42583	0	0	0	0	0	0	36	843	431	1808	1564	22	1349	614	31	793	95
42584	0	0	0	0	0	0	1	1265	295	2017	1390	0	1591	1317	45	1360	130
42585	0	0	0	0	0	0	0	573	275	797	565	0	742	325	19	483	50
42586	0	0	0	0	0	0	1	623	919	502	168	0	569	205	17	524	60
42587	0	0	0	0	0	0	32	9110	20971	2461	2647	45	22955	5648	144	6382	643
42588	0	0	0	0	0	0	30	2141	5486	60610	1547	0	3182	1025	66	1576	216
42589	0	0	0	0	0	0	124	3558	0	4311	1009	0	5960	1357	24	1592	138
12581	10000	2712	5398	119	1	1	1797	495	2499	2358	303	0	1257	059	32	1392	145
23081	0	0	0	0	0	0	11	3285	1037	4378	1234	496	2042	1197	87	2578	

A	B							C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
33501	0	0	1	0	0	0	0	3033	11541	10590	450	21	5804	3605	11929	1203	497	0	9310	2073	107	5055	499
33502	0	0	1	0	0	0	0	3528	13358	30424	679	72	7670	7322	18134	2353	589	9	9331	2491	110	5247	721
33503	0	0	1	0	0	0	0	2574	12020	20990	417	2	3344	3803	7051	1469	905	0	10419	2405	108	4067	451
33504	0	0	1	0	0	0	0	1029	11625	16427	381	24	4812	2483	3590	1443	502	4	9093	1212	110	4620	417
33505	0	0	1	0	0	0	0	5225	18916	37683	777	10	3317	6973	17174	3622	2329	0	9552	2768	203	5230	809
33506	0	0	1	0	0	0	0	7460	11794	21995	573	38	7044	14962	32623	5267	3759	0	24338	1026	189	5035	614
33507	0	0	1	0	0	0	0	2201	6536	12679	245	15	2678	3011	6058	1107	549	0	4514	1372	50	2319	263
73601	0	0	0	0	0	0	1	2677	12908	22901	495	48	6906	3385	15116	4037	2219	0	12512	3926	156	5798	555
73602	0	0	0	0	0	0	1	2030	9318	16269	347	34	5922	2248	7448	2721	1936	0	5710	3564	97	3472	367
93701	0	0	0	0	0	0	0	90	1340	2495	45	0	793	0	952	970	179	0	146	310	21	617	57
93702	0	0	0	0	0	0	0	5396	9153	18391	397	1	8151	2699	11484	1317	563	0	5803	2767	122	4330	443
23801	0	1	0	0	0	0	0	2523	16325	22903	524	18	5368	5674	12169	391	410	0	6520	4115	83	4168	562
23802	0	1	0	0	0	0	0	3160	10127	17267	327	23	3421	2547	5804	1318	472	0	5473	2607	102	3924	356
23803	0	1	0	0	0	0	0	4011	17337	20963	475	49	4743	4234	9588	2657	1011	0	7207	4277	133	4559	521
23804	0	1	0	0	0	0	0	1070	3290	6004	113	1	1160	1541	2806	517	146	0	1606	435	30	738	143
23805	0	1	0	0	0	0	0	4636	31643	46358	902	64	11398	7020	19116	1397	1170	0	14592	5532	283	7002	1003
23806	0	1	0	0	0	0	0	13603	39420	66041	1211	56	9796	13933	25209	803	728	17	16235	12517	129	6936	1471
23807	0	1	0	0	0	0	0	658	1109	2211	51	2	404	68	557	93	18	0	564	66	11	342	56
23808	0	1	0	0	0	0	0	4323	13576	17822	474	77	5212	5669	12014	1567	1413	0	8405	5284	163	3127	536
13901	1	0	0	0	0	0	0	114	2213	3503	74	96	509	456	997	45	18	0	310	506	10	328	30
13902	1	0	0	0	0	0	0	1983	6585	11906	244	11	2376	699	3124	305	22	5	927	1142	41	1365	262
13903	1	0	0	0	0	0	0	131	715	1119	23	0	225	0	315	40	0	18	231	96	3	112	29
54001	0	0	0	0	1	0	0	36	123	275	4	1	43	147	271	53	0	0	30	126	2	40	5
54002	0	0	0	0	1	0	0	1797	4710	12615	298	8	5040	2997	9563	2489	481	2	7534	2559	136	4093	328
44101	0	0	0	1	0	0	0	344	876	2184	39	1	440	234	743	635	159	0	234	164	12	404	47
44102	0	0	0	1	0	0	0	449	1319	2494	49	2	475	152	647	1160	26	0	584	217	13	504	55
64201	0	0	0	0	0	1	0	199	721	990	30	1	590	327	938	52	44	0	277	179	10	360	33
74301	0	0	0	0	0	0	1	3026	9255	19669	348	52	4806	3730	9034	4229	2270	0	5335	2739	131	4298	404
74302	0	0	0	0	0	0	1	155	2455	5700	135	2	1853	1412	3358	1124	203	0	432	805	52	1350	153
74303	0	0	0	0	0	0	1	1973	10651	16279	246	20	8151	1494	10216	420	642	48	5360	3220	65	5193	264
74304	0	0	0	0	0	0	1	430	3398	5051	141	1	1692	514	3212	858	231	2041	0	2296	31	1066	207
74305	0	0	0	0	0	0	1	2423	29668	63238	706	12	15773	20124	36147	2076	2053	0	15512	12366	233	11935	808
74306	0	0	0	0	0	0	1	1862	9160	11962	281	66	3801	2666	6980	2927	1010	0	4764	2170	111	3859	315
74307	0	0	0	0	0	0	1	116	577	1289	34	0	401	0	535	385	0	0	142	285	14	304	33
74308	0	0	0	0	0	0	1	1760	6995	15312	243	69	3001	3944	9020	4633	645	0	6843	2373	89	2831	264
74309	0	0	0	0	0	0	1	2955	12438	26770	417	86	7943	5817	14969	3862	2730	0	9922	4670	127	5590	477
74390	0	0	0	0	0	0	1	3349	11401	29436	554	57	9502	5652	18100	4980	3901	11	15964	6082	234	7322	607
74391	0	0	0	0	0	0	1	836	2608	6134	125	42	1422	982	4076	3600	865	0	2304	897	46	1300	140
84401	0	0	0	0	0	0	1	3003	10693	21292	332	76	4005	3673	11027	6209	3074	0	6780	4679	117	3860	392
14501	1	0	0	0	0	0	0	4049	2316	5361	92	1	754	472	1571	605	0	0	220	548	47	673	126
14502	1	0	0	0	0	0	0	1248	1360	2702	56	0	722	0	1037	272	0	0	149	361	21	496	51
54601	0	0	0	0	1	0	0	102	565	810	13	1	139	24	244	73	5	0	55	96	5	124	16
54602	0	0	0	0	1	0	0	62	399	381	21	1	265	125	410	196	30	0	170	128	9	211	28
54603	0	0	0	0	1	0	0	4982	31070	43146	1133	9	18344	5404	31488	3425	2080	4	26524	19220	344	12109	1273
94701	0	0	0	0	0	0	0	5515	10763	18606	401	4	7836	2039	11595	727	322	0	5739	3397	152	5170	447
94702	0	0	0	0	0	0	0	1550	3471	3446	190	14	3597	1541	8066	201	10538	0	1967	1220	59	1859	205
54801	0	0	0	0	1	0	0	5424	12923	21509	741	29	8026	7257	22357	4601	3555	0	25910	3163	234	6035	694
54802	0	0	0	0	1	0	0	1417	6556	10244	266	45	2592	3581	6787	1158	1185	0	7558	1534	122	1634	311
54803	0	0	0	0	1	0	0	242	1215	1564	35	2	511	1170	1701	195	200	0	285	120	10	323	42
34901	0	0	1	0	0	0	0	164	17	225	1	1	3	115	263	12	0	0	172	0	0	5	1

A	B							C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
34982	0	0	1	0	0	0	0	289	999	2429	41	1	308	177	576	863	0	0	416	122	16	245	56
34983	0	0	1	0	0	0	0	300	1000	2750	66	0	1136	0	1806	153	167	5	1950	345	13	571	89
34984	0	0	1	0	0	0	0	2445	3910	4759	132	1	1273	970	2512	1444	333	0	2430	869	36	975	134
34985	0	0	1	0	0	0	0	15	174	201	9	2	50	15	69	137	0	0	18	25	4	44	9
34986	0	0	1	0	0	0	0	35	363	650	12	1	80	248	380	86	43	0	0	101	2	49	13
34987	0	0	1	0	0	0	0	2093	21927	30541	648	4	7511	260	12841	1127	1556	39	8438	8905	118	4953	717
34988	0	0	1	0	0	0	0	1093	3263	5926	38	1	1073	1049	2721	996	421	0	1379	570	37	1031	95
34989	0	0	1	0	0	0	0	1748	6760	19537	269	6	2505	1546	5373	2657	1173	0	3493	1433	97	2143	317
34990	0	0	1	0	0	0	0	1680	6920	10825	242	1	2611	1633	4896	1617	392	0	4372	972	100	2324	268
85031	0	0	0	0	0	0	1	326	492	689	23	3	204	95	307	11	0	0	0	95	4	120	24