

NATIONAL ENERGY BOARD

STATEMENT OF POSITION

Regarding

SELECTION OF PIPE

for the

WHITEHORSE, YUKON TO CAROLINE, ALBERTA SEGMENT

of the

FOOTHILLS PIPELINE SYSTEM

Background

Foothills (Yukon) Limited and its associated companies applied to the National Energy Board to construct a 48-inch, 0.54-inch wall thickness, 1260 psi pipeline from the Alaska - Yukon border generally along the Alaska Highway through Whitehorse, Yukon, to Caroline, Alberta, where the pipeline would bifurcate into two smaller diameter lines carrying gas to the lower 48 states at Kingsgate, B.C., and Monchy, Saskatchewan.

The Board approved the Foothills scheme with some modifications, including provision for the future connection of Mackenzie Delta gas reserves via a lateral line generally along the Dempster Highway.

During subsequent negotiations between Canada and the United States, it was agreed that a technical study group would be established to examine pipeline sizes and operating pressures in addition to those proposed by the Foothills group, with particular attention being given to that portion of the pipeline system between Whitehorse, where the gas from the Dempster lateral would enter the system, and Caroline.

Paragraph 10 of the Canada - U.S. Agreement dated 20 September 1977 states:

10. Technical Study Group on Pipe

(a) The Governments will establish a technical study group for the purpose of testing and evaluating 54-inch 1120 pounds per square inch (psi), 48-inch 1260 psi, and 48-inch 1680 psi pipe or any other combination of pressure and diameter which would achieve safety, reliability and economic efficiency for operation

of the Pipeline. It is understood that the decision relating to pipeline specifications remains the responsibility of the appropriate regulatory authorities.

(b) It is agreed that the efficient pipe for the volumes contemplated* (including reasonable provision for expansion), subject to appropriate regulatory authorization, will be installed from the point of interconnection of the Pipeline with the Dempster Line near Whitehorse to the point near Caroline, Alberta, where the Pipeline bifurcates into a western and an eastern leg.

Two meetings of the Technical Study Group have been held, the first in Ottawa on 4 October 1977 and the second in Washington on 13 December 1977. At the second meeting there was full representation of the Alcan - Foothills group of companies, which presented technical and economic information in support of the companies' choice of low pressure pipe (either 48-inch 1260 psi or 54-inch 1120 psi) over that suggested by U.S. officials, i.e. 48-inch 1680 psi pipe.

At the conclusion of the second meeting, U.S. government officials expressed a lack of confidence in certain of the cost estimates presented by Foothills and suggested that an independent study be sponsored by the two governments. After consultation with Ministers, Canadian officials declined to participate in the sponsorship of a joint study, but indicated that some additional time would be allowed to permit U.S. officials to study the matter further. In view of the need for an early decision expressed by Foothills, it was requested that a response be

* Indicated to be 3.6 Bcf per day in paragraph 3(a) of the Agreement.

received from the United States by 8 February 1978 to allow a decision on the pipe specifications to be made by mid February.

United States Response

A response was received from the United States on 12 February and has been studied by the National Energy Board. Attached as Appendix I is a brief description of the technical considerations relating to safety and reliability which were under consideration and the conclusions of the Board in relation thereto.

A suggestion was made by United States officials at the December meeting that in considering the various options for pipe in the lower pressure range, an examination should be made of the possibility of using 56-inch 1080 psi pipe as an alternate to 54-inch 1120 psi pipe, on the grounds that there was more world experience in manufacturing and installing 56-inch diameter pipe than in 54-inch diameter pipe. While, at the time of the Canada - United States negotiations, 54-inch diameter pipe had been shown as the appropriate larger diameter pipe for consideration, Foothills agreed that it would have been just as logical to have selected 56-inch diameter pipe in relation to the 3.6 Bcf per day anticipated throughput.

The United States response includes consideration of the use of 56-inch diameter pipe as one alternative and this has been taken into account in the Board's analysis.

The response of the United States included an economic comparison of the use of four different pipe configurations between Whitehorse and Caroline under various throughput assumptions. The cases considered were the use of 48-inch 1260 psi pipe, looped as necessary; 48-inch 1680 psi pipe; 54-inch 1120 psi pipe; and 56-inch 1080 psi pipe; each with three different assumptions of rates of build-up in gas flows from Prudhoe Bay and the Mackenzie Delta. Further assumptions were made with respect to the value of fuel gas ranging from \$1.00 to \$2.62 per million Btu's expressed in 1975 dollars.

The general conclusions of the United States analysis were that at high flow volumes (3.6 to 4.5 Bcf per day) and an assumption of high fuel prices, the 48-inch 1680 psi system is superior in terms of cost of service, with the 56-inch 1080 psi system nearly as good, and the 54-inch 1120 psi system somewhat more costly. The 48-inch 1260 psi system would not be considered under these conditions. The analysis concluded that if there were an extended delay in attaching flows of gas from the Mackenzie Delta, then the economic choice would be a 48-inch 1260 psi system.

While the Board might not agree with some of the assumptions used in the United States analysis, it does not disagree with the general conclusions reached.

National Energy Board Conclusions

Safety and reliability of a pipeline are matters of primary concern to the Board. There has been a good record in the Canadian pipeline industry in this regard and there has been steady improvement in standards related to quality of steel, manufacturing procedures, pipe welding and other construction procedures.

The Board believes that moving from the general operating pressure range of 1000 psi, which is the present practice in North America, to that proposed for the 48-inch 1680 psi system, represents a large step into new technology. The Board would require thorough testing of the 48-inch, 0.72-inch wall thickness pipe, including the use of crack arrestors for the prevention of propagation of ductile fractures, before approving that design. Foothills has estimated that there could be a delay of up to two years in completion of the pipeline in order to carry out such testing before ordering pipe. This would neither be in the interests of the United States nor of Canada.

On the other hand, the Board is prepared to approve the use of 0.54-inch wall thickness pipe of the specifications proposed by Foothills in 48-inch, 54-inch or 56-inch diameters, subject only to confirmatory burst testing prior to commencement of construction. This means that, from a design point of view, there would be no delay in ordering pipe, and that planning for all other aspects of the pipeline system could proceed in a more orderly way.

An important feature, also, in the selection of 0.54-inch wall thickness pipe, is the fact that two Canadian pipe mills could supply pipe of the quality required and in diameters up to 56 inches. In the case of the heavier wall pipe only one Canadian mill has the manufacturing capability, thus reducing reliability and possibly affecting Canadian content. Furthermore, there appears to be only one United States company capable of making the high pressure pipe.

Insofar as the availability of component parts of the pipeline system or the availability of pipe laying equipment is concerned, it is not anticipated that the choice of diameter in the lower pressure range will be significant from the point of view of availability. The choice of 54-inch or 56-inch diameter systems over 48-inch might result in minor diminution of Canadian content of component parts. To some extent this will depend on the lead time available for Canadian manufacturers to respond to business opportunities.

Having concluded that from a safety and reliability point of view the choice of pipe must be restricted to the pressure range achievable with 0.54-inch wall thickness pipe (48-inch 1260 psi, 54-inch 1120 psi, 56-inch 1080 psi), the decision rests largely in the field of economics.

As indicated in the United States response, a key factor is the timing of the connection of the Mackenzie Delta reserves. With this in mind the Board has reviewed its conclusion contained in the Reasons for Decision, Northern Pipelines, that there was a need to supplement existing reserves of gas from western Canada sometime between 1982 and 1985. While recognizing that there has been continuing exploration success in the western Canadian sedimentary basin since the time of the Board's report, it is the Board's expectation that a detailed review of gas supply and demand in Canada, which will undoubtedly be undertaken within the next year, will still indicate a need for the Dempster lateral prior to 1990. In the Board's view, this restricts the choice on economic grounds to one between 54-inch and 56-inch diameter pipe since these diameters are the efficient ones for a throughput of 3.6 Bcf per day (2.4 from Alaska and 1.2 from the Delta) as contemplated in paragraph 3(a) of the Canada - U.S. Agreement.

The following are the relevant economic factors for consideration:

Whitehorse to Caroline Segment
(capacity 3.6 Bcf per day)

	Unit	48" 1260 psi looped	48" 1680 psi	54" 1120 psi	56" 1080 psi
Estimated Capital Cost of Foothills Pipeline in Canada (on basis of filed costs in Agreement)					
Initial Capacity for 2.4 Bcf/day	\$MM	3,873	4,418	4,234	4,413
Increment for 1.2 Bcf/day	"	1,670	470	586	409
Total for 3.6 Bcf/day	"	<u>5,543</u>	<u>4,888</u>	<u>4,820</u>	<u>4,822</u>
Estimated Fuel Consumption	%	6.8	7.3	8.0	7.7
Estimated Difference in 20-year average cost of service in Canada from 56-inch case					
(a) Fuel valued at \$1.00/MMBtu's	¢/MMBtu's	+2.2	-0.4	+0.3	-
(b) Fuel valued at \$1.60 "	"	+3.7	-0.5	+0.5	-
(all costs expressed in 1975 dollars and derived from U.S. technical study)					
Estimated Difference in cost of service in Canada from 56-inch case in 1985 in actual dollars					
(a) Fuel valued at \$1.63/MMBtu's (\$1.00 in 1975 dollars)	¢/MMBtu's	+6	-1	+2	-
(b) Fuel valued at \$2.61/MMBtu's (\$1.60 in 1975 dollars)	"	+7	-2	+3	-
(all costs on basis used in United States/Canada negotiations)					

Note the cost of service in 1985 from Prudhoe Bay to U.S. markets is about \$2.10 and from Delta to Empress is about \$1.50. The difference in cost of service in using the 56-inch low pressure pipe compared with 48-inch high pressure pipe is 1% or less.

The Board concludes that the incremental savings in cost of service for both United States and Canadian consumers over the life of the pipeline in using 56" diameter instead of 54" is sufficient to indicate a preference for the 56" diameter pipe. This choice is reinforced from a United States' viewpoint because of the greater fuel efficiency and therefore in the greater number of Btus delivered.

While the Foothills companies had applied for a 48-inch 1260 psi pipeline, with looping as required, they agreed at the time of the Canada - United States negotiations that consideration should be given to a larger capacity system between Whitehorse and Caroline. Foothills (Yukon) has subsequently advised the Board that it has no preference between 54-inch and 56-inch diameter pipe.

The United States had recognized in the Canada - United States Agreement the advantages to Canada of initially installing an economically efficient pipeline to carry up to 3.6 Bcf per day so as to facilitate the connection of Delta gas to markets. While the United States response indicated that based on the design volumes of 2.4 Bcf per day from Prudhoe Bay and 1.2 Bcf per day from the Mackenzie Delta, its preference is for 48-inch 1680 psi pipe, its second choice is for 56-inch 1080 psi pipe. The United States prefers 56-inch diameter to 54-inch because of greater fuel efficiency.

There is one other consideration in the choice. Paragraph 10 of the Canada - United States Agreement dated 20 September 1977 made provision for consideration of any combination of pressure and diameter of pipe which would achieve safety, reliability and economic efficiency. However, Annex III to the Agreement relating to cost allocation, contained cost estimates for 48-inch and 54-inch diameter pipes only. If 56-inch diameter pipe were chosen, it would require an addendum to Annex III to include costs for the 56-inch alternative which had been agreed upon by the two countries.

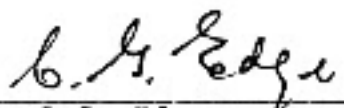
Inasmuch as the Canada - United States Agreement is included as Schedule I to Bill C-25, there would have to be a corresponding amendment to the Bill now before the House.

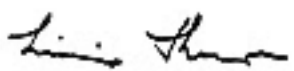
The Board understands that the inclusion of appropriate cost figures for 56-inch pipe in Annex III to the Agreement would be considered a technical change. It presumably would require a meeting of Canadian and United States officials to agree upon the determination of the figures and this could be undertaken very shortly.

Until the Northern Pipeline Act becomes law, there are no certificates in force, and with respect to the pipeline system in question there is no decision-making authority to approve the pipeline specifications. Section 18 of the Certificate Terms and Conditions contained in Schedule III to the Act provides that the specifications shall be those approved by the Minister and the Board.

By means of this report, the Board is indicating its intention to include in its approval of pipeline specifications subsequent to the enactment of Bill C-25, approval of 56-inch, 0.54-inch wall thickness Grade 70 pipe with a maximum allowable operating pressure of 1080 psi for that portion of the pipeline system between Whitehorse, Yukon and Caroline, Alberta.

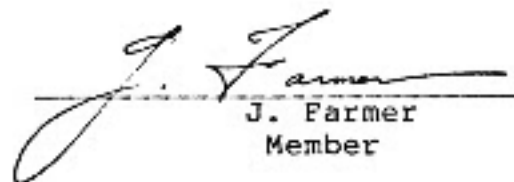

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17 February 1978

Appendix I
TECHNICAL REVIEW

1.0 Introduction

The National Energy Board has reviewed the United States report entitled "U.S. Government Safety and Reliability Evaluation of Different Size and Pressure Combinations for Alaska Gas Pipeline". This review relates to four specific areas:

- (a) burst testing
- (b) fracture control
- (c) construction welding
- (d) availability of materials

The United States report concludes that both the high- pressure system and the low-pressure systems can be built and operated safely and reliably. However, it did conclude that testing more than one alternative would delay completion of construction, perhaps as long as two years.

The National Energy Board agrees with much of the supporting information contained in the United States evaluation but does not agree with the conclusions derived therefrom.

2.0 Technical Considerations

2.1 Burst Tests

In the National Energy Board's opinion, selection of the 48-inch high-pressure system because of the extensive new technology involved would present the greatest risk of delays associated with the test program. This is particularly true when the required design, development, full scale testing and secondary testing of crack arrestor designs is taken into account. Because of this, the National Energy Board maintains the position that it is prepared to authorize the use of either 48-inch 1260 psi pipe, 54-inch 1120 psi pipe or 56-inch 1080 psi pipe with confirmatory burst testing prior to commencement of construction, but it would not be prepared to consider the use of 48-inch 1680 psi pipe until satisfactory burst tests had proven the viability of the design under the operating conditions anticipated.

2.2 Fracture Control

The ability to control either fracture initiation or propagation through pipe toughness is inherently less for the 48-inch high-pressure design. Such a design will likely require the development of a crack arrestor system that does not compromise established design constraints and acts effectively. No such

design has been proven in the field. The net result of these factors suggests a risk of decreased system reliability relative to more conventional pressures and wall thicknesses.

2.3 Construction Welding

The United States statement regarding the development, qualification and strict adherence to field welding procedures is fully supported. However, the United States view that the potential for realizing these objectives is equal for all designs is not accepted. The field welding of a 48-inch high-pressure system is more difficult due to the use of heavier (0.72-inch) wall thickness. On the basis of direct experience with 0.54-inch pipe, trial work on 0.72-inch pipe and analytical evaluation of root bead weld stresses, it is recognized that the implementation and enforcement of the complex welding procedures required for the 48-inch 0.72-inch pipe is critical. The ability to execute such a procedure reliably from an economic and technical point of view, has not been established. Until sufficient field welding tests and production trials are done to establish suitable procedures and the manpower and equipment requirements to achieve progress rates

compatible with other crews, the National Energy Board feels the present cost comparisons based on normal procedures may not be valid.

2.4 Availability of Materials

The supply of pipe for the project as a whole has a greater assurance of being achieved within the required cost and time schedules if a lower-pressure, thinner wall-thickness design is selected. At this time two North American manufacturers have demonstrated a production capability of meeting the strength and toughness requirements applicable to the low pressure systems and for pipe diameters up to 56 inches.

In respect to 48-inch high-pressure pipe two North American manufacturers have the potential to produce the high-toughness Grade 70 but their capabilities have not been fully proven.

3.0 Conclusion

The National Energy Board has concluded that the operating reliability and safety of any of the low-pressure alternatives would be high due to the design parameters and material selection used and due to recent Canadian experience with pipe of similar specifications. The National Energy Board is prepared

to authorize the use of low-pressure large-diameter pipe with confirmatory burst testing prior to commencement of construction.

The National Energy Board would not be prepared to consider the use of 48-inch 1680 psi pipe until satisfactory burst tests had proven the viability of the design under the operating conditions anticipated.

Sufficient capacity exists in North America to meet the low pressure pipe requirements of the project within the projected construction schedule.

The selection of 48-inch high-pressure pipe inherently would involve significantly higher risks of cost overrun and completion delays resulting from weld quality and other problems related to the 0.72-inch wall-thickness pipe. From the point of view of safety, reliability, material supply and maintenance of construction schedule, the selection of pipe specifications for the pipeline between Whitehorse and Caroline should be restricted to the low-pressure options involving 0.54-inch wall-thickness pipe.

