Cooperative Education and Training of Managers for Development Projects

CASE HISTORY

The Trans-Alaska Pipeline

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THE TRANS-ALASKA PIPELINE

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ABSTRACT

This case history describes the conception, planning, and construction of the Trans-Alaska Pipeline System (TAPS). Originally conceived of by the owner oil companies as simply a means to move their newly discovered oil from a remote location to markets, the pipeline ultimately became a project of great importance, in terms of both desirable and adverse consequences, to a variety of special interest groups and to every level of government. The expectations, pressures, and demands of these groups and of governmental bodies in effect converted a privately conceived and privately financed project into a quasi-public project. In the process the original design was significantly altered, the start of construction was delayed for years, and project costs escalated from an early estimate of approximately 900 million dollars to a final cost of nearly 8 billion dollars.

Therefore this case history focuses on the TAPS project from two perspectives. One is concerned with the pipeline project itself: its conception, economic feasibility, technical feasibility and design, its planning and management, the actual construction sequence, and finally start-up of the oil flow through the pipeline. The other focuses on the efforts of the special interest groups (including government agencies) to shape the project so as to serve their needs, and on an evaluation of the results (impacts) of these efforts.

Although the pipeline itself has been completed and is in operation, the total transportation system will not be completed until the means for transshipping oil eastward across the United States has been determined. In addition, the full impact of the project, both within Alaska and elsewhere, is still far from being understood. Thus the project is best viewed as one which represents the completion of a major component of a system, with the structure of the overall system and its effects not fully determined.
# THE TRANS-ALASKA PIPELINE

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A NOTE ON SOURCES

Although the authors of this case were not directly involved in the project itself or the formal policy structure surrounding it, they have both in an academic capacity and in their role as informed citizens maintained a deep interest in the TAPS experience. In an academic sense, the project represents a "laboratory experiment" in energy development and in large system management, which should be analyzed in an effort to improve our understanding of management principles and techniques. In a personal sense, both authors work in a university system where the demands for services and the funding of the system have been heavily affected by oil development and its socioeconomic consequences. Thus, the sources used for this case are those generally available to the public, and no attempt has been made to use any "internal" information, corporate or otherwise. The authors recognize that in some instances knowledge of some internal "fact" might result in a different interpretation of a particular event or argument, but they also believe that reliance on published materials is the best strategy for documenting the events described here in a fair and impartial manner.

Where a fact is general public knowledge and available in numerous sources, no specific citation is given. Those facts, or opinions, which are available only in a few sources have references cited. A bibliography at the end of the case provides a guide to material for further study. Basically this material falls into the following categories:

(a) Publications of Alyeska, and the owner oil companies.

(b) Industry oriented publications from oil and construction associations, or trade journals.

(c) Newspaper and magazine articles.

(d) Government publications, including transcripts of hearing testimony, and impact statements.

(e) Publications from or representing special viewpoints, such as those of environmental organizations.

(f) Full length books. Before construction started these tended to focus on special aspects or issues; following pipeline completion several books have been published describing the history of the whole project, usually from the author's individualistic viewpoint.

(g) Special evaluative reports following completion of construction. Of particular significance are the Summary of Trans-Alaska Pipeline System Critique Session sponsored by the U.S. Department of the Interior, and the report to the Alaska Pipeline Commission by the Commission’s Special Counsel, Terry F. Lenzner (Lenzner Report).
Vast administrative and capital resources are channeled into development projects, but lack of viable policies coupled with poor management results in a waste of these resources in all countries from highly industrialized to rural societies. Unequal access to these critical resources, together with their sub-optimal use, has seriously hindered the socio-economic development of many countries.

Indeed, experience indicates that attempts to accelerate economic and social growth have often floundered due to serious problems with policy implementation, project planning, and the management of projects. Despite more than a quarter century of intensive investment in all sectors of the economy and society, there has been either negligible or no increase in the quality of life of the poor, often resulting in misunderstanding and poor relations, both within and among countries.

In response to this situation, the East-West Center has worked, in cooperation with over 50 organizations in 15 countries during the period 1972 to 1977, to develop prototype curriculum materials for the education and training of project managers. Focusing on a new dynamic approach to project management, the prototype curriculum has been formulated within a cohesive framework, one which considers the entire project cycle as an integrated process. Basic to the curriculum is a series of case histories covering the entire spectrum of development projects from identification through completion, with evaluation as a basis for feedback in order to sharpen and refine the decision-making process and policy guidelines.

In September 1978, the Exxon Education Foundation awarded the East-West Center Resource Systems Institute (RSI) a two-year grant to research and write an additional 32 case histories of development projects. Awarded under the title of "Cooperative Education and Training of Managers for Development Projects" (MDP), the grant follows up on the initial research and curriculum development of the former PPIPM* project. In this regard, all cases commissioned under the Exxon grant are written in the framework of the Integrated Project Planning and Management Cycle (IPPMC). The IPPMC is a conceptual tool for observing and analyzing the process that constitutes the life of a development project (see diagram on page xiii).

The case histories now being researched and written under the terms of reference of the Exxon grant include diverse projects such as the Trans-Alaska Pipeline, geothermal power stations in Asia, the Pacific, and the United States, reforestation projects, and small hydroelectric projects for rural development. Plans are underway to commission a series of biomass energy cases, also from different socio-economic settings in the Asia-Pacific region. An exciting spin-off from these cases is a series of books based on groups or packages of cases which are being published by Pergamon Press, Inc. as a part of their Pergamon Policy Studies Series. Clearly, these books will help

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* PPIPM stands for Public Policy Implementation and Project Management.
to optimize the dissemination of knowledge for policy makers, project planners, and project managers.

These cases would not have been made possible without the collaboration and cooperation of many senior scholars and practitioners, and their respective institutions in Asia, the Pacific, and the United States. The General Editors wish to convey warmest thanks and deepest appreciation for the many contributions. Special thanks are conveyed to RSI Writer/Editor Barbara Yount and consulting editor Vicki Nelson for their many valuable suggestions on both format and style. Grateful acknowledgment is also due the Exxon Education Foundation for providing the support to continue the research and writing of these cases. It is hoped that the impact of this cooperative project will have profound implications in the context of international efforts to improve policy guidelines, as well as related project planning and management of development projects for all sectors of the economy and society.

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Research Fellow, RSI (1979-80)

August 1979
Integrated Project Planning & Management Cycle:

The Four Phases
Early in 1968, the Atlantic-Richfield Company (ARCO), which had been engaged in exploratory drilling on Alaska's North Slope, announced that its well had encountered a substantial flow of gas at 8,500 feet (2,591 meters). Further exploratory drilling confirmed that significant amounts of oil and gas were indeed present, and in a few months it became clear that reserves in the area represented the largest oil field ever discovered in the United States. The site of the discovery, the Prudhoe Bay region on Alaska's Arctic Ocean coastline, is a remote area then accessible year round only by air and only briefly during the summer by ships. The magnitude of the field clearly made it a priority for development to the production stage, but, just as clearly, a major transportation system would have to be constructed before any oil could be sent to market.

The system ultimately chosen was a pipeline: an 800-mile (1,287 kms.) link from the Arctic coast to the ice-free port of Valdez on the Gulf of Alaska. In Valdez oil would be shipped by tankers to refineries or other pipelines on the U.S. West Coast. The oil industry owner companies proudly proclaim that the Alaska Pipeline turned out to be "the most expensive privately-financed construction project in history" and for many represents a triumph of technology and engineering over a hostile environment.

Had this project been undertaken in another place or another time, the process of project planning, authorization, design, construction, and ultimate implementation would have been far simpler. The nature of Alaska itself--its location, difficult terrain, and harsh climate--created massive design and construction problems. Its fish, coastal mammals, and other wildlife represented unique commercial and ecological resources which to some extent would be threatened by oil development. The aesthetic values of Alaska and its virtually unspoiled natural environment focused the attention of environmentalists on the state. Other significant factors included world energy supply and demand relationships, the civil rights movement in the United States and a Native claims movement in Alaska, and the socioeconomic characteristics of Alaska.

Since, initially at least, the oil companies apparently did not fully realize the significance of some of these factors, they proceeded under naive assumptions about what was socially and politically acceptable and technically feasible in Alaska's physical environment. Consequently, not only was the start of construction seriously delayed, but the entire project was influenced continually by these factors.

From a national point of view, the project increased crude oil supplies domestically by about 15 percent and reduced the potential balance of payments deficits by billions of dollars. To the western states (California, This pipeline is referred to by several different names: the Alaskan Pipeline, the Trans-Alaska Pipeline, the Alyeska Pipeline (after the name of the pipeline corporation), and TAPS (after the original consortium name of Trans-Alaska Pipeline System).
Oregon, and Washington), the project first meant jobs during the construction phase but since has raised problems as the oil companies seek to dispose of Alaskan oil in a region where the refineries cannot absorb it and where no transshipment facilities of adequate size exist for shipping the oil to other parts of the United States. The "oil glut" on the West Coast has renewed demands for a restructuring of oil shipment allocations which would include shipping Alaskan oil to Japan, and in turn reallocating more Mideast oil to the eastern United States.

Thus a project which in the simplest sense represented only a technical problem of transportation to the oil companies actually was perceived by a number of other interest groups in terms of their own needs. In a sense, each interest group could be said to have perceived the pipeline as its project—to be designed to meet its needs; other interest groups' needs were viewed only as constraining limitations to be adjusted or worked around. Such multiple interests naturally led to a policy debate. That debate still continues and resultant policy decisions have had, or continue to have, a major impact on the project design, construction, and operation of the pipeline.

Physical Environment

The state of Alaska includes 586,000 square miles (1,517,740 sq. kms.)—over 375 million acres of land and inland water areas. Located in a semi-polar region, 83 percent north of the 60th parallel and 27 percent north of the Arctic Circle, Alaska is far removed from the mainland United States.

Geographical features such as mountain ranges divide Alaska into several major regions, each with distinct geographic, climatological, and ecological features (see Fig. 1). The region north of the Brooks Range (the North Slope) has a temperature range from 90°F to lower than 60°F below zero (32°C to -51°C) with a mean annual temperature of 10°F-20°F (-12°C to -7°C). Because of its very low precipitation, this area is referred to as an "arctic desert," even though the presence of permafrost (a condition in which, because of the short summer session, only the surface ground melts—underneath the ground remains permanently frozen) prevents water from being absorbed into the ground and creates an ideal nesting area for waterfowl. The interior area south of the Brooks Range and north of the Alaska Range [which includes Mt. McKinley—at 20,320 ft. (6,195 meters) the highest point in North America] has greater temperature extremes over 100°F to lower than 70°F below zero (or 38°C to -57°C) and greater precipitation. The massive Yukon River winds its way through this region from its origins in Canada to the Bering Sea. This area includes Fairbanks, the state's second largest city.

The area south of the Alaska Range represents a transition into a maritime climate along the Gulf of Alaska shoreline. Precipitation in this region is much higher and temperature changes are more moderate. All terminal sites which received serious consideration from TAPS were located in this maritime climate. Anchorage, the state's largest city, is located in this transition zone.
Fig. 1. PHYSICAL ENVIRONMENT AND WILDLIFE OF ALASKA

Source: Compiled by East-West Resource Systems Institute staff.
The state contains the 16 tallest mountains in the United States, more than 120 million acres of lakes, approximately 11 million acres of glaciers, and 10,000 streams and rivers. From 40 to 90 rivers are considered by different sources to have recreational and wilderness values of national interest. Alaska has over 47,000 miles (75,639 kms.) tidal ocean shoreline.

Attracted by the scenery, camping, fishing, and hunting, visitors to Alaska enjoy the opportunity to experience the wilderness. The value of these resources cannot be solely measured in terms of revenue from this major industry in Alaska. The recreational opportunities and the wilderness experience are very important also to Alaskans themselves, since many moved to the state because of its wilderness character.

Alaska contains a number of minerals of national interest including antimony, asbestos, chromium, copper, gold, iron, lead, and silver. Gold mining, an Alaska tradition, was responsible for the prosperity at the turn of the century but gold now is produced on a relatively small scale. Alaska's energy-related resources include coal, uranium, and a large number of hydroelectric sites and significant geothermal potential. The most commercially exploitable resources are oil and gas. Table 1 shows estimates of oil and gas reserves. The TAPS pipeline could ultimately be expected to serve not only the Prudhoe Bay field, but other northern fields as well, including offshore fields in that region.

Timber is a major harvestable resource in southeast Alaska, but has minor commercial significance elsewhere. Finally, Alaska has been estimated to have great agricultural potential even though the infrastructure to exploit it is not present and agricultural activities are of minor importance.

Wildlife

Because Alaska is a vast storehouse of natural resources, the state became a focal point in the battle between a development-oriented industry and environmentalists. Of particular significance to environmentalists (and Natives,* fishermen, and others who utilized them for profit or for recreation) are resources such as fish, birds, and marine as well as terrestrial mammals, and a number of rare or endangered species (see Fig. 1). Both pipeline and tankers would pass close to or through the habitats of much of this wildlife. While the oil companies assured everyone that environmental damage would be minimal, many of those outside the industry remained skeptical.

Traditionally the primary renewable resource in Alaska has been fish. The salmon fishery, for example, is the major source of employment for many coastal communities. Additional coastal fishing resources include halibut, king crab, and shrimp. Inland fisheries are primarily sport-oriented, although a number of rural area residents depend on inland fish stocks for

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*This term is used throughout this case history to refer to indigenous Alaskans.
### Table 1

**ESTIMATED ALASKA UNDISCOVERED RECOVERABLE RESOURCES AS A PROPORTION OF U.S. UNDISCOVERED RECOVERABLE RESOURCES, 1975**

<table>
<thead>
<tr>
<th></th>
<th>Billions of Barrels of Oil</th>
<th>Trillions of Cubic Feet of Gas</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
<td>Mean</td>
</tr>
<tr>
<td><strong>Onshore</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>United States</td>
<td>37</td>
<td>56</td>
</tr>
<tr>
<td>Alaska</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>Alaska percentage</td>
<td>16%</td>
<td>21%</td>
</tr>
<tr>
<td><strong>Offshore</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>United States</td>
<td>10</td>
<td>26</td>
</tr>
<tr>
<td>Alaska</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>Alaska percentage</td>
<td>30%</td>
<td>58%</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>United States</td>
<td>50</td>
<td>82</td>
</tr>
<tr>
<td>Alaska</td>
<td>12</td>
<td>27</td>
</tr>
<tr>
<td>Alaska percentage</td>
<td>24%</td>
<td>33%</td>
</tr>
</tbody>
</table>

*Statistical means are additive; high-low range values are not. Therefore, some distortion is involved in deriving Alaska high-low percentages.


subsistence. An oil spill accident along the coastline or a massive leak from a pipeline in the interior, then, could endanger a substantial economic and recreational resource.

Alaska provides 70 million acres (28,329,000 hectares) of the breeding habitat for 20 percent of all North American waterfowl (see Fig. 1) which are an important source of food to Alaskans and an important game for recreational hunters throughout the United States. Alaska's coastline provides a feeding and breeding habitat for 27 species of marine mammals, including whales, walrus, seals, sea lions, and sea otters.

Alaska also is the home of polar bears, caribou, moose, black and brown bears, sheep, musk-oxen, and many small furbearers. Polar bears (whose numbers were declining alarmingly just a few years ago but which have since recovered under a hunting prohibition) are found along the northern and northwestern Arctic coast. Caribou are found throughout most of the state especially in the Arctic areas. It was felt that the caribou's migration pattern might be altered by the disruption caused by the pipeline construction or even by its mere presence. Such a disruption might mean a drastic reduction in herd size.

**World Energy Relationships**

The Trans-Alaska Pipeline System (TAPS), although intended only to transport oil from one location in the United States to another, was developed within the context of a growing national and global interdependence on oil. For most of this century oil has best met industrialized economies' need for a low cost energy source since it has been cheap to produce, transport, and to sell. Recently world energy consumption has grown dramatically. In the United States, increased standard of living and population growth both have increased this dependency on oil and particularly on oil imports. Figs. 2 and 3 provide a graphic illustration of the U.S. energy situation in 1974, when pipeline construction was just beginning. Table 2 shows the U.S. production of proved resources of oil and natural gas, as well as (in parentheses) the impact of North Slope oil and gas on the reserves.

When war broke out between Israel and the Arab countries on October 6, 1973, the significance of U.S. dependency on imported oil was dramatized. On October 17, Arab oil ministers resolved to use the oil weapon to support their cause and, within a few days, the government of Saudi Arabia announced the imposition of output restrictions and an oil embargo aimed primarily at the United States.

In November 1973 the U.S. Congress passed the Trans-Alaska Pipeline Authorization Act and in January 1974 the Department of the Interior issued the permit authorizing construction. Ironically, while the embargo provided the final jolt required to obtain construction authorization, an accompanying but somewhat independent decision by the Organization of Petroleum Exporting Countries (OPEC) to more than triple oil prices probably restored the economic viability of the project. North Slope Alaskan oil could not solve the U.S. energy problem, but it could contribute one-sixth of the domestically produced oil in the 1980s (see Fig. 4).
Coal  
Oil  
Gas  
Nuclear  
Other

90%  
3%  
4%  
3%  
2%

Proved Reserves Economically Recoverable with Existing Technology

1974 Consumption Pattern

Fig. 2. PROVED RESERVES AND CONSUMPTION, 1974


mmb/d

18  
16  
14  
12  
10  
8  
6  

Total Domestic Demand

Imports

Total Domestic Supply

Fig. 3. U.S. OIL SUPPLY AND DEMAND, 1974

<table>
<thead>
<tr>
<th>Year</th>
<th>Oil, billion bbl.</th>
<th>Natural Gas, trillion cu. ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Year-End</td>
<td>Yearly Change</td>
</tr>
<tr>
<td>1964</td>
<td>38.74</td>
<td>0.09</td>
</tr>
<tr>
<td>1965</td>
<td>39.38</td>
<td>0.64</td>
</tr>
<tr>
<td>1966</td>
<td>39.78</td>
<td>0.41</td>
</tr>
<tr>
<td>1967</td>
<td>39.99</td>
<td>0.21</td>
</tr>
<tr>
<td>1968</td>
<td>39.31</td>
<td>-0.69</td>
</tr>
<tr>
<td>1969</td>
<td>37.78</td>
<td>-1.53</td>
</tr>
<tr>
<td>1970</td>
<td>37.10 (46.70)</td>
<td>-0.68</td>
</tr>
<tr>
<td>1971</td>
<td>35.77 (45.37)</td>
<td>-1.34</td>
</tr>
<tr>
<td>1972</td>
<td>33.53 (43.13)</td>
<td>-2.24</td>
</tr>
<tr>
<td>1973</td>
<td>32.15 (41.75)</td>
<td>-1.37</td>
</tr>
</tbody>
</table>

Note: Oil figures include natural gas liquids. Figures in parentheses include proved reserves ascribed to the North Slope. North Slope proved reserves are carried at 9.6 billion bbl.; natural gas at 22.9 trillion cu. ft.

Fig. 4. SOURCES OF NEW DOMESTIC OIL SUPPLIES

Reprinted from J. Darmstadter and H.H. Landsberg, "The Economic Background." In The Oil Crisis, ed. by Raymond Vernon, © 1976 by permission of W.W. Norton Co., Inc.

Social, Economic, and Political Changes

After World War II, a number of significant social, economic, and political trends had emerged in the United States. These included the maturing of the domestic economy, the emergence of a major concern for environmental quality, changing concepts of the quality of life, the development of an affirmative attitude toward rights of minority groups, and a shift in the balance of power between the states and the federal government. The oil companies apparently did not recognize that the United States had been reexamining the fundamental attitudes and values and that Alaska, because of its wilderness character and relatively unspoiled environment, was emerging as one of the national treasures within the new value system.

Environmental Concerns

A major shift in economic orientation has occurred in recent years. More than half of the U.S. gross national product now consists of services rather than goods. Accompanying this fundamental economic shift has been a shift in values and attitudes away from support of traditional industrial orientation toward different concepts about quality of life, including a concern for reduction of pollution and the preservation of the environment.
This emerging consciousness in America—to try to prevent environmental degradation that is physically harmful to humans, to preserve species of animal and plant life, and to retain undeveloped areas in their natural form—has led to pursuit of these goals by environmentalists through public pressure, litigation, and legislative action. In this context, the proposal to build a pipeline through Alaska could be expected to cause an immediate reaction. Not only did the environmentalists have the enthusiasm and organized strength to pursue their goals but also, in their argument against the dangers of "big oil," they could point to the then recent environmental damage from the Santa Barbara blowout and to the Torrey Canyon shipwreck.

**Demographic Characteristics**

During the 1950s and 1960s, Alaska's population more than doubled, from 128,000 to 302,000 in 1970, of which 51,000 were Natives. The three major urban areas (which would be considered small in the rest of the U.S.) are Juneau (the state capital), Fairbanks, and Anchorage.

The net migration into Alaska fluctuated substantially in reaction to past economic opportunities. Even at the early estimated cost of $900 million, the TAPS project could cause a major economic boom and a consequent (but probably not permanent) major increase in population. Valdez, Fairbanks, and Anchorage could expect major population influxes and the accompanying social and economic disruptions. Few of the earlier economic booms were likely to have as significant a long-term impact as North Slope oil development and the pipeline.

A major ethnic distinction divides Alaska's population into Natives and everyone else. The Natives are the dominant population in rural areas, while the mostly white population is dominant in the urban centers. Although numerically a minority, the Natives had a developed sense of identity and sufficient legal and political expertise to exert an influence on Alaskan affairs disproportionate to their numbers.

**Civil Rights**

In the 1940s, 1950s and 1960s, a combination of court decisions and legislation at the federal level focused on guaranteeing the rights of minorities. For the pipeline project, this trend had two serious implications:

1. Equal employment rights had now been established as one of the most important civil rights. Women and minorities could not be excluded from the pipeline labor force; contractors would face pressures for affirmative action to expand job opportunities for these groups.

2. Alaska's Natives seeking a settlement of their land claims would have a sympathetic audience. Native claims, which cast doubt on legal validity of land disposition and titles, caused a "land freeze." No pipeline could be built across land involved in the dispute until these claims were resolved.
Native Claims

To the Alaskan Natives the proposed pipeline represented both a crisis and an opportunity. From the Native point of view, granting a pipeline right-of-way to TAPS would dispose of land claimed by several Native villages and might endanger all of their claims. From the TAPS point of view, constructing a pipeline across land with uncertain ownership would substantially increase the level of risk associated with the project. Later, when pipeline managers finally recognized the delaying potential of unresolved Native claims, oil company lobbyists would throw their support behind legislation designed to resolve the claims.

State-Federal Relationships

In Alaska the federal influence has always been disproportionately great. Before statehood all significant legal power in Alaska was held by the federal government. Federal employment, both military and civil, was a major source of income. When Alaska attained statehood in January 1959, the legal power of Alaskans to control their state and their lives expanded substantially. However, the federal government still remained a major influence in Alaska, not only because it had increased its power throughout the United States, but to a great extent because it retained title to almost all of the land in Alaska.

For the proposed pipeline, these power relationships had two implications:

1. The federal government would exert a major influence in authorizing pipeline construction and in establishing rules governing design, construction practices, and hiring.

2. The state government would also exert authority and control over the project. Further, to the extent that state and federal interests differed, those building the pipeline would face contradictory pressures and demands. At the very least, duplication could be expected in the areas of project oversight controls and reporting requirements.

Conflicts between these dual sources of authority could add to delays in construction and thus could increase management difficulties and ultimately raise costs.
II. PLANNING, APPRAISAL, AND DESIGN

Identification and Development of the Pipeline Concept

Initial Reaction

Atlantic Richfield's announcement on January 16, 1968 that its Prudhoe Bay State No. 1 well had found a substantial amount of gas started a wave of excitement in both the oil industry and Alaska that continued to accelerate as more good news was made public. In February the company confirmed that it had a major discovery. On July 18, telegrams sent from Atlantic Richfield offices in Dallas began:

FOR RELEASE IMMEDIATELY - ATLANTIC RICHFIELD-HUMBLE ARCTIC SLOPE DISCOVERY TERMED ONE OF WORLD'S LARGEST.

PHILADELPHIA, JULY 18 - AN OIL AND GAS DISCOVERY ON THE ARCTIC SLOPE OF ALASKA BY ATLANTIC RICHFIELD COMPANY IN A JOINT VENTURE WITH HUMBLE OIL AND REFINING COMPANY HAS BEEN DESCRIBED BY A LEADING INDUSTRY CONSULTANT AS POTENTIALLY "ONE OF THE LARGEST PETROLEUM ACCUMULATIONS KNOWN TO THE WORLD TODAY." ROBERT O. ANDERSON, ATLANTIC RICHFIELD CHAIRMAN, ANNOUNCED HERE.1

The rest of the release went on to point out that in the opinion of one of the oil industries leading consulting firms (DeGolyer and MacNaughton) this discovery indicated a field with 5 to 10 billion barrels of recoverable oil. The pour point was 10°F below zero (or -23°C), which according to Anderson "means we will be able to move it by pipeline during the very severe winters in that Arctic area." Anderson also announced that pipeline and transportation studies would begin immediately, and that a minimum of three to four years would be required to develop the field.

Following the announcement, trading of Atlantic Richfield stock had to be suspended for several days because buy orders kept pouring in. When the stock opened it immediately jumped 34 1/2 points from its previous close at 147 1/2 and by the end of July it had risen to 200.

A few days earlier the stock of British Petroleum (BP), which held North Slope leases through a subsidiary, had increased by $320 million in one day's trading on the London market. This coincided with an announcement that BP was loading barges with drilling equipment and supplies, a preparatory action to a massive sea lift around Point Barrow to Foggy Island near Prudhoe Bay.

Other oil companies had also started to move in. Mobil Oil Corporation, in partnership with Phillips Petroleum Company, was loading barges for a trip down Canada's Mackenzie River to the North Slope. ARCO and Humble Oil and Refining Company meanwhile, had already begun construction on a year-round gravel air strip on the slope. This suggested to industry observers that ARCO and Humble might be considering year-round drilling operations! Up to this point, the soggy condition of the tundra had discouraged summer drilling.
Previous drilling test reports had already fired up enthusiasm. Early in the year the Fairbanks newspaper had quoted Alaska Senator E.L. ("Bob") Bartlett as saying that the North Slope field might rival the Middle East fields in size. An announcement on June 25 indicating oil and gas had been discovered at the Sag River well caused the Anchorage News to comment that:

An economic history of Alaska written in--say 1980--may point to an announcement on Tuesday, June 25, 1968, as the event that ushered in a bright new era for the state. A turning point, perhaps THE turning point.2

Thus the July 18 announcement fell upon eager ears. Everyone already knew oil was there but, for it to be economical to develop and transport the oil from this remote area, the volume of oil present had to be large. The announced estimate more than met this requirement. Amidst speculation that reserves might total 100 billion barrels, the general Alaskan reaction was one of elation. The governor of Alaska, Walter Hickel, immediately suggested extending the federally owned Alaska Railroad from Fairbanks to the North Slope instead of building a $400 million pipeline. In Fairbanks others argued for an immediate start on a winter road north; many Fairbanks residents were afraid that the North Slope would be supplied by barges and by large C130 Hercules aircraft flying from Anchorage. Clearly, the more directly a city would be linked to supplying the North Slope, the more money from this development would flow to its businesses and citizens. The road concept was soon expanded by some enthusiasts into a "transportation corridor" for any combination of pipeline, railroad, and road. Negative impacts seem not to have been seriously weighed at this time.

A few observers who began to take a broader view asked what the ultimate impact on the state would be. The Anchorage News commented that, while the future seemed assured, such a "bonanza" required bold new planning. The oil companies would make profits, but what would be the social dividends? What would be the effect on jobs? The News also asked rhetorically if all the people of Alaska would benefit from the bonanza. The Alaska Construction & Oil Report however, still dazzled, asked:

Might not the Prudhoe Bay discovery--huge as it may be--be only the first of two, three, or several oil field discoveries in the Slope area?

This concept staggers the imagination. It is hard enough at this point to realize after all the years of struggle and failure that the North Slope is now known to have a commercial oil field which might be one of the largest in the world. To go farther and think that this might just be the first of many such huge discoveries is more than the mind can encompass at this point.3

The Pipeline Concept

Some critics have suggested that the choice of a pipeline/tanker system as the means for transporting North Slope oil was made in haste and without due consideration to either alternative modes or alternative routes. A few environmentalists undoubtedly would have preferred that the North Slope oil

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not be developed at all at this time; others favored alternatives such as a trans-Canada route which they saw as preferable in terms of some combination of environmental and economic factors. The oil companies, the public officials in Alaska, and many officials in the federal executive branch strongly favored the TAPS project as an economic necessity, and felt any environmental problems could be overcome through appropriate technology.

TAPS was planned, appraised, and designed in the midst of demands made by the federal government, the state government, Native groups, civil rights groups, environmental groups, and others. Consequently, the project was constantly being replanned, reappraised, and redesigned. Perhaps the most accurate statement is that the pipeline evolved through a process of conflicting forces.

In the oil industry there are two commonly accepted ways of moving large quantities of oil: pipelines and tankers. Both require substantial initial investments, but once the investment is made variable operating costs per unit of oil transported are very low. It was only natural that the oil companies should think in terms of one or another of these modes (or, as it actually turned out, a combination of both) to move North Slope oil to market. Of the two modes, the pipeline has a disadvantage in terms of its relative inflexibility: it connects two points through a permanent link. Tanker capacities and destinations, on the other hand, can be adjusted to meet changes in the size and locations of markets. In most cases, on a per unit basis, shipment by tanker is cheaper than shipment by pipeline.

An intuitive examination of the transportation problem cast doubt on the feasibility of an all tanker system. Sailing in Arctic waters is difficult and dangerous. To move the oil to refineries on the U.S. East Coast, tankers would have to regularly traverse the Northwest Passage—channels between the Canadian mainland and a number of large islands which were filled with ice year-round. For centuries mariners had attempted to find a route through the Passage; for an equally long time ships had become trapped and many were ultimately crushed by the pressure of the ice. Shipping by tanker west from Prudhoe Bay would require sailing through the Beaufort Sea, past Barrow at Alaska's northern tip, through the Chukchi Sea and the Bering Strait. On a commercial basis, this route had been feasible in most years only during the brief period in late summer, when winds would drive the ice pack sufficiently far from shore to allow ships to pass unhindered. If the winds changed, ships could get trapped and be forced to spend a year locked into the ice. Clearly, special reinforced tankers with ice-breaking capabilities would be required to use either route. A second problem to be solved was caused by the shallowness of the Beaufort Sea, which would not allow a fully-loaded tanker of economical size closer than 25 miles (40 kms.) from shore. In that case, a long jetty and loading dock would be required, but this in turn would be subjected to tremendous pressures from the moving ice pack.

By comparison, a pipeline appeared to present fewer problems. The oil industry, experienced in pipeline construction, had developed the technology to deal with difficult problems many times before. Precedents in the north for pipelines included a recently completed transalpine pipeline; a short linkage between the Swanson River field and a marine terminal at Nikisiki;
a three-inch line from the port of Haines to Fairbanks; and the Canol Pipeline, built during World War II which connected Norman Wells with Whitehorse in Canada. During that same wartime period, the Alaska Scouts (a Native military unit) had surveyed a pipeline route from Barrow to Fairbanks in case the oil assumed to be in Naval Petroleum Reserve No. 4 would be needed.4

Several superficial studies of the feasibility of a trans-Alaska pipeline had been done a few years earlier as Humble and ARCO started their exploration program. Now both companies undertook intensive studies designed to provide the data on which firm engineering and cost estimates could be based.

Answers to a number of major questions would have to be found. It was assumed that the destination would be an ice-free port to be selected. Linked to choice of route was choice of a specific port. A general guideline was that the costs of construction would be directly proportional to the length of the pipeline.

Should the line be a hot-oil line (which might present problems in the permafrost areas), or should the oil be refrigerated? Oil leaves the wells at temperatures as high as 160°F (71°C) and the hydraulic friction of movement through the pipeline generates enough heat to maintain a relatively high temperature. On the other hand, cooling the oil would require a massive investment in refrigeration equipment and, since cold oil does not flow as readily as hot oil, a large number of additional pump stations would also be required. Chilling the oil would also cause the wax to separate out from the oil and coat the interior walls; removal and disposal of the wax would create a major problem of its own. Design capacity of the line required another fundamental decision. That design in turn required estimates to be made about the size of the Prudhoe Bay reserves (and any new discoveries in the future). Some basic decisions about the ability of markets to absorb the oil had to be made also.

Computer analysis had established the reservoir size at 9.6 billion barrels. Simulated production over the lifetime of the field eventually estimated a maximum level of 2 million barrels per day. (Since this was near the level of U.S. oil imports in the mid-1960s, the North Slope oil probably could decrease greatly the domestic oil production-consumption gap.) Using an estimate of daily production levels the size of pipe could be computed.

Possible Routes

In 1964 Humble Oil's Frank Therrell had been sent by his company to look at pipelines then operational in the Canadian Arctic; he now became one of the key members of Humble's planning team. In April 1968 the Humble and ARCO teams held a briefing for executives of their companies.5,6 The Humble team outlined a route that would run east from Prudhoe to the southern tip of Hudson Bay, and on to the East Coast. ARCO engineers outlined a route following the Mackenzie River south to connect with pipelines already in place near the U.S.-Canadian border. Major attention, however, focused on the shortest route: south from Prudhoe to the Gulf of Alaska. A rough estimate of the basic cost of construction was $750,000 per mile.
($465,000/kms.) for the buried portion, and twice that amount for any above ground sections. When support facilities were included, the result was a total cost estimate of $900 million.

The selection of Valdez as the terminus of the pipeline appears to have been done after considering other sites such as Whittier, the Cook Inlet, Seward, and Cordova. In response to a query from Russell Train of the Interior Department, the oil companies gave the following rationale for the choice of Valdez:

Valdez is the most northerly icefree port in Alaska, giving therefore the shortest possible pipeline route from the North Slope. Water depths within the port are more than adequate for the largest vessels afloat and adequate maneuvering room for such vessels is available. Deep water approaches to the port are also completely adequate. The port has good protection from winds in most directions provided by the surrounding mountain ranges.

Land suitable for use as a tank storage area exists on the south shore. This area does not slope as steeply as the hillsides more commonly found along the south coast and the bedrock is overlain by only a very thin layer of soft material, thus enabling the tanks to be founded on bedrock thereby providing a stable foundation beneath the tanks in the event of earthquakes.

The pipeline route, in addition to being the shortest, also has the advantage of presenting possibly fewer construction difficulties than the routes to other south coast areas. It is possible to route such a pipeline within reach of the existing highway for most of the way from Fairbanks south.

Port facilities exist in Valdez to facilitate the import of materials.

It is believed that the site chosen for the terminal will cause the minimum of interference with the commercial fisheries and fish and wildlife interests. An ecological study of the area of the port and its approaches is being arranged to study the likely effects on these aspects of life within the area in order to ensure that disturbance is kept to a minimum.

The study will examine the tidal action, currents and fishing characteristics of the water body within the port.

No native settlements exist within the area proposed for the terminal.

Whittier was ostensibly rejected at least in part because of restricted maneuvering space within the "Passage Canal"; Seward because of the incidence of heavy seas and because its port area had been destroyed in the 1964 earthquake. However, since Valdez also required passage through a narrow channel and the whole town had been destroyed by the same earthquake, it appears that the primary criterion actually was that the route to Valdez was the shortest.

At the end of July 1968, ARCO and Humble announced that a consulting firm, Pipeline Technologists, Inc., had been hired to study the route.
studies were initiated to look at detailed route characteristics, soil properties, and potential construction problems. Engineers also turned their attention to the special problems presented by pumping hot oil through a system which itself would be operating in an extremely cold environment. [A temperature of 80°F below zero (-62°C) has been recorded at what ultimately became Prospect Creek Camp 16 miles (26 kms.) north of the Arctic Circle.]

ARCO, Humble, and British Petroleum (BP) also commissioned another study which had a small section devoted to a trans-Canada pipeline to the midwest. A Canadian pipeline firm, Trans Mountain Oil Pipeline Co. of Vancouver, B.C., hired Bechtel Corporation to determine feasibility of building a link from the North Slope to existing Canadian pipelines. Those studies supported the economic feasibility of Canadian routes.

Alaska's Governor Hickel, meanwhile, supported the construction of a winter trail to the North Slope. Such winter trails, normally made of packed and graded snow, cause minimal environmental damage. However, in this case, poor construction practices destroyed the protective tundra covering the permanently frozen ground. The trail, later known as the "Hickel Highway," was completed too late in the winter of 1968-69 to carry much traffic. In the following spring it became apparent that the road was a disaster--both in the transportation and the ecological sense.

The Canadian alternatives still appeared to be viable during summer 1968 when oil company presidents met in Ottawa with the Canadian Minister of Energy, Mines, and Resources. However, the meeting resulted in strong indications that Canada would insist on Canadian control of a pipeline through its territory. The potential problems of financing in the Canadian money markets, split ownership, and of having to deal with two national governments instead of one discouraged serious consideration of a trans-Canada route by the oil companies.

Incorporated Venture

In October 1968, ARCO, Humble, and BP formed the Trans-Alaska Pipeline System (TAPS) as an unincorporated joint venture. Since this organization was funded by and used borrowed people from the sponsoring parent companies, the parent companies exerted control through a series of meetings and a number of committees. At this point, therefore, TAPS was more of an alliance than a tightly knit organization.

In November 1968, ARCO and Humble applied for land in Valdez for a terminal. By December the feasibility study was finished and the basic TAPS design concept had emerged. On February 10, 1969, ARCO, Humble, and BP formally announced their Alaska pipeline plan. Unlike some aspects of the detailed route and terminal location which were still under study, the concept of a 48-inch (122 cms.) diameter hot-oil pipeline approximately 800 miles long (1,287 kms.) clearly had been adopted. Initial capacity would be 500,000 barrels per day, rising to 1.2 million barrels by 1975, and finally to 2 million barrels by 1980. These increases in capacity would be made possible by adding more pump stations. Completion of the 500,000-barrel phase was expected in 1972.
Economic Impact of the Pipeline on Alaska

Because of its vast land area and generally harsh climate, Alaska had always had a major problem in establishing and maintaining a viable economic base and too long had been dependent upon the federal government for jobs and income. For many Alaskans, the Prudhoe Bay discoveries appeared to finally solve that problem: constructing the pipeline would provide a temporary boom, providing support for oil company operations would add a longer term economic component. Severance taxes and royalty oil revenues to Alaska state government would greatly reduce the need for individual income taxes and allow expanded governmental activity, which together with its multiplier effect, would constitute a major improvement in the economic base.

The September 1969 lease sale of Prudhoe Bay lands in the same area as the original discovery had bids totaling over $1.6 billion. Final awards of 164 tracts of 640 acres (259 hectares) gave the state total receipts of over $900 million—an unprecedented bonanza. At the same time, the state government became obligated to support development of a transportation system for moving the oil: in this case, support the TAPS pipeline. This sudden influx of $900 million into a chronically poverty-stricken state treasury seemed to provide proof of the benefits to be gained from oil development; future lease sales could be expected to enrich the state still further.

Alaska already had been a significant source of domestic oil and gas for a number of years. In 1970 petroleum industry payrolls were $56 million, and represented over 9 percent of total private sector wages and salaries in Alaska. (Prudhoe Bay-related petroleum activity is included in these figures.) Of the gross expenditures, only an estimated 25 percent of the petroleum industries' expenditures for Alaskan operations would flow directly into Alaska's private sector, but the multiplier factor would increase this sum by a factor of 1.5.8

Table 3 shows the significance of oil revenues for Alaska's state government. By 1971, non-bonus revenues had risen to a level of 13.5 percent of total state government income. With bonus payments from the 1969 sale factored in the petroleum industry contributed over 80 percent of that year's income.

Table 4 illustrates two important aspects of future revenue potential. First, the state would collect substantial production taxes on any oil being produced, and the percentage amount of this tax rises with an increase in the daily productivity of the well. Prudhoe wells could be expected to produce at high daily rates. Second, the amount of revenue would be dependent on wellhead value, which in turn is computed by subtracting all transportation costs from the refinery price. Thus wellhead value would be a function of both the market where the oil was sold (assuming prices differed between markets), and the costs of moving the oil to that market. Table 4 does not show the additional revenue from a 12½ percent royalty (again based on wellhead value) which is independent of a particular well's productivity. (The state also collects 90 percent of a similar 12½ percent royalty on the production of onshore wells leased from the federal government, and the production tax applies to oil produced on both federal and private lands.)
Table 3

IMPORTANCE OF REVENUES TO THE STATE FROM PETROLEUM INDUSTRY ACTIVITY BY FISCAL YEARS

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<td>Oil and gas income as a percentage of total state revenues</td>
<td>13.5</td>
<td>81.7</td>
<td>18.5</td>
<td>24.2</td>
<td>12.8</td>
<td>14.2</td>
<td>11.0</td>
<td>11.4</td>
<td>26.6</td>
<td>28.7</td>
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<tr>
<td>Oil and gas income as a percentage of total state revenues --excluding bonuses</td>
<td>13.5</td>
<td>15.0</td>
<td>18.1</td>
<td>13.7</td>
<td>8.1</td>
<td>7.7</td>
<td>7.4</td>
<td>8.1</td>
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In order to be able to tap this revenue, the wells have to be in production, which could only occur once a transportation system was available. Fig. 5 shows some indices of oil industry activity in Alaska. Particularly noticeable is the decline in exploratory and development well drilling which occurred when the pipeline project stalled in the face of opposition.

In 1972, even after delays, Alaska's Institute of Social, Economic and Government Research predicted that pipeline construction would mean a short-lived economic prosperity to Alaska and employment—especially pipeline-related employment would rise. Total work force in the mostly automated phases of oil production and pipeline maintenance would number no more than 600. Payrolls could approach $340 million in the second year of construction; would fall to $125 million when production began; and stabilize after three years at $55 million. The slump in Alaska payrolls after construction was finished could be tempered by state generated activity, especially if revenues were turned into wages, salaries, and transfer payments. Fig. 6 graphically portrays the impact over the life of this project as perceived before actual construction.

The Institute recognized then that, as pipeline construction tapered off, state government would be pressured to increase its spending level to maintain the higher levels of employment. It estimated that this situation would require additional expenditures of $200 million annually within four years after the start of construction. In addition, this initial level would presumably rise to $300 million annually within six years after the start of construction. In order to be able to tap this revenue, the wells have to be in production, which could only occur once a transportation system was available. Fig. 5 shows some indices of oil industry activity in Alaska. Particularly noticeable is the decline in exploratory and development well drilling which occurred when the pipeline project stalled in the face of opposition.

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The economic significance to the state of Alaska for both the private and public sectors could be summarized as follows:

1. A great need existed for new sources of economic activity and revenue as the proportional contribution of federal payrolls was declining;
Fig. 5. INDICES OF ALASKA PETROLEUM INDUSTRY MINING ACTIVITIES (Semi-Log Scale)

Source: Alaska Pipeline Report. Data were obtained from Alaska Department of Natural Resources, Division of Oil and Gas, Annual Report; Alaska Department of Labor, Statistical Quarterly, 1960-1970.
Fig. 6. ECONOMIC IMPACT OF NORTH SLOPE PETROLEUM DEVELOPMENT, PRODUCTION AND PIPELINE TRANSPORTATION ON POPULATION, EMPLOYMENT AND UNEMPLOYMENT (Assuming Pipeline Construction Begins in 1972)


Note: If construction begins in 1973 or later instead of 1972, the relationship shown here will still pertain, although with different dollar values.
2. Oil, once the pipeline was finished, could be expected to provide this long-run base, but the amount of revenues would be tied to the wellhead price.

3. The pipeline construction would result in a short-run boom and a sharply increased level of personal income. Although much of this income would leave the state, a substantial amount would also go to long-term Alaskans.

4. The construction boom would cause a major population increase, much of which would be temporary, but which would cause severe distortions in Alaska’s economic and social life.

5. The boom would generate longer run expectations of higher incomes and would increase demands for higher levels of state spending. Assuming wellhead prices were high, these revenues could be generated from the state’s oil production taxes and oil royalty receipts.

To most Alaskans, the obvious basic conclusion was that oil and the pipeline would vitalize the Alaskan economy and deserved enthusiastic support. Only residents whose traditional way of life or income would be endangered, such as coastal fishermen, could be expected to oppose the project from within the state.

Preliminary Design: Formal Application for Pipeline Permit

On June 6, 1969 TAPS formally filled an application for a pipeline right-of-way with the Office of the State Director, Bureau of Land Management (BLM), in Anchorage, Alaska. Excerpts from the application are given below:

GENTLEMEN: Atlantic Pipe Line Company, BP Pipe Line Corporation and Humble Pipe Line Company submit this Application for an oil pipeline right-of-way, together with two additional rights-of-way for ingress and egress to the primary right-of-way and eleven pumping plant sites for the construction of a 48" diameter oil pipeline system extending from a point in the north line of Township 8 North, Range 14 East, Umiat Meridian, to a point in Section 13, Township 9 South, Range 7 West, Copper River Meridian....

The primary purpose for which said right-of-way will be used is the construction, maintenance and operation of a 48" diameter pipeline and pumping stations for the transportation of liquid crude petroleum from the North Slope of Alaska to a marine terminal at Port Valdez....

Your Applicants request, a 54' wide right-of-way... together with an additional right-of-way 46' in width located parallel and adjacent to the 54' primary right-of-way above... which is reasonably necessary for the use, operation or maintenance of the primary right-of-way....

Your Applicants further request a second additional right-of-way 100' in width for a construction road necessary for ingress and egress to the primary and first additional right-of-way....
... The construction road will be designed and constructed to support the heavy axle loads incident to the pipeline logistics and construction. Where possible, the road will be constructed parallel and adjacent to the primary and first additional right-of-way, however, the topography dictates considerable divergence south of the Brooks Range.

Finally, in addition to the above, your Applicants request the temporary use, for construction purposes only, of areas on each side of all river and stream crossings ... 2-- to 500 feet in additional width and from 200 to 1,000 feet in length ... for storage of spoil materials and equipment work space. Additional temporary use during construction will also be required by construction contractors engaged by Applicants ... for the establishment of camps for their personnel and access to the right-of-way along the southern portion of the route where a construction road will not be built. These temporary use areas will not be identifiable until such time as the construction contractors are selected and after they have had opportunity to plan the construction....

... 7. The eleven pumping station easements requested ... each will be 1600 feet by 1200 feet and contain approximately 44 acres. A plot plan of a typical pumping station is included with the bound alignment map. In the initial phase, air strips of approximately 5000' by 200' will be required at stations Nos. 3 and 4 ... together with access to and from the station sites. Applications will be filed upon completion of engineering data....

One of the prime considerations in selecting the route applied for herein was an in-depth analysis of soil conditions to insure a pipeline location providing maximum physical stability, maximum burial of the pipeline, and minimum disturbance of the natural environment. Extensive field examination in conjunction with ground-proofed aerial photographic interpretation was used in plotting the pipeline and construction road right-of-way alignment.

Included with the application was the required filing fee of $10.00, maps, and other documents, including statements of intent to operate the pipeline as a common carrier.

A cover letter dated June 10, 1969 from TAPS to Russell Train at the Interior Department indicated that the application did not conform to regulations because detailed survey data sufficient to produce maps with the required level of accuracy, not yet available, were being generated and maps would be furnished upon completion. The letter also stated a need for flexibility in purchasing the estimated 13 million cubic yards (9,939,800 cubic meters) of gravel required, and pointed out that "time is of the essence," if construction was to begin early 1970, since six months of mobilization time would be required. Only short segments totaling approximately 40 miles (64 kms.), or 5 percent of total mileage, would be above ground construction. The following excerpts from the letter describe TAPS method of route selection:
I. PIPELINE ROUTE

The preliminary pipeline route selection was done by a task force of 27 men during the months of August and September 1968. There were five helicopter transported field parties involved in gathering data on several possible routes. From the evaluation of this data, a tentative route, with alternates, was chosen.

During the months of March and April of 1969, five more field parties were engaged in gathering soil data and samples along the tentative routes. These parties were comprised of a Party Chief, a Geologist, a three-man drilling crew and the necessary cat train personnel. The parties were supported by fixed wing aircraft and helicopters. The data collected included ground and air temperatures, geological observations, and drill hole logs and samples.

A ditching testing program was conducted in the Fairbanks area. This program was to determine the most feasible method and type of equipment to excavate different types of frozen soils. These test results will be made available to enable contractors to use optimum ditching methods with minimum damage to ground surface.

With the assistance of R&M Engr.-Geological Consultants, Arctic Engineering Consultants, and the University of Alaska, we have evaluated the data acquired from soil borings, from soil temperature readings, and from aerial photo interpretations. In addition, the entire route will be photographed using conventional color film and infrared film. Results of these new photos will be studied in detail to confirm the route being applied for.

The route as now proposed is a result of all of these studies in addition to the normal pipeline studies of hydraulic gradients, etc. This route is now thought to be the most economical and the most secure from damage to the pipeline and to the terrain. The route will of course be subject to minor alterations as we continue our studies with low altitude aerial photos and ground surveys....

II. RIGHT-OF-WAY WIDTH

The 54' R.O.W. width which is allowed by statute is not adequate for the construction of a 48" pipeline. The R.O.W. should be 100' width to accommodate the extremely large equipment that is necessary to handle the 48" pipe, and the large spoil pile of excavated soil. Attached are sketches of the required 100' wide pipeline R.O.W., and the 100' wide road R.O.W., for different methods of construction.

III. ROAD CONSTRUCTION

It will be necessary to construct approximately 390 miles of roadways to furnish access to the pipeline during construction. This road will begin at the Manley Hot Springs-Livengood Road at a point approximately 10 miles west of Livengood, and will continue generally north along the pipeline R.O.W. to Prudhoe. This road would be considered to be at least a semi-permanent, all-weather road. The total
traffic on this road will exceed 240,000 tons of freight during the construction of the pipeline.

The route for the road has been selected to follow the pipeline as nearly as possible. The road deviates from the pipeline R.O.W. in some areas, due primarily to the fact that a pipeline can negotiate much steeper grades than are practical for a road. Other factors taken into account were locations of stable soils, gravel borrow areas, rock quarry areas, and drainage features.

The road R.O.W. width should be 100 ft. to allow room for normal road construction methods for this type of terrain. The road would utilize normally accepted types of drainage structures, including culverts, bridges and fords.

There are numerous special studies in progress to determine the best methods of handling the Ecological, Archaelogical and Conservation problems that will be encountered during and after the construction of the pipeline and road. Results of these studies will establish procedures to be used to meet all requirements of minimum changes to the terrain.11

In summary, the TAPS proposal was for a 48-inch (122 cms.) diameter hot-oil pipeline which would be buried for over 90 percent of its 789-mile (1,270 kms.) length. Initial capacity would be 500,000 barrels a day, rising in stages to 2 million barrels a day. Approximately 641 miles (1,031 kms.) of the line would be across federal lands, with completion expected sometime in 1972. The application also requested a right-of-way and permit to build a haul road of slightly less than 400 miles (644 kms.) to support construction.

At this time a "land freeze" moratorium on disposition of federal lands in Alaska pending resolution of Alaskan Native claims was in effect, but the TAPS owners nevertheless hoped for quick approval. In their view, permits would be granted in July, and construction would follow shortly thereafter. TAPS had already made a substantial financial commitment to the pipeline concept by ordering 500,000 tons of 48-inch (122 cms.) pipe for $100 million from three Japanese companies earlier in the year. An additional $30 million order had also been placed for several of the giant pumps required to move the oil. ARCO's commitment already included a decision to build a new refinery at Cherry Point, Washington, to handle North Slope crude oil. (In September, ARCO placed an order with Bethlehem Steel Company for three new 120,000 dead weight ton tankers.)
III. SELECTION, APPROVAL, AND ACTIVATION

Opposition and Debate

The argument of the oil companies that "time is of the essence" and that permits should be granted rapidly in order to facilitate an early start of construction was not accepted by the Interior Department, despite the fact that the Nixon administration clearly favored increased energy independence, and despite the fact that the Secretary of the Interior was now Alaska's former governor, Walter ("Wally") Hickel, who had enthusiastically supported North Slope development and had advocated the "Hickel Highway" discussed earlier. This highway, just then emerging as an environmental and commercial disaster, threatened Hickel's credibility as an environmentally aware Secretary of the Interior. During his confirmation hearings, Hickel had promised to consult with appropriate Congressional committees before lifting the land freeze to authorize pipeline construction. After assuming his new post as Secretary, Hickel had established a task force to study North Slope development, with a major responsibility for strengthening oil drilling and production regulations to insure development compatible with wise conservation of the environment.

Clearly the Secretary now felt compelled to take a wider view than he had had as governor of Alaska. Immediate approval of the TAPS application would not be granted. In a letter to R.G. Dulaney, chairman of the TAPS management committee, Secretary Hickel explained the reason for the delay:

The Secretary of the Interior
Washington, June 27, 1969

Dear Mr. Dulaney:

Reference is made to the application for an oil pipeline right-of-way submitted by the Trans-Alaska Pipeline System on June 9, 1969, to the Bureau of Land Management Office, Anchorage, Alaska.

The application requests that an affirmative response be given by July 1. We assure you that as soon as we are satisfied that you have met the requirements of law and regulation, that the interests of the native peoples have been safeguarded, that environmental values will be adequately protected, that the responsible committees of Congress are in accord, and that consultation and coordination with other Federal agencies and with the State of Alaska have been achieved, we will grant the necessary permit or permits as expeditiously as possible.

We are continuing to process your application with priority attention, and look forward to fruitful and frequent interchanges with your representatives on this matter.

Sincerely yours,

Walter J. Hickel
Secretary of the Interior
Federal Task Force Questions

Meanwhile the North Slope Task Force, operating under the direction of Interior Undersecretary Russell Train, had been formulating its concerns into a list of questions, which were ready on the same day that TAPS submitted its application. In a cover letter to Dulaney, Train indicated that the 79 questions represented only preliminary thinking of the Interior Department, but were representative of questions which had to be answered satisfactorily before permits could be given for public land use. The questions ranged from design, location, and route selection, to environmental and other issues, including the Department's concern with construction in permafrost areas. A reply was requested within four weeks, but TAPS actually replied on June 19. A sampling of the more important questions include:

15. Have you completed a study of the environment, especially permafrost, as it relates to all types of engineering modifications including drill sites, camp sites, roadways, airfields, aircraft hangars, refuse disposal systems, water supply systems, storage tanks, heating plants, power plants, pumping stations, borrow pits, refineries, and other structures?

23. Have allowances been made for the seismic hazards of present in interior and southern Alaskan in site selection, design, and building of structures? What maximum accelerations have been used as design parameters? What provisions have been made for ground failure during earthquakes? What criteria are used to determine locations of probable ground failure?

24. In view of the fact that the major source of oil pollution to date in Alaska has been slop oil discharged with tanker ballast, what are your plans for ballast and bilge treatment facilities at pipeline terminus areas?

64. Pipeline alignments will cross migration routes used by mammals. What plans have been developed to preclude pipelines from becoming barriers to migration patterns?

70. What plans have been prepared for providing education, retraining, placement, and relocation of Alaskan natives affected by construction, maintenance, and operation of the pipeline and related facilities? Is TAPS prepared to take necessary steps to insure employment opportunities for natives? What is the attitude of the unions in this matter? Have discussions been held with union leadership?

72. What considerations are being given to safeguarding the family, social and cultural patterns of the native peoples who may be affected by the oil development?13

TAPS Answers

Dulaney responded with an 11-page list of answers, some of which also referred to detailed maps submitted as part of the original application. These answers are indicative of the companies' thinking about some of the major environmental, technical, and social questions:
15. Continuing studies of the environment as related to engineering design of structures incident to the Trans Alaska Pipeline System have to date included:

(a) Seismic study of pipeline and terminal facilities by seismic consultants, Dames & Moore.

(b) A prototype pipe test at Point Barrow, Alaska, consisting of 1100 feet of 40" diameter pipe laid under varying conditions to determine stresses developed due to freezing soil and ice formation was initiated in November, 1968 and is continuing. Incident to this work is an additional evaluation of artificial insulation as a substitute for tundra.

(c) A geological investigation of the proposed Yukon River crossing location has been completed.

(d) A research program conducted by the University of Alaska and funded by the Trans Alaska Pipeline System has been initiated to determine optimum methods of replacing or regenerating vegetation on the pipeline right-of-way.

(e) A geological and permafrost study utilizing geological consultants associated with the University of Alaska has been completed along the pipeline route. Data from this work is included in the pipeline right-of-way application filed with the Bureau of Land Management.

(f) An ecological survey evaluating the proposed pipeline route is currently under way.

(g) A marine ecology study at Port Valdez is currently being defined. This work is to be done by the University of Alaska.

(h) A geological investigation of the marine terminal site is currently under way.

23. Sites for pump stations and the terminal have been selected in areas which are believed to be safe from ground failure in the event of earthquake. Dames & Moore, Geological Consultants, have been engaged to evaluate the area crossed by the southern part of the pipeline route and in particular the southern terminal site. This evaluation will provide the maximum acceleration data which will be included in the design of facilities at the terminal. The terminal site was chosen after preliminary soils data indicated the area had not experienced vertical displacements during previous earthquakes.

24. All oily ballast water arriving in tankers at the southern terminal will be pumped ashore and passed through separators to extract the oil, thereby ensuring that ballast will not contaminate waters adjacent to the terminal. (See answer to Question 59.)

64. Currently, it is anticipated that approximately 95% of the pipeline will be buried and the above-ground portions will be in relatively short sections. Consequently no significant barriers to migration routes of mammals is anticipated. However, where necessary, ramps or underpasses will be provided to ensure adequate passageways for migrating mammals.

70. and 72. Trans Alaska Pipeline System has negotiated a contract with the Alaska Federation of Natives to compile a roster of available native labor who might be employed in construction of the pipeline.
Meetings have been held with prospective contractors and pledges obtained from contractors to ensure that maximum employment will be available for qualified natives and that on-the-job training opportunities will be provided by contractors employed to construct the pipeline system. Since Trans Alaska Pipeline System will construct the pipeline through independent contractors, no direct relationship with the unions is anticipated. It is understood that preliminary discussions with union leadership have been initiated by prospective contractors through their association on the pipeline construction.

It is obvious that the maximum use of locally employed personnel is in the enlightened self-interest of the Trans Alaska Pipeline System. Although the pipeline will be highly automated, employees will be required for station operation, pipeline maintenance, station maintenance, and terminal operation. Trans Alaska Pipeline System will participate in and encourage the training, education, and placement of native Alaskans.  

Environmental Fears

In comments accompanying the answers to the Task Force questions, Dulaney stated that, in his view, good pipeline design dictates design and construction procedures that cause a minimum disturbance to the natural environment and that "since we start from a common position" he expected that "our proposed development will be consistent with sound conservation principles." Dulaney went on to point out that some "questions asked are considerably broader than the pipeline project."  

The oil companies must have been surprised that permits were not granted rapidly. After all, the economic benefits to the nation and to Alaska of developing the North Slope oil were obvious. While there would be some environmental damage as a result of construction, the oil companies were prepared to take steps they considered reasonable to minimize this damage. Besides, the damage would be limited to a very tiny proportion (about 0.01 percent) of Alaska. Hardly anyone lived there. In many of the foreign countries where oil companies operated, the authority for making this kind of decision would be clear and a rapid response could be expected. Even in the United States, such decisions in the past had been made in a relatively straightforward manner.

Mr. Dulaney had underestimated the true complexity of the situation. Environmentalists and many others were not ready to accept TAPS assurances that good pipeline design would automatically mean minimum environmental damage or to agree that all questions surrounding the TAPS project should be project specific. The TAPS proposal would be attacked as bad design, as environmentally undesirable, and as socially disruptive. The resulting debate would take four years (see Appendix A for a chronology).

Opposition from the environmental movement became especially strong when those who placed a high value on environmental protection and preservation became aware of the proposed pipeline and its basic design.
In the view of environmentalists, major damage to the environment (both an aesthetic heritage and also the basis for subsistence economy for rural people) could occur through at least four distinct scenarios. First, poor construction practices and carelessness could pollute and scar the environment along the pipeline corridor. Because of Alaska's short growing season and the delicate character of tundra in permafrost areas, recovery from local environmental damage at best would be a slow process. Stream siltation during construction and any oil spills that might occur could destroy the spawning grounds of anadromous fish. Second, since the proposed design called for burying the hot-oil line in most areas where it crossed permafrost, and the line would then be inadequately supported and subject to buckling or rupture. Third, the route of the line crossed areas of severe earthquake activity, and the terminus would be located in an area which had experienced a massive earthquake (8.5 on the Richter scale) in 1964. Thus a severe earthquake which could rupture the line and the storage tanks could cause a massive oil spill. Finally, the oil would be transported from the terminal at Valdez to the U.S. West Coast in large supertankers. En route the tankers would have to pass through several narrow channels where the possibility of grounding or collision, again in the view of the environmentalists, would be great.

Factors in System Evaluation

Environmental concerns were not the sole basis of opposition. A number of critics began to argue that the proposed TAPS system dealt with only a portion of the transportation problem and that the wrong system had been proposed. Would the TAPS system deliver oil to the right markets? Midwestern senators and representatives protested that the need for oil was greater in their region than on the West Coast. What would be done with the natural gas?

The discovery of an estimated 9.6 billion barrels of oil on the North Slope was accompanied by discovery of an estimated 26 trillion cubic feet of natural gas, which could represent more than 10 percent of proved U.S. gas reserves. Clearly, this gas could not be wasted by flaring. Neither could it be ignored considering the U.S. goal of greater self-sufficiency. Although the ultimate total system for transporting North Slope energy to markets should handle both oil and gas, it appears that the oil companies holding North Slope leases were almost totally concerned with transporting oil alone. This approach should be evaluated both from the companies' point of view and from a larger socioeconomic perspective. The decision to develop transportation for the two resources separately may have been optimal for the oil companies; it may have been considerably less than optimal from national (and possibly also from the state of Alaska's) economic and environmental perspectives.

A second consideration in defining the desired system is that any system linking a resource to a market must insure a proper match between market demand and transportation system capacity. Economies of scale apply strongly to transportation systems and in the oil industry favor high volume systems, for example, the move toward larger and larger supertankers. If, however, the markets cannot absorb the full capacity of large volume systems, then the economies of scale will not be realized and both the resource owners as well as the transportation system operators will experience smaller-than-expected returns on their investments. Under these circumstances, the owners could
be expected to attempt either to stimulate market demand, or to attempt to reach alternative markets. In the case of energy resources, stimulating demand is no longer socially or politically viable in the United States. Alternative markets are still a viable option, provided the transportation system has the required flexibility. The North Slope oil transportation system was ostensibly designed to deliver oil to the lower 48 states; however, many believe that the oil companies always had the alternative Japanese market in mind.

A third consideration in system selection and design is that it be technically feasible. Before a proposed system is actually built, technical feasibility is determined by engineering analysis and prototype testing. This feasibility evaluation is strongly influenced by the past experience of those involved. Oil industry experience was heavily weighed toward pipelines and tankers.

The costs of alternatives must also be considered in system selection. Factors involved in economic evaluation are not limited to direct costs alone; the financial condition of the owners and their need for positive cash flows may outweigh direct construction costs as a consideration. In a high volume business like oil, it may be advantageous to incur higher construction costs in order to have an earlier cash inflow from oil sales. If, however, the transportation system is legally designated as a common carrier (that is, obligated to provide transportation on the same terms to system owners as well as to other potential users), a per unit fee, or tariff, is established by the regulatory authorities. This tariff is based mainly on the costs of construction. Higher transportation system tariffs do not harm the owners of the system when they ship through it, because for them tariff fees essentially represent internal transfer payments. For users who are not simultaneously owners, higher tariffs represent actual cash losses—losses which go to system owners. Thus, perceptions of economic desirability would not necessarily be the same for owner-users as for non-owner-users.

A final class of factors to be considered in system selection is made up of the secondary effects. These effects include national political, defense, and economic considerations, as well as more localized impacts. On a regional basis, employment, tax revenues, social disruption, and other factors must be evaluated. Environmental impact may have to be evaluated from local, national, and perhaps international viewpoints. Oil companies often point out that they try to minimize undesirable secondary effects from their activities. However, the conflict of interest is obvious, since reduction in undesirable secondary effects can often only be accomplished by substantial increase in project cost, both in money and in time delays. Reduction of undesirable secondary effects can be accomplished through two levels of decision making or control. First, the project alternative which inherently promises to have the lowest aggregate harmful secondary effects should be chosen. If the effects of all alternatives are harmful beyond acceptability, presumably no project would be authorized, but in reality political considerations may prevail over objective cost-benefit analysis. Second, once an alternative is selected, its implementation would be monitored closely to see that undesirable impact is not increased through poor construction practices.
Prediction of impact, however, requires both an adequate data base and appropriate evaluative methodology to apply to that data base. Table 5 is a partial indication of the complexity of impact analysis. For a system of sufficient size to deliver North Alaskan oil and for one which would operate in the difficult but fragile arctic environment, it would appear that proper impact evaluation would require a substantial length of time. Yet by late summer 1968—only a few weeks after the full extent of the Prudhoe Bay field could be estimated—oil men were already engaged in defining specifics for a pipeline across Alaska to a tidewater port on its coast.

To critics, it appeared that the TAPS concept had been chosen prematurely, without adequate consideration of alternatives, and that no permit should be granted until all alternatives had been fully investigated. The answers to the North Slope Task Force seemed to confirm that the design was based on partial data and that the design process was itself not complete. TAPS executives, however, pointed out that pipelines (unlike most projects) could be designed and built sequentially. Despite criticism from environmentalists, economists, and others concerned with both oil and impact, the oil companies (who could finance such a massive project) held unflinchingly to their first choice.

Opponents and Alternatives

As the pipeline debate began to intensify, both supporters and opponents became identifiable. Those who supported the project were:

1. The oil industry, which had a resource but no way to reach a market.

2. The state of Alaska, particularly through its government, which would derive substantial economic benefits from royalty revenues and severance taxes (the state in effect owns 25 percent of Prudhoe Bay oil).

3. Local state businesses and governments who would benefit from increased economic activity and an increased tax base.

4. Economically and defense-oriented federal government agencies for whom economic growth, reduced balance-of-payments deficits, and energy independence were of prime importance.

Those who opposed the design choice included:

1. The environmentalists, who feared irreparable damage to the environment from both the TAPS project and from subsequent development.

2. Those federal agencies charged with preserving environmental quality.

3. Some members of Congress, who either supported environmentalists or who preferred to have the oil diverted to the interior United States, primarily the Midwest.

4. The Alaskan Natives who did not want to have land they were in the process of claiming crossed by a pipeline prior to the establishment of their claims.
Table 5. CONCEPTUAL DIAGRAM OF IMPACT ANALYSIS

5. Some Canadians, who either favored a Canadian route on economic grounds or felt that tankers posed a severe ecological hazard to Canada's western coastline.

6. Some Alaskan fishermen and a number of other residents who preferred a simple nonindustrialized life-style.

Those delineations are of course oversimplified: some environmentally concerned individuals also work in the oil industry; not everyone in state government favored the pipeline. The desires of opponents also differed: some extreme environmentalists wanted to stop the project totally, while most others wanted to force through environment-preserving modifications.

Essentially five basic alternatives emerged, apart from not developing the oil field at all. (Fig. 7 shows the routes involved.) The alternatives were:

A. The TAPS proposal of a combined system of pipeline and tankers, which would deliver oil to the West Coast.

B. A longer tanker route directly from Prudhoe, around point Barrow, to the West Coast.

C. A sea route of almost 5,000 miles (8,045 kms.) from Prudhoe through the Northwest Passage to the Northeast.

D. A railroad through Canada to the Midwest.

E. A trans-Canada pipeline to the Midwest.

The alternative which received most attention was one across the northern portion of Alaska to the Canadian border and from there through Canada to link up with existing pipelines leading into either the midwestern or western states (Alternative E) and the original TAPS proposal (Alternative A).

National Environmental Policy Act

A framework for public debate on any major projects, including the pipeline, was established when the National Environmental Policy Act of 1969 (NEPA) was approved on January 1, 1970. The NEPA declared a national policy of encouraging productive and enjoyable harmony between man and his environment by promoting efforts to prevent or eliminate damage to the environment as well as stimulating the health and welfare of man. An Environmental Quality Council was created to analyze environmental trends, appraise programs and recommend national policies promoting improvement in the quality of the environment. Section 102 of the Act outlined the specific requirements that any proposed action, including the pipeline project, would have to meet by terms delineating environmental impact and providing for public comment. The Act imposed environmental impact statement requirements on all agencies and departments, including the Department of the Interior. Part C of Section 102 specifically requires identification of adverse environmental impacts, consideration of alternatives, and public distribution of these documents.
Fig. 7. ALTERNATIVE ROUTES


Note: Boxed numbers represent estimated shipping costs per barrel to mainland U.S.; unboxed numbers represent additional costs to deliver to midwest.
Approval of Trans-Alaska Pipeline System

Evaluation Process

Evaluation of the alternatives did not take place as an orderly process of analysis and review under the supervision of any single agency or individual. The process that took place is best described as adversary rather than as analytic. Each participant attempted to advance its choice through a combination of purportedly objective studies designed to reinforce the group's arguments, public relations efforts, Congress lobbying, and legal test actions (see Appendix A).

During the rest of 1969, more questions and answers were interchanged between TAPS, the Interior Department, and the various congressional committees. The actions of the Interior Department, which apparently favored the TAPS concept throughout the process, were directed toward issuing a permit as soon as possible, provided that the permit could be linked to a framework which would assure a certain amount of protection for both the environment and Native claims. The latter objective was met by passage of the Alaska Native Claims Settlement Act (ANCSA) in 1971. The Department's formula for assuring environmental protection was to link the permit to a set of contractual stipulations which would govern construction and adherence to which would be enforced by an on-the-scene "authorized officer" representing the Department. The Department also started to study a 12-mile wide transportation corridor along the proposed route, which would allow for some flexibility in response to conditions encountered during actual construction.

Despite the favorable attitude of the Interior Department, actual officially authorized construction in 1969 was relatively minor. Preliminary work on ground clearing at the Valdez terminal site was authorized by the Forest Service (the site lay in the Chugach National Forest). A short segment of the haul road connecting the south bank of the Yukon River to the end of the state highway system was authorized by the Interior Department.

The environmentalists adopted a number of tactics designed to prevent or slow down approval. Public relations tactics depended primarily on the use of the media to acquaint Americans with the potential dangers of the project and to mobilize citizen pressure on Congress. Lobbying and direct testimony at each of the several Congressional hearings was used to try to influence members of Congress directly. However, the most effective delaying tactic for the environmentalists turned out to be the court suit.

In January 1970, the Secretary of the Interior issued a Public Land Order establishing a transportation corridor, which would presumably have been followed by the appropriate permits for the pipeline itself. Opponents and critics of the pipeline turned to the courts. In March and April 1970, several suits were filed in the federal courts by both Native groups and environmental organizations. The three basic sources of legal grounds for challenging the TAPS plan were:

1. The 1920 Mineral Leasing Act which specified that a pipeline right-of-way should consist of the ground necessary for the width of the pipe plus 25 feet (8 meters) on either side. TAPS required a 100-foot (30 meters)
right-of-way. This Act provided a legal basis for those opposed to the pipeline to delay it through court challenge. (In reality, the extra width presented no problem in terms of land availability but did provide the technical grounds for challenge.)

2. The Alaska "land freeze" brought about by Native claims. Resolution of those claims was required before a permit would be granted.

3. The National Environmental Policy Act (NEPA) which became the primary basis for legal challenge to TAPS plans.

In April 1970, three environmental groups (the Wilderness Society, the Environmental Defense Fund, and the Friends of the Earth) petitioned in court to bar issuance of permits under provisions of NEPA and the Mineral Leasing Act. Initial arguments based on NEPA contended that an environmental impact statement had not been prepared as required by law and that opportunities for public input had not been sufficient. When the courts finally refused to accept the environmentalists' contention of noncompliance with NEPA, the environmentalists returned to the right-of-way width issue as a legal basis of argument. On this issue the courts upheld their position and the Interior Department was not allowed to issue the requisite permits. The Trans-Alaska Pipeline Authorization Act finally removed this barrier.

Native groups at first had thought that the TAPS project would offer them jobs, and several villages had signed waivers allowing TAPS to cross the lands they were in the process of claiming in return for promises of jobs on the project. However when TAPS announced the first awards of contracts, Native businesses failed to get even a single contract and disillusionment set in. The villages withdrew the waivers and instituted a lawsuit. For a period of time environmentalists and Natives were allies but, as the oil company lobbyists interceded on behalf of interests in Congress, the alliance weakened. The passage of the Alaska Native Claims Settlement Act (ANCSA) destroyed the basis for large-scale Native opposition while the provision of the Act which created profit-seeking Native Regional Corporations also created a powerful incentive for Natives to support economic growth and development in Alaska. Over a period of time, Natives would assume ownership of 44 million acres of land, some of which would have oil and gas potential. A pipeline would also be required to transport their oil. ANCSA also removed the original basis for the "land freeze" in Alaska.

During this period of opposition and debate, TAPS [which was reorganized and incorporated as the Alyeska Pipeline Service Company (Alyeska) in 1970] had relatively little control of events and was forced into essentially a position of reacting. The original design plan had to be modified from one in which about 95 percent of the pipeline would be buried to one in which only about half would be buried. Increasingly tighter stipulations proposed by the Interior Department further restricted Alyeska's freedom of choice in design and construction practices.

The state of Alaska suggested its own solutions: first, by proposing to build the haul road itself; and second, by suggesting that the state take over the pipeline financing in an effort to increase the state's own assets. Both concepts were rejected by Alyeska, which was now estimating project costs at $3 billion or more.

40
Major discussion about basic alternatives quickly began to focus on the two fundamental possibilities: the TAPS proposal and the trans-Canada alternative. Although a complete tanker system and a railroad system continued to be advocated by some, these systems never generated sufficient support to become serious contenders. Transportation of oil directly by tanker from the North Slope presented massive problems previously outlined. Although a basic decision to build a pipeline had already been reached by the oil companies, the experimental voyages of the specially constructed S.S. Manhattan are illustrative of the problems with a tanker system. The Manhattan was a reinforced tanker which Humble leased for a test voyage from the East Coast to Prudhoe Bay through the Northwest Passage. Accompanied by an icebreaker, the Manhattan experienced much difficulty with the ice. Despite its special construction, it had to be freed from the ice on several occasions and on the voyage back from Prudhoe a projection of ice ripped a long gash in the hull.

Transportation by railroad would involve immense construction expense, with many of the environmental problems associated with a pipeline, and would also lead to significant operating costs. The oil companies had briefly considered a railroad but quickly rejected this concept. (An Interstate Commerce Commission report in 1969 showed that the average railroad charge per ton-mile was five times as high as that for pipelines.) A variety of studies examined the cost and environmental characteristics of most major alternatives. Because each had to make economic and other assumptions in the analysis, results were often contradictory and open to criticism.

Environmental Impact Statement

The initial 196-page environmental impact statement (the January 1971 draft version) concluded that:

1. North Slope petroleum reserve was essential to the strength, growth, and security of the United States;

2. The earliest and most practical delivery means as well as the most environmentally safe of all considered means was the proposed Alyeska Pipeline System;

3. Foreseeable environmental costs would be at an acceptable level if construction and operation of the proposed pipeline was in accordance with Interior Department stipulations and all applicable laws and regulations relating to environmental protection.

That statement obviously was a superficial treatment of the issues and came under widespread attack for bias as well. The Department of the Interior began revising the statement but opponents also sued to force what they conceived to be requirements for compliance with NEPA. For example, the Canadian route had not been examined in detail because, according to the Secretary of the Interior, no one had applied for a permit for that route. In December 1971, the District Court in Washington, D.C., ruled that all alternatives must be considered.

At congressional and Interior Department sponsored public hearings, thousands of pages of testimony were collected as proponents and opponents
attempted to sway the decision in their favor. As a result of these hear-
ings, a revised six-volume environmental impact statement was compiled by
the Interior Department.

The Final Environmental Impact Statement was released on March 20, 1972.
Interior Secretary Rogers Morton claimed preparation of that statement and
that of an economic and security analysis had taken 175 employee-years and
$11 million to complete. The statement continued to support the Trans-Alaska
Pipeline concept. Objections to the content and conclusions of the statement
persisted, however, and were finally resolved only by the passage of the

The Final Environmental Impact Statement was accompanied by an analysis
prepared by the Interior Department's Office of Economic Analysis. This
analysis summarized the administration's conclusions:

1. North Slope oil delivered to the United States would reduce imports
of eastern hemisphere oil by an equal amount.

2. No transportation alternative was considered economically more
efficient than the Trans-Alaska Pipeline System; a pipeline through the
Mackenzie Valley of Canada was considered the only equally efficient
alternative.

3. North Slope oil development was considered an important national
security objective; the Trans-Alaska Pipeline System could deliver oil
sooner than the other efficient mode.

4. Delay in the development would place increased costs on the
nation's economy.

5. The short run impact of the Trans-Alaska Pipeline System on the
state of Alaska was considered to be mixed but the long run impact would
benefit the state to a degree determined by future state action.16

Over a period of time, the courts had considered the arguments of those
opposing the pipeline and the counter arguments of those favoring it. On
August 15, 1972 District Court Judge George L. Hart ruled that the legal
requirements of NEPA had been met and that the Interior Department could
deal with the right-of-way width problem by issuing special land use permits.
However, an appeals court reversed that ruling because of the Interior De-
partment's lack of authority to issue special permits. The U.S. Supreme
Court then refused to review the appeals court decision. Thus in 1973 the
issue was back in Congress, which now alone had the power, in effect, to
authorize the pipeline through special legislation.

Indications of an energy crisis were by now apparent to many in Cong-
ress. A number of bills were introduced by members and the hearings process
started once again. As an acceptable bill began to evolve, events in the
Mideast dramatized the seriousness of the energy problem for the United
States. The Trans-Alaska Pipeline Authorization Act of 1973 passed over-
whelmingly in both houses of Congress. The way was clear for the issuance
of the required permits, but the estimated cost of the pipeline had now
climbed past $4 billion.
Authorization

The Trans-Alaska Pipeline Authorization Act effectively settled the issue of legal authority for granting the required construction permits. It also defined the authority of the Interior Department regarding oversight, and imposed certain requirements and limitations upon the owner companies and Alyeska. Several of the key provisions are outlined here (see also Appendix B).

The Act set a 60-day limitation for legal challenges to be made in court following the granting of a right-of-way permit; as it turned out no new challenges were filed. The Act also required oil transported through the pipeline be shipped to the rest of the United States, and any foreign shipments only be allowed if the President designated them in the "national interest."

I. The Act's Purpose

A. Congress found the trans-Alaska pipeline to be the most viable alternative and earliest possible construction to be in the national interest;

B. Congress authorized prompt construction and directed the Secretary of the Interior and other appropriate federal agencies to administer various authorizations; the Secretary also was given power to provide greater environmental protection by modifying the route during construction.

II. Limits on further legal challenge were indicated; construction and operating activities could not be challenged under NEPA. A 60-day limit was set to claim an action would deny rights under Constitution of the United States.

III. The authority to modify permits regarding this section's provisions in public interest was given to Secretary of the Interior and other federal agencies and officers.

IV. Liability for Damages

A. Holders of right-of-way would be liable on a no-fault basis for damages along or near the right-of-way except for damages caused by an act of war or by U.S. governmental negligence or by the damaged party. No-fault liability would be limited to $50 million for any one incident and would be in proportion to ownership interest; liability for damages beyond this amount could be pursued under the ordinary rules of negligence.

B. Polluting activities by or on behalf of holder of right-of-way would have to be controlled and stopped at the holder's expense.

C. The owner and operator of each vessel used to transport oil from the pipeline would be liable without regard to fault for all damages resulting from discharges of oil from each vessel.

V. Negotiations with Canada by the President of the United States would be held regarding various aspects about any trans-Canada route.
VI. The civil rights section guaranteed all persons equal rights for receiving or participating in any activity conducted under various authorizations of the section.

VII. A width of right-of-way provision (from an amendment of the Mineral Act of 1920) extended the Secretary of Interior's authority to set right-of-way widths in accordance with construction and safety needs.

VIII. The President would use his authority to ensure that all regions of the United States would benefit equally indirectly or directly from the North Slope oil.

IX. Limitations on Export

A. There must be an express finding by the President that export of oil to a foreign country could not diminish the total quantity or quality of petroleum available in the United States and would be in national interest and be in accordance with the 1969 export act.

B. Congress could, by means of concurrent resolution of disapproval (concerning national interest), cause exports be ceased.

Pipeline Design

In order to insure that the Trans-Alaska Pipeline System did comply with the new standards of environmental integrity and to insure that the project could cope with the arctic environment, technical solutions representing new pipeline technology had to be developed.

The principal technical problems to be overcome were:

1. Insulating the permafrost from the hot oil, to keep the permafrost stable so that the pipeline would not rupture and sink.

2. Providing enough flexibility in the line to handle thermal expansion as the hot oil started to move.

3. Providing a design to resist rupture in case of a severe earthquake.

4. Providing rupture detection systems so that, in case of rupture, the line could be shut down before much oil spilled.

5. Providing rupture control by means of oil containment provisions at the pump stations and the terminal.

6. Reducing air emissions of hydrocarbons at the terminal to preserve ambient air quality.

7. Preventing minor oil leaks or spills in the waters of Port Valdez and providing rapid cleanup capability if such spills occurred.
8. Providing collision avoidance systems in Port Valdez, particularly in the approaches to Valdez Narrows, to prevent tanker collisions.

9. Providing game crossings along the pipeline route without disrupting traditional game migration patterns.

Figs. 8 through 12 summarize the essential features of technical design. The solutions to technical design problems include:

1. Where the pipeline is buried in permafrost, the line is insulated and the permafrost is refrigerated by pumping cold brine through buried pipes (Fig. 8).

2. Approximately half the pipeline is buried in stable soils with no refrigeration required (Fig. 8).

3. Expansion due to heated oil passing through above-ground pipe is compensated for by building the pipe in a zigzag configuration. This converts expansion into sideways movement (Fig. 9).

4. With the exception of strategically placed fixed anchor supports (Figs. 8 and 9) the above-ground portion of the pipe is attached to a sliding shoe which is free to move over a limited horizontal range. This allows adjustment both for thermal expansion and for movement due to earthquake activity (Fig. 8).

5. Where required, above-ground vertical support members (VSM) are designed with thermal radiation devices to prevent heat transfer to the permafrost (Fig. 8).

6. All tanks where bulk oil is stored are surrounded by dikes to contain any spills in case of rupture (Fig. 10).

7. Ballast water is pumped to a settling and filtration system for purification before being discharged into the sea (Fig. 11).

8. A vapor recovery system at the terminal prevents oil vapors from escaping into the atmosphere (Fig. 12).

9. Computer-aided centralized control of the system is provided by a master control station in Valdez.

10. Pressure deviations and flow variations are monitored to detect any ruptures or leaks in the line. Valve shutdown will contain most oil within the pipeline, and cleanup crews are on standby to deal with spills. The whole line can be shut down in 10 minutes. Check valves prevent reverse flow.

11. The terminal facility is designed to withstand an earthquake registering 8.5 on the Richter scale. Storage tanks are surrounded by dikes.

12. Stringent enforcement of the "rules-of-the-road" by the Coast Guard in the Valdez Narrows and its approaches, utilizing control concepts
Fig. 8. CONSTRUCTION MODES

Fig. 9. TYPICAL ZIGZAG CONFIGURATION


Fig. 10. PUMP STATION 1 (Origin Station)

Fig. 11. TERMINAL OIL AND BALLAST FLOW


Fig. 12. VALDEZ TERMINAL, MAXIMUM DEVELOPMENT

analogous to air traffic control, is designed to minimize the possibility of grounding or collision (Figs. 13 and 14).

A number of those technical solutions represent new pipeline technology --technology required to cope with the arctic environment and new standards of environmental integrity.

Fig. 13. PORT VALDEZ

A Complete System?

In summary, the Trans-Alaska Pipeline System called for construction of:

1. haul road,
2. pipeline itself,
3. pumping stations, and
4. Valdez terminal.

However, was this the total system required to transport oil and gas to markets? Actually, only a part of the problem was solved. The West Coast could only absorb a limited amount of Alaskan crude oil for its own use and the high sulfur content of Alaskan oil made it difficult to refine in the facilities in existence in that region. But shipping oil east from the Coast would require connections to the pipeline systems in the interior U.S. (see Fig. 15). Such connections would require new unloading facilities and new pipelines from these facilities to connect them to existing
Fig. 15. INDUSTRY DISPOSITION OF NORTH SLOPE CRUDE

interior systems. Alternatively, the oil could be shipped through the Panama Canal to Gulf Coast ports, but this would require costly off-loading to smaller tankers since the Canal cannot handle supertankers. This would in turn reduce wellhead price and revenues to the owners of the oil, which included the state of Alaska. The bill authorizing the pipeline prohibited foreign shipments of Alaskan oil, unless the President deemed such shipments in the national interest.* The TAPS project did not include any provisions for moving Prudhoe natural gas to market, although it was assumed that a gas pipeline would be built sometime in the future.

*As of the end of 1978, adequate transshipment facilities from the West Coast to the East have not been developed, and in fact have not even been fully authorized. Because an oil glut exists on the West Coast, the President is being urged to authorize an "oil swap," by which Alaska's oil would be sent to Japan and more Mid-Eastern oil would be shipped to the eastern United States. A similar swap, using Mexican instead of Arabian oil, is also being advocated by Alaska's state government. The President, however, has yet to make a decision. A gas pipeline concept has been approved, but may die due to lack of adequate financing.
IV. OPERATION, CONTROL, AND HANDOVER

Alaskan Construction Cycle

The traditional construction cycle in Alaska begins in winter when temperatures range to 75°F below zero (-59°C). In this viciously cold portion of the year, the Arctic tundra is frozen and its delicate surface is less likely to be damaged by the movement of equipment. During the dead of winter, heavy equipment and materials are moved to construction sites across temporary snow roads and ice bridges made by compacting several layers of snow and ice on the top of frozen ground, river and lake surfaces. The next step in the construction cycle begins in early spring. Warmer weather by late March or early April allows workers to achieve normal productivity levels. Once begun in spring, work often continues around the clock either until the project is completed or the weather cools in the fall. Most construction not completed by late September or early October is abandoned until the following spring; winter construction normally is too costly. Significantly, projects that find themselves even one month off schedule in October are potentially months behind schedule. Work not finished by October must wait up to seven months, until the following April, to be completed.

The builders of the trans-Alaska pipeline tried to follow Alaska's traditional construction cycle. Snow roads and ice bridges were built following construction permit authorization in December 1973. Heavier equipment and materials were moved across the frozen Arctic surface to construction camps between January and April 1974. Official construction commenced on April 29, 1974 in warmer weather. Fig. 16 shows the six sections assigned to major contractors. Workers and remaining materials were airlifted to construction zones after the snow and ice bridges had melted. The entire first portion of the construction plan—the haul road—was completed during the first construction season. Most of the other portions of the construction plan—the 800 miles (1,287 kms.) of pipe, the pump stations, and the marine terminal in Valdez—were completed during the 1975 and 1976 construction seasons. Some finishing construction was accomplished during the early portion of the 1977 season. Oil was introduced into the pipeline at Prudhoe Bay as scheduled on June 20, 1977.

The project organization structure and manpower levels tended to change with the flow of construction activity. In July 1974, the proportionate ownership of the pipeline was changed; Sohio, ARCO, Exxon, and British Petroleum now owned 90 percent. During that same summer, the highest number of administrative and craft workers—approximately 3,400—were employed. Major portions of actual construction were completed during the 1975 and 1976 construction seasons. Employment levels reached 21,000 workers during the summers of 1975 and 1976 with approximately 26 million employee-hours total by craft workers in each construction season. In 1977, Alyeska began to demobilize itself as a construction company and shifted its organization structure to an operating company. The level of construction activity tapered off in 1977 to a total employment level of under 11,000 workers.
Fig. 16. THE TRANS-ALASKA PIPELINE ROUTE
The total cost of the pipeline system was estimated at $900 million in 1969. Final tabulation in 1977 approximated $8 billion. Both private and public managers tried to explain this $7 billion difference between the 1969 estimate and actual construction costs. The State of Alaska Pipeline Commission documented instances of private management's poor planning, unnecessary duplication, poor inventory control, and low productivity in an attempt to determine responsibility for inflated construction costs. A report prepared for the Commission (the Lenzner Report) suggested that approximately $1.5 billion in cost overruns could be traced to poor management. Allegations by several federal and state commissions pointed out significant damage to fish and wildlife by construction workers. But by its own admission, public management caused "inestimable but unquestionably massive and unexpected costs" to the pipeline builders through overlapping and conflicting regulations.17

A score of government agencies reviewed actual construction and affected everyone from giant corporations such as Exxon and Atlantic Richfield right on down to the small subcontractors.

Haul Road Construction

Statistics associated with construction of the haul road, the pipeline, the pump stations, and the marine terminal show that each individual portion of the construction plan would dwarf most other construction projects by contemporary private industry. Those statistics related to the haul road in turn exemplify the gigantic scale of overall construction. Even before actual construction began, preparation for building the haul road had become a complex problem. Mobilization for construction of the highway started with delivery of 900,000 gallons of diesel fuel; 716 construction vehicles and other equipment which were deposited north of the Yukon River; 75 pieces of equipment which were taken out of storage at Prudhoe Bay and reconditioned; delivery of 600 prefabricated camp buildings; and distribution of 2,800 tons of camp supplies and equipment, necessary before workers could be put on the job.18

Private management's coordinated effort to build the haul road is indicative of the massive scale of the entire project (see Table 6). Some 358 miles (576 kms.) of highly compacted and graded gravel surface road were constructed in the Arctic wilderness along with 39 bridges, 1,029 culverts, 11 airports, and 135 mineral acquisition sites. Over 7,000 employees attended the one-day orientation necessary for authorization to pass north through the Yukon River checkpoint; 3,596 employees (including cooks, drivers, and janitors) made up the on-site support force for the equally large construction crews (tradesmen and supervisors), all of whom were warned not to disturb any of the area's wildlife.19

Although Alyeska had exclusive use of the highway during pipeline construction, its ultimate ownership reverted to the state of Alaska. The haul road was begun at Livengood in May 1970 and was completed at Prudhoe Bay in September 1974 (see Appendix C). Because of complications and delays caused by competing interest groups (similar to those associated with all phases of construction), more than five years were required to design, gain approvals for, and complete a road that required only nine months of actual construction time. The road itself was divided into eight sections. Five
Table 6
DEVELOPMENT STATISTICS OF THE HAUL ROAD,
ALYESKA PIPELINE PROJECT, 1977

| I. Pieces of vehicular equipment       | 716 heavy | 2,054 total |
| Yukon River ice bridge                | 1,074 truck loads | 24,700 total tons |
| Hercules air cargo transport          | 2,448 plane loads | 47,736 total tons |
| Consumed fuel                        | 1,171 plane loads | 8,530,110 total gals. |
| Air operations                       | 708 per day ave. | 127,440 total |

| II. Lodging accommodations            | 3,600 road const. |
| Accumulated man hours                 | 3,077,000 to date | 4,391,000 (projected) |
| Employees                             | 3,596 n. of Yukon | 7,447 at orientation |

| III. Miles of road                    | 358 n. of Yukon |
| Bridges, permanent                    | 20 |
| Bridges, temporary                    | 19 |
| Bridges, LF                          | 3,462 | 32,457 pilings |
| Culverts                             | 83,417 LF | 1,029 total |
| Construction camps                    | 12 n. of Yukon |
| Airports                             | 7 cargo, 4 light | 11 total |
| Mineral material sites                | 135 open sites |
| Mineral extractions                   | 22,636,000 cu. yd. gravel | 31,612,000 ton |

construction contractors were assisted by seven Alaska Native contractors and regulated by at least fourteen government agencies, including eight federal agencies and six from the state of Alaska.

Within the first six-month time frame allowed by the traditional construction cycle, employees working on the haul road had to learn how to use the special arctic equipment, to understand the constantly changing land forms of Alaska (from Arctic desert to the highest mountains in North America) and soil characteristics, and to construct the road across pristine wilderness.

Coordinating construction was complicated because Alyeska's corporate headquarters was maintained in Anchorage, but actual haul road construction
headquarters were 355 miles (571 kms.) north, in Fairbanks. In addition, no connecting roads or normal communication links existed. Coordinating haul road construction was further complicated by arctic weather and atmospheric conditions. Specifically, changing arctic weather patterns often delayed delivery of airlifted workers, supplies and equipment to construction points. Arctic atmospheric conditions are among the strangest in the world. Communication by voice radio is unreliable at best. In sum, the normal supervision and control mediums for building the haul road, indeed all portions of the project upon which management relied, were crippled in their effectiveness by the size, geographic location, uniqueness, and complexity of the project.

Pipeline Construction

The scope of the Trans-Alaska Pipeline project is massive by any standard. The project is often described as the largest construction project undertaken by private industry in history. While such a claim is difficult to prove within the context of world history, it is probably fair to say that building the Alaska pipeline was the largest construction project undertaken by contemporary private industry. The scope is vast for each of the four parts of the project's construction plan. In comparison, the work associated with the pipeline itself was probably greater than the work associated with the other three parts of the project (haul road, pump stations, and marine terminal). Nearly 15,000 workers were assigned to pipe installation and related tasks during the summer peak in 1975 and 1976 (see Appendix D). The workers assigned to pipelaying jobs worked on clearing the right-of-way, laying a gravel pad to protect the environment from damage by heavy equipment, or installing the pipe itself.

The first 1,900 feet (579 meters) of pipeline was buried beneath the Tonsina River on March 27, 1975. Tractor-backhoes ditched the Tonsina to depths of 18 feet (5 meters) below the stream bed and up to 10 feet (3 meters) below the maximum scour depth of the river channel. Each 300-foot (90 meters) section of pipe was precoated with 9 inches (0.2286 meters) of concrete to combat the buoyancy of the empty line. The cement coating, which weighed 80,000 pounds per 40 feet (12 meters) of pipe, anchored the pipe in its burial ditch. Tractors with side-mounted booms picked up the sections of pipe in webbed slings, holding the pipe for welding of additional sections to each end until the 1,900-foot (579 meters) span was completed. As more pipe installation continued along the right-of-way, the realities of the Alaskan terrain began to cause engineering and design modification. Alyeska engineers had detailed the pipelaying work on a mile-by-mile basis from Prudhoe Bay to Valdez before construction began but these mile-by-mile plans had to be constantly changed. When crews drilled holes for vertical support members (VSM), for example, subsurface soil conditions often caused the pipeline to be moved from one side of the right-of-way to the other; or, more expensively for Alyeska, portions of the pipeline planned for burial had to be elevated to avoid harm to the permafrost. But despite design changes, actual pipelaying moved quickly.

Pipelaying activities forged ahead of other portions of the project during 1975 because pipe burial and installation did not require the extensive site preparation common to terminal and pump station construction. By 1977, however, pipelaying had slowed; three sections of the line were part
of the last construction completed on the entire project. First, glacial soils in the original burial route and avalanche danger at the 4,790-foot (1,460 meters) Atigun Pass in the Brooks Range led to several route and design changes. An 8-foot square (2 meters square), 6,000-foot long (1,829 meters) concrete box with the pipe inside in a 21-inch (53 cms.) thickness of styrofoam was built. This entire unit was then placed at a steep vertical angle along the side of the right-of-way crossing Atigun Pass.

At Keystone Canyon, Section 1, the pipeline had to be rerouted along the canyon's 4-mile (6 kms.) lip because the highway precluded laying pipe on the canyon floor. At first, tracked vehicles such as bulldozers pulled materials and equipment up the canyon walls, but the rock faces proved too steep for drilling crews. Heavy equipment and materials were disassembled, flown to the top of the canyon, and reassembled above the rock face. Helicopters airlifted crews and materials to one of four canyon-top staging areas where, when work resumed, portions of the pipe were laid along a 60 percent grade. At the 2,500-foot (762 meters) Thompson Pass, Section 1, crews were faced with several miles with 45° slopes. Since the pipeline route followed an almost vertical grade, heavy equipment was anchored to the slopes by cables -- in fact, the pipe itself was winched up the side of the pass with a cable tramway system. Welders lashed to the pipe to keep their footing worked the entire 1976 construction season to complete the job. Not surprisingly, the last portion of pipe to be laid was at Thompson Pass.

Construction of Marine Terminal and Pump Stations

Responsibility for the marine terminal in Valdez and the initial eight pump stations was contracted to Fluor Corporation on December 21, 1972 (see Appendix E). Fluor completed most major planning and design work for its two portions of the project by July 1974, although some engineering changes occurred as late as the summer of 1977. Fluor's management activities are distinguished from the rest of the pipeline project by a number of important characteristics. First, since much of Fluor's work was performed inside, crews worked all winter. Also, because crews worked year-round, work force levels tended to remain relatively small. Fluor used between 5,000 and 6,000 workers during the construction peak in the summers of 1975 and 1976. Fluor's construction crews were also relatively constant. For example, the construction crew at Pump Section 1, Prudhoe Bay, fluctuated between 270 and 430 workers between January and August 1976. Fluor management however, did find its tasks to be more complicated than on previous pipeline construction projects. Welding required extra ability because of the special chemistry of the low-temperature metallurgy. Unusual stress, snow loads, permafrost, earthquake safety requirements, and government monitoring stipulations combined to make the Alaska terminal facility and pump stations unique.

Fluor supervised the terminal construction separately from the pump station construction. The Fluor-managed portions of the project were described this way by H.M. Stemmer, publisher of the Pipeline Digest:

The terminal at Valdez is capable of loading four tankers simultaneously at four berths; a fifth berth will be added later. The berths will be able to accommodate tankers up to 250,000 dwt.
They can be loaded at the rate of 110,000 barrels per hour. Tanker turnaround time, including docking ballast discharge, loading, documentation and undocking, will be about 24 hours.

Storage will include eighteen tanks, fifteen for oil storage and three for ballast. The oil storage tanks are 250 feet in diameter and 62 feet high and have a capacity of 510,000 barrels. The ballast tanks are 450,000-barrel capacity.

Initially, the pipeline will have eight pump stations, each equipped with three turbine-driven centrifugal pumps. The turbines are 13,500-hp Cooper Industries' Coberas which can use either gas or oil as fuel. The turbines will be muffled to meet OSHA noise standards. The eight stations give the pipeline a capacity of 1,200,000 barrels per day, the goal for 1977. When (all twelve) stations are in place, the capacity will be 2,000,000 barrels per day.

Formal Organizational Structure

Private industry organized its formal structure (see Table 7) by centralizing responsibility and authority for all construction at the top of a management pyramid. That meant the relatively few firms at the top of the organization, such as Alyeska, supervised all portions of construction simultaneously. On the other hand, each of the myriad of firms at the middle and bottom levels of the organization only had limited responsibility and authority by contract for a portion of the haul road, the pipeline, the marine terminal, or the pump stations.

Alyeska Owner Companies

Eight firms who controlled the pipeline venture comprised the owners' committee. The owners retained direct responsibility for setting overall project policy, acquiring capital, and sharing profits or losses. Agreement on project policy by the owners was a common prerequisite for major construction decisions and action. For example, agreement between the owners was necessary before major contractual arrangements could be formalized by Alyeska, such as which construction management contractor (CMC) to hire. Contractual arrangements, however, were just one of hundreds of necessary policy-making decisions since almost every aspect of construction was touched by the owners. In short, since each owner company itself is a massively large employer in its own right (ARCO, for example, has about 55,000 employees), it was able to distribute some of its own employees across the entire project to gain valuable information for decision making. One of the more efficient information-gathering structures for owner decision making was the ad hoc subcommittee system by which technical and expert advice flowed up the chain of command from the subcommittees and Alyeska. Then, once policy was decided, the owners controlled the implementation process down the chain of command by allowing the ad hoc subcommittees to work with all levels of the organization.

The $8 billion U.S. capital needed to complete the project required the owner companies to join together on a larger scale than had ever before been attempted. None of the owners alone could easily provide the money or assume
Table 7
PROJECT ORGANIZATIONAL STRUCTURE, SUMMER 1974

Federal Regulatory Agencies
- Department of Interior
- Alaska Pipeline Office
- Bureau of Land Management
- Bureau of Mines
- Bureau of Sport Fisheries and Wildlife
- Environmental Protection Agency
- Coast Guard
- Army Corps of Engineers
- Equal Employment Opportunity Commission
- Office of Federal Contract Compliance

Alyeska Owner Companies
- Standard Oil Company of Ohio
- Atlantic Richfield
- Exxon
- British Petroleum (BP)
- Mobil Oil Corporation
- Union Oil Company of Calif.
- Phillips Petroleum Company
- Amerada Hess

State of Alaska Regulatory Agencies
- Department of Highways
- Office of the State Pipeline Coordinator
- Division of Lands
- Department of Fish and Game
- Department of Natural Resources
- Department of Environmental Conservation
- Human Rights Commission

Alyeska Pipeline and Service Company
- Project Management
  - E.L. Patton ...... President
  - C.R. Elder ...... Executive Vice-President
  - G.N. Nelson ...... Vice President-Project Administration
  - P.D. May ........... Vice President-Project Management
  - T.J. Nohodinos ...... Chief Project Manager
  - N.E. Bauer ...... Senior Project Manager
  - E.F. Boyd ...... Manager Field Technical Services

Construction Management Contractor
- Bechtel, Incorporated
- Fluor Corporation

Execution Contractors
- Morrison-Knudsen--Section 1
- Perini Arctic Associates--Section 2
- H.C. Price--Section 3
- Associated-Green--Section 4
- Arctic Construction--Sections 5 and 6

Alaska Native Contractors
- Mina Construction Co., Inc.
- Tundra Construction
- Wright’s Alaska Construction
- Alaska Federation of Natives
- Carlo Construction Co.
- Northern Development Enterprises, Ltd.
- Etc.
the debt needed to complete the project. By joining together with proportionate shares, however, the owners were able to diffuse the financial risk and assemble the necessary $8 billion. When the proportionate share of ownership was restructured in 1974, the project was estimated at $4.5 billion. Sohio's share of ownership was $1.5 billion, ARCO's $945 million, Exxon's $900 million, BP's $713 million, and other owners contributed lesser sums (see Table 8).²¹

<table>
<thead>
<tr>
<th>Company</th>
<th>Percentage After July 1974</th>
<th>Percentage Before July 1974</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sohio</td>
<td>33.33</td>
<td>28.08</td>
</tr>
<tr>
<td>ARCO</td>
<td>21.00</td>
<td>28.08</td>
</tr>
<tr>
<td>Exxon</td>
<td>20.00</td>
<td>25.52</td>
</tr>
<tr>
<td>BP (British Petroleum)</td>
<td>15.77</td>
<td>8.68</td>
</tr>
<tr>
<td>Mobil</td>
<td>5.00</td>
<td>3.32</td>
</tr>
<tr>
<td>Union of Calif.</td>
<td>1.66</td>
<td>3.32</td>
</tr>
<tr>
<td>Phillips</td>
<td>1.66</td>
<td>3.32</td>
</tr>
<tr>
<td>Amerada Hess</td>
<td>1.50</td>
<td>3.30</td>
</tr>
</tbody>
</table>

The distribution of potential profits or losses resulting from the venture was set at the same proportionate share as ownership. Predictions of net profits accruing to the owners through the year 2005 range from $44 billion (U.S.) to $98 billion, or between $1.8 and $4 billion annually.²² Upon close examination, the risk of loss from the project seemed remote because the owners are legally recognized and governed as common carriers, with the right to repay costs and make a reasonable profit, and the ability to shift potential risk of financial loss to consumers through price increases.

Nevertheless, the owners would face a potential financial loss if the oil proved unsalable on the world market, if the pipeline had not been completed for some unknown reason such as a massive earthquake, or if the pipeline were to cause damage to the environment (the cost of oil cleanup if the pipeline ruptured).

Alyeska Project Management

Since Alyeska Project Management (Alyeska) had responsibility and authority for construction, it implemented the policies set by the owners. Specific tasks performed by Alyeska to meet its vested responsibilities depended upon the stage of construction—from planning and engineering to building. When during planning, for example, several companies were
interested in becoming CMC, Alyeska reviewed their initial proposals and recommended to the owners which firms should be awarded contracts.

Alyeska's engineering tasks included the design of the pipeline (originally planned for burial over 90 percent of its length). The engineering team revised this original design almost continuously throughout the project so that at completion approximately 52 percent of the pipeline was buried. Alyeska's building task was to supervise the firms doing the actual construction. As project manager, Alyeska did not intend to supervise on-site construction; it intended to audit and insure fulfillment of contractual obligations by the CMCs.

Among the other responsibilities delegated to Alyeska were preparation, revision, and control of the project budget. Constant revisions were necessary in order to maintain control of the budget because it escalated from $900 million initially to $4.5 billion in 1974, to $6.5 billion in 1975, to $7 billion in 1976, and finally to nearly $8 billion in 1977. Estimates attribute approximately 50 percent of these budget revisions to inflationary pressure, 30 percent to environmental requirements, and 20 percent to other items such as design changes or changes in engineering standards imposed by reviewing government agencies.

In addition to those more usual management duties, Alyeska provided a focal point for extensive government regulatory activity. Government agencies found it easier to go directly to Alyeska rather than deal with each owner individually. Acting in this focal point capacity, Alyeska satisfied environmental protection regulations by providing a steady stream of reports concerning the impact of construction on the approximate 30,000 acres (12,141 hectares) of land disturbed by construction. Government agencies required Alyeska to make reports regarding erosion control, construction-related oil spillage, sewage treatment standards at the construction camps, fair employment commitments, and damage to wildlife, for example. The focal point role Alyeska played included responsibility for public relations, including hosting government officials inspecting pipeline progress.

Construction Management Contractors

The organizational structure placed two CMCs (who reported directly to Alyeska) at the same level and in direct control of on-site construction. CMC duties were divided: Bechtel was responsible for construction of the haul road and pipeline and Fluor was responsible for the pump stations and marine terminal. Each CMC was given decision-making latitude within the boundary of its specific tasks. However Alyeska and the owners expected the CMCs to develop transportation plans for equipment to the job site, to plan construction camps, to set up policies and procedures to be followed by the execution contractors (ECs), to establish an organization for on-site quality inspection, to determine a method for strengthening control over the ECs, and to set up a procurement organization to achieve cost savings by buying needed supplies and equipment in bulk. 23

The relationship between the CMCs and other members of the organization differed. On the one hand, Fluor worked in conjunction with Alyeska to design the pump stations and marine terminal. Accordingly, Fluor was
intimately familiar with the engineering aspects of its tasks. Since much of the engineering design directly supervised by Fluor was then built by its own subsidiary, Fluor Construction Company, rather than another EC, the transfer from design to finished product was much simpler on the Fluor-supervised portion of the project. In addition, Fluor's supervisory communication links were relatively simple because each of its tasks was centrally located. On the other hand, Bechtel did not work in conjunction with Alyeska to design the pipeline and haul road. Alyeska's engineering of both the pipeline and haul road left Bechtel to manage the actual building through a multitude of ECs. Since it was responsible for building the pipeline and haul road according to Alyeska's specifications, Bechtel unlike Fluor, began its duties without intimate familiarity with the engineering aspects of its tasks. Thus at first Bechtel could not supervise as closely the work being done by its ECs. Also unlike Fluor, Bechtel's supervisory communication links were relatively complex because its two tasks were spread out over 800 miles (1,287 kms.) of Alaskan wilderness. Bechtel's ability to supervise and control its portions of the project, therefore, was somewhat less manageable.

Impacted Organizational Structure

Top Management

As might be expected, the formal organizational structure as it was conceived when construction began in the summer of 1974 was heavily affected by both internal and external stresses caused by policy-making, financial-arranging, and risk-distributing decisions made by the owners. Even before the 1974 construction start-up, the eight owners disagreed about basic policy. For example, Bechtel, Arctic Contractors (Arctic), and Morrison-Knudsen Company, Inc. (Morrison-Knudsen) were being considered for the general project planning contract. ARCO supported Bechtel, but the other owners favored Arctic. Eventually, the general planning contract was modified and awarded to Arctic in August 1972. Because of this particular conflict (refusal to authorize formal arrangements with Bechtel) Bechtel would later find that it did not have adequate project planning time.

Policy disagreements sometimes led to insightful solutions to project problems. In many cases, if individual owners and their subcommittees felt that on a particular problem they had more expertise than Alyeska, Alyeska found itself being bypassed first by one and then another member of that top management. For instance, top management took over much of the procurement function originally assigned to the CMGs. Alyeska was directed to purchase directly for the ECs, buying supplies and equipment at substantially cheaper bulk rates.

Alyeska's Management Role

Alyeska's management role was modified greatly by top level management decisions. In practice, Alyeska's role became that of mediator among all the various management levels in the organization. As already suggested, the opinions of the owners, their ad hoc subcommittees, and Alyeska differed.
An example of differing opinions involved Peter DeMay, Alyeska's Vice President in charge of Project Management, who had primary responsibility for the construction preparations. DeMay requested immediate appointment of a planning contractor from the four under consideration: Bechtel, Arctic, Morrison-Knudsen, or an unidentified firm. DeMay felt that Alyeska did not have the expertise to handle both engineering and construction planning.

Based on bids and interviews submitted by each of the contractors, DeMay favored Bechtel because he felt Bechtel would be able to do some of the detailed design work; he felt they were a company with expertise in pipeline work, estimates, logistics, systems, control procedures, and reporting techniques. E.L. Patton, President of Alyeska, concurred. "We wanted to get the biggest and most experienced contractor on the project as soon as we could get him. And in DeMay's and my judgment that was Bechtel." But the Owners Construction Committee gave Alyeska a four-month period to reconsider the matter further. Then, at the end of that time in May 1972, both Patton and DeMay recommended Bechtel once again but the Committee continued to drag its feet. In June the Committee rejected Alyeska's less encompassing proposal of awarding Bechtel a limited planning contract. This less encompassing proposal had not authorized Bechtel to perform CMC tasks.

Finally in August 1972, Alyeska was authorized to negotiate a limited planning contract with Arctic. From the outset, DeMay doubted that Arctic could fulfill their principal contractual duties, review design, and make cost estimates for manpower and equipment needs. After five months, Arctic still had not allayed Alyeska's fears; in fact Arctic's performance of their quite limited pipeline planning tasks caused DeMay to request that Bechtel be brought in to replace Arctic and then be kept on as CMC. Alyeska's early concern with Arctic was perhaps well founded because Arctic was in command of Construction Zones 5 and 6 where project cost overruns were eventually extremely high.

Alyeska continued its pressure to bring Bechtel on board as the CMC without success for sometime. Eventually, however, the owners agreed to award the CMC contract to Bechtel. The owners' reluctance toward Bechtel proved to be as well founded as had Alyeska's early insights about Arctic. That is, "Alyeska's soon learned that Bechtel's performance ... was not the panacea for which Alyeska's management was hoping." In 1974 Bechtel struggled without success to develop the cost control systems desperately needed for a project of such complexity.

Alyeska's project management team as well as most of its entire internal organization was staffed by employees on loan from the owner companies. Employees carried the management philosophy and style associated with their individual owner companies. Consequently, a mixed organizational climate at Alyeska encompassed every approach to management from democratic to authoritarian; no particular management philosophy prevailed. In addition, Alyeska employees generally did not have a career-oriented commitment toward the firm.

Construction Management Contractors

The Construction Management Contractors modified the entire organizational structure often by altering their internal actions and relationships
in response to environmental factors. Mild setbacks commonly changed con-
struction plans, budget estimates, cost controls, and equipment delivery
schedules. For example, delay in the delivery of necessary equipment placed
construction behind planned time frames and meant contractors had to hire
more workers just to get back on schedule. More on-site supervision than
necessary to direct the expanded work force resulted in budget overruns.

In the summer of 1975 a setback occurred when, for the first time since
1897, the ice pack in the Arctic Ocean scarcely moved from the shoreline.
A fleet of 47 barges and 23 tugs stalled nearly 300 miles (483 kms.) from
Prudhoe Bay, waiting for the ice to recede during July and August. Ten
barges and several tugs finally got to Prudhoe Bay in early September, de-
spite hull damage. Seventeen more barges were able to reach Prudhoe Bay on
October 5. Nineteen barges had to return to Seward and Anchorage. Because
the CMCs and other contractors had to reorganize to have the 19 barges un-
loaded and their needed cargo shipped to Prudhoe Bay via rail and truck,
the trucking fleet was expanded and shipping costs increased.

The failure of the ice pack to recede was just one of many events which
put the CMCs' construction plan off schedule. By November 30, 1975, the
pipeline system was scheduled to be 43 percent completed, but according to
Fig. 17, the entire project was only 37.6 percent completed. Only the pipe-
line itself was considered on schedule (see Fig. 18). The contractors in
charge of camp housing, camp sewage facilities, and delivery of equipment
or supplies most seriously affected and changed the construction timetable,
because they most often had problems meeting their contractual obligations.
For example, difficulties evolved for contractors drilling the holes for
pipeline support members when the contractors supplying the drilling equip-
ment were unable to meet delivery dates.28

Public Agency Involvement

The responsibilities, functions, and formal organizational structure
of the public agencies who influenced project construction were determined
by a statute described by the Department of Interior:

The trans-Alaska oil pipeline system is being constructed
through 574 miles [924 kms.] of Federal lands, 188 miles [302 kms.]
of State lands, and 39 miles [63 kms.] of private land. Public
Law 93-153 directed the Secretary of the Interior to issue, admin-
ister, and enforce the right-of-way permit through Federal lands
and to issue regulations or stipulations for protection of the
environment. The Secretary and the permittee companies signed the
right-of-way agreement on January 23, 1974. The agreement included
the stipulations required by Public Law 93-153.

Also on January 23, 1974, the Secretary named the Department's
Authorized Officer and delegated to him responsibility for insur-
ing compliance with the terms, conditions, and stipulations of the
agreement. On January 30, 1974, the Governor of Alaska named the
State Pipeline Coordinator and assigned to him responsibility for
surveillance of pipeline construction on State lands to insure
protection of the environment. An agreement between the Department
Fig. 17. PERCENTAGE OF CONSTRUCTION COMPLETED AS OF NOVEMBER 30, 1975


Fig. 18. PIPELINE SYSTEM SUMMARY SCHEDULE

of the Interior and the State of Alaska provides that either the Authorized Officer or the State Pipeline Coordinator may issue orders to protect the physical integrity of the pipeline on State lands. The State right-of-way lease, issued on May 3, 1974, includes stipulations similar to those in the Federal right-of-way permit.

To insure compliance with the right-of-way agreement, the Authorized Officer reviews and approves the plans for construction, operation, maintenance and termination of the pipeline system and monitors implementation of Alyeska's quality assurance and quality control programs. To meet these responsibilities, the Secretary established a separate organization headed by the Authorized Officer ....

Public management was formally organized so that the federal authorizing officer, the state pipeline coordinator and the Joint Fish and Wildlife Advisory Team did most of the monitoring (see Table 9). These three agents with several others had the power to halt the project if construction activities violated the law. Staff of the public organization is statistically shown in Table 10. The largest number of employees overseeing construction worked for private industry because the authorized officer contracted with private industry for expertise regarding compliance with environmental and technical stipulations. According to the Table, project staff consisted of 64 management and administrative employees, 37 technical employees, and 83 field surveillance employees.

Construction contractors and crews were not allowed to work in the Alaska wilderness without a formal notice to proceed from the authorized officer. A notice to proceed was given by the authorized officer when, in his opinion, the construction plan and design conformed with the general, technical, and environmental requirements of the law. Table 11 shows the status of notices to proceed with the building of portions of the project as of September 30, 1975. Public management attempted to insure that construction was not unnecessarily delayed because of its review process. Agency workdays often extended beyond eight hours each and workweeks often extended beyond a normal five-day week. "The average time the Authorized Officer took to review the applications and issue the 230 Federal notices to proceed was about 70 days; the average time the state pipeline coordinator took for the 449 state notices was about 65 days."

The impact of the various government agencies on construction was profound. A case-in-point is the gravel pit at scenic Sukakpak Mountain in the Brooks Mountain Range. A.P. Rollins, the authorized officer, gave permission for construction crews to quarry rock from a gravel site on the lower slopes of the mountain before the Bureau of Land Management had approved the action. The gravel was extracted and used for construction of the haul road. After the pit had been opened and the road completed, the Bureau of Land Management rejected the permit because Sukakpak Mountain is considered to be one of the most scenic vistas along the pipeline route. Alyeska and the contractors were required to take steps to rehabilitate the gravel pit to its natural state—at great expense.
Table 9. ORGANIZATION OF THE INTERIOR'S ALASKA PIPELINE OFFICE DURING PIPELINE CONSTRUCTION

<table>
<thead>
<tr>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secretary of the Interior</td>
</tr>
<tr>
<td>Undersecretary of the Interior</td>
</tr>
<tr>
<td>Authorized Officer</td>
</tr>
<tr>
<td>State Pipeline Coordinator (dotted line)</td>
</tr>
<tr>
<td>Joint Fish and Wildlife Advisory Team</td>
</tr>
<tr>
<td>Administrative</td>
</tr>
<tr>
<td>Design Review (dotted line)</td>
</tr>
<tr>
<td>Technical Support Contractor</td>
</tr>
<tr>
<td>Construction Monitoring</td>
</tr>
<tr>
<td>Pipeline Expertise Subcontractor</td>
</tr>
<tr>
<td>Environmental Expertise Subcontractor</td>
</tr>
</tbody>
</table>

Table 10

STAFF OF PUBLIC AGENCIES

<table>
<thead>
<tr>
<th></th>
<th>Federal</th>
<th>State</th>
<th>Fish and Wildlife</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Authorized Officer</td>
<td>Contractor</td>
<td></td>
</tr>
<tr>
<td>Management and administration</td>
<td>23</td>
<td>19</td>
<td>13</td>
</tr>
<tr>
<td>Technical</td>
<td>9</td>
<td>13</td>
<td>4</td>
</tr>
<tr>
<td>Field surveillance</td>
<td>16</td>
<td>39</td>
<td>15</td>
</tr>
<tr>
<td>Total</td>
<td>48</td>
<td>71</td>
<td>32</td>
</tr>
</tbody>
</table>


Table 11

STATUS OF NOTICES TO PROCEED, SEPTEMBER 30, 1975

<table>
<thead>
<tr>
<th>Status</th>
<th>Federal</th>
<th>State</th>
<th>Both</th>
<th>Percentage of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Issued</td>
<td>230</td>
<td>449</td>
<td>679</td>
<td>96</td>
</tr>
<tr>
<td>In process</td>
<td>7</td>
<td>24</td>
<td>31</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>237</td>
<td>473</td>
<td>710</td>
<td>100</td>
</tr>
</tbody>
</table>

Private Management Supervision and Control

Whether or not private management's bureaucratic machinery was as effective as reasonably possible in its efforts to supervise and control pipeline construction has been documented and debated since the project was first conceived. The threshold issue is whether future projects of this sort can overcome the pitfalls experienced by management in this particular project. Naturally some disputes erupted at the upper levels of the organization as management sorted out responsibilities and relationships. One example is when Alyeska criticized Bechtel for hiring too many people after Bechtel requested additional money to hire more people to correct alleged Alyeska errors. In other instances, however, sound judgment saved the day. When construction began, for example, management determined that the isolated nature of the construction camps and the basic integrity of the average worker precluded the necessity of an elaborate system to protect supplies and equipment from pilferage. However as the project evolved, large amounts of supplies and equipment could not be found. Management had to change its basic assumption concerning the isolated nature of the construction camps so Alyeska reorganized and tightened its security network.

Three of management's highest priority concerns were to meet the compressed time schedule each construction season and to achieve maximum labor productivity and quality control. Oil could not begin to flow uninterrupted toward the market in the summer of 1977 unless the time schedule was met, labor productivity was high, and the pipeline did not leak. Thus, in light of its earlier experiences, Alyeska lost little time in reducing its reliance on Arctic and sending in-house management to Section 5 when productivity on that section dropped, costs soared, and construction fell behind schedule.32

Alyeska's takeover of Arctic's work on Section 5 began in the spring of 1975. Alyeska observed that Arctic's crews often sat idle for substantial periods of time and that employee-hours expended by Arctic were increasing. At the same time, other EC's experienced decreases in employee-hours of work. Alyeska's time schedule warning system indicated that, since Arctic was seriously behind schedule, the entire pipeline project was behind schedule. Alyeska found that Arctic had insufficient management strength and depth at the middle and upper levels of the organization. This was evidenced by attitudes bordering on complacency, on poor planning, and on lack of goals and direction.33 After having worked in good faith with Arctic for one and a half years, Alyeska convinced the owners of what it had felt to be the case for over five years—that Arctic could not adequately supervise its portion of the project. Alyeska took over most of the on-scene supervision of construction in Sections 5 and 6.

Bechtel's duties as CMC for the haul road and pipeline were reduced in May 1975. Because of the owners' original delay in naming Bechtel as CMC and because of Alyeska's reliance on Bechtel for materials control, equipment logistics, and spare parts, Alyeska was unprepared for the 1975 construction season:

By the end of Bechtel's first year on the project, Alyeska realized that it should not have relied so heavily upon Bechtel to develop project controls.
This realization was documented in a memorandum to Alyeska's President Patton.

It appears rather obvious that Bechtel has failed to perform effectively in a number of major categories in which they definitely represented existing capability at the time of contract negotiation and award. The primary areas where they obviously failed to measure up seem to be in the very critical support services such as contracting, purchasing, systems support, transportation and logistics coordination, cost control and possibly estimating.

The memorandum went on to explain that:

while [it] is recognized that the complexity of the Project and other factors may have impacted on Bechtel's ability to delivery ... it is our opinion that one of the primary causes has been Bechtel's inability to assign adequately trained professional staff and construction talent to the Project that have in-depth construction management experience using proven systems and methods that are readily adaptable and suitable for use on TAPS.34

Alyeska felt that even though more than $5 billion had been committed on the project, successful project completion required significant change in the organizational structure. After 1975 Alyeska worked directly with the contractors in Sections 5 and 6, with Arctic forced to give way to Alyeska supervision. Bechtel became Project Services Contractor responsible for a greatly reduced number of tasks. Moving in for Bechtel, Alyeska began working directly with the ECs building the pipeline and working on the haul road. Alyeska's reorganization effort, shown in Table 12, resulted in the elimination of one entire level of management. That is, Alyeska management supervised the ECs directly.

Public Management Supervision and Control

The effectiveness of public management's efforts to supervise and control construction also has been documented and debated since the project began. Public management encouraged the pipeline builders to work as economically as possible since the costs of construction would be passed on to consumers. One way public supervision hoped to reduce the number of dollars spent on pipeline construction was by imposing high quality standards. These construction quality and cost standards were used for different purposes by different public managers, however, so that any interpretation of government construction requirements was unreliable. Further, since different supervisors reviewed the project at different times, the environmental and technical constraints applying to oil spills, dust, stream siltation, and wildlife depended on whether the public manager was observing road construction, pipeline construction, pump station construction, or marine terminal construction.35 One opinion of the result of government regulation and fluctuating standards already noted was that public supervision placed "inestimable but unquestionably massive and unexpected costs upon the private corporations that undertook construction of this pipeline."36

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Table 12. REVISED ORGANIZATIONAL STRUCTURE, SUMMER 1975

Alepada Hess Corporation
ARCO Pipe Line Company
Sohio Pipe Line Company
Exxon Pipeline Company
Mobil Alaska Pipeline Company
Phillips Petroleum Company
Union Alaska Pipeline Company
BP Pipelines, Inc.
(owners)

Alyeska Pipeline Service Company
/designer and builder, including quality assurance/

Management contractor for pump stations and terminal including quality control

Project Services Contractor for pipelines and roads including quality control

Execution Contractors

Execution contractors for pipeline and roads

As will be shown, there is little doubt that public management's efforts resulted in some very positive changes in both construction design and actual building. However, with the positive changes also came bureaucratic confusion, replete with conflicting goals and duplication. Public management added yet another level of complexity to an already difficult task. None of these agencies had full jurisdiction over noncompliance standards nor is this a complete list of government regulatory agencies impacting construction:

1. The Alaska Pipeline Office (APO): the federal agency under the Interior Department which was responsible for enforcing the right-of-way agreement on federal land—about 68 percent of the pipeline route.

2. The State Pipeline Coordinator's Office (SPCO): the state agency with responsibility for enforcing right-of-way lease stipulations on state land, which included about 32 percent of the project.

3. The U.S. Environmental Protection Agency: the federal agency with statutory authority to protect navigable waters from oil pollution.

4. The Joint State-Federal Fish and Wildlife Advisory Team (JFWAT): a combined federal and state unit that advised the APO and SPCO concerning protection of fish and wildlife. The unit included Marine Fisheries Service, and the state Department of Fish and Game.

5. The Alaska Department of Environmental Conservation (DEC): the state agency with statutory authority to protect the environment from oil pollution.

6. The Alaska Department of Labor (ADL): the state agency empowered to protect worker safety, whose authority also included control over storage of flammable liquids.

Pilferage

Although newspapers and other media covering the project often documented stories of pilferage by construction workers, the accuracy of that coverage is not easily discernible since different newspapers carried conflicting reports regarding the same events. Apparently the major Alaska newspapers, such as the Anchorage Times, tended to de-emphasize reports of theft while other newspapers, such as the Los Angeles Times, tended to emphasize them. Undoubtedly pilferage did occur. It is perhaps coincidental, for example, but nevertheless a documented fact that, when inspection of outgoing camp mail was instituted by Alyeska, construction camp employee mailings dropped 75 percent. This mail inspection was part of the general policy change installed by Alyeska after its earlier lack of security controls proved too costly.

That general policy change also included Alyeska's tightened security over inventory and camp buildings after the first year and a half of construction.
Controls such as ID's and authorization signatures, [had not been] utilized. Large warehouses and other areas were often unfenced and unguarded ... Expensive tools [had been] left unmarked.  

Mel Personnett, the pipeline's first security chief, cited great resentment and resistance by upper management towards strict security measures as his reason for leaving. However, Robert Sundberg, Personnett's replacement and a former Fairbanks chief of police, felt that paperwork was a "relatively loose procedure" for awhile.

Alyeska officials worried at the beginning of the project that security and inventory measures would slow down pipeline construction and that such measures--baggage inspection, for example--might anger workers. Embarrassed by hundreds of stories of theft and waste and also by Personnett's resignation, Alyeska gave Sundberg some leeway to do his job.

Sundberg related one mid-1976 incident when a guard spotted a yellow stick hammered in the ground beyond the gate where he was stationed. For some reason the guard became suspicious and started digging where the stick was marked. He uncovered a $2,000 hydraulic ram jack used for lifting equipment weighing up to 150 tons. To Sundberg, this illustrated "the devious measures some will take to thieve." He added "... Things are being lifted all over."  

Materials Procurement

Incidents of large-scale procurement of unsuitable materials and equipment occurred. In 1974 everyone hurried to begin work because of the compressed Alaska construction season. Because of this rush to begin, adequate testing procedures for untried equipment were not established. In addition, a substantial amount of expensive untried equipment was purchased early in the project which later had to be discarded. In one case a dozen Radmark backfill units were purchased without being tested under arctic environmental conditions. Use of the Radmark units was eventually discontinued because they were too slow, cumbersome, and prone to breakdowns.

The compressed construction cycle forced contractors to purchase more equipment than was originally estimated and delivery times were often too late to support the construction schedule. Distance between construction crews spread along the 800-mile route of the pipeline also contributed to equipment duplication. Poor documentation of materials and equipment location simply meant more of the same items had to be acquired. Additionally, poor documentation created the possibility of paying for the same equipment more than once--in fact, equipment costs may have been compounded not only by instances of duplicate purchases but also of duplicate payment.

Inventory Control

Alyeska has been cited for having had neither an effective inventory control system nor adequate warehouse space at the construction camps. One of the more significant lessons regarding inventory control was the recognition of the need for more warehousing. Materials and equipment were
stored outside at the construction camps or placed at construction location points for eventual use by crews. When winter weather began, materials and equipment were occasionally lost in the winter ice and snow. Construction crews working in the winter then reordered missing materials and equipment, only to find the original equipment when the snow melted. The cost of equipment lost, repurchased, and found again in the spring was significant. Expense because of contractors' often incomplete, inaccurate, and inadequate invoices was probably equally significant.

Since items worth less than $500 were not inventoried, it was possible for contractors who needed items worth less than $500 to repurchase materials already laying unused in warehousing areas. In addition, those small-cost items not specified in the inventory could be pilfered. Union leaders, such as Jesse Carr of the Alaska Teamsters, advised Alyeska to tighten the inventory control system.

Food Catering

The cost of food at the construction camps was more than double the original estimate. Specifically, the cost of camp and food catering was estimated at $204.2 million at the project's beginning in May 1974. When the last season of construction began in April 1977, food costs already increased 181 percent to $574.2 million. Most of this increase in food costs can be attributed to the expanded size of the labor force. However, some food costs increased unnecessarily.

Food cost controls were organized and implemented during the early phases of construction. Menu composition at the construction camps was satisfactory during the entire project by most standards, but at the beginning of construction, it was not uncommon to eat steak and lobster at dinner. Food cost controls quickly curtailed steak and lobster, but other expense problems persisted throughout the period of construction. The number of employees at each construction camp varied within the same day as well as between days. Therefore, since in many instances, worker head counts were incorrect, a great deal of unnecessary food was ordered, prepared, and not eaten. Another nagging cost was the number of unauthorized consumers eating meals. Many contractors moved up and down the line doing a variety of jobs in support of the construction crews. Many of these support service contractors melted in with the construction crews at meal time without permission, without paying for their meals. Management was never able to completely check this unauthorized practice.

Valdez Marine Terminal

The cost of construction at the terminal in Valdez rose exponentially, indicating a degree of mismanagement. The construction camp facility at Valdez limited the size of the work force because contractors who planned terminal construction had built the camp facility according to their estimates of necessary work force. The scope of the work at Valdez was increased when unexpected engineering problems necessitated quarrying 4.5 million more cubic yards of rock than anticipated. The camp facility would not accommodate the larger work force required to overcome this unplanned emergency so
the normal construction season was extended. Some Valdez contractors had to work into the more expensive colder months to finish their portion of the project in time for the arrival of the following construction season.

**Wage Payments**

Documented instances of lower salaries for white-collar management than for blue-collar employees they supervised made non-union supervisory jobs appear less desirable. Many better workers simply refused to assume supervisory tasks because additional responsibility could result in lower pay. Not surprisingly, the competency of first line supervision was potentially hindered. Workers willing to take on supervisory tasks were often inexperienced. Many supervisors lacked knowledge about how to deal with special weather conditions in Alaska, how to apply the work standards specified by upper management, how to build according to the technical specifications required by project engineering, and how to apply normal supervisory techniques commonly known to middle-level management.

Paychecks constituted the second category of wage payment problems. Paychecks were often distorted. Some workers received paychecks for as much as 168 hours per week (7 consecutive 24-hour days). Because of payroll system breakdowns during the last three months of 1976, eighteen workers were paid for working more than 143 hours in a single week and three workers were paid for a workweek of 168 hours.45

**Productivity Calculations**

Statistics of the actual increase in construction costs assignable to low labor productivity depends upon who computes the figures. Clearly, however, low labor productivity could have increased the cost of building the Alaska pipeline by as much as $1 billion.

The basic concept of productivity is to compare physical progress achieved to man-hours expended. Consequently, one way to measure productivity is to divide budgeted or projected man-hours per unit of progress by actual man-hours per unit of progress. Another method is to adjust budgeted man-hours by physical percent complete and divide it by actual man-hours expended. Both of these methods were used by Alyeska. Thus, for example, if labor productivity was .5, twice as much labor was being expended per unit of progress than had been projected. Similarly, if productivity was .1, then ten times the expected number of man-hours was being expended.

Productivity for direct execution contractor (EC) pipeline labor judged against the May, 1975 estimate indicates a productivity rating of only .57 for all pipeline sections. In early 1976, Alyeska re-estimated projected man-hour expenditures for the 1975 experience. [The] 1976 labor productivity computations are therefore based on substantially increased man-hour budget projections. Despite such modifications, the contractor's direct labor productivity on the
pipeline (cumulative through November, 1976) was ... 69; that is, it took approximately 1.45 times as many man-hours as projected (based on at least one year's TAPS construction experience) to achieve one unit of work on the pipeline. In fact, that rating is based on a man-hour budget that was periodically revised throughout 1976. Thus, included in the .69 rating is labor performance judged against man-hour projections which were modified on the basis of from one to two years' construction experience and analysis.

Certain individual construction activities had ratings which demonstrate ... inefficiencies even under the revised 1976 estimate. Some activities, such as "work area rehabilitation" in Section 3 had cumulative ratings as low as .19; that is, it took more than five times the man-hours to complete a unit of work than had been anticipated in previous budgets. In Section 5, it took nearly four times as long to elevate aboveground pipe than budgeted. This led to a forecasted man-hour overrun of over 143,000 man-hours in that section alone. A similar productivity rating for elevating pipe in Section 3 produced an overrun of nearly 217,000 man-hours. During a three-month period in the summer of 1976, Alyeska's Field Labor Detail Reports (FLDR) show that 74,938 direct man-hours were expended on Activity Code 7000, fuel line work; for the same period, the Reports record zero progress in linear feet.46

Explaining and interpreting the productivity figures developed by Lenzner and shown in Table 13 must be done with care. First, much of the low productivity levels in Section 5 results from its geographic location. Any topographical map of Alaska shows that Section 5 traverses the Brooks Mountain Range. The difficult terrain in Section 5 must be taken into account when work done there is compared to work done on the rest of the pipeline. The work on Section 5 is comparable with work done in the middle of the 19th century on America's transcontinental railroad. The construction crews laying track across the western mountain ranges moved slower than crews laying track across the flat plains. Section 5 crews found their work tougher and slower than crews in the relatively flat parts of Alaska. Management found each mile of work done in Section 5 to be more expensive than construction done in the relatively flat areas. Perhaps the miracle of all is that Section 5 was finished.

Much of the escalated construction costs resulted from lower worker productivity, but some employee-hour losses can be attributed to engineering design changes made whenever the unfamiliar arctic environment was better understood. Although they are standard practice in pipeline projects and normally not a problem, design changes were difficult to transmit to construction crews and difficult to implement because distances and transportation in the far north magnified problems. Sometimes more costly delays occurred because workers had to idly wait to receive drawings and materials. Waiting for design change blueprints to arrive increased both the labor required to complete the work and the need to buy more materials and equipment to meet compressed time frames once the blueprints did arrive.
Table 13
LABOR PRODUCTIVITY, 1975 AND 1976

Part A. Labor Productivity Comparison

<table>
<thead>
<tr>
<th>P/L Section</th>
<th>1975 (a)</th>
<th>1976 (b)</th>
<th>Cumulative Thru 11-28-76 (c)</th>
<th>1975 (d)</th>
<th>1976 (e)</th>
<th>Cumulative Thru 11-28-76 (f)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.83</td>
<td>.55</td>
<td>.67</td>
<td>47,600</td>
<td>115,200</td>
<td>72,200</td>
</tr>
<tr>
<td>2</td>
<td>.72</td>
<td>.70</td>
<td>.71</td>
<td>49,300</td>
<td>68,900</td>
<td>59,000</td>
</tr>
<tr>
<td>3</td>
<td>.88</td>
<td>.70</td>
<td>.78</td>
<td>41,800</td>
<td>62,300</td>
<td>51,100</td>
</tr>
<tr>
<td>4</td>
<td>.84</td>
<td>.61</td>
<td>.71</td>
<td>34,300</td>
<td>67,900</td>
<td>47,300</td>
</tr>
<tr>
<td>5</td>
<td>.78</td>
<td>.54</td>
<td>.62</td>
<td>66,000</td>
<td>156,700</td>
<td>105,000</td>
</tr>
<tr>
<td>Total</td>
<td>.80</td>
<td>.61</td>
<td>.69</td>
<td>239,000</td>
<td>471,000</td>
<td>334,600</td>
</tr>
</tbody>
</table>

(b) = Sample computation given in Part B.
(c) = From Project Control Report dated December 16, 1976, p. 10.
(d), (e), (f) = Computed from data contained in the January 15, 1976 and December 16, 1976 Project Control Reports. Direct employee hours expended divided by physical percentage complete.

Part B. Sample Computation of Productivity

<table>
<thead>
<tr>
<th>Year</th>
<th>Actual Direct Employee Hours + Expenditures (000)</th>
<th>Budget (000)</th>
<th>Productivity*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975</td>
<td>3,003.4</td>
<td>2,492.8</td>
<td>.83</td>
</tr>
<tr>
<td>1976</td>
<td>4,169.7</td>
<td>2,313.1</td>
<td>.55</td>
</tr>
<tr>
<td>Cumulative</td>
<td>7,173.1</td>
<td>4,805.9</td>
<td>.67</td>
</tr>
</tbody>
</table>

Note: The Project Control Reports provide data on actual employee hours expended and productivity for 1975 and cumulative through November 28, 1976. Cumulative Budget, or performance at 100% productivity, is obtained by multiplying .67 x 7,173.1. 4,805.9 represents what should have been spent at 100% productivity. The same computation is made to arrive at the 1975 Budget (for 1975 work only) of 2,492.8. A 1976 Budget (isolated from 1975) is the difference between cumulative and 1975. And 1976 productivity is 1976 Budget divided by 1976 Actual, or .55. To check to see if this figure is reasonable, an average of 1975 and 1976 productivity, weighted by direct employee hours expended, is computed as follows:

\[
\frac{3,003.4 \times .83 + 4,169.7 \times .55}{7,173.1} = .67
\]

approximately equal to .67 shown on the Project Control Reports.

†1975 through December 28, 1975.
‡Total less 1975 for "Actual" and "Budget."
§Cumulative through November 28, 1976.


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Alaskan Weather

Perhaps the best explanation attributes low labor productivity to the special working conditions in Alaska. Before the pipeline project was undertaken, only Alaskan Natives and a handful of Alaskans knew about the special attention and significance that had to be paid to arctic weather. Two Alaskans describe the impact of Alaskan weather on workers and machines:

In different parts of the country, when people think of "really cold" they all think of different temperatures. In the midwest it might be zero, in Minnesota forty below, in northern California thirty degrees. In the northern two-thirds of Alaska the magic number is sixty below zero. Sixty below is about the coldest it will get for an extended period of time, say two or three weeks. It may occasionally dip to sixty-five or seventy below, but you don't worry so much about that. When you're engineering a house you think in terms of keeping it warm at sixty below; if it'll stay warm at that temperature you're pretty well set. When you buy a parka that's really more expensive than you wanted, the clerk assures you, "You'll be glad you have it when it's sixty below." When you put antifreeze in your radiator, you keep adding it until the bubble floats at sixty below. Minus sixty is a very important temperature.

To someone who hasn't experienced extreme cold, forty below is cold, and so is minus sixty. But to someone who has worked outside at both temperatures, there is a world of difference. I'll take forty below any day. If forty is cold, sixty is downright mean. Animals other than humans have sense enough to stay home at that temperature. A Husky curls up with his tail over his nose and waits it out. Bears are in hibernation. The caribou and moose have headed for the high country. Surprisingly, the higher the altitude, the warmer it gets, at about one degree per hundred feet. Up in the mountains it will rarely get more than thirty below. That's where the moose spend the winter.

At sixty below you run into difficulties in breathing. You can actually frostbite your lungs by pumping too much cold air into them. Your throat can suffer the same malady. Part of the job of the sweeping hood and ruff of the Eskimo parka is to circumvent this problem. You walk about with a little tunnel in front of your face and produce a warm air pocket. In this way you keep your nose and cheekbones, the two most likely areas to frostbite, from freezing.

But it is more complicated than that. When it's that cold, you absolutely have to keep moving in order to maintain body heat. You can't stand around at sixty below. If you must stay in one place, you have to dance, jump up and down, flap your arms, shiver a little, wiggle your toes and fingers, keep everything in motion. That sounds tiring, but not impossible. But there's a catch. You can't move too much. If you get too hot, you sweat, and if you sweat, you freeze. You've got to move easily, just enough to keep warm, but not enough to perspire. The clothes that keep you warm
do their job because they are dry; down is almost completely useless when it gets wet, and while wool retains some insulating value, it hasn't got enough for sixty below.

Even the toughest bushwhackers and mountain men are susceptible to frostbite. It's a chance you take when you live in the wilds; if you happen to fall through the ice of a creek or have some kind of accident, you might get frostbite. But on the pipeline it usually happens through carelessness, through not being aware, through getting excited and insisting that the job must be done, no matter what. It's a lot of trouble to wear all the necessary protective gear, but if you try to substitute gloves for mittens at fifty below, you get stung, as a foreman of mine did, his first day on the job, while grabbing a piece of pipe. Often, the accidents happen soon after a man gets on the job. He wants to make a good showing, and he runs outside without his mittens, or without a ski mask, or with wet or untested boots, and within a few hours he's in the hospital. You have simply got to take care of yourself, especially if you haven't had much experience in cold weather. As you learn more you can cheat a little and get away with it, but by then you've outgrown the macho "I'm tougher than the winter is cold" bullshit. When it's seriously cold a good foreman won't push you, and if you want to keep all your fingers and toes, you won't let him. A Louisiana foreman who sits in his pickup all day long will sometimes try to make a crew live dangerously in cold weather, but he won't get very far.

But more often the problem is the exact opposite. The crew never learns to work in the cold at all. I account myself lucky that my first winter in the north I had a job that kept me outside all day long. I had to be out there, no matter what the weather. And then on the weekends I'd set out on foot to visit some friends who lived in a cabin ten miles out in the bush. I started in the fall and continued this all through the winter, never missing a day of work and never missing a weekend walk. As the days got colder and shorter I learned to cope with them, got the feel of the weather so that I could tell the temperature within ten degrees without a thermometer, learned how to dress, what to eat, and was able to experiment. I learned how to stay outside for long periods of time in extreme weather and without being uncomfortable.

On the pipeline it's a different matter. The strategy is not to get in tune with the cold, but to avoid it altogether. The idea is not to admit that this pipeline is being built in Alaska and get used to it, but to bring a little chunk of the lower 48 along. And so the camps are overheated trailer houses, the warm-up shacks are poorly insulated buildings heated with oversized stoves, and the philosophy is "stay warm."

And so the fifteen-minute policy comes into play. Fifteen minutes working, and fifteen in the shack. Those fifteen minutes outside don't give you time to get warmed up. It is merely a matter of getting colder and colder and then running back inside to get warmed up. In my experience it's the first hour outside that's the worst. If you stay outside an hour, and keep moving you've got it made. Then you can stay out all day.
The other emphasizes the effect of the cold on machines.

The cold is as tough on machines as it is on humans. Machinery can be the more sensitive ... While workers have stayed on the job at temperatures as low as minus 50 degrees, machines usually have to be shut down at minus 30 degrees. That was the "magic number" for the contractors since engineers found that metal fatigue becomes a severe problem at minus 30 degrees.

Preparations for such conditions were made well ahead of time. Vehicles were winterized and standard lubricants were replaced with arctic oils.

All through the winter most light vehicles were kept idling when not in use. If the engines were stopped, circulating tank heaters were plugged into outlets to prevent freeze-up of the vehicle's cooling system. Sometimes a battery heater was added along with deflection flaps to lessen the amount of cold air reaching the engine.

Major troubles arose when heavy equipment was allowed to shut down during the cold weather. Starting up again was a painstaking process. If the oil was too cold to flow, the crankcase was warmed with a heater in a process that might take four hours or two days, depending on the cold.

The job was only half done when the engine was warm enough to start. Cold hydraulic systems had to be brought into operation slowly. At temperatures of minus 45 degrees or so, steel and rubber can shatter like crystal. The operator therefore had to "exercise" his machine very slowly.48

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**Labor Management Considerations**

**The Labor Contract**

The Project Labor Agreement (PLA) between Alyeska and the major unions executed on April 29, 1974 covered wages, hours, and conditions of work. The PLA was supplemented by an agreement with the Pipeline Contractors Association. Final approval and interpretation of contract terms by management rested with Alyeska, contrary to the desires of Bechtel and Fluor. The prevailing wage rates in other Alaska contracts served as a basis for negotiating a pay settlement that averaged 25 percent to 30 percent above most pipeline-related work in the "lower 48" states. This settlement set the average pipeline worker's wages at about $50,000 per year.

The wage settlement also resulted from management's desire to obtain a no-strike provision. In the PLA no strike, slowdown, lockout, or interruption of work occurred. Alyeska's labor relations advisors felt that a no-strike provision was mandatory because the costs of even a very short strike would be extremely high. In the event of a "wildcat" strike, Alyeska retained the right to court suit, which it wisely used sparingly. While most disputes ended without strike, available evidence documents 15 separate
work stoppages between April 29, 1974 and the end of 1976. Work stoppages, when they did occur, were short but expensive. Alyeska estimated, for example, that a two-day interruption in Section 1 during August 1975 cost approximately $1.37 million. Inadequate handling of grievances, jurisdictional disputes, vast distances between individuals with authority to settle disagreements, normal inconsistencies in interpretation of contract language, and confusion of authority between all levels of management—public and private—appear to be among the major contributing factors to labor unrest during the pipeline project.

Employment Legislation

Federal and state civil rights legislation meant employment decisions regarding the project had to be made without discrimination on the basis of race, color, religion, sex, age, or physical handicap. The so-called "Alaska Hire Law" was another piece of legislation that affected employment. Under this provision Alaskans would have priority for pipeline employment over other American citizens. Although the law was not specifically aimed at minority groups and was found illegal in 1978, the Alaska Hire Law encouraged pipeline employment of minority group workers. Hanrahan and Gruenstein give one illustration of the general effect of employment legislation and an ensuing suit involves the Alaska Teamsters, Local 959:

As a former Teamster and a Native, Roy Huhndorf, president of Cook Inlet Region, Inc., one of the Native regional corporations, is not anti-union. But he noted to us that many Natives have felt the sting of Teamster discrimination and may not look kindly on future efforts by Local 959 to organize workers at Native-owned businesses. "I hesitate to say this," Huhndorf said, "but I foresee that a greater degree of confrontation will occur between the Teamsters Union and the Native-owned business ... The unions have not been friends of the Native people ... There's no great degree of love lost between them. It's hard to forget those types of injustices." Other natives cited examples of what they considered to be continuing discriminatory practices by the Teamsters. One college-educated Native told us how, on the basis of a written test, he was told by Teamster officials that he was unqualified for a pipeline job. When he appealed that decision to a higher union official, he said, the official began going back over his paper; the official found several places where the test corrector had awarded too few points and his score was boosted up to a passing grade. "I'm convinced that the reason I passed was because I complained," the Native said. "My complaining about my score showed the Teamsters that I might file charges of discrimination against them. So they gave me a passing grade just so they wouldn't make more trouble for themselves. But it made me wonder how many other Natives there were who deserved to pass but who didn't go and complain."

After great resistance by the Teamsters—which resulted in a successful discrimination suit filed by Alaska Legal Services—Alaska Natives were eventually hired for the pipeline project in greater numbers that had been foreseen by state and federal agencies and even Native leaders. The Alaska Federation of Natives in late 1976 reported:
"Coordinating its efforts with those of state, federal and local Native organizations, the AFN, Inc. Manpower Division was successful in locating jobs and training positions for well over 6,000 Alaska Natives during the two peak years of construction, 1975, 1976."

Approximately 10 percent of the pipeline labor force consisted of women, who performed nearly every manner of field job imaginable. Despite some documented instances of discrimination by male foremen about what kind of work women could or should perform, one of the broader benefits of the project was the acceptance of both sexes in the field work force. Essentially, no attempt was made to separate men and women, except in room accommodations. The net result of the slightly mixed work force was a realization that the work was indeed not too hard for women to perform. The operation of unwritten traditions in the construction trade protects all employees from doing work that is too hard, including women workers: if you cannot do the job, you do not have to. Therefore some women and other workers did not lift heavy weights or pack difficult loads. Further, the use of mechanized equipment on the project reinforced a lesson learned during World War II: women and men are equally able to push buttons and drive equipment with power steering and automatic transmissions.

Quality Control

Checks and Reviews

Private management organized its quality control checking activity into two functional areas. The CMCs were responsible for day-to-day field inspection of all work. Alyeska monitored and evaluated the CMCs' quality inspection efforts by random spot checks and audits designed to assure overall project quality. Alyeska instituted a bonus plan tied to quality and cost savings as an incentive for contractors to comply with project quality standards as well as to hold down costs. Private management had sole responsibility for checking and meeting construction quality standards but not the sole charge of administering the quality control program. Public management assumed the right to approve the quality of construction. Public inspectors reviewed everything, looking for substandard construction quality that might hurt the environment. One troubling concern was the report of the staff of the Energy and Power Subcommittee of the House Interstate and Foreign Commerce Committee which stated that once oil began to flow, Alyeska's detection system was so unsophisticated that up to 500 barrels of oil per day could leak unnoticed. Other evaluations of the detection system alleged that faulty welds would allow up to 1,700 barrels a day to leak undetected.

Field Inspection of Welds

Ketchbaw Industries (Ketchbaw) contracted for field inspection of pipe welds south of the Yukon River. Exam Company (Exam) inspected the welds north of the river. Pipe weld x-ray equipment was developed specifically for the Alaska construction environment. The goal of Ketchbaw and Exam
inspectors was to x-ray all pipeline girth welds on the same day they were completed. Welding x-ray and inspection crews were scheduled to remain within one-half mile of the welding crews so that flaws could be corrected with a minimum of backtracking. Unfortunately, the special x-ray equipment did not function properly at first and the x-ray crews fell up to five miles behind welding crews, causing costly pipe laying delays. In an effort to catch up with welding crews and move back on schedule, Ketchbaw apparently began to falsify its x-ray plates. A congressional investigation of Ketchbaw's illegally falsified x-rays drew national attention to Alaska.53

Weld rejections ranged to nearly 100 percent at the onset of welding operations. The overall project weld reject rate was 30 percent while reject rates for previous major projects averaged between 6 percent and 10 percent. Several factors explain the project's welding record. First, inspection was thorough and many inconsequential defects were found that normally would have been overlooked. Additionally, the oversized pipe required larger welds, increasing the chance of numerous hairline defects. Second, welders were dispatched to the field without adequate proof of their ability to produce high quality welds. Third, lack of welding certification inspectors caused serious delay so that inspection crews worked far behind welding crews. When a defect emerged, welding crews had to retrace their work for miles to make the necessary repairs.54

Finally, and perhaps most significantly, different standards of acceptability existed between and within various government agencies. Specifically, one state of Alaska agency determined that only 30 percent of Alyeska's 3,995 "questionable welds" needed to be redone. Alyeska had chosen to use welding rod capable of withstanding 50°F below zero (-46°C) instead of standard oil industry welding rod that withstands -20°F (-29°C). Nonetheless, the congressional investigation of Ketchbaw forced Alyeska into an estimated $80 million expense by requiring examination and repair of all 3,995 questionable welds. Environmentally this caused over 1,500 more holes in the ground, not to mention the added impact of machinery backtracking across the fragile wilderness.55

Workmanship

Both public and private managers contributed to the amount of poor workmanship that occurred on the pipeline. The lack of on-site supervision, confusing mandates from public authorities, the "cost-plus" nature of the project, and a complacent attitude on the part of many workers resulted in much substandard workmanship.

The fact that supervisors and quality control personnel were often unfamiliar with pipeline engineering and design specifications was singularly significant because design and engineering specifications were continually adjusted to cope with the arctic environment. Any supervisor or quality inspector who attempted to maintain construction quality standards on the basis of previous pipeline experience without careful adjustments for the wilderness environment soon found his crew producing low quality work. In some instances, supervisors completely disregarded engineering and design specifications. In one instance, poor workmanship resulted when a quality control inspector was not available to witness the work.
A vertical support member (VSM) was designed to go down 18 feet (5 meters) into the earth, but the crew drilled to a depth of 15 feet (4.6 meters). Rather than recalling the drilling crew, the supervisor allowed his mechanic to cut three feet (1 meter) off the VSM pipe. The extra chunk of pipe was buried in the snow before the inspector returned to the job site.56

In other instances, poor workmanship resulted when supervisors, government inspectors, and Alyeska field management substituted their judgment for standards specified by government regulation or pipeline engineers. This practice allowed for on-scene adjustments to actual pipeline design, undoubtedly at times producing a net benefit but also producing negative results because of disregard for design specifications. A costly example of the impact of the latter was the faulty pipeline welds already discussed. Not only did this mistake cost Alyeska millions of dollars in increased direct construction costs, but it also added inestimable sums of public management time and money spent to force Alyeska to redo more welds unnecessarily.

Completion

Oil In and Oil Spills

To Alyeska, perhaps the final measure of the success of the project was the call for "oil in" at Prudhoe Bay in 1977. Start-up of Alaska's oil pipeline presented technical problems unlike other pipelines. The oil was hot and the pipeline was cold. The pipeline heated while the oil cooled until the two reached the same temperature. The temperature difference at the beginning was great; the oil reached the pipeline at as much as 160°F (71°C); the pipeline's average temperature was 20°F (-7°C). The conventional method of starting a pipeline is to fill it with water to remove oxygen that could explode when mixed with hydrocarbons, place a separator called a "pig," in the line, and remove the water by moving crude oil through the line behind the separator. In Alaska, however, this method could not be used because the water would freeze. Rather than using water, the Alaska pipeline used nitrogen, which is an inert gas that cannot support combustion. The oil was put in the line and a ground party moved southward from Prudhoe Bay. The ground party inspected for oil leaks, checked clearances between shifting pipe and pipe supports, and looked to see that the vertical support members were able to accommodate the weight of the filled pipeline. For several weeks crews continued to check and double-check for oil leaks and weight distortion.57

Oil spills along the pipeline are not desirable to anyone, except perhaps saboteurs; nonetheless, they are almost inevitable. The pipeline design included highly sensitive oil leak detection devices. Public management required workers to report all oil spills regardless of size. When oil would leak, Alyeska would advise the proper government regulatory agency. Apparently four major oil spills occurred during construction.58 First, an estimated 60,000 gallons of fuel leaked from a buried pipeline at Galbraith Lake. The leak was not discovered immediately because the holding tanks feeding the line were filled on a routine schedule and no control existed over the amount of fuel being consumed. Second, an
explosion at Isabel Pass went awry in a fuel yard. Barrels of fuel were crushed by falling rock and workers spent two days cleaning the areas as well as bringing in new dirt to cover the spill. Third, a tanker truck overturned at Chandalar, spilling 8,500 gallons of fuel. A fourth spill of about 70,000 gallons occurred at Prudhoe Bay in January 1976. Fuel tanks were mistakenly topped off when the temperature was 50°F below zero (−46°C). When the temperature rose 60°F (330°C) in 12 hours, a valve burst, and oil spilled on the tundra. The cause of the spill appears to have been a lack of worker understanding about the special weather conditions of the far north. Because so many possibilities exist for oil spills unrelated to the actual movement of oil through the pipeline, Alyeska trained and equipped an oil spill cleanup crew, on immediate standby.

For the most part, the pipeline start-up process was relatively smooth, with only a few minor problems typical of those encountered in the early stages of first operating any massive system. There was one major exception, however. At Pump Station 8, a relatively minor problem of cleaning a strainer was compounded by human error (which itself may have made possible by inadequate fail-safe features in design). The result was an explosion and fire which destroyed the station, killed one man, and injured several others. Damage was estimated to range in the tens of millions of dollars and, without the pressure of Station 8's pumps, the pipeline had to be operated for months at a reduced flow rate of 800,000 barrels per day—two-thirds of the initial expected operating rate. The owner companies thus experienced a consequent loss of revenue.

Surplus Equipment

Alyeska found itself with huge amounts of surplus construction equipment that had to be sold at the completion of the project. This sale, which took approximately two years to complete, was perhaps one of the largest surplus equipment sales ever recorded, save after major wars. Alyeska's over 20,000-item list of used equipment had cost $800 million to purchase and included 240 cranes, 119 backhoes, 719 bulldozers, pipelayers and loaders, 1,340 generators, 1,357 trucks, 3,315 other vehicles, and 1,637 welding machines, as well as 1,500 gas-heated outhouses, originally priced at $10,000 each. Aside from its size, the surplus sale is significant for the several hundred million dollar revenue generated which had to be deducted from total construction costs. The owner companies were guaranteed a reasonable rate of return on their investments based on the cost of building the pipeline. Similarly, the state of Alaska was to receive a royalty that could be affected by the cost of building the pipeline. Thus both private and public management were concerned with surplus sale dollars. Private industry needed to dispose of extra equipment. Public management needed to ensure that the equipment brought a reasonable price because Alaska's royalties on Prudhoe Bay production could be reduced for years to come if the surplus equipment were sold for an unreasonably low price.

Demobilization

The organization and construction work described previously evolved to build the Alaska pipeline. When construction of the project was completed
during the summer of 1977, Alyeska was demobilized. In simplistic terms, Alyeska's "construction" company was dissolved and replaced by Alyeska "operating" company. All employment contracts were officially terminated so that employees could return to their parent company or elect to stay in Alaska as part of Alyeska operating company. The responsibility of Alyeska construction company had been to build the trans-Alaska pipeline. The responsibility of Alyeska operating company is to operate and maintain the pipeline.
V. IMPACT AND EVALUATION

The Alyeska project has had a major impact on the owner oil companies, Alaska, and the nation, and a secondary international impact. The complete effects are difficult to determine for several reasons, especially since the process of adjustment to this major social, economic, and environmental disturbance is not yet complete, or where it is apparently complete, it is either poorly documented or obscured by the effects of other disturbances.

A full evaluation would also require the introduction of a considerable amount of additional data and a level of analysis beyond the typically descriptive approach of a case study. Therefore it seems appropriate at this point only to indicate the scope and complexity of evaluating this project by introducing a few key issues. These issues can be divided into two broad categories: (1) the specific impacts of this project upon the various special interest involved; and (2) the general process of project selection, planning, and management.

Results and Impact

Oil Companies' Rewards

The pipeline must be considered a technical success: once authorization had been received, construction was completed on schedule. Instead of weeks, however, years were spent obtaining authorization and final costs were many times higher than originally estimated. While such costs would normally be recovered through tariffs, the owners' proposed tariffs have been contested on the grounds that a substantial amount of the cost overrun was due to poor planning and management. Thus full costs may not be recovered by the owner companies through tariffs. The owners as producers of Prudhoe Bay oil also face the possible reduced profit as long as the West Coast oil glut continues. On the other hand, the owner companies are now assured substantial access to domestic oil, and BP has obtained an effective entry into the U.S. oil market.

Impact on Alaska's Businesses

The "boom" period in many cases exceeded expectations. Many individual Alaskans and Alaska businesses experienced a period of sharp increases in incomes. Other people not employed either on the project or in some secondary supporting organization faced higher costs from pipeline-generated local inflation.

During the construction period, government agencies and many businesses found it difficult to retain employees when they could not match the earning potential of working on the pipeline. Employees on the line were often earning wages of $50,000 or more per year, although many of these were outsiders whose pay left the state. With increased population came increased demand. The resultant seller's market for many businesses then generated a secondary business expansion, which differed in intensity
for specific communities and for specific business sectors. The end of the pipeline construction has forced upon many businesses the unpleasant task of contraction. For those who overexpanded unwisely the ultimate prospect may be bankruptcy.

Impact in Alaskan Communities

All Alaskan communities have been affected to some extent by pipeline development. The effects on the smaller rural communities not on the pipeline route have been mostly indirect. Many rural area residents who worked on pipeline construction earned high wages, if only briefly and thus increased the cash income of their community. When workers returned to those communities, they brought not just more money but undoubtedly new values. Those communities also benefit from increased state oil taxes and royalty payments—for example, a 1978 legislative provision to spend over $100 million on rural school construction. Some communities lost residents to the urban centers or larger communities. The pipeline's impact on rural communities is difficult to separate from the impacts of the Native Claims Settlement Act and the 200-mile (322 kms.) U.S. fishery jurisdiction zone established in 1977.

Communities directly affected by the pipeline either exist directly on the pipeline route or provide important support and coordinating services. The first category includes Valdez, Glennallen, Delta, and Fairbanks. The other category includes Anchorage (the state's major commercial and transportation center, and the headquarters of Alyeska Pipeline Service Co., as well as the location of many government offices), Seward (which was a major supply port for construction), and the state capital of Juneau. Many of these communities experienced similar patterns of short-term impact: rapid increases in cost of living, improved economic conditions, physical expansion, increased crime, greater demand for government services, and temporarily reduced unemployment. Valdez appears to have attained a permanent and substantial economic base. Fairbanks is experiencing the consequences of overexpansion, including a much higher-than-normal level of unemployment. The effects of the end of the "boom period" in Anchorage to date have been relatively mild since secondary business expansion (including a large amount of building construction) has maintained a viable level of economic activity.

Effect on Alaskan Values

In Alaska, urban concepts of economic interdependence clash with rural concepts of self-sufficiency and subsistence from the land. Environmentalists predict ecological disaster from development, while growth advocates predict economic disaster and criticize environmentalists' adamant convictions on land use. Native leaders of regional corporations have to balance a congressional mandate with emphasis on profit-seeking expressed in the Native Claims Settlement Act against claims for social action or immediate distribution of all corporate assets to maintain the traditional subsistence life-style. Alaska is clearly a pluralistic society with differences in opinions as great in magnitude as the differences in its geography. The pipeline appears to have sharpened this conflict and created (although indirectly) the basis for increased polarization.
Effect on Alaska's State Government

The oil tax and royalty revenues have substantially increased state government tax receipts. Many citizens, then, have increased their demand for government services since they believe the state government is in a better financial position to deliver these services. Because of the higher-than-expected pipeline completion costs and the West Coast oil glut (which together have significantly increased transportation costs for North Slope oil and thus reduced wellhead value on which taxes and royalties are based), the state is actually receiving far less oil income than had been predicted. This smaller-than-expected revenue combined with increased expectations of services has paradoxically placed the state government of oil-rich Alaska in a fiscal squeeze necessitating curtailment in growth of services. As of January 1979, state officials are actively seeking federal permission for oil exchanges in which Alaskan oil would be shipped to Japan in return for increased oil shipments to the Gulf Coast or eastern United States from the Mideast or Mexico. Sale of Alaskan oil in Japan would increase its wellhead value substantially. For the same reason, Alaskans are probably the only people in the United States who are benefiting from OPEC price increases. In the context of decades rather than years, many Alaskans (and particularly Governor Jay Hammond) worry about how to sustain state government at a high level of services when the oil resources are used up. Alaskans have voted to establish a permanent fund into which at least 25 percent of oil revenues will be invested, in order to preserve at least a portion of the revenues for the future.

Effect on the Environment

Because of the slow rate of ecological adjustment in Alaska, the full environmental effects probably will not be apparent for years. As of January 1979, system (pipeline and tanker) failure has not caused an oil spill of crisis proportions. That does not conclusively prove, that such a spill could not happen in the future. During the process of construction and start-up, numerous smaller spills of fuel occurred, but their damage was localized, and Alyeska attempted to minimize damage through cleanup measures. A certain amount of localized damage was also due to siltation and erosion, although the stipulations required Alyeska to take steps to minimize these problems. During construction, wildlife was disturbed along the route and some (particularly bears) became camp nuisances. Longer-run effects on wildlife will still have to be evaluated.

Effect on the National Energy Situation

Although there is no doubt that the development of North Slope oil reserves is a major addition to domestic oil resources, the full benefits of this addition, are not yet being realized. The reluctance of the federal government to authorize an oil exchange involving oil shipments to Japan has reduced the net benefit to the U.S. balance of payments. In addition, apparently now the oil companies do not perceive a sufficient incentive to expand the pipeline capacity to the full design potential of two million barrels per day. Furthermore, the natural gas pipeline (although authorized), has yet to be supported by financial investors, and some doubt exists
that it will be built anytime in the near future. Therefore the natural gas resources of the North Slope may remain unavailable for some time.

Planning, Selection, and Management

The Delay in Approval

The long delay in obtaining federal authorization for the project undoubtedly contributed significantly to the project's increased costs. Then, although the substantial changes made in the design of the pipeline did mean that the final product has greater environmental integrity than the design originally proposed, it could be argued that many of these design improvements would have taken place during construction anyway as Alyeska's engineers came face-to-face with the actual problems in the field. It has also been suggested that the pipeline is "over-designed" since some design features (and some construction and inspection procedures) could not be justified in cost-benefit terms. Finally, despite the lengthy authorization process, less than the total system (from a national viewpoint) was actually authorized. The consequences are the oil glut and the tenuous future of North Slope natural gas.

Design Considerations

Much of the delay occurred because Alyeska was attempting to assure the federal government that it had an environmentally sound design. After authorization and during construction, however, more design changes were made. Questions remain unanswered. Would it have been better to authorize the concept of the system, and then to consider design features on a step-by-step basis? If no authorization had ultimately been the outcome, who should have borne the design costs? To what extent can industry gamble millions on design when authorization is not assured?

Management Limits

Although critics have accused Alyeska of mismanaging the project, those critics often were among those who, through their pressure tactics, greatly increased the complexity of the project—and therefore increased the planning and management problems. Critics also argue Alyeska should not recover through tariffs expenses incurred because of mismanagement. Would management have been more effective with fewer special interests? More generally, is it fair to expect a multi-purpose project to be very efficient according to any single standard?

These are only a few of the issues that should be considered when the Alyeska experience is evaluated. The project is complete; the system as designed works. Benefits are accruing to the owners, to the state, and to the nation. However, other impacts have not been fully realized because of related issues, such as the movement of oil from the West Coast, and because of continuing changes in world energy relationships. In addition, all environmental impacts are not yet fully realized. These still changing aspects of the project may influence evaluations.
# APPENDIX A

## PIPELINE DECISION CHRONOLOGY

<table>
<thead>
<tr>
<th>Date</th>
<th>Participant</th>
<th>Statement or Action</th>
<th>Effect</th>
<th>Estimated Pipeline Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>April 1967</td>
<td>ARCO and Humble Oil</td>
<td>Start of exploratory drilling at Prudhoe Bay State No. 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jan. 1968</td>
<td>ARCO</td>
<td>Announcement of gas flows in test well</td>
<td></td>
<td></td>
</tr>
<tr>
<td>July 1968</td>
<td>ARCO and Humble Oil</td>
<td>Large scale discovery confirmed</td>
<td>Favorable stock market response</td>
<td></td>
</tr>
<tr>
<td>July 1968</td>
<td>British Petroleum (BP)</td>
<td>Decision to resume exploratory drilling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>July 1968</td>
<td>ARCO and Humble Oil</td>
<td>Pipeline technologists of Houston, Texas, hired for pipeline feasibility study</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feb. 1969</td>
<td>ARCO, British Petroleum, and Humble Oil</td>
<td>Trans-Alaska Pipeline System (TAPS) formed to build 48-inch line of 500,000 barrels/day to be completed in 1972</td>
<td>$900 million</td>
<td></td>
</tr>
<tr>
<td>April 1969</td>
<td>Department of Interior</td>
<td>North Slope Task Force established</td>
<td></td>
<td></td>
</tr>
<tr>
<td>April 1969</td>
<td>Anderson of ARCO</td>
<td>Announced line would be above ground with ultimate capacity of 2,000,000 barrels/day</td>
<td></td>
<td></td>
</tr>
<tr>
<td>April 1969</td>
<td>TAPS</td>
<td>Orders placed for $100,000,000 of pipe from Japanese mills</td>
<td></td>
<td></td>
</tr>
<tr>
<td>June 1969</td>
<td>Governor Keith H. Miller of Alaska</td>
<td>Announced Valdez as terminal site</td>
<td></td>
<td></td>
</tr>
<tr>
<td>June 1969</td>
<td>TAPS</td>
<td>Applied to Bureau of Land Management (BLM) for pipeline right-of-way and permission to build haul road</td>
<td></td>
<td></td>
</tr>
<tr>
<td>June 1969</td>
<td>Secretary of Interior Walter Hickel</td>
<td>Outlines conditions for granting permit; unlikely approval</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summer 1969</td>
<td>TAPS</td>
<td>Continues research and design program; hires Fluor Ocean Services to design Valdez terminal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aug. 1969</td>
<td>TAPS</td>
<td>Sea lift of equipment to North Slope</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aug. 1969</td>
<td>Governor Miller of Alaska</td>
<td>Announces state plans to set up pipeline corridor and supervise project</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Date</td>
<td>Participant</td>
<td>Statement or Action</td>
<td>Effect</td>
<td>Estimated Pipeline Cost</td>
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<tr>
<td>Aug. 1969</td>
<td>Pipeline contractors associations and welders union</td>
<td>Sign agreement on wages - rate set $8.45/hour</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sept. 1969</td>
<td>State of Alaska</td>
<td>Auctions off 450,000 acres of Prudhoe Bay for $900 million - largest oil sale ever in U.S.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sept. 1969</td>
<td>First pipe arrives</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sept. 1969</td>
<td>Senator Jackson, Chairman of Senate Interior Committee</td>
<td>Questions adequacy of line design to prevent oil spills</td>
<td>Delay</td>
<td></td>
</tr>
<tr>
<td>Sept. 1969</td>
<td>Dr. Edward Teller</td>
<td>Suggest nuclear blast to create North Slope harbor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oct. 1969</td>
<td>Department of Interior</td>
<td>Hickel approves Interior's proposed environmental stipulations</td>
<td>Raised expecta-</td>
<td></td>
</tr>
<tr>
<td>Oct. 1969</td>
<td>Senate hearing</td>
<td>Interior supports granting of permit; Jackson objects citing unsolved techn-</td>
<td>tions permit</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>incal problems                                                                  would be granted</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Late 1969</td>
<td>TAPS and labor unions</td>
<td>Wages set at $6.38/hour for laborers, and $8.42/hour for operating engineers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Late 1969</td>
<td>General Dynamics</td>
<td>Suggests use of submarine tankers instead</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dec. 31, 1969</td>
<td>Congress</td>
<td>National Environmental Protection Act (NEPA) passed</td>
<td>Set stage for</td>
<td></td>
</tr>
<tr>
<td>Jan. 1970</td>
<td>Secretary Hickel</td>
<td>Signs order modifying federal land freeze in Alaska</td>
<td>Encouraged belief permit would be granted</td>
<td></td>
</tr>
<tr>
<td>Jan. 1970</td>
<td>Secretary Hickel</td>
<td>Voices reservations about pipe being laid in permafrost</td>
<td>Permit delayed</td>
<td></td>
</tr>
<tr>
<td>Jan. 1970</td>
<td>TAPS</td>
<td>Informa contractors that bids taken in Dec. 1969 would have to be re-bid later due to delay in securing permits</td>
<td>Permit delayed</td>
<td></td>
</tr>
<tr>
<td>Early 1970</td>
<td>W.F. Appelt, Houston engineer</td>
<td>Suggest construction of suspended pipeline</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Date</td>
<td>Participant</td>
<td>Statement or Action</td>
<td>Effect</td>
<td>Estimated Pipeline Cost</td>
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<td>--------------------------------------------</td>
<td>--------------------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>Jan. 1970</td>
<td>Humble Oil official</td>
<td>New cost estimates</td>
<td></td>
<td>$1.8 billion for 2,000,000 barrel/day capacity</td>
</tr>
<tr>
<td>Feb. 1970</td>
<td>Department of Interior</td>
<td>Declares more information on permafrost needed</td>
<td>Delay</td>
<td></td>
</tr>
<tr>
<td>April 1970</td>
<td>Alaskan native villages</td>
<td>File suit to protect land claims against pipeline crossing their land prior to claims being settled</td>
<td>Delay</td>
<td></td>
</tr>
<tr>
<td>April 1970</td>
<td>Environmental groups (Wilderness Society, Environmental Defense Fund, Friends of the Earth)</td>
<td>Petition court to bar permits under provisions of NEPA, and Minerals Leasing Act which restricts right-of-way width (TAPS desires full 100 feet)</td>
<td>Delays as Judge Hart issues injunctions against granting permits</td>
<td></td>
</tr>
<tr>
<td>Aug. 1970</td>
<td>TAPS</td>
<td>Record sea lift to North Slope</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aug. 1970</td>
<td>TAPS owners</td>
<td>Form Alyeska Pipeline Service Company to replace TAPS; Edward L. Patton of Humble Oil named president of Alyeska</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall 1970</td>
<td>Phillips Petroleum official</td>
<td>Revised completion estimate to 1974, and revised cost</td>
<td></td>
<td>$2 billion</td>
</tr>
<tr>
<td>Nov. 1970</td>
<td>President Nixon</td>
<td>Fired Nickel as Secretary of Interior and appointed Roger S. Morton.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Late 1970</td>
<td>Department of Interior</td>
<td>Announces public hearings on pipeline for early 1971</td>
<td>Delay</td>
<td></td>
</tr>
<tr>
<td>Jan. 1971</td>
<td>Department of Interior</td>
<td>Issues preliminary Environmental Impact Statement and schedules hearings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feb.-March 1971</td>
<td>Department of Interior</td>
<td>Environmental groups oppose pipeline at hearings on grounds that:</td>
<td>Delay</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Impact statement does not adequately explore alternatives</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Oil not now needed</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>- Need in future for North Slope oil would be greater</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Hearings produce 12,000 pages of testimony</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feb. 1971</td>
<td>Secretary Morton</td>
<td>Criticizes Alyeska for not supplying soil-test data; suggests alternate route through Canada</td>
<td>Delay</td>
<td></td>
</tr>
<tr>
<td>Feb. 1971</td>
<td>Alaska Governor William A. Egan</td>
<td>Argues for Alaskans' right to determine how their resources should be developed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Date</td>
<td>Participant</td>
<td>Statement or Action</td>
<td>Effect</td>
<td>Estimated Pipeline Cost</td>
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<tr>
<td>------------</td>
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<td>-------------------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>Early 1971</td>
<td>Congress</td>
<td>Begins consideration of Native Claims bill</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Early 1971</td>
<td>Environmental Protection Agency (EPA)</td>
<td>Asks that permit be delayed to allow full study of alternatives</td>
<td>Delay</td>
<td></td>
</tr>
<tr>
<td>March 1971</td>
<td>Alyeska's owners</td>
<td>Meet with Canadian government to discuss Canadian route - talks ended when Canadian response time judged to be too long</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spring 1971</td>
<td>Federal agencies</td>
<td>Support for pipeline from Office of Emergency Preparedness, Federal Power Commission, Department of Transportation; Interstate Commerce Commission shows rail transportation of oil more than five times as expensive as pipeline</td>
<td></td>
<td></td>
</tr>
<tr>
<td>April 1971</td>
<td>Cordova District Fisheries Union</td>
<td>Sues Secretaries of Agriculture &amp; Interior over permits for Valdez terminal</td>
<td>Delay</td>
<td></td>
</tr>
<tr>
<td>April 1971</td>
<td>Nixon Administration</td>
<td>Sends version of Native Claims bill to Congress - settlement consisting of $1 billion and 40 million acres suggested</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spring 1971</td>
<td>Northwest Study Group</td>
<td>Investigates pipeline to deliver natural gas from North Slope; gas production must follow oil production</td>
<td></td>
<td></td>
</tr>
<tr>
<td>July 1971</td>
<td>Alyeska</td>
<td>Submits three-volume project description to Department of Interior; document has 26 volumes of appendices</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summer 1971</td>
<td>Secretary Morton</td>
<td>Announces delay of Interior's environmental impact statement (EIS) to Dec. 15th</td>
<td>Delay</td>
<td></td>
</tr>
<tr>
<td>Oct. 1971</td>
<td>Alaska's Governor Egan</td>
<td>Proposes Alaska buy pipeline from owners and operate it</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Late 1971</td>
<td>David Anderson, Canadian MP from Vancouver, and Canadian Wildlife Association</td>
<td>Files suit in U.S. District Court, citing potential damage of oil spills to Canada's west coast</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dec. 1971</td>
<td>Congress</td>
<td>Passes Alaska Native Claims Settlement Act (ANCSA)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jan. 1972</td>
<td>Department of Interior</td>
<td>Sets aside 5 million acres utility and transportation corridor under authority of ANCSA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jan. 1972</td>
<td>Federal agencies</td>
<td>Pipeline support from Depts. of State and Defense, and from Council of Economic Advisers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Date</td>
<td>Participant</td>
<td>Statement or Action</td>
<td>Effect</td>
<td>Estimated Pipeline Cost</td>
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<td>------------</td>
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<td>--------------------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>March 1972</td>
<td>Department of Interior</td>
<td>Files EIS with Council on Environmental Quality</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spring 1972</td>
<td>Alyeska</td>
<td>Revises cost estimates</td>
<td></td>
<td>$3 billion</td>
</tr>
<tr>
<td>Spring 1972</td>
<td>Canadian Minister of Energy</td>
<td>Proposes a trans-Canada pipeline</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spring 1972</td>
<td>ARCO</td>
<td>Estimates wellhead price (market price less transportation costs from well) as $2.60/barrel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>May 1972</td>
<td>Secretary Morton</td>
<td>Announces intention to grant right-of-way permit as soon as it is allowed by courts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>May 1972</td>
<td>Environmental groups</td>
<td>File suit in response to Morton's announcement; argues right-of-way width of 100 feet is illegal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>June 1972</td>
<td>Senator Proxmire of Wisconsin</td>
<td>Starts investigation of Morton's intention to grant permit; argues oil really is needed in Midwest, thus suggesting trans-Canada pipeline</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spring 1972</td>
<td>Alaska Legislature</td>
<td>Pipeline Commission created to regulate services and rates</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aug. 1972</td>
<td>Judge Hart</td>
<td>Dissolves injunction; environmentalists plan appeal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oct. 1972</td>
<td>Court of Appeals</td>
<td>Court hears appeals; environmentalists encouraged by judicial response</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dec. 1972</td>
<td>Mathematical Sciences Northwest of Seattle</td>
<td>Completes report on social and economic effects on Alaska; report predicts substantial employment growth but no &quot;boom or bust&quot; effect</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Early 1973</td>
<td>Alyeska</td>
<td>Awards pump station contracts to Fluor Engineers and Constructors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Early 1973</td>
<td>Mackenzie Valley Pipeline Research, Ltd.</td>
<td>Announces study showing 48-inch trans-Canada line to be possible</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spring 1973</td>
<td>Nixon Administration</td>
<td>Proposes bill to amend Minerals Leasing Act</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spring 1973</td>
<td>Alaska's Senators Stevens and Gravel</td>
<td>Introduce bill in Senate to authorize and expedite construction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Date</td>
<td>Participant</td>
<td>Statement or Action</td>
<td>Effect</td>
<td>Estimated Pipeline Cost</td>
</tr>
<tr>
<td>------------</td>
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<td>----------------------------------------------------------</td>
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<td>-------------------------</td>
</tr>
<tr>
<td>Spring 1973</td>
<td>Representative Lee Aspin (D-Wis) and Senator Mondale (D-Minn)</td>
<td>Introduce bill designed to authorize only a trans-Canada line</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spring 1973</td>
<td>Nixon Administration</td>
<td>Petitions Supreme Court to overrule Appeals Court; court refuses to review appeal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>May 1973</td>
<td>Senate</td>
<td>Approves right-of-way bill suitable for Alyeska</td>
<td></td>
<td></td>
</tr>
<tr>
<td>July 1973</td>
<td>Senate</td>
<td>Passes bill to resolve right-of-way restrictions and authorize construction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oct. 1973</td>
<td>Arab Members of OPEC</td>
<td>Declared total embargo on oil shipments to U.S.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nov. 1973</td>
<td>President Nixon</td>
<td>Signs authorization bill passed by Congress</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jan. 23, 1973</td>
<td>Secretary Norton</td>
<td>Issues right-of-way permit</td>
<td></td>
<td>Construction authorized in principle</td>
</tr>
</tbody>
</table>

Source: Compiled by the authors from public documents.
APPENDIX B

PROVISIONS OF TRANS-ALASKA PIPELINE AUTHORIZATION ACT

Statement of Purpose:

CONGRESSIONAL FINDINGS

Sec. 202. The Congress finds and declares that:

(a) The early development and delivery of oil and gas from Alaska's North Slope to domestic markets is in the national interest because of growing domestic shortages and increasing dependence upon insecure foreign sources.

(b) The Department of the Interior and other Federal agencies, have, over a long period of time, conducted extensive studies of the technical aspects and of the environmental, social, and economic impacts of the proposed trans-Alaska oil pipeline, including consideration of a trans-Canada pipeline.

(c) The earliest possible construction of a trans-Alaska oil pipeline from the North Slope of Alaska to Port Valdez in that State will make the extensive proven and potential reserves of a low-sulfur oil available for domestic use and will best serve the national interest.

(d) A supplemental pipeline to connect the North Slope with a trans-Canada pipeline may be needed later and it should be studied now, but it should not be regarded as an alternative for a trans-Alaska pipeline that does not traverse a foreign country.

CONGRESSIONAL AUTHORIZATION

Sec. 203. (a) The purpose of this title is to insure that, because of the extensive governmental studies already made of this project and the national interest in early delivery of North Slope oil to domestic markets, the trans-Alaska oil pipeline be constructed promptly without further administrative or judicial delay or impediment. To accomplish this purpose it is the intent of the Congress to exercise its constitutional powers to the fullest extent in the authorizations and directions herein made and in limiting judicial review of the actions taken pursuant thereto.

(b) The Congress hereby authorizes and directs the Secretary of the Interior and other appropriate Federal officers and agencies to issue and take all necessary action to administer and enforce rights-of-way, permits, leases, and other authorizations that are necessary for or related to the construction, operation, and maintenance of the trans-Alaska oil pipeline system, including roads and airstrips, as that system is generally described in the Final Environmental Impact Statement issued by the Department of the Interior on March 20, 1972. The route of the pipeline may be modified by the Secretary to provide during construction greater environmental protection.
APPENDIX B (cont.)

Limits on Further Legal Challenge:

(d) The actions taken pursuant to this title which relate to the construction and completion of the pipeline system and to the applications filed in connection therewith necessary to the pipeline's operation at full capacity, as described in the Final Environmental Impact Statement of the Department of the Interior, shall be taken without further action under the National Environmental Policy Act of 1969; and the actions of the Federal officers concerning the issuance of the necessary rights-of-way, permits, leases, and other authorizations for construction and initial operation at full capacity of said pipeline system shall not be subject to judicial review under any law except that claims alleging the invalidity of this section may be brought within sixty days following its enactment, and claims alleging that an action will deny rights under the Constitution of the United States, or that the action is beyond the scope of authority conferred by this title, may be brought within sixty days following the date of such action. A claim shall be barred unless a complaint is filed within the time specified. Any such complaint shall be filed in a United States district court, and such court shall have exclusive jurisdiction to determine such proceeding in accordance with the procedures hereinafter provided, and no other court of the United States, of any State, territory, or possession of the United States, or of the District of Columbia, shall have jurisdiction of any such claim whether in a proceeding instituted prior to or on or after the date of the enactment of this Act. Any such proceeding shall be assigned for hearing at the earliest possible date, shall take precedence over all other matters pending on the docket of the district court at that time, and shall be expedited in every way by such court. Such court shall not have jurisdiction to grant any injunctive relief against the issuance of any right-of-way, permit, lease, or other authorization pursuant to this section except in conjunction with a final judgment entered in a case involving a claim filed pursuant to this section. Any review of an interlocutory or final judgment, decree, or order of such district court may be had only upon direct appeal to the Supreme Court of the United States.

Authority to Modify Permits:

(e) The Secretary of the Interior and the other Federal officers and agencies are authorized at any time when necessary to protect the public interest, pursuant to the authority of this section and in accordance with its provisions, to amend or modify any right-of-way, permit, lease, or other authorization issued under this title.

Liability for Damages:

Sec. 204. (a) (1) Except when the holder of the pipeline right-of-way granted pursuant to this title can prove that damages in connection with or resulting from activities along or in the vicinity of the proposed trans-Alaskan pipeline right-of-way were caused by an act of war or negligence of the United States, other government entity, or the damaged party, such holder shall be strictly liable to all damaged parties, public or private, without regard to fault for such damages, and without regard to ownership
of any affected lands, structures, fish, wildlife, or biotic or other natural resources relied upon by Alaska Natives, Native organizations, or others for subsistence or economic purposes. Claims for such injury or damages may be determined by arbitration or judicial proceedings.

(2) Liability under paragraph (1) of this subsection shall be limited to $50,000,000 for any one incident, and the holders of the right-of-way or permit shall be liable for any claim allowed in proportion to their ownership interest in the right-of-way or permit. Liability of such holders for damages in excess of $50,000,000 shall be in accord with ordinary rules of negligence.

(5) (b) If any area within or without the right-of-way or permit area granted under this title is polluted by any activities conducted by or on behalf of the holder to whom such right-of-way or permit was granted, and such pollution damages or threatens to damage aquatic life, wildlife, or public or private property, the control and total removal of the pollutant shall be at the expense of such holder, including any administrative and other costs incurred by the Secretary or any other Federal officer or agency. Upon failure of such holder to adequately control and remove such pollutant, the Secretary, in cooperation with other Federal, State, or local agencies, or in cooperation with such holder, or both, shall have the right to accomplish the control and removal at the expense of such holder.

(c) (1) Notwithstanding the provisions of any other law, if oil that has been transported through the trans-Alaska pipeline is loaded on a vessel at the terminal facilities of the pipeline, the owner and operator of the vessel (jointly and severally) and the Trans-Alaska Pipeline Liability Fund established by this subsection, shall be strictly liable without regard to fault in accordance with the provisions of this subsection for all damages, including clean-up costs, sustained by any person or entity, public or private, including residents of Canada, as the result of discharges of oil from such vessel.

Negotiations with Canada:

Sec. 301. The President of the United States is authorized and requested to enter into negotiations with the Government of Canada to determine--

(a) the willingness of the Government of Canada to permit the construction of pipelines or other transportation systems across Canadian territory for the transport of natural gas and oil from Alaska's North Slope to markets in the United States, including the use of tankers by way of the Northwest Passage;

(b) the need for intergovernmental understandings, agreements, or treaties to protect the interests of the Governments of Canada and the United States and any party or parties involved with the construction, operation, and maintenance of pipelines or other transportation systems for the transport of such natural gas or oil;

(c) the terms and conditions under which pipelines or other transportation systems could be constructed across Canadian territory;
(d) the desirability of undertaking joint studies and investigations
designed to insure protection of the environment, reduce legal and regula-
tory uncertainty, and insure that the respective energy requirements of
the people of Canada and of the United States are adequately met;

Advance Payments to Alaska Natives:

Sec. 407. (a) In view of the delay in construction of a pipeline to
transport North Slope crude oil, the sum of $5,000,000 is authorized to be
appropriated from the United States Treasury into the Alaska Native Fund
every six months of each fiscal year beginning with the fiscal year ending
June 30, 1976, as advance payments chargeable against the revenues to be
paid under section 9 of the Alaska Native Claims Settlement Act, until such
time as the delivery of North Slope crude oil to a pipeline is commenced.

Civil Rights:

Sec. 403. The Secretary of the Interior shall take such affirmative
action as he deems necessary to assure that no person shall, on the grounds
of race, creed, color, national origin, or sex, be excluded from receiving,
or participating in any activity conducted under, any permit, right-of-way,
public land order, or other Federal authorization granted or issued under
title II. The Secretary of the Interior shall promulgate such rules as he
deems necessary to carry out the purposes of this subsection and may en-
force this subsection, and any rules promulgated under this subsection,
through agency and department provisions and rules which shall be similar
to those established and in effect under title VI of the Civil Rights Act
of 1964.

Width of Right-of-Way (included as an
amendment of the Mineral Leasing Act
of 1920):

The width of a right-of-way shall not exceed fifty feet plus the
ground occupied by the pipeline (that is, the pipe and its related facili-
ties) unless the Secretary or agency head finds, and records the reasons
for his finding, that in his judgment a wider right-of-way is necessary
for operation and maintenance after construction, or to protect the envi-
ronment or public safety. Related facilities include but are not limited
to valves, pump stations, supporting structures, bridges, monitoring and
communication devices, surge and storage tanks, terminals, roads, airstrips
and campsites, and they need not necessarily be connected or contiguous
to the pipe and may be the subjects of separate rights-of-way.

Equitable Allocation of North Slope Oil:

Sec. 410. The Congress declares that the crude oil on the North Slope
of Alaska is an important part of the Nation's oil resources, and that the
benefits of such crude oil should be equitably shared, directly or indirect-
ly, by all regions of the country. The President shall use any authority
he may have to insure an equitable allocation of available North Slope and
other crude oil resources and petroleum products among all regions and all of the several States.

Limitation on Export:

"(u) Any domestically produced crude oil transported by pipeline over rights-of-way granted pursuant to section 28 of the Mineral Leasing Act of 1920, except such crude oil which is either exchanged in similar quantity for convenience or increased efficiency of transportation with persons or the government of an adjacent foreign state, or which is temporarily exported for convenience or increased efficiency of transportation across parts of an adjacent foreign state and reenters the United States, shall be subject to all of the limitations and licensing requirements of the Export Administration Act of 1969 (Act of December 30, 1969; 83 Stat. 841) and, in addition, before any crude oil subject to this section may be exported under the limitations and licensing requirements and penalty and enforcement provisions of the Export Administration Act of 1969 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 United States, and are in the national interest and are in accord with the provisions of the Export Administration Act of 1969: Provided, That the President shall submit reports to the Congress containing findings made under this section, and after the date of receipt of such report Congress shall have a period of sixty calendar days, thirty days of which Congress must have been in session, to consider whether exports under the terms of this section are in the national interest. If the Congress within this time period passes a concurrent resolution of disapproval stating disagreement with the President's finding concerning the national interest, further exports made pursuant to the aforementioned Presidential findings shall cease."
APPENDIX C

HAUL LOAD CONSTRUCTION: CHRONOLOGY OF EVENTS

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring 1966</td>
<td>Commitment to Development</td>
</tr>
<tr>
<td>Summer 1969</td>
<td>Design to Road - Livengood to Yukon River (65 mi.)</td>
</tr>
<tr>
<td>August 1969</td>
<td>Start of Construction - Livengood to Yukon River Road</td>
</tr>
<tr>
<td>October 1969</td>
<td>Initiated Design - Yukon River to Prudhoe Bay Road (350 mi.)</td>
</tr>
<tr>
<td>December 1969</td>
<td>Solicited Bids for Construction - Yukon River to Prudhoe Bay Road</td>
</tr>
<tr>
<td>January 1970</td>
<td>Awarded Construction Contracts - Yukon River to Prudhoe Bay Road</td>
</tr>
<tr>
<td>April 4, 1970</td>
<td>Injunction Issued Prohibiting Grant of Right-of-Way</td>
</tr>
<tr>
<td>May 1970</td>
<td>Agreement with State of Alaska on Yukon River Bridge</td>
</tr>
<tr>
<td>May - July 1970</td>
<td>Livengood to Yukon River Road Completed</td>
</tr>
<tr>
<td>February - December 1970</td>
<td>Design Surveys - North of Yukon River and Preparation of Road Construction Drawings</td>
</tr>
<tr>
<td>1971</td>
<td>Continued Injunction Prohibiting Construction</td>
</tr>
<tr>
<td></td>
<td>Design Surveys and Material Site Exploration - North of the Yukon River</td>
</tr>
<tr>
<td></td>
<td>Design Optimization of Construction Drawings</td>
</tr>
</tbody>
</table>
### APPENDIX C (cont.)

<table>
<thead>
<tr>
<th>Year</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1972</td>
<td>Continued Injunction Prohibiting Construction</td>
</tr>
<tr>
<td></td>
<td>Design Surveys for Access Roads and Material Site Exploration - North of Yukon River</td>
</tr>
<tr>
<td></td>
<td>Design of Access Roads and Preparation of Material Site Roads</td>
</tr>
<tr>
<td>1973</td>
<td>Continued Injunction Prohibiting Construction</td>
</tr>
<tr>
<td></td>
<td>Design Surveys for Access Roads, State Road Reroutes and Material Site Exploration - North of Yukon River</td>
</tr>
<tr>
<td></td>
<td>Design of Access Roads, State Road Reroutes and Preparation of Mining Plans</td>
</tr>
<tr>
<td>September 1973</td>
<td>Injunction Lifted</td>
</tr>
<tr>
<td>December 1973</td>
<td>Construction Permit Authorized</td>
</tr>
<tr>
<td>January - April 1974</td>
<td>Mobilization of Equipment and Camp Expansion Including Four New Camps</td>
</tr>
<tr>
<td>April 29, 1974</td>
<td>Official Construction Start</td>
</tr>
<tr>
<td>September 29, 1974</td>
<td>Overlay for Road Completed - Yukon River to Prudhoe Bay</td>
</tr>
</tbody>
</table>

Source: Alyeska Pipeline Service Company pamphlet dated September 29, 1974 from E.L. Patton, President, Alyeska Pipeline Service Company.
APPENDIX D

PIPELINE CONSTRUCTION: CHRONOLOGY OF EVENTS

<table>
<thead>
<tr>
<th>Date</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>March 27, 1975</td>
<td>First pipe laid--1,900 feet of pipe buried under Tonsina River</td>
</tr>
<tr>
<td>April 1975</td>
<td>First 1,800 feet of elevated pipe installed</td>
</tr>
<tr>
<td>May 1975</td>
<td>Labor force reaches 12,000 workers</td>
</tr>
<tr>
<td>July 1975</td>
<td>First indications of faulty x-rays found</td>
</tr>
<tr>
<td>July 1975</td>
<td>Alyeska revised constructions cost estimates to $6.5 billion</td>
</tr>
<tr>
<td>July - August 1975</td>
<td>Keystone Canyon, Section 1, portion of pipeline rerouted</td>
</tr>
<tr>
<td>September 1975</td>
<td>Work force peaks at 21,600 workers</td>
</tr>
<tr>
<td>December 1975</td>
<td>371 miles of pipe laid; pipeline nearly 50 percent completed</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Date</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>April - May 1976</td>
<td>Soil conditions between Salcha and Sourdough, Section 2, dictate last major mode change to elevated pipeline</td>
</tr>
<tr>
<td>May 1976</td>
<td>Alyeska issues technical report concerning faulty x-ray welds, after reviewing all 30,800 welds completed in 1975</td>
</tr>
<tr>
<td>May 1976</td>
<td>Work resumes in Keystone Canyon and Thompson Pass</td>
</tr>
<tr>
<td>June 1976</td>
<td>E.L. Patton becomes chairman and chief executive in charge of construction company; Dr. William J. Darch becomes president. Darch will head operating company</td>
</tr>
<tr>
<td>June 1976</td>
<td>1,700 feet of concrete-coated pipe floats to surface from 20 feet deep trench under Sagavanirktok River near Happy Valley</td>
</tr>
<tr>
<td>July 1976</td>
<td>Hydro testing ruptures 480 feet of pipe in Section 5; pipe replaced</td>
</tr>
<tr>
<td>Time Period</td>
<td>Description</td>
</tr>
<tr>
<td>---------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>July - August 1976</td>
<td>Extra effort expended to complete Atigun Pass, Section 5, and the Keystone Canyon and Thompson Pass portions of Section 1.</td>
</tr>
<tr>
<td>August - September 1976</td>
<td>Work force peaked near 21,000 workers</td>
</tr>
<tr>
<td>September 1976</td>
<td>3,175 of the 3,955 questionable welds reconfirmed</td>
</tr>
<tr>
<td>October 1976</td>
<td>Work at 4,790-foot Atigun Pass nearly completed, ditching at Thompson Pass completed</td>
</tr>
<tr>
<td>November 1976</td>
<td>Keystone Canyon completed; back-fill at Atigun Pass completed</td>
</tr>
<tr>
<td>December 6, 1976</td>
<td>Final piece of main pipeline laid; location Thompson Pass</td>
</tr>
<tr>
<td>December 1976</td>
<td>Main pipeline 97.5 percent completed</td>
</tr>
<tr>
<td>Spring 1977</td>
<td>60 miles of elevated pipe installed; 23 welds repaired</td>
</tr>
<tr>
<td>June 1977</td>
<td>Oil-in at Prudhoe Bay</td>
</tr>
</tbody>
</table>
APPENDIX E
CONSTRUCTION OF THE MARINE TERMINAL AND PUMP STATIONS:
CHRONOLOGY OF EVENTS

<table>
<thead>
<tr>
<th>Date</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>December 21, 1972</td>
<td>Fluor awarded contract for planning, engineering, and construction of terminal and pump stations. Fluor begins planning and engineering design activities</td>
</tr>
<tr>
<td>May 1, 1974</td>
<td>Fluor mobilizes for terminal construction. Cost of terminal set at $532.4 million</td>
</tr>
<tr>
<td>June 1974</td>
<td>Terminal site preparation begins</td>
</tr>
<tr>
<td>June - July 1974</td>
<td>Terminal power plant design completed</td>
</tr>
<tr>
<td>July 1974</td>
<td>Subsurface rock conditions cause voluminous broadening of scope of site preparation work</td>
</tr>
<tr>
<td>December 1974</td>
<td>Ground water, soil and rock conditions necessitate massive terminal design changes</td>
</tr>
<tr>
<td>January 1975</td>
<td>Fluor mobilizes for pump station construction; heavy equipment moved to remote construction sites</td>
</tr>
<tr>
<td>April 1975</td>
<td>Some materials and equipment left unflagged is damaged by snow removal equipment at terminal</td>
</tr>
<tr>
<td>August 1975</td>
<td>Alyeska concerned with construction delays caused by late delivery of materials and equipment</td>
</tr>
<tr>
<td>September 1975</td>
<td>Terminal construction crew steady at 3,100 workers; pump station crews peak at 1,800 workers</td>
</tr>
<tr>
<td>September 1975</td>
<td>12,000-cubic yard rock slide at Valdez; crews re-terrace hillside around the terminal</td>
</tr>
<tr>
<td>December 1975</td>
<td>Terminal and pump stations 25 percent completed</td>
</tr>
<tr>
<td>January 1976</td>
<td>Temperature north of Yukon River drops to -45°F (Wind chill -70°F)</td>
</tr>
</tbody>
</table>
January - March 1976  Crew at pump Station 1, Prudhoe Bay, drops to 270 workers
August 1976  Crew at pump station peaks at 430 workers
September 1976  Terminal 66 percent completed
November 1976  First ship docks at terminal--the Toshin Maru from Japan
November 1976  4,200 workers work into the winter at Valdez
December 1976  Terminal 83 percent completed; pump stations 92 percent completed
December 1976  First operating instructions sent 800 miles from the main control center in Valdez to pump Station 2 to test a mainline shut-off valve

April - May 1977  78 miles of gas line installed, 148-mile gas line completed providing power for first four pump stations
July 1977  Oil arrives at Valdez terminal from Prudhoe Bay
FOOTNOTES


2/ Ibid., p. 28.

3/ Ibid., p. 32.


6/ Roscow, 800 Miles to Valdez, pp. 10-19.

7/ Hearings, United States Senate Committee on Interior and Insular Affairs, fall 1979.


10/ Trans-Alaska Pipeline Application, June 6, 1969.


12/ Hickel to Dulaney, June 24, 1969.

13/ Train to Dulaney, June 6, 1969.

14/ Dulaney to Train, June 19, 1969.

15/ Ibid.

16/ Office of Economic Analysis, Department of Interior, An Analysis of the Economic and Security Aspects of the Trans-Alaska Pipeline, 1972.


18/ Roscow, 800 Miles to Valdez, pp. 96-97.

19/ Ibid., p. 97.

21/ Roscow, 800 Miles to Valdez, p. 104.


24/ Ibid., p. II:17.


27/ Ibid., p. II:57.


30/ Trans-Alaska Oil Pipeline--Progress of Construction, p. 33.

31/ Ibid., p. 43.

32/ Lenzner, Management, Planning and Construction, p. I:5.


34/ Ibid., pp. IV:4-5.


36/ Ibid., p. 5.

37/ Hanrahan and Gruenstein, Lost Frontier, p. 147.

38/ Ibid., p. 146.

39/ Ibid., pp. 146-147.

40/ Lenzner, Management, Planning and Construction, pp. IV:30-37.
41/ Ibid., p. II:85.
42/ Ibid., p. IV:5.
44/ Ibid., pp. XI:22-25.
47/ From Inside the Alaska Pipeline by Ed McGrath. Copyright (c) 1977 by Edward McGrath. Reprinted by permission of Celestial Arts, Millbrae, California, pp. 66-70.
48/ Reprinted from "South from Prudhoe" by H.M. Stemmer, ed. by permission of Universal News, Inc.
50/ Hanrahan and Gruenstein, Lost Frontier, pp. 224-225.
51/ McGrath, Inside the Alaska Pipeline, pp. 91-92.
52/ Hanrahan and Gruenstein, Lost Frontier, p. 162.
54/ Lenzner, Management, Planning and Construction, pp. VIII:20-23.
55/ Hanrahan and Gruenstein, Lost Frontier, p. 163.
56/ McGrath, Inside the Alaska Pipeline, p. 117.
57/ Roscow, 800 Miles to Valdez, p. 202.
58/ McGrath, Inside the Alaska Pipeline, pp. 119-121.


Alyeska Status Report, August 1972.


Knox, Robert F. Alaska Construction and Oil Report, September-October 1968.


Trans-Alaska Pipeline Authorization, June 6, 1969.


United States. Interstate and Foreign Commerce Committee, House of Repre- 
sentatives. Alyeska Oil Pipeline Oversight. Hearing before the Subcom-

United States. Joint Economic Committee Congress. Natural Gas Regulation 
and the Trans-Alaska Pipeline. Ninety-Second Congress, Second Session, 


United States. Congress. The Pricing of Alaskan North Slope Oil: A Critique 
THE EAST-WEST CENTER—officially known as the Center for Cultural and Technical Interchange Between East and West—is a national educational institution established in Hawaii by the U.S. Congress in 1960 to promote better relations and understanding between the United States and the nations of Asia and the Pacific through cooperative study, training, and research. The Center is administered by a public, nonprofit corporation whose international Board of Governors consists of distinguished scholars, business leaders, and public servants.

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