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February 14, 2019

Commercial Energy Consumers Association of British Columbia
c/o Owen Bird Law Corporation
P.O. Box 49130
Three Bentall Centre
2900 – 595 Burrard Street
Vancouver, BC V7X 1J5

Attention: Mr. Christopher P. Weaver

Dear Mr. Weaver:

Re: FortisBC Inc. (FBC)

Project No. 1598987

**Application for a Certificate of Public Convenience and Necessity (CPCN) for
the Grand Forks Terminal Station Reliability Project (the Application)**

**Response to the Commercial Energy Consumers Association of British
Columbia (CEC) Information Request (IR) No. 1**

On November 19, 2018, FBC filed the Application referenced above. In accordance with the British Columbia Utilities Commission Order G-250-18 setting out the Regulatory Timetable for the review of the Application, FBC respectfully submits the attached response to CEC IR No. 1.

If further information is required, please contact the undersigned.

Sincerely,

FORTISBC INC.

Original signed:

Doug Slater

Attachments

cc (email only): Commission Secretary
Registered Parties

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1 1. **Reference: Exhibit B-1, page 5**

2 **1.4 REGULATORY HISTORY**

3 FBC first proposed the installation of a second 161/63 kV transformer at GFT and the removal of 9L and 10L between CSC and CHR in its 2012-2013 Capital Expenditure Plan. In that application, the transformer addition project was linked to the Grand Forks to Warfield Fibre Project as the infrastructure required to integrate the transformer into the substation would be greatly reduced by the availability of a secure fibre-optic communications link to the remote substations. At that time, FBC also sought approval for expenditures related to the relocation and storage of a spare transformer at GFT.

4 In its Decision and Order G-110-12, the BCUC endorsed the relocation of the spare transformer, but rejected the proposed expenditures related to the installation of the second transformer because the need for increased reliability was not apparent. The BCUC also directed FBC to apply for a separate CPCN for approval of the project.

- 5 1.1 Please explain whether or not FBC considers the need for increased reliability to
 6 be more apparent now than it was when the BCUC issued its decision, and
 7 provide quantification for any evidence FBC is able to provide in terms of new vs
 8 historical information that the Commission was previously relying upon in its
 9 decision.

10 **Response:**

11 Please refer to the response to BCUC IR 1.1.1.

12

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1 2. **Reference: Exhibit B-1, page 6 and page 43**

With respect to the CPCN threshold, FBC is directed to apply to the BCUC for a CPCN for projects that require in excess of \$20 million in capital expenditures. The total forecast cost of the Project is not expected to exceed \$20 million, and FBC does not anticipate any significant public concerns with the proposed solution. On that basis, the Company would not typically file a CPCN application for a project of this nature.

As mentioned above, FBC first proposed this project in its 2012-2013 Capital Expenditure Plan application. In that application, FBC sought approval to recover only engineering/estimating expenditures with a subsequent application to propose procurement and installation of the fibre cable. At the time, the BCUC denied approval for the preliminary costs and directed that a CPCN be filed for the project.

The BCUC confirmed the requirement for a CPCN application in Order G-80-16. FBC is therefore filing this CPCN Application to ensure that the regulatory process can proceed in a timely manner to accommodate the Project schedule and in-service date.

2

6.4 RATE IMPACT

The Project construction period is between 2019 – 2021 with assets going into service in 2021 and 2022. A 40 year cost of service model was used to evaluate this option (Alternative B) against the others described in section 3. The leveled 40 year rate impact is 0.18% or \$0.20 per MWh. The annual bill impact for an average residential customer using 11,500 KWh at the 40 year leveled rate would be \$2.14. The rate impact in 2022 the year when all assets have been transferred into plant asset accounts will be 0.26 percent. This would equate to annual bill increase of \$3.36 for an average residential customer using 11,500 KWh.

3

- 4 2.1 Under the current PBR ratemaking, costs for projects below the CPCN threshold
 5 are normally included in formula capital and O&M, whereas costs included in a
 6 CPCN are flowed through to ratepayers. Please explain how FBC is proposing to
 7 handle the costs for this CPCN in its PBR given that FBC has been directed to
 8 file a CPCN for a project well below the CPCN threshold.
 9

10 **Response:**

- 11 FBC has already received approval to flow through the costs of the Project, subject to approval
 12 of the Project.
 13 On March 15, 2016, FBC filed an Application for Approval of Treatment for Major Capital Project
 14 Capital Expenditures under the Multi-Year Performance Based Ratemaking Plan for 2014-2019.
 15 The application sought approval of flow-through treatment for four projects, including the Grand
 16 Forks Terminal Station Reliability Project (then referred to as the Grand Forks Terminal Station
 17 Transformer Addition project), all of which were forecast to be less than the \$20 million CPCN
 18 threshold, on the basis that the projects were excluded from the 2013 base capital expenditure
 19 amount used to determine formula capital under the PBR Plan. The projects were excluded

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1 from the base capital envelope on the expectation that they would be the subject of CPCN
 2 applications although the projects were forecast not to exceed the CPCN financial threshold.¹

3 In Order G-80-16 dated June 3, 2016, the BCUC confirmed the requirement to file a CPCN
 4 application for the Project, and further determined that the expenditures for the four projects be
 5 excluded from the formula-driven base capital amount and should be flowed-through subject to
 6 approval of the projects.²

7
 8

9
 10 2.1.1 If costs are being treated as flow through, please describe the impact if
 costs were not flowed through, but instead included in formulaic
 spending.

11
 12

Response:

13
 14 The flow-through treatment of costs has already been approved. Please refer to the response
 to CEC IR 1.2.1.

15
 16

17
 18

19

20 2.1.2 Would FBC undertake the project if a CPCN were not required and
 costs were to be included in formulaic spending? Please explain why or
 why not.

21
 22

Response:

23
 24 The flow-through treatment of costs has already been approved. Please refer to the response
 to CEC IR 1.2.1.

25
 26

¹ The CPCN criteria applicable to FBC at the time of filing the 2014 PBR application included non-financial criteria under which FBC believed CPCN applications to be appropriate for these projects. In addition, the BCUC had previously ordered FBC to file a CPCN application for the Project.

² Order G-80-16, Appendix A, pages 4-5.

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1 3. **Reference: Exhibit B-1, page 12 and 13**

The 63 kV transmission lines 9L and 10L were originally constructed in 1908 and supplied power from the West Kootenay to customers in the Boundary and South Okanagan. Taps off these transmission lines were later built to supply a number of substations including CHR and RUC. In 1965, Grand Forks Terminal was constructed and GFT T1 was installed to connect the 63 kV transmission facilities to the 161 kV system via 11L. After GFT T1 was installed, it became the primary 63 kV supply for the Grand Forks area with 9L and 10L remaining as the backup supply. Both 9L and 10L each cover a total distance of 62.4 km between WTS and GFT. A geographic map of 9L and 10L is provided below in 3-2.

2

Figure 3-2: Geographic Map of 9L and 10L



In normal operation, 9L is open and 10L is de-energized between the CHR tap and CSC substation. As well, in normal operation, approximately 32.7 km of 10L is de-energized between the CHR tap and CSC substation due to its poor condition, and must be visually assessed and confirmed to be in suitable condition (and rehabilitated to minimum standards if necessary) before it can be placed in service. The condition of 9L and 10L will be discussed further in Section 3.2.1.3. Please refer to Appendix A for the existing 9L and 10L circuit arrangement.

Over the years, underbuilt distribution circuits were constructed on portions of both 9L and 10L to serve customers in the vicinity of the lines right of way. There are currently 46 customers supplied from distribution underbuild on 9L and 10L transmission structures as highlighted in Figure 3-3. Along 10L, 9.8 km of distribution underbuild serves 26 customers from CHR Feeder 1 (8.5 km single phase and 1.3 km three phase). Along 9L, 11.0 km of distribution underbuild serves 20 customers from CSC Feeder 3 (10.5 km single phase and 0.5 km three phase).

3

- 4 3.1 Would 10L normally be de-energized if it there were no portions that were in poor
 5 condition? Please explain.

6

7 **Response:**

- 8 No, 10L would not normally be de-energized if it was in good condition. FBC de-energized the
 9 line in 2010 because it was creating an operational challenge for the reasons explained in the
 10 Application.

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- 1
- 2
- 3
- 4 3.2 Please provide FBC's plans for 10L regarding where rehabilitation might occur
5 and the quantitative benefits reasons for doing so (i.e. Value of N-1 capability).
- 6

7 **Response:**

- 8 This Application seeks approval to install a second transformer at GFT, salvage 44.6 km of 9L
9 and 10L between CHR and CSC, and repurpose 20.8 km of 9L and 10L between CHR and CSC
10 to distribution. Under the preferred alternative, a large portion of 10L will be removed. The
11 portion of 10L that is repurposed to distribution will be rehabilitated as required. A detailed map
12 identifying the proposed transmission removal and distribution repurposing is included in the 9L
13 and 10L condition assessment report in Confidential Appendix C (Appendix VII).
- 14 Under the preferred alternative, the repurposed portions of 9L and 10L need to be rehabilitated
15 in order to continue providing service to customers who were supplied from distribution
16 underbuild circuits on 9L and 10L between CHR and CSC.

17

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1 4. **Reference: Exhibit B-1, page 13 and 14**

Over the years, underbuilt distribution circuits were constructed on portions of both 9L and 10L to serve customers in the vicinity of the lines right of way. There are currently 46 customers supplied from distribution underbuild on 9L and 10L transmission structures as highlighted in Figure 3-3. Along 10L, 9.8 km of distribution underbuild serves 26 customers from CHR Feeder 1 (8.5 km single phase and 1.3 km three phase). Along 9L, 11.0 km of distribution underbuild serves 20 customers from CSC Feeder 3 (10.5 km single phase and 0.5 km three phase).

2

3 4.1 Please explain why underbuilt distribution circuits were constructed on portions of
 4 9L and 10L over the years.

5

6 **Response:**

7 Underbuilt distribution circuits are common practice in the FBC system and other utilities. This
 8 type of configuration is usually limited to 63 kV and 138 kV circuits, and works well in areas
 9 where there is limited space for separate transmission and distribution right of ways (ROW).
 10 Distribution underbuild circuits were built on 9L or 10L to supply customers between CHR and
 11 CSC, while efficiently making use of the existing facilities.

12

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1 5. **Reference: Exhibit B-1, page 14 and page 15**

The maximum load that can be supplied by either 9L or 10L is 27 MW, which is insufficient to meet peak load conditions for the Grand Forks area.⁸ If both lines are operated in parallel, the maximum load that can be supplied increases to 45 MW. During seasonal peaks, both lines must operate in parallel to meet the load requirements in the event of an outage or failure to GFT T1. However, mountainous terrain, particularly in winter, can make it impossible to operate 9L and 10L in parallel since the lines traverse the Rossland Mountain Range, restricting physical access and making it extremely difficult to visually assess and rehabilitate 10L before it can be energized. As such, 9L and 10L are not a reliable secondary 63 kV supply for the Grand Forks area.

2

ability to restore customers is further impacted by the condition of the existing facilities at GFT and transmission lines 9L and 10L.

The purpose of the Project is to ensure FBC customers continue to receive safe and reliable service in the event of an outage or failure of GFT T1.

3

3.2 PROJECT NEED

The GFT Reliability Project is a reliability-driven project, as FBC cannot meet the single contingency (N-1) criteria for the 63 kV system in the Grand Forks area since parallel operation of 9L and 10L cannot be relied upon. As will be explained below, the likelihood of failure and the

4

ability to restore customers is further impacted by the condition of the existing facilities at GFT and transmission lines 9L and 10L.

The purpose of the Project is to ensure FBC customers continue to receive safe and reliable service in the event of an outage or failure of GFT T1.

5

- 6 5.1 Please discuss if there are other similar areas of the system that also do not
 7 have N-1 contingency at this point and the length of such lines vs the length of all
 8 lines.

9

10 **Response:**

11 Please refer to the response to BCOAPO IR 1.7.1.

12 FBC transmission lines operating at voltage levels below 160kV are, for the most part, operated
 13 in radial mode and do not meet N-1 planning criteria. For higher density load centers, this radial
 14 transmission is configured to provide substations with two sources of dual radial supply. Plans
 15 to operate important load centres for N-1 planning contingencies are justified on a case-by-case
 16 basis.

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- 1
2
3
4 5.1.1 If there are other similar areas of the system that also do not have N-1
5 contingency, please explain why this area is a priority.
6
7 **Response:**

8 Please refer to the response to BCOAPO IR 1.7.1. Since the Grand Forks area is part of the
9 interconnected system, the N-1 planning criteria applies.
10 The area served by the Kaslo, Crawford Bay and Coffee Creek substations, also does not meet
11 N-1 planning criteria. The area consists of a mix of residential, commercial, and indirect
12 customers.
13 The Grand Forks area was prioritized because the recorded seasonal peak load has been
14 above the backup supply capacity limitation (27 MW with a single line in service) several times
15 in the past five years. The backup supply for the Grand Forks (9L and 10L) area is also in
16 poorer condition than the other areas referenced above. The Grand Forks consists of a mix of
17 residential, commercial, indirect, and industrial customers.

18



<p style="text-align: center;">FortisBC Inc. (FBC or the Company)</p> <p style="text-align: center;">Application for a Certificate of Public Convenience and Necessity (CPCN) for the Grand Forks Terminal Station Reliability Project (the Application)</p>	<p style="text-align: center;">Submission Date: February 14, 2019</p>
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1 6. Reference: Exhibit B-1, page 15

3.2.1 Facilities Condition Assessment

3.2.1.1 GFT T1 Condition

GFT T1 is of 1965 vintage and is now 53 years old, exceeding the expected transformer lifespan of 40 years. In recent years, the load tap changer (LTC) tanks have been replaced and the oil has been processed. The unit is closely monitored and recent Dissolved Gas Analysis (DGA) results have been relatively stable.

ABB, a qualified transformer design contractor, performed a comprehensive condition assessment in 2018 for GFT T1 on behalf of the Company, which is provided in Appendix B. Based on the analysis, ABB recommends GFT T1 should not be kept in service for more than 15 years.⁹

The condition assessment calculated the Risk of Failure (RoF) for this transformer to be 2.6 percent based on the most recent DGA and the available test/maintenance data.¹⁰ The RoF for this unit is on the high side when compared to a typical utility population.

ABB's report identifies the second most failed component for this type of transformer is the LTC and the single most common cause of failure is inadequate short circuit strength. Both of these components are weak in this unit. Also, based on the age profile for over 7 thousand units in a particular subset of in-service transformers contained in the Transformer Industry-Wide Database (IDB), the most common end of life for a transformer occurs in the 35 to 45 year portion of the population. This unit is 53 years old. With each passing year, the probability of failure of this unit increases.

2

5

6 Response:

7 GFT T1 has operated with abnormal levels of dissolved hydrocarbon and hydrogen gases since
8 2002. Technical literature also describes dissolved hydrocarbon and hydrogen gases as fault
9 gases, and considers them as indicators of transformer condition.

10 The diverter tank/barrier boards were replaced to try to eradicate the issue of acetylene
11 generation. However, the issues persisted after these replacements were made. Similar
12 corrective actions were implemented on a different FBC transformer and after the normal leach-
13 in time (approximately one year), the unit stabilized at lower Dissolved Gas levels.

14 The GFT T1 Dissolved Gas levels stabilized only after the load tap changer was switched to
15 manual.

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1 Based on the above mentioned findings, FBC assumes that GFT T1 Dissolved Gas Signature
2 and unit health will be relatively stable as long as the load tap changer operation is not required.

3

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1 7. **Reference: Exhibit B-1, page 12 and page 17**

Over the past five years, the maximum winter and summer peak loads on GFT T1 were approximately 34 MW and 29 MW, respectively. GFT T1, with a nominal rating of 45/60 MVA, has sufficient capacity to meet the forecasted distribution demand for the Grand Forks area load over the system planning horizon of 20 years. The characteristics of the four distribution transformers from which GFT T1 serves the local customer base are as follows:

2

If there is a GFT T1 outage or failure, customers will be left without power until the system is reconfigured to the backup 63 kV supply from 9L and 10L. The reconfiguration can result in lengthy restoration times and energization of 10L may not be possible if the line cannot be accessed. With only 9L in service, the maximum load that can be supplied is only 27 MW, which is insufficient to meet the seasonal peak loads for the Grand Forks area. In order to use 9L and 10L as the secondary 63 kV supply for the Grand Forks area, extensive rehabilitation work will be required to ensure both lines are available when needed.

3

- 4 7.1 Please provide the dataset demonstrating the seasonal peaks for the relevant
 5 area, including the size, timing and duration of peak periods.

6

7 **Response:**

8 The fully functional Excel spreadsheets containing seasonal peak load data for GFT T1 over the
 9 past five years are provided in Attachment 7.1.

10 The winter and summer peak load are the instantaneous maximum values. The winter season
 11 is from November to the end of February. The summer season is from June to the end of
 12 August.

13 Over the past five years, the maximum winter peak was recorded as 33,583 kVA (rounded to 34
 14 MW) in winter 2016/17 and the maximum summer peak was recorded as 33,015 kVA (rounded
 15 to 33 MVA) in summer 2018.

16

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19 7.2 Please provide a discussion of the number of customers that would be left
 20 without power under a GFT T1 outage or failure if only 9L could be placed into
 21 service.

22

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1 **Response:**

2 The number of customers experiencing an outage cannot be determined with certainty, as it
3 would depend on the time of year the outage occurred and the Grand Forks area load at the
4 time. The Grand Forks area has 3,750 residential and commercial customers, 2,200 City of
5 Grand Forks customers, and 2 industrial customers. Depending on the load of these customers
6 at the time of the GFT T1 outage, some customer outages may be required if only 9L is in
7 service. With only a single line in service, the maximum Grand Forks area load that can be
8 supported is 27 MW. If the Grand Forks area load is greater than 27 MW, customer outages
9 would be required. The historical load data for GFT T1 provided in the response to CEC IR
10 1.7.1 shows that peak loads on GFT T1 often exceed this limit.

11

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1 8. **Reference: Exhibit B-1, Appendix B page 7-8**

- The transformer maintenance records provided by the customer indicate that 3 LTC diverter tubes were replaced in October 2014 due to their leaks. The high concentration of Hydrogen (H₂), Ethane (C₂H₆), and Acetylene (C₂H₂) shown in DGA sampled before October 2014 was from the diverter contamination. The 33 ppm to 54 ppm of Acetylene (C₂H₂) were found the years after the new oil was filled in October 2014, which were believed from the residual Acetylene (C₂H₂)

2

3 in the insulations. Note: Normally a level of 46 ppm Acetylene corresponds to an unacceptable
 4 high probability of failure. Additional monitoring is required to monitor the gassing trend.

5

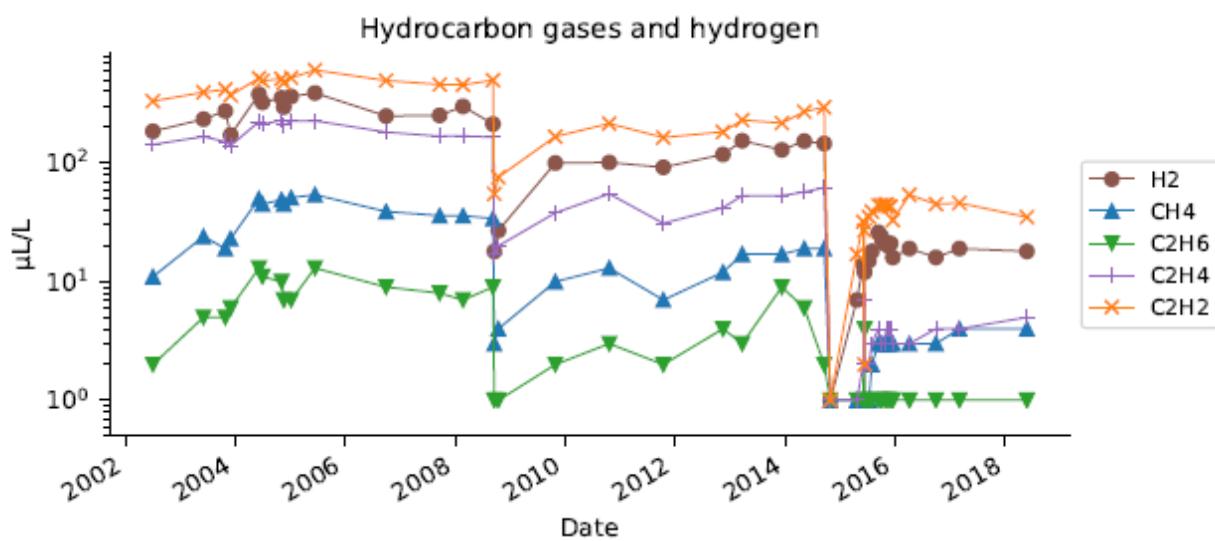
- 6
- 7 8.1 Has FBC been able to confirm that the 33 ppm to 54 ppm of Acetylene were from
 8 the residual Acetylene in the insulations? Please explain.

9

10 **Response:**

11 FBC cannot confirm that the 33 ppm to 54 ppm of acetylene (C₂H₂) were from the residual
 12 acetylene in the insulation.

13 Once dissolved in the solid insulation, acetylene is hard to remove. FBC assumes that some of
 14 the acetylene present in the GFT T1 oil is the result of gas leaking in from the solid insulation.
 15 Since the hydrocarbon gasses and hydrogen signature/ratio appear to have remained constant
 16 since 2002 (see figure below), it is FBC's assumption that the diverter tank replacement did not
 17 solve the underlying issues causing the acetylene generation.



15

16

17

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1
2 8.2 Please confirm that FBC is currently or has conducted additional monitoring of
3 the gassing trend and provide any updated information available to FBC.
4

5 **Response:**

6 Confirmed. After the 2014 repair, the unit was placed under increased surveillance and oil
7 samples were taken with increased periodicity until March 2017. After March 2017, FBC
8 determined the unit was relatively stable if the load tap changer operation was only performed
9 when strictly required. As such, the unit has now returned to annual oil testing periodicity.

10

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1 9. **Reference: Exhibit B-1, Appendix B, page 8**

- The carbon oxides levels were below the IEEE C57.104-2008 guide Condition Level 1 for the last few years. It is to be noted however that in 2014 this unit had the oil replaced and some of the markers of normal or abnormal aging were probably erased in the process. This observation is triggered by increased DGA levels recorded between 2003 and 2005. The CO₂/CO ratio is between 4 and 10. The normal CO₂/CO ratios are typically in the range of 5 to 9. The ratio of the carbon oxides suggests that these gas concentrations are likely due to the normal aging process of the transformer. For free breathing transformers with an ample supply of oxygen, there are typically high levels of carbon oxides generated under normal loading conditions. It is also typical that some of the CO will be converted to CO₂ in the presence of large quantities of oxygen. Oxygen acts as a catalyst to increase the generation rates of CO, CO₂ and combustible gases.

2

3 9.1 Please discuss the significance of the CO₂/CO ratio being between 4 and 10
 4 whereas the normal CO₂/CO ratios being in the range of 5-9.

5

6 **Response:**

7 The industry accepts that the CO₂/CO ratio only becomes significant when CO₂ is above 2000
 8 ppm or CO is above 500 ppm.

- 9 • A ratio below 3 indicates aging of insulation by arcing.
- 10 • A ratio above 10 indicates accelerated cellulose aging from thermal heating.
- 11 Ratios anywhere in between these thresholds indicate different aging rates and trends.
- 12 As a major transformer manufacturer and service provider, ABB has its own recommendations
 13 based on its experience.
- 14 For GFT T1 the upper and lower extremes of CO₂/CO trends can be an indication of arcing or
 15 abnormal accelerated paper aging.

16

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1 10. **Reference: Exhibit B-1, page 15 and Appendix B, page 17**

The condition assessment calculated the Risk of Failure (RoF) for this transformer to be 2.6 percent based on the most recent DGA and the available test/maintenance data.¹⁰ The RoF for this unit is on the high side when compared to a typical utility population.

ABB's report identifies the second most failed component for this type of transformer is the LTC and the single most common cause of failure is inadequate short circuit strength. Both of these components are weak in this unit. Also, based on the age profile for over 7 thousand units in a particular subset of in-service transformers contained in the Transformer Industry-Wide Database (IDB), the most common end of life for a transformer occurs in the 35 to 45 year portion of the population. This unit is 53 years old. With each passing year, the probability of failure of this unit increases.

2

Risk of Failure (%)	Condition
2.600	Transformer as is (C2H2 in oil and assuming no inhibitor)
0.524	Considering no acetylene in oil and inhibitor in oil.
0.262	New transformer design. (No gas in oil, inhibitor in oil, better short circuit withstand design)

Table 8 – Risk of Failure

The results above indicate a high risk of failure (2.6) for this transformer based on the current DGA in oil and available test and maintenance data. The below figure shows the Risk of Failure (RoF) compared to a transmission utility population. It can be seen that RoF is on the high side for this unit.

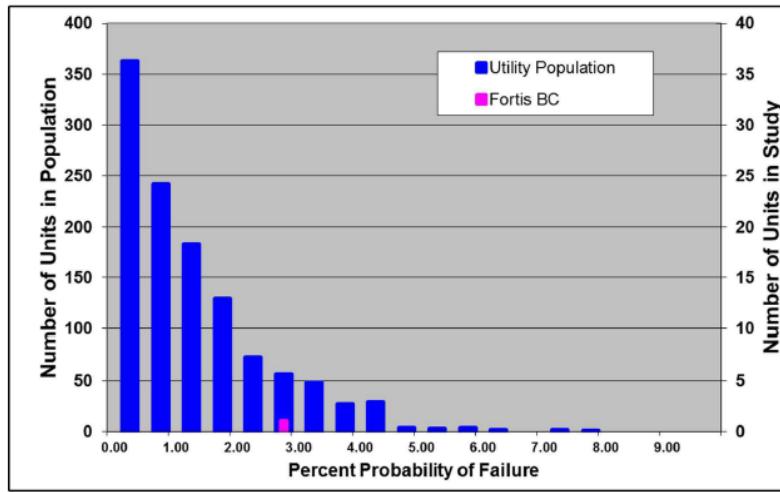


Figure 6 – Risk of Failure Compared to a Transmission Utility

3

- 4 10.1 Please confirm that the 2.6 percent probability of failure identified in the chart is
 5 FBC's Risk of Failure for this individual unit, and not for FBC's units as whole.

6

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1 **Response:**

2 Confirmed. The 2.6 percent Risk of Failure (RoF) identified in the chart is the RoF that was
 3 calculated by ABB for GFT T1.

4
5

6
7 10.2 If confirmed, please provide an estimate of the average probability of failure for
 8 these units for all of FBC, if possible.

9

10 **Response:**

11 The “Utility Population” shown in the graph above is not FBC. FBC does not calculate the RoF
 12 for each individual unit in the FBC system. All FBC transformers participate in a maintenance
 13 program and only if unusual trends are discovered through the regular testing will an
 14 independent consultant be contracted to perform the RoF calculations.

15
16

17
18 10.3 Please provide FBC’s assessment of how much the risk of failure will increase
 19 ‘with each passing year’.

20

21 **Response:**

22 Based on Table 9 in the ABB GFT T1 Condition Assessment Report (Appendix B), the risk of
 23 failure will increase from 2.6 percent in 2018 to 3.5 percent in 2048.

24 ABB calculated the risk of failure for 0, 10, 15, 20, 25 and 30 years, as seen in Table 9 of the
 25 report, reproduced below.

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Year	Risk of Failure
2018 (00 years)	2.60
2028 (10 years)	3.05
2033 (15 years)	3.26
2038 (20 years)	3.47
2043 (25 years)	3.49
2048 (30 years)	3.50

Table 9 – Projected Future Risk of Failure

- 1
 2
 3
 4
 5 10.4 Does FBC have pre-established criterion for itself regarding the risk of failure for
 6 transformers such as this? Please explain and provide the criterion if applicable.
 7

8 **Response:**

9 Please refer to the response to BCUC IR 1.2.3.

10

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1 11. **Reference: Exhibit B-1, page 15 and 16**

3.2.1.2 OLI T1 On-site Spare Transformer Condition

Oliver T1 (OLI T1) is a cold standby (normally de-energized) spare transformer located at GFT. It is a 161/63 kV transformer with a nominal rating of 45/60 MVA. The transformer was previously located at the Oliver Terminal, but was disconnected in 2011 as part of the Okanagan Transmission Reinforcement Project and relocated to GFT in 2014. The unit is of 1971 vintage and is now 47 years old, exceeding the expected transformer lifespan of 40 years.

In the event GFT T1 fails, it would likely take more than a year to repair or replace the unit based on historical procurement timelines. In the interim, FBC could install OLI T1 until a replacement unit could be procured. Although OLI T1 is on-site, it may take several weeks to

2

install due to substation reconfiguration and civil work required to accommodate the spare transformer.

A field inspection assessment of OLI T1 was performed in 2013 by ABB prior to its relocation to GFT. The field inspection assessment report is included as Appendix D. The report concluded the tensile strength of the insulation paper is in the upper "Mid-Life" category.¹¹ Therefore, once refurbished, this indicates the unit could be used for another 10 to 15 years.

Given that OLI T1 is normally de-energized, there is always some uncertainty with the condition of the unit and its availability for service. Further, if the transformer were damaged in the process of installing it in the location of the failed GFT T1, then both transformers could be unavailable for an extended period. This would leave FBC with no alternative but to attempt to serve whatever load it could in the Grand Forks area using only the aging 9L and 10L.

3

- 4 11.1 Does FBC have any reason to believe that the transformer was damaged in the
 5 process of installing it? Please explain.

6

7 Response:

8 The spare transformer, OLI T1, has never been installed to replace GFT T1. The transformer
 9 has never been damaged.

10 The statement above, "...if [OLI T1] were damaged in the process of installing it in the location
 11 of the failed GFT T1, then both transformers could be unavailable for an extended period" was
 12 intended to provide a hypothetical example of how 9L and 10L could be required as a 63 kV
 13 backup supply for the Grand Forks area for an extended period of time.

14

15

16

17

- 18 11.2 Does FBC normally run the risk of uncertainty regarding condition when
 19 transformers are used as back up and de-energized? Please explain.

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1 **Response:**

2 FBC does not run the risk of uncertainty regarding the condition of backup transformers. Please
3 refer to the response to BCUC IR 1.2.9 describing the measures taken for OLI T1.

4

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1 **12. Reference: Exhibit B-1, page 18**

3.2.2 Reliability

Typical industry transmission planning standards require the system to be planned such that all projected customer loads are served during both normal (N-0)¹² operation and single contingency (N-1)¹³ operation. As such, FBC transmission planning criteria specifies that firm customer load should be able to be supplied in N-0 and N-1 conditions.

2

¹² Normal operation, also referred to as N-0 reliability, means that with all major elements of the power system in service, the network can be operated to meet projected customer demand in order to avoid a load loss (customer outage).

¹³ Single contingency, also referred to as N-1 reliability, means that an outage of a single element with all other elements of the power system in service (a single transmission line, transformer, generating unit, power conditioning unit like a shunt capacitor bank, a shunt reactor bank, a series capacitor, a series reactor, etc.) results in no load loss.

3

- 4 12.1 Is the CEC's interpretation correct that all of FBC's transmission infrastructure is
 5 planned to N-1 contingency or does some part of the system have radial lines at
 6 N-0 contingency? Please explain.

7

8 **Response:**

9 Please refer to the responses to BCOAPO IR 1.7.1 and CEC IR 1.5.1.

10

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1 13. **Reference: Exhibit B-1, page 18 and 19**

FBC's transmission outage statistics show there have been a combined total of 54 outages on 9L and 10L over the past five years. The table below categorizes the total 9L and 10L outages by cause and shows the average duration, minimum duration, and maximum duration. Most outages to 9L and 10L are caused by snow unloading and lightning.

Table 3-1: 9L and 10L Outage Statistics (June 2013 - June 2018)

Description of Cause	Number of Outages	Avg Duration (hrs)	Min Duration (hrs)	Max Duration (hrs)
Snow	18	1.839	0.001	16.159
Tree Into Line	5	12.451	0.002	27.847
Equipment Failure	3	22.069	5.680	39.378
Pole Issue	5	9.096	1.176	17.052
Lightning	12	0.061	0.001	0.230
Human Interference	1	5.286	5.286	5.286
Conductor Issue	3	83.098	5.240	152.361
Flood	1	1.198	1.198	1.198
Forest Fire	2	0.914	0.127	1.701
Unknown	4	6.356	0.001	15.088
Total	54			

FBC's transmission outage statistics show there has been only a single outage to GFT T1 over the past five years, which was caused by lightning. The table below provides the outage cause and outage duration.

2

Table 3-2: GFT T1 Outage Statistics (June 2013 - June 2018)

Description of Cause	Number of Outages	Avg Duration (hrs)	Min Duration (hrs)	Max Duration (hrs)
Lightning	1	0.003	0.003	0.003
Total	1			

3

- 4 13.1 Please provide the number of customers that were affected in each outage if the
 5 information is available.

6

7 **Response:**

- 8 Please find below the number of customers affected for each outage in Table 3-1 and 3-2
 9 above.

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Description of Cause	Element	Down Timestamp	Up Timestamp	Total Direct Customers Affected	Total Indirect Customers Affected
SNOW	10 LINE	2013-12-01 9:29:17 AM	2013-12-01 9:29:22 AM	2342	0
SNOW	9 LINE	2013-12-16 10:00:29 AM	2013-12-16 10:17:32 AM	0	0
SNOW	9 LINE	2014-11-22 1:31:04 AM	2014-11-22 5:40:37 PM	0	0
SNOW	9 LINE	2015-01-05 4:31:04 AM	2015-01-05 6:48:46 AM	0	0
SNOW	9 LINE	2015-11-16 11:39:47 PM	2015-11-16 11:50:35 PM	0	0
SNOW	9 LINE	2015-11-17 4:04:11 AM	2015-11-17 8:09:23 AM	0	0
SNOW	10 LINE	2015-11-17 7:02:50 AM	2015-11-17 7:02:55 AM	2391	0
SNOW	10 LINE	2015-12-13 9:02:47 AM	2015-12-13 9:02:52 AM	0	0
SNOW	9 LINE	2015-12-13 1:03:34 PM	2015-12-13 1:07:25 PM	0	0
SNOW	9 LINE	2016-02-04 12:05:46 PM	2016-02-04 12:10:23 PM	0	0
SNOW	9 LINE	2016-12-13 10:55:04 PM	2016-12-13 11:58:00 PM	1916	1892
SNOW	9 LINE	2017-12-20 11:38:17 AM	2017-12-20 11:53:28 AM	0	0
SNOW	9 LINE	2018-01-23 11:56:26 PM	2018-01-24 1:07:28 AM	0	0
SNOW	10 LINE	2018-01-24 3:21:09 AM	2018-01-24 3:26:14 AM	2461	0
SNOW	9 LINE	2018-01-24 2:32:25 AM	2018-01-24 9:01:55 AM	0	0
SNOW	9 LINE	2018-01-28 7:22:59 PM	2018-01-28 7:56:11 PM	0	0
SNOW	9 LINE	2018-02-18 8:40:05 AM	2018-02-18 8:43:30 AM	0	0
SNOW	9 LINE	2018-02-18 10:35:43 AM	2018-02-18 10:52:46 AM	0	0
TREE INTO LINE	9EAST LINE	2013-08-05 8:02:01 PM	2013-08-06 3:06:36 PM	0	0
TREE INTO LINE	9 LINE	2014-05-14 7:38:33 PM	2014-05-14 7:38:39 PM	0	0
TREE INTO LINE	9 LINE	2016-12-27 8:26:57 PM	2016-12-28 11:43:00 AM	0	0
TREE INTO LINE	9 LINE	2018-01-28 10:15:20 PM	2018-01-28 10:19:03 PM	0	0
TREE INTO LINE	9 LINE	2018-02-18 11:00:46 AM	2018-02-19 2:51:34 PM	0	0
EQUIPMENT FAILURE	10 LINE	2015-03-16 2:10:43 AM	2015-03-17 5:33:23 PM	0	0

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Description of Cause	Element	Down Timestamp	Up Timestamp	Total Direct Customers Affected	Total Indirect Customers Affected
EQUIPMENT FAILURE	10 LINE	2015-09-14 9:48:41 PM	2015-09-15 6:57:32 PM	1449	0
EQUIPMENT FAILURE	10 LINE	2017-09-19 1:45:57 PM	2017-09-19 7:26:46 PM	0	0
POLE ISSUE	10 LINE	2015-08-12 9:26:00 PM	2015-08-13 2:29:07 PM	0	0
POLE ISSUE	10 LINE	2016-09-02 9:22:44 AM	2016-09-02 3:39:01 PM	0	0
POLE ISSUE	10 LINE	2016-09-17 4:26:25 PM	2016-09-17 5:37:00 PM	0	0
POLE ISSUE	10 LINE	2017-08-07 9:21:34 PM	2017-08-08 2:04:41 PM	1449	0
POLE ISSUE	10 LINE	2017-09-09 3:15:03 PM	2017-09-09 7:30:43 PM	0	0
LIGHTNING	9EAST LINE	2013-07-05 1:00:55 PM	2013-07-05 1:01:38 PM	0	0
LIGHTNING	9EAST LINE	2013-07-05 3:06:24 PM	2013-07-05 3:07:26 PM	0	0
LIGHTNING	10 EAST LINE	2013-08-25 10:15:20 PM	2013-08-25 10:15:23 PM	1421	0
LIGHTNING	9 LINE	2014-06-15 8:34:16 PM	2014-06-15 8:38:52 PM	0	0
LIGHTNING	9 LINE	2014-07-23 3:52:42 PM	2014-07-23 3:58:17 PM	0	0
LIGHTNING	9 LINE	2014-07-23 5:49:58 PM	2014-07-23 6:03:45 PM	449	1892
LIGHTNING	10 LINE	2014-09-02 8:19:39 PM	2014-09-02 8:31:44 PM	3528	1892
LIGHTNING	9 LINE	2014-09-30 2:05:14 PM	2014-09-30 2:05:20 PM	4449	1892
LIGHTNING	9 LINE	2015-07-20 7:37:03 AM	2015-07-20 7:39:53 AM	0	0
LIGHTNING	9 LINE	2016-06-23 3:58:59 PM	2016-06-23 4:01:53 PM	0	0
LIGHTNING	10 EAST LINE	2018-06-15 12:37:48 PM	2018-06-15 12:37:51 PM	1911	1892
LIGHTNING	9 LINE	2018-06-22 2:42:28 PM	2018-06-22 2:42:33 PM	2467	0
HUMAN INTERFERENC E	10 EAST LINE	2013-06-27 10:53:20 PM	2013-06-28 4:10:29 AM	1421	0
CONDUCTOR ISSUE	9 LINE	2013-09-27 9:58:25 AM	2013-10-03 6:20:06 PM	0	0
CONDUCTOR ISSUE	10 LINE	2013-12-07 9:02:31 PM	2013-12-11 4:44:05 PM	2342	0
CONDUCTOR ISSUE	9 LINE	2017-10-02 9:40:28 PM	2017-10-03 2:54:51 AM	457	1892

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Description of Cause	Element	Down Timestamp	Up Timestamp	Total Direct Customers Affected	Total Indirect Customers Affected
FLOOD	9 LINE	2018-05-11 6:07:03 AM	2018-05-11 7:18:56 AM	458	1892
FOREST FIRE	9 LINE	2016-06-07 12:24:42 PM	2016-06-07 12:32:18 PM	1907	1892
FOREST FIRE	9 LINE	2017-08-10 9:07:18 AM	2017-08-10 10:49:22 AM	0	0
Description of Cause	Element	Down Timestamp	Up Timestamp	Total Direct Customers Affected	Total Indirect Customers Affected
LIGHTNING	GFT TERMINAL	2014-08-19 2:06:21 PM	2014-08-19 2:06:31 PM	3534	1892

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1 **14. Reference: Exhibit B-1, page 20**

Do nothing or Status Quo was not considered an option because FBC cannot currently meet the N-1 transmission planning criteria in the event of a GFT T1 failure during seasonal peaks.

FBC also considered consolidating 9L and 10L into a single circuit using 477 ACSR (Aluminium Conductor Steel-Reinforced) but rejected this option because the capacity of the new line could not support the Grand Forks area load.

2

3 14.1 Please provide further elaboration on the need for FBC to meet N-1 transmission
 4 planning criteria.

5

6 **Response:**

7 All transmission elements that are part of the interconnected system (not radial) are subject to
 8 the N-1 contingency planning criteria as part of the FBC transmission planning standard. The N-
 9 1 planning criteria is the standard criteria used in the utility industry that is applicable to
 10 interconnected systems.

11

12

13 14.2 Please discuss whether or not FBC has been able to meet this need in the last
 14 several years.

15

16 **Response:**

17 FBC has not been able to meet the N-1 planning criteria in the past nor will it be able to meet it
 18 in the future with the current condition and reliability of lines 9L and 10L.

19 Please also refer to the response to CEC IR 1.5.1.1.

20

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1 **15. Reference: Exhibit B-1, page 24**

The comparative merits of the alternatives, including the financial impact, are summarized in the table below. The criteria that were evaluated are as follows:

1. Meets Single Contingency N-1 Transmission Planning Criteria: Ability to continue to serve all load during the outage of a single element.
2. Operations Accessibility and Operability: Considers the accessibility and operability of the facilities by FBC employees and contractors working on system repairs, performing routine maintenance, or transferring load during real-time outages.
3. Lifecycle Utilization: Considers the full lifecycle of the existing assets.

- 2 4. Project Risk: Considers Project risks, such as schedule, lands, and unforeseen environmental and archeological discoveries.
5. System Reliability: Refers to the availability of electrical supply on the transmission, distribution and substation facilities.
6. O&M and Sustainment Capital Costs: Costs related to maintaining the assets in place.
7. Present Value Incremental Revenue Requirement: The discounted value of the revenue requirement over 40 years.
8. Rate Impact: The leveled rate impact over the 40 year period.

3

4 15.1 Did FBC apply any weighting and provide scoring to the comparative merits in its
 5 analysis?

6

7 **Response:**

8 No, FBC did not apply weighting or scoring to each of the comparative merits as it would have
 9 been very subjective.

10 FBC performed a comparative analysis and evaluation of each technical and financial criterion
 11 for the three alternatives as described in Sections 3.5.1 and 3.5.2, respectively. FBC then
 12 selected Alternative B since it best met these criteria.

13

14

15

16 15.1.1 If yes, please provide.

17

18 **Response:**

19 Please refer to the response to CEC IR 1.15.1.

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1
2
3
4 15.1.2 If no, please explain why not.
5
6 **Response:**
7 Please refer to the response to CEC IR 1.15.1.

8

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1 16. Reference: Exhibit B-1, page 25 and 26

Table 3-3: Grand Forks Reliability Project Alternatives Comparison

Criteria	Alternative A	Alternative B	Alternative C
Technical			
Meets N-1 Transmission Planning Criteria	<ul style="list-style-type: none"> Second transformer at GFT provides alternate 161/63 kV supply at GFT. 	<ul style="list-style-type: none"> Second transformer at GFT provides alternate 161/63 kV supply at GFT. 	<ul style="list-style-type: none"> 9L and 10L provide alternate 63 kV supply from WTS for Grand Forks area.
Operations	<ul style="list-style-type: none"> GFT T1 load transfer can be transferred to GFT T2, and vice versa, remotely by System Control Centre (SCC). 	<ul style="list-style-type: none"> GFT T1 load transfer can be transferred to GFT T2, and vice versa, remotely by SCC. OLI T1 remains as an onsite spare which can be used in the event either GFT T1 or GFT T2 fail. 	<ul style="list-style-type: none"> Field staff must manually close switches on 9L and 10L to reconfigure for 63kV supply from WTS. OLI T1 remains as an onsite spare which can be used in the event GFT T1 fails.
Lifecycle Utilization ²¹	<ul style="list-style-type: none"> Makes use of remaining life of OLI T1 (15 years). Removes portions of the legacy transmission lines 9L and 10L. Given the condition of GFT T1 and OLI T1, both units could fail within a year of each other. This is considered to be a low risk. 	<ul style="list-style-type: none"> OLI T1 remains as on-site spare and available for future use. Removes portions of the legacy transmission lines 9L and 10L. 	<ul style="list-style-type: none"> OLI T1 remains as on-site spare and available for future use. Rehabilitates legacy transmission lines 9L and 10L.

2

Criteria	Alternative A	Alternative B	Alternative C
Project Risk			
Project Risk	<ul style="list-style-type: none"> <u>Schedule Risk:</u> Construction and removal window for 9L and 10L is impacted seasonally. <u>Lands Risk:</u> Confirm distribution ROW for portion of 9L and 10L that will be repurposed for distribution. Considered to be low risk. <u>Environmental and Archeological Risk:</u> Considered to be low risk. 	<ul style="list-style-type: none"> <u>Schedule Risk:</u> Construction and removal window for 9L and 10L is impacted seasonally. Lead time for a new transformer can be up to a year. <u>Lands Risk:</u> Confirm distribution ROW for portion of 9L and 10L that will be repurposed for distribution. Considered to be low risk. <u>Environmental and Archeological Risk:</u> Considered to be low risk. 	<ul style="list-style-type: none"> <u>Schedule Risk:</u> Construction window impacted seasonally. <u>Lands Risk:</u> None, no changes to transmission or distribution routes. <u>Environmental and Archeological Risk:</u> Considered to be low risk.
System Reliability			
System Reliability	<ul style="list-style-type: none"> Fewer outages are associated with transformers. 	<ul style="list-style-type: none"> Fewer outages are associated with transformers. 	<ul style="list-style-type: none"> More frequent outages are associated with transmission lines.
Financial			
O&M and Sustainment Capital Costs	<ul style="list-style-type: none"> Reduces 9L and 10L transmission O&M costs. Reduces 9L and 10L transmission rehabilitation capital costs. Reduces 9L and 10L urgent repairs. 	<ul style="list-style-type: none"> Reduces 9L and 10L transmission O&M costs. Reduces 9L and 10L transmission rehabilitation capital costs. Reduces 9L and 10L urgent repairs. 	<ul style="list-style-type: none"> No reduction in 9L and 10L transmission O&M. No reduction in transmission rehabilitation capital costs. Reduces 9L and 10L urgent repairs
Present Value of 40 year Cost of Service	\$9.959 million	\$9.960 million	\$14.004 million
Levelized Rate Impact	0.18 % \$0.20 \$/MWh (\$0.00020 \$/KWh)	0.18% \$0.20 \$/MWh (\$0.00020 \$/KWh)	0.26% \$0.28 \$/MWh (\$0.00028 \$/KWh)
Alternative Evaluation			
Ranking	2	1	3

3

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1 16.1 Please briefly state the total number of customers who will be impacted and the
 2 expected improvements in system reliability/outages etc. that will arise for them.
 3

4 **Response:**

5 The GFT Reliability project seeks to improve reliability for customers in the Grand Forks area
 6 supplied by the Grand Forks (GFT T3), Ruckles (RUC T3), Christina Lake (CHR T1) and
 7 Bradford/Roxul (BRA T1) distribution transformers. The normal 63 kV supply for these
 8 substations is from GFT T1. The customers that would be affected by a GFT T1 outage include
 9 3,570 residential and commercial customers, 2 industrial customers, and the City of Grand
 10 Forks electric utility with approximately 2,200 customers.

11 The system reliability criterion in Table 3-3 above refers to the availability of electrical supply on
 12 the transmission, distribution and substation facilities. This criterion was quantified based on
 13 the potential outage frequency of the backup 63 kV supply for GFT T1. Under Alternative A and
 14 Alternative B, the backup supply is provided by the second transformer GFT T2. Under
 15 Alternative C, the backup supply is provided from Warfield Terminal Station (WTS) via the 63 kV
 16 transmission lines 9L and 10L.

17 Please refer to the response to CEC IR 1.16.2 for a comparison of the outage statistics for 9L
 18 and 10L and GFT T1 for the period of June 2013 to June 2018. The results indicate there was
 19 only a single outage to GFT T1 over the past five years, while 9L and 10L had a combined total
 20 of 54 outages. Based on this past experience, GFT T2 is likely to have fewer outages than the
 21 transmission lines 9L and 10L.

22
 23

24

25 16.2 Please quantify the expected benefits in system reliability for each Alternative.
 26

27 **Response:**

28 The outage statistics for the 63 kV transmission lines 9L and 10L, for the period of June 2013 to
 29 June 2018, are provided in Table 3-1 on Page 18 of the Application and reproduced below.
 30 There were a total of 54 outages to transmission lines 9L and 10L in the five year period. The
 31 outage statistics for GFT T1, for the period of June 2013 and June 2018, are provided in Table
 32 3-2 on Page 19 of the Application and reproduced below. There was a single outage to GFT T1
 33 in the same five year period. Comparing these outage statistics indicates there are fewer
 34 outages associated with transformers than transmission lines, as indicated in the 'system
 35 reliability' criterion in Table 3-3 comparing the three alternatives considered.

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Table 3-1: 9L and 10L Outage Statistics (June 2013 - June 2018)

Description of Cause	Number of Outages	Avg Duration (hrs)	Min Duration (hrs)	Max Duration (hrs)
Snow	18	1.839	0.001	16.159
Tree Into Line	5	12.451	0.002	27.847
Equipment Failure	3	22.069	5.680	39.378
Pole Issue	5	9.096	1.176	17.052
Lightning	12	0.061	0.001	0.230
Human Interference	1	5.286	5.286	5.286
Conductor Issue	3	83.098	5.240	152.361
Flood	1	1.198	1.198	1.198
Forest Fire	2	0.914	0.127	1.701
Unknown	4	6.356	0.001	15.088
Total	54			

1

Table 3-2: GFT T1 Outage Statistics (June 2013 - June 2018)

Description of Cause	Number of Outages	Avg Duration (hrs)	Min Duration (hrs)	Max Duration (hrs)
Lightning	1	0.003	0.003	0.003
Total	1			

2

3

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1 **17. Reference: Exhibit B-1, page 27**

2 Alternative B provides an additional benefit over Alternative A. Because Alternative B includes installation of a new second transformer at this time as opposed to installing the on-site spare, it reduces the risk that both GFT T1 and GFT T2 could fail simultaneously. As mentioned in section 3.2.1, GFT T1 has a useful remaining life of 10 years and the on-site spare has a useful remaining life of at least 40 years.

- 3 17.1 What circumstances might cause both transformers to fail simultaneously?
 4 Please explain and discuss the likelihood of such an event occurring.

5 **Response:**

6 It would be difficult for FBC to predict the circumstances that could cause both transformers to fail simultaneously. The likelihood of this event occurring is very low.

7 In Alternative A, the spare transformer OLI T1 would be installed as the second transformer at Grand Forks Terminal (GFT T2). The estimated useful remaining lives for GFT T1 and OLI T1 are between 10 to 15 years. Therefore, given the age and condition of these transformers, it was assumed the likelihood of both failing simultaneously would be higher than compared to Alternative B (installs a new transformer as GFT T2). The example was provided to highlight a scenario where 9L and 10L would be required to provide the 63 kV supply for the Grand Forks area over an extended period of time. There would be a higher risk of this occurring in Alternative A as compared to Alternative B.

17
 18
 19
 20 17.2 Has FBC ever encountered a situation in which two transformers of similar remaining useful life failed simultaneously?
 21
 22
 23 **Response:**

24 FBC has never encountered a situation in which two transformers of similar remaining useful life failed simultaneously.
 25
 26

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1 **18. Reference: Exhibit B-1, page 27**

All three alternatives have Project risks associated with them. The schedule risk is lowest for Alternative A since OLI T1 is already on site, Alternative B is dependent on the approximately one year lead time for procurement of a new transformer, and Alternative C has a greater

2

likelihood of being impacted by seasonal construction windows. The lands risk is lowest for Alternative C since the distribution and transmission routes will not be changing, while Alternative A and Alternative B both require distribution rights-of-way to be confirmed for the portions of 9L and 10L that will not be removed. All alternatives have low unforeseen environmental and archaeological discovery risk during the construction phase based on FBC's historical experience in the GFT and along the 9L and 10L right-of-way.

Alternative A and Alternative B further improve system reliability by reducing exposure to transmission line outages through the removal of 9L and 10L, compared to Alternative C which rehabilitates the lines.

Based on the technical evaluation, Alternative A and Alternative B better address the technical criteria by supplying a second 161/63 kV supply at GFT as compared to Alternative C. However, Alternative B offers improved reliability compared to Alternative A since it includes installation of a new second transformer at GFT as opposed to installation of the on-site spare, thereby addressing the existing condition of GFT T1, which has exceeded the expected transformer lifespan of 40 years. This is because the on-site spare has a useful remaining life of only 10 to 15 years, whereas a new transformer would have a useful remaining life of 40 years. Furthermore, Alternative B is a more reliable option for the additional reason that OLI T1 would remain as an on-site spare at GFT. Therefore, Alternative B is the preferred solution as it best addresses the issue of transmission reliability for the Grand Forks area.

3

4 18.1 How did FBC value and/or account for 'schedule risk' in its evaluation? Please
 5 explain.

6

7 **Response:**

8 Please refer to Confidential Attachment 9.1 provided in the response to BCUC IR 1.9.1, for the
 9 GFT Reliability Project Risk Register. FBC considers the overall schedule risk for all three
 10 alternatives to be low.

11 The work on 9L and 10L can only be completed during the shoulder seasons due to access
 12 issues and the potential for forest fires. The schedule risk associated with the seasonal
 13 construction window for 9L and 10L is considered to be low because the project schedule is
 14 created to accommodate the seasonal construction window with schedule buffers included. This
 15 risk was considered for all three alternatives.

16 The other schedule risk that was evaluated was the need to procure a new transformer in
 17 Alternative B. The lead time for a new transformer can be up to a year. The schedule risk
 18 associated with the transformer lead time was considered to be low because FBC has

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1 agreements in place with approved vendors to supply quality product and set lead times.
2 Estimates have already been acquired for the GFT T2 transformer and lead times have been
3 established.

4
5

6

7 18.2 How did FBC value and/or account for 'system reliability' in its evaluation?
8 Please explain.

9

10 **Response:**

11 Please refer to the responses to CEC IRs 1.16.1 and 1.16.2.

12

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1 **19. Reference: Exhibit B-1, page 4 and page 28 and page 43**

Financial Criteria

1. O&M and Sustainment Capital Costs;
2. Present Value of Incremental Revenue Requirement; and
3. Rate Impact.

Based on these criteria, the Company submits that the best alternative for the Project is Alternative B, i.e., to provide a second transformer at GFT (GFT T2) by purchasing and installing a new 161/63 kV transformer, remove 44.6 km of the 9L and 10L transmission lines between CHR and CSC, and repurpose 20.8 km of the 9L and 10L transmission lines to distribution lines. Alternative B best addresses the condition of existing facilities and reliability issues for the Grand Forks area. The evaluation of the alternatives and selection of the recommended solution will be discussed in detail in Section 3.4 and Section 3.5.

2

3.5.2 Financial Evaluation

Alternative A and Alternative B will have a net reduction in O&M costs since a large portion of 9L and 10L will be removed. There will be no change in O&M costs for Alternative C. In addition, FBC transmission condition assessment and rehabilitation (sustainment capital) occurs on an eight-year cycle; removal of a portion of 9L and 10L will reduce these costs in Alternative A and Alternative B. All three alternatives will see a reduction in urgent repairs on 9L and 10L, with the largest reduction in Alternative A and Alternative B since a portion of the lines will be removed.

Although the initial capital cost of Alternative A is less than Alternative B, the present value of the incremental cost of service between Alternative A and Alternative B is substantially equal, since the leveled rate impact percentage and the \$ / MWh is the same (the present value for Alternative A is only \$1 thousand lower than Alternative B). Even though Alternative C has the lowest initial capital cost, its present value of incremental cost of service is highest because of the higher O&M and sustainment capital costs for 9L and 10L.

Based on the financial analysis, both Alternative A and Alternative B better minimize the financial impact of the Project than Alternative C. Of these two options, the Company prefers Alternative B since it results in the same rate impact to customers as Alternative A based on a leveled lifecycle analysis over a 40 year period and was the preferred alternative based on the technical criteria as explained above.

3

6.5 SUMMARY

In this section, FBC has described the Project cost estimate, the financial evaluation, accounting treatment, and the rate impact. The Project will cost \$12.2 million in 2018 dollars including net removal costs of \$4.3 million. The leveled rate impact of Alternative B is projected to be 0.18% or \$0.20 per MWh, and will add \$2.32 to the annual bill for the average customer using 11,500 KWh.

4

- 5 19.1 Please provide a full financial summary for each alternative which depicts FBC's
 6 financial analysis of the three options or indicate where this is provided in the
 7 application. Please include initial capital costs, sustainment capital, O&M,
 8 allowance for funds used during construction, any other relevant expenditures,
 9 present value calculations, all assumptions and any other inputs and calculations

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1 used to develop the financial assessment for each alternative. Please file
 2 confidentially if necessary.
 3

4 **Response:**

5 The full financial summaries of each of the alternatives have been included in Confidential
 6 Appendix J of the application.

- 7 • Confidential Appendix J 1.1 – Contains Alternative A
 8 • Confidential Appendix J 1.2 – Contains Alternative B
 9 • Confidential Appendix J 1.3 – Contains Alternative C

10 The following are the assumptions used for the Project financial analysis:

- 11 1. Capital costs are added to opening Electric Plant in Service (EPIS) and Rate Base at the
 beginning of the following year after the plant enters into service.
 13 2. Escalation rate for capital costs and for O&M is 1.7 percent.
 14 3. The remaining life for the existing transformer GFT-T1 is 15 years and for OLI-T1 is also
 15 years after it is reconnected to the electric system.
 16 4. New transformer has an asset life of 40 years.
 17 5. The income tax rate remains at 27 percent.
 18 6. For Alternatives A and B the book value of the Transmission Lines 9L and 10L that is
 being refurbished to distribution is the book value of lines times the distance of the lines
 being refurbished divided by the total distance of the lines.

21 Please refer to Confidential Attachment 19.1 containing the functional Excel spreadsheets for
 22 Alternatives A, B and C.

23 FBC is requesting that Attachment 19.1 be filed on a confidential basis pursuant to Section 18 of
 24 the BCUC's Rules of Practice and Procedure regarding confidential documents adopted by
 25 Order G-15-19, as these files contain the other inputs and calculations used for the financial
 26 assessment that, if disclosed, could negatively impact FBC's negotiating position.

27
 28

29
 30 19.2 Please discuss any quantification of risk reduction that was used in the financial
 assessment of the alternatives. Please file confidentially if necessary.
 31

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- 1
- 2 **Response:**
- 3 No quantification of risk reduction has been used in the financial assessment of the alternatives.

- 4
- 5
- 6
- 7 19.3 What value was assigned to the repurposing of 9L and 10L? Please provide and
8 file confidentially if necessary.

- 9
- 10 **Response:**
- 11 A portion of this response is being filed confidentially with the BCUC. FBC is requesting that
12 this information be filed on a confidential basis pursuant to Section 18 of the BCUC's Rules of
13 Practice and Procedure regarding confidential documents adopted by Order G-15-19, as it
14 contains commercially sensitive information that if disclosed, could negatively impact future
15 contract negotiations.

- 16 FBC assigned [REDACTED] to repurpose 9L and 10L lines from transmission to distribution.

17

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1 20. **Reference: Exhibit B-1, page 36**

1 | **5.5 PROJECT RESOURCES**

1 | **5.5.1 Project Management**

- 1 | FBC plans to have an FBC Project Manager who will manage all aspects of the Project, including, but not limited to, engineering, procurement, and construction. The Project Manager is responsible for coordinating all Project activity.
- 1 | Additionally, FBC plans to have an FBC Construction Manager on site who will manage both internal and external construction resources. The Construction Manager is responsible for coordinating all on-site activity.

1 | **5.5.2 Engineering**

- 1 | FBC plans to have an FBC Project Engineer and an FBC Design Technologist manage the engineering component of the Project. External engineering support may be required to complete design for the foundations and transformer pad/containment.

1 | **5.5.3 Construction Services**

- 1 | The construction activities will be managed directly on site by FBC. Construction will be performed by qualified construction workers and supervisors.

2

3 20.1 Does FBC require any additional personnel in product management, engineering,
 4 construction services or other roles in order to undertake the project? Please
 5 explain why or why not.

6

7 **Response:**

8 FBC assumes that “product management” should read “project management”. Project and
 9 construction management will be completed by internal personnel of FortisBC. Additional
 10 external personnel will not be required. FBC employees within project construction and
 11 engineering services have the knowledge and information to perform this work internally with
 12 the exception of the components identified below.

13 Civil/structural engineering, geotechnical and grounding studies will be completed externally and
 14 additional support will be required. These are skills and resources that FBC does not regularly
 15 require and normally outsources to reduce costs.

16

17

18

19 20.1.1 If yes, please quantify.

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1
2 **Response:**
3 A portion of this response is being filed confidentially with the BCUC. FBC is requesting that
4 this information be filed on a confidential basis pursuant to Section 18 of the BCUC's Rules of
5 Practice and Procedure regarding confidential documents adopted by Order G-15-19, as it
6 contains commercially sensitive information that if disclosed, could negatively impact future
7 contract negotiations.

8 FBC has allocated funds for the civil and structural engineering support and additional
9 geotechnical and grounding studies required for the project. Based on the Class 3 estimate for
10 Alternative B, FBC anticipates [REDACTED] of engineering costs for this external support.

11
12
13
14 20.2 Have the costs for project resources been included in the financial analysis?
15 Please explain.
16
17 **Response:**

18 Yes, the project resource costs have been included in the Class 3 estimate.

- 19 • Project Management costs are included in the Project and Owner's Management 4
20 percent overhead.
- 21 • Construction Manager Supervision is captured in the indirect costs for each component
22 of the project.
- 23 • Engineering has a built in estimate for the external engineering services.

24

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1 21. Reference: Exhibit B-1, page 39 and 40 and page 43

2 6.1 *PROJECT CAPITAL COST ESTIMATE*

Table 6-1: Summary of Estimated Project Capital Costs (\$000)

Particular	2018 \$	As-spent \$
Pre-Approval Costs	257	257
Construction	6,414	6,630
Contingency	1,184	1,225
AFUDC		400
Subtotal – Construction	7,855	8,512
Net Removal Costs	3,475	3,625
Contingency	866	903

3

Particular	2018 \$	As-spent \$
AFUDC		131
Subtotal – Net Removal	4,341	4,659
Total Project	12,196	13,171

4

The Project capital cost estimate was developed based on consideration of the substation upgrade work and the transmission/distribution work. FBC requested quotes from potential suppliers to compile the station upgrade estimate. FBC engaged DBS Energy, an engineering consulting company, to provide the 9L and 10L transmission lines estimate as part of the condition assessment. FBC's estimate for the station upgrade can be found in Confidential Appendix H, and the DBS estimate for the 9L and 10L work can be found in the condition assessment report in Confidential Appendix C.²²

5

Table 6-4: Schedule of Completion Inclusion in Rate Base (excluding AFUDC)

Year of Construction Complete	Construction Work to be completed	Estimated amount of capital (As-Spent \$) transfer to Plant-in-Service (\$ millions)	Date transfer to Opening Balance of Plant-in-Service
2020	Station	\$ 5.3	January 1, 2021
2020	Distribution Rebuild	\$ 1.4	January 1, 2021
2021	Distribution Rebuild	\$ 1.4	January 1, 2022
2020	Station Removal	\$ 0.1	January 1, 2021
2020	Transmission Removal	\$ 2.2	January 1, 2021
2021	Transmission Removal	\$ 2.3	January 1, 2022
TOTAL		\$12.7	

6

7 21.1 Please provide a breakdown for the Net Removal Costs of \$3,475,000. Please provide confidentially if necessary.

8

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- 1
- 2 **Response:**
- 3 The \$3,475,000 net removal costs is the 2018 dollar value of Station and Transmission &
4 Distribution removal costs not including contingency or AFUDC.
- 5 The breakdown of the amount can be viewed in Confidential Appendix I to the Application.

6

7

8

9 21.2 Please provide the basis for the Contingency of \$1,184,000. Please provide
10 confidentially if necessary.

11

12 **Response:**

13 This response is being filed confidentially with the BCUC. FBC is requesting that this
14 information be filed on a confidential basis pursuant to Section 18 of the BCUC's Rules of
15 Practice and Procedure regarding confidential documents adopted by Order G-15-19, as it
16 contains commercially sensitive information that if disclosed, could negatively impact future
17 contract negotiations.

18 [REDACTED]

19 [REDACTED]

20 [REDACTED]

21 [REDACTED]

22 [REDACTED]

23 [REDACTED]

24 [REDACTED]

25 [REDACTED]

26 [REDACTED]

27 [REDACTED]

28 [REDACTED]

29

30

31

32 21.3 Please provide the basis for the Contingency of \$866,000 in Net Removal.
33 Please provide confidentially if necessary.

34

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1 **Response:**

2 This response is being filed confidentially with the BCUC. FBC is requesting that this
3 information be filed on a confidential basis pursuant to Section 18 of the BCUC's Rules of
4 Practice and Procedure regarding confidential documents adopted by Order G-15-19, as it
5 contains commercially sensitive information that if disclosed, could negatively impact future
6 contract negotiations.

7 [REDACTED]
8 [REDACTED]
9 [REDACTED]

10 [REDACTED]
11 [REDACTED]
12 [REDACTED]
13 [REDACTED]
14 [REDACTED]
15 [REDACTED]
16 [REDACTED]
17 [REDACTED]

18
19
20
21 21.4 From how many suppliers did FBC request quotes to compile the station grade
22 estimate?
23

24 **Response:**

25 FBC obtained major material quotes from two different suppliers known to conform to FBC
26 equipment standards. For the remaining material, FBC relied on actual data from ongoing
27 capital projects and pricing from the FBC procurement department, which actively obtains
28 vendor quotes for FBC standard stock items to ensure FBC is getting fair value.

29

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1 22. **Reference: Exhibit B-1 page 41**

6.1.2 Transmission and Distribution

Transmission and distribution work will begin in 2020 after GFT T2 is installed. It is expected to take two years for 9L and 10L to be removed or have a portion repurposed for distribution. Work will occur primarily outside of winter. Transmission line work activities will be confined to existing FBC rights-of-way (ROW) and access roads. Distribution ROW will need to be acquired for the 9L and 10L distribution repurposing work.

Table 6-3 details the Project estimate which includes transmission line and conductor removal, distribution repurposing, recommended urgent work to stabilize the lines, and access road re-establishment. Conductor salvage credits are included in the net removal cost; based on \$2.50 per pound of copper which is subject to market changes.

The detailed cost estimate for the transmission and distribution work is provided in the 9L and 10L condition assessment report in Confidential Appendix C.²³

2

Table 6-3: Transmission and Distribution Capital Cost Summary (\$000)

Particular	2018 \$	As-spent \$
Pre-Approval Costs	87	87
Construction	2,137	2,229
Contingency	427	446
AFUDC		90
Subtotal – Construction	2,652	2,852
Net Removal Costs	3,429	3,578
Contingency	857	894
AFUDC		128
Subtotal – Net Removal	4,286	4,600
Total T&D Costs	6,938	7,452

3

- 4 22.1 Please explain how FBC will acquire the Distribution ROW need for the 9L and
 5 10L distribution work and provide quantification for costs. Please provide
 6 confidentially if necessary.

7

8 **Response:**

9 A portion of this response is being filed confidentially with the BCUC. FBC is requesting that
 10 this information be filed on a confidential basis pursuant to Section 18 of the BCUC's Rules of
 11 Practice and Procedure regarding confidential documents adopted by Order G-15-19, as it
 12 contains commercially sensitive information that if disclosed, could negatively impact future
 13 contract negotiations.

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- 1 FBC will attempt to negotiate with private property owners for sufficient land rights. Crown
2 rights will be applied for through the standard FrontCounterBC process. The current cost
3 estimate including documentation and survey is [REDACTED]
4

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1 23. **Reference: Exhibit B-1, page 42**

1 | **6.1.3 Project Contingency Model and Determination of Project Contingency**

- 1 | Contingency has been applied to the Project to account for certain items, conditions, or events
 1 | which may occur throughout the Project lifecycle. A contingency of 17.7 percent (including
 1 | Project loadings) was used for the stations component and a contingency of 20 percent was
 1 | used for the transmission and distribution component.

2

3 23.1 Please provide the rationale for the Contingency of 17.7% for the stations
 4 component. Please provide confidentially if necessary.

5

6 **Response:**

7 This response is being filed confidentially with the BCUC. FBC is requesting that this
 8 information be filed on a confidential basis pursuant to Section 18 of the BCUC's Rules of
 9 Practice and Procedure regarding confidential documents adopted by Order G-15-19, as it
 10 contains commercially sensitive information that if disclosed, could negatively impact future
 11 contract negotiations.

12 [REDACTED]

13 [REDACTED]

14 [REDACTED]

15 [REDACTED]

16 [REDACTED]

17 [REDACTED]

18 [REDACTED]

19 [REDACTED]

20

21

22

23 23.2 Please provide the basis for the Contingency of 20% for the transmission and
 24 distribution equipment and explain why it differs from the stations component.
 25 Please provide confidentially if necessary.

26

27 **Response:**

28 The contingency of 20 percent for the transmission and distribution portion of the project was
 29 selected by the independent contractor, DBS Energy Inc., who performed the condition

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1 assessment for 9L and 10L between CHR and CSC. Please refer to Section 4.4 in Confidential
2 Appendix C (9L and 10L Condition Assessment Report).

3

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1 **24. Reference: Exhibit B-1, page 42**

6.2 *OPERATION AND MAINTENANCE*

FBC expects that the retirement of 9L and 10L transmission lines will reduce transmission line O&M expenditures by approximately \$60 thousand per year and reduce brushing costs by an average of \$31 thousand per year. However, it is expected that O&M expenditures related to substation equipment will increase by approximately \$5 thousand per year. Overall, the Project is expected to reduce net O&M expenditures by approximately \$85 thousand²⁴ annually starting in 2021.

2

3 24.1 Please provide the sources of information that FBC used to develop its O&M
 4 expenditure reduction assessment.

5

6 **Response:**

7 DBS Energy Inc. estimated that if 9L and 10L were rehabilitated between CHR and CSC, the
 8 ongoing transmission O&M costs would be \$80,000/year (2018\$), which was assumed to be the
 9 annual average O&M at 0.5 percent of total line capital replacement cost.

10 In Alternative B, as 44.6 km of 9L and 10L between CHR and CSC are proposed to be
 11 removed, FBC assumed that there would be a transmission savings of \$60,000/year (2018\$).
 12 The annual vegetation management cost saving was determined using estimates from
 13 contractors in coordination with historical vegetation management costs over the past 10 years.
 14 Finally, incremental costs required to maintain a second transformer at GFT were estimated to
 15 be \$5,000/year (2018\$).

16

17

18

19 24.2 Why are O&M expenditures related to substation equipment likely to rise by
 20 \$5000? Please explain.

21

22 **Response:**

23 Please refer to the response to CEC IR 1.24.1.

24

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1 **25. Reference: Exhibit B-1, page 39 and page 43**

As previously discussed, the recommended alternative for the Project is Alternative B, which includes:

- Installing a second transformer at Grand Forks Terminal Station (GFT) by purchasing a new 161/63kV transformer as described in the Application; and
- Removing 44.6 km of the transmission lines 9 Line (9L) and 10 Line (10L) from CHR to CSC, and repurposing 20.8 km of transmission lines 9L and 10L to distribution lines.

2

6.3.1 Retirement of Existing Assets

As described in Section 3.3.2, a portion of the 9L and 10L transmission lines will be removed, sold for scrap and retired from plant. The gross book value of the electric plant related to transmission lines 9L and 10L that is being retired from electric plant in service and also from accumulated depreciation is \$3.22 million. This retirement has been planned in two phases and will be recorded when the distribution conversion work enters rate base. The book value of the remaining portions of the 9L and 10L transmission lines that are to be repurposed as distribution lines will be reclassified as distribution assets. This reclassification has no impact on the financial analysis.

3

- 4 25.1 Are there functional, life expectancy, or other limitations associated with utilizing
 5 repurposed lines such as the 9L and 10L for distribution? Please explain and
 6 provide quantification of such limitations.

7

8 **Response:**

9 FBC does not expect there to be any limitations because any repurposed portion of 9L or 10L
 10 being used for distribution would be maintained to meet its needs for functionality and design
 11 requirement.

12

13

14

- 15 25.2 Will the repurposed lines likely be used immediately or go into inventory for some
 16 period? Please explain.

17

18 **Response:**

19 The repurposed lines are intended to be used immediately to provide service to customers
 20 between CHR and CSC.

21

22

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1
2 25.3 If the lines are not expected to be used immediately, when does FBC expect that
3 it will use them?
4

5 **Response:**

6 Please refer to the response to CEC IR 1.25.2.

7
8
9
10 25.4 Please provide quantification of the revenue FBC expects to receive from the
11 sale of the scrap portion of the transmission lines.
12

13 **Response:**

14 A portion of this response is being filed confidentially with the BCUC. FBC is requesting that
15 this information be filed on a confidential basis pursuant to Section 18 of the BCUC's Rules of
16 Practice and Procedure regarding confidential documents adopted by Order G-15-19, as it
17 contains commercially sensitive information that if disclosed, could negatively impact future
18 contract negotiations.

19 In Section 4.4 of the Confidential Appendix C (9L and 10L Condition Assessment), the
20 quantification of the revenue that FBC expects to receive from the sale of the scrap portion of
21 the transmission lines is identified as "Salvage Credits". The salvage credit is valued at
22 [REDACTED]

23
24
25
26 25.5 Please provide a brief discussion of FBC's experience using repurposed
27 transmission lines.
28

29 **Response:**

30 Many sections of the old 63 kV FBC transmission system have been repurposed to distribution
31 over the years. As an example, portions of the 9L and 10L between Midway and Greenwood
32 corridor were repurposed to distribution in 2009.

33

FortisBC Inc. (FBC or the Company) Application for a Certificate of Public Convenience and Necessity (CPCN) for the Grand Forks Terminal Station Reliability Project (the Application)	Submission Date: February 14, 2019
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1 **26. Reference: Exhibit B-1, page 44**

7.1 RELIABILITY CONSIDERATIONS

Typical industry transmission planning standards require the system to be planned such that all projected customer loads are served during normal operation (N-0)²⁵ and single contingency (N-1).²⁶ As such, FBC transmission planning criteria ensure customer load can be supplied in N-0 and N-1 conditions.

Mandatory Reliability Standards (MRS) do not apply to the 9L and 10L transmission lines or the GFT transformers since these elements are not included as part of the Bulk Electric System (BES). To be included as part of the BES, transmission lines need to be operated at 100 kV or higher and transformers require the primary terminal and at least one secondary terminal operated at 100 kV or higher.

2

3 26.1 Please describe the significance of the inapplicability of the MRS to the 9L and
 4 10L transmission lines or GFT transformers in this application.

5

6 **Response:**

7 Mandatory Reliability Standards (MRS) are only applicable to the Bulk Electric System (BES)
 8 elements. The transmission lines 9L and 10L and the Grand Forks transformers are not part of
 9 the BES. Since MRS do not apply, the Transmission Planning (TPL) standards are not
 10 applicable to these facilities. Therefore, FBC transmission planning criteria defines the
 11 requirements for the Grand Forks Terminal Station Reliability Project.

Attachment 7.1

REFER TO LIVE SPREADSHEET MODELS

Provided in electronic format only

(accessible by opening the Attachments Tab in Adobe)

Attachment 19.1

REFER TO LIVE SPREADSHEET MODELS

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FILED CONFIDENTIALLY

(accessible by opening the Attachments Tab in Adobe)