The original documents are located in Box 9, folder: "Strategic Petroleum Reserve – Plan (3)" of the Frank Zarb Papers at the Gerald R. Ford Presidential Library.

APPENDIX A

ANALYSIS RELATED TO RESERVE SIZE

ESTIMATES OF IMPORT LEVELS

Two import levels for 1980 and 1985 have been estimated to provide a range of assumptions for the Reserve size analysis. These import levels are referred to as 1980 "low", 1980 "high", 1985 "low", and 1985 "high". They are presented in Table A-1 below with corresponding domestic supply and demand estimates.

Table A-1

1980 AND 1985 IMPORT PROJECTIONS, PLANNING ESTIMATES
(MMB/D)

Scenario	Demand	Supply	Imports
1980 "Low"	18.7	12.3	6.4
1980 "High"	19.8	12.3	7.5
1985 "Low"	20.2	12.9	7.3
1985 "High"	22.2	11.8	10.4

The assumptions used for deriving these planning estimates are stated below:

1980 "High" Planning Estimates

The 1980 Project Independence Evaluation System (PIES) reference solutions were the starting basis for these estimates. The following adjustments were made;

- o A $.52 per MCF real natural gas price is assumed;

- o No effective conservation is considered beyond that due to price effects;
- o Oil price controls are effective through 1980, allowing a maximum three percent annual real price increase;
- o Outer Continental Shelf (OCS) leasing is 500,000 acres per sale;
- o A low finding rate for oil is assumed;
- o Reductions in OCS production caused by reduced lease sales and lower Alaskan production (due to limited pumping capability) are taken directly from the PIES oil and gas supply schedules; and
- o Demand is adjusted upward by 0.4 MMB/D to make the gasoline consumption forecast consistent with current data.

1985 "High" Planning Estimates

The 1985 "High" planning case estimates were also derived from the PIES reference solution. The following adjustments were made to achieve the pessimistic solution for 1985:

- o Oil consumption is increased by 2.2 MMB/D and production is decreased by 0.6 MMB/D under the assumption that there is no deregulation of natural gas;
- o A lower production rate for the Naval Petroleum Reserve decreases supply by 0.1 MMB/D;
- o The assumption of a slower OCS leasing schedule reduces supply by 0.4 MMB/D;
- o Demand is increased by 0.5 MMB/D, while production is reduced by 1.6 MMB/D based on the assumption that domestic price control regulations are extended past 1979;
- o It is assumed that synthetic fuels will not augment

production levels, reducing supply by 0.3 MMB/D; and

- o Demand is decreased by 1.2 MMB/D. This is due to EPCA provisions which provide for low institutional constraints on nuclear construction; uncertainty concerning future coal production; and less than full effectiveness of conservation programs.

1980 "Low" Planning Estimates

Both demand and supply estimates are reduced by 1.1 MMB/D for the 1980 optimistic planning estimates. This is achieved by adjusting the "high" planning estimates as follows:

- o Conservation measures are employed more effectively to reduce demand by 0.7 MMB/D; and
- o The demand adjustment factor for gasoline consumption (+0.4 MMB/D) is not used in this case.

1985 "Low" Planning Estimates

The optimistic planning case estimates for 1985 are derived from the PIES reference solution as follows:

- o Less than full effectiveness of conservation programs is assumed, reducing demand by only 0.5 MMB/D;
- o Synthetic fuels will not be available for consumption, so production is reduced by 0.3 MMB/D;
- o Only partial extension of domestic price controls is assumed, decreasing supply by 0.4 MMB/D; and
- o Low finding rates for oil are assumed, limiting production by 0.8 MMB/D.

COST-BENEFIT ANALYSIS

An FEA cost-benefit study was undertaken to estimate the relative net benefits for various Reserve sizes, based on alternative assumptions regarding the severity of petroleum supply interruptions.

Net benefits are defined in this study as the difference between GNP levels after a petroleum supply interruption without a Reserve and with a Reserve.

The period studied spans the 15 years from 1976 to 1990. The Reserve is assumed to be filled at a linear rate, with 500 million barrels in storage at the end of 1982.

Reserve sizes studied range from 150 million to one billion barrels. Shortfalls range from 180 million barrels to 1.25 billion barrels, or from one to approximately seven million barrels per day, based on an interruption of 180 days.

DETERMINISTIC ANALYSIS

Methodology

A discounted benefit-cost methodology was employed to determine values of various Reserve sizes. Future costs and benefits were calculated in billions of constant 1976 dollars.

Gross National Product (GNP) was chosen as an estimator of the economic loss generated by an interruption of oil supplies for the following reasons:

- Ease of understanding and acceptance;
- Ability to compare with other results and projections;
- Ability to analyze components of the GNP; and
- Relative independence from price effects.

An alternative measure of economic loss, consumer surplus loss (CSL), was rejected for the following reasons:

- Requirement for a short-term price elasticity of crude oil demand;
- Need to artificially increase petroleum prices beyond credible extrapolation levels to simulate moderate shortfalls; and

- Controversy over measurement and validity.

The loss in GNP was estimated by using a modification of an input-output model developed at the Center for Naval Analysis (CNA). The GNP-loss function derived from this model has the following form:

$$\text{Percent of GNP Loss} = A\left(\frac{X-S}{D}\right)^2$$

where A= a constant, 170, derived from regression analysis based on the 1973-74 embargo;
X= average daily shortfall before Reserve use;
S= average daily Reserve drawdown; and
D= pre-interruption demand for petroleum (crude and products).

This function has the following important characteristics:

- Losses caused by even moderate shortfalls are far greater than costs of the Reserve, (as shown in the Figures below);

- Percent GNP-loss increases with increasing shortfall depth; and

- The marginal value of the Reserve decreases as total size of the Reserve increases.

It is assumed that only one interruption will occur in the 15-year study period. To control for uncertainty regarding the date of an interruption, the following adjustments were made:

For each Reserve size analyzed, a specified interruption was independently repeated for all even-numbered years (1978 to 1990). These results were weighted equally and averaged to estimate the characteristic benefit-cost behavior of each Reserve size and interruption scenario.

Annual costs through 1990, incorporating site acquisition, construction, operating, maintenance, planning, and personnel expenses, were estimated for each Reserve size. Capital opportunity costs for oil were also included and assumed to be 10 percent per year in constant dollars, in accordance with

Federal investment guidelines contained in OMB Circular A-94 (Revised).

The cost of oil, including transportation, was assumed to be $13 a barrel. Net benefits of various Reserve sizes were compared on the basis of an exponential drawdown rate. This strategy meets net shortfall levels by drawing down no more than one percent of the preceding day's remaining reserves (with a maximum of 3.3 MMB/D). After an interruption, the stockpile is replenished at the highest achievable rate. It is also assumed that the level and rate of acquisition of petroleum and facilities will not result in price increases in oil storage facilities or world oil prices.

Results

Reserve sizes analyzed range from 150 million to 1 billion barrels, but results are presented only for sizes of 275, 500, and 800 million barrels.

Results of the analysis indicate that no single Reserve size can minimize the damage of all potential interruptions in a cost-effective manner.

Small Reserve sizes (275 MMB and less) are cost-effective for all levels of interruption, but can reduce only a fraction of GNP losses for severe interruptions.

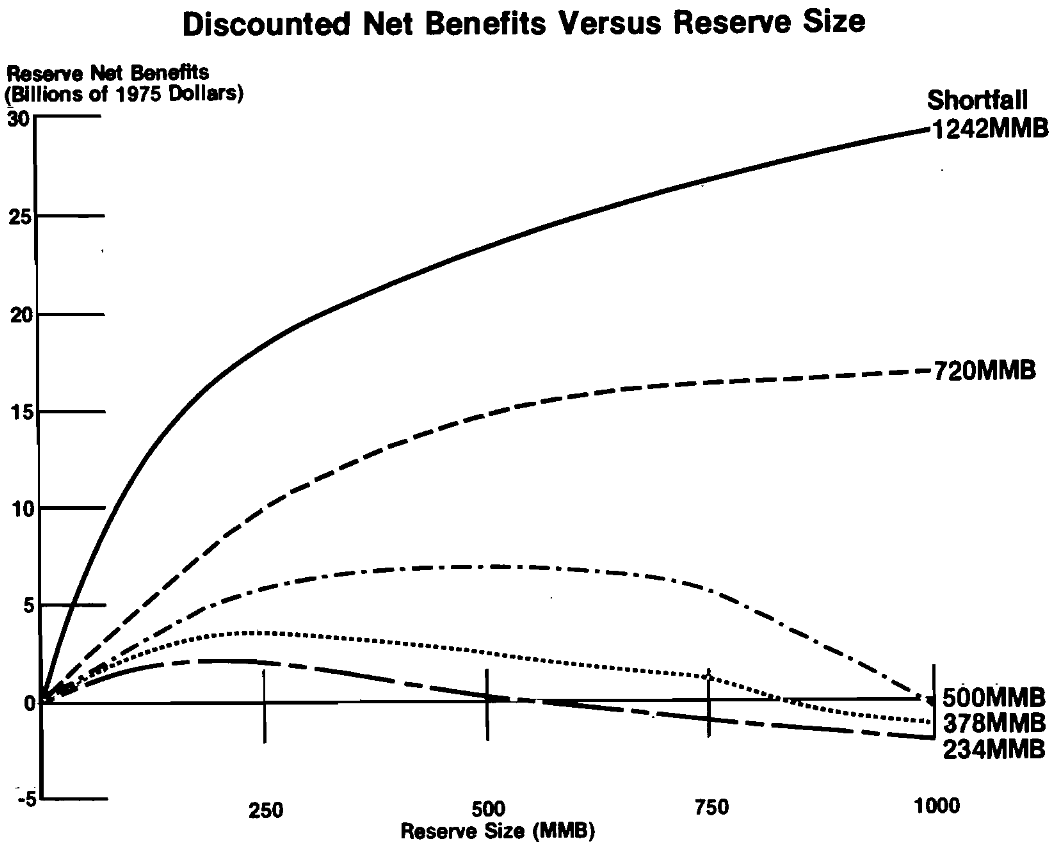
Large Reserves (800 MMB and greater) can minimize the impacts for both mild and severe shortfalls, but are only marginally cost-effective for mild interruptions. Large reserves can even exhibit negative benefits when faced with very small interruptions as shown in Figure A-1. This is because only a fraction of the available Reserves is used.

Medium Reserve sizes (greater than 275 MMB, but less than 800 MMB) are cost effective in meeting both small and large shortfalls, but still allow large remaining GNP losses when facing large interruptions. Therefore, they do appear to be slightly more cost-effective in dealing with a wider range of disruptions.

These findings are supported by Figure A-1 below.

Figure A-1 plots Reserve net benefits against Reserve size

Figure A-1



for five possible interruption depths ranging from 234 MMB to 1242 MMB.

GNP losses remaining after the reserve has been drawn down are shown in Figure A-2.

The present value of net benefits is shown in Table A-2 for three shortfall levels and three Reserve sizes.

Figure A-2

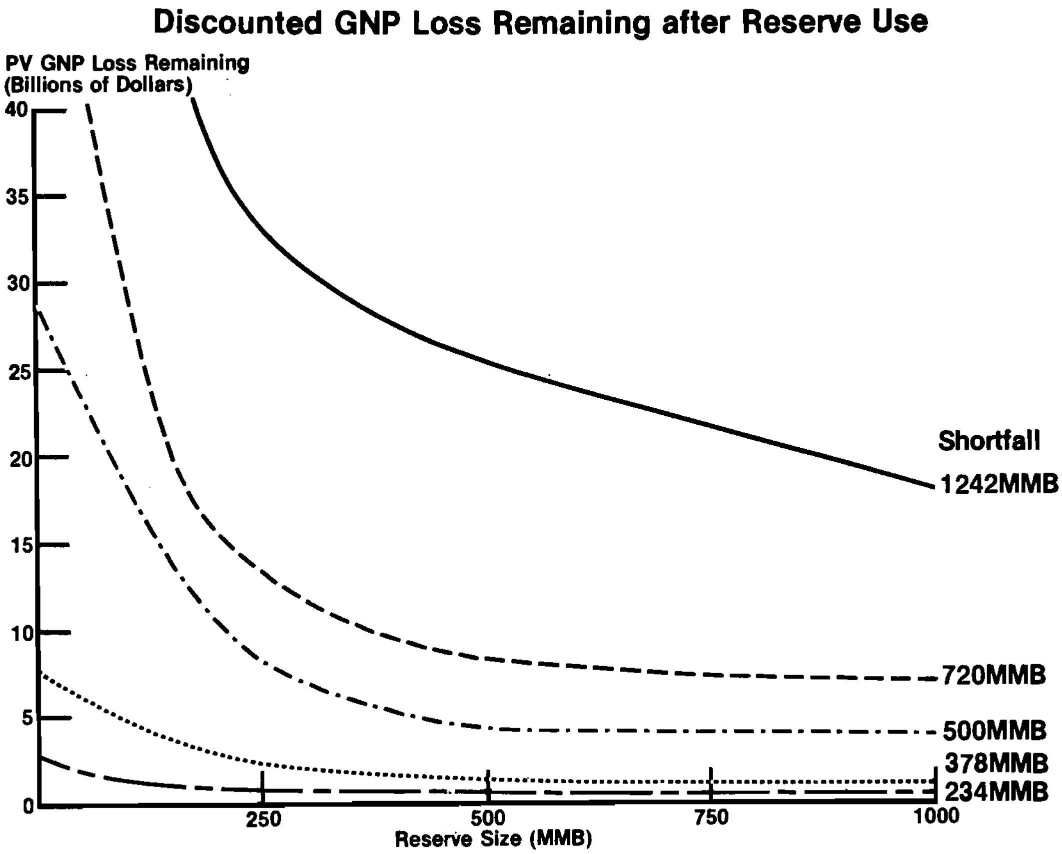


Table A-2

PRESENT VALUE NET BENEFITS
(dollars in billions)

Reserve Size MMB	Shortfall, MMB 375	500	750
275	+3.3	+7.6	+12.0
500	+2.5	+6.8	+14.6
800	+1.2	+5.7	+16.8

PROBABILITY ANALYSIS OF COST-BENEFIT RESULTS

The assumption that exactly one interruption will occur in the study period may overestimate or underestimate the benefits of the Reserve. A binomial probability distribution was employed to reflect the possibility of a number of interruptions occurring.

The probability of an interruption in a single year was assumed to be one, three, five, or ten percent, and the binomial distribution was used to derive the average expected number of interruptions over the 15-year period for each probability. The results of these calculations range from zero to four interruptions for the study period.

The binomial probability distribution was used because of its computational simplicity. It may not accurately represent the probability of various interruption scenarios.

The results can be summarized as follows:

- Most Reserve sizes remain cost-beneficial except when faced with very small shortfalls;

- For low annual probabilities of an interruption (between one and three percent), the net benefits of the Reserve remain roughly the same as in the deterministic analysis; and

- For moderate annual probabilities of a disruption (between three and seven percent), the increased probability of multiple disruptions over the study period increases the net benefits of larger Reserve sizes.

Table A-3 indicates the net benefits, weighted by probability of occurrence, for a series of possible interruptions ranging from 250 MMB to 1250 MMB.

Table A-4 summarizes the annual independent probabilities necessary for Reserve sizes of 275, 500, and 800 MMB to "break even" when faced with various interruption sizes. The "breakeven" probability is defined as that annual interruption probability which causes net benefits for a certain Reserve to be zero. Higher annual probabilities will result in positive net benefits for a given Reserve size.

Table A-3

NET BENEFITS, BY RESERVE SIZE
(dollars in billions)

Percent Probability of Occurrence in One Year	275 MMB	500 MMB	800 MMB
	Interruption = 250 MMB		
1	-2.7	-3.8	-5.0
3	-0.4	-1.3	-2.5
5	0.0	-0.7	-1.9
10	+2.3	+0.6	+0.4
	Interruption = 375 MMB		
1	-2.5	-3.5	-4.7
3	+1.0	+0.2	-1.7
5	+1.8	+1.1	-1.0
10	+5.0	+4.5	+3.3
	Interruption = 500 MMB		
1	-1.8	-2.8	-4.0
3	+4.1	+3.2	+2.1
5	+5.5	+4.6	+3.5
10	+11.0	+10.1	+9.0
	Interruption = 750 MMB		
1	-1.0	-1.6	-2.5
3	+7.5	+8.5	+9.1
5	+9.5	+10.9	+11.7
10	+17.3	+20.1	+22.1
	Interruption = 1250 MMB		
1	-0.1	-0.4	-0.9
3	+11.7	+14.2	+16.1
5	+14.2	+17.6	+20.0
10	+25.0	+31.0	+35.3

Table A-4

BREAKEVEN PROBABILITIES
(Percentages)

Potential Interruption (MMB)	Reserve Size (MMB)		
	275	500	800
275	1.8%	2.7%	5.5%
500	1.3%	1.8%	2.3%
800	1.2%	1.5%	2.0%

FACTORS EXCLUDED FROM THE ANALYSIS

Several factors were not included in the cost-benefit study because of quantification difficulties. It is assumed that these factors would affect the net benefits of all Reserve sizes approximately the same. Therefore, their omission should introduce no significant biases in the comparisons among sizes. They may bias the overall results, however.

Factors that tend to underestimate the net benefits of the Reserve

- The analysis considered only GNP loss incurred during the nominal duration of the shortfall. Long-run effects of a supply interruption were not included. It is assumed that these losses would be proportionate to those incurred during the interruption; and

- To reflect the uncertainty of the interruption duration, an exponential drawdown rate was used for all analyses. This rate limits the scheduled drawdown and mandates that only a fraction of the Reserve be used during a six-month interruption. Consequently, large Reserves were not credited with the full benefits they might provide if a linear or constant withdrawal rate were employed.

Factors that tend to overestimate the net benefits of the Reserve

- Demand reductions which would reduce GNP, may occur during an interruption with or without a Reserve. For example, concern about availability of gasoline may reduce automobile sales and tourist travel. These may have accounted for much of the GNP losses in 1973-4. The main impact of a supply interruption may occur because consumers and businesses reduce spending in the face of an uncertain future.

APPENDIX B

SELECTING TYPES OF CRUDE OIL FOR STORAGE

The analytical methodology employed in determining the types and proportion of each type of crude oil to be stored in the Reserve, as discussed in Chapter III, is presented below.

The primary approach employed eleven refinery Linear Programming models aggregated by 13 BOM refining areas, and considered 50 individual crudes and a wide variety of interruption scenarios to assure flexibility of response. This technical approach will be used continuously to support the acquisition strategy for SPR crude purchases and site configuration design.

Crude Assays

Initial efforts were to accumulate crude assays for major crude oil sources which could be candidates for SPR fill. This resulted in consideration of about 50 individual crude sources. Data were developed on qualities, yields, 1974 production, 1974 U.S. supply, and estimated 1980 U.S. supply for the individual crude oils. The quality and yield data were then used to arrive at several crude segregations of similar yields and qualities. Based on the properties of the crude oil and U.S. refining capabilities, about half of the individual crudes representing 80% of the 1974 production of the crudes considered were assigned to the six segregations with prime potential. (See Table B-1.) Each segregation was simulated by a single crude assay selected to represent the poorest yields and qualities of all crudes in that group. The remaining half were deemed less desirable for storage due to FEA limits on viscosity or pour point, or due to their particular yield and quality. These were not considered further.

Determination of Crude Segregations

Ranges were established for each important quality and yield for each crude segregation. A density range of five degrees API was chosen. Narrow sulfur ranges were established to separate the low- (sweet) and high-sulfur (sour) crudes. The target pour point limit of 30 degrees F. was met for all crude types except Types IV and V; in these cases, the limit was raised to 40 degrees F. The target viscosity limit specified of 100 SSU at 60 degrees F. maximum was met for all crude types except Type VI (Alaskan Prudhoe Bay), which requires a maximum viscosity limit of 180 SSU at 60 degrees F. The crudes were also segregated into low- and high-mercaptan types based on the mercaptan content of the jet fuel cut (375-500 degrees F.) If jet fuel contains more than 12 ppm mercaptans, it must be treated due to an unacceptable odor. This criterion was included because some refineries which produce jet fuel do not have facilities to treat high-mercaptan stocks and hence could not maintain product specifications using a high-mercaptan crude. Metals in the residual were also included. None of the crudes recommended for storage have a high metal content residual. Each crude type was designed to avoid mixing paraffinic and naphthenic reformer feed and jet fuel to avoid product downgrading.

The crude oils were also grouped by their yields of naphtha, distillate, gas oil and residual. Narrow yield ranges were required for each crude type to avoid downgrading by mixing crudes with other crudes of significantly poorer yield structure. The range of naphtha yield was restricted to six percent maximum. A maximum yield range of five percent was selected for residual. Distillate and gas oil yields are less critical because distillate can be processed in the catalytic cracking unit in place of gas oil. Maximum ranges of 12 percent were set for both distillate and gas oil.

Crude Prices

Current market prices of the selected foreign crudes were estimated based on public and private data. Shipping costs to the Gulf Coast were estimated based on current tanker rates. This resulted in a total cost, CIF, based on the U.S. Gulf Coast. U.S. crudes were priced equivalent to major foreign crudes of similar quality.

1980 Normal Forecast

In parallel with the crude oil groupings and pricing determinations, a forecast was developed of the U.S. 1980 "normal situation" with respect to the petroleum industry. This required forecasting product demands, imports, domestic raw material availability, raw material imports, U.S. refining capacity, and the capacity of major crude oil and petroleum product transportation modes. These data were developed for each of the eleven U.S. regional areas, as well as Puerto Rico and the Virgin Islands. The resulting 1980 normal cases

Table B-1

GROUPINGS OF SELECTED CRUDES INTO CRUDE TYPES

QUALITIES, YIELDS, AND RATES

		Qualities							Yields (Vol. %)				Rates (MB/CD)		
Group	Type	Gravity °API	Sulfur WT%	Pour Points °F	Viscosity SSU@60 °F	Mercaptans 375-500 °F+ PPM	Metals in Resid PPM	Crude Type	Naphtha 375 °F-	Distillate 375-620 °F	Gas Oil 20-1050 °F	Resid 1050 °F+	1974 Production	1974 U.S. Supply	Estimated 1980 U.S. Supply
I.	Intermediate-High Sulfur (32-36° API)														
	Criteria	32-36	1.0-1.9	_30	≤100	None	None	Asphaltic	26-31	22-26	32-34	12-17	11,004	2,016	3,090
II.	Very Light-Low Fulfur, Low Mercaptan (41-45° API)														
	Criteria	41-45	≤0.3	≤30	≤100	∠12	None	Paraffinic	38-44	26-30	24-32	3-8	1,212	486	810
III.	Intermediate-Low Sulfur, Low Mercaptan (29-34° API)														
	Criteria	29-34	≤0.5	≤30	≤100	∠12	None	Naphthenic	21-27	30-32	33-37	8-13	3,088	2,053	1,890
IV.	Light-Low Sulfur, Low Mercaptan (34-37° API)														
	Criteria	34-37	≤.03	≤40[b]	≤100	∠12	None	Naphthenic	31-33	32-44	23-32	0-5	1,794	1,312	1,400
V.	Very Light-Low Sulfur, High Mercp. (40-43° API)														
	Criteria	40-43	≤.05	≤40[b]	≤100	∠12	None	Intermediate	32-35	26-32	27-31	8-10	1,529	721	1,148
VI.	Intermediate-Intermediate Sulfur (27-29° API)														
	Criteria	27-29	≤1.0	≤30	≤180°	∠12	None		20-22	23.24	37-39		0	0	1,600
												Total	18,627	6,588	9,930

represent the best estimate of industry operation prior to initiation of an interruption.

The 1980 product demands were allocated to the appropriate refining districts assuming that each district experienced the same rate of growth in demand for each product over 1974 base levels.

Interruption Scenarios

In addition to the interruption case considered in Chapter III, a number of petroleum supply interruption scenarios were examined to assure flexibility of response. (See Table B-2.) Losses of crude oil by type and volume were estimated for each case. These crude oil volumes were subtracted from the forecast 1980 supply for the appropriate refining areas, and replaced with trial proportions of Type I sour and other sweet type crude oils. Summation of the optimum volumes for each geographic region resulted in the specification of candidate mixes for the SPR.

Table B-2

Interruption Scenarios Considered
For Crude Mix Implications

Scenario	Size (MMB/D)	Duration (DAYS)	Drawdown (MMB/D)
A	3.9	180	3.3
B	1.6	180	1.05
C	1.9	90	1.35
D	0.68	90	0.37
E	7.9	180	5.3
F	3.0	180	3.3

Crude Oil Availability

Table B-1 also shows 1974 production, 1974 U.S. supply, and estimated 1980 U.S. supply. Each crude segregation was designed to include at least 800 MB/D available United States 1980 supply to ensure availability of each crude type. Some individual crudes with small-volume potential were included within each type for flexibility. Twenty-three major crudes were selected as candidates for storage, including thirteen foreign crudes and ten domestic. These crudes comprise twothirds of the estimated 1980 United States supply and about 40 percent of 1974 free world production.

Many other crudes were not selected as candidates for storage for several reasons, including high residual yield, high pour point, high viscosity, unique yields, low supply, and inaccessible locations. The crudes not selected comprise about one-third of the estimated United States 1980 supply.

Refinery Capacity

Estimated refinery capacity in 1980 for use in Chapter III was derived from FEA's list of new refinery projects plus assumed expediting of all existing capacity at the rate of two percent per year. The crude processing capacity in the U.S. and its territories is thus forecast to increase from 14.9 MMB/D on January 1, 1975, to 18.6 MMB/D by January 1, 1980. Most refinery expansions since January 1, 1975, are oriented toward production of a high yield of low sulfur residual fuel and a low yield of gasoline. Recent expansions and those forecast for the future primarily include crude, vacuum, desulfurization and reforming units. The desulfurization unit expansions consist of naphtha, distillate and gas oil units with only a small amount of direct residual desulfurization capacity. It was also assumed that the industry would be able to add sufficient pentane/hexane isomerization and low pressure reforming capacity to meet a gasoline pool lead limit of 0.5 gm/gal in 1980. Over 80 percent of the additional capacity above the January 1, 1975, level was forecast to be located on the Gulf, West and the East Coasts, in line with announced locations of new projects.

U.S. and territories capacity utilization is thus forecast to increase from 86.3 percent in 1974 to 88.7 percent in 1980. Capacity utilization in each of the refining districts was based upon historic rates except for new projects which were used at 80 percent of capacity during the first two years of operation. Capacity utilization varied from 79 percent to 95 percent in the various districts. Petroleum supply and demand balances along with domestic refinery production are summarized in Table B-3.

Table B-3

1980 U.S. SUPPLY AND DEMAND[4/]
NORMAL SITUATION
(MB/CD)

	Oils Supply				Oils Demand[1/]		
	Production	Imports	Inventory & Loss	Domestic Refinery Production	Domestic Refinery Raw Materials[2/]	Exports	Domestic Demand for Products
Crude Oil							
Domestic	10,789		(27)		10,759	3	-
Foreign	-	6,000	(279)		5,721	-	-
Total Crude Oil	10,789	6,000	(306)		16,480	3	
Products							
Gas Plant & Unfinished							
Plant Condensate	42	89	-		115	-	16
Natural Gasoline	320	-	-		320	-	-
Other-Naphtha	36	-	-		36	-	-
Unfinished Naphtha & Gas Oil	-	88	-		88	-	-
Plant Ethane	310	-	-		-	-	310
Plant Propane	506	172	-		11	15	652
Plant I Butane	110	47	-		88	5	64
Plant N Butane	187	74	-		96	7	158
Total Plant & Unfinished	1,511	470	-		754	27	1,200
Refinery Finished							
Motor Gasoline		76	-	7,465		1	7,540
Aviation Gasoline		-	-	36		-	36
Naphtha to Petrochemicals		-	-	64		2	62
Special Naphtha & Misc.		5	-	177		8	174
Aromatics		-	-	143		-	143
Jet B - Naphtha Type		8	-	170		-	178
Jet A - Kerosene Type		129	-	795		-	924
Kerosene		-	-	134		-	134
Distillate Fuel Oil		77	-	3,774		1	3.850
Lubes		1	-	218		33	186
Waxes		-	-	24		2	22
Gas Oil to Petrochemicals		5	-	135		13	127
Carbon Black Feedstock		-	-	50		-	50
Residual Fuel Oil		698	-	2,452		15	3,135
Road Oil		-	-	20		-	20
Asphalt		31	-	505		1	535
Coke - Marketable		-	-	185		103	82
Coke - Catalyst		-	-	173		-	173
Still Gas/Ethane		-	-	727		-	727
Liquified Refinery Gases		-	-	502		-	502
Total Refinery Finished		1,030		17,749		179	18,600
Total Products	1,511	1,500	-	17,749	754	206	19,800[3/]

1/ Total demand equals total supply for each crude and product.

2/ Domestic refinery raw materials total 16,413 MB/CD which is equal to domestic refinery production less processing gain of 515 MB/CD.

3/ Demand in Puerto Rico and the Virgin Islands is 340 MB/CD which is included in this total.

4/ Includes U.S. territories: Puerto Rico, Virgin Islands, Guam, and Hawaii.

Crude Oil Allocation - Preinterruption

Refinery raw material and production allocations for the 1980 normal environment were developed. They were based on actual 1974 raw material processing and production in each district, plus processing additions for 1980.

The forecast of product grades is based upon exclusive requirements for unleaded gasoline for 1975 and later automobiles, and an increase in demand for low sulfur residual fuel oil. The unleaded portion of the motor gasoline pool is expected to increase from five percent in 1974 to 58 percent in 1980. The low sulfur residual fuel oil (0.5 percent sulfur maximum) portion of the total residual fuel oil demand is expected to increase by 12 percent from 1974 to 1980. The high sulfur bunker fuel grade portion is expected to decrease by seven percent.

Crude Oil Distribution

The 1980 domestic crude allocation to each refining area was based on 1974 historical data. The primary change in 1980 domestic crude supply is the addition of 1,600 MB/D of Alaskan Prudhoe Bay crude; 1,180 MB/D of this crude would remain on the West Coast and 420 MB/D would be distributed to Districts 2/3/4, 5, 6, 7/11 and 12. This supply pattern could result from several alternative transportation modes:

- Completion of the proposed Sohio pipeline (from Los Angeles to West Texas) and one of the proposed Northern Tier pipelines (from the West Coast to Northern Tier refineries).
- Completion of the proposed Sohio pipeline and expansion of pipelines from West Texas to Midwestern and Northern Tier refineries.
- Tanker delivery of Alaskan crude to the Gulf Coast with expansion of pipelines from the Gulf Coast to the Midwest and the Northern Tier.

Alaskan crude runs to inland Districts 5, 7/11 and 12 were set by the additional crude requirements. The remaining volume was distributed between 2/3/4 and 6.

An initial allocation of imported crude processing was made based upon:

- o Each district's ability to process sour imported crude.
- o Actual 1971 through 1975 imports into each district.
- o Minimum transportation cost.

These initial allocations were modified slightly to arrive at final allocations based upon crude selections by refinery model runs in the four areas (1, 2/3/4, 8 and 9) which process over 80 percent of imported crude oil. Estimated 1980 crude oil processing for Puerto Rico and the Virgin Islands and other Caribbean refineries were also considered. This estimate was developed by extrapolating 1974 and 1975 actual import data using available reserves and estimated 1980 production rates.

Crude and Product Transportation

A supply and demand balance for each refining area for both crude oil and petroleum products was derived. Flows of crude oil and petroleum products through the transportation system for the 1980 normal case were established. It was generally assumed that transportation facilities would be developed to enable industry to achieve the logistical patterns consistent with the base case requirements. This included the following specific assumptions: (1) pipeline capacity would be installed to move a total of 420 MB/D of Alaskan Prudhoe Bay crude oil from the West Coast to inland U.S. refining areas; (2) increased pipeline capacity would be installed between the Gulf Coast and major refining centers in Districts 2/3/4; (3) petroleum products pipelines between the Gulf Coast and the East Coast would be expanded by approximately 400 MB/D; (4) sufficient U.S. flag ships would be available to transport 1.6 MMB/D of Prudhoe Bay crude from Alaska to West Coast ports; (5) sufficient U.S. flag tankers would be available to handle the required product movements from the Gulf Coast to the East Coast.

Embargo Response - Normal Yields

The volume of crude oil supplied to each of the refining centers from interrupted sources was deleted from the available raw material supply. This involved BOM Refining Districts 1, 2/3/4, 8 and 9. Puerto Rico and the Virgin Islands were also affected. Each region was then allowed to choose the optimum amount of Type I and several sweet crude types at current CIF prices. The refinery LP models for the BOM Refining Districts mentioned above were utilized to select the least costly combination of crude types which could be processed in the available refining capacity to produce the same product yields as were produced in the normal 1980 scenario. The optimum proportion of crude types for Puerto Rico and the Virgin Islands was calculated separately.

Embargo Response - Reduced Gasoline Yield

In order to assess the effect of product yield slates on the optimum proportion of crude type, the required product output from each of the refining districts was varied such that distillate yield was increased by 22 percent, residual yield was increased by 34 percent, and gasoline production decreased by about 21 percent. A change in yield pattern of this type might occur if demand for gasoline were severely decreased through a rationing program. The optimum proportions of crude types were then redetermined for this new product demand pattern. The ratios of sour to sweet crudes desired for storage increased from approximately 2:1 to 10:1 when gasoline production was decreased.

Environmental restrictions on product qualities were included throughout this effort. The sulfur content of residual fuel oils was not allowed to increase during an embargo in order to permit use of higher proportions of the Type I intermediate, high-sulfur crude oils.

APPENDIX C

FACILITY REQUIREMENTS FOR PETROLEUM

STORAGE IN LEACHED AND CONVENTIONALLY MINED CAVERNS

This Appendix discusses the types of facilities which are common to leached cavern and conventional mine storage complexes. It also identifies those facilities specifically required for each form of underground storage. Table C-1 lists the major storage types and related facilities required for operation.

COMMON FACILITIES

Many of the ancillary facilities required for the storage of crude oil in underground caverns is common to the development of both leached caverns and conventionally mined caverns. Both will require oil distribution facilities including pipelines, pumps, surge tanks, barge docks, tanker docks and metering equipment. Security facilities will be similar for both types of caverns. A discussion of the facilities common to both types of oil storage follows.

For most storage sites, pipelines will be required to connect the storage caverns to existing or proposed marine terminals. In some instances, nearby refineries or crude pipelines servicing the Midwest will be supplied directly from the storage site. The number and capacity of pumps used for filling the storage cavern are determined by the rate of oil flow required during fill and the length and diameter of the supply pipeline. Similarly, the size of oil withdrawal pumps is a function of oil flow rate during withdrawal and the size of the distribution pipeline. In most site development, the same pipe will be used during fill and withdrawal and the volume and number of surge tanks required is dependent upon the design surge period, e.g., two days, and capacity of marine facilities. Tankage is required to accommodate varying oil flow rates among segments of the distribution system, to accommodate instances where two different types of crude are stored, and as short term backup for the cavern system on an emergency basis (to provide ship offloading capability at times when the caverns cannot receive oil). Where technically feasible and economical, direct oil injection at tanker

Table C-1

SUMMARY OF MAJOR FACILITIES

Solution Caverns in Salt Domes	Conventionally Mines Caverns in Salt and Limestone
Barge Docks	Barge Docks
Tanker Docks*	Tanker Docks*
Holding tanks	Holding tanks
Ballast treating**	Ballast treating**
Oil pipeline	Oil pipeline (Fill)
Oil pumps (fill & withdrawal)	Oil pumps
Metering equipment	Metering equipment
Water supply pipeline	Mine shaft
Water supply pumps	Submerged pumps (withdrawal)
Cavern wells	Electrical substation
Brine pipeline	Security and monitoring facility
Brine injection wells*	
Brine injection pumps	
Electrical substation	
Security and monitoring facility	

*Not required for all options.

**May not be required.

discharge rates, into the storage caverns is anticipated to minimize the amount of surge tankage required.

The oil storage program will employ existing barge and tanker dock facilities when available. The need to build new docks for the program is affected by the following:

- The amount of excess capacity for fill and withdrawal available at the existing docking facilities;
- Willingness of the current owners and operators of the facilities to allow FEA to negotiate for the use of the excess capacity;
- Required oil fill and withdrawal rates; and
- Availability of alternative means to fill and withdraw oil, e.g., pipelines, local refineries.

It is possible that ballast water facilities may not be required for each tanker dock location. The basis for this is that the docks would be used only during states of emergency, i.e., a national oil embargo; and treatment requirements for the relatively small quantities of ballast could conceivably be waived or the ballast retained aboard the tanker.

A metering or other flow measurement system at the terminal will be required to measure the quantities of oil loaded or unloaded from tankers at the point of custody transfer. Security measures for the facilities are standard for petroleum storage facilities. The main storage site will be fenced and appropriately lighted; all wellheads will have pneumatic gate valves on brine and crude lines to allow for remote control; these controls and all electrical equipment will be housed in a security building. Also, all pipelines will be equipped with pressure switches for monitoring flow and visually inspected for early detection of leaks. The facility will maintain standard fire prevention systems and warning devices.

LEACHED CAVERNS

The procedure that is required to prepare an existing leached cavern in salt for oil storage is less complex, and therefore, faster than leaching and converting new caverns in a salt dome. Consequently, only existing or previously leached caverns were considered for the ESR. The expansion of sites with existing caverns is a viable method to obtain part or all of the volume needed for the SPR.

Only after environmental and other regulatory approvals have been obtained and the rights to the dome have been purchased, can conversion of an existing dome take place. Prior to conversion, the existing wells and caverns must be tested for structural integrity. Existing leached-well casings and wellheads can be used for oil injection and withdrawal if they are in satisfactory condition; if damaged beyond repair, the wells must be plugged and abandoned. Further, if the diameter of the casing is too small, additional wells must be drilled to achieve desired design withdrawal rates. Once the wells are in place, the wellheads are connected to the onsite equipment such as pumps, pipelines, metering equipment and holding tanks.

Each cavern well has a casing cemented to the walls and a displacement string suspended within the cased hole. For fill, the oil is pumped into the section between the casing and displacement string (annulus) and displaces the brine (salt saturated water) in the bottom of the cavern up through the inside of the displacement pipe to the surface where it is connected to a brine disposal system.

This brine can either be delivered to a petrochemical plant for use as feedstock or disposed of by one of two disposal methods considered for the program: deep well injection into existing subsurface saline reservoirs (sandstone or limestone); or through a pipeline to a large body of water such as the Gulf of Mexico. Both methods are costly and raise some environmental concerns during storage cavern leaching, fill and withdrawal, which must be considered. Because of the high cost of a brine disposal well ($400,000 - $700,000), the number of injection wells needed have been minimized by the addition of brine pits or holding tanks to level out the flow rates required. For example, this procedure will allow the caverns to receive oil at tanker unloading rates, while brine is being disposed of at the average fill rate. During the time when ships are not being unloaded, i.e., tie up time, weather delays etc., this system will continue to dispose of brine.

The facilities required for brine disposal are dependent on the method used. If the brine is supplied to a nearby petrochemical company, then pumps and a pipeline to the plant's facilities are sufficient. (Additional raw water supply systems may be required to provide "suitable" brine feedstock to the petrochemical plant). Disposal via well injection involves the drilling of wells 5000 to 9000 feet deep. This method is relatively costly; each well is estimated to cost between $400,000 and $700,000. Additionally, the number of injection wells required is a function of the average oil fill rate since this rate and the brine disposal rate are equal (i.e., displacement activity). The third method, sea disposal, requires a pipeline that extends from the site to a point approximately 5 miles off the shoreline. The exact point of discharge will be determined by the circulation patterns of the sea in the areas being considered for disposal.

For withdrawal, raw (fresh, brackish or salt) water is pumped into the inner pipe which displaces crude oil back through the annulus of the casing. The raw water intake structure, pumps and piping must be designed to inject water into the cavern at a rate equal to the desired oil withdrawal rate. During the leaching operations for a new solution cavern, fresh, brackish or salt water can be used to dissolve the salt. Depending on the salinity of the water supply, water sources and facilities will be required to be able to inject and dispose of water volumes 7 to 8 times that of the volume of new space created.

It is planned that in the development of new leached space, oil will be stored in the cavern concurrent with the leaching operation. This process then involves a three-way flow of fluids as follows: raw water is pumped into the salt to create new space; brine is discharged; and oil is injected at the rate of new storage cavern development, at about one-seventh the raw water and brine flow rates.

The electrical power requirements are higher for leached caverns than conventional mines mainly due to the need to pump large volumes of water and brine. For existing leached caverns in salt, the water requirement to empty the oil from the cavern is equal to the volume of oil in the cavern. To develop a new cavern (leach new storage space), the amount of water needed is 7 times the storage space desired (8 times if sea water is used). In both instances, the volumes of water pumped are large and require much power, e.g., leaching of 100 million barrels of space costs $15 million for electrical power at current rates. Preliminary estimates indicate that internal power generation facilities are not cost effective compared to purchased electricity.

MINED CAVERNS

The process of mine conversion involves removing the old production and service shaft equipment, preparing the mine floor by excavating a sump and grading the floor, conducting necessary bulkheading and roof bolting, and installing casings for oil fill and withdrawal in one of the existing shafts or in a new shaft developed specifically for that purpose.

If there are current operations in a mine planned for oil storage, then provisions must be made to relocate the present mine operations to another site. This generally requires the sinking of new production and service shafts, initial mine development, and installation of underground and aboveground materials handling equipment. Because of this, the costs involved in acquiring an operating mine may be relatively high.

The electrical power requirements are somewhat lower than operations for similar volume solution caverns because there is no need to pump large volumes of brine or raw water.

Distribution facilities will be similar to leached cavern oil distribution facilities. The oil withdrawal system will consist of submersible pumps at the end of casings in the shafts. These pumps suck the oil out of the mine.

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APPENDIX E

ECONOMIC IMPACTS OF ESTABLISHING THE SPR

An overview of the economic impacts of establishing the Strategic Petroleum Reserve was presented in Chapter X. This appendix supplements Chapter X by explaining the underlying methodology and providing more complete results.

The analysis finds that developing the SPR will increase domestic production of the necessary supplies and equipment without perceptibly affecting prices. Acquiring the oil at the national average price is likely to increase domestic petroleum product prices until crude oil price controls expire in May 1979. The SPR is unlikely to affect petroleum prices in the world market, nor is it likely to affect competition in the domestic petroleum industry.

ASSUMPTIONS

Since final decisions remain to be made regarding many key issues affecting SPR implementation, nominal fill and construction schedules were prepared so that the economic impact assessment would be representative of the expected development process.

Size

The impact analysis is based on a 500 million barrel reserve consistent with the discussion of the size issue contained in Chapter II.

Schedule

Construction is assumed to begin in April 1977 with initial fill occurring during the third quarter of 1977. The fill schedule is consistent with the EPCA requirements and provides for 150 million barrels in storage by December 1978 and 500 million barrels in storage by December 1982.

Fill

The oil price estimates developed for this analysis were based on an assumed crude oil import price of $13.40 per barrel in 1976. This may be compared with the least cost crude slates in Chapter III comprised of Type I (intermediate, sour) and Type II (light, sweet) crudes whose import prices are in the range of $13.12 to $13.25 per barrel. The estimated cost of fill to the government assumes that the oil is purchased at the national average price, through the entitlements program. The cost of fill for the SPR reflects current estimates of the proportions of domestic and imported crude contained in the National Average.

Facilities

As described in Chapter X, the overall construction schedule was based on the time phased construction of a number of converted salt domes, newly leached salt domes, and mines currently under evaluation. The development costs of converted salt domes and mines were estimated at $1.50 per barrel ($1.00 per barrel for facility construction and $0.50 per barrel for land acquisition). The costs of newly leached salt domes were estimated at $1.64 per barrel ($1.54 per barrel for facility construction and $0.10 per barrel for land acquisition). Based on the assumed mix of facilities making up the Reserve, a nominal schedule of SPR equipment and material requirements was prepared. Similarly, nominal manpower requirements were also estimated. These schedules were developed from construction feasibility studies and environmental impact assessments of candidate sites.

ADMINISTRATION

Estimates of government expenditures for administering the development of the SPR (both government personnel and contractor studies) were prepared and included in the composite cost estimates and subsequent impact analysis.

MICROECONOMIC IMPACTS OF DEVELOPING THE SPR

This section focuses on the potential adverse impacts of developing the SPR on: the availability and prices of supplies and equipment, and any effects of their acquisition on domestic production; and any adverse effects on employment and wage levels. If industries are operating at close to full capacity or full employment, SPR requirements could increase competition and bid up prices or wage rates. On the other hand, where resources are readily available, the SPR requirements will induce increased output and employment without noticeably affecting prices or wage rates. The maximum annual cost is estimated to be incurred in calendar year 1977, reflecting the impact of land acquisition for several sites in addition to that year's cost of engineering, equipment and supplies. The costs exclusive of oil acquisition are under $320 million (1976 dollars) in every year. This is a small amount in relation to annual oil field expenditures, which would suggest that significant adverse impacts of the SPR are unlikely.[1] Specific equipment and materials requirements, including energy requirements are examined below. Results indicate that SPR demands are likely to be small relative to sectoral industrial capacity and expected demand, and should not significantly impact on prices and materials availability.

Manpower requirements for construction, fill, operations, and maintenance are also analyzed. Results indicate that some skilled manpower may be diverted from other employment and wage rates may be increased. On the other hand, unemployment of semiskilled and unskilled workers in SPR site localities will be reduced.

Impacts of Equipment and Materials Requirements

SPR development will require significant quantities of drilling rigs, steel plate, oil field tubular goods, steel pipe

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[1] U.S. domestic capital expenditures for petroleum production in 1974 were estimated at $11.5 billion. Domestic capital exploration and development expenditures in 1974 were estimated at $12.4 billion (Source: The Chase Manhattan Bank, American Petroleum Institute, Basic Petroleum Data Book (April 1976), Section V, Tables 8 and 9.

and electric power transformers. Two other major requirements are electric power and tankers. The quantities and availability of these items will be reviewed individually.

Drilling Rigs

Drilling activity was intense and drilling rigs were in short supply during the period 1974-1975. Lead times for small drilling rigs increased from 4 to 12 months. These lead times have been reduced to 3 to 10 months in 1976.[1] Only small rigs will be required for the SPR.

Table E-1

DRILLING RIGS AVAILABILITY

	1976	1977	1978	1979	1980	1981
New Additions*	245	** 275	300	325	350	375
Less Exports***	98	110	120	130	140	150
Net Additions	147	165	180	195	210	225
SPR Requirements	0	4	10	1	0	0
SPR Percentage of Net Additions	0	2.4	5.6	.5	0	0

*Project Independence Report, "Availabilities, Requirements, and Constraints on Materials, Equipment, and Construction," p. V-L-5.

**Oil and Gas Journal estimate, January 19, 1976, p.25.

***Calculated as 40 percent of production.

Recent Hughes rig counts have estimated that 1,766 rigs

[1] Oil and Gas Journal, January 19, 1976, pp.24-25

are currently operating in the United States.[1] This compares to a count of 1,793 active rigs in December 1975[2], the maximum in recent years. Given the expected net additions to the stock of workable rigs in 1976, some surplus throughout 1976-1977 can be anticipated.

Table E-1 lists annual estimates of net additions of rigs, which are projected to increase at a rate of 6.3 percent per year during the period 1976-1981, and SPR requirements during the same period. The maximum number of rigs required for the SPR in any one period is ten rigs in 1978. This represents only 5.6 percent of the net additions in that year. The SPR requirement in terms of the total stock of workable rigs is much smaller. Projections by FEA of drilling activity during 1976-1980 show constrained availability of rigs if all oil prices are decontrolled and if the price of imported oil should rise to $16 per barrel (1976 dollars), but only moderate growth in demand if oil remains priced near $13 per barrel.[3] However, even if rigs were in short supply, the SPR requirement is so small in relation to total availability that its impact must be considered negligible.

Steel Plate

Projections of production, production capacity and SPR requirements for steel plate are shown in Table E-2. This segment of the steel market has been depressed by the recent recession. Projected total U.S. production is less than eight million tons in 1976 and will require less than 60 percent of mill capacity to satisfy. While demand for steel plate could increase during later years of the SPR construction period, the maximum SPR requirement, 12.9 thousand tons, is needed in 1977, when mills are still likely to be operating at well below capacity. Therefore, the SPR should not affect prices or availability during 1977. Later requirements are too small to have any discernible impact on prices or availability.

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[1] Oil and Gas Journal, October 4, 1976: Hughes rig count as of September 27, 1976.

[2] Oil and Gas Journal, May 31, 1976, pp. 15-18.

[3] 1976 National Energy Outlook, pp. 75-77.

Table E-2

STEEL PLATE
(thousands of tons)

	1976	1977	1978	1979	1980	1981
Production	6361[1]	NA	NA	NA	NA	NA
Projected Capacity[2]	12,300	12,800	13,200	13,600	14,000	14,300
SPR Requirements	0	12.9	1.7	0	0	0
SPR Percentage of Domestic Capacity	0	0.1%	0.01%	0	0	0

[1] Based on Department of Commerce production estimates for first 7 months.

[2] American Iron and Steel Institute Annual Statistical Report, 1973; AISI Form AIS 10. Data for years 1976, 1978, 1979 and 1981 are linear projections.

Oil Field Tubular Goods

Demand for oil field tubular goods has remained high throughout 1976. However, supplies have been available because of excess inventories in the petroleum industry and an overall slack demand for other steel products.[1] Projections of production capacity and SPR requirements are shown in Table E-3. While utilization could increase if the economic recovery is sustained, SPR's requirements as a percent of total capacity are too small to have any noticeable impact on prices or availability.

Table E-3

OIL FIELD TUBULAR GOODS
(thousands of tons)

	1977	1978	1979	1980	1981
Domestic Capacity	2600	2833	3066	3300	3633
SPR Requirements	10.5	2.1	0	0	0
SPR Percentage of Domestic Capacity	0.41%	0.08%	0	0	0

Source: National Petroleum Council, Case 1, Energy Outlook estimates for 1980 and 1985. Estimate for 1977 is assumed equal to 1976 capacity estimate as given in Oil Daily, November 10, 1975. Estimates for 1978, 1979, and 1981 are linear interpolations. Capacity estimates are adjusted for imports, exports, and reuse.

Steel Pipe

SPR requirements (converted to short tons) are shown

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[1] Oil Daily, September 30, 1976.

with projections of industry capacity in Table E-4. About 75 percent of the SPR requirement will be acquired in 1977. This amount represents only 0.4 percent of capacity and should have no discernible impact on prices or availability.

Table E-4

STEEL PIPE
(thousands of tons)

	1977	1978	1979	1980	1981
Capacity	2900	2933	2966	3000	3060
SPR Requirements	37.1	11.2	0	0	0
SPR Percentage to Capacity	1.28%	0.38%	0	0	0

Source: American Iron and Steel Institute Annual Statistical Report, 1973; AISA Form AIS 10, "Industry and Data Projections."

Transformers

Major transformers required on a typical site would all fall within the 500 to 10,000 KVa range. Table E-5 forecasts production and availability of this class of transformers. Availability is ample to meet the SPR requirements and no adverse market impact is expected.

Tankers

Tanker capacity should be more than adequate during the period of fill. Figure E-1 shows that idle tanker capacity has risen steadily throughout 1975 and remains high in 1976. As mentioned in Chapter X, this condition is likely to persist until 1982. The development of the SPR could have a positive impact on the U.S. shipping industry by virtue of the Cargo Preference Act which requires up to 50 percent of the fill be transported by United States-flag commercial vessels to the extent that such vessels are available at fair and

Table E-5

TRANSFORMER AVAILABILITY (IN UNITS)
(500 to 10,000 KVa range)

	1977	1978	1979	1980	1981
Production*	40,000	43,000	46,000	50,000	54,000
SPR Requirements	19	32	0	0	0
SPR Percentage of Production	0.05%	0.07%	0	0	0

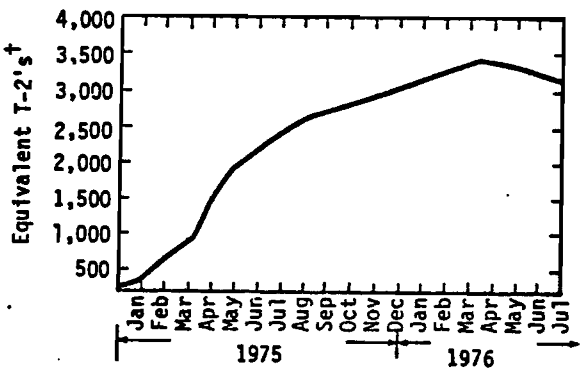
* Calculated at 85 percent industrial capacity. The figures for years 1978, 1979 and 1981 are linear projections.

Source: Bureau of Domestic Commerce, Department of Commerce.

reasonable rates. The detailed impacts of this provision have not been examined to date.

Figure E-1

IDLE TANKERS AND COMBOS*



*Vessels larger than 6,000 dwt idle for more than 6 weeks.

†T-2 = 16,000 dwt.

Source: Oil and Gas Journal, September 13, 1976, pp. 35-37.

Electric Power

SPR operations may require up to 60 megawatts of electric power during periods of maximum fill rate. Half of the ESR candidate sites, as well as about half of the candidate undeveloped salt domes, are located in Louisiana. Therefore, for purposes of analyzing electric power needs, it was assumed that the SPR would have its greatest impact in Louisiana.

Table E-6 shows the projected generating capacity for the Gulf States Utilities Company which serves most of Southern Louisiana. The table indicates that the utility should have ample capacity to meet an SPR demand of 60 megawatts and still maintain its reserve requirements at or near 15 percent.

Table E-6

GULF STATES UTILITIES COMPANY POWER CAPABILITY
(All Values in Megawatts)

Year	Generating Capacity	Load Responsibility*	Reserve	Percent
1977	6,119	5,005	1114	22.3
1978	6,650	5,616	1034	18.4
1979	7,190	6,141	1049	17.1
1980	7,730	6,713	1017	15.1
1981	8,493	7,337	1156	15.8
1982	9,423	8,016	1407	17.5
1983	10,363	8,757	1606	18.3
1984	11,050	9,565	1485	15.5
1985	11,990	10,445	1545	14.8

* Indicates the quantity of electrical output that Gulf States is expected to provide, including electrical output which must be provided to other utilities under prenegotiated agreements.

Source: Final Environmental Statement Related to Construction of River Bend Nuclear Power Station Units 1 and 2, Gulf States Utilities Company, Docket Nos. 50-458 and 50-459, September 1974.

IMPACTS OF MANPOWER REQUIREMENTS

Manpower requirements include skilled equipment operators, craftsmen such as welders and pipefitters, and technicians to install instrumentation and control equipment. Mine conversion will require a somewhat higher proportion of unskilled workers than salt dome development or conversion.

Total manpower requirements during the period of construction are estimated to vary between 150 and 1050 workers. Several skilled categories required may be in short supply, including welders, machinists, electricians, and pipefitters. Thus, the SPR may divert skilled manpower from other employment. This number is too small to be significant, however.

The SPR will increase employment in semi-skilled and unskilled categories. It is also likely to have favorable indirect effects on employment in the vicinity of the storage sites. The increased consumer demand for goods and services from the newly employed personnel will increase employment in other occupations.

IMPACT OF OIL ACQUISITION ON WORLD AND DOMESTIC PETROLEUM PRICES

Acquisition of petroleum for the SPR is unlikely to influence world oil prices, but may result in a slight increase in crude oil prices to domestic refiners and in prices of products they produce. The domestic price effects are due to the system of price controls on U.S. crude oil and products and the methods by which SPR oil is likely to be acquired.

Effect on World Prices

The effect of the SPR on world prices will depend on how the world market operates during the period of oil acquisition. It has been assumed here that the OPEC cartel will continue to control the world market through 1982. There are basically two alternative ways in which the OPEC cartel can operate. Each is discussed below.

OPEC Sets Price

Each OPEC member's production is automatically determined by the established price--given the consuming countries' demand schedules and certain price differentials to reflect differences in crude types and transportation costs. In practice there seems to be no evidence of any attempt by OPEC to employ other than a price-setting policy, although one country or another may voluntarily decide to restrict its production to a certain percentage of its capacity.

The maximum SPR requirement for oil in a 12-month period is expected to be less than 200 million barrels in the latter half of 1978 and the first half of 1979. This is about one percent of current world production and would require an increase of about 1.8 percent in OPEC's production rate. OPEC's shut-in capacity is currently 21 percent of its production and its total production capacity is increasing.[1] The SPR's average annual requirement of about 115 million barrels of oil during the 1978-1981 period is only one percent of OPEC's current annual production. It is impossible to say with complete confidence whether or not OPEC would increase its prices in response to such a small increment in demand, and if so, by how much. It seems reasonable, however, to asume that under an OPEC price-setting policy, SPR fill requirements could be satisfied by additional purchases at the OPEC price.

OPEC Sets Production Quotas

If OPEC were to change from a price-setting procedure to a production quota system, the increase in world demand caused by acquisition of oil for the SPR could slightly affect the world price. The price elasticity of world demand

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[1] FEA, Monthly Energy Review, September 1976, page 88: World and OPEC crude oil production rates in June 1976 were 56.9 and 30.2 million barrels per day, respectively.

is uncertain, but is generally believed to be quite low.[1] Assuming a value of -.108[2], and totally inelastic supply, the effect of the additional demand for the SPR would be to raise the world oil price by 4.2 percent, on average, during the period of fill (about $0.57 per barrel or 1.4 cents per gallon in terms of current world prices). This is considered to be highly unlikely.

Effect on Domestic Prices

Oil for the SPR will cost the U.S. economy the import price, whether or not imported oil is actually stored. If domestically produced oil were used, it would have to be replaced by additional imports. If the government pays the import price, then there will be no effect on domestic oil and product prices. However, the FEA is planning to use the entitlements program to acquire oil for the SPR at the national average price. Acquiring oil through the Entitlements Program would slightly increase the national average price, because the proportion of imported crude included in this average is increased by the SPR requirement. Based on the assumed crude oil import price of $13.40, the price effect of this purchase strategy was calculated. The price increase per barrel of crude consumed in the U.S. (imported and domestic) will average $0.05 during 1978 and $0.07 during the first five months of 1979, at which time price controls are scheduled to lapse. At this point, domestic crude prices are expected to rise to the level of the import price.

MACROECONOMIC IMPACTS

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[1]See, for example, Edward R. Fried and Charles L. Schultze (Editors), Higher Oil Prices in the World Economy, Brookings Institute (1975), "Overview" (by the editors), pp. 45-46.

[2]In the Data Resources Review, September 1975, pp. I.109-I.113, Philip Verleger, et al., estimate that an OPEC price increase of 35 percent in the price of crude oil would reduce the demand for oil by OECD countries by 3.68 percent during the first full year following the price change. This implies an average OECD price elasticity of demand for crude oil of .105 in the short run. OECD demand amounts to 67 percent of total world demand.

The preceding sections have estimated the possibility of minor effects on the price and availability of certain goods and services and on wage rates and the availability of certain labor categories. However, the program will also have indirect effects in the region of the storage facilities and throughout the economy. For example, because of the labor required to produce the various goods and services necessary for constructing storage facilities, the total increase in employment is greater than the additional labor required on-site. Furthermore, the increased employment leads to increased consumer spending which induces additional production and employment. On the other hand, government's financing of the SPR could reduce consumption and employment throughout the economy. For example, if income taxes were increased to finance the SPR, consumers' disposable income would be decreased, consumers' demand for goods and services would decrease, and production and employment would decrease.

This section estimates the indirect effects of the SPR on employment and GNP. The effects of construction expenditures, oil importation, and the method of financing are considered separately. Each estimate is obtained by applying GNP and employment multipliers. The GNP multipliers are derived from two extensive series of simulations of the economy's response to government actions using the Wharton quarterly forecasting model.[1 2] The employment multipliers are derived from a series of simulations using the Thurow model combined with the BLS interindustry input-output table.[3]

Results of Macroeconomic Analysis

The SPR is an unusual government program in three respects which will affect the way it impacts on the economy:

- o The increased importation of oil required by the SPR

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[1]Michael K. Evans, Macroeconomic Activity: Theory, Forecasting and Controls, Harper and Row (1969).

[2]Lawrence R. Klein, "The Wharton Model Mark III: A Modern IS-LM Construct," International Economic Review, Vol. 15, No. 3, October 1974, pp.573-594.

[3]Bureau of Labor Statistics, The Structure of the U.S. Economy in 1980 and 1985.

will not have the same effects as an increase in the level of imports for consumption because the oil will be stored as crude instead of being refined, distributed and used;

- Unlike most government programs, an unusually large proportion of the government's expenditure is for oil which will either be imported or will induce increased importation of an amount approximately equivalent to the quantity stored; and

- Oil for storage acquired before domestic crude oil price controls lapse (in 1979) will be partly paid for by consumers of petroleum products through an increase in the average price refiners pay for crude oil. (This is a consequence of the method by which the government will acquire SPR oil.)

Other effects of the program arise from:

- Payment to other countries for imported oil, the government's expenditure for developing and operating storage facilities (including the cost of fill operations);

- Government expenditures for developing and maintaining storage facilities and for fill operations; and

- The method by which the government finances its expenditures.

In considering how these six features of the SPR affect the program's impact, the last, financing, will be considered as quite independent of the effects of the other five. The total impact is the sum of the six effects.

Increased Importation of Oil

The effect of increased importation of crude oil would normally be considered to result in increased GNP and employment because value is added as oil passes through U.S. processing and distribution channels. (This effect is distinguished from the negative impacts normally associated with <u>payment</u> for imports.) These impacts will not occur. The only other identifiable positive impacts arise from the effect on the U.S. shipping industry (to the extent that U.S. ships are used in importing SPR crude) and from the effects of domestic distribution of profits from sale of the oil by international oil companies. These effects are considered minor and have been omitted from the analysis.

Government Expenditure for Oil

For the same reason, the portion of government SPR expenditures which is used to acquire oil does not have the GNP and employment impacts normally expected from Government Non-Defense expenditures. The relatively small effects on U.S. shipping and international oil companies have been ignored.

Effect of Price Controls

The U.S. refining industry acquires oil at the national average price rather than at the controlled domestic price or the uncontrolled price of imports. This is a result of the Entitlements Program, which requires refiners who purchase a disproportionately large part of their oil from domestic sources to compensate those which depend heavily on imports. Apart from the effects of features of the Entitlements Program which favor small refiners, individual U.S. refiners pay close to the nationally weighted average price of domestic and imported oil. The government is assumed to acquire oil for storage at the national average price, and the additional importation of oil resulting from government purchases will slightly increase the national average price. The net effect of this price change is an increase in the total cost of crude to refiners equal to the difference between the cost of SPR fill if purchased at the import price and SPR fill purchased through the Entitlements Program. When translated into increases in the prices of petroleum products, this amount will have a small adverse effect on GNP and employment.

Payment to Other Countries

The negligible effect on GNP of SPR oil importation has already been addressed. The effect of payment for imported oil will depend on how countries supplying the oil use the funds. Wide differences in balance of trade positions of the oil exporting countries preclude estimating the impact of payment for the oil. In the absence of certainty, two alternative assumptions which represent a range of probable impacts have been considered:

- Case 1 - The most conservative assumption is that the payment will be held as currency (that is increasing foreign demand deposits in U.S. banks), for an extended period of time. This is unlikely to occur, except to the small extent that increased currency holdings might be needed to handle transactions involving increased investment in U.S. assets or purchase of U.S. exports. Holding the funds as currency would have the effect of slightly bidding up other currencies relative to the U.S. dollar and, consequently, stimulating U.S. exports. Thus a positive, if small, effect on GNP might be expected. For this analysis, however, it was assumed that these effects would not be realized, and there would be no impact on GNP and employment; and

- Case 2 - An alternative assumption is that 50 percent of the funds will be used to purchase U.S. exports and the remainder will be held as currency, used to purchase U.S. securities or invested in U.S. assets. The purchase of exports will have effects on GNP and employment which are estimated using export multipliers. It is assumed that the purchase of U.S. exports will not occur immediately; funds could be directed to third countries before returning to the U.S. It is assumed that the 50 percent used to purchase U.S. exports will result in an increase in exports two quarters after the oil is acquired. It is also assumed that, when compared with the export effects, the positive investment effects can be ignored.

Government Expenditure for Developing and Maintaining Facilities and Fill Operations

This aspect of the program is similar to other government programs. Expected positive impacts on GNP and employment are assumed similar to the effects of other government non-defense expenditures involving similar dollar amounts.

Method of Government Financing

The financing requirements for a government program of about $2 billion per year are not large enough, in relation to the total government budget, to affect government policy. Taxes would probably not be increased, and the government would be expected to cover any resulting increase in its deficit by a routine increase in its borrowing. The impact of this increased borrowing will depend on Federal Reserve Board (FRB) policies in effect at the time. If the FRB is operating under a "tight" money policy and does not expand the money supply, the government borrowing will increase interest rates and thus reduce real investment, GNP and employment.

If, instead, the FRB is operating under an "accommodating" monetary policy in which it adopts target levels for interest rates, then financing the SPR will have no perceptible impact on GNP or employment. In the absence of knowledge about FRB policy, an accommodating policy has been assumed.

Table E-7 incorporates these six aspects of the SPR program and lists the annual GNP and employment impacts under each of the two assumptions concerning how payments for oil are used by exporting countries. Under Case 1 assumptions, SPR expenditures imply small changes in GNP and employment throughout 1977-1984. GNP and employment begin to increase in 1977 due to government expenditures for construction. Employment and GNP increases peak in 1979 and decline gradually thereafter.

Under Case 2 assumptions, where 50 percent of the payments for imported oil return to the U.S. through increased demand for exports, GNP and employment both rise more noticeably. The changes in GNP and employment peak in 1979 with a $2.8 billion increase in GNP and 67,657 new jobs, and both GNP and employment increases remain high until SPR construction and fill are completed in 1982.

Either assumption about likely responses of export demand from increased foreign oil payments thus leads to the conclusion that the development of the SPR will have positive effects on the economy. In general, these effects represent minor changes relative to total GNP and the labor force dur-

Table E-7

GNP AND EMPLOYMENT IMPACTS OF SPR
DEVELOPMENT AND FILL

Year	Case 1		Case 2	
	GNP ($ million)	Employment (jobs)	GNP ($ million)	Employment (jobs)
1977	268	6,826	286	6,826
1978	173	18,062	580	11,488
1979	522	18,170	2,849	67,657
1980	456	11,575	1,735	42,022
1981	337	8,261	1,571	37,963
1982	182	4,723	1,233	29,602
1983	68	1,746	180	4,385
1984	25	647	77	1,874

Case 1 is based on the extremely pessimistic assumption that payments for importation of oil do not create any additional demand for U.S. exports.

Case 2 assumes that 50 percent of payments for importation of oil are used within 6 months to purchase U.S. exports.

ing the 1977-1984 period. They do, however, imply economic changes in the positive direction.

MULTIPLIER ANALYSIS

Estimating the above GNP impacts of the SPR required the use of a macroeconomic model, that is, a model which represents the interactions between the aggregate measures of economic conditions and such activities as government expenditures, private investment, and consumption. One way to estimate the GNP impacts is to use a computer model to simulate the performance of the economy with and without the SPR. The difference in GNP indicated by the two simulations would be the GNP impact of the SPR. In the simulation with the SPR, the SPR would be represented as an increase in Government Non-Defense Expenditures (for facilities), a transfer to other nations of the cost of the oil, an increase in petroleum prices in the U.S., and an increase in government borrowing to finance the program.

The method used here, to focus on SPR-specific costs and impacts, is to infer the GNP impacts from previous computer model simulations in which the GNP impacts of relevant variables have been measured separately or in certain widely useful combinations. The results of these simulations are expressed as "multipliers." Thus, if a simulation is designed to measure the effect of an increase of $1 billion in Government Non-Defense Expenditures (GND), and GNP is found to increase by $2 billion, the GNP multiplier for GND is 2.0. That is: Increase in GNP = 2.0 x (Increase in GND). The GNP impacts are estimated here using: the multiplier for GND to represent the effects of government expenditures for facilities construction and fill operations; an Exports multiplier for the effect of increased foreign purchases of U.S. goods and services; and an Excise Tax multiplier as a surrogate for the effect of an increase in the National Average Price of crude oil. The apparent simplicity of multiplier analysis is deceptive and some care is needed in its application. Consider what is being assumed:

- Relationships, like that between GNP and GND, are linear; that is, the value of the multiplier is the same for all values of GND, although only the effect of a $1 billion increase was measured;
- The impact is the same, regardless of the values of all the other variables in the model; and
- As a corollary of the second assumption, the impact of the SPR is the sum of the impacts of its separate characteristics.

Such assumptions about the real U.S. economy would be generally unwarranted, and are not usually true of elaborate macro models. However, the linearity and additivity assumptions are justifiable approximations when the effects being estimated are small. In an economy with a GNP of about $1.5 trillion, a program involving $2 billion per year may be regarded as relatively small. The assumption that the multipliers are unaffected by other variables in the model such as price levels and unemployment is justified only by the fact that economic conditions in the future are not known and that the conditions represented in the simulations are, therefore, roughly appropriate. Offsetting these limitations of multiplier analysis is its great advantage. It indicates the relative importance of the various individual elements of a policy or program, such as the separate characteristics of the SPR.

Employment impacts could be estimated from employment multipliers calculated from the same simulations as the GNP multipliers. However, such multipliers do not distinguish the differential employment effects of the separate characteristics representing the SPR. For example, government expenditure on facilities would be likely to propagate through the economy differently from the petroleum consumers' subsidy of a portion of SPR fill costs, and would have different impacts on employment. The BLS employment multipliers mentioned earlier are calculated from simulations in which the macroeconomic impacts are further analyzed using the BLS Input-Output tables, so that propagation effects are represented.

The employment effects of the SPR are estimated separately for the construction expenditures, the impact of increased demand for U.S. exports, and the impact of higher domestic energy prices. The construction effects are estimated using the BLS "Construction, Mining, and Oilfield Machinery" multiplier. Effects arising from increased exports are estimated by using a weighted average multiplier for the nine major United States exporting industries. Finally, the effect of higher petroleum prices is estimated using a weighted average multiplier for twelve principal consumer industries.

The published BLS multipliers express employment effects in terms of jobs per billion dollars of final demand in 1963 dollars. For SPR calculations, these multipliers are deflated to 1976 dollars using the implicit price deflators for government, export, and personal consumption expenditures.[1] The deflated multipliers are:

Construction, Mining, and Oilfield Machinery-	25,486 jobs/$ billions
Weighted Average Exports-	23,758 jobs/$ billions
Weighted Average Personal Consumption-	30,314 jobs/$ billions

Employment impacts are estimated by applying these multipliers to the estimated GNP impacts of SPR construction

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[1] *Economic Report of the President*, 1976, pp. 174, 175.

expenditures, payments to producing countries for imported oil, and the increased cost of petroleum products in the U.S.

TIME DISTRIBUTION OF IMPACTS

In the real economy, and in the macromodels used to calculate the GNP multipliers employed in this analysis, the impacts of a change in government expenditure or any of the other variables characterizing the SPR are not fully realized instantly. A change in one period has repercussions in subsequent periods, which may oscillate or may decrease steadily, and which may quickly be attenuated or persist at relatively high intensity for several years. Thus, rather than estimate a single multiplier for a change in Government Non-Defense expenditures, the model simulations produce a series of multipliers representing the instantaneous and the future impacts.

Published multipliers are usually for a sustained rather than a one-period change. However, the development schedule for the SPR shows period-to-period variation which precludes estimating the impacts directly using the sustained change multipliers. Table E-8 shows published sustained change and derived one-period change GNP multipliers for Government Non-Defense expenditures, exports, and excise taxes.

APPLICATION OF THE MULTIPLIERS

In estimating the GNP impacts of the SPR, the GND one-period multipliers are applied to the schedule of construction expenditures (including cost of facilities operations and maintenance, and fill operations, but excluding site acquisition costs); and the Excise Tax multipliers, used as a surrogate for a petroleum price multiplier, are applied to the increased cost of petroleum products attributable to the government purchasing SPR oil at the National Average price rather than at the import price.

In the case where it is assumed that 50 percent of the total payment for the increased oil importation is used six months later to purchase U.S. exports, the Export Multiplier is applied with a delay of two quarters.

Table E-8

MULTIPLIERS FOR ESTIMATING THE CHANGES IN GNP DUE TO CHANGES IN GOVERNMENT NONDEFENSE EXPENDITURES, EXPORTS AND EXCISE TAXES IN CONSTANT DOLLARS

Quarter	Government Non-defense Expenditure Multiplier[1,2]		Export Multiplier[3]		Excise Tax Multiplier[4]	
	Sustained Change	Single Period Change	Sustained Change	Single Period Change	Sustained Change	Single Period Change
1	1.34	1.34	1.75	1.75	-1.80	-1.80
2	1.65	.31	2.15	.40	-1.99	- .19
3	1.90	.25	2.05	-.10	-1.45	.54
4	2.08	.18	1.99	-.06	-1.54	- .09
5	2.24	.16	1.95	-.04	-1.68	- .14
6	2.38	.14	1.95	0.0	-1.47	.21
7	2.50	.12	1.98	.03	-1.45	.02
8	2.61	.11	2.02	.04	-1.54	- .09
9	2.71	.10	2.05	.03	-1.68	- .14
10	2.81	.10	2.06	.01	-1.44	.24
11	2.89	.08	2.08	.02	-1.41	- .03
12	2.95	.06	2.08	0.0	-1.46	- .05

[1] Lawrence R. Klein, "The Wharton Model Mark III: A Modern IS-LM Construct," International Economic Review, Vol. 15, No. 3, October 1974, pp. 573-594.

[2] With accommodating monetary policy such that interest rates are held constant.

[3] Michael K. Evans, Macroeconomic Activity: Theory, Forecasting and Control, 1969, p. 569.

[4] Ibid., p. 572.

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APPENDIX G

LEGISLATION

The Energy Policy and Conservation Act of 1975, P.L. 94-163, encompasses several energy and conservation areas. Title I, Part B, pertains to the Strategic Petroleum Reserve and is reproduced below. In addition, Sec. 2. Statement of Purposes, and Sec. 3. Definitions are reproduced for easy reference.

STATEMENT OF PURPOSES

42 USC 6201. SEC. 2. The purposes of this Act are—

(1) to grant specific standby authority to the President, subject to congressional review, to impose rationing, to reduce demand for energy through the implementation of energy conservation plans, and to fulfill obligations of the United States under the international energy program;

(2) to provide for the creation of a Strategic Petroleum Reserve capable of reducing the impact of severe energy supply interruptions;

(3) to increase the supply of fossil fuels in the United States, through price incentives and production requirements;

(4) to conserve energy supplies through energy conservation programs, and, where necessary, the regulation of certain energy uses;

(5) to provide for improved energy efficiency of motor vehicles, major appliances, and certain other consumer products;

(6) to reduce the demand for petroleum products and natural gas through programs designed to provide greater availability and use of this Nation's abundant coal resources; and

(7) to provide a means for verification of energy data to assure the reliability of energy data.

DEFINITIONS

42 USC 6202. SEC. 3. As used in this Act:

(1) The term "Administrator" means the Administrator of the Federal Energy Administration.

(2) The term "person" includes (A) any individual, (B) any corporation, company, association, firm, partnership, society, trust, joint venture, or joint stock company, and (C) the government and any agency of the United States or any State or political subdivision thereof.

(3) The term "petroleum product" means crude oil, residual fuel oil, or any refined petroleum product (including any natural liquid and any natural gas liquid product).

(4) The term "State" means a State, the District of Columbia, Puerto Rico, or any territory or possession of the United States.

(5) The term "United States" when used in the geographical sense means all of the States and the Outer Continental Shelf.

(6) The term "Outer Continental Shelf" has the same meaning as such term has under section 2 of the Outer Continental Shelf Lands Act (43 U.S.C. 1331).

(7) The term "international energy program" means the Agreement on an International Energy Program, signed by the United States on November 18, 1974, including (A) the annex entitled "Emergency Reserves", (B) any amendment to such Agreement which includes another nation as a party to such Agreement, and (C) any technical or clerical amendment to such Agreement.

(8) The term "severe energy supply interruption" means a national energy supply shortage which the President determines—

(A) is, or is likely to be, of significant scope and duration, and of an emergency nature;

(B) may cause major adverse impact on national safety or the national economy; and

(C) results, or is likely to result, from an interruption in the supply of imported petroleum products, or from sabotage or an act of God.

(9) The term "antitrust laws" includes—

(A) the Act entitled "An Act to protect trade and commerce against unlawful restraints and monopolies", approved July 2, 1890 (15 U.S.C. 1, et seq.);

(B) the Act entitled "An Act to supplement existing laws against unlawful restraints and monopolies, and for other purposes", approved October 15, 1914 (15 U.S.C. 12, et seq.);

(C) the Federal Trade Commission Act (15 U.S.C. 41, et seq.);

(D) sections 73 and 74 of the Act entitled "An Act to reduce taxation, to provide revenue for the Government, and for other purpose", approved August 27, 1894 (15 U.S.C. 8 and 9); and

(E) the Act of June 19, 1936, chapter 592 (15 U.S.C. 13, 13a, 13b, and 21A).

(10) The term "Federal land" means all lands owned or controlled by the United States, including the Outer Continental Shelf, and any land in which the United States has reserved mineral interests, except lands—

(A) held in trust for Indians or Alaska Natives,

(B) owned by Indians or Alaska Natives with Federal restrictions on the title,

(C) within any area of the National Park System, the National Wildlife Refuge System, the National Wilderness Preservation System, the National System of Trails, or the Wild and Scenic Rivers System, or

(D) within military reservations.

PART B—STRATEGIC PETROLEUM RESERVE

10 USC 7421 et seq.

DECLARATION OF POLICY

42 USC 6231.

SEC. 151. (a) The Congress finds that the storage of substantial quantities of petroleum products will diminish the vulnerability of the United States to the effects of a severe energy supply interruption, and provide limited protection from the short-term consequences of interruptions in supplies of petroleum products.

(b) It is hereby declared to be the policy of the United States to provide for the creation of a Strategic Petroleum Reserve for the storage of up to 1 billion barrels of petroleum products, but not less than 150 million barrels of petroleum products by the end of the 3-year period which begins on the date of enactment of this Act, for the purpose of reducing the impact of disruptions in supplies of petroleum products or to carry out obligations of the United States under the international energy program. It is further declared to be the policy of the United States to provide for the creation of an Early Storage Reserve, as part of the Reserve, for the purpose of providing limited protection from the impact of near-term disruptions in supplies of petroleum products or to carry out obligations of the United States under the international energy program.

DEFINITIONS

42 USC 6232.

SEC. 152. As used in this part:

(1) The term "Early Storage Reserve" means that portion of the Strategic Petroleum Reserve which consists of petroleum products stored pursuant to section 155.

(2) The term "importer" means any person who owns, at the first place of storage, any petroleum product imported into the United States.

(3) The term "Industrial Petroleum Reserve" means that portion of the Strategic Petroleum Reserve which consists of petroleum products owned by importers or refiners and acquired, stored, or maintained pursuant to section 156.

(4) The term "interest in land" means any ownership or possessory right with respect to real property, including ownership in fee, an easement, a leasehold, and any subsurface or mineral rights.

(5) The term "readily available inventories" means stocks and supplies of petroleum products which can be distributed or used without affecting the ability of the importer or refiner to operate at normal capacity; such term does not include minimum working inventories or other unavailable stocks.

(6) The term "refiner" means any person who owns, operates, or controls the operation of any refinery.

(7) The term "Regional Petroleum Reserve" means that portion of the Strategic Petroleum Reserve which consists of petroleum products stored pursuant to section 157.

(8) The term "related facility" means any necessary appurtenance to a storage facility, including pipelines, roadways, reservoirs, and salt brine lines.

(9) The term "Reserve" means the Strategic Petroleum Reserve.

(10) The term "storage facility" means any facility or geological formation which is capable of storing significant quantities of petroleum products.

(11) The term "Strategic Petroleum Reserve" means petroleum products stored in storage facilities pursuant to this part; such term includes the Industrial Petroleum Reserve, the Early Storage Reserve, and the Regional Petroleum Reserve.

STRATEGIC PETROLEUM RESERVE OFFICE

Establishment. 42 USC 6233.

SEC. 153. There is established, in the Federal Energy Administration, a Strategic Petroleum Reserve Office. The Administrator, acting through such Office and in accordance with this part, shall exercise authority over the establishment, management, and maintenance of the Reserve.

STRATEGIC PETROLEUM RESERVE

42 USC 6234.

SEC. 154. (a) A Strategic Petroleum Reserve for the storage of up to 1 billion barrels of petroleum products shall be created pursuant to this part. By the end of the 3-year period which begins on the date of enactment of this Act, the Strategic Petroleum Reserve (or the Early Storage Reserve authorized by section 155, if no Strategic Petroleum Reserve Plan has become effective pursuant to the provisions of section 159(a)) shall contain not less than 150 million barrels of petroleum products.

Plan to Congress. Post, p. 965.

(b) The Administrator, not later than December 15, 1976, shall prepare and transmit to the Congress, in accordance with section 551, a Strategic Petroleum Reserve Plan. Such Plan shall comply with the provisions of this section and shall detail the Administrator's proposals for designing, constructing, and filling the storage and related facilities of the Reserve.

(c)(1) To the maximum extent practicable and except to the extent that any change in the storage schedule is justified pursuant to subsection (e)(6), the Strategic Petroleum Reserve Plan shall provide that:

(A) within 7 years after the date of enactment of this Act, the volume of crude oil stored in the Reserve shall equal the total volume of crude oil which was imported into the United States during the base period specified in paragraph (2);

(B) within 18 months after the date of enactment of this Act, the volume of crude oil stored in the Reserve shall equal not less than 10 percent of the goal specified in subparagraph (A):

(C) within 3 years after the date of enactment of this Act, the volume of crude oil stored in the Reserve shall equal not less than 25 percent of the goal specified in subparagraph (A); and

(D) within 5 years after the date of enactment of this Act, the volume of crude oil stored in the Reserve shall equal not less than 65 percent of the goal specified in subparagraph (A).

Volumes of crude oil initially stored in the Early Storage Reserve and volumes of crude oil stored in the Industrial Petroleum Reserve, and the Regional Petroleum Reserve shall be credited toward attainment of the storage goals specified in this subsection.

(2) The base period shall be the period of the 3 consecutive months, during the 24-month period preceding the date of enactment of this Act, in which average monthly import levels were the highest.

(d) The Strategic Petroleum Reserve Plan shall be designed to assure, to the maximum extent practicable, that the Reserve will minimize the impact of any interruption or reduction in imports of refined petroleum products and residual fuel oil in any region which the Administrator determines is, or is likely to become, dependent upon such imports for a substantial portion of the total energy requirements of such region. The Strategic Petroleum Reserve Plan shall be designed to assure, to the maximum extent practicable, that each noncontiguous area of the United States which does not have overland access to domestic crude oil production has its component of the Strategic Petroleum Reserve within its respective territory.

(e) The Strategic Petroleum Reserve Plan shall include:

(1) a comprehensive environmental assessment;

(2) a description of the type and proposed location of each storage facility (other than storage facilities of the Industrial Petroleum Reserve) proposed to be included in the Reserve;

(3) a statement as to the proximity of each such storage facility to related facilities;

(4) an estimate of the volumes and types of petroleum products proposed to be stored in each such storage facility;

(5) a projection as to the aggregate size of the Reserve, including a statement as to the most economically-efficient storage levels for each such storage facility;

(6) a justification for any changes, with respect to volumes or dates, proposed in the storage schedule specified in subsection (c), and a program schedule for overall development and completion of the Reserve (taking into account all relevant factors, including cost effectiveness, the need to construct related facilities, and the ability to obtain sufficient quantities of petroleum products to fill the storage facilities to the proposed storage levels);

(7) an estimate of the direct cost of the Reserve, including—

(A) the cost of storage facilities;

(B) the cost of the petroleum products to be stored;

(C) the cost of related facilities; and

(D) management and operation costs;

(8) an evaluation of the impact of developing the Reserve, taking into account—

(A) the availability and the price of supplies and equipment and the effect, if any, upon domestic production of acquiring such supplies and equipment for the Reserve;

(B) any fluctuations in world, and domestic, market prices for petroleum products which may result from the acquisition of substantial quantities of petroleum products for the Reserve;

(C) the extent to which such acquisition may support otherwise declining market prices for such products; and

(D) the extent to which such acquisition will affect competition in the petroleum industry;

(9) an identification of the ownership of each storage and related facility proposed to be included in the Reserve (other than storage and related facilities of the Industrial Petroleum Reserve);

(10) an identification of the ownership of the petroleum products to be stored in the Reserve in any case where such products are not owned by the United States;

(11) a statement of the manner in which the provisions of this part relating to the establishment of the Industrial Petroleum Reserve and the Regional Petroleum Reserve will be implemented; and

(12) a Distribution Plan setting forth the method of drawdown and distribution of the Reserve.

EARLY STORAGE RESERVE

42 USC 6235.

SEC. 155. (a)(1) The Administrator shall establish an Early Storage Reserve as part of the Strategic Petroleum Reserve. The Early Storage Reserve shall be designed to store petroleum products, to the maximum extent practicable, in existing storage capacity. Petroleum products stored in the Early Storage Reserve may be owned by the United States or may be owned by others and stored pursuant to section 156(b).

(2) If the Strategic Petroleum Reserve Plan has not become effective under section 159(a), the Early Storage Reserve shall contain not less than 150 million barrels of petroleum products by the end of the 3-year period which begins on the date of enactment of this Act.

(b) The Early Storage Reserve shall provide for meeting regional needs for residual fuel oil and refined petroleum products in any region which the Administrator determines is, or is likely to become, dependent upon imports of such oil or products for a substantial portion of the total energy requirements of such region.

Plan, transmittal to Congress.

(c) Within 90 days after the date of enactment of this Act, the Administrator shall prepare and transmit to the Congress an Early Storage Reserve Plan which shall provide for the storage of not less than 150 million barrels of petroleum products by the end of 3 years from the date of enactment of this Act. Such plan shall detail the Administrator's proposals for implementing the Early Storage Reserve requirements of this section. The Early Storage Reserve Plan shall, to the maximum extent practicable, provide for, and set forth the manner in which, Early Storage Reserve facilities will be incorporated into the Strategic Petroleum Reserve after the Strategic Petroleum Reserve Plan has become effective under section 159(a). The Early Storage Reserve Plan shall include, with respect to the Early Storage Reserve, the same or similar assessments, statements, estimates, evaluations, projections, and other information which section 154(e) requires to be included in the Strategic Petroleum Reserve Plan, including a Distribution Plan for the Early Storage Reserve.

INDUSTRIAL PETROLEUM RESERVE

SEC. 156. (a) The Administrator may establish an Industrial Petroleum Reserve as part of the Strategic Petroleum Reserve. Establishment. 42 USC 6236.

(b) To implement the Early Storage Reserve Plan or the Strategic Petroleum Reserve Plan which has taken effect pursuant to section 159(a), the Administrator may require each importer of petroleum products and each refiner to (1) acquire, and (2) store and maintain in readily available inventories, petroleum products in amounts determined by the Administrator, except that the Administrator may not require any such importer or refiner to store such petroleum products in an amount greater than 3 percent of the amount imported or refined by such person, as the case may be, during the previous calendar year. Petroleum products imported and stored in the Industrial Petroleum Reserve shall be exempt from any tariff or import license fee.

(c) The Administrator shall implement this section in a manner which is appropriate to the maintenance of an economically sound and competitive petroleum industry. The Administrator shall take such steps as are necessary to avoid inequitable economic impacts on refiners and importers, and he may grant relief to any refiner or importer who would otherwise incur special hardship, inequity, or unfair distribution of burdens as the result of any rule, regulation, or order promulgated under this section. Such relief may include full or partial exemption from any such rule, regulation, or order and the issuance of an order permitting such an importer or refiner to store petroleum products owned by such importer or refiner in surplus storage capacity owned by the United States.

REGIONAL PETROLEUM RESERVE

SEC. 157. (a) The Strategic Petroleum Reserve Plan shall provide for the establishment and maintenance of a Regional Petroleum Reserve in, or readily accessible to, each Federal Energy Administration Region, as defined in title 10, Code of Federal Regulations in effect on November 1, 1975, in which imports of residual fuel oil or any refined petroleum product, during the 24-month period preceding the date of computation, equal more than 20 percent of demand for such oil or product in such regions during such period, as determined by the Administrator. Such volume shall be computed annually. 42 USC 6237.

(b) To implement the Strategic Petroleum Reserve Plan, the Administrator shall accumulate and maintain in or near any such Federal Energy Administration Region described in subsection (a), a Regional Petroleum Reserve containing volumes of such oil or product, described in subsection (a), at a level adequate to provide substantial protection against an interruption or reduction in imports of such oil or product to such region, except that the level of any such Regional Petroleum Reserve shall not exceed the aggregate volume of imports of such oil or product into such region during the period of the 3 consecutive months, during the 24-month period specified in subsection (a), in which average monthly import levels were the highest, as determined by the Administrator. Such volume shall be computed annually.

(c) The Administrator may place in storage crude oil, residual fuel oil, or any refined petroleum product in substitution for all or part of the volume of residual fuel oil or any refined petroleum product stored in any Regional Petroleum Reserve pursuant to the provisions of this section if he finds that such substitution (1) is necessary or desirable for purposes of economy, efficiency, or for other reasons, and (2) may be made without delaying or otherwise adversely affecting the fulfillment of the purpose of the Regional Petroleum Reserve.

OTHER STORAGE RESERVES

Report to Congress. 42 USC 6238.

SEC. 158. Within 6 months after the Strategic Petroleum Reserve Plan is transmitted to the Congress, pursuant to the requirements of section 154(b), the Administrator shall prepare and transmit to the Congress a report setting forth his recommendations concerning the necessity for, and feasibility of, establishing—

(1) Utility Reserves containing coal, residual fuel oil, and refined petroleum products, to be established and maintained by major fossil-fuel-fired baseload electric power generating stations;

(2) Coal Reserves to consist of (A) federally-owned coal which is mined by or for the United States from Federal lands, and (B) Federal lands from which coal could be produced with minimum delay; and

(3) Remote Crude Oil and Natural Gas Reserves consisting of crude oil and natural gas to be acquired and stored by the United States, in place, pursuant to a contract or other agreement or arrangement entered into between the United States and persons who discovered such oil or gas in remote areas.

REVIEW BY CONGRESS AND IMPLEMENTATION

42 USC 6239.

SEC. 159. (a) The Strategic Petroleum Reserve Plan shall not become effective and may not be implemented, unless—

(1) the Administrator has transmitted such Plan to the Congress pursuant to section 154(b); and

(2) neither House of Congress has disapproved (or both Houses have approved) such Plan, in accordance with the procedures specified in section 551.

(b) For purposes of congressional review of the Strategic Petroleum Reserve Plan under subsection (a), the 5 calendar days described in section 551(f)(4)(A) shall be lengthened to 15 calendar days, and the 15 calendar days described in section 551 (c) and (d) shall be lengthened to 45 calendar days. Post, p. 965.

(c) The Administrator may, prior to transmittal of the Strategic Petroleum Reserve Plan, prepare and transmit to the Congress proposals for designing, constructing, and filling storage or related facilities. Any such proposal shall be accompanied by a statement explaining (1) the need for action on such proposals prior to completion of such Plan, (2) the anticipated role of the proposed storage or related facilities in such Plan, and (3) to the maximum extent practicable, the same or similar assessments, statements, estimates, evaluations, projections, and other information which section 154(e) requires to be included in the Strategic Petroleum Reserve Plan.

(d) The Administrator may prepare amendments to the Strategic Petroleum Reserve Plan or to the Early Storage Reserve Plan. He shall transmit any such amendment to the Congress together with a statement explaining the need for such amendment and, to the maximum extent practicable, the same or similar assessments, statements, estimates, evaluations, projections, and other information which section 154(e) requires to be included in the Strategic Petroleum Reserve Plan.

(e) Any proposal transmitted under subsection (c) and any amendment transmitted under subsection (d), other than a technical or clerical amendment or an amendment to the Early Storage Reserve Plan, shall not become effective and may not be implemented unless—

(1) the Administrator has transmitted such proposal or amendment to the Congress in accordance with subsection (c) or (d) (as the case may be), and

(2) neither House of Congress has disapproved (or both Houses of Congress have approved) such proposal or amendment, in accordance with the procedures specified in section 551.

(f) To the extent necessary or appropriate to implement—

(1) the Strategic Petroleum Reserve Plan which has taken effect pursuant to subsection (a);

(2) the Early Storage Reserve Plan;

(3) any proposal described in subsection (c), or any amendment described in subsection (d), which such proposal or amendment has taken effect pursuant to subsection (e); and

(4) any technical or clerical amendment or any amendment to the Early Storage Reserve Plan,

the Administrator may:

(A) promulgate rules, regulations, or orders;

(B) acquire by purchase, condemnation, or otherwise, land or interests in land for the location of storage and related facilities;

(C) construct, purchase, lease, or otherwise acquire storage and related facilities;

(D) use, lease, maintain, sell, or otherwise dispose of storage and related facilities acquired pursuant to this part;

(E) acquire, subject to the provisions of section 160, by purchase, exchange, or otherwise, petroleum products for storage in the Strategic Petroleum Reserve, including the Early Storage Reserve and the Regional Petroleum Reserve;

(F) store petroleum products in storage facilities owned and controlled by the United States or in storage facilities owned by others if such facilities are subject to audit by the United States;

(G) execute any contracts necessary to carry out the provisions of such Strategic Petroleum Reserve Plan, Early Storage Reserve Plan, proposal or amendment;

(H) require any importer of petroleum products or any refiner to (A) acquire, and (B) store and maintain in readily available inventories, petroleum products in the Industrial Petroleum Reserve, pursuant to section 156;

(I) require the storage of petroleum products in the Industrial Petroleum Reserve, pursuant to section 156, on such reasonable terms as the Administrator may specify in storage facilities owned and controlled by the United States or in storage facilities other than those owned by the United States if such facilities are subject to audit by the United States;

(J) require the maintenance of the Industrial Petroleum Reserve;

(K) maintain the Reserve; and

(L) bring an action, whenever he deems it necessary to implement the Strategic Petroleum Reserve Plan, in any court having jurisdiction of such proceedings, to acquire by condemnation any real or personal property, including facilities, temporary use of facilities, or other interests in land, together with any personal property located thereon or used therewith.

(g) Before any condemnation proceedings are instituted, an effort shall be made to acquire the property involved by negotiation, unless, the effort to acquire such property by negotiation would, in the judgment of the Administrator be futile or so time-consuming as to unreasonably delay the implementation of the Strategic Petroleum Reserve Plan, because of (1) reasonable doubt as to the identity of the owners, (2) the large number of persons with whom it would be necessary to negotiate, or (3) other reasons.

PETROLEUM PRODUCTS FOR STORAGE IN THE RESERVE

42 USC 6240. SEC. 160. (a) The Administrator is authorized, for purposes of implementing the Strategic Petroleum Reserve Plan or the Early Storage Reserve Plan, to place in storage, transport, or exchange—

(1) crude oil produced from Federal lands, including crude oil produced from the Naval Petroleum Reserves to the extent that such production is authorized by law;

(2) crude oil which the United States is entitled to receive in kind as royalties from production on Federal lands; and

(3) petroleum products acquired by purchase, exchange, or otherwise.

(b) The Administrator shall, to the greatest extent practicable, acquire petroleum products for the Reserve, including the Early Storage Reserve and the Regional Petroleum Reserve in a manner consonant with the following objectives:

(1) minimization of the cost of the Reserve;

(2) orderly development of the Naval Petroleum Reserves to the extent authorized by law;

(3) minimization of the Nation's vulnerability to a severe energy supply interruption;

(4) minimization of the impact of such acquisition upon supply levels and market forces; and

(5) encouragement of competition in the petroleum industry.

DRAWDOWN AND DISTRIBUTION OF THE RESERVE

42 USC 6241. SEC. 161. (a) The Administrator may drawdown and distribute the Reserve only in accordance with the provisions of this section.

(b) Except as provided in subsections (c) and (f), no drawdown and distribution of the Reserve may be made except in accordance with the provisions of the Distribution Plan contained in the Strategic Petroleum Reserve Plan which has taken effect pursuant to section 159(a).

(c) Drawdown and distribution of the Early Storage Reserve may be made in accordance with the provisions of the Distribution Plan contained in the Early Storage Reserve Plan until the Strategic Petroleum Reserve Plan has taken effect pursuant to section 159(a).

(d) Neither the Distribution Plan contained in the Strategic Petroleum Reserve Plan nor the Distribution Plan contained in the Early Storage Reserve Plan may be implemented, and no drawdown and distribution of the Reserve or the Early Storage Reserve may be made, unless the President has found that implementation of either such Distribution Plan is required by a severe energy supply interruption or by obligations of the United States under the international energy program.

(e) The Administrator may, by rule, provide for the allocation of any petroleum product withdrawn from the Strategic Petroleum Reserve in amounts specified in (or determined in a manner prescribed by) and at prices specified in (or determined in a manner prescribed by) such rules. Such price levels and allocation procedures shall be consistent with the attainment, to the maximum extent practicable, of the objectives specified in section 4(b)(1) of the Emergency Petroleum Allocation Act of 1973. Rules. 15 USC 753.

(f) The Administrator may permit any importer or refiner who owns any petroleum products stored in the Industrial Petroleum Reserve pursuant to section 156 to remove or otherwise dispose of such products upon such terms and conditions as the Administrator may prescribe.

COORDINATION WITH IMPORT QUOTA SYSTEM

SEC. 162. No quantitative restriction on the importation of any petroleum product into the United States imposed by law shall apply to volumes of any such petroleum product imported into the United States for storage in the Reserve. 42 USC 6242.

DISCLOSURE, INSPECTION, INVESTIGATION

SEC. 163. (a) The Administrator may require any person to prepare and maintain such records or accounts as the Administrator, by rule, determines necessary to carry out the purposes of this part. Recordkeeping. 42 USC 6243.

(b) The Administrator may audit the operations of any storage facility in which any petroleum product is stored or required to be stored pursuant to the provisions of this part.

(c) The Administrator may require access to, and the right to inspect and examine, at reasonable times, (1) any records or accounts required to be prepared or maintained pursuant to subsection (a) and (2) any storage facilities subject to audit by the United States under the authority of this part.

NAVAL PETROLEUM RESERVES STUDY

Report to Congress. 42 USC 6244.

SEC. 164. The Administrator shall, in cooperation and consultation with the Secretary of the Navy and the Secretary of the Interior, develop and submit to the Congress within 180 days after the date of enactment of this Act, a written report recommending procedures for the exploration, development, and production of Naval Petroleum Reserve Number 4. Such report shall include recommendations for protecting the economic, social, and environmental interests of Alaska Natives residing within the Naval Petroleum Reserve Number 4 and analyses of arrangements which provide for (1) participation by private industry and private capital, and (2) leasing to private industry. The Secretary of the Navy and the Secretary of the Interior shall cooperate fully with one another and with the Administrator; the Secretary of the Navy shall provide to the Administrator and Secretary of the Interior all relevant data on Naval Petroleum Reserve Number 4 in order to assist the Administrator in the preparation of such report.

ANNUAL REPORTS

Report to Congress and President. 42 USC 6245.

SEC. 165. The Administrator shall report to the President and the Congress, not later than one year after the transmittal of the Strategic Petroleum Reserve Plan to the Congress and each year thereafter, on all actions taken to implement this part. Such report shall include—

(1) a detailed statement of the status of the Strategic Petroleum Reserve;

(2) a summary of the actions taken to develop and implement the Strategic Petroleum Reserve Plan and the Early Storage Reserve Plan;

(3) an analysis of the impact and effectiveness of such actions on the vulnerability of the United States to interruption in supplies of petroleum products;

(4) a summary of existing problems with respect to further implementation of the Early Storage Reserve Plan and the Strategic Petroleum Reserve Plan; and

(5) any recommendations for supplemental legislation deemed necessary or appropriate by the Administrator to implement the provisions of this part.

AUTHORIZATION OF APPROPRIATIONS

42 USC 6246.

SEC. 166. There are authorized to be appropriated—

(1) such funds as are necessary to develop and implement the Early Storage Reserve Plan (including planning, administration, acquisition, and construction of storage and related facilities) and as are necessary to permit the acquisition of petroleum products for storage in the Early Storage Reserve or, if the Strategic Petroleum Reserve Plan has become effective under section 159(a), for storage in the Strategic Petroleum Reserve in the minimum volume specified in section 154(a) or 155(a)(2), whichever is applicable; and

(2) $1,100,000,000 to remain available until expended to carry out the provisions of this part to develop the Strategic Petroleum Reserve Plan and to implement such plan which has taken effect pursuant to section 159(a), including planning, administration, and acquisition and construction of storage and related facilities, but no funds are authorized to be appropriated under this paragraph for the purchase of petroleum products for storage in the Strategic Petroleum Reserve.

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