





APPENDIX E DFO NEED FOR DEVELOPMENT REPORT



**Need for Development
Sherwood Park Area Upgrade**

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Executive Summary

Load growth in the Sherwood Park area is producing a number of concerns related to the adequacy of the existing transmission and distribution facilities to provide capacity and reliability to meet customer needs.

The predicted load on the Broadmoor 420S substation source transformer is predicted to exceed its 42.0 MVA rating in 2017. In addition, the predicted load on 25 kV distribution feeders 746S-474LS, 746S-173LW, 746S-34LN, 746S-2239L, 420S-555L, 38S-222L, 38S-159LW and 45S-2229L are predicted to exceed 13.0 MVA within the next ten years. This exceeds FortisAlberta Inc. (FortisAlberta) feeder loading standards.

In the event of an N-1 contingency at the Sherwood Park 746S substation in 2014 there could be over 6.5 MVA of unsupplied load. This is predicted to increase to over 30.3 MVA by 2023 if left unaddressed. This violates FortisAlberta restoration criteria.

To address the capacity and reliability concerns in the area, the installation of an additional 138/25 kV 25/33/42 MVA LTC source transformer and three additional 25 kV feeder breakers at the Broadmoor 420S substation is proposed.

The requested completion date for the proposed Broadmoor 420S facility upgrade is September 1, 2016.

Upon completion of this transmission system upgrade, FortisAlberta is prepared to execute a DTS contract at the Broadmoor 420S substation for 53.3 MW.

Table of Contents

EXECUTIVE SUMMARY I

TABLE OF CONTENTS II

LIST OF TABLES AND FIGURES II

1. PROJECT DESCRIPTION 1

 1.1 BACKGROUND:..... 1

 1.2 PROPOSAL:..... 1

2. CRITERIA AND ASSUMPTIONS 2

 2.1 CRITERIA 2

 2.2 LOAD FORECAST 2

3. EXISTING SYSTEM ASSESSMENT 4

4. ALTERNATIVES ANALYSIS 5

 4.1 ALTERNATIVE 1: LOAD SHIFTING 5

 4.1.1 Description..... 5

 4.2 ALTERNATIVE 2: UPGRADES AT THE BROADMOOR 420S SUBSTATION 5

 4.2.1 Description..... 5

 4.2.2 Load Forecast 6

 4.2.3 Cost Estimate..... 8

 4.3 ALTERNATIVE 3: UPGRADES AT THE SHERWOOD PARK 746S SUBSTATION OR EAST EDMONTON 038S SUBSTATION..... 8

 4.4 ALTERNATIVE 4: UPGRADES AT THE BRETONA 45S SUBSTATION 8

5. ALTERNATIVES ASSESSMENT 8

 5.1 TECHNICAL AND ECONOMIC ANALYSIS 8

 5.1.1 Alternative 1 – Load Shifting 8

 5.1.2 Alternative 2 – Upgrades at the Broadmoor 420S Substation 9

 5.1.3 Alternative 3 – Upgrades at the Sherwood Park 746S Substation or East Edmonton 038S Substation 9

 5.1.4 Alternative 4 – Upgrades at the Bretona 45S Substation 9

6. CONCLUSION/RECOMMENDATIONS 9

Appendix A – Existing System..... 10

Appendix B – Alternative 2 – Upgrades at the Broadmoor 420S Substation..... 11

List of Tables and Figures

Table 2-1: FortisAlberta Load Forecast: Existing System 3

Table 3-1: Overview of Existing Substation Facilities..... 4

Table 4-1: FortisAlberta Load Forecast for Alternative 2 – Upgrades at Broadmoor 420S..... 7

Figure A-1: Existing System Including Committed Projects 10

Figure B-1: Alternative 2 – Upgrades at the Broadmoor 420S Substation 11

1. Project Description

1.1 Background:

The Broadmoor 420S substation is located on the west side of Sherwood Park, just east of the City of Edmonton. It has a single 138.0/26.5 kV 25/33/42 MVA source transformer supplying four 25 kV distribution feeders.

The distribution load in this area consists mainly of urban residential, commercial, and industrial loads. Load growth has generally been higher than system average. See Figure A-1 in Appendix A and Table 3-1 for an overview of the area substations and distribution facilities. Table 2-1 presents substation and feeder load levels and growth rate information.

Based on the historical load levels, forecast growth and committed load additions for the distribution systems supplied by the area substations, several capacity-related issues are predicted within the 10 year planning horizon. In 2017, the load on the Broadmoor 420S substation source transformer is predicted to exceed its 42.0 MVA rating. Within the next ten years, the predicted load on 25 kV distribution feeders 746S-474LS, 746S-173LW, 746S-34LN, 746S-2239L, 420S-555L, 38S-222L, 38S-159LW and 45S-2229L are predicted to exceed 13.0 MVA within the next ten years.

Reliability under contingency is also a concern for the distribution systems supplied by Sherwood Park 746S substation. In 2014 the amount of unsupplied load under an N-1 contingency could exceed 6.5 MVA. This is predicted to increase to over 30.3 MVA by 2023 if left unaddressed. This violates FortisAlberta restoration criteria.

1.2 Proposal:

After considering the alternatives to address the existing and predicted concerns for distribution service, a transmission system upgrade is proposed. This involves the installation of a 138/25 kV 25/33/42 MVA LTC source transformer and three additional 25 kV feeder breakers at the Broadmoor 420S substation. This will address the capacity and reliability concerns in the Sherwood Park area.

AltaLink Management Ltd. (AltaLink) will prepare a proposal for the required transmission upgrades. This will include an estimate for the transmission capital cost.

The estimated distribution cost associated with this alternative is \$3.1 million ($\pm 30\%$, 2014\$).

The requested completion date for the proposed Broadmoor 420S facility upgrade is September 1, 2016.

Upon completion of this transmission system upgrade FortisAlberta will execute a DTS contract at the Broadmoor 420S substation for 53.3 MW.

2. Criteria and Assumptions

The analysis for the proposed development in the Sherwood Park area has been conducted based upon the following criteria and assumptions.

2.1 Criteria

The maximum normal loading of FortisAlberta 25 kV distribution feeders is 13.0 MVA.

FortisAlberta restoration criteria require that back-up supply for contingency situations be available subject only to switching time.

Transmission equipment must not be operated at load levels in excess of the equipment ratings.

2.2 Load Forecast

Table 2-1 provides FortisAlberta historical and forecast peak load levels for the substations and feeders in the subject area. The load forecast is based on historical data, expected development trends and contracted new loads. This load forecast was used to assess all the alternatives presented in this Need for Development document.

3. Existing System Assessment

The existing distribution systems in the Sherwood Park area are shown in Figure A-1 in Appendix A and Table 3-1 provides an overview of the existing facilities and capacities for the area substations.

Table 3-1: Overview of Existing Substation Facilities

Substation	Sherwood Park 746S	Broadmoor 420S	Bretona 45S	East Edmonton 38S
Transformation Installed Capacity	T1 130.0/24.9 kV 25/33/42//47 MVA LTC T2 138.0/24.9 kV 25/33/42//47 MVA LTC	T1 138.0/26.5 kV 25/33/42 MVA LTC	T2 138.0/26.5 kV 25/33/42 MVA LTC	T3 130.0/24.9 kV 50.0/66.7/83.3//93.3 MVA LTC T2 130.0/24.9 kV 50.0/66.7/83.3//93.3 MVA LTC
Peak Station Load (2013/14 winter peak)	56.3 MVA	20.8 MVA	28.5 MVA	57.7 MVA
Available Capacity (N-0)	94.0 MVA	42.0 MVA	42.0 MVA	186.6 MVA
Firm Transformation Capacity (N-1)	47.0 MVA	0	0	93 MVA
25 kV Feeders	173LW 474LS 34LN 222LS 51LE 2239L	2032L 213L 347L 555L	2229L 2230L 2231L	107LN 118LN 2027L 28LS 106L 136LW 159LW 222L 135LW 183LE 2028L

The load on the Broadmoor 420S substation transformer is predicted to exceed its 42.0 MVA rating in 2017.

Over the next ten years, the following 25 kV feeders are predicted to carry load levels in excess of the normal feeder load maximum: 746S-474LS, 746S-173LW, 746S-34LN, 746S-2239L, 420S-555L, 38S-222L, 38S-159LW and 45S-2229L.

The amount of unsupplied load under N-1 contingency exceeds restoration criteria at Sherwood Park 746S.

4. Alternatives Analysis

The following alternatives were considered:

Alternative 1	Load Shifting
Alternative 2	Upgrades at the Broadmoor 420S Substation
Alternative 3	Upgrades at the Sherwood Park 746S Substation or East Edmonton 038S Substation
Alternative 4	Upgrades at the Bretona 45S Substation

4.1 Alternative 1: Load Shifting

4.1.1 Description

Load shifting on the existing distribution system cannot mitigate all the deficiencies in the area. There is insufficient feeder capacity.

As a result of this, the load forecast and costs have not been included in this document.

4.2 Alternative 2: Upgrades at the Broadmoor 420S Substation

4.2.1 Description

2016 at the Broadmoor 420S substation:

- **Add one (1) 138/25 kV 25/33/42 MVA LTC transformer**
- **Add three (3) 25 kV feeder breakers**

Refer to Appendix B, Figure B-1, for the simplified SLD showing the proposed system development. All three of the new 25 kV feeders will be supplied by the new transformer.

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 25 kV feeder breakers shall be equipped with associated equipment to enable under-frequency load shedding. 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.

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 TFO standard.

All 138 kV and 25 kV buses shall have adequate protection to minimize frequency and duration of outages associated with the failure of substation components upstream of the 25 kV bus.

4.2.2 Load Forecast

The load forecast resulting from this alternative is provided in Table 4-1.

4.2.3 Cost Estimate

The transmission capital cost for Alternative 2 will be provided by AltaLink.

The distribution capital cost for Alternative 2 is estimated at:

2016 \$3.1 million (2014\$, ±30%).

4.3 Alternative 3: Upgrades at the Sherwood Park 746S Substation or East Edmonton 038S Substation

Upgrading Sherwood Park 746S was explored. A high level assessment determined the site expansion required to install a third source transformer at Sherwood Park 746S and building new feeders out through the developed urban areas would result in significantly higher capital costs than the preferred alternative of upgrading Broadmoor 420S. Therefore, this option is not recommended.

Upgrading East Edmonton 038S was explored. A high level assessment determined the site expansion required to install additional source transformation at East Edmonton 038S and building new feeders would result in significantly higher capital costs than the preferred alternative of upgrading Broadmoor 420S. Therefore, this option is not recommended.

As a result of this, the load forecasts and costs for these two options have not been included in this document.

4.4 Alternative 4: Upgrades at the Bretona 45S Substation

Upgrading Bretona 45S was explored. The transmission upgrades that would be required: add one 138/25 kV 25/33/42 MVA LTC transformer and three 25 kV feeder breakers. From Figure A-1 in Appendix A, it is shown Bretona 45S is at a greater distance from the major load centres compared to Broadmoor 420S. The new distribution lines required from Bretona 45S would be approximately three times of that required from Broadmoor 420S. This alternative would result in high distribution capital costs relative to the preferred alternative of upgrading Broadmoor 420S. Therefore, this alternative is not recommended.

As a result of this, the load forecast and costs have not been included in this document.

5. Alternatives Assessment

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

5.1 Technical and Economic Analysis

5.1.1 Alternative 1 – Load Shifting

As discussed in the Alternatives Analysis section above, installing feeder breakers at East Edmonton 38S and building distribution facilities would result in high

capital distribution costs relative to the preferred alternative of upgrading Broadmoor 420S substation. Therefore, this alternative is not recommended.

5.1.2 Alternative 2 – Upgrades at the Broadmoor 420S Substation

Adding a transformer and three 25 kV feeder breakers at Broadmoor 420S can mitigate all the area deficiencies. This is the preferred technical solution because it enables FortisAlberta to provide robust and reliable distribution service to existing and future customers in the Sherwood Park area.

This alternative is acceptable.

5.1.3 Alternative 3 – Upgrades at the Sherwood Park 746S Substation or East Edmonton 038S Substation

As discussed in the Alternatives Analysis section above, upgrading Sherwood Park 746S or East Edmonton 038S would result in significantly higher capital costs relative to the preferred alternative of upgrading Broadmoor 420S substation. Therefore, neither of these options are recommended.

5.1.4 Alternative 4 – Upgrades at the Bretona 45S Substation

As discussed in the Alternatives Analysis section above, upgrading Bretona 45S would result in high capital distribution costs relative to the preferred alternative of upgrading Broadmoor 420S substation. Therefore, this alternative is not recommended.

6. Conclusion/Recommendations

After considering the alternatives to address the existing and predicted concerns for distribution service in the Sherwood Park area, the preferred alternative proposes the installation of an additional 138/25 kV 25/33/42 MVA LTC source transformer and three additional 25 kV feeder breakers at the Broadmoor 420S substation.

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

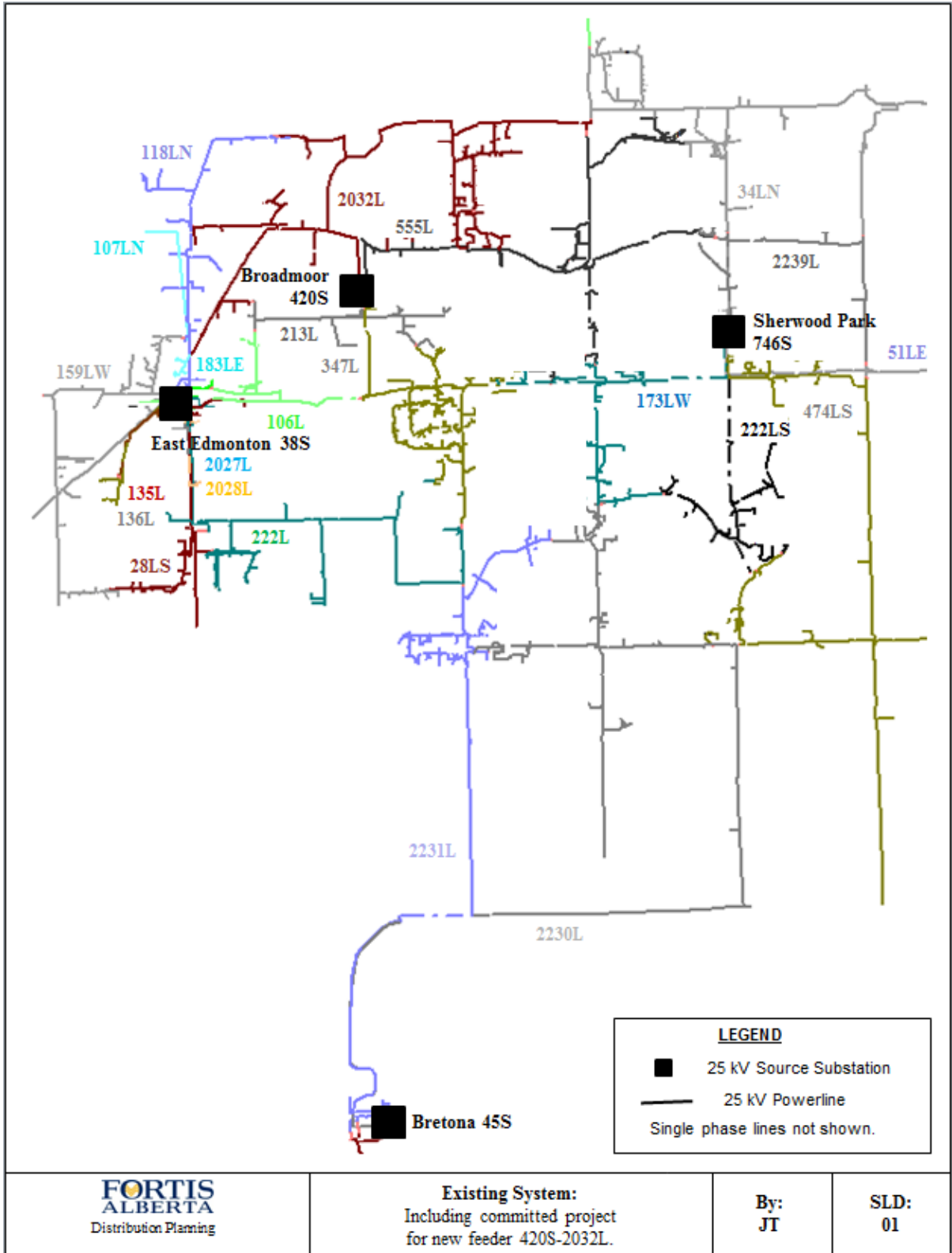
The estimated distribution capital cost associated with this proposal is \$3.1 million ($\pm 30\%$, 2014\$).

The requested completion date for the proposed Broadmoor 420S facility upgrade is September 1, 2016.

Upon completion of this transmission system upgrade, FortisAlberta will execute a DTS contract at the Broadmoor 420S substation for 53.3 MW.

Appendix A – Existing System

Figure A-1: Existing System Including Committed Projects



Appendix B – Alternative 2 – Upgrades at the Broadmoor 420S Substation

Figure B-1: Alternative 2 – Upgrades at the Broadmoor 420S Substation

