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When the trans-Alaska pipeline is completed, the system will consist of about 800 miles of 48-inch pipe, 12 pump stations, a communications system, and a terminal at Port Valdez. The project is financed by eight oil companies. It is constructed primarily on Federal land. Findings/Conclusions: The system became operational in June of this year and was to be capable of transporting 1.2 million barrels of oil a day by November 1977. Construction of the production facilities is on schedule and the developers of the field will be able to produce enough oil to meet the scheduled flow rates of the pipeline system. Alyeska Pipeline Service Company--agent for the owner companies--is responsible for developing a comprehensive quality assurance program to assure compliance with the environmental and technical stipulations of the right-of-way agreement. The Department of the Interior's Authorized Officer is responsible for approving this program and making sure that it is carried out. Although the Authorized Officer brought environmental problems to Alyeska's attention and obtained corrective action in most instances, the problems were not always corrected in a timely manner. Welding defects have been corrected and the leak control system has been approved. The effectiveness of the corrosion control system may not be known for several years. (Author/SC)

3547

03092



# *REPORT TO THE CONGRESS*

*BY THE COMPTROLLER GENERAL  
OF THE UNITED STATES*

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## **Trans-Alaska Oil Pipeline -- Information On Construction, Technical, And Environmental Matters Through Spring 1977**

**Department of the Interior**

This report presents information on the progress of construction of the trans-Alaska oil pipeline through spring 1977.

Although construction of the pipeline system had been slightly behind schedule, it became operational in June 1977. Construction progress was generally satisfactory into spring 1977.

Environmental problems that developed in the 1975 construction season continued in 1976 and carried over into 1977. The significance of these problems has not yet been determined, but Federal monitors are now in the process of assessing their impact.

The much publicized welding problems have been corrected by the Alyeska Pipeline Service Company.

After the completion of the GAO review and the preparation of this report, a serious accident occurred at pump station 8. The impact of this disaster on cost and final completion is not known at this time.

EMD-77-44

**AUGUST 23, 1977**



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

B-180224

To the President of the Senate and the  
Speaker of the House of Representatives

This report provides information on the progress of construction of the trans-Alaska oil pipeline through spring 1977, the Federal and State monitoring of construction, and certain environmental and technical matters related to the construction of the pipeline.

This work was done at the request of the former Chairman of the Subcommittee on Public Lands, House Committee on Interior and Insular Affairs.

We did not obtain written agency comments because of the timeliness of the information presented and the start of pipeline operation. We did, however, discuss the report with appropriate Federal and State officials who expressed general agreement with its contents. Alyeska was given a copy of the report to review but they did not comment.

We made our review pursuant to the Budget and Accounting Act, 1921 (31 U.S.C. 53), and the Accounting and Auditing Act of 1950 (31 U.S.C. 67).

We are sending copies of this report to the Director, Office of Management and Budget, and to the Secretary of the Interior.

A handwritten signature in black ink, reading "James B. Stacks".

Comptroller General  
of the United States

COMPTROLLER GENERAL'S  
REPORT TO THE CONGRESS

TRANS-ALASKA OIL PIPELINE--  
INFORMATION ON CONSTRUCTION,  
TECHNICAL, AND ENVIRONMENTAL  
MATTERS THROUGH SPRING 1977  
Department of the Interior

D I G E S T

When the trans-Alaska pipeline is completed, the system will consist of about 800 miles of 48-inch pipe, 12 pump stations, a communications system, and a terminal at Port Valdez. The project is financed by eight oil companies. It is constructed primarily on Federal land, and the Secretary of the Interior is responsible for assuring that the system is constructed in accordance with the environmental and technical stipulations set forth in the right-of-way agreement.

CONSTRUCTION SCHEDULE AND  
STATUS AS OF SPRING 1977

This report provides information on the status of the project through spring 1977. As of mid-April 1977 it was 95.9-percent complete compared to a planned 96 percent. The system became operational in June of this year and was to be capable of transporting 1.2 million barrels of oil a day by November 1977. Construction of the production facilities at the Prudhoe Bay oilfield is on schedule and the developers of the field will be able to produce enough oil to meet the scheduled flow rates of the pipeline system.

Subsequent to the completion of GAO's review and the preparation of this report a serious accident occurred at pump station 8. The impact of this disaster on cost and final completion is not known at this time. The explosion at pump station 8 was the result of human error according to preliminary reports by Alyeska and Government officials and does not relate to matters discussed in this report.

FEDERAL AND STATE MONITORING OF  
CONSTRUCTION OF THE TRANS-ALASKA  
OIL PIPELINE SYSTEM

Alyeska Pipeline Service Company--agent for the owner companies--is responsible for

developing a comprehensive quality assurance program to assure compliance with the environmental and technical stipulations of the right-of-way agreement. The Department of the Interior's Authorized Officer is responsible for approving the quality assurance program and for making sure that this is carried out.

In a prior report entitled "Trans-Alaska Oil Pipeline--Progress of Construction Through November 1975" Feb. 17, 1976 (RED-76-69), GAO reported that work frequently did not conform to the contract stipulations because Alyeska's quality assurance program did not function properly.

The most significant environmental problems noted by Federal monitors during the 1975 construction season were lack of erosion control, oil spills related to construction activities, and failure to comply with State sewage treatment standards. During the 1976 construction season only the sewage treatment problem had been corrected. Federal monitors reported that erosion control problems and oil spills continued throughout the 1976 construction season and carried over into 1977. In addition, violations of requirements for installation of big game crossings were also identified.

Although the Authorized Officer brought these matters to Alyeska's attention, and obtained corrective action in most instances, the problems were not always corrected in a timely manner. Corrective actions to reduce oil spillage and erosion control problems did not reduce their occurrence during the 1976 construction season, although some improvements were noted during spring 1977. (See chs. 4 and 5.)

#### TECHNICAL STIPULATIONS FOR THE PIPELINE SYSTEM

The technical stipulations included in the right-of-way agreement establish requirements for welding, corrosion control, and a control system to detect oil leaks, including those resulting from seismic events.

In August 1975, Alyeska began an audit which disclosed that 3,955 potential girth weld (a weld joining two sections of pipe) discrepancies had been made during the 1975 construction season. The audit was undertaken as a result of welding discontinuities found by Alyeska Quality Assurance and an employee of Ketchbaw Industries, radiographic inspection contractor at that time. Subsequent independent reviews of the radiographs relating to these welds by Mechanics Research, Inc., and other experts employed by the Authorized Officer indicated that the number of weld defects reported by Alyeska's audit may have been understated.

After an investigation of the weld defects by several groups of experts, a consensus was reached that the weld defects were minor and would not adversely affect the integrity of the pipeline. During the period that these investigations were in progress, Alyeska proceeded to repair the mainline girth welds that had been classified as defective, except for three welds for which the repair requirement was waived by the Department of Transportation which has established safety regulations for the design, construction, operation, and maintenance of the pipeline. Alyeska completed this work in May 1977 and as of June 1977 all nonconformances related to the integrity of the pipeline had been corrected.

The effectiveness of the corrosion control system for protection of the buried portion of the pipeline is not known at this time. Several years may elapse before Alyeska can satisfactorily demonstrate that the present corrosion control system is adequate.

Instead of a completely automatic system, Alyeska now plans to install a seismic control system consisting of earthquake sensing devices placed along the pipeline route with provision for automatic shutdown of the line if an operator does not respond to a seismic event. This change has been approved by the Authorized Officer.

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### ABBREVIATIONS

GAO      General Accounting Office  
MRI      Mechanics Research, Inc.

## CHAPTER 1

### INTRODUCTION

The Chairman of the Subcommittee on Public Lands, House Committee on Interior and Insular Affairs, asked us, in an April 3, 1975, letter, to report on the status of the construction of the trans-Alaska oil pipeline system at the end of the 1975 construction season and to identify any potential problems for the 1976 construction season. Pursuant to this request, we issued a report entitled "Trans-Alaska Oil Pipeline--Progress of Construction Through November 1975" Feb. 17, 1976 (RED-76-69).

This is our second report on the status of construction of the trans-Alaska oil pipeline and was prepared in response to the Chairman's request that we continue to monitor construction of the project. This report presents information on the status of project construction through spring 1977, and discusses the activities of Federal agencies responsible for monitoring construction of the pipeline system and the environmental and technical problem areas encountered to date.

We did not obtain formal comments from agency officials; however, we discussed the contents of this report with appropriate Federal and State officials who expressed general agreement with the information presented.

#### COMPANIES RESPONSIBLE FOR THE PIPELINE SYSTEM

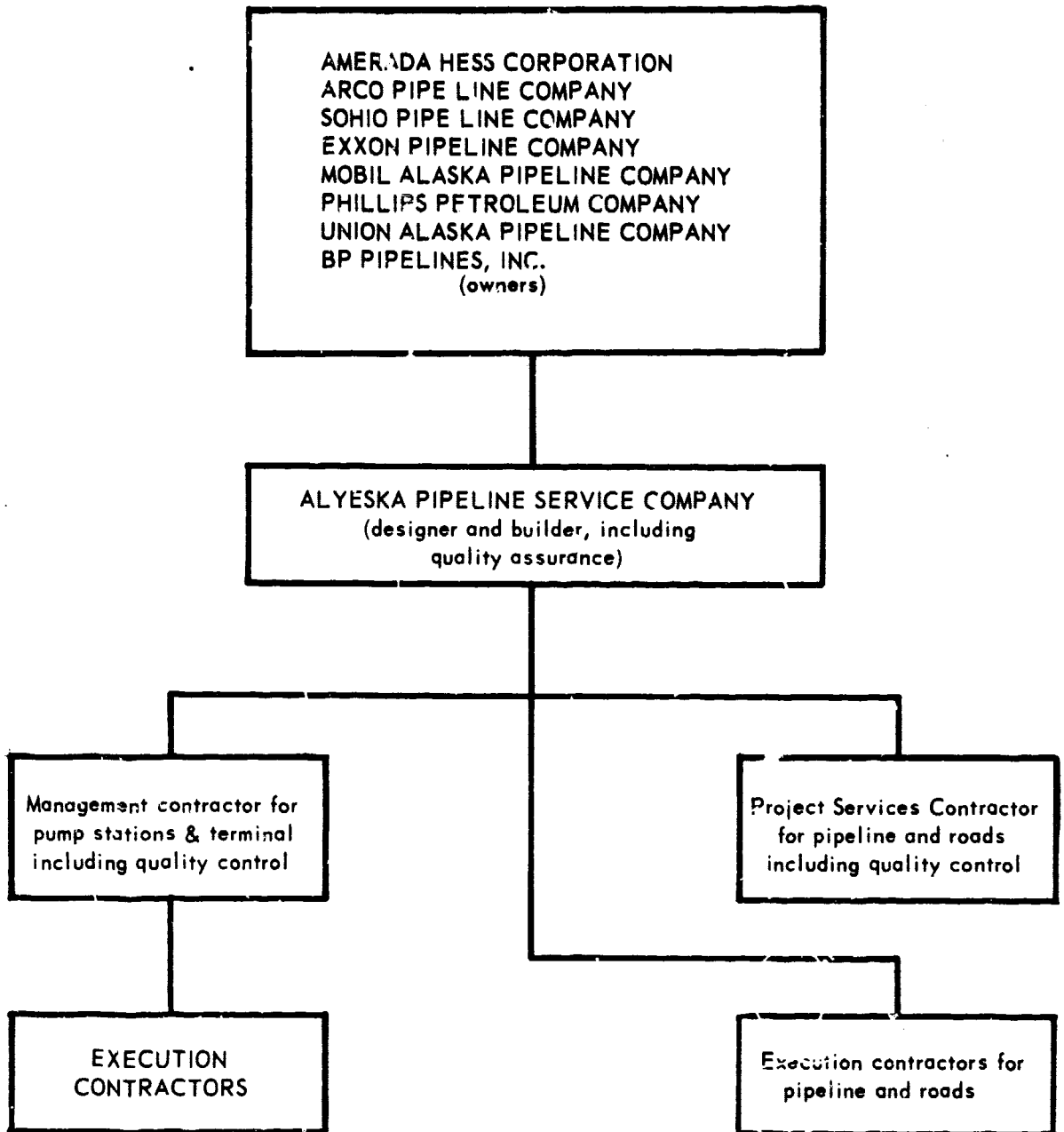
In August 1970 the permittee companies formed the Alyeska Pipeline Service Company as their common agent for designing and constructing the pipeline system. The organization of private interests involved in this undertaking is shown on page 2.

On January 23, 1974, the Secretary of the Interior and the owner oil companies signed the agreement and grant of right-of-way for the trans-Alaska oil pipeline. The right-of-way agreement includes stipulations designed to insure maximum protection of the environment. To insure compliance with these stipulations, the Department of the Interior established an organization to review the design of the pipeline system and to monitor its implementation.

Construction of the pipeline system officially began on April 29, 1974. The project is privately financed by the owner companies and the current approved construction budget is \$7.7 billion.



**COMPANIES RESPONSIBLE FOR DESIGNING, BUILDING, AND OPERATING THE TRANS-ALASKA OIL PIPELINE SYSTEM**



## THE TRANS-ALASKA OIL PIPELINE SYSTEM

The trans-Alaska oil pipeline extends from Prudhoe Bay on Alaska's North Slope to Port Valdez (see map on page 4). The pipeline system consists of about 800 miles of 48-inch pipe, 12 pumping stations, a communications system, and a terminal at Port Valdez. When completed the system will be capable of transporting 1.2 million barrels of oil a day.

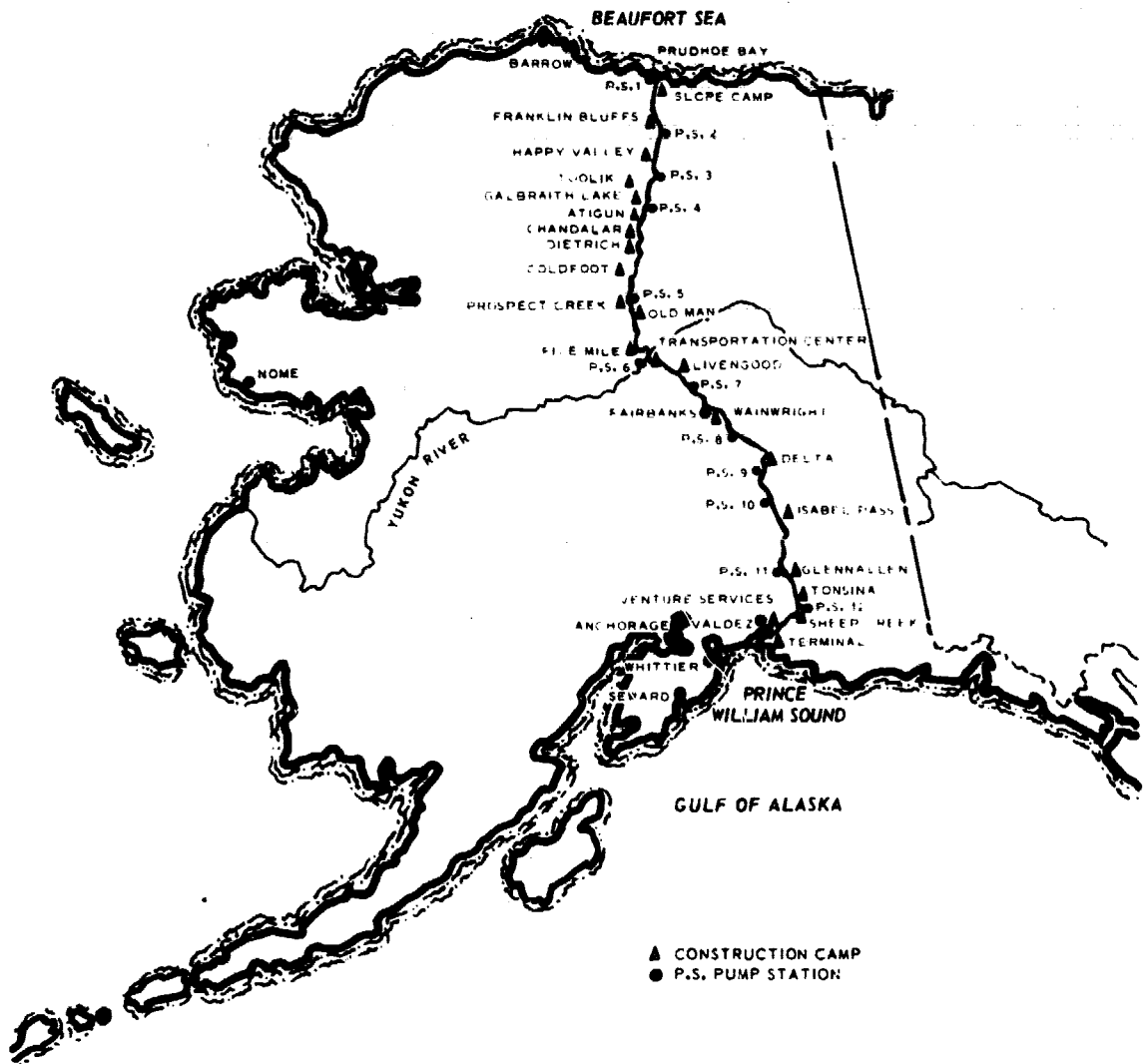
Before the start of pipeline construction, the right-of-way was cleared and a work pad was constructed. The gravel work pad, which covers most of the right-of-way, was needed to support construction and maintenance activities and to protect the tundra.

The climate, soil, and seismic conditions along the pipeline route are unusual and required special construction techniques. Temperatures range from the 90s in the summer to 80 below zero in the winter, the soil under much of the route is permanently frozen, and earthquakes ranging as high as 8.5 on the Richter scale all posed special construction and design problems.

In those areas where the soil becomes unstable when thawed, the pipeline was installed above the ground on support platforms which are 50 to 70 feet apart. A support platform consists of a crossbeam installed between two vertical supports placed in the ground. To compensate for the expansion and contraction of the above ground pipe, the line was built in a zigzag configuration. About 422 miles of the pipeline was constructed in the above ground mode.

About 341 miles of the pipeline is buried in the conventional manner in areas where the soil remains stable even when thawed. There are also about 4 miles of buried pipeline that required a special ground refrigeration system, and 32 miles of river and stream crossings.

# TRANS-ALASKA OIL PIPELINE ROUTE



## CHAPTER 2

### CONSTRUCTION SCHEDULE AND STATUS

#### THROUGH SPRING 1977

In November 1976 construction of the trans-Alaska oil pipeline system was 91-percent complete and was 3.5-percent behind schedule. By mid-April 1977 it was 95.9-percent complete compared to a forecasted 96 percent. The pipeline system became operational in June 1977. It was to be capable of transporting 1.2 million barrels of oil a day by November 1977. Development of the Prudhoe Bay oilfield is on schedule and the developers of the field will be able to produce enough oil to meet the scheduled flow rates of the pipeline system.

Subsequent to the completion of GAC's review and the preparation of this report a serious accident occurred at pump station 8. The impact of this disaster on cost and final completion is not known at this time. The explosion at pump station 8 was the result of human error according to preliminary reports by Alyseka and Government officials and does not relate to matters discussed in this report.

#### CONSTRUCTION SCHEDULE

Alyeska began pipeline system operations in June 1977 transporting 600,000 barrels of oil a day through the system by July 1977. To achieve this goal, the following facilities were mechanically complete:

- The oil pipeline.
- Five pump stations to move the oil and one pump station for pressure relief.
- Passthrough facilities at the other six pump stations.
- The terminal, including two berths and six oil storage tanks.
- The communications system.

To increase the system's capacity to transport 1.2 million barrels of oil a day three pump stations and two additional berths at the terminal will have to be completed. As of the first week of June 1977, the terminal was 92-percent complete compared to a planned 93.3 percent. The owner companies have not yet authorized construction of the additional facilities needed to expand the system's capacity above 1.2 million barrels a day.

## STATUS OF CONSTRUCTION

Alyeska planned to complete 94.5 percent of the pipeline system by November 1976, but as of that date the system was 91-percent complete. During winter and spring the schedule was improved upon and by mid-April 1977 the system was 95.9-percent complete compared to a planned 96 percent as shown in the following table.

### Percent of Construction Completed

	<u>Nov. 28, 1976</u>	<u>Apr. 17, 1977</u>
Pipeline:		
Planned	100.0	100.0
Actual	97.3	99.1
Pump stations:		
Planned	88.9	99.4
Actual	88.1	98.0
Terminal:		
Planned	87.4	89.3
Actual	81.1	88.7
Communications (note a):		
Planned	100.0	100.0
Actual	99.9	100.0
Total:		
Planned	94.5	96.0
Actual	91.0	95.9

a/Not included in the total system percentages.

### Pipeline

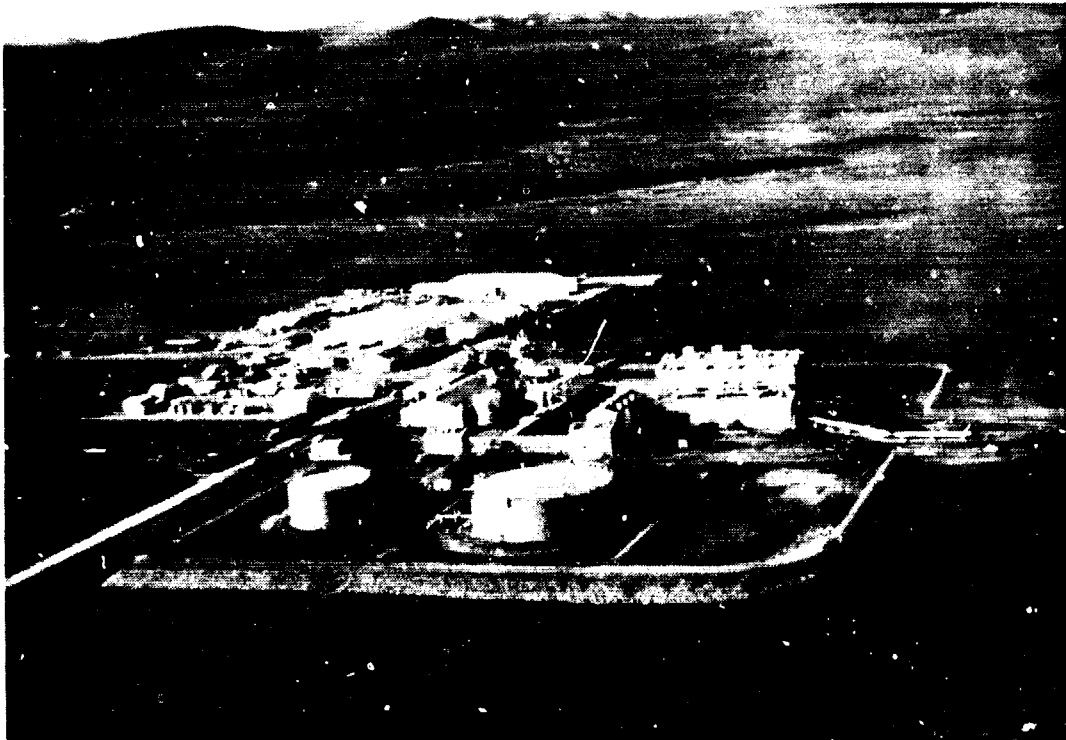
By April 17, 1977, the approximate 800 miles of mainline pipe from Prudhoe Bay to Port Valdez was 99.1 percent complete with all welding finished, except for tie-in welds where hydrostatic testing of the line was not yet complete. According to Alyeska officials, hydrostatic testing was the most significant remaining activity. Because this work could not be done during the winter, Alyeska resumed hydrostatic testing in March 1977 and completed this work in May 1977.

### Pump stations

Construction of the 12 pump stations was 98-percent complete as of April 17, 1977, compared to the planned



**Elevated pipeline on the North Slope. (1)**



**Pump Station three-permanent facilities in foreground and temporary construction facilities in background. (2)**

completion percentage of 99.4 percent. Alyeska anticipates that all pump stations will be completed by mid-July 1977. (See photograph 2 on p. 7.)

### Terminal

The Valdez terminal was 81.1-percent complete as of November 28, 1976, compared to 87.4-percent planned completion. According to Alyeska, construction of the terminal was behind schedule due primarily to (1) an increase in the amount of excavation work required, (2) delays in material deliveries, and (3) a limitation on the size of the work force. As of April 17, 1977, the terminal was 88.7-percent complete compared to a planned 89.3 percent, and all of the terminal facilities needed to begin operations were finished. Facilities needed to operate at the 1.2 million-barrel-a-day capacity will be completed by November 1977.

Alyeska told us they plan to maintain a larger work force at the terminal during the spring and summer of 1977 than previously planned in order to complete construction at the terminal on schedule. (See photograph 3 on p. 10.)

### Communications system

Both the main and alternate communications systems for the pipeline were completed by January 1977.

## STATUS OF RELATED ACTIVITIES

### The Prudhoe Bay oilfield

The Atlantic Richfield Company and BP Alaska Incorporated are developing the Prudhoe Bay oilfield, which will have about 150 operational wells. Piping will connect each well to one of six gathering centers where the natural gas will be separated from the crude oil before the oil enters the pipeline system.

Atlantic Richfield and BP Alaska officials told us construction of the oil production facilities was on or ahead of schedule and that they anticipate no difficulty in producing 600,000 barrels of oil a day by July 1977 and 1.2 million barrels a day by November 1977. We were advised that all of the building modules were onsite; the flow lines that carry the oil to the main pipeline system were in place; and 114 producing oil wells had been drilled. Two gathering centers, each capable of providing 300,000 barrels a day were completed by April 1977 and two additional gathering centers will be completed by July 1977.

## Vessel traffic control system for Port Valdez

The Trans-Alaska Pipeline Authorization Act requires that a vessel traffic system for the port of Valdez be established to reduce the possibility of ship collisions and groundings and to protect waterways, shorelines, personnel, and cargo. The Coast Guard is constructing the system which is scheduled for completion during fall 1977. The system will consist of tanker lanes, improved navigational aids, a communications system, a radar system, and a control center.

The Coast Guard has established the tanker lanes and has installed navigational aids, such as whistles, buoys, and lights. The project manager advised us that installation of electronic equipment, such as radar and radios, began about April 1977 and would be completed about September 1977. Until then, the Coast Guard will use temporary portable radar and communications equipment to provide service to tankers transporting oil from Port Valdez.





Valdez terminal as of September 27, 1976, showing loading berths in the right foreground. The power plant and vapor recovery facility is located between the east (14 tanks) and west (4 tanks) tank farms, and the control building is just to the right of the ballast water treatment facility (3 tanks). The temporary construction camp is at left center. (3)

### CHAPTER 3

#### MONITORING OF CONSTRUCTION OF THE TRANS-ALASKA OIL PIPELINE SYSTEM

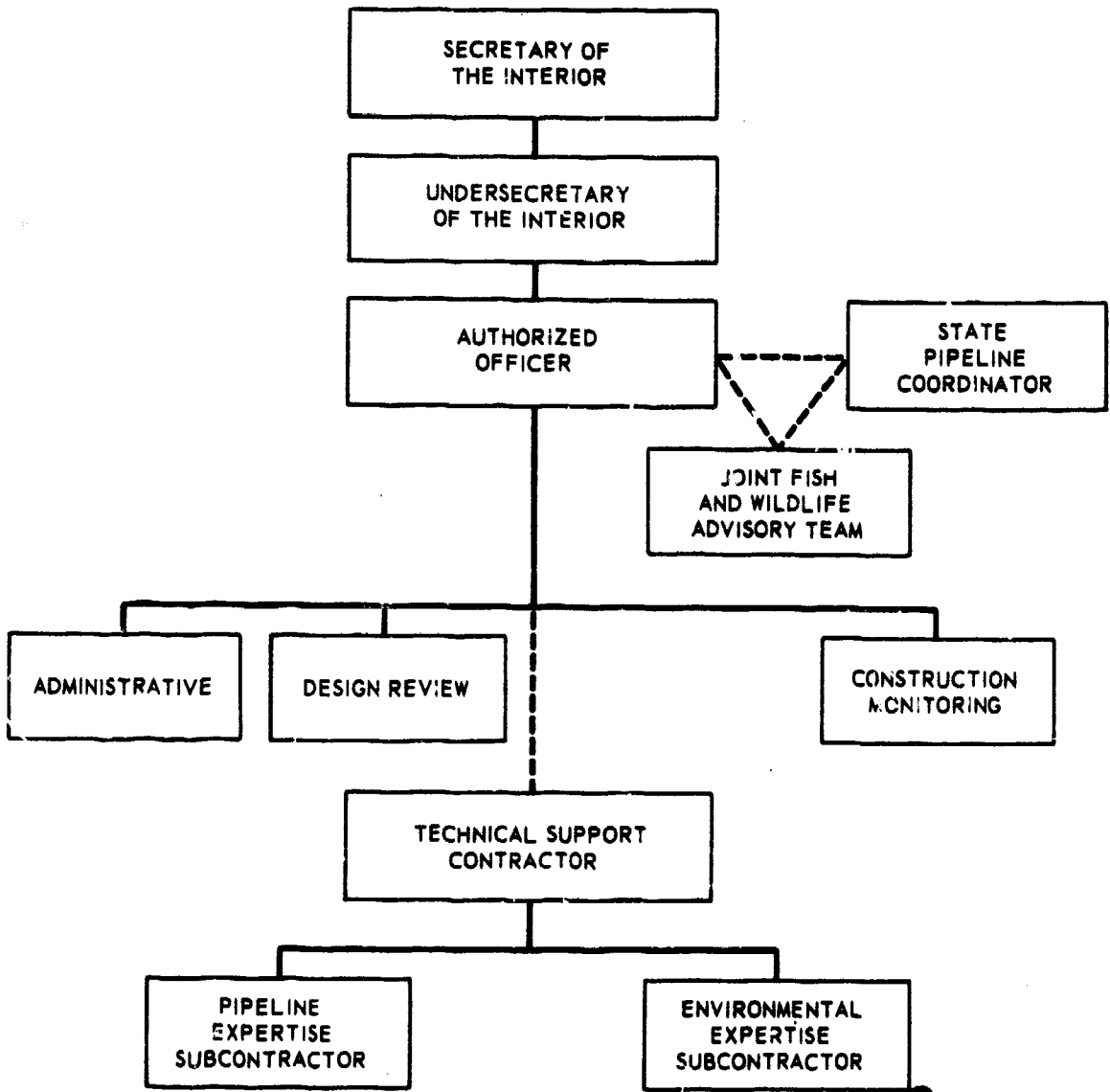
The trans-Alaska oil pipeline system is being constructed through 572 miles of Federal lands, 188 miles of State lands, and 39 miles of private land. Public Law 93-153 directed the Secretary of the Interior to issue, administer, and enforce the right-of-way permit through Federal lands and to issue regulations or stipulations for protection of the environment. On January 23, 1974, the Secretary and the owner companies signed the right-of-way agreement which 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 insuring 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 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 the implementation of Alyeska's quality assurance and quality control programs. The Authorized Officer has the authority to suspend any or all construction, operation, or maintenance activity, including the transport of oil, if Alyeska fails or refuses to comply with any provision of an order of the Authorized Officer, or of the right-of-way agreement, necessary to protect the environment. To meet these responsibilities, the Secretary established a separate organization headed by the Authorized Officer, as shown in the chart on page 12.

The Department of the Interior contracted with Mechanics Research, Inc., (MRI) for expertise on compliance with environmental and technical stipulations. To obtain expertise on fish and wildlife, the Authorized Officer and the State of

**ORGANIZATION OF INTERIOR'S ALASKA PIPELINE OFFICE  
DURING PIPELINE CONSTRUCTION**



Alaska established a joint fish and wildlife team. The staffing of these organizations is shown in the following table.

	Authorized Officer ( <u>note a</u> )	Contractor ( <u>note b</u> )	Fish and wildlife ( <u>note a</u> )
Management and administration	13	17	6
Technical	9	8	20
Field surveillance	<u>11</u>	<u>24</u>	<u>9</u>
Total	<u>33</u>	<u>49</u>	<u>35</u>

a/As of June 1977.

b/As of mid-May 1977.

#### CONSTRUCTION MONITORING PROGRAM

The right-of-way agreement requires that Alyeska establish a comprehensive quality assurance program designed to help assure that the environmental and technical stipulations are fully complied with during construction of the pipeline system.

The Authorized Officer tentatively approved Alyeska's quality assurance program in July 1974, but withheld final approval at that time because of certain deficiencies in the program. In July 1975, Alyeska revised their quality assurance program and the Authorized Officer gave final approval to Alyeska's program on August 18, 1975. At that time, about 22 percent of the total project was completed, including installation of about 33 percent of the pipe.

To monitor the effectiveness of Alyeska's quality assurance program, the Authorized Officer relied primarily on a spot check program conducted by the technical support contractor. The spot checks consisted of inspecting materials, workmanship, or work in process for compliance with the plans and specifications, the environmental and technical stipulations, or other provisions of the right-of-way agreement.

The Authorized Officer also received reports on construction activities from his own field representatives and from the Fish and Wildlife advisors. The Authorized Officer's

Field Representatives maintain a daily record of their activities and actions, and prepare field memos to formally transmit instructions and approval or disapproval actions to Alyeska. Fish and Wildlife advisors notified the Authorized Officer's Field Representatives of their observations and recommendations on matters relating fish and wildlife.

MONITORING PROBLEMS

During the 1975 construction season, instances of nonconforming work were not being corrected through Alyeska's quality assurance program. The Authorized Officer required Alyeska to strengthen their quality assurance program, but the actions taken did not prevent additional nonconformances from occurring.

Monitoring data for 1976 also shows that there was little, if any, improvement in the number of nonconformances reported by Federal monitors. While all nonconformances do not represent direct violations of the stipulations, this data shows that the quality assurance program did not improve in 1976.

	<u>1975 (note a)</u>		<u>1976 (note a)</u>	
	<u>Total reports</u>	<u>Number of nonconformance reports</u>	<u>Total reports</u>	<u>Number of nonconformance reports</u>
Spot check reports	3,976	1,406	4,995	1,613
Field memos	N/A	76	N/A	98
Advisory memos	N/A	139	N/A	194

a/Data covers the 4-month periods from May through August of 1975 and 1976.

On several occasions during the 1976 construction season, Federal monitors reported inadequacies in the quality assurance program. For example, on March 14, 1976, a Federal monitor reported that for a 2-day period during welding of mainline pipe, no quality control welding inspectors had been onsite to perform inspection and quality control functions.

Nonconforming work continued during the 1976 construction season because the actions taken by the Authorized Officer were not sufficient to assure correction of the weakness in the quality assurance program. In the summer of 1976, Federal monitoring efforts were reviewed by auditors

from the Department of the Interior and by an independent certified public accounting firm. These auditors reported that while the monitoring systems were generally adequate, the Authorized Officer had been reluctant to use his authority to stop construction activity as necessary to assure correction of deficiencies.

As of June 1977 all reported nonconformances having to do with the integrity of the pipeline had been corrected. Environmental deficiencies, however, continue to be a problem. The following examples are indicative of the need for aggressive action by the Authorized Officer to obtain corrective action by Alyeska.

### Erosion control

In 1975 Federal monitors found that Alyeska's failure to properly implement their erosion control plans had resulted in siltation of the water and land during spring breakup and instances of structural failure of the work pad. After the Authorized Officer brought this matter to Alyeska's attention, an inventory of the specific areas in need of erosion control work was completed and specific erosion control plans were developed for these areas.

In 1976 Federal monitors found erosion control problems similar to those that had occurred in 1975. Federal monitors told us that these conditions arose because Alyeska assigns a higher priority to pipeline construction than to the erosion control work.

The Authorized Officer did not require Alyeska to correct in a timely manner specific instances of nonconformances noted by Federal monitors. For example, construction of the work pad across the Tolovana River flats in 1975 obstructed the natural drainage and caused excessive ponding of water. The problem became increasingly worse, and by the fall of 1975 was jeopardizing the integrity of the work pad. In October 1975, the Authorized Officer's Field Representative directed Alyeska to eliminate the problem within 48 hours, but the problem was not corrected. In May and June 1976, the ponding condition was worse than it was in 1975. A nearby miner's trail eroded in an area 20-feet wide and 100-feet long, and silt was being deposited into the Tolovana River. The Authorized Officer's Field Representative again directed Alyeska to correct the problem and Alyeska ultimately took corrective action.

## Federal monitoring of mainline girth welds

Federal surveillance efforts on field welding during 1975 were limited primarily to visual inspection of those procedures which were known to produce very large reject rates. In addition Federal spot checking of radiography consisted of a review of equipment procedures, qualifications, and film handling. No attempt was made to interpret the radiographs because the Federal monitoring staff did not include qualified radiographers.

Federal monitors spot checked 1,067 of 30,805 welds made in 1975. Of these, 283 or 26.5 percent were reported to be in nonconformance with the specifications.

MRI reported that the welding deficiencies resulted from poor workmanship, welding with an unqualified procedure, welding outside the parameters of an approved qualified procedure, and from misinterpreted and fraudulent radiographs. Except for the misinterpreted and fraudulent radiographs, the Authorized Officer was aware of these problems as they occurred and had notified Alyeska that a problem existed. For example, the Authorized Officer expressed concern to Alyeska on numerous occasions in 1975 that the radiographers were far behind the welding crews and that it was questionable whether adequate welding quality could be controlled when the radiography units were miles behind the welding crews. However, Alyeska was not required to reduce the distance between the welders and the radiographers.

The new welding and radiographic control procedures developed for the 1976 construction season had been approved by the Authorized Officer. However, on April 23, 1976, the Authorized Officer advised Alyeska that the procedures were not being implemented properly. For example, the radiographic team was far behind the welders and the film interpretation for the preceding day's welding was not available to the foreman and welding supervisor as required. A MRI report on welding dated June 1, 1976, stated that Federal spot checks in the field continued to reveal problems in the implementation of approved welding procedures.

## OBSERVATIONS

The right-of-way agreement provides that Alyeska will be responsible for implementing a comprehensive quality assurance program designed to assure compliance with the environmental and technical stipulations. The Authorized

Officer was responsible for approving the quality assurance program and for monitoring its implementation.

Federal monitoring data shows that many nonconformances occurred during the 1975 and 1976 construction seasons because of inadequacies in Alyeska's quality assurance program and the Authorized Officer's unwillingness to use proper authority to assure compliance. The Authorized Officer brought these nonconformances to Alyeska's attention but the corrective action was not always initiated in a timely manner.



## CHAPTER 4

### ENVIRONMENTAL PROBLEMS

In our report entitled "Trans-Alaska Oil Pipeline-- Progress of Construction Through November 1975," Feb. 17, 1976 (RED-76-69), we reported that the most significant environmental problems during the 1975 construction season occurred due to the lack of erosion control, oil spills, and Alyeska's failure to comply with State standards for sewage treatment. We also reported on two minor problems involving the feeding of animals and the opening of a gravel pit on scenic Sukakpak Mountain. During the 1976 construction season, operation of sewage treatment plants improved and was no longer considered to be a problem. However, the other types of environmental problems noted in 1975 continued throughout the 1976 construction season, as discussed below. In addition, an audit in February 1976 disclosed that numerous big game crossings did not meet construction specifications.

#### EROSION CONTROL

Erosion causes environmental damage by removing soils from their natural locations and depositing them, in the form of sediments, where damage will result to other resources. Sediment deposited in streams adversely affects fishery resources; sediment deposited on land damages the natural vegetation.

In 1975 Federal monitors found that Alyeska's erosion control efforts were not always integrated with construction, drainage structures were inadequate in size and number, and disturbed areas had not been revegetated. As a result, the spring runoff caused siltation of water and lands, as well as saturation and structural failure of the work pad in many areas. (See photograph 4 on p. 20.)

Federal monitors found similar problems during the 1976 construction season. For example, a Federal evaluation team reported erosion control problems involving inadequate provisions for controlling drainage, ponding of water that resulted in erosion of the work pad, and inadequate treatment of back cuts. <sup>1/</sup> The report noted that Alyeska seems to respond to erosion control problems only

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<sup>1/</sup>Excavation (cutting back) of a sloped area.

when it becomes clear that pipeline construction activity would be shut down. Our review of Federal monitoring reports also showed numerous instances of Alyeska's failure to correct erosion problems in a timely manner. A listing prepared by the Joint Fish and Wildlife Advisory Team near the end of the 1976 construction season showed that erosion control continued to be a problem area and has carried over into the 1977 construction season.

### OIL SPILLS

From the beginning of the project in April 1974 through November 1976, about 376,000 gallons of oil and fuels had been spilled. About 199,000 gallons were spilled during the 12-month period ending November 30, 1976.

In August 1975, Alyeska initiated action to reduce oil spills from camp fuel systems, the major source of oil spills. These measures included pressure testing of the fuel systems, installation of fuel flow meters, replacement of substandard fittings, increased preventive maintenance, and programs of improved recordkeeping so that any changes are immediately checked for possible fuel leakage. Federal monitors subsequently reported that these procedures have significantly reduced the spillage of fuel from camp fuel systems. However, in 1976 there was no reduction in the amount of spillage as a result of fuel handling.

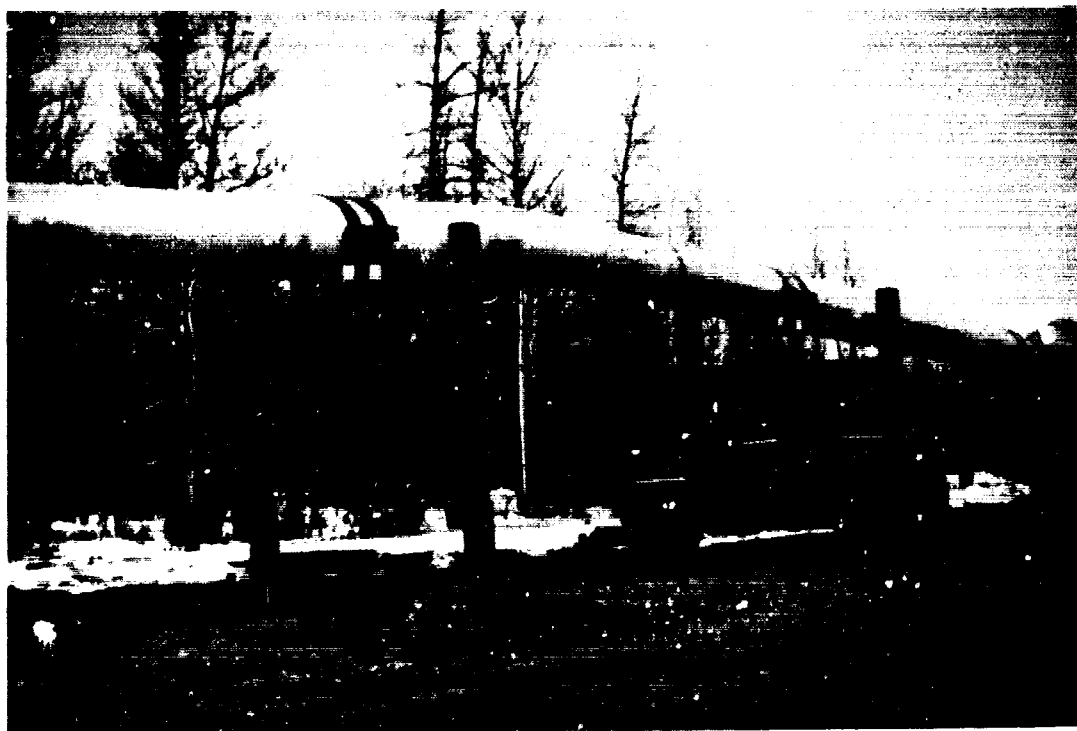
A November 1976 report by Federal monitors concluded that overall improvement in fuel handling procedures was not evident from field observations. As of spring 1977 the amount of spillage was reduced as a result of reductions in workforce and camp closings, but worker negligence was still causing problems.

### BIG GAME CROSSINGS

The pipeline design, submitted by Alyeska and approved by the Authorized Officer, includes over 500 elevated crossings. (See photograph 5 on p. 20.) In May of 1975 and throughout the 1975 and 1976 construction seasons, Fish and Wildlife advisors noted many instances where the elevated crossings had not been constructed to the minimum clearance. A February 1976 audit revealed that 88 of 224, or 39 percent, of the elevated crossings constructed during 1975 did not meet the required construction standards. Alyeska agreed, and in conjunction with the Fish and Wildlife advisors, developed a plan to correct the deficiencies for the 88 game crossings that did not meet the specifications. During the 1976 construction season, 69 of the 326 game crossings constructed did not meet specifications.



**Structural failure of the workpad caused by inadequate culvert. (4)**



**Elevated big game crossing. (5)**

Alyeska was required to correct these problems and completed remedial work on the big game crossings in June of this year.

#### MINOR PROBLEMS

Two minor problems included in our prior report have not been completely resolved. Federal monitors reported that workers refuse to keep their contacts with wildlife to a minimum, despite Alyeska's efforts and a new State law which imposes a \$1,000 fine on individuals convicted of feeding animals along the pipeline route. A Federal official told us that at least six bears were killed in 1976 to protect the workers or by vehicle accidents.

Restoration of the gravel pit at Sukakpak Mountain began in the fall of 1976. Federal officials told us that regrading of the site had been completed and that reseeding will be accomplished in 1977.

#### IMPACT OF ENVIRONMENTAL PROBLEMS

The Agreement and Grant of Right-of-Way gives the Authorized Officer authority to require the permittees to rehabilitate any natural resource that was seriously damaged or destroyed as a result of construction, operation, maintenance, or termination of all or any part of the pipeline system.

Fish and Wildlife advisors are in the process of assessing the impact of the environmental damage that has occurred. A habitat evaluation study is underway to identify terrestrial and aquatic habitat that has been lost, and to assess the impact of special pipeline structures (e.g., river crossings and game crossings) on the movement of fish and wildlife. The U.S. Fish and Wildlife Service is also conducting special studies to evaluate the potential and actual impact of construction of the pipeline on the environment.

According to the Fish and Wildlife advisors, the full impact of the environmental problems cannot be determined until the evaluation studies are completed. We were advised that some of these studies will be completed within 1 to 2 years, but that others will require 5 years to complete.

According to the Authorized Officer, Alyeska will be required to rehabilitate unanticipated damage to natural resources, such as siltation damage to fish spawning beds, or vegetation damaged by oil spills.

## OBSERVATIONS

The environmental stipulations of the right-of-way agreement were designed to minimize the environmental damage resulting from construction of the trans-Alaska oil pipeline system. Although the impact of construction on the environment is not known at this time, some environmental damage occurred because Alyeska (1) did not comply with the environmental stipulations and (2) has not corrected known environmental problems in a timely manner. Federal monitors are now in the process of assessing the overall impact of this construction project on the Alaskan landscape. According to the Authorized Officer, Alyeska will subsequently be required to revegetate and rehabilitate environmentally damaged areas.

## CHAPTER 5

### TECHNICAL STIPULATIONS FOR THE PIPELINE SYSTEM

The technical stipulations in the right-of-way agreement include requirements for pipeline welding, corrosion control, and a control system to detect oil leaks, including those resulting from seismic events.

#### MAINLINE WELDING PROBLEMS

In August 1975 Alyeska conducted an audit which disclosed the existence of potential girth weld (a weld joining two sections of pipe) discrepancies and radiographic problems. It was undertaken as a result of welding discontinuities found by Alyeska Quality Assurance and an employee of Ketchbaw Industries, radiographic inspection contractor at that time. The audit was eventually expanded to include a review of the 30,805 radiographs made during 1975. Identifying features for each radiograph were placed into a computerized data bank to isolate those radiographs where duplication or falsification may have occurred. The results of the Alyeska audit were released in April 1976 and showed the following:

<u>Discrepancy</u>	<u>Number of radiographs</u>	<u>Percent of total</u>
Radiographic deficiencies	1,403	4.6
Welding discontinuities	1,948	6.3
Other welding irregularities	<u>604</u>	<u>2.0</u>
	<u>a/3,955</u>	<u>12.8</u>

a/Subsequently increased to 3,958 by Alyeska.

The 1,403 radiograph deficiencies included 274 apparent duplications of radiographs; 605 missing radiographs (based on a comparison of weld numbers to the radiographs and the number of empty spaces in the boxes used to store radiographs) including 307 welds that had not yet been made; and 524 miscellaneous radiographic deficiencies.

The 1,948 welding discontinuities represented welding flaws which exceeded the acceptance criteria.

The 604 other welding irregularities included are burns, damaged pipe, and inadequate repairs.

Independent review of mainline  
girth weld problems by others

In May 1976 the Authorized Officer contracted with Arthur Andersen & Company, a firm of certified public accountants, to determine if Alyeska used adequate procedures and controls in its audit of the 1975 girth weld radiographs. In May 1976, the Authorized Officer also directed that Mechanics Research, Inc., perform an impartial technical audit of the 1975 radiographs.

The Arthur Andersen report issued on July 19, 1976, concluded that the findings of the Alyeska audit were inconclusive with respect to the condition of each pipeline girth weld due to the use of inadequate procedures and controls, and the absence of sufficient documentary evidence to perform an effective audit.

The MRI consultant's draft report issued on August 10, 1976, stated that 33.6 percent of the radiographs included in their sample showed a need for remedial work, compared to 12.8 percent reported by the Alyeska audit. Although Alyeska disagreed with the findings of the MRI report, they did agree that the MRI consultants had identified 66 additional defective welds. The existence of 66 additional defective welds in a sample of 1,801 radiographs raised the possibility that hundreds of additional welds may also have been defective.

Because the results of the MRI consultants' audit were based on readings and interpretations of radiographs performed by one individual, the Authorized Officer requested that MRI select an additional sample of radiographs for review. Based on a review of 90 additional radiographs selected at random from welds classified by Alyeska as good welds, an MRI subcontractor found that 39 of the 90 radiographs, or 43 percent, showed minor weld defects.

In May 1976 the Authorized Officer also contracted with Southwest Research Institute to determine the soundness of the 1975 mainline girth welds and to verify that the remedial work on the defective welds had been performed satisfactorily. To determine the magnitude of the defective weld problem, the Institute reviewed 76 of the 1975 radiographs and found that 14, or about 18 percent, were defective.

Actions taken to correct  
mainline girth welds

During the period that remedial work was in progress, the Authorized Officer's representatives spot checked about 50 percent of the ongoing work. In addition, the Institute verified weld locations, matched the weld with a valid radiograph, and interpreted the radiograph to determine whether the weld met requirements.

On September 1, 1976, Alyeska requested a waiver from the Department of Transportation <sup>1/</sup> for 612 welds buried in permafrost, in flood plains, or under rivers but not yet repaired. Alyeska contended that the 612 welds in question would not jeopardize the integrity or safety of the pipeline as a whole, and that the excavation required to perform remedial work on the welds was not in the public interest. In addition, Alyeska notified Transportation that, pending action on its requests, remedial work would continue on the 612 welds for which the waiver was requested.

In reviewing Alyeska's waiver request, Transportation was assisted by the National Bureau of Standards and a panel of five experts. As of November 26, 1976, 34 of the 612 welds remained to be repaired. On that date, Transportation granted a waiver for 3 of the 34 welds on the grounds that reexcavation would result in adverse environmental impact and the weld defects did not constitute a risk of failure during the expected life of the pipeline. A total of 21 welds were considered acceptable based on the results of a series of fracture mechanics analysis tests but a waiver was not granted because the required excavation work had been completed and thus most of the environmental and cost impacts had been incurred. Eight welds were found to be in need of repair and two welds were not evaluated by Transportation because Alyeska had not provided the dimensions of the weld defects.

Alyeska completed remedial work on the defective welds in May 1977. (See photograph 6 on p. 28.)

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<sup>1/</sup>The Department of Transportation has established safety regulations for the design, construction, operation and maintenance of pipelines operated by carriers engaged in interstate commerce which transport liquid hazardous materials.



## Significance of the 1975 girth weld defects

Alyeska contends that most of the 1975 welding defects were marginal and that the tolerance limits were not exceeded to any significant degree. In their opinion, the remedial work, in most instances, was unnecessary and was accomplished for the sole purpose of complying with Government regulations.

In assessing the soundness of the 1975 girth welds and of the base metal adjacent to the welds, the Institute concluded in their report of October 1976 that the quality of the radiography and welding during 1975 was satisfactory based on the results of their fracture mechanics analyses. The report states that these analyses were performed by personnel who are specialists in fracture mechanics and who also have many years of experience in the construction and operation of pipelines.

In a letter dated November 2, 1976, to the Authorized Officer, MRI stated that the reports of the various parties engaged to review the mainline girth weld defects reflect differences in interpretation between various individuals, and that these differences become magnified in a relatively narrow range of marginal defects which may, after detailed analysis, be considered acceptable. In MRI's opinion, the radiographic interpreters used by Alyeska in its audit of 1975 radiographs met the test of overall performance acceptability. In addition welds interpreted by Alyeska to be in compliance but identified in the MRI report as being in non-compliance were welds that "might be classified as marginally acceptable defects."

## EFFECTIVENESS OF CORROSION CONTROL SYSTEM HAS NOT YET BEEN DEMONSTRATED

The stipulations in the right-of-way agreement require detailed plans for corrosion resistant design and methods for early detection of corrosion. The stipulations are particularly concerned with the quality of the coating, adequate cathodic protection over the entire surface of the pipe, monitoring of cathodic protection, and precautions against internal corrosion of the pipeline. According to Transportation, corrosion is the major cause of pipeline leaks.

## Corrosion control system for the trans-Alaska oil pipeline

The 422 miles of aboveground pipe is coated with zinc or epoxy and covered with thermal insulation and a metal

protective jacket. Moisture entering the insulation will exit through drain holes provided at regular intervals in the outer metal jacket. Because of the temperature of the oil, the outside surface of the aboveground pipe will not be subjected to condensation and corrosion problems should be negligible.

Most of the 345 miles of buried pipe were coated with epoxy and covered by a layer of tape. In addition to this, a cathodic protection system consisting of two parallel zinc ribbons were placed in the bottom of the ditch, approximately 3 feet from each side of the center of the pipe. (See photograph 7 on p. 28.)

Alyeska gathers data from a test section of the pipeline to demonstrate the adequacy of the corrosion control system. An MRI project engineer advised us that sufficient data may not be available until the fall of 1977 to determine whether the present cathodic protection system is adequate. In addition, factors such as the coating's resistance to earth will not be known until the pipeline is in operation. A period of 2 to 5 years may elapse before earth adjacent to the line stabilizes sufficiently to determine whether additional corrosion control measures will be required over the life of the pipeline. For these reasons, the MRI engineer stated that Alyeska may not be able to demonstrate the effectiveness of the cathodic protection system within 1 year after completion of the pipeline as required by Transportation regulations.

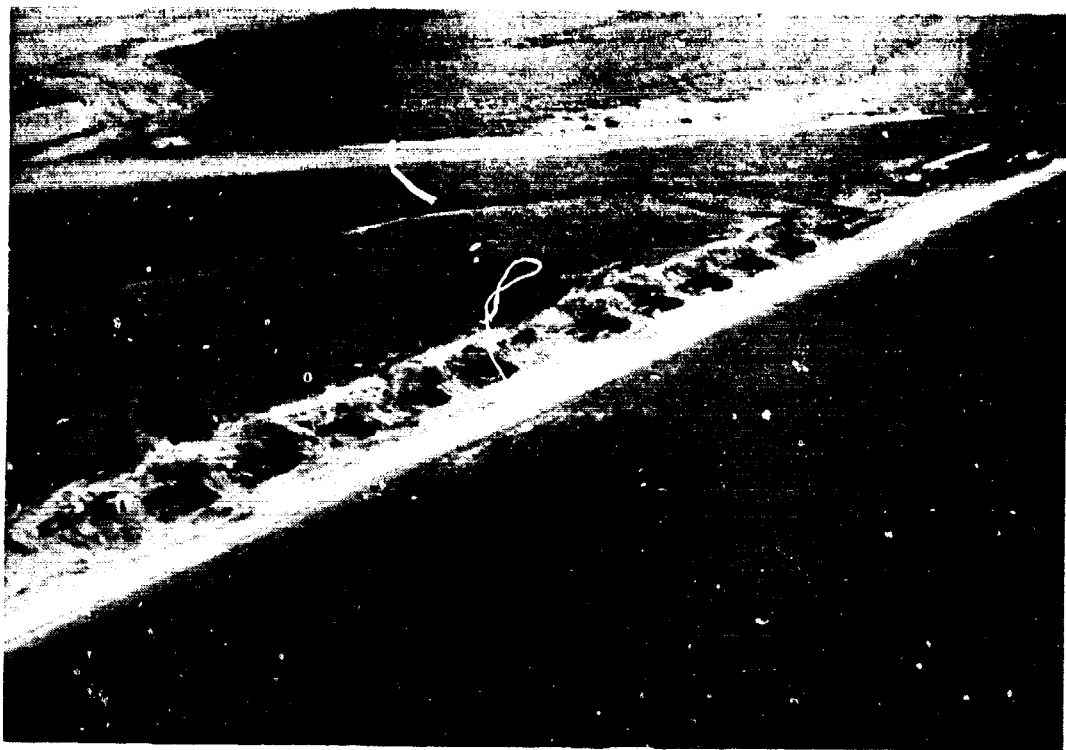
#### SUPERVISORY CONTROL SYSTEM

The trans-Alaska oil pipeline system will be monitored and controlled from the Operations Control Center at the Valdez terminal. Operating data will be transmitted between Valdez and the pump stations over the microwave communications system.

To regulate the flow of oil through the pipeline, each of the operating pump stations will have local control and instrumentation systems to monitor and regulate the flow and the pressures in the line. The supervisory control system also includes a system for detecting seismic events and oil leaks. Our comments on these systems follow.

#### Seismic control system

The stipulations require that the pipeline system be designed, where technically feasible, to include modern



Excavations to expose below-ground pipe for remedial weld work. (6)



Below-ground pipe exposed for remedial weld work, showing zinc anode in foreground and protective tape on pipe. (7)

state-of-the-art seismic procedures to prevent oil leakage resulting from earthquakes of certain established magnitudes. If not technically feasible, the stipulations require that the potential damage from an oil spill be minimized by special design provisions to include (1) a network of ground motion detectors that continuously monitor, record, and instantaneously signal the occurrence of ground motion in the vicinity of the pipeline at levels that would not be sufficient to limit operations and (2) a program for rapid shutdown of the system and prompt inspection of the system's integrity under the above circumstances.

Alyeska originally planned to install a completely automatic monitoring and shutdown system. However, the requirement for a totally automatic shutdown system was changed by Alyeska for the following reasons:

- A completely automatic monitoring system would be subject to false alarms that would degrade normal operation of the pipeline.
- Total shutdown of the system would render the leak detection system inoperable. If operations continue immediately after an earthquake, the presence and location of large leaks can be detected within minutes, and smaller leaks within a period of 24 hours.
- A programmed shutdown--combining both automatic and human responses--can be accomplished whenever seismic monitoring, leak detection, and other data indicate that such action is justified.

The Authorized Officer concurred in Alyeska's decision to delete the requirement for an automatic shutdown system. The Authorized Officer took the position that operator involvement in a programmed shutdown procedure enhances, rather than detracts from, the capabilities of the seismic control system, particularly with regard to early identification and location of leaks that would reduce the response and repair time and decrease the volume of oil spilled.

#### Leak detection system

The leak detection system uses (1) pressure deviation, (2) flowrate deviation, (3) flowrate balance, and (4) line-volume balance to identify leaks in the line. An MRI senior project engineer advised us that the overall sensitivity of the system will vary due to variances in the sensitivity of each instrument in the line-volume-balance leak detection

system. Officials told us that it will take 6 months to 1 year of actual operation before Alyeska has enough information to determine the size of leak that can be detected. All hardware, communications, and controls have been installed and the system became operational when oil started flowing through the pipeline in June 1977.

### OBSERVATIONS

An audit by Alyeska quality assurance disclosed that 3,955 defective welds were made during the 1975 construction season. However, independent reviews of the 1975 welds by MRI and other experts hired by the Authorized Officer indicated that the number of weld defects shown by the Alyeska audit was understated. MRI and other experts concluded that the weld defects were of minor significance and would not adversely affect pipeline integrity. Meanwhile, Alyeska proceeded to repair the mainline girth welds that had been classified as defective, except for three welds for which a waiver of the repair requirement had been granted by Transportation. Alyeska completed this work in May 1977.

The ability of the trans-Alaska oil pipeline's corrosion control system to protect the buried portion of the pipeline is not known at this time. Several years may elapse before Alyeska can satisfactorily demonstrate that the present corrosion control system is adequate.

Alyeska no longer plans to have a completely automatic system; however, the proposed changes in the system design have been approved by the Authorized Officer. The seismic control system to be installed will include earthquake sensing devices and provide for automatic shutdown if an operator does not respond to a seismic event within a certain period of time yet to be determined.

## CHAPTER 6

### SCOPE OF REVIEW

We reviewed pipeline activities at the Department of the Interior and Department of Transportation in Washington, D.C.; the Department of the Interior's Alaska Pipeline Office in Anchorage, Alaska; the Alyeska Pipeline Service Company in Anchorage, Alaska; and various field offices of these organizations along the pipeline route.

We reviewed applicable laws, regulations, and agreements relating to the granting of the right-of-way and protection of the environment during construction of the trans-Alaska pipeline system and their implementation. We also discussed these matters with officials of the above-named organizations.

PRINCIPAL OFFICIALS  
RESPONSIBLE FOR THE ADMINISTRATION  
OF ACTIVITIES DISCUSSED IN THIS REPORT

	<u>Tenure of office</u>	
	<u>From</u>	<u>To</u>
<u>DEPARTMENT OF THE INTERIOR</u>		
SECRETARY OF THE INTERIOR:		
Cecil D. Andrus	Jan. 1977	Present
Thomas S. Kleppe	Oct. 1975	Jan. 1977
Kent Frizzell (acting)	July 1975	Oct. 1975
Stanley K. Hathaway	June 1975	July 1975
Kent Frizzell (acting)	May 1975	June 1975
Rogers C. B. Morton	Jan. 1971	May 1975
ASSISTANT SECRETARY OF THE INTERIOR--ENERGY AND MINERALS:		
Joan M. Davenport	Apr. 1977	Present
William D. Bettenberg (acting)	Jan. 1977	Apr. 1977
William G. Fischer (acting)	Jan. 1976	Jan. 1977
Jack W. Carlson	Aug. 1974	Jan. 1976
King Mallory (acting)	May 1974	July 1974
Stephen A. Wakefield	Mar. 1973	Apr. 1974
John B. Rigg (note a)	Jan. 1973	Mar. 1973
Hollis M. Dole	Mar. 1969	Jan. 1973
ASSISTANT SECRETARY OF THE INTERIOR--LAND AND WATER RESOURCES:		
Guy R. Martin	Apr. 1977	Present
Jack O. Horton	Mar. 1973	Apr. 1977
OFFICE OF THE UNDER SECRETARY-- TECHNICAL ASSISTANT:		
Vacant	Jan. 1977	Present
John E. Latz	June 1973	Jan. 1977
OFFICE OF THE UNDER SECRETARY-- AUTHORIZED OFFICER:		
Morris J. Turner (acting)	Jan. 1977	Present
A. P. Rollins, Jr.	Jan. 1974	Jan. 1977
<u>a/Deputy Assistant Secretary in charge.</u>		