DFO NEED FOR DEVELOPMENT REPORT

Need for Development
Kananaskis Area Upgrades

Aug 1, 2018

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Executive Summary

FortisAlberta Inc. (FortisAlberta) is requesting system access service to address existing and predicted distribution system reliability concerns in the Kananaskis area. Existing contractual obligations and generic load growth in the Kananaskis area are producing a concern related to the adequacy of the existing transmission and distribution facilities to meet customer needs. In 2017, in the event of a single contingency (N-1) event affecting the regulator at the Mount Allan 115S substation, up to 5.6 MVA of customer loads could not be restored by switching only. The potential amount of unsupplied load is predicted to increase to as much as 7.0 MVA by 2027. This unsupplied load violates FortisAlberta planning criteria for electrical load restoration.

Potential solutions were assessed to address the reliability concerns in the Kananaskis area. Based on information available to FortisAlberta, technical merit and transmission and distribution capital cost, FortisAlberta identified a preferred solution. This involves installing a suitably sized 138/25 kV LTC transformer and one 25 kV feeder breaker at the Mount Allan 115S substation.

The full scope of the required transmission upgrades and estimated transmission capital costs associated with FortisAlberta's preferred alternative will be provided by the Transmission Facility Owner (TFO), AltaLink Management Limited (AltaLink).

The estimated distribution capital costs associated with FortisAlberta's preferred alternative is $0.49 million (±30%, 2019$).

The requested In-Service Date (ISD) for the transmission facility upgrades is Nov 1, 2019.

If FortisAlberta's preferred alternative is approved by the Alberta Utilities Commission (AUC), FortisAlberta will request an increase to the Demand Transmission Service (DTS) contract for the Mount Allan 115s substation of 4.6 MW, resulting in a DTS capacity of 7.7 MW.

Table of Contents

EXECUTIVE SUMMARY i
TABLE OF CONTENTS ii
LIST OF TABLES AND FIGURES ii
1. BACKGROUND 1
2. CRITERIA 2
3. FORECASTING METHODOLOGY 3
4. EXISTING SYSTEM ASSESSMENT 4
4.1 LOAD FORECAST 4
5. ALTERNATIVES ANALYSIS 4
5.1 ALTERNATIVE 1: DISTRIBUTION UPGRADES 5
5.1.1 Description 5
5.2 ALTERNATIVE 2: UPGRADES AT THE MOUNT ALLAN 115S SUBSTATION 5
5.2.1 Description 5
5.2.2 Load Forecast 6
5.2.3 Cost Estimate 6
5.3 ALTERNATIVE 3: TRANSMISSION UPGRADES AT THE POCATERRA 48S SUBSTATION 7
5.3.1 Description 7
6. ALTERNATIVES ASSESSMENT 7
6.1 TECHNICAL AND ECONOMIC ANALYSIS 7
6.1.1 Alternative 1 – Distribution Upgrades 7
6.1.2 Alternative 2 – Upgrades at the Mount Allan 115S Substation 7
6.1.3 Alternative 3 – Upgrades at the Pocaterra 48S Substation 8
7. CONCLUSION 8
Appendix A – Existing POD Substations & Distribution Systems in the Kananaskis Area 9
Appendix B – Alternative 2 Associated POD Substations & Distribution Systems in the Kananaskis Area 10

List of Tables and Figures

Table 4-1: FortisAlberta Historic and Forecast Load: Existing System 4
Table 5-1: Alternative 2 – Upgrades at the Mount Allan 115S Substation 6

Figure A-1: Existing POD Substations and Distribution Systems in the Kananaskis Area 9
Figure B-1: Alternative 2: Transmission and Distribution Upgrades in the Kananaskis Area 10

1. Background

The distribution deficiency driving the need identified by FortisAlberta in this application involves the Kananaskis area and is localized at the Mount Allan 115S substation.

The area served by the Mount Allan 115S substation is in the Kananaskis region of the eastern slope of the Canadian Rocky Mountains. The distribution system in the Kananaskis area supplies residential and commercial loads. Accessed by Highway 40, key tourism facilities and large loads in the area are the Nakiska Ski Resort and the Delta Kananaskis Lodge, located 0.8 km and 4.5 km respectively, south of the Mount Allan 115S substation.

The substations of potential relevance for the solution to the identified reliability concern are the Mount Allan 115S, Pocaterra 48S, Seebe 245S and Canmore 118S substations. These are the distribution Point of Delivery (POD) substations in the area which can potentially provide a solution for the identified reliability concern, as Highway 40 is the only route that FortisAlberta believes new distribution feeders can be built. See Figure A-1, Appendix A for a simplified sketch of the existing transmission substations and distribution systems in the area.

The Mount Allan 115S substation is located at LSD 4 SEC 13 TWP 23 RGE 9 W5M, approximately 1.2 km west of Highway 40 and 21 km south of the Highway 40 exit from the TransCanada Highway. The substation has one 132/23.9 kV 10 MVA de-energized tap changer (DETC) source transformer (T2) paired with a 25 kV 10 MVA regulator supplying one 25 kV feeder. The substation also has a 132/23.9 kV 6 MVA DETC spare source transformer (T1) which is normally de-energized. The distribution system supplied by the Mount Allan 115S substation has one three-phase distribution feeder tie with the Pocaterra 48S substation to the south.

The Pocaterra 48S substation is located at LSD 10 SEC 13 TWP 20 RGE 9 W5M, approximately 31 km from of the Mount Allan 115S substation, further south along Highway 40. Built to serve the 15 MW Pocaterra Hydro Generation Plant, the Pocaterra 48S substation has a 13.2/132 kV 18.75 MVA DETC transformer (T1) and a 13.8/23.9 kV 5 MVA DETC transformer (T2) supplying one 25 kV feeder which serves a small distribution load. There is one three-phase connection to the distribution system supplied by the Mount Allan 115S substation. Due to the configuration of the transformers at the Pocaterra 48S substation, the two distribution systems are 30° out of phase such that a service outage is necessary for load transfers between the two distribution systems.

The distribution system in the Exshaw area is supplied by the Seebe 245S substation located at LSD 7 SEC 10 TWP 25 RGE 8 W5M, approximately 21 km to the north of the

Mount Allan 115S substation. The Exshaw area is a major source of limestone for the production of cement. The Seebe 245S substation serves the 14 MW Horseshoe Hydro Generation Plant with a 12/138 kV 15/20/25 MVA transformer (T1). The T2 transformer, a 130/24.9 kV 15/20/25 MVA LTC unit, serves as a source for two 25 kV feeders. Though not connected to the Mount Allan 115S system due to distance and terrain, the Seebe 245S distribution system has one three-phase connection with the Canmore 118S substation.

The town of Canmore is approximately 21 km northwest of the Mount Allan 115S substation and separated from the Kananaskis area by mountainous terrain such that the distribution systems in the two areas are not connected. The Canmore 118S substation is located on the eastern edge of the Town of Canmore at LSD 14 SEC 27 TWP 24 RGE 10 W5M. It has two 138/25 kV 15/20/25 MVA Load Tap Changing (LTC) source transformers supplying three 25 kV feeders. The Canmore 118S substation has three-phase distribution ties to the Rundle 35S and Seebe 245S substations. Due to distance and terrain, it is not practical for the Canmore 118S substation to provide reliability support to the Mount Allan 115S substation.

2. Criteria

The analysis for the existing system and alternative solutions in the Kananaskis area has been conducted based upon the following criteria:

- The maximum normal loading of FortisAlberta 25 kV distribution feeders is 13.0 MVA.
- FortisAlberta planning criteria for electrical load restoration requires that adequate backup supply for contingency situations be available subject only to switching time. Backup capability refers to the ability to restore service after an interruption without necessarily first repairing the cause of the interruption.
- Transmission equipment must not be operated at load levels in excess of the equipment ratings.
- Distributed Energy Resources (DER) are not dispatchable by FortisAlberta and are not considered for the purposes of solving the identified deficiencies.
- Delivered voltage on the distribution system must comply with the requirements of CSA Standard *C235 - Preferred Voltage Levels for AC Systems, 0 to 50,000 V.*

3. Forecasting Methodology

FortisAlberta's load forecasting approach is performed on all the company's 25 kV distribution feeders that are connected to POD substations.

A consistent bottom-up load forecast approach, as described below, is utilized that incorporates localized influences specific to the area supplied by the distribution feeders and the associated POD substation. The load forecast involves statistical trending of historical recorded peaks, and includes aggregated committed load and the application of distribution system planning and engineering judgement. The resultant load forecast identifies the upper bounds of electric system peak capacity that would be required annually to address customer needs.

Committed loads include individual customer-contracted peak demands and load allocated to committed subdivision developments where FortisAlberta holds signed contracts with developers. Differences between the forecast and actual committed loads occur when customers do not make full use of their committed contracted demand.

On an annual basis, the peak demand load of each distribution feeder is obtained from meters located at the substation that serves the feeder. This recorded meter data is reviewed over a date range of March 1st of the current year through February 28 of the following year to capture the yearly distribution feeder peak loads.

Individual 25 kV feeder loads are then summed up, with the application of a coincidence factor to the individual distribution feeder peaks, to determine the predicted loading on the specific substation transformer that the 25 kV feeders are connected to. The resultant loads on the substation transformers are then totaled, with the application of a coincidence factor to the individual calculated transformer loads, to determine the total substation loads.

For individual substation load forecasting, the forecast increase from year 0 to year 1 is the result of the following four factors:

- forecasted aggregated customer load growth;
- new contracted committed load additions;
- existing contracted committed loads; and
- planned load transfers.

The DTS contract level of each project is determined from the load forecast table in the NFD document, that is associated with the preferred solution. This is done by identifying the predicted peak load at the POD substation and during the year of the project's ISD. A conversion of power units is needed to contract for DTS. This is accomplished by multiplying the POD forecast by the substation power factor (pf). The resultant is subsequently multiplied by a POD load coincidence factor of 0.9, to determine the DTS level that FortisAlberta requests from the AESO.

4. Existing System Assessment

A simplified sketch of the existing substations and distribution systems in the Kananaskis area is presented in Figure A-1, Appendix A.

4.1 Load Forecast

Table 4-1 provides FortisAlberta historical and forecast peak load levels for the substations and feeders in the Kananaskis area. The load forecast is based on historical data, expected development trends and contracted new loads. This load forecast was used to assess the existing system in this Need for Development document.

Table 4-1: FortisAlberta Historic and Forecast Load: Existing System

				MVA LOADING - RECORDED						PREDICTED - MVA LOADING									
			W	2013	2014	2015	2016	2017		2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
SUB		CAPACITY	or	Peak	Peak	Peak	Peak	Peak		Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak
No	Feeder	T/R MVA	S	MVA	MVA	MVA	MVA	MVA	PF	MVA	MVA	MVA	MVA	MVA	MVA	MVA	MVA	MVA	MVA
048S	**Pocaterra**	T2 5	W	**0.4**	**0.4**	**0.4**	**0.5**	**0.4**	89%	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**
048S	132LN		W	0.4	0.4	0.4	0.5	0.4	89%	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
115S	**Mount Allan**	T1 spare 6																	
115S		T2 10	W						97%										
115S		VR1 10	W	**7.8**	**7.5**	**7.4**	**8.0**	**7.4**	97%	**8.8**	**8.8**	**8.9**	**8.9**	**8.9**	**9.0**	**9.0**	**9.1**	**9.1**	**9.1**
115S	404LS		W	7.8	7.5	7.4	8.0	7.4	97%	8.8	8.8	8.9	8.9	8.9	9.0	9.0	9.1	9.1	9.1
245S	**Seebe**	T2 15/20/ 25	W	**8.7**	**8.9**	**8.0**	**9.2**	**8.7**	99%	**10.0**	**10.1**	**10.3**	**10.4**	**10.6**	**10.7**	**10.8**	**11.0**	**11.1**	**11.4**
245S	69LE		W	3.9	3.8	3.8	4.0	4.0	100%	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.2
245S	79LW		W	5.3	5.5	4.7	5.5	5.6	97%	6.4	6.4	6.5	6.5	6.6	6.6	6.6	6.7	6.7	6.8
		Total Area Load		**16.9**	**16.8**	**15.8**	**17.7**	**16.5**		**19.3**	**19.4**	**19.7**	**19.8**	**20.0**	**20.2**	**20.3**	**20.6**	**20.7**	**21.0**
		115S Station Load						7.4		8.8	8.8	8.9	8.9	8.9	9.0	9.0	9.1	9.1	9.1
		N-1 Capacity						0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Back-up from 48S						1.8		1.8	1.8	1.9	1.9	1.9	2.0	2.0	2.0	2.1	2.1
		Back-up from118S & 245S						0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		N-1 Unsupplied Load						5.6		7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.1	7.0	7.0

The following reliability concern was identified for the Kananaskis area from Table 4-1:

- In 2017, a reliability concern exists at the Mount Allan 115S substation. The level of unsupplied load at the Mount Allan 115S substation under N-1 contingency (loss of VR1) could be as high as 5.6 MVA. If left unaddressed, it is predicted to increase to 7.0 MVA by 2027. This exceeds FortisAlberta planning criteria for electrical load restoration. The unsupplied area includes the large tourism-related services located to the south of the substation.

There were no existing or forecast capacity concerns identified in the Kananaskis area.

5. Alternatives Analysis

A number of alternatives were considered based on information available to FortisAlberta, technical merit and distribution capital cost. Three alternatives are

presented in this document. These three alternatives have either the least distribution system development, the lowest estimated distribution capital cost or an expectation of the lowest combined transmission and distribution costs.

5.1 Alternative 1: Distribution Upgrades

5.1.1 Description

The Seebe 245S substation is the nearest substation with the capacity to provide reliability support for the Mount Allan 115S substation, i.e. no transmission upgrades would be required. The distribution upgrades required to eliminate the reliability concerns at the Mount Allan 115S substation would include upgrading 1.4 km of existing underground cable, installing 8.5 km of new underground cable, upgrading 12.7 km of single-circuit three phase powerline and rebuilding 2.9 km of single-circuit three phase powerline as double-circuit powerline. In addition, it would be necessary to relocate one existing 25 kV voltage regulator, install two additional 300 Amp 25 kV voltage regulators and add one electronic Recloser.

The estimated cost for these distribution upgrades is $12.7 million (2019$, ±30%).

As this alternative has a cost which is expected to be significantly higher than the preferred alternative, load tables and sketches have not been provided.

5.2 Alternative 2: Upgrades at the Mount Allan 115S substation

5.2.1 Description

2019 transmission upgrades at the Mount Allan 115S substation include:

- Install one appropriately-sized LTC source transformer,
- Add one 25 kV feeder breaker, and
- Other associated upgrades as required.

Distribution upgrades associated with this alternative would include building approximately 0.9 km of 500 MCM single-circuit underground line. In addition, bypass arrangements outside of the Mount Allan 115S substation will be established to enable load transfers between the two feeders and two transformers.

Refer to Appendix B, Figure B-1 for a simplified sketch showing the Alternative 2 system development.

All 25 kV overhead conductors, new and existing, exiting the substation and distribution feeder ties shall be 477 MCM. All underground feeder cables, new and existing, shall be 750 MCM. All transmission components on the secondary side of

the 25 kV source transformers, new and existing, shall be sized to enable the feeders to simultaneously supply 26 MVA per feeder. All 25 kV feeder breakers shall be equipped with associated equipment to enable under-frequency load shedding.

Transmission facilities must be equipped with the appropriate equipment for interconnection with FortisAlberta's Automated Metering system. Provisions should be made for interconnecting the substation transformer neutrals with the distribution line neutrals as per the AltaLink Management Limited (AltaLink) standard.

All 138 kV and 25 kV buses shall have adequate switch points and protection to minimize frequency and duration of outages associated with the maintenance or failure of substation components upstream of the 25 kV bus. Failure of such upstream components must not result in a total substation outage.

5.2.2 Load Forecast

The load forecast resulting from Alternative 2 is provided in Table 5-1.

Table 5-1: Alternative 2 – Upgrades at the Mount Allan 115S Substation

					MVA LOADING - RECORDED						PREDICTED - MVA LOADING									
				W	2013	2014	2015	2016	2017		2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
SUB		CAPACITY		or	Peak	Peak	Peak	Peak	Peak		Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak
No	Feeder	T/R	MVA	S	MVA	MVA	MVA	MVA	MVA	PF	MVA	MVA	MVA	MVA	MVA	MVA	MVA	MVA	MVA	MVA
048S	**Pocaterra**	T2	5	W	**0.4**	**0.4**	**0.4**	**0.5**	**0.4**	89%	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**
048S	132LN			W	0.4	0.4	0.4	0.5	0.4	89%	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
115S	**Mount Allan**	T1	Salvage 6																	
115S		T2	10																	
115S		VR1	10	W	**7.8**	**7.5**	**7.4**	**8.0**	**7.4**	97%	**8.8**	**1.0**	**1.0**	**1.0**	**1.1**	**1.1**	**1.1**	**1.2**	**1.2**	**1.2**
115S	404LS			W	7.8	7.5	7.4	8.0	7.4	97%	8.8	1.0	1.0	1.0	1.1	1.1	1.1	1.2	1.2	1.2
115S	NEW 2019	T1	New	W						97%		**7.8**	**7.8**	**7.8**	**7.9**	**7.9**	**7.9**	**8.0**	**8.0**	**8.0**
115S	NEW 2019		2019	W						97%		7.8	7.8	7.8	7.9	7.9	7.9	8.0	8.0	8.0
115S	Total Station			W						97%		**8.8**	**8.9**	**8.9**	**8.9**	**9.0**	**9.0**	**9.1**	**9.1**	**9.1**
245S	**Seebe**	T2	15/20/ 25	W	**8.7**	**8.9**	**8.0**	**9.2**	**8.7**	99%	**10.0**	**10.1**	**10.3**	**10.4**	**10.6**	**10.7**	**10.8**	**11.0**	**11.1**	**11.4**
245S	69LE			W	3.9	3.8	3.8	4.0	4.0	100%	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.2
245S	79LW			W	5.3	5.5	4.7	5.5	5.6	97%	6.4	6.4	6.5	6.5	6.6	6.6	6.6	6.7	6.7	6.8
			Total Area Load		**16.9**	**16.8**	**15.8**	**17.7**	**16.5**		**19.3**	**19.4**	**19.7**	**19.8**	**20.0**	**20.2**	**20.3**	**20.6**	**20.7**	**21.0**
								115S Station Load	7.4		8.8	8.8	8.9	8.9	8.9	9.0	9.0	9.1	9.1	9.1
								N-1 Capacity	0.0		0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
								Back-up from 48S	1.8		1.8	1.8	1.9	1.9	1.9	2.0	2.0	2.0	2.1	2.1
								Back-up from118S & 245S	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
								N-1 Unsupplied Load	**5.6**		**7.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Load Transfers in 2019	
Feeder	MW
115S-404LS	-7.8
115S-NEW	7.8

5.2.3 Cost Estimate

If Alternative 2 is selected, AltaLink will prepare a facility application for the requested transmission upgrades. This facility application will include an estimate of the transmission capital cost.

The distribution capital cost for Alternative 2 is estimated to be $0.49 million (2019$, ±30%).

5.3 Alternative 3: Transmission Upgrades at the Pocaterra 48S Substation

5.3.1 Description

The Pocaterra 48S substation does not currently have sufficient capacity on the T2 distribution source transformer to back-up the load at the Mount Allan 115S substation.

In addition, due to the location of the large loads near the Mount Allan 115S substation, it would be necessary to upgrade 31 km of three-phase distribution powerline in order to provide the 7.8 MVA of back-up capability. The estimated distribution cost is $4.5 million (2019$, ±30%).

If required, the full scope of the transmission upgrades could be provided by the TFO, AltaLink. After which, FortisAlberta could provide the load tables and sketches for the associated distribution upgrades.

6. Alternatives Assessment

The following section presents the technical and economic analysis of the alternatives considered in this Need for Development.

6.1 Technical and Economic Analysis

6.1.1 Alternative 1 – Distribution Upgrades

The existing and predicted reliability concern at the Mount Allan substation can be resolved by building distribution facilities to provide back-up for the Mount Allan 115S substation from the Seebe 245S substation. This is a technically acceptable solution. However, the cost is expected to be significantly higher than the preferred alternative.

As a result, Alternative 1 is not the preferred alternative.

6.1.2 Alternative 2 – Upgrades at the Mount Allan 115S Substation

Installation of an appropriately sized LTC source transformer and the addition of one 25 kV feeder breaker, plus associated distribution upgrades can address the existing and predicted reliability concerns at the Mount Allan 115S substation. The new source transformer provides the needed transformation capacity to transfer loads between the two transformers in case of N-1 contingencies.

The distribution costs associated with this alternative are lower than those for the other alternatives.

As a result, Alternative 2 is technically and economically acceptable and is the FortisAlberta preferred alternative.

6.1.3 Alternative 3 – Upgrades at the Pocaterra 48S Substation

The upgrade of distribution transformer capacity at the Pocaterra 48S substation and the resolution of the legacy out of phase interconnection between Pocaterra 48S and Mt. Allan 115S distribution systems, followed by associated distribution upgrades, can address the reliability concern at the Mount Allan 115S substation.

This is a technically possible solution. However, due to the identified scope and complexities, the cost is expected to be significantly higher than the preferred alternative.

As a result, Alternative 3 is not the preferred alternative.

7. Conclusion

After considering the alternatives to address the existing and predicted reliability concerns in the Kananaskis area, Alternative 2 is preferred by FortisAlberta as it resolves the concern at the lowest expected combined transmission and distribution cost. Alternative 2 includes transmission upgrades at the Mount Allan 115S substation:

- Installation of one appropriately-sized LTC source transformer,
- Addition of one 25 kV feeder breaker, and
- Other associated upgrades as required.

An estimate for the transmission system capital cost will be provided by the TFO, AltaLink.

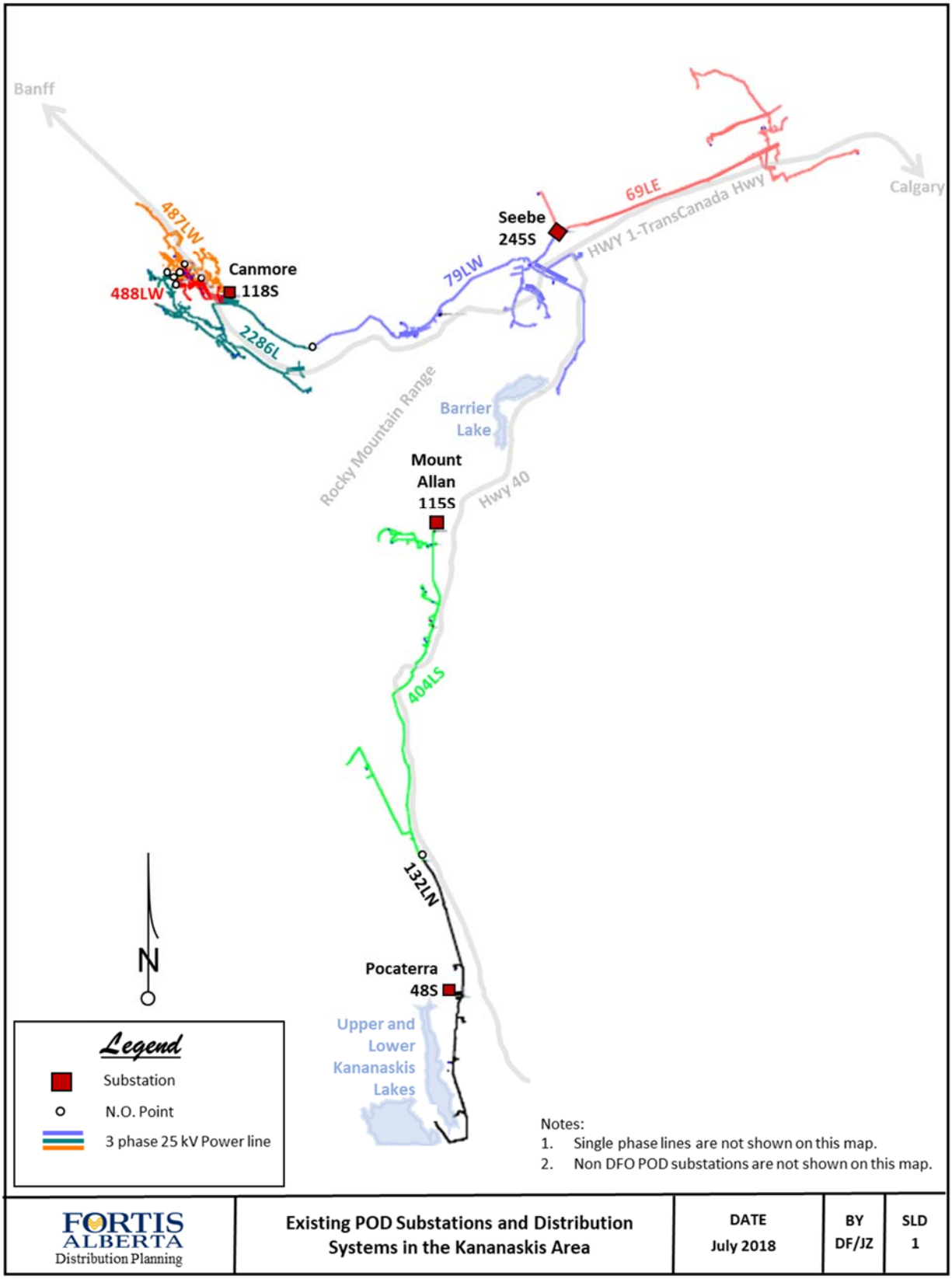
The estimated distribution capital cost associated with the preferred alternative is $0.49 million (±30%, 2019$).

The requested ISD for the Mount Allan 115S substation upgrade is November 1, 2019.

If FortisAlberta's preferred alternative is approved by the AUC, FortisAlberta will request an increase to the DTS contract at the Mount Allan 115S substation of 4.6 MW, resulting in a DTS capacity of 7.7 MW.

Appendix A – Existing POD Substations & Distribution Systems in the Kananaskis Area

Figure A-1: Existing POD Substations and Distribution Systems in the Kananaskis Area



Appendix B – Alternative 2 Associated POD Substations & Distribution Systems in the Kananaskis Area

Figure B-1: Alternative 2: Transmission and Distribution Upgrades in the Kananaskis Area