Petroleum Storage & Transportation Capacities

Volume I • Executive Summary

National Petroleum Council • December 1979

Petroleum Storage & Transportation Capacities

Volume I • Executive Summary

National Petroleum Council • December 1979

Committee on U.S. Petroleum Inventories, and Storage and Transportation Capacities
Robert V. Sellers, Chairman

NATIONAL PETROLEUM COUNCIL

C. H. Murphy, Jr., *Chairman*
H. J. Haynes, *Vice Chairman*
J. Carter Perkins, *Executive Director*

U.S. DEPARTMENT OF ENERGY

Charles W. Duncan, Jr., *Secretary*

The National Petroleum Council is a federal advisory committee to the Secretary of Energy.

The sole purpose of the National Petroleum Council is to advise, inform, and make recommendations to the Secretary of Energy on any matter requested by the Secretary relating to petroleum or the petroleum industry.

Library of Congress Catalog Card Number: 79-93026

Printed in the United States of America

TABLE OF CONTENTS

INTRODUCTION

In June 1978, the Secretary of Energy requested the National Petroleum Council (NPC) to prepare a report on petroleum inventories, and storage and transportation capacities in the United States (Appendix A). The National Petroleum Council has prepared similar reports at the request of the federal government since 1948, most recently the 1967 report entitled *U.S. Petroleum and Gas Transportation Capacities* and the 1974 report entitled *Petroleum Storage Capacity*.

To respond to the Secretary's request, the Chairman of the National Petroleum Council appointed the Committee on U.S. Petroleum Inventories, and Storage and Transportation Capacities. Robert V. Sellers, Chairman of the Board, Cities Service Company, was appointed Chairman.

A Coordinating Subcommittee and five task groups were appointed by the NPC Chairman to assist the Committee. R. Scott VanDyke, Vice President—Pipeline Transportation, Cities Service Company, was appointed Chairman of the Coordinating Subcommittee (see Appendix B for Council, Committee, Coordinating Subcommittee, and Task Group rosters).

This report provides detailed data on the storage and transportation of oil and natural gas to assist those responsible for emergency preparedness planning, but it does not attempt to analyze various hypothetical emergency situations. The report includes data on liquified petroleum gas (LPG) only in specifically identified transport facilities.

The logistical and inventory segments of the petroleum industry are ever-changing. The system capacities presented in the report are those that existed within the primary petroleum distribution system at a fixed point in time. The method by which petroleum inventories are stored and transported is an integrated and highly complex logistical process within which crude oil, petroleum products, and natural gas are moved from extraction and manufacturing to the consumer. It is important that the reader understand that the various components of this primary system do not exist in isolation; rather they function only as part of the very much larger U.S. and foreign petroleum and natural gas industry. Therefore, attempts to extrapolate from the data in this report may result in invalid conclusions.

The report consists of six volumes:

- Volume I — Executive Summary
- Volume II — Inventory and Storage Report
- Volume III — Petroleum Pipeline Report
- Volume IV — Tank Cars/Trucks Report
- Volume V — Waterborne Transportation Report
- Volume VI — Gas Pipeline Report

Volumes II through VI provide full details of the report. Included within each volume are data requested by the Secretary and an overview providing background information on industry operations. Each volume also contains a glossary of terms used in the report, a description of the report methodology, and appropriate maps, tables, charts, and graphs.

The report was unanimously adopted by the Committee and the Council. Minority comments have been submitted and are included in this volume as Appendix C.

OVERVIEW

The Petroleum Distribution System

The system of pipelines, tankers, barges, tank cars, and tank trucks that moves crude oil from producing areas to refining centers, and the similar modes of transportation that move refined products from refining centers to marketing areas, are generally categorized as the primary petroleum distribution system (Figures 1 and 2). A considerable amount of tankage must be provided within this transportation network in order to maintain normal flexibility for the overall operation of the supply system. The petroleum distribution system also includes the secondary distribution system and the consuming sector, which contain substantial capacity and tankage.

Crude oil and petroleum products in the primary distribution system are generally not owned by the companies transporting them.

Primary Crude Oil Systems

Primary crude oil trunklines are comparable to the long lines systems in communications or to the main lines of railroads. These trunklines are served by gathering systems in producing areas that may pick up crude oil from numerous oil fields as well as from marine unloading terminals.

Trunk pipelines are generally routed through focal points, or hubs, where a number of pipelines may converge. These hubs are comparable to locations on a railroad freight interchange system. At such points, transfers to carriers destined elsewhere may be implemented. Examples of such locations are: Midland and Odessa in western Texas; Longview in eastern Texas; Cushing, Oklahoma; Fort Laramie and Guernsey, Wyoming; and Patoka, Illinois. A large amount of storage capacity is required at these points, not only to enable the oil to be brought into the area from numerous producing regions, but also to provide the tankage for segregation, batching, and inventorying necessary for continuous pipeline operation before the oil can be moved to refineries.

Although pipelines are the principal mode of crude oil transportation, crude is also transported directly to refineries via tankers, barges, tank cars, and tank trucks.

Primary Products Distribution System

The primary products distribution system is composed of the products pipelines, tank cars, and tank trucks which move products overland and the barges and tankers that provide waterborne movements. While products are still in refinery tanks there is usually a choice as to the direction in which the products may move, along with a choice of the mode of transportation. Once a product is on its way in an element of the primary distribution system, it is generally committed to the geographic area which is serviced by the particular element.

For example, the Colonial Pipeline extends from the Houston-Beaumont, Texas, area to the New York Harbor area, and passes through the Baton Rouge, Atlanta, Greensboro, Richmond, Washington, D.C., Baltimore, and Philadelphia areas. The product in the primary distribution system can be sold or exchanged by the shipper at any point or diverted by the shipper to any delivery point along its geographic route. When the product is delivered out of the pipeline into a bulk terminal tank along the route, it leaves the primary system and enters the secondary system, and the ability to divert that product to a different geographic location becomes even more limited.

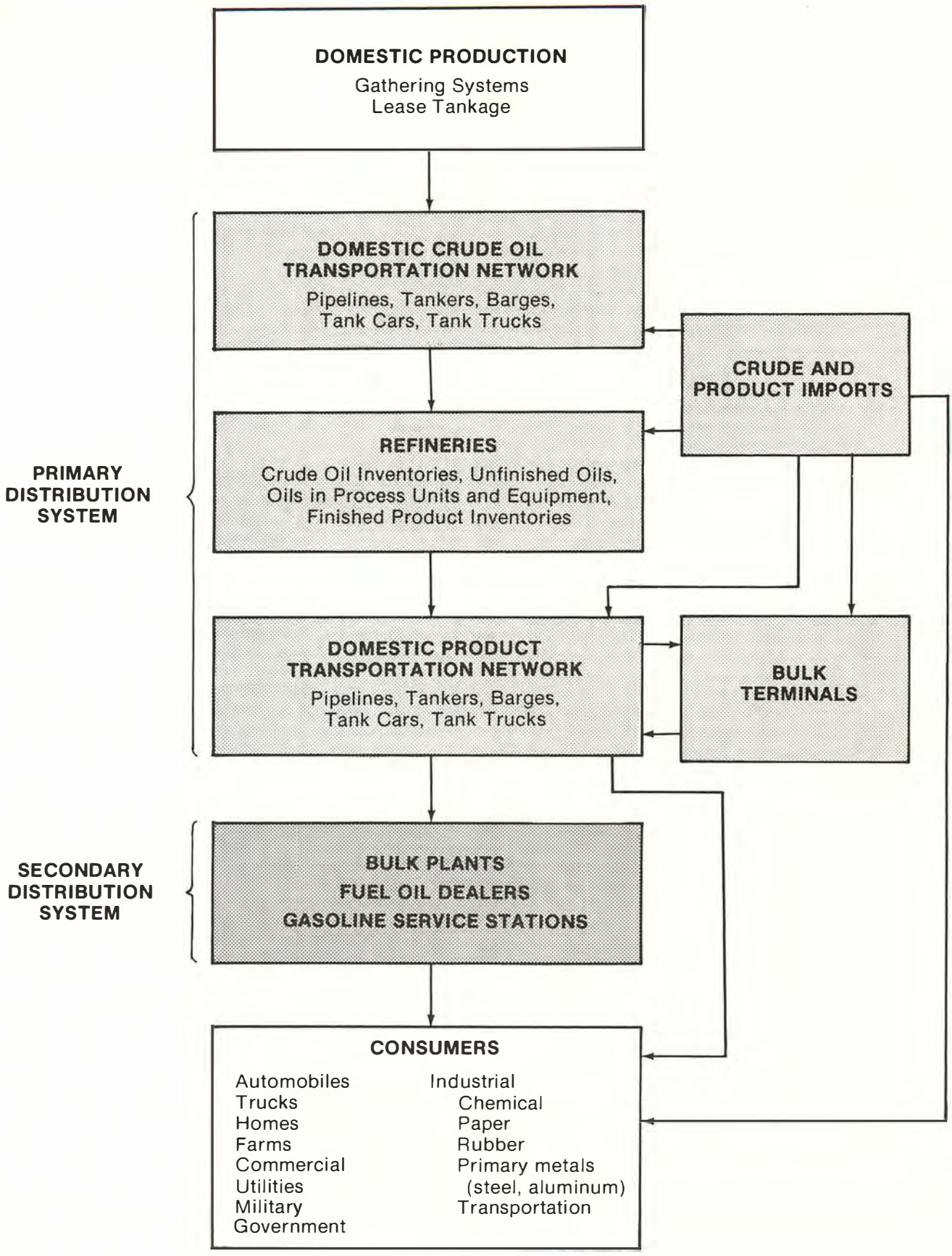


Figure 1. The Petroleum Distribution System.

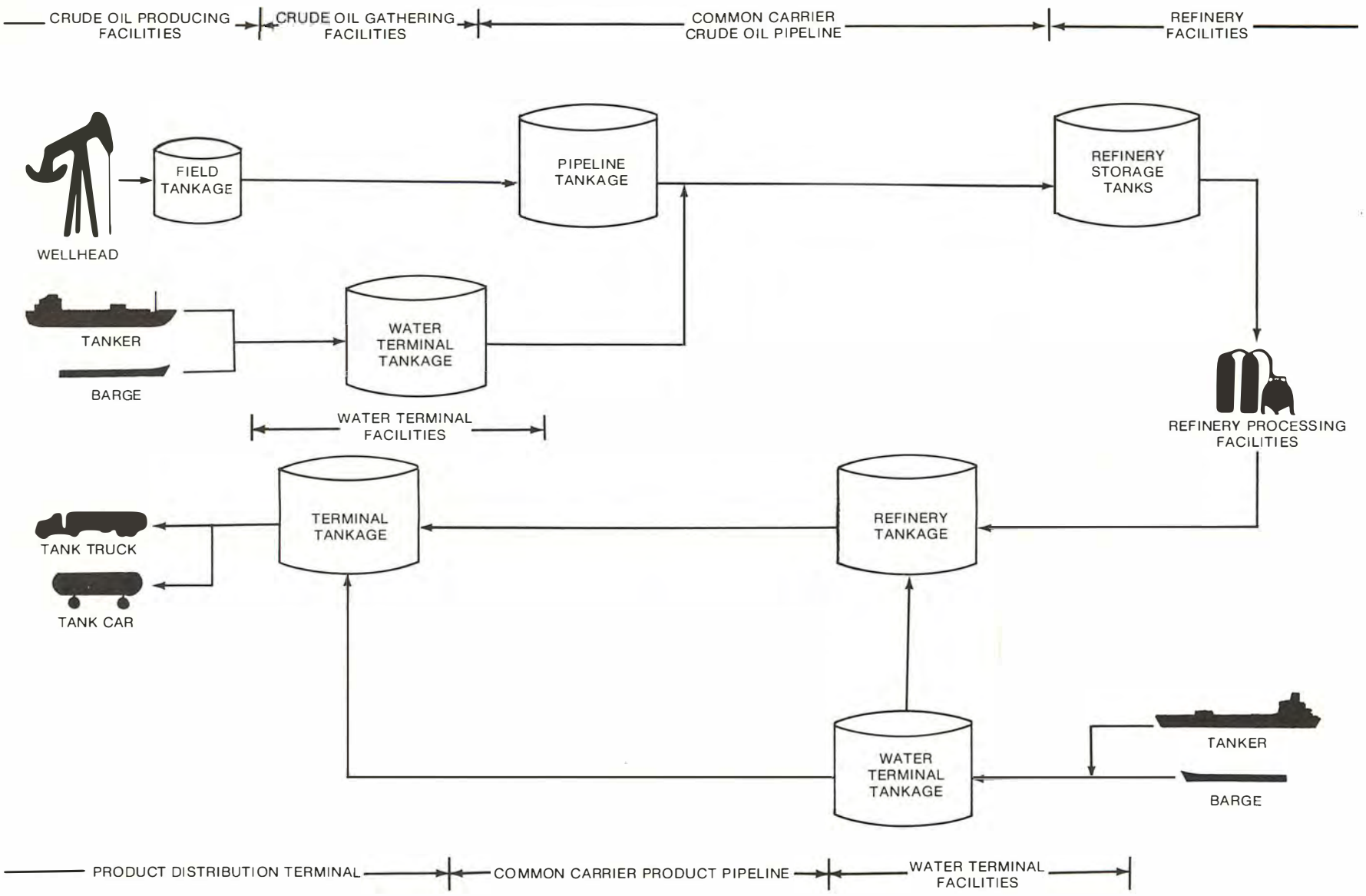


Figure 2. Simplified Crude Oil and Refined Products Flow Chart.

Secondary Distribution System

Petroleum products leave the primary distribution system either for further distribution through the secondary system or for direct sale to consumers. This secondary system includes small resellers of petroleum products, such as gasoline service stations or fuel oil dealers. Deliveries are generally made by tank truck. The secondary distribution system is similar to the primary distribution system in that it also holds a considerable amount of inventory and tank capacity.

Consumers of petroleum products include individuals who buy gasoline for their cars and distillate fuel oil to heat their homes. Among other consumers of petroleum products are the agricultural industry, utilities, large and small manufacturing industries, and transportation companies. Almost all consumers have their own storage facilities for the products they consume. The petroleum demand behavior of this segment has a significant impact on the ability of the primary system to operate smoothly. Further analysis of the secondary distribution system and the consumer sector is recommended.

The Gas Transmission System

Gas pipeline companies usually own a major portion of the gas moving through their respective systems; they also transport significant volumes of gas owned either by their customers or by other pipeline companies.

Natural gas is normally purchased by gas pipeline companies from production companies in the gas fields. These gas pipeline companies transport the gas to the market area where it is sold to distribution companies which make deliveries to the end use consumer. The components of a typical gas system from wellhead to consumer are shown in Figure 3.

As existing gas reserves are constantly being depleted and new gas reserves discovered and developed, the gathering segment of a pipeline must expand to connect new supply areas to the pipeline. In general, new gas discovery areas have become increasingly remote and in recent years have included the Rocky Mountain region as well as offshore locations in the Gulf of Mexico.

Gathering pipelines funnel into the main line transmission portion of the system. It is the main line segment, often consisting of multiple parallel lines with compressor stations every 40 to 130 miles, which spans the distance between the gas field and the market area. In contrast to the web of gathering lines, the main line follows a relatively straight cross-country course.

Once at the market area, gas is sold and delivered to various distribution companies, local utilities, and in some instances, directly to industrial customers. Often the delivery points are located directly on the main line. It is also common for deliveries to be made through a lateral line which branches out from the main line to link up with the buyer's distribution system.

Summary of Oil and Gas Transportation Facilities

A summary of current oil and gas transportation facilities is presented in Table 1 and in the discussion which follows.

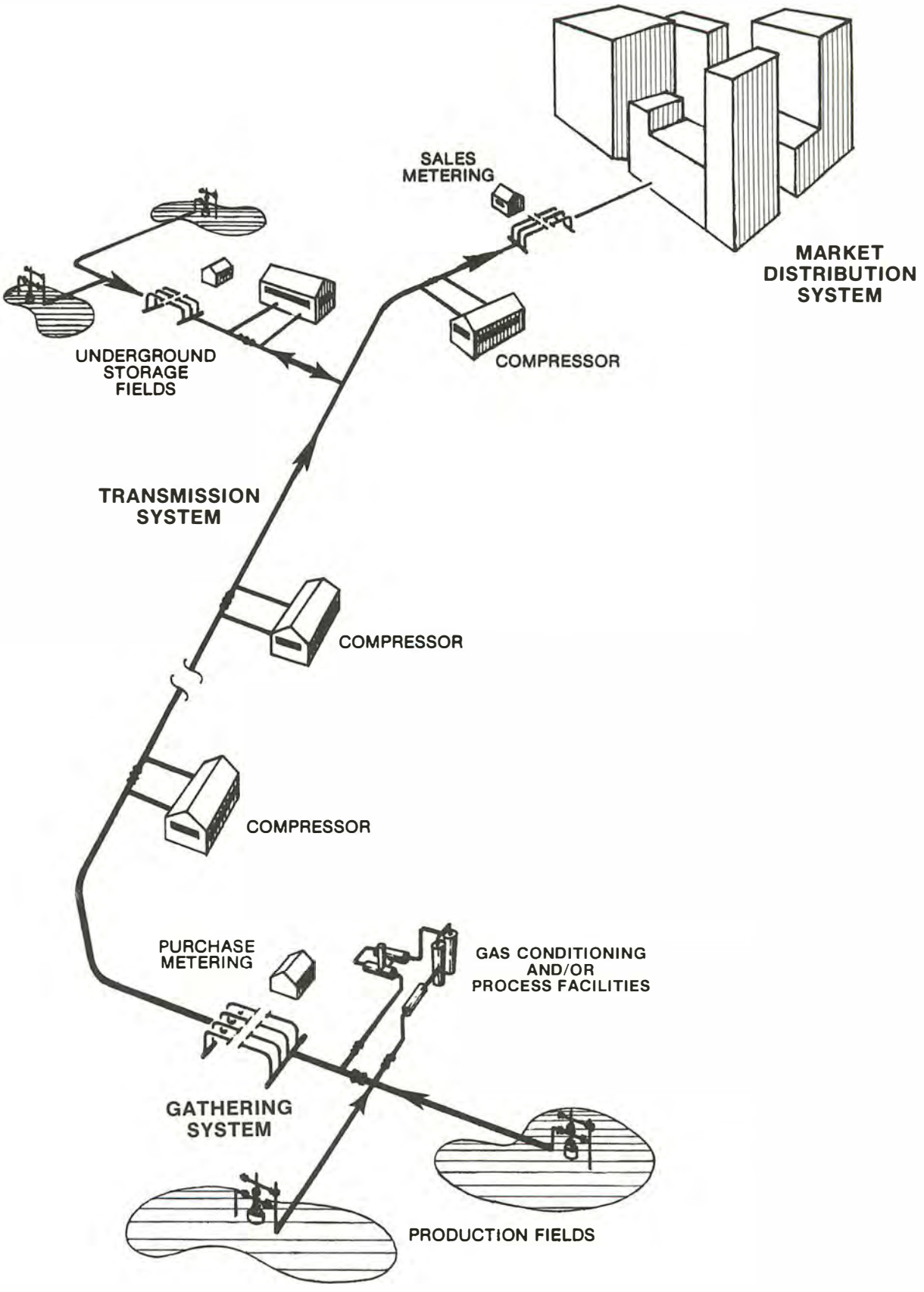


Figure 3. Typical Natural Gas Pipeline System.

TABLE 1

Oil and Gas Transportation Facilities

	Number of Units	Total Capacity
Gas Pipelines* (as of 12/31/77)	331,976 miles	NA
Petroleum Pipelines† (as of 12/31/78)	227,060 miles	NA
Tank Cars § (as of 7/15/79)	107,552	2,175.5 MMgal
Tank Trucks § (as of 12/31/78)	50,000	364.4 MMgal
Tank Barges § (as of July 1979)	3,971	71.4 MMbbl
Tank Ships § (as of July 1979)	352	97.0 MMbbl

*Includes gathering lines; excludes distribution lines.
†Includes gathering lines.
§Suitable for petroleum transportation.

Gas Pipelines

As of December 31, 1977, the U.S. natural gas network included 331,976 miles of pipeline — 71,462 miles of field and gathering systems and 260,514 miles of transmission lines. The mileage of the gas pipeline network has increased by approximately 17 percent since 1967.

Petroleum Pipelines

As of December 31, 1978, the U.S. petroleum pipeline network totaled 227,060 miles — approximately 145,770 miles of crude oil pipelines, 63,700 miles of refined product pipelines, and 17,590 miles of LPG/NGL lines.

Since 1967, approximately 38,070 miles of petroleum pipelines have been added to the network, accounting for approximately 5.9 million barrels per day capacity.

Tank Cars/Trucks

The 107,552 tank cars deemed suitable for carrying crude oil and petroleum products as of July 15, 1979, have a capacity of 2.2 billion gallons. The number of cars suitable for carrying petroleum has decreased by 24 percent since 1967, but their capacity has increased 28 percent, reflecting the industry trend of replacing older, smaller equipment with cars of greater capacity.

The number of petroleum tank trucks with over 3,500 gallons in capacity was approximately 50,000 as of December 31, 1978, compared with 81,300 tank trucks with over 2,000 gallons in capacity in 1967. The tank trucks have a total capacity of 364 million gallons.

Waterborne Transportation

The 3,971 barges deemed suitable for hauling petroleum as of July 1979 have a capacity of 71.4 million barrels. The 352 tankships have a capacity of 97 million barrels. Since 1967, the greatest increase in capacity has occurred in the capacity of tank ships.

HIGHLIGHTS OF TASK GROUP REPORTS

Volume II — Inventory and Storage Report

Overview

The principal objectives of this report were to determine the minimum operating inventory and total storage capacity of the primary petroleum distribution system.

The minimum operating inventory in 1978 for crude oil, gasoline, kerosine, distillate, and residual fuel oils totaled 720 million barrels. This inventory is not available for consumers. Storage capacity was 1.5 billion barrels as of September 30, 1978.

Figure 4 is a simplified diagram which explains the various components referred to as total primary inventory and storage capacity. The actual inventory available for consumers, including seasonal supplies, is indicated in the diagram.

Minimum Operating Inventory

Great emphasis is placed on the minimum operating inventory. Inventory below this level is not available for consumer use because it is required to fill pipelines, tank bottoms, and refinery process equipment; facilitate blending to meet product specifications; prepare for planned maintenance periods; handle unavoidable but anticipated emergencies; and sustain uninterrupted operations. Runouts and shortages would begin to occur if inventory were to fall below this level.

Based on the responses to the National Petroleum Council's *1979 Survey of Petroleum Storage Capacity and Inventory Availability in the United States*, the NPC concluded that the minimum operating inventories for crude oil and each of the major refined products are as follows:

U.S. Primary Distribution System
Minimum Operating Inventory — 1978
(Millions of Barrels)

Crude Oil	290
Gasoline	210
Kerosine	35
Distillate Fuel Oil	125
Residual Fuel Oil	60
TOTAL*	720

*Does not include minimum operating inventory of other feedstocks and products.

The minimum operating inventory of crude oil and major refined products has increased by 95 million barrels over the 625 million barrels of minimum operating inventory in 1973, the date of the last NPC survey. This increase reflects both physical increases in the distribution system and changes in definition which have added to the amount of inventory included in the primary system. Examples of physical changes are

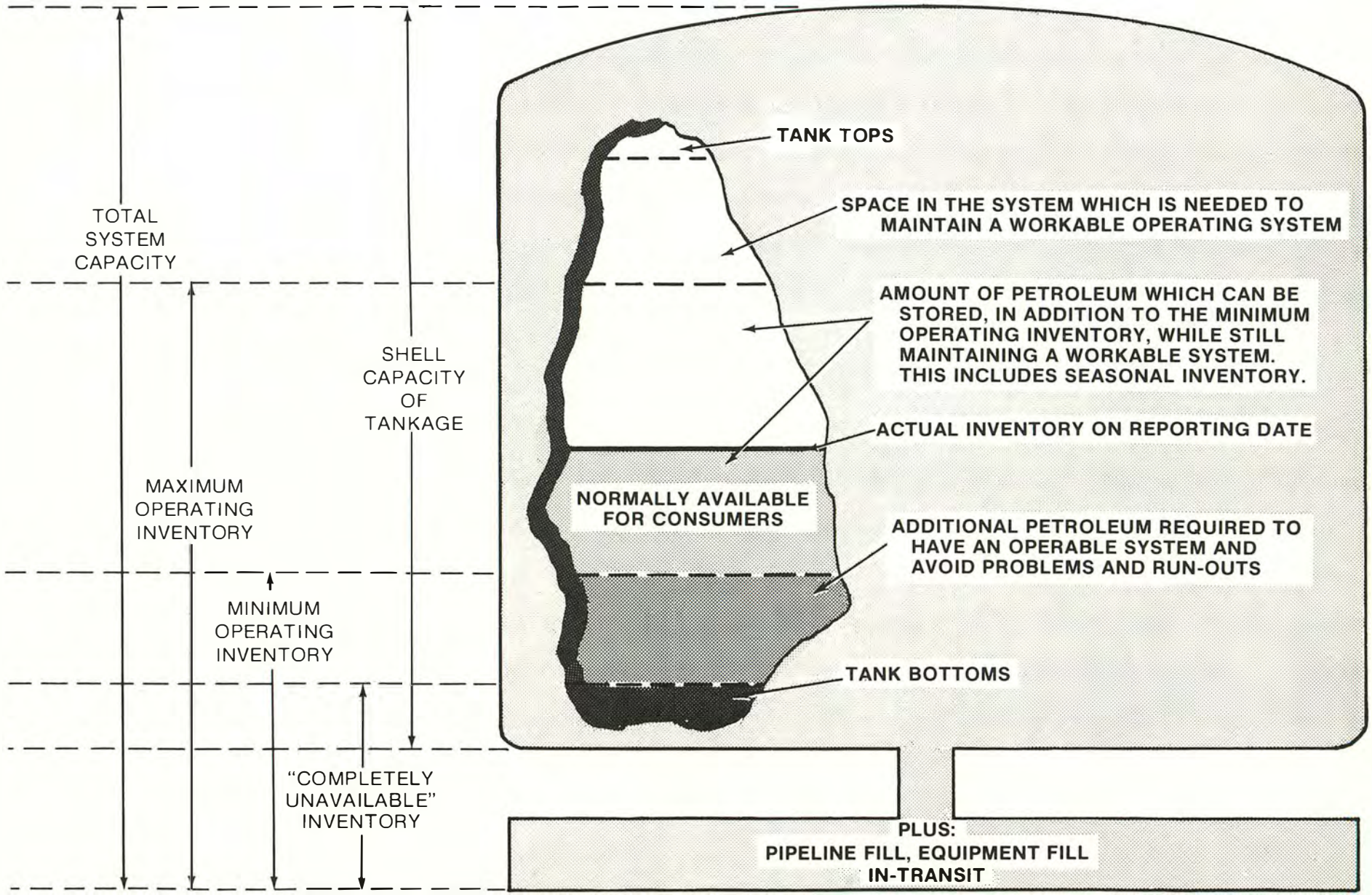


Figure 4. Simplified Diagram of Terms Describing Petroleum Inventories and Storage Capacities.

the Trans-Alaska Pipeline System (9 million barrels of linefill plus 9.1 million barrels of tank capacity at Valdez), Capline expansion, Texoma Pipeline, and Seaway Pipeline. Two changes in definition which have taken place since 1974 have increased the amount of crude oil and products included in DOE inventory statistics. Beginning in 1975, product inventories at major independent bulk terminals were added to the reporting system. Furthermore, as of January 1977, reporting of crude oil inventories was changed to include crude oil in pipelines which is from foreign sources and has cleared U.S. customs.

A company's minimum operating inventory is a function of many things, including (but not limited to) the level and location of demand, location of supply, availability of transportation and refining facilities, availability and location of tankage, and the cost of capital. While a company may, at times, drop below its minimum operating level, it may avoid serious problems by employing supply rearrangements or, on occasion, by an exchange with another company which may have additional supply available. However, a company does not plan its operations on the basis of supply rearrangements, particularly supply interruptions.

Maximum Operating Inventories

The report stresses that each company in the primary system has a maximum operating inventory. Exceeding that level can cause problems such as slowdowns or interruptions in the system. The empty space in tankage provides room for thermal expansion of the contents (protecting against accidental overfilling), receipt of inventory, and unavoidable but anticipated events such as emergencies and schedule changes.

Storage Capacity

Storage capacity of those liquids surveyed in the primary distribution system totaled 1.5 billion barrels as of September 30, 1978. Tank capacities of individual products and tankage under construction are reported as follows:

U.S. Primary Distribution System
Storage Capacity and Tankage Under Construction
(Millions of Barrels)

As of September 30, 1978

	Tank Capacity	Tankage Under Construction	Percentage
Crude Oil	462	12	3.0
Gasoline	438	5	1.0
Kerosine	90	less than 1	0.5
Distillate	365	3	1.0
Residual	162	1	0.5
	1,517	21+	

The National Petroleum Council concluded that no significant storage capacity exists for holding emergency supplies. Individual tanks alternate between full and empty, and at any point in time the whole storage system is approximately half full. This ratio is consistent with the industry's experience: inventory has averaged about 50 percent of tank capacity for the past thirty years.

Secondary/Consumer Storage

Storage capacity for gasoline and distillate fuel oil in the secondary and consumer distribution system is at least 500 million barrels, or 60 percent of the primary storage capacity for those products. The magnitude of this capacity suggests that shifts of sizable volumes of inventory between the primary and secondary/consumer segments could occur; these shifts could contribute to shortages or surpluses in the primary system.

Inventory Not Included in the Report

The following inventories are not included in Department of Energy statistics and, as the NPC data were reported in a manner consistent with the data collected by the Department, they are not included in this report:

- The federal government Strategic Petroleum Reserve (SPR). The capacity of the SPR is scheduled to be approximately 250 million barrels by June 1980. Crude oil inventory totaled 88.7 million barrels as of July 30, 1979.
- Crude oil and products located in U.S. possessions and territories. It is estimated that at least 45 million barrels of storage capacity is located in these areas.
- Transshipment facilities located in foreign countries adjacent to the United States. The total capacity at these transshipment terminals, located primarily in the Caribbean, is close to 50 million barrels; current expansion projects may add several million barrels to this total.
- Foreign crude and products bound for the United States.
- Most of the Alaskan North Slope crude oil in transit in tankers.

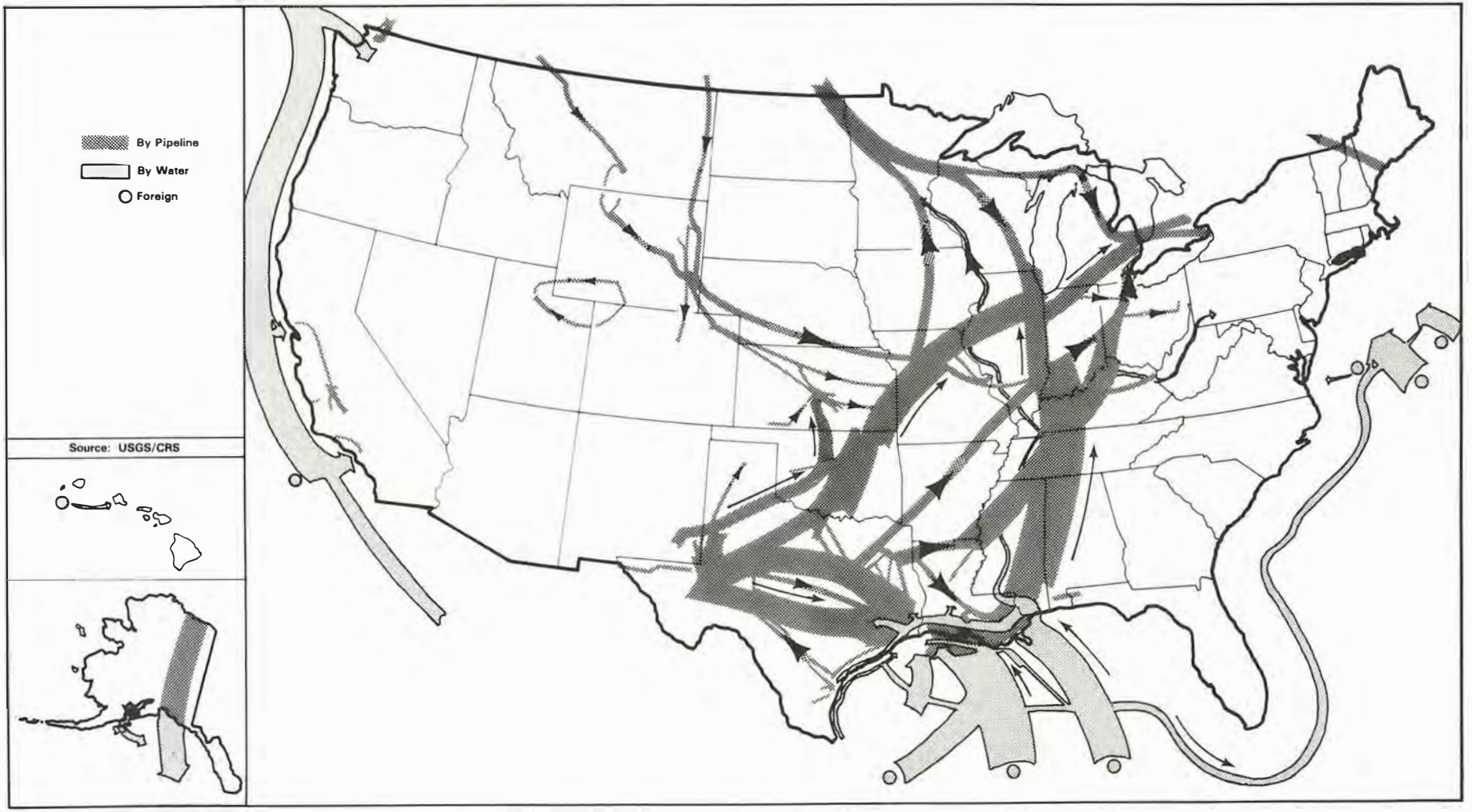
Volume III — Petroleum Pipeline Report

Overview

As of December 31, 1978, the U.S. petroleum pipeline network totaled 227,060 miles — approximately 145,770 miles of crude oil pipelines, 63,700 miles of refined product lines, and 17,590 miles of liquified petroleum gas/natural gas liquids (LPG/NGL) lines.

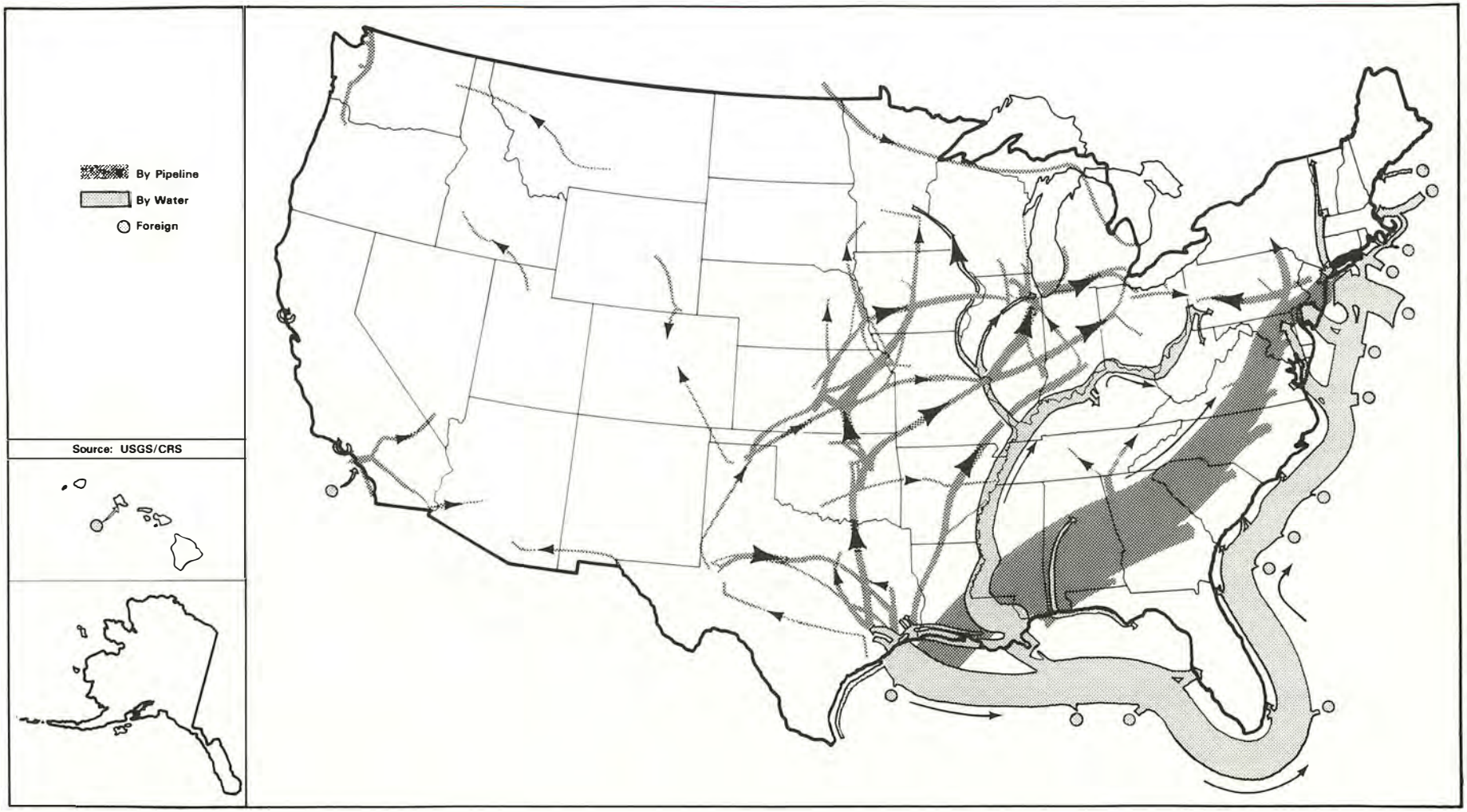
Since the 1967 NPC report, 38,070 miles of petroleum pipelines (12,840 miles of crude pipelines and 25,230 miles of product pipelines) have been added to the transportation network at a cost of $11 billion. Pipeline mileage added during that period included the completion of more than a dozen new major projects, accounting for approximately 5.9 million barrels per day (MMB/D) of present capacity.

The relative size and direction of crude oil movements in the United States are shown in Figure 5. The relative size and direction of movements of both refined products and LPG/NGL from key refining areas to terminals located at the marketplace are shown in Figure 6.



SOURCE: *Petroleum Supply Alternatives for the Northern Tier and Inland States Through the Year 2000 (Draft Report),* U.S. Department of Energy, Assistant Secretary for Policy and Evaluation, Office of Policy Analysis, Volume I, February 1979.

Figure 5. 1978 Crude Oil Movement.



SOURCE: *Petroleum Supply Alternatives for the Northern Tier and Inland States Through the Year 2000 (Draft Report)*, U.S. Department of Energy, Assistant Secretary for Policy and Evaluation, Office of Policy Analysis, Volume I, February 1979.

Figure 6. 1978 Refined Petroleum Products Movement.

The annual average capacities of common carrier crude oil, petroleum products, and LPG/NGL pipelines as of December 31, 1978, are depicted in Figures 7, 8, and 9. Volume III contains individual PAD maps for crude and petroleum product pipelines, area maps illustrating petroleum pipeline connections at or near major refining and pipeline distribution centers, and tables containing more detailed information than contained on the maps.

Planned Expansion

Principal crude oil pipeline expansion projects, planned or under construction as of December 31, 1978 (13 projects), will add 924 miles and 6.6 MMB/D capacity to the crude oil pipeline network.

Principal product pipeline expansion projects, planned or under construction as of December 31, 1978 (28 projects), will add 1,193 miles and 2.6 MMB/D of capacity.

Significant Trends

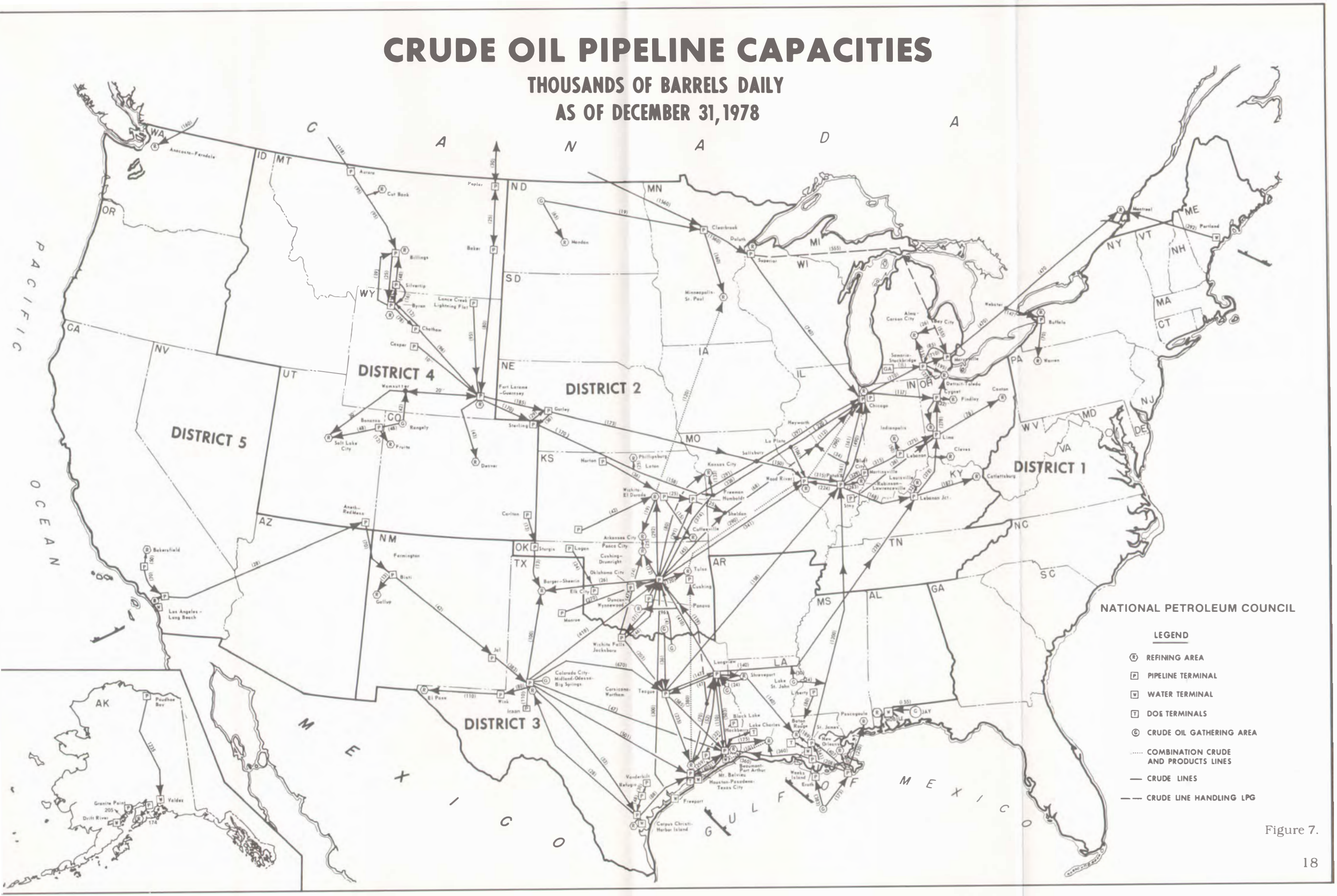
- With the decrease in domestic petroleum supplies from the lower 48 states, more crude oil is being imported through water terminals and transported to inland refineries by pipeline.
- Separation of different grades of crude oil or petroleum products in a pipeline is called *batching*. In recent years, this need for separation has been reduced because of batching of mixes of crude oils having similar qualities, and in an effort to move petroleum more efficiently, crude oil, LPG, NGL, and refined products are now frequently batched through the same lines.
- NGL is now transported through pipelines directly from field gas plants to central fractionation facilities. This transportation of NGL has simplified the field gas plants. The centralized fractionation facility provides economies of scale by separating large volumes of NGL into its marketable components (e.g., propane, butane).
- With the advent of higher priced crude oil, refined products, and LPG, more precise methods of measurement are being implemented.

Several developments within the industry may impact on emergency preparedness planning:

- The trend toward electrification of pumping stations affects the petroleum pipeline in two ways: (1) serious problems could develop if electrical power failures or curtailments should occur over large areas of the nation for long periods of time, and (2) the rising cost of electricity has increased pipeline operating costs, and more importantly, these increases affect the economics of expanding the capacity of existing systems. Due to the high power requirements for moving incremental volumes, expansion of existing lines by adding pumping horsepower is becoming less attractive. The alternative to adding pumping horsepower is to build a parallel line (loop). Looping offers lower operating costs but is more capital intensive.
- Future expansion of pipeline capacity could be delayed due to the difficulty in acquiring equipment for new pumping stations and pipelines (delivery time for large pumps and electric motors is presently 18 to 24 months).
- The time required to obtain new permits for pipeline construction has continued to increase, and two or three years are now commonly needed to obtain permits.

CRUDE OIL PIPELINE CAPACITIES

THOUSANDS OF BARRELS DAILY
AS OF DECEMBER 31, 1978



NATIONAL PETROLEUM COUNCIL

LEGEND

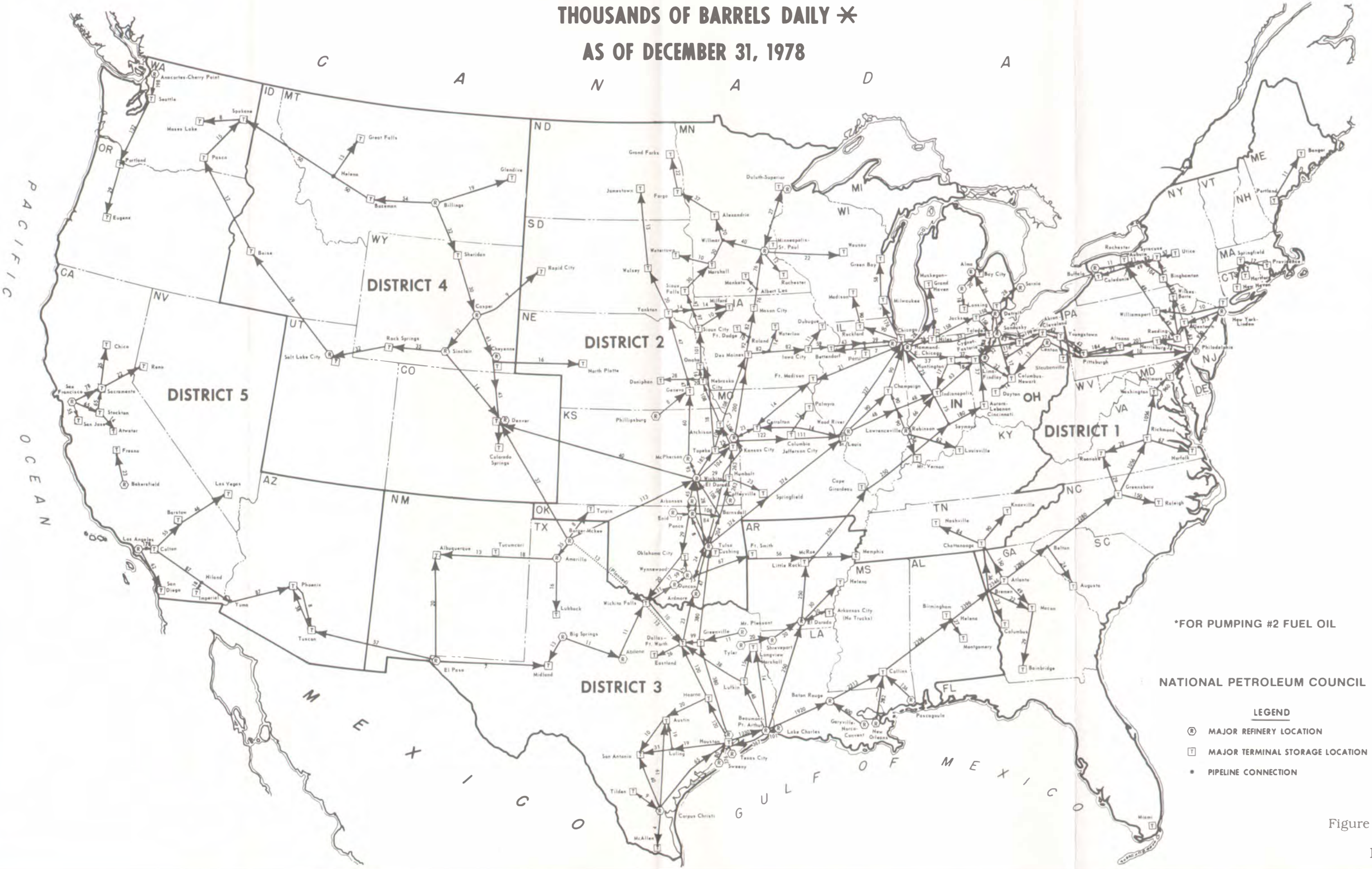
- (R) REFINING AREA
- [P] PIPELINE TERMINAL
- [W] WATER TERMINAL
- [T] DOE TERMINALS
- (C) CRUDE OIL GATHERING AREA
- ..... COMBINATION CRUDE AND PRODUCTS LINES
- — CRUDE LINES
- — — CRUDE LINE HANDLING LPG

Figure 7.

PETROLEUM PRODUCTS PIPELINE CAPACITIES

THOUSANDS OF BARRELS DAILY *

AS OF DECEMBER 31, 1978



*FOR PUMPING #2 FUEL OIL

NATIONAL PETROLEUM COUNCIL

LEGEND

- (R) MAJOR REFINERY LOCATION
- [T] MAJOR TERMINAL STORAGE LOCATION
- • PIPELINE CONNECTION

Figure 8.

LPG AND NGL PIPELINE CAPACITIES

THOUSANDS OF BARRELS DAILY

AS OF DECEMBER 31, 1978

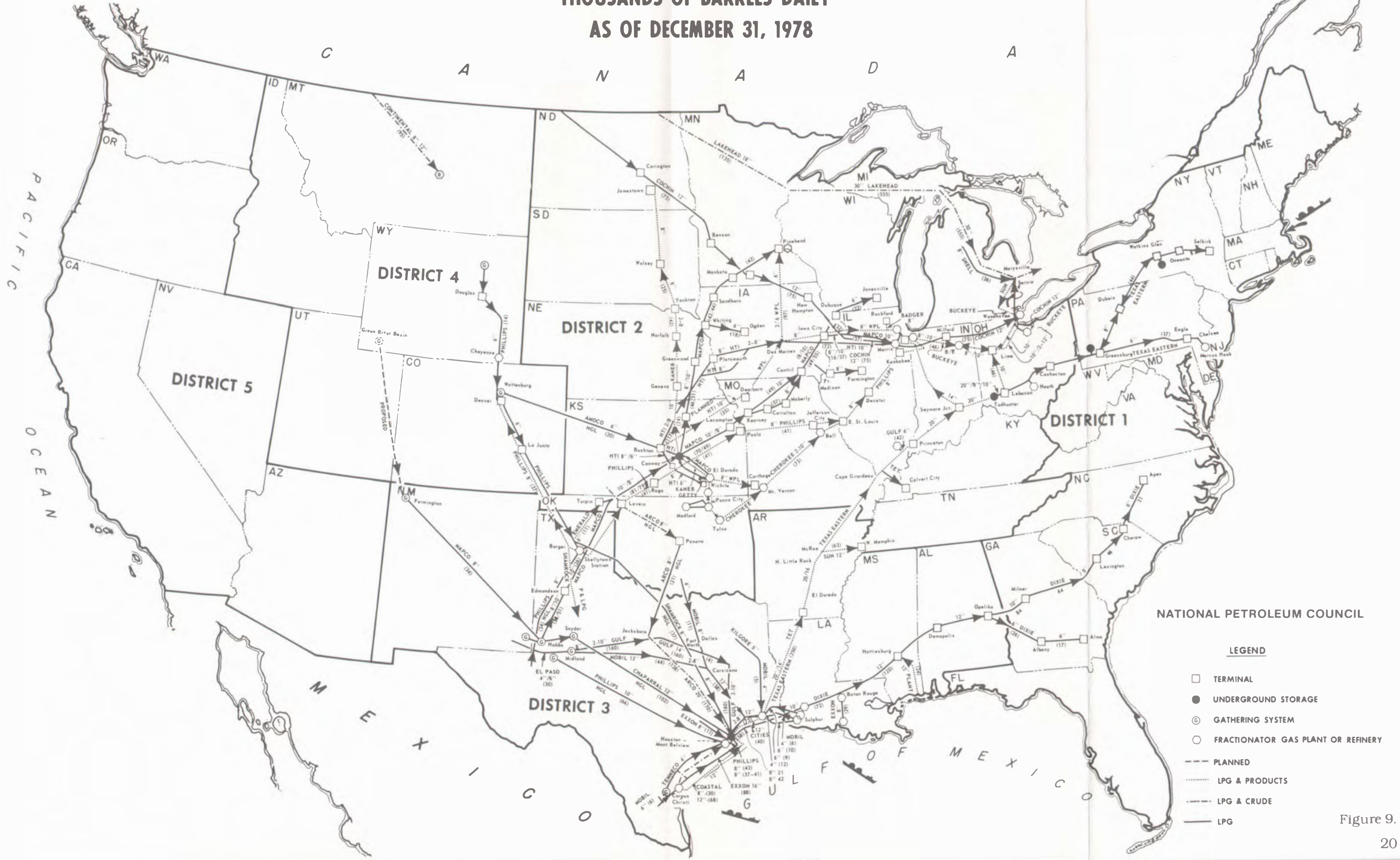


Figure 9.

- Movement of high viscosity crude oils would reduce the capacity of many pipeline systems by five to 30 percent. This potential decrease in capacity must be considered in any emergency planning situation involving increased movements of high viscosity crude.

Data in Volume III

In an effort to enhance the usefulness of the basic capacity information presented in this report, several items not found in the 1967 NPC report have been included:

- Area maps indicating interconnection of pipelines in the vicinity of major refining and pipeline centers. These maps expand the general location and direction information provided on the general maps by presenting details of interconnections to storage terminals, distribution terminals, refineries, and other pipeline facilities.
- Gravity and viscosity information as it relates to the capacity data presented for crude oil pipelines. This information may be desirable for future strategic planning to project the capacity of systems handling materials of viscosities and characteristics different than those reported herein.
- The reporting of the capacity for all refined petroleum product systems on a consistent basis; i.e., the capacity for transporting No. 2 fuel oil. The tables further present capacity information for most pipeline systems when transporting gasoline and the *normal* average product mix.

Volume IV — Tank Cars/Trucks Report

Tank Cars

Overview

As of June 15, 1979, there were 202,811 tank cars, representing a 3.6 billion gallon capacity, in the U.S. rail car fleet. Of that total, 107,552 tank cars (2.2 billion gallons in capacity) are considered to be suitable for carrying crude oil and petroleum products.

These suitable cars reflect a 19 percent increase in gallonage but a 33 percent decrease in actual car count since the 1967 NPC study, illustrating the industry trend of replacing older, smaller equipment with larger capacity, more specialized cars. A significant number of additional cars could be used in at least limited service, depending on the severity of the emergency and the availability of an adequate amount of time for car conversion work.

Emergency Preparedness Planning

The number of cars suitable for the transportation of crude oil and petroleum products is a subjective matter which would no doubt be dependent upon the severity of the emergency in question. This report takes a more conservative view in this respect than the 1967 NPC study, which reflected 20 percent nonsuitable cars versus the 45 percent reported in 1979.

Tank cars are designed to carry a large number of specialty products. Although they are flexible enough to be transferred into an alternate petroleum-based service, the cost of making them again suitable for their originally intended service would have to be measured in terms of the severity of the emergency. In addition to cost, a factor to be considered is that a large number of these other products would have to continue moving, even in a national energy emergency, if the economy were to continue operating. In an emergency, the federal government must take into consideration the varying priorities involved.

Nonsuitable Cars

Cars determined to be nonsuitable for carrying petroleum include aluminum cars; acid service cars; caustic soda liquid cars; clay slurry and titanium dioxide cars; lined cars; chlorine, liquid carbon dioxide, hydrogen sulfide and hydrocyanic acid cars; Canadian and Mexican cars; special feature cars (except those with alloy fittings); and tank cars built to DOT specifications 107, 109, 113, 115, 120, 121, 204, and 206.

Significant Trends

- Although many older cars are still in service, the U.S. tank car fleet is becoming newer, with increasing capacity. Over one-third of the petroleum tank car fleet (35 percent) consists of equipment under 11 years old, with individual capacities exceeding 20,500 gallons.
- Based on current trends, total capacity will not decline as older equipment is replaced by new, larger cars.

Geographic Breakdown

An analysis of the Interstate Commerce Commission *1977 One Percent Waybill Sample of Tank Car Shipments* reveals a high concentration of tank cars located in PADs I-III, as indicated below:

PAD Districts	Percentage of Carloads
I	21.5
II	28.8
III	40.4
IV	3.9
V	5.4
TOTAL	100.0

According to the analysis, Texas and Louisiana contain the greatest concentration of tank cars. One can assume for emergency planning purposes that tank cars are most likely to be found at their shipment origin locations.

Operating Constraints

Tank cars operate under certain constraints. For example, because of the poor condition of certain track, speed restrictions have been imposed and operating efficiency decreased. The condition of these track sections must be considered in emergency planning involving rail shipments of petroleum.

Tank Trucks

Overview

It is estimated that, as of December 31, 1978, there were over 50,000 tank vehicles of over 3,500 gallons in capacity in the United States, with a total fleet capacity of about 364.4 million gallons. Although these tank vehicles were not all designed primarily for petroleum service, it is believed they could be used to haul petroleum in an emergency.

The 1967 NPC survey included tank vehicles with a smaller capacity — 2,000 gallons or larger. The 3,500 gallon minimum capacity is considered more appropriate for emergency planning. In an emergency, smaller vehicles would probably remain in local service, while larger vehicles would be used to transport petroleum over long distances.

Significant Trends

- The trend toward 24-hour loading and unloading has increased utilization of individual trucks and, as a result, fewer vehicles are required to be in service.
- Gross loads have increased significantly as a result of federal legislation which permits states to increase vehicle size and weight restrictions. For example, the pre-1974 nominal limit of 73,280 pounds has been raised to 80,000 pounds in most states.

Geographic Breakdown

An analysis of tank truck locations indicates that the trucks are concentrated in PADs I and II.

PAD Districts	Percentage of Tank Vehicles
I	39.6
II	35.7
III	14.3
IV	3.0
V	7.4
TOTAL	100.0

Volume V — Waterborne Transportation Report

Overview

Waterborne transportation capacities consist of three major elements: equipment, navigable waterways, and receiving facilities.

Equipment

As of July 1979, there were 4,323 vessels registered in the United States which were suitable for transporting crude oil and petroleum products. Ninety-two percent (3,971 vessels) were non-self-propelled tank vessels (tank barges) and eight percent (352 vessels) were self-propelled tank vessels (tankships).

The total capacity of these 4,323 vessels is 168.4 million barrels. This capacity represents a fourfold increase in reported available capacity since the 1967 NPC study. The greatest increase occurred in the category of tankships.

In addition to the tank barges, the inland waterways fleet includes over 4,300 tow boats and tugs with a combined horsepower equivalent of 6.1 million.

Tankships are generally used on the East Coast Waterways System, while tank barges are overwhelmingly in service on the Gulf Intracoastal Waterway and the Mississippi River and tributaries.

Navigable Waterways

The inland waterways system of the United States includes 25,000 miles of navigable water, including navigable rivers, intracoastal waterways, canals, channels, and other waterways (Figure 10). Nearly 25 percent of this system is less than six feet deep and almost 80 percent is less than 14 feet deep. Thus, draft limits are imposed on the commercial traffic operating on most of the navigable waterways.

Included in Volume V is a list of 26 inland waterways, providing detailed information on river mileages, controlling depths, name or number of each lock facility, location, and size of lock chamber.

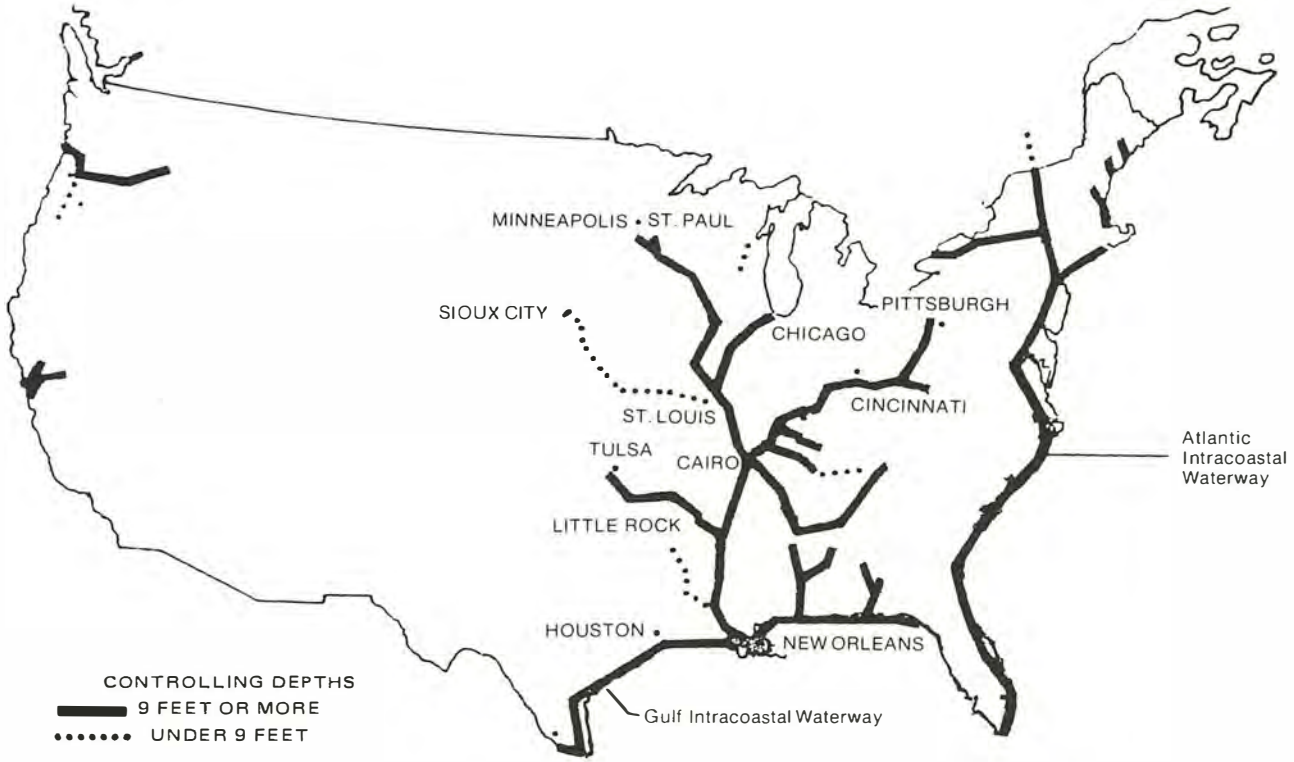
Petroleum Receiving Facilities

A representative listing of major U.S. coastal and inland waterways petroleum receiving facilities and the major receiving facilities in Puerto Rico and the Virgin Islands is contained in Volume V. Included in this listing are coastal facilities with 50,000 barrels or more of storage capacity; for facilities on the inland waterways system, the minimum storage capacity was set at 20,000 barrels. The data cover the years from mid-1974 to the third quarter of 1979 for coastal facilities and from 1977 to mid-1979 for inland facilities. The listing does not include all of the facilities in operation at present.

Significant Trends

The following significant trends have developed in waterborne transportation of petroleum in the United States:

- In the past 40 years, tonnage shipped on the inland waterways has more than tripled and the average length of haul has increased from 50 to 375 miles. Water carriers are second only to pipelines in volume of petroleum transported.
- Vessel construction continues to favor larger vessels.
- Technological developments over the years have enabled operators on the inland waterways to increase maximum tow size from 5,000 to 30,000 tons. Those advances include modern design features of barges and improved utilization and handling characteristics of towboats.
- The most significant trend regarding petroleum receiving facilities is the development of deepwater port facilities in the U.S. coastal waters capable of handling larger tankers of crude oil. The Louisiana Offshore Oil Port (LOOP) project, which is scheduled for completion in 1981, is the first of several planned deepwater ports. LOOP will have the capacity of receiving 1.4 MMB/D of crude oil when operational, and will handle the equivalent unloading of some 330 supertankers per year. LOOP and its associated pipeline system (LOCAP) are also projected to displace about 85 percent of the crude oil movements presently taking place on the lower Mississippi River System.



SOURCE: Adapted from *Final Environmental Impact Statement. Title XI*: U.S. Department of Commerce. Maritime Administration. February 1979.

Figure 10. Commercially Navigable Waterways of the United States.

Constraints

The waterborne transportation industry is confronted with problems which hamper efficiency, increase costs, and reduce flexibility. They include flooding, low water conditions, irregularities in winter movements, escalating volumes at smaller locks, manpower shortages, and certain restrictions resulting from legislation and governmental regulations.

Several existing locks and dams represent a serious constraint to navigation because of their size, age, and operational limitations. Those of specific concern include Lock and Dam 26 on the upper Mississippi River, Gallipolis Lock and Dam on the Ohio River, the Vermillion and Calcasieu Locks on the Gulf Intracoastal Waterway, and the Industrial Lock at New Orleans.

Volume VI — Gas Pipeline Report

Overview

As of December 31, 1977, the U.S. natural gas network (excluding distribution systems) included 331,976 miles of pipeline — 71,462 miles of field and gathering systems and 260,514 miles of transmission lines. This network of pipelines connects the gas producing regions (primarily the southwestern states, Louisiana, and the Gulf of Mexico) with consumers in nearly every area of the United States.

The major natural gas pipelines in the United States were utilized at approximately 68 percent of design capacity on a daily average basis in 1977. Although the actual capacity utilization may fluctuate widely in total and for individual lines, this figure indicates that significant spare capacity exists within the pipeline network at various times throughout the year.

Underground Storage and Gas Pipeline Interconnections

The natural gas transmission system is marked by its flexibility, resulting largely from the use of gas pipeline interconnections and underground storage.

Independent pipeline systems interconnect to form a grid across the United States. By means of this grid, gas can flow from one pipeline to another in response to changes in supply locations, demand patterns, short-term system activities, and emergencies. The flexibility of the system was effectively demonstrated during the supply emergency of the winter of 1976-77 when large volumes of gas were transported or displaced across the country to fuel-short areas in the east.

Underground storage is used to meet changing seasonal requirements. In the past 20 years, the number of underground storage facilities has nearly doubled. In 1977, there were 385 underground storage reservoirs located in 26 states. These reservoirs had a total capacity of 7.2 trillion cubic feet and actually contained 6.3 trillion cubic feet of gas volume. The unused capacity can be attributed to reservoir development or lack of gas supply.

Approximately 40 percent of the natural gas consumed annually by residential customers in the United States is withdrawn from underground storage.

Natural Gas Flow Patterns

Figure 11 depicts the flow pattern of natural gas in the United States. Shown to approximate scale are the maximum design flow capacity as of December 31, 1977, and the average 1977 daily flowing volumes.

Significant Trends

- Recent government policy changes resulting in increased gas supply have produced a greater use of pipeline facilities since 1977. Many interstate pipeline companies indicate that the supply situation has improved since then and may continue to do so in the near term, resulting in less unused capacity.
- Future projects which will affect supplies, and possibly flow patterns, are the Alaskan and Rocky Mountain projects, increases in Canadian and Mexican imports, LNG imports, and coal gasification plants.
- A shift in the gas market from industrial to residential and commercial loads would not affect flow patterns since the population tends to locate near industrial complexes.

NATIONAL GAS FLOW PATTERNS

MAXIMUM DESIGN FLOW CAPACITIES AS OF DECEMBER 31, 1977
AND
ACTUAL AVERAGE 1977 DAILY FLOWING VOLUMES

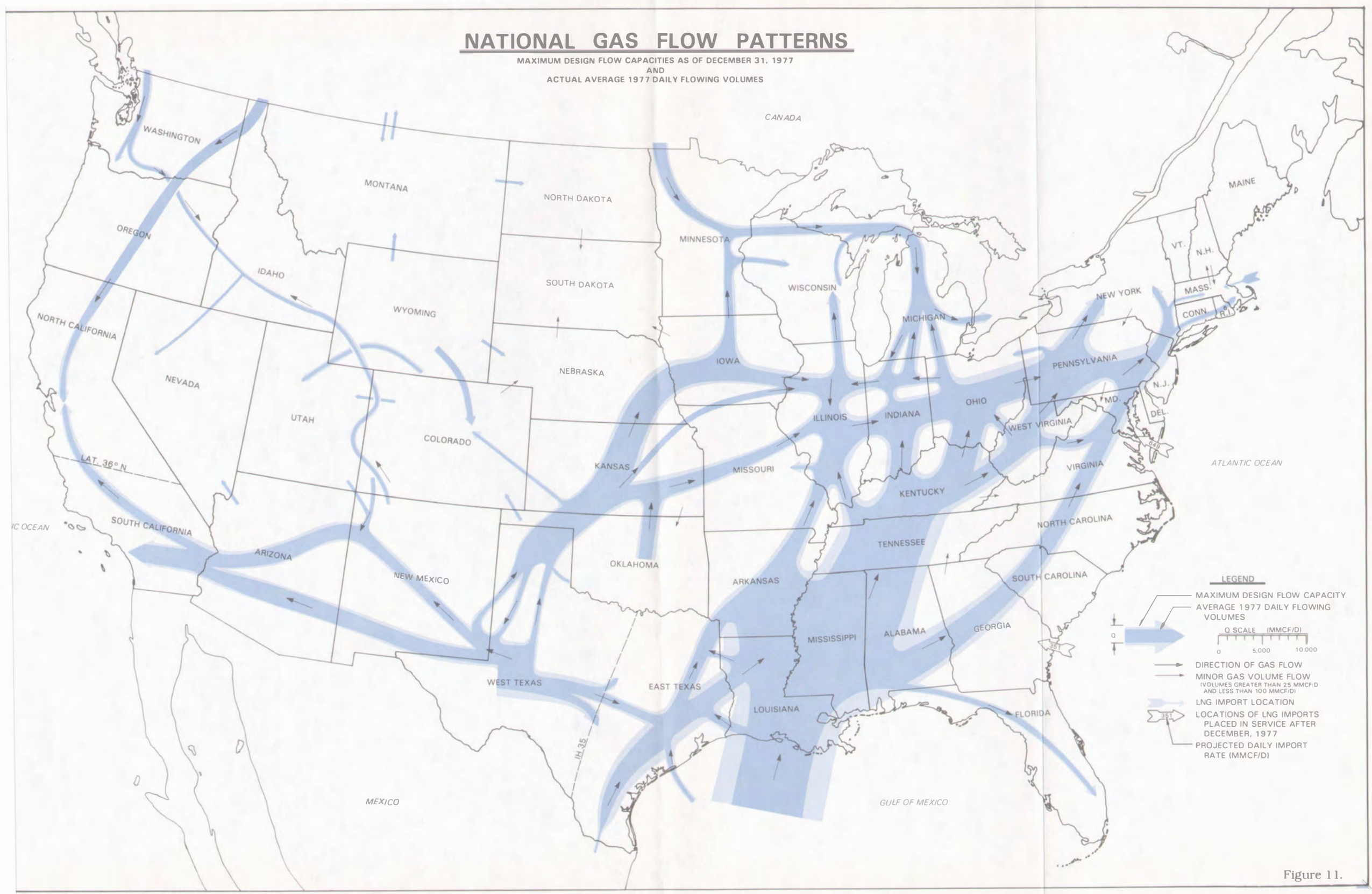


Figure 11.

APPENDICES

APPENDIX A

Request Letters

Department of Energy
Washington, D.C. 20585

June 20, 1978

Dear Mr. Chandler:

The ability of this Nation to withstand interruptions in normal oil supplies, whether by domestic dislocation or by foreign intervention, is immediately served by recourse to existing inventories of oil stocks. In addition, the United States has embarked on a Strategic Petroleum Reserve program to aid in meeting its commitments abroad and its commitments to consumers at home in case of another interruption of foreign oil supply. For industry and Government to respond appropriately to an emergency, our need for accurate information and understanding of primary petroleum inventories is greater than it has ever been.

Implicit in an understanding of petroleum inventories is the distinction between total stocks and those stocks which would be readily available for use. Such information is essential in evaluating correctly the extent of the contribution our oil stocks would be able to make in times of oil supply emergency and planning the development and use of the Strategic Petroleum Reserve.

Periodically the National Petroleum Council has conducted for the Department of the Interior a survey of the availability of petroleum inventories and storage capacity. The last such report was issued in 1974, the eighth in a series which began in 1948.

Accordingly, the National Petroleum Council is requested to prepare for the Department of Energy a new report on available petroleum inventories and storage capacity. This new report should emphasize the distinction between available stocks and those unavailable. For the purpose of this study, I will designate the Deputy Assistant Secretary for Policy and Evaluation to represent me and to provide the necessary coordination between the Department of Energy and the National Petroleum Council.

Sincerely,

James R. Schlesinger
Secretary

Mr. Collis P. Chandler, Jr.
Chairman
National Petroleum Council
1625 K Street, N.W.
Washington, D. C. 20006

Department of Energy
Washington, D.C. 20585

June 20, 1978

Dear Mr. Chandler:

The National Petroleum Council has prepared numerous studies in the past on the Nation's petroleum transportation systems. The last study on this subject was prepared over ten years ago and published on September 15, 1967.

The transportation data collected over the years by the Council has been used by the Federal Government for emergency preparedness planning purposes. The data includes information on major crude oil and petroleum product pipelines, natural gas transmission lines, inland waterway barges, tank cars and tank trucks. Detailed information is also included on the location, capacity and type of pump stations and compressor stations.

As part of the Government's overall review and update of emergency preparedness planning, current data are needed on the Nation's petroleum transportation systems. I, therefore, request the National Petroleum Council to undertake a detailed study to determine current petroleum and gas transportation capacities including natural gas transmission lines, crude oil and petroleum product pipelines, crude oil gathering lines in major producing areas, inland waterway barges, tank cars and tank trucks. With respect to transportation of oil and petroleum products, the study should cover the spatial and transportation relationships--the match ups--among refineries of varying capacities and crude oil sources.

The study should examine the industry's flexibility to meet dislocations of supply and outline the changing supply patterns of the petroleum and natural gas deliverability systems.

For the purpose of this study, I will designate the Deputy Assistant Secretary for Policy and Evaluation to represent me and to provide the necessary coordination between the Department of Energy and the National Petroleum Council.

Sincerely,

James R. Schlesinger
Secretary

Mr. Collis P. Chandler, Jr.
Chairman, National Petroleum Council
1625 K Street, N.W.
Washington, D. C. 20006

APPENDIX B

Council and Committee Rosters

National Petroleum Council
Roster

Jack H. Abernathy, Chairman
Big Chief Drilling Company

Jack M. Allen, President
Alpar Resources, Inc.

Robert O. Anderson
Chairman of the Board
Atlantic Richfield Company

R. E. Bailey
Chairman and
Chief Executive Officer
Conoco Inc.

R. F. Bauer
Chairman of the Board
Global Marine Inc.

Robert A. Belfer, President
Belco Petroleum Corporation

Harold E. Berg
Chairman of the Board and
Chief Executive Officer
Getty Oil Company

John F. Bookout
President and
Chief Executive Officer
Shell Oil Company

W. J. Bowen
Chairman of the Board
and President
Transco Companies Inc.

Howard Boyd
Chairman of the
Executive Committee
The El Paso Company

I. Jon Brumley
President and
Chief Executive Officer
Southland Royalty Company

Theodore A. Burtis
Chairman, President and
Chief Executive Officer
Sun Company, Inc.

John A. Carver, Jr.
Director of the Natural
Resources Program
College of Law
University of Denver

C. Fred Chambers, President
C & K Petroleum, Inc.

Collis P. Chandler, Jr.
President
Chandler & Associates, Inc.

E. H. Clark, Jr.
President and
Chief Executive Officer
Baker International

Edwin L. Cox
Oil and Gas Producer

Roy T. Durst
Consulting Engineer

James W. Emison, President
Western Petroleum Company

James H. Evans, Chairman
Union Pacific Corporation

Frank E. Fitzsimmons
General President
International Brotherhood of
Teamsters

John S. Foster, Jr.
Vice President
Energy Research and Development
TRW, Inc.

R. I. Galland
Chairman of the Board
American Petrofina, Incorporated

C. C. Garvin, Jr.
Chairman of the Board
Exxon Corporation

James F. Gary
Chairman and
Chief Executive Officer
Pacific Resources, Inc.

Melvin H. Gertz, President
Guam Oil & Refining Company, Inc.

Richard J. Gonzalez

F. D. Gottwald, Jr.
Chief Executive Officer,
Chairman of the Board and
Chairman of
Executive Committee
Ethyl Corporation

Maurice F. Granville
Chairman of the Board
Texaco Inc.

Frederic C. Hamilton, President
Hamilton Brothers Oil Company

Armand Hammer
Chairman of the Board and
Chief Executive Officer
Occidental Petroleum Corporation

Jake L. Hamon
Oil and Gas Producer

John P. Harbin
Chairman of the Board and
Chief Executive Officer
Halliburton Company

Fred L. Hartley
Chairman and President
Union Oil Company of California

John D. Haun, President
American Association of
Petroleum Geologists

Denis Hayes
Executive Director
Solar Energy Research Institute

H. J. Haynes
Chairman of the Board
Standard Oil Company
of California

Robert A. Hefner III
Managing Partner
GHK Company

Robert R. Herring
Chairman of the Board and
Chief Executive Officer
Houston Natural Gas Corporation

Ruth J. Hinerfeld, President
League of Women Voters
of the United States

H. D. Hoopman
President and
Chief Executive Officer
Marathon Oil Company

Mary Hudson, President
Hudson Oil Company

Henry D. Jacoby
Director, Center for
Energy Policy Research
Massachusetts Institute of Technology
Sloan School of Management

John A. Kaneb, President
Northeast Petroleum
Industries, Inc.

James L. Ketelsen
Chairman of the Board
President and
Chief Executive Officer
Tenneco Inc.

Thomas L. Kimball
Executive Vice President
National Wildlife Federation

George F. Kirby
Chairman and President
Texas Eastern Transmission Corp.

Charles G. Koch
Chairman and
Chief Executive Officer
Koch Industries, Inc.

John H. Lichtblau
Executive Director
Chief Executive Officer
Petroleum Industry Research
Foundation, Inc.

Jerry McAfee
Chairman of the Board
Gulf Oil Corporation

Paul W. MacAvoy
The Milton Steinbach Professor of
Organization and Management
and Economics
The Yale School of Organization
and Management
Yale University

Peter MacDonald, Chairman
Council of Energy Resource Tribes

D. A. McGee, Chairman
Kerr-McGee Corporation

John G. McMillian
Chairman and
Chief Executive Officer
Northwest Alaskan
Pipeline Company

Cary M. Maguire, President
Maguire Oil Company

C. E. Marsh, II
President
Mallard Exploration, Inc.

W. F. Martin
Chairman of the Board and
Chief Executive Officer
Phillips Petroleum Company

David C. Masselli
Energy Policy Director
Friends of the Earth

F. R. Mayer
Chairman of the Board
Exeter Company

C. John Miller, Partner
Miller Brothers

James R. Moffett, President
McMoRan Exploration Company

Kenneth E. Montague
Chairman of the Board
GCO Minerals Company

Jeff Montgomery
Chairman of the Board
Kirby Exploration Company

R. J. Moran, President
Moran Bros., Inc.

Robert Mosbacher

C. H. Murphy, Jr.
Chairman of the Board
Murphy Oil Corporation

John H. Murrell
Chief Executive Officer and
Chairman of Executive Committee
DeGolyer and MacNaughton

R. L. O'Shields
Chairman and
Chief Executive Officer
Panhandle Eastern
Pipe Line Company

John G. Phillips
Chairman of the Board and
Chief Executive Officer
The Louisiana Land
& Exploration Company

T. B. Pickens, Jr.
President
Mesa Petroleum Company

L. Frank Pitts, Owner
Pitts Oil Company

Rosemary S. Pooler
Chairwoman and
Executive Director
New York State
Consumer Protection Board

Donald B. Rice, President
Rand Corporation

Corbin J. Robertson
Chairman of the Board
Quintana Petroleum Corporation

James C. Rosapepe, President
Rosapepe, Fuchs & Associates

Henry A. Rosenberg, Jr.
Chairman of the Board and
Chief Executive Officer
Crown Central
Petroleum Corporation

Ned C. Russo, President
Stabil-Drill Specialties, Inc.

Robert V. Sellers
Chairman of the Board
Cities Service Company

Robert E. Seymour
Chairman of the Board
Consolidated Natural Gas
Company

J. J. Simmons, Jr.
President
Simmons Royalty Company

Theodore Snyder, Jr.
President
Sierra Club

Charles E. Spahr

John E. Swearingen
Chairman of the Board
Standard Oil Company (Indiana)

Robert E. Thomas
Chairman of the Board
MAPCO Inc.

H. A. True, Jr.
Partner
True Oil Company

Martin Ward, President
United Association of Journeymen
and Apprentices of the
Plumbing and Pipe Fitting
Industry of the United States
and Canada

Rawleigh Warner, Jr.
Chairman of the Board
Mobil Corporation

John F. Warren
Independent Oil Operator/Producer

Lee C. White, President
Consumer Energy Council
of America

Alton W. Whitehouse, Jr.
Chairman of the Board and
Chief Executive Officer
The Standard Oil Company (Ohio)

Joseph H. Williams
Chairman of the Board and
Chief Executive Officer
The Williams Companies

Robert E. Yancey, President
Ashland Oil, Inc.

National Petroleum Council

Committee on
U.S. Petroleum Inventories, and
Storage and Transportation Capacities

Chairman

Robert V. Sellers
Chairman of the Board
Cities Service Company

Government Cochairman

R. Dobie Langenkamp
Deputy Assistant Secretary
Oil, Natural Gas and Shale Resources
U.S. Department of Energy

Ex Officio

C. H. Murphy, Jr.
Chairman
National Petroleum Council
c/o Murphy Oil Corporation

Ex Officio

H. J. Haynes
Vice Chairman
National Petroleum Council
c/o Standard Oil Company of California

Secretary

Marshall W. Nichols
Deputy Executive Director
National Petroleum Council

* * *

W. J. Bowen
Chairman of the Board and President
Transco Companies Inc.

Theodore A. Burtis
Chairman, President and Chief Executive Officer
Sun Company, Inc.

O. C. Davis
Chairman of the Board and Chief Executive Officer
Peoples Gas Company

Cortlandt S. Dietler, President
Western Crude Oil, Inc.

James W. Emison, President
Western Petroleum Company

James H. Evans, Chairman
Union Pacific Corporation

Frank E. Fitzsimmons
General President
International Brotherhood of Teamsters

Andrew K. Fraser
Past Chairman of the Board
National Tank Truck Carriers, Inc.

Maurice F. Granville
Chairman of the Board
Texaco Inc.

Ruth J. Hinerfeld, President
League of Women Voters of the United States

John A. Kaneb, President
Northeast Petroleum Industries, Inc.

Thomas L. Kimball
Executive Vice President
National Wildlife Federation

Arthur C. Kreutzer
Former Executive Vice President
and General Counsel
National LP-Gas Association

Robert D. Lynch
Senior Vice President
Empire State Petroleum
Association, Inc.

John G. McMillian
Chairman and
Chief Executive Officer
Northwest Alaskan
Pipeline Company

John N. Nassikas
Squire, Sanders & Dempsey

R. L. O'Shields
Chairman and
Chief Executive Officer
Panhandle Eastern
Pipe Line Company

James C. Rosapepe, President
Rosapepe, Fuchs & Associates

Arthur R. Seder, Jr.
Chairman and President
American Natural Resources Company

William T. Smith
Past Chairman of the Board
Mid-Continent Oil & Gas Association
c/o Champlin Petroleum Company

Elvis J. Stahr
Senior Counselor and President
Emeriti
National Audubon Society

Robert E. Thomas
Chairman of the Board
MAPCO Inc.

Alton W. Whitehouse, Jr.
Chairman of the Board and
Chief Executive Officer
The Standard Oil Company (Ohio)

Joseph H. Williams
Chairman of the Board and
Chief Executive Officer
The Williams Companies

Robert E. Yancey, President
Ashland Oil, Inc.

National Petroleum Council

Coordinating Subcommittee
of the
Committee on
U.S. Petroleum Inventories, and
Storage and Transportation Capacities

Chairman

R. Scott VanDyke
Vice President—Pipeline
Transportation
Cities Service Company

Government Cochairman

Mario Cardullo
Acting Director
Division of Energy
Transportation Policy
Development
U.S. Department of Energy

Secretary

Joan Walsh Cassedy
Committee Coordinator
National Petroleum Council

* * *

Frank Breese
McGraw-Hill Inc.

Richard W. Carthaus
Vice President
Western Petroleum Company

L. E. Hanna
Vice President—Engineering
Panhandle Eastern
Pipe Line Company

Gordon D. Kirk, President
Sun Pipe Line Company

Charles J. Luellen
Executive Vice President
Ashland Petroleum Company

W. P. Madar
Vice President—Supply
The Standard Oil Company
(Ohio)

Walter B. Smith, Jr.
Manager, Traffic—U.S.
Petroleum Products Department
Texaco Inc.

* * *

Assistant to the Task Group

B. W. Primeaux
Manager, Planning & Project
Development
Transportation Division
Cities Service Company

National Petroleum Council

Inventory and Storage Task Group
of the
Committee on
U.S. Petroleum Inventories, and
Storage and Transportation Capacities

Chairman

W. P. Madar
Vice President—Supply
The Standard Oil Company (Ohio)

Government Cochairman

Earl Ellerbrake
Director of Transportation
Office of Oil and Natural Gas
Supply Development
Resource Applications
U.S. Department of Energy

Secretary

Charles Hennig
Consultant

* * *

Dale E. Choate, Manager
Supply Distribution and
Traffic Planning
U.S. Marketing and
Refining Division
Mobil Oil Corporation

Donald M. Prenowitz
Manager, Industry Analysis
Shell Oil Company

John S. Rossiter
Manager of Logistics Planning
Union Oil Company of California

John H. Smithson
Policy and Evaluation
U.S. Department of Energy

L. D. Thomas
Executive Vice President
Amoco Oil Company

* * *

Assistants to the Task Group

Stephen D. Bojack
Staff Director,
Logistics Planning
Standard Oil Company (Indiana)

Harald R. Leuba
Consultant

Steven A. Villas
Senior Crude Oil Trader
The Standard Oil Company (Ohio)

National Petroleum Council

Petroleum Pipeline Task Group
of the
Committee on
U.S. Petroleum Inventories, and
Storage and Transportation Capacities

Chairman

Gordon D. Kirk, President
Sun Pipe Line Company

Secretary

Joan Walsh Cassedy*
Committee Coordinator
National Petroleum Council

Government Cochairman

Robert G. Bidwell, Jr.
Chief
Crude Oil Allocation Branch
Economic Regulatory Administration
U.S. Department of Energy

* * *

E. I. Allen, President
Chevron Pipe Line Company

Patrick H. Corcoran
Executive Director
Association of Oil Pipe Lines

R. C. Day
Manager, Joint Interest
Marathon Pipe Line Company

Charles G. Goss, President
Explorer Pipeline Company

David Lindahl, Analyst
Environmental and Natural
Resources Division
Library of Congress

Howard A. Parker, President
Amoco Pipeline Company

* * *

Assistants to the Task Group

James V. Carboni
Crude Oil Allocation Branch
Economic Regulatory Administration
U.S. Department of Energy

Peter C. Coggeshall
Specialist, Corporate Planning
and Economics
Amoco Pipeline Company

Marvin F. Griffin
Manager, Project Analysis
Sun Pipe Line Company

Nancy Trycinski
Refinery Operations Branch
Economic Regulatory Administration
U.S. Department of Energy

Don L. Wiruth
Manager, Planning and
Project Development
Explorer Pipeline Company

---

*Succeeded J. Donald Durand, June 1979.

National Petroleum Council

Tank Cars/Trucks Task Group
of the
Committee on
U.S. Petroleum Inventories, and
Storage and Transportation Capacities

Chairman

Walter B. Smith, Jr.
Manager, Traffic—U.S.
Petroleum Products Department
Texaco Inc.

Government Cochairman

Barry Yaffe
Director, Energy Emergency
Management Information
Systems Project Office
Energy Information
Administration
U.S. Department of Energy

Secretary

Joan Walsh Cassedy
Committee Coordinator
National Petroleum Council

* * *

Grant Arnold
General Traffic Manager
The Ethyl Corporation

William H. Broderick
Manager—Distribution and Traffic
Mobil Oil Corporation

Kenneth P. Fischl
Manager, Tank Car Marketing
and Administration
Union Tank Car Company

Donald Frederick
National Council of
Farmer Cooperatives

Clifford J. Harvison
Managing Director
National Tank Truck Carriers, Inc.

Edgar Morgan
Vice President—Fuel Oil
National Oil Jobbers Council

John E. Nelson, President
Matlack, Inc.

Richard B. Nelson
Executive Vice President
Coastal Tank Lines, Inc.

John Ruan, III
Vice President, Operations
Ruan Transport Corporation

A. A. Wright
Legislative and Regulatory
Coordinator
Chevron U.S.A. Inc.

Assistants to the Task Group

Alex Finlay
Assistant General
Traffic Manager
Mobil Oil Corporation

Daniel F. O'Donnell
Vice President
Sales and Marketing
Coastal Tank Lines, Inc.

Michael D. Pattison
Assistant Manager
Transportation Rates
Ethyl Corporation

National Petroleum Council

Waterborne Transportation Task Group
of the
Committee on
U.S. Petroleum Inventories, and
Storage and Transportation Capacities

Chairman

Charles J. Luellen
Executive Vice President
Ashland Petroleum Company

Government Cochairman

James V. Rosapepe
Fuels and Energy Group
Maritime Administration

Secretary

Joan Walsh Cassedy
Committee Coordinator
National Petroleum Council

* * *

Lester C. Bedient
Vice President—General Manager
California Operations
Crowley Maritime Corporation

William A. Creelman, President
Transport Division
National Marine Service, Inc.

Robert L. Gray
Manager, River Operations
Ashland Petroleum Company

Ralph W. Hooper, President
Interstate and Ocean Transport Company

Carl H. Stuber, President
Cleveland Tankers, Inc.

Archie L. Wilson, President
Dixie Carriers, Inc.

* * *

Assistants to the Task Group

Tony Bruno
Vice President
Transport Division—Gulf Area
National Marine Service, Inc.

Robert B. Keifer, Jr.
Manager, Marine Transportation
Ashland Petroleum Company

Howard Lynch
Manager, Business Development
Interstate and Ocean Transport Company

Chester H. Walters
Vice President
Transport Division
National Marine Service, Inc.

National Petroleum Council

Gas Pipeline Task Group
of the
Committee on
U.S. Petroleum Inventories, and
Storage and Transportation Capacities

Chairman

L. E. Hanna
Vice President—Engineering
Panhandle Eastern
Pipe Line Company

Government Cochairman

Lucio D'Andrea
Director of Natural Gas
Division
Office of Oil & Natural Gas
Supply Development
U.S. Department of Energy

Secretary

Joan Walsh Cassedy
Committee Coordinator
National Petroleum Council

* * *

Robert E. Bradfield
Vice President
Engineering and Construction
Houston Pipeline Company

John Cota
Vice President
Engineering and Construction
Administration
Michigan Wisconsin
Pipe Line Company

Robert B. Kalisch
Assistant Director
Gas Supply and Statistics
American Gas Association

Howard M. McKinley
Vice President
Gas Operations
Pacific Gas & Electric Company

Lawrence J. Ogden
Director of Construction
and Operations
Interstate Natural Gas
Association of America

Charles E. Schorre, Director
Pipeline Systems Planning
Department
Transcontinental Gas Pipeline
Corporation

Harold W. Stafford
Public Utilities Specialist (Gas)
Federal Energy Regulatory
Commission

Joe E. Thompson
Vice President
Natural Gas Pipeline Company
of America

* * *

Assistants to the Task Group

John W. Hotzel
Supervising Engineer
Panhandle Eastern
Pipe Line Company

Joyce J. Huff
Engineering Mathematician
Panhandle Eastern
Pipe Line Company

Assistants to the Task Group (continued)

Phillip V. Isola
Manager, Operational Analysis
American Natural Service Company

F. J. Parsons
Manager of Gas Control
Pacific Gas & Electric Company

Donald B. Riblet
Assistant Chief Engineer
Houston Pipeline Company

Francis J. Robertson
Senior Engineer—Pipeline
Systems Planning Department
Transcontinental Gas Pipeline
Corporation

Walter M. Rzepczynski
Manager, Reservoir Engineering
Storage Division
Natural Gas Pipeline Company
of America

Janet E. Vanderpool
Staff Engineer—Facility
Analysis Engineering Department
American Natural Service Company

Lester W. Wurm
Supervising Engineer—
Technical Service Division
Panhandle Eastern
Pipe Line Company

APPENDIX C
Minority Views

Minority Views
On Certain Aspects of the
Report of the
National Petroleum Council's
Committee on
U.S. Petroleum Inventories, and
Storage and Transportation Capacities

Submitted by
James Carew Rosapepe

Concurred with by
Thomas L. Kimball
David C. Masselli
Rosemary S. Pooler
Theodore Snyder, Jr.
Elvis J. Stahr
Lee C. White

December 12, 1979

The Committee report represents a year of hard work and constructive participation by over 60 people in the oil, gas and related industries, as well as representatives from government and the labor, environmental and consumer movements. The information it presents, particularly the results of surveys of current capacities, is a significant addition to public understanding of the industry. It should be helpful to the Department of Energy and others responsible for emergency planning.

While there was representation of labor, environmental, and consumer interests on the full Committee, the credit for the report clearly belongs to the industry majority. They designed the studies, analyzed the results and wrote the report. The overwhelming amount of the committee's work was done by the NPC staff and the industry through the Coordinating Subcommittee and the five Task Groups. They devoted weeks and months to preparing the report.

As a result, the report, both in the data it reports and in the narrative, reflects the consensus of the industry majority of the Committee. A number of its key policy-related judgments deserve the support of non-industry groups as well.

For example, the Committee is absolutely right to put heavy emphasis on the importance of accurately measuring the extent of secondary and consumer storage and inventory. During the shortage of 1979, far too much concern was focused on the primary sector, in large part because the government lacks data on the other sectors.

Also, the Committee's conclusion that the industry lacks significant amounts of excess storage capacity underlines the need to successfully develop the government's Strategic Petroleum Reserve. When oil imports are drastically cut, the nation needs a ready source of additional supply.

Improving on past NPC storage and transportation studies, the report includes narrative primers in each section describing briefly how the industry works. By providing a context for the extensive data the Committee collected, the narrative makes the data more useful to readers. The overwhelming majority of the narrative in the Committee's report is factual, readable, and devoid of policy-related bias.

There are, however, a few points made in the report that, while eminently sensible when viewed strictly from the industry's perspective, do not reflect the reality of disagreement with the industry's view of the "facts." There are also a few areas in which the Committee either did not collect or did not report data that might have made the report more useful. These are the points on which I dissent from the majority's conclusions.

Two major policy-related themes—regulation and safety—are addressed explicitly or implicitly in each of the four transportation sections of the report. While the Committee's discussion of these topics is brief, the comments that are made reflect an industry perspective, not a value-free recitation of facts.

Regulation

The report blames environmental rules for "delays," consumer protection regulation for creating "uncertainty," and state standards for hampering "efficiency." Clearly, there are occasions when government regulation has these effects, sometimes unavoidably, sometimes not. But the implication that some readers may draw from most of the report's discussion of regulation is, in my view, off-target.

First, with few exceptions, the report makes no attempt to relate the alleged burden of regulation to the demands of emergency planning. Increased government regulation makes more work for industry executives. It complicates corporate planning. But it does not necessarily impede effective "emergency preparedness planning" which, according to Secretary Schlesinger's letters of June 20, 1978, was to be the focus of the study. Unfortunately, the Committee did not undertake a rigorous analysis of whether or not it does.

Second, by discussing the costs of regulation without reference to its benefits, the report gives the impression that the industry does not understand the legitimate public concerns that lead to regulation. Of course, "delays" can result from consideration of environmental impacts of pipeline construction. Of course, "uncertainty" is created when the Federal Energy Regulatory Commission (FERC) questions pipeline rates. Of course, "efficiency" can be affected by state laws that curb water pollution.

Lack of effective regulation, however, can lead to the same results. "Uncertainty" is what a worker's family feels when he is killed in a natural gas pipeline accident. "Efficiency" is impaired when water pollution destroys a local fishing or tourist industry. And "delays" occur when explosions put transportation facilities out of service.

Finally, as I participated in meetings of the Committee's Task Groups and Coordinating Subcommittee, it became clear to me that many industry executives see regulation primarily as a problem to which its removal would be a solution. References to it were included in the report generally to explain the difficulties the industry faces. That viewpoint, while certainly understandable, seems to me unrealistic.

Business abuse is what creates government regulation. One does not have to look far beyond the evening newspaper to recognize that oil tankers spill, gas pipelines leak, and tank cars turn over. Workers can be injured on the job and companies can make excessive profits. These things obviously do not happen all the time. But they happen more often than most Americans, including, I think, most industry executives, think they should.

To base emergency planning, or any other industry planning, on the assumption that EPA, OSHA, FERC, or the other government regulators will go away would be imprudent. One of the industry's greatest strengths has been the realism of its leaders. Regulation is a key area in which that strength needs to be applied.

Safety

One regulatory area that the report repeatedly stresses is safety. The gas pipeline section, for example, observes that "safety considerations are of great concern to the gas transportation industry." And we are told that government data show that "the petroleum pipeline industry provides the safest mode of liquid petroleum transportation when compared to other modes."

In one sense, it is to the industry majority's credit that they insisted on including in the report some discussion of safety issues. Unfortunately, they included only references to what government and industry are already doing to deal with inherent dangers in the

transportation of oil and gas. In my view, the unsolved problems of safety in this industry may be a greater "constraint" than current rules.

Consider the following points made by the National Transportation Safety Board, an independent federal agency that investigates major transportation accidents, in its 1978 annual report:

- "While the Safety Board first identified the need to require additional controls for (LPG) pipelines as early as 1970, no substantial changes in the safety requirements have been made."
- "Derailments of hazardous material tank cars on the nation's railroads—often resulting in explosion, fire, casualties, and extensive property damage—continue to occur at an alarming rate."
- "The risk potential for a release of LNG or other hazardous materials after a collision of super LNG tankerships or large crude oil vessels with smaller vessels or oil rigs is increasing daily, particularly in the Gulf of Mexico and off the Atlantic Coast."
- "Investigations of pipeline accidents over the past two years continue to identify compliance deficiencies by the pipeline industry."

Or read the report of the House Committee on Interstate and Foreign Commerce on H.R. 51, a bill sponsored by Rep. Edward Markey (D.-Mass.) and recently passed by the House to strengthen safety regulations:

- "The Committee received evidence that approximately 750,000 natural gas leaks are reported each year. In 1976, some 1,500 leaks resulted in accidents which caused 63 deaths and 366 serious injuries."
- "Nearly 90 percent of the (gas) pipeline system in use is not effectively covered by federal safety regulations."
- "The inadequacy of regulatory actions can be ascribed in large part to a lack of aggressive support within (the Department of Transportation)...Lacking effective leadership, the Office (of Pipeline Safety Operation in DOT) tended to follow the path of least resistance, adopting industry 'consensus' standards, delaying entry into controversial areas, and generally avoiding facing up to the hard issues of public safety."
- "The record before this Committee does not indicate that (the current) statutory framework has provided a successful resolution of the safety problem."

This is hardly a picture of adequate government oversight, let alone over-regulation.

The Committee included numerous references to what industry is doing to protect the safety of its workers and the public, but virtually no discussion of the problems that remain. That decision reflects, I think, a complacency within the industry about safety problems that I heard in meetings of the Committee and its Task Groups. And that complacency is the strongest argument for increased government safety regulation.

Section-by-Section Comments

Beyond these two broad concerns, I find a number of smaller points made in the report that differ from my own judgments. Discussed below are the more important of these points.

Inventory and Storage

- The report notes that left out of the Committee's survey are figures on inventory and storage capacities of:

  1. "Crude oil and products located in U.S. possessions and territories . . ."

  2. "Transshipment facilities located in foreign countries adjacent to the United States."

  3. "Foreign crude and products bound for the United States."

  4. "Most of the Alaskan North Slope crude oil in tankers." I concur with the Committee majority's judgment that this data was not needed to accomplish its tasks. Moreover, the report does provide estimates of the total capacities in U.S. possessions and in adjacent foreign transshipment facilities.

  More importantly, the Committee majority is correct in focusing increased attention on these sometimes overlooked aspects of the nation's inventory and storage base. The report notes, for example, that the storage capacity at adjacent foreign transshipment terminals "is significant. . .because it is equivalent to 15 percent of all the existing crude oil storage capacity in PADs I-IV."

  Precisely because the Committee is right about the importance of these elements of inventory and storage, it is unfortunate that data on them was not collected. While the figures were not needed for the Committee's analysis, their inclusion could only help the Department of Energy and the public better understand how the industry works.

Petroleum Pipelines

- The Committee majority decided to exclude data on private and gathering lines from this report on the theory that neither were important for emergency planning. That judgment may not have been correct in all cases. For example, there are private (non-common carrier) lines such as Amoco's in the midwest and several in California that are significant factors in their regions. Also, the capacities of some larger gathering lines (those that carry crude oil from wells to trunk lines) may be important to accomplishing enhanced production in times of shortage.

- The report asserts that "joint venture stock companies and undivided interest pipelines have made possible the building of larger diameter pipelines." It offers no evidence whatever that these joint ventures, generally made up of major oil companies that cooperate rather than compete, are the only or even the best way to "make possible" large oil pipelines. Indeed, the reason that oil companies are in the pipeline business at all is that Congress has allowed them, unlike coal companies which are barred from owning railroads, to transport their own commodities.

  Joint ventures of oil companies may be the most efficient and reasonable ways to finance major pipelines. Or they may not be. They may simply be ways for large oil companies to dominate their smaller competitors and overcharge consumers. The Federal Trade Commission is currently considering a petition submitted by Sen. Edward M. Kennedy (D.-Mass.) that asks precisely that question. The assertions in this report do not answer it.

Tank Cars/Trucks

- The report describes the "unit train concept (i.e., a number of connected tank cars)" as "a mini-pipeline on wheels." It does not, however, discuss or evaluate the possibility that greatly increased use of unit trains could (1) reduce the need to build new pipelines or expand existing ones, or (2) significantly increase the flexibility of the oil transportation system. The report says that "the tank car is generally less economical for hauling petroleum than are pipelines and tankers." When the importance of flexibility for emergency planning is factored into the analysis, however, this may be less true.
- The report notes "the industry trend of replacing older, smaller equipment with larger capacity (tank) cars." It neglects to point out that, according to the National Transportation Safety Board's 1978 Annual Report, "the jumbo tank car design did not represent a safety increase commensurate with their *(sic)* 200 percent increase in product capacity over that of the older tank cars."

Waterborne

- The report makes several references to the "lack of ready availability of manpower," particularly in the Great Lakes. Based on discussions with representatives of maritime labor, which was not represented on the Waterborne Task Group, I am not convinced that the report does not emphasize this problem more than is justified.
- The report puts considerably more stress on "constraints" that allegedly "hamper efficiency, increase costs, and reduce flexibility" in the waterborne sector than in any other. The, probably inadvertent, implication is that, compared to other sectors, waterborne is peculiarly burdened. It offers no evidence to indicate that is the case. Moreover, considering the public subsidies the industry has gotten over the years through the Army Corps of Engineers, I do not believe this implication is warranted.
- The report asserts that "non-subsidized tankers from the U.S. Flag Fleet are seldom used in international trade because higher labor costs and operating expenses make the U.S. fleet relatively uneconomic." While the report mentions "higher safety and equipment standards for U.S. flag vessels" as additional reasons, it ignores a key subsidy for foreign flag tankers—the ability of their owners, often major oil companies, to use the foreign tax credit and tax-free havens such as Liberia and Panama to avoid millions of dollars in U.S. income taxes.

Gas Pipelines

- The Committee asserts that "the costs of (major projects such as a large capacity system from Alaska or a coal gasification plant) will have to be shared by several companies which will own the common facilities." The report includes no evidence to support this assertion. There are a variety of other, perhaps preferable, ways to finance large pipeline and gasification projects; none of them are mentioned in the report.

APPENDIX D

Glossary

GLOSSARY

barge—general name given to the flat-bottomed vessel especially adapted for the transportation of bulk cargoes. Barges can be self-propelled, towed, or pushed.

barrel—the standard unit of liquid volume in the petroleum industry; equal to 42 U.S. gallons.

batches—homogeneous quantities of petroleum shipped through a pipeline usually having a specified minimum acceptable size.

bulk terminal—a nonconsumer facility used for storage and/or marketing of petroleum products which has a total storage capacity of 50,000 barrels or more or receives its petroleum products by barge, tanker, or pipeline.

common carrier pipeline—a pipeline with the authority and responsibility (state or federal) to provide public transportation for hire.

compressor station—any permanent combination of facilities which supplies the energy to move gas in transmission lines or into storage by increasing the pressure.

crude oil—raw, unrefined petroleum or hydrocarbon liquid.

crude oil gathering system—the network of small lines used to collect crude oil and gas liquids from individual production units or facilities.

distribution system—generally mains, services, and equipment which carry or control the supply of gas from the point of local supply to and including the sales meters.

draft—the depth of a vessel below the waterline.

fractionator—a processing plant which separates natural gas liquids into the marketable components ethane, propane, butane, and natural gasolines.

gravity—the weight per unit measure of petroleum liquid, usually expressed in either degrees API or related to water as a specific gravity. API gravity is a measure of density in degrees API; specific gravity is the weight per unit of a liquid as related to water.

LNG (liquified natural gas)—natural gas becomes a liquid at a temperature of -258°F and may be stored and transported in the liquid state.

loop—the construction of a pipeline parallel to an existing line, usually in the same right-of-way, to increase the capacity of the system.

LPG (liquified petroleum gases)—butane, propane, and ethane which are separated from natural and refinery gases by fractionation, and are transported in liquid form.

main line—distribution line that serves as a common source of supply for more than one service line.

maximum operating inventory—the maximum quantity that could be stored in the assigned tankage (plus inventories maintained outside of storage facilities) while still maintaining a workable operating system, but in addition to that required for normal operations.

minimum operating inventory—the inventory level below which operating problems and shortages would begin to appear in a defined distribution system. Includes *completely unavailable* inventory as well as inventory required to maintain normal operations; does not include seasonal inventory.

natural gas gathering line—a pipeline which transports natural gas from individual wells to compressor station, processing point, or main trunk pipeline.

NGL (natural gas liquids)—high vapor pressure, hydrocarbon liquids separated from wet natural gas and moved by pipeline to a fractionation facility where the components are separated into ethanes, propanes, butanes, and natural gasoline.

One Percent Waybill Sample—sample of origin points of car movements in the United States, which represent approximately one percent of all tank car movements. This sample is compiled by the Interstate Commerce Commission.

origin point—the point at which shipment originates; i.e., loading point.

Petroleum Administration for Defense (PAD) districts—a geographic aggregation for the 50 states and the District of Columbia into five districts, originally designed by the Petroleum Administration for Defense in 1950 for purposes of administration.

pipeline fill—inventory located between the shipping and receiving tanks on a pipeline system.

segregation—moving products or crude oil in a manner which maintains the identity and specifications of each individual batch.

tankage under construction—storage for which steel erection has commenced.

tank bottoms—inventory that falls below the normal suction line of the tank. For floating roof tanks, the amount required to keep the legs of the roof from touching the tank bottoms. The inventory in tank bottoms is unavailable.

tank car—rail car used for transporting liquids in bulk. It is constructed in accordance with varying specifications, due to physical properties and characteristics of products to be transported.

tank truck—prowered vehicle with bulk tank on same chassis (capacity in excess of 3,500 gallons). Possible varying specifications due to characteristics of products carried.

total system capacity—the sum of tank shell capacity, earthen/concrete reservoirs, slate pit storage, and unavailable inventory outside of tankage (defined as pipeline fill, inventory in refinery lines, operating equipment, and in-transit from domestic sources). In the case of crude oil inventories, producers' lease tankage is also included in total system capacity.

trunkline—a large diameter pipeline usually delivering petroleum into a refinery or production distribution terminal.

viscosity—the internal resistance to flow of a fluid. This characteristic is usually measured in Saybolt Seconds Universal (SSU) for petroleum liquids. This is the time required for a standard quantity of a liquid to flow through a standard orifice at a set temperature.

waterways—the more than 25,000 miles of navigable rivers, canals, and channels in the United States, maintained to a depth of at least nine feet.