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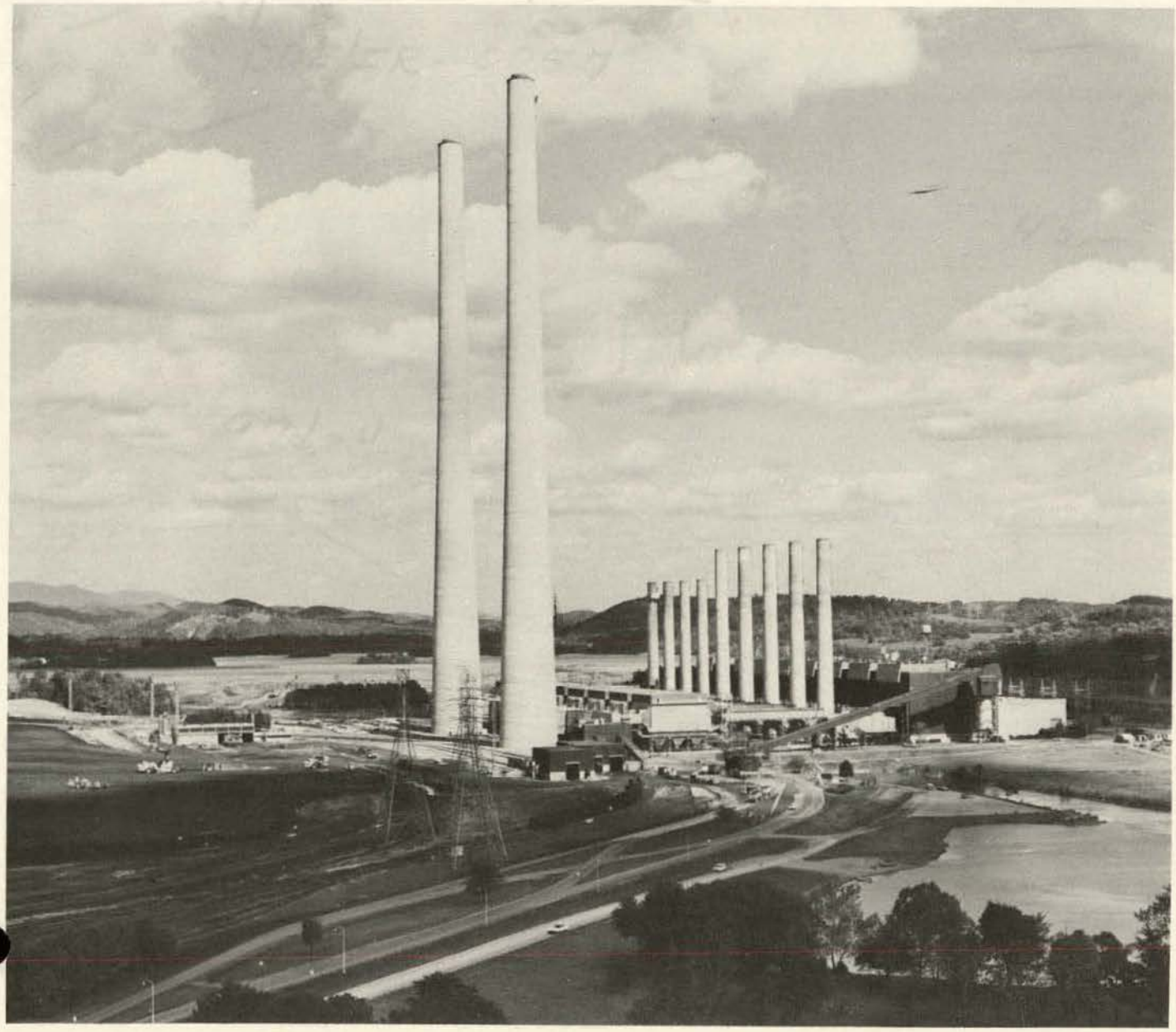
Projections of Cost, Duration, and On-Site Manual Labor Requirements for Constructing Electric Generating Plants, 1979–1983

MASTER

U.S. Department of Labor
U.S. Department of Energy
September 1979



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U.S. Department of Labor
Ray Marshall, Secretary

U.S. Department of Energy
Charles W. Duncan, Secretary

September 1979

Construction Labor Demand System

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Preface

This report represents part of a continuing effort to improve the Federal Government's ability to forecast and evaluate the resource requirements of future energy development. The analysis presented here was accomplished as part of the research program of the Construction Labor Demand System (CLDS). CLDS is a computerized management information system of the Department of Labor and is designed to forecast, on a short-term basis (1-5 years), occupational labor demand and other resource requirements. The research effort described in this report was jointly funded by the Employment Standards Administration of the U.S. Department of Labor and by the Office of Education, Business, and Labor Affairs of the U.S. Department of Energy.

William Hahn and William Schriver coordinated and directed the study. Survey data were collected and organized by James Rechnitzer. The forecasting methodology was developed by Soon Paik and Gary Hall, economists, and Ram Bashambu, civil engineer. Computer applications for this effort were designed and implemented by Jason Kim, Sandra McElroy, and Jerry Sayers, computer analysts. Within the Department of Energy, Norman Seltzer and Michael Tannen of the Manpower Assessment Program provided support and guidance for the development of the study.

The cooperation of the many utility companies that responded to the survey underlying this report is gratefully acknowledged. The assistance of John Rasmussen of the Edison Electric Institute (EEI) Construction Committee is particularly noted.

Contents

Introduction

The objective of this study is to provide a consistent set of base-line estimates of future capital costs and labor requirements for power plant construction which can be used by the government, utilities, constructors, labor organizations, industry vendors, and the general public for policymaking and planning purposes. Separate projections for nuclear, hydroelectric, and fossil-fueled electric generating facilities are included. Within each category, estimates of on-site labor requirements are provided for 14 separate craft classifications. Projections also are presented for each of 10 geographical regions of the United States.

It should be noted that the estimates are based upon power plants already under construction as well as those in advanced planning stages which are expected to be under construction during the 1979-1983 interval. The estimates rely heavily upon a special survey of utilities by the Department of Labor conducted in March and April of 1979. To insure continued usefulness, the projections will be revised periodically to reflect new information and changing circumstances.

The need for the type of research reported in this study is quite apparent given the nation's energy demands and the substantial resource requirements associated with power plant construction. A report issued earlier this year by the Economic Policy Council of the United Nations Association of the United States of America

recommended that the Federal Government give the highest priority to research in the field of energy-job relationships. "With each passing day it becomes apparent just how fundamental this subject is to our society and future."[1]

Part I presents forecasts of work-hour requirements per kilowatt of installed capacity, detailed by type of power plant. Part II provides the forecast of work-year requirements, by craft. Within Part III are presented regional requirements of construction labor. Part IV discusses the forecasts of costs for constructing electric power plants. Appendix A contains information on the conceptual framework of the forecasting model and the econometric procedures used to estimate trend functions. Appendix B provides tabular information on unit work-hour requirements for constructing electric power plants. Appendix C presents tabular information on forecasted unit plant costs. Appendix D discusses methods for converting constant dollars to current dollars for nuclear power plant construction. Appendix E provides a listing of data sources and references.

Highlights

The labor requirement forecasts presented in this paper cover all new power plant construction in progress or planned for the 1979-1983 period.[2] The craft mix, construction duration, cost, and on-site manual labor per installed kilowatt of electricity (KWe) for specific types and vintages of power plants were estimated by analyzing pooled time series and cross-sectional data collected in a survey of utilities by the Department of Labor as well as from secondary sources.

The Construction Labor Demand System estimates that power plant construction in the 1979-1983 period will result in a total on-site labor requirement of 881,790 work-years.[3] Labor requirements are forecasted to decline each year through the period, dropping by about 30 percent from an annual average of 200,330 work-years in 1979 to 142,840 work-years in 1983.

The forecasted decline in labor needs will parallel a downward trend in the number of electric generating units under construction or planned during the period. On an electric capacity basis, approximately 252,000 megawatts are associated with construction projects underway or planned in 1979. This is projected to fall to about 184,000 megawatts in 1983.

Among construction trades, pipefitters, electricians, carpenters, and ironworkers will be the most extensively utilized crafts with requirements totaling 197,980, 132,590, 90,570, and 71,360 work-years respectively during the 5-year period. Requirements for

workers in these crafts and most of the other trades will ease during the first half of the 1980's as power plant construction activity declines from a pace set in the late 1970's.

Requirements for workers in fossil-fueled power plant construction projects are projected to decline by 11 percent in the 1979-1981 period and then rebound, bringing the overall requirement in 1983 to a level about 1 percent higher than the base year of 1979. Labor requirements on nuclear construction jobs, on the other hand, are expected to grow by some 5,000 work-years between 1979 and 1980 and then decline sharply through 1983. Total requirements in the latter year are anticipated to be only about 55 percent of the demand in 1980. As a proportion of the overall power plant construction work force, nuclear is projected to decline from about 63 percent in 1980 to slightly less than 50 percent in 1983. The construction work force on hydroelectric generating units is forecasted to decline each year during the time frame of the study. Annual requirements are expected to dip by about 46 percent between 1979 and 1983.

About two-fifths of the labor requirements associated with power plant construction during the 1979-1983 period will be centered in the Southeastern and Midwestern sections of the nation. However, on-site labor requirements in these areas are forecasted to decline by some 36 percent during this time frame. In only two areas of the country, New York-New Jersey (95 percent) and the Rocky Mountains (7 percent), are increases in labor requirements forecasted between 1979 and 1983.

Recent years have witnessed increasing concerns over safety, reliability, and environmental protection which, in turn, have led to a substantially enlarged scope of work for constructing electric power plant generating stations. This development is reflected in increasing costs per kilowatt installed for power plant construction and a concomitant dampening of demand for electricity. Also contributing to rising costs per KWe have been higher financing costs and escalation of labor, materials, and equipment costs.

It is estimated that construction costs for large (1200 MWe) light water nuclear power plants located in areas of the country other than the South will increase (in 1975 dollars) from about $441 per KWe for units beginning construction in 1970 to around $1,077 per KWe for units started in 1985. On smaller nuclear power plants (900 MWe) in the non-South, costs (1975 $) will increase from about $482 per KWe in 1970 to near $1,164 per KWe for units started in 1985. Similar units built in the South[4] will cost about 18 percent less.

An important factor affecting costs has been the steady increase in construction duration for nuclear power plants. The average construction duration for nuclear units (1200 MWe) beginning construction in 1974 was 100 months and for those started in 1985 is forecasted to be 120 months. The cost-duration relationship is complicated by the fact that construction duration has, in some instances, been voluntarily delayed by utilities due to slower growth in demand for electrical energy than was originally anticipated.

In contrast to nuclear construction costs, projected costs for coal-fired plants show lesser increases. Large (800 MWe) coal plants in areas other than the South are projected to increase (in 1975 dollars) from $430 per KWe for units beginning construction in 1974 to $647 per KWe for units started in 1985. The additions of scrubbers for sulphur dioxide removal will increase the cost by about 20 percent.

Oil-fired and gas-fired power plants also show temporal increases in their unit plant cost estimations. (See Figures 11 and 12 in Part IV of text and Tables C-3 and C-4 in Appendix C).

Changes in unit work-hour requirements per KWe over time reflect temporal increases in dollars per KWe installed for all types of electric power plants except hydroelectric.

Part I. Work-Hour Requirements Per KWe

Figure 1 presents the CLDS forecast of work-hour requirements per kilowatt of installed capacity for nuclear power plant construction. Those units with 1979 construction starts in the South are expected to require 15.1 work-hours per KWe (900 MWe). Unit work-hour requirements are expected to grow at annual compound rates of 5.2 percent, 3.5 percent, and 1.5 percent during 1968-1974, 1975-1979, and 1980-1985 respectively. (See Appendix B). The geographic and size classifications for work-hours/KWe are weighted averages of the national work-hour forecast. Nuclear units constructed in the South are expected to require about 18 percent fewer work-hours per KWe of installed capacity than those in the non-South. Nine hundred MWe capacity nuclear units tend to require approximately 10 percent more work-hours per kilowatt of installed capacity than do 1200 MWe units.

Work-hour requirements for coal-fired electric generating plants are shown in Figure 2. The annual compound growth rates of unit work-hour requirements are expected to be 3.3 percent and 1.4 percent during 1974-1979 and 1980-1985 respectively. The addition of scrubbers is projected to increase unit work-hour requirements by approximately 20 percent. Units constructed in the South are estimated to require approximately 12 percent fewer work-hours per kilowatt of installed capacity than those in the non-South.

Oil-fired power plant construction unit work-hour requirements are displayed in Figure 3. The annual compound growth rates of unit work-hour requirements are expected to be 3.2 percent and 1.3 percent during 1974-1979 and 1980-1985 respectively. The addition of scrubbers is expected to increase work-hour requirements by approximately 20 percent and units built in the non-South are estimated to require approximately 14 percent more work-hours/KWe than those in the South. Five hundred megawatt units are expected to require approximately 7 percent more work-hours per kilowatt of installed capacity than 800 megawatt units.

The construction of 300 MWe gas-fired power plants in the non-South is forecasted to require 7.9 work-hours per kilowatt installed for 1985 construction starts (Figure 4). Work-hour requirements are expected to grow at annual compound rates of 3.1 percent and 1.1 percent during 1974-1979 and 1980-1985 respectively. It is expected that gas-fired units constructed in the non-South will require about 11 percent more work-hours per KWe of installed capacity than those in the South. Three hundred megawatt capacity units are projected to require 10 percent more work-hours per kilowatt installed than 500 megawatt capacity units.

No significant time trend was found in work-hour requirements for hydroelectric and pump storage units.

FIGURE 1.

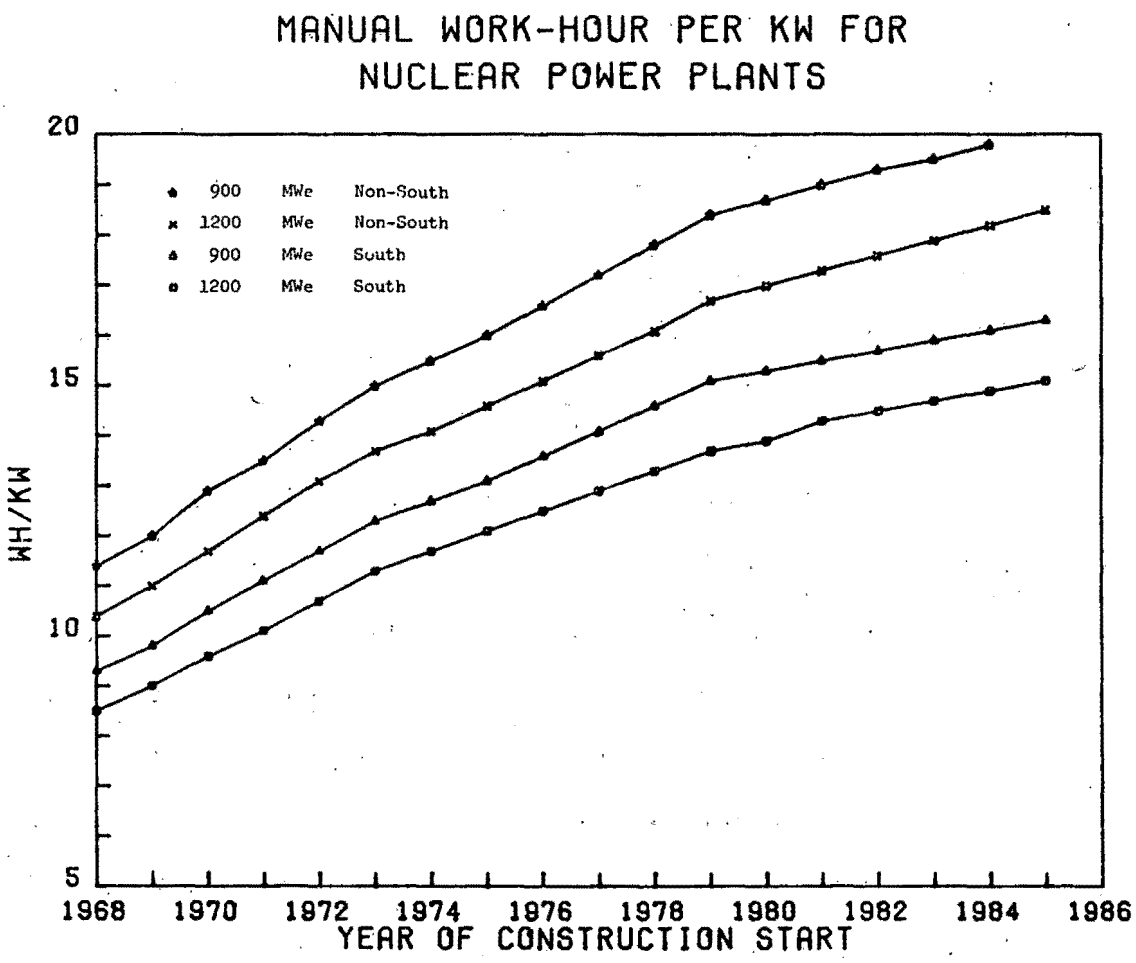
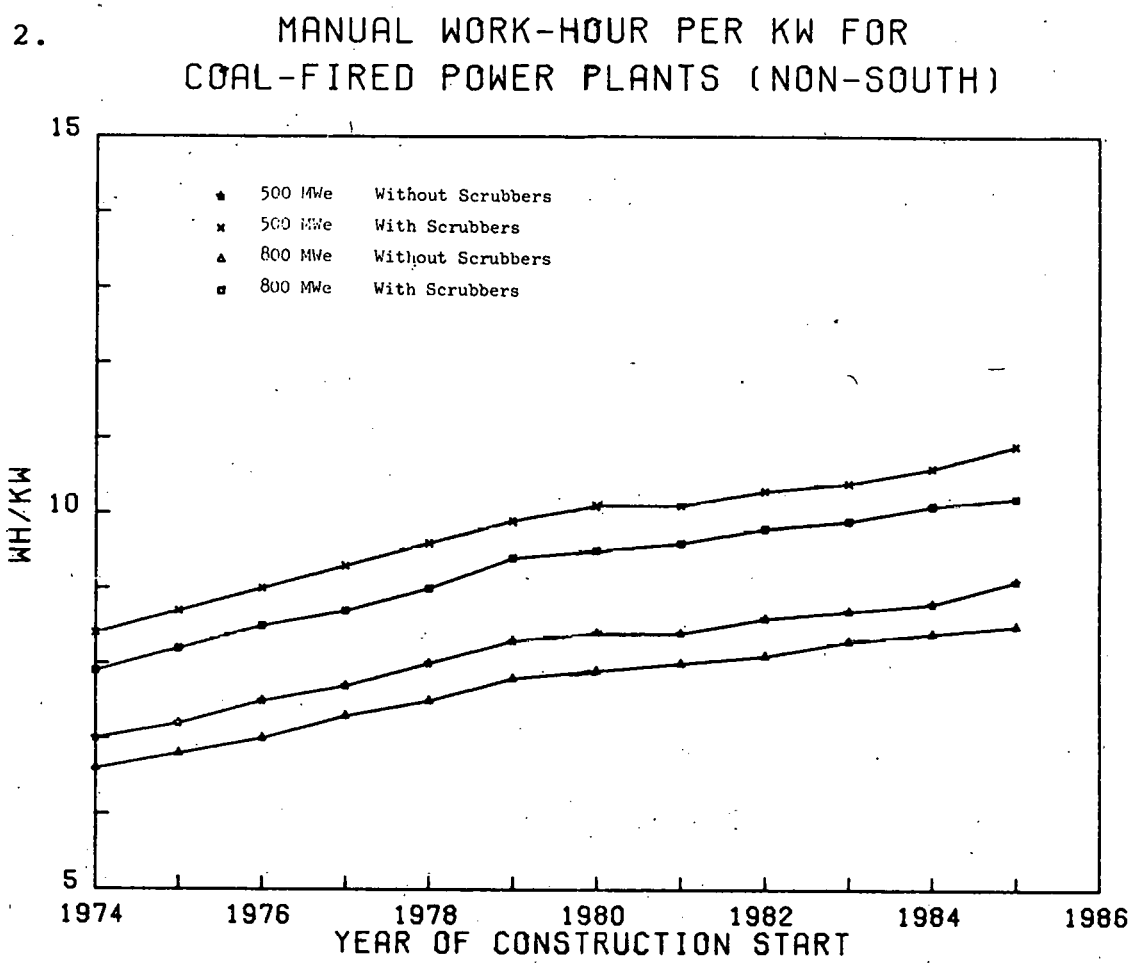

MANUAL WORK-HOUR PER KW FOR
NUCLEAR POWER PLANTS
900 MWe Non-South
1200 MWe Non-South
900 MWe South
1200 MWe South
WH/KW
20
15
10
5
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
YEAR OF CONSTRUCTION START

FIGURE 2.


MANUAL WORK-HOUR PER KW FOR
COAL-FIRED POWER PLANTS (NON-SOUTH)
500 MWe Without Scrubbers
500 MWe With Scrubbers
800 MWe Without Scrubbers
800 MWe With Scrubbers
WH/KW
15
10
5
1974
1976
1978
1980
1982
1984
1986
YEAR OF CONSTRUCTION START

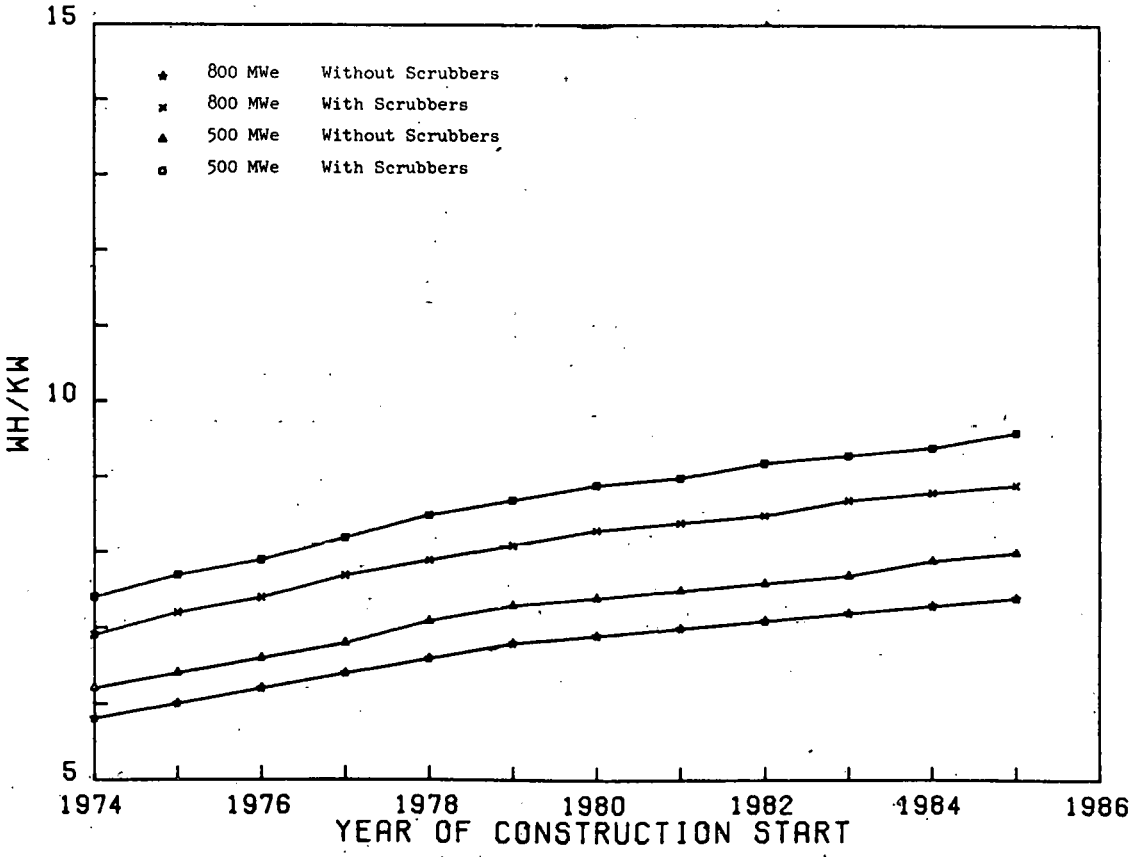
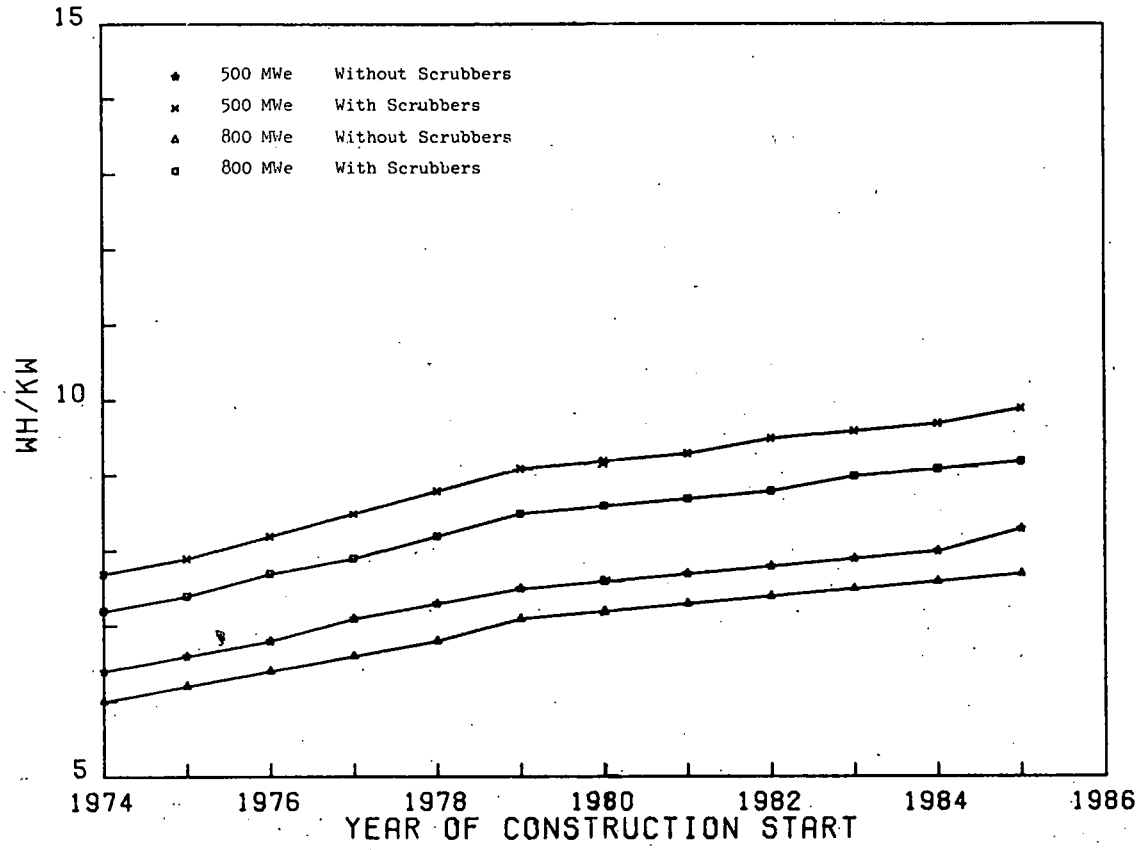

MANUAL WORK-HOUR PER KW FOR
COAL-FIRED POWER PLANTS (SOUTH)
800 MWe Without Scrubbers
800 MWe With Scrubbers
500 MWe Without Scrubbers
500 MWe With Scrubbers
WH/KW
15
10
5
1974
1976
1978
1980
1982
1984
1986
YEAR OF CONSTRUCTION START

FIGURE 3.


MANUAL WORK-HOUR PER KW FOR
OIL-FIRED POWER PLANTS (NON-SOUTH)
500 MWe Without Scrubbers
500 MWe With Scrubbers
800 MWe Without Scrubbers
800 MWe With Scrubbers
WH/KW
15
10
5
1974
1976
1978
1980
1982
1984
1986
YEAR OF CONSTRUCTION START

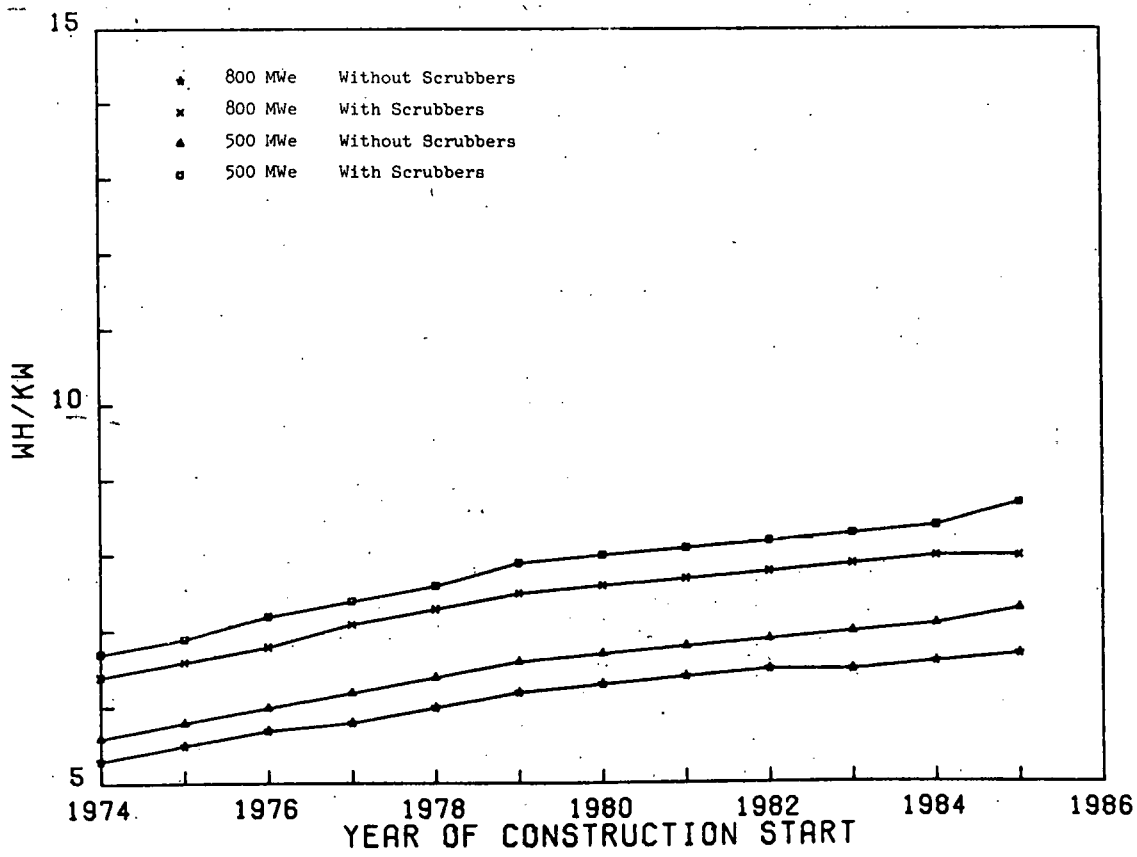
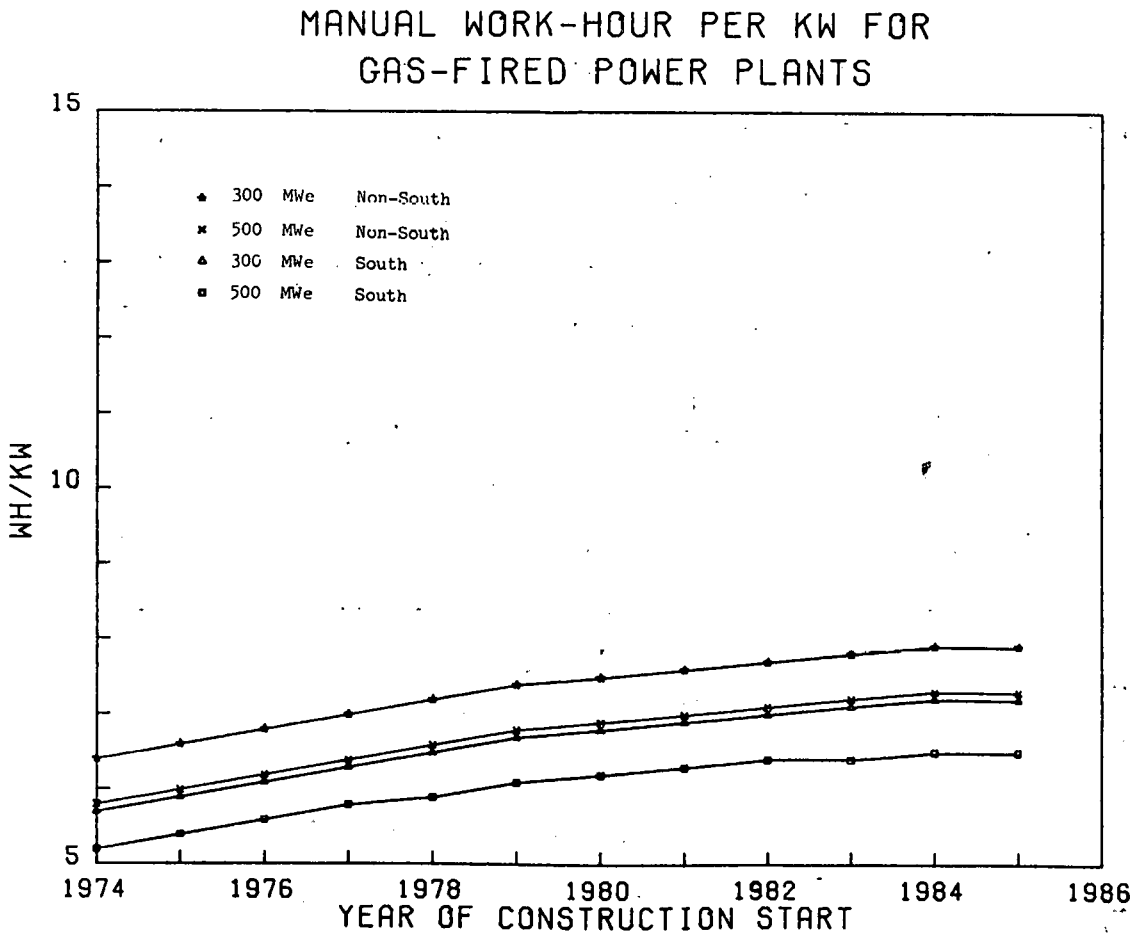

MANUAL WORK-HOUR PER KW FOR
OIL-FIRED POWER PLANTS (SOUTH)
800 MWe Without Scrubbers
800 MWe With Scrubbers
500 MWe Without Scrubbers
500 MWe With Scrubbers
WH/KW
15
10
5
1974
1976
1978
1980
1982
1984
1986
YEAR OF CONSTRUCTION START

FIGURE 4.


MANUAL WORK-HOUR PER KW FOR
GAS-FIRED POWER PLANTS
300 MWe Non-South
500 MWe Non-South
300 MWe South
500 MWe South
WH/KW
15
10
5
1974
1976
1978
1980
1982
1984
1986
YEAR OF CONSTRUCTION START

Part II. Craft Requirements

Table 1 presents the forecast of work-year requirements by craft, for the construction of all new electric generating facilities in the nation during the period 1979-1983. The projected requirements mirror anticipated declining activity levels, phases of construction, and categorical mix, i.e., the blend of nuclear, fossil (coal, oil, and gas), and hydro-electric facilities being constructed (see Table 2 and Figure 5).

Overall labor requirements will peak during 1979. However, among crafts there will be considerable divergence. For example, the need for asbestos workers is forecasted at its height in 1981. Laborers, carpenters, and ironworkers will be needed in greatest numbers in 1979, electricians and pipefitters in 1980 (see Table 3).

There are a number of factors contributing to the decline in power plant construction and concomitant reduction in labor requirements that will occur in the first half of the 1980's. Certainly, kilowatt-hour growth in the latter 1970's was less than robust as industry and residential users began to give serious attention to electric energy conservation techniques. Electric consumption from 1974 to 1977 grew at an annual rate of about 4.6 percent, compared with a historical rate of 7.5 percent. From 1977 to 1985 it is anticipated to increase 3.9 percent annually.[5]

At the same time as the growth rate for electricity was falling, the industry expanded reserve margins by bringing on-line substantial additions to generating capacity. Also, utilities in a number of cases delayed in-progress construction due to financial problems. Higher fuel and capital costs necessitated substantial rate increases and hardened resistance to further rate adjustments. By the same token, low capacity utilization, lengthening times of licensing and construction, and high inflation associated with new plant construction required even greater rate increases if utilities were to finance new plants. The ability of utilities to finance new debt or equity was thus impaired and building plans curtailed.

Nuclear units, requiring the largest capital investment per installed KWe and the longest construction lead-time of any type of electric generating plant, were the most heavily impacted by financial developments. Also diminishing the attractiveness of the nuclear option have been the costs of uncertainties associated with meeting increased safety and environmental regulations.

The analysis indicates that pipefitters will continue to be the craft most in demand on power plant construction. In base year 1979, requirements for fitters totaled 42,170 work-years, or 21 percent of total on-site labor needs; in 1983, the fitters' percentage rises to 23 percent (32,350 WY). Among other skilled occupations, the largest group working on-site in power plant

construction are electricians. Their share of total on-site labor increases from 14 percent in 1979 (27,440 WY) to 16 percent in 1983 (22,510 WY).

Work-year requirements for the nation are subdivided into categories of power plants, that is, nuclear, fossil, and hydroelectric. Annual craft requirements reach their highest in 1980, 1983, and 1979 respectively for nuclear, fossil, and hydroelectric generating stations. These anticipated patterns are shown graphically in Figure 6.

Nearly twice the number of work-years of construction labor will be required for building nuclear facilities (122,260 WY) in 1979 as fossil-fueled units (65,360 WY). However, as indicated in Table 4, on-site labor requirements for nuclear plants will drop precipitously through 1983 (69,730 WY); whereas, for fossil-fueled plants, requirements in 1983 (65,980 WY) will be slightly higher than in 1979 (Table 5). Field labor requirements for hydroelectric generating plants represented 6 percent (12,670 WY) of total labor involved in power plant construction in 1979 (Table 6); by 1983, this proportion is forecasted to decline to 5 percent (6,900 WY).

Table 1.

LABOR REQUIREMENTS

AREA : NATION
CATEGORY : POWER PLANTS
SUBCATEGRY: ALL SUBCATEGORY
LABOR UNIT: UNIT: WORK-YEARS*
TIME FRAME: 1979-1983

REPORT SECTION: NATION

CRAFT	1979	1980	1981	1982	1983	TOTAL	PERCENT CHANGE 79-80	80-81	81-82	82-83	79-83	79-PEAK
ASBEST WKS/INSUL	3440.	3730.	4150.	3910.	3770.	19000.	8.3	11.4	-5.9	-3.6	9.4	20.6
BOILERMAKERS	14280.	13850.	12810.	11970.	12390.	65300.	-3.0	-7.5	-6.6	3.6	-13.2	0.0
BRICKLAY-STMASON	790.	730.	670.	560.	480.	3230.	-7.3	-8.6	-16.5	-13.7	-39.0	0.0
CARPENTERS	23720.	21020.	17790.	15100.	12940.	90570.	-11.4	-15.4	-15.1	-14.3	-45.5	0.0
CEMENT-CONC FINI	2750.	2650.	2360.	2020.	1810.	11590.	-3.7	-10.9	-14.3	-10.7	-34.3	0.0
ELECTRICIANS	27440.	29820.	28030.	24790.	22510.	132590.	8.7	-6.0	-11.6	-9.2	-18.0	8.7
IRON WKS	17800.	16220.	14020.	12150.	11170.	71360.	-8.8	-13.6	-13.4	-8.0	-37.2	0.0
LABORERS	31720.	29490.	26570.	22350.	19370.	129500.	-7.0	-9.9	-15.9	-13.3	-38.9	0.0
MILLWRIGHTS	4970.	5440.	5270.	4650.	4280.	24610.	9.4	-3.2	-11.7	-7.9	-13.9	9.4
OPERATING ENGR	15740.	14690.	13070.	11440.	10270.	65210.	-6.7	-11.0	-12.5	-10.3	-34.8	0.0
PAINTERS	3690.	4020.	4030.	3530.	3140.	18410.	8.9	0.2	-12.4	-11.2	-15.1	9.2
PIPEFITTERS	42170.	45070.	42020.	36370.	32350.	197980.	6.9	-6.8	-13.4	-11.0	-23.3	6.9
SHEET METAL WKS	2750.	3140.	3120.	2820.	2600.	14430.	13.9	-0.5	-9.7	-7.7	-5.6	13.9
TRUCK DRIVERS	7840.	7700.	6730.	5650.	4950.	32870.	-1.8	-12.5	-16.1	-12.3	-36.8	0.0
OTHER WORKERS	1220.	1170.	1010.	910.	810.	5120.	-4.1	-14.2	-9.4	-11.6	-34.1	0.0
TOTAL WORKERS	200330.	198740.	181660.	158220.	142840.	881790.	-0.8	-8.6	-12.9	-9.7	-28.7	0.0

*Work-years (37 hrs./wk., 4.345 wks./month, 12 months) = 1,929.2 work-hours/year.

Note: Due to rounding, sums of individual items may not equal totals.

Table 2

New Electric Generating Capacity Under Construction
or Planned, by Type of Facility, 1979-1983
(As of September 1979)

Type	1979		1980		1981		1982		1983	
	MWe	Units	MWe	Units	MWe	Units	MWe	Units	MWe	Units
Nuclear	131,699	118	122,710	109	112,542	99	99,578	87	80,522	70
Fossil	100,305	266	96,710	251	91,260	230	94,061	240	89,774	220
Hydro	20,001	147	15,619	116	16,831	115	17,167	94	14,156	83
TOTAL	252,005	531	235,039	476	220,633	444	210,806	421	184,452	373

Source: See Appendix E (Data Sources and References)

FIGURE 5

NEW ELECTRIC GENERATING CAPACITY UNDER CONSTRUCTION

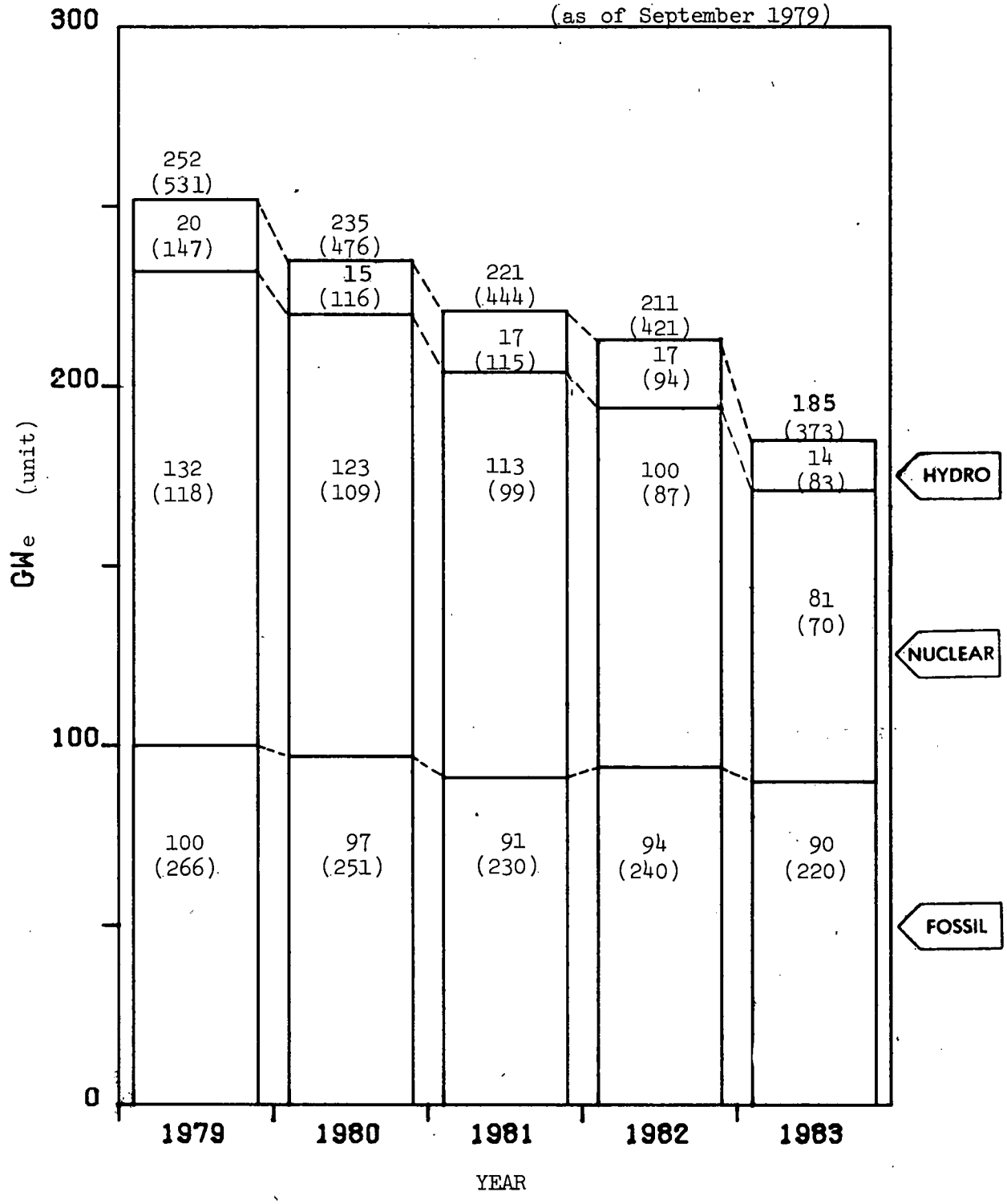


Table 3

Labor Requirement Peaks, by Craft and Year of Peak, for Electric Generating Power Plant Construction 1979-1983

Craft	Year of Peak Requirements
Asbestos Workers	1981
Boilermakers	1979
Bricklayers	1980
Carpenters	1979
Cement-Concrete Finishers	1979
Electricians	1980
Iron Workers	1979
Laborers	1979
Millwrights	1980
Operating Engineers	1979
Painters	1981
Pipefitters	1980
Sheet Metal Workers	1980
Truck Drivers	1979
Other Construction Workers (NEC)	1981
Total (All Crafts)	1979

(NEC): Not Elsewhere Classified

FIGURE 6.

On-Site Labor Requirements for Constructing Electric Generating Power Plants, by Type of Facility 1979-1983

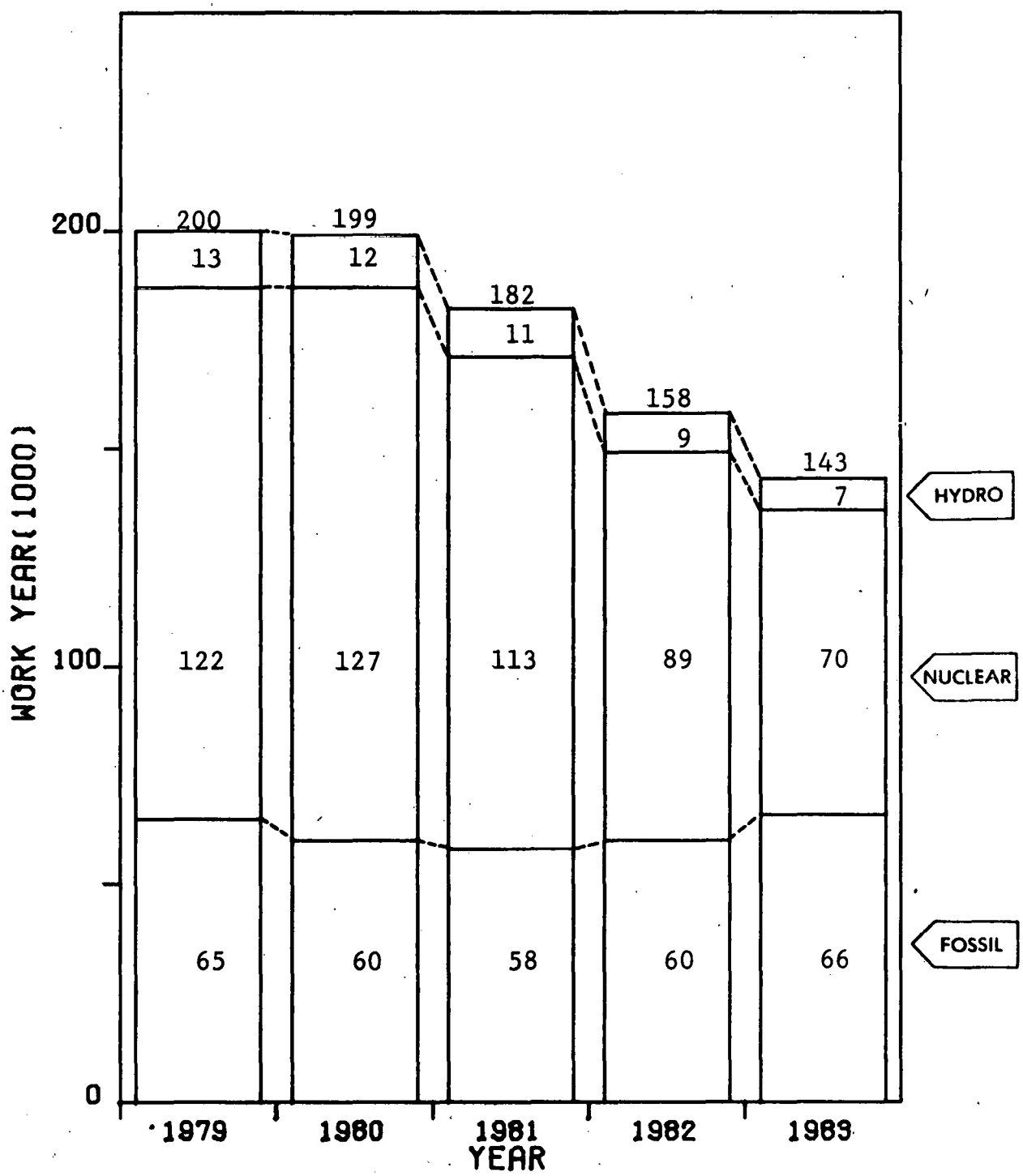


Table 4

LABOR REQUIREMENTS

AREA : NATION
CATEGORY : POWER PLANTS
SUBCATEGRY: NUCLEAR/FOSSIL/HYDRO/
LABOR UNIT: UNIT: WORK-YEARS*
TIME FRAME: 1979-1983

REPORT SECTION: NATION -- NUCLEAR

							PERCENT CHANGE					
CRAFT	1979	1980	1981	1982	1983	TOTAL	79-80	80-81	81-82	82-83	79-83	79-PEAK
ASBEST WKS/INSUL	1070.	1530.	2120.	1820.	1520.	8060.	42.8	38.4	-13.8	-16.7	41.9	97.6
BOILERMAKERS	4120.	4390.	3700.	2850.	2300.	17360.	6.5	-15.7	-23.0	-19.4	-44.2	6.5
BRICKLAY-STMASON	500.	450.	410.	270.	180.	1810.	-9.9	-8.8	-33.0	-34.2	-63.8	0.0
CARPENTERS	16630.	14540.	11650.	8670.	6240.	57730.	-12.6	-19.8	-25.6	-28.0	-62.5	0.0
CEMENT-CONC FINI	1860.	1820.	1580.	1190.	920.	7370.	-1.8	-13.4	-24.6	-22.4	-50.2	0.0
ELECTRICIANS	17330.	20620.	19050.	15550.	12610.	85160.	19.0	-7.6	-18.4	-18.9	-27.2	19.0
IRON WKS	11220.	10160.	8270.	6210.	4490.	40350.	-9.5	-18.6	-24.9	-27.7	-60.0	0.0
LABORERS	20150.	19100.	16920.	12720.	9540.	77930.	-5.2	-14.1	-22.5	-25.0	-52.7	0.0
MILLWRIGHTS	2460.	3010.	2950.	2360.	1960.	12740.	22.5	-2.1	-19.9	-17.0	-20.4	22.5
OPERATING ENGR	8510.	8030.	6680.	5240.	4020.	32480.	-5.6	-16.9	-21.6	-23.3	-52.8	0.0
PAINTERS	2570.	2980.	3030.	2510.	2070.	13160.	16.0	1.5	-17.1	-17.5	-19.5	17.8
PIPEFITTERS	29270.	33460.	30620.	24560.	20040.	137950.	14.3	-8.5	-19.8	-18.4	-31.5	14.3
SHEET METAL WKS	1380.	1890.	1830.	1550.	1250.	7900.	36.7	-2.9	-15.2	-19.5	-9.4	36.7
TRUCK DRIVERS	4650.	4780.	4000.	3060.	2320.	18810.	2.6	-16.2	-23.7	-24.1	-50.2	2.6
OTHER WORKERS	540.	550.	460.	350.	270.	2170.	1.8	-16.4	-23.0	-24.1	-50.3	1.8
TOTAL WORKERS	122260.	127310.	112770.	88920.	69730.	520990.	4.1	-11.4	-21.1	-21.6	-43.0	4.1

* Work-years (37 hrs./wk., 4.345 wks./month, 12 months) = 1,929.2 work-hours/year.

Note: Due to rounding, sums of individual items may not equal totals.

Table 5

LABOR REQUIREMENTS

AREA : NATION
CATEGORY : POWER PLANTS
SUBCATEGRY: NUCLEAR/FOSSIL/HYDRO/
LABOR UNIT: UNIT: WORK-YEARS*
TIME FRAME: 1979-1983

REPORT SECTION: NATION -- FOSSIL**

CRAFT	1979	1980	1981	1982	1983	TOTAL	PERCENT CHANGE 79-80	80-81	81-82	82-83	79-83	79-PEAK
ASBEST WKS/INSUL	2370.	2190.	2050.	2070.	2240.	10920.	-7.7	-6.4	1.0	8.0	-5.8	0.0
BOILERMAKERS	9820.	9140.	8850.	8820.	9820.	46450.	-6.9	-3.1	-0.4	11.4	0.0	0.0
BRICKLAY-STMASON	290.	280.	260.	280.	300.	1410.	-4.0	-7.8	8.2	7.7	3.1	3.1
CARPENTERS	5500.	4970.	4820.	5310.	5800.	26400.	-9.7	-3.0	10.2	9.2	5.4	5.4
CEMENT-CONC FINI	710.	650.	620.	690.	770.	3440.	-8.4	-4.7	11.1	11.9	8.4	8.4
ELECTRICIANS	9490.	8510.	8310.	8600.	9410.	44320.	-10.4	-2.3	3.4	9.4	-0.9	0.0
IRON WKS	5820.	5330.	5130.	5380.	6180.	27840.	-8.5	-3.6	4.8	14.9	6.3	6.3
LABORERS	7580.	7030.	6830.	7250.	7950.	36640.	-7.3	-2.8	6.1	9.6	4.9	4.9
MILLWRIGHTS	1930.	1770.	1670.	1740.	1880.	8990.	-8.2	-5.6	4.3	7.9	-2.4	0.0
OPERATING ENGR	4820.	4550.	4400.	4680.	5040.	23490.	-5.7	-3.2	6.3	7.7	4.6	4.6
PAINTERS	960.	890.	860.	870.	960.	4540.	-7.6	-3.9	1.9	10.2	-0.2	0.0
PIPEFITTERS	12370.	11090.	10950.	11310.	11970.	57690.	-10.4	-1.2	3.3	5.8	-3.2	0.0
SHEET METAL WKS	1330.	1210.	1250.	1210.	1320.	6320.	-9.6	3.4	-3.1	9.2	-1.1	0.0
TRUCK DRIVERS	2130.	2010.	1860.	1940.	2100.	10040.	-5.8	-7.4	4.3	8.2	-1.5	0.0
OTHER WORKERS	230.	220.	200.	220.	240.	1110.	-6.3	-6.9	6.0	9.3	1.0	1.0
TOTAL WORKERS	65360.	59810.	58070.	60370.	65980.	309590.	-8.5	-2.9	4.0	9.3	0.9	0.9

*Work-years (37 hrs./wk., 4.345 wks./month, 12 months) = 1,929.2 work-hours/year.

**If requested, separate data on labor requirements to construct coal-, oil-, and gas-fired power plants can be made available.

e: Due to rounding, sums of individual items may not equal totals.

Table 6

LABOR REQUIREMENTS

AREA : NATION
CATEGORY : POWER PLANTS
SUBCATEGRY: NUCLEAR/FOSSIL/HYDRO/
LABOR UNIT: UNIT: WORK-YEARS*
TIME FRAME: 1979-1983

REPORT SECTION: NATION -- HYDRO

CRAFT	1979	1980	1981	1982	1983	TOTAL	PERCENT CHANGE 79-80	80-81	81-82	82-83	79-83	79-PEAK
BOILERMAKERS	330.	330.	260.	270.	210.	1400.	-0.4	-20.2	2.3	-20.4	-35.2	0.0
CARPENTERS	1590.	1520.	1320.	1070.	880.	6380.	-4.3	-13.3	-18.9	-17.3	-44.4	0.0
CEMENT-CONC FINI	180.	180.	160.	140.	110.	770.	-3.5	-8.3	-14.3	-20.2	-39.5	0.0
ELECTRICIANS	610.	680.	700.	580.	470.	3040.	10.6	3.5	-17.9	-17.7	-22.6	14.5
IRON WKS	760.	750.	610.	520.	450.	3090.	-0.9	-18.5	-15.0	-12.9	-40.1	0.0
LABORERS	3990.	3370.	3310.	2330.	1870.	14870.	-15.3	-1.8	-29.6	-19.9	-53.1	0.0
MILLWRIGHTS	590.	660.	650.	530.	430.	2860.	11.9	-0.8	-17.8	-19.3	-26.4	11.9
OPERATING ENGR	2410.	2120.	1970.	1500.	1190.	9190.	-12.1	-6.9	-23.9	-20.6	-50.6	0.0
PAINTERS	160.	150.	150.	150.	100.	710.	-3.0	-0.9	-1.2	-32.1	-35.5	0.0
PIPEFITTERS	520.	500.	500.	410.	330.	2260.	-3.6	-0.6	-17.3	-21.0	-37.5	0.0
TRUCK DRIVERS	1050.	910.	870.	650.	510.	3990.	-13.3	-4.8	-25.2	-20.7	-51.0	0.0
OTHER WORKERS	490.	460.	390.	390.	330.	2060.	-7.4	-13.7	-1.5	-13.6	-32.0	0.0
TOTAL WORKERS	12670.	11620.	10910.	8540.	6900.	50640.	-8.3	-6.2	-21.7	-19.2	-45.5	0.0

* Work-years (37 hrs./wk., 4.345 wks./month, 12 months) = 1,929.2 work-hours/year.

Note: Due to rounding, sums of individual items may not equal totals.

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Part III. Regional Construction Labor Requirements

Tables 7 through 16 show annual craft requirements by work-months[6] for each of the ten (10) DOL regions (Figure 7). Percentage changes from year-to-year are presented for each craft. Also shown is the percentage change of the peak work-month requirements from those of the year 1979. When reviewing percentage changes, users should make reference to the magnitude of the base. Requirements for asbestos workers in Region 1 show a substantial increase of 1,779.3 percent from 1979 to 1983, however, the 1979 base is a modest 120 work-months.

Table 17 provides a summary of overall craft requirements by year and region. Regions 4, 5, and 6 account for about 54 percent of overall craft requirements during the period of this analysis. Respectively, these regions maintain first, second, and third rankings for years 1979, 1980, 1981, and 1982. In 1983, however, intense nuclear construction activity (13 units) in Region 2 and concomitant slowdowns in other regions are expected to result in that area moving from ninth position (1979) to 3rd position (1983). Estimated labor requirements, by region, are shown graphically in Figure 8. Table 18 shows power plant capacity under construction or planned by year, type, and region.

A strong increase, 26 percent, in craft requirements for Region 1 (New England) is expected between 1979 and 1980. Continued growth is shown from 1980 to 1981, but at a reduced rate; thereafter requirements decrease at a considerable pace. This reduction will

be primarily associated with a lessening in the number of fossil-fueled units being built in 1982 and 1983 compared to the previous years.

Region 2 (New York-New Jersey), unlike any of the other regions, is expected to witness a continuous growth in overall on-site requirements through 1983. The CLDS project file indicates that new units with a capacity of 17,719 MWe are under construction or coming on-line in the region in 1979. This is projected to increase to 21,344 MWe in 1983. Substantial increases in absolute and percentage terms are indicated for boilermakers, electricians, operating engineers, and pipefitters.

Labor requirements for power plant construction in the Middle Atlantic states (Region 3) are projected to decline by more than one-half in the 1979-1983 period. This reduction reflects primarily a slowdown in nuclear power plant construction; units totaling some 8,801 MWe were under construction or coming on-line in 1979, and in 1983 the comparable figure will be 3,111 MWe.

Region 4 (Southeastern U.S.) is the most active area for nuclear power plant construction. CLDS data indicate that in 1979 some 33 units totaling approximately 37,750 MWe of capacity were under construction. This activity level will decline each year through 1983, with the latter year showing 19 units with a capacity of 22,360 MWe. Construction of fossil-fueled plants, on the other hand, will remain relatively stable in the area through the 1979-1983 period. Overall, labor requirements in the region are forecasted to decline by approximately 37 percent, from 548,380 work-months to 343,450 work-months.

The number of nuclear units under construction in Region 5 (Midwest) in 1983 (13) is expected to be only one-half the number that were being built in 1979. However, the decline in fossil-fueled units being built will be more modest, slowing from 51 units to 42 units. Labor requirements are projected to be off some 34 percent between these years, totaling 314,140 work-months in 1983.

The South Central area (Region 6) is currently the center for an active construction program for fossil-fueled units. This region is expected to retain this prominence for the entire study period. However, there will be some slowdown in fossil-fueled power plant construction as well as a more severe leveling-off of nuclear activity. Consequently, labor requirements will dip from 350,520 work-months in 1979 to 214,760 work-months in 1983.

The largest relative decline in projected on-site construction labor is expected to occur in Region 7 (Iowa, Kansas, Missouri, and Nebraska). The work force between 1979 and 1983 is expected to fall by some 60 percent from 148,710 work-months. Underlying this drop is the coming on-line of 2 of 3 nuclear units within the time frame and a drop in fossil activity from 29 units under construction in 1979 to 16 in 1983.

No nuclear power plant construction is scheduled to take place in the Rocky Mountain area (Region 8) during the study period. However, a relatively steady amount of construction work will be

taking place on fossil and hydroelectric units. Labor requirements are anticipated to rise by about 29 percent from 1979 through 1981 and then ease by approximately 17 percent between 1981 and 1983.

Region 9 (Arizona, California, Hawaii, and Nevada) should sustain a modest growth in the construction of generating plants using fossil fuels. Nevertheless, declines in hydroelectric and nuclear activity should reduce the overall requirements for on-site labor by nearly two-fifths in the study period.

The CLDS data base shows a virtual shutdown of hydroelectric construction in the Northwest (Region 10) by 1983 as well as little activity in fossil plant construction. Nuclear construction activity, on the other hand, will ease only modestly. On the labor side, requirements are expected to decrease from 165,790 work-months in 1979 to 112,230 work-months in 1983.

FIGURE 7.

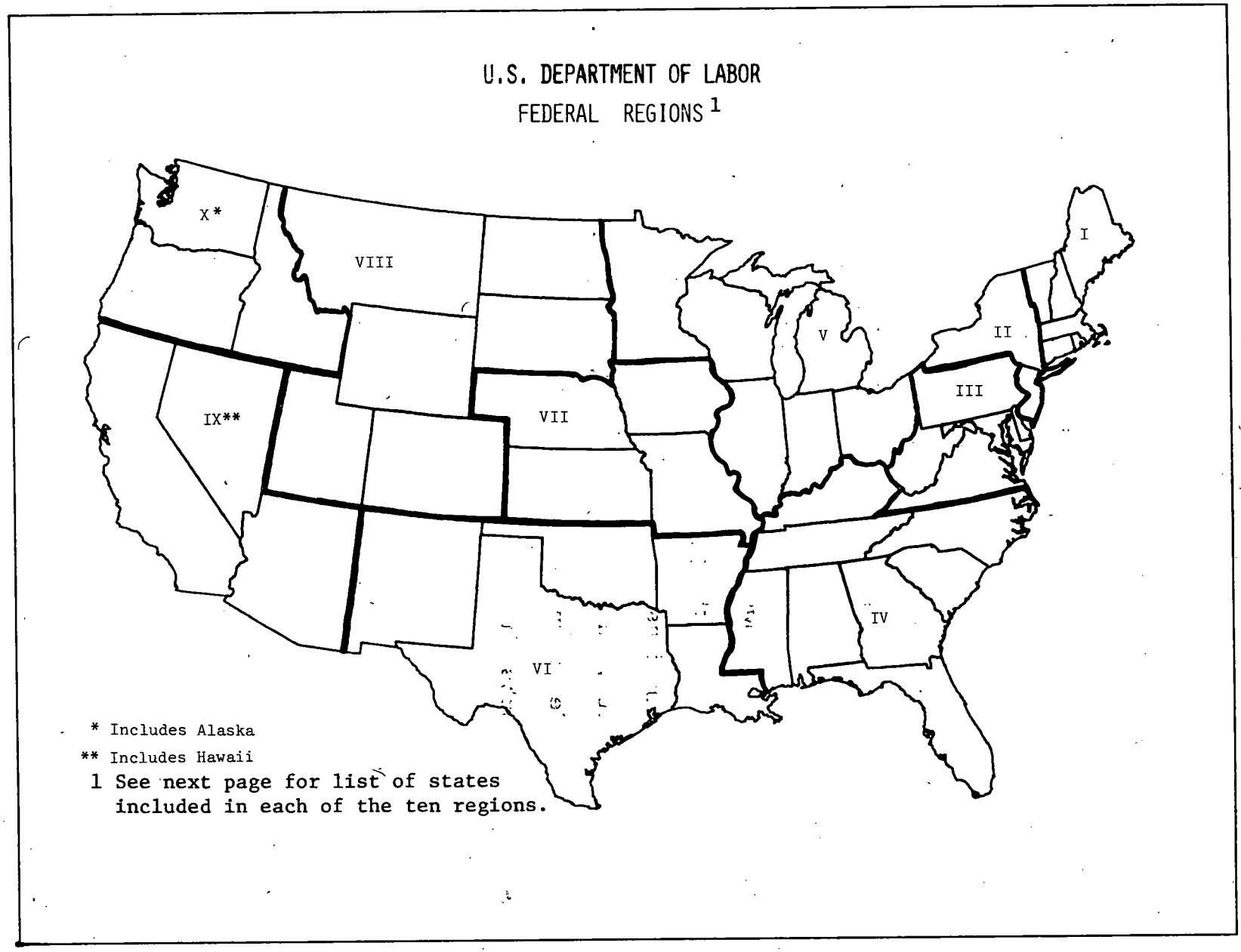

U.S. DEPARTMENT OF LABOR
FEDERAL REGIONS 1
X*
VIII
I
V
II
IX**
VII
III
IV
VI
* Includes Alaska
** Includes Hawaii
1 See next page for list of states included in each of the ten regions.

Figure 7 (Cont'd)

Region	States
I:	Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont
II:	New Jersey, New York
III:	Delaware, District of Columbia, Maryland, Pennsylvania, Virginia, West Virginia
IV:	Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee
V:	Illinois, Indiana, Michigan, Minnesota, Ohio, Wisconsin
VI:	Arkansas, Louisiana, New Mexico, Oklahoma, Texas
VII:	Iowa, Kansas, Missouri, Nebraska
VIII:	Colorado, Montana, North Dakota, South Dakota, Utah, Wyoming
IX:	Arizona, California, Hawaii, Nevada
X:	Alaska, Idaho, Oregon, Washington

Table 7

LABOR REQUIREMENTS

AREA : DOL REGION
CATEGORY : POWER PLANTS
SUBCATEGRY: ALL SUBCATEGORY
LABOR UNIT: UNIT: WORK-MONTHS*
TIME FRAME: 1979-1983

Region 1

CRAFT	1979	1980	1981	1982	1983	TOTAL	PERCENT CHANGE 79-80	80-81	81-82	82-83	79-83	79-PEAK
ASBEST WKS/INSUL	120.	630.	1520.	2260.	2190.	6720.	437.5	142.4	49.1	-3.3	1779.3	1842.7
BOILERMAKERS	3750.	5750.	5990.	4770.	3660.	23920.	53.1	4.2	-20.3	-23.3	-2.5	59.5
BRICKLAY-STMASON	620.	550.	540.	360.	210.	2280.	-11.8	-2.2	-32.2	-41.9	-66.0	0.0
CARPENTERS	14390.	12230.	10480.	8100.	5650.	50850.	-15.0	-14.3	-22.7	-30.3	-60.8	0.0
CEMENT-CONC FINI	1190.	1460.	1360.	1150.	830.	5990.	22.3	-6.3	-16.0	-27.3	-30.0	22.3
ELECTRICIANS	9740.	17710.	21750.	19240.	15610.	84050.	81.8	22.8	-11.6	-18.9	60.3	123.3
IRON WKS	10170.	9430.	8030.	6400.	4440.	38470.	-7.3	-14.8	-20.3	-30.6	-56.3	0.0
LABORERS	17050.	17100.	15880.	12970.	10110.	73110.	0.3	-7.1	-18.3	-22.1	-40.7	0.3
MILLWRIGHTS	1020.	2150.	2920.	2860.	2670.	11620.	111.0	35.7	-1.8	-6.7	162.2	186.2
OPERATING ENGR	7060.	7520.	6630.	5140.	3780.	30130.	6.5	-11.9	-22.5	-26.5	-46.5	6.5
PAINTERS	1270.	1820.	2260.	2920.	2510.	10780.	43.9	24.2	28.8	-13.9	98.3	130.2
PIPEFITTERS	15720.	26560.	32050.	30180.	25790.	130300.	69.0	20.7	-5.9	-14.5	64.1	104.0
SHEET METAL WKS	530.	1380.	1970.	1910.	1570.	7360.	159.3	42.7	-2.7	-18.0	195.0	270.0
TRUCK DRIVERS	3020.	3460.	3220.	2560.	1940.	14200.	14.6	-7.0	-20.6	-24.0	-35.7	14.6
OTHER WORKERS	360.	410.	380.	300.	220.	1670.	14.4	-7.8	-21.4	-27.3	-39.7	14.4
TOTAL WORKERS	86010.	108150.	114980.	101120.	81180.	491440.	25.7	6.3	-12.1	-19.7	-5.6	33.7

* Work-months (37 hrs./wk., 4.345 wks./month) = 160.8 work-hours/month.

Note: Due to rounding, sums of individual items may not equal totals.

Table 8

LABOR REQUIREMENTS

AREA : DOL REGION
CATEGORY : POWER PLANTS
SUBCATEGRY: ALL SUBCATEGORY
LABOR UNIT: UNIT: WORK-MONTHS*
TIME FRAME: 1979-1983

Region 2							PERCENT CHANGE					
CRAFT	1979	1980	1981	1982	1983	TOTAL	79-80	80-81	81-82	82-83	79-83	79-PEAK
ASBEST WKS/INSUL	530.	510.	1180.	2850.	3310.	8380.	-3.2	131.0	141.0	16.2	526.6	526.6
BOILERMAKERS	3860.	5940.	7090.	10360.	11080.	38330.	53.8	19.4	46.1	6.9	187.0	187.0
BRICKLAY-STMASON	270.	670.	880.	790.	670.	3280.	146.3	31.2	-10.4	-15.4	145.0	223.2
CARPENTERS	18090.	20620.	25070.	26750.	25580.	116110.	14.0	21.6	6.7	-4.4	41.4	47.9
CEMENT-CONC FINI	1990.	2190.	2760.	3180.	3320.	13440.	9.8	26.4	15.2	4.3	66.9	66.9
ELECTRICIANS	13730.	18060.	24200.	31820.	33990.	121800.	31.6	34.0	31.5	6.8	147.5	147.5
IRON WKS	11640.	14000.	17020.	18950.	17300.	78910.	20.3	21.5	11.3	-8.7	48.6	62.8
LABORERS	21420.	25760.	31470.	35530.	34850.	149030.	20.2	22.2	12.9	-1.9	62.7	65.8
MILLWRIGHTS	1990.	2620.	3620.	4870.	5740.	18840.	32.0	38.1	34.6	17.9	189.2	189.2
OPERATING ENGR	9900.	11930.	13860.	15680.	15960.	67330.	20.5	16.2	13.1	1.8	61.1	61.1
PAINTERS	1600.	1940.	2720.	3840.	4210.	14310.	21.2	39.9	41.2	9.7	162.7	162.7
PIPEFITTERS	20690.	27300.	35620.	44830.	49650.	178090.	32.0	30.5	25.9	10.7	140.0	140.0
SHEET METAL WKS	800.	1430.	1920.	2540.	2750.	9440.	79.6	34.3	32.1	8.4	245.4	245.4
TRUCK DRIVERS	4300.	6430.	6920.	7220.	7280.	32150.	49.6	7.6	4.4	0.7	69.3	69.3
OTHER WORKERS	740.	1040.	1420.	1520.	1480.	6200.	41.6	36.0	7.1	-2.7	100.6	106.3
TOTAL WORKERS	111550.	140460.	175750.	210730.	217160.	855650.	25.9	25.1	19.9	3.0	94.7	94.7

* Work-months (37 hrs./wk., 4.345 wks./month) = 160.8 work-hours/month.

Note: Due to rounding, sums of individual items may not equal totals.

Table 9

LABOR REQUIREMENTS

AREA : DOL REGION
CATEGORY : POWER PLANTS
SUBCATEGRY: ALL SUBCATEGORY
LABOR UNIT: UNIT: WORK-MONTHS*
TIME FRAME: 1979-1983

Region 3

CRAFT	1979	1980	1981	1982	1983	TOTAL	PERCENT CHANGE 79-80	80-81	81-82	82-83	79-83	79-PEAK
ASBEST WKS/INSUL	4140.	3240.	2730.	2590.	2580.	15280.	-21.9	-15.7	-5.0	-0.5	-37.7	0.0
BOILERMAKERS	13020.	9790.	8270.	6530.	6880.	44490.	-24.8	-15.5	-21.0	5.4	-47.1	0.0
BRICKLAY-STMASON	520.	280.	200.	140.	240.	1380.	-45.9	-30.0	-30.1	76.8	-53.2	0.0
CARPENTERS	19170.	14550.	9530.	7590.	8540.	59380.	-24.1	-34.4	-20.4	12.5	-55.4	0.0
CEMENT-CONC FINI	2690.	2190.	1570.	1160.	1160.	8770.	-18.6	-28.3	-26.3	-0.1	-57.0	0.0
ELECTRICIANS	30470.	26010.	21270.	15380.	12910.	106040.	-14.6	-18.2	-27.7	-16.1	-57.6	0.0
IRON WKS	13370.	10650.	7020.	5190.	7200.	43430.	-20.3	-34.2	-26.0	38.7	-46.1	0.0
LABORERS	28690.	23290.	16570.	14020.	15390.	97960.	-18.8	-28.8	-15.4	9.8	-46.3	0.0
MILLWRIGHTS	6250.	5860.	5490.	3750.	2680.	24030.	-6.2	-6.3	-31.7	-28.6	-57.1	0.0
OPERATING ENGR	14920.	12440.	9840.	8530.	8210.	53940.	-16.6	-20.9	-13.3	-3.7	-44.9	0.0
PAINTERS	3610.	3360.	2810.	2200.	1640.	13620.	-7.0	-16.6	-21.6	-25.5	-54.6	0.0
PIPEFITTERS	41750.	33190.	28390.	19940.	16790.	140060.	-20.5	-14.5	-29.8	-15.8	-59.8	0.0
SHEET METAL WKS	3130.	2460.	2330.	1640.	1450.	11010.	-21.6	-5.1	-29.7	-11.4	-53.7	0.0
TRUCK DRIVERS	8170.	6690.	4480.	3410.	3190.	25940.	-18.1	-33.1	-23.9	-6.3	-60.9	0.0
OTHER WORKERS	2460.	2030.	1360.	960.	790.	7600.	-17.5	-33.1	-29.3	-17.5	-67.8	0.0
TOTAL WORKERS	192360.	156030.	121850.	93040.	89670.	652950.	-18.9	-21.9	-23.6	-3.6	-53.4	0.0

*Work-months (37 hrs./wk., 4.345 wks./month) = 160.8 work-hours/month.

Note: Due to rounding, sums of individual items may not equal totals.

Table 10

LABOR REQUIREMENTS

AREA : DOL REGION
CATEGORY : POWER PLANTS
SUBCATEGRY: ALL SUBCATEGORY
LABOR UNIT: UNIT: WORK-MONTHS*
TIME FRAME: 1979-1983

Region 4

CRAFT	1979	1980	1981	1982	1983	TOTAL	PERCENT CHANGE 79-80	80-81	81-82	82-83	79-83	79-PEAK
ASBEST WKS/INSUL	9020.	8530.	10270.	11370.	9630.	48820.	-5.4	20.4	10.8	-15.3	6.8	26.1
BOILERMAKERS	34450.	33040.	32420.	29630.	31190.	160730.	-4.1	-1.9	-8.6	5.2	-9.5	0.0
BRICKLAY-STMASON	1780.	1720.	1430.	1320.	1210.	7460.	-3.3	-16.6	-8.0	-8.2	-31.9	0.0
CARPENTERS	68890.	56900.	46850.	39080.	30350.	242070.	-17.4	-17.7	-16.6	-22.3	-55.9	0.0
CEMENT-CONC FINI	8170.	7180.	6550.	5360.	4040.	31300.	-12.1	-8.8	-18.2	-24.6	-50.5	0.0
ELECTRICIANS	67900.	70220.	71040.	64360.	48690.	322210.	3.4	1.2	-9.4	-24.3	-28.3	4.6
IRON WKS	46760.	41890.	36240.	30180.	24590.	179660.	-10.4	-13.5	-16.7	-18.5	-47.4	0.0
LABORERS	82550.	75610.	70890.	58730.	44610.	332390.	-8.4	-6.3	-17.1	-24.0	-46.0	0.0
MILLWRIGHTS	13660.	13700.	14110.	13010.	10560.	65040.	0.3	3.0	-7.8	-18.8	-22.7	3.3
OPERATING ENGR	41110.	37640.	36000.	31220.	25360.	171330.	-8.5	-4.4	-13.3	-18.8	-38.3	0.0
PAINTERS	12660.	12600.	11680.	10880.	9590.	57410.	-0.5	-7.3	-6.8	-11.9	-24.3	0.0
PIPEFITTERS	126460.	126120.	120730.	106730.	80900.	560940.	-0.3	-4.3	-11.6	-24.2	-36.0	0.0
SHEET METAL WKS	6860.	8140.	8310.	8340.	6320.	37970.	18.7	2.0	0.4	-24.2	-7.8	21.7
TRUCK DRIVERS	25040.	24590.	20700.	16840.	14310.	101480.	-1.8	-15.8	-18.7	-15.0	-42.8	0.0
OTHER WORKERS	3090.	3190.	2740.	2410.	2100.	13530.	3.2	-14.1	-12.1	-12.9	-32.1	3.2
TOTAL WORKERS	548380.	521070.	489950.	429480.	343450.	2332330.	-5.0	-6.0	-12.3	-20.0	-37.4	0.0

* Work-months (37 hrs./wk., 4.345 wks./month) = 160.8 work-hours/month.

Note: Due to rounding, sums of individual items may not equal totals.

Table 11

LABOR REQUIREMENTS

AREA : DOL REGION
CATEGORY : POWER PLANTS
SUBCATEGRY: ALL SUBCATEGORY
LABOR UNIT: UNIT: WORK-MONTHS*
TIME FRAME: 1979-1983

Region 5

CRAFT	1979	1980	1981	1982	1983	TOTAL	PERCENT CHANGE 79-80	80-81	81-82	82-83	79-83	79-PEAK
ASBEST WKS/INSUL	8250.	11920.	11820.	7920.	7390.	47300.	44.4	-0.8	-33.0	-6.7	-10.5	44.4
BOILERMAKERS	35180.	31630.	23390.	25970.	26820.	142990.	-10.1	-26.1	11.1	3.3	-23.8	0.0
BRICKLAY-STMASON	2050.	1630.	1760.	1420.	1110.	7970.	-20.5	7.9	-19.3	-21.9	-45.9	0.0
CARPENTERS	50450.	42890.	40250.	33770.	27300.	194660.	-15.0	-6.2	-16.1	-19.1	-45.9	0.0
CEMENT-CONC FINI	5960.	5120.	4730.	4050.	3700.	23560.	-14.0	-7.7	-14.2	-8.6	-37.8	0.0
ELECTRICIANS	77840.	76300.	60920.	51210.	55300.	321570.	-2.0	-20.2	-15.9	8.0	-29.0	0.0
IRON WKS	41390.	34870.	32570.	28630.	25630.	163090.	-15.8	-6.6	-12.1	-10.5	-38.1	0.0
LABORERS	67470.	62200.	56430.	46330.	40790.	273220.	-7.8	-9.3	-17.9	-11.9	-39.5	0.0
MILLWRIGHTS	11870.	12490.	9770.	8210.	8560.	50900.	5.3	-21.8	-16.0	4.3	-27.9	5.3
OPERATING ENGR	32850.	28740.	24430.	22690.	21810.	130520.	-12.5	-15.0	-7.1	-3.9	-33.6	0.0
PAINTERS	7750.	9020.	8870.	6540.	5790.	37970.	16.4	-1.6	-26.2	-11.5	-25.3	16.4
PIPEFITTERS	107730.	106740.	85670.	73160.	73810.	447110.	-0.9	-19.7	-14.6	0.9	-31.5	0.0
SHEET METAL WKS	7420.	8420.	6230.	5120.	6070.	33260.	13.6	-26.1	-17.8	18.7	-18.1	13.6
TRUCK DRIVERS	15680.	13510.	11300.	9940.	9010.	59440.	-13.8	-16.4	-12.0	-9.4	-42.5	0.0
OTHER WORKERS	1770.	1440.	1230.	1160.	1060.	6660.	-19.0	-14.6	-5.6	-8.9	-40.4	0.0
TOTAL WORKERS	473670.	446930.	379340.	326100.	314140.	1940180.	-5.6	-15.1	-14.0	-3.7	-33.7	0.0

* Work-months (37 hrs./wk., 4.345 wks./month) = 160.8 work-hours/month.

Note: Due to rounding, sums of individual items may not equal totals.

Table 12

LABOR REQUIREMENTS

AREA : DOL REGION
CATEGORY : POWER PLANTS
SUBCATEGRY: ALL SUBCATEGORY
LABOR UNIT: UNIT: WORK-MONTHS*
TIME FRAME: 1979-1983

Region 6

CRAFT	1979	1980	1981	1982	1983	TOTAL	PERCENT CHANGE 79-80	80-81	81-82	82-83	79-83	79-PEAK
ASBEST WKS/INSUL	7200.	6220.	7870.	7270.	7030.	35590.	-13.6	26.5	-7.6	-3.4	-2.4	9.3
BOILERMAKERS	34050.	31920.	33880.	29480.	27000.	156330.	-6.3	6.2	-13.0	-8.4	-20.7	0.0
BRICKLAY-STMASON	1420.	1450.	1310.	1110.	980.	6270.	1.7	-9.6	-15.1	-12.1	-31.4	1.7
CARPENTERS	38110.	32590.	26540.	21850.	19280.	138370.	-14.5	-18.6	-17.7	-11.7	-49.4	0.0
CEMENT-CONC FINI	5040.	4790.	4020.	3440.	3120.	20410.	-4.9	-16.0	-14.5	-9.2	-38.0	0.0
ELECTRICIANS	45170.	43130.	44510.	35100.	28620.	196530.	-4.5	3.2	-21.1	-18.5	-36.6	0.0
IRON WKS	29580.	26050.	22600.	17680.	16420.	112330.	-11.9	-13.3	-21.8	-7.1	-44.5	0.0
LABORERS	49150.	43510.	37980.	31540.	27910.	190090.	-11.5	-12.7	-17.0	-11.5	-43.2	0.0
MILLWRIGHTS	8730.	8390.	8620.	7250.	6220.	39210.	-3.8	2.7	-15.8	-14.2	-28.7	0.0
OPERATING ENGR	24430.	23270.	20800.	17510.	15340.	101350.	-4.7	-10.6	-15.8	-12.4	-37.2	0.0
PAINTERS	7940.	7620.	6920.	5600.	4710.	32790.	-4.1	-9.2	-19.0	-15.9	-40.7	0.0
PIPEFITTERS	79800.	72180.	69110.	54250.	44050.	319390.	-9.6	-4.3	-21.5	-18.8	-44.8	0.0
SHEET METAL WKS	5570.	5380.	6280.	5360.	4610.	27200.	-3.5	16.7	-14.6	-13.9	-17.2	12.6
TRUCK DRIVERS	12860.	13560.	12050.	9410.	8340.	56220.	5.4	-11.1	-21.9	-11.4	-35.2	5.4
OTHER WORKERS	1470.	1560.	1360.	1120.	1130.	6640.	6.0	-12.8	-17.3	1.1	-22.8	6.0
TOTAL WORKERS	350520.	321610.	303840.	247970.	214760.	1438700.	-8.2	-5.5	-18.4	-13.4	-38.7	0.0

* Work-months (37 hrs./wk., 4.345 wks./month) = 160.8 work-hours/month.

Note: Due to rounding, sums of individual items may not equal totals.

Table 13

LABOR REQUIREMENTS

AREA : DOL REGION
CATEGORY : POWER PLANTS
SUBCATEGRY: ALL SUBCATEGORY
LABOR UNIT: UNIT: WORK-MONTHS*
TIME FRAME: 1979-1983

Region 7

CRAFT	1979	1980	1981	1982	1983	TOTAL	PERCENT CHANGE 79-80	80-81	81-82	82-83	79-83	79-PEAK
ASBEST WKS/INSUL	4050.	4510.	4430.	3050.	2260.	18300.	11.2	-1.8	-31.0	-26.1	-44.3	11.2
BOILERMAKERS	14810.	12520.	9110.	6910.	6830.	50180.	-15.5	-27.2	-24.2	-1.2	-53.9	0.0
BRICKLAY-STMASON	830.	500.	360.	260.	280.	2230.	-39.1	-27.5	-28.0	6.1	-66.3	0.0
CARPENTERS	15520.	11500.	7480.	5170.	4700.	44370.	-25.9	-35.0	-31.0	-9.0	-69.7	0.0
CEMENT-CONC FINI	1580.	1490.	1070.	760.	580.	5480.	-5.5	-28.2	-29.1	-23.9	-63.4	0.0
ELECTRICIANS	22560.	24690.	20290.	12790.	9850.	90180.	9.5	-17.8	-36.9	-23.0	-56.3	9.5
IRON WKS	14420.	10660.	7680.	5610.	5880.	44250.	-26.1	-28.0	-27.0	4.9	-59.2	0.0
LABORERS	20330.	17770.	12670.	8350.	6620.	65740.	-12.6	-28.7	-34.1	-20.8	-67.5	0.0
MILLWRIGHTS	4080.	4180.	3610.	2290.	1860.	16020.	2.4	-13.7	-36.6	-18.9	-54.6	2.4
OPERATING ENGR	10910.	9100.	6110.	4610.	4440.	35170.	-16.6	-32.8	-24.6	-3.7	-59.3	0.0
PAINTERS	2160.	2620.	2960.	2100.	910.	10750.	21.5	13.0	-29.2	-56.8	-58.0	37.3
PIPEFITTERS	29310.	34520.	28970.	17320.	12470.	122590.	17.8	-16.1	-40.2	-28.0	-57.4	17.8
SHEET METAL WKS	3010.	2770.	2550.	1450.	1460.	11240.	-7.8	-8.2	-43.1	0.5	-51.5	0.0
TRUCK DRIVERS	4470.	4360.	3050.	2110.	1510.	15500.	-2.4	-30.1	-30.8	-28.2	-66.1	0.0
OTHER WORKERS	670.	480.	330.	230.	190.	1900.	-28.8	-30.1	-31.0	-19.3	-72.3	0.0
TOTAL WORKERS	148710.	141680.	110670.	73020.	59830.	533910.	-4.7	-21.9	-34.0	-18.1	-59.8	0.0

* Work-months (37 hrs./wk., 4.345 wks./month) = 160.8 work-hours/month.

Note: Due to rounding, sums of individual items may not equal totals.

Table 14

LABOR REQUIREMENTS

AREA : DOL REGION
CATEGORY : POWER PLANTS
SUBCATEGRY: ALL SUBCATEGORY
LABOR UNIT: UNIT: WORK-MONTHS*
TIME FRAME: 1979-1983

Region 8

CRAFT	1979	1980	1981	1982	1983	TOTAL	PERCENT CHANGE 79-80	80-81	81-82	82-83	79-83	79-PEAK
ASBEST WKS/INSUL	4220.	3880.	4450.	5240.	4010.	21800.	-8.2	14.7	17.8	-23.4	-4.9	24.0
BOILERMAKERS	13710.	15500.	18540.	16300.	15760.	79810.	13.0	19.6	-12.0	-3.4	14.9	35.2
BRICKLAY-STMASON	350.	560.	410.	380.	320.	2020.	61.2	-26.4	-8.3	-16.0	-8.6	61.2
CARPENTERS	11330.	13250.	15020.	13460.	11450.	64510.	16.9	13.3	-10.4	-14.9	1.1	32.6
CEMENT-CONC FINI	1360.	1490.	1610.	1690.	1510.	7660.	9.6	7.9	4.8	-10.7	10.8	24.0
ELECTRICIANS	16190.	17370.	19970.	20790.	19750.	94070.	7.3	15.0	4.1	-5.0	22.0	28.4
IRON WKS	11420.	13790.	13750.	12730.	11650.	63340.	20.8	-0.3	-7.4	-8.5	2.0	20.8
LABORERS	16260.	18820.	23230.	20770.	16490.	95570.	15.8	23.4	-10.6	-20.6	1.4	42.9
MILLWRIGHTS	3810.	4440.	5600.	5810.	5360.	25020.	16.7	25.9	3.9	-7.8	40.8	52.7
OPERATING ENGR	11490.	13550.	15030.	13170.	10720.	63960.	17.9	10.9	-12.4	-18.6	-6.7	30.8
PAINTERS	1520.	1530.	1710.	2080.	1910.	8750.	0.9	11.5	21.8	-8.4	25.6	37.1
PIPEFITTERS	18910.	18880.	22830.	22740.	20560.	103920.	-0.2	20.9	-0.4	-9.6	8.7	20.7
SHEET METAL WKS	2170.	2310.	3310.	2840.	2210.	12840.	6.3	43.4	-14.3	-22.2	1.6	52.5
TRUCK DRIVERS	4060.	4550.	5550.	5400.	4110.	23670.	11.8	22.0	-2.7	-24.0	1.0	36.5
OTHER WORKERS	1720.	1550.	1720.	2000.	1480.	8470.	-10.0	11.0	16.7	-25.9	-13.6	16.6
TOTAL WORKERS	118520.	131460.	152720.	145400.	127270.	675370.	10.9	16.2	-4.8	-12.5	7.4	28.9

* Work-months (37 hrs./wk., 4.345 wks./month) = 160.8 work-hours/month.

Note: Due to rounding, sums of individual items may not equal totals.

Table 15

LABOR REQUIREMENTS

AREA : DOL REGION
CATEGORY : POWER PLANTS
SUBCATEGRY: ALL SUBCATEGORY
LABOR UNIT: UNIT: WORK-MONTHS*
TIME FRAME: 1979-1983

Region 9

							PERCENT CHANGE					
CRAFT	1979	1980	1981	1982	1983	TOTAL	79-80	80-81	81-82	82-83	79-83	79-PEAK
ASBEST WKS/INSUL	2550.	3300.	3570.	1970.	3750.	15140.	29.6	8.2	-44.8	90.1	47.1	47.1
BOILERMAKERS	12620.	14190.	9450.	7540.	12140.	55940.	12.4	-33.4	-20.2	61.0	-3.8	12.4
BRICKLAY-STMASON	960.	780.	560.	330.	320.	2950.	-18.5	-28.5	-40.9	-4.0	-66.9	0.0
CARPENTERS	27920.	26560.	14630.	10910.	10380.	90400.	-4.9	-44.9	-25.4	-4.8	-62.8	0.0
CEMENT-CONC FINI	2760.	3480.	2270.	1440.	1610.	11560.	26.0	-34.6	-36.6	11.6	-41.7	26.0
ELECTRICIANS	24520.	39660.	27130.	21250.	21360.	133920.	61.7	-31.6	-21.7	0.5	-12.9	61.7
IRON WKS	20440.	19140.	11230.	9230.	10820.	70860.	-6.3	-41.3	-17.8	17.2	-47.1	0.0
LABORERS	40160.	40760.	28880.	19110.	17610.	146520.	1.5	-29.1	-33.8	-7.8	-56.1	1.5
MILLWRIGHTS	4710.	7470.	5400.	3890.	3700.	25170.	58.5	-27.8	-27.8	-4.9	-21.5	58.5
OPERATING ENGR	19900.	19690.	13780.	10030.	9560.	72960.	-1.0	-30.0	-27.2	-4.6	-51.9	0.0
PAINTERS	3510.	4770.	4720.	2530.	2650.	18180.	35.7	-1.1	-46.3	4.7	-24.6	35.7
PIPEFITTERS	35750.	59530.	40320.	29180.	28460.	193240.	66.5	-32.3	-27.6	-2.4	-20.4	66.5
SHEET METAL WKS	1990.	3310.	2550.	2300.	2140.	12290.	66.4	-23.1	-9.6	-6.8	7.9	66.4
TRUCK DRIVERS	9060.	9680.	8320.	6010.	5000.	38070.	6.8	-14.0	-27.8	-16.8	-44.8	6.8
OTHER WORKERS	1670.	1670.	980.	560.	520.	5400.	0.4	-41.4	-43.0	-7.7	-69.0	0.4
TOTAL WORKERS	208530.	254010.	173790.	126290.	130030.	892650.	21.8	-31.6	-27.3	3.0	-37.6	21.8

* Work-months (37 hrs./wk., 4.345 wks./month) = 160.8 work-hours/month.

Note: Due to rounding, sums of individual items may not equal totals.

Table 16

LABOR REQUIREMENTS

AREA : DOL REGION
CATEGORY : POWER PLANTS
SUBCATEGRY: ALL SUBCATEGORY
LABOR UNIT: UNIT: WORK-MONTHS*
TIME FRAME: 1979-1983

Region 10

CRAFT	1979	1980	1981	1982	1983	TOTAL	PERCENT CHANGE 79-80	80-81	81-82	82-83	79-83	79-PEAK
ASBEST WKS/INSUL	1250.	2020.	2010.	2240.	2520.	10040.	61.5	-0.8	11.7	12.4	101.0	101.0
BOILERMAKERS	5870.	5900.	5560.	4880.	4120.	26330.	0.7	-5.8	-12.3	-15.5	-29.7	0.7
BRICKLAY-STMASON	650.	620.	550.	500.	320.	2640.	-5.4	-11.3	-9.1	-35.6	-50.9	0.0
CARPENTERS	20800.	21130.	17400.	13160.	9580.	82070.	1.6	-17.7	-24.4	-27.2	-53.9	1.6
CEMENT-CONC FINI	2270.	2410.	2340.	1890.	1560.	10470.	6.0	-3.1	-19.0	-17.6	-31.3	6.0
ELECTRICIANS	21140.	24750.	25240.	24330.	20970.	116430.	17.1	2.0	-3.6	-13.8	-0.8	19.4
IRON WKS	14380.	14200.	11910.	9490.	7110.	57090.	-1.2	-16.1	-20.3	-25.1	-50.5	0.0
LABORERS	37550.	29100.	24600.	19260.	14810.	125320.	-22.5	-15.4	-21.7	-23.1	-60.5	0.0
MILLWRIGHTS	3560.	3960.	4070.	3590.	3340.	18520.	11.3	2.8	-11.9	-6.8	-6.1	14.4
OPERATING ENGR	16320.	12360.	10040.	7330.	5650.	51700.	-24.2	-18.7	-27.0	-22.9	-65.3	0.0
PAINTERS	2310.	3010.	3760.	3660.	3510.	16250.	30.4	24.8	-2.5	-4.1	52.2	62.8
PIPEFITTERS	29940.	35760.	40500.	36900.	32160.	175260.	19.4	13.3	-8.9	-12.9	7.4	35.3
SHEET METAL WKS	1580.	2040.	2010.	2160.	2030.	9820.	29.1	-1.8	7.8	-6.1	28.3	36.7
TRUCK DRIVERS	7420.	5530.	5160.	4640.	4090.	26840.	-25.5	-6.7	-10.1	-11.9	-44.9	0.0
OTHER WORKERS	760.	740.	580.	520.	450.	3050.	-2.8	-20.7	-11.5	-12.7	-40.5	0.0
TOTAL WORKERS	165790.	163530.	155740.	134560.	112230.	731850.	-1.4	-4.8	-13.6	-16.6	-32.3	0.0

* Work-months (37 hrs./wk., 4.345 wks./month) = 160.8 work-hours/month.

Note: Due to rounding, sums of individual items may not equal totals.

Table 17

On-Site Labor Requirements for Electric Generating Power Plant Construction, By Region, 1979-1983 (work-months)

Region	1979	1980	1981	1982	1983	Total
1	86,010	108,150	114,980	101,120	81,180	491,440
2	111,550	140,460	175,750	210,730	217,160	855,650
3	192,360	156,030	121,850	93,040	89,670	652,950
4	548,380	521,070	489,950	429,480	343,450	2,332,330
5	473,670	446,930	379,340	326,100	314,140	1,940,180
6	350,520	321,610	303,840	247,970	214,760	1,438,700
7	148,710	141,680	110,670	73,020	59,830	533,910
8	118,520	131,460	152,720	145,400	127,270	675,370
9	208,530	254,010	173,790	126,290	130,030	892,650
10	165,790	163,530	155,740	134,560	112,230	731,850
Total Work-Months*	2,404,040	2,384,930	2,178,630	1,887,710	1,689,720	10,545,030

* Un-sited units not included

FIGURE 8

On-Site Labor Requirements for Electric Generating Power Plant Construction, by Region (Eastern U.S.), 1979-1983

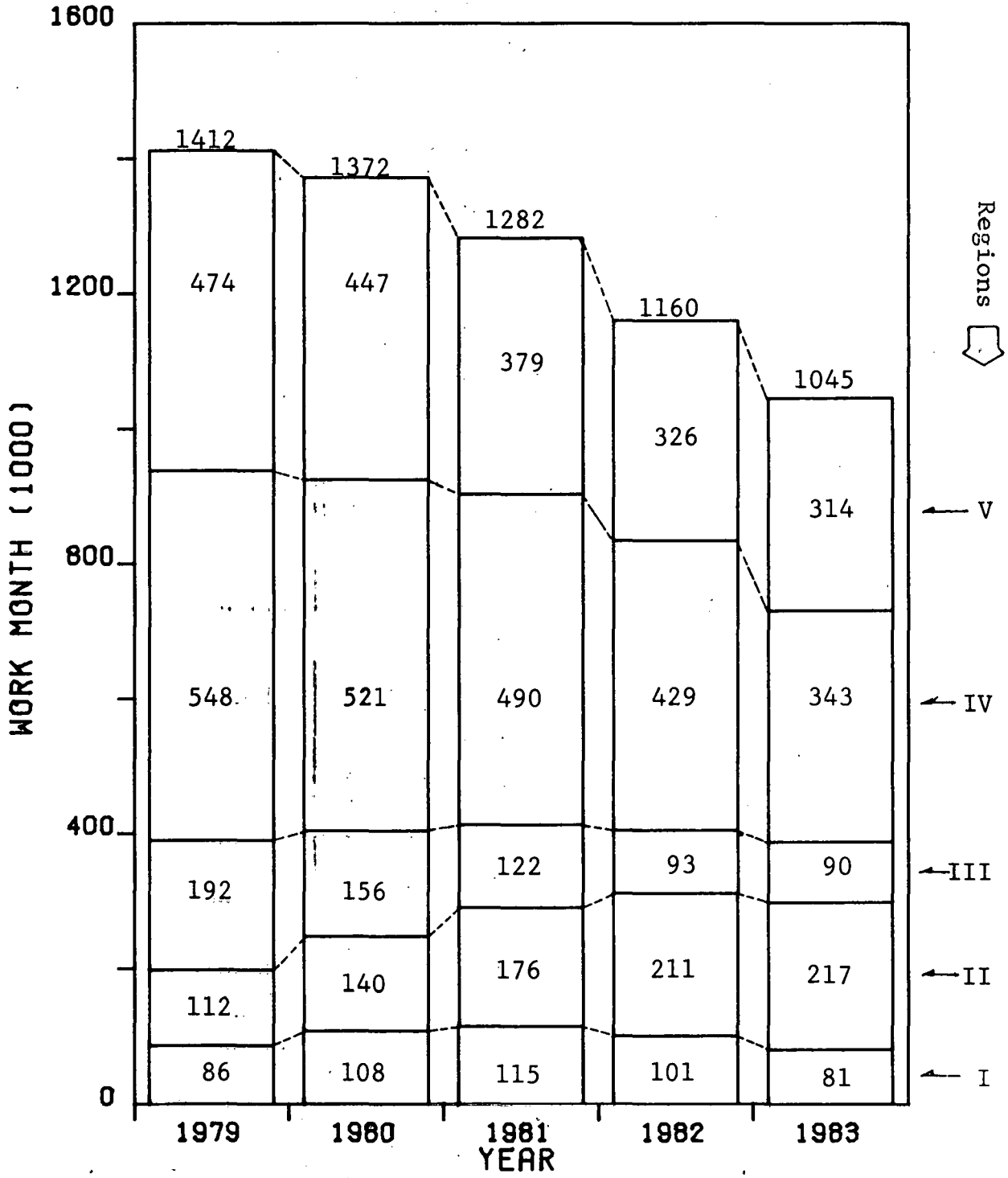


FIGURE 8 (Cont'd)

On-Site Labor Requirements for Electric Generating Power Plant Construction, by Region (Western U.S.), 1979-1983

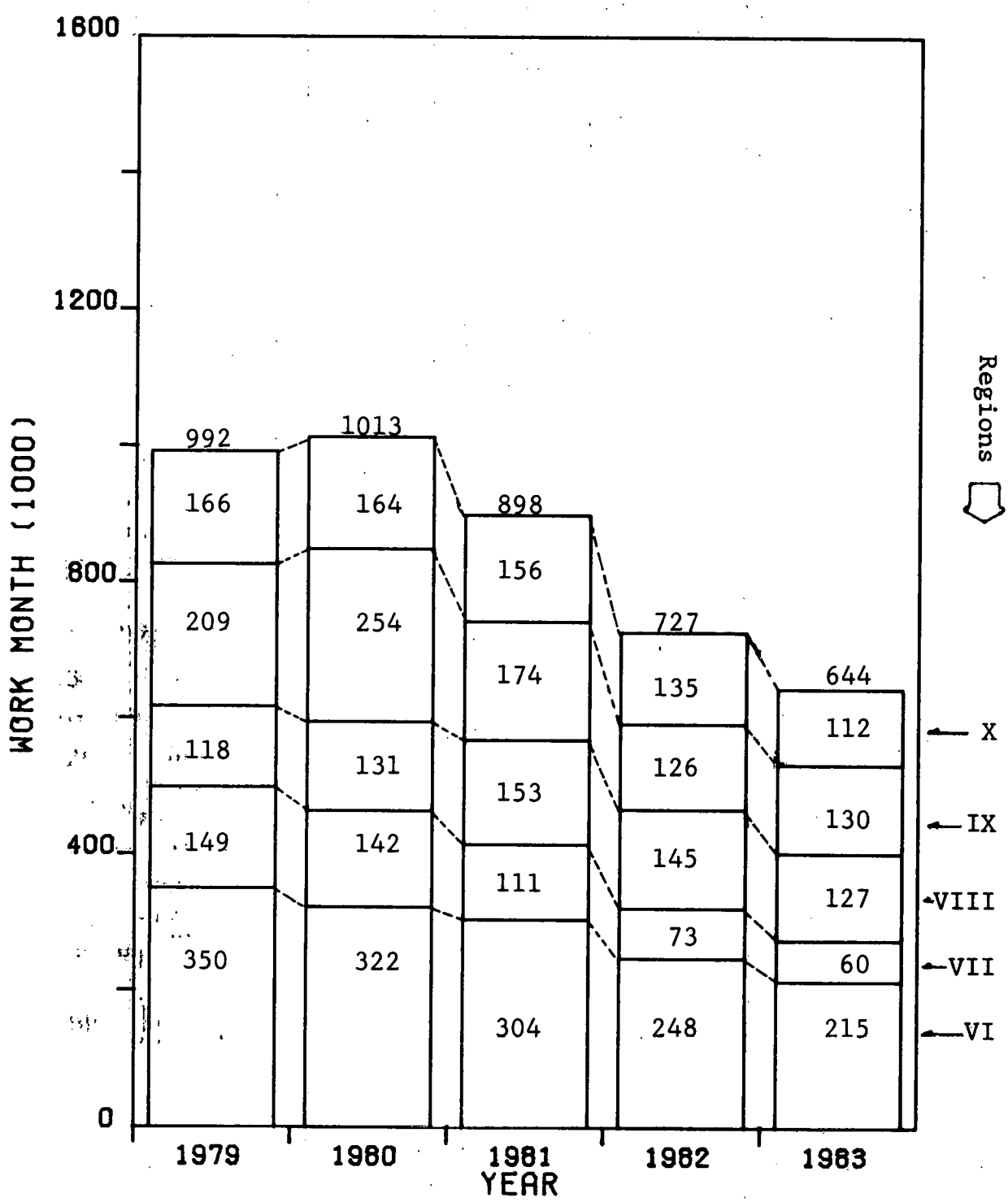


Table 18

New Electric Generating Capacity Under Construction or Planned,
by Type of Facility, by Region, 1979-1983
(As of September 1979)

NUCLEAR

Region	1979 MWe	1979 Units	1980 MWe	1980 Units	1981 MWe	1981 Units	1982 MWe	1982 Units	1983 MWe	1983 Units
1	6,930	6	6,930	6	6,930	6	6,930	6	6,930	6
2	14,619	13	14,704	13	15,184	13	15,184	13	15,184	13
3	8,801	9	7,867	8	6,922	7	5,104	5	3,111	3
4	37,751	33	33,571	29	29,064	25	26,773	23	22,360	19
5	27,308	26	25,468	24	22,522	21	19,507	18	13,957	13
6	11,275	10	11,275	10	10,125	9	7,710	7	4,160	4
7	3,450	3	3,450	3	3,450	3	3,450	3	1,150	1
8	-	-	-	-	-	-	-	-	-	-
9	10,389	9	8,269	7	7,169	6	4,844	4	4,844	4
10	11,176	9	11,176	9	11,176	9	10,076	8	8,826	7
Nation	131,699	118	122,710	109	112,542	99	99,578	87	80,522	70

Table 18 (Cont'd)

New Electric Generating Capacity Under Construction or Planned,
by Type of Facility, by Region, 1979-1983
(As of September 1979)

FOSSIL

Region	1979 MWe	1979 Units	1980 MWe	1980 Units	1981 MWe	1981 Units	1982 MWe	1982 Units	1983 MWe	1983 Units
1	999	11	1,045	12	1,099	10	846	6	689	5
2	1,090	5	2,070	8	1,940	6	2,790	7	3,030	7
3	7,209	12	6,583	11	3,432	7	5,897	15	5,475	12
4	18,641	40	21,469	44	21,839	45	20,200	40	19,854	38
5	18,120	51	17,080	43	16,507	43	15,578	43	15,679	42
6	26,675	51	23,436	44	20,961	39	23,786	43	20,760	35
7	9,399	29	8,338	29	7,112	24	5,603	19	5,073	16
8	12,169	31	11,362	28	12,750	27	12,075	26	11,635	25
9	5,298	32	4,694	29	4,772	25	5,908	37	6,204	37
10	702	3	630	2	215	2	115	1	115	1
Unsited	3	1	3	1	633	2	1,263	3	1,260	2
Nation	100,305	266	96,710	251	91,260	230	94,061	240	89,774	220

Table 18 (Cont'd)

New Electric Generating Capacity Under Construction or Planned,
by Type of Facility, by Region, 1979-1983
(As of September 1979)

HYDROELECTRIC

Region	1979 MWe	1979 Units	1980 MWe	1980 Units	1981 MWe	1981 Units	1982 MWe	1982 Units	1983 MWe	1983 Units
1	12	1	12	1	12	1	-	-	-	-
2	2,010	9	2,019	10	3,021	15	3,102	19	3,130	21
3	3,730	12	3,819	13	3,819	13	5,498	13	2,898	7
4	4,075	34	2,563	24	2,331	20	2,151	17	2,206	18
5	80	3	80	3	120	5	40	2	40	2
6	182	3	182	3	182	3	182	3	600	4
7	217	7	284	8	98	2	-	-	-	-
8	3,834	27	3,694	23	4,177	27	4,077	25	4,077	25
9	2,232	20	2,081	17	2,186	15	893	8	335	4
10	3,629	31	885	14	885	14	374	6	20	1
Unsited	-	-	-	-	-	-	850	1	850	1
Nation	20,001	147	15,619	116	16,831	115	17,167	94	14,156	83

Source: See Appendix E (Data Sources and References)

Part IV. Costs Per KWe

Figure 9 displays average cost per kilowatt (in constant 1975 dollars) for the construction of nuclear-fueled (light water reactors) electric generating facilities for project starts from 1968-1985 by unit size and location. Examination of Figure 9 reveals that nuclear power plants with construction start dates in 1979 will cost twice as much as comparable ones started in 1968 (1975 $).

For those nuclear power plants (1200 MWe capacity) in the non-South with construction starting in 1985, the approximate cost per kilowatt will be $1,077 (1975 $), i.e., 32 percent more than those started in 1979. Unit plant costs (1975 $/KWe) for nuclear power plants with 1979 construction starts in the non-South are approximately 22 percent higher than for plants located in the South. The scaling factor was found to be 0.73. See Appendix C for estimating equations and tables for each fuel type.

Average cost per kilowatt for construction of coal-fired power plants is presented in Figure 10 by unit size and location. The average cost per KWe in the non-South for an 800 MWe unit started in 1979 is $542 (1975 $, without scrubbers). The addition of scrubbers increases unit plant cost by approximately 20 percent. Construction costs are approximately 18 percent lower in the South as compared to the non-South. Eight hundred MWe units in the non-South with construction starting in 1985 will cost $776 (1975 $) per

kilowatt installed (with scrubbers); this represents a 19 percent increase over 1979. The scaling factor is 0.89.

Unit plant costs for oil-fired power plants are presented in Figure 11. A 500 MWe unit (with scrubbers) with construction starting in 1979 will average $652/KWe (1975 $) if built in the non-South. Construction cost per KWe of installed capacity for oil-fired units constructed in the non-South are approximately 22 percent higher than for those built in the South. The addition of scrubbers increase average costs by approximately 20 percent. Average cost per KWe of installed capacity for construction of a 500 MWe unit is approximately 12 percent higher than for an 800 MWe unit. The scaling factor is 0.93.

Gas-fired unit plant costs are displayed in Figure 12. Large (500 MWe) units starting construction in 1979 in the South will average $422 (1975 $) per kilowatt of installed capacity. Unit plant costs are approximately 18 percent lower in the South as compared to the non-South. For 300 MWe units in the non-South with construction initiations in 1985, average costs are expected to rise to $649/KWe (1975 $). The scaling factor is 0.85.

Figure 13 displays the average cost per kilowatt for hydro-dam and pump storage facilities for 1979-1983. No significant inter-temporal increase in average cost per KWe was found. The scaling factors are estimated to be 0.68 and 0.77 for hydro-dam and pump storage electric power plants respectively.

Appendix A describes the conceptual framework for modelling work-hours/KWe and cost/KWe.

FIGURE 9.

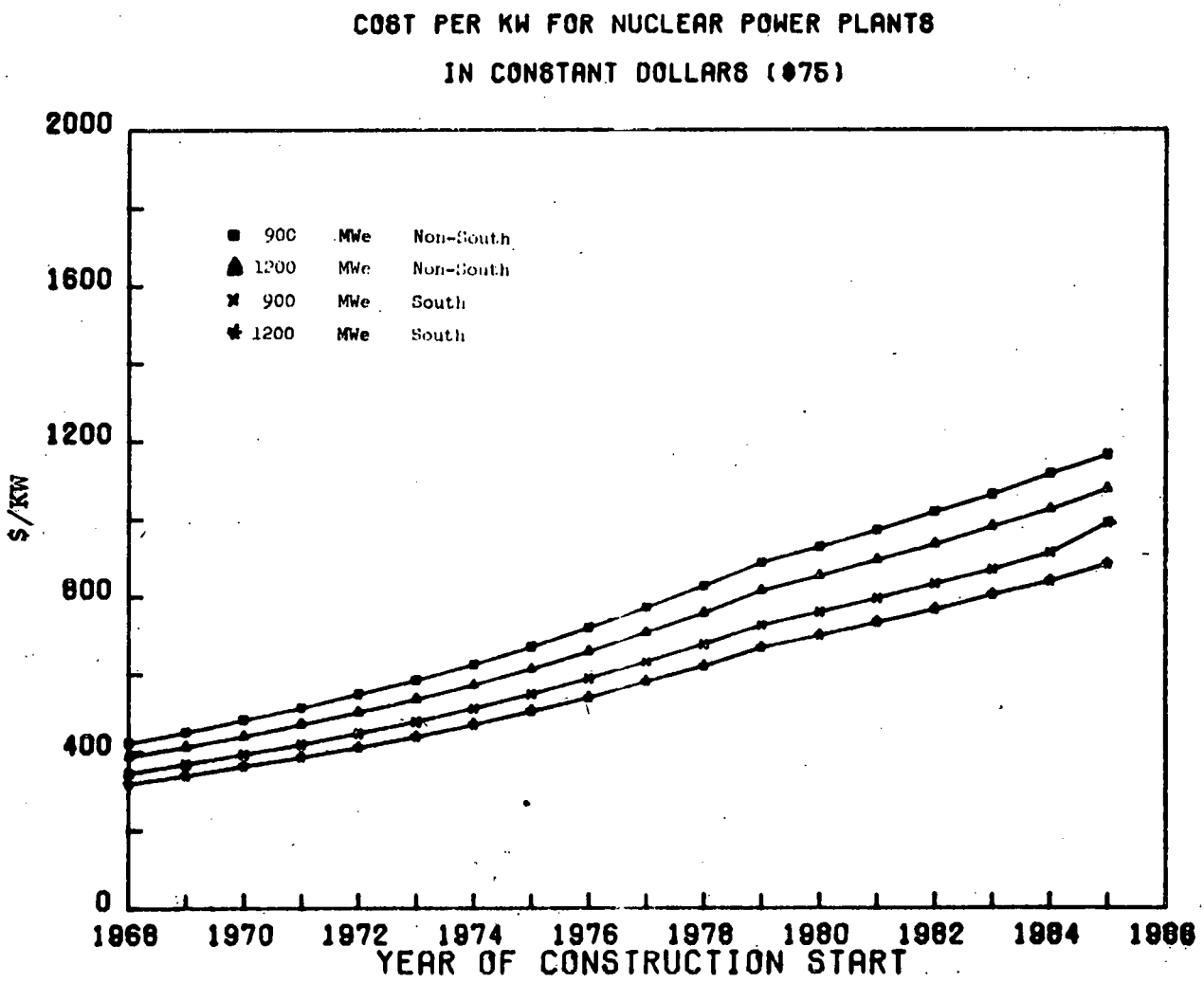
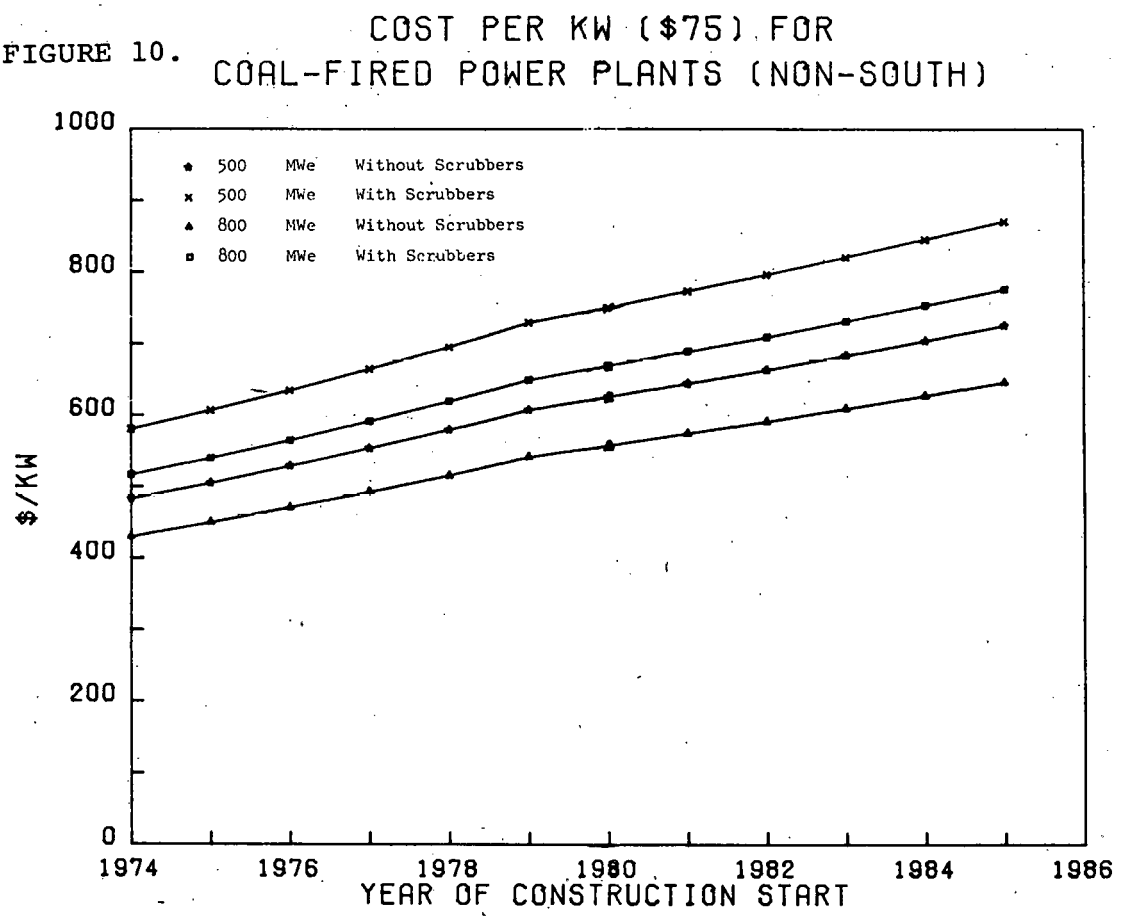

COST PER KW FOR NUCLEAR POWER PLANTS
IN CONSTANT DOLLARS (#75)
900 MWe Non-South
1200 MWe Non-South
900 MWe South
1200 MWe South
$/KW
2000
1600
1200
800
400
0
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
YEAR OF CONSTRUCTION START

FIGURE 10.


COST PER KW ($75) FOR
COAL-FIRED POWER PLANTS (NON-SOUTH)
500 MWe Without Scrubbers
500 MWe With Scrubbers
800 MWe Without Scrubbers
800 MWe With Scrubbers
$/KW
1000
800
600
400
200
0
1974
1976
1978
1980
1982
1984
1986
YEAR OF CONSTRUCTION START

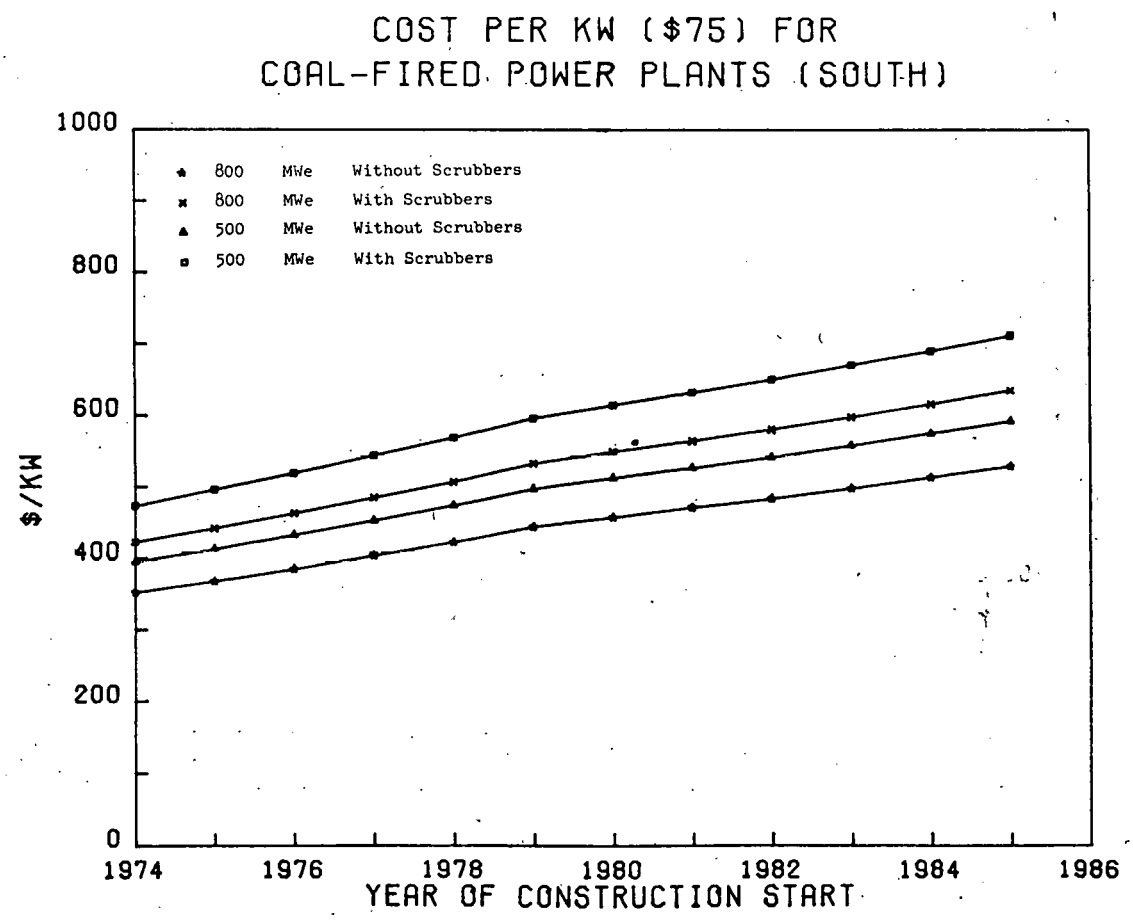

COST PER KW ($75) FOR
COAL-FIRED POWER PLANTS (SOUTH)
800 MWe Without Scrubbers
800 MWe With Scrubbers
500 MWe Without Scrubbers
500 MWe With Scrubbers
$/KW
1000
800
600
400
200
0
1974
1976
1978
1980
1982
1984
1986
YEAR OF CONSTRUCTION START

FIGURE 11.

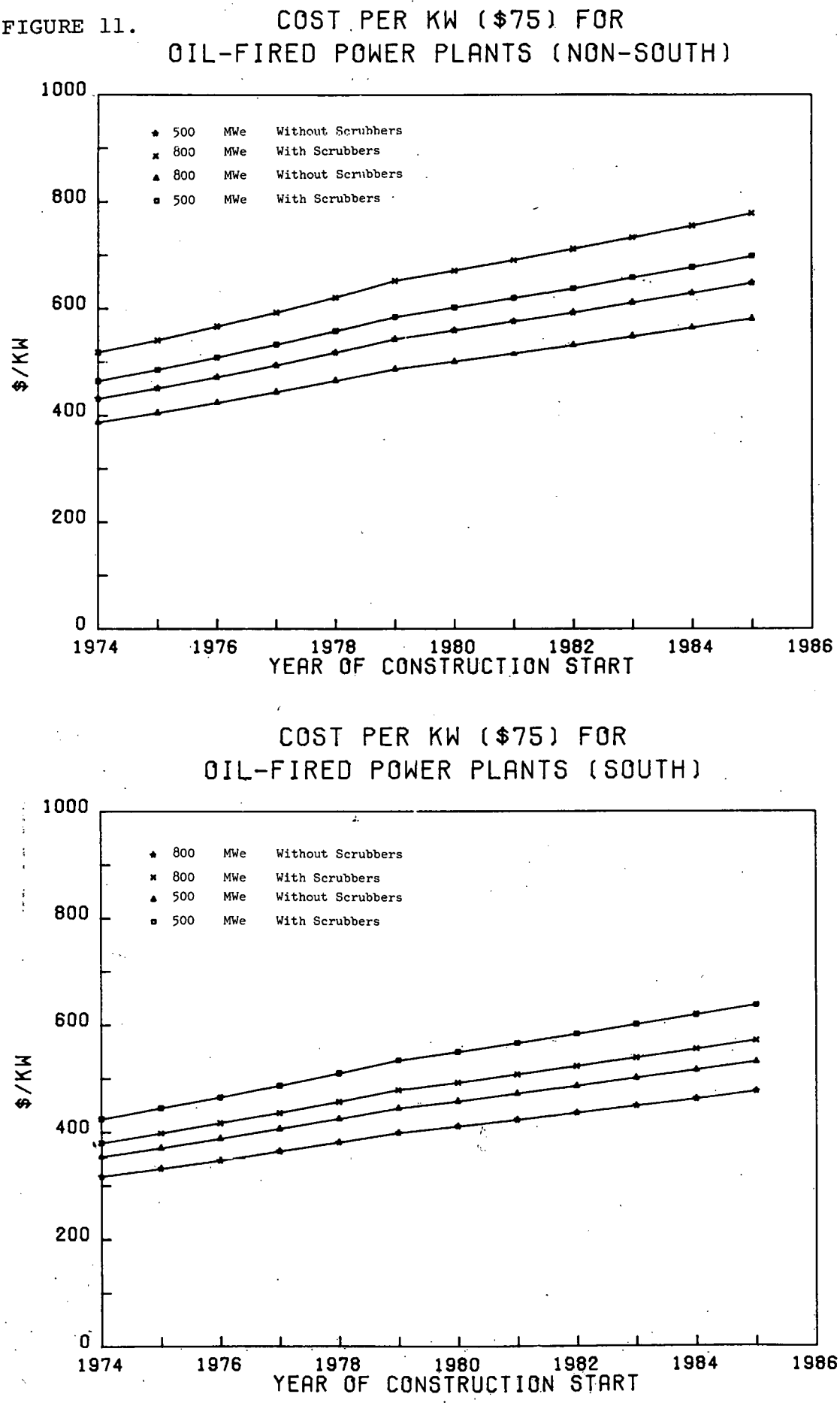

COST PER KW ($75) FOR
OIL-FIRED POWER PLANTS (NON-SOUTH)
500 MWe Without Scrubbers
800 MWe With Scrubbers
800 MWe Without Scrubbers
500 MWe With Scrubbers
$/KW
1000
800
600
400
200
0
1974
1976
1978
1980
1982
1984
1986
YEAR OF CONSTRUCTION START
COST PER KW ($75) FOR
OIL-FIRED POWER PLANTS (SOUTH)
800 MWe Without Scrubbers
800 MWe With Scrubbers
500 MWe Without Scrubbers
500 MWe With Scrubbers
$/KW
1000
800
600
400
200
0
1974
1976
1978
1980
1982
1984
1986
YEAR OF CONSTRUCTION START

FIGURE 12.

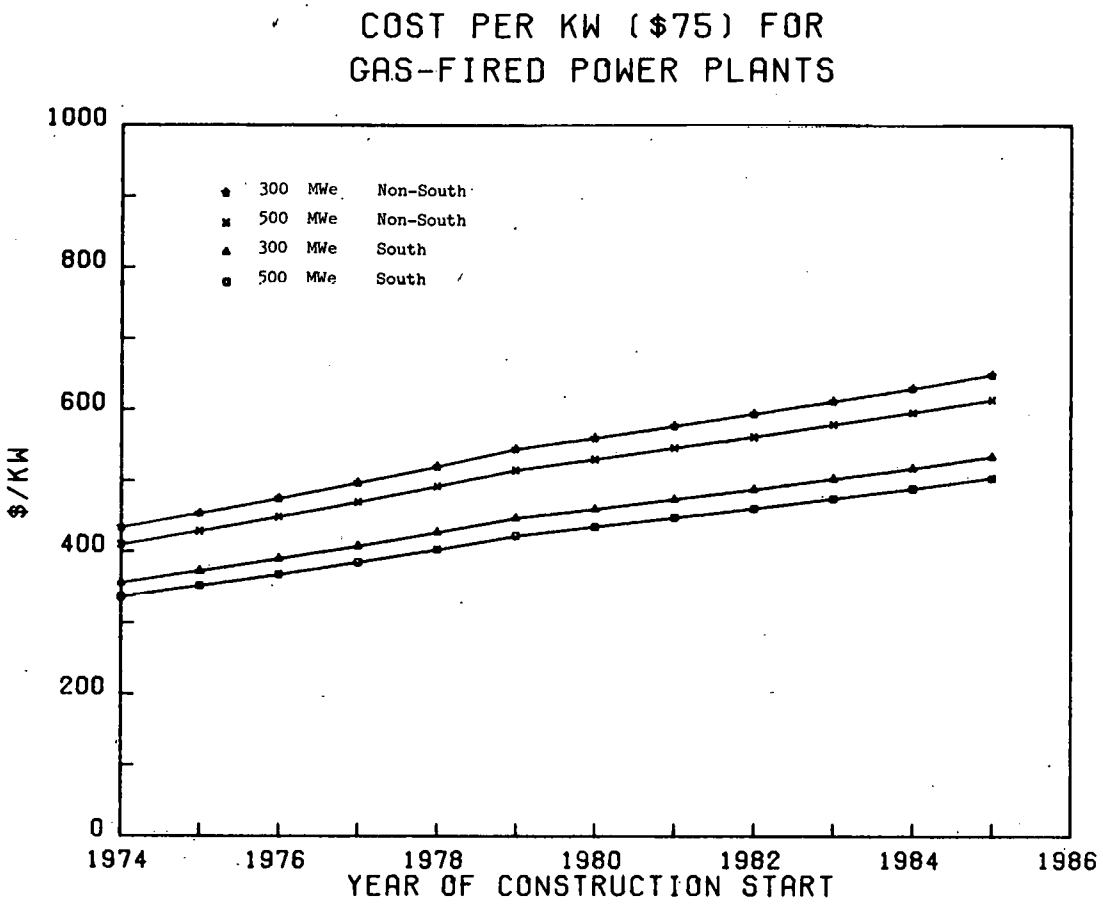
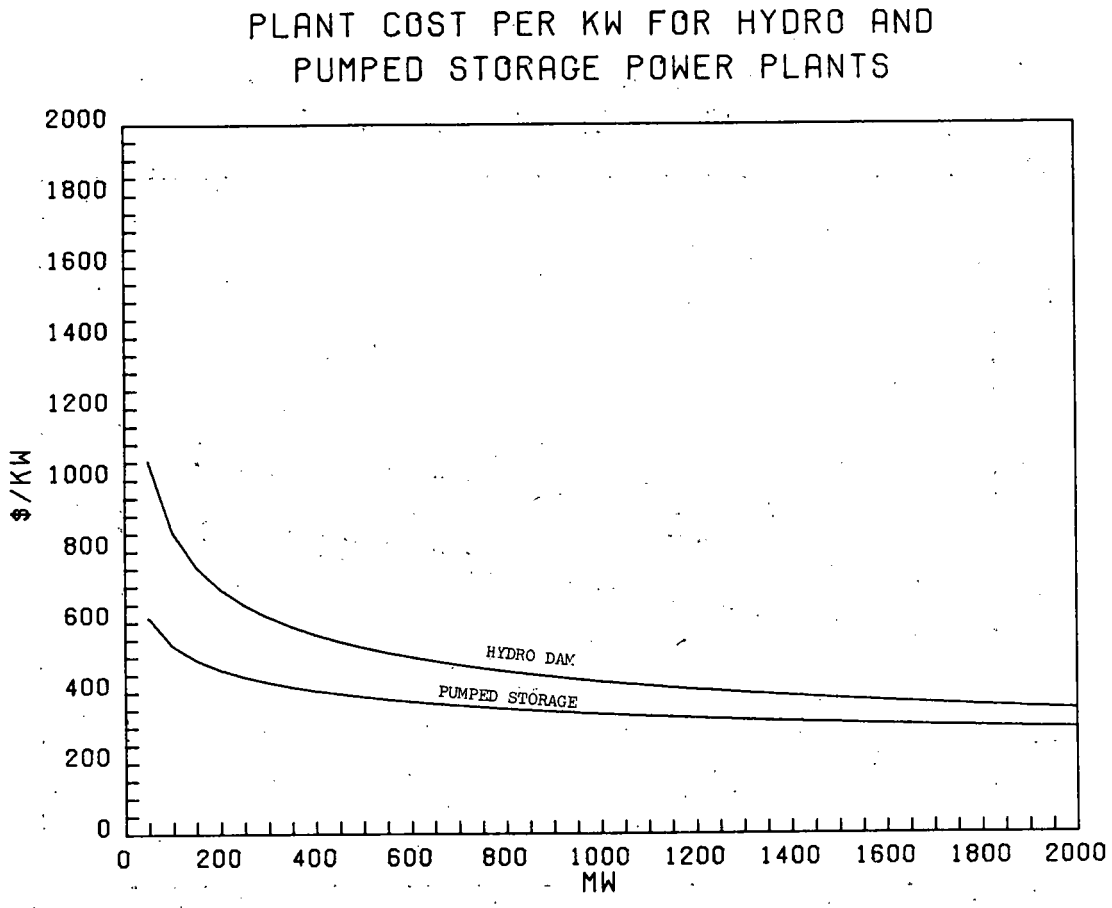

COST PER KW ($75) FOR
GAS-FIRED POWER PLANTS
1000
800
600
400
200
0
$/KW
300 MWe Non-South
500 MWe Non-South
300 MWe South
500 MWe South
1974
1976
1978
1980
1982
1984
1986
YEAR OF CONSTRUCTION START

FIGURE 13.


PLANT COST PER KW FOR HYDRO AND
PUMPED STORAGE POWER PLANTS
$/KW
2000
1800
1600
1400
1200
1000
800
600
400
200
0
HYDRO DAM
PUMPED STORAGE
0
200
400
600
800
1000
1200
1400
1600
1800
2000
MW

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Notes

1. United Nations Association of the United States of America, Energy and Employment: Issues and an Agenda for Research, A report of the Energy and Jobs Panel of the Economic Policy Council, UNA-USA, June 1979.

2. Excluded from the scope of this study is construction activity associated with a new national energy plan, e.g., converting existing generating facilities from gas and oil to coal burning units.

3. In this report, work-years are defined as 1,929.2 work-hours per year (37 hrs./wk., 4.345 wks./month, 12 months).

4. For purposes of this study, "South" includes the following states: Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, New Mexico, North Carolina, Oklahoma, South Carolina, Tennessee, and Texas.

5. U.S. Department of Energy, Energy Information Administration, Annual Report to Congress, 1978, Vols. 1-3, DOE/EIA-0173/1-3.

6. Work-months (37 hrs./wk., 4.345 wks./month) = 160.8 work-hours/month.

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APPENDIX A: Conceptual Framework For Modelling WH/KWe and Cost/KWe

I. Forecasting Model of Construction Labor Requirements

A model forecasting a vector of construction labor requirements of j-th craft at t-th calendar month in region r, $\left[(WH)_{jtr}\right]$, j = 1, 2, . . . , 29, is

$$(1\text{-}1) \quad \left[(WH)_{jtr}\right] = \sum_{\text{all } i} \sum_{\text{all } q} \sum_{T=t-D-1}^{t} \left[Q_{iqTr} \cdot (WH/KWe)_{iqTr} \cdot A_{iqr}^{dt}\right]$$

where Q_{iqTr} = electric generating capacity (KWe) of i-th type of power plant whose construction start is in T-th calendar month in region r; D is longest duration in months;

$(WH/KWe)_{iqTr}$ = unit work-hour requirements per KWe corresponding to Q_{iqTr} with capacity size q;

A_{iqr}^{dt} = (29 x 1) occupational profile vector of i-th type of power plant whose capacity is q in region r, where 29 refers to the 29 construction occupations and d represents planned months of construction duration; the vector corresponds to t-th month.

For short-term forecasts of work-hour requirements, Q's are provided as collected projects and A's are assumed to be stable over a short period of time. Then, it is required to estimate only WH/KWe for different types of electric power plants.

II. Construction Labor Requirements Function

In order to forecast work-hour requirements, especially for the construction of electric power plants, it is necessary to consider the interactions of three major factors: (1) economies of scale, (2) "learning-by-doing" through standardized designs, and (3) increases in the scope of work due to expansion of safety and environmental regulations. To capture these aspects, let us consider a production function having two productive inputs, labor (WH), and capital (K) in the following form:

$$(2\text{-}1) \quad V = F(WH, K; \lambda) = G\{\alpha(\lambda)WH, \beta(\lambda)K\}$$

where λ is a vector of exogenous forces affecting production, and α and β are functions of λ alone. We may identify $\alpha(\lambda)WH$ and $\beta(\lambda)K$ as "adjusted labor" and "adjusted capital", respectively.

If it is assumed that exogenous forces (λ) affect production in such a way that relative input shares remain constant for movements along the expansion path, then the production function (2-1) can be rewritten as follows:

$$(2\text{-}2) \quad V = G\{\alpha(\lambda)WH, \alpha(\lambda)K\} = \alpha(\lambda)G(WH, K)$$

since $\alpha(\lambda) = \beta(\lambda)$. The labor requirements function can be derived from the production function (2-2) such that it is solved for the labor required as a function of output and capital.

$$(2\text{-}3)\quad WH = G^{-1}\{V/\alpha(\lambda),\ K\}$$

Here, $V^* = V/\alpha(\lambda)$ is not a simple output. It reflects a production output which embeds all the impacts of exogenous forces (λ). Furthermore, note that the long-run labor requirements function derived from any production function (i.e., homogeneous) can be represented as a straight line with zero intercept.

The regression equations to be estimated have the following forms:

$$(2\text{-}4)\quad WH = b_o + b_1 V^* + b_2 D_c + b_3 D_r$$

$$(2\text{-}5)\quad \ln WH = \ln b_o + b_1 \ln V^* + b_3 D_c + b_3 D_r$$

$$(2\text{-}6)\quad (WH/KW_e) = b_o + b_1(V^*/KW_e) + b_2 D_c + b_3 D_r$$

$$(2\text{-}7)\quad \ln(WH/KW_e) = b_o + b_1 \ln(V^*/KW_e) + b_2 D_c + b_3 D_r$$

where D_c and D_r are dummy variables indicating cooling tower and region, respectively.

III. Plant Cost Function

In estimating the plant cost function for the construction of electric power plants, several explanatory variables are included as arguments. The construction start year (T) or the natural logarithm (LR) of the regulation index is selected as a proxy variable explaining the impacts of regulatory changes on construction costs (C) of electric power plants. The other explanatory variables included in the plant cost function estimation are: (a) the plant size (MW_e) to capture the economies of scale; (b) the natural logarithm (LN) of the cumulative number of power plants built by each architect engineer to explain any cost-learning effects ("learning-by-doing"); (c) the dummy variable (D_c) indicating whether the plant uses

a cooling tower; (d) the regional dummy variable (D_r) showing whether the plant is located in the Southern U.S.

The regression equations utilized for the estimation of plant cost functions are:

(3-1) $C = b_o + b_1 MW_e + b_2 T + b_3 LN + b_4 D_c + b_5 D_r$

(3-2) $\ln C = b_o + b_1 \ln MW_e + b_2 T + b_3 LN + b_4 D_c + b_5 D_r$

(3-3) $C = b_o + b_1 MW_e + b_2 LR + b_3 LN + b_4 D_c + b_5 D_r$

(3-4) $\ln C = b_o + b_1 \ln MW_e + b_2 LR + b_3 LN + b_4 D_c + b_5 D_r$

(3-5) $(C/KW_e) = b_o + b_1 MW_e + b_2 T + b_3 LN + b_4 D_c + b_5 D_r$

(3-6) $\ln(C/KW_e) = b_o + b_1 \ln MW_e + b_2 T + b_3 LN + b_4 D_c + b_5 D_r$

(3-7) $(C/KW_e) = b_o + b_1 MW_e + b_2 LR + b_3 LN + b_4 D_c + b_5 D_r$

(3-8) $\ln(C/KW_e) = b_o + b_1 \ln MW_e + b_2 LR + b_3 LN + b_4 D_c + b_5 D_r$

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APPENDIX B: CLDS Forecasts of Unit Work-Hour Requirements (WH/KWe) for Constructing Electric Power Plants, Through 1985

Table B-1 : Forecasts of Unit Work-Hour Requirements (WH/KW_e)[c] for the construction of nuclear power plants (LWR)

Region	MWe	68*	70	72	74	76	79	81	83	85
Non-South	LT 1000[a]	11.4	12.9	14.4	15.5	16.6	18.4	19.0	19.5	20.1
	GE 1000[b]	10.4	11.7	13.1	14.1	15.1	16.7	17.3	17.9	18.5
South	LT 1000	9.3	10.5	11.7	12.7	13.6	15.1	15.5	15.9	16.3
	GE 1000	8.5	9.6	10.7	11.7	12.5	13.7	14.3	14.7	15.1

Note: * Year indicates the year of construction start

a LT = less than, data for 900 MWe

b GE = greater than or equal to, data for 1200 MWe

c Includes direct and indirect manual on-site labor requirements (including cooling towers)

Table B-2 : Forecasts of Unit Work-Hour Requirements (WH/KW)[c] for the construction of coal-fired power plants

Region	MWe	Scrubber	74*	76	79	81	83	85
Non-South	LT 700 [a]	W	8.4	9.0	9.9	10.1	10.4	10.9
		W/O	7.0	7.5	8.3	8.4	8.7	9.1
	GE 700[b]	W	7.9	8.5	9.4	9.6	9.9	10.2
		W/O	6.6	7.0	7.8	8.0	8.3	8.5
South	LT 700	W	7.4	7.9	8.7	9.0	9.3	9.6
		W/O	6.2	6.6	7.3	7.5	7.7	8.0
	GE 700	W	6.9	7.4	8.1	8.4	8.7	8.9
		W/O	5.8	6.2	6.8	7.0	7.2	7.4

Note: * Year of construction start

a LT = less than, data for 500 MWe

b GE = greater than or equal to, data for 800 MWe

c Includes direct and indirect manual on-site labor requirements

Table B-3 : Forecasts of Unit Work-Hour Requirements (WH/KW)[c] for the construction of oil-fired power plants

Region	MWe	Scrubber	74*	76	79	81	83	85
Non-South	LT 700[a]	W	7.7	8.2	9.1	9.3	9.6	9.9
		W/O	6.4	6.8	7.5	7.7	7.9	8.3
	GE 700[b]	W	7.2	7.7	8.5	8.7	9.0	9.2
		W/O	6.0	6.4	7.1	7.3	7.5	7.7
South	LT 700	W	6.7	7.2	7.9	8.1	8.3	8.7
		W/O	5.6	6.0	6.6	6.8	7.0	7.3
	GE 700	W	6.4	6.8	7.5	7.7	7.9	8.0
		W/O	5.3	5.7	6.2	6.4	6.5	6.7

Note: * Year of construction start

a LT = less than, data for 500 MWe

b GE = greater than or equal to, data for 800 MWe

c Includes direct and indirect on-site labor requirements

Table B-4 : Forecasts of Unit Work-Hour Requirements (WH/KWe)[c] for Construction of Gas-Fired Power Plants

Region	MWe	74*	76	79	81	83	85
Non-South	LE 300[a]	6.4	6.8	7.4	7.6	7.8	7.9
	GT 300[b]	5.8	6.2	6.8	7.0	7.2	7.3
South	LE 300	5.7	6.1	6.7	6.9	7.1	7.2
	GT 300	5.2	5.6	6.1	6.3	6.4	6.5

Note: * Year of construction start

a LE = less than or equal to, data for 300 MWe

b GT = greater than, data for 500 MWe

c Includes direct and indirect on-site labor requirements

Table B-5 : Forecasts of Unit Work-Hour Requirements (WH/KW) for Hydroelectric and Pump Storage Power Plants

TYPE/MWe	50	100	200	300	400	500
Dam & Hydro	14.6	16.0	17.5	18.4	19.1	19.7

TYPE/MWe	100	200	300	400	600	800	1000	1200	1450
Pump Storage	15.7	10.6	8.9	8.1	7.2	6.8	6.5	6.4	6.2

Table B-6

ESTIMATED REGRESSION COEFFICIENTS OF WORK-HOUR REQUIREMENTS (WH) FOR NUCLEAR POWER PLANTS

Dependent Variable	Constant	Value[1]	(Value/kW)[1]	Tower	Northeast and North Central	R^2	$\bar{R}^2$	S.E.	N
WH	3,603.7200 (1.8)	0.0131 (3.8)	-	3,137.0900 (2.4)	-3,518.1500 (-2.6)	0.61	0.54	2,894.86	20
WH	-	0.0183 (10.3)	-	3,691.8300 (2.7)	-3,120.9600 (-2.2)	0.94	0.93	3,064.68	20
ln (WH)	-1.0234 (-0.5)	0.7828 (5.4)	-	0.2032 (1.8)	-0.3642 (-3.1)	0.71	0.66	0.25	20
ln (WH)	-	0.7047 (109.0)	-	0.2070 (1.9)	-0.3621 (-3.2)	0.99	0.98	0.24	20
WH	3,785.5600 (1.6)	0.0130 (3.1)	-	-	-	0.35	0.31	3,501.00	20
WH	-	0.0194 (13.4)	-	-	-	0.90	0.89	3,643.53	20
*ln (WH)	-0.9889 (-0.4)	0.7768 (4.4)	-	-	-	0.51	0.48	0.30	20
ln (WH)	-	0.7015 (137.2)	-	-	-	0.99	0.98	0.30	20
WH/kW	5.6842 (3.7)	0.863×10^{-5} (3.3)	-	2.5306 (2.6)	-1.3950 (-1.4)	0.54	0.45	2.17	20
WH/kW	6.0273 (3.2)	-	0.0082 (2.5)	2.5862 (2.4)	-2.4195 (-2.0)	0.43	0.32	2.40	20
ln (WH/kW)	-3.6744 (-2.8)	0.4560 (4.5)	-	0.2076 (2.6)	-0.1188 (-1.5)	0.65	0.58	0.17	20

Table B-6 (Continued)

ESTIMATED REGRESSION COEFFICIENTS OF WORK-HOUR REQUIREMENTS (WH) FOR NUCLEAR POWER PLANTS

Dependent Variable	Constant	Value	(Value/kW)[1]	Tower	Northeast and North Central	R^2	$\bar{R}^2$	S.E.	N
ln (WH/kW)	-0.7021 (-0.7)	-	0.4859 (3.2)	0.2143 (2.3)	-0.2328 (-2.2)	0.51	0.42	0.20	20
WH/kW	6.3297 (3.8)	0.875×10^{5} (3.0)	-	-	-	0.33	0.29	2.47	20
ln (WH/kW)	-3.8339 (-2.5)	0.4724 (4.1)	-	-	-	0.48	0.45	0.20	20

* Used for forecasts
1. In logarithm when the dependent variable is in logarithm.
t - Statistics are in the parenthesis.

Note: Values are in 1975 dollars.

Table B-7

ESTIMATED REGRESSION COEFFICIENTS OF WORK-HOUR REQUIREMENTS (WH) FOR COAL-FIRED POWER PLANTS

Dependent Variable	Constant	Value[1]	(Value/kW)[1]	Northeast and North Central	South	R^2	$\bar{R}^2$	S.E.	N
WH	-4.5800 (-0.01)	0.0176 (10.6)	-	-	-	0.79	0.78	804.46	32
WH	-	0.0176 (29.1)	-	-	-	0.96	0.95	791.38	32
*ln (WH)	-4.8600 (-4.8)	1.0656 (12.8)	-	-	-	0.85	0.84	0.21	32
ln (WH)	-	0.6667 (166.9)	-	-	-	0.99	0.98	0.27	32
ln (WH/kW)	0.2663 (0.2)	0.1530 (1.3)	-	-0.4633 (-4.6)	-0.2777 (-2.1)	0.46	0.40	0.25	32
WH/kW	2.6700 (2.5)	-	0.0115 (5.2)	-0.9516 (-1.6)	-	0.62	0.59	1.44	32
WH/kW	1.6510 (1.9)	-	0.0132 (6.6)	-	-	0.59	0.58	1.47	32
ln (WH/kW)	-3.0100 (-4.2)	-	0.8240 (6.9)	-	-	0.62	0.61	0.20	32

* Used for forecasts

1. Logarithmic value is used when the dependent variable is in logarithm.

Note: Values are in 1975 dollars.

Table B-8

ESTIMATED REGRESSION COEFFICIENTS OF WORK-HOUR REQUIREMENTS (WH) FOR OIL-GAS-FIRED POWER PLANTS

Dependent Variable	Constant	Value[1]	(Value/kW)[1]	Northeast and North Central	South	R^2	$\bar{R}^2$	S.E.	N
WH	1,084.6800 (2.9)	0.0072 (2.8)	-	1,214.7800 (3.7)	491.1400 (1.4)	0.81	0.75	421.75	13
WH	-	0.0129 (5.8)	-	1,369.6200 (3.2)	696.9700 (1.6)	0.97	0.96	557.53	13
ln (WH)	1.6265 (0.9)	0.5060 (3.1)	-	0.4618 (3.2)	0.2489 (1.7)	0.81	0.75	0.18	13
ln (WH)	-	0.6462 (73.8)	-	0.4082 (3.2)	0.2111 (1.6)	0.99	0.98	0.17	13
WH	1,194.8800 (3.1)	0.0085 (3.4)	-	898.3400 (3.5)	-	0.77	0.72	443.43	13
WH	-	0.0156 (10.5)	-	923.9200 (2.7)	-	0.97	0.96	593.68	13
ln (WH)	0.6361 (0.3)	0.6025 (3.6)	-	0.2962 (2.6)	-	0.75	0.70	0.19	13
ln (WH)	-	0.6566 (109.4)	-	0.2839 (2.7)	-	0.99	0.98	0.19	13
WH	1,237.6300 (2.3)	0.0110 (3.2)	-	-	-	0.48	0.43	630.09	13
WH	-	0.0184 (14.3)	-	-	-	0.94	0.93	731.38	13
*ln (WH)	-1.0222 (-0.5)	0.7539 (3.9)	-	-	-	0.58	0.54	0.24	13
ln (WH)	-	0.6677 (123.8)	-	-	-	0.99	0.98	0.23	13

Table B-8 (Continued)

ESTIMATED REGRESSION COEFFICIENTS OF WORK-HOUR REQUIREMENTS (WH) FOR OIL-GAS-FIRED POWER PLANTS

Dependent Variable	Constant	Value[1]	(Value/kW)[1]	Northeast and North Central	South	R^2	$\bar{R}^2$	S.E.	N
WH/kW	1.6946 (1.7)	-	0.0108 (2.9)	0.9930 (2.1)	-	0.55	0.46	0.85	13
ln (WH/kW)	-0.7485 (-0.8)	-	0.4052 (2.4)	0.1883 (2.1)	-	0.49	0.39	0.16	13
WH/kW	2.2418 (2.0)	-	0.0104 (2.5)	-	-	0.36	0.30	0.97	13

* Used for forecasts

1. In logarithm when the dependent variable is in logarithm.

Note: Values are in 1975 dollars.

Table B-9

ESTIMATED REGRESSION COEFFICIENTS OF WORK-HOUR REQUIREMENTS (WH) FOR FOSSIL-FIRED POWER PLANTS

Dependent Variable	Constant	Value[1]	(Value/kW)[1]	Northeast and North Central	South	R^2	$\bar{R}^2$	S.E.	N
ln (WH)	-	0.6631 (164.2)	-	0.1233 (1.6)	-	0.99	0.98	0.25	45
WH	306.7400 (1.0)	0.0164 (11.9)	-	-	-	0.77	0.76	768.36	45
WH	-	0.0177 (32.9)	-	-	-	0.96	0.95	769.14	45
ln (WH)	-3.5622 (-3.9)	0.9612 (12.7)	-	-	-	0.79	0.78	0.22	45
ln (WH)	-	0.6670 (207.5)	-	-	-	0.99	0.98	0.26	45
WH/kW	6.8395 (8.2)	0.6120×10^{5} (1.7)	-	-2.6709 (-4.3)	-2.2970 (-3.0)	0.38	0.33	1.83	45
ln (WH/kW)	-0.4660 (-0.4)	0.2076 (2.1)	-	-0.3872 (-4.2)	-0.3531 (-3.2)	0.40	0.36	0.26	45
ln (WH/kW)	-2.4236 (-5.0)	-	0.7253 (8.7)	-	-	0.64	0.63	0.20	45
WH/kW	1.6078 (2.8)	-	0.0132 (9.1)	-	-	0.66	0.65	1.33	45

1. In logarithm when the dependent variable is in logarithm.

Note: Values are in 1975 dollars.

APPENDIX C: CLDS Forecasts of Unit Plant Costs ($/KWe: 1975 dollars) for Constructing Electric Power Plants, Through 1985

Table C-1 : Forecasts of Unit Plant Costs ($/KW: 1975 dollars)[c] for Nuclear Power Plants (LWR)

Region	MW	68*	70	72	74	76	79	81	83	85
Non-South	LT 1000[a]	423	482	549	625	719	887	971	1063	1164
	GE 1000[b]	388	441	502	572	658	815	894	981	1077
South	LT 1000	346	394	449	512	589	726	795	870	990
	GE 1000	317	362	411	469	539	667	732	803	882

Note: * Year of construction start

a LT = less than, data for 900 MWe

b GE = greater than or equal to, data for 1200 MWe

c Includes cooling towers

Table C-2 : Forecasts of Unit Plant Costs ($/KWe: 1975 dollars) for Coal-Fired Power Plants

Region	MWe	Scrubber	74*	76	79	81**	83	85
Non-South	LT 700[a]	W	580	635	730	774	821	871
		W/O	483	529	608	645	684	726
	GE 700[b]	W	516	565	650	690	732	776
		W/O	430	471	542	575	610	647
South	LT 700	W	473	519	596	633	671	712
		W/O	395	433	497	527	559	593
	GE 700	W	423	463	533	565	599	636
		W/O	352	385	444	471	499	530

Note: * Year of construction start

a LT = less than, data for 500 MWe

b GE = greater than or equal to, data for 800 MWe

** Figures from 1980 to 1985 are calculated, allowing annual increases of 3%, based on EPRI (See Charles L. Rudusill, "Comparing Coal and Nuclear Generating Costs", EPRI Journal, October 1977) and NERA (See Lewis J. Perl, "Power Plant Costs", talk given at the Eastern Economic Association Convention, April 1978); earlier years were estimated by regression analysis of FPC and CLDS data.

Table C-3 : Forecasts of Unit Plant Costs ($/KW: 1975 dollars) for Oil-Fired Power Plants

Region	MW	Scrubber	74*	76	79	81**	83	85
Non-South	LT[1] 700	W	518	567	652	691	733	778
		W/O	431	472	543	576	611	648
	GE[2] 700	W	464	509	584	620	658	698
		W/O	387	424	487	516	548	581
South	LT 700	W	424	465	534	566	601	637
		W/O	354	388	445	472	501	531
	GE 700	W	380	417	479	508	539	571
		W/O	317	347	399	423	449	476

Note: * Year of construction start

[1] LT = less than, data for 500 MWe

[2] GE = greater than or equal to, data for 800 MWe

** Figures from 1980 to 1985 are calculated, allowing annual increases by 3%, based on EPRI (See Charles L. Rudusill, "Comparing Coal and Nuclear Generating Costs", EPRI Journal, October 1977) and NERA (See Lewis J. Perl, "Power Plant Costs", talk given at the Eastern Economic Association Convention, April 1978); earlier years were estimated by regression analysis of FPC and CLDS data.

Table C-4 : Forecasts of Unit Plant Costs **($/KWe - 1975 dollars) for Gas-Fired Power Plants

Region	MWe	74*	76	79	81	83	85
Non-South	LE 300	434	475	544	577	612	649
	GT 300	410	449	515	546	579	614
South	LE 300	356	390	447	474	503	534
	GT 300	336	368	422	448	475	504

Note: * Year of construction start

LE = less than or equal to, data for 300 MWe

GT = greater than, data for 500 MWe

** Source is 1978 CMDS Report ("Labor and Capital Requirements For Constructing Electric Generating Power Plants", U.S. Department of Labor/U.S. Department of Energy, January 1978); earlier years were estimated by regression analysis of FPC and CLDS data.

Table C-5 : Forecasts of Unit Plant Costs ($/KW: 1975 dollars)*
for Hydroelectric and Pump Storage Power Plants

Type	MWe	50	100	200	300	400	500
Dam & Hydro		1050	853	693	613	563	526

Type	MWe	100	200	300	400	600	800	1000	1200	1400
Pump Storage		533	464	428	404	373	352	336	324	315

* Excludes reservoir properties acquisition and preparation.

Table C-6

ESTIMATED REGRESSION COEFFICIENTS OF PLANT COSTS (C) FOR NUCLEAR POWER PLANTS

Dependent Variable	Constant	MW[1]	Start Year	Regulation	Design Learning	Tower	South	R^2	$\bar{R}^2$	S.E.	N
C	-2,996,744.9100 (-4.6)	455.5600 (4.7)	46,286.5200 (4.5)	-	-33,252.4500 (-1.8)	23,200.6100 (0.7)	-90,684.0000 (-2.6)	0.55	0.52	139,085.66	74
C	-3,064,054.2300 (-4.8)	458.6400 (4.7)	47,305.1800 (4.7)	-	-31,826.9200 (-1.7)	-	-90,535.9300 (-2.6)	0.55	0.52	138,500.57	74
*ln (C)	0.7212 (0.6)	0.7316 (5.2)	0.1101 (5.8)	-	-0.0828 (-2.4)	0.0861 (1.3)	-0.2089 (-3.1)	0.63	0.60	0.26	74
ln (C)	-	0.7576 (5.7)	0.1182 (8.9)	-	-0.0879 (-2.7)	0.0787 (1.2)	-0.2201 (-3.4)	0.99	0.98	0.26	74
ln (C)	0.4367 (0.4)	0.7341 (5.2)	0.1143 (6.1)	-	-0.0779 (-2.3)	-	-0.2080 (-3.1)	0.62	0.60	0.26	74
ln (C)	-	0.7503 (5.6)	0.1191 (9.0)	-	-0.0814 (-2.5)	-	-0.2150 (-3.3)	0.99	0.98	0.26	74
C/kW	-3,220.9900 (-4.5)	-0.1926 (-1.8)	58.8700 (5.3)	-	-40.7200 (-2.0)	-45.8800 (1.2)	-95.7200 (-2.5)	0.34	0.29	152.34	74
C/kW	-3,354.1100 (-4.7)	-0.1865 (-1.7)	60.8900 (5.5)	-	-37.9100 (-1.9)	-	-95.4300 (-2.4)	0.33	0.29	152.75	74
ln (C/kW)	0.7212 (0.6)	-0.2683 (-1.9)	0.1101 (5.8)	-	-0.0828 (-2.4)	0.0861 (1.3)	-0.2089 (-3.1)	0.39	0.35	0.26	74
ln (C/kW)	0.4367 (0.4)	-0.2658 (-1.9)	0.1143 (6.0)	-	-0.0779 (-2.3)	-	-0.2080 (-3.1)	0.38	0.34	0.26	74
C	42,125.2300 (0.5)	491.2700 (5.1)	-	67,478.6500 (4.3)	-31,575.1200 (-1.7)	22,593.1800 (0.6)	-103,383,2600 (-2.8)	0.54	0.51	141,099.94	74
C	-	536.1300 (13.4)	-	65,234.2400 (4.3)	-27,194.9400 (-1.6)	22,540.5900 (0.6)	-103,830.1100 (-2.9)	0.94	0.93	140,345.02	74

Table C-6 (Continued)

ESTIMATED REGRESSION COEFFICIENTS OF PLANT COSTS (C) FOR NUCLEAR POWER PLANTS

Dependent Variable	Constant	MW[1]	Start Year	Regulation	Design Learning	Tower	South	R^2	$\bar{R}^2$	S.E.	N
C	41,981.6000 (0.5)	494.5400 (5.2)	-	69,111.3200 (4.4)	-30,259.2100 (-1.6)	-	-103,617.0500 (-2.8)	0.54	0.51	140,470.93	74
C	-	539.2400 (13.6)	-	66,870.7600 (4.5)	-25,896.9900 (-1.6)	-	-104,061.8400 (-2.9)	0.94	0.93	139,730.70	74
ln (C)	7.4750 (7.9)	0.8139 (5.7)	-	0.1532 (5.0)	-0.0760 (-2.1)	0.0887 (1.3)	-0.2366 (-3.3)	0.60	0.57	0.27	74
ln (C)	7.4579 (7.9)	0.8180 (5.7)	-	0.1602 (5.3)	-0.0712 (-2.0)	-	-0.2372 (-3.3)	0.59	0.57	0.27	74
ln (C)	-	1.9408 (139.7)	-	0.0652 (1.7)	-0.0105 (-0.2)	0.0807 (0.8)	-0.3179 (-3.3)	0.99	0.98	0.37	74
ln (C)	-	1.9421 (141.0)	-	0.0718 (1.9)	-0.0064 (-0.1)	-	-0.3183 (-3.3)	0.99	0.98	0.37	74
C/kW	640.7700 (7.0)	-0.1410 (-1.3)	-	83.3200 (4.7)	-37.2500 (-1.8)	46.0600 (1.1)	-110.4900 (-2.7)	0.30	0.25	156.89	74
C/kW	640.4700 (7.0)	-0.1343 (-1.2)	-	86.6500 (5.0)	-34.5700 (-1.7)	-	-110.9600 (-2.7)	0.29	0.25	157.22	74
ln (C/kW)	7.4750 (7.9)	-0.1860 (-1.3)	-	0.1532 (5.0)	-0.0760 (-2.1)	0.0887 (1.3)	-0.2366 (-3.3)	0.34	0.29	0.27	74
ln (C/kW)	7.4579 (7.8)	-0.1820 (-1.3)	-	0.1602 (5.3)	-0.0712 (-2.0)	-	-0.2372 (-3.3)	0.32	0.28	0.27	74

* Used for forecasts

1. In logarithm when the dependent variable is in logarithm.

t - Statistics are in the parenthesis.

Note: Costs are in 1975 dollars.

Table C-7

ESTIMATED REGRESSION COEFFICIENTS OF PLANT COSTS (C) FOR COAL-FIRED POWER PLANTS

Dependent Variable	Constant	MW[1]	Commercial Op. Year	Northeast	North Central	South	Mountain	R^2	$\bar{R}^2$	S.E.	N
C	-	261.5700 (19.)	1,054.0300 (4.7)	-60,134.5000 (-3.5)	-65,423.88 (-4.0)	-87,985.9400 (-5.3)	-32,805.08 (-2.0)	0.92	0.91	48,636.87	218
ln (C)	-	0.9250 (32.6)	0.0839 (35.7)	0.0676[2] (1.7)	-	-	-	0.99	0.98	0.28	218
C	-550,847.6500 (-9.3)	245.5800 (21.0)	8,054.7600 (9.8)	-	-	-31,949.8000 (-4.7)	-	0.74	0.73	43,220.21	218
C	-	248.6900 (18.0)	449.1100 (4.1)	-	-	-37,578.2600 (-4.7)	-	0.91	0.90	51,116.70	218
*ln (C)	2.2577 (6.3)	0.8953 (34.8)	0.0563 (11.8)	-	-	-0.2067 (-5.2)	-	0.88	0.87	0.25	218
ln (C)	-	0.9413 (35.1)	0.0836 (37.1)	-	-	-0.1880 (-4.4)	-	0.99	0.98	0.27	218
C	-575.133.3100 (-9.3)	241.2200 (19.7)	8,313.7100 (9.7)	-	-	-	-	0.71	0.70	45,253.74	218
C	-	243.6900 (16.9)	358.5800 (3.2)	-	-	-	-	0.90	0.89	53,502.82	218
ln (C)	2.1185 (5.6)	0.8916 (32.7)	0.0579 (11.4)	-	-	-	-	0.86	0.85	0.27	218
ln (C)	-	0.9353 (33.6)	0.0835 (35.6)	-	-	-	-	0.99	0.98	0.28	218

* Used for forecasts

1. In logarithm when the dependent variable is in logarithm.
2. Coefficient estimated for the regional dummy Northeast and North Central.

Note: Costs are in 1975 dollars.

Table C-8

ESTIMATED REGRESSION COEFFICIENTS OF PLANT COSTS (C) FOR OIL-FIRED POWER PLANTS

Dependent Variable	Constant	MW[1]	Commercial Op. Year	Northeast and North Central	South	R^2	$\bar{R}^2$	S.E.	N
C	-193,856.5600 (-2.6)	222.0300 (18.2)	2,643.6500 (2.6)	26,900.0500 (4.3)	-	0.73	0.72	37,849.77	155
ln (C)	4.4624 (7.5)	0.9130 (31.1)	0.0192 (2.3)	0.2724 (5.5)	-	0.88	0.87	0.30	155
ln (C)	-	0.9443 (27.8)	0.0780 (28.6)	0.2433	-	0.99	0.98	0.35	155
C	-197,160.2100 (-2.6)	232.2400 (18.7)	2,854.5100 (2.7)	-	-22,565.4700 (-2.9)	0.72	0.71	39,078.50	155
C	-	234.5900 (18.6)	140.2100 (1.5)	-	-23,753.9200 (-3.0)	0.91	0.90	39,790.68	155
*ln (C)	4.2804 (6.7)	0.9353 (29.8)	0.0220 (2.5)	-	-0.1481 (-2.3)	0.86	0.85	0.32	155
ln (C)	-	0.9630 (27.3)	0.0784 (27.3)	-	-0.1248 (-1.7)	0.99	0.98	0.36	155
C	-210,131.6800 (-2.7)	230.2300 (18.1)	2,983.1700 (2.8)	-	-	0.70	0.69	39,997.48	155
ln (C)	4.2021 (6.5)	0.9349 (29.4)	0.0227 (2.5)	-	-	0.86	0.85	0.33	155
ln (C)	-	0.9623 (27.1)	0.0781 (27.1)	-	-	0.99	0.98	0.37	155

* Used for forecasts

1. In logarithm when the dependent variable is in logarithm.

Note: Costs are in 1975 dollars.

Table C-9

ESTIMATED REGRESSION COEFFICIENTS OF PLANT COSTS (C) FOR GAS-FIRED POWER PLANTS

Dependent Variable	Constant	MW[1]	Commercial Op. Year	Northeast and North Central	South	R^2	$\bar{R}^2$	S.E.	N
C	-275,650.7800 (-4.8)	176.8300 (17.3)	3,946.9200 (4.9)	45,493.6600 (5.6)	-	0.77	0.76	25,729.54	129
ln (C)	3.9951 (6.1)	0.8542 (28.8)	0.0291 (3.1)	0.5080 (5.4)	-	0.89	0.88	0.29	129
ln (C)	-	0.8580 (25.4)	0.0850 (31.8)	0.5178 (4.9)	-	0.99	0.98	0.34	129
ln (C)	3.9616 (5.5)	0.8634 (26.4)	0.0292 (2.8)	-	0.1080 (1.4)	0.86	0.85	0.33	129
ln (C)	-	0.8680 (23.9)	0.0845 (29.2)	-	0.1471 (1.7)	0.99	0.98	0.36	129
C	-265,900.9400 (-4.2)	181.1400 (15.9)	3,842.9800 (4.2)	-	-	0.72	0.71	28,654.78	129
ln (C)	4.0549 (5.6)	0.8610 (26.2)	0.0283 (2.7)	-	-	0.86	0.85	0.33	129
ln (C)	-	0.8650 (23.6)	0.0851 (29.4)	-	-	0.99	0.98	0.36	129

1. In logarithm when the dependent variable is in logarithm.

Note: Costs are in 1975 dollars.

Table C-10

ESTIMATED REGRESSION COEFFICIENTS OF PLANT COSTS (C) FOR OIL-GAS-FIRED POWER PLANTS

Dependent Variable	Constant	MW[1]	Commercial Op. Year	Northeast and North Central	South	R^2	$\bar{R}^2$	S.E.	N
C	-242,890.1700 (-4.5)	212.9300 (21.6)	3,357.8000 (4.4)	28,859.9600 (5.7)	-	0.76	0.75	34,571.47	221
ln (C)	3.9243 (8.6)	0.8937 (37.1)	0.0275 (4.2)	0.3261 (7.5)	-	0.89	0.88	0.29	221
ln (C)	-	0.9065 (32.6)	0.0812 (36.4)	0.2576 (5.2)	-	0.99	0.98	0.34	221
C	-282,936.2100 (-5.0)	223.1000 (21.6)	4,024.3300 (5.1)	-	-14,247.23 (-2.2)	0.73	0.72	36,658.63	221
C	-287,162.0400 (-5.1)	221.8000 (21.3)	4,057.3500 (5.1)	-	-	0.73	0.72	36,963.17	211
ln (C)	3.2996 (6.6)	0.9173 (34.3)	0.0359 (5.0)	-	-	0.86	0.85	0.33	221
ln (C)	-	0.9241 (31.6)	0.0810 (34.4)	-	-	0.99	0.98	0.36	221

1. In logarithm when the dependent variable is in logarithm.

Note: Costs are in 1975 dollars.

Table C-11

ESTIMATED REGRESSION COEFFICIENTS OF PLANT COSTS (C) FOR FOSSIL-FIRED POWER PLANTS

Dependent Variable	Constant	MW[1]	Commercial Op. Year	Northeast and North Central	South	R^2	$\bar{R}^2$	S.E.	N
C	-458,102.8300 (-9.6)	234.1500 (24.4)	6,456.2700 (9.6)	15,708.9500 (3.2)	-	0.71	0.708	45,014.87	365
ln (C)	2.4633 (7.0)	0.9122 (40.6)	0.0484 (9.9)	0.1925 (5.4)	-	0.86	0.859	0.32	365
ln (C)	-	0.9386 (39.9)	0.0803 (42.0)	0.1865 (4.9)	-	0.99	0.989	0.34	365
C	-442,571.7100 (-9.2)	243.6000 (25.7)	6,324.7800 (9.4)	-	-20,355.1100 (-3.5)	0.71	0.708	44,900.68	365
C	-	252.4000 (24.1)	168.9200 (2.2)	-	-24,239.4600 (-3.7)	0.89	0.889	49,844.15	365
ln (C)	2.4570 (6.8)	0.9369 (40.9)	0.0478 (9.4)	-	-0.0993 (-2.3)	0.85	0.849	0.34	365
ln (C)	-	0.9620 (40.2)	0.0797 (40.6)	-	-0.0850 (-1.8)	0.99	0.989	0.36	365
C	-454,565.1000 (-9.4)	240.0100 (25.1)	6,455.5400 (9.5)	-	-	0.70	0.699	45,582.94	365
C	-	248.3900 (23.5)	125.7500 (1.7)	-	-	0.88	0.879	50,727.39	365
ln (C)	2.4174 (6.6)	0.9330 (40.6)	0.0484 (9.5)	-	-	0.85	0.849	0.34	365
ln (C)	-	0.9583 (40.0)	0.0797 (40.5)	-	-	0.99	0.989	0.36	365

1. In logarithm when the dependent variable is in logarithm.

Note: Costs are in 1975 dollars.

Table C-12

ESTIMATED REGRESSION COEFFICIENTS OF PLANT COSTS (C) FOR HYDRO-DAM POWER PLANTS

Dependent Variable	Constant	MW^1	UMW^1	R^2	S.E.	N
C	17,475.8900 (0.3)	624.9300 (3.7)	-	0.53	117,827.70	14
C	-	670.5400 (6.7)	-	0.78	113,736.3200	14
*ln (C)	8.1256 (8.4)	0.6860 (3.7)	-	0.53	0.71	14
ln (C)	-	2.2274 (24.3)	-	0.98	1.77	14
C/kW	1,146.2600 (5.1)	-1.1728 (-1.6)	-	0.17	514.06	14
ln (C/kW)	8.1256 (8.4)	-0.3139 (-1.7)	-	0.19	0.70	14
UC	22,217.7600 (1.1)	-	405.6300 (2.2)	0.28	45,259.93	14
UC	-	-	570.1800 (5.1)	0.67	45,560.25	14
ln (UC)	8.4777 (10.4)	-	0.5298 (2.8)	0.39	0.63	14
ln (UC)	-	-	2.4901 (20.3)	0.97	1.94	14

Table C-12 (Continued)

ESTIMATED REGRESSION COEFFICIENTS OF PLANT COSTS (C) FOR HYDRO-DAM POWER PLANTS

Dependent Variable	Constant	MW[1]	UMW[1]	R^2	S.E.	N
C/kW	1,243.7100 (5.8)	-	-4.3386 (-2.2)	0.28	477.64	14
ln (C/kW)	8.4777 (0.4)	-	-0.4702 (-2.4)	0.33	0.63	14

* Used for forecasts

1. In logarithm when the dependent variable is in logarithm.

C - Stands for total costs of the combined units.
UC - Indicates plant costs of one unit.
UMW is unit MW corresponding to UC.

Note: Costs are in 1975 dollars.

Table C-13

ESTIMATED REGRESSION COEFFICIENTS OF PLANT COSTS (C) FOR PUMP STORAGE POWER PLANTS**

Dependent Variable	Constant	MW^1	UMW^1	R^2	S.E.	N
C	40,174.7800 (0.9)	233.5900 (5.9)	-	0.90	50,707.83	6
C	-	264.0300 (15.5)	-	0.98	49,418.45	6
*ln (C)	7.1847 (7.4)	0.7740 (5.4)	-	0.88	0.18	6
ln (C)	-	1.8197 (49.2)	-	0.99	0.62	6
C/kW	350.0000 (6.4)	-0.0594 (-1.3)	-	0.29	60.08	6
ln (C/kW)	7.1847 (7.4)	-0.2259 (-1.6)	-	0.39	0.18	6
UC	13,241.0300 (1.6)	-	208.8400 (6.5)	0.91	8,494.05	6
UC	-	-	255.2400 (16.7)	0.98	9,703.03	6
ln (UC)	7.0821 (18.9)	-	0.7286 (10.4)	0.96	0.10	6
ln (UC)	-	-	2.0445 (29.6)	0.99	0.90	6

Table C-13 (Continued)

ESTIMATED REGRESSION COEFFICIENTS OF PLANT COSTS (C) FOR PUMP STORAGE POWER PLANTS**

Dependent Variable	Constant	MW^1	UMW^1	R^2	S.E	N
C/kW	393.2800 (10.2)	-	-0.4496 (-3.0)	0.70	39.29	6
ln (C/kW)	7.0821 (18.9)	-	-0.2713 (-3.9)	0.79	0.10	6

* Used for forecasts

1. In logarithm when the dependent variable is in logarithm.

C - Total plant costs of combined units.
UC - Plant costs of one unit.
UMW - Unit MW.

Note: Costs are in 1975 dollars.

** It should be noted that only six observations were available to estimate pump storage cost and labor requirements per installed kilowatt of capacity. Although the unadjusted R^2's obtained were .88 and .62 respectively, the small number of observations may detract from the reliability of the forecasts.

Table C-14

ESTIMATED REGRESSION COEFFICIENTS OF PLANT COSTS (C) FOR HYDRO-ELECTRIC AND PUMP STORAGE POWER PLANTS

Dependent Variable	Constant	MW^{1}	UMW^{1}	R^2	S.E.	N
C	95,763.2700 (2.5)	221.2900 (4.0)	-	0.47	122,735.91	20
C	-	318.7300 (7.1)	-	0.73	138,898.90	20
ln (C)	8.4840 (13.4)	0.6038 (5.5)	-	0.62	0.59	20
ln (C)	-	2.0524 (27.5)	-	0.98	1.91	20
C/kW	948.5600 (6.6)	-0.5323 (-5.6)	-	0.27	461.69	20
ln (C/kW)	8.4840 (13.4)	-0.3961 (-3.6)	-	0.42	0.59	20
UC	34,640.6800 (2.4)	-	186.3100 (2.1)	0.20	40,761.75	20
UC	-	-	347.1400 (5.8)	0.64	45,393.05	20
ln (UC)	8.6624 (15.0)	-	0.4659 (3.7)	0.43	0.55	20
ln (UC)	-	-	2.3090 (24.2)	0.97	1.96	20

Table C-14 (Continued)

ESTIMATED REGRESSION COEFFICIENTS OF PLANT COSTS (C) FOR HYDRO-ELECTRIC AND PUMP STORAGE POWER PLANTS

Dependent Variable	Constant	MW[1]	UMW[1]	R^2	S.E.	N
C/kW	1,074.7000 (6.9)	-	-2.9101 (-3.2)	0.36	432.86	20
ln (C/kW)	8.6624 (15.0)	-	-0.5340 (-4.3)	0.50	0.55	20

1. In logarithm when the dependent variable is in logarithm.

C - Total plant costs of combined units.
UC - Plant costs of one unit.
UMW - One unit MW.

Note: Costs are in 1975 dollars.

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APPENDIX D: Method for Converting Constant Dollars to Current Dollars

Appendix D: Method for Converting Constant Dollars to Current Dollars

The following example illustrates a method for computing current or accounting dollars from constant dollars for construction of a nuclear power plant (1,150 MWe capacity) in a non-South location. Construction is assumed to begin in July 1979.

Background

1. Table C-1, "Forecasts of Unit Plant Costs for Nuclear Power Plants" indicates $815/KWe (constant 1975 dollars) for a 1200 MWe capacity plant in a non-South location with construction starting in July 1979.
2. The scaling factor for converting costs to various other sizes is assumed to be .7.
3. Handy-Whitman indices (1949=100) for non-South location (which measures cost trends for all steam generation plants) are given as 365.7, 386.7, 416.5, and 435.7 for consecutive years starting with July 1975. After July 1978, a 7 percent consecutive annual increase is assumed.
4. The forecasted construction duration for plants starting in 1979 is 8½ years and it is assumed that the nuclear steam supply system is purchased 3½ years before the construction start.
5. Assume the following cash flow model in constant 1975 dollars expressed as a percentage of total project costs for each year of expenditures; 0.6, 2.3, 6.1, 8.7, 10.5, 11.2, 12.0, 13.7, 12.5, 10.5, 9.3, and 2.6 with a total period of 12 years during which expenditure occurs.

Methodology

1. First, constant 1975 dollars for a 1200 MWe capacity unit are scaled to constant 1975 dollars for a 1,150 MWe capacity unit using a scaling factor of .7 as follows:[1]

$$\text{Constant 1975 dollars for 1,150 MWe capacity unit} = \left(\frac{1150}{1200}\right)^{.7} \times \frac{1200 \times 815}{1150}$$

$$= \$825.47/\text{KWe}$$

$$= \$949,300,000$$

2. Total constant 1975 dollars when multiplied by a 1975 constant dollar cash flow for each year will yield the numbers shown in column 3 of Table D-1.
3. Based on an assumed construction duration for this nominal plant, a new schedule of construction has been set up as shown in column 4 of Table D-1.
4. The Handy-Whitman indices multiplier in column 5 are the ratios of the index for that particular year with the 1975 index.
5. Column 3 multiplied by column 5 yields the current dollar costs expended in each year.
6. The sum of column 6 is the current dollar estimate for the 1,150 MWe capacity nuclear plant in a non-South location.

This methodology would be typically applicable to all types of power plants as illustrated in the Table. It should be noted that the cash flow pattern, construction duration, and 7 percent annual increase assumed in this case may vary for individual plants.

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1. The scaling factor of .7 was estimated by regression analysis of capital costs of electric power plants. See Table C-6 of Appendix C.

Table D-1

EXAMPLE FOR CONVERTING CONSTANT DOLLARS TO CURRENT DOLLARS
($ x 1,000)

Years from Completion	Cash Flow % in Constant '75 Dollars	Annual Expenditure in Constant '75 Dollars	New Schedule of Payments	*Handy-Whitman Index Multiplier	Annual Current Expenditures
11	0.6	$ 5,700	1976	386.7/365.7	$ 6,030
10	2.3	21,830	1977	416.5/365.7	24,860
9	6.1	57,910	1978	435.7/365.7	68,990
8	8.7	82,590	1979	466.2/365.7	105,290
7	10.5	99,680	1980	498.8/365.7	135,960
6	11.2	106,320	1981	533.7/365.7	155,160
5	12.0	113,920	1982	571.1/365.7	177,900
4	13.7	130,050	1983	611.0/365.7	217,280
3	12.5	118,660	1984	653.8/365.7	212,140
2	10.5	99,680	1985	699.6/365.7	190,690
1	9.3	88,280	1986	748.6/365.7	180,710
0	2.6	24,680	1987	801.0/365.7	54,060
Total	100.0	$949,300			$1,529,070
Dollars/KWe		$ 825.47			$1,329.6

*Actual indices are thru July '78 and 7% annual increase has been assumed thereafter.

APPENDIX E: Data Sources and References

Data Sources

Subject	
•WH/KWe	•1979 CLDS Utility Survey
•Activity	•Inventory of Power Plants in the U.S., Energy Information Administration, U.S. Department of Energy, Washington, D.C., various issues.
•Plant Costs	•1979 CLDS Utility Survey •Steam - Electric Plant Construction Costs and Annual Production Expenses, Energy Information Administration, U.S. Department of Energy (old FPC), Washington, D.C., 1960-1975. •Engineering News-Record, McGraw-Hill, Inc., New York, N.Y., January 20, 1977; January 19, 1978; and January 18, 1979. •Central Station Nuclear Plants, U.S. ERDA, Washington, D.C., March 31, 1976. •The Nuclear Industry, U.S. AEC, Washington, D.C., 1974. •U.S. Central Station Nuclear Electric Generating Units: Significant Milestones, Division of Nuclear Power Development, U.S. Department of Energy, Washington, D.C., October 1978. •Program Summary Report, Office of Management and Program Analysis, U.S. NRC, Washington, D.C., March 16, 1979. •Handy-Whitman Index of Public Utility Construction Costs, Whitman, Requardt and Associates, Baltimore, Maryland, 1960-1978.
•Duration	•1979 CLDS Utility Survey •Construction Status Report: Nuclear Power Plants, NUREG 0030, Vol. II, No. 1, Office of Management and Program Analysis, U.S. NRC, Washington, D.C., February 1979.

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