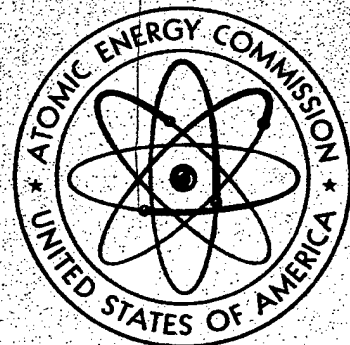

NUCLEAR POWER GROWTH 1974 - 2000

DISTRIBUTION STATEMENT A
Approved for Public Release
Distribution Unlimited

20031126 096



FEBRUARY, 1974

UNITED STATES ATOMIC ENERGY COMMISSION
Office of Planning and Analysis

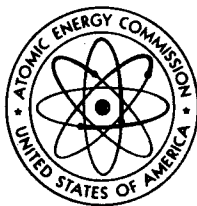
LEGAL NOTICE

This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Atomic Energy Commission, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights.

AMC TECHNICAL LIBRARY
5001 Eisenhower Avenue
Alexandria, Virginia 22333

WASH-1139 (74)
UC-80

NUCLEAR POWER GROWTH 1974-2000



FEBRUARY 1974

DISTRIBUTION STATEMENT A
Approved for Public Release
Distribution Unlimited

UNITED STATES ATOMIC ENERGY COMMISSION
Office of Planning and Analysis

TABLE OF CONTENTS

	Page
Introduction	VII
Summary	1
Domestic Forecasts	5
Foreign Forecasts	19
Reactor and Fuel Cycle Characteristics	23
Separative Work, Feed, and Uranium Requirements	27
Plutonium Production and Availability	33
Fabrication, Conversion, and Reprocessing Demands	37
Sensitivity Analyses	41
Appendix A—Foreign Uranium Enrichment Supply	43
Appendix B—Annual and Cumulative Separative Work, Feed, and U ₃ O ₈ Requirements at Various Enrichment Plant Tails Assays	45
Appendix C—United States Reactor List	61
Appendix D—Foreign Reactor List	67

LIST OF TABLES

Table	Page
1 Nuclear Electrical Capacity	2
2 Separative Work Requirements	2
3 Enrichment Plant Feed Requirements	3
4 Uranium Requirements	3
5 Forecasts of Energy Consumption and Electric Generating Capacity in the United States	6
6 Forecasts of U.S. Nuclear Power Growth	8
7 Total Energy Supply for U.S. Forecasts	11
8A Nuclear Power Capacity by Reactor Type, United States, Case A	13
8B Nuclear Power Capacity by Reactor Type, United States, Case B	14
8C Nuclear Power Capacity by Reactor Type, United States, Case C	15
8D Nuclear Power Capacity by Reactor Type, United States, Case D	16
9 Comparisons of Official AEC Nuclear Power Forecasts	17
10 Forecasts of Foreign Nuclear Capacity	20
11 Nuclear Power Capacity by Reactor Type, Foreign, Case Y	22
12 Thermal Reactor Characteristics	24

Table		Page
13	Fast Breeder Reactor Characteristics	25
14	Fuel Cycle Lead Times	25
15	Annual Separative Work Demand	28
16	Annual Enrichment Plant Natural Uranium Feed Requirements ..	29
17	Sample Demand on United States Enrichment Facilities	30
18	Annual Uranium Demand	30
19	Fissile Plutonium Recovery and Utilization, United States, Case D.	34
20	Fissile Plutonium Recovery and Utilization, Foreign, Case Y	35
21	Fuel Fabrication, Conversion, and Reprocessing Demand, United States, Case D	38
22	Fuel Fabrication, Conversion, and Reprocessing Demand, Foreign, Case Y	39
A-1	Foreign Separative Work Supply Schedules	44
A-2	Foreign Separative Work Requirements	44
B-1	Annual Enrichment Demand, United States, Case A	46
B-2	Cumulative Enrichment Demand, United States, Case A	47
B-3	Annual Enrichment Demand, United States, Case B	48
B-4	Cumulative Enrichment Demand, United States, Case B	49
B-5	Annual Enrichment Demand, United States, Case C	50
B-6	Cumulative Enrichment Demand, United States, Case C	51
B-7	Annual Enrichment Demand, United States, Case D	52
B-8	Cumulative Enrichment Demand, United States, Case D	53
B-9	Annual Enrichment Demand, Foreign, Case X	54
B-10	Cumulative Enrichment Demand, Foreign, Case X	55
B-11	Annual Enrichment Demand, Foreign, Case Y	56
B-12	Cumulative Enrichment Demand, Foreign, Case Y	57
B-13	Annual Enrichment Demand, Foreign, Case Z	58
B-14	Cumulative Enrichment Demand, Foreign, Case Z	59
C-1	United States Central Station Nuclear Power Reactors in Operation February 1974	61
C-2	United States Central Station Nuclear Power Reactors Ordered, Announced, and Planned	63
D-1	Foreign Central Station Nuclear Power Reactors Operating, Ordered, Announced and Planned	67

LIST OF FIGURES

	Page
1 Installed Nuclear Capacity, United States	7
2 Diagram of Energy Flows	10
3 Nuclear Additions as a Fraction of Total Thermal Additions, United States	12
4 Range of Installed Capacity for Each Reactor Type. United States	12
5 Installed Nuclear Capacity, Foreign	20
6 Installed Capacity for Each Reactor Type, Foreign, Case Y	21
7 Cumulative World-Wide Separative Work Demand	30

	Page
8 Cumulative World-Wide Enrichment Plant Natural-Uranium Feed Requirements	31
9 Cumulative World-Wide Uranium Requirements	31
10 Sensitivity of Separative Work Demand to Tails Assay and Installed Nuclear Capacity	41
11 Sensitivity of Separative Work Demand to Installed Nuclear Capacity and Capacity Factor	42
12 Sensitivity of Separative Work Demand to Plutonium Recycle and Breeder Introduction Date	42
A-1 Derivation of Annual Foreign Enrichment Supply Schedules	44

INTRODUCTION

The Office of Planning and Analysis periodically prepares forecasts of nuclear power growth to provide a basis for planning certain AEC programs. The forecasts are made not to predict precise points in the future, but rather to predict a range of values within which the future is likely to be. While fixed plans must be made, the range of forecasts permits planners to make sensitivity analyses assuring that the plans can meet the potential future conditions. Users of this forecast should, therefore, consider the range of the forecasts rather than a particular schedule of values. It also should be recognized that the range of forecasts or elements of the forecast could be greater than reported here. The nuclear generating capacity could range from zero to 100% of the total base load electric generating capacity, depending on whether one expects a moratorium or complete technical failure of nuclear power or that the economic, environmental and social benefits of nuclear power far surpass any other technology. In this regard, this forecast assumes that in the latter part of this century the economic and environmental benefits of nuclear power are such that it becomes the dominant technology for base load electric power generation.

NUCLEAR POWER GROWTH 1974-2000

SUMMARY

This forecast of the growth of nuclear power in the United States and the rest of the world represents a current evaluation of domestic and foreign trends in the growth of nuclear power, the future capability of foreign nations to supply uranium enrichment services to reactor operators, the timing and application of plutonium recycle technology, and the timing and rate of introduction of the fast-breeder reactor (FBR).

A total of seven separate cases has been prepared, four for the United States and three for the rest of the world. These cases are not intended to specify precise future situations but rather to provide a reasonable range of estimates of the growth of nuclear power and the concomitant range of requirements for separative work, uranium and related materials and services. These cases are summarized in Table 1. Corresponding requirements for uranium enrichment services, uranium feed to enrichment plants, and uranium concentrate (U_3O_8) are summarized in Tables 2, 3 and 4, respectively.

Forecasts for the next decade are based on an analysis and evaluation of nuclear plants already operating, those under construction, and those planned. Forecasts beyond this period and to the year 2000 are based on extrapolations of near-term

growth trends together with differing assumptions about future trends in energy consumption and electricity generating capacity.

Cases A and X present the lowest domestic and the lowest foreign forecasts, respectively. Both are based on the assumption that the current trend toward increased slippage in reactor construction will continue unabated and that the long-term demand for electricity will be relatively low. Domestic Case C and foreign Case Z are the highest presented. They are based on assumptions of legislative changes in the regulatory process, a marked improvement in construction time, relatively high future demand for electricity, and predominance of nuclear fuel over fossil fuel for new electricity generating plants. Cases B and Y postulate continued improvement in the regulatory processes, fewer construction delays than at present, and continuation of current trends in electricity demand. Domestic Case D assumes that actions are taken to achieve long-term energy conservation, continued improvements are made in regulatory processes, fewer construction delays are incurred, and the long-term demand for electricity is relatively low.

As shown in Table 1, the ranges of nuclear power capacity installed by the end of 1980 will be 85,000

Table 1
NUCLEAR ELECTRICAL CAPACITY
(Thousands of Megawatts at End of Calendar Year)

February 1974 Forecast					WASH-1139(72)				
United States Case	1980	1985	1990	2000		1980	1985	1990	2000
A.....	85	231	410	850	Low.....	127	256	412	825
B.....	102	260	500	1200	Most Likely.....	132	280	508	1200
C.....	112	275	575	1400	High.....	144	332	602	1500
D.....	102	250	475	1090					
Foreign Case									
X.....	113	290	640	1600	* Low.....	143	312	600	1635
Y.....	140	387	780	2130	* Most Likely.....	161	359	724	2060
Z.....	157	420	900	2550	* High.....	173	414	850	2500

* Excludes Peoples Republic of China.

MWe to 112,000 MWe in the United States and 113,000 to 157,000 MWe in foreign countries. There will be 231,000 to 275,000 MWe in the United States and 290,000 to 420,000 MWe abroad by the end of 1985, and there will be 850,000 to 1,400,000 MWe and 1,600,000 to 2,550,000 MWe by the end of 2000. The forecast for the next few years is somewhat lower than that presented in the previous fore-

cast (WASH-1139(72)) as can be seen in Table 1. In the United States, this reduction is the result of continuing long project schedules which have a multiplicity of causes. Some of the more obvious problems are late equipment delivery, construction delays, strikes, poor labor productivity, and regulatory problems. The previous forecast underestimated the difficulty in responding to the situation resulting

Table 2
SEPARATIVE WORK REQUIREMENTS*
(Millions of SWU)

United States Case	0.20% ²³⁵ U Enrichment Plant Tails Assay				0.30% ²³⁵ U Enrichment Plant Tails Assay			
	1980 Annual	1985	1990	2000	1980	1985	1990	2000
A.....	14.3	28.8	45.2	71.4	11.3	23.0	36.3	57.4
B.....	17.8	33.1	57.4	104.4	14.1	26.4	46.0	84.0
C.....	17.6	35.7	66.6	121.	13.9	28.5	53.4	97.4
D.....	17.9	30.8	53.2	93.6	14.2	24.6	42.7	75.3
Foreign Case								
X.....	15.9	34.8	66.7	119.	12.6	27.5	52.8	93.6
Y.....	17.9	42.9	76.9	153.	14.1	33.9	60.7	121.
Z.....	22.6	49.6	93.7	206.	17.8	39.1	74.1	163.
United States Case Cumulated From 1973								
A.....	62.2	173.	363.	979.	49.4	138.	290.	785.
B.....	71.1	197.	430.	1285.	56.4	156.	343.	1030.
C.....	77.0	212.	481.	1482.	61.1	169.	384.	1189.
D.....	73.6	194.	414.	1194.	58.4	154.	330.	957.
Foreign Case								
X.....	66.6	195.	463.	1444.	52.6	154.	366.	1142.
Y.....	86.4	249.	567.	1796.	68.2	196.	447.	1419.
Z.....	92.4	277.	657.	2216.	72.8	218.	518.	1752.

* With plutonium recycle beginning in 1977.

Table 3
ENRICHMENT PLANT NATURAL URANIUM FEED REQUIREMENTS*
(Thousands of Metric Tons of Uranium)

0.20% ²³⁵ U Enrichment Plant Tails Assay					0.30% ²³⁵ U Enrichment Plant Tails Assay			
United States Case	1980 Annual	1985	1990	2000	1980	1985	1990	2000
A-----	17.8	33.0	49.3	73.8	21.4	40.2	60.4	91.0
B-----	22.4	38.1	63.4	109.0	27.0	46.3	77.5	134.
C-----	22.0	41.1	74.1	126.	26.5	50.0	90.4	155.
D-----	22.2	34.8	58.5	97.2	26.7	42.4	71.5	120.
Foreign Case								
X	20.5	44.2	81.8	137.	24.6	53.2	98.9	168.
Y	23.9	54.9	94.9	177.	28.6	66.1	115.	216.
Z	30.6	64.1	116.	237.	36.6	77.1	140.	290.
United States Case Cumulated From 1973								
A	76.7	207.	418.	1068.	92.5	251.	508.	1308.
B	88.1	235.	496.	1408.	106.2	285.	602.	1723.
C	95.5	254.	556.	1624.	115.	307.	676.	1987.
D	91.3	231.	476.	1307.	110.1	253.	579.	1600.
Foreign Case								
X	87.7	252.	585.	1745.	104.9	303.	705.	2119.
Y	115.	327.	724.	2185.	138.	392.	872.	2652.
Z	124.	365.	843.	2682.	148.	437.	1014.	3255.

* With plutonium recycle beginning in 1977.

Table 4
URANIUM REQUIREMENTS*
(Thousands of Short tons of U₃O₈)

0.20% ²³⁵ U Enrichment Plant Tails Assay					0.30% ²³⁵ U Enrichment Plant Tails Assay			
United States Case	1980 Annual	1985	1990	2000	1980	1985	1990	2000
A	25.2	45.5	68.5	97.	30.3	55.2	83.5	119.
B	28.9	52.9	87.6	143.	34.8	64.2	106.6	175.
C	29.4	58.5	102.4	165.	35.5	70.9	125.	203.
D	31.5	49.8	81.5	128.	37.9	60.4	99.3	157.
Foreign Case								
X	33.3	66.4	119.	194.	39.2	78.7	142.	234.
Y	39.6	84.2	144.	259.	46.5	99.9	171.	311.
Z	54.9	97.5	169.	331.	54.9	116.	202.	400.
United States Case Cumulative From 1973								
A	111.	294.	587.	1466.	134.	355.	712.	1789.
B	126.	334.	699.	1931.	152.	404.	848.	2356.
C	137.	363.	787.	2226.	165.	438.	953.	2716.
D	133.	329.	671.	1793.	161.	397.	814.	2187.
Foreign Case								
X	154.	409.	907.	2584.	179.	481.	1074.	3088.
Y	194.	520.	1120.	3293.	226.	612.	1326.	3926.
Z	208.	577.	1282.	3929.	243.	680.	1521.	4708.

* With plutonium recycle beginning in 1977.

from the "Calvert Cliffs" decision, particularly the longer construction schedules and environmental report preparation. In other countries, the near-term reductions are due primarily to site approval difficulties. Most of these difficulties are expected to be overcome later so that the forecast ranges presented here for the year 2000 are not very different from the ones presented in WASH-1139(72).

The annual and cumulative separative work demands corresponding to each of these seven cases are shown in Table 2 beginning with 1973. These demands are shown for enrichment facilities operating at either 0.20% or 0.30% ^{235}U tails assay. Corresponding requirements for enrichment plant feed in the form of UF_6 are shown in Table 3, and the corresponding total amounts of U_3O_8 which must be produced are shown in Table 4.

Most nuclear power plants are expected to be operated during the period of this forecast as base

loaded plants. All plants are assumed to operate at approximately a 75% capacity factor, except during the first three years of commercial operation when their operating time is assumed to be less to allow for a startup and break in period. After their fifteenth year of operation, they are projected to operate at lower capacity factors because of increasing age and newer base load plants. This results in an apparent average capacity factor for all nuclear plants of between 65% and 70% after 1975.

Demand data for fresh fuel fabrication, spent fuel reprocessing, and uranium conversion to UF_6 are provided. These are based on standard lead and delay times applicable to each phase of the fuel cycle.

Lists of operating nuclear plants and those under construction and planned or announced are given in Appendices C and D.

DOMESTIC FORECASTS

Domestic nuclear power growth is analyzed in both the near and long term. The near-term forecasts extend into the early 1980's and are controlled largely by decisions already made about individual power plants. The forecasts of the long-term, from the early 1980's to the end of the century, are based on social, economic, and technological factors which will be critical in determining future energy demands. Four forecast cases have been developed which represent a range of probable energy demands and nuclear energy contribution to the supply.

Near-Term Forecasts

For the period up to the early 1980's, the forecasts are based on data on known nuclear power plants which are operating, under construction, on order, planned, or announced. The four forecast cases discussed below are based on differing assessments of the success the industry will have in meeting the schedules for commercial operation of both nuclear and fossil power plants and on the demand for electrical energy.

Case A

This case presents the lowest forecast of nuclear capacity. The assumption is made that delays in bringing nuclear plants on line continue to plague the industry. The sources of delay are manifold including late equipment deliveries, construction delays, strikes, poor labor productivity and regulatory problems. It is not assumed that any particular source of delay is predominant or that any particular source is corrected, but rather that some of these sources of delay will remain.

The project time consists of about 2 years for planning and design, license application and environmental report preparation, 2 years for construction permit approval, and 6 years for construction and start-up. As shown in Table 5, Case A forecasts 85,000 MW of nuclear generating capacity to be on line at the end of 1980 out of a total electrical generating system capacity of 655,000 MW. By comparison, present utility schedules indicate about 124,000 MW of nuclear capacity on line by 1980. Case A forecasts 231,000 MW of nuclear capacity for 1985.

Table 5

FORECASTS OF ENERGY CONSUMPTION AND ELECTRIC GENERATING CAPACITY IN THE UNITED STATES

	Case	1960	1970	1975	1980	1985	1990	1995	2000
Energy Consumed, Million Btu per Capita-----	A	247.	329.	357.	378.	401.	429.	462.	499.
	B	247.	329.	372.	428.	485.	558.	635.	719.
	C	247.	329.	376.	434.	497.	569.	650.	737.
	D	247.	329.	364.	399.	438.	494.	563.	642.
Fraction for Electricity Generation-----	A	.18	.24	.29	.33	.37	.42	.46	.51
	B	.18	.24	.29	.31	.34	.40	.45	.50
	C	.18	.24	.29	.34	.38	.43	.49	.54
	D	.18	.24	.29	.32	.36	.41	.46	.50
Energy Consumed for Electricity Generation, Million Btu per Capita-----	A	44.2	80.3	105.	125.	148.	180.	215.	253.
	B	44.2	80.3	107.	133.	166.	220.	283.	357.
	C	44.2	80.3	111.	147.	189.	246.	316.	399.
	D	44.2	80.3	107.	129.	156.	201.	257.	324.
Apparent Capacity Factor-----	A	.49	.52	.50	.49	.50	.51	.51	.52
	B								
	C								
	D								
Heat Rate, Thousands Btu per kwh-----	A	10.7	10.5	10.2	10.1	10.0	9.8	9.8	9.6
	B								
	C								
	D								
Total Electric Generating Capacity per Capita, kw per Capita-----	A	.97	1.67	2.36	2.88	3.33	4.14	4.90	5.81
	B	.97	1.67	2.41	3.07	3.76	5.07	6.45	8.19
	C	.97	1.67	2.50	3.38	4.25	5.67	7.27	9.22
	D	.97	1.67	2.41	2.99	3.52	4.62	5.85	7.45
Total Electric Generating Capacity, Thousands of MW-----	A	168.	341.	510.	655.	800.	1040.	1280.	1575.
	B	168.	341.	520.	700.	903.	1275.	1685.	2220.
	C	168.	341.	540.	770.	1020.	1425.	1900.	2500.
	D	168.	341.	520.	680.	865.	1160.	1530.	2020.
Total Nuclear Generating Capacity, Thousands of MW-----	A	.02	5.8	43.3	85.0	230.9	410.	620.	850.
	B	.02	5.8	47.3	102.1	260.0	500.	820.	1200.
	C	.02	5.8	52.0	112.4	275.0	575.	960.	1400.
	D	.02	5.8	47.3	102.1	250.0	475.	760.	1090.

Case B

This case assumes that there will be some improvement over recent experiences in construction and regulation. Specifically, project times will average 8 years with about 15 months for planning and design, license application and environmental report preparation; 15 months for construction permit issuance; and about 5½ years for construction and start-up. Nuclear capacity would then be 102,100

MW in 1980 out of a total system capacity of 700,000 MW. In 1985, the nuclear capacity is forecast to be 260,000 MW.

Case C

This case assumes additional improvements in construction performance and regulatory processes. New legislation and rules would permit construction to begin prior to completion of the construction permit

application safety review. The site environmental review would be completely separated from the safety review. This presupposes that standardized plant designs would be used in the license application. The project time would be about 6 years with 1 year for design and planning, license application preparation and environmental review and 5 years for construction and start up with concurrent operating license review and approval. Under these assumptions, the nuclear capacity in 1980 would be 112,400 MW out of a total system capacity of 770,000 MW. The 1985 nuclear capacity is forecast to be 275,000 MW.

Case D

This case assumes a general reduction in the growth rate of electricity use which for the near-term means a reduction in non-essential and extravagant uses. The total electric generating capacity in 1980 is forecast to be 680,000 MW compared to 700,000 MW for Case B, with the same nuclear capacity of 102,100 MW and the same assumptions about nuclear project schedules as in Case B. The reduction in electricity production in the near-term is realized by reducing the use of oil and gas fired plants. The 1985 nuclear capacity is forecast to be 250,000 MW.

Long-Term Projections

The forecast beyond the early 1980's is based on assessments of possible changes in technologies and relative prices, structural changes in the economy and in relations with the rest of the world, as well as changes in the needs and desires of American society. It is not only that there will be more options open in the more distant future, but also that measures taken in the near-term will influence future results, especially in any specific energy area such as nuclear power.

Each of the near-term nuclear growth projections in Cases A through D, above, could be combined with various long-term results. The near-term problems in plant construction do not necessarily determine long-term programs or their ultimate degree of success. However, in order to calculate meaningful ranges of the possible implications of nuclear power, the near-term forecasts of low capacity have been tied to long-term forecasts of low demand; and high near-term capacities have been tied to high future demands. The yearly forecasts of the nuclear capacity for these cases are shown in Figure 1. and Table 6

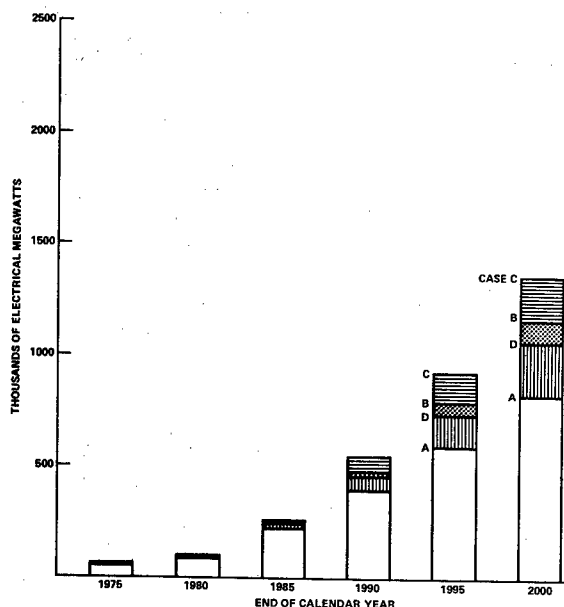


FIGURE 1. INSTALLED NUCLEAR CAPACITY, UNITED STATES

The forecasts of energy consumption and total generating capacity are shown by five year intervals in Table 5.

The long-term forecasts of nuclear power development start with assessments of population and economic growth, but separate cases are developed reflecting alternative paths of development in the energy sector. The population and economic projections are linked to a level of total energy resource consumption modified by such considerations as the effect of successful conservation measures, the potential for greater use of electricity in the economy, and the existence of energy resource supply constraints. These considerations have been examined in an analytical framework which facilitates a systematic examination of the patterns of energy use and energy supply.

The Census Bureau's "Series E" population projection was used as a basis for the energy and economic growth forecasts. This projection indicated that total U.S. population is expected to increase from 205 million in 1970, to 228 million in 1980, and 271 million by the year 2000. It assumes that net immigration will not exceed 400,000 persons annually, a figure in accord with recent experience and present immigration regulations, and furthermore that the fertility rate (births per female) will gradually decline to replacement level. The fertility

Table 6
FORECASTS OF U.S. NUCLEAR POWER GROWTH
(Thousands of Electrical Megawatts) *

Calendar Year	Case A		Case B		Case C		Case D	
	Additions	Cumulated	Additions	Cumulated	Additions	Cumulated	Additions	Cumulated
1974	3.4	27.5	8.7	32.8	18.1	42.1	8.7	32.8
1975	15.9	43.3	14.5	47.3	9.8	52.0	14.5	47.3
1976	9.8	53.1	7.0	54.3	8.5	60.5	7.0	54.3
1977	7.4	60.5	7.0	61.3	4.9	65.4	7.0	61.3
1978	4.0	64.5	8.3	69.7	7.4	72.7	8.3	69.7
1979	7.9	71.7	11.8	80.7	14.6	86.5	11.8	80.7
1980	13.4	85.0	21.5	102.1	26.0	112.4	21.5	102.1
1981	29.2	114.2	32.2	134.3	32.0	144.4	24.9	127.
1982	28.4	142.6	28.1	162.4	30.1	174.4	28.	155.
1983	31.2	173.8	25.8	188.2	34.6	209.0	29.	184.
1984	31.2	205.0	34.7	222.9	31.	240.	32.	216.
1985	25.9	230.9	37.1	260.0	35.	275.	34.	250.
1986	34.1	265.	42.	302.	48.	323.	38.	288.
1987	35.	300.	43.	345.	57.	380.	43.	331.
1988	35.	335.	48.	393.	60.	440.	44.	375.
1989	37.	372.	52.	445.	65.	505.	48.	423.
1990	38.	410.	55.	500.	70.	575.	52.	475.
1991	42.	452.	60.	560.	72.	647.	52.	527.
1992	43.	495.	61.	621.	74.	721.	56.	583.
1993	43.	538.	65.	686.	77.	798.	57.	640.
1994	42.	580.	66.	752.	80.	878.	60.	700.
1995	40.	620.	68.	820.	82.	960.	60.	760.
1996	45.	665.	69.	889.	85.	1045.	63.	823.
1997	46.	711.	74.	963.	87.	1132.	65.	888.
1998	48.	759.	75.	1038.	89.	1221.	65.	953.
1999	46.	805.	80.	1118.	90.	1311.	67.	1020.
2000	45.	850.	82.	1200.	89.	1400.	70.	1090.

* Rounding anomalies and plant retirements affect cumulated data.

rate has been decreasing steadily since the mid-1950's, suggesting that the latter assumption is not at variance with current trends. This projection implies that a stationary level of population would be reached in the absence of immigration in approximately 70 years.

Estimates of the size of the work force were made taking into account the recent trend toward greater female participation in the labor force and available information on the age-specific components of the total population projection. Combining the work force projection with the assumption that per employee productivity continues to increase at an annual rate of 2.6 percent, the average annual historic rate of growth over the last 25 years, resulted in a projection of economic growth as measured by the Gross National Product (GNP). Real GNP, that is GNP without taking account of inflation, was pro-

jected to increase at a compound rate of 3.9 percent annually in view of these expectations concerning population growth and productivity.

Total energy resource consumption and energy inputs to the electrical sector were related to GNP growth to serve as a basis for additional analysis. Case B represents a projection of energy growth which assumes a continuation of the past relationship between energy consumption and GNP, together with a further increase in the importance of electricity as a secondary energy source. On this basis total energy consumption was projected to increase at a 3.6 percent annual compound rate. Thus, while per capita energy use is expected to grow, this projection also implies that the declining long-term trend in energy inputs required to produce a dollar of output will continue. Furthermore, the projection indicates that the share of total primary energy required

by the year 2000 for electricity generation will nearly double as it has for a similar time period in the past.

Case B inherently assumes that factors historically important in shifting the pattern of energy use in favor of electricity will influence future demand. Electricity is expected to remain a useful, convenient, and inexpensive form of energy relative to available substitutes. Technological innovation will proceed so that the rate of introduction of devices, processes, and other end uses for electricity will not change from past experience.

On this basis the Case B forecast indicates that kilowatt-hour requirements will increase from 1.5 trillion in 1970 to some 10 trillion by the year 2000. Nuclear power is expected to satisfy 70 percent of the electricity demand by that year. The installed nuclear capacity projection resulting from these assumptions is 260,000 MWe in 1985 and 1,200,000 MWe by the year 2000.

The basic scheme for assessing the relationship between production and consumption was developed at Brookhaven National Laboratory. It is a network diagram which traces the energy flow from five energy supply sources—uranium, hydroelectric, coal, oil and gas—through the refining, transportation, and conversion phases to final consumption. Solar power, geothermal power, and other potential energy sources are not specifically included in the flow diagram because it is felt that too little information is currently available to assess the impacts of these sources. Furthermore, fourteen different categories define the total final demand, and for each demand category a utilizing device or devices are specified together with their respective efficiencies. Efficiencies are also specified in the conversion, transportation, and refining steps of supplying energy to the end uses. Figure 2 shows an example of this type of energy flow diagram.

In studying total energy consumption, a separate analysis was conducted of these fourteen major energy demand categories in the residential, commercial, industrial, and transportation end-use sectors since it was not possible to develop these projections by directly relating them to elements of the Gross National Product. In addition, a supply analysis was undertaken to investigate the potential for providing adequate supplies to meet these energy requirements. The most important considerations addressed in these analyses are summarized in the following:

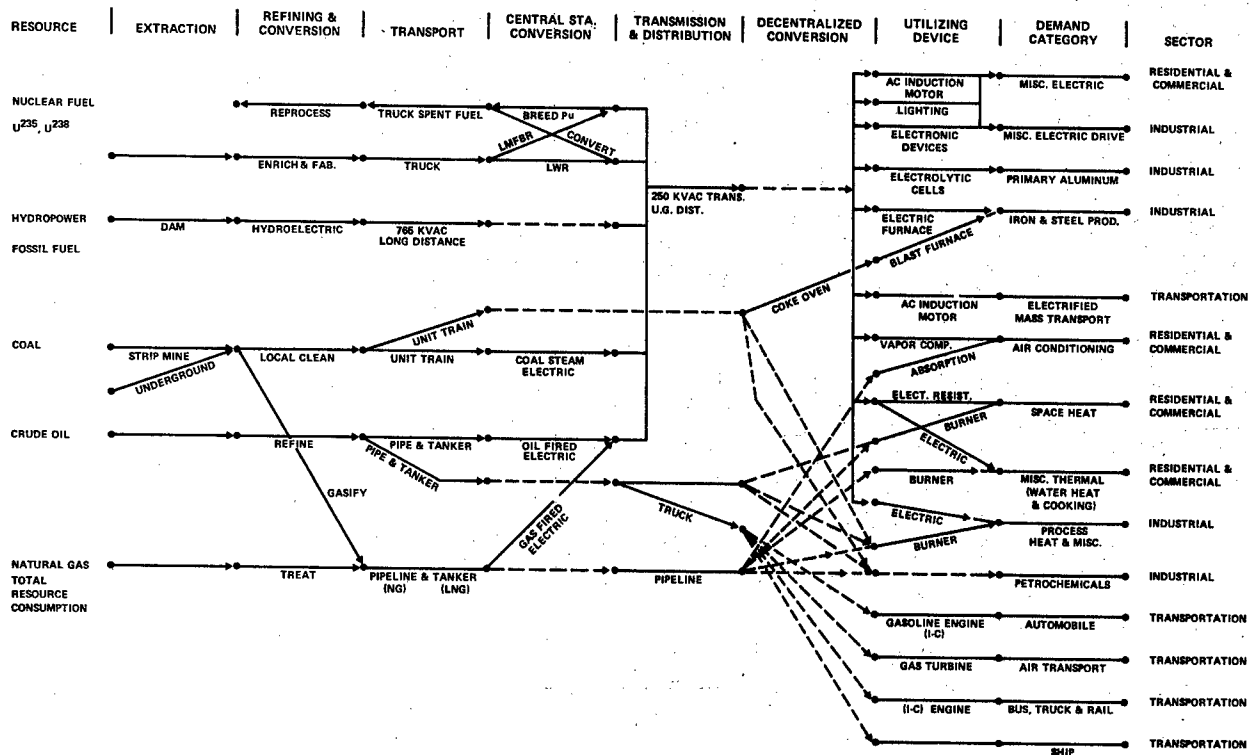
Supply	Demand
Limits to continued growth of petroleum & natural gas supplies	Improvements in efficiency of end use devices
Limits on the use of petroleum & natural gas supplies for electrical production	Impact of conservation measures on final demand
Relative contribution of strip & underground mining to coal supplies	Expected increase in number of households
Greater substitution of electricity where technically feasible	Expected growth in transportation & changes in mode of travel
Use of synthetic gas from coal as a supplement to natural gas supplies	Changes in the price of energy

Case C may be characterized as based on a continuation of the same general long-term historical trend in total energy consumption as Case B, but with a different means utilized to satisfy demand. In this case it is assumed that electricity will remain cheap relative to oil and natural gas, but that energy prices on the whole will not change significantly relative to other commodities. As a result, it is expected that a more rapid shift to electricity would occur where technically feasible. Specifically, it is assumed that all new housing added beyond 1977 are all-electric homes, that electricity is substituted for heating and cooling in the commercial sector and in certain industrial end-uses particularly for process heat, and further that electric vehicles and electric transportation constitute an important fraction of transportation needs by the end of the century.

As a consequence of these considerations, coal use for electric generation and for synthetic gas production is projected to expand significantly by 1985, but not to grow as rapidly in the following fifteen years, attaining a level slightly higher than that in Case B. Oil consumption is expected to decline in comparison to the Case B projection, especially in the latter years of the forecast, while electricity will increase in importance, supplying nearly 55 percent of total energy requirements. Nuclear power is projected to play a major role in generating electricity, reaching a total capacity of 275,000 MWe by 1985 and 1,400,000 MWe by the year 2000. About 11 trillion kilowatt hours are forecast to be generated in the year 2000 on the basis of Case C assumptions.

Case D considers the situation where total consumption of all forms of energy is reduced through conservation measures, but where these measures are not so stringent as to limit improvements in standard of living or economic development. In this view, all end use energy demands are met, but fewer energy resources are consumed because higher energy prices relative to other commodities cause industrial and

FIGURE 2. DIAGRAM OF ENERGY FLOWS



other energy consumers to improve the efficiency with which they use energy.

Efficiency improvements are expected to take place primarily in space heating and air-conditioning uses, in industrial process heating and steel making, as well as in both private and public transportation modes. Average increases of 10 percent in utilization efficiencies for these end uses in 1985 and 20 percent for the year 2000 result in annual savings in total energy consumption of 10 percent per year compared with Case B. This is equivalent to an annual savings of 20 quadrillion Btu by the year 2000. These factors reduce electrical energy requirements as well as total energy consumption.

A slower rate of economic growth owing to a decreased emphasis on the production of goods, coupled with higher energy prices relative to other commodities characterizes Case A. Maximum efforts are made to conserve energy by increasing utilization efficiencies in all sectors including residential and commercial space heating and cooling, oil use for air and ground transportation, coal used in steel making, electrical use in aluminum production, and in industrial process heat applications. Actual reductions in demand also occur in several sectors, notably in

petrochemical requirements and process heat use, as a result of a slower rate of economic growth. High energy costs result in less demand for heating and cooling in homes through adjustments in temperature and expenditures for more household insulation. Internalization of pollution control costs, coupled with electric rate structure revisions to discourage peak use, are expected to affect electricity consumption. Similarly, the high energy costs assumed in this case will cause shifts away from inefficient transportation modes such as private vehicles and airplanes and increase the use of buses and railways.

This combination of factors reduces total energy consumption in the year 2000 by 30 percent from the projection in Case B. Only 7 trillion kilowatt-hours will be needed to meet electrical demand, and nuclear power is expected to supply some 70 percent of this requirement. The Case A projection is that 231,000 MW will be in operation by 1985, while 850,000 MWe will be installed by the year 2000.

The use of fuel to supply requirements for the electric and nonelectric components of energy demand as well as an overall summary of total future energy needs projected for each case is shown in

Table 7. This table indicates that total energy requirements for the cases considered range from 135 to 200 quadrillion Btu by the year 2000, the lower figure representing assumptions of both a slowdown in economic growth and increased efficiency of energy use and the higher figure assuming greater electrification of the economy, continued economic growth, and little change in the efficiency with which energy is utilized.

Assuming coal remains competitive with nuclear power in some areas of the country, while residual fuel oil use in power plants is limited by considerations of independence from foreign supply sources, the Case D projection is that 250,000 MWe of nuclear power will be installed by 1985, and this will increase to 1,090,000 MWe by 2000. About 9 trillion kilowatt-hours are forecast to be generated in 2000 on the basis of Case D assumptions.

Table 5 shows that the fraction of energy used for generating electricity in each of these cases con-

tinues the established trend toward increased electrification resulting in about one-half of the energy being for electricity in the year 2000. The highest energy consumption case, Case C, also projects the highest fraction of energy used for electricity generation.

Developing forecasts of total and nuclear electric generating capacity involves judgments and projections of the average time per year that plants are in operation and the rate at which the plants consume energy to generate electricity. The apparent system capacity factor, defined as the total electricity generated in a year divided by the electricity that could have been generated in a year (8,760 hours) by the capacity available at the end of the year, has remained constant at about 50 percent for several years and is expected to remain near that level for the rest of the century. The heat rate, or rate of energy consumption in the production of electricity, has been steadily dropping—from 10,700 Btu/kwh

Table 7
TOTAL ENERGY SUPPLY FOR U.S. FORECASTS
Quadrillion (10¹⁵) Btu

		Case A		Case B		Case C		Case D	
	1973	1985	2000	1985	2000	1985	2000	1985	2000
ELECTRIC									
OIL.....	3.4	6.2	4.1	6.4	8.3	7.2	8.3	6.1	6.5
GAS.....	3.9	3.1	1.0	3.3	2.1	3.7	2.1	3.0	1.6
COAL *.....	8.7	9.6	10.6	12.0	14.2	15.1	14.8	10.5	13.8
NUCLEAR.....	0.9	13.2	47.8	14.6	66.9	15.7	78.5	14.2	60.8
OTHER.....	2.9	3.6	5.3	3.6	5.3	3.6	5.2	3.6	5.2
TOTAL.....	19.8	35.7	68.8	39.9	96.8	45.3	108.9	37.4	87.9
NON-ELECTRIC									
OIL.....	31.3	31.5	37.5	42.3	59.6	40.8	54.1	36.4	49.9
GAS.....	19.7	19.3	16.0	24.1	23.9	22.4	22.3	21.5	24.2
COAL *.....	4.8	9.7	13.0	10.3	14.7	10.9	14.3	9.5	12.3
TOTAL.....	55.8	60.5	66.5	76.7	98.2	74.1	90.7	67.4	86.4
SUMMARY									
OIL									
Domestic.....	22.2								
Imported.....	12.5								
TOTAL.....	34.7	37.7	41.6	48.7	67.9	48.0	62.4	42.5	56.4
GAS									
Natural.....	23.6	22.4	17.0	27.4	26.0	26.1	24.4	24.5	25.8
Synthetic.....	-0-	(2.1)	(4.1)	(2.2)	(4.5)	(2.8)	(4.3)	(2.1)	(4.1)
TOTAL.....	23.6	(24.5)	(21.1)	(29.6)	(30.5)	(28.9)	(28.7)	(26.6)	(29.9)
COAL *.....	13.5	19.3	23.6	22.3	28.9	26.0	29.1	20.0	26.1
NUCLEAR.....	0.9	13.2	47.8	14.6	66.9	15.7	78.5	14.2	60.8
OTHER.....	2.9	3.6	5.3	3.6	5.3	3.6	5.2	3.6	5.2
GRAND TOTAL.....	75.6	96.2	135.3	116.6	195.0	119.4	199.6	104.8	174.3

* Includes coal used to provide synthetic gas.

in 1960 to 10,500 Btu/kwh in 1970. This value will likely continue to decrease to about 9,600 Btu/kwh in 2000. These assumptions about the system capacity factor and about improvements in the efficiency of conversion of heat energy to electrical power were used to calculate electrical generating capacity requirements.

The results of such calculations are shown in Table 5. For example, in Case D, the electrical generating capacity including all types of sources increases from 680,000 MW (2.99 kw per capita) in 1980 to 2,020,000 MW (7.45 kw per capita) in 2000. The range of capacity in 1980 will be 655,000 to 770,000 MW, in 1985 it will be 800,000 to 1,020,000 MW, and in 2000 it will be 1,575,000 to 2,500,000 MW. The portion of this capacity that will be nuclear power plants will increase steadily to over 50 percent. As explained in the above assumptions, Cases B and C reflect heavier demands for nuclear plants than do Cases A and D. The range of installed capacity forecast for nuclear power in 1980 is 85,000 to 112,400 MW, and in 2000 it is 850,000 to 1,400,000 MW.

Reactor Types

The types of reactors that will comprise the nuclear capacity in the United States for the remainder of the century are light-water reactors (LWRs) high-temperature gas-cooled reactors (HTGRs) and fast breeders (FBRs). The FBRs are expected to penetrate the nuclear market at the same percentage rate that LWRs penetrated the total thermal plant market beginning in 1967 (Figure 3). The demonstration breeder is expected to become operational in the early 1980's with commercial breeder introduction in about 1988; analyses were also made for commercial breeder introduction in 1993 and for no breeder introduction within the forecast period.

The HTGR is assumed to penetrate the nuclear market to the extent of about 10 percent of additions in the early 1980's, increasing to 15 percent of thermal reactor additions by the late 1980's, and remaining at that level for the rest of the century. While higher penetration is possible, insufficient information is available to predict it with confidence at this time. The remaining nuclear additions are expected to be LWRs, of which one-third are assumed to be boiling-water reactors, and two-thirds to be pressurized-water reactors.

The range of electric generating capacity expected for each reactor type is shown on Figure 4, as well

as the range of total nuclear capacity with time. The light water reactors dominate the 1980 installed capacity. In 1990 LWR capacity will range from 372,000 to 512,000 MW and in 2000 from 644,000 to 1,020,000 MW.

The HTGR capacity in 1990 will range from 34,000 to 58,000 MW and in 2000 from 82,000

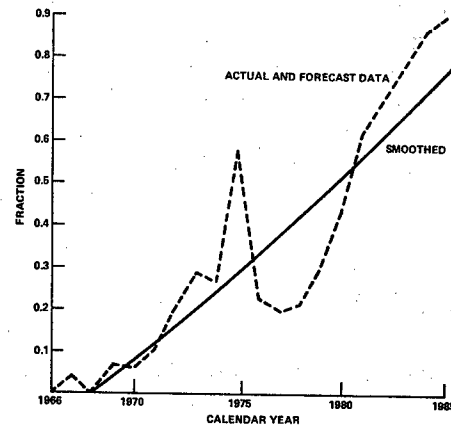


FIGURE 3. NUCLEAR ADDITIONS AS A FRACTION OF TOTAL THERMAL ADDITIONS, UNITED STATES

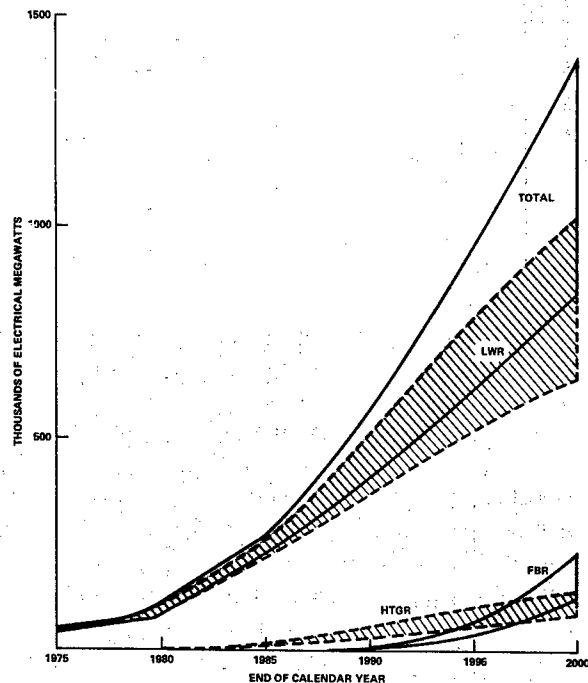


FIGURE 4. RANGE OF INSTALLED NUCLEAR CAPACITY BY REACTOR TYPE, UNITED STATES

Table 8A

NUCLEAR POWER CAPACITY BY REACTOR TYPE IN ELECTRICAL MEGAWATTS
 United States, Case A (Plutonium Recycle, 75% capacity factor)

-CY-	HTGR	PWR	BWR	OTHER	NATURAL	FBR	TOTAL	ADDITIONS	CUMULATED RETIRED	CAPACITY FACTOR, PERCENT
1973	40	13800	9500	800	0	0	24100	24100	0	24
1974	330	15500	10800	800	0	0	27500	27500	40	47
1975	330	26700	15500	800	0	0	43400	43400	40	60
1976	330	34500	17500	800	0	0	53100	53200	40	65
1977	330	41900	17500	800	0	0	60500	60600	40	72
1978	330	43900	19500	800	0	0	64500	64600	40	74
1979	330	48000	23300	0	0	0	71700	72500	840	73
1980	330	55000	29700	0	0	0	85000	85900	930	73
1981	1100	76500	36600	0	0	0	114200	115100	930	72
1982	2200	92100	47900	0	0	0	142600	143600	930	68
1983	4900	113500	55000	0	0	400	173800	174800	930	68
1984	7200	133200	64100	0	0	400	205000	205900	930	67
1985	9000	149700	71900	0	0	400	230900	231800	930	68
1986	13500	169400	81700	0	0	400	265000	265900	930	69
1987	18400	190100	91000	0	0	400	300000	300900	930	69
1988	22800	210700	99300	0	0	2200	335000	335900	930	69
1989	28400	231700	109800	0	0	2200	372000	372900	930	70
1990	33700	252000	119900	0	0	4400	410000	410900	930	70
1991	39500	273800	130800	0	0	7800	452000	452900	930	70
1992	45200	295200	141500	0	0	13100	495000	495900	930	70
1993	50600	315700	151800	0	0	19900	538000	538900	930	70
1994	55600	334800	161300	0	0	28300	580000	580900	930	70
1995	60200	352000	169900	0	0	37900	620000	620900	930	70
1996	65000	370000	178900	0	0	51100	665000	665900	930	70
1997	69600	387600	187700	0	0	66000	711000	711900	930	70
1998	74100	404600	196200	0	0	84000	759000	759900	930	70
1999	78200	419900	203900	0	0	103000	805000	805900	930	70
2000	81800	433500	210500	0	0	124000	849800	850900	1130	69

Table 8B

NUCLEAR POWER CAPACITY BY REACTOR TYPE IN ELECTRICAL MEGAWATTS
 United States, Case B (Plutonium Recycle, 75% capacity factor)

-CY-	HTGR	PWR	BWR	OTHER	NATURAL	FBR	TOTAL	ADDITIONS	CUMULATED RETIRED	CAPACITY FACTOR, PERCENT
1973	40	3800	9500	800	0	0	24100	24100	0	26
1974	330	17000	14700	800	0	0	32800	32800	40	47
1975	330	28600	17500	800	0	0	47300	47300	40	60
1976	330	35700	17500	800	0	0	54300	54300	40	70
1977	330	41900	18300	800	0	0	61300	61400	40	73
1978	330	46300	22300	800	0	0	69700	69700	40	74
1979	330	53100	27300	0	0	0	80700	81500	840	73
1980	1100	67800	33200	0	0	0	102100	103000	930	72
1981	2200	88300	43300	0	0	400	134300	135200	930	69
1982	3800	106800	51400	0	0	400	162400	163300	930	67
1983	6500	119600	61600	0	0	400	188200	189100	930	68
1984	7700	145100	59700	0	0	400	222900	223800	930	58
1985	12100	167700	79900	0	0	400	260000	260900	930	68
1986	18400	192500	90700	0	0	400	302000	302900	930	68
1987	24500	217800	102300	0	0	400	345000	345900	930	69
1988	31300	244300	115200	0	0	2200	393000	393900	930	69
1989	39100	273800	129900	0	0	2200	445000	445900	930	69
1990	47000	303700	144800	0	0	4400	500000	500900	930	69
1991	55300	335000	160500	0	0	9200	560000	560900	930	69
1992	63300	365300	175600	0	0	16700	621000	621900	930	69
1993	71500	396300	191100	0	0	27000	686000	686900	930	69
1994	79500	426200	206100	0	0	40200	752000	752900	930	70
1995	87200	455500	220800	0	0	56500	820000	820900	930	70
1996	94500	483100	234600	0	0	76800	889000	889900	930	70
1997	102000	511500	248700	0	0	100800	963000	963900	930	70
1998	109100	538100	262000	0	0	128800	1038000	1038900	930	70
1999	116100	564700	275400	0	0	161800	1118000	1118900	930	69
2000	122800	589800	287700	0	0	199800	1200000	1201100	1130	69

Table 8C

NUCLEAR POWER CAPACITY BY REACTOR TYPE IN ELECTRICAL MEGAWATTS
 United States, Case C (Plutonium Recycle, 75% capacity factor)

-CY-	HTGR	PWR	BWR	OTHER	NATURAL	FBR	TOTAL	ADDITIONS	CUMULATED RETIRED	CAPACITY FACTOR, PERCENT
1973	40	13800	9500	800	0	0	24100	24100	0	24
1974	330	24400	16600	800	0	0	42100	42200	40	42
1975	330	33400	17500	800	0	0	52000	52000	40	61
1976	330	41900	17500	800	0	0	60500	60600	40	71
1977	330	43900	20300	800	0	0	65400	65400	40	73
1978	330	47200	24400	800	0	0	72700	72800	40	74
1979	330	56500	29700	0	0	0	86500	87400	840	73
1980	1100	76800	34200	0	0	400	112400	113400	930	72
1981	2200	94800	47000	0	0	400	144400	145300	930	67
1982	3800	114300	55900	0	0	400	174400	175400	930	67
1983	7600	133500	67500	0	0	400	209000	209900	930	67
1984	10100	154700	74800	0	0	400	240000	240900	930	68
1985	14400	175500	84700	0	0	400	275000	275900	930	69
1986	20900	203600	98100	0	0	400	323000	323900	930	68
1987	29100	237100	113400	0	0	400	380000	380900	930	68
1988	37800	270100	129900	0	0	2200	440000	440900	930	68
1989	47500	306900	148300	0	0	2200	505000	505900	930	68
1990	57600	344900	167300	0	0	5200	575000	575900	930	68
1991	67500	382300	186000	0	0	11200	647000	647900	930	69
1992	77200	419100	204400	0	0	20200	721000	721900	930	69
1993	87000	456000	222800	0	0	32200	798000	798900	930	69
1994	96600	492200	241000	0	0	48200	878000	878900	930	69
1995	105900	527400	258500	0	0	68200	960000	960900	930	70
1996	114900	561400	275500	0	0	93200	1045000	1045900	930	70
1997	123700	594800	292300	0	0	121200	1132000	1132900	930	70
1998	132100	626500	308100	0	0	154200	1221000	1221900	930	70
1999	140100	656600	323100	0	0	191200	1311000	1311900	930	70
2000	147300	683900	336600	0	0	232200	1400000	1401100	1130	70

Table 8D

NUCLEAR POWER CAPACITY BY REACTOR TYPE IN ELECTRICAL MEGAWATTS
 United States, Case D (Plutonium Recycle, 75% capacity factor)

-CY-	HTGR	PWR	BWR	OTHER	NATURAL	FBR	TOTAL	ADDITIONS	CUMULATED RETIRED	CAPACITY FACTOR, PERCENT
1973	40	13800	9500	800	0	0	24100	24100	0	26
1974	330	17000	14700	800	0	0	32800	32800	40	46
1975	330	28600	17500	800	0	0	47300	47300	40	60
1976	330	35700	17500	800	0	0	54300	54300	40	70
1977	330	41900	18300	800	0	0	61300	61400	40	73
1978	330	46300	22300	800	0	0	69700	69700	40	74
1979	330	53100	27300	0	0	0	80700	81500	840	73
1980	1100	67800	33200	0	0	0	102100	103000	930	72
1981	2200	82200	42100	0	0	400	127000	127900	930	70
1982	3800	100500	50300	0	0	400	155000	155900	930	68
1983	6600	117200	59700	0	0	400	184000	184900	930	68
1984	6600	140600	68300	0	0	400	216000	216900	930	67
1985	10600	161400	77600	0	0	400	250000	250900	930	68
1986	16300	184000	87300	0	0	400	288000	288900	930	68
1987	22500	209200	98900	0	0	400	331000	331900	930	69
1988	28700	233500	110600	0	0	2200	375000	375900	930	69
1989	35900	260700	124200	0	0	2200	423000	423900	930	69
1990	43300	289000	138300	0	0	4300	475000	475900	930	69
1991	50500	316100	151900	0	0	8500	527000	527900	930	69
1992	57900	343900	165800	0	0	15400	583000	583900	930	69
1993	65100	371100	179400	0	0	24400	640000	640900	930	70
1994	72300	398300	193000	0	0	36400	700000	700900	930	70
1995	79100	424200	205900	0	0	50800	760000	760900	930	70
1996	85800	449400	218500	0	0	69300	823000	823900	930	70
1997	92400	474300	231000	0	0	90300	888000	888900	930	70
1998	98500	497500	242600	0	0	114300	953000	953900	930	70
1999	104400	519600	253700	0	0	142300	1020000	1020900	930	70
2000	110100	541300	264300	0	0	174300	1090000	1091100	1130	69

to 147,000 MW. The fast breeder capacity in 2000 is expected to range from 124,000 to 232,000 MW. The relative abundance of each reactor type in operation in the United States at the end of each year is presented in Tables 8A through D which describes the reactor mix under Cases A, B, C, and D. Note that these tables also give data on the overall capacity factor for all nuclear plants in operation each year.

Given its demonstrated fuel cost advantages, it is possible that nuclear power may be used for some nonelectricity generating applications such as direct process steam. This forecast does not explicitly recognize such applications and could, therefore, understate nuclear energy capacity toward the end of this century.

Comparison with Past AEC Forecasts

The present forecast is noticeably lower in the near-term for the United States than the forecast prepared a year ago, WASH-1139(72). This essentially represents a slippage; thus Case A is about a 20-month slippage from last year's Most Likely Case; Cases B and D are about a 12-month slippage; and Case C is about an 8-month slippage. The near-term reduction results primarily from two causes, a general lengthening of nuclear project schedules and a slight reduction in the rate of growth of energy consumption. Many events occur between ordering a reactor and its start of operation, events whose impact on schedules have often been minimized in planning. These events include delays caused by late equipment delivery, labor stoppages, intervention regulatory complications and other causes. Experience with these events has resulted in longer schedules for reactors now in the planning and construction stages. The previous forecast seriously overestimated the ability to respond to the new situation resulting from the "Calvert Cliffs" decision by the U.S. Court of Appeals for the District of Columbia Circuit Court on AEC's responsibilities under NEPA. That decision in the summer of 1971, contributed to a 17 month hiatus in the issuance of construction permits and a 14 month hiatus for full power operating licenses. In addition, the Commission's rules were amended in March 1972 to prohibit any site preparation or construction until after the issuance of a construction permit. Prior to this rule change, site preparation and certain preconstruction activities were permitted before construction permit issuance. The 1972 forecast was optimistic in that it expected environmental data collection and reports

to proceed on an earlier schedule than actually occurred and did not completely account for the longer construction time resulting from the new rules. However, even with the long period between the issuance of construction permits cited above, the average Regulatory staff review time has been reduced each year for the past several years.

The other factor reducing the near-term forecasts is a slight slowing of the rate of increase in energy consumption in the United States. The long-term forecasts assume that total energy consumption will grow less rapidly than it has historically, primarily because higher energy prices are expected to act as an incentive to consumers to conserve energy by improving their efficiency of energy utilization. Electrical energy demand similarly is not expected to increase as rapidly as it has in the past for the same reason, although it is projected to increase more rapidly than total energy use because of its convenience and its substitutability for other forms of energy. The penetration of nuclear reactors into the total market for generating capacity is somewhat lower in the near term for this forecast than for previous ones. In the long term, however, the range of forecasts presented here is about the same as last year's forecast. Table 9 shows a comparison between this and several recent forecasts made by the AEC.

Table 9
COMPARISONS OF OFFICIAL AEC NUCLEAR
POWER FORECASTS

Forecast Made in Year	Installed Capacity at End of Calendar Year in Millions of Electrical Kilowatts			
	1975	1980	1985	2000
1962 ¹	16	40	100	734
1964 ²	29	75		
1966 ³	40	95		
1967 ⁴	61	145	255	
1970 ⁵	59	150	300	
1971 ⁶	57	151	306	
1972 ⁷ —Most Likely Case	54	132	280	1200
1974 ⁸ —Case A	43	85	231	850
Case B	47	102	260	1200
Case C	52	112	275	1400
Case D	47	102	250	1090

¹ AEC Report to the President "Civilian Nuclear Power," December 1962.

² WASH-1055, "Estimated Growth of Civilian Nuclear Power," March 1965.

³ AEC Press Releases—S-20-66, June 7, 1966, and S-23-66, September 8, 1966.

⁴ WASH-1084, "Forecast of Growth of Nuclear Power," December 1967.

⁵ WASH-1139, "Forecast of Growth of Nuclear Power," January 1971.

⁶ WASH-1139 (Rev. 1), "The Growth of Nuclear Power, 1972-1985," December 1971.

⁷ WASH-1139(72), "Nuclear Power, 1973-2000," December 1972.

⁸ The present forecast.

FOREIGN FORECASTS

The United States has considerable interaction with other countries in civilian nuclear matters, particularly in the areas of enrichment services, reactor technology and components. Therefore, forecasts covering the rest of the world have been prepared as an aid in defining these possible markets.

Three forecasts of foreign nuclear capacity have been prepared and are labeled Cases X, Y, and Z. They are shown in Table 10 and Figure 5. By the end of 1980, the total nuclear capacity in other countries, is expected to be between 113,000 MW and 157,000 MW; between 290,000 MW and 420,000 MW in 1985; 640,000 MW to 900,000 MW through 1990; and to range between 1,600,000 MW and 2,550,000 MW through 2000. The present near-term forecast for foreign countries is slightly lower than the previous forecast. This is because some nations are finding it increasingly difficult to find acceptable sites for nuclear power plants. It is assumed that these difficulties will be overcome eventually, and nuclear power for the longer term is expected to exceed the estimates of last year's foreign forecast.

The forecasts of foreign nuclear capacity have been derived by use of a methodology that is similar in some but not all respects to that described for the United States. The method has been applied to 30

major foreign nations including the USSR and the People's Republic of China, and it has been applied to the world as a whole. Known plants are listed in Appendix D.

In the near term, the forecast cases are based on data about known nuclear power plants which are operating, under construction, on order, planned, or announced. The three cases reflect different assessments of the likelihood of meeting the announced schedules for commercial operation.

In the long term, the foreign forecast cases are based on a continuation of near-term trends together with extrapolations of the trends in total energy consumption, patterns of use, and electrical generating capacity additions. As in the methodology for domestic cases, extrapolations of the trends in fraction of energy used for electricity, apparent capacity factor, and heat rates were made. Together with analyses, extrapolations of trends in total energy consumption and population were used to arrive at estimates of total electric generating capacity additions as well as those additions expected to be nuclear.

Cases X, Y, and Z make up the nuclear forecast for all of the world except the United States.

Table 10
FORCASTS OF FOREIGN NUCLEAR CAPACITY*
(Thousands of Electrical Megawatts)

Calendar Year	Case X		Case Y		Case Z	
	Additions	Cumulated	Additions	Cumulated	Additions	Cumulated
1974	3.2	26.7	10.1	33.6	10.1	34.8
1975	11.7	38.4	11.1	44.7	11.7	46.6
1976	8.6	46.9	9.9	54.6	15.4	62.0
1977	15.4	62.3	20.5	75.2	19.8	81.8
1978	18.4	80.7	19.2	94.3	17.4	99.2
1979	17.1	97.8	13.8	108.0	25.2	124.4
1980	14.8	112.6	32.3	140.3	33.0	157.4
1981	30.7	143.2	41.2	181.5	46.5	203.9
1982	40.	183.	44.	226.	45.	249.
1983	41.	224.	55.	281.	50.	299.
1984	30.	254.	53.	333.	56.	355.
1985	36.	290.	53.	387.	65.	420.
1986	50.	340.	57.	444.	76.	496.
1987	60.	400.	72.	516.	85.	581.
1988	70.	470.	79.	595.	97.	678.
1989	85.	555.	87.	682.	107.	785.
1990	85.	640.	98.	780.	115.	900.
1991	85.	725.	96.	876.	120.	1020.
1992	85.	810.	110.	986.	130.	1150.
1993	90.	900.	116.	1102.	140.	1290.
1994	90.	990.	126.	1228.	150.	1440.
1995	90.	1080.	138.	1367.	160.	1600.
1996	95.	1175.	140.	1506.	170.	1770.
1997	100.	1275.	150.	1657.	180.	1950.
1998	106.	1380.	156.	1812.	191.	2140.
1999	110.	1490.	153.	1965.	200.	2340.
2000	110.	1600.	165.	2130.	210.	2550.

* Rounding anomalies and plant retirements affect cumulated data.

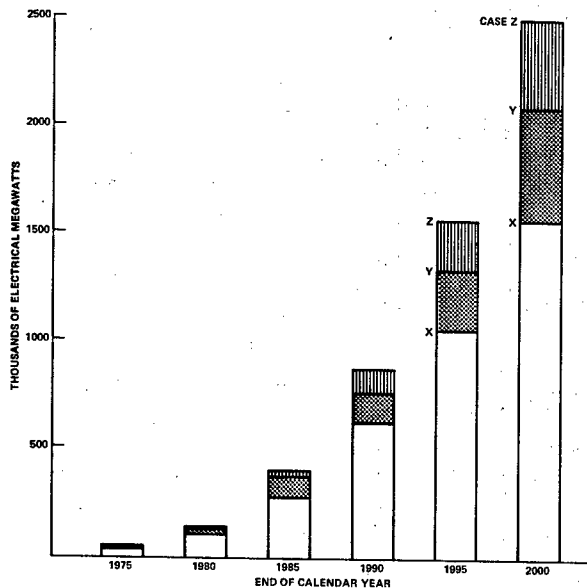


FIGURE 5. INSTALLED NUCLEAR CAPACITY, FOREIGN

Case X which is the lowest assumes slippages in commercial operation dates owing to delays in equipment deliveries, construction, and licensing together with strikes and lower productivity rates. There will be some conservation of energy which will result in slower growth of demand for electricity. By the end of 1980 foreign nuclear power capacity will be 113,000 MW, by the end of 1985 it will be 290,000 MW, and by the end of 2000 it will be 1,600,000 MW.

Case Y is the medium case. It assumes some shortening of time delays prior to construction. The rate of growth of demand for electricity will continue as in the immediate past, and there will be some increase in demand for nuclear fueled power plants especially in Japan and West Germany. This Case projects 140,000 MW by the end of 1980; 387,000 MW by the end of 1985; and 2,130,000 by the end of 2000.

Case Z is the highest of the cases considered—157,000 MW by the end of 1980; 420,000 by the end of 1985; and 2,550,000 MW by the end of 2000. This Case is based on assumptions of substantial reduction in length of time required for approval and construction, shifts from other sources of energy to electricity, and greater demand for nuclear generation of electricity.

The FBR is expected to be introduced in other countries slightly earlier than in the United States. There are now existing or planned projects totaling nearly 6000 MW which are likely to come into commercial operation before 1986. Thereafter, the penetration of the FBR into the nuclear market is expected to occur at the same market-share rate as in the United States. For Case Y, over 13,000 MW will be in operation by the end of 1990 and about 395,000 MW (see Table 11 and Figure 6) by 2000.

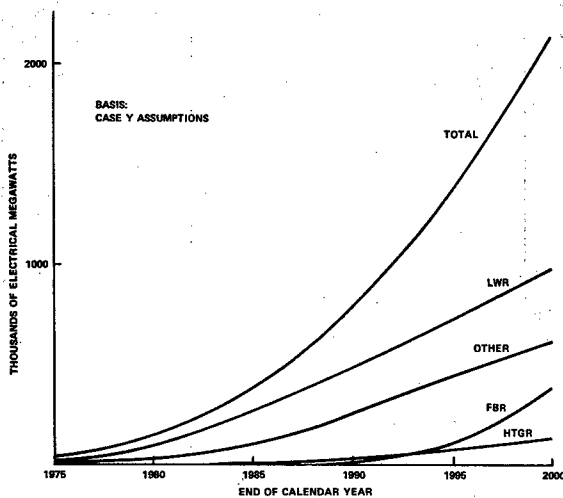


FIGURE 6. INSTALLED NUCLEAR CAPACITY BY REACTOR TYPE, FOREIGN

The HTGR is not expected to make a significant contribution before 1980, but is expected to capture about 10 percent of the non-breeder market by 1990 and to continue near that level of market penetration. The total HTGR capacity is expected to be 36,000 MW and 137,000 MW in 1990 and 2000, respectively, for Case Y. No HTGR additions are forecasted for the Centrally Planned Economies.¹

Natural-uranium fueled reactors are assumed to penetrate the total foreign market at a rate equal to the projected nuclear additions in Canada, plus the non-breeder additions in India. It is likely that the majority of the natural uranium reactors will be in these two nations. The assumption as used is an attempt to allow for the probabilities, tending to offset each other, that some natural-uranium fueled reactors will be built outside Canada and India and that not all the Canadian and Indian thermal reactors will be of this type. The Advanced Thermal Reactor is expected to constitute a varying fraction of Japanese additions during the 1980's and early 1990's. These reactors have a fuel cycle which is based on the use of natural uranium and self-generated plutonium and are included in the forecast of "other" reactors shown on Table 11. Light-water reactors are expected to comprise the remainder of the nuclear capacity additions for the rest of the century. Pressurized-water and boiling-water reactors are assumed to be built abroad in approximately equal numbers.

¹ For purposes of this study, Centrally Planned Economies are taken as Bulgaria, Czechoslovakia, Democratic Republic of Germany, Hungary, Peoples Republic of China, Poland, Romania and USSR.

Table 11

NUCLEAR POWER CAPACITY BY REACTOR TYPE IN ELECTRICAL MEGAWATTS
 Foreign, Case Y (Plutonium Recycle, 75% capacity factor)

-CY-	HTGR	PWR	BWR	OTHER	NATURAL	FBR	TOTAL	ADDITIONS	CUMULATED RETIRED	CAPACITY FACTOR, PERCENT
1973	0	5800	4500	1130	11200	870	23500	23500	0	59
1974	0	9400	7500	4300	11600	870	33600	33600	0	66
1975	0	14200	10400	7100	11600	1470	44700	44700	0	65
1976	0	17900	12900	10400	12900	1470	54600	54600	0	69
1977	300	28300	18900	12500	13600	1470	75200	75200	0	68
1978	300	37300	26300	14500	14400	1470	94300	94300	0	67
1979	300	44400	29900	15500	16400	1470	108000	108000	0	68
1980	3100	57800	40700	20300	16400	2100	140300	140300	0	68
1981	4100	73200	53900	25800	20200	4400	181500	181500	0	66
1982	5200	87600	72900	32300	23100	4400	225500	225500	0	65
1983	5200	105800	95900	42800	26800	4400	280900	280900	0	65
1984	5200	121300	115000	54800	31800	5400	333400	333400	0	66
1985	7400	140000	130900	68100	34800	5900	386900	386900	0	67
1986	11300	154800	145700	84200	41800	5900	443700	443700	0	68
1987	17300	175200	165400	102700	49600	5900	515900	515900	0	68
1988	21500	196400	186400	122900	58600	9100	594700	594700	0	68
1989	28200	220100	210100	146400	68100	9100	681900	681900	0	68
1990	35900	245700	235700	170200	79100	13400	780000	780000	0	68
1991	44200	267300	257300	195600	90000	21600	875900	875900	0	69
1992	53200	292200	282200	221300	101600	35300	985700	985700	0	69
1993	62700	316200	306200	247400	115100	54700	1102200	1102200	0	69
1994	73600	341100	331100	274400	128200	80200	1228500	1228500	0	69
1995	84600	368700	358600	299600	141600	113900	1366900	1366900	0	69
1996	95400	394200	384200	323900	154900	153700	1506200	1506400	200	69
1997	106500	420400	410400	348000	168900	202500	1656600	1656800	200	69
1998	117200	447000	437000	368800	183100	258900	1811900	1812900	1000	69
1999	127700	469300	459200	390100	196900	321900	1965000	1966000	1000	69
2000	136800	494100	484100	409400	211100	394600	2130000	2131000	1000	69

REACTOR AND FUEL CYCLE CHARACTERISTICS

For nearly all plants which will start operation before about 1979, enough specific information is available on design and expected operating characteristics to enable the fuel cycle to be represented separately for each reactor. For reactors which start at later times, generalized, or model, plant data have been used. The characteristics of these model plants are shown in Tables 12 and 13. The models used to represent plants starting after about 1980 include some improvements which seem to be reasonable but which remain to be demonstrated. The characteristics given are for reactors in the 800 to 1,200 MWe size range. Although a number of units scheduled to go into operation in many countries are of much smaller size and have somewhat different characteristics, the ones shown for the larger plants have been used. The error introduced by this simplification is small because only a small fraction of the total additions to capacity is involved and the characteristics are not greatly different in most cases. Where reactor types to be constructed in a country are unknown, it is assumed in this forecast that additions to capacity will be divided according to the reactor mix schedule discussed above.

Nuclear plants are assumed to operate for about 40 years at the capacity factors given below.

1st year of operation—40%
2nd year of operation—65%
3rd year of operation—65%
4th through 15th year
of operation—75%

(or as defined by
case assumptions)

16th and over—dropping linearly 2 percentage
points per year to a minimum of
25%

The capacity factor is defined as the actual power produced during a period divided by the power that could have been produced had the reactor operated at full power level continuously throughout the period. Although a value of 80% is often used, analysis of actual nuclear and fossil plant experience

Table 12
THERMAL REACTOR CHARACTERISTICS¹

	Boiling Water Reactor	Pressurized Water Reactor	High Temperature Gas-Cooled Reactor	Advanced Gas Reactor (British)		Advanced Thermal Reactor (Japanese)	Heavy Water Reactor (Canadian)
				Inner Core	Outer Core		
Thermal Efficiency, %	34	33	39	42		31	30
Specific Power, MW _{th} /MTU	28	38	82	13		13	22
Initial Core, Average							
Irradiation Level, MWD _{th} /MTU	17000	22600	54500	13000		13700	6900
Fresh Fuel Assay, Wt% ²³⁵ U	2.03	2.26	93.15	1.46	1.75	1.2	.71
Spent Fuel Assay Wt% ²³⁵ U	.86	.74	(⁴)	.75	1.00	.33	.31
Fissile Pu Recovered, kg/MTU ²	4.8	5.8	(⁴)			4.3	1.7
Feed Required, ST U ₃ O ₈ /MW ³					2.5		
at 0.3% Tails	.581	.498	.456		.737	.577	.199
at 0.2% Tails	.494	.422	.367		.640	.516	.199
Separative Work Required, SWU/MW ³							
at 0.3% Tails	185	174	311	188		103	0
at 0.2% Tails	239	222	366	249		142	0
Replacement Loadings (Annual rate at steady state and 75% plant factor)							
Irradiation Level, MWD _{th} /MTU	27500	32600	95000	20000		20000	9600
Fresh Fuel Assay, Wt% ²³⁵ U	2.73	3.21	93.15	2.10	2.54	.71	.71
Spent Fuel Assay, Wt% ²³⁵ U	.84	.90	(⁴)	.59	.78	.15	.2
Fissile Pu Recovered, kg/MTU ²	5.9	7.0	(⁴)		4.0	(⁶)	2.3
Feed Required, ST U ₃ O ₈ /MW ³						(⁶)	
at 0.3% Tails	.179	.191	.106		.165		.125
at 0.2% Tails	.144	.154	.085		.133		.125
Separative Work Required, SWU/MW ³							
at 0.3% Tails	84	94	73	69			0
at 0.2% Tails	105	117	85	89			0
Replacement Loadings (Annual rate with plutonium recycle; ⁷ 75% plant factor)							
Fissile Pu Recycled, kg/MW ³	.163	.167				.3	
Fissile Pu Recovered, kg/MTU ^{2,8}	8.1	9.5				5.5	
Feed Required, ST U ₃ O ₈ /MW ^{3,5}							
at 0.3% Tails	.148	.158				.072	
at 0.2% Tails	.121	.129				.072	
Separative Work Required, SWU/MW ³							
at 0.3% Tails	66	75				0	
at 0.2% Tails	82	93				0	

¹ MW_{th} is thermal megawatts, MW_e is net electrical megawatts, MWD_{th} is thermal megawatt days, MTU is metric tons (thousand of kilograms) of uranium, and ST U₃O₈ is short tons of U₃O₈, yellowcake from an ore processing mill. One SWU is equivalent to one kg of separative work.

² After losses.

³ For replacement loadings, the required feed and separative work are net, in that they allow for the use of uranium recovered from spent fuel. Allowance is made for fabrication and reprocessing losses.

⁴ All spent fuel and fission production (primarily ²³⁵U) are recycled on a self generated basis. Only one re-cycle of ²³⁵U is assumed.

⁵ Includes natural uranium to be spiked with plutonium; 0.0087 ST U₃O₈/MW_e for BWR and 0.0067 for PWR.

⁶ Self sustaining plutonium recycle is implicit in the design of this reactor.

⁷ Plutonium available for recycle ratchets up each pass because not all of the plutonium charged is burned. Therefore, more plutonium is recovered from mixed oxide fuel than from standard uranium fuel and this increment increases with each cycle (3-6 years per cycle) requiring several passes to reach steady state. The data shown represent conditions for the 1980's when most reactors will be discharging fuel which has only seen one recycle pass.

⁸ Average for all fuel discharged with full recycle of self-generated plutonium. For mixed oxide fuel (natural U spiked with self-generated plutonium) the spent fuel from BWRs contains 15.1 kg Pu per MTU and from PWRs, 18.7.

Table 13
FAST BREEDER REACTOR
CHARACTERISTICS
(75% Capacity Factor)

	Early Oxide	Advanced Oxide
Net Electrical Output (MWe).....	1,000	1,000
Total Thermal Power (MW _{th}).....	2,500	2,500
Core.....	2,289	2,232
Axial Blanket.....	25	22
Radial Blanket.....	186	246
Initial Reactor Inventory (Kilograms)		
Core Uranium.....	12,910	10,080
Core Fissile Plutonium.....	1,860	1,320
Axial Blanket Uranium.....	6,400	5,330
Radial Blanket Uranium.....	25,700	19,400
Average Discharge Exposure (MWDt/MT Charged)		
Core.....	110,000	110,000
Axial Blanket.....	2,000	2,000
Radial Blanket.....	10,000	17,000
Breeding Ratio.....	1.15	1.25
Compound Doubling Time (Years)....	19.6	8.8

suggests that a lower capacity factor is usually achieved. A gradual buildup to 75% and later reduction has been assumed for most cases considered here. It has also been assumed that the fuel management practices of reactor operators will be such that reactors without on line refueling capability will be refueled on an annual basis but that a varying fraction of the core may be replaced at each reload, the fraction depending on the capacity factor for the preceding period. The data shown on Tables 12 and 13 are those that apply to operation at a 75% factor.

The fuel cycle lead times which are used in this analysis are shown on Table 14. For the typical enriched-uranium reactor, one quarter-year is required for conversion of refined U_3O_8 to UF_6 , one quarter for enrichment, one for fabrication (two quarters for the fabrication of the larger quantities of first cores) and one for shipping and pre-loading inventories. An additional two quarters are allowed for pre-operational testing and startup.

When material is discharged from reactors, it is assumed to spend two quarter-years in cooling basins and one in reprocessing facilities. An additional quarter is allowed for converting the recovered uranium to UF_6 and shipping it to an enrichment facility. Plutonium is considered available for fabrication

three quarters after discharge. Because two quarters are required for fabrication, shipping and pre-loading inventories and because only self-generated plutonium recycle is assumed, the majority of the plutonium produced for recycle remains out of the reactor until the second annual reload following discharge.

For natural-uranium fueled reactors, the times assumed for the parts of the fuel cycle are similar to those assumed for enriched-uranium fueled reactors except that no time is allowed for the enrichment step. Uranium must thus be available from the refinery only 5 quarters before commercial operation. The plutonium from these reactors is assumed not to be recycled and the discharged material may be of sufficient value to warrant reprocessing only when FBR demands cause an increase in the value of the contained plutonium. Despite the uncertainty in this timing, the material from the natural-uranium fueled reactors is included in the tables as part of reprocessing loads after the normal cooling period. The plutonium thus appears in industry inventories as though it had been recovered at that time.

The material requirements shown throughout this report are based on the conservative assumption that

Table 14
FUEL CYCLE LEAD TIMES
(Quarter Years)

	FBR	Natural U Reactors	Enriched U Reactors
1. U_3O_8 procurement to enriched U withdrawal.....	0	0	2
2. Enrichment.....	0	0	1
3. a. Enriched U withdrawal for first cores to commercial operation.....	5 ^a	5 ^c	5
b. Enriched U withdrawal for reloads to charging.....	2 ^b	2 ^d	2
4. a. Fabrication—first cores.....	2	2	2
b. Fabrication—reloads.....	1	1	1
5. Discharge to reprocessing.....	2	2 ^e	2
6. Discharge to return of spent fuel as enriched fuel to fabrica- tion.....	4	4 ^e	4
7. Discharge to return of Pu.....	3	3 ^e	3

^a Depleted U withdrawal for first cores to commercial operation.

^b Depleted U withdrawal for reloads to charging.

^c U_3O_8 procurement to commercial operation.

^d U_3O_8 procurement to charging.

^e Minimum time. Reprocessing may not occur until plutonium is needed for utilization in FBRs.

1 percent of the material fabricated is not recoverable. Where data are available, allowance is also made for the cold scrap generated during fabrication. Similarly it is assumed that 1.3 percent of the uranium and 1 percent of the plutonium are not recovered during reprocessing of irradiated fuel.

It is assumed that the plutonium to be recycled will be mixed with natural uranium and fabricated

into fuel pins which are separated from those containing enriched uranium. This should result in lower fabrication costs than would be the case if plutonium were mixed throughout the fuel. To calculate the savings in feed and separative work to be gained from recycle, plutonium has been assumed to replace ^{235}U in reload fuel at a rate of 0.8 gram ^{235}U per gram of fissile plutonium originally charged.

SEPARATIVE WORK, FEED, AND URANIUM REQUIREMENTS

One of the most important uses of a forecast of nuclear power growth is in planning for the various supporting facilities and production requirements implied by the forecast. The separative work, feed, and uranium requirements implied by these forecasts are given in Tables 15, 16, and 18. Figures 7 through 9 give graphic illustrations of these effects for the combinations of Case D for the United States and Case Y for foreign countries. The reactor characteristics used to arrive at these separative work and feed requirements are those discussed above. After spent fuel is reprocessed, the uranium at or above 0.40% ^{235}U is assumed to be converted to UF_6 and fed to the enrichment plants for reenrichment. The annual separative work demand for each of the four domestic and three foreign cases is shown in Table 15 and the cumulative demand in Figure 7 for the combination of U.S. Case D and foreign Case Y. Cases D and Y take into account fixed commitment contracts for enrichment services which have to be made with the USAEC.

The demand in 1980 in the United States is expected to range from 11.3 to 14.2 million SWU¹. In 1990 the demand will range from 36 to 53 million SWU, and in 2000 the demand might range from 57 to 97 million SWU. The demand in foreign countries could range from 13 to 18 million SWU in 1980. In 1990 the demand might range from 53 to 74 million SWU, and in 2000 the range extends from 94 to 163 million SWU. These demands are calculated as of the time of shipment of enriched UF_6 from the enrichment plants operating at a tails assay of 0.30% ^{235}U . The demands at other tails assays are shown in the tables of Appendix B.

The natural-uranium feeds necessary to support these levels of enrichment activity are shown in Table 16 and Figure 8. The 1980 requirements for the United States range from 21,000 to 27,000

¹ One separative work unit (SWU) is equivalent to one kg of separative work.

Table 15
ANNUAL SEPARATIVE WORK DEMAND
(Millions of SWU, 75% Capacity Factor, Pu Recycle)

Calendar Year	Enrichment Plant Tails Assay = 0.20%							Enrichment Plant Tails Assay = 0.30%						
	United States Cases				Foreign Cases			United States Cases				Foreign Cases		
	A	B	C	D	X	Y	Z	A	B	C	D	X	Y	Z
1974	3.2	4.2	5.8	4.4	2.7	4.3	5.2	2.5	3.3	4.6	3.4	2.2	3.4	4.1
1975	6.3	6.7	6.2	7.0	6.0	8.1	6.6	5.0	5.3	4.9	5.6	4.7	6.4	5.2
1976	5.7	7.1	8.0	7.2	6.4	8.5	11.1	4.5	5.7	6.3	5.7	5.1	6.8	8.7
1977	7.8	9.0	9.0	8.8	10.1	10.5	9.2	6.2	7.2	7.2	7.0	7.9	8.3	7.3
1978	8.9	10.8	12.4	11.5	9.5	14.8	16.7	7.1	8.6	9.8	9.1	7.5	11.7	13.2
1979	12.6	12.0	14.6	13.3	11.7	17.1	15.8	10.0	9.5	11.6	10.6	9.3	13.6	12.5
1980	14.3	17.8	17.6	17.9	15.9	17.9	22.6	11.3	14.1	13.9	14.2	12.6	14.1	17.8
1981	16.7	17.8	18.9	20.6	19.0	22.6	25.7	13.3	14.2	15.0	16.3	15.0	17.8	20.2
1982	18.8	21.5	24.6	22.8	22.5	27.9	29.8	14.9	17.1	19.6	18.1	17.7	21.9	23.5
1983	22.8	24.7	25.9	21.2	22.6	32.3	36.4	18.1	19.6	20.7	16.9	17.8	25.4	28.7
1984	24.0	28.5	30.4	24.8	29.8	36.8	42.6	19.2	22.8	24.2	19.8	23.5	29.1	33.6
1985	28.8	33.1	35.7	30.8	34.8	42.9	49.6	23.0	26.4	28.5	24.6	27.5	33.9	39.1
1986	31.2	36.5	41.1	35.1	38.7	49.7	57.7	24.9	29.1	32.9	28.1	30.5	39.2	45.5
1987	34.2	41.3	47.6	38.5	46.3	55.7	66.9	27.4	33.1	38.1	30.8	36.6	43.9	52.8
1988	38.4	46.3	53.5	44.1	55.6	64.3	76.7	30.7	37.1	42.8	35.4	44.0	50.8	60.6
1989	41.1	51.8	59.8	49.0	60.2	71.0	84.9	32.9	41.5	47.9	39.3	47.6	56.0	67.1
1990	45.2	57.4	66.6	53.2	66.7	76.9	93.7	36.3	46.0	53.4	42.7	52.8	60.7	74.1
1991	49.0	62.4	72.9	58.4	71.6	85.0	102.9	39.3	50.1	58.5	46.9	56.7	67.2	81.4
1992	51.8	68.2	79.5	62.9	77.2	91.1	111.9	41.6	54.7	63.8	50.5	61.1	72.0	88.5
1993	54.7	73.5	86.7	68.0	81.9	99.3	124.5	43.9	59.0	69.6	54.6	64.9	78.5	98.5
1994	57.9	78.5	92.6	72.3	91.4	111.8	141.1	46.5	63.1	74.4	58.1	72.4	88.3	111.6
1995	61.4	84.0	99.1	77.3	98.3	122.7	153.0	49.4	67.5	79.6	62.1	77.8	96.9	121.1
1996	64.3	89.6	105.7	81.9	103.9	132.6	164.8	51.7	72.0	84.9	65.8	82.2	104.8	130.4
1997	67.4	94.2	110.7	85.8	109.8	139.6	176.6	54.2	75.7	89.0	68.9	86.8	110.3	139.8
1998	68.6	98.6	114.7	89.0	113.5	144.2	184.7	55.1	79.3	92.3	71.6	89.7	114.0	146.2
1999	69.5	101.3	117.9	91.1	115.5	150.2	194.0	55.9	81.5	94.9	73.3	91.2	118.6	153.6
2000	71.4	104.4	121.0	93.6	118.6	153.3	205.9	57.4	84.0	97.4	75.3	93.6	121.1	163.0

metric tons of uranium (MTU) and for foreign countries range from 25,000 to 37,000 MTU. The 1990 requirements for the United States and foreign countries will range from 60,000 to 90,000 and 99,000 to 140,000 MTU, respectively. The requirements in the year 2000 are expected to range between 91,000 and 155,000 MTU in the United States and between 168,000 and 290,000 MTU in foreign countries.

Although the requirements for feed and separative work mentioned above are expected to be needed in the times mentioned, it is unlikely that the total burden will be borne by facilities in the United States. It is assumed that the United States will supply most of the foreign requirements for separative work during the 1970's and early 1980's, but a lesser fraction of the new foreign requirements by the end

of the century. The foreign capability, if the total demand is to be satisfied, is expected to approach the levels indicated in Appendix A. The four schedules of foreign supply of enriching services discussed in Appendix A provide a range of expectations. The demands for separative work to be done in United States facilities are shown in Table 17.

The total world-wide uranium demand for all reactors is shown in Table 18 and in Figure 9 for Cases D and Y only. About a million short tons of U_3O_8 (STU $_3O_8$) will be required through 1985, and another million tons will be needed through 1990. The total world-wide requirements by the end of the century are expected to exceed 6 million tons of U_3O_8 .

The amounts of uranium, in the form of U_3O_8 , shown in Table 18 and Figure 9, include the amounts

Table 16
ANNUAL ENRICHMENT PLANT NATURAL-URANIUM FEED REQUIREMENTS
(Thousands of MTU, 75% Capacity Factor, Pu Recycle)

Calendar Year	Enrichment Plant Tails Assay = 0.20%							Enrichment Plant Tails Assay = 0.30%						
	United States Cases				Foreign Cases			United States Cases				Foreign Cases		
	A	B	C	D	X	Y	Z	A	B	C	D	X	Y	Z
1974	4.2	5.5	7.7	5.8	3.6	5.7	7.1	5.0	6.6	9.2	6.9	4.4	6.8	8.5
1975	8.3	8.8	8.2	9.2	8.4	11.6	9.3	9.9	10.5	9.8	11.0	10.0	13.7	11.1
1976	6.8	8.6	9.7	8.8	8.6	11.1	14.8	8.3	10.4	11.7	10.6	10.2	13.3	17.6
1977	9.3	10.8	10.4	10.5	13.3	13.6	11.9	11.2	13.1	12.7	12.8	15.9	16.3	14.3
1978	10.2	12.7	14.8	13.9	12.4	20.0	22.4	12.5	15.5	18.0	16.8	14.9	23.9	26.7
1979	15.4	14.3	18.0	16.1	14.8	21.7	20.2	18.7	17.3	21.7	19.5	17.9	26.0	24.3
1980	17.8	22.4	22.0	21.2	20.5	23.9	30.6	21.4	27.0	26.5	26.7	24.6	28.6	36.6
1981	20.5	21.5	22.8	25.7	24.4	29.7	34.3	24.8	26.0	27.6	31.0	29.3	35.7	41.1
1982	22.6	25.4	29.1	27.5	29.2	36.9	39.2	27.3	30.8	35.3	33.3	35.1	44.3	47.1
1983	26.9	29.2	30.0	24.2	28.7	42.8	47.8	32.6	35.4	36.5	29.5	34.6	51.3	57.4
1984	27.7	32.8	35.0	27.5	37.6	47.1	55.4	33.7	39.9	42.5	33.6	45.3	56.7	66.5
1985	33.0	38.1	41.1	34.8	44.2	54.9	64.1	40.2	46.3	50.0	42.4	53.2	66.1	77.1
1986	35.3	41.5	47.0	39.9	48.8	63.0	73.9	43.0	50.6	57.2	48.6	58.8	75.9	89.0
1987	38.1	46.4	54.2	42.9	58.5	70.5	85.4	46.6	56.6	65.9	52.4	70.5	85.1	102.9
1988	42.6	51.7	60.4	49.4	70.0	80.8	96.8	52.0	63.1	73.5	60.3	84.4	97.6	116.8
1989	45.0	57.6	66.8	54.5	74.6	88.4	106.1	55.0	70.2	81.5	66.5	90.1	106.8	128.2
1990	49.3	63.4	74.1	58.5	81.8	94.9	115.5	60.4	77.5	90.4	71.5	98.9	114.9	139.8
1991	53.3	68.4	80.3	63.9	86.5	104.1	125.6	65.2	83.6	98.1	78.2	104.9	126.1	152.2
1992	55.8	74.4	86.8	68.4	92.4	110.6	134.9	68.5	91.0	106.2	83.7	112.3	134.3	163.8
1993	58.4	79.7	94.3	73.5	97.5	119.5	149.0	71.7	97.6	115.4	90.1	118.6	145.3	181.1
1994	61.7	84.6	99.9	77.7	108.6	134.4	168.7	75.8	103.7	122.4	95.3	132.1	163.4	205.1
1995	65.2	90.1	106.3	82.8	116.5	147.0	182.0	80.1	110.5	130.4	101.6	141.9	178.9	221.5
1996	67.9	95.7	113.0	87.2	122.7	158.1	194.9	83.5	117.4	138.6	107.1	149.5	192.5	237.3
1997	71.1	100.1	117.6	90.8	129.5	165.3	207.6	87.4	122.9	144.4	111.6	157.9	201.5	253.1
1998	71.7	104.4	120.9	93.8	133.4	169.2	215.1	88.3	128.3	148.7	115.4	162.8	206.6	262.6
1999	72.0	106.4	123.4	95.3	135.3	175.5	224.7	88.8	130.9	151.9	117.4	165.4	214.5	274.7
2000	73.8	109.0	125.7	97.2	137.1	176.5	236.6	91.0	134.2	154.9	119.8	168.0	216.3	289.6

required to provide both the enrichment feed and the natural uranium needed for plutonium recycle fuel and natural-uranium fueled reactors. The 1980 requirements for the United States range from 30,000 to 38,000 short tons of U_3O_8 , and in foreign countries the range is from 39,000 to 55,000 STU_3O_8 . The 1990 requirements range from 84,000 to 125,000 STU_3O_8 and from 142,000 to 202,000 STU_3O_8 in the United States and other countries, respectively. The ranges of requirements for the year 2000 will have increased to 119,000 to 203,000 STU_3O_8 and 234,000 to 400,000 STU_3O_8 .

Additional Enrichment Capacity

The timing of additional enrichment capacity in the United States is a matter of serious concern. The time at which additional capacity is needed, beyond

the capacity of the present three plants with the planned improvements (Cascade Improvement Program and Cascade Upgrading Program), is a function of several factors. Among these factors are the U.S. nuclear power capacity, the foreign nuclear capacity which contracts with the U.S. for enriching services, the extent of plutonium recycle, the capacity factor of the nuclear plants, and the rate of breeder introduction.

Significant shifts in one or more of these variables can dramatically affect the date at which new enriching capacity is required. For example, the range of the timing of this need is from 1982 to 1990. The earlier date will follow from high U.S. and foreign nuclear power with low foreign enriching capability. The latter date follows from low nuclear growth with high foreign enriching capability. If plutonium is not recycled, the demand for enriching services

will be higher, hence additional capacity will be needed earlier in the period. The same is true for high nuclear power plant capacity factors. The reverse is true for low capacity factors and early breeder introduction.

In addition, the supply planning of the existing U.S. enrichment plants must be taken into account including the timing of improvements and capacity uprating, power supplies obtained, operating tails assay, stockpile reserves, etc. Changes in these variables in combination can affect the date of new capacity need by two or three years.

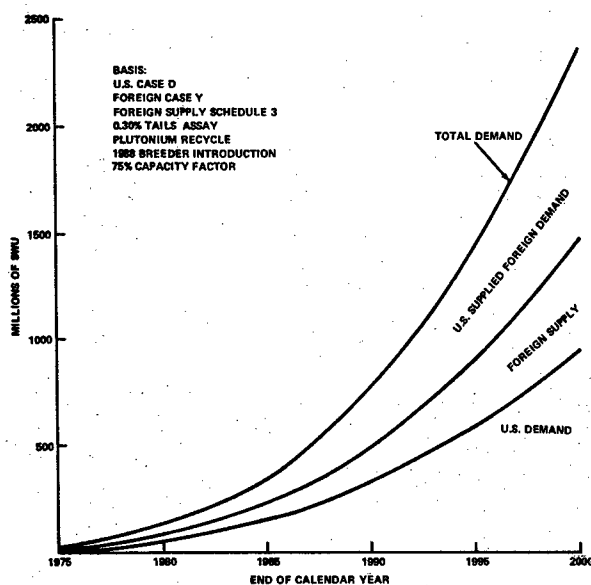


FIGURE 7. CUMULATIVE WORLD-WIDE SEPARATIVE WORK DEMAND

Table 17
SAMPLE DEMAND ON UNITED STATES
ENRICHMENT FACILITIES¹
(Millions of SWU, 0.30% Tails Assay)

Calendar Year	Annual	Cumulated
1973	6,000	6,000
74	5,600	11,600
75	10,200	21,800
76	10,300	32,100
77	12,400	44,400
78	16,600	61,200
79	18,300	79,300
1980	20,200	99,600
81	23,300	122,800
82	27,000	149,900
83	27,100	177,000
84	30,500	207,500
85	36,900	244,400
86	42,400	286,700
87	45,800	322,500
88	52,700	385,200
89	58,600	443,900
1990	63,400	507,200
91	70,200	577,400
92	76,300	653,600
93	82,700	736,400
94	89,900	826,200
95	96,500	922,800
96	102,700	1,025,400
97	107,800	1,133,200
98	111,400	1,244,600
99	115,300	1,359,900
2000	117,600	1,477,600

¹ Basis for this sample is United States Case D and Foreign Case Y, plutonium recycle, 75% reactor capacity factor, and assuming Foreign Enrichment Supply Schedule 3.

Table 18
ANNUAL URANIUM DEMAND
(Thousands of STU_3O_8 , 75% Capacity Factor, Pu Recycle)

Calendar Year	Enrichment Plant Tails Assay = 0.20%							Enrichment Plant Tails Assay = 0.30%						
	United States Cases				Foreign Cases			United States Cases				Foreign Cases		
	A	B	C	D	X	Y	Z	A	B	C	D	X	Y	Z
1974	8.1	9.3	10.3	9.7	10.9	14.5	13.8	9.7	11.2	12.3	11.6	12.4	16.6	15.9
1975	9.8	11.3	11.6	11.7	14.2	18.3	19.0	11.8	13.6	14.0	14.1	16.3	21.1	22.0
1976	10.5	12.7	13.1	12.6	17.6	19.6	20.7	12.7	15.3	15.9	15.2	20.4	22.7	24.2
1977	12.8	15.4	16.6	16.0	20.1	25.4	26.0	15.5	18.7	20.1	19.4	23.4	29.7	30.3
1978	16.9	17.9	21.7	19.8	21.4	21.1	31.6	20.5	21.6	26.2	23.8	25.0	36.5	37.1
1979	21.9	24.2	26.3	25.2	27.0	33.5	37.6	26.3	29.1	31.6	30.4	31.7	39.4	44.1
1980	25.2	28.9	29.4	31.5	33.3	39.6	46.6	30.3	34.8	35.5	37.9	39.2	46.5	54.9

Table 18
ANNUAL URANIUM DEMAND—Continued
(Thousands of STU_3O_8 , 75% Capacity Factor, Pu Recycle)

Calendar Year	Enrichment Plant Tails Assay = 0.20%							Enrichment Plant Tails Assay = 0.30%						
	United States Cases				Foreign Cases			United States Cases				Foreign Cases		
	A	B	C	D	X	Y	Z	A	B	C	D	X	Y	Z
1981	28.4	30.9	34.2	35.0	39.3	48.1	53.0	34.2	37.3	41.3	42.2	46.4	56.8	62.5
1982	32.7	36.1	39.1	34.3	42.7	57.1	61.9	39.5	43.7	47.4	41.5	50.4	67.4	73.2
1983	36.2	41.1	43.1	34.4	48.3	64.4	72.8	43.9	49.7	52.3	41.9	57.1	76.2	86.3
1985	40.3	47.0	50.6	41.5	58.8	72.6	83.8	48.9	57.0	61.2	50.5	69.7	86.1	99.5
1985	45.5	52.9	58.5	49.8	66.4	84.2	97.5	55.2	64.2	70.9	60.4	78.7	99.9	115.7
1986	48.9	58.5	67.2	55.2	76.4	95.3	111.5	59.4	71.1	81.4	67.0	90.7	113.2	132.7
1987	53.8	65.3	76.1	61.6	90.6	108.1	127.5	65.4	79.3	92.3	74.8	107.7	128.4	151.8
1988	58.6	72.8	84.6	69.3	101.7	121.1	142.0	71.2	88.5	102.7	84.2	121.2	144.0	169.3
1989	62.9	80.5	93.6	75.2	110.1	131.9	155.2	76.7	97.9	113.7	91.5	131.4	156.9	185.4
1990	68.5	87.6	102.4	81.5	118.7	143.6	169.3	83.5	106.6	124.6	99.3	141.8	171.0	202.4
1991	72.8	94.8	110.8	88.0	126.6	155.6	183.5	88.8	115.6	135.0	107.2	151.5	185.3	219.6
1992	76.3	102.2	119.9	94.3	135.0	167.8	200.5	93.1	124.7	146.2	115.0	161.6	200.0	240.2
1993	80.1	108.9	128.4	100.4	146.7	185.5	223.3	97.9	132.9	156.8	122.6	175.8	221.1	267.9
1994	84.6	115.7	136.3	106.4	158.7	203.5	244.0	103.4	141.3	166.6	130.0	190.5	243.1	293.4
1995	88.6	122.8	144.7	112.5	168.2	219.4	262.0	108.4	150.2	177.0	137.7	202.1	262.4	315.3
1996	92.4	129.2	151.9	117.7	177.5	232.5	279.6	113.1	158.1	186.0	144.1	213.4	278.4	336.8
1997	94.8	134.7	157.1	122.0	185.2	241.7	293.8	116.3	165.1	192.6	149.5	222.8	289.5	354.2
1998	95.6	138.9	161.1	123.1	190.2	250.4	306.8	117.4	170.4	197.7	153.4	228.9	300.1	370.1
1999	97.2	142.2	164.6	127.6	194.5	257.8	322.7	119.4	174.5	202.1	156.6	234.1	309.0	389.6
2000	97.0	142.7	164.8	127.6	194.0	258.7	330.6	119.2	175.4	202.7	156.9	233.9	310.6	399.9

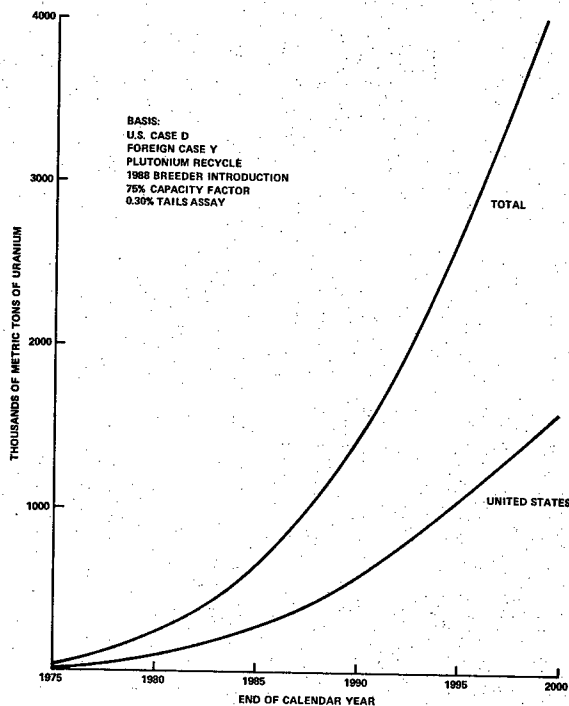


FIGURE 8. CUMULATIVE WORLD-WIDE ENRICHMENT PLANT NATURAL-URANIUM FEED DEMAND

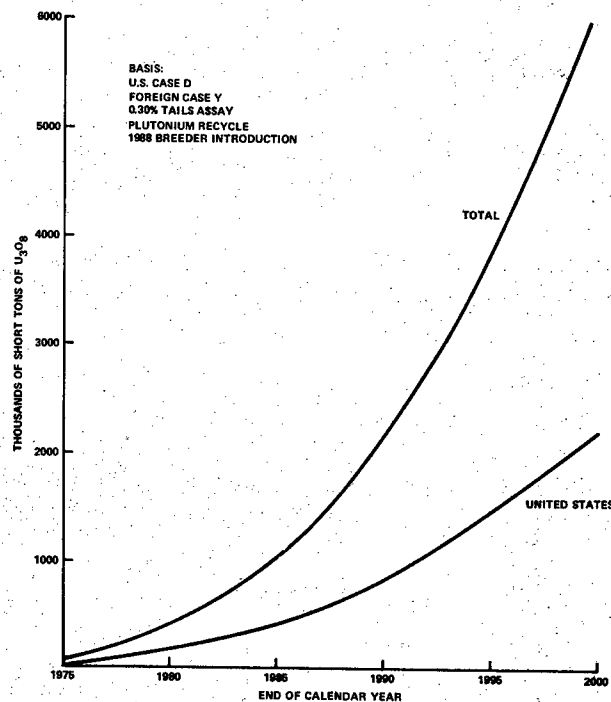


FIGURE 9. CUMULATIVE WORLD-WIDE URANIUM DEMAND

PLUTONIUM PRODUCTION AND AVAILABILITY

Tables 19 and 20 show, for the United States and for other nations, the annual and cumulated fissile plutonium recovery and use, for Case D in the United States and Case Y in other countries, at 75% capacity factor. The first part of each table shows the amounts of plutonium which are expected to be recovered from light water reactors, and from breeder and other reactors each year. The plutonium shown as recovered is shown as of the time it returns from a reprocessing facility, some 3 quarters of a year after discharge from the reactor. The cumulative amount recovered is also shown. The second part of each table shows the amounts of plutonium used for recycle, for breeder fuel, and for other uses. The cumulative amounts used are also shown. The difference in the cumulative amount recovered and cumulative amount used is shown as the inventory of plutonium at the end of each year. In 1980, in the United States, 10,300 kg (forecast range 10,200 to 11,500) of fissile plutonium will be recovered from LWRs and 7,900 kg (forecast range 7300 to 8300) will be drawn for fabrication into recycle fuel. By the year 2000, 132,000 kg (forecast range 111,000 to 164,000) will be recovered from LWR discharges, 97,000 kg (forecast range 71,000 to 131,000) from

FBR discharges. There will be 59,000 kg (forecast range 59,000 to 68,000) being used for recycle and 164,000 kg (forecast range from 116,000 to 219,000) being used for FBR fuel.

Plutonium recycle is initiated in LWRs in 1977 by inserting 25% of the plutonium available at that time at each LWR. Graphite reactors in Communist countries are also treated in this fashion. This method is comparable to the more likely scenario where 25% of the plants would decide and be licensed to recycle plutonium, however, it avoids the necessity of deciding which specific plants elect to recycle. The fraction recycled is increased to half in 1978, three-fourths in 1979 and one in 1980. Recycle is continued at the maximum rate until priority uses, principally as breeder fuel, reduce the supply available for recycle. Needs are anticipated up to six years in advance and the recycle fraction is adjusted so that plutonium will be available as needed for breeders. For example, in a case combining Case D for U.S. and Y for other countries, all at 75% capacity factor, most LWR and graphite reactor plutonium is available for recycle until late 1980's when breeders are introduced worldwide. By the year 2000 nearly half of the U.S. generated

Table 19

FISSILE PLUTONIUM RECOVERY AND UTILIZATION, KILOGRAMS
United States, Case D (Plutonium Recycle, 75% capacity factor)

-CY-	RECOVERY NATURAL			UTILIZATION					YEAR-END INVENTORY
	LWR	BREEDER	OTHER	TOTAL ANNUAL	CUMULATED	LWR RECYCLE	BREEDER FUEL	OTHER USES	
1973	0	0	0	0	0	0	0	0	0
1974	0	0	0	0	0	0	0	0	0
1975	230	0	0	230	230	0	0	16	16
1976	2400	0	0	2400	2600	380	0	680	1060
1977	5200	0	0	5200	7800	2400	0	1500	3900
1978	8600	0	0	8600	16400	6300	0	1690	8000
1979	10200	0	0	10200	26600	7400	0	2100	9500
1980	10300	0	0	10300	36900	7900	0	2400	10300
1981	12200	0	0	12200	49100	9700	0	2400	12000
1982	17000	0	0	17000	66200	14900	0	0	14900
1983	21300	0	0	21300	87500	18800	0	0	18800
1984	25300	0	0	25300	112800	23100	0	0	23100
1985	30400	0	0	30400	143200	28500	0	0	28500
1986	35600	0	0	35600	178800	31200	0	0	31200
1987	42800	0	0	42800	221600	35800	3400	0	39200
1988	48300	0	0	48300	269900	41900	820	0	42700
1989	54900	0	0	54900	324800	41200	7200	0	48400
1990	62300	860	0	63200	388000	45000	11400	0	56400
1991	69800	1480	0	71200	459200	46300	18000	0	64300
1992	77900	3000	0	80900	540100	48700	25500	0	74200
1993	86300	6600	0	92900	633100	49400	36200	0	85600
1994	94100	11800	0	105900	739000	47800	48800	0	97500
1995	101100	19400	0	120500	859500	46100	65400	0	113200
1996	108200	29400	0	137600	997100	44600	82400	0	128500
1997	115500	42000	0	157400	1154500	44600	103400	0	147900
1998	121900	57600	0	179500	1334000	49000	123800	0	172800
1999	127400	76100	0	203500	1537500	57000	137400	0	194400
2000	132400	97400	0	229800	1767300	59000	164300	0	223300

Table 20

FISSILE PLUTONIUM RECOVERY AND UTILIZATION, KILOGRAMS
Foreign, Case Y (Plutonium Recycle, 75% capacity factor)

-CY-	RECOVERY NATURAL			TOTAL ANNUAL	CUMULATED	UTILIZATION					YEAR-END INVENTORY
	LWR	BREEDER	AND OTHER			LWR RECYCLE	BREEDER FUEL	OTHER USES	TOTAL ANNUAL	CUMULATED	
1973	172	12	2400	2600	2600	0	11	0	11	11	2600
1974	280	12	3100	3400	6000	0	1270	0	1270	1280	4700
1975	530	580	2500	3600	9600	0	660	0	660	1940	7700
1976	840	810	1980	3600	13300	340	1020	22	1380	3300	9900
1977	2000	1110	3600	6800	20000	1100	1240	143	2500	5800	14200
1978	4400	1380	6000	11800	31900	3300	1180	1090	5600	11400	20400
1979	6300	1310	6600	14200	46100	6300	4300	750	11300	22700	23300
1980	8600	1390	6500	16500	62600	5700	3800	1150	10700	33400	29200
1981	11000	1390	7400	19700	82300	7900	2100	500	10500	43900	38400
1982	14200	2200	8100	24500	106800	10500	3000	960	14500	58500	48300
1983	19000	3300	8700	31100	137800	13300	6200	1440	21000	79400	58400
1984	25100	3800	10400	39200	177100	18700	3600	1870	24100	103500	73500
1985	31700	4000	10800	46400	223500	24100	4400	2900	31400	134900	88500
1986	37000	4800	12900	54700	278200	30600	4800	2900	38300	173300	105000
1987	43100	5400	15300	63700	341900	35300	10800	4500	50700	224000	118000
1988	50100	5400	17500	73000	414900	42500	7900	6300	56600	280600	134300
1989	57700	5500	20700	83900	498800	49800	17800	7800	75400	356000	142800
1990	65900	7000	23800	96700	595500	57100	26500	9900	93600	449600	145900
1991	75800	8500	28300	112600	708100	65800	40200	11800	117800	567400	140700
1992	85100	11400	33400	129900	838000	75100	58500	14900	148500	715900	122100
1993	94900	18200	38400	151400	989400	85800	80900	18300	185000	900900	88500
1994	105000	28600	43900	177500	1166900	63200	112300	15300	190700	1091600	75400
1995	115300	44500	49300	209100	1376000	44300	145600	12300	202100	1293700	82300
1996	126100	65800	55900	247900	1623900	39500	188600	11900	240000	1533700	90100
1997	137600	93900	62500	294000	1917900	39600	235200	12600	287400	1821100	96700
1998	149000	128800	69000	346700	2264500	49400	278900	15200	343500	2164600	99900
1999	155100	170600	73200	398900	2663400	61900	311700	18700	392300	2556900	108600
2000	156900	220100	77300	454300	3117700	68800	373500	20700	463000	3019900	979900

plutonium is available for recycle. In other nations the figure is about one-third. This indicates that plutonium should be plentiful and will not limit breeder growth. In addition, plutonium recycle may be expected to reduce worldwide needs for separative

work and uranium by 7% to 8% from now to the end of the century. It is apparent that there is sufficient plutonium available to support additional breeders or to minimize the impact should breeder performance not measure up to current expectations.

FABRICATION, CONVERSION, AND REPROCESSING DEMANDS

The characteristics of reactors given above and the total capacity forecasts, together with the fuel cycle parameters also discussed, lead to an estimate of the expected demand for fuel fabrication, conversion of uranium to UF_6 for cascade feed, and chemical reprocessing of spent fuel. Results are given in Table 21 for the U.S. Case D and in Table 22 for other countries Case. Y. The calculations have been performed on a quarter-year basis. The LWR mixed-oxide data are plutonium recycle fuel and are considered to be natural uranium spiked with plutonium. The HTGR fissile and fertile demands are for highly enriched uranium and for thorium. The cores and axial blankets for fast reactors are shown as FBR

mixed oxides in the tables; the FBR radial blankets consist exclusively of depleted uranium.

Conversion to UF_6 is based on the assumption that the material to be fed to the cascades will consist partly of natural uranium entering the fuel cycle and partly of recovered material from spent fuel. The latter material is nearly all at enrichment assays ranging from 0.7 to 1.0 percent ^{235}U .

Reprocessing is assumed to occur in the third quarter following discharge from the reactor. Breeder cores and blankets are not treated separately because they are partially mixed in reprocessing and are similar in character at the reprocessing stage.

Table 21

FUEL FABRICATION, CONVERSION AND REPROCESSING DEMAND
United States, Case D (Plutonium Recycle, 75% capacity factor)

-CY-	CONVERSION TO UF ₆ IN METRIC TONS OF U		FRESH FUEL FABRICATION LOAD IN METRIC TONS OF HEAVY METAL					SPENT FUEL REPROCESSING LOAD IN METRIC TONS OF HEAVY METAL				
	NATURAL URANIUM*	RECOVERED URANIUM	LWR UO ₂	LWR MIXED OXIDE	HTGR FISSILE	HTGR FERTILE	FBR MIXED OXIDE	FBR BLANKET	LWR MIXED OXIDE	HTGR FISSILE	HTGR FERTILE	FBR MIXED OXIDE
1973	6000	4	640	0	0	6	0	0	4	0	0	0
1974	6900	0	1390	0	0	2	0	0	0	0	0	0
1975	11100	50	1770	0	0	2	0	0	250	0	3	0
1976	11000	780	1740	10	0	2	0	0	930	0	2	0
1977	13300	1150	2400	60	0	2	0	0	1310	0	2	0
1978	19600	1570	3000	178	0	2	0	0	1710	0	2	0
1979	22200	1780	3900	270	1	28	0	0	1660	0	2	0
1980	29600	1680	4900	280	2	41	9	0	1740	0	2	0
1981	32300	2000	5600	310	3	60	0	11	2300	0	2	0
1982	28000	2700	6000	460	6	116	2	2	3000	0	7	0
1983	31400	3200	5200	610	3	43	3	3	3700	0	12	4
1984	34000	3600	5900	750	10	181	3	3	4300	1	20	6
1985	43500	4300	7100	900	14	260	4	3	5600	2	42	7
1986	49300	5000	8700	1010	17	290	4	3	6200	3	62	7
1987	53800	5600	9300	1180	20	330	42	51	7000	4	96	7
1988	61700	6200	10400	1350	25	400	14	12	8100	5	131	7
1989	67100	7000	11500	1410	29	450	75	86	8900	7	170	25
1990	73200	7800	12300	1520	33	490	128	147	9900	9	210	32
1991	79900	8600	13300	1560	38	540	200	230	11000	11	260	64
1992	84900	9500	14300	1630	42	590	290	320	11900	13	310	130
1993	91400	10300	15300	1680	47	640	410	450	13000	15	350	230
1994	97300	11200	16100	1660	51	680	550	590	14000	17	400	360
1995	102500	12200	17200	1640	55	720	740	790	14900	18	450	540
1996	108200	13100	18200	1600	55	770	930	970	15800	20	490	770
1997	113000	14000	18900	1530	63	800	1170	1190	16800	22	540	1050
1998	115800	14800	19600	1620	67	830	1420	1430	17500	24	580	1370
1999	118200	15600	20100	1860	70	870	1570	1520	18300	26	620	1750
2000	120300	16400	20400	1980	73	890	1870	1780				

* Based on enrichment plant tails assay of 0.30% ²³⁵U

Table 22

FUEL FABRICATION, CONVERSION AND REPROCESSING DEMAND
Foreign, Case Y (Plutonium Recycle, 75% capacity factor)

-CY-	CONVERSION TO UF ₆ IN METRIC TONS OF U		FRESH FUEL FABRICATION LOAD IN METRIC TONS OF HEAVY METAL						SPENT FUEL REPROCESSING LOAD IN METRIC TONS OF HEAVY METAL					
	NATURAL URANIUM	RECOVERED URANIUM*	LWR UO ₂	LWR MIXED OXIDE	HTGR FISSILE	HTGR FERTILE	FBR MIXED OXIDE	FBR BLANKET	LWR MIXED OXIDE	HTGR FISSILE	HTGR FERTILE	FBR MIXED OXIDE	FBR BLANKET	
1973	6700	340	4000	0	0	0	0	0	2600	0	0	0	0	
1974	7800	660	4300	0	0	0	20	22	3000	0	0	0	0	
1975	14300	330	5600	0	0	0	8	7	3100	0	0	0	12	
1976	14200	740	5200	8	0	10	12	10	3600	0	0	0	14	
1977	17600	1210	6200	43	0	0	14	11	3300	0	0	0	21	
1978	23700	1440	7700	199	0	2	13	11	3800	0	0	0	24	
1979	25300	1920	8600	260	4	95	37	41	4500	0	2	23	23	
1980	32300	2000	9300	330	3	55	54	61	5000	0	2	24	24	
1981	37300	2700	10700	300	2	35	24	20	5700	0	2	24	24	
1982	44700	3400	13100	430	3	29	35	29	6300	1	15	41	41	
1983	53500	4200	15200	580	3	32	65	65	7400	1	27	61	61	
1984	60200	5100	16600	750	7	126	45	40	8900	1	29	69	69	
1985	69800	6200	18900	1080	11	190	50	42	10400	1	32	87	87	
1986	73700	7600	21700	1240	14	250	53	45	12200	1	34	93	93	
1987	89300	8800	24400	1600	15	240	122	130	13700	2	46	93	93	
1988	99800	10200	27600	2000	21	350	82	72	15800	3	69	93	93	
1989	109300	11800	30600	2400	26	410	187	200	18200	4	98	97	97	
1990	118400	13300	32900	2800	31	480	290	320	20900	5	129	129	129	
1991	128300	15200	36200	3300	36	550	450	500	23800	7	169	150	150	
1992	136700	17200	39300	3900	42	630	650	720	26700	9	220	210	210	
1993	149500	19100	42400	4500	50	730	910	990	29900	11	270	330	330	
1994	165800	21100	46800	4000	56	800	1260	1360	33400	13	320	530	530	
1995	183300	23000	50800	3100	62	870	1630	1730	36900	16	380	810	810	
1996	195200	25100	54800	2800	70	950	2100	2200	40300	19	450	1200	1200	
1997	202300	27200	58100	2900	76	1020	2700	2700	43900	21	520	1700	1700	
1998	210000	29100	60400	3300	82	1080	3200	3200	47500	24	590	2300	2300	
1999	215200	31500	63500	4000	87	1110	3500	3500	50800	27	660	3100	3100	
2000	217800	34500	65100	4500	91	1130	4300	4100	54400	30	730	3900	3900	

* Based on enrichment plant tails assay of 0.30% ²³⁵U

SENSITIVITY ANALYSES

Several variations on the forecasts presented above were calculated to determine the sensitivity of various derived quantities to some of the assumptions underlying the basic forecast. These variations include enrichment tails assay, total installed nuclear capacity, mix of reactor types, plutonium recycle, and capacity factor. Separative work has been chosen as a sample parameter for discussion of sensitivities.

The effect of changing the assumed enrichment tails assay and total capacity forecast is shown in Figure 10. Operation of the enrichment facilities at various tails assays can almost exactly offset the effect of different forecasted capacities. Compared with the forecast of capacity as described by Case D and a tails assay of 0.30 percent ^{235}U , virtually the same cumulative uranium enrichment requirements result if the low forecast, Case A, becomes an actuality and the cascades are operated at 0.20 percent tails assay or if the high capacity, of Case C, becomes an actuality and the cascades are operated at 0.40 percent tails assay. This conclusion is valid during the entire century.

Figure 11 shows the effect on the separative work demand of varying operating capacity factors of reactors built under each set of assumptions. The uncertainty in the capacity forecast produces an un-

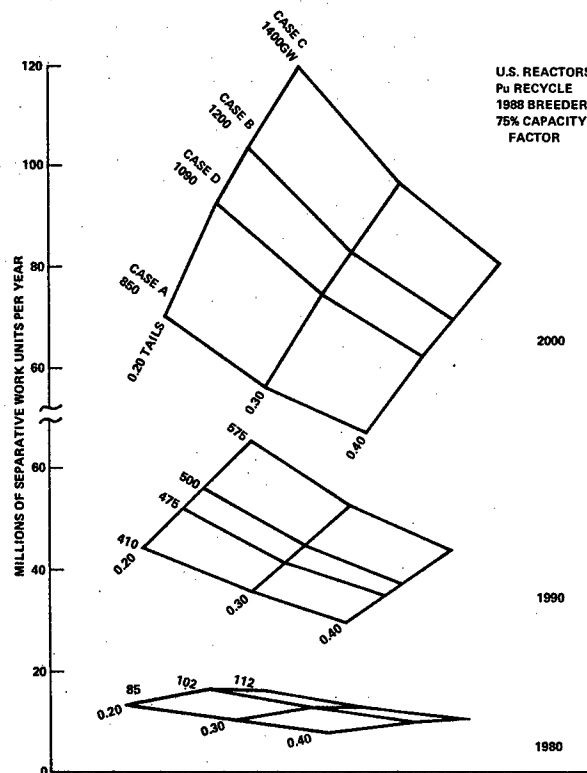


FIGURE 10. SENSITIVITY OF SEPARATIVE WORK DEMAND TO TAILS ASSAY AND INSTALLED NUCLEAR CAPACITY

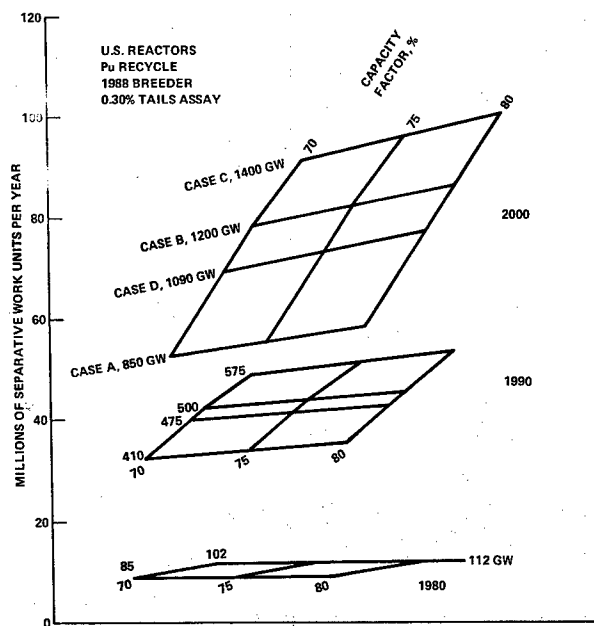


FIGURE 11. SENSITIVITY OF SEPARATIVE WORK DEMAND TO INSTALLED CAPACITY AND CAPACITY FACTOR

certainty in the annual separative work demand of over 25 percent, or about ± 20 million SWU in the year 2000. The differences in reactor capacity factors (70 to 80%) produce an uncertainty in the demand for separative work of less than about 5%, or about ± 4 million SWU.

An additional variation that was investigated is plutonium recycle. As discussed earlier it was assumed that plutonium would be recycled on a self-generated basis beginning at relatively low rates in 1977 and would be slowly reduced in the late 1990's as breeder reactors begin to need the plutonium. An

alternative assumption is that plutonium is not recycled in thermal reactors. The effects of this assumption and the assumption of FBR introduction date on the separative work demand are shown in Figure 12. Plutonium recycle has the effect of delaying the cumulative demands by some 6 to 10 months. Delaying the FBR from 1988 to 1993 has the effect of increasing the annual demands by some 10 to 16 million SWU by the year 2000.

Variations in the mix of reactors in the forecasts were investigated. The effects of such variations are minor compared to the effects of the differing total installed nuclear generating capacities.

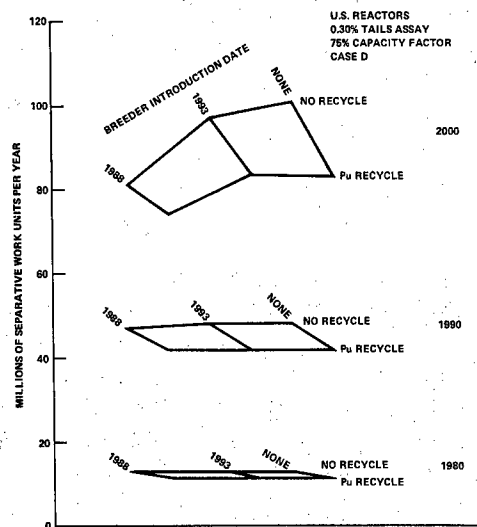


FIGURE 12. SENSITIVITY OF SEPARATIVE WORK DEMAND TO PLUTONIUM RECYCLE AND BREEDER INTRODUCTION

APPENDIX A

FOREIGN URANIUM ENRICHMENT SUPPLY

Four estimates of foreign enrichment supply are presented in Table A1. The schedules are based on a 0.30% tails assay and foreign forecast Case Y.

The schedules were derived by projecting separate work demand to be furnished by the U.S. and subtracting such demand from the foreign requirements for Case Y.

The estimates for the portion of the foreign demand to be furnished by the U.S. were derived in three steps. All foreign supply schedules used the same projection of foreign requirements to be furnished by the U.S. Atomic Energy Commission through FY 1982, based on contracts entered into and projected to be entered into through the end of FY 1974. Four estimates were made of the percentage of foreign requirements which might be served by the U.S. in the years 1990 through 2000. These estimates ranged from 15% to 45% of the total foreign demand including that of the Centrally Planned Economies,¹ increasing by steps of 10%

from one schedule to another. These two time periods for each schedule, the present through 1982 and the period 1990 through 2000, were then connected by a smooth curve for each of the four schedules as shown in Figure A1.

In the year 2000, the percentages of foreign demand estimated to be served by the U.S. for total demand, and demand excluding Centrally Planned Economies are related as follows:

Foreign Supply Schedule	Percent of Demand Supplied by U.S.	
	Total Demand	Demand excluding Centrally Planned Economies
1	15	22
2	25	37
3	35	52
4	45	67

¹ For purposes of this study, Centrally Planned Economies are taken as Bulgaria, Czechoslovakia, Democratic Republic of Germany, Hungary, Peoples Republic of China, Poland, Romania, and USSR.

The split in foreign demand between Centrally-Planned Economies and nonCentrally Planned Economies is shown on Table A2.

Table A1

FOREIGN SEPARATIVE WORK SUPPLY SCHEDULES
 (Thousands of SWU at 0.30% Tails Assay)

Calendar Year	Schedule			
	(1)	(2)	(3)	(4)
1973	800			
1974	1,200			
1975	1,800			
1976	2,200			
1977	2,900			
1978	4,200			
1979	5,900			
1980	8,000			
1981	10,800			
1982	13,900	13,300	13,000	12,500
1983	17,500	16,100	15,200	13,900
1984	21,900	20,000	18,400	16,100
1985	26,400	23,900	21,600	18,300
1986	30,900	27,700	24,800	20,700
1987	36,300	32,400	28,900	24,100
1988	42,500	37,700	33,500	28,100
1989	47,300	41,700	36,700	30,800
1990	52,200	45,700	40,100	33,800
1991	57,400	49,900	43,800	36,900
1992	61,700	53,200	46,200	38,900
1993	67,300	57,800	50,300	42,200
1994	74,600	64,300	56,600	47,400
1995	82,100	71,400	62,500	52,600
1996	88,900	77,700	67,900	57,200
1997	93,400	81,800	71,400	60,000
1998	96,800	85,200	74,100	62,300
1999	100,100	88,300	76,600	64,600
2000	103,000	90,700	78,700	66,600

Table A2

FOREIGN SEPARATIVE WORK REQUIREMENTS
 Millions of SWU

(Case Y with plutonium recycle, 0.30% tails assay)

Calendar Year	Non-Centrally Planned Economies		Centrally Planned Economies		Total	
	Annual	Cumulated	Annual	Cumulated	Annual	Cumulated
1973	3.4	3.4	.6	.6	4.0	4.0
74	2.6	6.0	.8	1.4	3.4	7.4
75	5.1	11.1	1.3	2.7	6.4	13.8
76	5.8	16.8	1.0	3.7	6.8	20.5
77	6.8	23.6	1.5	5.2	8.3	28.8
78	10.2	33.7	1.5	6.8	11.7	40.5
79	10.9	44.6	2.7	9.5	13.6	54.1
1980	11.1	55.7	3.0	12.5	14.1	68.2
81	14.0	69.7	3.8	16.3	17.8	86.0
82	17.1	86.9	4.8	21.0	21.9	107.9
83	19.5	106.4	5.9	26.9	25.4	133.3
84	22.1	128.5	7.0	33.9	29.1	162.4
85	25.1	153.6	8.8	42.7	33.9	196.3
86	29.1	182.7	10.1	52.8	39.2	235.5
87	31.8	214.5	12.1	64.9	43.9	279.4
88	36.1	250.5	14.7	79.6	50.8	330.1
89	39.3	289.8	16.7	96.3	56.0	386.1
1990	41.6	331.5	19.1	115.4	60.7	446.9
91	45.9	377.3	21.3	136.7	67.2	514.0
92	48.2	425.5	23.8	160.5	72.0	586.0
93	52.2	477.7	26.3	186.8	78.5	664.5
94	59.0	536.6	29.3	216.2	88.3	752.8
95	65.0	601.6	31.9	248.1	96.9	849.7
96	70.5	672.1	34.3	282.4	104.8	954.5
97	74.5	746.6	35.8	318.2	110.3	1064.8
98	76.3	822.8	37.7	356.0	114.0	1178.8
99	79.4	902.2	39.2	395.2	118.6	1297.4
2000	81.2	983.4	39.9	435.1	121.1	1418.5

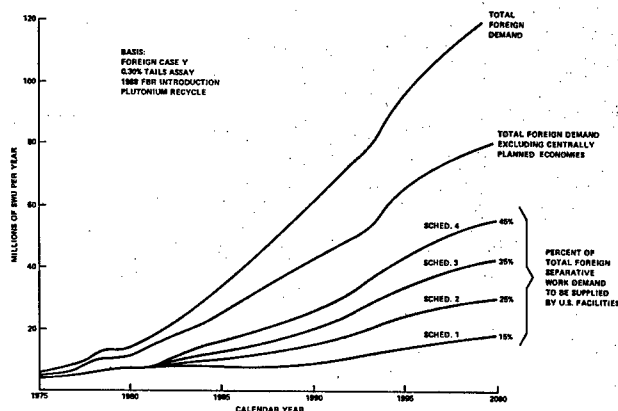


FIGURE A1 DERIVATION OF ANNUAL FOREIGN ENRICHMENT SUPPLY SCHEDULES

The results of these estimates were then translated to the schedules of foreign enrichment supply, based on Case Y and 0.30% tails assay as shown in Table A1.

In other cases (i.e. different demands, tails assays, etc.) percentages of U.S. supply of foreign requirements were maintained to derive modified projections of foreign enrichment supply by the identical methodology.

APPENDIX B

**ANNUAL AND CUMULATIVE SEPARATIVE WORK,
FEED, AND U_3O_8 REQUIREMENTS AT VARIOUS
ENRICHMENT PLANT TAILS ASSAYS**

Table B1

ANNUAL ENRICHMENT DEMAND
United States, Case A (Plutonium Recycle, 75% capacity factor)

CY-	.200 PERCENT TAILS ASSAY				.250 PERCENT TAILS ASSAY				.300 PERCENT TAILS ASSAY				.400 PERCENT TAILS ASSAY			
	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	SEP WORK -K SWU-
1973	3400	4600	5700	3000	5000	6200	2700	5500	6800	2200	7000	8600	2200	7000	8600	2200
1974	3200	4200	8100	2800	4500	8800	2500	5000	9700	2100	6300	12300	2100	6300	12300	2100
1975	6300	8300	9800	5600	9000	10700	5000	9900	11800	4200	12600	15100	3800	10600	16300	3800
1976	5700	6800	10500	5000	7500	11500	4500	8300	12700	3800	10600	16300	5100	14400	20000	5100
1977	7800	9300	12800	6500	10100	14000	6200	11200	15500	5900	16200	26300	5900	16200	26300	5900
1978	8900	10200	16900	7500	11300	18500	7100	12500	20500	8300	24000	33700	8300	24000	33700	8300
1979	12600	15400	21900	11200	16500	23900	10000	18700	26300	9400	27500	38800	9400	27500	38800	9400
1980	14300	17800	25200	12600	19400	27500	11300	21400	30300	11000	31700	43900	11000	31700	43900	11000
1981	16700	20500	28400	14800	22400	31000	13300	24800	34200	12400	35200	50700	12400	35200	50700	12400
1982	18800	22600	32700	16600	24700	35700	14900	27300	39500	15100	42000	56400	15100	42000	56400	15100
1983	22800	26900	36200	20200	29500	39600	18100	32600	43900	16000	43600	63000	16000	43600	63000	16000
1984	24000	27700	40300	21300	30400	44100	19200	33700	48900	19200	51900	71100	19200	51900	71100	19200
1985	28800	33000	45500	25600	36200	49800	23000	40200	55200	20800	55800	76700	20800	55800	76700	20800
1986	31200	35300	48900	27700	38700	53600	24900	43000	59400	22900	60500	84500	22900	60500	84500	22900
1987	34200	38100	53800	30400	41900	59000	27400	46600	65400	25700	67500	92100	25700	67500	92100	25700
1988	38400	42600	58600	34100	46800	64200	30700	52000	71200	27600	71600	99300	27600	71600	99300	27600
1989	41100	45000	62900	36500	49400	69100	32900	55000	76700	30400	78600	108100	30400	78600	108100	30400
1990	45200	49300	68500	40200	54300	75200	36300	60400	83500	32900	84900	115100	32900	84900	115100	32900
1991	49000	53300	72800	43500	58600	79900	39300	65200	88500	34900	89300	120800	34900	89300	120800	34900
1992	51800	55800	76300	46100	61500	83800	41600	68500	93100	36900	93600	127200	36900	93600	127200	36900
1993	54700	58400	80100	48600	64400	88000	43900	71700	97900	39100	98900	134400	39100	98900	134400	39100
1994	57500	61700	84600	51500	68000	93000	46500	75800	103400	41500	104700	141000	41500	104700	141000	41500
1995	61400	65200	88600	54700	71800	97400	49400	80100	108400	43400	109100	147300	43400	109100	147300	43400
1996	64300	67900	92400	57200	74800	101600	51700	83500	113100	45500	114300	151400	45500	114300	151400	45500
1997	67400	71100	94800	60000	78400	104400	54200	87400	116300	46400	115600	153000	46400	115600	153000	46400
1998	68600	71700	95600	61000	79100	105300	55100	88300	117400	47000	116400	155700	47000	116400	155700	47000
1999	69500	72000	97200	61900	79500	107100	55900	88800	119400	48300	119300	155600	48300	119300	155600	48300
2000	71400	73800	97000	63500	81400	106900	57400	91000	119200							

Table B2

CUMULATIVE ENRICHMENT DEMAND
United States, Case A (Plutonium Recycle, 75% capacity factor)

	.200 PERCENT TAILS ASSAY				.250 PERCENT TAILS ASSAY				.300 PERCENT TAILS ASSAY				.400 PERCENT TAILS ASSAY			
	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	
1973	3400	4600	5700	3000	5000	6200	2700	5500	6800	2200	7000	8600				
1974	6600	8800	13800	5800	9600	15000	5200	10500	16500	4300	13300	20900				
1975	12900	17100	23700	11400	18600	25800	10200	20400	28300	8500	25900	36000				
1976	18600	23900	34200	16400	26100	37200	14700	28700	41000	12200	36500	52300				
1977	26400	33200	46900	23300	36200	51200	20900	39900	56500	17400	50900	72300				
1978	35300	43500	63900	31200	47400	69700	28000	52400	77000	23300	67100	98700				
1979	47900	58900	85700	42400	64300	93600	38100	71100	103400	31600	91100	132400				
1980	62200	76700	110900	55000	83700	121100	49400	92500	133700	41000	118600	171200				
1981	78900	97200	139300	69800	106100	152100	62700	117300	168000	52000	150300	215100				
1982	97700	119700	172000	86400	130800	187800	77600	144600	207500	64400	185500	265800				
1983	120500	146600	208300	106600	160300	227500	95700	177200	251400	79500	227500	322200				
1984	144500	174300	248600	127900	190700	271600	114900	211000	300300	95500	271100	385200				
1985	173300	207300	294000	153500	226800	321400	137900	251100	355400	114700	323100	456300				
1986	204600	242600	342900	181100	265600	375000	162800	294100	414900	135500	378800	533100				
1987	238800	280700	396700	211500	307400	433900	190200	340700	480300	158400	439300	617600				
1988	277200	323300	455300	245600	354200	498200	220900	392700	551500	184200	506800	709700				
1989	318200	368200	518200	282100	403700	567200	253900	447700	628200	211700	578400	808900				
1990	363400	417500	586700	322300	457900	642400	290100	508100	711700	242100	657000	917000				
1991	412400	470800	659500	365800	516500	722300	329400	573400	800500	275100	741900	1032100				
1992	464200	526600	735700	411900	578000	806100	371000	641900	893600	310000	831200	1152900				
1993	518900	585100	815800	460500	642400	894100	414900	713600	991500	346800	924800	1280100				
1994	576800	646800	900400	512100	710300	987100	461400	789400	1094900	385900	1023700	1414500				
1995	638300	711900	989000	566700	782200	1084500	510800	869500	1203300	427400	1128300	1555600				
1996	702600	779800	1081400	623900	857000	1186200	562500	953000	1316500	470800	1237400	1702800				
1997	770000	850900	1176200	683900	935300	1290500	616600	1040400	1432700	516300	1351700	1854300				
1998	838600	922500	1271800	744900	1014400	1395900	671800	1128700	1550100	562600	1467300	2007300				
1999	908000	994600	1369100	806800	1053900	1503000	727700	1217500	1669500	609600	1583700	2163000				
2000	979400	1068300	1466000	870400	1175400	1609800	785100	1308500	1788600	657900	1703000	2318600				

Table B3
ANNUAL ENRICHMENT DEMAND
United States, Case B (Plutonium Recycle, 75% capacity factor)

-CY-	.200 PERCENT TAILS ASSAY				.250 PERCENT TAILS ASSAY				.300 PERCENT TAILS ASSAY				.400 PERCENT TAILS ASSAY			
	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	
1973	3500	4800	6700	3100	5200	7300	2800	5700	8000	2300	7200	10200				
1974	4200	5500	9300	3700	6000	10100	3300	6600	11200	2700	8400	14100				
1975	6700	8800	11300	5900	9600	12400	5300	10500	13600	4400	13300	17400				
1976	7100	8600	12700	6300	9400	13800	5700	10400	15300	4700	13400	19700				
1977	9000	10800	15400	8000	11800	16900	7200	13100	18700	6000	16800	24000				
1978	10800	12700	17900	9800	14000	19600	8600	15500	21600	7100	20000	27800				
1979	12000	14300	24200	10600	15600	26400	9500	17300	29100	7900	22400	37300				
1980	17800	22400	28900	15700	24500	31500	14100	27000	34800	11700	34500	44500				
1981	17800	21500	30900	15800	23500	33800	14200	26000	37300	11800	33400	47900				
1982	21500	25400	36100	19000	27800	39500	17100	30800	43700	14200	39700	56100				
1983	24700	29200	41100	21900	32000	44900	19600	35400	49700	16300	45600	64000				
1984	28500	32800	47000	25300	35900	51500	22800	39900	57000	19000	51500	73400				
1985	33100	38100	52900	29300	41700	57900	26400	46300	64200	22000	59800	82600				
1986	36500	41500	58500	32400	45600	64100	29100	50600	71100	24400	65500	91600				
1987	41300	46400	65300	36700	51000	71500	33100	56600	79300	27700	73400	102300				
1988	46300	51700	72800	41100	56800	79800	37100	63100	88500	31100	81800	114200				
1989	51800	57600	80500	46000	63200	88200	41500	70200	97900	34800	91100	125400				
1990	57400	63400	87600	51000	69700	96100	46000	77500	106600	38600	100600	137900				
1991	62400	68400	94800	55500	75200	104100	50100	83600	115600	42000	108700	149600				
1992	68200	74400	102200	60600	81800	112300	54700	91000	124700	45900	118400	161600				
1993	73500	79700	108900	65400	87700	119600	59000	97600	132900	49500	127000	172500				
1994	78500	84600	115700	69900	93100	127100	63100	103700	141300	53000	135100	183500				
1995	84000	90100	122800	74700	99200	135000	67500	110500	150200	56700	144000	195200				
1996	89600	95700	129200	79700	105400	142100	72000	117400	158100	60500	153200	205800				
1997	94200	100100	134700	83800	110300	148300	75700	122900	165100	63600	160500	215000				
1998	98600	104400	138900	87800	115100	153000	79300	128300	170400	66600	167600	222100				
1999	101300	106400	142200	90200	117300	156600	81500	130900	174500	68500	171100	227600				
2000	104400	109000	142700	93000	120200	157300	84000	134200	175400	70600	175600	229100				

Table B4

CUMULATIVE ENRICHMENT DEMAND
United States, Case B (Plutonium Recycle, 75% capacity factor)

	.200 PERCENT TAILS ASSAY				.250 PERCENT TAILS ASSAY				.300 PERCENT TAILS ASSAY				.400 PERCENT TAILS ASSAY			
	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	
-CY-	1973	3500	4800	6700	3100	5200	7300	2800	5700	8000	2300	7200	10200			
	1974	7700	10400	16100	6800	11200	17500	6100	12300	19200	5100	15600	24300			
	1975	14400	19200	27400	12700	20800	29800	11400	22900	32800	9400	29000	41700			
	1976	21500	27800	40100	19000	30300	43600	17100	33300	48100	14200	42300	61300			
	1977	30500	38600	55500	27000	42100	60500	24200	46400	66800	20100	59200	85400			
	1978	41300	51300	73400	36600	56000	80100	32800	61900	88400	27300	79200	113200			
	1979	53400	65600	97500	47200	71700	106500	42400	79200	117600	35200	101500	150500			
	1980	71100	88100	126400	62500	96200	138000	56400	106200	152400	46800	136000	195000			
	1981	89000	109500	157300	78700	119600	171700	70600	132200	189700	58600	169500	242900			
	1982	110400	134900	193400	97700	147400	211200	87700	163000	233400	72800	209100	295000			
	1983	135100	164100	234500	119500	179400	256200	107300	198400	283100	89200	254800	363000			
	1984	163600	196900	281600	144800	215300	307700	130100	238300	340100	108200	306300	436300			
	1985	196700	234900	334500	174100	257100	365600	156500	284600	404300	130200	366100	519000			
	1986	233200	276500	393000	206500	302600	429700	185700	335200	475300	154600	431600	610500			
	1987	274500	322900	458300	243200	353600	501300	218700	391800	554600	182300	504900	712900			
	1988	320800	374600	531200	284300	410400	581100	255800	454800	643100	213300	586700	827100			
	1989	372500	432100	611700	330300	473600	669300	297300	525100	741000	248100	671800	953500			
	1990	429900	495600	699300	381300	543300	765400	343400	602500	847600	286700	778300	1091400			
	1991	492300	564000	794100	436800	618400	869500	393400	686200	983200	328700	887000	1241000			
	1992	560500	638400	896400	497500	700300	981700	448200	777200	1087900	374600	1005300	1402600			
	1993	634000	718100	1005200	562800	788000	1101300	507200	874800	1220800	424200	1132400	1575100			
	1994	712600	802700	1120900	632700	881100	1228400	570300	978500	1362200	477100	1267500	1758600			
	1995	796600	892800	1243700	707400	980300	1363400	637800	1089000	1512300	533800	1411500	1953800			
	1996	886200	988500	1372800	787100	1085700	1505500	709700	1206500	1670500	594300	1564700	2159500			
	1997	980400	1088600	1507600	871000	1195900	1653800	785500	1329400	1835600	657900	1725200	2374600			
	1998	1079000	1193000	1646500	958800	1311000	1806800	864800	1457700	2006000	724600	1892700	2596600			
	1999	1180300	1299400	1788700	1048900	1428300	1963400	946200	1588600	2180500	793100	2063900	2824300			
	2000	1284700	1408400	1931400	1141900	1548500	2120700	1030200	1722800	2355900	863700	2239500	3053400			

Table B5

ANNUAL ENRICHMENT DEMAND
United States, Case C (Plutonium Recycle, 75% capacity factor)

	.200 PERCENT TAILS ASSAY				.250 PERCENT TAILS ASSAY				.300 PERCENT TAILS ASSAY				.400 PERCENT TAILS ASSAY			
	SEP WORK -K SWU-	FEED -MT-	U ₂ O ₈ -ST-		SEP WORK -K SWU-	FEED -MT-	U ₂ O ₈ -ST-		SEP WORK -K SWU-	FEED -MT-	U ₂ O ₈ -ST-		SEP WORK -K SWU-	FEED -MT-	U ₂ O ₈ -ST-	
-CY-																
1973	3400	4600	8000		3000	5000	8700		2700	5500	9600		2200	7000	12100	
1974	5800	7700	10300		5100	8400	11200		4600	9200	12300		3800	11700	15600	
1975	6200	8200	11600		5500	8500	12700		4900	9800	14000		4100	12400	17800	
1976	8000	9700	13100		7000	10600	14400		6300	11700	15900		5300	15000	20500	
1977	9000	10400	16600		8000	11500	18100		7200	12700	20100		6000	16500	25900	
1978	12400	14800	21700		11000	16300	23700		9800	18000	26200		8200	23200	33500	
1979	14600	18000	26300		12900	19600	28700		11600	21700	31600		9600	27800	40400	
1980	17600	22000	29400		15500	24000	32100		13900	26500	35500		11500	33900	45400	
1981	18900	22800	34200		16700	24500	37400		15000	27600	41300		12400	35400	53000	
1982	24600	29100	39100		21800	31900	42800		19600	35300	47400		16400	45500	60900	
1983	25900	30000	43100		23000	32900	47200		20700	36500	52300		17300	47200	67300	
1984	30400	35000	50600		26500	38400	55300		24200	42500	61200		20200	55000	78800	
1985	33700	41100	58500		31700	45100	64100		28500	50000	70900		23800	64600	91300	
1986	41100	47000	67200		36500	51500	73500		32900	57200	81400		27500	73900	104900	
1987	47600	54200	76100		42200	59400	83300		38100	65900	92300		31900	85200	118900	
1988	53500	60400	84600		47500	66300	92600		42900	73500	102700		35900	95100	132300	
1989	59800	66800	93600		53100	73300	102500		47900	81500	113700		40200	105500	146800	
1990	66600	74100	102400		59200	81400	112300		53400	90400	124600		44800	117200	161000	
1991	72900	80300	110800		64800	88200	121600		58500	98100	135000		49100	127300	174700	
1992	79500	86800	119900		70700	95400	131600		63800	106200	146200		53600	138000	185400	
1993	86700	94300	128400		77100	103700	141000		69600	115400	156800		58400	150000	203300	
1994	92600	99900	136300		82400	109500	149800		74400	122400	166600		62500	159400	216300	
1995	99100	106300	144700		89200	117100	159100		79600	130400	177000		66900	170000	230100	
1996	105700	113000	151900		94000	124400	167100		84900	138600	186000		71300	180700	242100	
1997	110700	117600	157100		98600	129600	172900		89000	144400	192600		74800	188500	250900	
1998	114700	120900	161100		102100	133300	177400		92300	148700	197700		77600	194300	257700	
1999	117900	123400	164600		105000	136100	181300		94900	151900	202100		79800	198700	263700	
2000	121000	125700	164800		107700	138800	181700		97400	154900	202700		81500	202900	264800	

Table B6

CUMULATIVE ENRICHMENT DEMAND
United States, Case C (Plutonium Recycle, 75% capacity factor)

	.200 PERCENT TAILS ASSAY				.250 PERCENT TAILS ASSAY				.300 PERCENT TAILS ASSAY				.400 PERCENT TAILS ASSAY			
	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	
1973	3400	4600	8000	3000	5000	9700	2700	5500	9600	2200	7000	12100				
1974	9200	12400	18400	8100	13400	20000	7300	14800	21900	6000	18700	27800				
1975	15400	20500	30000	13600	22300	32700	12200	24500	35900							
1976	23400	30300	43200	20700	32900	47000	18500	36300	51800	10100	31000	45600				
1977	32400	40700	59700	28700	44400	65200	25700	49000	71900	15400	46100	66100				
1978	44800	55600	81400	39600	60700	88800	35600	67000	98100	21400	62500	92000				
1979	59400	73500	107700	52500	80300	117500	36000	67000	98100	29500	85700	125500				
1980	77000	95500	137100	68000	104300	149600	47200	88700	129700	39100	113600	165900				
1981	95800	118300	171300	84700	129200	187000	61100	115100	165200	50700	147400	211400				
1982	120500	147400	210400	106600	161100	229800	76000	142700	206500	63100	182900	264400				
1983	146400	177400	253600	129600	194000	277000	95700	178000	253900	79500	228400	325300				
1984	176800	212400	304100	156500	232300	332400	116400	214500	306200	96700	275500	392600				
1985	212500	253500	362700	188200	277400	396400	140600	257100	367400	117000	330500	471400				
1986	253600	300500	429900	224700	328900	470000	169200	307100	438400	140800	395000	562700				
1987	301200	354700	506000	266900	388300	553300	202000	364200	519800	168300	469000	667500				
1988	354700	415100	590600	314400	454600	646000	240100	430200	612100	200100	554200	786400				
1989	414400	481900	684200	367500	527900	748500	282900	503700	714800	236000	649300	918800				
1990	481100	556000	786600	426800	609300	860800	330800	585200	828400	276200	754800	1065500				
1991	554000	636300	897400	491600	697500	982400	384300	675600	953100	321000	872100	1226500				
1992	633500	723100	1017300	562300	792900	1114000	442800	773700	1088000	370000	999400	1401200				
1993	720200	817300	1145700	639400	896600	1255000	506600	879800	1234200	423600	1137400	1590700				
1994	812700	917200	1282000	721700	1006500	1404800	576200	995200	1391000	482000	1287400	1794000				
1995	911900	1023600	1426700	809900	1123600	1563900	650600	1117600	1557500	544500	1446800	2010300				
1996	1017500	1136500	1578600	903900	1248000	1731000	730200	1248000	1734500	611400	1616800	2240300				
1997	1128300	1254100	1735700	1002500	1377600	1903900	815200	1386600	1920500	682700	1797500	2482400				
1998	1243000	1375100	1896800	1104600	1510900	2081300	904200	1531000	2113100	757500	1986000	2733300				
1999	1360900	1498500	2061400	1209600	1647000	2262700	996500	1579700	2310800	835100	2180300	2991000				
2000	1481900	1624200	2226200	1317300	1785700	2444400	1091300	1831600	2512900	914900	2379000	3254700				
							1188700	1986600	2715500	996800	2581900	3519500				

Table B7

ANNUAL ENRICHMENT DEMAND
United States, Case D (Plutonium Recycle, 75% capacity factor)

-CY-	.200 PERCENT TAILS ASSAY				.250 PERCENT TAILS ASSAY				.300 PERCENT TAILS ASSAY				.400 PERCENT TAILS ASSAY			
	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	
1973	3500	4800	6900	3100	5200	7500	2800	5700	8200	2300	7200	10400				
1974	4400	5800	9700	3800	6300	10600	3400	6900	11600	2900	8700	14800				
1975	7000	9200	11700	6200	10000	12800	5600	11000	14100	4600	14000	17900				
1976	7200	8800	12600	6300	9600	13700	5700	10600	15200	4700	13600	19500				
1977	8800	10500	16000	7800	11500	17500	7000	12800	19400	5900	16400	24900				
1978	11500	13900	19800	10100	15200	21600	9100	16800	23900	7600	21700	30700				
1979	13300	16100	25200	11800	17600	27500	10600	19500	30400	8800	25100	38900				
1980	17900	22200	31500	15800	24200	34300	14200	26700	37900	11800	34200	48400				
1981	20600	25700	35000	18200	28100	38200	16300	31000	42200	13500	39700	54000				
1982	22800	27500	34300	20200	30100	37500	18100	33300	41500	15100	42800	53400				
1983	21200	24200	34400	18800	26600	37800	16900	29500	41900	14100	38300	54100				
1984	24800	27500	41500	22000	30200	45500	19800	33600	50500	16600	43700	65200				
1985	30800	34800	49800	27300	38200	54500	24600	42400	60400	20500	55000	77900				
1986	35100	39900	55200	31100	43800	60500	28100	48600	67000	23400	63000	86400				
1987	38500	42900	61600	34200	47100	67500	30800	52400	74800	25800	68000	96500				
1988	44100	49400	69300	39200	54300	76000	35400	60300	84200	29600	78100	108600				
1989	49000	54500	75200	43500	59900	82500	39300	66500	91500	32900	86300	118200				
1990	53200	58500	81500	47300	64300	89400	42700	71500	99300	35800	92900	128400				
1991	58400	63900	88000	51900	70300	96500	46900	78200	107200	39300	101600	138800				
1992	62900	68400	94300	55900	75200	103300	50500	83700	115000	42400	108900	149100				
1993	68000	73500	100400	60500	80900	110300	54600	90100	122600	45800	117300	159100				
1994	72300	77700	106400	64300	85500	116900	58100	95300	130000	48800	124200	168900				
1995	77300	82800	112500	68800	91100	123700	62100	101600	137700	52200	132400	178900				
1996	81900	87200	117700	72800	96100	129500	65800	107100	144100	55300	139700	187600				
1997	85800	90800	122000	76300	100100	134200	68900	111600	149500	57900	145800	194700				
1998	89000	93800	125100	79200	103500	137700	71600	115400	153400	60200	150800	200000				
1999	91100	95300	127600	81100	105200	140500	73300	117400	156600	61600	153600	204300				
2000	93500	97200	127600	83300	107300	140700	75300	119800	156900	63300	156900	204900				

Table B8

CUMULATIVE ENRICHMENT DEMAND
United States, Case D (Plutonium Recycle, 75% capacity factor)

-CY-	.200 PERCENT TAILS ASSAY				.250 PERCENT TAILS ASSAY				.300 PERCENT TAILS ASSAY				.400 PERCENT TAILS ASSAY			
	SEP WORK -K SWU--	FEED -MT--	U ₃ O ₈ -ST--	SEP WORK -K SWU--	FEED -MT--	U ₃ O ₈ -ST--	SEP WORK -K SWU--	FEED -MT--	U ₃ O ₈ -ST--	SEP WORK -K SWU--	FEED -MT--	U ₃ O ₈ -ST--	SEP WORK -K SWU--	FEED -MT--	U ₃ O ₈ -ST--	SEP WORK -K SWU--
1973	3500	4830	6900	3100	5200	7500	2800	5700	8200	2300	7200	10400	2300	7200	10400	2300
1974	7900	10600	16600	7000	11500	18000	6200	12600	19800	5200	15900	25100	5200	15900	25100	5200
1975	14900	19800	28300	13200	21500	30800	11800	23600	33900	9800	29900	43000	9800	29900	43000	9800
1976	22100	28600	40900	19500	31100	44600	17500	34200	49100	14500	43500	62600	14500	43500	62600	14500
1977	30900	39100	56900	27300	42600	62000	24500	47000	68400	20400	59900	87400	20400	59900	87400	20400
1978	42400	53000	76700	37500	57800	83700	33700	63800	92400	27900	81600	118100	27900	81600	118100	27900
1979	55700	69100	101900	49300	75500	111200	44200	83300	122800	36700	106700	157000	36700	106700	157000	36700
1980	73600	91300	133400	65100	99700	145500	58400	110100	160600	48500	140900	205400	48500	140900	205400	48500
1981	94200	117000	168400	83300	127700	183800	74700	141100	202900	62000	180600	259400	62000	180600	259400	62000
1982	117000	144600	202700	103500	157900	221300	92900	174400	244400	77100	223400	312800	77100	223400	312800	77100
1983	138200	168800	237200	122300	184400	259100	109800	203900	286200	91200	261700	366900	91200	261700	366900	91200
1984	163000	196300	278700	144200	214700	304600	129600	237600	336700	107700	305400	432000	107700	305400	432000	107700
1985	193700	231100	328500	171500	252900	359100	154200	280000	397100	128300	360400	509900	128300	360400	509900	128300
1986	228800	271000	383700	202700	296700	419600	182200	328600	464200	151700	423300	596400	151700	423300	596400	151700
1987	267300	313900	443300	236900	343900	487000	213000	381000	538900	177500	491300	692900	177500	491300	692900	177500
1988	311500	363400	514600	276100	398100	563000	248400	441300	623200	207100	569400	801500	207100	569400	801500	207100
1989	360500	417900	589800	319600	458000	645500	287700	507800	714700	240000	655700	919800	240000	655700	919800	240000
1990	413700	476400	671300	366900	522300	734900	330400	579400	813900	275800	748600	1048200	275800	748600	1048200	275800
1991	472100	540300	759300	418900	592600	831400	377200	657600	921100	315100	850200	1187000	315100	850200	1187000	315100
1992	535000	608700	853600	474800	667800	935000	427700	741300	1036200	357500	959100	1336100	357500	959100	1336100	357500
1993	603000	682200	954000	535200	748700	1045300	482300	831300	1158800	403300	1076400	1495200	403300	1076400	1495200	403300
1994	675300	759900	1060400	599600	834200	1162200	540400	926600	1288800	452100	1200600	1664000	452100	1200600	1664000	452100
1995	752600	842600	1172900	668400	925400	1285900	602500	1028200	1426400	504200	1333100	1843000	504200	1333100	1843000	504200
1996	834500	929900	1290600	741200	1021400	1415400	668300	1135300	1570600	559500	1472800	2030500	559500	1472800	2030500	559500
1997	920300	1020700	1412600	817500	1121500	1549600	737200	1246900	1720000	617400	1618600	2225200	617400	1618600	2225200	617400
1998	1009300	1114500	1537600	896800	1225000	1687300	808800	1362300	1873400	677600	1769400	2425200	677600	1769400	2425200	677600
1999	1100400	1209900	1665200	977900	1330200	1827900	882100	1479700	2030000	739200	1923000	2629500	739200	1923000	2629500	739200
2000	1194000	1307100	1792900	1061200	1437400	1968500	957400	1599500	2186900	802500	2079900	2834400	802500	2079900	2834400	802500

Table B9

ANNUAL ENRICHMENT DEMAND
Foreign, Case X (Plutonium Recycle, 75% capacity factor)

	.200 PERCENT TAILS ASSAY				.250 PERCENT TAILS ASSAY				.300 PERCENT TAILS ASSAY				.400 PERCENT TAILS ASSAY			
	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-		SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-		SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-		SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	
1973	4200	6100	9300		3700	6500	9900		3300	7200	10500		2700	9000	12500	
1974	2700	3600	10900		2400	4000	11600		2200	4400	12400		1780	5500	14800	
1975	6000	8400	14200		5300	9100	15100		4700	10000	16300		3900	12600	19800	
1976	6400	8500	17600		5700	9300	18800		5100	10200	20400		4200	13000	24900	
1977	10100	13300	20100		8900	14400	21600		7900	15200	23400		6600	20200	28900	
1978	9500	12400	21400		8400	13500	23000		7500	14900	25000		6200	18900	30800	
1979	11700	14800	27000		10400	16200	29100		9300	17900	31700		7700	22800	39300	
1980	15900	20500	33300		14100	22300	35900		12600	24600	39200		10400	31300	48800	
1981	19000	24400	39300		16800	26600	42500		15000	29300	46400		12400	37400	57900	
1982	22500	29200	42700		19800	31800	46100		17700	35100	50400		14600	44800	63000	
1983	22600	28700	48300		19900	31300	52200		17800	34500	57100		14700	44300	71700	
1984	29800	37600	58800		26300	41000	63600		23500	45300	69700		19400	58000	87600	
1985	34800	44200	66400		30700	48200	71900		27500	53200	78700		22700	68100	99100	
1986	38700	48800	76400		34100	53200	82800		30500	58800	90700		25200	75200	114200	
1987	46300	58500	90600		40800	63800	98200		36600	70500	107700		30200	90200	135900	
1988	55600	70000	101700		49100	76400	110400		44000	84400	121200		36400	108000	153000	
1989	60200	74600	110100		53100	81500	119600		47600	90100	131400		39400	115600	166200	
1990	66700	81800	118700		58900	89400	129000		52800	98900	141800		43700	127100	179800	
1991	71600	86500	126600		63200	94700	137700		56700	104900	151500		46900	135100	192300	
1992	77200	92400	135000		68200	101300	146900		61100	112300	161600		50600	144900	205300	
1993	81900	97500	146700		72400	106900	159700		64900	118600	175800		53700	153300	223400	
1994	91400	108600	158700		80700	119100	172800		72400	132100	190500		59900	170900	242700	
1995	98300	116500	168200		86800	127800	183300		77800	141900	202100		64400	183600	257800	
1996	103900	122700	177500		91700	134600	193500		82200	149500	213400		68000	193600	272300	
1997	109800	129500	185200		96900	142100	201900		86800	157900	222800		71800	204500	284500	
1998	113500	133400	190200		100200	146500	207500		89700	162800	228900		74100	211100	292400	
1999	115500	135300	194500		101900	148700	212100		91200	165400	234100		75300	214800	299100	
2000	118600	137100	194000		104500	150900	211800		93600	168000	233900		77200	218700	299500	

Table B10

CUMULATIVE ENRICHMENT DEMAND
Foreign, Case X (Plutonium Recycle, 75% capacity factor)

	.200 PERCENT TAILS ASSAY				.250 PERCENT TAILS ASSAY				.300 PERCENT TAILS ASSAY				.400 PERCENT TAILS ASSAY			
	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	
1973	4200	6100	9300	3700	6500	9900	3300	7200	10500	2700	9000	12500	2700	9000	12500	
1974	6900	9700	20300	6100	10500	21500	5400	11500	22900	4500	14500	27300	4500	14500	27300	
1975	12900	18100	34400	11400	19600	36600	10200	21500	39200	8400	27100	47100	8400	27100	47100	
1976	19400	26700	52000	17100	28900	55400	15300	31800	59600	12600	40100	72000	12600	40100	72000	
1977	29400	40000	72200	25900	43400	77000	23200	47600	83000	19100	60200	100900	19100	60200	100900	
1978	38900	52400	93600	34300	56900	100000	30700	62500	108000	25300	79200	131700	25300	79200	131700	
1979	50600	67200	120600	44700	73100	129100	40000	80400	139700	33000	102000	171000	33000	102000	171000	
1980	66600	87700	153900	58700	95400	165100	52600	104900	178900	43400	133300	219800	43400	133300	219800	
1981	85600	112100	193300	75500	122000	207500	67600	134300	225200	55900	170700	277800	55900	170700	277800	
1982	108000	141300	236000	95300	153800	253700	85300	169400	275600	70400	215500	340700	70400	215500	340700	
1983	130700	170000	284300	115200	185100	305900	103200	204300	332800	85200	259800	412400	85200	259800	412400	
1984	160400	207600	343100	141500	226200	369500	126700	249300	402400	104600	317800	500000	104600	317800	500000	
1985	195200	251800	409400	172200	274400	441400	154200	302500	481200	127300	385900	599000	127300	385900	599000	
1986	233900	300600	485900	206300	327600	524200	184700	361300	571900	152500	461100	713300	152500	461100	713300	
1987	280100	359100	576500	247100	391500	622500	221300	431800	679600	182700	551300	849200	182700	551300	849200	
1988	335800	429100	678200	296200	467900	732900	265300	516200	800800	219100	659300	1002200	219100	659300	1002200	
1989	395900	503700	788300	349300	549400	852400	312900	606300	932100	258500	774900	1168400	258500	774900	1168400	
1990	462600	585500	907100	408200	638800	981500	365700	705200	1074000	302300	901900	1348200	302300	901900	1348200	
1991	534100	671900	1033700	471400	733500	1119200	422300	810100	1225400	349200	1037000	1540500	349200	1037000	1540500	
1992	611300	764400	1168700	539500	834800	1266000	483500	922300	1387000	399800	1181900	1745800	399800	1181900	1745800	
1993	693200	861900	1315400	611900	941700	1425700	548300	1040900	1542800	453500	1335200	1969200	453500	1335200	1969200	
1994	784700	970400	1474100	692600	1060800	1598500	620700	1173100	1753300	513400	1506000	2212000	513400	1506000	2212000	
1995	883000	1087000	1642300	779400	1188600	1781800	698500	1315000	1955400	577700	1689600	2469800	577700	1689600	2469800	
1996	986900	1209600	1819700	871200	1323200	1975300	780700	1464500	2168700	645700	1883200	2742100	645700	1883200	2742100	
1997	1096700	1339100	2004900	968100	1465400	2177200	867500	1622300	2391500	717500	2087700	3026700	717500	2087700	3026700	
1998	1210300	1472500	2195100	1068300	1611900	2384700	957300	1785200	2620300	791700	2298800	3319000	791700	2298800	3319000	
1999	1325800	1607800	2389600	1170100	1760600	2596800	1048500	1950500	2854400	867000	2513600	3618100	867000	2513600	3618100	
2000	1444300	1745000	2583600	1274700	1911500	2808600	1142100	2118500	3088300	944200	2732300	3917600	944200	2732300	3917600	

Table B11

ANNUAL ENRICHMENT DEMAND
Foreign, Case Y (Plutonium Recycle, 75% capacity factor)

-CY-	200 PERCENT TAILS ASSAY				250 PERCENT TAILS ASSAY				300 PERCENT TAILS ASSAY				400 PERCENT TAILS ASSAY			
	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-		SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-		SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-		SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	
1973	5100	7700	11900		4500	8300	12600		4000	9100	13500		3300	11400	16200	
1974	4300	5700	14500		3800	6200	15500		3400	6800	16600		2800	8700	20100	
1975	9100	11600	18300		7100	12600	19600		6400	13700	21100		5200	17300	25800	
1976	8500	11100	19600		7500	12100	21000		6800	13300	22700		5600	16900	28000	
1977	10500	13600	25400		9200	14800	27300		8300	16300	29700		6800	20800	36700	
1978	14800	20000	31100		13100	21700	33500		11700	23900	36500		9600	30300	45300	
1979	17100	21700	33500		15100	23600	36100		13600	26000	39400		11300	33200	49100	
1980	17900	21900	39600		15700	26000	42700		14100	28600	46500		11600	36400	57900	
1981	22600	29700	48100		19300	32400	52000		17800	35700	56800		14700	45500	71000	
1982	27900	36900	57100		24500	40200	61700		21900	44300	67400		18000	56300	84300	
1983	32300	42800	64400		28400	46600	69600		25400	51300	76200		20900	63300	95500	
1984	36800	47100	72600		32500	51400	78600		29100	56700	86100		24000	72500	108300	
1985	42900	54900	84200		37800	59900	91200		33900	66100	99900		27900	84400	125700	
1986	49700	63000	95300		43800	68700	103200		39200	75900	113200		32300	97200	142500	
1987	57700	70500	108100		49100	77000	117200		43900	85100	128400		36200	109000	161900	
1988	64300	80800	121100		56700	88300	131400		50800	97600	144000		41900	125100	181700	
1989	71000	88400	131900		62600	96600	143000		56000	106800	156900		46200	137200	198000	
1990	76900	94900	143600		67800	103900	153800		60700	114900	171000		50100	147800	215900	
1991	85000	104100	155600		75000	113900	168900		67200	126100	185300		55500	162400	234200	
1992	91100	110600	167800		80400	121200	182100		72000	134300	200000		59400	173200	252800	
1993	99300	119500	185600		87600	131000	201400		78500	145300	221200		64800	187700	279700	
1994	111900	134500	203700		98700	147400	221400		88400	163500	243300		73000	211200	308400	
1995	122900	147200	219500		108400	161500	238700		97100	179100	262600		80200	231500	333300	
1996	132600	158200	232800		117000	173500	253300		104800	192600	278800		86600	249100	354300	
1997	139900	165700	242100		123500	181900	263500		110600	202000	290100		91400	261600	368800	
1998	144500	169600	250900		127500	186500	273100		114200	207100	300700		94400	268700	382400	
1999	150500	175900	258100		132800	193400	281000		118900	215000	309400		98200	279300	393700	
2000	153400	176700	259000		135300	194400	282100		121200	216500	310900		100100	282000	396200	

Table B12

CUMULATIVE ENRICHMENT DEMAND
Foreign, Case Y (Plutonium Recycle, 75% capacity factor)

-CY-	.200 PERCENT TAILS ASSAY				.250 PERCENT TAILS ASSAY				.300 PERCENT TAILS ASSAY				.400 PERCENT TAILS ASSAY			
	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	
1972	5100	7700	11900	4500	8300	12600	4000	5100	13500	3300	11400	16200	3300	11400	16200	
1974	9400	13500	26400	8300	14600	28100	7400	16000	30200	6100	20100	36300	6100	20100	36300	
1975	17500	25100	44800	15400	27100	51300	13800	29700	51300	11300	37300	62100	11300	37300	62100	
1976	26100	36200	64300	23000	39200	67700	20500	43000	74100	16900	54300	90100	16900	54300	90100	
1977	36500	49800	89700	32200	54100	95900	28800	59300	103700	23800	75000	126800	23800	75000	126800	
1978	51400	69800	120800	45300	75800	129500	40500	83200	140200	33400	105300	172100	33400	105300	172100	
1979	68500	91500	154300	60400	99400	165600	54100	109300	179600	44700	138500	221300	44700	138500	221300	
1980	86400	115400	193900	76200	125400	208300	68200	137900	226200	56200	174900	279200	56200	174900	279200	
1981	109000	145100	242000	96100	157800	260300	86000	173600	282900	70900	220400	350100	70900	220400	350100	
1982	136900	182100	299100	120600	198000	321900	107900	217900	350300	88900	276800	434500	88900	276800	434500	
1983	169200	224800	363500	149100	246600	391500	133300	269200	426500	109800	342000	530000	109800	342000	530000	
1984	206100	271900	436000	181600	296000	470100	162400	325900	512500	133800	414500	638200	133800	414500	638200	
1985	249000	326800	520200	219400	353800	561300	196300	391900	612400	161800	499000	763900	161800	499000	763900	
1986	298600	389800	615500	263200	424600	664600	235500	467800	725600	194100	596200	906400	194100	596200	906400	
1987	354300	460200	723600	312200	501500	781700	279400	552900	854000	230300	765100	1068300	230300	765100	1068300	
1988	418700	541100	847000	369000	598800	913100	330100	650500	998100	272200	830200	1250000	272200	830200	1250000	
1989	489600	629400	976600	431500	686400	1056100	386100	757300	1155000	318400	967400	1448000	318400	967400	1448000	
1990	566500	724400	1120200	499400	790300	1211900	446900	872300	1325900	368600	1115200	1663900	368600	1115200	1663900	
1991	651600	828400	1275800	574400	904200	1380800	514000	998400	1511300	424000	1277700	1898100	424000	1277700	1898100	
1992	742700	939000	1443600	654800	1025300	1562900	586000	1132700	1711200	483500	1450800	2150900	483500	1450800	2150900	
1993	842000	1058600	1629200	742400	1156400	1764400	664500	1278000	1932400	548300	1638500	2430600	548300	1638500	2430600	
1994	953900	1193100	1832900	841100	1303800	1985700	752800	1441500	2175700	621300	1849800	2739000	621300	1849800	2739000	
1995	1076800	1340300	2052400	949500	1465300	2224400	849900	1620700	2438300	701400	2081300	3072400	701400	2081300	3072400	
1996	1209400	1498500	2285200	1066400	1638800	2477700	954700	1813200	2717100	788000	2330400	3426600	788000	2330400	3426600	
1997	1349300	1664200	2527300	1189900	1820700	2741200	1065300	2015200	3007100	879400	2592000	3795500	879400	2592000	3795500	
1998	1493900	1833800	2778200	1317400	2007000	3014300	1179500	2222300	3307800	973700	2860700	4177900	973700	2860700	4177900	
1999	1644400	2009700	3036300	1450200	2200400	3295200	1298400	2437400	3617200	1071900	3140000	4571600	1071900	3140000	4571600	
2000	1797900	2186400	3295300	1585500	2394800	3577400	1419600	2653900	3928100	1172000	3422000	4967800	1172000	3422000	4967800	

Table B13
ANNUAL ENRICHMENT DEMAND
Foreign, Case Z (Plutonium Recycle, 75% capacity factor)

-CY-	.200 PERCENT TAILS ASSAY				.250 PERCENT TAILS ASSAY				.300 PERCENT TAILS ASSAY				.400 PERCENT TAILS ASSAY			
	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	
1973	5000	7600	12600	4400	8200	13400	3900	9000	14400	3200	11200	17300	3200	11200	17300	
1974	5200	7100	13800	4600	7700	14700	4100	8500	15900	3400	10700	19200	3400	10700	19200	
1975	6600	9300	19000	5800	10100	20300	5200	11100	22000	4200	13900	26900	4200	13900	26900	
1976	11100	14800	20700	9800	16000	22300	8700	17600	24200	7200	22400	29800	7200	22400	29800	
1977	9200	11900	26000	8200	13000	27900	7300	14300	30300	6000	18200	37500	6000	18200	37500	
1978	16700	22400	31600	14700	24300	34100	13200	26700	37100	10900	33900	46100	10900	33900	46100	
1979	15800	20200	37600	14000	22000	40500	12500	24300	44100	10400	31000	54800	10400	31000	54800	
1980	22600	30600	46600	19900	33300	50300	17800	36600	54900	14600	46400	68500	14600	46400	68500	
1981	25700	34300	53000	22600	37300	57200	20200	41100	62500	16600	52200	78100	16600	52200	78100	
1982	29800	39200	61900	26300	42700	66900	23500	47100	73200	19300	60000	91800	19300	60000	91800	
1983	36400	47800	72800	32100	52100	78800	28700	57400	86300	23600	73100	108400	23600	73100	108400	
1984	42600	55400	83800	37600	60300	90800	33600	66500	99500	27700	84900	125200	27700	84900	125200	
1985	49600	64100	97500	43700	69900	105600	39100	77100	115700	32200	98400	145600	32200	98400	145600	
1986	57700	73900	111500	50800	80700	120900	45500	89000	132700	37500	113800	167400	37500	113800	167400	
1987	66900	85400	127500	59000	93200	138300	52800	102900	151800	43500	131600	191800	43500	131600	191800	
1988	76700	96800	142000	67600	105700	154200	60600	116800	169300	50000	149600	214200	50000	149600	214200	
1989	84900	106100	155200	74900	115900	168700	67100	128200	185400	55400	164400	234800	55400	164400	234800	
1990	93700	115500	169300	82700	126300	184100	74100	139800	202400	61200	179700	256800	61200	179700	256800	
1991	102900	125600	183500	90800	137400	199500	81400	152200	219600	67300	196000	278900	67300	196000	278900	
1992	111900	134900	200500	98800	147800	218200	88500	163800	240200	73200	211300	305400	73200	211300	305400	
1993	124500	149000	223300	109900	163300	243200	98500	181100	267900	81500	234000	341100	81500	234000	341100	
1994	141100	168700	244000	124500	184900	266000	111600	205100	293400	92300	265000	374400	92300	265000	374400	
1995	153000	182000	262000	135100	199600	285800	121100	221500	315300	100200	286400	402800	100200	286400	402800	
1996	164800	194900	279600	145500	213800	305100	130400	237300	336800	107900	307100	430700	107900	307100	430700	
1997	176600	207600	293800	156000	227900	320700	139800	253100	354200	115700	327800	453500	115700	327800	453500	
1998	184700	215100	306800	163100	236300	335000	146200	262600	370100	121100	340600	474100	121100	340600	474100	
1999	194000	224700	322700	171300	247000	352500	153600	274700	389600	127100	356700	499500	127100	356700	499500	
2000	205900	236600	330600	181800	260200	361500	163000	289600	399900	134900	376600	513800	134900	376600	513800	

Table B14

CUMULATIVE ENRICHMENT DEMAND
 Foreign, Case Z (Plutonium Recycle, 75% capacity factor)

	.200 PERCENT TAILS ASSAY				.250 PERCENT TAILS ASSAY				.300 PERCENT TAILS ASSAY				.400 PERCENT TAILS ASSAY			
	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	SEP WORK -K SWU-	FEED -MT-	U ₃ O ₈ -ST-	
-CY-																
1973	5000	7600	12600	4400	8200	13400	3900	9000	14400	3200	11200	17300				
1974	10300	14700	26400	9100	15900	28100	8100	17400	30200	6600	21900	36400				
1975	16500	24000	45400	14800	26000	48400	13300	28500	52200	10900	35800	63300				
1976	27900	38800	66100	24600	42100	70700	22000	46100	76300	18100	58200	93100				
1977	37200	50700	92100	32800	55000	98600	29300	60400	106700	24200	76400	130600				
1978	53900	73000	123700	47500	79300	132700	42500	87100	143800	35100	110200	176800				
1979	69700	93200	161300	61500	101300	173100	55100	111400	187900	45400	141200	231600				
1980	92400	123900	207900	81400	134600	223400	72800	148000	242800	60100	187600	300100				
1981	118100	158100	260900	104100	171900	280700	93100	189100	305300	76700	239900	378200				
1982	147900	197400	322700	130300	214700	347600	116600	236100	378400	96000	299800	470000				
1983	184300	245200	395500	162400	266800	426400	145200	293500	464700	119600	373000	578400				
1984	227000	300600	479300	199900	327100	517100	178800	360100	564200	147300	457800	703600				
1985	276600	364700	576700	243700	397000	622700	217900	437200	679800	179600	556200	849300				
1986	334200	438600	688200	294500	477700	743600	263400	526200	812500	217000	670000	1016700				
1987	401100	524000	815700	353500	570800	891900	316200	629000	964300	260600	801600	1208400				
1988	477900	620900	957700	421100	676600	1036100	376700	745800	1133600	310600	951200	1422600				
1989	562800	727000	1113000	496000	792500	1204800	443800	874000	1319000	366000	1115600	1657400				
1990	656500	842500	1282300	578700	918900	1388900	517900	1013800	1521400	427200	1295200	1914200				
1991	759400	968100	1465700	669500	1056300	1588400	599300	1166000	1740900	494500	1491200	2193100				
1992	871300	1103000	1666300	768300	1204100	1806600	687800	1329800	1981100	567600	1702500	2498500				
1993	995800	1252000	1889600	878200	1367400	2049800	786300	1510900	2249000	649100	1936500	2839700				
1994	1136900	1420600	2133600	1002700	1552300	2315800	897900	1716000	2542400	741400	2201400	3214100				
1995	1289900	1602700	2395600	1137800	1751900	2601600	1018900	1937500	2857700	841600	2487800	3616900				
1996	1454700	1797500	2675300	1283300	1965700	2906700	1149300	2174900	3194500	949500	2794900	4047600				
1997	1631300	2005100	2969100	1439300	2193600	3227400	1289100	2428000	3548700	1065200	3122700	4501100				
1998	1815900	2220200	3275800	1602400	2429900	3562400	1435400	2690600	3918800	1186300	3463300	4975200				
1999	2009900	2445000	3598500	1773700	2676900	3914900	1588900	2965200	4308300	1313400	3820000	5474700				
2000	2215800	2681500	3929100	1955500	2937100	4276400	1751900	3254800	4708300	1448400	4196700	5988500				

APPENDIX C

UNITED STATES REACTOR LIST

Table C1

UNITED STATES CENTRAL STATION NUCLEAR POWER REACTORS IN OPERATION—FEBRUARY 1974

Plant Name	Utility	Reactor Type	Net Power, MWe	Date of Commercial Operation	
				Mo	CY
Shippingport.....	Duquesne Light.....	PWR	90	12	57
Dresden #1.....	Commonwealth Edison.....	BWR	200	8	60
Yankee.....	Yankee Atomic Electric Company.....	PWR	175	2	61
Indian Point #1.....	Consolidated Edison.....	PWR	265	10	62
Humboldt Bay #3.....	Pacific Gas & Electric.....	BWR	69	8	63
Big Rock Point.....	Consumers Power.....	BWR	70	11	65
N-Reactor.....	WPPSS.....	GR	850	7	66
Peach Bottom #1.....	Philadelphia Electric.....	HTGR	40	6	67
San Onofre #1.....	Southern California Edison.....	PWR	430	1	68
Haddam Neck.....	Connecticut Yankee.....	PWR	575	1	68
LaCrosse.....	Dairyland Cooperative.....	BWR	53	8	69
Nine Mile Point #1.....	Niagara Mohawk.....	BWR	625	12	69
Oyster Creek.....	Jersey Central Power & Light.....	BWR	650	12	69
Ginna.....	Rochester Gas & Electric.....	PWR	470	7	70
Dresden #2.....	Commonwealth Edison.....	BWR	809	8	70
Point Beach #1.....	Wisconsin Electric Power.....	PWR	497	12	70
Millstone #1.....	Millstone Point Company.....	BWR	652	3	71
Robinson #2.....	Carolina Power & Light.....	PWR	730	3	71
Monticello.....	Northern States Power.....	BWR	545	7	71
Dresden #3.....	Commonwealth Edison.....	BWR	809	11	71

Table C1

**UNITED STATES CENTRAL STATION NUCLEAR POWER REACTORS
IN OPERATION—FEBRUARY 1974—Continued**

Plant Name	Utility	Reactor Type	Net Power, MWe	Date of Commercial Operation	
				Mo	CY
Vermont Yankee	Vermont Yankee	BWR	514	11	72
Palisades #1	Consumers Power	PWR	821	12	72
Maine Yankee	Maine Yankee Atomic Electric	PWR	860	12	72
Pilgrim #1	Boston Edison	BWR	664	12	72
Point Beach #2	Wisconsin Electric Power	PWR	497	12	72
Quad Cities #1	Com. Ed./Ia.-Ill. G&E	BWR	800	12	72
Quad Cities #2	Com. Ed./Ia.-Ill. G&E	BWR	800	12	72
Surry #1	Virginia Electric Power Co.	PWR	819	12	72
Turkey Point #3	Florida Power & Light	PWR	725	12	72
Surry #2	Virginia Electric Power Co.	PWR	819	5	73
Turkey Point #4	Florida Power & Light	PWR	725	7	73
Oconee #1	Duke Power	PWR	886	10	73
Indian Point #2	Consolidated Edison	PWR	873	11	73
Browns Ferry #1	TVA	BWR	1117	12	73
Ft. Calhoun #1	Omaha Public	PWR	457	12	73
Oconee #2	Duke Power	PWR	886	12	73
Peach Bottom #2	Philadelphia Electric	BWR	1065	12	73
Prairie Island #1	Northern States Power	PWR	550	12	73
Zion #1	Commonwealth Edison	PWR	1080	12	73
Arnold #1	Iowa Electric Light & Power	BWR	569	1	74
Cooper	Nebraska Pub. Power District	BWR	778	1	74
Calvert Cliffs #1	Baltimore Gas & Electric	PWR	875	2	74

Table C2

**UNITED STATES CENTRAL STATION NUCLEAR POWER REACTORS
ORDERED, ANNOUNCED, AND PLANNED**

Plant Name	Utility	Reactor Type	Net Power, MWe	Status	Scheduled for Commercial Operation	
					Mo.	CY
Allens Creek #1	Houston Lighting & Power	BWR	1150	Ord.		80
Allens Creek #2	Houston Lighting & Power	BWR	1150	Ord.		82
Arkansas Nuclear #1	Arkansas Power & Light	PWR	850	Ord.	3	74
Arkansas Nuclear #2	Arkansas Power & Light	PWR	926	Ord.	10	76
Atlantic #1	Public Service Elec. & Gas	PWR	1200	Ord.	5	80
Atlantic #2	Public Service Elec. & Gas	PWR	1200	Ord.	1	81
Atlantic #3	Public Service Elec. & Gas	PWR	1200	Ord.	1	82
Atlantic #4	Public Service Elec. & Gas	PWR	1200	Ord.	1	84
Bailly	No. Indiana Public Service	BWR	660	Ord.	3	78
Beaver Valley #1	Duquesne Light	PWR	885	Ord.	5	75
Beaver Valley #2	Duquesne Light	PWR	885	Ord.	6	79
Bellefonte #1	TVA	PWR	1279	Ord.	9	79
Bellefonte #2	TVA	PWR	1279	Ord.	6	80
Blue Hills #1	Gulf States Utilities	PWR	918	Ord.	10	81
Blue Hills #2	Gulf States Utilities	PWR	918	Ann.		80
Boardman #1	Portland General Electric	PWR	1260	Ord.		80
Boardman #2	Portland General Electric		1260	Plan.		82
Braidwood #1	Commonwealth Edison	PWR	1120	Ord.	10	80
Braidwood #2	Commonwealth Edison	PWR	1120	Ord.	3	82
Browns Ferry #2	TVA	BWR	1117	Ord.	7	74
Browns Ferry #3	TVA	BWR	1117	Ord.	12	74
Brunswick #1	Carolina Power & Light	BWR	855	Ord.	12	75
Brunswick #2	Carolina Power & Light	BWR	855	Ord.	12	74
Byron #1	Commonwealth Edison	PWR	1120	Ord.	5	79
Byron #2	Commonwealth Edison	PWR	1120	Ord.	3	80
Callaway #1	Union Electric	PWR	1100	Ann.		81
Callaway #2	Union Electric	PWR	1100	Ann.		83
Calvert Cliffs #2	Baltimore Gas & Electric	PWR	875	Ord.	2	75
Catawba #1	Duke Power	PWR	1180	Ord.	3	79
Catawba #2	Duke Power	PWR	1180	Ord.	3	80
Central Alabama #1	Alabama Power	BWR	1100	Ord.		81
Central Alabama #2	Alabama Power	BWR	1100	Ord.		82
Charlestown #1	Narragansett Electric		950	Ann.		80
Charlestown #2	Narragansett Electric		950	Ann.		82
Cherokee #1	Duke Power	PWR	1200	Ord.		84
Cherokee #2	Duke Power	PWR	1200	Ord.		85
Cherokee #3	Duke Power	PWP	1200	Ord.		86
Clinch River	U.S. Government	LMFBR	400	Ord.		80
Clinton #1	Illinois Power	BWR	950	Ord.		80
Clinton #2	Illinois Power	BWR	950	Ord.		82
Comanche Peak #1	Texas Power & Light	PWR	1160	Ord.	1	80
Comanche Peak #2	Texas Power & Light	PWR	1150	Ord.	1	82
Commonwealth Edison #1	Commonwealth Edison		1100	Plan.	3	82
Commonwealth Edison #2	Commonwealth Edison		1100	Plan.	10	82
Cook #1	Indiana & Michigan Elec.	PWR	1096	Ord.	10	74
Cook #2	Indiana & Michigan Elec.	PWR	1096	Ord.	1	76
Crystal River #3	Florida Power	PWR	825	Ord.	12	74
Davis-Besse #1	Toledo Edison	PWR	906	Ord.	5	75
Davis-Besse #2	Toledo Edison		906	Ann.	6	81
Davis-Besse #3	Toledo Edison		906	Ann.	1	83
Diablo Canyon #1	Pacific Gas & Electric	PWR	1131	Ord.	3	75
Diablo Canyon #2	Pacific Gas & Electric	PWR	1156	Ord.	3	76
Douglas Point #1	Potomac Electric Power	BWR	1237	Ord.	3	80
Douglas Point #2	Potomac Electric Power	BWR	1237	Ord.		81
Erie #1	Ohio Edison		1200	Ann.	1	82
Erie #2	Ohio Edison		1200	Ann.	1	83

Table C2

**UNITED STATES CENTRAL STATION NUCLEAR POWER REACTORS
ORDERED, ANNOUNCED, AND PLANNED—Continued**

Plant Name	Utility	Reactor Type	Net Power, MWe	Status	Scheduled for Commercial Operation	
					Mo.	CY
Farley #1	Alabama Power	PWR	866	Ord.	12	75
Farley #2	Alabama Power	PWR	866	Ord.	1	77
Fermi #2	Detroit Edison	BWR	1171	Ord.	8	76
Fermi #3	Detroit Edison	BWR	1125	Ord.	8	81
FitzPatrick	Power Auth. St. of NY	BWR	853	Ord.	6	74
Forked River	Jersey Central Po. & L.	PWR	1120	Ord.	11	78
Ft. Calhoun #2	Omaha Public Power Dist.		900	Plan.		81
Ft. St. Vrain	Colorado Public Service	HTGR	330	Ord.	4	74
Fulton #1	Philadelphia Electric	HTGR	1140	Ord.	5	81
Fulton #2	Philadelphia Electric	HTGR	1140	Ord.	5	83
Grand Gulf #1	Mississippi Power & Light	BWR	1290	Ord.	6	79
Grand Gulf #2	Mississippi Power & Light	BWR	1290	Ord.	6	81
Greenwood #2	Detroit Edison	PWR	1240	Ord.	8	80
Greenwood #3	Detroit Edison	PWR	1240	Ord.		81
Harris #1	Carolina Power & Light	PWR	915	Ord.	3	78
Harris #2	Carolina Power & Light	PWR	915	Ord.		79
Harris #3	Carolina Power & Light	PWR	915	Ord.		80
Harris #4	Carolina Power & Light	PWR	915	Ord.		81
Hartsville #1	TVA	BWR	1290	Ord.	12	80
Hartsville #2	TVA	BWR	1290	Ord.	12	81
Hartsville #3	TVA	BWR	1290	Ord.	6	81
Hartsville #4	TVA	BWR	1290	Ord.	6	82
Hatch #1	Georgia Power	BWR	822	Ord.	4	74
Hatch #2	Georgia Power	BWR	825	Ord.	4	78
Hope Creek #1	Public Service Elec. & Gas	BWR	1067	Ord.	5	81
Hope Creek #2	Public Service Elec. & Gas	BWR	1067	Ord.	5	82
Houston #1	Houston Light & Power		1150	Paln.	2	81
Indian Point #3	Consolidated Edison	PWR	965	Ord.	12	74
Inola	Public Service of Oklahoma	PWR	1100	Ord.		82
Islote	Puerto Rico WRA	PWR	600	Ord.		79
Jacksonville #1	Jacksonville Elec. Auth.	PWR	1110	Ord.	4	82
Jacksonville #2	Jacksonville Elec. Auth.	PWR	1110	Ord.	4	84
Jamesport #1	Long Island Lighting	PWR	1150	Ord.	6	81
Jamesport #2	Long Island Lighting	PWR	1150	Ord.	6	84
Kewaunee	Wisconsin	PWR	541	Ord.	6	74
LaSalle County #1	Commonwealth Edison	BWR	1078	Ord.	10	78
LaSalle County #2	Commonwealth Edison	BWR	1078	Ord.	10	79
Limerick #1	Philadelphia Electric	BWR	1100	Ord.	4	79
Limerick #2	Philadelphia Electric	BWR	1100	Ord.	6	80
Lower Lehigh #1	Pennsylvania Power & Light		1100	Ann.		83
Lower Lehigh #2	Pennsylvania Power & Light		1100	Ann.		85
McGuire #1	Duke Power	PWR	1180	Ord.	3	76
McGuire #2	Duke Power	PWR	1180	Ord.	3	77
Mendocino #1	Pacific Gas & Electric	BWR	1128	Ord.	7	83
Mendocino #2	Pacific Gas & Electric	BWR	1128	Ord.	7	84
Metropolitan X-1	Metropolitan Edison		1150	Plan.	6	83
Midland #1	Consumers Power	PWR	492	Ord.	3	80
Midland #2	Consumers Power	PWR	818	Ord.	3	79
Middle South #1	Middle South Utilities (La.)	PWR	1150	Plan.	6	82
Middle South #2	Middle South Utilities (La.)	PWR	1150	Plan.	6	84
Millstone #2	Millstone Point	PWR	828	Ord.	12	74
Millstone #3	Northeast Utilities	PWR	1150	Ord.		79
Montague #1	Northeast Utilities		1100	Ann.		81
Montague #2	Northeast Utilities		1100	Ann.		85
Nine Mile Point #2	Niagara Mohawk Power	BWR	1080	Ord.	11	78
North Anna #1	Virginia Electric Power	PWR	934	Ord.	4	75

Table C2

**UNITED STATES CENTRAL STATION NUCLEAR POWER REACTORS
ORDERED, ANNOUNCED, AND PLANNED—Continued**

Plant Name	Utility	Reactor Type	Net Power, MWe	Status	Scheduled for Commercial Operation	
					Mo.	CY
North Anna #2	Virginia Electric Power	PWR	934	Ord.	4	76
North Anna #3	Virginia Electric Power	PWR	938	Ord.	4	77
North Anna #4	Virginia Electric Power	PWR	938	Ord.	4	78
Northwest Illinois #1	Commonwealth Edison		1100	Plan.	3	81
Northwest Illinois #2	Commonwealth Edison		1100	Plan.	10	81
Oconee #3	Duke Power	PWR	886	Ord.	6	74
Palo Verde #1	Arizona Public Service		1270	Ann.		81
Palo Verde #2	Arizona Public Service		1270	Ann.		83
Palo Verde #3	Arizona Public Service		1270	Ann.		85
Peach Bottom #3	Philadelphia Electric	BWR	1065	Ord.	12	73
Perkins #1	Duke Power	PWR	1200	Ord.		81
Perkins #2	Duke Power	PWR	1200	Ord.		82
Perkins #3	Duke Power	PWR	1200	Ord.		83
Perry #1	Cleveland Elec. Illuminating	BWR	1205	Ord.		79
Perry #2	Cleveland Elec. Illuminating	BWR	1205	Ord.		80
Pilgrim #2	Boston Edison	PWR	1180	Ord.	8	80
Pilgrim #3	Boston Edison	PWR	1180	Plan.	5	82
Prairie Island #2	Northern States Power	PWR	555	Ord.	10	74
Quanicassee #1	Consumers Power	PWR	1150	Ord.		81
Quanicassee #2	Consumers Power	PWR	1150	Ord.		82
Rancho Seco #1	Sacramento Mun. Util. Dist.	PWR	913	Ord.	6	74
Rancho Seco #2	Sacramento Mun. Util. Dist.		1100	Plan.		80
River Bend #1	Gulf States Utilities	BWR	934	Ord.	2	80
River Bend #2	Gulf States Utilities	BWR	934	Plan.	10	82
Salem #1	Public Service Elec. & Gas	PWR	1131	Ord.	3	75
Salem #2	Public Service Elec. & Gas	PWR	1156	Ord.	3	76
San Joaquin #1	Los Angeles Dept. W&P		1100	Plan.	12	81
San Joaquin #2	Los Angeles Dept. W&P		1100	Plan.	12	82
San Joaquin #3	Los Angeles Dept. W&P		1100	Plan.	12	83
San Joaquin #4	Los Angeles Dept. W&P		1100	Plan.	12	84
San Onofre #2	Southern California Edison	PWR	1140	Ord.	9	80
San Onofre #3	Southern California Edison	PWR	1140	Ord.	12	81
Seabrook #1	Pub. Serv. of New Hampshire	PWR	1260	Ord.	11	79
Seabrook #2	Pub. Serv. of New Hampshire	PWR	1260	Ord.		81
Sequoyah #1	TVA	PWR	1177	Ord.	12	75
Sequoyah #2	TVA	PWR	1177	Ord.	8	76
Shoreham #1	Long Island Lighting	BWR	854	Ord.	7	77
Skagit	Puget Sound Power & Light		1100	Ann.		82
Somerset #1	N. Y. State Electric & Gas	BWR	1220	Ann.		82
Somerset #2	N. Y. State Electric & Gas	BWR	1220	Ann.		84
South Texas #1	Houston Lighting & Power	PWR	1250	Ord.		80
South Texas #2	Houston Lighting & Power	PWR	1250	Ord.		82
So. California Ed. HTGR #1	Southern California Edison	HTGR	1160	Plan.		84
So. California Ed. HTGR #2	Southern California Edison	HTGR	1160	Plan.		85
St. Lucie #1	Florida Power & Light	PWR	833	Ord.	6	75
St. Lucie #2	Florida Power & Light	PWR	833	Ord.	12	79
Sterling	Rochester Gas & Electric	PWR	1100	Ann.	9	80
Summer #1	South Carolina Electric & Gas	PWR	915	Ord.	1	78
Summer #2	South Carolina Electric & Gas		915	Ann.		81
Summit #1	Delmarva Power & Light	HTGR	770	Ord.	5	80
Summit #2	Delmarva Power & Light	HTGR	770	Ord.	6	82
Surry #3	Virginia Electric Power	PWR	950	Ord.		80
Surry #4	Virginia Electric Power	PWR	950	Ord.		81
Susquehanna #1	Pennsylvania Power & Light	BWR	1120	Ord.	11	79
Susquehanna #2	Pennsylvania Power & Light	BWR	1120	Ord.	5	81
Three Mile Island #1	Metropolitan Edison	PWR	819	Ord.	8	74

Table C2

**UNITED STATES CENTRAL STATION NUCLEAR POWER REACTORS
ORDERED, ANNOUNCED, AND PLANNED—Continued**

Plant Name	Utility	Reactor Type	Net Power, MWe	Status	Scheduled for Commercial Operation	
					Mo.	CY
Three Mile Island #2	Metropolitan Edison	PWR	905	Ord.	9	76
Trojan	Portland General Electric	PWR	1130	Ord.	7	75
Tyrone #1	Northern States Power	PWR	1100	Ann.		82
Tyrone #2	Northern States Power	PWR	1100	Ann.		83
Vidal #1	Southern California Edison	HTGR	770	Ord.	6	82
Vidal #2	Southern California Edison	HTGR	770	Ord.	6	83
Vogtle #1	Georgia Power	PWR	1121	Ord.	4	80
Vogtle #2	Georgia Power	PWR	1121	Ord.	4	81
Vogtle #3	Georgia Power	PWR	1121	Ord.		82
Vogtle #4	Georgia Power	PWR	1121	Ord.		83
Waterford #3	Louisiana Power & Light	PWR	1165	Ord.	10	77
Watts Bar #1	TVA	PWR	1219	Ord.	3	78
Watts Bar #2	TVA	PWR	1219	Ord.	12	78
Wisconsin #1	Wisconsin Electric Power	PWR	900	Ord.		80
Wisconsin #2	Wisconsin Electric Power	PWR	900	Ord.		82
Wisconsin #3	Wisconsin Electric Power	PWR	900	Ann.		83
Wisconsin #4	Wisconsin Electric Power	PWR	900	Ann.		85
Wisconsin #5	Wisconsin Electric Power	PWR	900	Ann.		86
Wisconsin #6	Wisconsin Electric Power	PWR	900	Ann.		88
Wolf Creek	Kansas Gas & Electric	PWR	1100	Ann.	4	81
WPPSS #1	Wash. Pub. Pow. Sup. Sys.	PWR	1200	Ord.		80
WPPSS #2	Wash. Pub. Pow. Sup. Sys.	BWR	1103	Ord.	9	77
WPPSS #3	Wash. Pub. Pow. Sup. Sys.	PWR	1300	Ord.		81
Zimmer #1	Cincinnati Gas & Electric	BWR	810	Ord.	8	77
Zimmer #2	Cincinnati Gas & Electric	BWR	1170	Ord.		82
Zion #2	Commonwealth Edison	PWR	1080	Ord.	5	74

APPENDIX D

FOREIGN REACTOR LIST

Table D1

FOREIGN CENTRAL STATION NUCLEAR POWER REACTORS OPERATING,
ORDERED, ANNOUNCED AND PLANNED

Country	Plant Name	Utility	Reactor Type	Net Power, MWe	Status	Scheduled for Commercial Operation	
						Mo.	CY
Argentina	Atucha #1	CNEA	HWR	318	Ord.	12	73
	Atucha #2	CNEA		800	Plan.	12	85
	Cordoba	EPEC	HWR	600	Ord.	12	78
	Argentina #5			800	Plan.	12	84
	Madriena	SEGBA		600	Plan.	12	83
	Bahia Blanca			600	Plan.	12	80
Australia	Australia #1	Electric Comm. NSW		800	Plan.	12	81
Austria	Tullnerfeld #1	Gemeinschaft Kernkraftwerke	BWR	700	Ord.	12	76
	Austria #2		LWR	1200	Ann.	12	80
Bangladesh	Roopur		PWR	200	Ann.	12	79
Belgium	Doel #1	EBES	PWR	390	Oper.	12	73
	Tihange	EDF/SEMO	PWR	870	Ord.		75
	Doel #2	EBES	PWR	390	Ord.	5	75
	Belgium #4			800	Plan.	12	81
	Belgium #5			800	Plan.	12	82
Brazil	Angra Dos Reis #1	FURNAS	PWR	626	Ord.	3	77
	Angra Dos Reis #2	FURNAS		800	Ann.	12	80
	Angra Dos Reis #3	FURNAS		1000	Plan.	12	82
	Angra Dos Reis #4	FURNAS		600	Plan.	12	84

Table D1

FOREIGN CENTRAL STATION NUCLEAR POWER REACTORS OPERATING,
ORDERED, ANNOUNCED AND PLANNED—Continued

Country	Plant Name	Utility	Reactor Type	Net Power, MWe	Status	Scheduled for Commercial Operation	
						Mo.	CY
Bulgaria	Koslodj #1		PWR	405	Ord.	7	74
	Koslodj #2		PWR	405	Ord.	12	75
	Koslodj #3		PWR	405	Ann.	12	76
	Kodlodj #4		PWR	405	Ann.	12	77
	Kodlodj #5		PWR	405	Ann.	12	78
Canada	Douglas Point	Ontario Hydro	HWR	200	Oper.	1	67
	Gentilly	Hydro Quebec	HWR	250	Oper.	12	71
	Pickering #1	Ontario Hydro	HWR	508	Oper.	7	71
	Pickering #2	Ontario Hydro	HWR	508	Oper.	12	71
	Pickering #3	Ontario Hydro	HWR	508	Oper.	10	72
	Pickering #4	Ontario Hydro	HWR	512	Oper.	6	73
	Bruce #1	Ontario Hydro	HWR	750	Ord.	6	77
	Bruce #2	Ontario Hydro	HWR	750	Ord.	12	75
	Bruce #3	Ontario Hydro	HWR	750	Ord.	12	78
	Bruce #4	Ontario Hydro	HWR	750	Ord.	12	79
	Bruce #5	Ontario Hydro	HWR	750	Plan.	12	81
	Bruce #6	Ontario Hydro	HWR	750	Plan.	12	82
	Bruce #7	Ontario Hydro	HWR	750	Plan.	12	83
	Bruce #8	Ontario Hydro	HWR	750	Plan.	12	83
	Gentilly #2	Hydro Quebec	HWR	500	Ord.	12	79
	Gentilly #3	Hydro Quebec	HWR	1000	Ord.	12	78
	Hydro 1000-1	Hydro Quebec	HWR	1000	Plan.	7	78
	No Name #1	Hydro Quebec	HWR	500	Plan.	10	78
	No Name #2	Hydro Quebec	HWR	500	Plan.	1	79
	Hydro 1000-2	Hydro Quebec	HWR	1000	Plan.	10	79
	Hydro 1000-3	Hydro Quebec	HWR	1000	Plan.	3	80
	Bowmanville #1	Ontario Hydro	HWR	750	Plan.	12	82
	Bowmanville #2	Ontario Hydro	HWR	750	Plan.	12	83
	Bowmanville #3	Ontario Hydro	HWR	750	Plan.	12	84
	Bowmanville #4	Ontario Hydro	HWR	750	Plan.	12	85
Chile	Chile #1	ENDESA		400	Ann.	12	79
	Chile #2	ENDESA		600	Ann.	12	84
Czechoslovakia	Bohunice 1A		GCR	110	Oper.	12	72
	Bohunice 2A		PWR	413	Ord.	12	79
	Bohunice 2B		PWR	440	Ord.	12	79
	Bohunice V1-1		PWR	761	Ord.	12	77
	Bohunice V1-2		PWR	761	Ord.	12	80
Finland	Loviisa #1		PWR	420	Ord.	6	76
	Loviisa #2		PWR	420	Ord.	4	78
	Finnish #3		BWR	660	Ann.	12	78
	Vuosaari			600	Plan.	12	82
	Meisaari			720	Plan.	12	92
France	Chinon #2	EDF	GCR	200	Oper.	2	65
	Chinon #3	EDF	GCR	480	Oper.	8	66
	St. Laurent #1	EDF	GCR	480	Oper.	6	69
	St. Laurent #2	EDF	GCR	515	Oper.	8	71
	SENA (Chooz)	EDF/EBES	PWR	266	Oper.	4	67
	Bugey #1	EDF	GCR	540	Oper.	4	72
	Phenix	CEA	FBR	250	Oper.	12	73
	Bugey #2	EDF	PWR	930	Ord.	12	76
	Bugey #3	EDF	PWR	930	Ord.	12	77
	Fessenheim #1	EDF	PWR	890	Ord.	11	75

Table D1

FOREIGN CENTRAL STATION NUCLEAR POWER REACTORS OPERATING,
ORDERED, ANNOUNCED AND PLANNED—Continued

Country	Plant Name	Utility	Reactor Type	Net Power, MWe	Status	Scheduled for Commercial Operation	
						Mo.	CY
France	Fessenheim #2	EDF	PWR	890	Ord.	11	76
	FDR-Demo #1	EDF/RWE	FBR	1000	Ord.	3	81
	St. Laurent #3	EDF	BWR	995	Plan.	11	79
	Dampierre	EDF	BWR	995	Plan.		81
	Caux-1	EDF		750	Ord.	12	82
	Caux-2	EDF		750	Plan.		83
	Caux-3	EDF		750	Plan.		84
	Caux-4	EDF		750	Plan.		85
	Languedoc #1	EDF		1000	Ann.	12	80
East Germany	Languedoc #2	EDF		1000	Plan.	12	81
	Rheinsberg #1		HWR	70	Oper.	12	66
	Nord 1 #1		PWR	365	Oper.	12	73
	Nord 1 #2		PWR	365	Ord.		75
	Nord 2 #1		PWR	365	Ord.		77
	Nord 2 #2		PWR	365	Ord.		78
West Germany	East Germany #1			1000	Plan.	12	80
	Kahl VAK	RWE	BWR	15	Oper.	2	62
	KRB Gundrenmingen	KRB/RWE	BWR	237	Oper.	4	67
	KWL Lingen	VEW	BWR	160	Oper.	9	68
	KWO Obrigheim	KWO	PWR	328	Oper.	12	68
	KKS Stade	NWK	PWR	630	Oper.	3	72
	KKW Wuergassen	Pruessische EW	BWR	640	Oper.	3	72
	KKN Neiderachbach	GFN (Karlsruhe)	HWGCR	100	Oper.	4	73
	KKI Isar	Isar Amperwerke	BWR	870	Ord.	12	77
	Biblis #1—Unit A	RWE	PWR	1150	Ord.	6	74
	Biblis #2—Unit B	RWE	PWR	1178	Ord.	10	76
	KKB Brunsbuetel	NWK/HEW	BWR	770	Ord.	2	75
	BASF #1	BASF	PWR	660	Ord.	12	78
	BASF #2	BASF	PWR	660	Ord.	12	79
	Unterweser	NWK/PEW	PWR	1230	Ord.	12	76
	KKP Philipsburg #1	Nord Badenwerk/EVS	BWR	864	Ord.	1	76
	KKP Philipsburg #2	Nord Badenwerk/EVS	BWR	864	Ord.	8	78
	THTR	Consortium	HTGR	300	Ord.	12	76
	SNR Kalkar	PSB	FBR	300	Ord.	12	78
	Leverkusen	Farbanfabriken		600	Ord.	12	78
	GKN Neckarwestein	GKN	PWR	800	Ord.	1	76
	Kaerlich (Koblenz)	RWE	PWR	1300	Ord.	12	78
	FBR-Demo	EDF/RWE	FBR	1000	Ord.	12	84
	Kruemmel (Geesthacht)	NWK/HEW	BWR	1260	Ord.	12	77
	KKP Philipsburg #3	Nord Badenwerk EVS	BWR	864	Ord.	9	79
	KKP Philipsburg #4	Nord Badenwerk EVS	BWR	864	Ord.	3	80
	Biblis #3	RWE	PWR	1240	Plan.	6	79
	KKB Brunsbuetel #2	NWK/HEW	BWR	770	Plan.		
	Breisach #1	EVS/Badenwerk	PWR	1240	Plan.	6	79
	Breisach (KRB) #2	EVS/Badenwerk	PWR	1300	Plan.	12	81
	Raum Grosswelzheim	RWE	LWR	1200	Ann.	12	78
	Oberweser	Preussische EW	LWR	1300	Plan.	12	80
	Grafenheinfeld	BWAG	LWR	1200	Plan.	12	79
	PREAG	BWAG		860	Plan.	12	78
	Lingen #2	VEW	HTGR	1100	Plan.	12	78
	Oberrrheim	KKW Sud/EVS	LWR	1300	Ord.	12	79
	Emden	NWK	LWR	1300	Plan.		81
	Buttel/St. Margarethen	NWK	LWR	1300	Plan.		82
	Cuxhaven	NWK	LWR	1300	Plan.		83

Table D1
FOREIGN CENTRAL STATION NUCLEAR POWER REACTORS OPERATING,
ORDERED, ANNOUNCED AND PLANNED—Continued

Country	Plant Name	Utility	Reactor Type	Net Power, MWe	Status	Scheduled for Commercial Operation	
						Mo.	CY
Greece	Greek #1	Public Power Corp.		600	Plan.	12	82
	Greek #2	Public Power Corp.		600	Plan.	12	83
	Greek #3	Public Power Corp.		750	Plan.	12	84
Hong-Kong	Hong-Kong #1			500	Plan.	12	79
	Hong-Kong #2			500	Plan.	12	81
Hungary	Paks #1	MVMT	PWR	440	Plan.	6	81
	Paks #2	MVMT	PWR	440	Plan.	6	81
India	Tarapur #1	Ind. Dept. At. Energy	BWR	200	Oper.	4	69
	Tarapur #2	Ind. Dept. At. Energy	BWR	200	Oper.	4	69
	Rapp #1	Ind. Dept. At. Energy	HWR	200	Oper.	1	73
	Rapp #2	Ind. Dept. At. Energy	HWR	200	Ord.	1	75
	Kalpakkam #1	Ind. Dept. At. Energy	HWR	200	Ord.	3	74
	Kalpakkam #2	Ind. Dept. At. Energy	HWR	200	Ord.	3	77
	Narora #1	Ind. Dept. At. Energy	HWR	200	Ann.	1	80
	Narora #2	Ind. Dept. At. Energy	HWR	200	Ann.	1	81
	Indian #9	Ind. Dept. At. Energy		500	Plan.	1	79
	Indian #10	Ind. Dept. At. Energy		500	Plan.	1	80
	FBR Prototype	Ind. Dept. At. Energy	FBR	500	Plan.	1	81
Iran	Iran #1			400	Plan.	6	81
Ireland	Irish #1			500	Plan.	1	79
	Irish #2			250	Plan.	12	80
	Irish #3			250	Plan.	12	82
Israel	Israel #1			400	Plan.	7	80
Italy	SENN		BWR	150	Oper.	1	64
	SELNI		PWR	247	Oper.	11	64
	Latina		GCR	200	Oper.	1	64
	Caorso		BWR	800	Ord.	4	75
	Enel-5		PWR	1000	Ord.	6	78
	Enel-6		LWR	800	Ord.	12	78
	Enel-7		LWR	1000	Plan.	12	80
	Sicily-1		LWR	700	Plan.	4	82
Jamaica	Jamaica #1			200	Plan.	12	80
	Jamaica #2			200	Plan.		80
Japan	Tokai-Mura	JAPCO	GCR	157	Oper.	6	67
	Tsuruga	JAPCO	BWR	340	Oper.	3	70
	Fukushima #1	TEPCO	BWR	460	Oper.	3	71
	Mihama #1	KEPCO	PWR	320	Oper.	11	70
	Mihama #2	KEPCO	PWR	470	Oper.	7	72
	Fukushima #2	TEPCO	BWR	784	Oper.	10	73
	Shimane #1	CEPCO	BWR	439	Ord.	11	73
	Mihama #3	KEPCO	PWR	781	Ord.	8	76
	Fukushima #3	TEPCO	BWR	760	Ord.	12	74
	Fukushima #4	TEPCO	BWR	760	Ord.	8	76
	Fukushima #5	TEPCO	BWR	760	Ord.	12	75
	Fukushima #6	TEPCO	BWR	1100	Ord.	3	77
	Takahama #1	KEPCO	PWR	781	Ord.	7	74
	Takahama #2	KEPCO	PWR	781	Ord.	5	75
	Shimane #2	CEPCO	BWR	750	Ord.	5	80
	Shimane #3	CEPCO	BWR	750	Ord.	5	82
	Shimane #4	CEPCO	BWR	1000	Plan.	7	83

Table D1

FOREIGN CENTRAL STATION NUCLEAR POWER REACTORS OPERATING,
ORDERED, ANNOUNCED AND PLANNED—Continued

Country	Plant Name	Utility	Reactor Type	Net Power, MWe	Status	Scheduled for Commercial Operation	
						Mo.	CY
Japan	Hamaoka #1	Chubu EPCO	BWR	500	Ord.	11	74
	Hamaoka #2	Chubu EPCO	BWR	850	Ord.	6	77
	Hamaoka #3	Chubu EPCO	BWR	750	Plan.		80
	Genkai #1	Kyushu EPCO	PWR	529	Ord.	2	75
	Genkai #2	Kyushu EPCO	PWR	529	Ord.	2	78
	Genkai #3	Kyushu EPCO	LWR	826	Plan.	2	80
	Genkai #4	Kyushu EPCO	LWR	826	Plan.	7	82
	Genkai #5	Kyushu EPCO	LWR	826	Plan.	12	83
	Onagawa #1	Tohoku EPCO	BWR	500	Ord.	3	77
	Onagawa #2	Tohoku EPCO	BWR	750	Ord.	12	79
	Onagawa #3	Tohoku EPCO	BWR	750	Ann.	12	82
	Hamaoka #4	Chubu EPCO	BWR	1100	Plan.	1	79
	Hamaoka #5	Chubu EPCO	HTG	1100	Plan.		80
	Hamaoka #6	Chubu EPCO	BWR	1500	Ord.	12	81
	Hamaoka #7	Chubu EPCO	BWR	1500	Ord.	12	82
	Hamaoka #8	Chubu EPCO	BWR	1500	Ord.		84
	Hokuriku #1 (Shiga)	Hokuriku EPCO	PWR	500	Ord.	12	77
	Hokuriku #2	Hokuriku EPCO	PWR	800	Plan.	8	79
	Hokuriku #3	Hokuriku EPCO	PWR	800	Plan.		83
	Ohi #1	KEPCO	PWR	1122	Ord.	4	77
	Ohi #2	KEPCO	PWR	1122	Ord.	8	77
	Ikate #2	Shikoku EPCO	PWR	559	Ord.	4	77
	Ikate #2	Shikoku EPCO	PWR	566	Ord.	7	79
	N-1 (Tokyo #7)	TEPCO	BWR	1100	Ord.	1	78
	N	Hokkaido EPCO	BWR	327	Ord.	11	77
	N-3 (Tokyo #8)	TEPCO	BWR	1100	Ord.	3	78
	ATR (Fugen)	Chubu EPCO	HTG	200	Ord.	3	75
	N-2 (Tokyo #9)	TEPCO	BWR	1100	Plan.	1	79
	N-4 (Tokyo #10)	TEPCO	BWR	1100	Plan.	7	79
	N-5 (Tokyo #11)	TEPCO	BWR	1100	Plan.	10	80
	N-6 (Tokyo #12)	TEPCO	BWR	1100	Plan.	7	81
	N-8 (Tokyo #13)	TEPCO	BWR	1100	Plan.	1	82
	N-9 (Tokyo #15)	TEPCO	BWR	1500	Plan.	6	82
	N-10 (Tokyo #14)	TEPCO	BWR	1100	Plan.	8	82
	N-11 (Tokyo #16)	TEPCO	BWR	1500	Plan.	7	83
	N-12 (Tokyo #17)	TEPCO	BWR	1500	Plan.	8	83
	N-13 (Tokyo #18)	TEPCO	BWR	1500	Plan.	7	84
	N-14 (Tokyo #19)	TEPCO	BWR	1500	Plan.	8	84
	Kansai-U	KEPCO	PWR	1200	Plan.	7	77
	Kansai-V	KEPCO	PWR	1200	Plan.	1	79
	X1 (Kansai #10)	KEPCO	PWR	1200	Plan.	1	78
	X2 (Kansai #11)	KEPCO	PWR	1200	Plan.	7	79
	X3 (Kansai #12)	KEPCO	PWR	1200	Plan.	1	80
	X4 (Kansai #13)	KEPCO	PWR	1200	Plan.	1	81
	X5 (Kansai #14)	KEPCO	PWR	1200	Plan.	7	81
	X6 (Kansai #15)	KEPCO	PWR	1200	Plan.	1	82
	X7 (Kansai #16)	KEPCO	PWR	1200	Plan.	1	83
	X8 (Kansai #17)	KEPCO	PWR	1500	Plan.	7	83
	Kansai #18	KEPCO	PWR	1500	Plan.	1	84
	Kansai #19	KEPCO	PWR	1500	Plan.	1	85
	Kansai #20	KEPCO	PWR	1500	Plan.	7	85
	FBR Proto (Monju)		FBR	300	Plan.	6	79
	Takai-Mura #2	JAPCO	BWR	1100	Ord.	8	77

Table D1

FOREIGN CENTRAL STATION NUCLEAR POWER REACTORS OPERATING,
ORDERED, ANNOUNCED AND PLANNED—Continued

Country	Plant Name	Utility	Reactor Type	Net Power, MWe	Status	Scheduled for Commercial Operation	
						Mo.	CY
South Korea	Tonganae #1	KECO	PWR	564	Ord.	12	75
	Tonganae #2	KECO	PWR	564	Plan.	12	79
	Rok #3	KECO	LWR	600	Plan.	12	79
Luxemburg	Lux #1		PWR	1100	Plan.		
Mexico	Laguna Verde #1	FURNAS	BWR	800	Ord.	12	77
	Laguna Verde #2	FURNAS	LWR	800	Ord.	12	78
	Sonora Project #1			1100	Plan.	12	79
	Sonora Project #2			1100	Plan.	12	80
Netherlands	Dodewaard		BWR	55	Oper.		60
	Borselle	PZEM	PWR	450	Oper.	7	73
	Dutch #2	GKN	LWR	600	Plan.	6	78
	Dutch #3	GKN	LWR	1000	Plan.	6	80
New Zealand	New Zealand #1			420	Plan.	12	82
	New Zealand #2			420	Plan.	12	84
Norway	Skiens Fjord	Norsk Hydro	LWR	600	Plan.	12	79
	Oslo Fjord	NVE Statakraftwerkene		800	Plan.		81
Pakistan	Kanupp	PAEC	HWR	125	Oper.	1	69
	PAEC #1	PAEC		400	Plan.		
	PAEC #2	PAEC		500	Plan.		79
Philippine	Philippine #1	Manila Electric		600	Ord.	6	80
	Philippine #2	Manila Electric		600	Plan.	6	81
Poland	Poland #1			1000	Plan.	12	80
Portugal	Portugal #1			500	Plan.	12	79
Romania	Romanian #1		PWR	440	Ord.	12	78
	Romanian #2		PWR	440	Plan.	12	78
Singapore	Singapore #1			500	Plan.	12	80
South Africa	Koeberg A	ESCOM	LWR	500	Plan.	9	81
	Safr #2	ESCOM		600	Plan.	12	82
	Safr #3	ESCOM		800	Plan.	12	83
Spain	Zorita #1	UEM	PWR	153	Oper.	8	69
	Sta. Maria De Garona	Nuclenor	BWR	460	Oper.	5	71
	Vandellos	Hifrenze	GCR	487	Oper.	12	72
	Zorita #2	UEM	LWR	500	Plan.	2	80
	Lemoniz #1	IBUERCO	PWR	902	Ord.	4	77
	Lemoniz #2	IBUERCO	PWR	902	Ord.	6	78
	Almaraz #1	Hidroelec Espanola	PWR	902	Ord.	4	77
	Almaraz #2	Hidroelec Espanola	PWR	902	Ord.	2	78
	Cofrentes	Hidroelec Espanola		930	Ann.		70
	Cataluna #1	FESCA	PWR	902	Ord.	9	77
	Cataluna #2	FESCA	PWR	902	Plan.	12	78
	Trillo #1	UEM		1200	Plan.	12	81
	Trillo #2	UEM		1200	Plan.	12	85
	Electra Del Viesgo #1	Electra Del Viesgo		900	Ord.	12	80
Sweden	Oskarshamn #1	OKG	BWR	440	Oper.	8	71
	Oskarshamn #2	OKG	BWR	580	Ord.	8	74
	Oskarshamn #3	OKG		900	Plan.	6	80
	Ringhals #1	Sw. State Power Bd.	BWR	760	Ord.	4	74

Table D1

FOREIGN CENTRAL STATION NUCLEAR POWER REACTORS OPERATING,
ORDERED, ANNOUNCED AND PLANNED—Continued

Country	Plant Name	Utility	Reactor Type	Net Power, MWe	Status	Scheduled for Commercial Operation	
						Mo.	CY
Sweden	Ringhals #2	Sw. State Power Bd.	PWR	809	Ord.	11	74
	Ringhals #3	Sw. State Power Bd.	PWR	900	Ord.	12	77
	Ringhals #4	Sw. State Power Bd.	PWR	900	Ord.	7	79
	Barseback #1	Syosvenska Kraft	BWR	580	Ord.	7	75
	Barseback #2	Syosvenska Kraft	BWR	900	Ord.	7	77
	Vastra Frolunda		LWR	750	Plan.	12	80
	Hisingen		LWR	750	Plan.	12	80
	Gauli #1	Krangede AB	LWR	500	Plan.	12	80
	Gauli #2	Krangede AB	LWR	500	Plan.	12	82
	Gauli #3	Krangede AB	LWR	500	Plan.	12	84
	Gauli #4	Krangede AB	LWR	500	Plan.	12	87
	Forsmark #1	Sw. State Power Bd.	BWR	900	Ord.	7	78
	Forsmark #2	Sw. State Power Bd.	BWR	900	Ann.	7	80
	Forsmark #3	Sw. State Power Bd.		800	Plan.		
	Forsmark #4	Sw. State Power Bd.		800	Plan.		
	Swede Hetr				Plan.		
Switzerland	Beznau #1	NOK	PWR	350	Oper.	12	69
	Beznau #2	NOK	PWR	350	Oper.	3	72
	Muhleberg	BKW	BWR	306	Oper.	10	72
	Leibstadt		BWR	875	Ord.	12	77
	Kaiseraugst	ENK	BWR	850	Ord.	6	79
	Gosgen	Consortium	PWR	920	Ord.	12	78
	Garben #1	PC of Canton & Bern	LWR	880	Plan.	12	80
	Graben #2	PC of Canton & Bern	LWR	880	Plan.	12	81
	Ruethi #1	NOK		650	Ann.		
	Verbois			900	Plan.	12	80
Taiwan	Chinshan #1	Taiwan Power	BWR	604	Ord.	9	77
	Chinshan #2	Taiwan Power	BWR	604	Ord.	9	78
	Chinshan #3	Taiwan Power	BWR	900	Ord.	12	78
	Chinshan #4	Taiwan Power	BWR	800	Ord.	4	80
	Northern 2 #1	Taiwan Power	BWR	900	Ord.		78
	Northern 2 #2	Taiwan Power	BWR	900	Ord.		79
Thailand	Phai Bay	EGAT		500	Plan.	12	80
Turkey	Turk #1		HWR	325	Plan.		
United Kingdom	Calder Hall #1	UKAEA	GCR	50	Oper.	9	56
	Calder Hall #2	UKAEA	GCR	50	Oper.	9	56
	Calder Hall #3	UKAEA	GCR	50	Oper.	9	56
	Calder Hall #4	UKAEA	GCR	50	Oper.	9	56
	Chapel Cross #1	UKAEA	GCR	50	Oper.	11	58
	Chapel Cross #2	UKAEA	GCR	50	Oper.	11	58
	Chapel Cross #3	UKAEA	GCR	50	Oper.	11	58
	Chapel Cross #4	UKAEA	GCR	50	Oper.	11	58
	Berkeley #1	CEGB	GCR	138	Oper.	6	62
	Berkeley #2	CEGB	GCR	138	Oper.	6	62
	Bradwell #1	CEGB	GCR	150	Oper.	7	62
	Bradwell #2	CEGB	GCR	150	Oper.	7	62
	Hunterston A #1	SSEB	GCR	160	Oper.	5	64
	Hunterson A #2	SSEB	GCR	160	Oper.	6	64
	Trawsfynydd #1	CEGB	GCR	250	Oper.	3	65
	Trawsfynydd #2	CEGB	GCR	250	Oper.	3	65
	Hinkley Point A #1	CEGB	GCR	250	Oper.	3	65
	Hinkley Point A #2	CEGB	GCR	250	Oper.	3	65
	Dungeness A #1	CEGB	GCR	275	Oper.	10	65
	Dungeness A #2	CEGB	GCR	275	Oper.	10	65

Table D1

FOREIGN CENTRAL STATION NUCLEAR POWER REACTORS OPERATING,
ORDERED, ANNOUNCED AND PLANNED—Continued

Country	Plant Name	Utility	Reactor Type	Net Power, MWe	Status	Scheduled for Commercial	
						Mo.	CY
United Kingdom	Sizewell A #1	CEGB	GCR	290	Oper.	3	66
	Sizewell A #2	CEGB	GCR	290	Oper.	3	66
	Oldbury #1	CEGB	GCR	300	Oper.	12	67
	Oldbury #2	CEGB	GCR	300	Oper.	4	68
	Winfreth	UKAEA	HWR	94	Oper.	2	68
	Wylfa #1	CEGB	GCR	590	Oper.	1	71
	Wylfa #2	CEGB	GCR	590	Oper.	8	71
	Windscale	UKAEA	AGR	35	Oper.	2	63
	PFR	UKAEA	FBR	254	Oper.	10	73
	Hinkley Point B #1	CEGB	AGR	625	Ord.	9	73
	Hinkley Point B #2	CEGB	AGR	625	Ord.	12	73
	Hunterston B #1	SSEB	AGR	625	Ord.	12	73
	Hunterston B #2	SSEB	AGR	625	Ord.	12	73
	Dungeness B #1	CEGB	AGR	625	Ord.	12	74
	Dungeness B #2	CEGB	AGR	625	Ord.	12	74
	Hartlepool #1	CEGB	AGR	625	Ord.	12	74
	Hartlepool #2	CEGB	AGR	625	Ord.	12	75
	Sizewell B #1	CEGB		660	Ann.		77
	Sizewell B #2	CEGB		660	Ann.		77
	Sizewell B #3	CEGB		660	Ann.		77
	Sizewell B #4	CEGB		660	Ann.		77
	Heysham #1	CEGB	AGR	625	Ord.	12	75
	Heysham #2	CEGB	AGR	625	Ord.	12	76
	Oldbury B	CEGB	HTG	650	Ann.		
	Portskewett #1	CEGB		625	Ann.		
	Portskewett #2	CEGB		625	Ann.		
	Stake Ness	NSHEB		1220	Plan.	12	79
	CFR	CEGB	FBR	1300	Plan.	10	79
USSR	Troitsk		LGR	600	Oper.	12	58
	Beloyarsk #1		LGR	94	Oper.	12	64
	Beloyarsk #2		LGR	200	Oper.	12	67
	Novo-Voronezh #1		PWR	210	Oper.	12	64
	Novo-Voronezh #2		PWR	375	Oper.	12	69
	Novo-Voronezh #3		PWR	440	Oper.	12	72
	Bor-60		FBR	12	Oper.	12	69
	BN-350		FBR	350	Oper.	7	73
	VK-50		BWR	70	Oper.	1	66
	Novo-Voronezh #4		PWR	410	Oper.	12	73
	Novo-Voronezh #5		PWR	1000	Ord.	12	75
	Lenin #1		LGR	1000	Ord.	12	73
	Lenin #2		LGR	1000	Ord.	12	74
	Kola #1		PWR	440	Ord.	12	75
	Kola #2		PWR	440	Ord.	12	75
	Smolensk #1		LWGR	1000	Ord.	3	77
	Smolensk #2			1000	Ord.		
	Koursk #1		LGR	1000	Ord.	12	75
	Koursk #2		LGR	1000	Ord.	7	77
	Tchernobylsk #1		GMR	1000	Ord.	8	78
	Tchernobylsk #2		GMR	1000	Ann.		
	Bilibino		LWGR	150	Ord.	5	77
	Oktemberyan #1		PWR	410	Ord.	12	75
	Oktemberyan #2		PWR	410	Ord.	12	75
	BN-600		FBR	600	Ord.	6	74
Yugoslavia	Videmkrsko	Electro Priureda	LWR	600	Plan.	12	78
	Prevlako			800	Plan.	12	80