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February 18, 2021

British Columbia Utilities Commission
Suite 410, 900 Howe Street
Vancouver, B.C.
V6Z 2N3

Attention: Mr. Patrick Wruck, Commission Secretary

Dear Mr. Wruck:

Re: FortisBC Energy Inc. (FEI)

Project No. 1599129

Application for a Certificate of Public Convenience and Necessity (CPCN) for the Pattullo Gas Line Replacement Project (the Application)

Response to the British Columbia Utilities Commission (BCUC) Information Request (IR) No. 2

On August 31, 2020, FEI filed the Application referenced above. In accordance with BCUC Order G-350-20 setting out the Regulatory Timetable for the review of the Application, FEI respectfully submits the attached response to BCUC IR No. 2.

If further information is required, please contact the undersigned.

Sincerely,

FORTISBC ENERGY INC.

Original signed:

Diane Roy

Attachments

cc (email only): Registered Parties

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A. PROJECT JUSTIFICATION

19.0 Reference: PROJECT JUSTIFICATION

Exhibit B-6, British Columbia Utilities Commission Information Request 1.1, 16.4; Attachment 1.1, pp. 1–2

Pattullo Bridge Replacement Project

In response to British Columbia Utilities Commission (BCUC) Information Request (IR) 1.1 for FortisBC Energy Inc.'s (FEI) application for a Certificate of Public Convenience and Necessity (CPCN) for the Pattullo Gas Line Replacement Project (PGR Project or Project) (Application), FEI provides an agreement between the Province of British Columbia (represented by the Ministry of Highways) and British Columbia Electric Company, dated April 11, 1957 (Bridge Agreement) as Attachment 1.1.

Section 3 of the Bridge Agreement states:

> 3. On termination of this agreement, the Company will, within a reasonable time, remove all pipeline and attachments from the said bridge and will leave it in a condition satisfactory to the Minister of Highways.

Section 6 of the Bridge Agreement states in part:

> 6. That after receiving notice in writing of the intention of the Province to reconstruct, alter or repair the Bridge, the Company will move or alter their pipeline or cease transmission of gas if same is necessary for the safe completion of the reconstruction, alteration or repairs. All such alteration by the Company shall be carried out at their own expense.

In response to BCUC IR 16.4, FEI states:

> As per Section 3 of the Bridge Agreement, FEI is responsible for removing the gas line and its attachments from the existing Pattullo Bridge. This includes all asset retirement activities including decommissioning, dismantling and removal

costs related to the Pattullo Gas Line. Unless FEI reaches an agreement with MoTI providing otherwise, FEI is responsible for all costs associated with removing the gas line.

19.1 Please confirm, or otherwise explain, whether FEI is responsible for all costs associated with the decommissioning, dismantling and removal of the Pattullo Gas Line as a result of Section 6 of the Bridge Agreement.

19.1.1 If not confirmed, please identify and provide reference to the relevant section(s) of any agreements in place which require FEI to be responsible for all the costs for the decommissioning and removal of the Pattullo Gas Line.

19.1.1.1 If no agreements require FEI to be responsible for all costs associated with the decommissioning, please explain how it was determined that FEI should be responsible for the costs. Please provide any supporting documents or agreements.

Response:

FEI confirms that, as per the Bridge Agreement, FEI is responsible for the costs of decommissioning, dismantling, and removal of the Pattullo Gas Line.

19.2 Please discuss whether FEI has entered, or plans to enter, into negotiations with Ministry of Transportation and Infrastructure (MoTI) with respect to the removal of the gas line under the Pattullo Bridge.

19.2.1 If yes, please provide the status or outcome of the negotiations to date.

19.2.2 If not, please explain why not.

Response:

Yes, FEI has commenced discussions and continues to negotiate with MoTI with respect to the removal of the Pattullo Gas Line affixed on the Pattullo Bridge. However, these negotiations have not been concluded to date and, until an agreement is reached, FEI must presume that it is responsible for all costs associated with removing the Pattullo Gas Line.

20.0 Reference: PROJECT JUSTIFICATION

Exhibit B-6, BCUC IR 2.2

Pattullo Bridge Replacement Project

In response to BCUC IR 2.2, FEI states:

> As such, FEI is currently working towards a target date of commissioning the new gas line and decommissioning the existing gas line by March 31, 2023 (excluding removal of the decommissioned gas line from the Pattullo Bridge).

20.1 Please explain when FEI expects to remove the decommissioned gas line from the Pattullo Bridge.

Response:

FEI expects to remove the decommissioned gas line from the Pattullo Bridge once the new gas line is constructed, commissioned, in-service and operating safely in conjunction with the overall gas distribution system.

21.0 Reference: PROJECT JUSTIFICATION

Exhibit B-6, BCUC IR 5.4

Significance of the Pattullo Gas Line to the Metro Vancouver Distribution System

In response to BCUC IR 5.4, FEI states:

> FEI is continuing to evaluate alternatives to restore system resiliency in the Metro Vancouver area which is currently provided by the LMIPSU Project. Until the scope of the Project is better defined, FEI is unable to provide additional information about any follow-up project(s) to restore resiliency at this time, including project overview, timing, or anticipated cost.

21.1 Please explain when FEI expects to be able to provide additional information about any follow-up project(s) to restore resiliency, including project overview, timing, or anticipated cost.

Response:

FEI intends to continue the scope definition once the PGR Project is fully defined and underway. Considering FEI's internal planning cycles, and review and approval processes, FEI expects to provide additional information about any follow-up project(s) in the next Long Term Gas Resource Plan, which FEI intends to file in 2022.

B. ALTERNATIVES EVALUATION

22.0 Reference: ALTERNATIVES EVALUATION

Exhibit B-1-1, Section 4.3.5, pp. 37–38

Alternative 5 – Peak Shaving Facility / Virtual Gas Line

On page 37 of the Amended Application, FEI states:

> Under peak demand conditions (approximately minus 12°C), the peak shaving facility or virtual gas line would need to deliver approximately 100,500 standard cubic metres per hour (Sm3/hr) of gas into the system.

On page 38, FEI explains that the two delivery alternatives liquified natural gas and compressed natural gas (LNG and CNG), by which the required demand or load could be supplied using a peak shaving facility or virtual gas line, were determined to be not feasible because they are not able to meet the large capacity requirement.

22.1 Please explain how FEI determined that that the peak shaving facility or virtual gas line would need to deliver approximately 100,500 standard cubic metres per hour (Sm3/hr) of gas into the system.

Response:

FEI determined the CNG/LNG injection requirements by replacing the Pattullo Gas Line supply in a hydraulic model of the trunk distribution system with a hypothetical supply located on the New Westminster side of the crossing in the vicinity of Queens Park on McBride Boulevard near 6th Avenue, delivering gas into the trunk distribution system. The supply of injected gas modelled at that location is optimal to support the downstream district stations whose inlet pressure would be most affected by the absence of the Pattullo Gas Line. Locating the potential supply close to the required need would minimize the amount of gas injection required. Other less optimal locations would drive higher injection requirements to support the system to a similar extent. The delivery volume reflects the approximate requirements at the end of the forecast period (i.e. 2039).

22.1.1 Please describe any assessments to determine the potential system capacity shortfall without the Pattullo Gas Line and provide the results of these assessments.

Response:

FEI conducted an assessment using a hydraulic model of the system which indicated the trunk distribution system would have insufficient inlet pressure at several stations without the Pattullo Gas Line. Three stations are very close to or below the minimum 515 kPa inlet pressure, and all stations would be above their RUN1[1] capacity because of the lower inlet pressures and therefore do not have the redundancy to meet required gas flows if equipment were to fail at the station.

The percentages in the table below indicate how far in excess of the available station capacity the required system flow on a peak day in 2023-24 could be without the Pattullo Gas Line. All stations would be above the capacity of RUN1, meaning there would be no system redundancy to mitigate against unexpected failures. The station at First Street and Queens would not have sufficient capacity even with all equipment in operation (i.e. RUN1&2 CAP in the table). As a result, that station lacks sufficient capacity to maintain the required delivery pressure into the downstream distribution system. This reduced distribution system pressure would result in customer outages due to insufficient pressure to safely and reliably operate their appliances.

Station Name	Peak Day Flow (m^3/hr)	Upstream pressure (kPa)	FID	RUN1 CAP	%	RUN1&2 CAP	%
6 Avenue and Cumberland Street	14652.1	518.8	40063	9,972	147%	16,537	89%
16 Street and Canada Way	14442.1	523.0	40058	14,293	101%	21,589	67%
Mcpherson Avenue and Beresford	6107.0	542.1	40197	5,638	108%	8,802	69%
16 Street and Mary	6846.0	524.7	40053	5,963	115%	9,723	70%
Imperial Street and Jubilee Av	9016.8	551.1	40055	7,238	125%	12,764	71%
Henderson Avenue and Jackson S	8062.7	506.3	40051	5,938	136%	9,534	85%
1 Street and Queens Avenue	10594.9	475.5	40074	5,919	179%	9,289	114%

22.2 Please discuss the feasibility of using a peak shaving facility or virtual gas line as a short-term mitigation method to address any potential system capacity shortfall, if the PGR Project is delayed.

Response:

As a short-term mitigation measure, a virtual gas line utilizing LNG or CNG would be smaller in scope than a permanent solution to replacing the Pattullo Gas Line. FEI estimates that up to 35,000 m³/hour, or approximately 4 to 5 large truck loads of CNG per hour, would be required to be injected into the system at a location along McBride Avenue in New Westminster on peak hours in the winter of 2023-24 without the support of the Pattullo Gas Line to keep all district station inlets pressures operating within acceptable limits. The supply requirements would be

[1] RUN1 and RUN2 refer to the redundant regulator runs (pressure reducing equipment) installed at each station. Redundant regulator runs are provided to ensure sufficient capacity to meet downstream customer demand in the event of an unexpected equipment failure or during planned maintenance.

roughly a third of what was described in Sections 4.3.5.1 and 4.3.5.2 of the Amended Application. Consequently, FEI does not consider a virtual gas line, even to support peak shaving, as a feasible solution for the PGR Project.

22.2.1 Please describe any assessments to determine the feasibility of LNG and CNG delivery, including engineering and cost studies and provide the results of these assessments.

Response:

Due to the technical and logistical challenges associated with delivering the required large gas volumes (as explained in Section 4.5.3 of the Amended Application), FEI determined that LNG and/or CNG delivery alternatives would not be feasible. Therefore, FEI did not conduct any engineering and cost studies for these alternatives beyond what was included and described in the Amended Application.

23.0 Reference: ALTERNATIVES EVALUATION

Exhibit B-6, BCUC IR 10.3.2

Schedule Impacts

In response to BCUC IR 10.3.2, FEI states:

> FEI assessed the impact on the distribution system if the Pattullo Gas Line were removed in advance of the new system being in service. However, such a schedule was deemed not viable. The removal of the Pattullo Gas Line without a replacement supply leaves the remaining system incapable of providing sufficient capacity at several district regulating stations during peak winter conditions. The risk of entering a winter period with a distribution system unable to meet FEI's forecast peak demand does not meet FEI's design criteria and could result in significant customer outages, both of which are unacceptable to FEI. [*Emphasis added*]

23.1 Please provide details of FEI's design criteria, as referenced in the preamble above.

Response:

FEI's design criteria, as referenced in the preamble, refer to the need to ensure that inlet pressures at regulating stations in the system are sufficient to allow the station regulators to pass the volume of gas required to meet the downstream customer demand under peak conditions experienced on a Design Degree Day. In addition, FEI ensures the reliability and resiliency of its stations by including a parallel (redundant) regulator run which can support the downstream system should equipment in the primary regulator run fail unexpectedly or require planned maintenance. These practices are common in the industry and are employed at regulating stations throughout FEI's system.

23.2 Please discuss whether FEI applies the design criteria explained in response to the IR above to its other distribution systems.

23.2.1 If not, why not?

Response:

Yes, the design criteria outlined in the response to BCUC IR2 23.1 are applied by FEI across all other distribution systems.

24.0 Reference: ALTERNATIVES EVALUATION

Exhibit B-1, Section 4.4.2.2, p. 45; Exhibit B-1-1, Section 4.4.2.2, p. 44; Exhibit B-1-1, Section 4.4.4.4.2, pp. 54–55, Table 4-9; Exhibit B-6, BCUC IR 12.8

Financial Evaluation, Benchmark Comparison and Criteria Weightings

On page 45 of the Application, FEI states it used the following financial criterion to evaluate the alternatives:

1. **Levelized Delivery Rate Impact:** Ability for an alternative to be completed with the lowest possible delivery rate impact over the approximate financial life of the asset (i.e., 73-year analysis period) for the PGR Project. Alternatives that minimize the levelized delivery rate impact to FEI's non-bypass customers score the highest. [Emphasis added]

On page 44 of the Amended Application, dated December 15, 2020 (Amended Application), FEI used the following financial criterion to evaluate the alternatives:

2. **Levelized Delivery Rate Impact:** Ability for an alternative to be completed with the lowest possible delivery rate impact over the approximate financial life of the asset (i.e., 68-year analysis period) for the PGR Project. Alternatives that minimize the levelized delivery rate impact to FEI's non-bypass customers score the highest. [*Emphasis added*]

On page 55 of the Amended Application, FEI provides Table 4-9 illustrating the financial comparison between Alternative 6A (Gaglardi Route) and Alternative 6D (Sperling Route) in terms of levelized delivery rate impact over a 68-year analysis period to FEI's non-bypass customers.

24.1 Please explain why the financial analysis period was changed from 73 years to 68 years.

24.2 In a format similar to Table 4-9, please provide the financial analysis for Alternatives 6A and 6D over the 73-year analysis period. Please comment on any significant variances from the financial analysis over the 68-year analysis period presented in Table 4-9.

Response:

The 73-year analysis period in the original Application was chosen based on a 70-year post-project analysis period plus three prior years for the construction period from 2020 to 2022. The post-project 70 years was calculated using the approved depreciation rate of IP pipeline at 1.35 percent (i.e. 1/0.0135 = 74 years, rounded down to 70 years). In the response to CEC IR1 3.5,

FEI discussed changing the financial analysis period from 73 years to 77 years (i.e., 74 years plus three prior years) to remove the rounding variances.

However, upon further consideration since filing the IR response and while preparing the Amended Application, FEI believes it is more appropriate to set the analysis period to the average service life (ASL) of IP pipeline at 65 years as determined in FEI's 2017 Depreciation Study (approved through Order G-165-20), plus three prior years for construction (i.e., 65 + 3 = 68 years). FEI considers that using ASL is more appropriate for the analysis period since ASL does not include the accumulated gains/losses embedded within the depreciation rates that existed at the time of the depreciation study which are unrelated to the prospective future life of the assets of the current Amended Application. Using the ASL is consistent with the basis of the analysis period used in FEI's recently filed CPCN Applications such as the Okanagan Capacity Upgrade (OCU) Project, Tilbury LNG Storage Expansion (TLSE) Project, and Coastal Transmission System Integrity Management Capabilities (CTS TIMC) Project.

FEI notes that the change from a 73 to 68 year analysis period is immaterial in terms of rate impact and does not change the alternatives analysis shown in Table 4-9 of the Amended Application. Table 1 and Table 2 below set out the financial analyses of Alternative 6A (Gaglardi Route) and 6D (Sperling Route), respectively, with an analysis period of 60, 68, 73, and 77 years. It can be seen that the PV of incremental revenue requirement changes by 1.4 percent and the levelized delivery rate impact changes by approximately 0.01 percent between these different analysis periods.

Table 1: Comparison of financial analysis periods for Alternative 6A: Gaglardi Route

	Alternative 6A: Gaglardi Route			
	60 years	68 years	73 years	77 years
Total Capital Costs, AACE Class 4, 2020 ($ millions)	173.313	173.313	173.313	173.313
PV of Incremental Revenue Requirement ($ millions)	175.534	176.881	177.435	178.003
Levelized Delivery Rate Impact (in %)	1.138%	1.130%	1.127%	1.127%
Levelized Delivery Rate Impact (in $/GJ)	0.0513	0.0510	0.0508	0.0509
Average Residential UPC (in GJ/yr)	90.00	90.00	90.00	90.00
Average Residential Bill Impact per year (in $)	4.59	4.59	4.59	4.59

Table 2: Comparison of financial analysis periods for Alternative 6D: Sperling Route

	Alternative 6D: Sperling Route			
	60 years	68 years	73 years	77 years
Total Capital Costs, AACE Class 4, 2020 ($ millions)	175.354	175.354	175.354	175.354
PV of Incremental Revenue Requirement ($ millions)	177.221	178.56	179.085	179.638
Levelized Delivery Rate Impact (in %)	1.149%	1.141%	1.137%	1.137%
Levelized Delivery Rate Impact (in $/GJ)	0.0518	0.0515	0.0513	0.0514
Average Residential UPC (in GJ/yr)	90.00	90.00	90.00	90.00
Average Residential Bill Impact per year (in $)	4.68	4.68	4.59	4.59

Further on page 44 of the Amended Application, FEI states:

> The cost estimates were benchmarked against the LMIPSU Project. The LMIPSU Project is a particularly relevant benchmark, as it was recently completed and faced similar urban construction challenges that would be expected for the three overland routes considered for the PGR Project.

24.3 Please specify the analysis period used in the LMIPSU Project. If not 68-years, please explain why the PGR Project did not use the same analysis period as the LMIPSU Project.

Response:

The analysis period used in the LIMPSU Project was 60 years. This analysis period was based on the average service life (ASL) of IP pipeline at 64 years as determined in FEI's 2009 Depreciation Study (approved through Order G-44-12), and was rounded down to 60 years. FEI notes that, as shown in the response to BCUC IR2 24.1, the difference in the levelized rate impact between a 60 year analysis period and a 68 year analysis period is immaterial and has no impact on the alternatives evaluation completed for the PGR Project.

In response to BCUC Information Request IR 12.8, FEI states:

> The LMIPSU Project consists of both the Coquitlam Gate IP project (which was largely completed in late 2019, and represented the majority of the total project costs), and the Fraser Gate IP project (which is scheduled for completion in

2021). Since construction of the Fraser Gate IP project has not yet started, and the Coquitlam Gate IP project comprises most of the project costs, this response addresses only the latter project. The capital cost details, as provided in FEI's Q3 2020 Progress Report to the BCUC, including forecast (Forecast Total at Completion column - 5) and actual (Spent to Date – column 3) up to September 30, 2020, are presented below:

Description	CPCN Estimate (1)	Revised Control Budget - Feb 2018 (2)	Spent to Date (3)	Estimate to Complete (4)	Forecast Total at Completion (5) = (3)+(4)	Variance Over / (Under) (6) = (5)-(2)/(2)	Percentage Budget Spent (7=(3)/(2)
	($000s)					(%)	
Project Management	1,626	13,409	11,151	587	11,738	-12%	83%
EPCM	13,293	43,583	31,750	947	32,697	-25%	73%
Permits and Approvals	5,695	16,054	3,604	3,757	7,361	-54%	22%
Property and Right of Way	1,137	5,442	1,280	150	1,430	-74%	24%
Materials	29,873	27,949	26,335	0	26,335	-6%	94%
Inspection	5,157	10,641	6,934	10	6,944	-35%	65%
Construction	135,551	304,916	296,301	4,114	300,415	-1%	97%
Tie-in and Commissioning	1,049	4,553	3,643	1,129	4,772	5%	80%
Contingency	29,632	36,042	0	11,212	11,212	-69%	0%
PST	3,292	1,651	1,762	0	1,762	7%	107%
Sub-total	226,305	464,239	382,759	21,906	404,665	-13%	82%
AFUDC	12,236	28,752	17,954	0	17,954	-38%	62%
Total	238,541	492,991	400,713	21,906	422,619	-14%	81%
Demolition	4,169	3,940	669	7,259	7,928	101%	17%
AFUDC Demolition	115	178	28	89	117	-35%	16%
Total Capital Cost - Coquitlam IP	242,825	497,109	401,410	29,254	430,663	-13%	81%

[…]

The major construction challenges encountered include:

- Managing public impacts, in the form of traffic congestion, construction activity and noise;
- Delays in receiving municipal, government and third-party permits and approvals including changes to traffic control plans;
- Unanticipated third-party utilities;
- Unanticipated sub-surface conditions and obstructions encountered along trenchless crossings; and
- Schedule delays in the completion of the facilities.

24.4 Please explain whether the variance between the "CPCN Estimate" and "Forecast Total at Completion" for the Coquitlam Gate IP project is a result of the major construction challenges encountered. Please discuss any other factors that contributed to the variance.

Response:

The variance between the "CPCN Estimate" and "Forecast Total at Completion" for the Coquitlam Gate IP project is a result of numerous factors, including the major construction challenges encountered. For a detailed description of the other factors, please refer to Attachment 24.4 for a copy of the LMIPSU – Coquitlam Gate IP Material Change Report which was filed on December 1, 2017.

24.4.1 Please discuss how FEI has incorporated lessons learned from the Coquitlam Gate IP project, and other past projects as applicable, to inform the development of the class 4 cost estimate of the PGR Project.

Response:

FEI has incorporated lessons learned from the Coquitlam Gate IP project and other past projects as applicable to inform the development of the class 4 cost estimate of the PGR Project as follows:

- Identification of the types of reviews and engineering input required to improve the maturity of the estimate;
- Utilization of actual productivity rates as a benchmark where applicable for all engineering estimates; and
- Utilization of lessons learned for improving:
    - stakeholder management strategies based on interfacing with various stakeholders;
    - actual timelines from all permitting activities to plan and ensure the PGR Project milestones are not affected; and
    - traffic management strategies based on the interface of the construction activities with the general public during construction.

The lessons learned have been, and will continue to be, incorporated into the different aspects of the Project planning.

24.5 Please identify the LMIPSU cost estimates used to benchmark the PGR Project class 4 cost estimates (i.e. CPCN estimate, estimate to complete, combination, etc.), and provide the rationale for using that estimate as the basis for comparison.

Response:

The LMIPSU project cost estimates were not used to benchmark the PGR Project Class 4 cost estimate. Construction of the Coquitlam Gate IP project was substantially complete by Q4 2019 and therefore actual costs (spent to date) were readily available to be used as a benchmark for the Project Class 4 cost estimate. The use of actual (as-built) costs as the basis of comparison is a widely accepted industry best practice.

In response to IR 12.8, FEI states that "[t]he actual contingency to date is shown as zero because schedule risks did not materialize and hence the associated cost impact did not occur or was recorded within each applicable line item."

24.6 Please explain whether the contingency estimate for the Coquitlam Gate IP project only covered uncertainty of schedule risk. If yes, please discuss why other risks are not covered. If not, please elaborate on which other risks are covered under the contingency estimate.

Response:

No, the contingency estimate for the Coquitlam Gate IP project covered all project risks including uncertainty of schedule risk and was based on the level of project definition at the time the contingency estimate was developed.

As referenced in the LMIPSU CPCN Application, the contingency estimate was $29.632 million. In the LMIPSU CPCN Application, section 3.4.1.4.3 "Project Contingency and Monte Carlo Analysis", a detailed explanation of the contingency estimate development was presented. In addition, Confidential Appendix A-23 – Basis of Estimate, provided additional details and states (page 16):

> The contingency allowance is intended to cover the cost of unforeseen items not apparent during the preparation of the estimate for both direct and indirect costs. Contingency allowance is not intended to cover the cost of scope changes.

In the LMIPSU Coquitlam Gate IP Project Material Change Report (page 43), FEI identified the need to further review the contingency estimate:

> 5.13 CONTINGENCY VARIANCE
>
> FEI has not provided an updated contingency at this time for a number of reasons. FEI has yet to negotiate construction contracts and has not yet achieved resolution on municipal permitting. Once these two critical areas are further defined, FEI plans to undertake an updated risk register and Monte Carlo simulation to develop a contingency that appropriately reflects the Project's exposure to risk.

In the Coquitlam Gate IP Project Q1 2018 report, Table 3-2 (page 18), the contingency under column 2, "Revised Control Budget – Feb. 2018" was increased to $36.042 million. The increase of $6.42 million ($36.042 - $29.632) was explained on page 8:

> FEI has included a contingency to account for the potential delays associated with obtaining approval from the City of Coquitlam. However, due to the uncertain nature of some of the issues, FEI has not included additional contingency to account for possible but unlikely events associated with permitting issues. In general, the amounts included for contingency are consistent with what was included in the MCR and account for items that are known requirements or have a reasonable likelihood of occurring but do not include high impact low probability elements (eg. removal of the NPS 20 as part of this Project).

To summarize, the updated contingency estimate reflected all risks based on the information available at that time.

24.6.1 Please clarify whether the contingency estimate for the PGR Project covers uncertainty of specific risks or all risks identified in the risk matrix. If specific risks, please explain why.

Response:

The contingency estimate for the PGR Project covers both the uncertainty of project-specific risks as well as all systemic risks identified in the risk register (The project risk matrix is used for prioritization of risks identified in the risk register). The risk register is used to identify all project risks and categorize each risk as either project-specific or a systemic risk. The uncertainty is then simulated using the hybrid methodology along with the Monte Carlo simulation as described in Appendix E. The output of the simulation is then used to derive a cost distribution curve from which a contingency is established to cover all project risks at a P50 confidence level.

On page 54 of the Amended Application, FEI states:

> Alternative 6A (Gaglardi Route) and Alternative 6D (Sperling Route) were developed to an AACE Class 4 cost estimate. The refined cost estimate took into consideration the development activities of each route from the technical progression as well as feedback from engagement and consultation with stakeholders, landowners and the community.

24.7 Please discuss how variations within the AACE Class 4 cost estimate range can impact the financial scores of Alternatives 6A and 6D. Include examples illustrating the impact at the extremes of the cost range.

Response:

Table 1 below shows the financial evaluation of Alternatives 6A and 6D with the AACE Class 4 cost estimates varied from P10 (low range) to P90 (high range). It can be seen that there is no material difference when comparing the two alternatives at any of the estimate levels, as the range of levelized delivery rate impact varies from 0.88 percent to 1.45 percent for Alternative 6A and similarly from 0.86 percent to 1.49 percent for Alternative 6D. As discussed in Section 4.4.4.4.2 of the Amended Application, FEI considers that the two alternatives are equivalent when compared financially, even if the low (P10) and high (P90) range of cost estimates are considered.

Table 1: Financial Evaluation of Alternatives 6A and 6D (P10 to P90)

	Alternative 6A: Gaglardi Route			Alternative 6D: Sperling Route		
	P10	P50	P90	P10	P50	P90
Total Capital Costs, AACE Class 4 ($ millions)	134.028	173.313	222.467	131.844	175.354	229.777
PV of Incremental Revenue Requirement over 68 years ($ millions	137.053	176.881	226.741	135.222	178.560	232.756
Levelized Delivery Rate Impact over 68 years (in %)	0.88%	1.13%	1.45%	0.86%	1.14%	1.49%
Levelized Delivery Rate Impact over 68 years (in $/GJ)	0.0395	0.0510	0.0654	0.0390	0.0515	0.0671
Average Residential UPC (in GJ/yr)	90.00	90.00	90.00	90.00	90.00	90.00
Average Residential Bill Impact per year over 68 years (in $)	3.56	4.59	5.89	3.51	4.64	6.04

FEI notes that the type of work for Alternatives 6A and 6D is similar (both are mostly IP pipelines in the City of Burnaby) and the cost estimates are completed by the same consultant (Mott MacDonald) in 2020. Therefore, FEI believes it is highly unlikely that one cost estimate will be realized in the low range of P10 while the other will be realized in the high range of P90. For example, if there is over or under-estimation within the cost estimates, FEI believes it would happen to both cost estimates in the same direction rather than in opposite directions. However, in order to be responsive, FEI calculated the total weighted score of Alternative 6A

and 6D in Table 2[2] below assuming the hypothetical scenario in which Alternative 6A (Gaglardi Route) is realized at the lower range (P10) level while Alternative 6D (Sperling Route) is realized at the high range (P90) level. It can be seen that even at this unlikely scenario, Alternative 6D (Sperling Route), which is the preferred alternative, still has a higher overall weighted score than Alternative 6A (Gaglardi Route).

Table 2: Overall Alternative Weighted Score
(Alternative 6A @ P10 cost estimate and Alternative 6D @ P90 cost estimate)

Criterion	Weighting	Alternative 6A: Gaglardi Route (Class 4)	Alternative 6D: Sperling Route (Class 4)
Schedule Impacts	54%	2	3
Community, Indigenous and Stakeholder Impacts	22.5%	2	3
Environmental and Archaeological Impacts	13.5%	3	2
Rate Impact	10%	3	1
Weighted Score:	100%	2.24	2.67

Table 4-7 on page 48 of the Amended Application provides a summary of FEI's assessment of Alternatives 6A, 6B and 6C against all evaluation criteria. Table 4-10 on page 55 of the Amended Application provides a summary of FEI's assessment of Alternatives 6A and 6D against all evaluation criteria. FEI provides a weighting to each of the four criteria: Schedule Impacts (54 percent); Community, Indigenous and Stakeholder Impacts (22.5 percent); Environmental and Archaeological Impacts (13.5 percent); and Rate Impact (10 percent).

24.8 Please discuss how the percentage weightings for each criterion were determined.

Response:

After establishing the Project objectives, FEI developed both non-financial and financial evaluation criteria and associated weightings through discussions with various internal stakeholders. These were then further broken down to sub-criteria.

Each subject matter expert reviewed the evaluation criteria and suggested a weighting based on their experience with similar projects, while remaining cognizant of the Project objectives. The

[2] Laid out similarly to Table 4-10 of the Amended Application.

combination of weightings from all subject matter experts indicated the relative importance of the criteria. The table below highlights the criteria and sub-criteria. The Project Sponsor reviewed and accepted the proposed evaluation criteria and weighting.

Parameter	Weight	Criteria	Weight	Sub-Criteria	Weight
Non-financial	90%	Environmental and Archaeological Impacts	15%	Environmental	10%
				Archaeological	5%
		Community, Indigenous and Stakeholder Impacts	25%	Land Acquisition & ROW	10%
				Public Consultation and Engagement	15%
		Schedule Impacts	60%	Project Schedule	15%
				Project Execution Certainty	20%
				Construction and Permitting	25%
Financial	10%	Financial	100%	PV of Incremental Annual Revenue Requirement	100%

The percentage weightings for each criteria are the product of the weighting of the parameter by the weighting of the criteria (i.e. 90 percent (Non-financial) x 15 percent (Environmental and Archaeological Impacts) = 13.5 percent). The overall weighting is provided in Table 4-3 of the Amended Application.

FEI conducted a sensitivity analysis, after completion of scoring the criteria, to confirm the impacts of the weightings. The results indicated no change to the preferred alternative.

25.0 Reference: ALTERNATIVES EVALUATION

Exhibit B-1-1, Section 4.4.4.1, pp. 49–50

Changes to Alternative 6A (Gaglardi Route)

On pages 49 and 50 of the Amended Application, FEI states:

> The Class 4 Gaglardi Route reflects two key changes:
>
> - First, FEI adjusted the route to avoid the Burnaby Lake Regional Nature Park, and instead progressed on Cariboo Road and 16th Avenue in Burnaby. This route change was made primarily to avoid environmentally sensitive wetlands and riparian areas, and the Cariboo Conservation area, limiting impacts to species at risk and associated lengthy permitting requirements. However, it results in additional urban construction activities on arterial roadways causing increased cumulative traffic impacts.
> - Second, in response to feedback from the City of Burnaby that it could not accommodate the location of the PRS, FEI relocated the PRS for the Gaglardi Route to the City of New Westminster. This results in an additional 500 metres of gas line construction along the route and permit requirements from two municipalities.

25.1 Please provide the incremental savings and/or costs that resulted from modifying the Gagliardi Route to progress on Cariboo Road and 16th Avenue in Burnaby.

Response:

FEI can compare the Class 5 cost estimate for the Class 5 Gaglardi Route to the Class 4 estimate for the Class 4 Gaglardi Route, but cannot specifically identify the incremental costs that resulted from modifying the Gaglardi Route to progress on Cariboo Road and 16th Avenue in Burnaby. This is for two reasons:

- It is not an "apples-to-apples" comparison: FEI did not complete a Class 4 estimate for the Class 5 Gaglardi Route presented in Figure 4-9 of the Amended Application. Therefore, FEI cannot make an "apples-to-apples" comparison to the Class 4 Gaglardi Route in Figure 4-12 of the Amended Application.
- The impacts of modifying the route are included as systemic risk in the early stage estimates: FEI evaluated the incremental impacts associated with construction restrictions on Cariboo Road, but did not assign a value to the cost and schedule impacts in the base estimates. At the Class 4 stage based on the level of project definition, the methodology to quantify the systemic risk impacts such as these, which include restrictions due to limited construction hours and a requirement to restore all lanes of traffic on a nightly basis once work has stopped on Cariboo Road, is described in AACE RP 42R-08 *Risk Analysis and Contingency Determination Using Parametric*

Estimating. The net impact is reflected in the Class 4 estimate's contingency and the increased uncertainty in the accuracy range.

25.2 Please provide the incremental costs for the relocation of the Pressure Regulating Station (PRS) to the City of New Westminster.

Response:

The incremental cost for the relocation of the PRS to the City of New Westminster is approximately $27 million including contingency, based on a factored cost estimating methodology prepared by Mott MacDonald. These incremental costs are associated with the following additional scope items that would need to be addressed beyond just the increased length of the project:

- Additional stakeholder consultation due to the increased length and routing into the City of New Westminster;
- Additional land acquisition considerations for the proposed McBride PRS;
- Traffic impact studies to determine impacts from both the PGR Project and the Pattullo Bridge Replacement project construction timing, specifically for McBride Boulevard/10th Avenue traffic;
- Geotechnical investigations for the McBride PRS site and conventional boring of McBride Boulevard;
- Survey of expanded study area/route;
- Trenchless crossing of 10th Avenue to mitigate traffic impacts;
- Trenchless crossing of McBride Boulevard to mitigate traffic impacts;
- Reduced construction productivity due to anticipated impacts of Pattullo Bridge Replacement traffic management;
- Access issues and complexities for construction of the McBride PRS; and
- Potential additional cost uncertainties associated with the factored estimate approach.

25.3 Please elaborate on why the City of Burnaby could no longer accommodate the location of the PRS.

Response:

During early consultation, the City of Burnaby confirmed that the 17th Avenue and Newcombe Street location for the proposed Pressure Regulating Station (PRS) would be viable. However, at a meeting between FEI and the City on August 12, 2020, FEI indicated that the proposed location of the PRS would need to be under the roadway, and the City responded that this location would not be feasible because FEI's PRS design does not permit vehicle loading. FEI asked the City about traffic volumes and the need for vehicles to drive into the dead-end road at 17th Avenue and Newcombe Street. The City responded that installing the PRS under the roadway at this location would block access to heavy vehicles such as garbage trucks and snow ploughs.

25.3.1 Please discuss whether other nearby locations in Burnaby were considered, and why these locations were ultimately rejected.

Response:

FEI considered four other potential nearby locations for the PRS within the City of Burnaby, in addition to the Newcombe Street & 17th Avenue location. The availability of other nearby locations was severely limited due to current land use zoning and distance from FEI's existing infrastructure. The four other potential locations were ultimately rejected on the basis that they are not currently zoned for utility use and the City of Burnaby indicated that a lengthy rezoning process would be required, which would have negative impacts to the Project schedule.

C. PROJECT DESCRIPTION

26.0 Reference: PROJECT DESCRIPTION

Exhibit B-1-1, Section 5.3, pp. 58, 59, 65

Final Route Development

On page 58 of the Amended Application, FEI states:

> Gas line routing is an iterative process starting with a wide 'corridor of interest' and then narrows this corridor to a more defined route at each design phase as more data is acquired, resulting in a final alignment.

On page 59 of the Amended Application, FEI states:

> Figure 5-1 below shows a map of the identified corridor shaded in yellow, with the existing FEI Lower Mainland Intermediate Pressure System Upgrade (LMIPSU) NPS 30 gas line in blue at the top and the existing trunk distribution system in blue at the bottom. The objective of the PGR Project is to construct a north to south gas line connection between these two systems within the identified corridor.

On page 65, of the Amended Application FEI states, "The routing process and ranking indicated that the preferred route includes Sperling Avenue for Segment 1, the Nursery Street crossing of TCH1 for Segment 2, and Lakefield Drive for Segment 3."

Later, on page 65 of the Amended Application, FEI states:

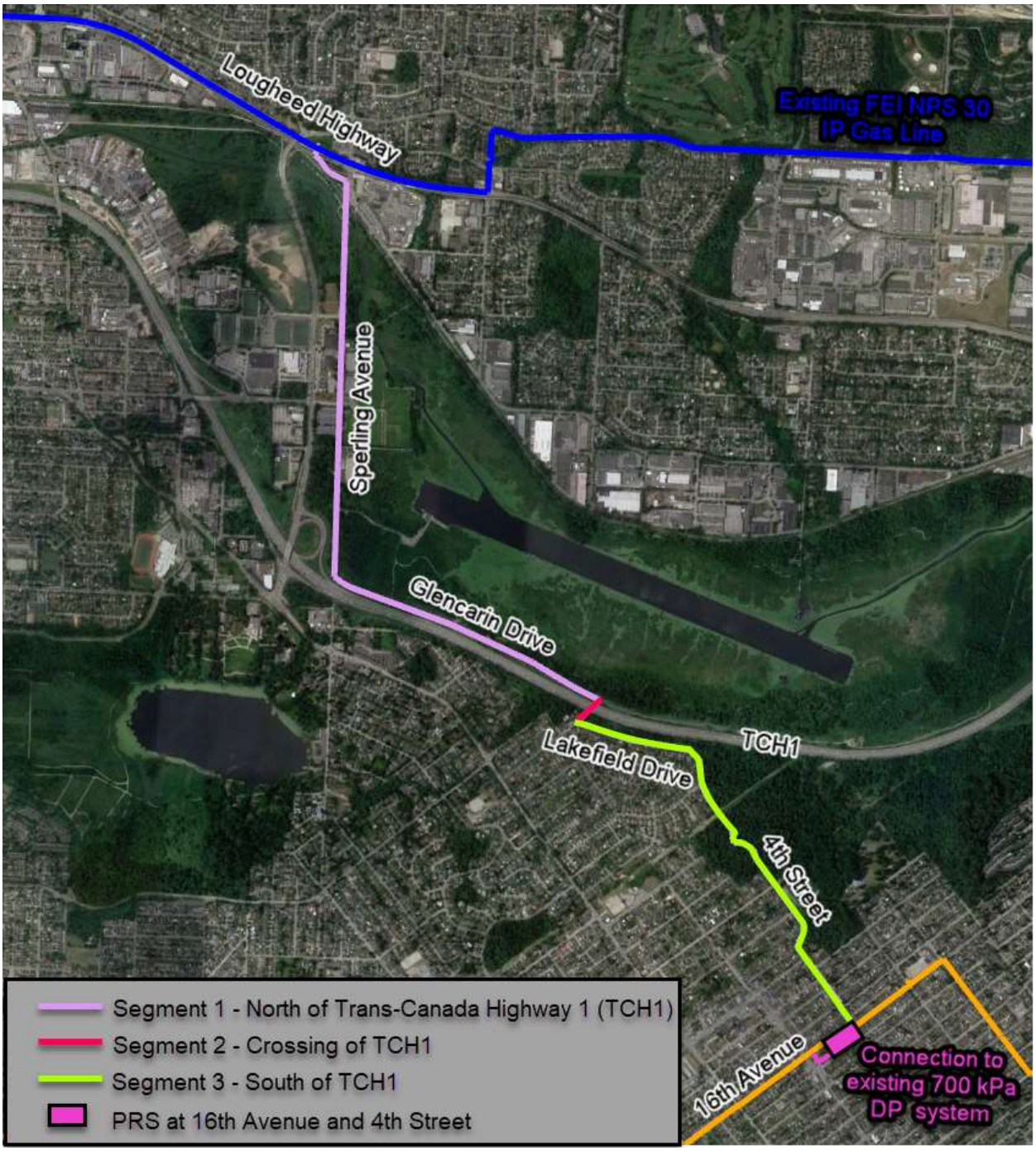
> The final stage of the routing process will occur during the detailed design phase, which is scheduled for completion as shown in Table 5-10 below. This will involve a detailed field investigation of the route and the environment in which the gas line is to be constructed….
>
> The outcome of the final stage of the routing process will comprise a confirmed gas line route and complete list of the affected landowners and stakeholders, which will facilitate finalizing the scope of work and detailed construction execution plans.

26.1 Please provide a map of the preferred route described in the preamble indicating the three route segments.

Response:

Figure 1 below presents the preferred route alignment described in Section 5.3.2.6 of the Amended Application (page 65). This preferred route alignment is the same as the alignment of the Sperling Route shown in Figure 4-13 of the Amended Application (page 25).

Figure 1: Preferred Route Alignment along Sperling Avenue



Segment 1 is the take-off from the existing LMIPSU NPS 30 (762 mm) gas line near the intersection of Lougheed Highway and Sperling Avenue and travels south along Sperling Avenue and east on Glencarin Drive.

Segment 2 crosses TransCanada Highway 1 near Nursery Street.

Segment 3 connects the TransCanada Highway 1 crossing to the PRS via Lakefield Drive and 4th Street to the PRS location on 16th Avenue and 4th Street in the City of Burnaby.

26.2 Please explain whether FEI is seeking approval of a CPCN to construct and operate the PGR Project based on the preferred route described in the preamble or based on any potential routing within the identified corridor shown in Figure 5-1.

26.2.1 If the preferred route, please explain what changes to the preferred route would require or trigger a new CPCN or other review and approval by the BCUC.

26.2.2 If any potential routing within the identified corridor, please explain how the BCUC is to evaluate the public convenience and necessity of the PBR Project and the associated consultation, environmental and technical considerations when the preferred route has not yet been identified.

Response:

FEI is seeking approval of a CPCN to construct and operate the PGR Project based on the preferred Sperling Route, as described in the preamble and shown in Figure 4-13 of the Amended Application and in the response to BCUC IR2 26.1.

As explained in Section 5 of the Amended Application, the final pipeline route within the Sperling Route corridor remains to be determined during the last stages of FEI's iterative pipeline routing process. During this process, FEI will complete the detailed design of the Project to achieve a fully engineered and defined final pipeline route alignment, reflecting consultation, environmental, and technical considerations.

In the event that a material change to the proposed route alignment is necessary (i.e., a portion of the gas line cannot be constructed in the approved corridor), FEI will file an application for approval from the BCUC to modify the route at least 90 days before construction is proposed to commence. To support the material change to the route alignment, FEI's application will include the justification, cost, schedule, and risks including associated consultation, technical and environmental considerations. This approach will provide the BCUC an opportunity to assess the revised Project route, and is consistent with the BCUC's direction to FEI in its Decision and Order C-11-15 granting a CPCN for FEI's Lower Mainland Intermediate Pressure System Upgrade (LMIPSU) projects.

26.3 Please explain, with rationale, at which stage in the design phase (30%, 60% or 90%) the route for the PGR Project will be finalized.

Response:

At the 30 percent design stage, FEI plans to finalize the route as a required deliverable for the Class 3 estimate for the PGR Project. At the 30 percent design maturity, FEI will review and approve the route mapping, surveys, topography, geotechnical investigations, and alignment sheets for the route. This is consistent with Table 3 of AACE RP 97R-18 *Cost Estimate Classification System – As Applied in Engineering, Procurement, and Construction for the Pipeline Transportation Infrastructure Industries.*[3] A Class 3 estimate has a level of definition that varies between 10 to 40 percent, but it is common practice in the pipeline industry to finalize deliverables at the 30 percent design maturity level.

As FEI progresses the design of the PGR Project to the 60 percent design phase, or as land and ROW negotiations are finalized, minor adjustments to the route alignment (i.e. micro-routing within the final route) can still occur to accommodate new information related to crossing and boring designs or piping discipline drawings.

At the 90 percent design stage, FEI will complete the final pipeline alignment sheets as part of a construction package.

26.4 Should information be acquired which leads FEI to change or finalize its preferred route prior to the close of the evidentiary record in this proceeding, please confirm, or otherwise explain, that such information will be provided to the BCUC.

Response:

Based on the Project schedule and activities planned for 2021, FEI does not expect to acquire new information which could lead FEI to change or finalize its preferred route prior to the close of the evidentiary record in this proceeding. However, if FEI were to acquire any such information, FEI would provide it to BCUC.

[3] https://web.aacei.org/resources/publications/recommended-practices.

27.0 Reference: PROJECT DESCRIPTION

Exhibit B-1-1, Section 4.4.4.2, p. 51, Section 5.4.2.8, p.69

Major Crossings

On page 51 of the Amended Application, FEI states:

> The Sperling Route ties into the newly constructed NPS 30 (762 mm) LMIPSU gas line at Lougheed Highway and Sperling Avenue. The IP gas line would then continue south along Sperling Avenue towards TCH1 and cross the BNSF Railway and Still Creek. The gas line would then cross TCH1 between Sperling Avenue and Nursery Street by an auger bore and proceed along Lakefield Drive and 4th Street and continue to the inlet of the PRS near the intersection of 16th Avenue and 4th Street. A short 700 kPa gas line would connect the PRS to the trunk distribution system. Refer to Figure 4-13 below for a map of the route.

On page 69 of the Amended Application, FEI states:

> The majority of the crossings required for the PGR Project will be constructed using open cut trench methods. Major crossings will utilize trenchless or aerial crossings.

27.1 Please identify each major crossing on the Sperling route and explain FEI's preferred crossing method for each of these major crossings.

27.2 Please explain whether each of the preferred crossing methods described in response to IR 27.1 have been finalized.

27.2.1 If not, when does FEI anticipate finalizing the crossing method for each major crossing?

27.2.2 If not, please explain whether FEI is seeking approval of a CPCN to construct and operate the PGR Project based on the preferred crossing method for each major crossing.

27.2.2.1 If yes, please explain whether a change in crossing method would require or trigger a new CPCN or other review and approval by the BCUC.

27.2.2.2 If no, please explain how the BCUC is to evaluate the public convenience and necessity of the PBR Project and the associated consultation, environmental and technical considerations when the preferred crossing methods have not yet been identified.

Response:

FEI has finalized the preferred crossing methods for the three major crossings for the Sperling Route as set out in the table below.

Major Crossing	Finalized Preferred Crossing Method
Still Creek	Aerial Crossing
BNSF railway	Conventional Auger Bore Trenchless Crossing
TransCanada Highway 1 (TCH1)	Conventional Auger Bore Trenchless Crossing

As indicated in the table above, FEI's preferred crossing method for these three major crossings is by a trenchless methodology. Conventional open trench crossings are not suitable for these three locations due to specific considerations associated with each site: environmental impacts (for Still Creek), third-party railway impacts (for the BNSF railway), and unacceptable traffic disruption (for the TCH1).

As summarized in Trenchless Evaluation Matrix for Still Creek (P-00758-PIP-STD-0001) and the Crossing Methodology Selection Report (P-00758-PIP-REP-0066) in Appendix C-1 of the Amended Application, FEI evaluated various trenchless crossing methodologies for the crossing of Still Creek. As indicated in these reports, at the time of filing the Amended Application, FEI had identified that the preferred option for crossing Still Creek and the BNSF railway was a single HDD crossing.

To support finalizing the crossing methods for BNSF Railway, Still Creek and TCH1, FEI recently completed the following activities:

1. detailed site investigations for each crossing;
2. sub-surface geotechnical investigations; and
3. detailed mitigation plans to address the specific construction impacts at each crossing location.

The rationale for the finalized crossing methods at each location are discussed below.

Still Creek Crossing

FEI has selected an aerial crossing option as the final crossing method of Still Creek. The aerial crossing option includes removing the existing bridge across Still Creek and installing a new bridge that can accommodate supporting the gas line without encroaching within the highwater elevations of Still Creek.

A conventional open trench crossing is not suitable for Still Creek due to environmental impacts. Still Creek is a fish bearing body of water and is the critical habitat for the western painted turtle and Pacific water shrew.

Although the sub-surface geotechnical investigations revealed favorable conditions for an HDD crossing of Still Creek that were not originally anticipated, FEI rejected an HDD methodology due to the following:

- An HDD crossing would have significant adverse impacts associated with workspace, commuter/pedestrian traffic impacts, and socio-economic impacts. Due to the current usage of the section of Sperling Avenue south of Sprott Street and the surrounding land, FEI would:
    - require additional temporary workspace outside of existing road allowances and into environmentally sensitive areas;
    - not be able to accommodate traffic management to allow for safe coordination of product pipe installation into the HDD borehole; and
    - cause prolonged disruption for users of the recreational facilities (tennis courts, rowing club, wildlife rescue) in the area.
- An HDD crossing would impact the section of Sperling Avenue south of Sprott Street twice during the project: first during the HDD product pipe fabrication and installation and second by the product pipe installation within the Sperling Avenue south of Sprott Street. Each impact could last up to 8 weeks in duration.
- An HDD crossing is a risk to project execution schedule. A failed HDD attempt would have a significant impact to the project schedule, which if it occurred, could leave the Project unable to meet the required in-service date, as further discussed in the response to BCUC Confidential IR1 3.4.

BNSF Railway

FEI had previously considered an HDD crossing that would extend across both Still Creek and the BNSF railway in a single, continuous bore. However, as a result of selecting an aerial crossing for Still Creek, a conventional bore crossing of BNSF Railway will be required. FEI's investigation revealed favourable geotechnical conditions at this location which are suitable for this crossing methodology. A conventional open trench crossing is not suitable for this location due to impacts to the BNSF railway; an open trench crossing would potentially disrupt rail service for an extended period and would not be permitted by BNSF.

TCH1 Crossing

FEI has concluded that the preferred method and location for crossing TCH1 is a conventional bored crossing at Nursery Street. A conventional open trench crossing is not suitable at this location due to unacceptable traffic disruption; an open trench crossing would disrupt traffic on TCH1 for several weeks with a minimum of two lanes impacted at a time. Additional trenchless methods were not evaluated at the TCH1 crossing due to the suitability of an auger bore at this location. A conventional auger bore is well suited for the proposed crossing length and

anticipated geotechnical materials, allows optimization of the crossing profile, and requires less temporary workspace than other trenchless alternatives.

27.3 Should information be acquired which leads FEI to change or finalize its preferred method for major crossings prior to the close of the evidentiary record in this proceeding, please confirm, or otherwise explain, that such information will be provided to the BCUC.

Response:

Confirmed.

28.0 Reference: PROJECT DESCRIPTION

Exhibit B-1-1, Section 4.4.4.2, p. 52

Burnaby Lake Area

On page 52 of the Amended Application, FEI states:

> FEI's investigation into the Sperling Route identified a number of technical and stakeholder challenges requiring several studies and discussions. The poor soil conditions in the Burnaby Lake area are characterized by very soft peat (i.e. potentially unstable soils) and a high ground water table presenting challenges during construction and ongoing operations and maintenance of the gas line. The route would also impact assets managed by MoTI, BC Hydro and traverse Metro Vancouver's Burnaby Lake Regional Park.

28.1 Please describe the construction and ongoing maintenance challenges associated with poor soil conditions in the Burnaby Lake area.

Response:

Construction challenges associated with poor soil conditions in the Burnaby Lake area include:

- Trench excavation stability:

  FEI anticipates pipe trench excavation stability issues in the soft soil and potentially unstable ground environment that will require design and construction of an appropriate soil retaining structure. This will likely include deep sheet piling retaining systems within the project areas.

- Shallow ground water table:

  The shallow ground water table in this soil environment requires significant dewatering in the pipe trench excavation. FEI will carry out engineering assessments to provide appropriate design and construction mitigation measures, as needed, in relation to the geotechnical and hydrological implications of significant dewatering in the project area.

- Ground movement and vibration to adjacent utilities:

  The presence of soft soil areas will require a detailed ground monitoring program to monitor and mitigate ground movements and vibrations caused by project construction activities that may impact the integrity of adjacent utilities and infrastructure.

- Backfill specifications.

  Soft soil areas also present challenges associated with using traditional imported soil backfill materials and achieving the compaction level commonly required for pipe trenches in similar projects. In addition, the additional weight of the backfill materials on soft soils will result in long-term settlement that may impact the pipe and adjacent infrastructure. Therefore, special pipe trench design and construction considerations will be implemented to ensure a negligible net load increase on these soils as a result of

pipe installation. This includes the use of geotechnically and environmentally approved lightweight backfill materials in the pipe trench.

Many of the construction issues mentioned above will also apply for ongoing maintenance activities such as integrity digs and/or potential repair activities as part of normal pipeline operation and maintenance. Depending on the situation (i.e., size, location, and purpose of the digs and/or repair excavations), design and construction measures similar to those implemented for the installation of the pipe will likely be needed to mitigate these issues.

The presence of the pipe in soft soil or potentially unstable soil areas requires special integrity management considerations in the design and operation phases. These will ensure that the pipe is well protected against ground movements that may be caused by natural phenomena including seismic events and/or adjacent third party developments and activities. For those areas, supplementary design requirements related to pipe material selection and appropriate welding procedures will be implemented. In addition, such areas will be included in the FEI Natural Hazards Management Program and associated geotechnical database. This will ensure that the locations are managed via regular monitoring and assessment as part of FEI's Integrity Management Program.

Notwithstanding the concerns listed above, FEI has extensive experience with successfully designing and operating gas lines in challenging soil conditions including, for example, in Burns Bog in Delta, BC. As such, none of the challenges discussed above are expected to preclude FEI from safely and reliably installing and operating the new gas line.

28.2 Please describe any investigations and studies required to address the technical challenges associated with the Burnaby Lake area and provide a timeline for when they will be completed.

Response:

FEI has identified a variety of investigations and studies to address the technical challenges associated with the poor soil conditions in the Burnaby Lake area.

Geotechnical investigations including intensive desktop study and geotechnical field drilling have been carried out. The findings of these investigations will be summarized in a Factual Geotechnical Report that will provide an understanding of the geotechnical site characterization of the project area. This report is expected to be completed in February 2021.

Based on the Factual Geotechnical Report, a Geotechnical Interpretive and Analysis study will be carried out to provide interpretation of the subsurface conditions encountered and their implications on the pipe design and construction. The study will include geotechnical

recommendations for piping foundations, special pipe trench design, and geotechnical parameters for pipe response analysis and constructability assessment. The study is expected to be completed in March 2021.

A Pipe Response Analysis Study will be carried out to examine the pipe stresses/strains under potential ground deformations that may be encountered during its operating life, including those induced by seismic events. The study will identify locations where pipe design mitigation requirements (e.g. increasing pipe strain capacity and/or strain-based design measures) are required. This study is expected to be completed in April 2021.

A Constructability Assessment will be carried out to identify the construction measures required to manage the unfavorable site soil conditions at the subject area. Among other construction considerations, the assessment will provide an appropriate excavation plan including: proper excavation sequence, an effective soil retaining system, a detailed ground monitoring plan, and rigorous geotechnical field review plan during construction. The assessment report is expected to be completed in May 2021.

29.0 Reference: PROJECT DESCRIPTION

Exhibit B-1-1, Section 5.6, p. 75

Early Works Permits

On page 75 of the Amended Application, FEI states:

> The preliminary Project execution schedule is based on receiving a BCUC decision by Q3 2021, an early works program after the BCUC decision, and an assumed construction start of Q2 2022.

29.1 Please describe the early works program and associated regulatory process for obtaining permits for early works.

Response:

The early works program is currently being developed as the Project design progresses and advances to completion of all Class 3 deliverables. The early works program is expected to be defined at the completion of the Class 3 deliverable milestone which is targeted for May 2021. In the gas line construction context, early works refers to any field construction activity that can be started before the owner supplied materials are required to be provided to the Contractor. In addition to the availability of owner supplied materials, early works could be any field construction activity that would mitigate a delay to the construction progress. Regardless of the scope of work to be included in the early works program, all predecessor milestones related to the early works program such as, but not limited to, design completion, permit approvals, and construction contracts are required to be completed.

As the PGR Project has a schedule constraint that is driven by the Province's Pattullo Bridge Replacement Project, FEI plans to commence mainline construction (the work that commences after completion of early works) no later than March 1, 2022. To further mitigate schedule pressures, commencing the mainline construction earlier, in conjunction with the early works, is currently being investigated and evaluated. Once the early works scope is defined in May 2021, along with the possibility of any earlier start to mainline construction, the associated regulatory process for obtaining permits will be sequenced and prioritized accordingly.

29.2 Please explain whether FEI requires the BCUC's decision to obtain permits for early works.

Response:

No, FEI does not require the BCUC's decision to obtain permits for early works.

30.0 Reference: PROJECT DESCRIPTION

Exhibit B-1-1, Section 5.9.2, p. 80

BC Oil and Gas Commission - New Gas Line Application

On page 80 of the Amended Application, FEI states:

> The construction, operation and decommissioning activities of the Project are governed by the Oil and Gas Activities Act. The Project will require a new gas line application, which FEI plans to file in Q3 of 2021. A gas line application involves considerable technical scrutiny by the BCOGC. Public and Indigenous consultation, ROW acquisition, land acquisitions, land or access rights, archaeological requirements, design reviews, and environmental permits/approvals for work in and around fish bearing streams are all components of the application. Each component must receive BCOGC approval prior to the start of construction. The current schedule assumes a 5-month approval period from the time of filing.

30.1 Please describe in detail the process for compilation and review of a new gas line application to the BC Oil and Gas Commission (BCOGC), and provide a breakdown of the timeline for each phase of the process.

Response:

The process for compilation and review of a new gas line application to the BC Oil and Gas Commission (BCOGC) includes the following general processes:

1. Project and permit planning;
2. Application compilation and submission;
3. Application review and decision by the BCOGC;
4. Permit issuance and review of permit conditions; and
5. Post-permit actions.

Further detail of these sequential processes and associated timelines are provided below.

1. Project and Permit Planning (estimated timeline of 8 to 12 months)

In order to identify BCOGC permitting requirements, an interdisciplinary team considers the project scope and spatial footprint required to execute the Project. This planning process requires information sharing from the following disciplines which advise on project specific considerations:

- Project Management;

- Engineering;
- Property Services;
- Construction;
- Operations;
- Archaeology;
- Environmental;
- Community and Indigenous Relations; and
- Permitting.

The Project team then reviews the project scope and spatial footprint to develop a permitting strategy and determine the BCOGC permitting requirements, including the type of permit application, the associated deliverables, and the schedule for completing the permitting process.

2. Application Compilation and Submission (estimated timeline of 3 to 4 months)

During the application compilation period, the Project team prepares and provides the completed application deliverables for review and compilation within the BCOGC's Application Management System (AMS). Subject to changes in the confirmed Project scope, the deliverables that have been identified for the PGR Project include:

- Archeology Information Form;
- Piping and Instrumentation Diagram (P&ID);
- Appurtenance Design List;
- Pressure Test Specifications;
- Plot Plans;
- Environmental Management Plan (Habitat Assessments as required);
- Consultation & Notification to landowners and stakeholders;
- Indigenous engagement; and
- Construction Plans, Design Drawings, and Mapping.

Once all of the required deliverables have been compiled in the BCOGC's AMS system, the application is submitted to the BCOGC for review.

3. Application Review and Decision by the BCOGC (estimated timeline of 4 to 5 months)

Applications to the BCOGC are reviewed in the order they are received; therefore, FEI's application review timeline will vary based on the number of applications already in the

BCOGC's review queue. This sequence of review is applicable to all proponents, unless there are special circumstances in which case a proponent can provide justification to the BCOGC to request a priority review.

The BCOGC does not provide or commit to a standard application review timeline. When applications are complete, the typical range of application review time that FEI has observed is one to three months from the time of submission until the BCOGC makes a decision and issues a permit. This range also assumes that the application did not require edits to address missing, unclear, or erroneous information, and that consultation is undertaken within the prescribed period (generally within a period of 30 days or less). Major pipeline amendment applications such as the PGR Project tend to have a longer review period of four to five months (150 days) as described in the response to Burnaby IR1 11.2.

4. Permit Issuance and Review of Permit Conditions

Once the BCOGC's statutory decision maker completes their application review and compiles the permit with all conditions, the approved and signed permit document is emailed to all the parties identified in the permit application's "permit distribution contacts" data field.

The BCOGC also sends a copy of the approved permit to all First Nation communities that were consulted during the application review. WorkSafeBC also receives a copy of the permit so they are aware of potential upcoming construction projects that they may choose to audit.

The proponent is responsible for immediately reviewing the entire list of permit approvals and conditions. This includes:

- Ensuring that the permit includes all of the permissions that were requested in the application;
- Confirming whether there are erroneous permit conditions; and
- Considering whether the permit conditions are reasonable and will allow the project team to effectively complete the project within scope.

The project team must respond to the BCOGC as soon as practicable to negotiate options where required.

5. Post-Permit Actions

In addition to actions set out in the permit conditions, the BCOGC requires that each pipeline permit holder file post permit notices within a specified timeframe. The post permit notice requirements are as follows:

- Notice of Construction Start to Indigenous Groups – required 1 week prior to construction start;
- Notice of Construction Start (NCS) – Required 48 Hours prior to construction start;

- Notice of Pressure test (NPT) – 48 Hours prior to pressure testing;
- Leave to Open (LTO) – 24 Hours prior to commissioning;
- Post Construction Plan (for new crown land applications) – To be completed within 60 Days after LTO submittal; and
- As-Built Submission – To be completed 90 days after LTO submittal.

30.2 Please describe in detail the required deliverables for the new gas line application to the BCOGC including Indigenous and public consultation, ROW acquisition, land acquisitions, land or access rights, environmental assessments, archaeology impact assessment and design drawings.

Response:

In addition to the deliverables described in the response to BCUC IR2 30.1, the following deliverables are required when submitting what is referred to by the BCOGC as a "major pipeline amendment application" for the PGR Project:

- **Project Description Letter** – Provides details on the project scope and timelines.
- **First Nations Project Description Form** – A BCOGC template of questions that provide insight into the project scope, timeline, and mitigation efforts. The BCOGC uses this form to initiate their own engagement process with First Nations who have interests in the project.
- **Construction Plan** – Consists of a diagram of the proposed pipeline alignment and right of way, information regarding temporary workspaces, and watercourses within a 200 metre radius of the project.
- **Consultation & Notification Line List, and Notification Letter –** A BCOGC-specific template to provide contact information, land information, and a summary of responses or concerns received from the landowner or rights holder.

  This deliverable reflects the consultation and notification processes that must be completed prior to submitting an amendment application. These processes include:

  - Drafting and sending a notification letter with prescribed language from the BCOGC that must go out to all landowners and stakeholders who are identified as impacted by the project based on its footprint; and
  - If the BCOGC chooses, they can also request that notification letters be sent to all landowners within a 200 metre radius of the project centerline.

- **Geomatics Deliverables (shapefiles, scale maps, consultation & notification mapping)** – Shapefiles are uploaded into the BCOGC Application Management System (AMS) and provide, in particular, specific location information with respect to the Project. Geomatics information is a requirement for all BCOGC applications and may include trapper and guide outfitter boundaries, and municipal boundaries in relation to the project footprint.
- **Pressure Test Specifications** – These specifications establish the required testing information to comply with the applicable Canadian Standards Association Z662 Oil and Gas Pipeline Systems standard. Pressure Test Specifications are provided by the engineer of record.
- **Piping and Instrumentation Diagram (P&ID)** – A BCOGC-specific pipeline P&ID that provides information about pipelines and installations, their locations, specifications, and BCOGC pipeline and installation registration numbers, broken down into projects and segments.
- **Archaeology Information Form (AIF)** – A required document if a project's footprint is on land that hasn't previously been disturbed for an oil or gas activity. The AIF provides information on the archaeological potential of a site and if further field assessment is required. An AIF is completed by an archaeologist.
- **Archaeological Impact Assessment (AIA) and/or Preliminary Field Reconnaissance (PFR) (if required)** – An AIA or PFR is required if areas of high archaeological potential are identified by the archaeologist upon reviewing the AIF.
- **Environmental Management Plan** – An environmental management plan is required if environmental receptors or watercourses are impacted by the project. This plan is provided by a Qualified Environmental Professional (QEP).
- **Crossing Typicals (for all roads, utilities, waterbodies, aerial crossings)** – Crossing typicals are engineering drawings providing a generic crossing plan showing the specifications required by CSA which will be implemented for any crossings within the project.
- **Appurtenance Design List** – The appurtenance design list provides engineering specifications for valves, regulators, risers, and heaters.
- **Individual Ownership Plans (IOP)** – An IOP is required for private land within an application area, where a land owner is directly impacted and a surface agreement is required.
- **Geotechnical Assessment**– Geotechnical Assessments provide information regarding the subsurface conditions of an area and provide an evaluation on the geotechnical feasibility of a site. The assessment process includes a desktop review of geological/geotechnical information, field investigation, and reporting.

Based on the PGR Project scope and footprint, the following BCOGC authorizations and associated deliverables may also be required:

In-Stream Works (Section 11 of the Water Sustainability Act)

- **Fisheries Habitat Assessment** – Provided by a QEP if the project impacts watercourses or water bodies that are fish bearing.
- **First Nations Consultation & Engagement Letter (mail out)** – First Nations Groups identified as having administrative boundaries within the project area are notified before submission of the application. The BCOGC carries out consultation with the First Nations Groups during the application review period.
- **In-stream Works Environmental Management Plan** – Provided by a QEP, the in-stream environmental management plan includes mitigation measures relating to fish and aquatic habitat, riparian vegetation, and water quality.
- **HDD Feasibility Assessment (where applicable)** – Required for horizontal directional drilling (HDD) below watercourses. This assessment provides a geotechnical review and engineering analysis.
- **Crossing Typicals** – As described above, crossing typicals are engineering drawings providing a generic crossing plan which may be implemented for a portion of the project.
- **Shapefiles** – Stream impact shapefiles are uploaded to the BCOGC system to provide coordinates of the impact. These impacts are also assigned a BCOGC impact number for the entire watercourse.

Short-Term Water Use Approval (Section 10 of the Water Sustainability Act)

- **Water Supply/Demand Analysis** – This deliverable requires details about the water source, withdrawal volumes, and potential impacts to water supplies.
- **Environmental Flow Needs Assessment (if required)** – This deliverable requires an assessment of volume and water flow timing, in relation to the functioning of an aquatic ecosystem. The BCOGC may request this deliverable as part of the short-term water use approval.

Archeological Authorizations (Section 12.4 of the Heritage Conservation Act)

- **Completion of an HCA Application for Site Alteration** – Required where an AIF, AIA, or construction reveals an archaeological site within the project footprint that cannot be avoided.

30.3 Please compare the information in the PGR CPCN Application to the required deliverables for the new gas line application to the BCOGC.

30.3.1 In the above response, please describe any additional information required for the BCOGC application and associated timeline for acquiring the information.

Response:

The assessment undertaken by the BCUC in approving a CPCN application is fundamentally different from applications to the BCOGC. As an economic regulator, the BCUC assesses an application for a CPCN to determine whether a proposed project is in the public interest. In making this determination, the BCUC considers a number of factors including rate impacts (cost to customers) and the ability for the proposed project to deliver safe and reliable service. In contrast, as a technical regulator, the BCOGC's mission is to protect public safety, safeguard the environment and respect those affected by oil and gas activity. Project costs and rate impacts are not a consideration in BCOGC determinations.

The BCOGC therefore requires different deliverables and additional information as compared to the BCUC. FEI provides a description of the various purposes for the BCOGC to review the Project below and, where applicable, sets out additional information requirements as part of these processes.

1. **Jurisdiction over Watercourses:** Pursuant to section 11 of the *Water Sustainability Act*, the BCOGC oversees any impacts to watercourses that could be implicated by the project scope. Streams fall within the jurisdiction and protection of the provincial Crown, with the BCOGC responsible for reviewing any potential impacts to watercourses associated with the Project.
2. **Ensure Public Safety:** The BCOGC's engineering department will review the engineering details of the Project to ensure that it is being designed and built in accordance with appropriate Canadian standards.
3. **Exercise Jurisdiction over the *Heritage Conservation Act*:** Where a project involves new permanent areas for oil and gas activity, the BCOGC has the jurisdiction to review any potential impact to archaeological features that could come in contact with the project. The BCOGC also issues permissions related to altering an archaeological site if impacts to site cannot be avoided.
4. **Review Notification Requirements under the Consultation and Notification Regulation of the *Oil and Gas Activities Act*:** In an amendment application, the BCOGC requires proponents to submit a notification letter to all landowners and rights holders impacted by a project. The letter describes the project and provides recipients the opportunity to contact the BCOGC with any questions or concerns. Where an amendment is deemed to be "major" (as defined in the Consultation and Notification Regulation), a notification letter may be need to be sent to all landowners within the 200 metre radius of the project.

5. **Consultation with Indigenous Groups:** If a project may impact provincial crown land or a watercourse within the province, as a Crown agency, the BCOGC is responsible for fulfilling the Crown's duty to consult with Indigenous groups.
6. **Review for potential adverse environmental impacts:** The BCOGC will review the Project's environmental management plan to ensure that environmental impacts associated with the Project have the appropriate mitigations in place.

Please refer to the response to BCUC IR2 30.1 for timelines associated with gathering additional deliverables.

30.4 Please specify when FEI expects to receive approval of its new gas line application from the BCOGC.

Response:

Based on the current project permitting schedule, FEI expects to receive approval of its new gas line application from the BCOGC by the end of September 2021.

30.4.1 Given the timing described above, and that a new gas line application is required prior to construction, please explain why FEI requires a CPCN approval from the BCUC by Q3 2021.

Response:

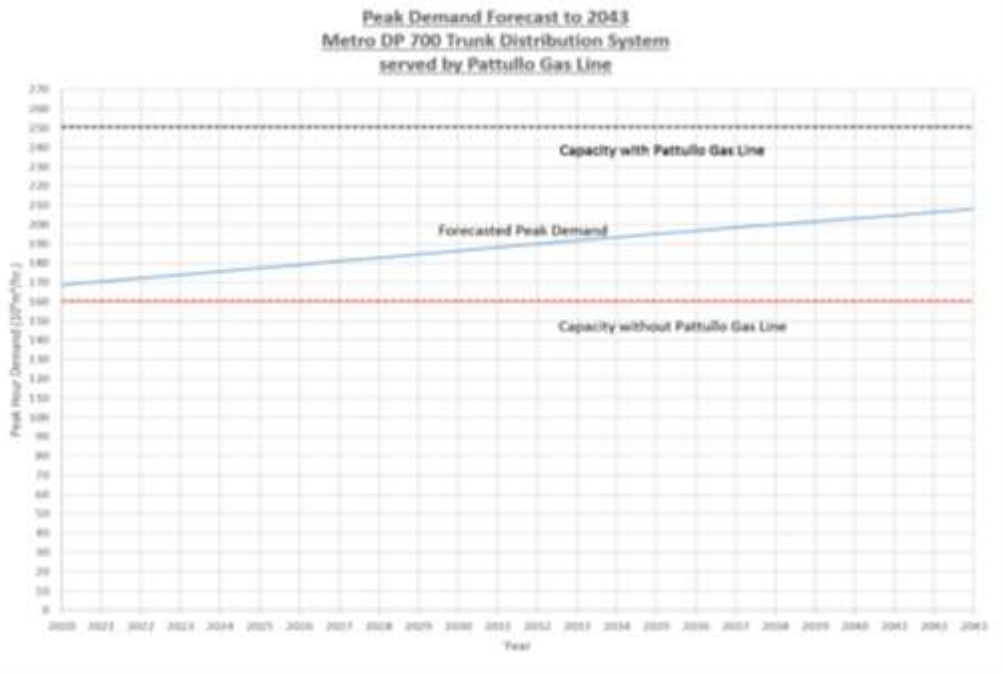
As described in Table 5-10 of the Amended Application, FEI plans to mobilize for early works construction in Q4 of 2021. In accordance with section 45 of the *Utilities Commission Act*, FEI is required to obtain a CPCN approval prior to beginning construction of the Project. Obtaining a CPCN for the Project by Q3 2021 will ensure that early works construction begins as scheduled, thereby enabling FEI to meet the Project schedule and milestones.

31.0 Reference: PROJECT DESCRIPTION

Exhibit B-9, CEC IR 5.5

System Capacity with PGR Project

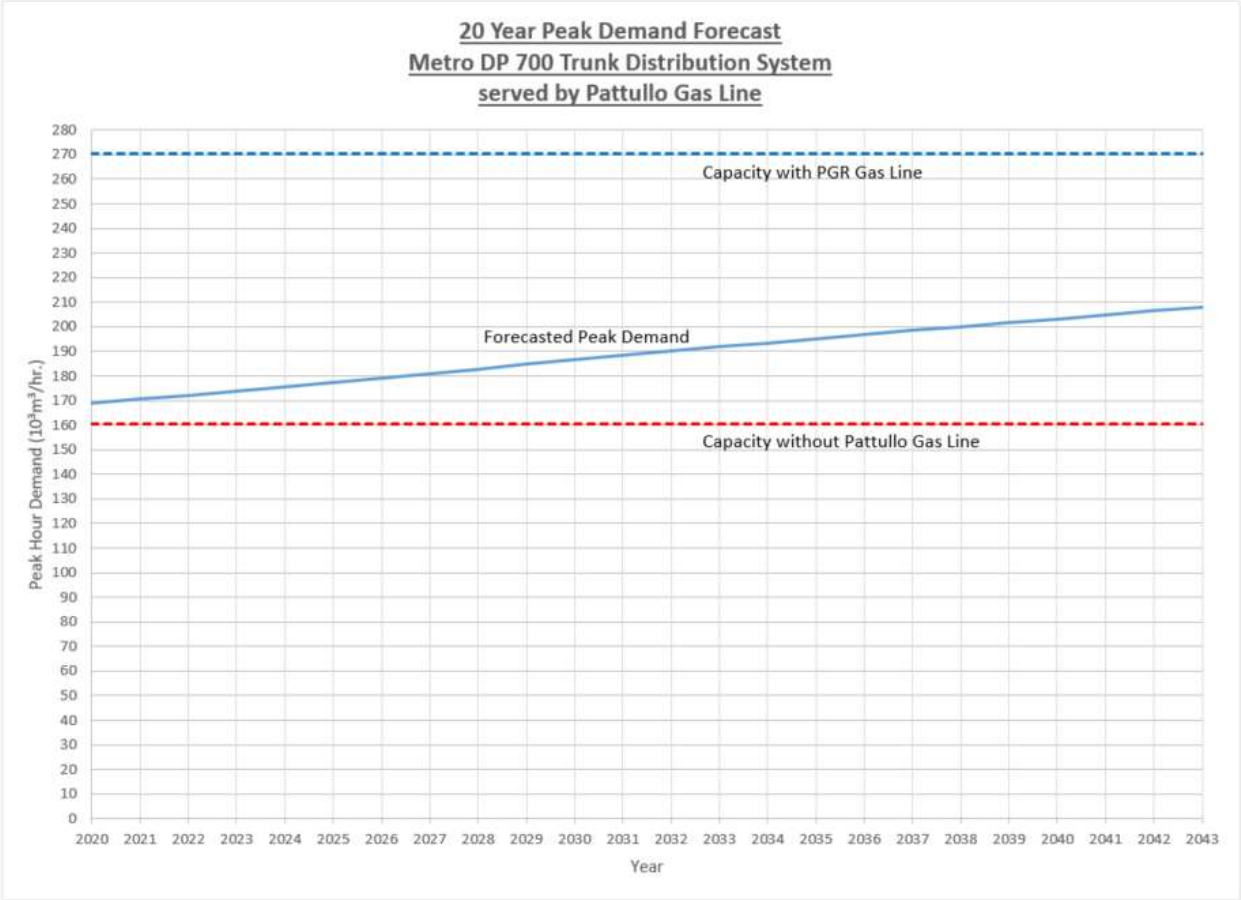
In response to CEC IR 5.5, FEI provided the following figure which shows peak demand and available system capacity, both with and without the Pattullo Gas Line.



31.1 Please provide a revised version of the above figure which illustrates system capacity with the PGR Project (i.e. system capacity with the proposed new gas line but without the PGL).

Response:

The following is a revised version of the figure showing the capacity of the new gas line proposed in the PGR Project (Sperling Route option). The system capacity is approximately 8 percent greater than what would be available to the system if the existing Pattullo Gas Line were to remain in service.



31.2 Please quantify any surplus system capacity with the PGR Project for each year from 2023 to 2043. (i.e. system capacity with PGR Project in excess of the forecasted peak demand).

Response:

The following table quantifies the difference, year over year, between the available capacity with the PGR Project along the Sperling Route and the forecasted peak demand for the system.

Year	Available Capacity with PGR Project ($10^3m^3/hr.$)	Required Capacity to Meet Peak Demand ($10^3m^3/hr.$)	Net Additional Capacity ($10^3m^3/hr.$)
2023	270.3	174.0	96.3
2024	270.3	175.7	94.6
2025	270.3	177.4	92.9
2026	270.3	179.2	91.1

Year	Available Capacity with PGR Project ($10^3m^3/hr.$)	Required Capacity to Meet Peak Demand ($10^3m^3/hr.$)	Net Additional Capacity ($10^3m^3/hr.$)
2027	270.3	181.0	89.3
2028	270.3	182.9	87.4
2029	270.3	184.7	85.6
2030	270.3	186.5	83.8
2031	270.3	188.2	82.1
2032	270.3	190.0	80.3
2033	270.3	191.8	78.5
2034	270.3	193.5	76.8
2035	270.3	195.2	75.1
2036	270.3	196.9	73.4
2037	270.3	198.5	71.8
2038	270.3	200.1	70.2
2039	270.3	201.7	68.6
2040	270.3	203.3	67.0
2041	270.3	204.8	65.5
2042	270.3	206.4	63.9
2043	270.3	208.0	62.3

31.3 Please discuss whether there is an opportunity for FEI to reduce the PGR Project costs by minimizing any surplus system capacity with the PGR Project.

31.3.1 Please describe any assessments to determine the optimal pipe diameter of the proposed new gas line, including engineering and cost studies and provide the results of these assessments.

Response:

FEI disagrees with the characterization that there is "surplus system capacity with the PGR Project." As described below, FEI needs to undertake the Project with the system capacity proposed in the Amended Application and therefore does not consider that there is an opportunity to reduce costs on this basis.

There are three major components of the PGR Project that could in theory be adjusted to reduce costs: (i) the interconnection with the existing Coquitlam Gate IP NPS 30 gas line; (ii) the

new PRS in Burnaby; and (iii) the length or diameter of the new 5.6 km gas line that will interconnect the two locations.[4]

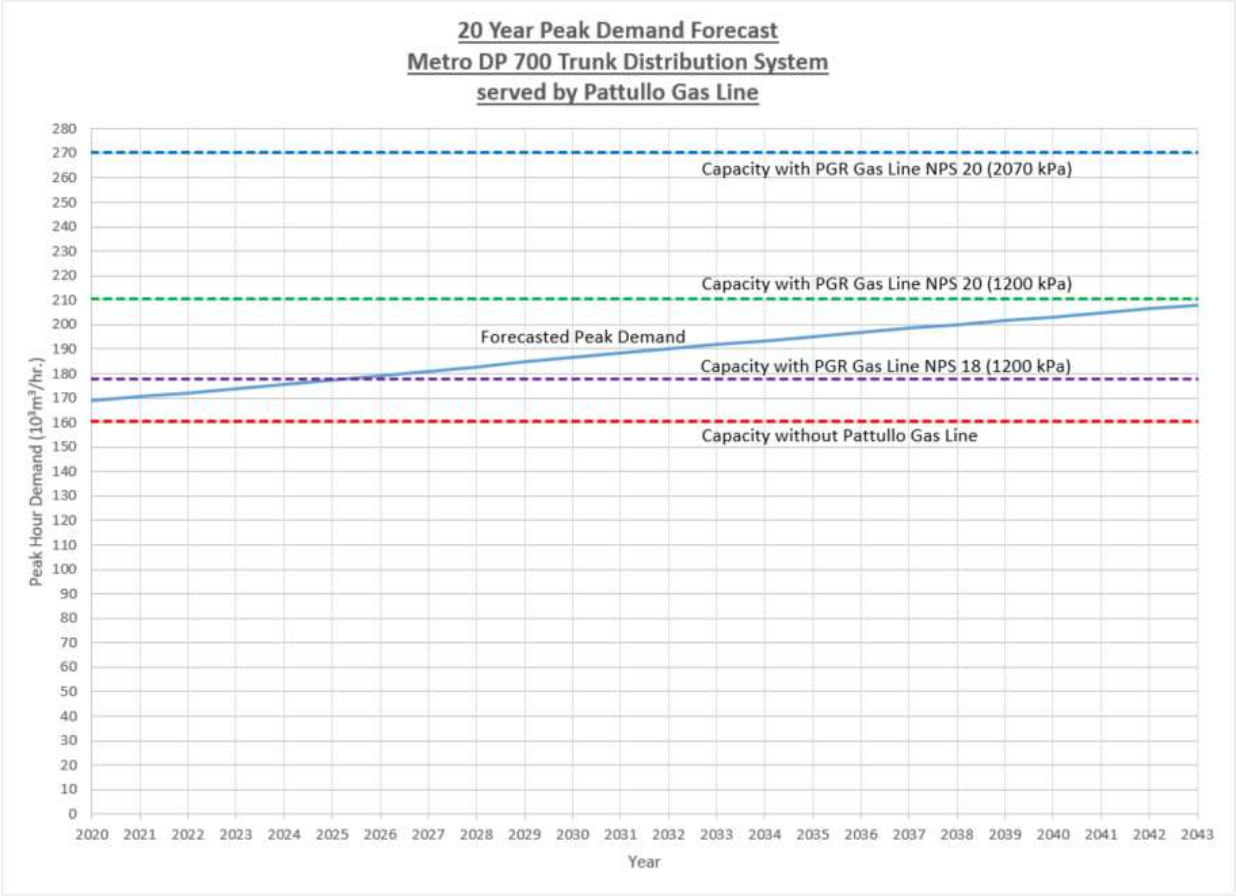
Adjustments (i) and (ii) would, in fact, not materially reduce costs. First, the interconnection at the Coquitlam Gas IP gas line is required to provide a source of supply to the new gas line. Changes to the equipment at this location to reduce gas flows would have no material impact on costs because the costs of the interconnection are primarily driven by the operating pressures of the equipment, not gas flow rates. Second, the new PRS in Burnaby is required to reduce from IP to DP pressure to ensure safe operation of the distribution system and, similar to the above, changes to the flow capacity would have no material impact on the station's cost.

Adjustment (iii), reducing the length or diameter of the pipe, would not be consistent with the Project objectives or be in the interest of ratepayers:

- **Reducing the Length of Pipe:** As described in the Amended Application, FEI considers pipe length as part of its route determination process, and the proposed Sperling Route is the most cost-effective solution that meets the Project objectives. There are no further opportunities to reduce the length of the new gas line.
- **Reducing the Diameter of Pipe:** NPS 20 is the optimal diameter for the gas line. The limiting condition which dictates the minimum size of the new gas line is the lowest sending-end pressure at the inlet to the new gas line where it interconnects with the Coquitlam Gate IP line. In this case, the low-end inlet pressure is 1200 kPa[5], meaning that the PGR Project must be designed to operate at a minimum pressure of 1200 kPa while still having sufficient capacity to meet forecast customer demand. As shown in the figure below, only an NPS 20 gas line would have sufficient capacity to meet customer demand to the end of the 20-year planning horizon. The next smaller standard pipe diameter of NPS 18 would only result in a minimal reduction in project costs, but would have sufficient capacity to meet forecast customer demand for only three years beyond Project completion. Using a smaller diameter pipe would therefore require FEI to replace the gas line with a new, larger diameter, pipe within a relatively short time period and with similar impacts as those associated with the PGR Project.

[4] Scope adjustments to the fourth project component – the very short (50 metre) segment of DP gas line required to interconnect the PRS with the existing DP system in Burnaby – would have no material impacts on Project costs.

[5] Although the maximum operating pressure of the Coquitlam Gate IP line is 2070 kPa, for overall system flow reasons the gas line is operated at a lower pressure of 1200 kPa for significant portions of the year.



For all these reasons, FEI considers that it has already appropriately sized the equipment for the Project, and there are no further opportunities to reduce costs by reducing the capacity of the Project.

31.4 Please discuss the feasibility of modifying the existing distribution system (e.g. gas line main and pressure regulating station upgrades) as a short-term mitigation method to address any potential system capacity shortfall, if the PGR Project is delayed.

31.4.1 Please describe any assessments to determine the feasibility of debottlenecking the distribution system, including engineering and cost studies and provide the results of these assessments.

Response:

Modifying the existing distribution system as a short-term mitigation method to address system capacity shortfall would not be feasible due to the need to install above-ground bypass assemblies as discussed below. As such, FEI has not considered this approach for any further assessments to mitigate a delay in the PGR Project construction.

While some short-term mitigation could be achieved by upgrading stations, FEI would need to bypass several stations that would experience inlet pressures too low for the existing or upgraded stations to operate reliably during design capacity conditions. Specifically, FEI would need to install bypass assemblies with control and monitoring devices to ensure the downstream system could not exceed the Maximum Operating Pressure (MOP) of 420 kPa.

The stations in the trunk distribution system are primarily below grade stations (pit stations) located in or near city road allowances. These facilities are designed to be compact and are not typically capable of allowing space for modification and bypass installation. The figure below shows a typical pit station (vent stack and instrument cabinet shown to the left of the bus stop) at 6th Ave and Cumberland Street in New Westminster.

Figure 1: 6th Avenue and Cumberland Street Pressure Regulating Station

Bypasses would need to be located outside these existing facilities and above ground, which is not feasible as they would be exposed to third-party damage (e.g., vehicle accidents or

vandalism) and intrusive to the residential and commercial communities where the stations are located.

FEI has considered a similar approach in the CPCN application for the Okanagan Capacity Upgrade (OCU) Project to facilitate managing peak demand that exceeds the design capacity in the year prior to the anticipated construction of the upgrade. However, in the instance of the OCU Project, the stations identified for bypass construction are above ground, in fenced properties, and outside of city road allowances.

D. PROJECT COST ESTIMATE

32.0 Reference: PROJECT COST ESTIMATE

Exhibit B-1-1, Section 5.10.1, p. 82; Exhibit B-6, BCUC IR 15.4

Base Cost Estimate

FEI states on page 82 of the Amended Application:

> FEI developed the Project cost estimate in conjunction with Mott MacDonald Canada Ltd (Mott MacDonald), based on criteria from AACE International Recommended Practices 18R-97 and 97R-18. …
>
> […]
>
> The total base Project cost estimate is $124.333 million in 2020 dollars, which includes the sum of Mott MacDonald's estimate and FEI's portion of the base estimate.

In response to BCUC IR 15.4, FEI states:

> FEI has undertaken additional preliminary constructability and other site reviews for the Gaglardi Route, and is in the process of doing the same for the Sperling Route. The modifications to the estimating methodology during development of the Class 4 cost estimate, which better define the scope of the Project and reduce uncertainties in the estimates' expected accuracy range….

32.1 In view of the modifications to the estimating methodology, please provide the expected accuracy range of the PGR Project class 4 cost estimate.

Response:

As shown in Figure 5-5 (Quantitative Risk Analysis - Monte Carlo Simulation) of the Amended Application, the output of the quantitative risk analysis concluded that the P50 capital cost estimate is approximately $154.4 million, with P90/P10 ranges of approximately $195.2 to $123.2 million before escalation and AFUDC. Based on these numbers, the expected accuracy range of the PGR Project Class 4 cost estimate is approximately -20 to +27 percent.

32.2 In the event that a change in project scope, schedule or other factor(s) may materially change the cost estimate to complete the project, please explain how this will be addressed in terms of internal FEI approvals

Response:

Any change to the Project's scope and schedule that impacts cost is first reviewed and analyzed by the project team as part of FEI's integrated change management system and process. The change management system covers the management of scope, cost and schedule change over the life cycle of the project from project need, through execution and close out. The FEI change management system includes the documentation, tracking systems, and approval levels necessary for authorizing changes.

If a change in scope, schedule, or other factors materially change the cost estimate, the project team is required to prepare a material change request and seek approval for the change. All change request approvals must comply with FEI's Authorities Policy.

33.0 Reference: PROJECT COST ESTIMATE

Exhibit B-1-1, Section 5.10.3, p. 84; Exhibit B-6, BCUC IR 15.5

Cost Estimate Validation

On page 84 of the Amended Application, FEI states that the following validation of the cost estimate was completed:

> An external independent review to verify and validate that the estimate, as well as schedule, met the AACE Class 4 criteria and requirements and that a well-documented, reasonable and defensible estimate was developed;

In response to BCUC IR 15.5, FEI states that modifications to the estimating methodology during development of the Class 4 cost estimate was undertaken to better define the scope of the Project and reduce uncertainties in the estimates' expected accuracy range. The modifications included "additional independent reviews of the cost estimate(s) and estimate assumptions including a review of the materials, take-offs, productivity rates, etc."

33.1 Please elaborate on the independent reviews that have been undertaken on the Class 4 cost estimate.

33.2 Discuss any concerns raised by the independent review(s) and provide a copy of the review(s).

Response:

The independent reviews undertaken on the Class 4 estimate were completed by Universal Pegasus International (UPI) and Validation Estimating LLC. Please refer to the responses to CEC IR2 29.2 and 29.3 for the activities included in the estimate validation review. Please also refer to the response to BCUC Confidential IR1 1.1 for the feedback received from the independent reviews. No concerns were raised by UPI's independent review, which concludes the basis of estimate was well thought out and presented. The report identifies various risks that should be quantified. All the projects risks were identified in the report Appendix E-1 - Project Risk Assessment Report and quantified as described in the report Appendix E-2 - Capital Cost and Schedule Risk Analysis and Contingency Estimate.

34.0 Reference: PROJECT COST ESTIMATE

Exhibit B-1-1, Section 5.6.1, p. 75; Section 5.10.4, p. 84; Section 5.10.4.3, p. 85; Section 5.10.4.4, p. 86; Section 5.10.4.5, p. 88; Exhibit B-6, BCUC IR 15.6, 15.8.3

Risk Analysis and Contingency Determination

On page 84 of the Amended Application, FEI states:

> YPCI [Yohannes Project Consulting Inc.] conducted multiple workshops with the Project team to develop a risk register for the Project to identify risks that could likely occur. As the engineering advances on the Project, the probability or the consequence of several identified risks were either mitigated entirely or reduced. All of the risks associated with the Project are contained within the Pattullo Gas Line Replacement (PGR) Sperling Avenue Route – Qualitative Risk Assessment Report Class 4,…

34.1 Please comment on the likelihood of new risks emerging and how FEI is monitoring for new risks as engineering work on the PGR Project advances.

Response:

FEI has a risk management framework process in place for all projects which is used for identifying, managing, and monitoring project risks throughout each phase of a project's lifecycle. Emerging project risks will be identified on an on-going basis during the Project's lifecycle. Risks are identified using several methods:

- Review of risks identified from ongoing stakeholder consultations; environmental studies and assessments; engineering studies and investigations; engineering design reviews; contract formation, bid review, evaluation and awards; construction readiness reviews; construction field reports; field inspection and monitoring activities; and commissioning activities.
- Periodic individual or group interviews conducted with risk owners and other selected Project team members.
- Change request reviews – changes that may have an impact to the Project baseline plan (cost, schedule, performance, etc.). Project controls will assess risks of any change request to the project plan using the integrated change management process.

It is possible that some new risks may be identified (and some mitigated) during the engineering phase. The identification and mitigation of risks are recorded in the project's risk register.

34.1.1 Please indicate if there have been any new risks identified since YPCI has completed its report. If so, please provide a description of the risk, the type of risk, activities being undertaken to mitigate or eliminate the risk.

Response:

There have been no new major risks identified since completion of the Class 4 deliverables. Some minor risks as related to continued stakeholder engagement were identified as follows:

- Future development plans in direct proximity to the gas line alignment along the Sperling segment can cause minor schedule and design risks due to additional time and resources to coordinate the respective projects to have sufficient underground space availability for the gas line installation. FEI will eliminate or mitigate the risk through continued engagement with the City of Burnaby to facilitate their ongoing coordination of the respective projects; and
- Potential restrictions on the use of property and FEI's ability to obtain statutory right of way and permits for construction can cause additional minor schedule risk. FEI will eliminate or mitigate the risk through continued engagement with stakeholders and micro-routing activities to minimize construction and environmental impacts to specific areas.

On page 85 of the Amended Application, FEI states:

> Following the completion of the YPCI Risk Report, Validation Estimating completed a quantitative analysis to evaluate the impact of Project specific risks and systemic risks. Validation Estimating completed a Monte Carlo simulation to determine a distribution of possible cost outcomes associated with the existing scope of the Project at different levels of confidence. The analysis derived a risk adjusted P50 cost of $154.4 million representing a contingency of 24 percent.

34.2 Please confirm, or otherwise explain, that all the identified risks to date were (i) used in the quantitative analysis to evaluate the impact of the project specific and systemic risks, and (ii) used as inputs into the Monte Carlo simulation. If not, please explain why not.

Response:

Please refer to Confidential Appendix E-2, Validation Estimating Contingency Report, page 6 for a description of the methodology utilized for the quantitative analysis for the Project. The method is aligned with AACE RP 42R-08 *Parametric Model Analysis of Systemic Risks* and RP 65R-11 *Expected Value Analysis of Project Specific Risks*. As part of the methodology, all

identified systemic risks are quantified using Validation Estimating's empirical knowledge. These are then used as inputs to a parametric model which produces an output of the impact of all systemic risks (without using a Monte Carlo simulation). All project-specific risks in the risk register are also qualitatively evaluated, and only those risks that are classified as critical event risks are quantified through a deterministic expected-value method (probability times impact). As noted in the report, the Monte Carlo simulation is then used to combine the risks together into a single probabilistic output for both cost and schedule impacts.

34.3 Please confirm, or otherwise explain, that each risk identified in the risk register is classified as either a project specific risk or a systemic risk. If not confirmed, please explain why not.

Response:

FEI confirms that each risk identified in the risk register is classified as either a project-specific risk or a systemic risk.

34.4 Please explain whether the number and types of risks would be different if the PGR Project had a higher level of project definition. If yes, please explain how the contingency would be impacted.

Response:

As the project definition increases, the project's uncertainty generally reduces which could reduce the number and type of risks and, consequently, the project contingency. As part of the risk management process, the cost of implementing specific risk response strategies and mitigation is included in the project base cost estimate update. The remaining risks after mitigation, to reflect the higher level of definition, can differ in number and type and the contingency is often reduced.

34.5 Please explain the rationale for selecting a P50 level of confidence to derive the contingency amount, including a description of any analyses and/or assessments conducted to support this selection. Discuss if higher confidence levels were considered, and if so, why there were ultimately rejected.

Response:

The rationale for selecting a P50 level of confidence is consistent with the AACE definition for contingency and aligns with the industry best practice for contingency funding, which was confirmed by a leading industry expert.

FEI engaged Validation Estimating LLC (John Hollmann), a leading industry expert, to conduct a risk analysis, to develop a contingency estimate, and to confirm the reasonableness of FEI's selection of contingency at the P50 level of confidence for the Project. The analyses and/or assessments conducted to support this selection are as follows:

As stated in the memo provided as Confidential Appendix E-2 to the Amended Application, page 17, Hollmann concluded and recommended the following:

> Tables 4 & 5 summarized the recommended percentages to add to the base estimate and overall schedule duration at various levels of confidence of underrun. The Consultant recommends the "mean" value be used for contingency determination, although it is common to use the P50 value.

Further to above, Hollmann concluded in the memo provided for both the Gaglardi and Sperling alternatives, as Confidential Appendix E-4 to the Amended Application, page 2, the following:

> In summary, a decision by FEI to fund the contingency for the two projects options at a P50 confidence level, but also a specific infrastructure impact management reserve of C$12M for the Gaglardi option is reasonable. The management reserve amount is prudent without being overly cautious.

In summary, the choice of a P50 level of confidence aligns to industry best practice, was confirmed by a leading industry expert and is appropriate to establish a contingency amount. As such, a higher confidence level was not considered.

34.5.1 Please explain how the level of project definition for the PGR Project affected the determination of the appropriate confidence level

Response:

The level of project definition does not affect the determination of the appropriate confidence level. Please refer to FEI's response to BCUC IR2 34.5 regarding the setting of the confidence level.

On page 88 of the Amended Application, FEI states it "will fund escalation at $7.7 million, which corresponds to the P50 level of confidence."

34.6 Please clarify why a P50 level of confidence was used to fund escalation. Discuss if higher confidence levels were considered, and if so, why there were ultimately rejected.

Response:

Please refer to the response to BCUC IR2 34.5 where FEI explained the rationale for selecting a P50 level of confidence to derive the contingency amount. FEI used a similar rationale to select the P50 value as the basis for the level of confidence used to fund escalation.

In response to BCUC IR 15.6, FEI states it "will conduct a formal risk analysis using an integrated, hybrid method to develop cost and schedule contingency and management reserve estimates."

34.7 Please discuss whether FEI is funding a management reserve for the PGR project. If yes, please provide the reserve amount, clarify how it was determined and how it will be managed.

Response:

No, FEI is not funding a management reserve for the Project.

In response to BCUC IR 15.7.1, FEI states, "the contingency estimate will be refined from a Class 4 cost estimate to better reflect the additional work completed."

34.8 Please explain how the contingency has been modified to reflect the maturity in the project design.

Response:

FEI modifies the contingency at each cost estimate class level of project definition based on the updated risk register as part of the risk management process. As such, the contingency is quantified at each estimate class level of project definition. FEI expects to have the contingency recalculated for Class 3 by May 2021. Please also refer to the response to BCUC IR2 34.5.

On page 75 of the Amended Application, FEI states it "[t]he integrated team will consist of FEI, the engineering design firm and a contractor working collaboratively to deliver the Project for the lowest cost and completion prior to the schedule constraint."

In response to BCUC IR 15.8.3, FEI states, "[a]ny expenditures in excess of the Project reserve would require additional internal approvals, which, depending on the magnitude, may include authorization from the President and CEO and/or the Board of Directors."

34.9 With consideration to the project risks and schedule constraint, please discuss whether the contingency and/or project reserve limits FEI's willingness to spend additional dollars.

34.9.1 If not, please discuss if there is an upper limit to FEI's willingness to spend additional dollars to ensure a timely completion. If an upper limit exists, please provide the limit and explain why it is considered reasonable.

34.9.2 If yes, please discuss how schedule delays will be addressed.

Response:

FEI has not proposed a management reserve for the Project.

Yes, the contingency limits FEI's willingness to spend additional dollars as FEI's expectation and goal is to complete the Project within the internal control budget, with access to contingency to manage identified risks. FEI will manage the Project with the express aim to avoid any expenditures in excess of the contingency and any proposal to make additional expenditures would be heavily scrutinized by FEI's project team and management. FEI would only be willing to spend dollars in excess of the contingency if they were confirmed to be prudent and cost-effective based on the particular facts at that time.

The total cost estimate for the Project is based on a probabilistic Monte Carlo simulation and properly accounts for systemic and project specific risks, including potential schedule delays. FEI expects that the Project's final actual cost will fall within the accuracy range with an 80 percent confidence interval (P10 to P90). By setting the Project contingency at a cost value to achieve a P50 confidence level, FEI has accounted for the expected impact of known risks and events likely to be encountered, while recognizing that the contingency is expected to be spent.

Further, FEI continues to refine the Project budget and actively manage Project expenditures as more information becomes available. This refinement process incorporates cost control mechanisms, including internal approvals, which are intended to ensure the Project is

completed without the need for additional expenditures, despite project risks and schedule constraint. For example, as described in response to BCUC IR1 15.3.1, following the receipt of firm bids, FEI will prepare a revised internal control budget which will be used to monitor and control the Project's actual costs. This budget must be reviewed and accepted by the Executive Sponsor (Vice President, Major Projects), providing an additional cost control mechanism.

35.0 Reference: PROJECT COST ESTIMATE

Exhibit B-1-1, Section 6.2, p. 90, Table 6-1; Exhibit B-6, BCUC IR 5.3.1, 14.1

Capital Cost Estimate

On page 90 of the Amended Application, FEI summarizes the total PGR Project estimated capital cost in both 2020 and as spent dollars as follows:

Table 6-1: Breakdown of the PGR Project Capital Cost Estimate ($millions)

	2020 $	As-Spent $	Reference
Engineering and Development	9.935	9.946	Section 5.10.1 and Confidential Appendix D (2020 $)
Material	4.419	4.777	Section 5.10.1 and Confidential Appendix D (2020 $)
Construction - Direct and Indirect	86.162	90.020	Section 5.10.1 and Confidential Appendix D (2020 $)
Decommission and Abandonment	11.151	11.867	Section 5.10.1 and Confidential Appendix D (2020 $)
Property and Right of Way	4.166	4.237	Section 5.10.1 and Confidential Appendix D (2020 $)
Project Management and Owner's Costs	14.113	15.293	Section 5.10.1 and Confidential Appendix D (2020 $)
Subtotal Project Capital Cost	129.946	136.140	See Note 1 for 2020 $ and Note 2 for As-spent $
Contingency	30.100	31.640	Section 5.10.4.4 and see Note 2 for As-spent $
Subtotal Project Capital Costs w/ Contingency	160.046	167.779	Table 6-2; Row 10; Col 1 (2020 $) & Col 2 (As-spent $)
CPCN Application	0.350	0.350	Section 6.4.3
CPCN Preliminary Stage Development	2.507	2.507	Section 6.4.3
Subtotal w/ Deferral Costs	162.903	170.636	Table 6-2; Row 14; Col 1 (2020 $) & Col 2 (As-spent $)
AFUDC	-	7.305	Table 6-2; Row 14; Col 3
Tax Offset	-	(2.587)	Table 6-2; Row 14; Col 4
TOTAL Project Cost	***162.903***	***175.354***	***Table 6-2; Row 14; Col 1 (2020 $) & Col 5 (As-spent $)***

Notes:

1. *The Project capital cost of $129.946 million in 2020 dollars is equal to the base cost estimate of $124.333 million (Section 5.10.1) plus $5.612 million of capitalized development costs incurred by FEI from February to November 2020.*
2. *The as-spent cost is equal to the amount in 2020 dollars plus escalation. The total escalation at a P50 confidence level is $7.733 million (Section 5.10.4.5), of which $6.193 million is escalation on the base capital cost and $1.540 million is escalation on contingency.*

35.1 Please provide a breakdown, by cost category, of the $5.612 million of capitalized development costs incurred by FEI from February to November 2020. Include a detailed description and the associated cost for each line time.

Response:

Please refer to the table below for a breakdown of the $5.612 million of capitalized development costs incurred by FEI from February to November 2020. A description for each line item is provided below the table.

		$000s
Project Services		
Archaeological & Environmental	$	335
Consultation & Engagement		368
Project Management		1,243
Property Services		38
Regulatory & Permitting		150
Engineering		
Design & Validation	$	1,825
Geotechnical		1,196
Engineering Survey		458
Total	**$**	**5,612**

- **Archaeological & Environmental**: Includes development of environmental management plans, internal oversight, and audits;
- **Consultation & Engagement:** Includes consultation, engagement, and communication with the public, local governments, Indigenous communities, and other stakeholders;
- **Project Management:** Includes project management, project support, legal review, and procurement services;
- **Property Services:** Includes work related to potential land and land rights acquisitions;
- **Regulatory & Permitting:** Includes resourcing and coordination of compliance permitting as well as costs for permit applications; and
- **Engineering:** Includes engineering and engineering support for the pipeline, stations, electrical & instrumentation, civil, and geotechnical.

35.1.1 Please explain why these costs were not included in the base cost estimate.

Response:

The base cost estimate for the preferred Sperling Route alternative was developed by Mott MacDonald with an assumed project execution schedule beginning in December 2020, as described in Section 5.6 of the Amended Application. As such, costs incurred by FEI prior to December 2020 that are specifically related to the Sperling Route are considered part of the Project capital cost, but not included in the base cost estimate as it was outside the assumptions considered by Mott MacDonald.

In response to BCUC IR 14.1, FEI provided a breakdown and detailed description of the proposed work to be completed and materials to be procured prior to the expected CPCN decision.

35.2 Please reconcile the work to be completed and materials to be procured provided in response to BCUC IR 14.1 to the $5.612 million of capitalized development costs incurred by FEI from February to November 2020, as appropriate.

Response:

While the $5.612 million of capitalized development costs was incurred between February and November 2020, the list of work identified in FEI's response to BCUC IR1 14.1 is forecast to complete by July 2021. Of the list of work identified in BCUC IR1 14.1, only the geotechnical borehole investigations and engineering survey programs were complete prior to November 2020 and are thus included in the $5.612 million of capitalized development costs. The costs for the geotechnical borehole investigation and the engineering survey are $1.196 million and $458 thousand, respectively, as identified in BCUC IR2 35.1. The remainder of the $5.612 million of capitalized development costs is not related to the list of work identified in BCUC IR1 14.1.

35.3 Considering the work that has been completed since filing the Amended Application, please explain if there have been any other changes to the definition or key characteristics of the PGR Project. If so, please specify the changes and the associated cost.

Response:

FEI confirms there have not been any changes to the definition or key characteristics of the PGR Project since filing the Amended Application on December 15, 2020.

In response to BCUC IR 5.3.1, FEI states:

> Once FEI receives a favourable decision on the Application from the BCUC, and following the receipt of firm bids, a revised internal control budget is established which is used for monitoring and controlling Project actual costs. This budget (updated cost estimate) is reviewed and accepted by the executive sponsor (Vice President, Major Projects).

35.4 Please elaborate on the process and timelines of events for making the financial investment decision for the PGR Project (including review and acceptance of the budget, approval to make expenditures, BCUC approval, etc.).

Response:

FEI is required to proceed with the Project as described in Section 3 Project Need of the Amended Application. Based on the non-financial and financial evaluation discussed in Section 4 Alternatives Evaluation, FEI selected the Sperling Route, which has the highest overall weighted score based on a Class 4 estimate. FEI's Board of Directors has approved the estimated capital expenditures for the Project, such that the BCUC's approval is the final financial investment decision step required before proceeding with the Project. FEI expects to complete the development of the final control budget in September 2021 following the final negotiated contract with the construction contractor. FEI will provide the control budget as part of any Project reporting requirement to the BCUC. If there is a later material change to the Project budget, this information will be provided to the BCUC as soon as practicable.

36.0 Reference: PROJECT COSTS

Amended Application, Section 5.2, p. 58; Section 5.6.6, p. 77

Pattullo Gas Line Removal

On page 58 of the Amended Application, FEI states:

> The Project scope will also include the modification, decommissioning and/or abandonment of existing infrastructure no longer required due to the removal of the Pattullo Gas Line crossing of the Fraser River. This includes:
>
> - Abandoning and removing the Pattullo Gate Station in the City of Surrey and approximately 800 metres of NPS 20 (508 mm) gas line operating at a MOP of 700 kPa affixed to the Pattullo Bridge;
> - Abandoning in place approximately 1.2 km of the remaining NPS 20 (508 mm) gas line operating at a MOP of 700 kPa from the Pattullo Gate Station to the intersection of McBride Boulevard and Royal Avenue; and
> - Modifying approximately 5.5 km of the Livingston to Pattullo NPS 18 (457 mm) (LIV PAT 11 457) transmission gas line and associated work due to the removal of the Pattullo Gate Station.

36.1 Please clarify whether the gas line in on either side of the Pattullo Bridge will be abandoned in place. If not, please explain why not, and provide the incremental costs of removing the gas line as compared to abandoning in place.

Response:

The NPS 20 (508 mm) gas line, which is located on either side of the Pattullo Bridge between the Pattullo Gate Station in the City of Surrey and the intersection of McBride Boulevard and Royal Avenue in the City of New Westminster, will be abandoned in place, grout filled and capped every 200 metres. The abandonment process will follow applicable FEI specifications.

36.1.1 Please explain if FEI has consulted with the municipalities on the proposed treatment of the gas line. If not, please explain why not.

Response:

As noted in Appendix J-3 of the Amended Application, FEI consulted about the Project, including the proposed abandonment in place of the Pattullo Gas Line, with the City of Surrey on June 19, 2020 and with the City of New Westminster on July 7, 2020. FEI will continue to consult with each municipality regarding the proposed treatment of the Pattullo Gas Line as the Project progresses.

Please also refer to the response to CEC IR2 24.1.

36.2 Please identify, with rationale, any assets that will continue to be used and useful following the decommissioning of the gas line.

Response:

As described in Section 5.4.4 of the Amended Application, approximately 5.5 km of the Livingston to Pattullo NPS 18 (LIV PAT 457) transmission gas line and associated infrastructure will require modification due to the removal of the Pattullo Gate Station. The following assets will continue to be used and useful:

- A 3.3 km section of the LIV PAT 457 will be repurposed by downgrading its Maximum Operating Pressure to 2070 kPa and will terminate at 128th Street and 100th Avenue Station in the City of Surrey.
- A 2.2 km section of the LIV PAT 457 will be deactivated, by isolating the section between 128th Street and 100th Avenue Station and Pattullo Gate Station. The pipe integrity will be maintained by filling it with a low pressure dry nitrogen (to prevent internal corrosion), and cathodic protection (to prevent external corrosion). The gas line will be protected in this way so that it may be repurposed in the future to re-establish gas supply to the North Surrey region to support forecast peak demand beyond the 20-year planning window.

Additional information regarding portions of the Pattullo Gas Line that will be decommissioned and abandoned are described in Section 5.4.5 of the Amended Application. During the decommissioning process, these assets will either be removed or grout filled and capped every 200 metres.

36.3 Please discuss whether any above-ground assets will be abandoned in place. If yes, please provide rationale.

Response:

None of the above-ground assets will be abandoned in place. Instead, each above-ground asset will be removed.

36.4 Please discuss the level of restorative work, if any, that will be completed following the removal or abandonment of the gas line.

Response:

The following restorative work will be required following the removal or abandonment of the Pattullo Gas Line:

- The abandonment and removal of the Pattullo Gate Station in the City of Surrey, which involves the demolition and removal of building, foundation, piping and equipment, will require restoration work including regrading and seeding of the site.
- The abandonment in place of approximately 1.2 km of the remaining NPS 20 (508 mm) gas line, located between the Pattullo Gate Station and the intersection of McBride Boulevard and Royal Avenue, will involve the restoration of approximately 10 sites. This restorative work will include backfilling and compaction in order to restore these sites to at least their pre-existing condition. In undertaking this restorative work, FEI may be required to follow the City of Surrey and City of New Westminster Municipal Master Construction Document requirements.

36.4.1 Explain if this restorative work is included in the cost estimate. If included, please identify the estimated costs for the restorative work. If not included, please explain why not, and provide the cost estimate for the restorative work.

Response:

The restorative work is included in the cost estimate and is described on page 16 of Confidential Appendix D of the Amended Application, as follows:

WBS	Description	Quantity	Unit	Unit Cost	Total $
NPS 20 700 DP in New Westminster					
M-000X.3.G.1.3	Tie-Ins Backfill/Restoration	5	sites	$10,000	$50,000
NPS 20 700 DP in Surrey from Bridge to Pattullo Gate Station					
M-000X.3.G.1.3	Tie-Ins Backfill/Restoration	5	sites	$10,000	$50,000
Pattullo Gate Station					
M-000X.3.G.2.2	Restore and Seed	15	days	$5,500	$82,500
				Total:	**$182,500**

On page 77 of the Amended Application, FEI states:

> Decommissioning and abandonment of the existing Pattullo Gas Line is scheduled to be complete by the end of Q1 2023. Any other existing infrastructure modifications that do not affect the timelines associated with the Pattullo Bridge Replacement project schedule will continue and be complete by Q3 2023.

36.5 Please discuss the modifications that are not timeline dependent and will be completed by Q3 2023.

Response:

Modifications that are not timeline dependent and will be completed by Q3 2023 include those listed in Section 5.4.4 of the Amended Application and relate to the Livingston to Pattullo NPS 18 (457 mm) (LIV PAT 457) transmission gas line, as follows:

- A new TP/IP regulating facility will be incorporated into the Roebuck Valve Station, located in the City of Surrey. To maintain ILI capability of the existing LIV PAT 457, the receiving barrel located at Pattullo Gate Station will be relocated to Roebuck Valve Station;
- 3.3 km of the LIV PAT 457 will be downgraded to a Maximum Operating Pressure of 2070 kPa and terminate at 128th Street and 100th Avenue station. Modifications to this station's equipment will enable it to accept a lower inlet pressure and while supporting the distribution system under peak day conditions; and
- 2.2 km section of the LIV PAT 457 will be deactivated by isolating the section between 128th Street and 100th Avenue station and Pattullo Gate Station. This will be accomplished by installing a blind at the outlet of the 128th Street and 100th Avenue station and the inlet to the Pattullo Gate Station, purging the line, and maintaining a low pressure blanket with nitrogen.

36.5.1 Please explain the risks and consequences if these modifications are not completed by Q3 2023.

Response:

There are no significant risks or consequences associated with not completing the system modifications by Q3 2023 as described in Section 5.4.4 of the Amended Application.

37.0 Reference: ACCOUNTING TREATMENT

Amended Application, Section 1.3, p. 9; Exhibit B-6, BCUC IR 17.3

PGR Application and Development Costs deferral account

On page 9 of the Amended Application, FEI states:

> For the Application costs, FEI has estimated $350 thousand related to expenses incurred by FEI for the preparation and regulatory review process for the Application. For the Preliminary Stage Development costs, FEI is proposing to record $2.507 million, which are the actual costs to January 31, 2020, less the tax deduction available for certain capitalized development costs incurred by FEI after January 31, 2020. The Application and Preliminary Stage Development costs are recorded in the proposed non-rate base deferral account on a net-of-tax basis, attracting FEI's weighted average cost of capital (WACC) until transfer to rate base. FEI proposes to transfer the balance in the deferral account to rate base on January 1, 2022 and commence amortization over a three-year period.

In response to BCUC IR 17.3 FEI states, "no approval of the proposed deferral account is required prior to the BCUC's decision on the CPCN for the PGR Project."

37.1 Please explain whether the Application and Preliminary Stage Development costs are currently recorded in the proposed deferral account.

37.1.1 If yes, please provide the authority under which FEI is currently deferring these costs.

37.1.2 If not, please provide the accounting treatment of the costs, the journal entry(ies), and reference to the relevant US GAAP standard supporting the treatment of these costs.

Response:

FEI confirms the application costs incurred to date and the actual preliminary stage development costs incurred by FEI up to January 31, 2020 are both currently recorded in a deferral account. It is FEI's normal practice to determine whether costs qualify for expense, capital, or deferral treatment in accordance with US GAAP at the time the expenditures are made. There is often an unavoidable time lag between when the initial costs are incurred and when approval of the regulatory treatment is received, due to the timing of applying for and receiving decisions from the BCUC. The deferral account treatment is consistent with past FEI CPCN applications, as well as US GAAP, for deferral of costs where there is reasonable assurance that an incurred cost is probable of being recovered.

To clarify the response to BCUC IR1 17.3, FEI was referencing that given the deferral account was not proposed to be included in rate base until 2022, approval of the deferral account was

not required prior to the BCUC's decision on the Amended Application, which FEI anticipates will occur prior to the setting of FEI rates for 2022.

37.2 Under a scenario where the proposed deferral account is not approved by the BCUC, please explain how FEI will treat the Application and Preliminary Stage Development costs.

37.2.1 Please clarify whether the timing of the decision impacts the treatment of the costs for accounting purposes.

Response:

As discussed in the response to BCUC IR1 17.3.2.6, if the BCUC does not approve the proposed deferral account, these costs could either be expensed as a flow-through item, or capitalized as a Project cost. FEI considers the Project's application and preliminary stage development costs to be prudently incurred and necessary for the preparation of the CPCN application. The costs, as well as the proposed regulatory treatment, are consistent with past CPCN applications that have had similar deferral accounts approved by the BCUC.

FEI clarifies that the treatment of the application and preliminary stage development costs for accounting purposes is only dependent upon the BCUC's decision of whether the proposed deferral account is approved or not. The timing of the decision has no impact on the treatment of the costs for accounting purposes. If the proposed deferral account is approved, FEI will transfer the costs from the non-rate base deferral account to rate base on January 1 of the following year (e.g. January 1, 2022 if a BCUC decision is received in 2021). If the proposed deferral account is not approved, FEI will either re-categorize the costs as an expense at the next Annual Review following the BCUC decision, or include them as part of the project capital cost, which will enter rate base when the Project is complete and in-service.

E. ENVIRONMENT AND ARCHAEOLOGY

38.0 Reference: ENVIRONMENT AND ARCHEOLOGY

Exhibit B-1-2, Appendix H-1, Section 6.3, pp. 52–53

Environmental Permitting and Approvals

Table 6.3 on page 52 to 53 outlines the potential regulatory approvals and timelines for the selected alignment. The required approvals include a request for project review to Fisheries and Oceans Canada (DFO) and an application for the Waste Discharge Authorization to the BCOGC.

38.1 Please clarify if FEI has submitted a request for project review to DFO. If yes, please provide the date of submission. If not, please provide the anticipated date of submission.

Response:

On February 1, 2021, FEI submitted a request for review to DFO in relation to the proposed aerial crossing of Still Creek. An additional request for review for the remainder of the potential watercourse crossings is expected to be submitted later in Q1 2021.

38.2 Please clarify if FEI has submitted an application for the Waste Discharge Authorization to the BCOGC. If yes, please provide the date of submission. If not, please provide the anticipated date of submission.

Response:

FEI has not submitted a Waste Discharge Authorization to the BCOGC at this time. A better understanding of the Project's construction methodology[6] is needed before FEI will be able to determine if a Waste Discharge Authorization will be required. It is expected that this determination will be made in early Q2 2021 as part of the Project's detailed engineering phase, with the application to BCOGC expected to follow in late Q2 2021, if required.

[6] For example, will excavation depths require the management of groundwater through well-pointing and if so, where will this water be discharged.

F. CONSULTATION

39.0 Reference: CONSULTATION

Exhibit B-1-1, Section 8.3.4, p. 125; Section 8.3.3, p. 123; Appendix J-7

FEI's Engagement with Indigenous Groups to Date

FEI states on page 125, "At the time of filing, Indigenous groups have not raised any concerns directly related to the Sperling Route."

FEI states on page 123 that no formal position regarding the engagement process thus far has been received from Indigenous groups. As the Project is still early in its development, FEI is in discussion with Indigenous groups regarding the type of funding to support their engagement activities and the framework of an agreement between FEI and these groups.

The engagement log with Indigenous groups regarding the Sperling Route in Appendix J-7 shows two sets of emailed updates to the Indigenous groups on October 2 and October 8 regarding updates on the Sperling Route, including references to items such as the need for Heritage Investigation Permits which had previously been granted to FEI for the PGR Gaglardi Route.

39.1 Please provide an update on the status of funding to support engagement by Indigenous groups, and any currently anticipated impact on project timeframes.

Response:

At the request of, and with input from Kwikwetlem First Nation (KFN), FEI drafted a preliminary draft capacity funding framework. In September 2020, FEI provided the draft framework to KFN for review. KFN has confirmed receipt of the draft framework, and FEI is currently awaiting feedback. FEI continues to regularly follow-up with KFN to understand how to support their engagement in the Project.

FEI offers capacity funding to all Indigenous groups that express interest in the Project, thereby ensuring these groups are able to meaningfully engage on issues that affect their interests. At this time, only KFN has requested funding.

To date, there have been no impacts to Project timelines, nor any indication of future impact to timelines as a result of FEI's engagement with Indigenous groups.

39.2 Please provide an update with regards to any feedback which has been received from Indigenous groups relating to the Sperling route, including any concerns raised, plans to address these concerns and any potential project impacts.

Response:

Feedback from Indigenous groups regarding the Sperling Route remains limited, with no concerns raised regarding the route. FEI expects to receive additional feedback in relation to archaeological and environmental overview documents, which are forthcoming and will be provided to Indigenous groups once completed in early 2021.

A number of Indigenous groups have expressed interest in the Project's archaeology program. Kwikwetlem Nation and Kwantlen Nation representatives participated alongside FEI's archaeological consultants (Stantec) during the geotechnical program as Indigenous monitors, while Musqueam Nation and Tsleil-Waututh Nation participated remotely due to COVID restrictions in their communities. Feedback received has been neutral with no concerns raised; however, Indigenous groups have expressed interest in reviewing future archaeology reports, which FEI has committed to providing once available.

Finally, Tsleil-Waututh Nation and Kwikwetlem Nation have expressed an interest in the economic opportunities associated with the Project, including contracting opportunities. FEI has committed to speak with these Indigenous groups regarding these opportunities as the Project progresses.

40.0 Reference: CONSULTATION

Exhibit B-1-1, Section 8.2.5.3, pp. 117–118

Terms of Reference with the City of Burnaby

FEI states on pages 117 and 118 of the Amended Application:

> In an effort to achieve Project acceptance, including obtaining the rights and approvals for the necessary statutory right-of-way and temporary workspace, FEI again discussed jointly coordinated projects proposed by the City. These projects, in the context of the Sperling Route, include the construction of a bike path along the gas line alignment. On December 11, 2020, FEI and the City signed an agreement (Terms of Reference) setting out the terms on which FEI would construct the Project along the Sperling Route Corridor in the City of Burnaby. The City is supportive of the Sperling Route. The Terms of Reference is attached as Confidential Appendix J-19.

40.1 Please explain the basis for requesting that the entire Terms of Reference document be held confidential.

40.1.1 If possible, please file a redacted version as a public exhibit.

Response:

FEI requested that the entire Terms of Reference be held confidential because it contains commercially sensitive terms related to the construction of the Project. In particular, public disclosure of the nature and terms of the agreement could prejudice FEI's negotiating position with other parties, including with other municipalities or stakeholders in relation to future projects. Further, FEI does not consider that filing a redacted version of the Terms of Reference would be practicable or helpful to the public. The extent of redactions necessary to mitigate prejudicing FEI's future negotiating position with other parties would render the document unreadable, and may lead to misapprehension by the public as to the meaning and purpose of the document.

Consistent with the BCUC's confidentiality guidelines, should participants in this proceeding require access to some or all of the information filed confidentially, FEI has provided an Undertaking of Confidentiality in Appendix B-3, to be executed before confidential information may be released to registered parties under the terms of the undertaking. Therefore, there is no prejudice to participants in this proceeding by keeping the entire Terms of Reference confidential.

40.2 Please explain for how long FEI requests confidentiality be maintained for the Terms of Reference.

Response:

FEI requests confidentiality for the Terms of Reference be maintained indefinitely. Please refer to the response to BCUC IR2 40.1 for the basis in requesting that the entire Terms of Reference be held confidential.

Attachment 24.4

Diane Roy
Vice President, Regulatory Affairs

Gas Regulatory Affairs Correspondence
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December 1, 2017

British Columbia Utilities Commission
Suite 410, 900 Howe Street
Vancouver, BC
V6Z 2N3

Attention: Mr. Patrick Wruck, Commission Secretary and Manager, Regulatory Support

Dear Mr. Wruck:

Re: FortisBC Energy Inc. (FEI or the Company)

Project No. 3698818

Lower Mainland Intermediate Pressure (IP) System Upgrade (LMIPSU) Projects – Coquitlam Gate IP Project

Material Change Report

On December 19, 2014, FEI filed its Application for a Certificate of Public Convenience and Necessity (CPCN) for the LMIPSU Projects. On October 16, 2015, the British Columbia Utilities Commission (the Commission) issued its Decision and CPCN Order C-11-15 (the Decision). Directive 35 of the Decision directed FEI to file, among other things, Material Change Reports as follows:

> Material Change Report
> The report should identify and detail any significant delays (i.e. greater than 6 months) or material cost variances (i.e. greater than 10 percent of the execution capital cost summary total that approval of this CPCN is based on). These must be reported to the Commission as soon as practicable or within 30 days or if within the 30 days be included in the Quarterly Progress Report. The Material Change Report must highlight the reasons for the delay or material cost variance, FEI's consideration of the options available and actions FEI is taking to address the issue.

On October 31, 2017, FEI filed its 2017 third quarter Quarterly Progress Reports for the Coquitlam Gate IP and the Fraser Gate IP Projects, through which it provided notice of a material change to cost and a potential material change to schedule. In those reports, FEI

indicated that it planned to provide a subsequent update to the Commission in the form of material change reports by November 2017.

FEI is now submitting the attached Material Change Report in accordance with Commission Directive 35 of the Decision for the Coquitlam Gate IP Project. FEI requires more time to complete the Fraser Gate IP Material Change Report and plans to file this report on December 8, 2017.

Request for Confidentiality:

The public version of this Material Change Report has been redacted to remove commercially sensitive details about the contractual negotiations. FEI requests that the redacted information be filed on a confidential basis pursuant to Section 18 of the Commission's Rules of Practice and Procedure regarding confidential documents established by Order G-1-16, and remain confidential to the Commission only. In this Material Change Report, FEI includes financial and schedule information relevant to its contract procurement activities. Disclosure of this sensitive information could hamper effective contractual pipeline and facilities negotiations as the Project progresses, as well as for future projects. The information contained in this report regarding total project cost and schedule is also sensitive, as the Projects both have construction procurement activities underway. FEI believes the release of such information could be used to prejudice contractual negotiations for these Projects and for future projects. FEI, therefore, requests that the Commission keep and hold this redacted information confidential.

If further information is required, please contact the undersigned.

Sincerely,

FORTISBC ENERGY INC.

Original signed:

Diane Roy

Attachments

FORTISBC ENERGY INC.

Lower Mainland Intermediate Pressure System Upgrade Projects Coquitlam Gate IP

REDACTED

Material Change Report

December 1, 2017

Table of Contents

Index of Tables and Figures

1. INTRODUCTION

FortisBC Energy Inc. (FEI or the Company) has now completed the detailed pipeline engineering and stations facilities engineering for the Coquitlam Gate IP Project. The detailed pipeline and facilities engineering commenced in Q1 2016 and ramped up to full capacity by Q2 2016. The detailed pipeline engineering deliverables were completed and Issued for Construction (IFC) in early Q2 2017 slightly behind the planned Q1 2017 completion.

Purchase orders for materials that will be procured by FEI and issued to the contractors prior to construction start are almost fully executed. FEI is now focusing on acquiring the necessary permits and approvals prior to engaging contractors to execute the construction.

The Company has also successfully executed an early works program throughout Q1, Q2 and Q3 2017, as detailed in the Project Quarterly Progress Reports to the BCUC. The scope of this program is relatively small compared to the overall Project scope. It comprised construction and installation of approximately 80 metres of the Coquitlam Gate IP pipeline along a new pipeline easement acquired by the Company to install the pipeline through private property between Graveley Street and East 1st Avenue in Vancouver. FEI also constructed two smaller diameter lateral pipelines that will interface the Coquitlam Gate IP pipeline with the existing IP system and completed short extensions and general upgrades to existing culverts located along the base of Burnaby Mountain where the new pipeline will be installed parallel and adjacent to the existing NPS 20 pipeline. This scope also includes FEI engaging a local mechanical fabrication firm to pre-fabricate the pit stations that will be installed by the pipeline contractor starting in 2018.

FEI completed the early works scope to avoid stakeholder and environmental construction timing restrictions and thereby mitigate risk of the pipeline contractor not meeting these timing restrictions in 2018 during the Coquitlam Gate IP pipeline construction.

During ongoing review and evaluation of the Coquitlam Gate IP Project control budget and schedule FEI has identified a material cost variance and schedule delay to the control budget and baseline schedule respectively. In this report, FEI identifies and details material change to both cost and schedule, including reasons for the change, FEI's consideration of the options available and the actions FEI is taking to address the issues.

2. REGULATORY CONTEXT

On December 19, 2014, FEI filed its Application for a Certificate of Public Convenience and Necessity (CPCN) for the Lower Mainland Intermediate Pressure System Upgrade (LMIPSU) Projects which sought approval to construct and operate two intermediate pressure (IP) pipeline segments in the BC Lower Mainland to replace two existing segments (Application). The two projects are described as follows:

- A Nominal Pipe Size (NPS) 30 pipeline of approximately 20 km operating at 2070 kPa between Coquitlam Gate Station and the East 2nd Avenue & Woodland Station in East Vancouver to replace an existing NPS 20" pipeline (Coquitlam Gate IP Project or the Project);
- A small segment of NPS 30 pipeline between the Fraser Gate Station and East Kent Avenue and Elliot Street (Fraser Gate IP Project).

On October 16, 2015 the Commission determined that the CPCN Guidelines had been met and found the projects to be in the public interest and granted a CPCN to FEI to construct and operate the Fraser Gate and Coquitlam Gate IP Projects as outlined in the Application and subsequent evidentiary update.

In consideration of FEI's submissions with respect to the need for timely reporting on the progress of the projects, the Commission established a reporting regime with three elements:

- Quarterly Progress Reports starting in March 2016 outlining actual costs incurred to date, an updated forecast of costs and the status of project risks.
- Material Change Reports identifying and detailing any significant delays or material cost variances and the reasons for the delay or cost variance and FEI's consideration of options available and actions taken by FEI to address the issue.
- A Final Report including a breakdown of the final project costs compared to Application cost estimates with an explanation and justification of any material cost variances.

In accordance with the reporting requirements, FEI has submitted separate Quarterly Progress Reports for each Project, with the most recent reports filed for Q3 2017 on October 31, 2017. Through the Q3 2017 Quarterly Progress Report, FEI provided notice of a material change to cost and a potential material change to schedule in accordance with Commission Directive 35[1] as set out in the decision attached to Order C-11-15.

[1] Page 69 of the decision attached to Order C-11-15.

FEI is now submitting a material change report in accordance with Commission Directive 35[2] having consideration of the requirements as set out in the decision attached to Order C-11-15:

> Material Change Report
>
> The report should identify and detail any significant delays (i.e. greater than 6 months) or material cost variances (i.e. greater than 10 percent of the execution capital cost summary total that approval of this CPCN is based on). These must be reported to the Commission as soon as practicable or within 30 days or if within the 30 days be included in the Quarterly Progress Report. The Material Change Report must highlight the reasons for the delay or material cost variance, FEI's consideration of the options available and actions FEI is taking to address the issue.

2.1 *PURPOSE OF THE MATERIAL CHANGE REPORT*

FEI's understanding of specific Project challenges and opportunities has continued to evolve with the increased project definition, which is to be expected in accordance with typical lifecycle of project development. FEI now understands the existing constraints in greater detail, particularly buried utilities, workspace limitations, traffic management and stakeholder expectations and requirements along the pipeline route corridor. Furthermore, FEI has also gauged market conditions in relation to construction cost and schedule through receipt of proposals from pipeline and stations construction proponents. Consequently, FEI has identified unforeseen cost increases and schedule delays, associated with the realization of a number of risks.

This report includes an estimate of the material cost variance based on the information currently available. The estimate reflects information received from pipeline and stations contractor bid proposals, municipal requirements to obtain permits, additional Engineering, Procurement, and Construction Management (EPCM) resources required, and FEI's estimates of owner's costs. FEI's estimate indicates the magnitude of the potential cost variance, however the Company is in the process of considering various options to mitigate cost pressures and optimize the Project control budget including [redacted] which, once complete, will allow FEI to re-baseline the Project control budget.

FEI has established that the Project impacts driving the material cost variance will also incur a material schedule variance, including a delay to the completion of some components of the Project from 2018 to 2019. [redacted]

[2] Page 69 of the decision attached to Order C-11-15.

Due to feedback from pipeline construction proposals related to challenges with schedule and cost variances, FEI has requested additional pricing option submissions from the pipeline construction proponents to allow for alternative scheduling and phased in-service options over a two year period. FEI has requested this feedback to inform the ongoing change management options analysis, and also inform the Project optimization strategy that will outline how FEI intends to proceed with and successfully deliver the Project discussed in this report.

This report contains updated cost information to what was included within the Q3 report filed with the Commission on October 31, 2017, including updated construction and permitting estimates. The Project is now at a critical juncture as FEI prepares to engage pipeline and facilities contractors and commence field construction work. [redacted] As such, FEI anticipates construction contract prices, [redacted] and associated schedule updates will not be finalized until February 2018. Once finalized, FEI intends to provide a revised control budget for the Project, and a detailed Project execution schedule.

As FEI is not expecting to finalize and compile updated cost and schedule information to what is included within this material change report until February, 2018, FEI requests the Commission's approval to delay filing of the Q4 quarterly report until February 28, 2018. FEI believes that this additional time is necessary to provide the Commission with the most accurate information on Project costs and schedule, resulting from the conclusion of the construction contracts and [redacted] in early February.

Due to materiality of the cost and schedule variances, FEI recommends the following regulatory process to review variances. FEI believes that a written process, with one round of Information Requests from the Commission, provides for an appropriate and efficient review.

Table 2-1: Proposed Regulatory Timetable

ACTION	DATE (2018)
Commission Information Request No. 1	Thursday, January 4
FEI Response to Information Requests No. 1	Tuesday, January 30

3. EVALUATION OF PROJECT NEED AND PREFERRED ALTERNATIVE

In the Application, FEI noted that the Coquitlam Gate IP pipeline was nearing the end of its service life due to an unacceptable frequency of gas leaks resulting from non-preventable active corrosion and based on a third party engineering assessment indicating that leak prevention cannot be effectively managed by maintenance activities.[3] FEI confirmed that rehabilitation would not fully address pipeline risk[4] and to address safety and regulatory concerns the pipeline requires replacement.[5]

3.1 *EVALUATION OF PROJECT NEED*

FEI confirms that the need to replace the Coquitlam Gate IP pipeline remains regardless of cost and schedule variances. The basis upon which the Commission provided its determination that the Project was in the public interest still exists.

As described on page 7 of the Decision to BCUC Order No. C-11-15, the Commission found that FEI had justified the need to rehabilitate or replace the Coquitlam Gate IP pipeline stating:

> The Panel accepts that repair or rehabilitation of the Coquitlam Gate IP pipeline is required to address pipeline integrity issues resulting from increased frequency of actual and projected gas leaks due to non-preventable corrosion. Further, the Panel agrees that rehabilitation or replacement is required to ensure FEI is compliant with OGC requirements to prevent, remediate the cause or contain and eliminate spillage as required of a permit holder under section 37(1) of the OGAA.

When comparing rehabilitation over evaluation, the Commission also found that the need to replace the Coquitlam Gate IP pipeline was justified and stated on page 8 of the Decision:

> While rehabilitating the Coquitlam Gate NPS 20" pipeline would be considered by the OGC, it would require that every weld be inspected. Moreover, FEI would also have to demonstrate that the rest of the pipeline was fit for service and, in addition, continue the increased survey on uninspected sections of the pipeline. No cost estimates have been provided to satisfy these provisions. Further, FEI has based its estimate on a dig occurring every 12 metres in spite of the fact that it has no technical methods to identify weld girth locations from above the ground. FEI acknowledges that multiple digs may be required to locate each weld. Based on this, the Panel places little weight on the FEI estimates for the number of required digs and resultant costs to rehabilitate the pipeline. Given this

[3] Application, pp.28-29.
[4] FEI response to BCUC IR 2.1.1.
[5] Application, pp.28-29.

> uncertainty and the fact that replacement in-kind with a new NSP [sic] pipeline operating at 1200 kPa has a lower estimated cost than rehabilitation of the existing pipeline, the Panel is persuaded that replacement of the existing pipeline is a more cost effective choice than rehabilitation of the existing pipeline.

As described in the Application, FEI has committed to replacement of the pipeline as an integral part of its response to Oil and Gas Commission (OGC) Order 2013-25 and not undertaking pipe replacement could result in the OGC finding that FEI has failed to comply with a provision of the *Oil and Gas Activities Act* (OGAA). The status quo of continuing ongoing integrity and leak management is not an appropriate alternative as it will not address the reliability, safety, or regulatory concerns associated with the unacceptable projected frequency of gas leaks. Further rehabilitation of the existing Coquitlam Gate IP pipeline is not considered to be a feasible alternative because rehabilitation does not fully address pipeline risk and the cost estimate completed at the time of the Application demonstrated that this alternative was more expensive than the NPS 20 replacement alternative. Interveners also supported replacement over rehabilitation as set out of page 8 of the Decision:

> CEC submits that it has evaluated the issue and, using its judgement of these factors, submits there is adequate justification for replacement of the pipeline.[52] CEC further submits "rehabilitation is technically challenging and may miss areas that require repair. Since the pipeline has already exceeded its expected life of 50 years, it is reasonable to assume that rehabilitation focused on the girth welds, and potentially misses some, and may not result in the longevity that might be provided by a new pipeline." CEC also raises the concern that there is still some chance of the failure of the pipeline rehabilitation resulting in the requirement to replace the pipeline in the future.[4]
>
> BCOAPO submits that rehabilitation is eliminated as an option because it is more expensive than replacing it with new equivalent pipe without fully mitigating potential future corrosion leaks.

3.2 *EVALUATION OF REPLACEMENT ALTERNATIVES*

FEI presented seven alternatives in the Application with only the replacement alternatives (Alternatives 3 to 6) providing the ability to eliminate the elevated reliability, safety and regulatory risk (including with respect to the OGAA) posed by the existing Coquitlam Gate IP pipeline as a result of corrosion beneath field applied coating at girth welds.

The alternatives evaluated in the Application were as follows:

- Alternative 1 - Do nothing (Status quo of continuing ongoing integrity and leak management).

- Alternative 2 - Rehabilitate the existing NPS 20 Coquitlam Gate IP operating at 1200 kPa in place;
- Alternative 3 - Replace (in-kind) the existing NPS 20 Coquitlam Gate IP operating at 1200 kPa with a NPS 20 pipeline operating at 1200 kPa;
- Alternative 4 - Replace the existing NPS 20 Coquitlam Gate IP operating at 1200 kPa with a NPS 24 pipeline operating at 2070 kPa.
- Alternative 5 - Replace the existing NPS 20 Coquitlam Gate IP operating at 1200 kPa with a NPS 36 pipeline operating at 1200 kPa;
- Alternative 6 - Replace the existing NPS 20 Coquitlam Gate IP operating at 1200 kPa with a NPS 30 pipeline operating at 2070 kPa (preferred alternative); and
- Alternative 7 - Replace the existing NPS 20 Coquitlam Gate IP operating at 1200 kPa with a NPS 42 pipeline operating at 1200 kPa.

Alternative 7 was eliminated from further consideration due prohibitive construction constraints associated with the installation of NPS 42 pipeline along the more densely developed sections of the route and Alternative 5 was eliminated from further consideration on the basis of both it being more expensive than the other alternatives and it did not achieve the resiliency objectives of the Project. As described above in Section 3.1, rehabilitation of the existing Coquitlam Gate IP pipeline was not considered to be a feasible alternative because rehabilitation does not fully address pipeline risk and as demonstrated by the cost estimate completed at the time on the Application, this alternative was more expensive than the NPS 20 replacement alternative.

In light of the materiality of the cost and schedule variances, FEI has re-evaluated the Project alternatives considered in the Application and confirms that Alternative 6 continues to be the preferred solution to eliminate future gas leaks resulting from non-preventable active corrosion on the existing NPS 20 pipeline.

The basis upon which the Commission found that Alternative 6 was the preferred alternative continues to be applicable.

Described on page 19 of the Decision to BCUC Order No. C-11-15, the Commission found that FEI had presented sufficient evidence to support its determination that Alternative 6 provides sufficient additional benefits to justify the additional costs and accepts Alternative 6 as the preferred alternative.

The cost variances and schedule delays that the Project has been experiencing for the preferred solution (Alternative 6) would also be similarly realized for Alternative 3 and Alternative 4, should they have been developed to the same level of project definition and be bid competitively to the market in the same fashion as Alternative 6 has been. Each of these other alternatives would be subject to the same issues and constraints that are currently driving the material cost and schedule changes for Alternative 6 such as:

- The urban environment in which this Project is being constructed;
- Dense utilities, construction complexity, traffic management, and constrained workspace;
- Competitive market bids for the construction which would demonstrate similarly escalated costs for each alternative given that each alternative would encounter the same project complexity; and
- [redacted]

While there would be minor variation between the relative material costs due to the different pipe diameters, FEI has determined that the relative difference would still be such that the evaluation of the replacement alternatives would result in the same determination of Alternative 6 as the preferred alternative.

Further, Project decisions made to date, including executing the early works program, placing purchase orders for the NPS 30 mainline pipe and fittings and the stations facilities materials reinforces the Company's decision that Alternative 6 remains the preferred alternative. Implementation of Alternative 3 or 4 at this stage would be unjustified and incur unnecessary additional Project cost and schedule variances to procure the appropriate material and to redesign and engineer the new alternative. FEI concludes that the cost pressures the Project is experiencing would be similar for any replacement alternative and FEI continues to consider Alternative 6 to be the preferred solution for the Project.

3.3 *EVALUATION OF ROUTE OPTIONS*

FEI presented the route options considered, route options analysis, and selected preferred route in Section 3.3.4 of the Application. Further details on the evaluation of the selected preferred route alignment were also presented in Appendix A-17 of the Application.

As described in Section 3.3.4.7 of the Application, the City of Burnaby, during consultation in November 2014, indicated that its preference was for the pipeline to be realigned from the alignment submitted in the Application to a new alignment along Lougheed Highway. Subsequently, FEI completed further assessment of the potential traffic impacts from the proposed pipeline construction on Lougheed Highway and worked with City of Burnaby staff to fully understand the potential impacts from construction. In early 2015 FEI determined that a route option along Lougheed Highway was technically feasible, constructible, and that a collaborative cooperative approach by FEI and the City of Burnaby would mean that traffic issues could be managed with reasonable efforts. This effort resulted in a revised route alignment for the Coquitlam Gate IP pipeline which is described in detail in the Project Evidentiary Update.

The detailed routing and pipeline engineering has now been completed on the preferred route alignment, including the realignment through Burnaby described in the Evidentiary Update to the CPCN Application. The final pipeline horizontal alignment and vertical profile has resulted in precise pipe quantities and bend angles which have been issued to market for material pricing and vendor selection. As described in the previous section, purchase orders have been placed for the pipeline materials and delivery of same materials is scheduled for Q1 2018.

Various route options were analysed during the route options analysis and evaluation process. The feasible options identified were analysed against a set of evaluation criteria to determine the preferred Coquitlam Gate IP pipeline alignment. The preferred alignment is routed primarily along major arterial traffic routes through Coquitlam, Burnaby and Vancouver. The factors outlined in this report which have incurred Project cost and schedule material variances are independent of the route option evaluation criteria utilized during the route selection process. Therefore, FEI has determined that the evaluation of the feasible route options considered in the Application and Evidentiary Update would result in the same determination of preferred route alignment.

Further, and in the same context as the preferred alternative described above, Project decisions made to date, including executing the early works program, placing purchase orders for the NPS 30 mainline pipe and fittings reinforces the Company's decision that the selected preferred route alignment remains the optimum selection.

Similar to the preferred Alternative previously described, implementation of an alternative route alignment at this stage would also be unjustified and incur unnecessary additional Project cost and schedule variances to procure the appropriate material. FEI concludes that the cost pressures the Project is experiencing would be similar for any other route option and FEI continues to consider the selected preferred route option to be appropriate for the Project.

4. MATERIAL CHANGE – PROJECT SCHEDULE

This section summarizes the Project baseline schedule submitted with the Application, presents the current forecast to complete the Project, and identifies the delays to the baseline schedule.

4.1 *BASELINE SCHEDULE*

The Project schedule was submitted in Appendix A-20-1 and the schedule milestones in Section 3.3.6 of the Application. The schedule was compiled based on input from various Project disciplines during the pre-Application development stage and was based on the Project definition at that time.

For the purposes of categorizing the Project progress and achievements to date, and considering that the Project is now at the critical juncture immediately prior to moving into construction, the Application baseline schedule is represented in the following construction-centric breakdown:

- 2016-2017 Pre-construction activities: complete detailed routing and engineering, complete material procurement, acquire necessary permitting and approvals required by the Owner, and award construction contracts early to enable sufficient time for the successful contractor to develop and obtain all the necessary traffic management related permits;
- 2018 Construction, tie-in and commissioning: complete construction of NPS 30 IP pipeline and stations, tie-in and commissioning; and
- 2019 Post-construction: decommission and abandon the existing NPS 20 IP pipeline, and clean-up the NPS 30 Coquitlam Gate IP construction.

4.2 *FORECAST SCHEDULE DELAY*

The material schedule variance that the Project is now forecasting have been caused by delays in some of the pre-construction activities. The variance is a result of [redacted] Additionally, through the pipeline construction proposals, the proponents expressed concern with completing the pipeline construction in 2018. Through the subsequent information requested from pipeline proponents for an extended construction schedule, [redacted] where one proponent would be selected to complete the entire Project.

4.2.1 Pre-Construction Planning

The pre-construction components of the Project schedule were presented in Table 3-12 of the Application which included all activities to develop the Project to the "construction ready" state. This schedule demonstrates that it was FEI's intent to have the following Project components completed by Q3 2017:

1. Detailed pipeline and facilities engineering complete to Issue For Construction (IFC) level of development;
2. All Project materials procured with a confirmed delivery dates to the nominated Project stockpile site for March 2018;
3. Construction management team and support services assembled;
4. The necessary fleet of permits acquired for construction start, or permit requirements established and agreed to between FEI and the permitting entity and in place for the pipeline contractor to acquire the permits in a timely fashion during construction; and
5. Construction contract in place for construction start in April 2018.

4.2.1.1 Permitting Process Delays

Items 1 through 5 above occur sequentially in the Project schedule timeline progression as each activity generally needs to be partially or fully completed before the subsequent activity can commence. [redacted] As reported in the 2017 quarterly reports, FEI also adjusted the baseline schedule construction component which, at that time, reflected an earlier construction start date in late 2017 to mitigate construction schedule risk for the 2018 in service date. [redacted] This has impacted the construction contract and negotiation to the extent that it will not be feasible to start the construction sufficiently early in line with the revised baseline schedule in 2018 to allow for the NPS 30 IP pipeline and facilities to be tied-in and commissioned in 2018.

FEI outlined the multiple permitting and applications for approval processes in Section 3.3.8 of the Application. [redacted]

FEI had considered that the permitting effort for the Project would be a significant undertaking. As such, at the outset of the Project front end engineering and design (FEED) phase, and well

in advance of submission of the Application, FEI engaged all major stakeholders in Q4 2013 to present the Project at a high level. This approach established the fundamental framework for FEI's stakeholder consultation throughout the Project which has continued for approximately 4 years as evidenced in significant detail throughout the evidentiary update that was provided in early 2015 to establish the new route alignment through Burnaby.

Subsequent to receipt of the CPCN, FEI has further engaged with all local stakeholders (e.g. BC Hydro, Metro Vancouver, TransLink) and local municipal authorities (City of Coquitlam, City of Burnaby, and City of Vancouver). The ongoing level of engagement is further evidenced through the Company's BCUC quarterly update reports which outline that FEI has issued the 30 percent, 60 percent, and 90 percent engineering design deliverables and 30 percent and 70 percent Traffic Management Plans (TMPs) to the municipalities for review and comment in Q3 2016 and Q1 2017 prior to finalizing all related deliverables to 100 percent to obtain the necessary permits and approvals.

As of Q3 2017, [redacted] and the construction risk associated with trying to meet the 2018 in service date, FEI is now planning for the Project to be partially in-service in 2018, with a 2019 Project completion date.

4.2.2 Construction Execution

Section 3.3.5.1 through 3.3.5.4 of the Application noted the construction methodologies, construction activities and construction management plan requirements. The detail presented in the Application was based on the preliminary Construction and Execution Plan (CEP) developed during the pre-Application stage. The pipeline construction productivity rate assumptions in terms of assumed length (metres) of pipeline installed per day were also developed during this stage, and submitted in Appendix A-24 of the Application. These two components formed the basis for the construction timeline in the Project baseline schedule indicating that the Coquitlam Gate IP pipeline and facilities would be constructed between April and October 2018.

The tie-in and commissioning activities were scheduled to be completed by FEI employed construction crews in 2018 immediately after the pipeline and station construction was complete to facilitate an in-service date in 2018.

4.2.2.1 Pipeline Construction, Tie-In and Commissioning Delays

FEI has progressed the detailed construction execution planning for the Project in conjunction with the completion of detailed pipeline routing and pipeline and stations engineering design in 2017. As the Project definition increased through more finalized engineering design deliverables, unforeseen construction challenges due primarily to increased density and proximity to existing infrastructure, workspace limitations, overarching traffic management requirements, and third party stakeholder requirements became apparent. As a result, FEI could not be certain if a 2018 in service date would be achievable without consulting pipeline

construction proponents who specify the means and methods of construction, and provide detailed construction schedules to support their approach to construction.

FEI received construction proposals from three contractors in August 2017. FEI specified in the pipeline construction RFP that the contractor could mobilize to site in Q4 2017 and commence construction in Q1 2018, and that the Project construction should be substantially complete and ready for tie-in by September 2018. This completion date was required to facilitate FEI sufficient time to tie-in and connect the Project to the existing IP system, and then commission and put the new system into service by starting to flow gas prior to the end of 2018.

FEI was informed by the pipeline construction proponents during the RFP interview process in Q3 2017 that there was significant concern regarding the timing of the work. Through reviewing the proposals, it became apparent that the proponents perceived a high degree of risk associated with meeting the September 2018 substantial completion date.

In reviewing the pipeline construction proposals, FEI determined that there was no schedule contingency to deal with delay risk that could arise during construction. This meant that the proponents might not achieve substantial completion until later in 2018 which would impact the FEI tie-in and commissioning activities and likely move this scope into 2019 to avoid the risk of supply interruption from construction during the colder winter season.

4.2.3 Post Construction Restoration, Decommissioning and Abandonment

The Project baseline schedule included final restoration of any aspects of the Coquitlam Gate IP pipeline including decommissioning and abandonment of the existing NPS 20 IP pipeline to be completed in 2019. Due to the forecast Project delay, the completion of these activities will now occur in 2020.

4.2.4 Current Forecast to Complete

FEI is providing notice of a material variance to schedule as outlined in the previous sections and is now anticipating Project completion by 2020. The potential impact to the Project in terms of the schedule delay is outlined in the following table.

Table 4-1: Milestone Summary

Milestone	Planned Finished Date per CPCN	Q3 Quarterly Report	Forecast Finish Date	Actual Finish Date	Variance in Months*	Status
Receive BCUC Approval	Q3 - 2015	Q4 - 2015	Q4 - 2015	Oct 16, 2015	(1)	Complete
Award EPCM Contract	Line item added for tracking purposes	Q2 - 2016	Q2 - 2016	Jan 1, 2016	(3)	Complete
Completion of detailed engineering facility (IFB)	Line item added for tracking purposes	Q3 - 2017	Q3 - 2017	Aug 30, 2017	0	Complete
Completion of detailed engineering pipeline (IFB)	Line item added for tracking purposes	Q1 - 2017	Q1 - 2017	Feb 28, 2017	0	Complete

Milestone	Planned Finished Date per CPCN	Q3 Quarterly Report	Forecast Finish Date	Actual Finish Date	Variance in Months*	Status
Completion of detailed engineering facility (IFC)	Line item added for tracking purposes	Q4 - 2017	Q4 - 2017	Nov 2017		Complete
Completion of detailed engineering pipeline (IFC)	Line item added for tracking purposes	Q2 - 2017	Q2 - 2017	April 14, 2017	0	Complete
Completion of Phase 1, 3, 4 & 5 early works program	Line item added for tracking purposes	Q1 - 2017	Q1 - 2017	Various	0	Complete
Completion of Phase 2 early works program	Line item added for tracking purposes	Q4 - 2017	Q4 - 2017			In progress
Delivery – long lead material items	Additional line item added for tracking	Q1 - 2018	Q1 - 2018	Various		In progress
Issue construction RFP to market	Additional line item added for tracking	Q2 - 2017	Q2 - 2017	May 25, 2017	0	Complete
Submission of Material Change Report	Additional line item added for tracking	Q4 - 2017	Q4 - 2017	Dec 1, 2017	0	Complete
Award construction contract	Q2 - 2017	Q1 - 2018	Q1 - 2018			In progress
Receive permits & approvals	Additional line item added for tracking	[redacted]	[redacted]			[redacted]
Construction Start	Additional line item added for tracking	Q1 - 2018	Q2 - 2018			
Mechanical completion	Additional line item added for tracking	2018	2019			
Construction complete / In service	Q4 - 2018	2018	2019			
Restoration complete	Q2 - 2019	2019	2020			

** brackets indicates an advanced target date.*

5. MATERIAL CHANGE – PROJECT COST ESTIMATE

The material change presented in this section is based on the variance between the original AACE Class 3 cost estimate control budget (as-spent basis) submitted in the Application and the current forecast cost to complete the Project. The variance is detailed as the difference between the line items submitted in Application Appendix E-3-1 and updated cost estimates for these line items including feedback from recent pipeline and stations construction RFP submissions received in Q4 2017.

5.1 *AACE CLASS 3 COST ESTIMATE*

The Company prepared the Project cost estimate based on the AACE Cost Estimate Classification System, and in accordance with the CPCN Guidelines. The details pertaining to the preparation of the cost estimate are presented in Section 3 of the Application, and Appendices A-22 through A-27.

5.1.1 Estimate Preparation, Components and Consolidation

The framework adopted to prepare the AACE Class 3 Project is presented in Section 3.4 of the Application and the WorleyParsons Estimate Preparation Plan attached in Appendix A-22 of the Application.

The Project cost estimate was based on input from different sources comprising FEI owners costs estimates which were developed by FEI Subject Matter Experts (SMEs) and department leads, e.g. Project Management Office (PMO), internal engineering, property services etc. and WorleyParsons (WP) engineering, construction, and cost estimating SMEs located in the WP Burnaby offices, Calgary offices, and Edmonton offices. The various cost estimate components were compiled and consolidated by the FEI/WP project team and presented in Appendix E of the Application.

5.1.2 Project Definition

AACE International Recommended Practice No. 17R-97 introduces project definition as the primary characteristic in determining the estimate classification. Each estimate class corresponds to a level of project definition expressed as a percentage of project complete definition, e.g. AACE Class 3 estimate corresponds to 10 percent to 40 percent project definition. The degree of project definition roughly corresponds to the percent complete of engineering. For a particular industry, the inputs necessary to inform the level of project definition includes a range of documents and information which is usually accompanied by a typical set of deliverables that are used to support the types of estimates used in that industry.

The Project capital cost estimate and supporting deliverables submitted with the Application comprised a range of typical pipeline and stations facilities deliverables that were tailored to the Project specifics including the urban location of the pipeline route corridor. These deliverables

were considered to meet the AACE Class 3 estimate classification in terms of project definition based on the engineering deliverables that were developed to 10 percent to 40 percent complete. FEI submitted that an AACE Class 3 cost estimate was included in the Application with a stated accuracy range of +30 percent to -20 percent.

The material cost variance described in this report exceeds the stated accuracy range of the AACE Class 3 Project cost estimate submitted in the Application. The intent of this section of the report is to compare the project definition and deliverables that formed that basis of the AACE Class 3 estimate submitted in the Application to the current forecast to complete the Project, and provide FEI the forum in which to rationalize the cost variances within the framework of the updated Project definition.

The Project cost estimate work breakdown structure presented in Appendix E-3-1 of the Application comprised the following line items:

1. Project Management;
2. Engineering Procurement and Construction Management (EPCM);
3. Permits and Approvals;
4. Property and Right of Way;
5. Owners Inspection;
6. Materials;
7. Construction;
8. Tie-In and Commissioning;
9. Contingency; and
10. PST.

These cost line items are considered in the same order in the following sections in terms of presenting the variance between the AACE Class 3 cost estimate submitted in the Application and the current estimated forecast to complete.

5.2 *OVERALL COST VARIANCE SUMMARY*

The overall AACE Class 3 control budget, forecast total final cost, and estimated variance is summarized in the table below and presented in further detail in the following sections:

Table 5-1: Estimated Total Final Cost and Variance

Item	Description	Class 3 Control Budget ($,000,000)	Estimated Total Final Cost ($,000,000)	Estimated Variance ($,000,000)
1	Project Management	[redacted]	[redacted]	[redacted]
2	EPCM	[redacted]	[redacted]	[redacted]
3	Permits and Approvals	[redacted]	[redacted]	[redacted]
4	Property and ROW	[redacted]	[redacted]	[redacted]
5	Materials	[redacted]	[redacted]	[redacted]
6	Inspection	[redacted]	[redacted]	[redacted]
7a	Construction (Pipeline)[1]	[redacted]	[redacted]	[redacted]
7b	Construction (Stations)	[redacted]	[redacted]	[redacted]
8	Tie-In and Commissioning	[redacted]	[redacted]	[redacted]
9	Contingency	[redacted]	[redacted]	[redacted]
10	PST	[redacted]	[redacted]	[redacted]
11	***Sub-Total***	[redacted]	[redacted]	[redacted]
12	AFUDC[3]	[redacted]	[redacted]	[redacted]
13	TOTAL	[redacted]	[redacted]	[redacted]
	Demolition	[redacted]	[redacted]	[redacted]
	AFUDC Demolition	[redacted]	[redacted]	[redacted]
	TOTAL CAPITAL COST	[redacted]	[redacted]	[redacted]

Notes:

[redacted]

2. *No contingency is reported here as the Project has materially changed and hence the contingency needs to be re-evaluated. This will be done following negotiation with construction contractors to appropriately account for the Project's exposure to risk.*

3. *AFUDC has been calculated based on the original contingency allowance.*

5.3 *PROJECT MANAGEMENT COST VARIANCE*

The AACE Class 3 control budget, forecast final cost, and estimated variance is summarized in the following table:

Table 5-2: Project Management Estimated Total Final Cost and Variance

Description	Class 3 Control Budget ($,000,000)	Estimated Total Final Cost ($,000,000)	Estimated Variance ($,000,000)
Project Management	[redacted]	[redacted]	[redacted]

The management resourcing estimate for the Project is outlined in Section 3.3.7 of the Application and comprises FEI project services from the Project Management Office (PMO), stakeholder management, communications, and other support resources including legal and financial accounting services.

The Project Management budget line item one (1) in Application Appendix E-1-1 includes FEI's estimated cost to provide these project services throughout the Project lifecycle to end in 2019 to facilitate pipeline abandonment, restoration and Project close-out. The current forecast for project management services to support the Project through to completion in 2020 after commissioning of the Coquitlam Gate IP pipeline and stations, and decommissioning and abandonment of the NPS 20 IP is forecast to incur a variance of [redacted] million. The reasons for the cost variances include:

1. Additional project management resources (accounting for approximately [redacted] percent of the variance) to:
   a) coordinate the multi-facetted third party external stakeholder engagement process;
   b) integrate the third party requirements into the Project team;
   c) manage the ongoing change as the Project develops;
   d) deliver the Project early works program; and
   e) Additional resources to oversee the EPCM contractor;
2. Funding requirements for additional third party staff in external organizations to facilitate meeting project permitting timelines accounting for [redacted] percent of the variance (e.g. funding dedicated municipal staff to review FEI Project deliverables as a function of utility permitting process); and
3. Additional communications resources to support community and stakeholder communications over the extended Project schedule and to support the project management team above what was originally anticipated due to the challenges associated with the urban nature of the project and implementation of the early works accounting for approximately 50 percent of the variance.

5.4 *EPCM COST VARIANCE*

The AACE Class 3 control budget, forecast final cost, and estimated variance is summarized in the following table:

Table 5-3: EPCM Estimated Total Final Cost and Variance

Description	Class 3 Control Budget ($,000,000)	Estimated Total Final Cost ($,000,000)	Estimated Variance ($,000,000)
EPCM	[redacted]	[redacted]	[redacted]
FEI Internal Engineering	[redacted]	[redacted]	[redacted]
Total	[redacted]	[redacted]	[redacted]

5.4.1 Engineering Procurement and Construction Management

The AACE Class 3 cost estimate for the Engineering, Procurement, and Construction Management (EPCM) line item was based on [redacted] of the estimated total construction and materials costs for the Project. This is included in the Application as line item two (2) in the summary table in Appendix E-3-1. At that time it was the opinion of the WorleyParsons team that utilizing a higher percentage range would over inflate the EPCM cost estimate line item due to the disproportionality high pipeline construction estimate for the Coquitlam Gate IP pipeline compared to non urban pipeline construction costs.

After receiving Project approval, FEI selected WorleyParsons to provide the EPCM services under an EPCM contract which was executed in January 2016 for the provision of these services from Q1 2016 to Q1 2019. The EPCM contract negotiated price was within the accuracy range of the AACE Class 3 estimate. However, as FEI progressed the project planning, detailed engineering and procurement activities throughout 2017, it become apparent that the original strategy utilized to determine the AACE Class 3 estimate, and the EPCM contract negotiated price, underestimated the required EPCM scope, and therefore the actual cost to deliver the Project. The EPCM engineering, procurement, and construction management components are now forecast to incur cost variances totalling approximately [redacted] due to additional:

1. Engineering resources to incorporate third party and stakeholder requirements into the design process;
2. Engineering resources to engage with FEI internal stakeholder groups to ensure FEI's expectations are met in terms of delivering the final pipeline and stations facilities assets;
3. Engineering resources to manage the third party engineering survey contractor and to capture and process necessary data from along the pipeline corridor and integrate the information into the engineering design and deliverables;

4. Additional traffic and utility management resources to prepare Traffic Management Plans and utility relocation designs;
5. Procurement resources to manage the procurement process with multiple vendors across multiple procurement packages;
6. Construction management resources to progress the construction RFP process; and
7. Construction management resources and third party inspection resources to monitor the contractor activities onsite throughout the pipeline and stations facilities construction.

5.4.1.1 Engineering (E)

The EPCM engineering resources were the first component of the third party EPCM team to fully mobilize to the Project upon commencement of the Coquitlam Gate IP pipeline detailed routing and engineering activities in Q1 2016. As the detailed engineering progressed the Project team engaged all FEI and major external stakeholders at the 30 percent, 60 percent, and 90 percent design complete milestones to facilitate third party reviews of the pipeline and facilities engineering deliverables. The EPCM budget included the effort to facilitate and process third party reviews, on the basis that the review process would align with the engineering timeline and result in a suite of requirements as pertains to the Project drawings and specifications.

However, the review of the engineering deliverables by the third party stakeholders was inextricably linked to the overall Project permitting process. As such, it was not possible to enforce a strict timeline for the stakeholders to fully complete their reviews, nor was it possible to contain the review to only the engineering documents and deliverables. Other factors pertaining to the stakeholders review process which are detailed in this report delayed the overall review process.

As the multitude of various third party stakeholder internal departments reviewed the engineering deliverables in a sporadic fashion throughout 2017, FEI had to manage the ongoing rework of engineering deliverables associated with continuous late requests and comments. As a result, the third party stakeholders review and permit requirements has contributed to ongoing rework of the pipeline and stations facilities engineering deliverables beyond the EPCM contract budget allowances.

Further to these cost pressures it became apparent as the pipeline and facilities engineering scope was completed throughout 2017 that there would be insufficient EPCM budget funds to continue to engage the necessary engineering resources to support the EPCM procurement activities which was ramping up in Q2 2017, and the EPCM construction management effort which was also ramping up in Q3/Q4 2017. It was also determined that there would be insufficient budget to complete the production of engineering record drawings stage at the end of the Project.

The material change to the EPCM costs includes the forecast for the engineering services to complete the Project including the extended Project schedule to 2019.

5.4.1.2 Procurement (P)

The EPCM procurement resources are responsible for expediting the Project materials and services procurement and contract administration requirements. FEI provides procurement resources to assist with certain contractual and legal aspects of the Project procurement process. The procurement effort required for the Project has resulted in additional resources than initially estimated when the EPCM contract was executed.

The material change to the EPCM costs includes the forecast for the procurement services to complete the Project including the extended Project schedule to 2019.

5.4.1.3 Construction Management (CM)

As the detailed pipeline routing and pipeline and stations engineering scope progressed, the construction management component of the EPCM contract mobilized to the Project in early 2016 and ramped up in 2017 to commence detailed construction planning and early works planning and execution. The construction management effort required for the Project has also resulted in additional resources than initially estimated when the EPCM contract was executed.

The material change to the EPCM costs includes the forecast for the construction management services to complete the Project including the extended Project schedule to 2019.

5.4.2 FEI Engineering Oversight

The FEI engineering oversight AACE Class 3 cost estimate was based on a projected resources and time estimate to support the Project through to completion in Q1 2019. However, the material change to the Project Schedule which will extend the Project duration by up to one year will require extended FEI engineering oversight and incur a cost variance.

5.5 *PERMITS AND APPROVALS COST VARIANCE*

The AACE Class 3 control budget, forecast final cost, and estimated variance is summarized in the following table:

Table 5-4: Permits Estimated Total Final Cost and Variance

Description	Class 3 Control Budget ($,000,000)	Estimated Total Final Cost ($,000,000)	Estimated Variance ($,000,000)
Permits and Approvals	5.7	13	7

FEI outlined the multiple permitting and applications for approval processes in Section 3.3.8 of the Application. The Permits and Approvals budget line item includes the costs associated with obtaining permits and approvals from the OGC, environmental agencies, archaeology agencies and the municipalities, and other third parties stakeholders which at the time were considered to be nominal permit application fees.

[redacted]

5.5.1 Major Third Party Stakeholders

In order to proceed with construction, FEI requires the following local government agencies permits and approvals:

5.5.1.1 BC Hydro

FEI requires sign off from BC Hydro transmission engineering, distribution engineering, cables group, civil and structures group, operations group, and lands on the design of the gas infrastructure which is located in municipal space, including roads, parks, and other municipal right of ways in order to complete construction. The BC Hydro sign off is in the form of a Compatible Use Letter (CUL) permit issued to FEI.

FEI has engaged with BC Hydro teams since Q1 2014 with regard to acquiring the CUL permit. FEI and BC Hydro initiated a suite of engineering studies to investigate the potential for the proposed Coquitlam Gate IP pipeline to negatively impact adjacent BC Hydro assets. Correspondingly FEI determined if there were any pipeline measures required to mitigate the potential impact to the pipeline from the adjacent BC Hydro assets. In addition to the engineering studies, all BC Hydro stakeholders comprehensively reviewed the Coquitlam Gate IP route alignment to ensure it was compatible with existing above ground and buried BC Hydro infrastructure. FEI successfully acquired the first of three CUL in Q4 2017. The remaining two CUL permits are expected to be issued to FEI pursuant to clarifying some minor outstanding technical queries.

The final cost to complete the BC Hydro CUL permit process and implement identified mitigation measures is approximately $2.0 million. This cost was not contemplated within the original cost estimate provide in the Application and it contributes to a portion of the Engineering, Construction and Project Management variances.

5.5.1.2 Ministry of Transport and Infrastructure (MOTI)

Activities are ongoing in the pursuit of an approved permit from MOTI to bring the gas line under the MOTI ROW at Highway 1 and First Avenue. FEI will submit a plan demonstrating how the MOTI infrastructure, particularly the bridge foundations associated with the Highway 1 overpass, will be protected from potential damage during the pipeline construction. An estimate of approximately $150 thousand to conduct this work was provided by MOTI Burnaby office staff on November 15, 2017. This cost was not contemplated within the original cost estimate provided in the Application and is not reflected in the updated Estimated Total Final Cost and Variance Table 5-4.

5.5.1.3 TransLink

The engagement with TransLink has been largely to discuss field construction schedules (and subsequent impacts to them) and the Project Traffic Management Plan, which TransLink had provided comments on. There are no major permits required from TransLink. There are ongoing discussions with respect to bus layovers on Willingdon and communications going forward for the duration of the Project.

5.5.1.4 Metro Vancouver

FEI is pursuing a Crossing Agreement with Metro Vancouver for their utilities impacted by the Coquitlam Gate IP pipeline alignment. FEI is actively engaged with Metro Vancouver to address their comments on the alignment, and resolve any outstanding issues.

5.5.2 Municipal Authority Typical Permitting Requirements

In order to proceed with construction, FEI requires the following municipal permits and approvals:

- Utility Permit - As outlined in the operating agreement with each municipality, FEI is required to obtain municipal approval for this type of installation in municipal space such as roads and parks (Utility Permit); and
- Construction Permits – The contractor will be required to seek the appropriate municipal permits and approvals to facilitate construction based on their means and methods, including noise variance permits and traffic permits.

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

Table 5-5: Municipal Requirements Previously Identified

Item	Municipality	Description of Requirement	[redacted]	[redacted]	Comment
1	City of Coquitlam	Paving Como Lake Avenue	[redacted]	[redacted]	Although only requested by the City of Coquitlam, estimate range included all municipalities (~20 km)
2	City of Coquitlam	Removal of existing NPS 20 pipeline	[redacted]	[redacted]	Estimate range included for the City of Coquitlam only (~6km)
3	City of Burnaby	Paving of walking path	[redacted]	[redacted]	
4	City of Burnaby	Culvert replacement (3)	[redacted]	[redacted]	
5	City of Burnaby	Purchase of Graveley and Bainbridge sites	[redacted]	[redacted]	
6	City of Vancouver	Changes in depth of the pipeline to accommodate future City infrastructure	[redacted]	[redacted]	
	Total		[redacted]		

[redacted]

5.6 *PROPERTY AND RIGHT OF WAY COST VARIANCE*

The AACE Class 3 control budget, forecast final cost, and estimated variance is summarized in the following table:

Table 5-6: Property and Right of Way Estimated Total Final Cost and Variance

Description	Class 3 Control Budget ($,000,000)	Estimated Total Final Cost ($,000,000)	Estimated Variance ($,000,000)
Property and Right of Way	1.14	2	1

Sections 3.3.3.6 and 3.3.8.4 of the Application noted that the Coquitlam Gate IP Project may involve the acquisition of new land and access rights for an approximate 70 metres of the proposed route alignment between Boundary Road and Highway 1. FEI has finalized this new land and access right negotiations and, as part of the early works, completed construction of the short section of the Coquitlam Gate IP pipeline through this area. The forecast variance of $0.7 million is due to increased ROW costs.

5.7 *INSPECTION COST VARIANCE*

The AACE Class 3 control budget, forecast final cost, and estimated variance is summarized in the following table:

Table 5-7: Inspection Estimated Total Final Cost and Variance

Description	Class 3 Control Budget ($,000,000)	Estimated Total Final Cost ($,000,000)	Estimated Variance ($,000,000)
Inspection	[redacted]	[redacted]	[redacted]

The Project inspection scope includes inspection services performed during the pipeline construction to monitor the pipeline contractor activities and ensure that the pipeline and stations facilities will be constructed and tested to meet the Company's specifications. The levels of inspection range from personnel on site during construction, to specialist services provided by industry vendors. The main inspections that will be engaged during the construction phase of the Project include:

1. FEI NPS 30 IP pipeline construction inspectors (to monitor the contractor's construction practices during construction of the NPS 30 IP pipeline);
2. FEI NPS 20 IP pipeline right of way (ROW) inspectors;
3. FEI non-destructive examination (NDE) contractor;

4. FEI pipeline calliper tool inspection contractor; and
5. FEI pipeline In-Line Inspection (ILI) contractor.

Due to increased inspection requirements as a result of the increased complexity of the Project and the increased construction schedule from one season to two years the inspection services are now forecast to incur a variance of approximately [redacted]

5.8 *MATERIALS COST VARIANCE*

The AACE Class 3 control budget, forecast final cost, and estimated variance is summarized in the following table:

Table 5-8: Materials Estimated Total Final Cost and Variance

Description	Class 3 Control Budget ($,000,000)	Estimated Total Final Cost ($,000,000)	Estimated Variance ($,000,000)
Materials	29.87	27	(3)

The detailed engineering scope included development of engineering specifications for all of the pipe, fittings, equipment and ancillary components that will comprise the pipeline and stations mechanical systems, and which will contain pressurized natural gas. To ensure these components will meet the Project specifications, will be manufactured to the highest quality, and will be delivered to the construction site in sufficient time, it was necessary for FEI to procure these components ahead of time and issue them to the selected pipeline and stations construction contractor(s).

The AACE Class 3 estimate for the pipeline and stations materials included line pipe, induction bends, station pipe and fittings, valves and equipment. The purchase orders for these components have now been placed with the respective vendors totalling approximately $27 million. This compares to the AACE Class 3 materials cost estimate total of $29.87 million, resulting in a forecast savings of approximately $3 million.

5.9 *PIPELINE CONSTRUCTION COST VARIANCE*

The following sections compare the AACE Class 3 cost estimate for the pipeline construction to the current forecast cost to complete construction including construction RFP bids received and rationalizes the cost variance.

The forecast cost to complete construction is based on the average of the construction RFP proposal submissions and will be subject to confirmation after the contractor negotiations are completed in Q1 2018 and construction contract execution in Q1 2018. The proponents were requested to submit lump sum pricing to construct the segment of the pipeline in Coquitlam,

Burnaby, and Vancouver separately, and also to construct the total pipeline. The estimated total to complete presented in the table below is based on the proponent pricing to complete the total pipeline.

The RFP proposal submissions included a lump sum pricing format, but did not provide any further cost breakdown. The detailed cost breakdown presented in the table below is based on a forensic analysis of the proponent submissions from which the variance was calculated based on a comparison of resources, materials, and equipment requirements outlined in the proponent written submissions to the AACE Class 3 estimate.

Table 5-9: Pipeline Construction Estimated Total

Description	Class 3 Control Budget ($,000,000)	Escalation ($,000,000)	Estimated Total Final Cost ($,000,000)	Estimated Variance ($,000,000)	
[redacted]					
[redacted]	[redacted]	[redacted]	[redacted]		[redacted]
[redacted]	[redacted]	[redacted]	[redacted]		[redacted]
[redacted]	[redacted]	[redacted]		[redacted]	
[redacted]	[redacted]	[redacted]		[redacted]	
[redacted]	[redacted]	[redacted]		[redacted]	
[redacted]	[redacted]	[redacted]		[redacted]	
[redacted]	[redacted]	[redacted]		[redacted]	
[redacted]				[redacted]	
[redacted]	[redacted]	[redacted]		[redacted]	
[redacted]	[redacted]	[redacted]		[redacted]	
[redacted]	[redacted]	[redacted]		[redacted]	
[redacted]	[redacted]	[redacted]	[redacted]		[redacted]
[redacted]	[redacted]	[redacted]	[redacted]		[redacted]
[redacted]	[redacted]	[redacted]	[redacted]		[redacted]
[redacted]	[redacted]	[redacted]	[redacted]		[redacted]
[redacted]	[redacted]	[redacted]	[redacted]		[redacted]
[redacted]	[redacted]	[redacted]	[redacted]		[redacted]

5.9.1 Preliminary Construction Execution Plan

Section 3.3.5 of the Application indicated that the Coquitlam Gate IP pipeline would generally be constructed under existing roadways. Section 3.3.5.1 through 3.3.5.3 of the Application noted

the construction methodologies, construction activities and construction management plan requirements. The detail presented in the Application summarized the key points from the preliminary Construction Execution Plan (CEP).

The preliminary CEP identified that the primary determinant of the construction methodology for the Coquitlam Gate IP pipeline would be the proposed location of the pipeline along municipal roadways and the number and type of buried municipal utilities (water, sanitary, and storm) along the route. The preliminary CEP also indicated that the service connections from these utilities to adjacent houses and commercial and industrial properties would complicate the use of conventional pipeline construction techniques not tailored to the urban location. For example, a typical block in Vancouver, which is 185 metres in length, equates to 28 houses and over 80 existing service connections that the pipeline may have to cross. Given that the pipeline is approximately 100 blocks in length, this equated to a significant number of connections.

The preliminary CEP considered a number of pipeline trenched and trenchless construction methodologies which were assessed in terms of their ability to execute the pipeline construction along a heavily trafficked urban corridor with multiple utilities, whilst also maximizing the construction efficiency through maximum productivity.

The proposed construction methodology selected for the preliminary CEP was “stove piping”. Similar to conventional pipeline construction, laying of the pipe end-to-end and welding would occur in one section while excavation of the trench would occur in the adjacent section. The step by step description of this process included:

1. Pipe would be strung on rollers at the end of the proposed excavation and welded together and inspected.
2. Asphalt along the portion of the roadway to be excavated would be saw cut.
3. The portion of asphalt related to that particular day’s length of excavated trench would be removed by an excavator and trucked off-site to be recycled.
4. A hydro-vac truck would hydro-vac the trench line locating and identifying all of the existing utilities and utility service connections to be crossed.
5. The excavator would start excavating the pipeline trench working around the utility and utility service connections which would be hand excavated to prevent damage. All crossing utilities and service connections would be supported as they are unearthed.
6. As the excavation proceeds, sand bedding would be placed on the bottom of the trench.
7. Once a sufficient amount of excavation has been completed to prevent interference, the pipeline is pulled into the trench over the bedding sand under the utilities and service connections.
8. After the pipe is pulled into place, trench boxes and shoring would be placed into the trench to prevent collapse. Steel plates would be placed over the excavation for safety.

9. Once a particular section of pipe between tie-in points is pulled in, the trench boxes and shoring is removed, the trench is backfilled and asphalt replaced.

5.9.1.1 Preliminary Traffic Management Review

Traffic management was also a critical component considered during development of the preliminary CEP. Preliminary Traffic Management reviews were completed and submitted in Appendix A-18 of the Application. The preliminary CEP considered that the pipeline construction along the roadways would require phased lane closure of sections of the roadways to accommodate the pipeline construction outlined above.

The preliminary CEP and traffic management reviews considered that typically a section of two to four city blocks (300 to 750 metres) would be closed at any particular time. This length would be dictated by the distance between major roadway intersections that would be crossed without trenching. In turn the preliminary CEP considered that the longer the length of roadway that could be shut down the more efficient the construction would be. This is because, for each section of shut down road forming the construction zone, construction equipment and worksite materials have to be decommissioned and setup in new locations. Therefore, reducing the lengths of the closed section would introduce more mobilization and demobilization and therefore reduce productivity.

The preliminary CEP considered that for each section where there are few utility crossings to deal with, pipe could be welded together for the entire length and placed in the trench. Where utility density is higher, stove pipe construction will be used and as discussed above much of the pipeline as possible would be welded above ground and pulled into the pipeline trench.

The preliminary CEP also considered that for each construction section all home and business access requirements have to be accounted for, but access to intermediate cross streets would be blocked for the duration of the section under construction. This was required in the interest of pipeline construction efficiency, so that the longest possible section of pipe could be welded together and inspected above ground prior to lowering/dragging into the trench and therefore maximizing pipeline construction productivity.

5.9.2 Pipeline Construction Request for Proposal (RFP)

FEI is currently evaluating RFP proposal submissions received for the construction of the Coquitlam Gate IP pipeline. The information presented in the proponent submissions has informed FEI's understanding of the how potential pipeline construction contractors view the Coquitlam Gate IP pipeline construction scope, and the construction methods and techniques, cost, and timeline the proponents consider necessary to install the pipeline.

Since the preliminary CEP was completed, the final Coquitlam Gate IP pipeline alignment has not changed significantly. It is still routed along the same municipal road corridors as the preferred alignment applied for in the Application. This information was included in the recent

construction RFP issued for the Coquitlam Gate IP pipeline construction. However, the route alignment component of the Project constitutes only one aspect of the project definition. Reflective of the current project definition, there are a number of other aspects of the Project construction that are now understood in greater detail and which are based on engineering deliverables such as the detailed engineering survey and utility locate program, pipeline profile, traffic management plans etc.. These engineering deliverables were developed during the detailed engineering phase of the Project and were executed after receipt of Project approval.

These aspects and their impact to the preliminary CEP are outlined in the following sections in terms of the material changes to the AACE Class 3 cost estimate and the magnitude of the cost variance based on the current forecast cost to complete the Project.

5.9.3 Indirect Construction Costs

Indirect contractor construction costs include mobilization, demobilization of the construction equipment and personnel to the construction site, site supervision of the construction workforce throughout the construction period, maintenance and service of the facilities and equipment, and security of the work site.

5.9.3.1 Mobilization, Demobilization, and Supervision

The AACE Class 3 indirect construction costs estimate is included in Appendix 1 of the Pipeline Basis of Estimate included in Appendix A-24 of the Application. The basis of this estimate included one pipeline contractor executing to the CEP as outlined above on a single construction spread comprising the entire pipeline length utilizing multiple work fronts from Coquitlam Gate station to Woodland station. The cost estimate included indirect costs totalling approximately [redacted] covering mobilization, supervision, maintenance and service, trucking, security, and demobilization.

5.9.3.1.1 VARIANCE ANALYSIS

The preliminary CEP assumed traffic management phases that would align with the proposed construction sequence and direction of pipeline construction that was believed to support an efficient construction execution plan and driven by optimum productivity rates along the route. However, the TMPs currently approved by the municipalities include requirements that might not yield the level of construction productivity assumed in the preliminary CEP. Specifically, the TMPs include:

- 13 segments;
- 23 sub-segments ranging from <100 m to 1.5 km in length; and
- 21 work plans and submittals associated with traffic management.

The [redacted] TMP also requires that FEI's pipeline contractor must complete all activities within a particular sub-segment prior to mobilizing to the adjacent sub-segment. This means that the contractor cannot progress the pipeline construction in a linear fashion sequentially from segment to segment. Instead, as the initial construction activities (e.g. utility locate and pavement cutting and removal) are competed in one segment they must demobilize from the current work sub-segment and remobilize to a different sub-segment until the latter construction activities (e.g. backfilling and pavement restoration) are fully complete. This will incur greater mobilization and demobilization, and site management costs. The contractor RFP bids indicate a total indirect man-day allowance could be [redacted] times the AACE Class 3 cost estimate which would be equivalent to a variance amount of approximately $[redacted] million.

5.9.4 Direct Construction Costs

Direct construction costs include all construction costs directly related to construction of the pipeline.

5.9.4.1 Trench Excavation and Maintenance (Depth, Width, Shoring, Water Management)

Appendices A-22 and A-23 of the Application and Evidentiary Update Appendices A-23 and A-24 includes the WorleyParsons Basis of Estimate and Pipeline Basis of Estimate. These documents detail how the Coquitlam Gate IP pipeline alignment was sub-divided into approximately 50 segments based on the perceived varying construction challenges along the pipeline corridor.

A critical determinant of the construction challenges was the desktop review that was completed based on BC One Call data. A municipal as-built utility data search determined the number and size of utility crossings in each section. From this desktop review the civil components of the pipeline trench was estimated. Application Appendix A-26 includes the WorleyParsons Civil Basis of Estimate document which details the approach adopted to quantify the material that would be removed from the pipeline trench during pipeline construction excavation operations, and also quantify the amount of materials that would be required to backfill the trench after the pipe was laid on the trench bottom and to reinstate the road surface.

Application Appendix A-26, Section 3.1, refers to a typical drawing that was prepared to represent the trench design that was anticipated and would be required to accommodate construction of the Coquitlam Gate IP pipeline in the urban environment with multiple utility crossings. The trench width was assumed to be 1.25 metres to 2.0 metres depending on whether or not shoring was required. The expected depth of cover to the top of the pipeline ranged from 1.2 metres to 1.8 metres, and trench shoring allowed for approximately 60 trench boxes.

The major factors informing this analysis included the size and assumed depth of the existing utilities identified, and an assumed minimum separation of 0.3 metres from the NPS 30

Coquitlam Gate IP pipeline to third party utilities. Based on this analysis the average depth of cover across the Coquitlam Gate IP preferred alignment was calculated to be 1.5 metres.

5.9.4.1.1 VARIANCE ANALYSIS

A detailed engineering survey and utility locate program completed as part of the detailed pipeline route design activities has confirmed the number of expected utility crossings along the Coquitlam Gate IP pipeline alignment. Stakeholder engagement has also confirmed the minimum vertical offset requirements of 0.6 metres to 1.0 metres when crossing third party utilities. In some locations where existing utilities are stacked on top of each other, for example at intersections, or the existing utilities are deeply buried, the Coquitlam Gate IP pipeline will be installed with up to 4.0 m depth of cover. This will result in a very deep trench which will require extensive shoring to stabilize the trench during pipe installation. As a result of this project definition, the average depth of cover to the Coquitlam Gate IP final alignment profile has increased from approximately 1.5 metres to 2.5 metres. These requirements are reflected in the completed engineering deliverables, e.g. pipeline route alignment sheets, construction plans, and construction specifications.

Furthermore, contrary to the preliminary CEP, and based on construction RFP proponent feedback, it is now considered likely that the construction contractor [redacted]

The AACE Class 3 estimated an asphalt removal volume of [redacted] m3 and excavated quantity spoil for disposal of [redacted] m3. These calculated volumes were based on the initial assumed trench design and pipeline average depth of cover. Based on the wider and deeper trench now required to accommodate the Issued for Construction (IFC) trench profile and the contractors execution plan the quantity of spoil to be excavated and removed is estimated at [redacted] and the quantity of pavement to be cut and removed is estimated at [redacted] m3. The resulting variance to the AACE Class 3 estimate is forecast at approximately [redacted] million.

5.9.4.2 Trench Backfill (Imported backfill material supply and install)

The imported backfill material will be required to replace the excavated trench materials which will be hauled off site and disposed of. The imported backfill materials will be engineered and installed to meet master municipal construction documents (MMCD) requirements. The AACE Class 3 estimate allowed provisions based on the CEP, pipeline depth of cover, and trench design at that time. This equated to an estimated backfill volume of [redacted] m3, asphalt pavement of [redacted] m2 and curb restoration of [redacted] meters.

5.9.4.2.1 VARIANCE ANALYSIS

Based on the wider and deeper trench now considered necessary to accommodate the Issued for Construction (IFC) trench profile, the quantity of backfill materials required is estimated at 193,000 m3, and the quantity of pavement to be reinstated is estimated at [redacted] m2, and the quantity of curb replacement estimated at [redacted] meters. Overall the volume of material to be imported and quantity of curb to be replaced has increased significantly and the resulting overall variance to the AACE Class 3 estimate is forecast at approximately $[redacted] million.

5.9.4.3 Construction Productivity

Application Appendix A-23 and A-24 includes the WorleyParsons Basis of Estimate and Pipeline Basis of Estimate documents. These documents present the pipeline construction productivity assumed. Section 6.1.7 clarifies that the key driver behind all production for the Coquitlam Gate IP pipeline is excavation.

The Coquitlam Gate IP construction productivity was based on segmenting the pipeline into approximately 50 segments (excluding trenchless crossings) ranging from 30 metres to 1,300 metres in length. Productivity rates were then applied to these segments which ranged from 30 to 70 metres/day depending on construction complexity and work space considered available per segment. This translated to an overall weighted average production rate of 46 metres/day.

This productivity is in contrast to a typical pipeline project where productivity is typically driven by pipe welding productivity. The excavation driven productivity is due to the heavy congestion and safety guidelines with construction in an urban area. The pipeline productivity was also discussed in further detail in FEI's response to BCUC IR 1.1.1.

5.9.4.3.1 VARIANCE ANALYSIS

Feedback presented in the construction RFP submissions from construction proponents indicate a slower average production rate of approximately [redacted] compared to the AACE Class 3 basis of estimate assumptions. The cost increase from the AACE Class 3 estimate is approximately [redacted] million.

5.9.4.4 Mainline Welding (Crossing Pipe and Line Pipe Joint Length)

The AACE Class 3 estimate assumed that the pipeline would be 100 percent constructed using nominal pipe lengths of 22 metres to minimize the welding required. Subject to completion of the detailed construction execution planning, the Project team determined that shorter 18 metres and 12 metres should be utilized in the urban environment on a 60 percent and 40 percent split respectively to minimize pipe transport logistical challenges.

5.9.4.4.1 VARIANCE ANALYSIS

This change in pipe length will result in approximately 400 to 500 additional pipeline circumferential girth weld joints which will incur an increase of approximately $[redacted] million to the pipeline welding AACE Class 3 component.

5.9.4.5 Utility Location (Number of underground utilities)

The preliminary routing analysis and master crossing list prepared during the FEED phase of the Project identified approximately 600 to 700 utility crossings. The utility locate program completed with the engineering survey to support the detailed engineering located approximately 1,678 underground utilities. Considering that this would equate to a utility crossing every 10 metres to 15 metres on average, and the pipe lengths that will be installed range in length from 12 metres to 18 metres, provides an indication of the challenges associated with identifying the utilities and installing the pipeline underneath.

5.9.4.5.1 VARIANCE ANALYSIS

The AACE Class 3 cost estimate allowed $1.8 million for two hydro-vac trucks and support crew to expose these utilities in approximately 100 days. The construction RFP bid submissions has allowed for a four-way ground scan and daylighting by multiple dedicated utility crews to locate the underground utilities through hydro-vac holes. [redacted] The additional cost to reflect the increased hydro-vac excavation crews would approximate [redacted] million.

5.9.4.6 Additional Construction Crew Resourcing

The AACE Class 3 basis of estimate assumed that the Coquitlam Gate IP pipeline was to be constructed utilizing five mainline crews, including boring crews, one utility crew, and dedicated traffic management crews for each mainline crew.

5.9.4.6.1 VARIANCE ANALYSIS

[redacted] The resulting variation in cost between the AACE Class 3 cost estimate and the construction bids is estimated to approximate [redacted] million.

5.9.4.7 Trenchless Crossings

The FEED scope included three long trenchless crossings totalling 1,174 metres in length, and thirteen short trenchless crossings totalling 675 metres in length. The AACE Class 3 cost estimate for this scope totalled approximately [redacted] million.

5.9.4.7.1 VARIANCE ANALYSIS

[redacted]

5.9.4.8 Exchange Rate

The Basis of Estimate assumed an exchange rate of [redacted]

5.9.4.8.1 VARIANCE ANALYSIS

The current exchange rate is CAD [redacted] The variance primarily relates to construction equipment which is typically estimated and bid in US dollar equivalent. The impact to the AACE Class 3 cost estimate would incur an increase of approximately [redacted] million.

5.9.4.9 Additional Sundries

The FEED scope included for 4 test heads and other associated pipeline testing and drying allowances. The AACE Class 3 cost estimate allowed $175,000 for these components.

5.9.4.9.1 VARIANCE ANALYSIS

[redacted]

5.9.5 Contractors Overhead and Profit (OH&P)

[redacted]

5.9.5.1.1 VARIANCE ANALYSIS

[redacted]

5.9.6 Contractor Risk Allowances

[redacted]

[redacted]

5.9.6.1.1 VARIANCE ANALYSIS

[redacted]

5.9.7 Unit Price Items

The AACE Class 3 cost estimate included [redacted]

5.9.7.1.1 VARIANCE ANALYSIS

[redacted]

5.9.8 Demolition (Pipeline Abandonment)

The AACE Class 3 cost estimate allowed [redacted] million for abandonment of the existing NPS 20 IP pipeline after the Coquitlam Gate IP pipeline is constructed.

5.9.8.1.1 VARIANCE ANALYSIS

[redacted]

5.10 *OTHER INDIRECT CONSTRUCTION COSTS*

The AACE Class 3 control budget included [redacted] for other indirect construction costs such as:

- Geotechnical investigation support;
- Materials and equipment laydown area and Project offices; and
- Utility locates and daylighting.

[redacted]

Table 5-10: Indirect Estimated Total final Cost and Variance

Description	Class 3 Control Budget ($,000,000)	Estimated Total Final Cost ($,000,000)	Estimated Variance ($,000,000)
Other Indirect Construction Costs	[redacted]	[redacted]	[redacted]

5.11 *FACILITIES CONSTRUCTION COST VARIANCE*

The following sections compare the level of project definition that supported the AACE Class 3 cost estimate to the stations facilities project definition at 100 percent detailed design complete, with design deliverables Issued for Construction (IFC), and construction RFP submissions received from stations construction proponents.

5.11.1 Coquitlam Gate Station Cost Variance Summary

The Coquitlam Gate station is an existing FEI facility which will be upgraded as part of the Project as noted in Section 3.3.2 and 3.3.3 of the Application. The Coquitlam Gate station cost variance is summarized in the following table.

Table 5-11: Coquitlam Gate Station Estimated Total Cost and Variance

Description	Class 3 Control Budget ($,000,000)	Escalation ($,000,000)	Estimated Total Final Cost ($,000,000)	Estimated Variance ($,000,000)
Structures	[redacted]	[redacted]	[redacted]	[redacted]
Metering and Pressure Regulating (M&R) Systems	[redacted]	[redacted]	[redacted]	[redacted]
Demolition	[redacted]	[redacted]	[redacted]	[redacted]
Total	[redacted]	[redacted]	[redacted]	[redacted]

5.11.2 Woodland Station Cost Variance Summary

East 2nd & Woodland (Woodland) station is an existing FEI site which will be upgraded as part of the Project as noted in Section 3.3.2 and 3.3.3 of the Application. The Woodland station cost variance is summarized in the following table.

Table 5-12: Woodland Station Estimated Total Final Cost and Variance

Description	Class 3 Control Budget ($,000,000)	Escalation ($,000,000)	Estimated Total Final ($,000,000)	Variance ($,000,000)
Structures	[redacted]	[redacted]	[redacted]	[redacted]
Metering and Pressure Regulating (M&R) Systems	[redacted]	[redacted]	[redacted]	[redacted]
Demolition	[redacted]	[redacted]	[redacted]	[redacted]
Total	[redacted]	[redacted]	[redacted]	[redacted]

5.11.3 Variance Analysis

Coquitlam Gate station and Woodland station upgrade scope is presented in Section 3.3.3.4.1 of the Application. The preliminary engineering drawings are presented in Appendix A-13 and A-14 of the Application. The stations basis of estimate is included in Application Appendix A-25.

The Coquitlam Gate station upgrade scope will involve decommissioning and demolishing existing parts of the site and constructing new gas metering and pressure regulating infrastructure and buildings. The Woodland station upgrade scope will involve demolishing an existing muster building, site environmental remediation, and installing gas metering and pressure regulating infrastructure and buildings.

The estimate variation is presented having consideration of the following stations facilities scope components as presented in Application Appendix E-3-1:

- Structures (buildings);
- Metering and pressure regulation; and
- Demolition.

5.11.3.1 Structures (Buildings)

The proposed upgrades to the existing Coquitlam Gate station will take place within the existing station facility fence line and comprise a new inlet connection to the FEI transmission pressure system, a new outlet connection to the Coquitlam Gate IP pipeline, new gas filtration equipment, new gas pre-heat equipment, new gas pressure reduction equipment and gas flow rate metering equipment. The equipment will be interconnected to form a complete system, and some of the equipment and interconnecting pipework will be contained within buildings located onsite. The

buildings protect the equipment, provide noise abatement and house ancillary systems including power, telecommunications, lighting and security, and control and instrumentation hardware and software. The new equipment, systems, and buildings will replace older equipment and buildings that will be demolished and removed prior to the new construction.

The proposed upgrades at Woodland station will involve the installation of similar types of mechanical equipment and systems as Coquitlam Gate station. The equipment and pipework will be different sizes to Coquitlam Gate station to suit the particular operating parameters of the Woodland site. The arrangement of the equipment is also different to suit the smaller site footprint, and all of the proposed equipment will be contained within a single building, compared to Coquitlam Gate station where there will be multiple buildings.

The Coquitlam Gate and Woodland stations buildings included in the preliminary site layout submitted with the Application and the buildings included in the final site layout at 100 percent detailed design are generally similar in terms of overall floor space footprint area. During the detailed design process the arrangement and orientation of the mechanical equipment and pipework systems within each station was optimized which modified the sites layout and, in the case of Coquitlam Gate station amalgamated some of the building into one larger building location. However, some aspects of the Coquitlam Gate and Woodland station buildings also changed considerably between the preliminary design and 100 percent detailed design.

For both stations the preliminary building design assumed steel buildings comprising a steel superstructure with metal cladding for the walls and roof panels. The building components would be pre-fabricated off-site and then transported to site and erected on concrete foundations. During the preliminary design process it was recognized by the Project team that Woodland station would likely involve custom engineered building panels to provide a certain aesthetic in keeping with the urban location. An allowance was provided in the AACE Class 3 cost estimate for the provision of architectural professional services to guide the detailed design in this regard.

When the detailed design of the stations commenced, FEI engaged with the City of Vancouver to define the Woodland station site development and building permit requirements. The City of Vancouver mandated a particular building design and aesthetic for the Woodland station site through reference to other existing utility buildings recently constructed including the False Creek Energy Centre and a BC Hydro electrical sub-station. In addition, site boundary offset requirements dictated the maximum building floor area and extent of development within the site, and building wall height requirements, roof height requirements, and wall to roof spatial ratio requirements dictated a particular roof design. FEI has worked with a Project architect throughout the detailed design process to successfully incorporate the City of Vancouver requirements into the Woodland station building design. The resulting final approved building design varies significantly from the preliminary design in that it now comprises reinforced wall construction with a custom architectural designed steel roof structure. The building will also have to be fully constructed onsite as it will not be possible to pre-fabricate any of the components off site and then transfer to the site for erection.

FEI also engaged with the City of Coquitlam through the detailed design process. The strict building development requirements at the Woodland station site are not required at the Coquitlam Gate station site. However, FEI maintained the same building design philosophy in terms of a concrete building with a metal roof. The reason for adopting this strategy was to maintain uniformity across the buildings in terms of materials, and also to leverage the superior noise abatement properties of solid concrete walls as opposed to steel cladding panels.

The variation in the building design philosophy from pre-fabricated steel to poured concrete also required a different construction execution plan. The construction of the concrete building design will require additional personnel, equipment, and materials to construct the building onsite. The ongoing widespread building construction throughout the Metro Vancouver region has placed the skilled trades necessary to erect a concrete building in high demand. It is therefore likely that a component of the cost difference between the steel building and the concrete building is amplified through the limited availability of these resources.

Overall, the changes to the building design, increased construction equipment, resources, and materials, and the limited availability of the skilled resources necessary to construct the Coquitlam and Woodland stations facilities building have incurred the cost variance between the AACE Class 3 estimate and the current forecast to complete of approximately [redacted] which represents an increase of [redacted] over the AACE Class 3 cost estimate.

5.11.3.2 Metering and Pressure Regulating (M&R) Systems

The Coquitlam Gate station is primarily purposed with providing gas pressure regulation and gas flow rate reading and recording (metering) functions. FEI will monitor and control the gas supply to the Coquitlam Gate IP pipeline from the transmission pressure system though the functionality of this station. To support the primary station's functionality the mechanical systems also include gas filtration and heating. Together the filtration, metering, heating, and pressure control equipment is connected through a network of large diameter and small diameter pipework, valves and fittings.

The Coquitlam Gate and Woodland stations preliminary basis of design submitted in the Application was informed by FEI system capacity requirements in terms of flow rates and pressures that new station would be required to process. This information was utilized to prepare the preliminary mechanical equipment and pipework design and sizing calculations. The system capacity requirements were reconfirmed during the detailed design phase. Overall, there was minimal difference between the preliminary and detailed capacity requirements, therefore the basis of design did not vary significantly.

In addition to the mechanical systems there is also an electrical distribution network within the station to power the electrical and electronic systems that energize and control the various operational and safety systems. In addition there is a control system that monitors and controls the filtration, metering, heating, pressure regulating, and safety and over pressure protection systems.

The Coquitlam Gate station preliminary equipment layout included a separate building for the pressure regulating system and the heating system. During the detailed design process the pressure regulating equipment and heating equipment were combined into a single larger building to meet operational requirements. The Woodland station preliminary equipment layout included a separate building containing the filtration and pressure regulating equipment, and a small enclosure for the pipeline pig receiver. During the detailed design it was necessary to combine all of the station mechanical equipment into a single building. In the case of both stations the amalgamation of more mechanical equipment in buildings, and the combination of separate buildings together into a single building has resulted in a more complex construction execution strategy in order to be able to build the building structure whilst also installing the mechanical equipment, pipe, fittings, and ancillary equipment and systems within the buildings.

[redacted]

5.11.3.3 Demolition and Site Remediation

At Woodland station there is no existing infrastructure within the station site, only an existing muster building which was planned to be removed.

The preliminary demolition plan developed for the Application included the decommissioning and removal of all intermediate pressure infrastructure at Coquitlam Gate station. It was considered that the existing muster buildings would be retained.

The only variation to the preliminary demolition plan is the muster building at Coquitlam Gate station will now be demolished and muster function relocated off site. Overall there is a [redacted] increase between the AACE Class 3 cost estimate and the forecast to complete because the demolition scope now includes environmental site remediation costs at Woodland station.

5.12 *TIE-IN AND COMMISSIONING COSTS VARIANCE*

Approximately $1 million was included in the AACE Class 3 cost estimate for the tie-in and commission scope that will be completed by FEI. Some additional materials not previously not accounted for, and a larger number of temporary odourization units required, have resulted in a variance of $0.5 million.

5.13 *CONTINGENCY VARIANCE*

[redacted]

6. FEI CHANGE MANAGEMENT OPTIONS ANALYSIS

FEI has determined that it will not be possible to execute and deliver the Project within the AACE Class 3 cost estimate submitted in the Application and that a 2018 in service date is also not achievable. FEI is currently evaluating various construction execution strategies and schedule options for Project delivery, which include a 2019 in-service date. Various options that FEI is currently reviewing to address the issues are outlined in this section, including FEI's recommended actions to continue to progress the Project.

[redacted]

The municipalities of Coquitlam, Burnaby, and Vancouver are major Project stakeholders. Through ongoing consultation, each municipality has identified a number of requests and requirements. [redacted] The consultation process adopted by FEI with regard to the affected municipalities and a summary of the requests is provided in Section 5.5 of this report.

[redacted]

6.1.1 [redacted]

[redacted]

6.1.2 [redacted]

[redacted]

[redacted]

[6] BCUC Order G-113-12
[7] Page 8, District of Coldstream Reasons for Decision Appendix A to Order G-113-12.

[redacted]

6.1.4.1 City of Burnaby

In addition to FEI's requirements outlined in Section 5.5, there are additional elements of the Project which will impact the City of Burnaby:

1. Above ground Infrastructure at Bainbridge Avenue and Graveley Street - FEI intends to utilize a portion of unopened road allowance at both locations to install valve and gas pressure regulation stations, which would have above ground infrastructure and would hinder the land from being used as a road in the future. This has been done historically without issue, and FEI did not foresee a concern with this design during the FEED stage. However, the City of Burnaby has indicated that despite FEI's efforts to incorporate feedback from staff and requests for modifications to design of the stations, it requires FEI to compensate the City of Burnaby for the use of the land.

[redacted]

[redacted]

[8] Described in Section 5.4.3.

Through discussions with the City of Coquitlam, FEI had believed a mutually agreeable solution could be reached to provide FEI with the certainty it requires to proceed with Project construction [redacted]

[redacted]

[9] This item is intended to mitigate the risk with TMP, proposed work hours, CSA as described in Section 5.4.2.

[redacted]

[redacted]

6.1.4.4 Summary of Municipal Agreements:

[redacted]

Table 6-1: Summary of Municipal Agreements

Permitting Authority	[redacted]	[redacted]	[redacted]
City of Burnaby			
	Removal of the NPS 20, if conflicts in the future	[redacted]	
	Execute work to upgrade Broadway, replace Eagle Creek Culvert and pave walking path	[redacted]	[redacted]
City of Coquitlam			
	Community Benefit	[redacted]	[redacted]
	Removal of the NPS 20, if conflicts in the future	[redacted]	
	Financial contribution for the City to pave Como Lake Avenue from curb to curb	[redacted]	[redacted]
City of Vancouver			
	Removal of the NPS 20, if conflicts in the future	[redacted]	
	Financial contribution for traffic studies and modifications	[redacted]	[redacted]
	Commitment to complete all work within the agreed upon work windows in 2018	[redacted]	

Permitting Authority	[redacted]	[redacted]	[redacted]
Other			
OGC, Environmental and Archaeology related permits			[redacted]
Total			[redacted]

6.2 *CONSTRUCTION EXECUTION STRATEGY*

FEI received three submissions in response to the pipeline construction request for proposals (RFP) issued to the market in Q2 2017. The proponents' construction execution plans submitted to FEI indicate that pre-construction activities, including the successful proponent acquiring their necessary permits, would need to commence in Q4 2017. This would facilitate a pipeline construction start in early Q1 2018 in order to meet the pipeline substantial completion date in early Q4 2018. Substantial completion means that the pipeline contractor would have fully constructed, tested and prepared the pipeline and pit stations facilities for tie-in to the existing system. The successful achievement of this milestone would be critical for FEI to then complete tie-in activities and connect the new Coquitlam Gate IP pipeline system to the existing IP system, and finally facilitate FEI commissioning activities to bring the Coquitlam Gate IP pipeline system online and achieve the 2018 in-service date.

[redacted]

[redacted] This clarification request was subsequently issued to the proponents on October 20, 2017, to request that the contractors re-evaluate the construction prices and schedule on the basis of a newly defined Project execution timeline. In order to better position the Project for negotiation, the Project team limited the clarification questions to address the implications of the new schedule and the discount associated with award to a single contractor.

FEI is currently assessing the following construction execution strategy options based on the ongoing engagement with the three pipeline construction proponents who submitted RFP proposals and proposal clarification responses in November.

6.2.1 Multiple Construction Spreads

Prior to receiving the initial pipeline construction RFP proposals, the Project team anticipated that an alternative execution strategy could be required should the proponents indicate that the 2018 schedule was at risk of not being achievable. As such, FEI structured the RFP such that the Coquitlam Gate IP pipeline was sectioned into three distinct pipeline construction spreads: Spread A comprised the section of the pipeline through the City of Coquitlam; Spread B comprised the section of the pipeline through the City of Burnaby; and Spread C comprised the section of the pipeline through the City of Vancouver.

The proponents were asked to submit separate bid prices to construct each spread. This pricing strategy would give FEI the option to award the spreads individually, or any other combination that would mitigate the risk to the 2018 in-service date.

6.2.2 Multi Year Pipeline Construction Schedule

In addition to the planned Coquitlam Gate IP pipeline construction there is significant other third party large scale development construction underway in the coming years. The Project has engaged with stakeholders along the pipeline route corridor and coordinated the construction schedule for some sections of the pipeline with the third party construction schedules in 2018. This has already dictated certain schedule commitments in 2018 that will still have to be managed throughout a multiyear pipeline construction program. As a result it is likely that the section of the Coquitlam Gate IP pipeline in Vancouver and in west Burnaby will still need to be constructed in 2018 if a multiyear schedule is adopted by the Project.

[redacted] construction timing constraints and conflicts with other third party scheduled construction work in 2018 along the pipeline corridor as previously described, and municipalities' preference for work schedule. Therefore, FEI re-engaged with the pipeline construction proponents to outline a new construction schedule.

On October 20, 2017, FEI issued a revised schedule to pipeline construction proponents for their submission of revised pricing. FEI requested proponents provide detailed schedules that reflect a longer construction schedule with a modified in-service date in 2019.

6.2.3 Phased Commission of Pipeline and Stations

FEI anticipates that it may be possible to tie-in and commission the segments of the Coquitlam Gate IP pipeline as they are completed in 2018 and into 2019. Therefore, in early October, the Project team updated and advanced an alternative execution strategy, to facilitate a phased asset in service across 2018 and 2019, with a 2019 Project in-service date.

In order to minimize the impact of these changes on financing costs and to bring value to FEI customers, there was a particular focus on commissioning as much of the project as possible in

2018. This would enable the Project to put in-service assets into rate base January 1, 2019, and avoid incurring AFUDC for an additional year, as well as ensure real progress is realized in 2018. Each aspect of the project was evaluated for existing timing restrictions, risks of material delivery and [redacted] and feasibility of early tie in to generate a new construction schedule. The Project team used the outcome of this exercise to generate the Pipeline Construction post proposal clarification, described in the previous section.

Commencing the stations construction scope early in 2018 will ensure that Coquitlam Gate and Woodland stations are constructed and commissioned in 2018. This will facilitate executing the optimized pipeline and stations construction schedule to construct, tie-in, commission as much of the Coquitlam Gate IP infrastructure in 2018 as possible and the balance in 2019. This would facilitate the entry of some of the Project into rate based in 2019 and the remainder in 2020.

6.2.4 FEI Recommended Course of Action

Revisions to the CEP are required to address the schedule challenges, and also to ensure an achievable expectation is set to protect FEI's reputation and ensure that an aggressive schedule does not drive safety or environmental issues or unnecessarily increase Project costs [redacted]

FEI believes it will be feasible to complete the Coquitlam Gate IP pipeline and facilities through a strategic phased two year Project execution strategy. Therefore it will be possible to tie in a number of Project assets in 2018, and the remainder in 2019. FEI is working to determine which assets are most appropriate to construct in 2018.

FEI anticipates providing more detail on construction schedule in February 2018. However, given feedback from municipalities, and other third parties with work planned around the time of the Project construction, FEI is anticipating a two year construction schedule comprising the construction of the Coquitlam Gate IP pipeline segment in Vancouver and sections of Burnaby segment in 2018, with the balance of the Burnaby segment and the Coquitlam segment largely delayed to 2019.

6.3 *PROJECT COST MANAGEMENT*

Since the Project was approved, FEI has identified and evaluated certain factors which were "known unknowns" and "unknown unknowns" during preparation of the AACE Class 3 cost estimate, but are now realized as driving the material cost variance. The major Project scope items in terms of pipeline length, location, route alignment, number of stations facilities have changed minimally since the Project was approved. However, understanding and definition of other scope items such as the pipeline depth of cover, construction methodologies, and construction productivity, which refer to the "known unknowns", are now substantially defined.

Other factors such as the Company's RFP pricing requirements, municipal permitting process and utility permit [redacted] other third party requirements, and other assumptions made during preparation of the AACE Class 3 estimate, which refer to the "unknown unknowns" have been realized in terms of cost variances and schedule delay.

The AACE Class 3 estimate did not anticipate the magnitude of Project costs associated with three key areas:

[redacted]

FEI believes that it could not have justified inflating the construction estimates based on unknown-unknown risk factors at the time the Project was originally estimated. Instead, FEI will manage the cost variances within the framework of the overall Project change management to ensure the cost variances are minimized to the extent possible. To implement the optimum cost management strategy, and ensure maximum value to rate payers, FEI has considered the following options:

6.3.1 Restructuring Project Execution and Delivery Model

Section 3.3.7.1 of the Application notes that pipeline detailed routing and pipeline and facilities detailed design would be executed by a specialist engineering consultant contracted by FEI. Additionally, any other specialist services required for environmental management, geotechnical investigation and analysis would also likely be specialist external professional services contracted by FEI. In addition to these resource requirements FEI engineering resources would provide oversight required to monitor implementation of these services and to manage the deliverables.

The Coquitlam Gate IP pipeline is a large scale project. To ensure successful project delivery, FEI required additional resources skilled in the execution and delivery of larger urban pipeline projects. FEI engaged WorleyParsons to assist FEI with the FEED to support the Application.

Section 3.3.7.1 of the Application noted that FEI would further require external engineering, procurement, and construction management professional services to assist the Company with Project delivery and execution. The basis for this approach, the associated scope of services, and the AACE Class 3 cost estimate is outlined in Section 1.6.9 of Appendix A-23 that was filed confidentially with the Application. As outlined, these services would be engaged under a single EPCM umbrella contract for these Project requirements.

Subsequent to Project approval FEI analyzed various EPCM contract strategies in terms of issuing a competitive market request for proposal for these services, or engaging WorleyParson to provide these services on a contract extension basis. Following the receipt and review of a proposal from WorleyParsons FEI elected to award the EPCM contract to WorleyParsons for the following reasons:

- Following an expression of interest and a request for information from the market, FEI engaged WorleyParson to deliver the FEED scope and assist FEI in developing the Project prior to submission of the CPCN Application, this experience on the part of WorleyParsons was considered by FEI to lend significant advantage in terms of offsetting an extensive learning curve that would be associated with engaging a different EPCM contractor;
- FEI considered that retaining the services of the same consultant that developed the preliminary Project definition and cost estimating would maintain ownership of the knowledge base and be in a more advantageous position to assist FEI during the detailed Project development phases compared to engaging a different EPCM contractor who could disown responsibility in terms of not having ownership of the FEED engineering deliverables;
- FEI understood WorleyParsons to be multi-discipline, cross-jurisdictional international organization with the listed capabilities and proven experience to deliver FEI the necessary EPCM scope requirements;
- FEI gauged the market conditions in western Canada in 2015 during EPCM contract negotiations with WorleyParsons to be depressed in terms of the Oil and Gas market downturn and as such that this motivation would likely impart the necessary value in terms of negotiated cost; and
- FEI rationalized that the above positives would deliver value to the Project in terms of extending the contract to WorleyParsons, balanced against the risks associated with engaging a new EPCM contractor.

The current Project organization structure involves a relatively small cohort of FEI resources supported by an extensive external team provided by WorleyParsons. This arrangement has successfully delivered the Project to date. However, in light of the Project forecast cost variations FEI will re-evaluate the EPCM contract and delivery to ensure FEI can attest to the value given the magnitude of the variation. Some of the key components that FEI will consider as part of the re-evaluation will include:

1. Fully resource the necessary project team from within FEI;
2. Engage an external third party audit to confirm the value to FEI from the forecast EPCM cost to complete; and

3. Competitively bid the Construction Management (CM) portion of the EPCM scope to deliver the Project construction phase.

6.3.1.1 Engineering (E)

Approximately [redacted] person-hours was included in the engineering (E) component of the EPCM contract. The current forecast including the early works effort and based on the material schedule variance to complete the Project is approximately [redacted] This represents a [redacted] increase.

6.3.1.2 Procurement (P)

Approximately [redacted] person-hours was included in the procurement (P) component of the EPCM contract. The current forecast based on the material schedule variance to complete the Project is approximately [redacted] This approximates [redacted] increase.

6.3.1.3 Construction Management (CM)

Approximately [redacted] person-hours was included in the construction management (CM) component of the EPCM contract. The current forecast based on the material schedule variance to complete the Project is approximately [redacted] person-hours. This represents a 340 percent increase.

6.3.2 Innovative Construction Contract Strategies

[redacted]

6.3.3 Contractor Risk Sharing

[redacted]

The contract form is based on past practice for pipeline projects undertaken by FEI while also incorporating elements of typical large diameter utility contracts. This format had been successfully utilized for other major pipeline projects.

[redacted]

[redacted]

6.3.4 FEI Recommended Course of Action

FEI is intending to proactively manage the Project cost variance, forecast cost to complete and risk in the following areas.

6.3.4.1 Professional Services Contracts

FEI evaluated the following project delivery models immediately after Project approval and prior to engaging the necessary resources to execute the Project:

1. Engineering, Procurement and Construction Management (EPCM) model;
2. Engineering, Procurement and Construction (EPC or design build) model; and
3. Design, manage and execute utilizing FEI internal support and resources.

The EPCM model was selected on the following rationale:

a) Cost – the cost risk associated with an EPC model is shifted to the contactor and therefore the approach could present additional costs and risks (i.e. risk of no or limited bidders). Due to the urban nature of the LMIPSU project and the extensive urban footprint, the cost/risk allocation is shared amongst the parties under an EPCM arrangement.

b) Schedule: the Project schedule does not allow for a traditional design-build approach as some components of the detailed design was currently underway and therefore the Project had progressed beyond the point of executing an EPC (design-build) contract without compromising the Project schedule.

c) Owner Involvement – Project control is weighted towards FEI under an EPCM model. This is important as FEI would fulfil key roles in areas such as stakeholder and First Nations engagement and lands; and

d) General – EPC “turn-key” contracts are typically associated with operating facility projects and not linear pipeline projects.

WorleyParsons was selected as the preferred EPCM services contractor to support FEI to execute on the LMIPSU Project as previously outlined. The professional services currently contracted to the Project are mainly accounted for through the EPCM contract that will incur [redacted] of the forecast total cost to complete the Project. FEI has already outlined that the provision of these services is critical to the overall successful delivery of the Project.

Going forward FEI maintains that retained external project support through the EPCM model structure is the optimum approach. FEI will ensure an efficient contracting strategy that will successfully deliver the Project, and FEI will implement the necessary measures to demonstrate the integrity of this model. FEI anticipates providing an update on its approach in the next quarterly report.

6.3.4.2 Pipeline Construction Contract

Completion of an award recommendation for the pipeline construction contract based on technical and commercial information is anticipated by January 2018. [redacted]

6.3.4.3 Stations Facilities Construction Contract

The stations construction RFP was issued mid-August, 2017. Preliminary responses were received late October 2017, and firm proposals with IFC drawings are expected in December 2017. Evaluation of proposals, negotiation of contract and conditional contract award is anticipated by mid-January 2018 and it is anticipated that the contract price and construction schedule agreed to with the contractor will be incorporated into the revised Project costs and schedule by February 2018.

The following steps have been taken proactively to manage the associated risk to facilities cost and schedule:

- Separated scope from mainline pipeline to ensure costs are not inflated by subcontractor mark-ups; and
- Separated demolition and contaminated site clean-up from construction scope, to enable appropriate selection of resources.

7. FEI PROJECT OPTIMIZATION STRATEGY

FEI is aware that certain factors which are now known to drive the overall cost variance could not have reasonably been foreseen during the FEED stage in preparing the AACE Class 3 cost estimate. This section will principally address the tasks and activities that are planned up to and including the execution of the construction of the pipelines.

7.1 *MINIMIZE SCHEDULE DELAY*

In order for the Project to avoid incurring unnecessary costs FEI intends to proceed expeditiously with construction related Project activities to minimize schedule delays and deliver the earliest in-service date possible in 2019. FEI has worked with stakeholders and third parties for over four years, particularly within the two years since Project approval, to secure the current construction window. [redacted] there are some critical areas where 2018 construction remains necessary to avoid delays of two or more years in Project completion.

In Vancouver, and in certain portions of Burnaby, other third party infrastructure projects are scheduled to allow for FEI's 2018 work window and construction start is required as early as April 2018. In order for FEI to meet these construction windows, FEI must be in a position to proceed with contract award by February 15, 2018. [redacted]

7.2 *CONTROL AND LIMIT PROJECT COST VARIANCE*

Following the material changes to the costs and schedule presented in this report the Project budget and schedule will need to be re-baselined and Project costs will need to be completed with updated Owner's and EPCM costs. It is estimated that Owner's costs and EPCM costs will increase due to the requirement to extend the schedule. The detailed engineering and material procurement has substantially been complete and final costs will then be reported. [redacted]

In parallel with pipeline and facilities contractor evaluation and contract award, [redacted], the Project team will work to update the Project execution plan to incorporate the feedback received from these processes.

Following this, the resource requirements (quantities and durations) to support construction execution will be determined and cost forecasts will be determined for Owner's and EPCM costs. This process may include the re-evaluation of the form of contract and participation from the EPCM consultant, to further facilitate cost reduction. Elimination of the current EPCM

resource is not considered a viable option. It is anticipated that this evaluation will be complete by the end of December 2017.

In addition, the Project cost estimate will be updated to reflect the current spend for material and equipment, which is anticipated to be completed by the end of December 2017.

Once sufficient progress is made on construction contractor selection [redacted]

Once the items above have been sufficiently complete, the Project team will work to compile updates to the Project cost and schedule forecast and provide this new control budget and schedule to the Commission as part of the next Project Quarterly Report. It is anticipated that this will be available by the end of February 2018.