Strategic Petroleum Reserve Plan

(Public Law 94-163, Section 154)

December 15, 1976

Federal Energy Administration Strategic Petroleum Reserve Office

Refineries previously using interrupted crude oil would be provided crude oil from the Reserve. The analysis of refinery capacity expected to be available shows that the refineries will have adequate capacity to produce the desired products on a timely basis. This avoids the need to store refined products that are costly or that may be difficult or impossible to store for long periods. It also provides flexibility of response to a wide range of interruptions by providing crude oil to refineries which have the flexibility to adjust yields for the production of the necessary products to meet the specific needs of an interruption.

If future estimates show that available refinery capacity may be inadequate to respond to interruptions of supply, with crude oil available from the Reserve, consideration will be given to storing selected refinery products. (See Chapter III.)

TYPES OF CRUDE

Based on detailed studies of refinery needs, product yields, and possible import interruptions, it is planned to store only two or possibly three types of crude oil. About 60 percent of the crude will be a type with an intermediate gravity (32-36 degrees API) and a sulfur content of 1.0 - 1.9 percent. The remainder will consist of one or two types of low sulfur crude (less than 0.5 percent) with gravity ranging from intermediate to very light. The types of low sulfur oil to be stored will be determined in part by prices and quantities offered in response to requests for proposals.

This mix of crudes will permit the Reserve to respond effectively to a wide range of interruptions, and assure that refineries will be able to receive an acceptable crude to replace lost imports. It will minimize the cost of the SPR by avoiding the need for many separate storage facilities. It also will provide flexibility in procuring the oil and will alleviate any problem of substantially driving up market prices which might occur if only one type were obtained. (See Chapter III.)

OIL ACQUISITION

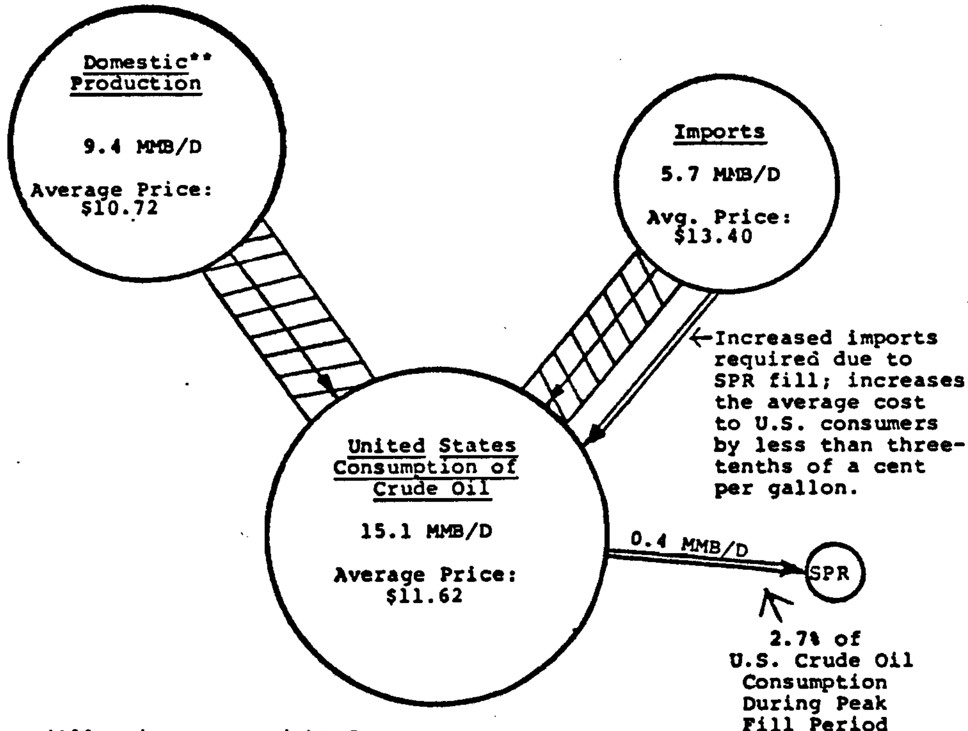
The FEA will request offers from interested sellers of oil for the Reserve. Awards will be based on criteria which will include total costs to the economy, total costs to the Federal budget, availability of adequate quantities of the desired types of oil, delivery flexibility and capability, environmental impact, and impact on world supply. The FEA also plans to revise its Crude Oil Entitlements program to permit U.S. suppliers of oil to FEA to earn entitlements to price-controlled domestic oil if they sell crude oil for the SPR. This is expected to result in prices for the SPR oil near the national average price.

The expected effect of this acquisition approach is that the SPR would receive, in effect, some oil at domestic prices and some at import prices. This would reduce the cost to the Federal budget while adding less than two-tenths of a cent to a gallon of petroleum product for consumers for about two years until price controls are due to end. It would put the U.S. Government in essentially the same position as other U.S. buyers of crude oil. It provides an equitable way for the petroleum industry and users to pay a share of the costs of the Reserve which will benefit the industry and petroleum users during an interruption. (See Figure I-3.)

It would be undesirable to take royalty oil for the Reserve because of the disruption it would have on those small refiners now relying on that supply. It would not be economical to use oil directly from Naval Petroleum Reserves because of the expected high market prices of that oil in the future and the logistical difficulties of using the oil. It is instead preferable to sell that oil at market prices and use the Budget revenues to acquire other oil that is more suitable for the Reserve. If changes in the availability or estimated cost of royalty oil or NPR oil make either of these sources attractive in the future, FEA will propose a revision to the Plan to use such oil for at least a portion of the SPR requirements. (See Chapter III.)

Figure I-3

CRUDE OIL ACQUISITION PROCESS
(Estimates for 1978)*



*All prices are weighted averages
**Domestic production is estimated at 7.3 MMB/D @ $9.95, 2.1 MMB/D @ $13.40

TYPES OF STORAGE FACILITIES

Based on detailed study of alternative types of storage, it was concluded that the Reserve should be stored in underground cavities. Salt dome caverns or mines or rock caverns are the lowest cost forms of storage, and will minimize environmental problems and provide maximum security. Existing underground cavities are available for much of the planned Reserve, and new cavities can be formed efficiently.

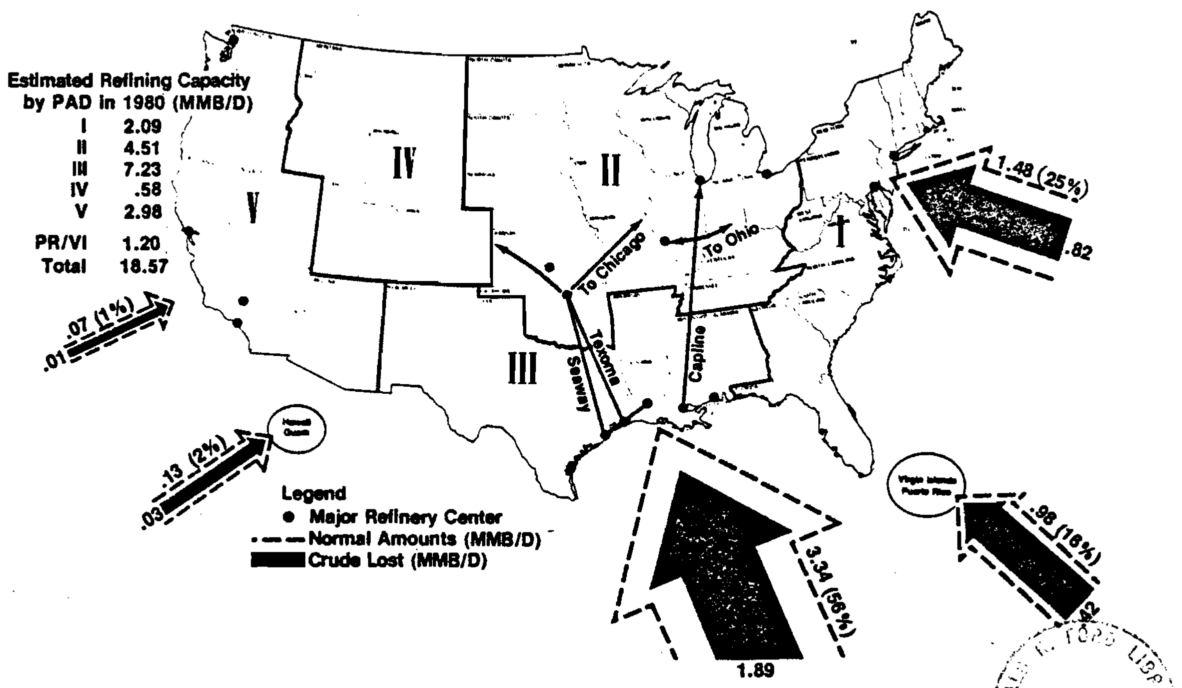
The higher costs and potential environmental hazards of using steel tanks and oil tanker ships for storage make these undesirable. At this time FEA sees no need to use tanks or ships for storage. (See Chapter IV.)

LOCATION OF STORAGE

The storage cavities will be located where they are most accessible to tankers or major pipelines, or both, to provide for rapid withdrawal during an interruption, and to permit the Reserve to be used for a wide range of interruptions. The most desirable locations appear to be in the Gulf Coast area because it provides ready access to the primary imported crude oil distribution system of the country. Storage in this area can feed the major crude oil pipelines to the interior of the country, the Gulf Coast refineries, and East Coast, West Coast and noncontiguous area refineries by tanker.

The three market areas most dependent on oil imports that are likely to be interrupted are: the interior of the country served by the major crude oil pipelines fed from the Gulf Coast; the Gulf Coast refinery complexes; and the East Coast and Caribbean refineries. Locating the bulk of the Reserve storage in the Gulf Coast area will maximize the flexibility of the Reserve, and will minimize the time required to move the oil to refineries during an interruption. (See Figure I-4).

Figure I-4
Normal Crude Import Flows and Losses from a Severe Interruption in 1980



Most or all of the oil will be stored in a few large sites, which are located near terminals that will be able to supply tankers and/or major crude oil pipelines. Dispersion of the storage would increase costs and environmental impacts. Dispersion of the storage away from major ports would also reduce the flexibility of the Reserve to respond to a variety of interruptions.

Final decisions on sites for the initial storage will be made early in 1977, and will be selected from among the eight candidate sites discussed in this Report. The sites for the full 500 MMB will be selected by late 1977 or early 1978. The full Reserve capacity may be obtained by expanding some or all of the initial sites, or by acquiring additional sites.

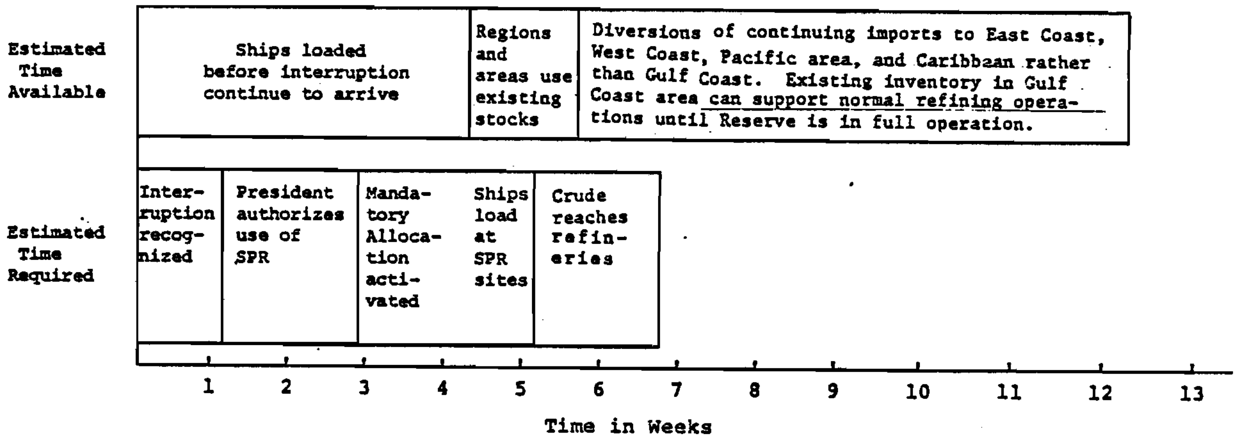
Storage capacity for about 240 MMB will be developed in sites selected from the eight candidate Early Storage sites, and FEA intends to fill this capacity to 150 MMB by December 1978. The additional volume at those sites will be filled after 1978. (See Chapter IV.)

REGIONAL PETROLEUM RESERVE

Reserves for the Regions heavily dependent on imports, and for the noncontiguous areas of the country, will be maintained in the large central crude oil facilities. Extensive analysis shows that it will be possible to move the crude oil to refineries and on to users in time to avert the loss of petroleum from an import supply interruption. (See Figure I-5.)
The expected small loss of imported refined products as shown in Figure I-2 means that available refineries will be able to make up the loss without any reduction in supply to the Regions dependent on the imports of refined products. An allocation system will assure that all Regions and noncontiguous areas receive an equitable share of available crude oil and refinery products. Maintaining these Reserves in the central storage will minimize costs and environmental impacts, as well as increase the ability to use the Reserve to respond to a wide range of supply interruptions. It will result in no loss of protection for the Regions and noncontiguous areas. FEA has determined that it would not be practicable to store a component of the Reserve in any of the noncontiguous areas because the costs and environmental haz-

Figure I-5

TIME AVAILABLE AND REQUIRED
TO MOVE SPR CRUDE OIL TO USERS



ards of such storage would be undesirable and the benefits would be minimal.

FEA will continue to monitor the needs of Regions and noncontiguous areas. If future estimates of petroleum supply vulnerability indicate that Regions or noncontiguous areas could not be protected with the SPR located in large central facilities, and if it is practicable to store a portion of the Reserve in the Regions or noncontiguous areas to provide the desired protection, FEA will propose a Plan Amendment to provide for such storage. (See Chapter V.)

INDUSTRIAL PETROLEUM RESERVE

FEA will not exercise its discretionary authority to require industry to store a portion of the Reserve. The FEA analysis indicates that an Industrial Petroleum Reserve (IPR) would not accelerate the development of the SPR, and any regional protection that might be provided by an IPR could be achieved more efficiently with Government storage. There would likely be serious legal and administrative problems with implementing an IPR, which could delay the SPR program and increase its costs. If the Industrial Reserve were dispersed throughout the country, it would reduce the response flexibility of the SPR, as well as increase the possibility of environmental damage. It would increase the cost to the economy for the storage because of more costly facilities, and most of these higher costs would be passed along to petroleum consumers. It also would create inequities among refiners and importers because of different costs of compliance and varying abilities among firms to pass the costs along to consumers.

The planned oil acquisition process for the SPR would pass a share of the Reserve costs along to the industry and users, without the inequities and the complex regulatory process that would be required for an Industrial Reserve.

FEA will continue to study the use of industrial storage, and petroleum inventories maintained by industry, as a means of reducing U.S. vulnerability to interruptions. It is important that industry does not begin to rely on the SPR stocks to substitute for their own inventories to meet peak demands or other contingencies. The study will consider whether there may be a need to require that industry maintain minimum levels of inventories. FEA also will analyze alternative means of paying for a portion of the costs of the Reserve, including such options as a tax on petroleum imports. The results of these studies and any recommendations will be reported to Congress in an Annual Report or a Plan Amendment. (See Chapter VI.)

RESERVE USE

The plans to use the Reserve will be an integral part of a larger, more comprehensive plan to respond to national energy emergencies, as well as to provide the means to fulfill obligations of the United States under the emergency allocation provisions of the International Energy Program. Plans for drawdown and distribution of the Reserve will be consistent with national goals and objectives, and with other programs which would be implemented in managing such a crisis. Factors which will influence the decisions to use the Reserve include: the state of the economy; the depth and duration of the interruption; the potential for conservation; the availability of the Reserve; and its capability to respond.

The decision on whether and how to use the Reserve will be made by the President in the event of an interruption. Contingency plans will be developed for a variety of interruption conditions, for consideration by the President in making a decision. The President must find the existence of a "severe energy supply interruption" as defined by the EPCA, before the Reserve could be used. It is considered to be infeasible and undesirable to try to specify any precise conditions for using the Reserve or how it will be used, because (1) there are innumerable factors that might affect such decisions, and (2) one of the objectives of the Reserve, to deter a politically motivated interruption, is furthered by ensuring that potential embargoing producers are uncertain of our intentions concerning when and how the Reserve would be used. (See Chapter VII.)

ALLOCATION OF CRUDE AND PRODUCTS

A key to the effectiveness of the Reserve to respond to an interruption will be a system to allocate available crude oil, residual oil and refined products, to assure an equitable distribution of any economic hardships resulting from an interruption. The Distribution Plan is now being developed and will be consistent with the objectives contained in section 4 of the Emergency Petroleum Allocation Act (EPAA) of 1973 to ensure that available petroleum is equitably distributed. It will be coordinated with the other features of the contingency plans being developed by FEA in accordance with the EPCA.

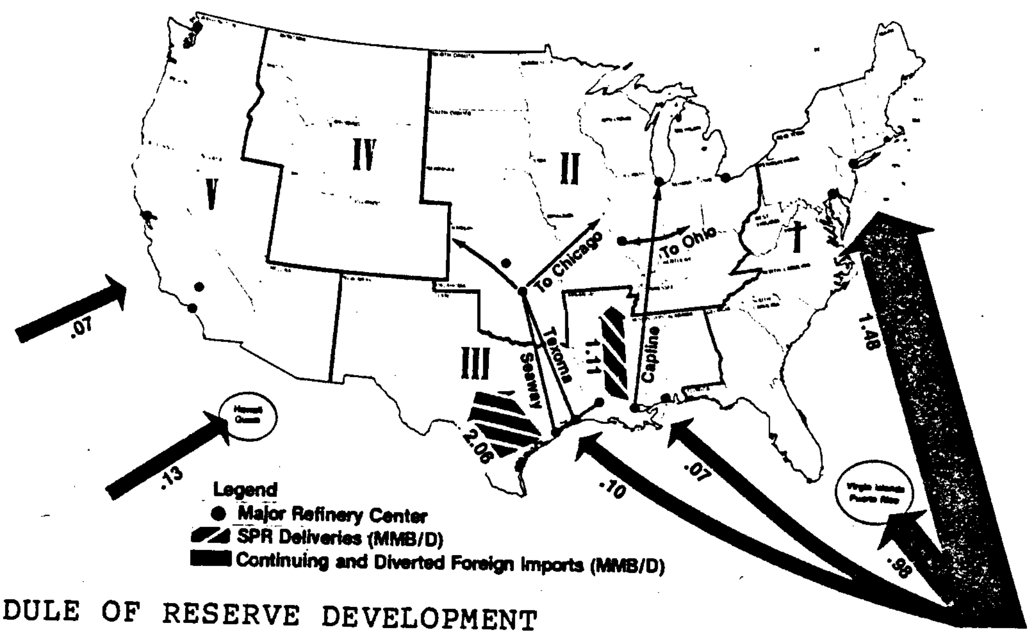
During the next several months, as the Reserve is being developed, an allocation system will be developed to assure the effective and efficient use of the SPR, as well as assuring that all Regions and areas of the country receive an equitable share of available crude oil and products. (See Chapter VII.)

TRANSPORTATION OF RESERVE CRUDE

The petroleum industry will be primarily responsible for the physical movement of the SPR crude oil to refineries after it is released from storage. FEA will assure that the oil is readily accessible to ports and pipeline terminals near the storage sites. It will assure that the port facilities near the storage sites will be able to handle the maximum drawdown of the Reserve. The petroleum industry will be responsible for assuring that the crude is then moved to where it is needed.

Industry is expected to significantly revise normal shipping patterns during a major interruption to respond to the availability of the SPR crude in the Gulf Coast area and to the economics of distribution. For example, uninterrupted imports of crude oil normally destined to the Gulf Coast may be diverted to the East Coast or Caribbean refineries to meet those needs, while the crude oil from the Reserve is used to meet refinery needs in the Gulf Coast area and in the interior of the country. This will minimize both transportation time and costs. This may mean that even for relatively severe interruptions, little of the SPR crude oil may be shipped out of the Gulf Coast area, because the needs of other areas might be met more economically by using uninterrupted imports that are directed to those areas. (See Figure I-6 and Chapters IV, V, and VII.)

Figure I-6
Possible Interruption Crude Import Flows
(Continuing Imports, Diversions and Reserve Replacements)



SCHEDULE OF RESERVE DEVELOPMENT

It is planned to have 500 MMB in storage by the end of 1982, as well as 325 MMB by the end of 1980 and 150 MMB by the end of 1978. An intensive effort will be needed to meet the target of 150 MMB by the end of 1978. It also will not be easy to reach 500 MMB by the end of 1982, because the latter parts of the storage are expected to be in newly created cavities or caverns, rather than in existing space, which will slow the fill rate. Every effort will be made, however, to meet the goal of 500 MMB by the end of 1982, while avoiding excessive costs and minimizing undesirable environmental and economic impacts.

It will not be practicable to meet the target of storing 10 percent of the Reserve (50 MMB) by June of 1977. The large underground facilities cannot be ready for filling by that time, and aboveground facilities for this amount of storage would present severe environmental hazards and high costs. This Plan proposes to revise that schedule accordingly. (See Chapter VIII.)

COSTS

The total cost of a 500 MMB Reserve is estimated to be between $7.5 and $8.0 billion. Approximately 90 percent of the cost will be for purchasing and transporting the crude oil. The average cost of construction and land acquisition for salt caverns and mines is estimated at between $1.38 and $1.65 per barrel and will occur primarily in the earlier periods of SPR development. The cost estimate for crude oil is based on current world prices, and assumes that the oil will be obtained at the national average price (including imports). (See Chapter IX.)

ECONOMIC IMPACTS

The aggregate economic effects of developing a Reserve are expected to be mixed and of limited magnitude. A temporary impact on the local economy in the vicinity of the storage facilities will be felt through higher employment, increased consumption of goods and services, and increased tax revenues. Most of the effects of the program will be spread throughout the economy and will be too small to be perceived. The crude oil acquisition is expected to increase domestic prices of petroleum slightly (less than two-tenths of a cent per gallon) for about two years until price controls are due to end. Crude oil procurement will be implemented with a view to minimizing any upward pressures on world oil prices. (See Chapter X).

ENVIRONMENTAL ASSESSMENT

A Programmatic Environmental Impact Statement and site specific draft Environmental Impact Statements on the eight candidate near-term sites have been prepared in accordance with the National Environmental Policy Act of 1969. Similar environmental assessments have been initiated for the long term candidate storage sites, and draft statements for these sites will be published in the spring of 1977. The published statements have shown that while there will be some environmental impacts, they generally will be localized and temporary. There are expected to be no significant long range or permanent impacts to the environment as a result of establishing a Strategic Petroleum Reserve. (See Chapter XI.)

CHAPTER II

SIZE OF THE RESERVE

CONCLUSIONS

FEA has analyzed whether there is a reasonable basis for proposing a Reserve size other than approximately 500 MMB, which is specified by the EPCA to be developed by December 1982. After estimating the potential vulnerability of the United States under different supply interruption scenarios, FEA considered the desirability of smaller and larger Reserve sizes.

It is concluded that a smaller size would not adequately reduce U.S. vulnerability, even though it may be attractive from a cost-benefit point of view. A significantly larger size would be appropriate if there is a high probability that 1985 imports will be at about the 10 MMB/D level.

A 500 MMB size would provide adequate protection for the most likely interruptions, with imports at approximately the 7.5 MMB/D level in 1980 and 1985. This size also would be cost effective in responding to a wide range of interruptions.

FEA proposes to retain the goal of a 500 MMB size by December 1982, for now. If subsequent estimates of vulnerability show a need for a larger or a smaller Reserve, proposals to increase or decrease the size will be made in Plan Amendments or in Annual Reports to the Congress. In addition, various other factors that might affect the size of the Reserve, such as emergency energy conservation measures, require further analysis.

This chapter also includes an examination of the maximum daily drawdown capability of the Reserve. A drawdown capability of up to 3.3 MMB/D is found to be adequate with a 500 MMB Reserve.

LEGISLATIVE GUIDANCE

The Energy Policy and Conservation Act (EPCA) of 1975 states that the Strategic Petroleum Reserve (SPR) may contain up to one billion barrels of petroleum products, of which not less than 150 MMB must be in place by December 1978.

The Act provides that, to the maximum extent practicable and unless otherwise justified, the SPR Plan should follow the fill schedule set forth in the Act. That schedule provides that, except to the extent that any change is justified by the Plan, by 1982 the Reserve should equal the total volume of crude oil imported during the three consecutive months during 1974-1975 when import levels were highest. This amount is approximately 495 MMB (rounded to 500 MMB for convenience). (See Table II-1).

Table II-1

CRUDE IMPORTS 1974-1975

	MMB/D						
	USA[1]	PR[2]	VI[3]	Guam[4]	Total	MMB	
Jan 74	2,392	190	610	28	3,210	99.5	
Feb	2,248	190	398	28	2,864	80.2	
Mar	2,462	190	458	28	3,138	97.3	
Apr	3,267	190	381	28	3,866	116.0	
May	3,748	183	277	28	4,236	131.3	
Jun	3,957	239	561	28	4,785	143.6	
Jly	4,167	227	619	28	5,041	156.3	
Aug	3,852	211	354	28	4,445	137.8	
Sep	3,758	193	593	28	4,572	137.2	
Oct	3,936	190	344	28	4,498	139.4	
Nov	3,997	140	402	28	4,567	137.0	
Dec	3,979	159	854	28	5,020	155.6	
Jan 75	3,964	212	740	28	4,944	153.3	
Feb	4,061	228	429	28	4,746	132.9	
Mar	3,853	195	446	28	4,522	140.2	
Apr	3,416	221	467	28	4,132	124.0	
May	3,493	171	346	28	4,038	125.2	
Jun	3,907	185	311	28	4,431	132.9	
Jly	4,337	204	690	28	5,259	163.0	
Aug	4,661	178	689	28	5,556	172.2	
Sep	4,664	206	270	28	5,168	155.0	} 495.3[5]
Oct	4,416	170	807	28	5,421	168.1	
Nov	4,634	171	489	28	5,322	159.7	
Dec	4,496	220	590	28	5,334	165.4	

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1 Source: Monthly Energy Review December 1975 for data shown from January 1974 - December 1975.

2 Source: FEA Weekly and Monthly Petroleum Reporting System (WPRS and MPRS) for data shown from May 1974 - November 1975. FEA estimate for data shown for December 1975. Oil and Gas Import estimates for data shown for January 1974 - April 1974.

3 Source: Census Bureau, Summary of U. S. Export and Import Merchandise Trade for data shown from January 1974 - November 1975. FEA estimate for data shown for December 1975.

4 Source: FEA Entitlements Office.

5 Three highest consecutive months of crude imports. Total is 495.3 million barrels.

Under the legislation, FEA could, in this SPR Plan, propose a size which is less or more than the 495 MMB scheduled for 1982, ranging from 150 MMB to 1,000 MMB, without a change in the legislation. It was assumed that, as required by the statute, justification would be needed to propose any size other than approximately 500 MMB.

It is clear that the Act permits subsequent changes in the Reserve size, through amendments to the Plan. Thus, the reserve is not a static facility which, once a decision has been made, must remain bound by that decision.

U.S. VULNERABILITY

The appropriate size of the Reserve depends primarily on the estimates of the U.S. vulnerability to petroleum supply interruptions. The U.S. is vulnerable in three major ways to future oil supply interruptions, i.e., economic vulnerability, foreign policy vulnerability, and military vulnerability.

Based on the U.S. experience in the 1973-74 interruption, it is evident that a petroleum supply interruption can create major negative impacts on the U.S. economy. The reduction of petroleum supplies may result in a loss of employment and income to all sectors of the economy, higher petroleum prices, and in a general loss of welfare. In addition, simply the uncertainty about future availability of petroleum supplies can create a lack of confidence and cause an economic disruption.

The potentially severe economic impact of an oil interruption in turn creates foreign policy vulnerability. Influence over world petroleum supplies is a potent foreign policy tool for the major oil producing countries. The dependence of the U.S. on oil imports exposes it to threats of oil interruptions, as well as actual interruptions, which are intended to promote the objectives of the producing countries. This dependence reduces the flexibility of the U.S. in responding to certain international events, and may force the U.S. to take actions which are inconsistent with domestic or foreign policy objectives.

Heavy dependence on imported oil also can create a military vulnerability. With dependence on distant oil sources, there could be a reduction in petroleum imports to the U.S. and its allies in conjunction with a military conflict.

ESTIMATING POTENTIAL LOSSES OF PETROLEUM

In order to develop a Reserve that is adequate to diminish U.S. vulnerability, it is necessary to make an estimate of vulnerability in terms of the amount of oil that might be lost from interruptions.

In estimating potential losses there are several factors that have to be considered, including the following:

- o The time during which the SPR is to provide protection;
- o The level of imports during those periods;
- o The depth of import interruptions;
- o The duration of the interruptions; and
- o The implications of International Energy Program (IEP) emergency allocation measures.

Time During Which the SPR is to Provide Protection

Because of the time required to develop a Reserve, it will not be possible to develop a 500 MMB Reserve prior to about 1982. On the other hand, projections of import dependence and vulnerability beyond 1985 are difficult to estimate. Although the SPR is planned to provide protection for the decade of the 1980's and beyond, estimating its need beyond 1985 is not feasible now. Thus for this analysis, FEA has concluded that 1980 and 1985 should be used as the years for estimating vulnerability for current planning of the Reserve.

It will be necessary to reconsider this analysis in the future, as estimates of dependence and vulnerability for 1985 and beyond become clearer.

Level of Imports During This Period

FEA selected four estimates of future import levels for purposes of estimating vulnerability. They are a "1980 low", a "1980 high", a "1985 low" and a "1985 high" estimate. The import levels are shown in Table II-2.

Table II-2

1980 AND 1985 IMPORT PROJECTIONS-PLANNING ESTIMATES FOR VULNERABILITY ANALYSIS

(MMB/D)

Assumptions	Demand	Domestic 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 "high" levels represent moderately pessimistic estimates in view of current objectives for reducing dependence on oil imports. FEA believes that the "low" level for 1985 is attainable if the U.S. works to increase domestic production and improve energy conservation. For estimating vulnerability at this time, FEA believes it would be appropriate to focus on the 1980 high estimate of 7.5 MMB/D and the 1985 low estimate of 7.3 MMB/D. The trends in import levels must be evaluated in the future to determine whether this assumption should be changed.

The basis for estimating the 1980 and 1985 import levels is discussed in Appendix A.

Depth of Import Interruptions

The national security agencies have considered several possible import interruptions, both embargoes and physical interruptions. Two interruptions have been selected as being the most likely, designated Scenarios #1 and #2.

Scenario #1 assumes that embargoing countries would reduce all oil exports by 25 percent and deny all oil supplies to the United States, resulting in a daily total reduction of exports of 3.8 million barrels per day (MMB/D). It is assumed that there will be no excess capacity or surge production in non-embargoing countries. This scenario results in a shortfall to the U.S. of 3.7 million barrels a day. After implementing IEP emergency allocation measures the U.S. daily shortfall would be 1.7 MMB/D, assuming the 1980 high import level. Even without IEP assistance, the shortfall could be partially offset by obtaining oil from other countries.

Scenario #2 assumes that the same embargoing countries would reduce all oil exports by 50 percent and deny all oil supplies to the United States, resulting in a daily total reduction of exports of 8.3 MMB/D. Under the assumption of no excess capacity in non-embargoing countries, a shortfall to the U.S. of 3.7 MMB/D is projected. After receiving IEP allocations, the U.S. shortfall would be 3.3 MMB/D, also assuming the 1980 high import level.

These two interruptions, with variations regarding durations, import levels, and IEP emergency allocation, would result in shortfalls ranging from less than 500 MMB to over 1,000 MMB. Smaller, less likely, interruptions would be covered by a Reserve sized to meet either of these two scenarios.

For estimating the U.S. vulnerability to interruptions, both scenarios were analyzed.

Duration of Interruptions

The analysis considered three alternative durations, three, six, and nine months. Six month durations are believed to be possible for the two embargo interruption scenarios, in view of the experience with the 1973-74 embargo lasting five months. For estimating U.S. vulnerability, FEA has assumed durations of six to nine months.

Implications of International Energy Program Emergency Allocation Measures

Current contingency planning is based on the assumption that all IEP obligations will be met. To estimate U.S. vulnerability, therefore, FEA assumed that the U.S. would meet all of its obligations to other IEP countries and that the U.S. would receive its full IEP allocation rights when appropriate. In some cases the U.S. would be relying quite heavily on IEP allocations, as in the case of scenario #1. For scenario #2 there is relatively little difference in the loss to the U.S. with or without IEP assistance. Even without IEP assistance, the impact of an interruption could be partially offset by obtaining some supplies from other countries.

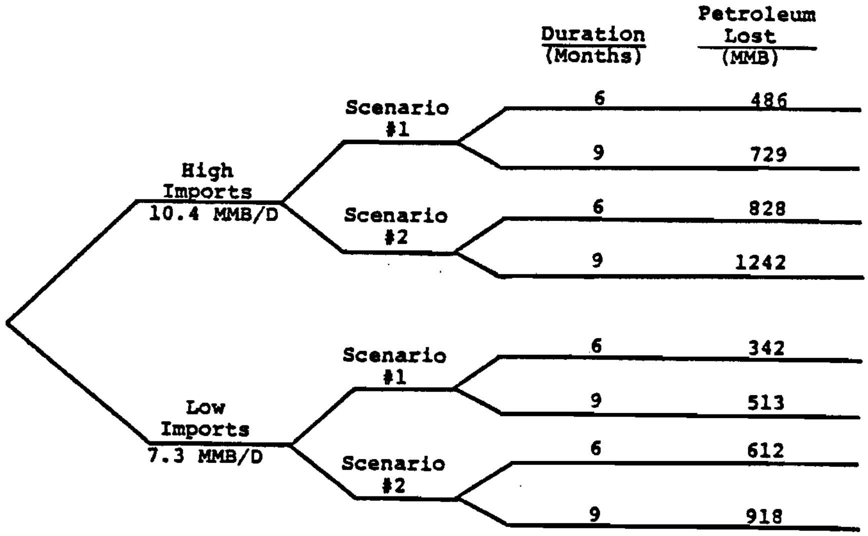
POTENTIAL PETROLEUM LOSSES

Based on the preceding estimates of import levels, depth of interruptions, duration and IEP assistance, potential petroleum losses were estimated. The potential losses for 1985 are shown in Figure II-1.

Figure II-1

POTENTIAL PETROLEUM LOSSES FOR 1985

(Assuming IEP Allocation)



(Only 1985 losses are shown here because the losses at the 1985 low imports level are similar to the losses at the 1980 import levels.) The losses range from a low of 342 MMB to a high of 1242 MMB, with IEP assistance.

APPROPRIATE RESERVE SIZE TO DIMINISH VULNERABILITY

To help determine the Reserve size that will adequately diminish U.S. vulnerability to the potential petroleum losses, several factors were considered, including estimates of demand restraint measures that could be introduced during an interruption, the extent to which industry inventories might be useful during an interruption, the ability to increase oil production from available fields, and the way a Reserve might be used.

Possible Energy Conservation Measures

To help determine the appropriate Reserve size, the analysis considered how much of the lost petroleum supplies could be offset by reducing consumption of petroleum so as to have minimal economic impact. If energy conservation measures could be implemented to reduce consumption in ways that have little adverse impact on the economy, it would be possible to reduce the reserve size accordingly.

FEA has been developing Energy Conservation Contingency Plans (ECCP) to be implemented in time of a petroleum supply interruption. These plans are under review in the Executive Branch prior to being submitted to Congress. This effort has considered a wide range of possible energy conservation actions which could reasonably be implemented during the relatively short time frame of a supply interruption, and which could avoid serious impacts on the economy. This planning has resulted in the development of five separate actions, as follows:

- Emergency heating, cooling, and hot water restrictions for public, commercial and industrial buildings (230 thousand barrels per day (MB/D));
- Emergency commuter parking management (125 MB/D);
- Weekend gasoline and diesel fuel retail distribution restrictions (160 MB/D);

- o Emergency boiler combustion efficiency requirements (50 MB/D); and

- o Emergency restrictions on illuminated advertising and outdoor gas lighting (5 MB/D).

These measures are estimated to reduce their respective types of consumption by the amounts indicated, for a total of 570,000 barrels per day. This is a reduction in consumption of approximately 2.8 percent.

In addition to representing only a small reduction in consumption, some of the actions would have a substantial impact on some parts of the economy. For example, the Weekend Gas Sales Restrictions plan is criticized for impact on the tourism industry and regions of the country which depend on tourism. The Outdoor Lighting Restrictions Plan is claimed to be an inequitable imposition on small businesses which depend on lighted signs as their principal form of advertising.

The results of FEA's economic analysis of two of the plans are summarized in Table II-3. The effects of the Weekend Gas Sales Restrictions plan are found to be the most severe of all of the plans. For example, GNP would be reduced by 0.6 percent, with a 200,000-person reduction in jobs. FEA's analysis of the economic effects for the other measures indicates no significant macroeconomic effects.

Although further analysis is being done to identify additional opportunities for energy conservation, it appears that it will be difficult to identify acceptable actions that will result in reductions substantially above three percent, without severe economic impacts. As part of the continuing analysis, consideration is being given to attaining seven percent and ten percent reductions in consumption. These were selected because they are goals of the International Energy Agency. The IEP requires that participating countries shall at all times have ready a program of demand restraint measures enabling it to reduce its rate of consumption in an emergency by seven to ten percent, depending on the level of the shortfall of supplies. However, in an emergency, participating countries may use emergency petroleum reserves held in excess of their IEP emergency reserve commitment, rather than take the reductions in consumption.

Table II-3

CHANGES IN SELECTED MACROECONOMIC VARIABLES DUE TO ECCP'S[1/]

	Weekend Gas Sales Restrictions	Commuter Parking Restrictions
Change in GNP $ billion	-11.12 (-0.60%)	+2.77 (+0.15%)
Change in Total Consumption Expenditures $ billion	- 8.71 (-0.74%)	+1.83 (+0.22%)
Change in Car Sales million units	-0.11 (-1.15%)	+0.06 (+0.66%)
Change in Persons Employed thousands	- 200 (-0.24%)	+ 120 (+0.14%)

1/ The other ECCP measures have negligible impacts on the macroeconomic variables included in this table.

At the seven percent level, demand restraint would reduce consumption by 1.4 MMB/D, or 252 MMB in six months; the corresponding figures for ten percent demand restraint are 2.0 MMB/D and 360 MMB. The attainment of seven and ten percent demand restraint levels could only be achieved over an extended period of time with full cooperation of all energy-consuming sectors in the United States. Such reductions are likely to require gasoline rationing and other fairly severe measures.

With the primary purpose of the Reserve being to minimize the vulnerability of the U.S. to interruptions or the threat of interruptions, the Reserve should be sized to avoid the need for reductions in consumption which would cause significant economic impact or create strong social/political pressures on the Government for alternative actions to bring relief.

Clearly, full replacement of the lost petroleum during an interruption would minimize the economic losses and any political pressures. It is estimated, however, that a reduction of up to three percent can be obtained by the end of three months with a relatively small impact on GNP. It should be possible to obtain a three percent reduction in consumption through a directed conservation effort, with relatively little loss of petroleum for higher priority activities. If an interruption extended to six months, it might be feasible to reduce consumption by about six percent by the end of that period by a continued gradual phasedown of consumption. This would result in an average reduction of three percent over the six months.

More rapid or deeper reductions would be much more difficult to achieve except through general shortages of petroleum which would have serious economic effects and place strong pressures on the Government to take alternative actions to end the interruption.

The economic losses resulting from demand restraint reduction are reflected in an estimated cost of six billion dollars in GNP loss from an average reduction of seven percent for six months and an estimated GNP loss of $12 billion from an average reduction of 10 percent for six months. The economic impacts resulting from reductions in energy use will vary significantly depending on how and where the reductions are made. The impacts stated above have been calculated based on estimating primary impacts on the total economy of a generalized reduction (seven or ten percent for six months). The economic impact could be more or less severe than these estimates indicate, depending on the types of action taken.

With the objective of diminishing U.S. vulnerability to interruptions, FEA believes it is appropriate at this time to plan the Reserve size assuming that conservation savings would reduce consumption on a linear basis throughout the duration of the interruption to obtain a three percent reduction after three months, and a six percent reduction after six months, for an average of three percent in six months. If the reduction rate were continued beyond six months, it would result in a nine percent reduction by the end of nine months. This approach would allow the Reserve to be used to cushion the impact on the economy, and would result in a reduction in consumption of about 27 MMB during three months, about 108 MMB during six months, and about 243 MMB during nine months.

Industry Inventories

Industry normally maintains levels of inventories that are somewhat larger than the minimum essential levels required to continue operations. The largest portion of the inventories is required to maintain the regular flow of petroleum through the distribution system, but some inventories are maintained to protect against contingencies such as surges in demand or shortfalls in supply, and to accommodate seasonal changes in product demand.

Industry stocks of petroleum at the primary level are estimated to total approximately 820 MMB, consisting of about 280 MMB of crude oil and 540 MMB of a variety of products. There are estimated to be a few hundred million more barrels of refined products stored by secondary distributors and users. Much of this inventory could not be used during an emergency, because it is needed to keep the petroleum distribution and refining system operational. The unavailable quantity is in the form of pipeline charge, refinery charge, tank bottoms and products in various stages of transit. It has been estimated that about 80 percent of the crude oil inventory is needed to keep the system operating smoothly, and that about 75 percent of the product inventories is needed to avoid distribution problems.

During a major supply interruption, it would be possible for industry to take actions to draw down inventories below the minimum levels normally needed for efficient operations. This is discussed in detail in Chapter V. This could be done by industry on a one-time basis at the outset of an interruption if the inventories could be restored to minimum efficient levels as the Reserve petroleum becomes available.

Experience during the 1973-74 embargo indicates that industry will not draw down inventory levels below minimum efficient levels without assurance of replacement supplies to quickly restore the inventories to permit continued operations.

It is estimated that only about 50 to 60 MMB of current crude oil inventories could be considered as a substitute for Reserve storage (the amount in excess of 80 percent of inventories). It is assumed that a temporary drawdown of inventories by more than about 60 MMB would be done only if industry could quickly replace the oil by drawdown from the Reserve.

It is not evident at this time that any of the refined product inventories should be relied upon as a substitute for crude oil in the Reserve. In order to use refined products as a substitute for Reserve crude oil, it would be necessary to plan to reduce or shut down certain refinery operations during an interruption while the refined product stocks are being reduced. FEA plans to study further the feasibility of relying on refined product stocks as a substitute for crude oil in the Reserve. Pending a more detailed analysis of the availability of refined product inventories, and further projections of needs by product type during an interruption, FEA believes that it would be unwise to rely on refined product inventories to reduce the level of crude oil in the SPR.

Ability to Increase Production from Available Fields

The ability to obtain above-normal amounts of production from oil fields that are not affected by an interruption has been considered. If such increased production were possible, it could permit a reduction in the Reserve size.

The projections of normal production rates in the 1980's are, of course, uncertain, but they indicate essentially no excess capacity in the U.S., or in any other country that is likely to be supplying the U.S. in the event of the interruptions discussed above. This is unlike the 1973-74 interruption when there was some excess capacity available in countries not participating in the embargo.

Under some circumstances, oil production can be increased through a "surge" above the maximum efficient rate of recovery (MER). Surge production, according to the definition of the MER, may have serious adverse effects on reservoir pressure and other engineering concerns and may reduce ultimate recoverability. The long-term costs to the oil producers would be high, and it is not certain that adequate incentive would exist for the surge. Surge production is therefore a highly uncertain contribution during an emergency, and should not be relied upon in planning the SPR size.

Use of a Reserve

In determining the desired size of the Reserve, consideration was given to the relationship between Reserve size and how the Reserve might be used during an emergency.

Experience with petroleum reserves in some other countries during the 1973-74 embargo indicates that small reserves may not be used at all during an embargo interruption because the duration of the interruption is unknown and the reserves are not large enough to significantly offset the oil losses for a lengthy period; there may be a desire to "save" the reserve in case conditions become more critical. A reserve that is not used has no value in reducing economic vulnerability. It also does not reduce foreign policy vulnerability if the Government is not confident that the reserve can substantially negate the impact of likely interruptions.

A large reserve is more likly to be used to minimize the economic impact of an interruption, thereby substantially increasing its economic value. It also would reduce concern among Government officials regarding threats of interruptions.

If a Reserve is to be developed at all, it should be large enough to overcome the reluctance to use it effectively. To help estimate the size of a reserve needed to overcome that reluctance, it was assumed that a reserve should be large enough to permit a drawdown of enough oil each day to cover the import losses (after demand restraints), while not using more than 2.3 percent of the remaining reserve each day. This exponential drawdown strategy would gradually reduce use of the Reserve, and extend its availability indefinitely. For purposes of estimating an adequate size, a drawdown ceiling of 2.3 percent per day of the remaining Reserve was selected. The conservatism reflected in this ceiling rate means that in planning for a six month interruption the Reserve would have to be large enough to have about 15 percent of it remaining at the end of six months.

Table II-4 shows estimates of the Reserve size needed to cover the potential losses shown in Figure II-1. These sizes assume full replacement of import losses after taking the demand restraint reductions discussed above, and without relying on any industry inventories or surge production capacity. These sizes would still leave enough of the Reserve remaining at the end of the interruption to assure that the Reserve is used effectively. If industry crude oil inventories were relied upon, these sizes could be reduced by about 60 MMB.

Table II-4

RESERVE SIZES NEEDED WITH EXPONENTIAL DRAWDOWN RATE (MMB)

	Potential Petroleum Losses		Reserve Size Needed	
	1985 Imports		1985 Imports	
	Low	High	Low	High
Scenario #1				
6 mos.	342	486	265	445
9 mos.	513	729	275	521
Scenario #2				
6 mos.	612	828	600	869
9 mos.	918	1242	744	1120

As with other strategic systems, two important measures of the effectiveness of a Reserve will be its value in deterring embargoes and the amount of time it provides the U.S. to resolve the causes if an interruption occurs. The deterrent effect is likely to be related to the perception by potential embargoing countries of the willingness of the U.S. to use the Reserve effectively. If the Reserve is large enough to permit an exponential drawdown policy as discussed above, it is likely to have a strong deterrent effect because of the perception that it will be used effectively, and in the event deterrence fails it will provide substantial time to resolve the problem.

SELECTION OF APPROPRIATE RESERVE SIZE

In view of the range of possible Reserve sizes shown in Table II-4, the question is what size is the most appropriate for current planning. Is there a basis for selecting a size other than 500 MMB barrels?

Two alternatives to a 500 MMB size are discussed below:

275 MMB: -- This level would cover the six and nine month shortfalls under scenario #1.

800 MMB: -- This level would cover a nine month scenario #2 embargo at the low import levels. It would be adequate for a six month scenario #2 embargo if high import levels are assumed for 1985.

RESULTS OF ANALYSIS OF ALTERNATIVE SIZES

500 MMB Size

A 500 MMB Reserve would permit essentially full replacement of lost imports under scenario #1, for nine months, assuming an import level of up to 10.4 MMB/D in 1985. For scenario #1, it would provide ample flexibility of response to largely prevent an impact. It would make the U.S. essentially invulnerable to the more likely scenario #1.

Under scenario #2, a 500 MMB size would be marginally adequate for six months, assuming some use of industry inventories and recognizing that the exponential drawdown estimate would leave about 75 MMB in storage at the end of six months. With 500 MMB it would permit the U.S. to essentially fully offset the import losses of a deep interruption like scenario #2, for several months, to provide time for foreign policy actions without the domestic pressures brought about by a severe shortage of petroleum.

A major advantage of a larger Reserve is the time provided to resolve the cause of the interruption, whether it is an embargo or a physical interruption. Policy makers would have a reasonable period of time to address the underlying causes without the pressure of severe economic losses.

275 MMB Size

A 275 MMB Reserve would be able to cover a scenario #1 interruption for nine months, assuming the low import levels in 1985. It would cost about $3.7 billion less than a 500 MMB size.

The major weakness of this size is that it would not be able to effectively offset the impact of a severe interruption. With only 275 MMB, an interruption of the depth of scenario #2 would require the U.S. to begin quite severe reductions in consumption within a few weeks after the start of an embargo. Because of the uncertainty about duration, the U.S. would not be able to afford to wait to begin such reductions. Therefore a major interruption would likely have the desired effect (for the embargoing countries) of requiring sizeable reductions in U.S. petroleum usage (and the resulting economic dislocations) within a few weeks after initiation of an interruption. It also would force the U.S. to continue to be very concerned with threats of interruptions because of the lack of confidence that the Reserve is adequate.

800 MMB Size

An 800 MMB size would provide a high level of insurance, assuming imports in the 7.5 MMB/D range, and would be particularly desirable if the high import levels are assumed for 1985. An 800 MMB Reserve would make the U.S. largely invulnerable to a scenario #2 interruption of up to nine months duration at the low import level and for six months at the high import level. A Reserve of this size would provide the confidence necessary to permit its immediate use at the outset of a scenario #2 interruption and provide essentially complete replacement of lost imports for several months. This would permit reasoned efforts to resolve the problems leading to the interruption in a manner acceptable to the U.S., without a severe economic cost to the country. This size would largely negate the effectiveness of any threats of planned interruptions, except for the most critical situations.

An 800 MMB Reserve would cost about $5 billion more than a 500 MMB Reserve. In order to adequately justify the higher costs of this alternative, it would be necessary to assume the high import levels in 1985.

FEA believes that this Nation can hold down its dependence on foreign oil through reasonable efforts to increase domestic production and conserve energy; and thus, it is appropriate at this time to plan for the low import level in 1985.

In regard to the question of whether the Reserve should be sized to respond to an extended wartime interruption of petroleum, FEA believes that further study of that issue would be desirable before recommending an increase in the Reserve size for that purpose. In view of the high costs of developing a Reserve that could adequately respond to an extended wartime interruption, there needs to be further analysis of the likely depth and duration of such an interruption and of alternatives for limiting the vulnerability. Since it now appears that the end of 1982 is about as soon as we can economically build a 500 MMB Reserve, a decision does not have to be made now on whether to expand the Reserve.

Conclusions Regarding Changing the Reserve Size

There appears to be no strong basis for proposing a change in the size of the Reserve at this time, based on the objective of diminishing vulnerability.

If trends in import levels, changes in the international energy scene, or other analyses indicate that 500 MMB would be inappropriate, FEA will propose a Plan Amendment later to increase or reduce the size.

ECONOMIC ANALYSIS -- COSTS AND BENEFITS OF THE RESERVE

To extend the investigation of the size of the Reserve, an analysis was conducted to determine whether a 500 MMB size would be cost effective in terms of savings to the economy. The methodology and the detailed results of the study are included in Appendix A.

The analysis produced no clearly optimal size for the Reserve. It indicates that any Reserve size is cost beneficial if it is assumed that a shortfall <u>will</u> occur that would require use of the bulk of the Reserve. If it is assumed that smaller (scenario #1) shortfalls have a higher probability than large shortfalls then small Reserve sizes become more attractive in terms of cost-benefit ratios. The major weakness of a small Reserve, from a cost-beneficial viewpoint, is that it is quickly exhausted, resulting in a large economic loss. Also, the benefits from a small Reserve size may be overstated because of the probability that a small Reserve would not effectively reduce all economic impacts, since it would deal with only part of a large interruption.

A 500 MMB Reserve would have net benefits of about $8.75 billion if a single 500 MMB shortfall occurred in fifteen years. It would continue to have a positive cost-benefit ratio if only a single 200 MMB shortfall occurred in fifteen years.

The probability analysis shows that even if there is only a 3 percent annual probability of a 500 MMB shortfall, a 500 MMB Reserve would be a cost-beneficial investment.

A 275 MMB Reserve would have net benefits of about $5 billion if a 275 MMB shortfall occurred. It would continue to have a positive cost-benefit ratio if only a 150 MMB shortfall occurred.

This size clearly would have a high cost-benefit ratio if larger shortfalls occurred, but the net benefits would be less than from a 500 MMB Reserve for large shortfalls. For example, for an 800 MMB shortfall, the net benefits from a 275 MMB size would be $18 billion, compared with $30 billion for a 500 MMB size.

The primary weakness of a 275 MMB size compared with a 500 MMB size is the GNP loss under large interruptions. For a 500 MMB shortfall, a 275 MMB Reserve would have a remaining GNP loss of about $10 billion, compared with $4.6 billion with a 500 MMB Reserve (in 1975 dollars without discounting).

An 800 MMB Reserve would have the disadvantage of negative net benefits for smaller shortfalls, below about 250 MMB. If it were assumed, however, that there is an equal probability of a shortfall of 275, 500, or 800 MMB, this size provides the highest net benefits. This size would have the advantage of minimizing GNP lost in the event of a large shortfall. The major weakness of this size from a cost-benefit viewpoint is the low probability of a shortfall in the 800 MMB range, if we assume the 7.4 MMB/D import level in 1985.

In summary, the cost-benefit analysis shows that both a 275 MMB size, and a 500 MMB size would be attractive from a cost-benefit viewpoint, based on current estimates of likely shortfalls. It would be difficult to justify an 800 MMB size on a cost-benefit basis, unless it is assumed that there is a high probability of imports at the 10 MMB/D level in 1985. Even then, it would not be necessary to start construction on such a large Reserve now.

DRAWDOWN CAPABILITY

A related question to the Reserve size is the maximum daily drawdown capability of the Reserve. This feature of the Reserve directly influences possible coverage and, therefore, the vulnerability of the U.S.

The initial planning for the Early Storage Reserve provided for 150 days for drawdown of the Reserve. If this were applied to a 500 MMB size, the drawdown rate would be 3.3 MMB/D. The question then is whether 3.3 MMB/D is reasonable based on the scenarios and shortfalls assumed.

The upper limit on needed drawdown capability is established on the basis of the petroleum shortfall due to a given supply interruption. The following table shows the plausible daily shortfalls for 1980 and 1985 for the scenarios considered.

Table II-5

DAILY SHORTFALL
(MMB/D)

Scenario Number	1980 Low Imports	1980 High Imports	1985 Low Imports	1985 High Imports
1	1.7	1.7	1.9	2.7
2	2.8	3.3	3.4	4.6

With relatively low demand restraints (less than 3 percent), the President would have the flexibility to draw down the Reserve to completely replace the lost imports under scenarios #1 and #2, assuming an import level of about 7.5 MMB/D in 1980 and 1985. Accordingly, it is concluded that a maximum drawdown rate of 3.3 MMB/D would be desirable and adequate.

If import levels were to increase significantly above the 7.5 MMB/D level, this proposed drawdown capability may not be adequate. The issue of the daily drawdown capability will be reviewed periodically, along with the size of the Reserve. An increase in Reserve size also may provide for an increase in the daily drawdown capability.

ANALYSIS OF CRUDE OIL TYPES TO BE STORED

Background

Optimization of the crude oil mix to be stored involves a tradeoff between the cost of building the storage system, the acquisition cost of each crude oil, and the ability of the refining industry to convert such crudes into the desired, environmentally acceptable product mix. A large number of individual crudes could be stored, providing an apparent flexibility for refinery processing. This approach, however, would be the most expensive solution in terms of the cost of the storage facilities. FEA studies indicate that each additional crude oil segregation adds approximately $.15 per barrel to the total cost of storage at that location. It also would significantly increase the problems of assuring that the desired crude type is provided to the appropriate refineries.

In addition to refinery compatibility, cost, and availability, FEA has established storability criteria for SPR crude oils. These criteria include a maximum pour point of 30 degrees F to avoid solidification in storage facilities. A maximum desired viscosity of 100 SSU at 60 degrees F with an absolute maximum of 200 SSU at 60 degrees F was also established to assure compatibility with pump and pipeline design specification. A desired heavy metals content of 125 parts per million with no absolute maximum was also adopted to avoid refinery catalyst contamination problems.

Analytical Approach

Development of the desired list of crudes to be stored followed from the application of two independent refinery model approaches. The first approach involves the application of historically validated refinery Linear Programming models aggregated by BOM Refining Districts projected to the 1980 timeframe, while the second approach used was to evaluate crude oil candidates on a refinery by refinery basis in the year 1975.

Composition of the crude to be stored was determined by the more precise refinery Linear Programming model technique.

The methodology employing the refinery Linear Programming technique is characterized as follows:

- Initial efforts were directed to accumulation of crude assays for major crude oil sources which could be candidates for SPR fill. This resulted in consideration of about 50 individual crude sources.
- Ranges were established for each important quality and yield for each crude, to segregate the crudes into categories or types. For example, a density range of 5 degrees API was chosen.
- The availability of each crude type, in 1974 and 1980, was estimated.
- Market prices of the foreign crudes were estimated.
- A forecast was developed of the U.S. 1980 "normal situation."
- 1980 U. S. refining capacity was estimated, and refining capacity utilization was forecast.
- Refinery raw material and production allocations for the 1980 normal environment were developed.
- A supply and demand balance for each refining district for both crude oil and petroleum products was derived.
- A number of supply interruptions were postulated and the losses of crude oil by type and volume were estimated.
- The volume of crude oil supplied to each of the refining districts from interrupted sources was deleted from the available raw material supply. Each district was then allowed to choose the optimum amount of the different crude types, at the current CIF prices. The refinery LP models for the BOM Refining Districts 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 Hawaii, Guam, Puerto Rico and the Virgin Islands was calculated by hand.

This analysis is discussed in detail in Appendix B.

The second method for evaluating crude storage candidates involved the use of small refinery simulation models. One such model was built for each refinery in the United States that processed imported crudes in 1975. Each model was "benchmarked" with the refinery's 1975 input of domestic and imported crudes, its major unit capacities, and its 1975 product yields. Storage crude candidates were evaluated in each refinery model by substituting them individually for crudes that were assumed unavailable under a particular interruption scenario. The desirability of each storage candidate was determined by comparing the refinery's simulated product output with its pre-embargo product output.

For each refinery, the simulation models predict the yield of major products (gasoline, kerosene, distillate, and high- and low-sulfur residual) that result when a certain slate of crudes is charged to the refinery. Each model simulates the following sequence of refinery operations:

- Crude is cut by the atmospheric distillation unit (up to its capacity) into two naphthas, kerosene, light gas oil, and reduced crude.

- Reduced crude is cut by the vacuum distillation unit (up to its capacity) into light gas oil, heavy gas oil, and vacuum residual oil.

- A series of conversions is then performed on these cuts. A preassigned priority scheme maximizes the yields of the most valuable products, subject to the capacities of conversion units (reforming, hydrocracking, catcracking + alkylation, gas-oil desulfurization, coking, vis-breaking, and residual desulfurization) and the volume quantities of the cuts. Yields in the reforming, catcracking, and desulfurization units depend on crude assay characteristics.

- The intermediate products (ten gasoline stocks, nine gas-oil and residual stocks) are blended to meet the following specifications: research octane on gasoline, weight percent sulfur on fuel oils, and viscosity on residual fuel oils. Residual fuel oil is split into two pools according to total sulfur content.

- o These yields are adjusted by a set of correctors generated by "benchmarking" each model on 1975 import, capacity, and yield data.

The simulation models also calculate the refinery's operating cost for processing each crude slate. This cost is based on a "Nelson Index" approach to predicting refinery operating costs, using a refinery complexity factor (summed weighted ratios of major conversion unit capacities to total crude capacity) and the percentage capacity utilization of major units.

These simulation models were used to predict the reaction of each refinery to a crude mix consisting of uninterrupted pre-embargo crudes and each storage candidate crude. Output information for each simulation run (one refinery operating on one crude candidate constitutes a run) includes the volume of total crude charged, volume of storage crude charged, refinery operating cost, and the volume yields of gasoline, kerosene, distillate fuel, low-sulfur residual, high-sulfur residual fuels, and "other petroleum products."

Numerous evaluation runs were made to determine the impact that candidate storage crudes would have on regional refinery product yields. The output from these runs was processed to determine the least cost assignment of crudes to refineries that would result in the maintenance of pre-embargo regional refinery yields.

Results of the Analysis

The analysis resulted in the selection of the following possible combinations of crude oil as being the most desirable for storage in the Reserve:

1. Type I: Intermediate - High Sulfur
   Type II: Very Light - Low Sulfur

2. Type I: Intermediate - High Sulfur
   Type III: Intermediate - Low Sulfur

3. Type I: Intermediate - High Sulfur
   Type IV: Light - Low Sulfur - Low Mercaptan

4. Type I: Intermediate - High Sulfur
   Type II: Very Light - Low Sulfur
   Type IV: Light - Low Sulfur

Approximately 60 percent of the Reserve should consist of the Type I crude. The remainder could be one or two of the Types II, III, and IV.

This will permit storage of only two or three types of crude oil in the SPR, thereby minimizing development costs and simplifying the distribution of the oil during an interruption.

The selected crude types will permit the SPR to provide replacement crude oil that will be acceptable to any affected refinery, and will permit the production of an acceptable range of products. These crude oil combinations are the least cost alternatives which allow refineries to produce the same product yields as were produced in the 1980 pre-interruption base case. If only one type of crude oil were selected for storage, it would have to be a relatively expensive light low sulfur crude. In effect, this would mean that during an embargo the average refinery would be processing a better (and hence more expensive) crude oil than is needed to meet product specifications. The inclusion of higher sulfur crudes (Type I) in the storage mix reduces the costs of the total stockpile, without violating environmental standards for refined products.

This list of storage alternatives will provide flexibility in the crude oil procurement process while simultaneously reducing the risks of adverse market impacts of this procurement. The low sulfur crude oils designated by Types II, III, and IV, are about equally available and, if stored in the proper mixes, will be suitably compatible with refinery requirements.

The alternatives provide a framework for the crude oil acquisition process described below as well as for the site development efforts. Final decisions concerning which of these crude oil types to acquire will follow from continuing trade-off studies which account for crude oil market availabilities and prices in addition to all the factors influencing SPR site development, fill, and operation. The least cost SPR can be achieved if a posture of flexibility is maintained in the procurement process to permit consideration of a range of offers during the acquisition and development phases.

CRUDE OIL ACQUISITION FOR THE STRATEGIC PETROLEUM RESERVE

FEA intends to propose use of the authorities granted in the Emergency Petroleum Allocation Act (EPAA) to allow the Government to obtain the benefit of domestic price controls for imported crude oil for the SPR to the same extent that those benefits accrue to domestic refiners that process imported crude oil under FEA's domestic crude oil allocation (entitlements) program. The Government would engage in competitive procurement but would expect to receive the benefits of cost equalization through amendments to be proposed to the entitlements program. This proposal is only one of several options examined by FEA, and a final choice will be made following completion of the review process including the requirements of the National Environmental Policy Act of 1969.

Under this proposal the Government would acquire crude oil to fill the SPR pursuant to the Federal procurement laws and regulations, probably by using negotiated procurement. Sellers, however, would be able to earn or be required to purchase entitlements for volumes sold to the Government by inclusion of those volumes in their crude runs under the entitlements program. Depending upon the source of crude oil, a refiner would either be required to purchase or be permitted to sell additional entitlements for the crude sold to the Government. FEA currently is considering the possibility of extending this treatment to importers as well as refiners.

The entitlement benefit or obligation (depending on whether imported or domestic oil is involved) would flow through to the Government since suppliers' offers would be subject to downward adjustment by an amount equal to the value of entitlements at the time of supply. The price to the Government should be roughly equal to the national average composite price to refiners (including imports).

This procurement approach will require modification of the existing domestic crude oil entitlements program, so that persons making sales to the Government would include within their volumes subject to cost equalization any amounts of domestic or imported oil sold to the Government for the SPR. Thus, for example, a refiner's entitlement rights or obligations would be based on his runs to still plus sales to the SPR.

If acceptable offers are obtained from U.S. sellers, this approach would reduce the need for direct Government involvement in the world oil market.

This procurement approach is also calculated to have the least adverse impact on the competitive environment in the industry. The "burden" of providing the SPR oil at near the national average composite price would be spread among U.S. refiners/importers and petroleum consumers through the entitlements program, in the form of slightly higher costs for crude and higher product prices (estimated to be less than two-tenths of a cent per gallon on the average over the acquisition period).

FEA believes that its proposed approach would be consistent with Federal procurement laws and with the objectives of the EPAA. The SPR would be filled without the need for any compulsory sales to the Government. Finally, this approach would be expected to allow FEA to meet the EPCA objective of minimizing the cost of the SPR.

All potential sellers, both foreign and domestic, would be given an opportunity to present offers under this option. The Government would be free to consider all valid offers, including those of foreign offerors which might reflect a discounted price for foreign oil, thus preserving the opportunity to reduce the total cost to the economy. In addition, it should permit relatively low net costs to the budget of the SPR oil (near the national average composite price). Therefore, budget costs should be reduced by about $2.25 a barrel compared with Government procurement at world market prices. This reflects the estimated average differential between import prices and national average composite prices until price controls end.

FEA's approach would require industry and petroleum users, in effect, to pay some of the costs of the SPR oil, by paying the higher costs of imports to compensate for oil sold to the SPR. Industry and consumers would pay about $470 million of the SPR oil cost between now and May 31, 1979, assuming an average differential of $2.25 a barrel and purchases of 210 MMB by the time price controls are due to end on May 31, 1979.

This approach appears to be the most desirable in view of the opportunity it provides to hold down the budget costs of the SPR and to pass along some of the SPR costs to the oil industry and consumers in a way that avoids serious inequities among firms or users of oil. This approach can also be tailored to permit FEA to test the feasibility of obtaining significant discounts on foreign oil. Thus, the requests for proposals will make it clear that the award decision will consider the cost to the economy as well as the cost to the budget. If significant discounts are offered directly from foreign sources, FEA will then be able to consider the desirability of accepting such offers for at least a part of the SPR needs, even though costs to the budget -- but not to the economy -- may be higher than for other offers.

At present, FEA is authorized to buy only the first 150 million barrels of petroleum for the ESR. A request for authorization of appropriations of funds to purchase the balance of the petroleum required for the entire SPR will be submitted to the Congress in the spring of 1977.

Alternative Approaches Considered

In addition to the preferred approach outlined above, FEA has considered several other options and has reached a preliminary conclusion that they are not as desirable as the option outlined above. This conclusion will be reconsidered if the proposed option subsequently appears to be infeasible or disadvantageous. Several of these options are noted below.

Purchase the Oil Without Using FEA Regulatory Authorities

FEA could purchase oil at lowest possible prices from foreign or domestic sellers, without any use of the FEA regulatory authorities to reduce the price. This option is undesirable because it is considered unlikely that it would result in significantly greater discounts on foreign oil than might be obtained under the preferred approach, and discounts of about 20 percent below normal import prices are likely to be needed to make this option comparable to the preferred method in terms of budget costs.

Use Royalty Oil

This approach would impact small refiners that now rely on and benefit from access to royalty oil that is produced from U.S. Government lands. It would be necessary to terminate existing Interior Department royalty oil contracts to use this oil. The supply of royalty oil is not sufficient for the SPR, and even if this approach were adopted, other oil would be required. Also, transportation costs for moving this widely dispersed oil to any market will be substantially greater than the cost of unloading ocean tankers into reserve facilities.

This approach would have unfavorable impacts that would extend beyond the small refineries immediately concerned. Offshore royalty oil (which is the oil which would be most desirable to use) has been sold since 1973 to small refiners to deal with a shortage of crude oil on the world market, which first emerged then. Strong patterns of use and reliance on it have developed. These patterns do not relate to the physical qualities of the oil or to the transportation system, since the oil is exchanged for oil from other sources. Instead, they relate to the financial benefits of having preferential access to price-controlled old oil. The refinery entitlement preference for small refiners provided for in EPCA has made access to this oil of considerable financial benefit to these refiners. Access to this oil has also lowered the legal ceiling prices for sales of products by the refiners currently receiving it. The result is that access to royalty oil has benefited customers of small refiners buying gasoline and other price-controlled products. It is possible that even with decontrol of gasoline and other products that some part of these savings would be passed on to the consumers.

If royalty oil were taken in kind for storage in the SPR or for exchanging for more suitable or readily available oil, the revenue given up by the Government would be less than the expected purchase price for the oil. Under current contracts, royalty oil sells for an average price of about $7.82 per barrel (May 1976), much of it being old oil. The national average price was $10.31 at that time and the average import price was $13.58.

The possible use of royalty oil will continue to be reviewed. If changes in the use or estimated costs of royalty oil make this an attractive option for a portion of SPR needs, the oil acquisition plan will be revised accordingly, with an appropriate submission for Congressional review.

Use Naval Petroleum Reserve Oil

Acquiring NPR oil appears to have few advantages. It would have little or no budgetary benefit compared with purchases at world market prices, and it would have higher budget costs than the national average composite price during price controls. Its use would also create administrative difficulties because of transportation problems or the need to exchange it for other crude oil. Since it is sold competitively without price controls and is located at a great distance from the expected SPR reserves, it is more cost-effective for the Government to continue to sell the NPR oil on the market. This provides revenues to the Federal budget that reduce the total Federal outlays.

NPR oil is free of price regulation under P.L. 94-258, and is sold competitively. Present regulations treat NPR oil as imported oil for entitlements purposes, so that it can be expected to sell in new contracts at prices equivalent to import prices. While price controls continue, it is expected that the price before entitlements will remain substantially above the effective average acquisition price for large refiners.

Only Stevens Zone oil from Elk Hills meets the crude oil specifications required by the SPR. Stevens Zone production is expected to be about 30 to 35 MMB per year. Transportation costs to Gulf Coast storage sites via coastal shipping, however, would make storage of NPR oil more costly than exchanging it in West Coast markets for delivery of other oil to the Gulf Coast sites.

SPECIFIC OIL ACQUISITION STEPS

The SPR oil will be purchased under the Federal Procurement Regulations (Title 41, CFR Chapter 1) by the FEA or another Government agency (e.g., the Department of Defense through Defense Fuel Supply Center) acting as an agent on behalf of the FEA. An interagency agreement will be prepared as required.

A request for proposals for crude oil required will be prepared calling for offers on at least two crude types. Due to cost-benefit trade-offs and some program uncertainties that can be evaluated only after receipt of offers, the solicitation is expected to be structured so as to maximize FEA's flexibility. To the maximum extent possible, it will detail specifications for alternate crude types (i.e., maximum allowable sulfur content, gravity, etc.), quantities, timeframes, loading and discharge criteria, inspection and acceptance clauses, notification of award procedures and evaluation criteria.

Among the evaluation criteria will be included: environmental protection, laid-down cost (considering cost to the economy as well as cost to the budget), delivery schedules, and loading facilities.

Procurement will be initiated approximately six months prior to the expected date that the first storage site is expected to be capable to receive and store product.

The Government will assume ownership of the petroleum at point of loading on FOB origin contracts or at the delivery point specified under those contracts of the "destination delivered" type. Some offers of each type may be accepted.

Delivery to the storage location may involve several modes of transportation prior to arrival at the site. Some shipments could start by loading on VLCCs (very large crude carriers) and be brought into transshipment points (storage) and then loaded on smaller tankers; or VLCCs may cross load directly to smaller tankers. The smaller tankers (50 MDWT) will discharge at docks where arrangements will have been made to pump directly to Government storage via Government-owned or leased pipelines or through common carrier pipelines. Depending on the distance from dock to site, intermediate storage may have to be arranged. Each time the petroleum changes mode of delivery or is temporarily stored, quality/quantity inspection will be accomplished.

All feasible modes of transportation (tankers, barge, pipeline) will be considered, evaluated and utilized as necessary. Site specific transportation modes will depend on final site selection.

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CHAPTER V

STORAGE FOR THE REGIONAL PETROLEUM RESERVE AND NONCONTIGUOUS AREAS

CONCLUSIONS

The EPCA requires that the SPR Plan provide for the establishment of a Regional Petroleum Reserve (RPR) in, or readily accessible to, any FEA region that imported 20 percent or more of its refined product demand during the preceding 24 months. FEA Regions 1 through 4 meet these criteria due to high imports of residual oil. The EPCA also states that the SPR should 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 SPR within its respective territory."

FEA has concluded that storage of crude oil in large centralized facilities in the Gulf Coast area would provide a Reserve that would be readily accessible to Regions 1 through 4, and would effectively meet the crude oil, residual oil and refined product needs of those Regions as well as all other Regions of the country, in the event of a petroleum supply interruption, without delaying or otherwise adversely affecting fulfillment of the purpose of the RPR. FEA also has determined that it would not be practicable or necessary to store a portion of the Reserve in the noncontiguous areas of the country. Storage of crude oil in centralized facilities in the Gulf Coast area would permit ready and nondiscriminatory protection for the noncontiguous areas.

Sufficient transportation and refining capacity is forecast to be available to distribute and refine the centrally stored crude oil with no adverse effects on either the Regions or noncontiguous areas. The availability of crude oil and refined product inventories for the Regions and noncontiguous areas, as well as imports in transit, will provide adequate time to obtain crude oil from the central Reserve, transport it to refineries, and distribute the refined products to users before Regions or noncontiguous areas are impacted in the event of a severe supply interruption.

All Regions and noncontiguous areas will be protected by the planned central Reserve, and by a system of petroleum allocation to assure that all areas of the country will receive an equitable share of available crude oil, residual, and refined products. The allocation system will assure equitable distribution of all available crude oil, including continued imports, domestic production and SPR oil. The allocation program also will be designed to assure that residual oil and refined products are produced and allocated equitably throughout the country.

The analysis of the impact of an interruption in petroleum supply considered the needs of all regions in addition to Regions 1 through 4. In particular, consideration has been given to the ability of the SPR and the associated distribution plan to assure protection of areas such as the West Coast, and the Northern Tier region. It is concluded that the planned system and allocation procedures will assure equitable protection of all areas of the United States.

Storage of a portion of the Reserve in the Regions or in the noncontiguous areas would reduce the overall flexibility of the Reserve, increase the potential environmental problems, and significantly increase the cost of the Reserve. The cost per barrel of storage in new underground rock caverns in the Regions would be more than double the cost of central underground storage. Where aboveground tanks are required, the cost would be about four times the cost of central storage.

LEGISLATIVE PROVISIONS, AND QUALIFYING REGIONS AND AREAS

Section 157 of the EPCA requires the SPR Plan to provide for an RPR in, or readily accessible to, any FEA region in which product imports equal or exceed 20 percent of refined product demand during the preceding 24 months. The RPR is not to exceed imports of the highest three consecutive months of the preceding 24-month period, recomputed annually. The petroleum in the RPR is to be counted as part of the quantities of crude required in the SPR. The legislation further states that crude oil, residual fuel oil, or any refined petroleum product may be placed in storage in substitution for all or part of the volume of residual fuel oil or any refined petroleum product stored in any Regional Petroleum Reserve. This substitution may be accomplished if it: (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.

Section 154(d) of the EPCA states that "the SPR 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 SPR within its respective territory".

The passage "to the maximum extent practicable" is amplified in the Conference Substitute Report which states that the requirement is not absolute and, further, that "...if local siting of a component of the Reserve within such noncontiguous area is not practicable, the Strategic Reserve Plan should provide that such area will be assured ready and nondiscriminatory access to petroleum products stored elsewhere in the Reserve". The quantity of any petroleum products to be stored in each noncontiguous area is to be a part of, rather than in addition to, the quantities of crude or refined products required for the SPR. Any amount stored in Regions or noncontiguous areas could be used to meet not only the demands of the area it is stored in, but also other national demands during an interruption, as the Administrator deems fit. Monitoring and drawdown procedures would be in accordance with the guidelines associated with central storage under Federal control.

FEA Regions 1 through 4 imported 20 percent or more of their residual oil requirements in 1974-1975 and are projected to continue to do so in 1980; they thus qualify for an RPR. The need of these Regions for an assured supply of residual oil will be provided by the SPR, as will the needs of other Regions where less than 20 percent of product consumption is imported.[1] The forecast 1980 import percentages for gasoline, distillate and residual oil in Regions 1 through 4 and the noncontiguous Pacific and Caribbean areas are shown in Table V-1. The FEA Regions and noncontiguous areas are shown in Figure V-1.

The noncontiguous areas of the country that were considered

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[1]FEA has interpreted the EPCA to mean that the SPR, distributed in accordance with appropiate allocation plans, must be capable of assuring that the impact of any interruption for all Regions and areas and product categories is equitably distributed; and, further, that this is to be accomplished in the most efficient and economical way possible.

Table V-1

REFINED PRODUCT DEMAND AND IMPORTS BY FEA REGION

JANUARY 1974–DECEMBER 1975

FEA Region	Motor Gasoline Demand[1] MB/CD	Motor Gasoline Imports[2] MB/CD	%	Distillate Fuel Oil Demand[3] MB/CD	Distillate Fuel Oil Imports[2] MB/CD	%	Residual Fuel Oil Demand[3] MB/CD	Residual Fuel Oil Imports[2] MB/CD	%
1	294	29	10	309	55	18	380	221	58
2	534	34	6	484	59	12	592	376	64
3	634	10	2	348	13	4	424	233	55
4	1106	1	0	342	4	1	339	230	68
5	1337	0	0	600	1	0	192	12	6
6	763	9	1	286	11	4	172	10	6
7	405	0	0	139	0	0	18	0	0
8	222	1	1	101	0	0	30	0	0
9	714	1	0	164	1	1	304	24	8
10	228	1	1	127	0	0	78	0	0

1980 PROJECTIONS[4]

FEA Region	Motor Gasoline Demand MB/CD	Motor Gasoline Imports MB/CD	%	Distillate Fuel Oil Demand MB/CD	Distillate Fuel Oil Imports MB/CD	%	Residual Fuel Oil Demand MB/CD	Residual Fuel Oil Imports MB/CD	%
1	325	13	4	520	13	3	385	121	31
2	637	24	4	753	25	3	675	221	33
3	712	11	2	435	12	3	517	107	21
4	1213	11	1	254	11	4	397	100	25
5–8	3391	12	0	1333	11	1	554	102	18
9–10[5]	1167	2	-	542	45	8	335	2	1
9–10[6]	40	3	8	50	2	4	41	3	7
PR-VI	55	-	0	179	-	0	15	-	0
TOTAL	7540	76	1	3850	77	2	3135	698	22

1 PAD level data from BOM Mineral Industry Surveys 1974-1975, distributed to FEA regions proportionally from Ethyl Corp. data.

2 PAD level data from BOM Mineral Industry Surveys 1974-1975, distributed to FEA regions proportionally from FEA Office of Oil and Gas Report of Oil Imports 1974-1975. Shipments of products from Puerto Rico and Virgin Islands have been removed from BOM data.

3 Source: BOM Sales of Fuel Oil and Kerosine in 1974.

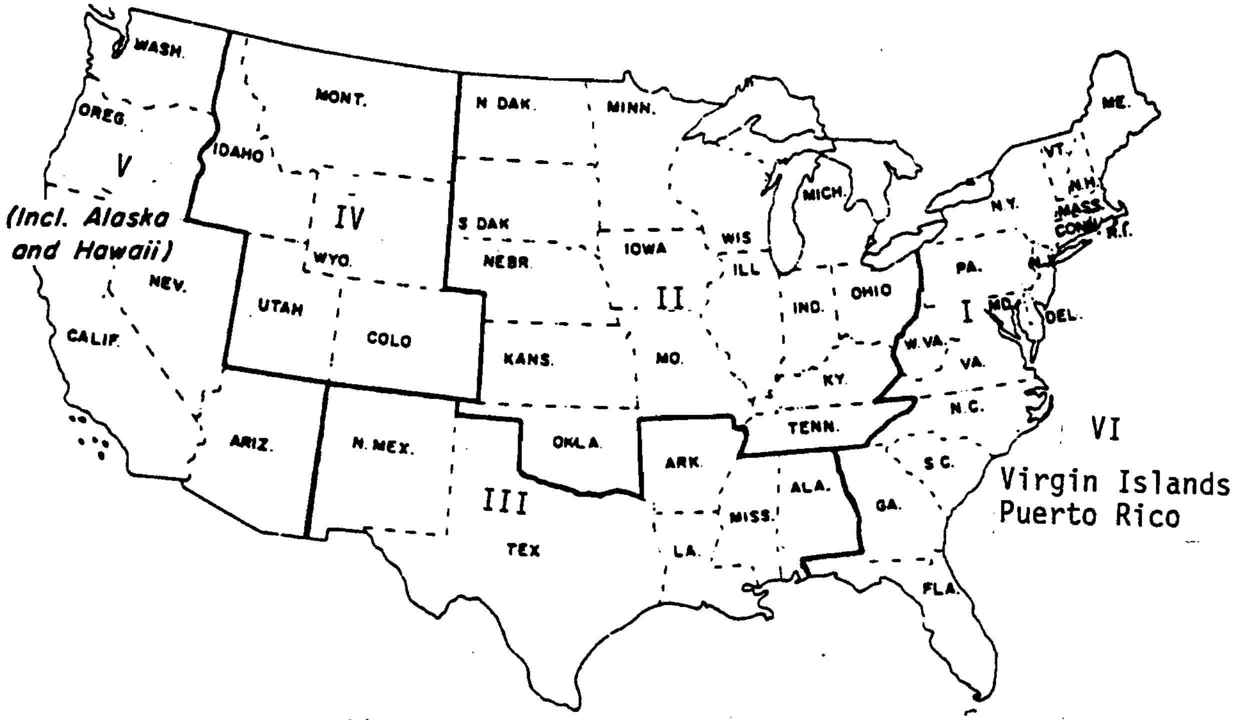
4 Assumes U.S. average demand of 19.8 million barrels per day and 7.5 million barrels per day of product imports (excluding shipments from Puerto Rico and Virgin Islands). FEA region data calculated from individual product growth rates and refinery capacity forecasts.

5 Except Hawaii, Guam, American Samoa, Pacific Trust

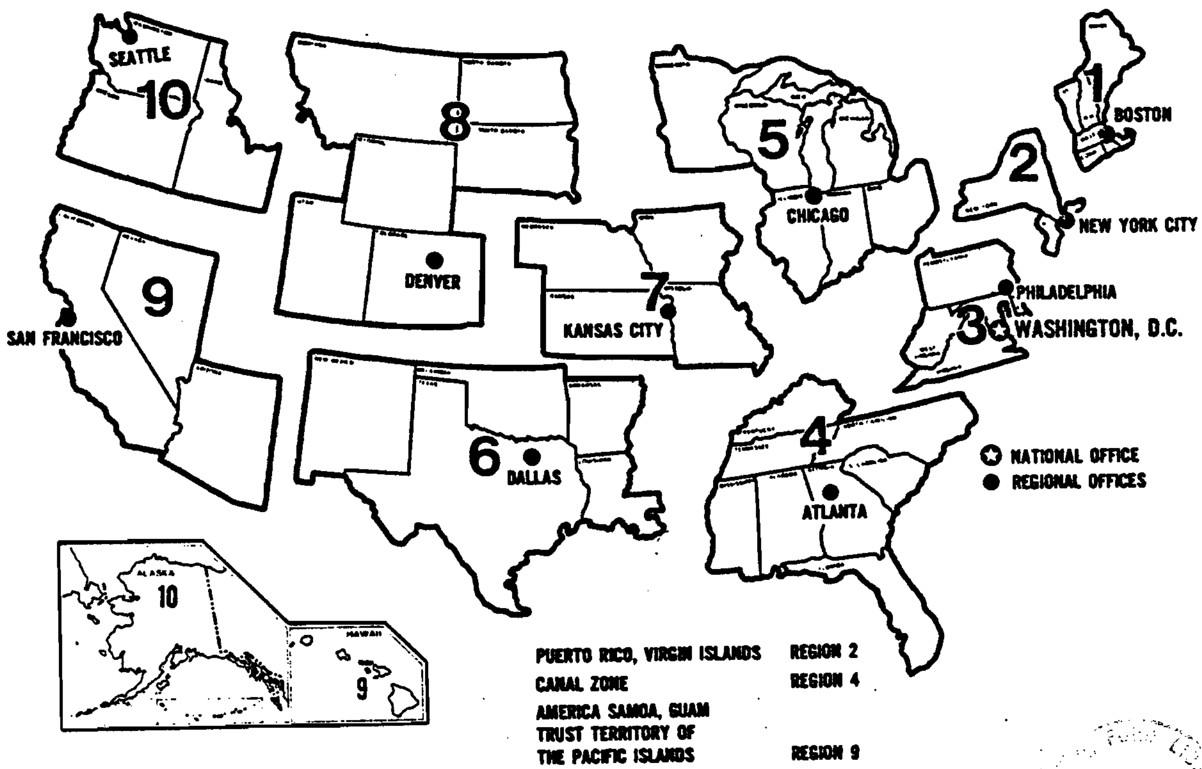
6 Includes only Hawaii, Guam, American Samoa, Pacific Trust

Figure V-1

PETROLEUM ADMINISTRATION FOR DEFENSE (PAD) DISTRICTS



Federal Energy Administration - REGIONS



for storage were Puerto Rico, the Virgin Islands, Panama Canal Zone, Hawaii, Guam, American Samoa, and the Pacific Trust Territory.

BASIS OF THE ANALYSIS

The background data and assumptions for the analysis are provided in this section. They include forecasts of supply and demand, potential import interruption definitions, costs of facilities, and other assumptions for the regional and noncontiguous area analysis. Forecasts of refinery capacity used in this analysis are presented in Chapter III.

Forecasts

Forecasts from the Project Independence Evaluation System (PIES) and other FEA data for 1980 provided the principal basis for the analysis. Although interim forecasts between 1980 and 1985 are not available, nothing in the 1985 PIES forecasts appears to be in conflict with the conclusions reached. Since there are many uncertainties in projecting that far ahead, FEA will reexamine the need for storage in the Regions and noncontiguous areas as new projections for 1985 become available.

Demand and Supply

The demand for petroleum products in 1980 is estimated to be 19.8 million barrels a day (MMB/D). Foreign imports total 7.5 MMB/D of which 6.0 MMB/D are crude oil and 1.5 MMB/D are refined products, including gas plant and unfinished oils. Domestic refinery crude runs-to-still, natural gas liquids, and processing gains produce 18.3 MMB/D of domestic finished products and 0.2 MMB/D of export products.

For purposes of this analysis, Puerto Rico, the Virgin Islands, the Hawaiian Foreign Trade Zone, Guam, Panama Canal Zone, American Samoa, and the Pacific Trust Territory are all treated the same as mainland United States; that is, their receipts from foreign sources are included in the total of U.S. imports, and their product deliveries to local and mainland demand centers are considered as transfer shipments. The forecasts of supply and demand for each Petroleum Administration for Defense (PAD) District are shown in Table V-2. See Figure V-1 for a map of these Districts. Normal 1980 crude oil and finished product inventories at the refinery and bulk terminal (primary) level were estimated using the

Table V-2

1980 FORECAST SUPPLY AND DEMAND OF U.S. AND TERRITORIES 1/

Millions of Barrels Per Day (MMB/D)	TOTAL	PAD I	PAD II	PAD III	PAD IV	PAD V (except Hawaii)	HAWAII AND PACIFIC 2/	PAD VI
Supply								
Crude Oil								
Domestic	10.30	.43	2.84	4.36	.52	2.14	.01	-
Foreign	6.00	1.48	1.18	2.16	-	.07	.13	.98
Total Crude	16.30	1.91	4.02	6.52	.52	2.21	.14	.98
Gas Plant & Unfinished	1.47	.18	.36	.59	.04	.19	.01	.10
Processing Gain	.53	.06	.13	.21	.02	.07	.01	.03
Product Imports								
Unfinished Oils	.47	.06	.12	.19	-	.07	-	.03
Residual Oil	.70	.64	.03	-	-	.02	-	.01
Distillate	.08	.08	-	-	-	-	-	-
Gasoline	.08	.06	-	.01	-	.01	-	-
Jet Fuel	.14	.07	-	.01	-	.03	.02	.01
Other	.03	.02	.01	-	-	-	-	-
Total	1.50	.93	.16	.21	-	.08	.02	.05
Total Local and Import Supply	19.80	3.08	4.67	7.53	.58	2.60	.18	1.16
Inter-PAD Transfers	-	3.99	.59	(3.81)	(.03)	(.01)	.04	(.77)
Total Supply	19.80	7.07	5.26	3.72	.55	2.59	.22	.39
Demand								
Residual Oil	3.14	1.85	.33	.35	.04	.50	.05	.02
Distillate	3.85	1.63	1.12	.42	.13	.33	.04	.18
Gasoline	7.58	2.49	2.56	1.12	.24	1.07	.04	.06
Jet Fuel	1.10	.39	.20	.12	.03	.27	.05	.04
Other Demand	4.13	.71	1.05	1.71	.11	.42	.04	.09
Total Demand	19.80	7.07	5.26	3.72	.55	2.59	.22	.39

1/ 1980 forecast product totals reflect historic product growth rates and lower gasoline usage. Product totals are distributed to PAD's on the basis of 1975 actual figures.
2/ Includes Hawaii, Guam, American Samoa, and Pacific Trust Territory.

same days of supply ratio calculated from 1975 demand rates and 1975 inventories. Additional information on supply and demand estimates for Regions 1 through 4, the West Coast, Northern Tier area and the Pacific area is provided later in this chapter.

Since total demand is expected to increase from 16.3 MMB/D in 1975 to 19.8 MMB in 1980, while imported products decrease from 1.9 MMB/D to 1.5 MMB/D, a significant decrease in the dependence on imported products will be noted at various points in the analysis. The percentage of product imports is expected to decrease from 12 percent of total demand in 1975 to 8 percent in 1980. If larger product imports occur, product interruption impacts would be increased and estimates of the number of days to reach critical inventory levels would be reduced.

Scenarios

The Regional and noncontiguous analyses use the most severe 1980 interruption scenario described in Chapter II, the loss of 3.3 MMB/D per day of imports, including .13 MMB/D of products. To maintain a "worst case" situation, drawdown of the SPR at the maximum rate possible (3.3 MMB/D) is assumed. This scenario assumes that no demand restraints will be in effect.

The "maximum drawdown" scenario was selected because it would put the maximum strain on the transportation and refining systems. If the systems can handle this load, presumably they can handle any lesser drawdown rate. If there is a more severe interruption of imports, it would not result in a greater demand on transportation because no more than 3.3 MMB/D could be taken out of the Reserve. Accordingly, a more severe interruption would result in a reduction in total consumption and in reduced demands on transportation. Chapter III indicates that the refinery capacity to replace product import shortfalls is adequate.

Costs of Regional and Noncontiguous Area Storage vs. Central Storage

Preliminary estimates indicated that the most economical storage within Regions 1 through 4 would be in conventional mines, either by adapting existing mines or constructing new ones for storage purposes. A feasibility study contract was let with a mining engineering firm to identify suitable areas and to develop estimated costs of conventional mine storage in each of those Regions. The report indicated that there were numerous locations on the East Coast within reasonable access of port and pipeline facilities where the rock mass would provide natural containment by a combination of impermeability of the rock and surrounding ground water pressure. None of the Regions, however, had existing mines of suitable impermeability and location. No suitable underground sites have been identified in the noncontiguous areas for construction of underground mine storage. It now appears that any storage at these locations would have to be aboveground.

The six areas listed below were selected for preparation of cost estimates for new conventional mines in Regions 1 through 4:

- Hingham - Quincy, Massachusetts
- Groton - New London, Connecticut
- Long Island Sound, New York
- Marcus Hook, Pennsylvania
- Raleigh, North Carolina
- Atlanta, Georgia

Because many alternate locations appeared to be comparable in feasibility and cost, the site-specific aspect of the cost estimates was de-emphasized. Storage caverns of various sizes were included for estimating costs, and provisions were made for using existing or developing new dock facilities, and for connection to existing distribution pipelines. The cost estimates are shown in Table V-3, ranging from $5.81 per barrel for a 20 MMB facility at Marcus Hook to $9.20 per barrel for a 3 MMB facility in the same area.

The estimated cost of aboveground steel tanks located in Regions 1 through 4 and the noncontiguous areas, and conventional mines located in Regions 1 through 4, are compared with the estimated cost of central storage in Gulf Coast salt caverns, in Table V-4. The table shows the cost per barrel for land and facilities and the discounted present value of operation and maintenance costs for 15 years.

If a product is to be stored (such as #6 oil) that requires heating in order to be handled, there is an additional cost for heating equipment and energy.

The initial fill of most of the candidate salt dome sites will be accomplished partially by barge since the schedule requires fill to begin prior to completion of pipeline facilities. The use of barges increases the cost of initial fill. It is assumed that proposed pipeline connections will be operational prior to refill requirements. Consequently, refill

Table V-3

ESTIMATED COSTS/BBL OF ANY CONVENTIONAL MINE FACILITIES

	Size (MMB)	Land Acquisition and Terminal Facilities	Storage Caverns	Mechanical and Electrical	Engineering Administration and Contingencies	Total
Hingham-Quincy	10	$ .07	$4.63	$ .21	$1.19	$6.10
Groton-New London	3	.28	6.16	.63	1.88	8.95
Long Island Sound	15	.06	4.69	.13	1.05	5.93
Marcus Hook	3	.26	6.44	.57	1.93	9.20
Marcus Hook	20	.10	4.55	.16	1.00	5.81
Raleigh	10	.11	4.55	2.02	1.61	8.29
Atlanta1/	10	.08	4.55	.60	1.26	6.49

1/ Connects with Plantation Pipeline for No. 2 fuel oil only.

Table V-4

COSTS OF ALTERNATIVE
PETROLEUM RESERVE FACILITIES

	Cost Per Barrel (FY 76 Dollars)		
	Tanks	Regional Caverns	Gulf Coast Salt Caverns
Site Acquisition, Construction and Facilities*	$10.00	$5.95	$1.51
Static Operations(15 yrs.)**	.09	.09	.09
Initial Fill Cost	.48	.48	.64
Total Facilities, Fill and Operation	$10.57	$6.52	$2.24
Additional Cost to Heat No. 6 Residual Oil ***	.15	.38	-
Cost per Withdrawal Cycle			
Withdrawal ***	$.18	$.10	$.06
Refill	.48	.48	.19

*These costs are the mid-point of ranges of likely costs of fully developed storage capacity. The range for steel tanks is $8-$12; for rock caverns, it is $5.81 to $6.10 for storage of the 10 to 20 MMB at a coastal site and for salt storage in the Gulf region, it is $1.38 to $1.65. Site specific conditions may cause variance from the values shown above for particular locations, but the variance should be within the specified ranges and the mid-points are expected to be adequate planning figures.

**Discounted present value at 10% per year cost of money.

***The heating cost for tanks is $.15 per barrel for equipment plus $.08 added to the cost per withdrawal cycle to heat the oil when needed. For caverns, the oil would be kept at 130 degrees at all times; the discounted present value for equipment and continuous heating for 15 years is shown, based on 10% cost of money per year.

costs are priced at the lower figure. The $2.24 per barrel estimated for storage in salt domes is a 15-year life cycle cost that includes site acquisition, construction, original filling, and 15 years of operating costs.

The leasing of 10 to 20 MMB of existing tanks was determined by FEA to be possible, but at rentals estimated at $1.80 to $3.00 per barrel per year. This would be substantially higher than the annualized cost of new conventional mines of 10 to 20 MMB capacity at $0.78 per barrel, per year, based on 15-year amortization of the $5.95 initial cost at a 10 percent per year cost of money. New conventional mines have been determined to be the most economical and efficient storage facilities to consider for storage within Regions 1 through 4.

Analytical Approach

Because central storage in the Gulf Coast area would increase the flexibility of the Reserve to respond to a variety of scenarios, would reduce environmental hazards, and would be less costly than storage within Regions 1 through 4 or the noncontiguous areas, it was appropriate to determine whether storage located within the Regions is necessary.

The analysis first considered whether local crude oil and product availability could be maintained from existing inventories during the initial period of an import interruption, i.e., the period before shipments from a central Reserve reach the refining and distribution system. This phase considered whether existing stocks, ships in transit and continuing imports could maintain supplies at the refinery and bulk terminal level for longer than necessary to allow use of the central SPR to be authorized and for the Reserve crude to move through the system. Then, as a separate question, the study considered the "steady-state" ability to transport product and crude at the 3.3 MMB/D maximum drawdown rate and to distribute the supplies within the time constraints imposed.

For both the initial stage and steady-state time periods, the data are divided into an East Coast-Gulf Coast and a West Coast-Pacific Area analysis. Although it is possible to balance the supply endurance for both crude and product between the two coasts, mainly by diversion of continuing imports, transportation is less costly if adequate supply balancing can be accomplished on each coast separately.

INITIAL IMPACT OF AN INTERRUPTION

To measure the ability of the industry to withstand the initial impacts of a supply disruption, the largest of the 1980 scenarios described in Chapter II was analyzed. Geographic shortfall patterns were determined based on the forecast distribution of imports in 1980. For each PAD, as well as for FEA Regions 1 through 4 and Hawaii and the Pacific area, 1980 runs-to-still were forecast, and crude and product inventory levels were estimated to be the same number of days of supply as calculated for 1975. Anticipated crude imports of the various specifications were considered.

East Coast-Gulf Coast Analysis

The analysis of the East Coast-Gulf Coast supply endurance combines PADs I, II, III and VI, since crude and refined product supplies are routinely balanced by industry shipments and import diversions within these areas. These PADs include the East Coast, the central states, the Gulf of Mexico, the Virgin Islands and Puerto Rico. Where applicable, additional data is furnished for FEA Regions 1, 2, 3, and 4. The estimates developed are based on the assumption that tankers bound for Gulf Coast ports would be redirected to East Coast or Caribbean ports as needed to minimize transportation costs while balancing supplies. Under these conditions, Gulf Coast import needs would then be met from the SPR located there.

A critical crude oil inventory level of 10 days of supply at the normal rate of crude runs-to-still was judged to be necessary to maintain full refining production. For each district only the excess over that level was considered to be available for drawdown to support initial interruption requirements. In this analysis, the average daily loss of crude oil imports was drawn from these "available" inventories until they were depleted, to calculate the estimated days of available supply. After that number of days, refinery inventories would be down to 10 days supply (at the normal runs-to-still rate) if no supplemental crude oil had been received. Table V-5 shows the calculation of the 1980 forecast of days-of-available-supply under a severe interruption (i.e. 3.3 MMB/D).

Expected industry crude oil inventory levels in 1980 were found to be adequate in the 3.3 MMB/D shortfall scenario to assure continued refinery runs, at the forecast runs-to-still rate, for 87 days in the eastern United States without any receipts from the SPR, before reaching a critical level. (See Table V-5).

Table V-5

POTENTIAL 1980 CRUDE INTERRUPTION AND EXISTING SUPPLY ENDURANCE

(Compatible with a 3.3 MMB/D Import Interruption)

CRUDE OIL	Total	PAD I	PAD II	PAD III	PAD IV	PAD V (Except Hawaii)	PAD VI	Hawaii, Hawaii Trade Zone & Guam
1980 Pre-Interruption Demand (MMB/D)	16.3	1.9	4.0	6.6	.5	2.2	1.0	.14
Est. Days of Supply (1975)	21.2	13.2	26.6	24.0	40.2	26.9	13.2	18.0
Est. Inventory Levels (MMB)	345.6	25.1	106.4	158.4	20.1	59.2	13.2	2.52
Pre-Interruption Imports (MMB/D)	6.0	1.5	1.2	2.1	-	.1	1.0	.13
Crude Oil Interruption	3.17	.82	.67	1.22	-	.01	.42	.03
Days at Shortfall Rate to Reduce Available Inventories to 10 Days of Supply at the Runs-to-Stills Rate 1/	58	7	99	76	-	> 365	8	37
Average Days Supply in Transit	31	32	33	33	Pipeline	25	30	17
Interrupted Amount in Transit (MMB)	102.3	26.2	22.1	40.3	-	.3	12.6	.51
Inter-PAD Diversions (MMB/D)	-	.44	(.36)	(.31)	-	(.03)	.23	.03
Net Shortfall (MMB/D)	3.17	.38	1.05	1.56	-	.04	.12	-
Days to 10 days Supply with Diversion 2/	89	87	87	87	> 365	> 365	87	> 365

1 Excess of inventory over 10 days demand, divided by the crude oil interruption.
2 Excess of inventory over 10 days demand, divided by the net shortfall after diversions.

Crude oil shipments in transit at the time of an interruption would continue to arrive in U.S. or Caribbean ports, though some of them would be diverted by industry from the Gulf to the East Coast to balance supplies. In the East Coast analysis, these shipments provide crude for an average of 32 days at normal import rates.

Inventories in PAD I were used to reflect the approximate average inventory situation in FEA Regions 1 through 4. For example, without any diversion of inbound shipments, PAD I was estimated to be capable of continued normal operations for seven days based on inventories above the critical 10 day level, plus 32 days based on supplies in transit. With diversions from Gulf Coast shipments, the total time to reach a critical crude stock level was raised to 87 days, the average for the eastern U.S. The 87-day period was the total estimated time that industry in the Eastern and Central states, Puerto Rico, and the Virgin Islands could maintain normal refinery output without any receipts from the SPR and without reaching a critical crude inventory level.

Product inventories depend on both current refinery production and continuing imports. If refineries maintained normal production schedules for the 87 days projected above, product inventories at the primary level would decline only at the rate of the product import interruption. The critical minimum product inventory at the refinery and bulk terminal level was assumed to be the entire seasonal inventory buildup plus one-half of the normal inventory at the lowest yearly level. In PAD I, for example, the lowest inventory of the year normally occurs at the end of March. Following this rationale, half of the March inventory amount could be drawn down at any time of the year if needed. The drawdown could not be greater, however, even if inventory were higher, because the larger inventory was considered to be needed to support high seasonal demands in the period ahead.

Figure V-2 shows the normal rise in critical inventory level in advance of the peak demand season.

Table V-6 shows the forecast of 1980 inventories at the high and low months based on 1975 patterns for residual oil, distillate and total products for PADs I, II, and III, where product inventories are considered more critical. The lowest PAD I inventory of all products at the primary level in 1980 was estimated to be at the beginning of May, when it will be 229 MMB, equal to 36 days of supply at the May demand rate. Of this, one-half, or 114.5 MMB was assumed to be available for drawdown before reaching a level where deliveries would become uncertain.[1] The high aggregate product inventory in 1980 was estimated to be 312 MMB on the first of December, equal to 37 days of supply at the December usage rate. At the higher inventory level, no more inventory can be drawn down than at the beginning of May without reducing supplies for the winter season below a critical level.

The ability to shift refining toward higher fuel oil production should be kept in mind when considering these individual products. Although days of supply at the full demand rate

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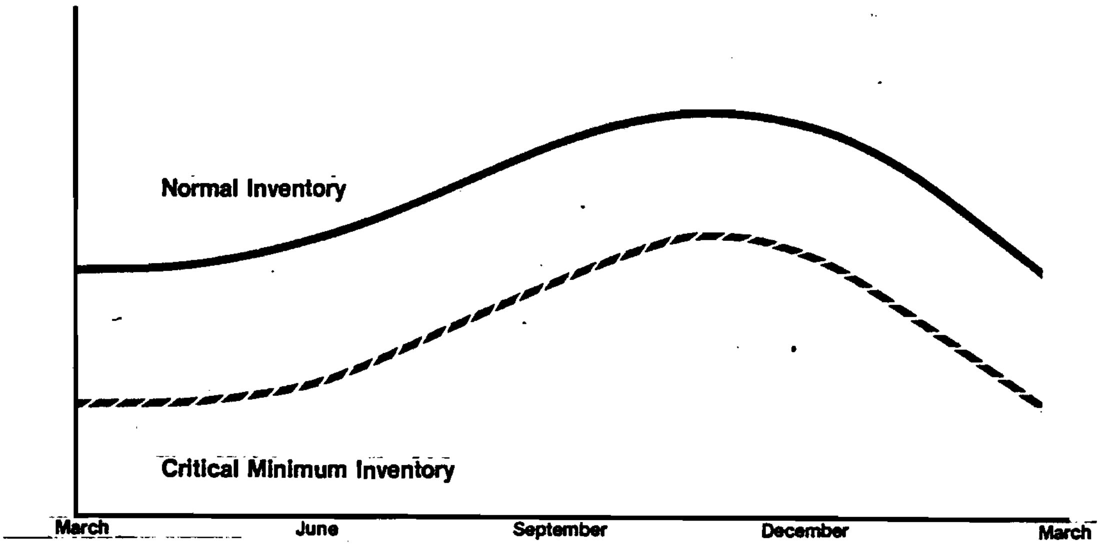
[1] It should be recognized, however, that even a small decrease in normal working inventories will introduce inefficiencies and rising costs, which will increase significantly as the critical minimum level is approached.

Figure V-2
Total Product Inventory at Refineries and Bulk Terminals



are noted here, the drawdown of supplies during an import interruption would be only at the rate of the import shortfall, not at the full demand rate.

Corresponding figures for PADs II and III and for residual oil and distillate individually are also shown in Table V-6. For the "worst case" 1980 (3.3 MMB/D) import interruption described in Chapter II, the product portion is estimated at .13 MMB/D. The breakdown by product and PAD depends, of course, on the actual interruption, as does the total amount of product shortfall. A reasonable estimate of the distribution of a product interruption of this size is shown in Table V-7. Based on this data, it would take several years for a product interruption to reduce supplies to a critical level if crude continued to be available.

Although there are typically more days of inventory supply of distillate than of residual oil, companies can blend the two under controlled conditions as needed during a shortage so that one would not run out before the other. Therefore,

Table V-6

ESTIMATED 1980 PRODUCT DEMAND AND INVENTORIES FOR PADs I, II AND III

(Assuming 19.8 MMB/D Average Demand for all Products)

	Total PADs I, II & III	PAD I	PAD II	PAD III
Residual Oil				
Low Inventory				
Month[1]	Apr	Apr	May	Jul
Demand, MMB/D[2]	2.17	1.49	.27	.38
Inventory, MMB[3]	64	43	9	12
High Inventory				
Month	Dec	Nov	Jan	Dec
Demand, MMB/D	2.76	1.85	.42	.41
Inventory, MMB	80	55	12	14
Distillate				
Low Inventory				
Month	May	May	May	Jun
Demand, MMB/D	2.75	1.25	1.04	.40
Inventory, MMB	174	69	64	39
High Inventory				
Month	Dec	Dec	Dec	Dec
Demand, MMB/D	4.52	2.55	1.47	.50
Inventory, MMB	293	140	93	59
Total Products				
Low Inventory				
Month	Jul	May	Jul	Jul
Demand, MMB/D	15.43	6.35	5.31	3.89
Inventory, MMB	658	229	212	199
High Inventory				
Month	Dec	Dec	Dec	Dec
Demand, MMB/D	18.15	8.41	5.70	4.04
Inventory, MMB	778	312	241	224

1 Months with the lowest and highest beginning of the month inventory are determined from the Bureau of Mines Mineral Industries Survey (BOM-MIS) inventories in 1975.

2 Demand is the average daily rate from Table 2 factored by the monthly seasonal adjustment reflected in BOM-MIS 1975 demand.

3 Inventories are the same number of days supply at the beginning of the current month as in 1975.

Table V-7

POTENTIAL 1980 PRODUCT INTERRUPTION AND ENDURANCE OF EXISTING SUPPLY
(Compatible with a 3.3 MMB/D import interruption)

	REGION I	REGION II	REGION III	REGION IV	PAD I	PAD II	PAD III	PAD IV	PAD V	PAD VI	HAWAII AND PACIFIC 1/	TOTAL PADs AND PACIFIC
Residual Oil												
Pre-Interruption Demand (MMB/D)	.38	.67	.52	.40	1.85	.33	.35	.04	.50	.02	.05	3.14
Pre-Interruption Imports (MMB/D)	.14	.26	.13	.12	.64	.03	- 4/	-	.03	-	.002	.70
Reducible Inventory 2/ (MMB)	4.56	8.04	6.24	4.80	22.19	4.39	6.39	.34	6.97	1.45	.70	42.43
Import Interruption (MMB/D)	.007	.012	.006	.005	.034	.003	-	-	.001	-	-	.038
Days to Exhaust Reducible Inventory 3/	651	670	1040	960	653	1463	-	-	-	-	-	1117
Distillate												
Pre-Interruption Demand (MMB/D)	.52	.75	.44	.25	1.63	1.12	.42	.13	.33	.18	.04	3.85
Pre-Interruption Imports (MMB/D)	.02	.03	.01	.01	.07	-	-	-	.002	-	.007	.08
Reducible Inventory (MMB)	10.48	15.12	8.87	5.04	32.86	30.76	18.52	2.21	6.96	1.80	.84	93.95
Import Interruption (MMB/D)	.008	.012	.006	.005	.034	-	-	-	-	.001	.003	.038
Days to Exhaust Reducible Inventory	1310	1260	1478	1008	966	-	-	-	-	1800	280	2472
Total Products												
Pre-Interruption Demand (MMB/D)	1.48	2.75	2.35	2.69	7.07	5.26	3.72	.55	2.59	.39	.22	19.80
Pre-Interruption Imports (MMB/D)	.26	.48	.23	.22	1.14	.16	.10	-	.08	-	.02	1.50
Reducible Inventory (MMB)	22.50	41.81	35.73	40.90	107.50	104.99	99.02	8.86	37.56	5.15	3.19	366.27
Import Interruption (MMB/D)	.015	.028	.14	.013	.07	.01	.01	-	.01	.01	.02	.130
Days to Exhaust Reducible Inventory	1500	1493	2552	3146	1536	10499	990	-	3756	515	159	2817

1/ Includes Hawaii, Guam, American Samoa, and the Pacific Trust Territories.

2/ Assumed to be ½ of refinery and bulk terminal inventories at the lowest point in the year. Region I through IV inventories are assumed to be the same number of days supply as PAD I, and Hawaii and the Pacific the same as PAD V.

3/ Reducible inventory divided by the import interruption.

4/ Dashes indicate less than 5 MB/D or a reducible inventory or a number of days that is not significant.

inventories of the two fuel oils should be considered in combination as well as separately. Furthermore, the wide flexibility of refinery yields, particularly in shifting toward a higher percentage of fuel oils, and the routine practice of balancing product flows throughout PADs I, II, III, and IV, make it necessary to consider product inventories as a whole in order to get an accurate picture of product inventory endurance.

West Coast and Pacific Area

Product demands for the contiguous West Coast (PAD V, except Hawaii) in 1980 are forecast at approximately 2.6 MMB/D. Roughly 92 percent of this total demand will be satisfied by local refinery production from domestic crude supplies and three percent from refining of crude imports. The remaining five percent will be imported products.

The low forecast of crude imports reflects the substantial crude oil production in the Western U.S. and increasing supplies from Alaska. Although considered to be relatively secure, any interruption of normal supplies of crude imports to the West Coast could be replaced primarily by diversions or, if necessary, SPR crudes since the majority of the local refining capacity is located on the coast of California and, to a lesser extent, Washington with port access to Pacific shipping.

Forecast 1980 product demands for Hawaii and the Pacific territories is approximately 220 MB/D. Of these product demands, 73 percent will be supplied by local refining, 18 percent by transfers from mainland refining centers and nine percent by product imports. Although almost all of the current crude oil supplies for the Pacific refineries are imported, some shift to Alaskan crude is forecast to occur by 1980.

The majority of the crude imports for local refineries are of a light-low sulfur type. Interruption of these crude imports is considered to be very unlikely but they could be replaced by industry diversions of similar types or by SPR supplies.

For the West Coast, Alaska, Hawaii, Guam, American Samoa, and the Pacific Trust Territory, refinery operations could continue at normal levels for several months during a 3.3 MMB/D interruption in 1980 before reaching the critical level of 10 days supply of crude, assuming diversion of shipments by industry. Of this total time, 20 days would consist of ships in transit at the beginning of the interruption. For the

West Coast, some sweet crude may be diverted from the Gulf Coast if necessary to meet the West Coast crude requirements.

Substantial crude oil production in the Western U.S. and increasing supplies from Alaska contribute to the low import forecast reflected in Table V-2. Moreover, the sources of western imports have been relatively stable; there was little reduction in imports in 1973-74 except as a result of planned diversions. Only 10 percent of the total country's product imports are expected to come into the West Coast and Pacific locations.

Still another contributor to the low vulnerability of the West is the relatively high inventory level normally carried. For example, average crude inventories in PAD V and the Pacific areas in 1975 were 61.5 MMB, which was equivalent to 26 days of supply at the runs-to-still rate. For a comparison, the average PAD I crude inventory of 25.1 MMB was 13 days supply at the runs-to-still rate.

Transportation Capacity

During the period of initial interruption impacts, and prior to the initiation of SPR drawdown, additional tanker capacity would be needed only for balancing inventories not being accomplished by the usual industry diversion of ships in transit when the interruption began. It is anticipated that many more ships would be idled in U.S. waters by the interruption than would be needed for any unusual shipments. Even considering isolated increases in tanker requirements resulting from the potential diversion of domestic crude supplies (e.g. Alaskan to Gulf Coast), a net increase in tanker availability is expected to occur.

Time Required to Activate the SPR

To determine whether shipments from central storage and subsequent transport of Reserve crude to East Coast bulk terminals could be achieved in time to avoid significant consumer shortages, the timing of crisis management activities was estimated as follows:

Weeks after Interruption	Events
1	o Existence of the interruption is established (considered to be conservative; a severe interruption would likely be known more quickly).
2	o A decision to use the Reserve is made by the President (depends on many variables; in a severe interruption, a decision could be made more quickly. The timing would be within the control of the President).
3	o Mandatory allocation program is activated.
4	o Tanker arrangements are made through routine industry channels.
5	o Ships reach storage sites and load.
6	o Crude ships load from Reserves and begin to arrive at Caribbean, Gulf and East Coast ports.
7	o Ships arrive at East Coast from Caribbean and Gulf with products refined from SPR crude.

The estimated time required to establish a flow of crude oil to refineries is six weeks compared with the minimum expected endurance by the East and Gulf Coast areas of about 12 weeks (87 days). The refined product flow could be supported with substitute shipments in about seven weeks, compared with inventory protection estimated at over a year at the refinery and bulk terminal levels for the 3.3 MMB/D interruption scenario. Additional stocks at the secondary level would provide added protection for consumers. If a different demand pattern or interruption scenario resulted in a reduction of the 87-day estimate by a factor of two, sufficient time would still be available for Reserve deliveries of crude oil to East Coast refineries. The product interruption could be ten times as large as the scenario examined, without exhausting stocks before the SPR could be activated.

Conclusions Regarding Initial Interruption Impact

Based on the studies conducted, it is concluded that storage of crude oil or products within the Regions or noncontiguous areas is not necessary to satisfy the initial impact supply requirements.

- o Available industry inventories of crude oil and refined products, supplemented by continuing domestic and imported supplies, provide sufficient days-of-supply protection even against the severe interruption impacts.
- o Forecast 1980 tanker resources and availabilities are more than adequate to distribute supplies during the initial interruption impacts.

AFTER THE INITIAL IMPACT

After crude oil from the SPR has moved through the refining and distribution system and products begin to reach retail inventories, the ability to support final demand over an extended period will depend on adequate refining and transportation capabilities. If sufficient crude supplies, refining capacity, and transportation are all available, no product shortage would be expected. Chapter III established that sufficient refining capacity would be available to justify the more economic storage of crude oil rather than refined products. This section examines the transportation capacity available to handle the maximum 3.3 MMB/D drawdown rate and the ability to maintain inventories above the critical level on a "steady-state" basis. A larger interruption is also considered for sensitivity purposes. Since the problems are potentially quite different on the East and West Coast, they are dealt with separately.

Inventories

In the Initial Impacts Section, it was shown that crude inventories and shipments in transit provided sufficient supply endurance to continue normal refinery runs until crude replacements from the SPR could reach refinery centers. It was not necessary to encroach on seasonal product inventory build-ups in any Region. Normal refinery yield shifts to increase gasoline production in the spring and fuel oil in the fall could take place despite an import interruption. Product inventories could remain above critical levels including the entire planned seasonal build-up of high demand products, until SPR crude reserves begin to reach refineries.

Tanker Requirements

During an import interruption, some continuing imports to the Gulf Coast would be diverted to the East Coast and the Caribbean and the West Coast and Pacific, if necessary, to meet requirements for specific crude types. They would be replaced by shipments from the nearby Reserves. This would reduce transportation costs and requirements for ships to move the Reserves. If tankers were not diverted to Caribbean refineries, shipments of crude oil from the SPR to that area (except Puerto Rico) could be made in foreign-flag vessels. In either case, replacement of product imports lost would come from increased refinery utilization with most of it being shipped to the East Coast from the Gulf or Caribbean, and to Hawaii and the Pacific from mainland West Coast centers.

For the 3.3 MMB/D maximum drawdown case, 1.5 MMB/D was estimated to be shipped by pipelines from the central Reserves to Gulf and Midwest refineries. This quantity would replace interrupted and diverted crude imports and would not increase crude pipeline loads. It is likely that the maximum requirement for U.S.-flag shipping would occur if inbound crude shipments to the Gulf were diverted to the Caribbean and the East Coast. In that case, the replacement of 1.80 MMB/D of interrupted crude oil and finished products would be shipped from the SPR to Gulf ports, and .05 MMB/D of replacement products would be shipped from the Gulf to the East Coast in U.S.-flag tankers.

A total of 1,349 thousand deadweight tons (MDWT) of additional U.S.-flag tanker capacity would be required to move SPR crude and the increase in refined products. No reduction in U.S.-flag tanker requirements is assumed as a result of interrupted imports. The details of the calculation are shown in Table V-8. This analysis is based on the maximum SPR design drawdown rate of 3.3 MMB/D, so that a larger requirement for shipping would not occur even with a larger import interruption. In fact, a larger interruption would make more tankers available.

Figure V-3 shows a map of how crude oil might be distributed during a supply interruption. It shows how continuing imports could be diverted to meet East Coast, Caribbean, West Coast and Pacific area needs, while the SPR is used to meet the needs of the interior of the country and the Gulf Coast area.

Availability of Tankers

The Maritime Administration (MARAD) has conducted a detailed analysis[1] of the expected availability of U.S. tankers in the 1980s. The study identified tankers by name, size and loaded draft and determined that 11,713 MDWT would be suitable for use in carrying crude from Reserve sites in the Gulf to ports on the Gulf and East Coasts. The analysis eliminated 9,921 MDWT of the ships, which would be needed for other domestic trade such as carrying Alaskan crude and domestic product trade. The Maritime Administration study found that the remaining 1,792 MDWT would be available for movement of the SPR crude oil.

MARAD also concluded that there would be substantial underutilized capacity in the domestic fleet due to tankers running at less than normal speeds and capacity, and estimated that full utilization would provide the equivalent of another 800 MDWT that could be used for Reserve drawdown. A total of 2,592 MDWT was, therefore, estimated to be available for SPR shipments; slightly less than twice the tonnage estimated to be needed for the 3.3 MMB/D maximum drawdown case. Table V-9 shows this availability calculation.

Although the MARAD study indicated there would be an adequate supply of U.S. tankers to support the maximum drawdown, the feasibility of using foreign-flag ships has been explored. The Secretary of the Treasury has the authority to waive the restriction on domestic carriage between U.S. ports by foreign vessels if necessary in the interest of national defense. MARAD anticipates that the national defense need could be demonstrated if U.S. tankers were inadequate to meet

[1] Maritime Administration, U.S. Dept. of Commerce; Strategic Petroleum Reserve Transportation Requirements and U.S. Flag Tanker Supply; August 23, 1976.

Table V-8

ESTIMATED ADDITIONAL U.S.-FLAG TANKER REQUIREMENTS FOR MAXIMUM SPR DRAWDOWN

(MMB/D)	TOTAL	PAD I	PAD II	PAD III	PAD IV	PAD V Except Hawaii	PAD VI	HAWAII AND PACIFIC 1/
Pre-Interruption Imports								
Crude	6.00	1.48	1.18	2.16	-	.07	.98	.13
Products	1.50	.93	.16	.21	-	.13	.05	.02
Total	7.50	2.41	1.34	2.37	-	.20	1.03	.15
Import Interruption								
Crude	3.17	.82	.67	1.22	-	.01	.42	.03
Product	.13	.07	.01	.01	-	.01	.01	.02
Total	3.30	.89	.68	1.23	-	.02	.43	.05
Crude to Produce Product Lost	.13	.02	.02	.05	-	.03	.01	-
Crude Shortfall Before Diversions	3.30	.84	.69	1.27	-	.04	.43	.03
Diversion of Crude Shipments	-	.84	(.47)	(.87)	-	.04	.43	.03
Net Crude Shortfall	3.30	-	1.16	2.14	-	-	-	-
Crude Imports During Interruption	2.83	1.50	.04	.07	-	.10	.99	.13
Crude from SPR by:								
Pipeline	1.50	-	1.07	.43	-	-	-	-
U.S.-Flag Ships	1.80	-	.09	1.71	-	-	-	-
Replacement of Products by:								
Local Refining	.06	.02	.01	.01	-	.01	.01	-
U.S.-Flag Ships 2/	.07	.05	-	-	-	-	-	.02
U.S.-Flag Ships Required, MDWT 2/	1349	95	61	1155	-	-	-	38

1/ Includes Hawaiian Trade Zone, Guam, American Samoa, and the Pacific Trust Territories

2/ Includes crude shipments to the Gulf averaging 5 days round trip and product shipments to Hawaii and the East Coast averaging 14 days round trip. Assumes the Caribbean is supplied by diversion. If it is not, fewer U.S.-flag ships would be required. 7.4 barrels per deadweight ton (DWT) assumed. Entered under destination PAD.