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September 5, 2023

British Columbia Public Interest Advocacy Centre
Suite 803 470 Granville Street
Vancouver, B.C.
V6C 1V5

Attention: Leigha Worth, Executive Director

Dear Leigha Worth:

Re: FortisBC Inc. (FBC)

Application for Approval of a Certificate of Public Convenience and Necessity for the A.S. Mawdsley Terminal Station Project (Application) ~ Project No. 1599424

Response to the British Columbia Public Interest Advocacy Centre representing BC Old Age Pensioners' Organization, Active Support Against Poverty, Council of Senior Citizens' Organizations of BC, Disability Alliance BC, and Tenant Resource and Advisory Centre (BCOAPO) Information Request (IR) No. 2

On February 24, 2023, FBC filed the Application referenced above. In accordance with the regulatory timetable established in BCUC Order G-70-23 and Exhibit A-9[1] for the review of the Application, FBC respectfully submits the attached response to BCOAPO IR No. 2.

If further information is required, please contact the undersigned.

Sincerely,

FORTISBC INC.

Original signed:

Sarah Walsh

Attachments

cc (email only): Commission Secretary
Registered Interveners

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[1] By letter dated August 23, 2023, the Panel granted FBC an extension to file its responses to IR No. 2 on Tuesday, September 5, 2023.

23.0 Reference: Exhibit B-4, BCUC 1.2.1 and 1.2.2

Exhibit B-6, BCOAPO 1.1.6

Exhibit B-1, page 18 (Tables 3-2 and 3-3)

Preamble: The responses state:

"ASM T1 and T2 are configured with a single high side circuit breaker to 11E Line. As a result, any transformer fault or bus fault results in an outage to both transformers and 11E Line. Post contingency flow with only one transformer in service results in that transformer being overloaded. Due to this overloading, FBC cannot currently maintain service to downstream load. FBC identified the potential for overloading in 2019.

In the event of an outage or failure of one of the two ASM transformers during peak periods, FBC would be forced to either shed load or reduce system reliability by opening 11E Line. Although the number of customers and amount of load needing to be shed will fluctuate based on how overloaded the remaining ASM transformer is, in the worst case scenario, up to 27,146[1] customers (all the customers in the Boundary and Similkameen area) could be impacted. By opening 11E Line, FBC reduces reliability of supply only to the Boundary region and if another contingency event occurred, it would cause a full blackout to the Boundary region.

Based on 2022 historical actuals, if a failure of one of the two ASM transformers occurred, the remaining transformer would have been overloaded for approximately 23 percent of the year." (BCUC 1.2.1)

"In the event of an outage or failure of both ASM transformers during peak periods, voltage collapse will occur when the Boundary and Similkameen area loads reach approximately 200 MW. Boundary and Similkameen area loads will need to be curtailed to under 200 MW until both transformers can be put back into service. The length of curtailment would depend on the severity of the transformer failure." (BCUC 1.2.2)

"During an 11E Line N-1 contingency event where the source to the Boundary and Similkameen load is only 40L (230 kV) and 42L (63 kV), the maximum Boundary and Similkameen area load before voltage collapse occurs is approximately 200 MW. This load limit is the same for both summer and winter." (BCOAPO 1.1.6)

23.1 Does the opening of the 11E Line have the same impact on the supply to the Boundary and Similkameen area as an outage of both transformers at ASM?

23.1.1 If not, please explain why.

Response:

Yes, the opening of 11E Line as described in the preamble to the question has the same impact on the supply to the Boundary and Similkameen areas as an outage of both transformers at the ASM Terminal Station.

23.2 The response to BCUC 1.2.1 states "As a result, any transformer fault or bus fault results in an outage to both transformers and 11E Line". For how long does the outage of both transformers and 11E Line last?

Response:

The duration of an outage of both transformers is determined by the severity of the fault, whereas the duration of an outage on 11E Line is determined by the location and severity of the fault. For example, a simple fault could result in an outage of hours, whereas a more serious fault, such as a transformer tap changer failure, could result in an outage of months.

23.2.1 Assuming no other outages during this period, what is the supply capability to the Boundary and Similkameen area? As part of the response, please indicate each point of supply and its associated capability under both normal and emergency conditions.

Response:

With both ASM transformers and 11E Line out of service, the remaining system can support approximately 200 MW of Boundary and Similkameen load. The remaining points of supply are BEN T1 (through 40 Line) and 42 Line to serve the Boundary and Similkameen areas. Both BEN T1 and 42 Line capabilities are shown in the table below; however, these ratings are not the limiting factor when determining how much load can be served in these regions. The limiting factor is the voltage, with voltage violations beginning to occur in the Boundary region with load levels higher than approximately 200 MW.

With both ASM transformers and 11E Line out of service, FBC's system reliability decreases to the Boundary region and if another contingency event occurred, it would cause a full blackout to the Boundary region.

Please also refer to the response to BCUC IR2 30.1.

Name	Summer Limits (MVA)		Winter Limits (MVA)	
	Normal	Emergency	Normal	Emergency
BEN T1	168	210	205	218
42L	66	73	92	97

23.3 The response to BCUC 1.2.1 states:

"Due to this overloading, FBC cannot currently maintain service to downstream load. FBC identified the potential for overloading in 2019.

In the event of an outage or failure of one of the two ASM transformers during peak periods, FBC would be forced to either shed load or reduce system reliability by opening 11E Line. Although the number of customers and amount of load needing to be shed will fluctuate based on how overloaded the remaining ASM transformer is, in the worst case scenario, up to 27,1461 customers (all the customers in the Boundary and Similkameen area) could be impacted."

Please confirm that, based on the responses to BCUC 1.2.2 and BCOAPO 1.1.6, with Line 11E open (or unavailable) FBC can reliably serve up to 200 MW of load in the Boundary and Similkameen area. If not confirmed, please explain why.

Response:

Confirmed; however, as explained in the response to BCOAPO IR2 23.2.1, this is not a long-term solution.

23.3.1 Exhibit B1, Tables 3-2 and 3-3 indicate that peak load in the Boundary and Similkameen area has been and will be (until 2034 per BCUC 1.2.13) less than 200 MW. Given the responses to BCOAPO 1.1.6 and BCUC 1.2.2, why would it be necessary to shed load in the Boundary and Similkameen area following the failure of one of the two ASM transformers? Why can't the 11E Line be opened instead, with no customers impacted?

Response:

The two referenced IRs (BCOAPO IR1 1.6 and BCUC IR1 2.2) are in regard to voltage violations when both ASM transformers and/or 11E Line are out of service. In these scenarios, 11E Line is already open and the Boundary and Similkameen area load is already being supplied by 40 Line and 42 Line. Please also refer to the response to BCOAPO IR2 23.2.1.

23.4 The response states "Post contingency flow with only one transformer in service results in that transformer being overloaded." Assuming no other outages during this period, what is the supply capability to the Boundary and Similkameen area with one ASM transformer in service? As part of the response, please indicate each point of supply and its associated capability under both normal and emergency conditions.

23.4.1 Why is it not possible to address the overloading on the remaining transformer by increasing supply to the Boundary and Similkameen area from one of these other supply points?

Response:

The supply capability of each point of supply when only one ASM transformer is in service is provided in the table below. FBC notes that the actual flow through each point of supply is determined by the overall provincial generation dispatch and the network configuration. The provincial generation dispatch is decided by BC Hydro (Balancing Authority) and the network configuration is then determined by the actual system conditions at that time; therefore, FBC is not able to simply increase supply from other points if only one ASM transformer is in service. The above factors cause the majority of the Boundary and Similkameen area load to be served from the ASM Terminal Station.

Name	Summer Limits (MVA)		Winter Limits (MVA)	
	Normal	Emergency	Normal	Emergency
BEN T1	168	210	205	218
ASM T1/T2	80	100	88	108
42L	66	73	92	97

23.5 The response states "By opening 11E Line, FBC reduces reliability of supply only to the Boundary region and if another contingency event occurred, it would cause a full blackout to the Boundary region" – (emphasis added). Please explain why opening 11E Line only reduces the reliability of supply to the Boundary region and not also the Similkameen region.

Response:

When 11E Line is opened it causes the Boundary region to be fed radially from 48 Line through the Bentley Station with no redundancy. Thus, the next outage of 48 Line will cause a full blackout to the Boundary region as there is no other supply to the region.

This is not the case in the Similkameen area due to the possibility to transfer load to BC Hydro or to feed load through 42 Line or 40 Line. However, transferring load to BC Hydro is not always a reliable or available solution as detailed in the response to BCUC IR2 28.2.

24.0 Reference: Exhibit B-4, BCUC 1.2.1 and 1.2.11

Exhibit B-6, BCOAPO 1.2.6

Exhibit B-7, CEC 1.5.6

Exhibit B-1, page 19 (Figure 3-7)

Preamble: The responses state:

"Based on 2022 historical actuals, if a failure of one of the two ASM transformers occurred, the remaining transformer would have been overloaded for approximately 23 percent of the year". (BCUC 1.2.1)

"The load flow through the ASM transformers is determined by three main factors: (1) the Boundary and Similkameen load (i.e., customer demand); (2) generation dispatch (with generation from the Waneta hydroelectricity facility (WAN) having the greatest impact)2; and (3) system configuration. The fluctuations shown in the actual winter peak load flow values in the Updated Table 3-2 above are mainly due to the fluctuations in WAN generation dispatch. The summer peak load flow is more consistent because typically WAN generating units are all online during this time. This generated power flows through the ASM Terminal Station (and through FBC's service territory) to serve the Boundary and Similkameen area loads and at some points to other parts of FBC's service territory to be used outside the Boundary and Similkameen area. Therefore, peak loads as measured at the ASM Terminal Station differ from the peak loads for the area presented in Tables 3-2 and 3-3 of the Application." (BCUC 1.2.11)

"FBC provides the following table showing the number of instances, hours and percentage of the year where load exceeded the capabilities of one ASM transformer. FBC clarifies that for all of these instances, both transformers were in service and thus not overloaded". (CEC 1.5.6)

24.1 With respect to Figure 3-7, please confirm that (per CEC 1.5.6) both ASM transformers were available at the time of the actual winter and summer peaks for 2017 through 2022?

<u>Response:</u>

Confirmed, both ASM transformers were available at the time of the actual summer and winter peaks from 2017 through 2022.

24.2 With respect to CEC 1.5.6, if in any of the instances noted only one transformer had been in service would the actions need to address potential overloading of the remaining transformer have results in the shedding or curtailing of customer load?

24.2.1 If yes, please explain why. As part of the response please indicate if the fact power flowing through ASM serves load outside of the Boundary and Similkameen area (per BCUC 1.2.11) would have contributed to the need to shed/curtail load.

Response:

Although shedding load is an operator action at FBC's disposal to alleviate ASM transformer overloading, it would not be undertaken in the scenarios referenced in CEC IR1 5.6. The shedding or curtailing of load is always used as a last resort if no other options are available. Under these scenarios, FBC would instead open the 11 Line path to correct the overloading. However, the opening of 11 Line is a corrective operator action that violates FBC's Transmission Planning Criteria. Thus, it is not an alternative to this Project.

25.0 Reference: Exhibit B-4, BCUC 1.2.11 and 1.2.19

Exhibit B-6, BCOAPO 1.2.6

Exhibit B-1, page 18 (Table 3-2)

Preamble: The responses state:

"The peak loads shown in Tables 3-2 and 3-3 are representative of FBC customer loads (i.e., customer demand) in the area only, whereas peak loads at the ASM Terminal Station include load flows for other reasons besides customer loads and therefore, in some cases, peak loads as measured at the ASM Terminal Station (shown in the Updated Table 3-2 below) are higher than the peak loads shown in Table 3-2 of the Application.". (BCUC 1.2.11)

"The fluctuations shown in the actual winter peak load flow values in the Updated Table 3-2 above are mainly due to the fluctuations in WAN generation dispatch. The summer peak load flow is more consistent because typically WAN generating units are all online during this time. This generated power flows through the ASM Terminal Station (and through FBC's service territory) to serve the Boundary and Similkameen area loads and at some points to other parts of FBC's service territory to be used outside the Boundary and Similkameen area. Therefore, peak loads as measured at the ASM Terminal Station differ from the peak loads for the area presented in Tables 3-2 and 3-3 of the Application. " (BCUC 1.2.11)

"To calculate the actual historical values in Table 3-2, historical data was used for 34 Line, 40 Line and 42 Line. These three lines feed the Boundary and Similkameen area loads. From this data, a percentage was calculated identifying how much of the Boundary and Similkameen area load was served from the ASM transformers (34 Line). The table below shows the historical percentages that were calculated.". (BCUC 1.2.19)

"The historical (2017-2022) summer and winter peak loads for the Boundary and Similkameen areas are provided in Table 3-2 of the Application.

The following tables show the distribution of load served from each of the ASM Terminal Station and the Bentley (BEN) Terminal Station. The remaining load is served from 42 Line.

Please also refer to the response to BCUC IR1 2.11 for an explanation why the peak loads shown in the tables below are not directly comparable to the peak loads shown in Table 3-2 of the Application. The factors impacting the ASM Terminal Station peak load flows set out in the response to BCUC IR1 2.11 also impact the peak load flows at the BEN Terminal Station." (BCOAPO 1.2.6)

25.1 BCOAPO 1.2.6 requested the history of the Boundary and Similkameen area load served from ASM and BEN. The values for ASM provided in the response to BCOAPO 1.2.6 match those provided in BCUC 1.2.11 (Updated Table 3-2). However, according to BCUC 1.2.11 the Updated Table 3-2 also includes load flows for other reasons (e.g. to meet serve loads outside the Boundary and Similkameen area). Please reconcile and clarify whether the response BCOAPO 1.2.6 provides the total peak for ASM or the portion of the ASM peak serving loads in the Boundary and Similkameen area.

Response:

The response to BCOAPO IR1 2.6 provides the total peak load for the ASM Terminal Station. For the reasons set out in the response to BCUC IR1 2.11, FBC is not able to break out only the ASM Terminal Station peak loads served in the Boundary and Similkameen area.

25.2 With respect to BCUC 1.2.19, do the peak load levels determined for the 34 Line include loads used to service areas outside of the Boundary and Similkameen area?

25.2.1 If not, please explain why given Line 34 is the only supply to ASM and, according to BCUC 1.2.11, ASM loads include loads to serve areas outside of the Boundary and Similkameen area.

25.2.2 If yes, why is it appropriate to use the 34L Line load to determine the portion of the ASM peak serving loads in the Boundary and Similkameen area?

Response:

The peak loads identified in the response to BCUC IR1 2.19 serve the Boundary and Similkameen area loads and, depending on the system configuration at that time, serve other parts of FBC's service territory outside the Boundary and Similkameen area as well.

It is appropriate to use 34 Line load to determine the portion of ASM peak serving loads in the Boundary and Similkameen area because the load flow through 34 Line will be the same as the load flow through the ASM Terminal Station.

26.0 Reference: Exhibit B-4, BCUC 1.2.2, 1.2.13, 1.2.15 and 1.2.19

Exhibit B-6, BCOAPO 1.1.6

Exhibit B-1, page 12 (Figure 3-2) and page 19

Preamble: The responses state:

"In the event of an outage or failure of both ASM transformers during peak periods, voltage collapse will occur when the Boundary and Similkameen area loads reach approximately 200 MW. Boundary and Similkameen area loads will need to be curtailed to under 200 MW until <u>both</u> transformers can be put back into service. The length of curtailment would depend on the severity of the transformer failure." (emphasis added - BCUC 1.2.2)

"To calculate the actual historical values in Table 3-2, historical data was used for 34 Line, 40 Line and 42 Line. These three lines feed the Boundary and Similkameen area loads. From this data, percentage was calculated identifying how much of the Boundary and Similkameen area load was served from the ASM transformers (34 Line)." (BCUC 1.2.19)

"During an 11E Line N-1 contingency event where the source to the Boundary and Similkameen load is only 40L (230 kV) and 42L (63 kV), the maximum Boundary and Similkameen area load before voltage collapse occurs is approximately 200 MW. This load limit is the same for both summer and winter." (BCOAPO 1.1.6)

26.1 The response to BCUC 1.2.15 confirms that the Boundary and Similkameen area load is supplied from two sources (i.e., via ASM and by the interconnection to British Columbia Hydro and Power Authority (BC Hydro) at Vaseux Lake Terminal Station). However, the response to BCUC 2.1.19 indicates there are three sources of supply. Please reconcile:

<u>Response:</u>

FBC confirms that there are only two sources of supply to the Boundary and Similkameen area:

1. the ASM Terminal Station; and
2. the interconnection to BC Hydro at the Vaseux Lake Terminal Station.

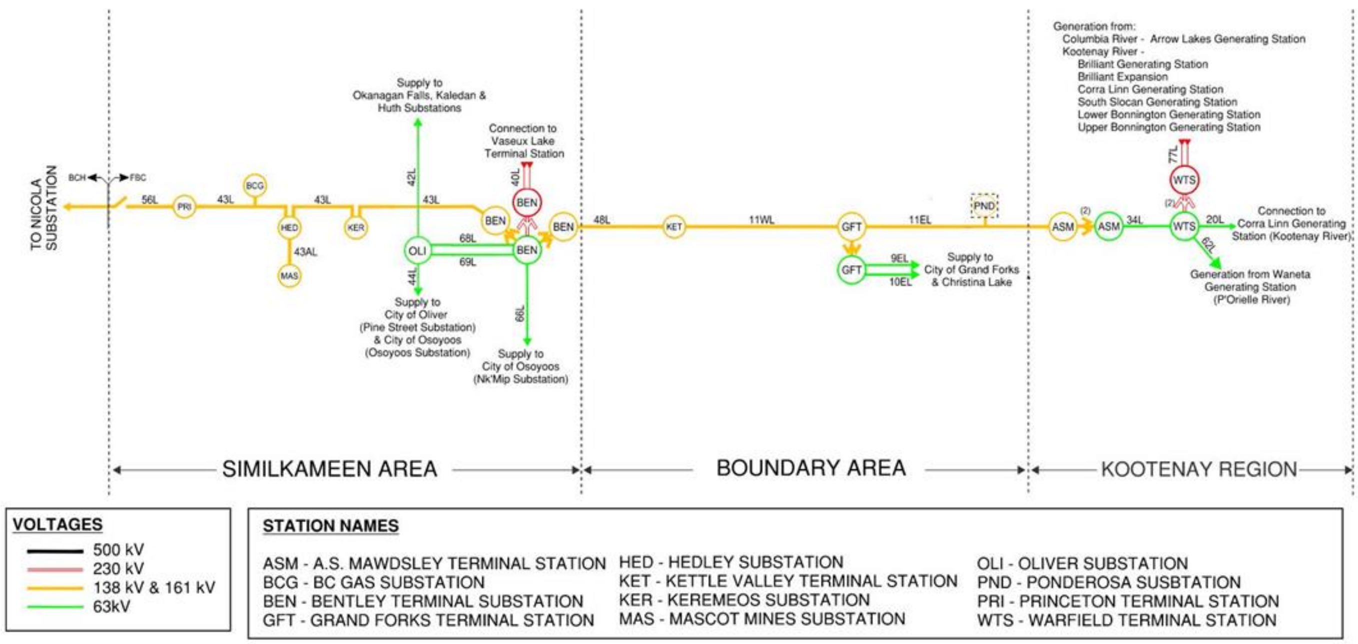
These two sources of supply (i.e., two stations) are fed through three transmission lines that supply or feed the Boundary and Similkameen area:

1. 34 Line (through the ASM Terminal Station);

2. 40 Line (from the Vaseaux Lake Terminal Station); and
3. 42 Line (from the Vaseaux Lake Terminal Station via Huth to the Oliver Substation). 42 Line is a redundant loop configuration and depending on system load, generation dispatch, and system configuration, 42 Line can supply north to the Okanagan Falls, Kaledan and Huth regions or can feed south to the Oliver region.

The following updated Figure 3-2 shows the addition of 42 Line, which is an approximately 36 km transmission line at 63 kV from Huth to the Oliver Substation.

Updated Figure 3-2: Boundary and Similkameen Power Supply Single Line Diagram with the Addition of 42 Line



The supply capability of 42 Line, set out in the following table, is able to meet the increasing Boundary and Similkameen load for the current planning horizon.

Table 1: 42 Line Summer and Winter Supply Capability

	Normal (MVA)	Emergency (MVA)
Summer	66	73
Winter	92	97

26.2 The line 42L referenced in the response to BCOAPO 1.1.6 does not appear on Figure 3-2. Please provide a revised Figure 3-2 that includes 42L.

26.2.1 Please describe the nature of 42L (i.e., single or multiple circuit), its role and its supply capability.

26.2.2 Please comment on the capability of 42L to meet the increasing Boundary and Similkameen area loads.

Response:

Please refer to the response to BCOAPO IR2 26.1.

26.3 If not provided in the response to the preceding question, please describe the make-up of the 200 MW of supply capability to the Boundary and Similkameen area when both ASM transformers are not available.

Response:

Please refer to the response to BCOAPO IR2 23.2.1.

26.3.1 Please reconcile the 200 MW with the response to BCOAPO 1.2.2 which indicates the summer and winter capabilities of the Bentley Substation are 168 MVA and 205 MVA respectively.

Response:

The response to BCOAPO IR1 2.2 provides the summer and winter normal capabilities of the Bentley Substation (BEN T1). The summer and winter emergency capabilities for BEN T1 are shown below:

Name	Summer (MVA)	Winter (MVA)
BEN T1	210	218

When both ASM transformers are unavailable, the Boundary and Similkameen area loads will be served from 40 Line and 42 Line.

26.4 Exhibit B-1 (page 19) indicates that new loads and generation conditions have resulted in ASM exceeding the N-1 planning criteria. However, BCUC 1.2.2 states that outage or failure of both ASM transformers during peak periods, voltage collapse will occur when the Boundary and Similkameen area loads reach approximately 200 MW while BCUC 1.2.13 shows that Boundary and Similkameen area loads are currently less than 200 MW (and will remain so until 2030). Based on the foregoing, is it the need for ASM to also manage the flow of generation to points outside of the Boundary and Similkameen areas (as opposed to just load growth in these areas) that is resulting in ASM currently exceeding the N-1 planning criteria?

Response:

Yes, the ASM transformers need to manage the flow of generation as well as load growth in the area.

26.5 Please explain why the Boundary and Similkameen area loads will need to be curtailed to under 200 MW until both ASM transformers can be put back into service. Why wouldn't the capability to supply the Boundary and Similkameen area increase when just one of the transformers was put back into service?

Response:

In the case where a single ASM transformer is put back into service after an outage to both transformers, the capability to supply the Boundary and Similkameen area load would increase; however, the single ASM transformer that is back in service would be overloaded and exceed its emergency rating unless the Boundary and Similkameen area load is curtailed to under 200 MW.

27.0 Reference: Exhibit B-4, BCUC 1.2.4

Preamble: The Response states:

> "FBC notes that transformers have various functional failures; not all functional failures impede a power transformer's ability to perform its primary function. In the case of ASM T1 and T2, the primary function is to convert electricity from 63 kV to 161 kV. The table below lists the historical failure data for ASM T1 and T2, regardless of functional failure type and system impact."

27.1 Which of the noted failures impacted the station's ability to supply load to the Boundary and Similkameen area.

Response:

With the exception of three entries in the table provided in the response to BCUC IR1 2.4 (i.e., the December 20, 2018 entry, the December 2, 2019 entry, and the 2022-Present entry), all of the outages/failures listed in the table were events that impacted the station's ability to supply load to the Boundary and Similkameen area.

FBC has revised the table provided in the response to BCUC IR1 2.4 below to only include the events that impacted the station's ability to supply load. FBC has also included a new "Impacts" column in the table, which indicates whether the actual supply of load to the Boundary and Similkameen area was impacted for each entry.

<table>
<tr><th>Date</th><th>Element</th><th>Outage /Failure</th><th>Supply of Load to the Boundary and Similkameen Impacted (Y/N)</th><th>Description</th></tr>
<tr><td>May 16, 2018</td><td>Station</td><td>Outage</td><td rowspan="8">No</td><td rowspan="8">Only ASM Terminal Station's ability to supply load impacted. System redundancy supplied load until ASM restored.</td></tr>
<tr><td>Oct. 22 - 26, 2018</td><td>Station</td><td>Outage</td></tr>
<tr><td>Oct. 30, 2018</td><td>Station</td><td>Outage</td></tr>
<tr><td>Nov. 20, 2018</td><td>ASM T2</td><td>Failure & Outage</td></tr>
<tr><td>Mar. 26-27, 2019</td><td>Station</td><td>Outage</td></tr>
<tr><td>July 25, 2019</td><td>Station</td><td>Outage</td></tr>
<tr><td>Oct. 21–23, 2019</td><td>Station</td><td>Outage</td></tr>
<tr><td>Oct. 28 – Nov.1, 2019</td><td>ASM T2</td><td>Failure & Outage</td></tr>
</table>

<table>
<tr><th>Date</th><th>Element</th><th>Outage /Failure</th><th>Supply of Load to the Boundary and Similkameen Impacted (Y/N)</th><th>Description</th></tr>
<tr><td>Feb. 1, 2020</td><td>Station</td><td>Outage</td><td rowspan="4">Yes</td><td rowspan="4">Implemented system load reductions.</td></tr>
<tr><td>Feb. 7 - 8, 2020</td><td>Station</td><td>Outage</td></tr>
<tr><td>Jun. 7, 2020</td><td>Station</td><td>Outage</td></tr>
<tr><td>Jan. 2, 2021</td><td>Station</td><td>Outage</td></tr>
<tr><td>May 27, 2021</td><td>Station</td><td>Outage</td><td>No</td><td>Only ASM Terminal Station's ability to supply load impacted. System redundancy supplied load until ASM restored.</td></tr>
<tr><td>Jun. 1-2, 2021</td><td>Station</td><td>Outage</td><td>Yes</td><td>Implemented system load reductions.</td></tr>
<tr><td>Sep. 7-10, 2021</td><td>ASM T1</td><td>Outage</td><td>No</td><td>Only ASM Terminal Station's ability to supply load impacted. System redundancy supplied load until ASM restored.</td></tr>
<tr><td>Oct. 9-20, 2021</td><td>Station</td><td>Outage</td><td>Yes</td><td>Implemented intermittent system load reductions.</td></tr>
<tr><td>May 7, 2022</td><td>Station</td><td>Outage</td><td>No</td><td>Only ASM Terminal Station's ability to supply load impacted. System redundancy supplied load until ASM restored.</td></tr>
<tr><td>Jun. 13 - 24, 2022</td><td>Station</td><td>Outage</td><td rowspan="2">Yes</td><td rowspan="2">Implemented intermittent system load reductions.</td></tr>
<tr><td>Oct. 9, 2022</td><td>Station</td><td>Outage</td></tr>
<tr><td>May 23-26, 2023</td><td>ASM T1</td><td>Outage</td><td rowspan="2">No</td><td rowspan="2">Only ASM Terminal Station's ability to supply load impacted. System redundancy supplied load until ASM restored.</td></tr>
<tr><td>May 29 - Jun. 2, 2023</td><td>ASM T2</td><td>Outage</td></tr>
</table>

27.2 Did any of the failures actually impact the supply of load to the Boundary and Similkameen area?

Response:

Please refer to the response to BCOAPO IR2 27.1.

28.0 Reference: Exhibit B-4, BCUC 1.2.6; 1.2.13 and 1.2.14

Exhibit B-6, BCOAPO 1.1.3; 1.1.4 and 1.2.3

Exhibit B-1, page 19

Preamble: The responses state:

"Yes, all parts of FBC's interconnected system achieve N-1 planning criteria. Currently there are no other N-1 contingencies that are not satisfied within FBC's system. As the load grows, reinforcement plans will be applied so that the N-1 planning criteria is met." (BCUC 1.2.6)

"During a 34 Line N-1 contingency event where the source to the Boundary and Similkameen load is only 40 Line (230 kV) and 42 Line (63 kV), the maximum Boundary and Similkameen area load before voltage collapse occurs is approximately 200 MW. This load limit is the same for both summer and winter." (BCOAPO 1.1.3)

"During an 11E Line N-1 contingency event where the source to the Boundary and Similkameen load is only 40L (230 kV) and 42L (63 kV), the maximum Boundary and Similkameen area load before voltage collapse occurs is approximately 200 MW. This load limit is the same for both summer and winter." (BCOAPO 1.1.6)

"During a 40L or BEN T1 contingency event, the maximum Boundary and Similkameen area load before voltage collapse occurs is approximately 190 MW. This load limit is the same for both summer and winter." (BCOAPO 1.2.3)

"In the Kootenay region, FBC has planned upgrades to 20 Line to provide adequate capacity during normal and single contingency conditions. This upgrade project was identified in FBC's 2021 Long Term Electric Resource Plan (LTERP) as taking place in the 2028-2029 timeframe (Table 6-3, page 130).

For the Boundary and Similkameen areas, in addition to the ASM Terminal Station CPCN Project, FBC is planning to undertake a transmission project within the next 10 years which involves the addition of a second 230 kV line from Vaseux Lake to Bentley station and the addition of a second 168 MVA (230/63 kV) transformer at Bentley. The purpose of this project is to prevent voltage instability in the case of a 40 Line N-1 contingency by providing a secondary path from Vaseux Lake to Bentley. As currently configured, the Similkameen region will experience low voltage violations when the combined load of the Similkameen and Boundary regions reaches approximately 190 MW. FBC notes that this transmission project was not included in FBC's 2021 LTERP because at the time the LTERP was developed, FBC was able to offload to BC Hydro through 56 Line when necessary. This operational procedure is no longer available to FBC due to a BC Hydro large load customer that is limiting the amount of load FBC can transfer." (BCUC 1.2.14)

28.1 Please clarify whether the first two sentences in the response to BCUC 1.2.6 are meant to infer that: i) all parts of FBC's interconnected system achieve N-1 planning criteria or ii) all parts of FBC's interconnected system except for the AMS Terminal Station achieve N-1 planning criteria.

Response:

The first two sentences in the response to BCUC IR1 2.6 are meant to confirm that all parts of FBC's interconnected system achieve N-1 planning criteria with the exception of the ASM Terminal Station. Currently, during a single contingency (N-1) event, a single ASM Terminal Station transformer is not able to meet current customer loads (i.e., the remaining transformer would be overloaded).

Further, both 34 Line and 11E Line, and 40 Line and BEN T1, currently achieve N-1 planning criteria, but as loads grow in the Boundary and Similkameen areas, they will start to violate N-1 planning criteria. Currently, during N-1 contingency events for 34 Line, 11E Line, 40 Line or BEN T1, there are no planning criteria violations because current load is still able to be served from alternative sources.

28.2 Please explain why the AMS Terminal Station does not currently achieve the N-1 planning criteria (per Exhibit B-1, page 19) but (according to BCUC 1.2.6) lines 34L and 11EL do.

Response:

Please refer to the response to BCOAPO IR2 28.1.

28.3 Please explain why the AMS Terminal Station does not currently achieve the N-1 planning criteria (per Exhibit B-1, page 19) but (according to BCUC 1.2.6) line 40L and BEN do.

Response:

Please refer to the response to BCOAPO IR2 28.1.

28.4 Please confirm that (per BCUC 1.2.13) the forecast load for the Boundary and Similkameen areas is expect to reach 190 MW such that line 40L and BEN will not achieve the N-1 planning criteria in 2030.

Response:

Confirmed. As noted in the response to BCUC IR1 2.14, FBC is planning to undertake a transmission project within the next 10 years which involves the addition of a second 230 kV line from Vaseux Lake to the Bentley station and the addition of a second 168 MVA (230/63 kV) transformer at Bentley. The purpose of this project is to prevent voltage instability in the case of a 40 Line N-1 contingency by providing a secondary path from Vaseux Lake to Bentley. As currently configured, the Similkameen region will experience low voltage violations when the combined load of the Similkameen and Boundary regions reaches approximately 190 MW.

28.4.1 What plans, if any, does FBC have to address BEN not achieving the N-1 planning criteria in 2030?

Response:

Please refer to the responses to BCOAPO IR2 28.4 and BCUC IR1 2.14.

28.5 Please confirm that (per BCUC 1.2.13) the forecast load for the Boundary and Similkameen areas expect to reach 200 MW such that line 34L and 11EL will not achieve the N-1 planning criteria in 2034.

Response:

FBC confirms that, in the absence of this Project and based on the forecast load, 34 Line and 11E Line will not meet the N-1 planning criteria in 2034.

28.5.1 Please confirm that the current project addresses the future issue regarding 34L not achieving the N-1 planning criterial in 2034. If not, please explain why not and what FBC's future plans to address this issue are.

Response:

Confirmed.

28.5.2 What plans, if any, does FBC have to address 11EL not achieving the N-1 planning criteria in 2034?

Response:

In addition to this Project, FBC anticipates the need to install a capacitor bank near the Ponderosa substation in the Boundary region to address the voltage violations that are forecast to occur in 2034 during an 11E Line N-1 contingency event. As explained in the response to BCOAPO IR1 1.6, during an 11E Line N-1 contingency event, where the source to the Boundary and Similkameen area load is only 40 Line (230 kV) and 42 Line (63 kV), the maximum Boundary and Similkameen area load before voltage collapse occurs is approximately 200 MW.

29.0 Reference: Exhibit B-4, BCUC 1.2.11

Exhibit B-1, page 12 (Figure 3-2)

Preamble: The response states:

"The load flow through the ASM transformers is determined by three main factors: (1) the Boundary and Similkameen load (i.e., customer demand); (2) generation dispatch (with generation from the Waneta hydroelectricity facility (WAN) having the greatest impact); and (3) system configuration.

The fluctuations shown in the actual winter peak load flow values in the Updated Table 3-2 above are mainly due to the fluctuations in WAN generation dispatch. The summer peak load flow is more consistent because typically WAN generating units are all online during this time. This generated power flows through the ASM Terminal Station (and through FBC's service territory) to serve the Boundary and Similkameen area loads and at some points to other parts of FBC's service territory to be used outside the Boundary and Similkameen area. Therefore, peak loads as measured at the ASM Terminal Station differ from the peak loads for the area presented in Tables 3-2 and 3-3 of the Application.

The forecast values shown in the Updated Table 3-3 below use a calculated average of historical contributions of the ASM Terminal Station and BEN Terminal Station to the Boundary and Similkameen load. This causes the forecast to be more consistent (i.e., less fluctuations) as compared to the historical values."

29.1 Please explain how power generated at WAN flows through the ASM Terminal Station to serve parts of FBC's service territory other than the Boundary and Similkameen area loads. In particular, please explain i) what other parts of FBC's system are being served via the ASM Terminal Station, ii) how (with reference to Figure 3-2) they are connected to ASM and iii) how are the loads in these areas served when WAN is not generating (or only generating at lower levels of output).

Response:

FBC provides the following explanations:

i) The other parts of the system that the ASM Terminal Station can serve are the Okanagan Falls, Kaleden and Huth substations.

ii) Please refer to the updated line diagram (Updated Figure 3-2) provided in the response to BCOAPO IR2 26.1 which shows how these substations are connected to ASM.

iii) Loads in these areas are served from the Vaseux Lake substation when WAN generation is low.

29.2 Please explain how the ASM Terminal Station Peak Load Forecast for 2023-2027 (per BCUC 1.2.11, Updated Table 3-3) accounts for this additional flow through the ASM Terminal Station to serve parts of FBC's service territory other than the Boundary and Similkameen area loads.

29.2.1 If Updated Table 3-3 does not account for these loads, please provide a revised version that does.

Response:

The forecast values shown in the Updated Table 3-3 use a calculated average of historical contributions of the ASM Terminal Station and the BEN Terminal Station. Using historical actuals ensures the portion of additional flow through the ASM Terminal Station to serve parts of FBC's service territory other than the Boundary and Similkameen area loads are incorporated in the Updated Table 3-3.

30.0 Reference: Exhibit B-4, BCUC 1.2.11

Exhibit B-6, BCOAPO 1.9.1

Preamble: The responses state:

"The forecast values shown in the Updated Table 3-3 below use a calculated average of historical contributions of the ASM Terminal Station and BEN Terminal Station to the Boundary and Similkameen load. This causes the forecast to be more consistent (i.e., less fluctuations) as compared to the historical values." (BCUC 1.2.11)

"No, it is not possible to increase the supply of power from the transmission interconnection to BC Hydro at Vaseux Lake Terminal Station based on the current facilities in place or if upgrades were undertaken on FBC's facilities." (BCOAPO 1.9.1)

30.1 Please explain why, for purposes of forecasting the ASM Terminal Station peak load FBC applied the historic percentage of load supplied to the Boundary and Similkameen area from BCH's Vaseux Lake Terminal Station via 40L and BEN when, according to BCOAPO 1.9.1, supply from BCH's Vaseux Lake Terminal Station cannot be increased. If the supply from Vaseux cannot be increased wouldn't all of the increase in the Boundary and Similkameen area load increase (or most depending upon the capability of 42L) have to be supplied via ASM?

<u>Response:</u>

The response to BCOAPO IR1 9.1 was answered in the full context of BCOAPO IR1 9.1.3 and 9.1.4, which asked if the VAS Terminal Station could be used to offset load growth while keeping the ASM Terminal Station transformers the same size.

FBC clarifies that the supply from the VAS Terminal Station will increase as the Boundary and Similkameen load increases, but not to the extent where it eliminates the need for an upgrade to the ASM Terminal Station transformers.

The proportion of load served by the ASM Terminal Station versus the VAS Terminal Station depends on the following factors:

- **Boundary and Similkameen area load.** FBC has been seeing increased demand in recent years, specifically with industrial load which has had a greater impact on ASM transformer loadings because of where the increased load is situated.
- **Provincial generation dispatch** (with Waneta Hydro Station generation having the greatest impact). Waneta generation will have more of an effect on the ASM Terminal

Station transformer flow as opposed to the VAS Terminal Station due to the location of generation.

- **System configuration.** WAN generation is closer to the ASM Terminal Station; therefore, as WAN generation increases, the ASM Terminal Station will see more of an increase in power flow compared to the VAS Terminal Station.

31.0 Reference: Exhibit B-4, BCUC 1.2.21

Exhibit B-1, page 12, Figure 3-2

Preamble: The response states:

"The flow through the ASM transformers can be reduced by opening the 11 Line path as dictated by the peak duration requirements. Alternatively, FBC could shed load in the Boundary and/or Similkameen areas. The amount of load shedding required would be determined by the percentage of post contingency ASM transformer overloading. These operational solutions would only be resorted to in a contingency condition where the remaining ASM transformer is overloaded.

Since 2019, FBC has put these operational procedures in place to be implemented when necessary. However, these post contingency operational changes are in violation of FBC's Transmission Planning Criteria and therefore are not sustainable in the long-term.

The operational change of opening 11 Line causes the Boundary region to be fed radially (only from one source) from the Kootenays. This operational change will reduce the reliability of supply to the Boundary region, and a contingency event while in this configuration would cause a blackout in the Boundary region, leaving approximately 4,090 customers without power."

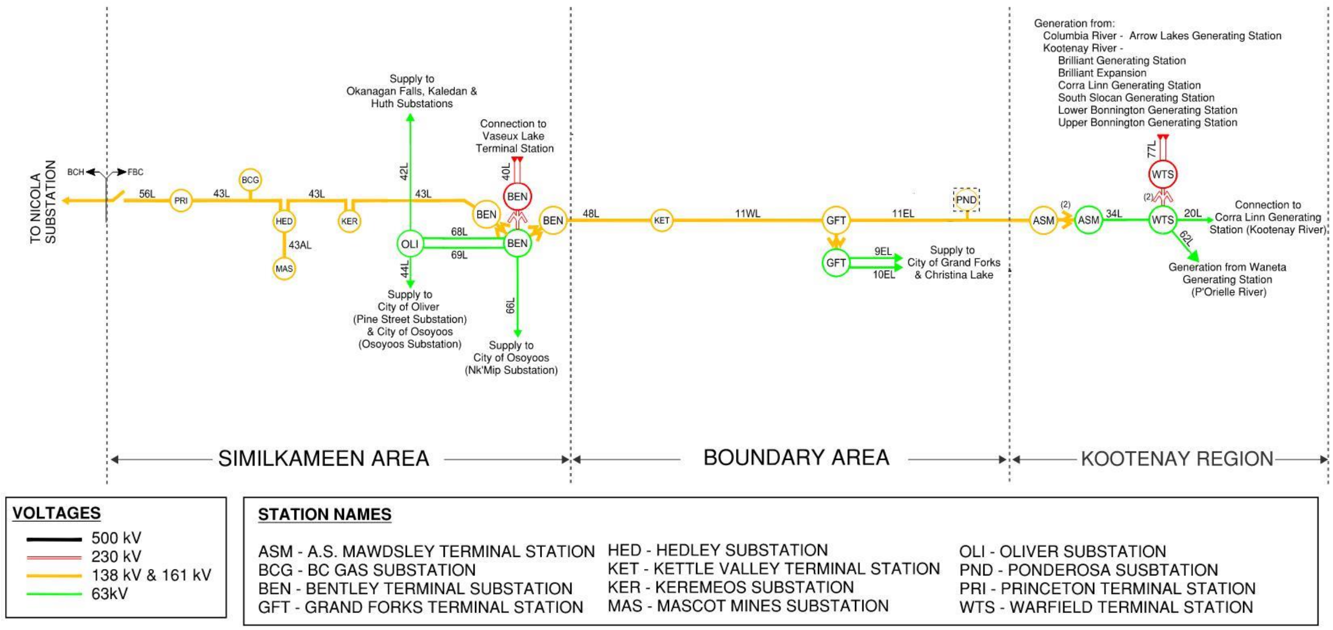
31.1 With respect to the last paragraph in the Preamble, please identify (with reference to Figure 3-2 with the inclusion of 42L) the "one source" that would be used to feed the Boundary Region if the 11 Line is open and its capability.

Response:

The "one source" referenced in the preamble to this IR depends on where the 11 Line path is opened.

- If 11E Line is opened, then the remaining line serving the Boundary region is 48 Line, which has a summer emergency capacity of 222 MVA.
- If 48 Line/11W Line are opened, then the remaining line serving the Boundary region is 34 Line, which has a summer emergency capacity of 261 MVA.

Please refer to the updated Figure 3-2 below for reference.



31.1.1 The paragraph suggests that without any further contingencies FBC would still be able to serve the Boundary area load, please confirm that this is the case. If not, why not

Response:

FBC would be able to serve the Boundary area load with the 11 Line path opened; however, in doing so, FBC reduces reliability of supply to the Boundary region, and if another contingency event occurred, it would cause a full blackout to the Boundary region. Please also refer to the response to BCOAPO IR2 23.2.1.

31.2 The last paragraph in the response to BCUC 1.2.21 makes no mention of reduced reliability of supply to the Similkameen area if the 11 Line is open such that a further contingency event would lead to a blackout or load shedding in that area. Please clarify if this is case.

31.2.1 If yes, please explain how the Similkameen area supplied would be supplied if there was a contingency event while the 11 Line was open such that its reliability is unaffected (while the Boundary area is impacted) by opening the 11 Line.

31.2.2 If not confirmed, please explain how the supply to the Similkameen area is affected by the opening of the 11 line and what the impact of a further contingency would be.

Response:

Please refer to the response to BCOAPO IR2 23.5.

32.0 Reference: Exhibit B-4, BCUC 1.3.4

Exhibit B-1, Appendix B, page 4 (of 21)

Preamble: The response states B states:

"Transformers that undergo condition assessment investigation and report include:

- Loss of life calculation due to paper/solid insulation aging, based on loading (historical and future)
- Insulating oil aging
- Bushing's condition
- Core and winding condition
- LTC condition"

32.1 Are each of the five items identified in the Preamble addressed in Appendix B (per page 4 items A through E?

32.1.1 If yes, please indicate under which of the areas (A through E) each of the five items is addressed.

32.1.2 If not, why not and does this lead to any shortcomings in the conclusions/recommendations presented in Appendix B?

Response:

FBC confirms that each of the five items identified in the response to BCUC IR1 3.4 (and listed in the preamble) are addressed in Appendix B (i.e., categories A through E on page 4). Each of the items are factors considered in the key aspects of risk.

FBC provides the following five categories from Appendix B (i.e., A through E on page 4 of Appendix B) and indicates where each of the five items listed in the response to BCUC IR1 3.4 are addressed:

Category A (Risk of Short-circuit Failure)

- Loss of life calculation due to paper/solid insulation aging, based on loading (historical and future)
- Insulating oil aging
- Core and winding condition

Category B (Winding Thermal Condition)

- Loss of life calculation due to paper/solid insulation aging, based on loading (historical and future)
- Insulating oil aging

Category C (Risk of Dielectric Failure)

- Loss of life calculation due to paper/solid insulation aging, based on loading (historical and future)
- Insulating oil aging
- Core and winding condition

Category D (Accessory Failures)

- Bushing's condition
- LTC condition

Category E (Random Failure)

- Considers random failure causes not associated with the original design or condition. This category would consider various random modes which are related to the transformer and its sub-components (i.e., paper/solid insulation, insulating oil, core and winding, bushings, and LTC).

33.0 Reference: Exhibit B-7, CEC 1.5.6

Preamble: The response states:

> "FBC provides the following table showing the number of instances, hours and percentage of the year where load exceeded the capabilities of one ASM transformer. FBC clarifies that for all of these instances, both transformers were in service and thus not overloaded."

33.1 For purposes of the Table provided in CEC 1.5.6, please clarify what FBC means by "overloaded" (i.e., did the load exceed the normal rating or the emergency rating of one ASM transformer per BCUC 1.2.17?).

<u>Response:</u>

Overloaded means the load exceeded the 80 MVA nameplate rating (i.e., the normal rating) of one ASM transformer. FBC clarifies that for all of the instances provided in the response to CEC IR1 5.6, both transformers were in service and thus not overloaded.

34.0 Reference: Exhibit B-7, CEC 1.6.6

Exhibit B-6, BCOAPO 1.1.3 and 1.2.3

Preamble: The responses state:

"In the Boundary and Similkameen areas, the relevant single contingencies that cause thermal and voltage violations during N-1 conditions are:

• Transformer outage at the ASM Terminal Station;

• 40L/BEN T1 outage; and

• 34L outage.

Please refer to the response to BCUC IR1 2.21 for operational changes that will be performed in the event of an N-1 contingency event." (CEC 1.6.6)

"During a 34 Line N-1 contingency event where the source to the Boundary and Similkameen load is only 40 Line (230 kV) and 42 Line (63 kV), the maximum Boundary and Similkameen area load before voltage collapse occurs is approximately 200 MW. This load limit is the same for both summer and winter."`(BCOAPO 1.1.3)

"During a 40L or BEN T1 contingency event, the maximum Boundary and Similkameen area load before voltage collapse occurs is approximately 190 MW. This load limit is the same for both summer and winter." (BCOAPO 1.2.3)

34.1 Is the response to CEC 1.6.6 indicating that, based on current peak load conditions in the Boundary and Similkameen area, i) on their own any one of the events listed could cause thermal and voltage violations or ii) following an N-1 contingency event any of the three events listed could cause thermal and voltage violations?

34.1.1 If CEC 1.6.6 is to be interpreted per (i), reconcile this with the responses to BCOAPO 1.1.3 and 1.12.3 and the fact that current and forecast (to 2027) peak load in the Boundary and Similkameen area is less than 190 MW (per Exhibit B-1, page 18).

Response:

The response to CEC IR1 6.6 is stating that on their own, any one of the events could cause thermal or voltage violations at certain load levels. FBC provides further elaboration as follows:

- A transformer outage at the ASM Terminal Station would result in thermal (overloading) violations for the remaining ASM transformer if left in service.
- During a 40 Line or BEN T1 N-1 contingency event, the maximum Boundary and Similkameen area load before voltage collapse occurs is approximately 190 MW. Peak load in the area is estimated to surpass 190 MW in the year 2030, as set out in the Expanded Table 3-3 provided in the response to BCUC IR1 2.13.
- During a 34 Line N-1 contingency event, the maximum Boundary and Similkameen area load before voltage collapse occurs is approximately 200 MW. Peak load in the area is estimated to surpass 200 MW in the year 2034, as set out in the Expanded Table 3-3 provided in the response to BCUC IR1 2.13.

35.0 Reference: Exhibit B-7, CEC 1.10.1

Exhibit B-8, ICG 1.4.2

35.1 Is the 53 year average service life referenced in CEC 1.10.1 based on the lives of the 6 transformers noted in the response to ICG 1.4.2?

If not, what is the 53 years based on?

Response:

The six transformers listed in the response to ICG IR1 4.2 relate to all transmission level power transformers retired in the FBC system, which include one non-CGE transmission power transformer. The 53-year average service life referenced in the response to CEC IR1 10.1 considered only CGE transformers that operated at the transmission level and were previously retired. Please refer to the revised table from the response to ICG IR1 4.2 below listing only the CGE power transformers used to calculate the average service life. As the table below shows, the average age at removal is 53.2 years, which FBC rounded to 53.

Removal Year	Age at Removal
2011	54
2010	58
2010	58
2010	45
2008	51
Average	**53**

36.0 Reference: Exhibit B-6, BCOAPO 1.4.4

36.1 The initial question posed was:

"With respect to steps #3 and #4 (as described in BCUC 4.4) please provide a schedule that sets out the 2022 peak values for January, for February, November, and December, as well as June, July, August derived by applying the described methodology to each of the years 2003 to 2022 (or the alternative years identified in previous response), identify the resulting 1-in-20 winter and summer 2022 peaks and provide the 1-in-20 winter and summer peak system forecast through to 2027."

The response only provided the 1-in-20 winter and summer peak system forecast through to 2027. Please also provide the information requested in the first part of the question (i.e., a schedule that sets out the 2022 peak values for January, for February, November, and December, as well as June, July, August derived by applying the described methodology to each of the years 2003 to 2022 (or the alternative years identified in previous response) and identify the resulting 1-in-20 winter and summer 2022 peaks.

Response:

FBC notes that the table provided in the response to BCOAPO IR1 4.4 did include a schedule that set out the 2022 peak values for January, February, November, December, June, July and August derived by applying the described methodology. The table provided in the response to BCOAPO IR1 4.4 is reproduced here for convenience.

Table 1: 2022-2027 Peak Values (MW)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2022	839	765	695	573	542	780	702	697	589	605	825	842
2023	846	772	701	578	547	786	708	703	594	611	833	850
2024	850	775	704	581	549	789	711	706	596	613	836	853
2025	855	779	708	584	552	794	715	710	600	617	841	858
2026	858	782	711	586	554	797	718	713	602	619	844	861
2027	869	792	720	594	562	808	727	722	610	627	855	873

The 2022 peak values for January, February, November, December, June, July and August were developed as part of the methods used to develop the winter and summer peaks. To provide an example, FBC describes how the value of 839 MW for January (shaded yellow in Table 1 above and shown in Table 2 below) was developed:

- First, the actual peaks from 2003 to 2022 are entered on the diagonal of Table 2 in the orange cells. The actual January peak for 2003, for example, was 497 MW.
- Next, the growth rates are entered in the second column.

- The actual peaks are then escalated for each year to arrive at the final row, labelled 2022. For 2003, the escalated value in 2022 is 608 MW.
- For 2004, the escalated value is 839 MW (shaded in yellow) and represents the maximum value for the 2022 row. This maximum value is then recorded in Table 1 above for January 2022.

Table 2: Calculation of January Peak

January Year	MW GR	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
2003	1.8%	497																			
2004	1.5%	504	696																		
2005	3.6%	523	721	686																	
2006	1.7%	532	734	698	545																
2007	0.1%	533	735	699	546	668															
2008	-0.3%	531	733	697	544	666	662														
2009	2.3%	543	750	713	557	681	677	669													
2010	-4.4%	519	717	682	532	651	647	639	632												
2011	3.8%	539	744	708	553	676	672	664	656	643											
2012	-1.1%	533	736	700	546	669	665	657	649	636	727										
2013	2.2%	545	752	715	558	683	679	671	663	650	743	614									
2014	-1.1%	539	744	707	552	676	672	664	656	643	735	607	615								
2015	-1.9%	528	729	694	542	663	659	651	643	630	721	596	603	598							
2016	0.1%	529	730	694	542	664	659	652	644	631	721	596	604	599	617						
2017	6.2%	562	775	737	576	705	700	692	684	670	766	633	641	636	655	721					
2018	-1.8%	551	761	724	565	692	687	679	671	658	752	622	630	624	643	708	641				
2019	2.8%	567	783	744	581	711	707	699	690	676	773	639	647	642	661	728	659	595			
2020	-1.6%	558	771	733	572	700	696	688	679	666	761	629	637	632	651	717	649	586	722		
2021	5.3%	588	811	772	603	737	733	724	716	701	802	663	671	665	686	755	683	617	760	613	
2022	3.4%	608	839	798	623	762	758	749	740	725	829	685	694	688	709	780	706	638	786	634	804

All other calculations for other months in 2022 in Table 1 are similar. The winter and summer peaks are then simply the maximum values recorded for the winter and summer months, respectively. The following table adds winter and summer peak columns to Table 1.

Table 3: 2022-2027 Winter and Summer Peak Values (MW)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Winter	Summer
2022	839	765	695	573	542	780	702	697	589	605	825	842	846	780
2023	846	772	701	578	547	786	708	703	594	611	833	850	850	786
2024	850	775	704	581	549	789	711	706	596	613	836	853	855	789
2025	855	779	708	584	552	794	715	710	600	617	841	858	858	794
2026	858	782	711	586	554	797	718	713	602	619	844	861	869	797
2027	869	792	720	594	562	808	727	722	610	627	855	873	880	808

The winter peak of 846 MW recorded for 2022 is the maximum of the four monthly peak values shaded yellow. The predicted 2022 winter peak of 846 MW is the January value recorded for January 2023.

The summer peak of 780 MW recorded for 2022 is the maximum of the three monthly peak values shaded green. As shown, the predicted 2022 summer peak of 780 MW is the June 2022 value.

37.0 Reference: Exhibit B-7, BCOAPO 1.5.1

Exhibit B-1, page 18 (Table 3-3)

Preamble: The response states:

"In the Distribution Load Forecast, the forecast for each substation feeder is based on the summer and winter peaks over the last five years. The slope of the seasonal peaks from the last five years is applied to the maximum peak from the last five years. The forecast also takes into consideration developments or load transfers that are planned for that year. Any development or load transfer that has been entered into the forecast is added or subtracted from the forecasted values that were calculated. From the feeder level forecast, the substation transformer forecast is created. The transformer forecast is the sum of the feeder seasonal peaks attached to the transformer and multiplied by the transformer diversity."

37.1 What five years were used to determine the forecast for each substation feeder? In particular, did the five years include 2022?

Response:

The five years used to determine the forecast for each substation feeder are 2017-2021. 2022 was not used in the five years.

37.2 With respect to Tables 1 and 2 in BCOAPO 1.5.1, is the multiplication of the scaling factor to the total non-coincident peak meant to yield the values provided in Table 3-3 (Exhibit B-1)?

37.2.1 If not, please explain how the values I Table 3-3 are derived from the substation forecast provided in BCOAPO 1.5.1.

Response:

Yes, all the non-coincident peaks except Ponderosa are multiplied by the scaling factor and will yield the values provided in Table 3-3 (Exhibit B-1). Any slight discrepancies are due to rounding errors.

38.0 Reference: Exhibit B-6, BCOAPO 1.5.2

Preamble: The response states:

> "The 1-in-20 year peak load forecast is a probabilistic method and all else equal should be exceeded, on average, once every 20 years. A circumstance where the actual results exceed forecast is to be expected approximately 5 percent of the time, and FBC does not believe that its load forecasting methodology should be modified when this expected situation occurs."

38.1 Please explain more fully how the 1-in-20 year peak load forecast (which uses the highest out of 20 peak values for 2022 as the starting point) is based on a probabilistic model such that, all else equal, the result will be exceeded once in 20 years.

Response:

For a detailed explanation of the method, please refer to the response to BCUC IR1 2.8.

The peak value selected for use as the design value is the maximum value that was recorded in the 20-year time frame used to develop the forecast. Since the peak value represents one of 20 possible values, FBC calculates the probability of the peak occurring as 1 in 20. FBC used the term "probabilistic model" to describe the model based on the underlying method.

38.2 Did the actual data used to develop the 1-in-20 year system peak forecast and the Distribution Planning forecast include 2022 data in both instances?

38.2.1 If yes, such that the actual peak loads for 2022 were used in the forecast methodology, please explain why the resulting 2023-2027 peak load forecast for the Boundary and Similkameen areas (per Table 3-3) is less than the actual peak load experienced in 2022 (per Table 3.2).

Response:

The actual data used to develop the 1-in-20 year system peak forecast and the Distribution Planning forecast does not include 2022 data. The forecast available at the time of filing the Application was based on the FBC Annual Review for 2023 Rates forecast which was filed on August 5, 2022 and did not include 2022 actuals.

39.0 Reference: Exhibit B-6, BCOAPO 1.7.1 and 1.7.2

Exhibit B-4, BCUC 1.3.5

Preamble: The responses state:

"As discussed in the response to BCUC IR1 3.5, FBC has adopted the recommendations from the CEATI 30/113-20186 report that a Probability of Failure (PoF) of 2 percent or higher is a high risk of failure. The table below provides FBC's interpretation of the PoF thresholds contained in the CEATI report and ABB – Hitachi Fit at 50 white paper.

PoF (Estimate)	Response Time for Intervention	Risk Level (FBC)
12%	1 month	Critical
4%	1 year	High
2%	2 years	

". (BCOAPO 1.7.1)

"The Hitachi report (Appendix B) refers to "high risk of failure" in terms of the likelihood of a failure event (i.e., probability of failure) and the associated impact of failure (i.e., "Importance"). Based on Figure 7 in Appendix B, Hitachi has classified ASM T1 and ASM T2 as having a "high risk of failure" based on the probability of failure being greater than 2 percent and the transformers level of "Importance"." (BCOAPO 1.7.2)

"FBC adopted the recommendations of the CEATI report upon its publication in 2018. Prior to the CEATI report being published, there was no guidance regarding the acceptable Total Risk of Failure (TRoF)4 for a utility.

The ASM transformers are critical to FBC's network operation and, due to their condition, overloading will potentially lead to unforeseen failures. Therefore, FBC has concluded that a PoF higher than 2 percent for the ASM transformers is not acceptable." (BCUC 1.3.5)

39.1 BCOAPO 1.7.1 indicates that FBC considers the risk level as being high if the probability of failure is 2% and the response time for intervention is two years. The response to BCUC 1.3.5 indicates that it's a probability of failure of more than 2% and the importance of ASM to the system that results in the risk being unacceptable. In these responses, what is the difference (in any) FBC attaches to the terms \`high\` and \`unacceptable\`?

39.1.1 Please reconcile and explain FBC`s view as to the role that importance to the system and response time for intervention play in making the probability (in FBC`s view) high/unacceptable.

Response:

FBC has classified the risk level as both "high" and "unacceptable" for ASM T1 and T2.

The categorization of the probability of failure of ASM T1 and T2 as "high" is based on the CEATI 30/113 Report and the Hitachi Report. In the case of ASM T1 and T2, FBC further considers the risk level to be unacceptable because of the criticality of ASM T1 and T2 to the system and the response time caused by the long-lead times for replacement transformers.

FBC follows the CEATI Report 3081 definitions of risk categorization as follows:

> Risk Categorization is a more formal approach to grouping and categorizing risks in a structured way, to allow for discussion, characterization and subsequent analysis and audit of risks.[1]

In contrast, for the probability of failure / risk acceptance, otherwise referred to as risk tolerance, FBC follows the considerations in CEATI Report 30/113 as follows:

> An acceptable [Probability of Failure] level … depends on the consequences of failure and the business context. The consequence of failure is a function of the size and type of the load and a function of the redundancy of the system at the point of supply. Safety, environmental, economic, and other issues also need to be considered…An acceptable [Probability of Failure] would need to be determined for each individual asset…This depends on the individual organization and the consequence of failure.[2]

In other words, and as explained in the response to BCUC IR1 3.5, FBC used the CEATI 30/113 Report to guide what an acceptable probability of failure would be generally for a transformer. FBC then considered the specific circumstances of the ASM transformers to determine whether, given that the ASM transformers' probability of failure exceeds 2 percent, the risk is unacceptable, which FBC validated through the commissioning of the Hitachi Report.

Finally, the criticality of the ASM transformers to FBC's network operation, their condition, and the length of time required to replace the transformers, all led FBC to determine that the risk of failure is unacceptable.

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[1] CEATI, Stations Equipment Asset Management Program, REPORT No. T163700-308 (November 2014). "Risk Level Assessment for Operating, Maintenance and Capital Funding Expenditures" by Doble Engineering.

[2] CEATI, Stations Equipment Asset Management Program, REPORT No. T163700-30/113 (May 2018). "Translating the Health Index into Probability of Failure" by Doble Engineering.

39.2 How do FBC`s risk levels of Critical, High, Moderate and Normal (per BCOAPO 1.7.1) correspond to the risk categorization used by Hitachi (per Appendix B, page 10) of Critical, Urgent, Priority and Normal?

Response:

The risk levels provided in the response to BCOAPO IR1 7.1 are FBC's general interpretation of the probability of failure (PoF) levels for transformers set forth in the CEATI 30/113-2018 Report. Hitachi has provided a risk categorization that considers both the PoF and Importance of ASM T1 and T2 in the FBC system. Therefore, the PoF levels form one consideration in the Hitachi Report but are not the full picture, as the risk level associated with a specific asset, depending on system configuration, available redundancy and outage impact, may result in a corresponding risk level that is higher or lower than the one provided in the table in BCOAPO IR1 7.1 (i.e., the Hitachi Report also considers the *Importance* of the specific assets). The PoF risk levels thus do not directly correspond to the risk categorization used by Hitachi.

40.0 Reference: Exhibit B-4, BCUC 1.8.1

Preamble: The response states:

> "When evaluating Alternative 3 against this criterion, FBC only evaluated the future expansion potential of the ASM Terminal Station to ensure an "apples-to-apples" assessment was undertaken between Alternatives 3 and 5. For clarity, the ranking of "2" for Alternative 5 considered only the expansion potential on the WTS site and did not consider the expansion potential on the existing ASM Terminal Station site."

40.1 Since Alternative 3 includes the retention of WTS whereas Alternative 5 includes the demolition of AMS, why wouldn`t an "apples-to-apples" assessment involve including consideration of WTS in the assessment of Alternative 3`s potential for expansion but excluding AMS in the assessment of Alternative 5`s potential for future expansion?

Response:

The difference between the expansion potential of Alternative 3 and Alternative 5 is that Alternative 3 (i.e., replacing the existing two power transformers with two new larger capacity transformers and rebuilding the ASM station) cannot be accommodated on the existing ASM parcel of land, and expanding the station footprint would be much more difficult than expanding the WTS site to accommodate the new transformers. This is why the potential for expansion is ranked higher (superior) for Alternative 5 than for Alternative 3, regardless of the considerations of the availability of the other station for future use (i.e., the availability of WTS under Alternative 3 and the availability of ASM under Alternative 5).

Further, the Potential for Future Expansion evaluation did not consider the availability of WTS land under Alternative 3 because splitting the 161/63 kV capacity to 11E Line over the two parcels (WTS and ASM) in the future would require implementing Alternative 6, which was eliminated during pre-screening for the reasons explained in the response to ICG IR1 5.3.

FBC also notes that even though the ASM Terminal Station is proposed to be demolished under Alternative 5, the land will still be owned by FBC, as the land contains other buildings/structures and is being used by the FBC Warfield Operations, as further explained in the response to BCUC IR1 12.1. Therefore, even if FBC had considered the other site as part of the Potential for Future Expansion criterion, Alternative 5 would still be superior.

41.0 Reference: Exhibit B-6, BCOAPO 1.1.3 and 1.1.6

Preamble: The responses state:

"During a 34 Line N-1 contingency event where the source to the Boundary and Similkameen load is only 40 Line (230 kV) and 42 Line (63 kV), the maximum Boundary and Similkameen area load before voltage collapse occurs is approximately 200 MW. This load limit is the same for both summer and winter..." (BCOAPO 1.1.3)

"During an 11E Line N-1 contingency event where the source to the Boundary and Similkameen load is only 40L (230 kV) and 42L (63 kV), the maximum Boundary and Similkameen area load before voltage collapse occurs is approximately 200 MW. This load limit is the same for both summer and winter." (BCOAPO 1.1.6)

41.1 Please indicate how the supply to the Boundary and Similkameen area would be maintained during a 11E Line or 34 Line contingency event and outline the capability of each supply point and the limiting factor(s) at each point such that the maximum Boundary and Similkameen area load before voltage collapse occurs is approximately 200 MW.

Response:

Please refer to the response to BCOAPO IR2 23.2.1.

42.0 Reference: Exhibit B-6, BCOAPO 1.2.3

Preamble: The response states:

"During a 40L or BEN T1 contingency event, the maximum Boundary and Similkameen area load before voltage collapse occurs is approximately 190 MW. This load limit is the same for both summer and winter."

42.1 Please indicate how the supply to the Boundary and Similkameen area would be maintained during a 40L or BEN T1 contingency event and outline the capability of each supply point and the limiting factor(s) at each point such that the maximum Boundary and Similkameen area load before voltage collapse occurs is approximately 190 MW.

<u>Response:</u>

During a 40 Line or BEN T1 contingency event, supply to the Boundary and Similkameen area is maintained by the 34 Line/ASM Terminal Station and 42 Line transmission facilities. The normal and emergency limits for 34 Line, ASM T1/T2 and 42 Line are shown in the table below.

Name	Summer Limits (MVA)		Winter Limits (MVA)	
	Normal	Emergency	Normal	Emergency
ASM T1/T2	80	100	88	108
42 Line	66	73	92	97
34 Line	255	261	261	261

43.0 Reference: Exhibit B-6, BCOAPO 1.2.1, 1.2.2, 1.2.6 and 1.9.1

Preamble: The responses state:

The winter and summer limits for each of the two Vaseux Lake Terminal Station transformers are greater than 200 MVA (BCOAPO 1.2.1)

The normal (N-0) limits for 40 Line and the single transformer at BEN are:

Name	Summer (MVA)	Winter (MVA)
40L	337	476
BEN T1	168	205

(BCOAPO 1.2.2)

Historically, the winter and summer peak loads at BEN have been less than 60 MW. (BCOAPO 1.2.6)

"No, it is not possible to increase the supply of power from the transmission interconnection to BC Hydro at Vaseux Lake Terminal Station based on the current facilities in place or if upgrades were undertaken on FBC's facilities.

The flow through this station is determined by the overall provincial generation dispatch and the network configuration. The provincial generation dispatch is decided by BC Hydro (Balancing Authority and Planning Coordinator) and the network configuration is then determined by the actual system conditions at that time. The supply of power FBC is able to receive from this interconnection is therefore limited by these factors." (BCOAPO 1.9.1)

43.1 Please explain more fully why, if system conditions at Line 11E, Line 34 or ASM were such that there was a shortfall of supply to the Boundary and Similkameen area, BC Hydro wouldn`t/couldn`t increase supply to the area through the Vaseux Lake Terminal Station.

Response:

Please refer to the response to BCOAPO IR2 30.1.

44.0 Reference: Exhibit B-6, BCOAPO 1.13.1

Exhibit B-1, pages 34-39

44.1 Please confirm that in Table 4-3 the score assigned to Alternative 5 is equal to or higher than that assigned to Alternative 3 in all categories except Land Availability?

<u>Response:</u>

Confirmed.

45.0 Reference: Exhibit B-6, BCOAPO 1.14.3

Exhibit B-1, page 39

Preamble: The response states:

> "FBC clarifies it has applied the same assumptions for contingency on the base capital cost estimates for both Alternatives 3 and 5.
>
> As noted in Section 6.2 of the Application, FBC applied a contingency of 15 percent for the Station construction and removal costs, excluding the add-on costs which are calculated on top of the base station capital cost estimate. These add-on costs include material handling costs, indirect costs, and provincial sales taxes. Alternative 3 further includes site preparation costs with an inbuilt contingency to address brownfield construction staging (as further explained in the response to BCOAPO IR1 14.1) so a second contingency is not added on top of the existing contingency.
>
> A contingency of 10 percent is applied for the Transmission, Distribution, and Fibre modification components for both Alternatives 3 and 5. Please refer to the response to BCUC IR1 15.1 for further explanation of the basis of these contingency amounts."

45.1 Does fact the site preparation costs included for Alternative 3 have an inbuilt contingency to address brownfield construction staging mean that the overall contingency percentage used for Alternative 3`s Station construction and removal costs is greater than 15 percent (i.e., greater than that used for Alternative 5)?

45.1.1 If not and the overall contingency for Station construction and removal costs is the same for both Alternatives, please explain why this is appropriate when "Alternative 5 has better constructability, lower construction risk, and less equipment procurement risk than Alternative 3." (per page 39).

<u>Response:</u>

FBC clarifies that it applied a 15 percent contingency to the station construction and removal costs for both Alternative 3 and Alternative 5. However, due to the brownfield construction staging for Alternative 3, as noted in the response to BCOAPO IR1 14.3, FBC *further* added the site preparation costs (with an inbuilt contingency) separately from the rest of the station construction costs. Thus, the 15 percent contingency was not applied on top of the inbuilt contingency already added to the site preparation costs. As such, it is correct that when considering the overall station construction costs, including the site preparation work, the overall contingency for Alternative 3 (i.e., the 15 percent plus the inbuilt contingency for the site preparation work) is higher than Alternative 5 (i.e., 15 percent only). This higher overall contingency for Alternative 3 is reflective of the fact that Alternative 5 has better constructability and lower construction risk, as stated on page 39 of the Application (and as referenced above).

46.0 Reference: Exhibit B-4, BCUC 1.20.2.1

Preamble: The response states:

> "FBC's third party QEP has established working relationships and authorized the receiving facility in Swan Hills, Alberta. If the TCLP test results exceed the BC Hazardous Waste Regulation criteria, soil will be sent for disposal at Swan Hills. In this scenario, where soil is sent for disposal at Swan Hills, additional costs will be incurred for transporting the contaminated soil. FBC does not anticipate schedule impacts for this additional soil remediation".

46.1 Have the costs associated with transporting and disposing of any contaminated soil been included in the Project`s costs and, if so, how (i.e., in the base cost or the contingency allowance)?

Response:

The potential additional costs for the soil transport/disposal to Swan Hills have been identified in the Project's Risk Register as a medium potential risk, but have not been included in the Project's base capital cost estimate. Rather, the costs related to contaminated soils would be covered by the Project contingency, if required.

47.0 Reference: Exhibit B-4, BCUC 1.15.5

Exhibit B-1, page 55 (Table 6-1)

Preamble: The response states:

"FBC classified the ASM Project as a medium cost risk primarily due to market volatility, unpredictable commodity escalation, extended procurement timelines, and contaminated soil disposal risks. As a medium cost risk, these risks are more likely to materialize than for a low cost risk classed project such as the KBTA Project; therefore, FBC has reflected those cost risks estimate for the ASM Project through the Identified Risk Allowance categories, including a material escalation cost. This keeps the contingency for the ASM Project at similar levels to other projects."

47.1 Please explain more fully (with reference to Table 6-1) where and how FBC has reflected those cost risks estimate for the ASM Project through the Identified Risk Allowance categories, including a material escalation cost, in the overall cost of the Project.

<u>**Response:**</u>

The identified risk allowance for the station is $1.248 million (in 2022 dollars), which is included as part of the AACE Class 3 base capital cost and is shown on page 4 of Confidential Appendix G-1. Please also refer to page 18 of Confidential Appendix G-1 which summarizes the identified risk allowances for the ASM Project in the various categories, such as civil, buildings, structures & buswork, and station equipment. Within each category, the identified risk allowances could include materials escalation as well as risks related to contract and labour. For example, please see page 8 of Confidential Appendix G-1 for the detailed breakdown of the identified risk allowances as well as estimates for the Civil and Site categories.

Given that the identified risk allowance for the station construction is part of the Class 3 base capital cost estimate, the $1.248 million (in 2022 dollars) as mentioned above is included as part of Line 1 Station Construction Costs in Table 6-1 of the Application.