DOCUMENT RESUME

00166 - [AC590984]

Survey of Publications on Exploration, Development and Delivery of Alaskan Oil Market. B-174944; EMD-77-11. January 14, 1977. Released January 17, 1977. 40 pp.

Report to Sen. Henry M. Jackson, Chairman, Senate Committee on Interior and Insular Affairs; by Elmer B. Staats, Comptroller General.

Issue Area: Energy: Executive Branch Organization and Processes for Dealing with Energy Problems (1611).
Contact: Energy and Minerals Div.
Budget Function: Natural Resources, Environment, and Energy: Energy (305).
Organization Concerned: Alyeska Pipeline Service Co.; Atlantic Richfield Co.; Department of the Interior; Federal Energy Administration; Interstate Commerce Commission; Standard Oil Co., Inc.
Congressional Relevance: Senate Committee on Interior and Insular Affairs.
Authority: Mineral Leasing Act of 1920 (P.L. 93-153). Alaskan Vessel Traffic Regulation Act of 1977. National Environmental Policy Act of 1969. Trans-Alaska Pipeline System Authorization Act of 1973.

Information was gathered from more than 100 publications on the feasibility, advisability, and building and operation of the Trans-Alaska Pipeline System.
Findings/Conclusions: The existence of oil in Alaska has been known since about 1902. It is in a sandstone formation under heavy permafrost layer, near Prudhoe Bay and is the high-sulfur, heavy crude type. Leasing began in 1969, after which the lessees divided the area in half. Estimated initial production will be 1,200,000 barrels a day by 1978 and development expenditures are estimated to be $2,430 million by 1979. The need for the pipeline was first evaluated in 1963 and construction finally permitted in 1973, after proper legislation was enacted and conservation group injunctions ruled upon. The pipeline extends 801 miles from Prudhoe Bay to Valdez, across several mountain ranges and land of varying degrees of stability. The pipeline has safety valves to guard against oil leaks, and special construction techniques and materials were used because of the ground and temperature conditions. Continual monitoring of the pipeline will be maintained by a computer in Valdez and a microwave communications system. Completion is expected in 1977, at an estimated cost of $7.7 billion. Three long range distribution systems are being considered and one short term system. (shipping through the Panama Canal). The long range plans are trans-provincial, northern tier, and Sohio mid-continent. Foreign sales require Presidential and Congressional approval. There appears to be an adequate domestic tonnage supply for marine transportation. The ICC has regulatory

jurisdiction. (SS)

REPORT TO THE SENATE COMMITTEE ON INTERIOR AND INSULAR AFFAIRS

BY THE COMPTROLLER GENERAL OF THE UNITED STATES

Survey Of Publications On Exploration, Development, And Delivery Of Alaskan Oil To Market

This report presents the results of GAO's survey of published information readily available which appeared to be the most relevant and informative on Alaskan oil.

The survey included over 100 publications, documents, studies, and articles obtained from Federal, State, and industry sources.

EMD-77-11

JAN. 14, 1977

COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

B-174944

The Honorable Henry M. Jackson
Chairman, Committee on Interior
and Insular Affairs
United States Senate

Dear Mr. Chairman:

In your August 24, 1976, letter and later discussions with your office, we were requested to examine the origins and effects of the increases in cost to construct the Trans-Alaska Pipeline System. We were also requested to address several other major issues including current estimates of the total cost to develop the Prudhoe Bay oil field and to move the oil to the lower 48 States, and the best current projections for pipeline and tanker tariffs.

In this report, we are presenting the results of our literature research. We did not verify or evaluate the accuracy of the material obtained. As a result, we are not expressing any opinions, conclusions, or recommendations on the matters discussed in this report.

In preparing this report, we reviewed over 100 publications, documents, studies, and articles obtained during September and October 1976 from 12 Federal and State agencies and 4 companies. Appendix VI is a bibliography of this material.

We have organized the material into five appendixes which address issue areas raised in your letter. The appendixes were prepared from information contained in documents which were readily available and appeared to be the most relevant and informative to the issue being discussed. At the beginning of each appendix, we briefly outline the scope of our data base. We include statements regarding the quantity and nature of the source documents reviewed, and where we found inconsistencies in the data reviewed, we disclose this at the appropriate place within the appendix.

Appendix I, Arctic Oil, presents information on the history of the North Slope, the discovery of oil there and production from fields leased by oil companies from Alaska.

Appendix II, Trans-Alaska Pipeline System, presents information on the pipeline system, its components, construction, and cost.

Appendix III, Distribution Systems and Markets for Alaskan Oil, contains information on proposed markets and distribution systems for Alaskan oil.

Appendix IV, Marine Transportation, presents information on the marine transportation components related to moving Alaskan oil to the lower 48 States and the major factors affecting this issue area.

Appendix V, Transportation Cost Considerations, discusses the various components which will affect the Trans-Alaska Pipeline System tariff rate.

Since this report solely presents the results of our literature research, without verification of any information presented, we have not discussed its contents with any of the principals involved.

Sincerely yours,

Comptroller General
of the United States

Contents

ABBREVIATIONS

ARCO	Atlantic Richfield Company
dwt	deadweight tons
ICC	Interstate Commerce Commission
Sohio	The Standard Oil Company
TAPS	Trans-Alaska Pipeline System

APPENDIX I

ARCTIC OIL

INFORMATION BASE

We reviewed 15 publications and documents on Arctic oil exploration and the Prudhoe Bay field. The documents contained material which ranged from being very specific and technical, dealing with such matters as geologic formations, to being more general and describing factors related to field leasing and proposed development.

HISTORY OF ARCTIC OIL EXPLORATION

The search for oil in the Arctic first began in 1923. Early explorers reported numerous oil seeps in northern Alaska. During World War II, the U.S. Government began exploring an area near Prudhoe Bay. This area became known as Naval Petroleum Reserve No. 4. However, at that time, the Government did not locate oil in commercial quantities. Further exploration of these fields, with the exception of limited oil company activity, did not take place until the 1960s. Early in March 1968, the Atlantic Richfield Company (ARCO) confirmed its first successful exploratory well at Prudhoe Bay. During initial testing of this well, oil flowed at a rate of 1,152 barrels a day.

Within months of the ARCO discovery, every major oil company with lease holdings on the North Slope began active exploration. In 1 year, the number of wells drilled increased from 2 to 30.

PRUDHOE BAY FIELD

Field characteristics

The Prudhoe Bay oil field is a land area approximately 600 miles north of Anchorage, Alaska, on the flat-lying coastal plain of the Alaskan North Slope, about 120 miles north of the Brooks Range. Permafrost underlies much of this area and makes drilling and earthmoving difficult because the material is permanently frozen and may consist of anything from solid rock to muddy ice and may extend from a few feet to hundreds of feet below the surface.

The most important reservoirs within the field are sandstones belonging to the Sadlerochit Formation. Inplace hydrocarbon volumes in the reservoir are 35.1 trillion standard cubic

APPENDIX I

feet of natural gas and 19.83 billion stock tank barrels 1/ of crude oil and natural gas liquids. This geologic information was based on a 1974 report prepared for Alaska by H.K. van Poollen and Associates, Inc., and the State of Alaska Division of Oil and Gas.

Prudhoe Bay crude oil is a high-sulfur ("sour") heavy crude (specific gravity = 27) which comes from the ground at temperatures ranging up to 180 degrees Fahrenheit.

Upon discovery of oil on the North Slope, the oil consulting firm of DeGolyer and MacNaughton rated the field at between 5 and 10 billion barrels. Others, including the international oil consultant, Walter J. Levy, made a 15 to 20 billion barrel estimate and even went on to speculate at 40 billion barrels. Most current estimates, including the owner-companies' agent, Alyeska, place the recoverable reserves at about 10 billion barrels, which is as much as the combined reserves in Louisiana, Oklahoma, Kansas, and half of Texas.

Prudhoe Bay leasing

After the discovery of North Slope oil, Alaska started leasing the oil rights to its lands. A lease sale was held on September 10, 1969; a total of 412,453 of the available 1.2 million acres of North Slope land was leased to the highest bidders. At that time, this was the largest oil lease sale in U.S. history, and Alaska received initial revenues in excess of $900 million from the sale, an average price of about $2,132 per acre leased.

The original lease sale and later intercompany transactions resulted in the estimated ownership of the lands leased in the Prudhoe Bay field as shown in the following table. It is important to note that precise field ownership percentages are still being negotiated among the owner companies. The following statistics represent the data shown in our source documents and discussions with an owner company.

1/ A stock tank barrel is a unit of measure of crude oil obtained when the gas and intermediate components are removed during a separation process.

APPENDIX I

Estimated Ownership
Prudhoe Bay Field

Owner companies	Estimated recoverable reserves (billion barrels)	Percent ownership
The Standard Oil Co.	5.100	51.0
ARCO	1.970	19.7
Exxon	1.970	19.7
Mobil	.325	3.3
Phillips	.290	2.9
Others (note a)	.345	3.4
Total	10.000	100.0

a/ Primarily Amerada Hess, Louisiana Land, and Getty.

Field development

For the purposes of development and operation, the owner companies divided Prudhoe Bay field into two areas (units) of approximately equal size. BP Alaska was designated operator of the western unit and ARCO was designated operator of the eastern unit.

Both the western unit and the eastern unit of the field are expected to be operated under a "unit agreement." Unitization provides for one main operator and minimizes the need for building duplicate facilities and drilling unnecessary wells. This approach is therefore more economical and affords greater protection to the environment. Under such an agreement, all leasees of interest in each unit allocate the production from the reservoir and costs to develop the reservoir among themselves. As of September 1976, no unit allocation basis had been agreed on.

The initial development plan provided for about 130 wells to be drilled and spaced throughout the field. As of April 1, 1976, 97 production wells had been drilled.

The oil will flow from the wells to gathering centers (or flow stations) where gas and water will be separated from the oil before the oil enters the pipeline system. Four gathering centers are now under construction and are scheduled to

APPENDIX I

be ready for operation by mid-1977. They will be capable of handling at least 1,200,000 barrels a day of crude oil. Two additional gathering centers are planned, and at least one of them is anticipated to be placed in operation by mid-1978. Produced gas will be reinjected into the reservoir until a gas pipeline is available. No production plan for gas has been agreed on.

Field production

Current owner company estimates show that initial production from the Prudhoe Bay field will be at a rate of 1,200,000 barrels of oil a day by 1978. All our source documents suggest it may be possible to increase total production from the Prudhoe Bay field and other as yet undeveloped fields in the same area to as much as 2 million barrels a day by 1982. However, we know of no specific plans at this time to develop fields other than Prudhoe Bay.

The following table shows the current production projections for the Prudhoe Bay field and delivery of this oil to Valdez through the Trans-Alaska Pipeline System (TAPS) for the years 1977 through 1985.

Year	Production using facilities presently under construction	Production using facilities expanded to ultimate design capability
	(million barrels a day)	
1977 (last half)	.6	-
1978-81	1.2	-
1982-85	1.2	a/ 2

a/ Assumes production from fields other than Prudhoe Bay and expansion of TAPS to 2 million barrels a day.

The above production levels assume a maximum efficient rate for the present Prudhoe Bay field of an estimated 1,500,000 barrels a day. Maximum efficient rate is the highest rate at which oil can be produced from an underground reservoir without damaging the reservoir or causing rapid loss of reservoir pressure which could reduce the total amount of oil that can be recovered. An accurate prediction of a maximum efficiency rate cannot be made until a history of production exists. Also, Alaska must approve the rate to be used, and as of September 1976, Alaska had not approved any rate.

APPENDIX I

One owner company estimated that a production rate of approximately 1,500,000 barrels a day could be sustained for 6 to 8 years, or, alternatively, that a production rate of 1,200,000 barrels a day could be sustained for a longer period. Two other owner companies have projected production rates ranging from 1,200,000 to 1,600,000 barrels a day for 1978 through 1982.

Field development expenditures

ARCO's expenditures for exploring, developing and producing the eastern unit of the Prudhoe Bay field through 1979, exclusive of equalization payments resulting from field unitization, are expected to total approximately $1,230 million. Of this amount, $530 million has been expended through June 30, 1976. Equalization payments arise when properties to be combined in a unit have not been proportionately developed. Under these circumstances, it is necessary for the unitization agreement to provide for some adjustment among the participants to compensate for inequality of development. These adjustments to equalize development costs are typically made in several ways, including cash, larger unit interests, oil payments, unequal contributions to later development, and delayed participation in the unit.

In 1975 BP Alaska estimated that the costs of the initial phase of development would amount to approximately $1,200 million for its part of the Prudhoe Bay field. This cost estimate again is exclusive of any equalization payments which may be made upon unitization.

TRANS-ALASKA PIPELINE SYSTEM

INFORMATION BASE

We reviewed 40 publications and documents about the Trans-Alaska Pipeline System. The documents contained material which was, for the most part, generally consistent. However, some data on scheduled completion dates and final cost estimates was inconsistent. These inconsistencies are identified where they appear in this appendix.

PRECONSTRUCTION OCCURRENCES

The need for a pipeline to transport oil from northern Alaska to an ice-free southern port was first evaluated in 1963. Other more comprehensive studies for supplying North Slope oil to the west coast and other markets followed.

An engineering consulting firm evaluated the technological feasibility of such a pipeline and studied the proposed route. This study was undertaken in the late summer and fall of 1968 and resulted in a report favorable to the proposed route. The companies then proceeded to develop a project staff. This staff reviewed and concurred with the decision to construct the pipeline which was announced in February 1969.

In December 1969, after the announcement to construct TAPS, the Congress passed the National Environmental Policy Act of 1969 which required any agency of the Federal Government, before taking action which might have an impact on the environment, to consider alternative courses of action. The agency, after soliciting the views of other Federal agencies which have jurisdiction over the environmental matters involved, is required to publish a detailed statement disclosing the environmental impact assumed to result from the action to be taken.

In March 1970 three private conservation organizations brought a lawsuit against the Secretary of the Interior in the U.S. District Court for the District of Columbia, and a preliminary injunction was granted in April 1970 restraining the Secretary from issuing permits for constructing the pipeline until the act's requirements were met.

In March 1972 the Secretary of the Interior issued the final environmental impact statement and, in May 1972, announced his intention to issue the construction permit.

In August 1972 the U.S. District Court for the District of Columbia ruled that the environmental impact statement "reasonably met all requirements of the National Environmental Policy Act" and lifted the injunction prohibiting the issuance of the pipeline permits. The environmental groups appealed this ruling to the U.S. Court of Appeals for the District of Columbia. On February 9, 1973, the court of appeals reversed the district court ruling and ordered the district court to reinstate the injunction because the Secretary's permit had exceeded the width of the right-of-way permitted under the Mineral Leasing Act of 1920. This issue was resolved on November 16, 1973, when the Congress enacted Public Law 93-153 amending the Mineral Leasing Act of 1920. The law increased the right-of-way width that the Secretary of the Interior could authorize and authorized construction of the trans-Alaska pipeline.

PIPELINE COMPONENTS

TAPS is comprised of four primary components

--801 miles of 48-inch pipe,
--12 pump stations
--Valdez terminal, and
--a communications system.

The pipeline

The trans-Alaska oil pipeline extends 801 miles from Prudhoe Bay on Alaska's North Slope to Valdez, which is a year-round, sheltered, ice-free southern port on the Gulf of Alaska (see p. 15). The 801-mile pipeline route takes it over several mountain ranges and across land where some of the soil is stable and some is unstable. The pipeline crosses 356 rivers or streams.

The pipe is 48 inches in diameter and was purchased in 40-foot and 60-foot lengths. The 40-foot sections were welded into 80-foot lengths before being transported to locations along the pipeline route for further welding.

The pipeline contains 142 valves of varying types which control oil flow in any direction and prevent a reversal of oil flow. The purpose of the valves is to limit oil spilled from leaks or breaks.

A 361-mile-long, 28-foot-wide, gravel-surface road that roughly parallels the pipeline route was built from the Yukon River crossing to the Prudhoe Bay oilfield. This road was built by Alyeska and will eventually be incorporated into Alaska's road system. Existing roads were used for the section of the pipeline running from Valdez to the Yukon River.

A total of 28 construction camps were built along the pipeline route along with temporary airfields near the camps for the support of road and pipeline construction. Permanent State airfields were constructed near three of the camps and, in addition to being used during the construction of the pipeline system, will be used for the operation and maintenance of the pipeline.

Special construction techniques were required along the route because:

--Temperature extremes range from 90 degrees during the summer months to minus 80 degrees during the winter months.
--The soil is permanently frozen for much of the route.
--Earthquakes ranging up to 8.5 on the Richter scale have occurred in one area.

Using conventional techniques, about 365 miles of pipe was buried where the soil is stable. In areas where the soil would become unstable if thawed by heat from the pipeline, about 408 miles, the pipe was installed above the ground and mounted on support platforms. This pipe was covered with insulation to protect it from the temperature extremes.

About 23 miles of pipe was buried below the 356 rivers and streams crossed. Another 4 miles of pipe was buried and equipped with a ground refrigeration system which allowed the pipe to be buried in soil that is unstable. This requirement was established because if the pipe were installed above ground in these areas, it would block animal movement.

Pipe temperatures can range from a minus 70 degrees Fahrenheit when empty of oil in mid-winter to 145 degrees Fahrenheit when filled with oil at maximum pumping rate. Over this temperature range, the pipe expands more than 18 inches in a typical 1200-foot above ground section.

To allow for the expansion and contraction of the above ground pipe, the line is being built in trapezoidal sections. The trapezoidal sections convert changes in pipe length to sideways movement. This design permits a maximum of 96 inches of sideways movement and a maximum of 50 inches of lateral movement in the opposite direction for contraction. Another 24 inches of lateral motion is provided for in the event of an earthquake. To prevent the soil around the platform supports from thawing, a thermal device is being installed inside many of the supports to keep the ground frozen.

Pump stations

Each of the 12 pump stations planned for the pipeline system will have shops, warehouses, personnel housing, a food service facility, electrical generators, a central heating plant, water treatment and storage facilities, a sewage and waste disposal system, and an automatic fire detection and extinguishing system.

Each station is designed to contain a maximum of four multistage, centrifugal pumps, driven by 13,500 horsepower jet engine-power turbine drivers which will pump the oil. During the initial phase of operation, 600,000 barrels of oil a day, one pump will be operated in each of five pump stations. When the line reaches a capacity of 1.2 million barrels of oil a day, two pumps will be used at eight stations. Three pumps will be operated at each of 12 stations at the pipeline's peak capacity of 2 million barrels a day. Also, operating stations will be equipped with a spare pump to be used in case of malfunction.

Each pump station will be equipped with an automatic pressure-relief system able to detect excessive static and surge pressures in the pipeline. To relieve such pressures, valves will divert oil out of the line into a 55,000-barrel, pressure-relief tank. When normal operating conditions are restored, a booster pump will transfer the oil from the relief tank back into the line.

Valdez terminal

The terminal site covers about 1,000 acres on the south shore of Port Valdez. The terminal will contain 18 510,000-barrel tanks to store the oil received through the pipeline from Prudhoe Bay until it is loaded aboard tankers.

Three fixed berths and one floating berth are being built at the port to handle tankers which will arrive to receive the oil. The four berths will permit the simultaneous loading of four tankers up to 150,000 tons each. The tankers will be loaded at the rate of 80,000 to 110,000 barrels an hour.

The terminal will be equipped with a ballast water treatment facility to process the ballast water received from incoming tankers. The ballast water will be transferred to one of three 430,000-barrel tanks where the oil will be recovered and transferred to the terminal's oil storage tanks. The ballast water will then be treated and discharged into the sea.

A vapor-recovery system is being constructed to prevent oil fumes in the storage tanks from escaping into the atmosphere. Flue gases from the boilers of the terminal powerplant will be

compressed for discharge into the space above the oil in the storage tanks, to provide an inert gas blanket over the crude oil. The inert gas will be fed, under low pressure, into the tanks as oil is being withdrawn for loading. When the storage tanks are being filled, vented gas will be withdrawn to the vapor-recovery unit for reprocessing. Any excess gas will be bypassed to an incinerator.

To prevent damage from earthquakes, the terminal facilities at Valdez are being built largely on bedrock, well above the level of potential seismic sea waves. All storage tanks will be surrounded by dikes to contain any spilled oil.

The entire pipeline will be monitored 24 hours a day from a control center in Valdez. A computer at the center will receive a continual flow of information from all points along the pipeline. (A backup computer will be available on standby.) The computer center will evaluate the information and react accordingly. Local automation will also be installed at every pump station so that the line can be protected independently of the main control center. The line can be shut down in less than 10 minutes.

The Coast Guard is constructing a vessel traffic system for the port of Valdez to reduce the possibility of ship collisions and groundings and to protect waterways, shorelines, personnel, and cargo. The system will consist of tanker lanes, improved navigational aids, a communications system, a radar system, and a control center.

The Alaskan legislature passed the Alaskan Vessel Traffic Regulation Act which will become effective July 1, 1977. It requires tankers using the port to pay a risk premium. This premium will provide funds for a State-administered program to prevent oil spills and to clean up if there is a spill.

Communications system

The pipeline communications system consists of a microwave system, a backup satellite communications system, and a radio communications system. The microwave system will provide 240 channels for public use and 60 channels for pipeline use. The microwave system generally parallels the pipeline; has 41 permanent microwave stations; and will link all pump stations, pipeline maintenance stations, and remotely controlled block valves with the Valdez control center.

The microwave system will be backed up by the satellite system and will enable three pump stations and the Valdez terminal

to communicate with each other. The satellite is designed to handle all pipeline control data in the event of any break in communications along the chain of microwave stations.

COMPLETION SCHEDULE

Construction of TAPS was scheduled for completion in two phases in 1977. Phase I is scheduled for completion by July 1, 1977, when the pipeline system will have the capability of transporting 600,000 barrels a day. Phase II is scheduled for completion by November 1, 1977, when the pipeline system will be capable of transporting 1.2 million barrels a day. Our source data is inconsistent on whether these scheduled completion dates will be met. The pipeline builders have not changed the construction completion date for the project since construction began on April 29, 1974. The pipeline builders stated, in an October 11, 1976, trade journal article, that despite the existence of problems, their construction program will meet its completion deadline. The builders indicated that it may even be completed early, around May 1, 1977.

Others, however, are not as optimistic concerning the completion of construction. A 1975 report on the status of TAPS done by Alaska's Office of the Pipeline Coordinator estimated that a 6-month delay in startup is likely. The report also stated, however, that construction could be accelerated to meet the scheduled completion date. A 1976 House subcommittee staff, in a memorandum to the subcommittee chairman, stated that the staff has serious doubts that the line will be operational by the summer of 1977. This opinion is shared by a Kuhn, Loeb, and Co., oil analyst who stated that only under the best of circumstances will the system be completed by mid-1977 and that the possibility exists for a delay of as long as a year beyond the July 1, 1977, deadline.

OWNERSHIP

In August 1970, eight companies entered into an agreement and formed a separate corporation, Alyeska Pipeline Service Company, as the contractor to engineer, design, and construct the pipeline system and all related facilities. The agreement provides that once construction is complete, Alyeska will operate the pipeline. The companies originally forming Alyeska were Atlantic Pipeline Co., B P Pipeline, Inc., Humble Pipeline Co., Amerada Hess Corp., Home Pipeline Co., Mobil Pipeline Co., Phillips Petroleum Co., and Union Oil Company of California. Later reorganization resulted in the following approximate ownership interest in the pipeline:

Owner company	Percent of pipeline ownership
Amerada Hess Corp.	1.50
ARCO Pipeline Co.	21.00
Sohio Pipeline Co.	33.34
Exxon Pipeline Co.	20.00
Mobil Alaska Pipeline Co.	5.00
Phillips Petroleum Co.	1.66
Union Alaska Pipeline Co.	1.66
BP Pipeline, Inc.	15.84
	100.00

These owners are either major oil companies or subsidiaries of major oil companies.

The assets are owned in common; each of the owners is an individual common carrier and will file for its own tariff rate in accordance with State and Federal laws and regulations covering its share of the capacity in TAPS. The owners will each collect their own revenues payable by shippers under such tariffs.

CONSTRUCTION COSTS

Alyeska's current forecast cost for TAPS is $7.7 billion. This cost forecast is for completion of the system to an initial design capacity of 1.2 million barrels a day. No allowance is made in this estimate for capitalized interest on investment incurred individually by the pipeline owners.

The Standard Oil Company (Sohio) estimated total capitalized interest expense for the eight owner companies at $1.3 billion, raising the total cost of constructing the pipeline to $9 billion. Sohio estimates that expanding the throughput to 1.6 million barrels a day will cost an additional $675 million. As Sohio stated, however, this estimate was subject to variation, depending on the timing of the expansion. No estimates were available on the cost to expand to 2 million barrels a day.

Since February 1969 when plans were first announced for constructing TAPS, the estimate of construction costs has increased from $900 million to $7.7 billion. It should be pointed out that the following major design changes occurred after the decision to construct the pipeline:

APPENDIX II

--Construction of a 365-mile secondary highway, rather than a temporary haul road.
--Construction of about half the line above ground, entailing massive amounts of additional materials for pipe supports.
--Special designs to meet strict seismic criteria.
--Construction of a ballast treatment plant at the terminal to meet stricter water quality standards.

The following table traces the increases in the cost estimates for the pipeline from 1969 to June 1976. It was prepared from information obtained from Alyeska press releases and material provided by Sohio.

Chronology of Cost Increases
Trans-Alaska Pipeline System

February 1969	Preliminary cost estimate for construction to initial design capacity of 600,000 barrels a day is $900 million. This is a budgetary figure based on general information available at the time.
March 1970	TAPS will cost about $1.3 billion.
March 1971	Preliminary estimates indicate that the requirements set out in the initial draft of the environmental schedule and technical stipulations will increase the cost by $400 million to $2.2 billion.
March 1972	The cost of a 1.2 million-barrel-a-day line is estimated at about $2.45 billion.
March 1973	The cost of a 1.2 million-barrel-a-day line is estimated at about $2.86 billion.
October 1974	The forecast cost of TAPS is $5.982 billion. The increased cost from 1969 is due primarily to three major causes: increased cost of material, increased cost of labor, and more sophisticated design and engineering.

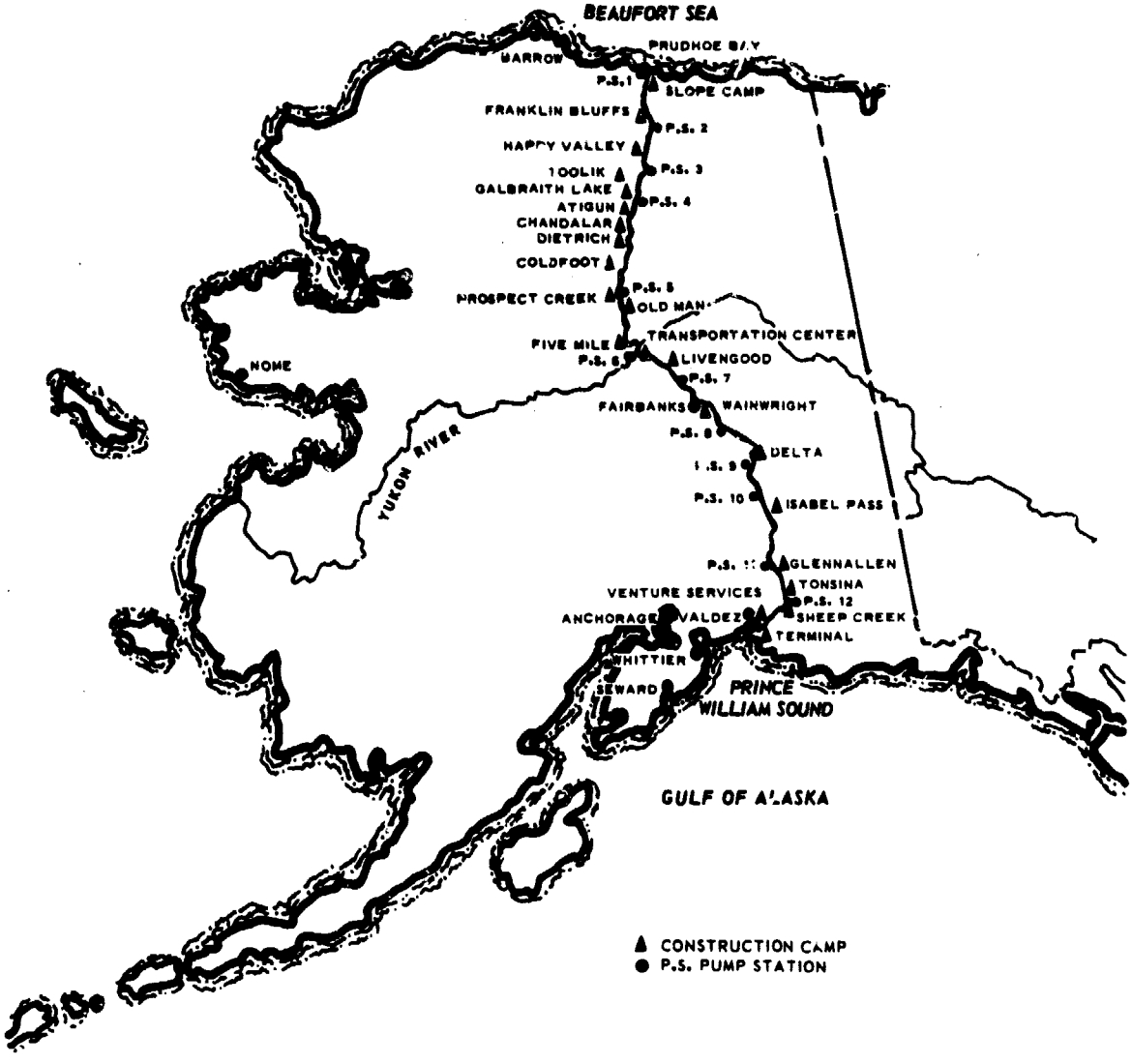
June 1975	The forecast cost of TAPS is $6.375 billion. Increases in the estimate resulted from construction experience, improved definition of construction and support requirements, and compression of the construction schedule to meet the planned July 1977 startup date.
June 1976	The forecast cost of TAPS is $7.7 billion. This increase includes the effects of lower productivity, additional materials and associated freight and transportation, and additional construction equipment. Anticipated reinspection or repair costs for resolution of the current welding and x-ray problems are included.

As previously discussed, a 1975 report by Alaska's Office of the Pipeline Coordinator states that the pipeline may not become operational until 6 months after the summer 1977 scheduled startup. The report also states that the incremental capital investment for delays in pipeline completion are basically a straight-line function with time and are estimated to be approximately $80 million a month. This would indicate that if a 6-month delay were to occur, the total cost of TAPS could increase by $480 million.

Although the Alyeska press releases gave some general reasons for the escalating costs, the other documents reviewed did not contain information which provided any factual details on the reasons for the escalating costs. None of the documents reviewed ascribed a specific part of the expected total cost to negligence, mismanagement, illegal, or improper activities.

APPENDIX II

TRANS-ALASKA OIL PIPELINE ROUTE



DISTRIBUTION SYSTEMS AND MARKETS FOR ALASKAN OIL

INFORMATION BASE

We reviewed 36 publications and documents which discussed one or more markets for Alaskan oil. There was general agreement among the reports which discussed the same market or distribution system concerning the advantages, disadvantages, time frames, and other details involved for that particular system.

DOMESTIC MARKETS

When the Congress was debating the TAPS Authorization Act in 1973, it was expected that all the Alaskan North Slope oil would be consumed on the west coast. In April 1973 the Department of the Interior estimated that Alaskan oil would be fully used in Washington State, Oregon, Nevada, California, Arizona, Hawaii, and Alaska. However, several recent documents reviewed estimated that excess Alaskan crude oil on the west coast could range from 300,000 to 800,000 barrels a day in 1978. 1/ As a result, considerable attention has been focused on the transportation of Alaskan oil to refineries in the northern tier States (Michigan, Minnesota, Montana, North Dakota, Washington, and Wisconsin), midcentral and eastern States, midwestern States, and the Gulf Coast.

Distribution systems

Three pipeline projects (trans-provincial, northern tier, and Sohio mid-continent) are being seriously considered by their sponsors as long-term solutions to the Alaskan oil surplus on the west coast. The projects are in various stages of planning. Another proposal is to move the Alaskan oil by tanker through the Panama Canal to either the gulf coast or east coast. This proposal is considered by Exxon and Sohio to be a short-term solution to the movement of Alaskan oil until one or more of the pipelines is constructed.

1/ The Federal Energy Administration is finalizing a draft report which discusses the impending crude oil excess on the west coast and alternative distribution systems.

Sohio mid-continent pipeline

The Sohio mid-continent pipeline proposal calls for a 1000-mile pipeline system extending from Long Beach, California, to Midland, Texas. This proposal involves reversing the flow in existing 800-mile natural gas pipeline and converting it an oil carrier, which according to Sohio is a relatively simple and inexpensive operation. This would be connected to about 200 miles of new pipeline. At Midland, the system would connect with existing oil lines which serve the Midwest. Sohio stated that initial capacity will be 500,000 barrels a day, with potential for expansion up to 1 million barrels a day. Sohio believes that the pipeline would be able to handle most, if not all, of the surplus Alaskan oil and estimates that it would be completed 12 to 14 months after receiving permits to start construction. Sohio estimated the cost of this system at $500 million.

The California Air Resources Board has expressed concern about this proposal because it contends that the emissions resulting from the unloading of oil tankers in Long Beach harbor and escaping from the storage tanks would violate State and Federal air-quality standards. Sohio has stated that it is willing to guarantee an equivalent reduction in emission by paying for pollution controls at other companies' plants in the Long Beach area. In this way, Sohio said, there would be no overall deterioration of air quality.

Trans-provincial pipeline

The trans-provincial pipeline proposal calls for constructing a new port at Kitimat, British Columbia, and constructing a new 30-inch, 780-mile pipeline extending from Kitimat to Edmonton, Alberta. The pipeline would transport some Canadian as well as Alaskan oil. At Edmonton, the new pipeline would connect with existing lines and would serve about a dozen refineries in Washington, Montana, Minnesota, and North Dakota that currently depend on Canadian oil. The sponsors, which are refiners in the northern tier plus two major Canadian pipeline companies, claim the pipeline could be initially operational with a capacity of 300,000 barrels a day within 16 to 22 months after receipt of permits to start construction. The sponsors estimate that the eventual capacity of the pipeline could be 600,000 barrels a day, of which 420,000 barrels a day could be Alaskan oil. The sponsors estimate that the line will cost $418 million and capacity will be achieved 2 years after startup.

A Federal Energy Administration official stated that this line could be built faster than some of the other proposed lines because it has few environmental problems and would require fewer permits. However, according to the Federal Energy Administration official, the northern tier refineries are not currently equipped to process oil with the high sulphur content of Alaskan oil.

Northern tier pipeline

The northern tier pipeline proposal calls for construction of a new 40/42-inch, 1,500-mile pipeline from Port Angeles, Washington, to Clearbrook, Minnesota. At this point, it would connect to the Minnesota pipeline and the Lakehead pipeline. This line would serve basically the same region as the trans-provincial pipeline. The sponsors, which are two railroads, three consulting firms, and two small oil companies, claim the pipeline system could be initially operational, with a capacity of 600,000 barrels a day, 24 months after receipt of permits to start construction. The eventual capacity could be 800,000 to 1.2 million barrels a day, of which 600,000 barrels a day could be Alaskan oil. The sponsors estimate that the line will cost about $868 million.

A problem with this proposal, according to a Federal Energy Administration official, is that 1,500 miles of new pipeline would have to be constructed which would require many government permits. Also, citizens of Port Angeles, Washington, voted against construction of a proposed Port Angeles tanker port that would have to be built as part of the project. City officials said they would abide by the vote in future dealings with northern tier officials.

Another problem is a recently enacted Washington State law which limits the size of tankers entering Puget Sound to 125,000 deadweight tons. This law also mandates that a tug escort all tankers larger than 40,000 deadweight tons through the Sound. Although ARCO has successfully challenged the constitutionality of the law in Seattle Federal district court, the State government intends to continue to enforce the law and appeal the court's decision.

Panama Canal routes

Since the canal is only capable of handling tankers of 58,000 to 60,000 deadweight tons, the following three methods have been proposed to move Alaskan oil through the canal.

--Transport the oil on small (60,000 dwt) tankers, fully loaded, for the entire route.
--Use medium-size tankers (60,000 to 90,000 dwt) from Valdez to the canal's Pacific side and lighten them with small tankers on the Pacific side. Both would then transit the canal to the gulf coast.
--Use large tankers (greater than 100,000 dwt) from Valdez to the canal's Pacific side and off-load to smaller vessels for the final leg through the canal to the gulf coast.

Sohio estimated that the marine transportation cost for a Panama route will range from $2.10 to $2.55 a barrel regardless of which method may be used. This cost is $1.50 to $1.75 a barrel more than the marine transportation cost from Valdez to California markets, which Sohio estimates would range from $0.60 to $0.80 a barrel. Standard Oil Company of California estimated that the marine transportation cost for the Panama Canal route would be $2.72 a barrel. A recent trade journal article stated that the higher transportation cost of this proposal might be absorbed by the producers to make the oil competitive with foreign oil delivered to the gulf coast.

FOREIGN MARKETS

The TAPS Authorization Act, requires that

> "before any crude oil * * * may be exported * * * the President must make and publish an express finding that such exports will not diminish the total quantity or quality of petroleum available to the U.S."

The act also provides for congressional veto power over a President's decision to export any oil. There has been some discussion in recent newspaper and trade journal articles regarding exchanges with Japan, but it has been limited to discussion because of the problems foreseen in getting approval from the President and the Congress. An exchange with Japan would involve shipping Alaskan oil southwest to Tokyo, Japan. An equivalent amount of Persian Gulf oil, originally intended for Japan, would be shipped around Africa and into the U.S. gulf or east coast. Standard Oil Company of California officials have stated that in the shortrun, exchanges with Japan probably would be the most efficient and least costly means of moving Prudhoe Bay oil to market.

A more likely possibility, according to a recent trade journal article, is that of short-term exchanges involving Canada (permitted by the TAPS Authorization Act). Some congressional leaders, who are opposed to exports to Japan, have urged the Federal Energy Administration to arrange for such an exchange with Canada. The problems with any direct exchange, according to the article, are that western Canada refineries are equipped to process only low-sulfur crude, not North Slope high-sulfur crude, and tankering Prudhoe Bay oil around Cape Horn to eastern Canada refineries which do process high-sulfur crude would be costly.

Another option that has been discussed in a recent trade journal would involve a three-way trade involving both Canada and Japan. Under such a system, Canada would deliver oil to the U.S. northern tier and Puget Sound; an equal amount of Prudhoe Bay oil would go to Japan; and an equal amount of Middle East oil, otherwise destined for Japan, would go to eastern Canada. However, this option would require specific Presidential and congressional approval.

MARINE TRANSPORTATION

INFORMATION BASE

We reviewed 10 publications and documents on marine transportation of North Slope crude oil. Much of the literature on tanker costs, while in general agreement, is speculative due to the volatile nature of marine economics and markets. We obtained a detailed analysis of tanker demand and supply prepared by Maritime Administration which provided valuable insight into the availability of U.S. flag tankers. Several documents also furnished information regarding the plans of individual companies to meet their tanker transportation requirements.

TONNAGE DEMAND TO SUPPLY COMPARISON

Only two of our source documents discussed the relationship of demand and supply of available tonnage. One document projected an excess of available tonnage and the other document projected a deficit. We were unable to reconcile the differences.

A 1976 Maritime Administration study included a comparison of total tonnage potentially available to transport oil from Valdez and the demand for that tonnage for the various proposed tanker routes. Its study concluded that there was an adequate supply of domestic tonnage to handle the Alaskan trade, including the additional demand of the gulf routes. The following table highlights the Maritime Administration comparison.

Alaska Trade
U.S. Tanker Supply/Demand Balance

	Deadweight tons		
	1978	1980	1982
Total Alaska-suited supply	8,401,300	9,527,000	9,677,000
Total Alaska demand	4,638,200	5,563,000	6,911,200
Surplus	3,763,100	3,964,000	2,765,800

Sohio, in its response to a Senate Interior and Insular Affairs Committee's questionnaire, estimated that only 200,000 barrels a day of the potential west coast surplus can be handled by the U.S. fleet and 100,000 to 400,000 barrels a day cannot be handled.

TONNAGE DEMAND

Originally, it was envisioned that the entire supply of North Slope oil would be transported by tanker from Valdez to the west coast. However, the inability of the west coast markets to absorb all of the North Slope production (see Appendix III) has resulted in alternative markets being considered. Some alternative markets may require additional tonnage. Current estimates of tanker demand for distribution of the oil from Valdez to the west and gulf coasts, prepared by the Maritime Administration, are shown in the following table.

Tanker Demand for Alaskan Oil Trade

	Deadweight tons		
	1978	1980	1982
Valdez to Puget Sound	159,200	159,200	189,600
Valdez to San Francisco	564,800	564,800	664,800
Valdez to Long Beach	827,200	827,200	971,200
Valdez to Panama	2,205,600	2,866,400	2,633,600
Panama to Galveston	881,400	1,145,400	1,452,000
Total	4,638,200	5,563,000	6,911,200

This analysis required specific assumptions regarding the daily production of oil, the magnitude of the west coast surplus, a lack of pipelines from the west coast to the Midwest, specific distribution of quantities on the west coast, and tanker transshipments on the Panama Canal route.

If pipeline capacity from the west coast to the Midwest becomes available (see Appendix III), thus eliminating the need for a Panama Canal route, tanker requirements could be reduced to approximately 2.6 million deadweight tons in 1978, 2.9 million deadweight tons in 1980, and 3.6 million deadweight tons in 1982.

TONNAGE SUPPLY

Of the documents reviewed, the Maritime Administration study provided the only detailed analysis of available U.S. flag tonnage. The study developed a ship-by-ship inventory of tankers suited for Alaskan trade. The inventory shows the existence of a substantial pool of U.S. tankers which is potentially available to serve the Alaskan trade given adequate market inducements. Except for the tonnage already committed to the Alaskan trade

(discussed below), most of the other tankers included in the inventory are currently committed to trade. This will tend to impede their movement to the Alaskan trade to the extent that the market does not provide, to both the owner and charterer, sufficient economic inducement for charter renegotiation. The study stated that to exclude these tankers because they were chartered would not be appropriate. To the extent that the demand for tonnage exceeds supply in the Alaskan trade, freight rates will rise and the needed economic inducement for charter renegotiation will develop. The fundamental issue will be the price at which that capacity can be secured and not the adequacy of the U.S. fleet in terms of physical capacity. The necessity to renegotiate charter commitments will be reflected in the ultimate market price. Also, as discussed on page 25, the requirements of merchant marine transportation legislation may impede use of some tankers now engaged in foreign trade.

The information shown in the following table was abstracted from the Maritime Administration analysis. It shows the total U.S. tanker fleet which will be potentially available in calendar years 1978, 1980, and 1982.

U.S.-Flag Tanker Fleet
Alaskan-Suited Supply

Trade category	Deadweight tons		
	1978	1980	1982
Domestic trade fleet	2,895,300	3,965,000	4,115,000
Foreign trade fleet	5,506,000	5,562,000	5,562,000
Total	8,401,300	9,527,000	9,677,000

TONNAGE COMMITTED TO ALASKAN TRADE

Several oil companies have made announcements to either construct, charter, or divert existing tankers which they control for the Alaskan trade. The total committed tonnage, as shown in the following table, is discussed in more detail in the following sections.

APPENDIX IV

Company	Tankers	Tonnage
Sohio	17	1,831,000
ARCO	9	906,000
Exxon	6	417,000
Shell	2	376,000
Mobil	1	129,000
Total	35	3,659,000

Sohio

Sohio has undertaken an ambitious tanker construction program. Sohio has contracted for the construction of 10 tankers with approximately 1,400,000 deadweight tons of capacity.

--Two 80,000 deadweight ton tankers have been completed and are presently in nonoil service until the TAPS startup.
--Two 120,000 deadweight ton tankers are under construction and will be available in 1977 in time for TAPS' 1.2 million barrel a day capacity.
--Six 165,000 deadweight ton tankers are contracted for and are to be delivered between the third quarter of 1977 and 1979.

In addition, Sohio also has chartered seven smaller ships under 3-year agreements to move the oil which may be surplus to the needs of the west coast through Panama Canal to the gulf coast.

ARCO

ARCO currently operates seven tankers totaling 600,000 deadweight tons which it plans to use to move the North Slope oil. In addition, ARCO has two 150,000 deadweight ton tankers under construction contracts for delivery in 1979 and 1980. ARCO is expected to use its tankers to serve company refineries at Cherry Point, Washington, and Los Angeles, California. Four of the nine tankers could also pass through the Panama Canal, if necessary.

Exxon

Exxon has stated that six tankers totaling 417,000 deadweight tons from its fleet could be available to move Alaskan oil to its Benecia, California, refinery. Exxon is also considering tanker movements to the gulf coast.

Other companies

Shell and Mobil Oil have announced plans to ship Prudhoe Bay crude oil to their west coast refineries on their own existing ships.

IMPLICATIONS OF MERCHANT MARINE ACTS ON ALASKAN TANKER SUPPLY

Tankers used in moving Alaskan oil to the lower 48 states will be subject to the Merchant Marine Act of 1920, commonly known as the Jones Act. This act requires that cargo moved between domestic ports be carried in ships registered in the United States. The act further requires that the ships must be American owned and built with the exception of foreign-built ships admitted to American registry before enactment and continuing under such registry. In addition, earlier statutes in effect require that the ships be commanded by Americans. Ownership requirements of the act preclude U.S. corporations with greater than 25 percent foreign ownership from owning U.S. registry ships.

This requirement necessitates that Sohio, to meet its Alaskan shipping requirements, arrange for the construction of the required tankers and enter into charter agreements with American shipping firms that will own the tankers. (See p.24.)

Also the Merchant Marine Act of 1936, as amended, provides for operating and/or construction differential subsidies to U.S. flag ships involved in foreign trade. Under terms of the act, receipt of either form of subsidy from the Maritime Administration precludes the tanker from operating in domestic trade. In order for such ships to become eligible for domestic trade, it would be necessary for tankers receiving operating differential subsidies to forego subsidy assistance for the period of domestic employment. For ships receiving construction differential subsidies, their owners would be required to repay the subsidy proportional to the period engaged in domestic trade, up to a maximum of 6 months in any year.

The merchant marine acts will affect the transportation of Alaskan oil by possibly limiting the supply of available tonnage and by increasing the unit transportation costs.

The Maritime study showed that of the total 5,506,000 deadweight of Alaskan-suited U.S. flag ships involved in foreign trade in 1978 (see p.23), 3,695,900 will be receiving a differential subsidy. Also, 3,751,900 of the total 5,562,000 deadweight tons involved in foreign trade in both 1980 and 1982 will be receiving a differential subsidy.

Two primary components which determine unit transportation costs are the cost to construct the tanker and the cost to operate it. Data contained in a 1975 Maritime Administration study indicated that the cost to construct a tanker in American shipyards was approximately twice as great as in foreign yards. This study also indicated that it cost approximately twice as much to operate an American ship than a foreign flag ship. The following comparison of construction and operating costs from the Maritime Administration study illustrates the cost differences.

1975 Estimated Construction Costs

Registry	80,000 deadweight ton tanker
U.S.	$43 million
Foreign	22 million

1975 Daily Operating Costs--80,000 deadweight ton tanker (note a)

	U.S. flag, U.S. crew	Panamian flag, Liberian flag, Greek crew	U.K. flag, U.K. crew
Vessel costs			
Base wages	$4,409	$ 838	$ 750
Maintenance and repair	1,004	663	663
Hull and machinery insurance	708	609	609
Protection indemnity	466	233	233
Subsistence	143	109	107
Stores, supplies, and equipment	193	156	156
Other	75	76	76
Total	$6,998	$2,684	$2,594

a/ Certain assumptions regarding tanker speed, crew size, and bunker fuel consumption were made in arriving at these estimates

Jones Act waiver

Mechanisms are available to increase tonnage for domestic trade through the use of foreign flag ships if the U.S. flag fleet should prove inadequate.

The Congress may waive Jones Act limitations for a tanker or trade route thereby increasing available tonnage for a specific period of time. Integral to prior congressional waivers has been a finding that a tonnage shortage does in fact exist and that alternative means of transportation (landbased) are not available.

The Maritime Administration's study stated that the Secretary of the Treasury, through the Bureau of Customs, administers a waiver process. The study also stated that the following four factors would be considered in determining the need for an administrative waiver.

--The waiver is necessary in the interest of national defense.
--The Bureau of Customs will consider possible economic harm to the U.S. maritime industry resulting from a Jones Act exemption.
--The determination must be made that suitable U.S. flag tankers and alternative nonmarine transportation are not available.
--Potential benefit or harm to broad general interests possibly might outweigh the potential harm to maritime interests.

Either type of waiver would most likely be limited in scope to the Alaskan trade and include time limits based on future availability of U.S. tankers presently under construction or on order. Historically, congressional waivers have required 3 to 9 months to process and administrative waivers approximately 3 to 6 months.

APPENDIX V

TRANSPORTATION COST CONSIDERATIONS

INFORMATION BASE

We studied 11 publications and documents on transportation cost considerations. The documents contained material which was, for the most part, comprised of broad superficial analyses and tariff and cost estimates which were conjectural. This material was supplemented by discussions with Interstate Commerce Commission (ICC) representatives.

REGULATORY JURISDICTION

There appears to have been an assumption, from the outset, by the owner companies and ICC that economic regulation of TAPS lies within the jurisdiction of ICC by virtue of the Hepburn Act of 1906.

The Bureaus of Competition and Economics, Federal Trade Commission, reported to the Commission in September 1975 that the Congress should consider questions as to the scope, and even existence, of ICC's regulatory authority over TAPS. The report contains a detailed analysis of regulatory jurisdiction of ICC over TAPS. On the basis of a review of relevant laws and court cases, the Bureau report stated that:

1. If the oil is exported outside the United States from Valdez, ICC would have regulatory jurisdiction.
2. If the oil is moved by private tanker from Valdez to the lower United States, ICC jurisdiction is clouded.
3. If the oil is moved by common carrier tanker from Valdez to the lower United States, jurisdiction would appear to rest in ICC, but the tanker carriage would be subject to Maritime Commission jurisdiction.

The report also discussed the jurisdiction of the Alaska Pipeline Commission. It stated that the State's enabling legislation provides for regulation "only to the extent not preempted" under the Interstate Commerce Act. The report further stated that, in theory at least, the State authority exists in those areas when ICC does not regulate but may not exist at all if ICC does not have any regulatory authority. We found no other source which discussed this issue.

TARIFFS AND RATES

A tariff, although sometimes used synonomously with the term "rate," is actually a schedule of rates submitted to ICC. The TAPS tariffs will be schedules filed with ICC listing proposed pipeline rates to be levied on oil moved from Prudhoe Bay to Valdez.

Although an 8-percent rate of return has been established in precedent by ICC as just and reasonable, pipeline subsidiaries, under a 1941 consent decree, may not return more than a 7-percent dividend to their parent companies. As a result, the practice of most companies party to this consent decree is to limit the rate of return to 7 percent.

The tariff rate, in addition to being determined by the rate of return, will be determined by the amount of annual operating costs, consisting of pipeline amortization; expenses to operate the pipeline; interest costs; and Federal, State, and local taxes.

Pipeline amortization

TAPS amortization will be determined by

--the capitalized pipeline costs,
--the net salvage value of TAPS, and
--the average service life over which TAPS' construction costs will be amortized.

Capitalized pipeline costs include both total construction costs and construction loan interest costs which have been capitalized for the period preceeding pipeline operations.

Net salvage value is computed by subtracting the cost of salvage operations from the value of the salvageable material. If the value of the material salvaged is greater than the cost to salvage, the resulting amount would be, in effect, subtracted from the cost of the pipeline. If the value of salvageable material is less than the cost to recover the material, the resulting amount is termed negative net salvage. An analysis in a recent issue of Public Utilities Fortnightly argues that provision should be made for the addition of any negative net salvage amount to the rate base. This analysis also points out that there is regulatory reluctance to incorporate this negative net salvage amount into the depreciation accrual rates because the costs of removing currently operating facilities are expenditures that have not yet been incurred.

ICC personnel believe that due to the hostile environment and the fact that much of the pipe is buried, TAPS might realize a negative net salvage value.

The question of negative salvage is important to the tariff ratemaking process because the TAPS right-of-way agreement between the Federal Government and the owner companies provides for the rehabilitation of Federal properties upon termination of TAPS.

Service life, for pipelines, is more a function of the productive life of the oil reserves than a function of equipment lifespan. ICC has not yet determined the service life for TAPS, but a recent financial analysis cited a 35-year lifespan for the pipeline. ICC representatives agreed that a figure close to this was probably realistic.

Operating expenses and interest costs

All expenses necessary to the operation of the pipeline can be included in the tariff rate. Operating expenses generally include labor, fuel, maintenance, and other costs. On systems startup, interest payments on TAPS construction loans will continue to be significant. One study indicated interest costs will account for 25 percent or more of total annual operating expenses.

Federal, State, and local taxes

Corporate Federal taxation is generally limited to an income tax rate of 48 percent on taxable income. Since State and local taxes are allowed as deductions for Federal income tax purposes, any changes in State and local tax receipts will directly affect Federal tax receipts.

Alaska and its local jurisdictions are proposing or are currently levying numerous taxes against both the pipeline and production of Prudhoe Bay oil reserves. A number of these taxes are under consideration for revision. There are also proposals for additional taxes. Taxes levied on pipeline companies and producing companies generally are considered together since an increase in pipeline costs will tend to increase tax revenues received by Alaska from pipeline companies but decrease the tax revenues received from producing companies. Likewise, a decrease in pipeline costs will tend to decrease tax revenues received by Alaska from pipeline companies but increase the tax revenues received from producing companies.

Pipeline taxes

Taxes levied on the pipeline will affect the tariff rate. An increase in these taxes will tend to increase the tariff rate since taxes are considered an operating cost. Existing pipeline taxes are:

--Corporate income tax: the statutory rate is 9.4 percent on State taxable income.
--Business license tax: tax rate of 0.25 percent on all gross receipts in excess of $100,000.
--Ad valorem tax: tax rate is 2 percent of the assessed value of the pipeline system. This is a State tax. However, each taxing jurisdiction may levy a property tax of up to 3 percent on the locally assessed value; this tax would be a credit against the State ad valorem tax.

Production taxes

While not directly affecting the tariff rate, taxes levied on crude oil production may affect Alaska's revenue expectations and the producing companies' expected profits. An increase in existing production taxes or enactment of a proposed production tax will tend to increase Alaska's revenues from oil production and decrease the producing companies' profits. Existing and proposed production taxes are:

--State royalty of 12.5 percent on the landed value of the oil.
--Severence tax, essentially 8 percent, on the landed value of the oil; it is proposed that this tax be increased to 14.5 percent.
--Conservation tax of 0.125 percent a barrel removed or sold from lease or property.
--Proposed excess value tax: the proposed rate varies between proposals but the essential rate in all proposals is generally about 40 percent of profits in excess of an amount which has not yet been established. This is in addition to the State corporate income tax.
--The corporate income tax and ad valorem tax listed under pipeline taxes will also be levied against the income generated by the production of oil and against the assets used in the production, respectively.

In addition, Alaska started levying a 2-percent tax on the estimated reserves in the ground assessed annually beginning January 1, 1976, and extending for 2 years. This tax may be claimed as a credit against production taxes paid in the previous 12 months.

TARIFF RATE PROJECTIONS

Projections of TAPS tariff rates incorporate many assumptions, including the final TAPS construction costs, the costs ICC will allow in the valuation, operation startup, the cost of the borrowed money, and State and local tax rates. Additionally, tariff rate projections are made for specific pipeline capacities; the tariff rate for 1.2 million barrels a day would be higher than the rate for a flow of 1.5 million barrels a day.

Five of the documents reviewed projected a tariff rate. These projections were made between December 1975 through October 1976. The tariff rate projections for four of the documents ranged from a low of $4.17 a barrel at 1.5 million barrels a day to a high of $4.89 a barrel at 1.2 million barrels a day. The fifth document projected a rate of $4 to $5 a barrel at 1.2 million barrels a day.

FILING TARIFFS AND SETTING RATES

Each of TAPS' eight owner companies will, as individual common carriers, file a tariff with ICC. They are expected to do so in May or June 1977, shortly before commencing pipeline operations. Alyeska will not file a tariff since it will only act as pipeline operator for the eight owner companies.

ICC's role in overseeing pipeline tariffs and pipeline valuation is to assure the public that the pipeline tariff rates are in accord with the recovery of a legal rate of return and related pipeline investment and operating expenses.

The documents reviewed did not discuss the method by which tariffs are filed and rates are set. ICC representatives informed us that Valuation Report Docket No. 1215 (Ajax Pipe Line Company, January 1939) 1/ and Valuation Report Docket No. 1284 (Ajax Pipe Line Corporation, December 1949) 2/ are the precedent cases for crude oil pipeline valuation. We have not looked beyond these cases to determine what additional criteria, if any, ICC may use.

1/ Interstate Commerce Commission, Valuation Reports, Volume 48, May 1938-December 1939.

2/ Id., Volume 50, December 1949-February 1951.

APPENDIX VI

LITERATURE RESEARCH BIBLIOGRAPHY

Agreement and Grant of Right-of-Way for Trans-Alaska Pipeline, January 23, 1974.

"Alaska Pipeline Delays and Cost Overruns Are Feared by Oil Analyst, Despite Assurances." The Wall Street Journal, n.d.

"Alaska Pipeline May Beat July Target." The Oil and Gas Journal, October 11, 1976.

"Alaska Pipeline's Welding Problems Easing, Report Says." The Wall Street Journal, September 13, 1976.

"Alaska Report: Alyeska Humming Along Toward Early Completion." The Oil and Gas Journal, June 7, 1976.

"Alaska's Prudhoe Bay Oil: Profitability and Taxation Potential" (Reprint of Tanzer Economic Associates, Inc., Report to Alaska State Legislature, January 9, 1976), Alaska State Senate Journal, Juneau, Alaska, February 12, 1976.

"Alyeska Chief Says Line Victim of Election Year." Anchorage Times, July 24, 1976.

"Alyeska Moves to Speed Line Construction." The Oil and Gas Journal, September 6, 1976.

"Alyeska Pipeline Cost Surges to $7.7 Billion." The Oil and Gas Journal, July 12, 1976.

"Alyeska Pipeline Service Co., Data Sheets, Anchorage, Alaska

Ballast Treatment Facility	May 1975
Insulation (Supports)	May 1975
Heat Pipes	May 1975
Insulation (Pipe)	May 1975
Vapor Recovery System	June 1975
Gate and Check Valves	August 1975
Tanker Berths	November 1975
Drainage Structures	December 1975
Pipe Ditch Plugs	January 1976
Work Pad Insulation	February 1976
Zigzag Configuration	February 1976
Pump Station Facilities	March 1976

Alyeska Pipeline Service Co. Information About Sales and Contracting Opportunities: Major Active Contracts and Purchase Orders. Anchorage, Alaska, December 20, 1975.

APPENDIX VI

Alyeska Pipeline Service Co., News Releases, Anchorage Alaska.

No. 362, June 19, 1975
No. 423, September 30, 1975
No. 486, January 5, 1976
No. 492, January 15, 1976
No. 496, January 23, 1976
No. 517, March 1, 1976
No. 535, April 2, 1976
No. 542, April 13, 1976
No. 564, May 7, 1976
No. 600, June 21, 1976
No. , June 25, 1976
No. 609, June 30, 1976
No. 626, July 29, 1976
No. 640, August 24, 1976
No. , September 8, 1976
No. 647, September 9, 1976
No. 649, September 15, 1976
No. 654, September 17, 1976

Alyeska Pipeline Service Co., Questions and Answers, Anchorage, Alaska, n.d.

Alyeska Pipeline Service Co., TAPS Cost Chronology, Anchorage, Alaska, n.d.

"Alyeska Sticks to Summer-77 Start-Up." The Oil and Gas Journal, July 26, 1976.

The American Association of Petroleum Geologists. Developments in Alaska in 1975. Washington, D.C. 1976.

American Petroleum Institute, Directory of Petroleum Industry Washington Representatives. Washington, D.C., March 1975.

American Petroleum Institute, Technical Report No. 2 - Organization and Definitions for the Estimation of Reserves and Production Capacity of Crude Oil, Washington, D.C., June 1970.

Atlantic Richfield Company, Annual Report-1975, Los Angeles, California, March 22, 1976.

"Beefed-Up Tanker Fleets Readied for North Slope Oil," The Oil and Gas Journal, June 14, 1976.

Bonner and Moore Associates, Inc. Crude Oil Supply Alternatives for the Northern Tier States, FEA Contract Study, Houston, Texas, July 24, 1976.

Breeding, Clark W. and others, Income Taxation of Natural Resources, Englewood Cliffs, N.J., Prentice Hall, Inc., 1975.

The Bureau of Competition, and the Bureau of Economics, Report to the Federal Trade Commission on the Structure, Conduct, and Performance of the Western States Petroleum Industry. (Unadopted). Federal Trade Commission. Washington, D.C., September 1975.

"California Snubs Alaska Oil Forcing U.S. to Reconsider," New York Times, September 21, 1976.

Cicchetti, Charles J., Alaskan Oil: Alternative Routes and Markets. Washington, D.C., Resources for the Future, Inc., 1972.

Clark, Norman J., Elements of Petroleum Reservoirs, Dallas, Texas, American Institute of Mining, Metallurgical, and Petroleum Engineers, 1969.

Committee on Interior and Insular Affairs and Committee on Commerce, United States Senate, Questionnaire on Potential Problems Associated with the Delivery of Crude Oil from Alaska's North Slope, August 23, 1976.

Committee on Interior and Insular Affairs, United States Senate, The Trans-Alaska Pipeline and West Coast Petroleum Supply, 1977-1982: A Staff Analysis, November 1974.

Congressional Research Service, Library of Congress. Highlights of the Department of the Interior's Environmental Report and Decision on the Proposed Trans-Alaska Oil Pipeline. Washington, D.C. July 1, 1972.

Congressional Research Service, Library of Congress, Literature Search Citation File, Washington, D.C., September 13, 1976.

Congressional Research Service, Library of Congress, North Alaska Oil and Related Issues, Washington, D.C., November 13, 1972.

The Council of State Governments, "State Headlines," Lexington, Kentucky, October 18, 1976.

"DOT Dubious about Alyeska Weld Check." The Oil and Gas Journal, June 28, 1976.

Elia, Charles J., "Profit Forecasts on Alaskan Oil Vary Widely as Analysts Assess Size of West Coast Surplus," Wall Street Journal, October 7, 1976.

APPENDIX VI

"Errors Blamed for Pipeline Costs." The Washington Star, September 11, 1976.

Fact Sheet--Trans-Alaska Pipeline System. n.p. n.d.

Faust, G. Robert, "A Positive Rationale for Negative Net Salvage," Public Utilities Fortnightly, (July 29, 1976).

Federal Energy Administration, Crude Oil Supply Alternatives for the Northern Tier States. Washington, D.C., August 1976.

"Firms to Seek Canada Permit for Oil Line Feeding N. Tier." The Oil and Gas Journal, July 19, 1976, 62.

Fisher, William L., DOI Testimony Before the Subcommittee on Public Lands, House Interior and Insular Affairs Committee on Transportation and Distribution of Alaskan Oil. August 3, 1976.

Fisher, Dr. William L., Statement Before the Joint Senate Commerce and Interior and Insular Affairs Committees on the Transportation and Distribution of Alaskan Oil, September 21, 1976.

Harnett, Joseph D., SOHIO Testimony Before the Subcommittee on Public Lands of the House Committee on Interior and Insular Affairs. August 5, 1976.

Hill, John A., FEO Testimony Before the Subcommittee on Public Lands of the Interior Committee of the House of Representatives. August 3, 1976.

Hill, John A., Statement Before the Senate Interior and Senate Commerce Committees, September 21, 1976.

"House, GAO Aides See Delay Likely for Alyeska Start-Up." The Oil and Gas Journal, September 13, 1976.

"In Alaska Pipeline Probe: House Investigators Accuse Government Officials." The Journal of Commerce, September 9, 1976.

"Interior, DOT to Oversee Alyeska Work." The Oil an Gas Journal, July 12, 1976.

Jackson, Henry M., Opening Statement for Joint Interior/ Commerce Committee Hearing on the Effect of the Trans-Alaska Pipeline on the West Coast Crude Oil Supply, September 21, 1976.

APPENDIX VI

James, Richard D., "Marketing Mess, West Coast Oil Glut Is Forecast When Line in Alaska Opens in '77," Wall Street Journal, October 25, 1976.

Legislature of the State of Alaska. CS for Senate Bill No. 174. n.d.

Legislature of the State of Alaska. House Bill No. 803. February 17, 1976.

Leibman, Paul R. and Petrie, Thomas A., Special Report on Alaskan Tax Proposals, H.C. Wainwright and Co., New York, New York, January 22, 1976.

L. F. Rothschild and Co., Proposed Tax Changes in Alaska, New York, New York, January 28, 1976.

L. F. Rothschild and Co., Proposed Tax Changes in Alaska II, New York, New York, March 5, 1976.

L. F. Rothschild and Co., Proposed Tax Changes in Alaska III: Focus on Atlantic Richfield and Standard Oil of Ohio, New York, New York, April 21, 1976.

L. F. Rothschild and Co., The Trans-Alaska Pipeline and Prudhoe Bay Crude Oil Production Analysis of Unit Costs and Profit Potential, New York, New York, December 2, 1975.

McKinney, Stewart B., Testimony Before the House Public Lands Subcommittee Regarding Distribution of Prudhoe Bay Crude, August 2, 1976.

Miller, Kenneth G. and Houghton, James L., Oil and Gas Federal Income Taxation, Chicago, Illinois, Commerce Clearing House, Inc., 1976.

Milner, Byron E., ARCO Statement Before the House Subcommitee on Public Lands, Committee on Interior and Insular Affairs, August 5, 1976.

Mobil Oil Corporation, The Language of Oil, New York, New York, December 1974.

Morgan Stanley and Company, Prospectus for SOHIO Pipeline Company Debentures, New York, New York, April 27, 1976.

National Technical Information Service, Dialog Literature Search, September 11, 1976.

"Newsletter." The Oil and Gas Journal, September 6, 1976.

94th Congress, H.R. 49--Naval Petroleum Reserves Production Act of 1976, P.L. 94-258, Washington, D.C., April 5, 1976.

93rd Congress, S. 1081--Mineral Leasing Act of 1920, Amendments and Trans-Alaska Oil Pipeline Authorization. P.L. 93-163, Washington, D.C., November 16, 1973.

"North Slope Crude Seen Yielding about $2 a Barrel Profit." Petroleum Intelligence Weekly, June 21, 1976.

"Oil Firms Near Accord," Anchorage Times, July 29, 1976.

"Part of Prudhoe Crude to Travel Canal.", The Oil and Gas Journal, October 4, 1976.

"Passes, Welding Slow Pipe-laying." Anchorage Daily News, July 23, 1976.

Patton, Edward L., Alyeska Testimony Before Energy and Power Subcommittee of House Interstate and Foreign Commerce Committee, June 21, 1976.

Patton, E. L., Alyeska Letter to Senator Jackson in Response to Senate Questionnaire dated August 23, 1976, September 15, 1976.

"Pipeline Construction Backed." The Washington Post, September 11, 1976.

"Pipeline Contractors Gain Arctic Construction Experience." The Oil and Gas Journal, February 23, 1976.

"Pipeline Economics." The Oil and Gas Journal, August 23, 1976.

"Response to the August 23, 1976 Questionnaire of the Senate Interior and Insular Affairs and Commerce Committees," by:

Alyeska Pipeline Service Co., September 15, 1976.
Ashland Oil Inc., September 13, 1976.
Atlantic Richfield, Co., September 21, 1976.
Butler Associates, Inc., September 13, 1976.
Department of the Army, September 14, 1976.
Department of the Interior, September 14, 1976.
Department of State, September 10, 1976.
Exxon, Corp., September 17, 1976.
Federal Energy Administration, September 14, 1976.
Federal Power Commission, September 14, 1976.
Interstate Commerce Commission, September 13, 1976.
The Standard Oil Co., September 15, 1976.
State of Alaska, September 16, 1976.

APPENDIX VI

State of California, September 14, 1976.
State of Washington, September 13, 1976.

"Roundup." Business Week, July 12, 1976, 40.

Smith Barney, Harris Upham and Co., and Merrill Lynch, Pierce, Fenner and Smith, Inc., Preliminary Prospectus for Arco Pipeline Company Guaranteed Notes, New York, New York, September 15, 1976.

SOHIO Transportation Company, West Coast-Mid Continent Pipeline Project, Cleveland, Ohio, June 1976.

The Standard Oil Company, Annual Report--1975, Cleveland, Ohio, March 15, 1976.

The Standard Oil Company, Proxy Statement, Cleveland, Ohio, August 28, 1969.

The Standard Oil Company, SOHIO Letter to the U.S. General Accounting Office in Response to Information Request, Washington, D.C., September 24, 1976.

State of Alaska. Assessment of Project Status: Trans-Alaska Pipeline. February 1975. Office of the Pipeline Coordinator. Anchorage, Alaska.

State of Alaska, Office of the Pipeline Coordinator, Annual Report for 1974, Anchorage, Alaska, December 31, 1974.

State of Alaska, Office of the Pipeline Coordinator, Annual Report for 1975, Anchorage, Alaska, January 30, 1976.

Sturm, Paul. "The Great Pipeline Race," Forbes, August 15, 1976, 22.

"Tanker Trade Sick Despite Intense Remedial Efforts," The Oil and Gas Journal, September 13, 1976.

Testimony by Officials of ARCO, BP Alaska, First Citibank of New York, and the Governor of Alaska Before the State Legislature regarding proposed taxation of Alaskan oil. March 31, 1976.

United States General Accounting Office. Information on the Proposed Alaska Oil Pipeline. (B-174944), June 27, 1973.

United States General Accounting Office. Trans-Alaska Oil Pipeline--Progress of Construction Through November 1975. (RED 76-79) February 17, 1976.

APPENDIX VI

United States House of Representatives, Committee on Interior and Insular Affairs. Press Release. July 1, 1976. Washington, D.C.

United States House of Representatives, Conference-Report--Development of Certain National Petroleum Reserves, Washington, D.C., March 23, 1976.

United States House of Representatives. Hearings Before the Subcommittee on Public Lands of the Committee on Interior and Insular Affairs on H.R. 9130 to amend Section 2B of the Mineral Leasing Act of 1920 and to authorize a Trans-Alaska Oil and Gas Pipeline, Washington, D.C., June 1973.

United States House of Representatives. Subcommittee on Energy and Power Memorandum to Congressman John Dingell. Subject: Alyeska Pipeline - Preliminary Report, September 8, 1976.

United States Maritime Administration, "Analysis of the Annual Escalation of Costs Associated with the Marine Transportation of Imported LNG and Crude Oil Since 1970 . . . ", Washington, D.C. n.d.

United States Maritime Administration, "Tanker Availability for Alaskan Crude Oil Transportation," Washington, D.C., September 29, 1976.

United States Senate. Hearings Before the Committee on Interior and Insular Affairs on the Status of the Proposed Trans-Alaska Pipeline, Washington, D.C., September 9, 1969.

W. J. Levy Consultants Corp., A Note on Proposed Changes in Alaska's Gross Production Tax: A Report to the Alaska State Legislature, New York, New York, April 1976.