Attachment NEB U-31-1

Mackenzie Gas Project

Community Gas – Pipelines

1. INTRODUCTION

A screening level evaluation was undertaken to determine the typical cost required for community gas pipelines to provide gas to eight communities along the Mackenzie Valley pipeline route. The evaluation of the pressure reduction and metering facilities for the communities is outlined in NEB U-30, Attachment NEB U-30-1, Mackenzie Gas Project, Community Gas – Pressure Reduction and Metering Facilities.

The community gas pipeline evaluation indicated that the cost to install small diameter low-pressure pipelines to the various communities along the Mackenzie Valley ranges from $1 to 98 million per community. The aggregate cost would be about $204 million. The average cost of these pipelines would be about $1 million/km or $300,000 per diameter inch per kilometre ($/dia. in./km).

The estimated 20-year average incremental increase in tolls as a result of adding pipelines ranged from 0.001–0.023 $/GJ per community. The aggregate toll impact would be 0.051 $/GJ. The estimated average incremental increase in cost of service ranged from $0.1–11.1 million per year, and the aggregate total for the eight communities was $23.1 million per year. For the combined facilities and community gas pipelines, the estimated total incremental increase in tolls was 0.065 $/GJ and the increase in cost of service was $30.1 million per year.

The evaluation assumed that the community gas pipeline would be installed in the year after Mackenzie Valley pipeline construction was completed. The estimate basis assumed that each pipeline would be installed on a stand-alone basis. Opportunities to gain efficiencies and potentially reduce costs would be evaluated during engineering.

2. PIPELINE BASIS

Table 2-1 shows the communities included in this evaluation and the expected gas pipeline requirements for each. If natural gas were to be supplied to a community, community supply and pipeline design requirements would be analyzed.

The community gas pipeline is assumed to have a maximum operating pressure of 4.9 MPa. The pipeline would start at the outlet of the pressure reduction and metering facility, which would be located at the Mackenzie Valley pipeline right-of-way. The community gas pipeline would be expected to follow as direct a route as possible to the local community. This evaluation does not consider:

- the community gas distribution system requirements
- any integration or conversion of the community power generation facilities

For this evaluation, the pipe material was assumed to be Grade 359 Schedule 40. This is a realistic substitute for the actual design material. The corresponding wall thickness provides a diameter to thickness (D/t) ratio ranging from 15 to 24. Specific pipe parameters, including stress and strain requirements, will be determined during engineering design.

Table 2-1: Mackenzie Valley Community Gas Pipeline Parameters

Community	Total Gas Demand (m^3/d)	Distance to Community (km)	Pipe Size (NPS)	Pipe Size (mm)	Pipe Grade	Wall Thickness (mm)	D/t
Inuvik	130,000	28	6	168.3	359	7.1	23.7
Fort Good Hope	24,000	5	3	88.9	359	5.5	16.2
Norman Wells	36,000	1	3	88.9	359	5.5	16.2
Tulita	14,000	7	3	88.9	359	5.5	16.2
Déline	20,000	110	4	114.3	359	6.0	19.1
Wrigley	6,000	5	2	60.3	359	3.9	15.5
Fort Simpson	43,000	23	4	114.3	359	6.0	19.1
Jean Marie River	3,000	25	2	60.3	359	3.9	15.5

3. ASSUMPTIONS

The assumptions made for this evaluation included:

1. The community natural gas pipeline is constructed to CSA standard Z662.

2. The road access and construction workforce infrastructure from the Mackenzie Gas Project is not available.

3. Each pipeline is constructed independently of the others and in winter.

4. The pipeline is buried.

5. Mackenzie Valley pipeline natural gas quality is acceptable for community gas.

6. Emergency venting, if required, is done at the pressure reduction and metering facility.

7. Pig launchers and receivers are located on the pipeline.

8. A manual block valve and an automated pipeline isolation valve are located at the downstream end of the pipeline.

9. Mechanical connection on the mainline tie-in is accomplished via hot tap or pre-installed extruded tee fitting, which is included as part of the Mackenzie Valley pipeline cost and is not part of the community pipeline cost.

10. Gas enters the pipeline at -1°C. Additional heating might be required at the community to preheat the gas to an appropriate temperature above its hydrocarbon dew-point.

4. DESIGN PARAMETERS

The Mackenzie Gas Project proponents have not undertaken design work for small diameter pipelines comparable to the community gas pipelines. Without the benefit of any design work, the community natural gas pipeline is assumed to be subjected to geothermal loads similar to those of the Mackenzie Valley pipeline. As small diameter pipe tends to be both more flexible than larger diameter pipe and potentially more influenced by seasonal temperature changes, Schedule 40 pipe material was used in this evaluation.

Community gas pipelines were generally assumed to end at a power generation facility located at the edge of the community. This evaluation did not include:

- converting the power generation system to use natural gas fuel
- the community gas distribution system, which would start at the end of the pipeline

Table 4-1 identifies some of the site-specific considerations assumed for pipeline installation for each community.

5. COST ESTIMATES

A screening level cost estimate was developed for each location, using calculated costs for steel and external coatings based on the described design parameters. The cost of the pipeline construction was based on a dollars per diameter-inch per kilometre" ($/dia.in./km) basis, taking the small pipe diameter and short lengths into account. These pipeline construction costs ranged from $60,000 to 100,000 /dia.in./km. Horizontal directional drilling costs for the Liard River at Fort Simpson and the Great Bear River at Déline were added to the costs.

The capital cost for the community gas pipeline also includes factored costs for:

- engineering
- project management
- indirect costs
- overhead and burden
- owner's costs
- contingency

Table 5-1 shows the capital costs of the community gas pipelines by community. The average estimated cost for these pipelines is $1 million/km, or $300,000 /dia.in./km. The cost variation among the communities is the result of different pipe diameters and distances, and site-specific considerations, such as HDD crossings.

Table 4-1: Community-Specific Considerations

Community	Site-Specific Considerations
Inuvik	• The pipeline will start at the outlet of the Inuvik area facility. • The pipeline will generally be parallel to the Mackenzie Highway from Campbell Lake into Inuvik. • Because of the size of Inuvik and the location of the power generation facilities and existing natural gas distribution system, the pipeline is assumed to end at the eastern edge of the community
Fort Good Hope	• The pipeline will follow the existing surface disturbance, i.e., the cutline, from the Mackenzie Valley pipeline into the community.
Norman Wells	• The pipeline will start at the block valve site and terminate at the Imperial Oil Limited central processing facilities, where existing gas distribution exists.
Tulita	• The pipeline will start at the secondary site of the Great Bear River compressor station and continue to the eastern end of the community. • The pipeline will cross the Enbridge pipeline. • The pipeline will cross both the winter road and the municipal road.
Déline	• The pipeline route will follow the winter road access and Great Bear River to the mouth of Great Bear Lake on the east side of the river. • The pipeline will cross the Great Bear River near the mouth of the lake – assuming a horizontal directionally drilled (HDD) crossing will be constructed, similar to that at Fort Simpson.
Wrigley	• The pipeline will cross one creek. • The pipeline will cross both the winter road and the municipal road.
Fort Simpson	• The pipeline is assumed to start at Manners Creek block valve site. • An HDD crossing of the Liard River (700 m of water) will be constructed downstream of the ferry crossing. • The pipeline route will generally be parallel to the Mackenzie Highway, on west side of highway to avoid residences. • Eight creek crossings will be required. • Two Mackenzie Highway crossings will be required. • Eight road crossings will be required. • One water crossing will be required to the main island at the south end of the community. • Specific conditions were not evaluated within the town site for installing the pipeline to the power generation facility near the north end of the community.
Jean Marie River	• The pipeline will cross the Enbridge pipeline. • One watercourse crossing will be required.

Table 5-1: Community Gas Pipeline Capital Cost

Community	Distance (km)	Pipe Size (NPS)	$/km	$/dia.in./km	Capital Cost ($M)
Inuvik	28	6	1,493,000	249,000	41.8
Fort Good Hope	5	3	955,000	318,000	4.8
Norman Wells	1	3	953,000	318,000	1.0
Tulita	7	3	952,000	317,000	6.7
Déline	110	4	888,000	222,000	97.7
Wrigley	5	2	637,000	318,000	3.2
Fort Simpson	23	4	1,573,000	393,000	36.2
Jean Marie River	25	2	514,000	257,000	12.9
Total	204				204.1
Average			1,000,000	300,000	

6. TOLL IMPACTS

Incremental tolls and cost of service were calculated for each of the communities, based on the:

- volumes delivered
- capital and operating costs expended

The incremental costs are relative to the toll assumptions from the Project Update (34.3 Mm^3/d volume throughput).

Annual average gas volumes used in the evaluation were assumed to be 50% of the peak demand (see Table 3-1, shown previously). It was also assumed that all of the gas volumes received the benefits of the NWT Small Market Rebate Expense.

Capital and operating costs for the facilities were determined in a similar way to calculations for the Mackenzie Gas Project.

The toll model was run over a 20-year period. Table 6-1 shows the average toll and cost of service impacts as a result of the facilities.

Table 6-1: Pipeline Toll and Cost of Service Impacts as a Result of the Additional Facilities

Community	Incremental Tolls 20-year Average		Incremental Cost of Service 20-year Average	
	Facilities and Pipeline ($/GJ)	Pipelines ($/GJ)	Facilities and Pipeline ($M/a)	Pipelines ($M/a)
Inuvik	0.013	0.011	5.5	4.7
Fort Good Hope	0.003	0.001	1.3	0.5
Norman Wells	0.002	0.001	0.7	0.1
Tulita	0.003	0.002	1.6	0.8
Déline	0.025	0.023	11.9	11.1
Wrigley	0.003	0.001	1.4	0.4
Fort Simpson	0.011	0.009	5.3	4.1
Jean Marie River	0.005	0.003	2.4	1.5
Total	0.065	0.051	30.1	23.1
Note: Totals might appear incorrect because of rounding.				