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Lessons learned from the experience of building the Trans-Alaska Pipeline will be useful for the proposed building of a gas pipeline by the Alcan consortium from Alaska through Canada to the lower 48 States. Alyeska Pipeline Service Corporation acted as the common agent for the eight companies involved in the pipeline system. Costs of building the Trans-Alaska Pipeline were grossly underestimated. Estimates for costs were low because of lack of past experience and low contingency allowances. Planning was based on minimal site data and unrealistic assessments. These same problems will be encountered by Alcan. Some escalating costs may have been avoided with fixed-price contracts, more systematized budgetary controls, and government auditing of costs during rather than after construction. There was no evidence to support claims that Government environmental requirements during construction caused significant delays. Present data may be insufficient to judge the economic feasibility of the proposed pipeline. This should be weighed carefully in view of expected pressure for guaranteed financing of project costs and for rolled-in pricing of the delivered gas. (Author/HTW)

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STATEMENT OF
MONIE CARFIELD, JR., DIRECTOR
ENERGY AND MINERALS DIVISION
BEFORE THE
SENATE COMMITTEE ON ENERGY
AND NATURAL RESOURCES

Mr. Chairman:

We appreciate your invitation to discuss the tentative conclusions of our study of the planning and construction of the trans-Alaska Pipeline. As you know, we are in the process of drafting our report, which we hope to complete and issue in a matter of weeks. I would appreciate it if the full report could be made part of the record at that time.

Building the oil pipeline in Alaska was a pioneer experience not only for the oil companies and workers involved, but also for the Federal Government. It turned out to be a costly experience, but we now have the benefit of hindsight. From our study, we believe there are important lessons to be learned. We urge that these lessons be applied in the development of the gas pipeline which the Alcan consortium of companies proposes to build from Alaska through Canada to the lower 48 states.

- We believe, for example, that the costs of building the proposed gas line may be grossly under-estimated. This was the case with the Trans-Alaska Pipeline. From an original estimate in 1969 of \$863 million, final costs will be about \$7.8 billion exclusive of interest charges.
- A significant factor in this under-estimation was that planning was based on minimal site data, with several technical uncertainties left unresolved. We believe Alcan's budget estimates will increase significantly, for the same reasons.
- Some of these escalating costs may also have been avoided with fixed price contracts, more systematized budgetary controls, and government auditing of costs during construction instead of after construction was completed.
- Alyeska gave us no evidence to support its claims that Government requirements to minimize environmental damage during construction caused significant construction delays.
- We believe present data may be insufficient to judge the economic feasibility of the proposed gas pipeline. Such feasibility and the need for the system's construction should be weighed carefully in view of pressure which can be expected to build for guaranteed financing

of project costs and for rolled-in pricing of the delivered gas. In these cases, financial risks would be shifted from private lenders to the public, as either taxpayers or consumers. We believe this warrants careful consideration before proceeding with the gas pipeline.

I will expand on each of these points and spell out our recommendations in the following brief review of the work of our study. It focused on the issues of project budget estimates, project management, and project labor.

PROJECT BUDGET ESTIMATES

In 1970, the 8 owner companies involved in planning the proposed Trans-Alaska Pipeline entered into an agreement to form a separate corporation, Alyeska Pipeline Service Corporation (Alyeska), to act as their common agent to engineer, design, and construct the pipeline system.

The first estimate of construction costs had been developed the previous year. In 1969, the owner companies estimated that a pipeline system for transporting oil from Prudhoe Bay to Valdez would cost \$863 million. The final cost, with construction substantially completed, is estimated to be about \$7.8 billion.

We examined the basis of the original estimate to determine why it proved to be so low.

One factor was the lack of historical experience on which

forward projections could be made. In 1969, there was no experience on pipeline construction in the Arctic. The 1969 estimate was based on limited information available at that time. It was prepared before the pipeline had been designed or engineered and before extensive soil studies were performed. It was based on material and labor prices prevailing in 1969, with no allowance for cost escalation and no expectation of the subsequent four-year delay in start of construction because of environmental lawsuits.

The oil companies' estimate provided very little leeway for such unforeseen developments. It included a contingency allowance of only about 10 percent even though in normal engineering practice, initial estimates based on an outline design are only expected to be accurate to within a margin of 15 to 30 percent. Even a 30 percent contingency would have been way off, given the fact that the actual cost will be several hundred percent over the original estimate. While Alcan does now have the experience of Alyeska to draw on, we note that Alcan has included less than a 10 percent contingency allowance in its original \$6.7 billion estimate.

The 1969 oil pipeline estimate also

--omitted the costs of increasing system capacity to 1.2 million barrels per day,

--greatly underestimated the number of miles of elevated pipeline required,

- did not anticipate the need to construct a highway bridge across the Yukon River,
- assumed a system and design which reflected a much lower level of environmental concern than was eventually required, and
- failed to grasp the magnitude of the support structure such as camps and airstrips that would be required.

Interim budget estimates

From 1969 to May 1974, the cost estimate increased several times to reflect more detailed system definition and design, additions to system size and sophistication, delay costs, and the results of cost estimates prepared by outside companies under contract with Alyeska.

Alyeska did not gear up to develop a detailed comprehensive budget until after May 1974, by which time they had already been granted both Federal and State right-of-way agreements.

We note that Alcan's estimate of costs is growing rapidly. In March 1977, Alcan's budget estimate was \$6.7 billion, including interest, in 1975 dollars. Alcan's current estimate is \$9.6 billion, including interest. However, Administration officials have stated that their current cost estimate for the Alcan project is between \$10.5 billion and \$13.7 billion.

Because of inflation, the final costs are likely to be higher than the Administration's \$13.7 billion estimate. Further, we believe the estimates are likely

to increase significantly, exclusive of inflation, because they are based on minimal site specific data and several important technical uncertainties remain to be overcome.

Alyeska's base control budget

Substantial efforts were made by Alyeska, the owner companies, management contractors, and execution contractors in 1974 and early in 1975 to develop a more accurate and detailed budget estimate. A budget control estimate of \$6.4 billion, as of April 30, 1975, was ultimately developed as a control mechanism and accepted by the owner companies. The base control estimate was the first estimate supported by firm commitments for nearly all permanent materials and for most of the construction equipment, support services, camps, and other temporary facilities.

The design engineering was about 90 percent complete at this stage, but uncertainties still existed as to soil conditions, labor productivity, and equipment durability and effectiveness. The haul road had been built, and pipeline construction had begun, with the terminal and pump stations being about 5 and 3 percent complete, respectively.

Reasons for increase over base control budget

As pipeline construction proceeded from 1975 to 1977, the control budget was continually revised upward through hundreds of amendments. By June 1977, the approved control

budget had increased to about \$7.8 billion, about \$1.5 billion, or 23 percent, in excess of the control budget.

About \$1 billion of the increase occurred in pipeline construction, the other \$0.5 billion increase occurred in terminal and pump station construction. The principal reason for the increase was that 53 percent more direct labor hours (about 20 million hours) were needed to complete the project than estimated. The direct labor hour increase was caused primarily by unexpected site conditions and construction difficulties, worker inefficiency and inexperience, and more winter work than planned.

All these factors were not beyond Alyeska's control. More geotechnical and site-specific work prior to start of construction would have reduced the number of surprises encountered once construction started. For example, unexpected subsurface conditions were encountered at the Valdez Terminal site once excavation was started. This led to much more extensive site preparation work than planned. Also, once ditching operations were started to lay the pipe, it was found that many areas had more groundwater than anticipated. Both of these surprises were costly.

There have been similar patterns of costs spiraling after optimistic estimates in other projects of the same type.

It happened in North Sea oil development, for example.

A 1975 management study pointed out that many North Sea project developers submitted grossly optimistic initial cost estimates--estimates which made totally inadequate allowances for the cost of overcoming the many problems likely to occur during any large development project. These difficulties are inevitable in untried areas such as the Arctic and the North Sea.

Why do project managers tend to make such unrealistic assessments? The study noted a cluster of beliefs which have widespread industry acceptance:

1. Teams assessing a project's feasibility generally believe that realistically high estimates might result in worthwhile projects being rejected too early. Since these teams frequently develop a deep personal involvement with a project, they may in fact become promoters rather than objective evaluators.
2. It is also widely held that estimates which start at a low level and then gradually rise over time, are more acceptable than those which are realistic.
3. Furthermore, it is believed that costs will tend to rise to meet any approved estimate or amount of money available.

It is clear that it is in the public interest to insist

on realistic initial assessments. The most reliable basis for establishing budget estimates is the development of as much site-specific data as is economically practical. In the case of the gas pipeline, for example, the earlier and more thoroughly that site-specific work can be done, the better will be the project engineering. If project engineering and system design are based on more complete data, both become less subject to change.

PROJECT MANAGEMENT

When Alyeska was organized to engineer, design, and construct the pipeline system, the oil companies retained control of the project through an owner's construction committee. Alyeska top management also consisted primarily of personnel on loan from the owner companies. They met monthly with the committee, which made or approved all major decisions. For instance, the committee made the final decision on selection of the management contractors and construction execution contractors. They also approved the budget control estimate, and had to pass on all construction amendments in excess of \$5 million.

A four tier management structure existed. After Alyeska was formed in 1970, the corporation hired two management contractors: Fluor Engineers and Constructors, Inc. in December 1972 for the terminal and pump station construction and Bechtel, Inc. in October 1973 for the pipeline construction. In June 1974, Alyeska contracted with five execution

contractors for pipeline construction, while Fluor became the execution contractor for the terminal and pump stations. Alyeska assumed management responsibility for pipeline construction in early 1975.

The primary objective of management was to complete construction at the earliest practicable date in order to start oil flowing on schedule, and to avoid the large costs to the owner companies that would have resulted from construction delays. Construction began on April 29, 1974, with the goal of getting oil flowing in the line 3 years later, by the summer of 1977. The project managers' primary objective was to insure that milestone dates were met. If they were not, this meant hiring more workers, paying for more overtime, and (or) having more work done in the winter, when productivity was lower. The managers from the eight owner companies faced strong internal pressures for quick development.

Types of contracts

Alyeska's contracts with its management and execution contractors were reimbursable cost plus fixed fee and fixed overhead. The advantage to Alyeska in awarding these reimbursable type contracts was that this form of contract could be negotiated and settled more quickly than fixed-price-type contracts. Alyeska also lacked adequate information on which fixed prices could be negotiated. Contractors

would not bid fixed-price-type contracts because there was no definitive design, and other factors such as soil conditions and labor productivity in extremely cold climates were unknowns.

Under cost-reimbursement contracts, the contractor has little financial interest in controlling costs because his profits are not affected by the final project costs. Thus, the contractor does not have the same incentive to minimize costs as would exist under other contractual arrangements, such as fixed-price contracts. This type of contract provides the most incentive for efficiency because contractor profits are directly affected by costs. Since fixed price contracts require precise project specifications and detailed design, this is yet another reason why site-specific data should be developed early and thoroughly. We recognize that it is not always possible to enter into this type contract. However, it is desirable to provide the contractor with such incentives to control costs whenever possible.

Management control systems

The management control systems in place when construction began in April 1974 were less than ideal. The systems, including cost control, inventory control, and security programs, had to be changed over the 3-year construction period. For example, Alyeska's cost reporting system

initially could not provide up-to-date information on actual costs. The May 1975 budget control estimate was not based on actual outlays because of inconsistent and erroneous coding of costs in 1974 and early 1975. Furthermore, even though Alyeska's first overall pipeline cost report was not published until September 1975, at that late date the report could not use actual costs, since no central computerized system to collect actual costs had been developed. It was not until December 1975--the end of the second construction year--that the cost control system began to function properly.

How a project is going to be managed is clearly important for an adequate assessment of its feasibility. We believe this aspect of the Alcan gas pipeline has been given little attention to date. Although the Federal Power Commission's hearings on the alternative gas line proposals resulted in an impressive volume of information, we noted that most information involved the environmental, technical, and economic merit of each proposal. Only minimal information on details of project management and control systems has been assembled.

Since Alcan probably will be subject to the same internal pressures for quick development as was the case with Alyeska, we believe it is extremely important for Alcan to develop effective management systems early in the planning phase.

This will enable Alcan management to develop the information required to exercise better management control over project execution.

NO-STRIKE CLAUSE

Alyeska negotiated an umbrella-type project labor agreement with 16 international unions in late 1973 and early 1974. The agreement was for the duration of construction and included a strong, enforceable no-strike clause with procedures for resolving all types of jurisdictional disputes. It provided for uniform working conditions and adopted Alaska wage rates and contractor contributions to Union benefit funds.

Alyeska's experience shows that the no-strike clause in the labor agreement prevented any section-wide or project-wide strikes. As far as we could determine, there were relatively few work stoppages for a project of this size --76 as best we could determine. On the other hand, there were slowdowns. Although we don't know how many, our discussions with Alyeska and contractor personnel indicated that slowdowns may have occurred often enough to interfere with productivity. We could not determine the significance of this interference since adequate records were not maintained.

GOVERNMENT INVOLVEMENT

We also examined the impact of government requirements on construction of the Alyeska pipeline. The U.S. Government

and the State of Alaska granted Alyeska right-of-way agreements to construct the pipeline on public lands. To protect the public interest in these lands, the agreements contained requirements--many of which were to minimize environmental degradation during construction--with which Alyeska had to comply. To assure that Alyeska did comply, both the State and Federal Governments reviewed Alyeska's system design and construction plans, and monitored construction activities to see that plans were being implemented as approved.

Some disagreements did arise during construction over the meaning of the requirements. Alyeska personnel generally interpreted the requirements less restrictively than government personnel.

Because of the differences in interpretations, Alyeska had to make some adjustments to accommodate the government interpretation of the requirement. It was also claimed that the requirements complicated the task of designing and building the pipeline system. However, in response to our requests, Alyeska did not provide any evidence showing where significant construction delays had been caused by this type of problem.

No on-going audit

The right-of-way agreements granted to Alyeska did not contain any requirement that the government be allowed to conduct an on-going audit during construction to insure that

monies expended were prudently incurred and, therefore, were an allowable expense to be included in tariff submissions. As you know, there have been many allegations about mismanagement and monies being improperly spent by Alyeska. The Interstate Commerce Commission is currently conducting an audit to determine which costs should be allowable. Because of the size of the project, this is an extremely difficult task to do within available time constraints.

Because it has proved to be so difficult to post-audit the Alyeska project, we believe a decision should be made now that Alcan's costs will be audited during construction. We believe this would benefit both Alcan and the government. Alcan would not be left in doubt until project completion as to whether its costs would be recoverable through the tariff. The government would be in a far better position to conduct a more effective audit of costs. In this regard, it should be pointed out that no agency of the U.S. Government will have the authority to audit the costs of constructing that portion of the line, about 2,000 miles, that goes through Canada.

These costs in Canada will constitute a significant portion of the total costs of building the pipeline. If they are unrestrained, total costs could increase greatly. We believe the U.S. Government's agreement with the Canadian government should be amended to stipulate that requirements identical to, or at least similar to, those imposed by the

U.S.--such as for budgeting, management, and audit controls--will be implemented by Canadian government overseers of the pipeline construction there.

The Federal Power Commission also has recognized the need for an on-going audit during construction of the gas pipeline. The Commission's recommendation to the President dated May 1, 1977, stated that quarterly audits should be established to determine whether costs incurred would be permitted to be recovered through the project's tariff.

We further believe that a clear and specific requirement be established in the agreement to provide the government with direct access to project files and records. At the time of our study, three separate audit groups needed Alyeska data. To respond to these requests, Alyeska hired a law firm to act as liaison. In the interest of obtaining as much information as possible for these hearings, we agreed to this. While we can appreciate Alyeska's need for the arrangement, it caused us procedural difficulties in getting the information necessary to carry on our review, and left us with much uncertainty about the completeness and accuracy of the information given in response to our requests.

Before turning to two other important aspects of the proposed gas pipeline project, I will sum up the key lessons to be learned from the Alyeska experience, which we hope, will be applied to the Alcan project.

- We should be skeptical of initial and interim cost estimates. Final costs are bound to be significantly higher than these estimates.
- We should insist on site-specific data and on thorough investigation of technical and geological uncertainties. This is the only way to avoid unpleasant and costly surprises during development.
- Government approval should be contingent on detailed planning for management control including budgetary controls. We believe Alcan should have its managerial house in order before construction is allowed to begin.
- We were given no evidence that governmental restraints to minimize environmental degradation created significant complications in Alyeska's construction schedule. This may also prove to be the case with gas pipeline construction.
- We should insist on an on-going government audit of the Alcan project's expenditures. This is clear from the difficulties of auditing Alyeska costs after construction was completed.
- Our agreement with the Canadian government should be amended to stipulate that an on-going audit and other U.S. requirements affecting the gas pipeline construction will be implemented during construction in Canada.

OTHER ISSUES

I would like to discuss briefly two related issues which are of concern to us. They do not arise as a result of our audit of the Alyeska experience, but stem from concerns we have expressed in other reports dealing with high cost energy supply situations.

First, is the question of government guarantees of the cost of the pipeline. Considerable discussion developed this year over a so-called "all-events" tariff which would amount to a guarantee to return at least debt service and, perhaps, equity should the project not be completed. In essence, such a guarantee would shift the risk from the company to the U.S. taxpayer.

We understand that both Alcan and the Administration now say that there is no need for such a guarantee. We also see no need for such a guarantee and support the Administration's position. Should the issue arise again, however, we believe careful thought should be given to whether the Federal government should undertake such risk. There may simply be much more attractive alternatives for government risk-taking than the Alcan pipeline. The government should more thoroughly explore those alternatives before making any such commitments.

That brings me to the second point. Any assessment of alternatives should be made on the basis of incremental cost.

The cost of Alcan-delivered gas should be compared "at the margin" against other energy supply or demand reducing strategies. This is particularly important since there will be great pressure to "roll-in" the price of Alcan gas when it is delivered to relieve consumers of Alcan gas from a sudden price spike. Whether or not such roll-in should be allowed is a question of equity, which can be decided after further study at a future date. But the actual rolling-in of the price should not be confused with the need to base decisions on whether or not to subsidize Alcan on the true marginal cost of that alternative as compared to others.

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In closing, I emphasize that our comments should not be construed as taking a GAO position either for or against the eventual construction of the Alcan project. Rather, we believe the final project cost can not be realistically estimated until more site-specific data is obtained, the technological problems solved, the project substantially designed and engineered, and a base control budget established. We expect the current project estimates will be revised upward.

That concludes my statement, Mr. Chairman, I will be happy to answer any questions.