March 6, 2015

Attention: Wade Vienneau
Executive Director - Facilities
Alberta Utilities Commission
Fifth Avenue Place
4th Floor, 425 - 1 Street SW
Calgary, AB T2P 3L8

Dear Mr. Vienneau:

Re: Application to the Alberta Utilities Commission (AUC) for approval of the Deer Hill 1012S Substation Needs Identification Document

Please find enclosed the Alberta Electric System Operator (AESO) application for approval of the Needs Identification Document (NID) for the proposed Deer Hill 1012S Substation pursuant to Section 34 of the Electric Utilities Act.

The AESO understands that AltaLink Management Ltd. (AltaLink) will file the related facilities application shortly. The AESO requests that the Commission combine the NID and the facilities application and consider them together pursuant to Section 15.4 of the Hydro and Electric Energy Act.

Please do not hesitate to contact the below if you have questions or concerns regarding the foregoing:

Melissa Mitchell-Moisson
Senior Regulatory Coordinator
need.applications@aeso.ca
403-539-2948

Sincerely,

Warren Cleundring
Manager, Regulatory
Alberta Utilities Commission

In the Matter of the Need for the Deer Hill 1012S Substation


Application of the Alberta Electric System Operator for Approval of the Deer Hill 1012S Substation Needs Identification Document
PART A - APPLICATION

1 Introduction

1.1 Application – Pursuant to Section 34(1)(c) of the Electric Utilities Act (Act), and in accordance with further provisions set out in legislation,\(^1\) the Alberta Electric System Operator (AESO) applies to the Alberta Utilities Commission (Commission) for approval of the Deer Hill 1012S Substation Needs Identification Document (Application).

1.2 Application Overview – FortisAlberta Inc. (FortisAlberta), as the legal owner of the electric distribution facilities (DFO) in the Edson area (AESO Planning Area 29, Hinton/Edson), has requested transmission system access service to reliably serve load growth in the area. FortisAlberta’s request can be met by constructing a new 138-25 kV substation, to be designated as Deer Hill 1012S, and two new 138 kV transmission circuits connecting the new substation to the existing 138 kV transmission line 854L (“Proposed Transmission Development”, as further described in Section 2.2). The requested in-service date for the Proposed Transmission Development is February 2016.

This Application describes the need for transmission development arising from the DFO’s request for system access service. Having followed the AESO Connection Process,\(^2\) the AESO has determined that the Proposed Transmission Development provides a reasonable opportunity for the market participant to exchange electricity. The Proposed Transmission Development is aligned with the AESO’s long-term plans in the Edson area. The AESO, in accordance with its responsibility to plan the transmission system, submits this Application to the Commission for approval.\(^3,4\)


\(^2\) For information purposes, refer to note iv of Part C of this Application for more information on the AESO Connection Process.

\(^3\) For information purposes, some of the legislative provisions relating to the AESO’s planning duties and duty to provide system access service are referenced in notes i and ii of Part C of this Application.

\(^4\) Note v of Part C of this Application describes the Application scope in more detail.
1.3 AESO Directions to the TFO – During the AESO Connection Process, the AESO issued various directions to AltaLink Management Ltd. (AltaLink) as the legal owner of transmission facilities (TFO), including direction to assist the AESO in preparing this Application.\(^5\)

\(^5\) The directions are described in more detail in the following sections of this Application and in Part C, note vi.
2 Need Overview and Proposed Transmission Development

2.1 Duty to Provide Transmission System Access Service – The AESO, pursuant to its responsibilities under Section 29 of the Act, must provide system access service on the transmission system in a manner that gives all market participants (in this case the DFO) a reasonable opportunity to exchange electric energy and ancillary services.

The DFO, in executing its duties as defined under Section 105(1)(b) of the Act, has determined that the Proposed Transmission Development is the preferred development to reliably serve load growth in the Edson area. The DFO has made the appropriate applications to the AESO to obtain transmission system access service.\(^6\)

Through the AESO Connection Process, the AESO, the DFO and the TFO have collaborated to determine the characteristics of the Proposed Transmission Development and assess the impacts of connecting the Proposed Transmission Development to the transmission system. The AESO has issued directions to the TFO to prepare a Facility Proposal\(^7\) to meet the DFO’s identified need.

2.2 Proposed Transmission Development – The Proposed Transmission Development includes the following major elements:\(^8\)

1. Add a new 138-25 kV substation, designated Deer Hill 1012S, with one 138-25 kV transformer rated at approximately 25/33/42 MVA, and with two 138 kV breakers and four 25 kV breakers;

\(^6\) For information purposes, some of the duties of the DFO are described in note vii of Part C of this Application.

\(^7\) Also referred to as facility application, or FA, under Commission Rule 007.

\(^8\) Details and configuration of equipment required for the Proposed Transmission Development, including substation single-line diagrams, are more specifically described in the AESO’s Functional Specification included in the TFO’s Transmission Facility Proposal. Also, further details will be determined as detailed engineering progresses and DFO operating requirements are finalized. Routing and/or siting of transmission facilities do not form part of this Application and are addressed in the TFO’s Facility Proposal. The new 138 kV circuits are currently estimated to have a length of approximately 100 metres. This is subject to change as routing is finalized by the TFO. Distribution facilities that may subsequently be connected to the Proposed Transmission Development are the responsibility of the DFO and are not included in this Application.
2. Add two new 138 kV transmission circuits connecting the proposed Deer Hill 1012S substation to the existing 138 kV transmission line 854L using an in-and-out connection configuration;

3. Add a new telecommunications tower; and

4. Modify, alter, add or remove equipment, including disconnect switches, and any operational, protection, control and telecommunication devices required to undertake the work as planned and ensure proper integration with the transmission system.

2.3 Proposed Transmission Development Cost Estimates – The AESO directed the TFO to prepare a cost estimate for the Proposed Transmission Development. The TFO estimated the in-service cost of the Proposed Transmission Development, described in Section 2.2, to be approximately $15 million ($2016).\(^9\) In accordance with the ISO Tariff, the AESO has determined that there are no system-related costs associated with the Proposed Transmission Development.

2.4 Transmission Development Alternatives – To meet the requested load increase, one other transmission alternative to the Proposed Transmission Development was identified and ruled out.

1. Add a new substation connected to the Marlboro 348S substation – this alternative would add a new 138-25 kV substation, designated Deer Hill 1012S, and connect it to the existing Marlboro 348S substation using approximately 11 km of 138 kV transmission circuit. The existing Marlboro 348S substation would be reconfigured from a T-tap to an in/out connection to transmission line 854L. This alternative was ruled out by the DFO as it would require materially more transmission facilities at a higher cost as compared to the Proposed Transmission Development.

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\(^9\) Further details of this cost estimate can be found in Appendix B, with an approximate accuracy level of +20%/-10%.
The Proposed Transmission Development, selected since it reliably serves the new load with less new transmission facility development, forms the basis of the cost estimates and the Connection Assessment described herein.\(^\text{10}\)

### 2.5 Connection Assessment

Power flow, voltage stability and short circuit analyses were conducted to assess the impact that the Proposed Transmission Development and the associated load would have on the transmission system.\(^\text{11}\) Power flow and short circuit analyses were conducted prior to and following connection of the Proposed Transmission Development and voltage stability analysis was performed following connection. Load and generation assumptions used in the analyses align with the AESO 2012 Long-term Outlook Update (2012LTOU) corporate forecast. While the AESO has since updated its corporate forecast in the 2014 Long-term Outlook, the updated forecast would not materially alter the connection assessment results or conclusions.

These analyses indicate that the Proposed Transmission Development will not adversely impact transmission system performance.

### 2.6 Transmission Interdependencies

There are no transmission interdependencies associated with the Proposed Transmission Development. Future AESO needs identification documents in the Edson area will assume the Proposed Transmission Development will be in-service for the date specified, unless new information indicates otherwise.

### 2.7 AESO Participant Involvement Program

The AESO directed the TFO to assist the AESO in conducting a participant involvement program (PIP), in accordance with requirement NID14 and Appendix A2 of Commission Rule 007. Between September 2014 and February 2015, the TFO and the AESO used various methods to notify occupants, residents, landowners, government bodies, agencies and stakeholder groups in the project area.

\(^{10}\) Details of the connection alternatives are included in Appendix A. The DFO considered and ruled out distribution system upgrades and load shifting on the distribution system. The DFO’s report detailing this analysis is included as Appendix E, Sections 4 and 5.

\(^{11}\) The Connection Assessment is included as Appendix A.
groups (the stakeholders) of the need for the Proposed Transmission Development in the area where transmission facilities could be installed to address the identified need. The AESO notified the public in the area where transmission facilities could be installed, of its intention to file this Application with the Commission. No concerns or objections have been raised regarding the need for the Proposed Transmission Development.\(^{12}\)

2.8 Information Regarding Rule 007, Section 6.1 - NID13 – The AESO has been advised that the TFO’s Facility Proposal addresses the major aspects listed in Commission Rule 007, Section 6.1 – NID13.\(^{13}\) In consideration of that fact, and as the filing of the Application is combined with the TFO’s Facility Proposal, the AESO has not undertaken a separate assessment of the sort contemplated in Commission Rule 007, Section 6.1 – NID13.

2.9 Approval is in the Public Interest – Having regard to the following:

- the transmission planning duties of the AESO as described in Sections 29, 33 and 34 of the Act;
- the System Access Service Request;
- the DFO’s Need for Development report;
- the Connection Assessment;
- information obtained from the AESO PIP Activities; and
- the AESO’s long-term transmission system plans;

it is the conclusion of the AESO that the Proposed Transmission Development provides a reasonable opportunity for the market participant to exchange electricity. In consideration of these factors, the AESO submits that approval of the Application is in the public interest.

\(^{12}\) Further information regarding the AESO’s PIP for this Application is included in Appendix C.

\(^{13}\) Please refer to the letter included as Appendix D of this Application.
3 Request to Combine this Application with the Facility Proposal for Consideration in a Single Process

3.1 Pursuant to Subsection 35(1) of the Act, the AESO has directed the TFO to prepare a Facility Proposal to meet the need identified. The AESO understands that the TFO’s Facility Proposal will be filed shortly. The AESO requests, and expects that the TFO will request, that this Application be combined with the Facility Proposal for consideration by the Commission in a single process. This request is consistent with Section 15.4 of the *Hydro and Electric Energy Act* and Section 6 of Commission Rule 007.

3.2 While it is believed that this Application and the Facility Proposal will be materially consistent, the AESO respectfully requests that in its consideration of both, the Commission be mindful of the fact that the documents have been prepared separately and for different purposes. The purpose of this Application is to obtain approval of the need for the identified transmission system developments and provide a preliminary description of the manner proposed to meet that need. In contrast, the Facility Proposal will contain more detailed engineering and designs for the Proposed Transmission Development and seek approval for the construction and operation of specific facilities.

14 The AESO understands that AltaLink intends to file a Facility Proposal relating to this Application to be titled *Deer Hill 1012S Substation*. 
4 Relief Requested

4.1 The AESO submits that its assessment of the need to meet the market participant’s request for transmission system access service is technically complete and that approval of the need for the Proposed Transmission Development is in the public interest.

4.2 For the reasons set out herein, and pursuant to Section 34 of the Act, the AESO requests that the Commission approve this Application, including issuing an approval of the need to connect the Proposed Transmission Development, as follows:

A. Add a new 138-25 kV substation, designated Deer Hill 1012S, with one 138-25 kV transformer and with two 138 kV breakers;

B. Add two new 138 kV transmission circuits connecting the proposed Deer Hill 1012S substation to the existing 138 kV transmission line 854L using and in-and-out connection configuration; and

C. Modify, alter, add or remove equipment, including disconnect switches, and any operational, protection, control and telecommunication devices required to undertake the work as planned and ensure proper integration with the transmission system.

All of which is respectfully submitted this 6th day of March, 2015.

Alberta Electric System Operator

[Signature]

Scott M. Bias, P. Eng.
Senior Regulatory Specialist, Regulatory
PART B – APPLICATION APPENDICES

The following appended documents support the Application (Part A).

APPENDIX A  Connection Assessment – Appendix A contains the Engineering Study Report, Fortis Edson New Substation/POD (Deer Hill 1012S) that assesses the transmission system performance prior to and following the connection of the Proposed Transmission Development. As part of the AESO Connection Process, the DFO engaged a consultant to conduct the connection assessment (Study). The AESO defined the Study scope, and provided the system models and Study assumptions. The AESO also reviewed this report and its conclusions, and finds the Study acceptable for the purposes of assessing the impacts of the Proposed Transmission Development on the transmission system.

APPENDIX B  TFO Capital Cost Estimates – Appendix B contains detailed cost estimates corresponding to the Proposed Transmission Development. These estimates have been prepared by the TFO at the direction of the AESO, to an approximate accuracy level of +20%/-10%, which exceeds the accuracy required by Commission Rule 007, NID11.

APPENDIX C  AESO PIP – Appendix C contains a summary of the PIP activities conducted regarding the need for the Proposed Transmission Development. Copies of the relevant materials distributed during the PIP are attached for reference.

APPENDIX D  Information Regarding Rule 007, Section 6.1 - NID13 – Appendix D contains a letter provided by the TFO confirming that the seven major aspects of Commission Rule 007, NID13 will be addressed within the TFO’s Facility Proposal.

APPENDIX E  Distribution Deficiency Report – Appendix E contains the DFO’s Need for Development Edson Area Transmission Facility Upgrades that provides information in support of the DFO’s request for the Proposed Transmission Development, including describing the need for development.

APPENDIX F  AESO Transmission Planning Criteria – Basis and Assumptions – The AESO has recently revised the Transmission Reliability Criteria,
Part II Transmission System Planning Criteria, Version 0, dated March 11, 2005 primarily to remove criteria that are now included in the Transmission Planning (TPL) Standards.\textsuperscript{15} Appendix F contains the Transmission Planning Criteria – Basis and Assumptions, Version 1, which includes the applicable thermal and voltage limits in support of the TPL standards. Planning studies that are included in this Application meet all the performance requirements of the specified TPL standards (TPL-001-AB-0, TPL-002-AB-0, and specified contingencies associated with TPL-003-AB-0).

\textsuperscript{15} TPL Standards are included in the current Alberta Reliability Standards.
PART C – REFERENCES

i. AESO Planning Duties and Responsibilities – Certain aspects of the AESO’s duties and responsibilities with respect to planning the transmission system are described in the Act. For example, Section 17, Subsections (g), (h), (i), and (j), describe the general planning duties of the AESO. Section 33 of the Act states that the AESO “must forecast the needs of Alberta and develop plans for the transmission system to provide efficient, reliable, and non-discriminatory system access service and the timely implementation of required transmission system expansions and enhancements.” Where, as in this case, the market participant (refer to note ii below) is requesting the expansion or enhancement of the capability of the transmission system to meet its distribution planning needs, the AESO must prepare and submit for Commission approval, as per Section 34(1)(c), a needs identification document that describes the need to respond to requests for system access service, including the assessments undertaken by the AESO regarding the manner proposed to address that need. Other aspects of the AESO’s transmission planning duties and responsibilities are set out in Sections 8, 10, and 11 of the Transmission Regulation.

ii. Duty to Provide Transmission System Access – Section 29 of the Act states that the AESO “must provide system access service on the transmission system in a manner that gives all market participants [the DFO in this case] wishing to exchange electric energy and ancillary services a reasonable opportunity to do so.”

iii. AESO Planning Criteria – The AESO is required to plan a transmission system that satisfies applicable reliability standards. Transmission Planning (TPL) standards are included in the Alberta Reliability Standards, and are generally described at: http://www.aeso.ca/rulesprocedures/17006.html. In addition, the AESO’s Transmission Planning Criteria – Basis and Assumptions is included in Appendix F.

iv. AESO Connection Process – For information purposes, the AESO Connection Process, which changes from time to time, is generally described at: http://www.aeso.ca/connect

v. Application for Approval of the Need for Expansion or Enhancement of the Capability of the Transmission System – This Application is directed solely to the question of the need for

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16 The legislation and regulations refer to the Independent System Operator or ISO. "AESO" and "Alberta Electric System Operator" are the registered trade names of the Independent System Operator.

17 This link is provided for ease of reference and does not form part of this Application.

18 This link is provided for ease of reference and does not form part of this Application.
expansion or enhancement of the capability of the transmission system as more fully described in the Act and the Transmission Regulation. This Application does not seek approval of those aspects of transmission development that are managed and executed separately from the needs identification document approval process. Other aspects of the AESO’s responsibilities regarding transmission development are managed under the appropriate processes, including the ISO Rules, Alberta Reliability Standards and the ISO Tariff, which are also subject to specific regulatory approvals. While the Application or its supporting appendices may refer to other processes or information from time to time, the inclusion of this information is for context and reference only.

Furthermore, this Application is directed solely to the question of the need for expansion or enhancement of the capability of the transmission system. Any reference within the Application to market participants or other parties and/or the facilities they may own and operate or may wish to own and operate, does not constitute an application for approval of such facilities. The responsibility for seeking such regulatory or other approval remains the responsibility of the market participants or other parties.

vi. **Directions to the TFO** – Pursuant to Subsection 35(1) of the Act, the AESO has directed the TFO, in whose service territory the need is located, to prepare a Facility Proposal to meet the need identified. The Facility Proposal is also submitted to the Commission for approval. The TFO has also been directed by the AESO under Section 39 of the Act to prepare a proposal to provide services to address the need for the Proposed Transmission Development. The AESO has also directed the TFO, pursuant to Section 39 of the Act and Section 14 of the Transmission Regulation, to assist in the preparation of the AESO’s Application.

vii. **Duties of owner of electric distribution systems** – The duties of DFOs to make decisions about building, upgrading and improving their electric distribution systems are described in Section 105(1)(b) of the Act. The DFO, being responsible for electric distribution system planning, determines its need for transmission system access service based on its own distribution planning guidelines and criteria. While the DFO’s plans are considered during the AESO Connection Process, the AESO, in executing its duties to plan the transmission system, does not oversee electric distribution planning or the development of specific DFO planning criteria. The AESO does, however, seek to ensure that DFO load growth forecasts used in the Connection Process are consistent with AESO load growth forecasts as described in Part A of this Application.

viii. **Capital Cost Estimates** – The provision of capital costs estimates in the Application is for the purposes of relative comparison and context only. The AESO’s responsibilities in respect of
project cost reporting are described in the *Transmission Regulation*, including Section 25, and ISO Rule 9.1.
# Engineering Study Report

Fortis Edson New Substation/POD  
(Deer Hill 1012S)  

AESO Project Number: P1515  
Revision: 1  
Revision Date: 2015-02-13

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AltaLink APEGGA Permit Number P-7862
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Executive Summary

Project Overview

Fortis Alberta Inc. (Fortis) submitted a System Access Service Request (SASR) to the AESO for a new point of delivery (POD) substation to address distribution service concerns in the Edson area. The new POD “Deer Hill 1012S substation,” located at NW-28-55-18-W5, is recommended and will include one 138/25 kV 25/33/42 MVA LTC transformer and three 25 kV feeder breakers.

Fortis has indicated that the Demand Transmission Service (DTS) capacity at the new POD will be 7.2 MW. The expected in-service date for this project is February 1, 2016.

Existing System

This project is located within the AESO’s Hinton/Edson planning area (Area 29) which is comprised of 138 kV transmission systems. Bickerdike 39S is the only 240 kV source in the area and is fed from Sundance 310P in the Wabamun planning area (Area 40) by means of the 240 kV lines 973L/974L from. One of 138 kV transmission lines 854L runs in close proximity to the project site. 854L runs from Bickerdike 39S to Benbow 397S substation, which is in neighboring area (Area 24 Fox Creek).

Study Summary

This Engineering Study Report (ESR) describes the system performance studies that assessed the impact of the new Deer Hill 1012S substation, and the associated load, on the transmission system. Load flow and short circuit studies were performed for the system prior to and following the recommended developments being connected to identify any system constraints. Voltage stability studies were also performed following connection of the recommended development.

The study area comprises the AESO planning areas of Fox Creek (Area 24) and Hinton/Edson (Area 29). The study includes all Category A (N-G-0) and Category B (N-G-1) contingencies within the study area and on the tie lines from the study area to the surrounding areas. All branches, 69 kV and above, in the study area and the tie lines to the surrounding areas are monitored for thermal violations. All buses within the study area are monitored for voltage violations.

Alternative Selected

Initial alternative screening reduced the number of alternatives to the Fortis recommended alternative, the new Deer Hill 1012S substation, which includes:

- Install a new substation with 138/25 kV 25/33/42 MVA LTC transformer connected to transmission line 854L via in/out configuration.
- Build two new 138 kV transmission lines, of approximately 1 km each, to feed the new substation.

Conclusions

The connection assessment performed for the Deer Hill 1012S substation indicates that the recommended development will not adversely impact the transmission system.
1. Introduction

This ESR documents the result of the system performance studies that assessed the impact of the addition of recommended new Deer Hill 1012S substation, and the associated load, on the transmission system.

1.1. Project

1.1.1. Project Overview

Fortis submitted a SASR to the AESO with the proposal of a new point of delivery (POD) substation to address distribution service concerns in the Edson area. After considering distribution and transmission alternatives, the preferred alternative to build a new POD substation, "Deer Hill 1012S," to include one 138/25 kV 25/33/42 MVA LTC transformer and three 25 kV feeder breakers (collectively the Project) to be located at NW-28-55-18-W5. Figure 1 provides an overview of the existing transmission system in the study area. The expected in-service date for this project is February 1, 2016.

1.1.2. Load Component

- The expected power factor is 0.9
- Type of load: Industrial (Oil & Gas)
- The DTS is 7.2 MW by February 1, 2016
1.2. Study Scope

1.2.1. Study Objectives

The objectives of the study were the following:

- To assess the impacts of connecting the Project and associated load addition to the transmission system.
- To identify any pre- and post-development system constraints.

1.2.2. Study Area

1.2.2.1. Study Area Description

The study area comprises the AESO planning areas of Fox Creek (Area 24) and Hinton/Edson (Area 29). The Project is located within the AESO Hinton/Edson planning area (Area 29), which is comprised of 138 kV transmission systems. Bulk power to the region is mainly supplied from the Wabamun planning area (Area 40) by means of 240 kV lines. Bickerdike 39S is the only 240 kV source in the area and is fed from Sundance 310P in the Wabamun planning area (Area 40) by means of the 240 kV lines 973L and 974L. The 138 kV transmission line, 854L, running
between Bickerdike 39S and Benbow 397S substations, is in close proximity to the project site in neighboring area (Area 24 Fox Creek).

The study includes all Category A and Category B contingencies within the study area and on the tie lines from the study area to the surrounding areas. All branches above 69 kV in the study area and the tie lines to the surrounding areas were monitored for thermal violations. All buses within the study area were monitored for voltage violations.

1.2.2.2. Existing Constraints

ISO rule 304.4 ID#2010-007RS, formerly OPP 702 Voltage Control, was applied to ensure the system pre-contingency voltages at critical buses in the study area are within the desired range. Neither thermal overloads nor voltage violations were observed prior to the Project addition, see Section 4 for details.

1.2.3. Studies Performed

Load Flow and Short Circuit studies were performed using 2015 winter peak (2015WP) and 2016 summer peak (2016SP) load scenarios for the existing system before the Project addition. Load Flow, Voltage Stability, and Short Circuit studies were performed using 2015WP and 2016SP load scenarios for the system performance after the Project addition as summarized below.

Studies performed for the pre-connection analysis:

- Power Flow analysis (Categories A and B for 2015WP and 2016SP load scenarios)
- Short-Circuit analysis (Category A for 2015WP load scenario)

Studies performed for the post-connection analysis:

- Power Flow analysis (Categories A and B for 2015WP and 2016SP load scenarios)
- Voltage Stability analysis (Categories A and B for 2015WP load scenarios)
- Short-Circuit analysis (Category A for 2015WP and 2023WP load scenarios)

1.3. Report Overview

The Executive Summary provides a high-level summary of the report and its conclusions. Section 1 introduces the Deer Hill 1012S substation engineering study report. Section 2 describes the reliability criteria, system data, and other study assumptions used in this report. Section 3 describes the study methodology. Section 4 discusses the pre-connection assessment of the system. Section 5 presents the connection alternatives considered and studied. Section 6 provides a technical analysis of the connection alternative selected for further study. Section 7 provides the results of the short-circuit analysis. Section 8 presents a summary and conclusions of this study.
2. Criteria, System Data, and Study Assumptions

2.1. Criteria, Standards, and Requirements

2.1.1. AESO Transmission Reliability Criteria

The Alberta Reliability Standards and the AESO’s Transmission Planning Criteria – Basis and Assumptions (Reliability Criteria) were applied in this study to assess the system performance following Category A (i.e., all elements in service) and Category B (i.e., an element out of service) contingencies.

The following is a general explanation of the Reliability Criteria and Alberta Reliability Standards applied throughout this study:

- The Alberta Reliability Standards requires that system performance be evaluated under Category A (N-0) and Category B (N-1) conditions.
- Category A represents a normal system with no contingencies and all facilities in service. Under Category A conditions, the system must be able to supply all firm load and firm transfers to other areas. All equipment must operate within its applicable rating, voltages must be within their applicable ratings, and the system must be stable with no cascading outages.
- Category B events result in the loss of any single specified system element under specified fault conditions with normal clearing. The specified elements are a generator, a transmission circuit, a transformer or single pole of a DC line. The acceptable impact on the system is the same as of Category A.
- AESO Thermal Loading Criteria requires that the continuous thermal rating of any transmission element shall not be exceeded under normal operating conditions. In this study, thermal limits were assumed to be one hundred percent of the normal summer and winter ratings.
- System-Normal minimum and maximum voltage limits specified by the Alberta Reliability Standards were used to identify Category A system voltage violations, while the extreme minimum and maximum limits were used to identify the Category B system violations. Table 1 shows the acceptable steady state voltages for different transmission voltage classes.
- Voltage Deviation Criteria was applied for Category B contingency analysis as shown in Table 2.
- Cascading outages or unplanned losses of load/generation following a single contingency are not acceptable. All single contingencies that resulted in cascading outages or unplanned loss of load/generation were recorded as transmission system deficiencies.
Table 1: Acceptable Range of Steady-State Voltages

<table>
<thead>
<tr>
<th>Nominal</th>
<th>Extreme Minimum</th>
<th>Normal Minimum</th>
<th>Normal Maximum</th>
<th>Extreme Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>475</td>
<td>500</td>
<td>525</td>
<td>550</td>
</tr>
<tr>
<td>240</td>
<td>216</td>
<td>234</td>
<td>252</td>
<td>264</td>
</tr>
<tr>
<td>260*</td>
<td>234*</td>
<td>247*</td>
<td>266*</td>
<td>275*</td>
</tr>
<tr>
<td>144</td>
<td>130</td>
<td>137</td>
<td>151</td>
<td>155</td>
</tr>
<tr>
<td>138</td>
<td>124</td>
<td>135</td>
<td>145</td>
<td>152</td>
</tr>
<tr>
<td>72</td>
<td>65</td>
<td>68.5</td>
<td>75.5</td>
<td>79</td>
</tr>
<tr>
<td>69</td>
<td>62</td>
<td>65.5</td>
<td>72.5</td>
<td>76</td>
</tr>
</tbody>
</table>

*Acceptable range of steady state voltage for Fort McMurray area only.

Table 2: Acceptable Post-Contingency Voltage Deviations

<table>
<thead>
<tr>
<th>Parameter and Reference Point</th>
<th>Time Period</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Post Transient (Up to 30s)</td>
</tr>
<tr>
<td></td>
<td>Post Auto Control (30s to 5min)</td>
</tr>
<tr>
<td></td>
<td>Post Manual Control (Steady State)</td>
</tr>
<tr>
<td>Voltage Deviation from Steady-State at Low-Voltage Load Bus</td>
<td>+/- 10%</td>
</tr>
</tbody>
</table>

2.1.2. AESO Operating Policies and Procedures (OPPs) and Authoritative Documents (ADs)

ISO rule 304.4 ID #2010-007RS, formerly OPP 702, was used to establish system normal voltage profiles for the study area.

2.2. Load and Generation Assumptions

2.2.1. Load Assumptions

Study cases were developed based on the AESO’s published 2015 Summer Peak and Winter Peak planning base cases. Area coincident peak load forecast for the area 29 was used for 2016SP and 2015WP load scenarios. Forecast values align with the AESO 2012 Long-term Outlook Update (2012 LTOU) with consideration for percentile metering.

Table 3: Forecast Area Load (2012 Long-term Outlook Update)

<table>
<thead>
<tr>
<th>Forecasted Areas &amp; Region Summer and Winter Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area Name (Number)</td>
</tr>
<tr>
<td>--------------------</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Fox Creek (24)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Hinton/Edson (29)</td>
</tr>
</tbody>
</table>
2.2.2. Generation Assumptions

Table 4 presents the generation level dispatched for pre-connection and post-connection under summer and winter peak load conditions in the study area. Whitecourt generator was taken out of service to represent the N-G condition.

<table>
<thead>
<tr>
<th>Bus Number</th>
<th>Machine Name</th>
<th>Machine ID</th>
<th>Pmax (MW)</th>
<th>SP</th>
<th>WP</th>
</tr>
</thead>
<tbody>
<tr>
<td>4017</td>
<td>COLD CR9</td>
<td>1</td>
<td>20</td>
<td>18.3</td>
<td>18.3</td>
</tr>
<tr>
<td>4017</td>
<td>COLD CR9</td>
<td>2</td>
<td>30</td>
<td>18.3</td>
<td>18.3</td>
</tr>
<tr>
<td>13020</td>
<td>EDSON 8</td>
<td>G1</td>
<td>11.5</td>
<td>9.2</td>
<td>11.1</td>
</tr>
<tr>
<td>408</td>
<td>WHITEGE9</td>
<td>1</td>
<td>31.8</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2674</td>
<td>CC02</td>
<td>G1</td>
<td>18.6</td>
<td>11.4</td>
<td>13.6</td>
</tr>
</tbody>
</table>

2.3. System Projects & Customer Connection Projects

There is currently no system project in Hinton/Edson Area (Area 29) within the time frame of studied scenarios. The relevant recent and future customer connection projects with their in-service dates (ISDs) are outlined in Table 5.

The transmission system configuration assumed for the 2015WP and 2016SP scenarios included the existing system and future project additions expected to be in service by the studied year according to project ISDs listed in Table 5.

<table>
<thead>
<tr>
<th>Project Number</th>
<th>Project Name</th>
<th>Planning Area</th>
<th>Planned ISD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1382</td>
<td>Fortis Benbow 397S-Feeder Breaker</td>
<td>24-Fox Creek</td>
<td>Oct 31, 2014</td>
</tr>
</tbody>
</table>

1 This project is cancelled. Cancellation of this project does not adversely impact the study results and the study recommendations do not change.
2.4. Facility Ratings and Shunt Elements

The key transmission lines and shunt elements with their rating in the study area and its surrounding are listed in Tables 6 to 7.

Table 6: Summary of Transmission Line Ratings

<table>
<thead>
<tr>
<th>Transmission Line</th>
<th>From Facility</th>
<th>To Facility</th>
<th>Summer (MVA)</th>
<th>Winter (MVA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>615L</td>
<td>Cold Creek 602S</td>
<td>Watson Creek 104S</td>
<td>120</td>
<td>145</td>
</tr>
<tr>
<td>745L</td>
<td>Bickerdike 39S</td>
<td>Cold Creek 602S</td>
<td>174</td>
<td>215</td>
</tr>
<tr>
<td>671L</td>
<td>Bickerdike 39S</td>
<td>Edson 58S</td>
<td>174</td>
<td>215</td>
</tr>
<tr>
<td>847L</td>
<td>Bickerdike 39S</td>
<td>Cold Creek 602S</td>
<td>121</td>
<td>148</td>
</tr>
<tr>
<td>740L</td>
<td>Bickerdike 39S</td>
<td>Coalspur 426S</td>
<td>99</td>
<td>133</td>
</tr>
<tr>
<td>740L</td>
<td>Bickerdike 39S</td>
<td>Edson 58S</td>
<td>112</td>
<td>135</td>
</tr>
<tr>
<td>854L</td>
<td>Bickerdike 39S</td>
<td>Marlboro 348S tap</td>
<td>263</td>
<td>263</td>
</tr>
<tr>
<td>854L</td>
<td>Marlboro 348S tap</td>
<td>Benbow 397S</td>
<td>167</td>
<td>201</td>
</tr>
<tr>
<td>202L</td>
<td>Edson 58S</td>
<td>Cynthia 178S</td>
<td>85</td>
<td>90</td>
</tr>
<tr>
<td>720L</td>
<td>Fox Creek 347S</td>
<td>Benbow 397S</td>
<td>86</td>
<td>91</td>
</tr>
<tr>
<td>890L</td>
<td>Edson 58S</td>
<td>Pinedale 207S</td>
<td>75</td>
<td>79</td>
</tr>
<tr>
<td>744L</td>
<td>Pinedale 207S</td>
<td>Entwistle 235S</td>
<td>75</td>
<td>79</td>
</tr>
<tr>
<td>973L</td>
<td>Bickerdike 39S</td>
<td>Sundance 310P</td>
<td>333</td>
<td>333</td>
</tr>
<tr>
<td>974L</td>
<td>Bickerdike 39S</td>
<td>Sundance 310P</td>
<td>333</td>
<td>333</td>
</tr>
<tr>
<td>7L90</td>
<td>Fox Creek 741S</td>
<td>Little Smoky 813S</td>
<td>109.3</td>
<td>139</td>
</tr>
<tr>
<td>7L199</td>
<td>Fox Creek 741S</td>
<td>Fox Creek 347S</td>
<td>109.3</td>
<td>139</td>
</tr>
<tr>
<td>720L</td>
<td>Fox Creek 347S</td>
<td>Benbow 397S</td>
<td>86</td>
<td>91</td>
</tr>
<tr>
<td>854L</td>
<td>Benbow 397S</td>
<td>Malboro 348S</td>
<td>167</td>
<td>201</td>
</tr>
<tr>
<td>864L</td>
<td>Kaybob tap</td>
<td>Chevron Kaybob 551S</td>
<td>86</td>
<td>91</td>
</tr>
<tr>
<td>864AL</td>
<td>Benbow 397S</td>
<td>Kaybob 346S</td>
<td>99</td>
<td>133</td>
</tr>
<tr>
<td>864BL</td>
<td>Chevron Knight tap</td>
<td>Chevron Knight 355S</td>
<td>99</td>
<td>133</td>
</tr>
<tr>
<td>199L</td>
<td>Fox Creek 347S</td>
<td>Whitecourt 268S</td>
<td>85</td>
<td>90</td>
</tr>
</tbody>
</table>
### Table 7: Summary of Shunt Elements in the study Area and surroundings

<table>
<thead>
<tr>
<th>Nominal Bus Voltage (kV)</th>
<th>Capacitors</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of Switched Shunt Blocks</td>
</tr>
<tr>
<td>Cold Creek 602S</td>
<td>1</td>
</tr>
<tr>
<td>Edson 58S</td>
<td>1</td>
</tr>
<tr>
<td>Cynthia 178S</td>
<td>1</td>
</tr>
<tr>
<td>Amoco Brazeau 358S</td>
<td>1</td>
</tr>
<tr>
<td>Brazeau 62S</td>
<td>1</td>
</tr>
<tr>
<td>Violet Grove 283S</td>
<td>1</td>
</tr>
<tr>
<td>Fox Creek 741S</td>
<td>1</td>
</tr>
</tbody>
</table>

### 2.5. Voltage Profile Assumptions

ISO rule 304.4 ID #2010-007RS, formerly OPP 702, was used to establish normal system (i.e., pre-contingency) voltage profiles for all area busses prior to commencing the study. Table 8 provides a list of minimum and maximum voltages based on the ISO rule 304.4 ID #2010-007RS.

### Table 8: Summary of Voltage at Key Nodes in the Study Area

<table>
<thead>
<tr>
<th>Substation Name and Number</th>
<th>Area</th>
<th>Nominal Voltage (kV)</th>
<th>Minimum Operating Limit (kV)</th>
<th>Desired Range (kV)</th>
<th>Maximum Operating Limit (kV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bickerdike T38S</td>
<td>29</td>
<td>240</td>
<td>255</td>
<td>258-263</td>
<td>264</td>
</tr>
<tr>
<td></td>
<td>29</td>
<td>138</td>
<td>135</td>
<td>140-144</td>
<td>145</td>
</tr>
<tr>
<td>Edson T58S</td>
<td>29</td>
<td>138</td>
<td>135</td>
<td>138-144</td>
<td>145</td>
</tr>
<tr>
<td>Lodgepole T61</td>
<td>30</td>
<td>138</td>
<td>138</td>
<td>138-144</td>
<td>145</td>
</tr>
<tr>
<td>Brazeau T62S</td>
<td>30</td>
<td>240</td>
<td>240</td>
<td>240-256</td>
<td>257</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>138</td>
<td>140</td>
<td>140-144</td>
<td>145</td>
</tr>
<tr>
<td>Amoco Willesden Green T68S</td>
<td>30</td>
<td>240</td>
<td>243</td>
<td>245-256</td>
<td>264</td>
</tr>
</tbody>
</table>
3. **Study Methodology**

3.1. **Study Scenarios**

The following load scenarios were selected for the Project connection study:

- 2015 Winter Peak Load Condition (2015WP) – Pre-connection System Assessment
- 2016 Summer Peak Load Condition (2016SP) – Pre-connection System Assessment
- 2015 Winter Peak Load Condition (2015WP) – Post-connection System Assessment with new substation
- 2016 Summer Peak Load Condition (2016SP) – System Assessment with new substation

The pre-connection system is defined as the 2015 system configuration immediately prior to the Project addition.

3.2. **Connection Studies Carried Out**

Load flow and short circuit studies were performed using 2015WP and 2016SP load scenarios for the existing system before the Project addition (pre-connection) and load flow, voltage stability and short circuit studies were performed using 2015WP and 2016SP load scenarios for the system performance after the Project addition (post-connection) as summarized below.

Studies performed for the pre-connection analysis:

- Power flow analysis (Categories A and B for 2015WP and 2016SP load scenarios)
- Short-Circuit analysis (Category A for 2015WP load scenario)

Studies performed for the post-connection analysis:

- Power flow analysis (Categories A and B for 2015WP and 2016SP load scenarios)
- Voltage stability analysis (Categories A and B for 2015WP load scenarios)
- Short-Circuit analysis (Category A for 2015WP and 2023WP load scenarios)

3.3. **Power Flow Analysis**

Pre- and post-connection power flow studies were performed to assess the system performance for all Category A and Category B conditions. The system in the study area and its vicinity was monitored to identify any violations to the Reliability Criteria, including thermal overload and voltage issues.

The contingencies considered for the power flow studies include the outage of transmission elements rated at 69 kV and above in the study area and its vicinity.

PSS/E 33 contingency power flow analysis function was used as the study tool.

3.3.1. **Contingencies Studied**

The study includes all Category B contingencies within the study area and the tie lines from the study area to the surrounding areas.
3.4. Voltage Stability (PV) Analysis

The objective of the voltage stability criteria is to determine the ability of a power system to maintain sufficient reactive power margins at each bus in the system under normal and abnormal steady-state operating conditions. In the study, PV (Power-Voltage) analysis was performed according to the Western Electricity Coordinating Council (WECC) Voltage Stability Assessment Methodology, as described in detail in the Alberta Reliability Standards. The reference load level is the forecast peak load level.

PV curves were generated for Category A conditions and a select set of critical Category B contingencies in the study area. The voltage stability analysis will be performed using the PV method as follows:

- The PV analysis was performed by increasing load in the study area (Areas 24 & 29) and increasing generation in an area remote from the study area (Area 25). P/Q ratio should be maintained constant while scaling area load.
- The analysis was performed initially with discrete switched capacitors and reactors, LTC transformers and phase shifting transformers locked. Adjusting switched capacitors and reactors, in the pre- or post- contingency case is considered as appropriate if performance issues are identified.
- Results are provided for the N-0 condition and the top five worst case contingencies as identified by the studies.

PSS/E 33 PV analysis function was used as the study tool.

3.4.1. Contingencies Studied

The study includes all Category B contingencies within the study area and the tie lines from the study area to the surrounding areas.

3.5. Short-Circuit Analysis

For the short-circuit analysis, all generators in and around the study area were switched on to evaluate the maximum fault current under three-phase-to-ground faults and single-line-to-ground faults.

PSS/E 33 automatic sequencing fault calculation function was used as the study tool.
4. Pre-Connection System Assessment

4.1. Pre-Connection Power Flow Analysis

The pre-connection system is defined as the 2015 system configuration without the Project addition. The steady-state performance of the pre-connection system was assessed under the 2015WP and 2016SP loading scenarios. The power flow analyses were based on the Reliability Criteria, System Data and Study Assumptions as described in Section 2.

4.1.1. 2015WP Scenario

The steady state performance of the system under normal conditions (Category A) and single contingency (Category B) were assessed using the 2015WP scenario with pre-connection system configuration. The results of the power flow analysis are summarized in Table 9 and presented by the plots in Attachment A.

(A) System Normal (N-0) Results:

No overloads or voltage violations were observed for the 2015WP scenario with pre-connection system configuration.

(B) Single Element Contingency (N-1) Results:

No overloads or voltage violations were observed for the 2015WP scenario with pre-connection system configuration.

Table 9: Summery of Pre-Connection System Performance – 2015WP

<table>
<thead>
<tr>
<th>Contingency</th>
<th>Thermal Overloads</th>
<th>% of Overload</th>
<th>Voltage Violation</th>
<th>Figure in Attachment A</th>
</tr>
</thead>
<tbody>
<tr>
<td>N-0: Normal Operation</td>
<td>None</td>
<td>--</td>
<td>None</td>
<td>A-1</td>
</tr>
<tr>
<td>N-1: 854L Benbow 397S to Bickerdike 39S</td>
<td>None</td>
<td>--</td>
<td>None</td>
<td>A-2</td>
</tr>
<tr>
<td>N-1: 671L Bickerdike 39S to Edson 58S</td>
<td>None</td>
<td>--</td>
<td>None</td>
<td>A-3</td>
</tr>
<tr>
<td>N-1: 7L90 Fox Creeck741S to Little Smoky 813S</td>
<td>None</td>
<td>--</td>
<td>None</td>
<td>A-4</td>
</tr>
<tr>
<td>N-1: 973L Bickerdike 39S to Sundance 310P</td>
<td>None</td>
<td>--</td>
<td>None</td>
<td>A-5</td>
</tr>
<tr>
<td>N-1: 720L Fox Creek 347S to Benbow 397S</td>
<td>None</td>
<td>--</td>
<td>None</td>
<td>A-6</td>
</tr>
</tbody>
</table>

4.1.2. 2016SP Scenario

The steady state performance of the system under normal conditions (Category A) and single contingency (Category B) were assessed using the 2016SP scenario with pre-connection...
system configuration. The results of the power flow analysis are summarized in Table 10 and presented by the plots in Attachment A.

(A) System Normal (N-0) Results:
No overloads or voltage violations were observed for the 2016SP scenario with pre-connection system configuration.

(B) Single Element Contingency (N-1) Results:
No overloads or voltage violations were observed for the 2016SP scenario with pre-connection system configuration.

Table 10: Summary of Pre-Connection System Performance – 2016SP

<table>
<thead>
<tr>
<th>Contingency</th>
<th>Thermal Overloads</th>
<th>% of Overload</th>
<th>Voltage Violation</th>
<th>Figure in Attachment A</th>
</tr>
</thead>
<tbody>
<tr>
<td>N-0: Normal Operation</td>
<td>None</td>
<td>--</td>
<td>None</td>
<td>A-7</td>
</tr>
<tr>
<td>N-1: 854L Benbow 397S to Bickerdike 39S</td>
<td>None</td>
<td>--</td>
<td>None</td>
<td>A-8</td>
</tr>
<tr>
<td>N-1: 671L Bickerdike 39S to Edson 58S</td>
<td>None</td>
<td>--</td>
<td>None</td>
<td>A-9</td>
</tr>
<tr>
<td>N-1: 7L90 Fox Creeck 741S to Little Smoky 813S</td>
<td>None</td>
<td>--</td>
<td>None</td>
<td>A-10</td>
</tr>
<tr>
<td>N-1: 973L Bickerdike 39S to Sundance 310P</td>
<td>None</td>
<td>--</td>
<td>None</td>
<td>A-11</td>
</tr>
<tr>
<td>N-1: 720L Fox Creek 347S to Benbow 397S</td>
<td>None</td>
<td>--</td>
<td>None</td>
<td>A-12</td>
</tr>
</tbody>
</table>
5. Connection Alternatives

5.1. Overview

Two transmission alternatives were identified to facilitate the connection of the new load:

- Alternative 1 – In/Out connection to Transmission Line 854L
- Alternative 2 – Connection to Marlboro 348S

Alternative 1 – In/Out connection to Transmission Line 854L

Alternative 1 requires installing a new substation (Deer Hill 1012S) with 138/25 kV 25/33/42 MVA LTC transformer connected to transmission line 854L via in/out configuration. The transmission work involves the construction of approximately 1 km of new in/out 138 kV line to feed the 138/25 kV 25/33/42 MVA LTC transformer. Figure 2 provides an overview of the Alternative 1 in the study area.

Figure 2: Overview of the Alternative 1 in the study area
Alternative 2 – Connection to Marlboro 348S

Alternative 2 requires converting the Marlboro 348S connection to line 845L from a T-tap to an in/out configuration and then connecting the new substation (Deer Hill 1012S) radially to Marlboro 348S. The in/out conversion for Marlboro 348S is required to maintain the reliability requested by Fortis. This alternative involves building a new 138 kV transmission line (approximately 11 km) in parallel with the existing 854AL for an in/out conversion and the re-configuration of Marlboro 348S substation. Figure 3 provides an overview of the Alternative 2 in the study area.

Figure 3: Overview of the Alternative 2 in the study area

5.2. Connection Alternatives Evaluated

Alternative 2 includes additional transmission facility development associated with significantly higher cost and it has greater schedule risks compared with Alternative 1.

Fortis prefers Alternative 1 as it is technically acceptable and satisfies the ISD for the identified load increase as discussed within Fortis’ Distribution Deficiency Report².

² Filed under a separate cover.
5.2.1. Connection Alternatives Selected for Further Studies

Alternative 1 was selected for further analysis as it is deemed acceptable by criteria and provides the customer with the requested level of reliability.
6. Technical Analysis of the Connection Alternatives

Alternative 1 was modeled and studied using 2015WP and 2016SP system conditions, similar to those studied for the pre-connection system described in Section 4. Additional loads associated with the development under study were also modeled in the study cases where the total area load remained consistent with the forecast. The study results are summarized in the subsections that follow.

6.1. Preferred Alternative

6.1.1. Power Flow Analysis

The post-connection system is defined as the 2015 system configuration with the Project addition. The steady-state performance of the post-connection system was assessed under the 2015WP and 2016SP loading scenarios. The power flow analyses were based on the Criteria, System Data and Study Assumptions as described in Section 2.

6.1.1.1. 2015WP Scenario

The steady state performance of the system under normal conditions (Category A) and single contingency (Category B) were assessed using the 2015WP load scenario. The results of the power flow analysis are summarized in Table 11 and presented by the plots in Attachment B.

(A) System Normal (N-0) Results:
No overloads or voltage violations were observed for the 2015WP scenario with post-connection system configuration.

(B) Single Element Contingency (N-1) Results:
No overloads or voltage violations were observed for the 2015WP scenario with post-connection system configuration.

<table>
<thead>
<tr>
<th>Contingency</th>
</tr>
</thead>
<tbody>
<tr>
<td>N-0: Normal Operation</td>
</tr>
<tr>
<td>None</td>
</tr>
<tr>
<td>-</td>
</tr>
<tr>
<td>None</td>
</tr>
<tr>
<td>B-1</td>
</tr>
<tr>
<td>N-1: 854L Deer Hill 1012S to Bickerdike 39S</td>
</tr>
<tr>
<td>None</td>
</tr>
<tr>
<td>-</td>
</tr>
<tr>
<td>None</td>
</tr>
<tr>
<td>B-2</td>
</tr>
<tr>
<td>N-1:685L Deer Hill 1012S to Benbow 397S</td>
</tr>
<tr>
<td>None</td>
</tr>
<tr>
<td>-</td>
</tr>
<tr>
<td>None</td>
</tr>
<tr>
<td>B-3</td>
</tr>
<tr>
<td>N-1:671L Bickerdike 39S to Edson 58S</td>
</tr>
<tr>
<td>None</td>
</tr>
<tr>
<td>-</td>
</tr>
<tr>
<td>None</td>
</tr>
<tr>
<td>B-4</td>
</tr>
<tr>
<td>N-1:7L90 Fox Creeck741S to Little Smoky 813S</td>
</tr>
<tr>
<td>None</td>
</tr>
<tr>
<td>-</td>
</tr>
<tr>
<td>None</td>
</tr>
<tr>
<td>B-5</td>
</tr>
<tr>
<td>N-1: 973L Bickerdike 39S to</td>
</tr>
<tr>
<td>None</td>
</tr>
<tr>
<td>-</td>
</tr>
<tr>
<td>None</td>
</tr>
<tr>
<td>B-6</td>
</tr>
</tbody>
</table>
6.1.1.2. 2016SP Scenario

The steady state performance of the system under normal conditions (Category A) and single contingency (Category B) was assessed using the 2016SP scenario. The results of the power flow analysis are summarized in Table 12 and presented by the plots in Attachment B.

(A) System Normal (N-0) Results:
No overloads or voltage violations were observed for the 2016SP scenario with post-connection system configuration.

(B) Single Element Contingency (N-1) Results:
No overloads or voltage violations were observed for the 2016SP scenario with post-connection system configuration.

Table 12: Summary of Post Connection System Performance – 2016SP

<table>
<thead>
<tr>
<th>Contingency</th>
<th>Thermal Overloads</th>
<th>% of Overload</th>
<th>Voltage Violation</th>
<th>Figure in Attachment B</th>
</tr>
</thead>
<tbody>
<tr>
<td>N-0: Normal Operation</td>
<td>None</td>
<td>--</td>
<td>None</td>
<td>B-8</td>
</tr>
<tr>
<td>N-1: 854L Deer Hill 1012S to Bickerdike 39S</td>
<td>None</td>
<td>--</td>
<td>None</td>
<td>B-9</td>
</tr>
<tr>
<td>N-1: 685L Deer Hill 1012S to Benbow 397S</td>
<td>None</td>
<td>--</td>
<td>None</td>
<td>B-10</td>
</tr>
<tr>
<td>N-1: 671L Bickerdike 39S to Edson 58S</td>
<td>None</td>
<td>--</td>
<td>None</td>
<td>B-11</td>
</tr>
<tr>
<td>N-1: 974L Bickerdike 39S to Sundance 310P</td>
<td>None</td>
<td>--</td>
<td>None</td>
<td>B-12</td>
</tr>
<tr>
<td>N-1: 973L Bickerdike 39S to Sundance 310P</td>
<td>None</td>
<td>--</td>
<td>None</td>
<td>B-13</td>
</tr>
<tr>
<td>N-1: 720L Fox Creek 347S to Benbow 397S</td>
<td>None</td>
<td>--</td>
<td>None</td>
<td>B-14</td>
</tr>
</tbody>
</table>

6.1.2. Voltage Stability Analysis

Voltage stability analysis was performed using the 2015WP scenario to investigate the system active power margins after the Project development under Category A conditions and a select set of critical Category B contingency conditions. The total load of 252.2 MW for 2015WP in the study area was considered as the reference point of the PV analysis. The sink sub-system
includes the loads at the AESO planning areas Fox Creek (Area 24) and Hinton/Edson (Area 29). The source system was formed by the generation in planning area 25\(^3\).

The PV analysis confirms that there is no voltage stability violation after the connection of the Project. The study area voltage stability margins under N-0 and N-1 system conditions are listed in Table 13. The PV plots are presented in Attachment C.

**Table 13: Summary of Post-Connection PV Analysis Results – 2015WP**

<table>
<thead>
<tr>
<th>Operation Conditions</th>
<th>2015 WP Forecasted load (MW)</th>
<th>105% Margin (MW)</th>
<th>Meets Voltage Criteria?</th>
</tr>
</thead>
<tbody>
<tr>
<td>N-0: Normal Operation</td>
<td>252.2</td>
<td>264.8</td>
<td>YES</td>
</tr>
<tr>
<td>N-1: 854L Deer Hill 1012S to Bickerdike 39S</td>
<td>252.2</td>
<td>264.8</td>
<td>YES</td>
</tr>
<tr>
<td>N-1: 685L Deer Hill 1012S to Benbow 397S</td>
<td>252.2</td>
<td>264.8</td>
<td>YES</td>
</tr>
<tr>
<td>N-1: 7L90 Fox Creek 741S to Little Smoky 813S</td>
<td>252.2</td>
<td>264.8</td>
<td>YES</td>
</tr>
<tr>
<td>N-1: 973L Bickerdike 39S to Sundance 310P</td>
<td>252.2</td>
<td>264.8</td>
<td>YES</td>
</tr>
<tr>
<td>N-1: 720L Fox Creek 347S to Benbow 397S</td>
<td>252.2</td>
<td>264.8</td>
<td>YES</td>
</tr>
</tbody>
</table>

### 6.1.3. Transient Stability Analysis

Not Applicable

### 6.2. Conclusions and Recommendations

Power flow results demonstrate that the load increase associated with the Project will not cause thermal overloads or voltage violations to the study area under Category A or Category B operating conditions.

Voltage stability analysis (PV) results indicate that the voltage stability margins of the system in the study area with the Project, meet the AESO requirements.

---

\(^3\) The Base Cases found on AESO’s website divide area 25 into three areas. These areas are 58 (Dover), 59 (Ruth Lake) and 61 (Christina Lake). When area 25 is referenced in this document it relates to all four of these study areas in the cases (25, 58, 59, and 61).
7. Short-Circuit Analysis

The analysis of maximum fault levels was carried out based on normal system operation with all transmission elements in service and all generation has been dispatched.

7.1. Pre-Connection

Short circuit studies were performed using the 2015WP scenario to determine the fault levels in the system before the Project addition (Pre-connection). Short circuit analysis results are summarized below in Table 14.

<table>
<thead>
<tr>
<th>Substation Name and Number</th>
<th>Base Voltage (kV)</th>
<th>Pre-Fault Voltage</th>
<th>Pre-Fault Voltage (pu)</th>
<th>3-Φ Fault (kA)</th>
<th>1-Φ Fault (kA)</th>
<th>Positive Sequence Thevenin Source Impedance (R1+jX1) (pu)</th>
<th>Positive Sequence Thevenin Source Impedance (R1+jX1) (pu)</th>
<th>Zero Sequence Thevenin Source Impedance (R0+jX0) (pu)</th>
<th>Zero Sequence Thevenin Source Impedance (R0+jX0) (pu)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marlboro 348S</td>
<td>138</td>
<td>141.5</td>
<td>1.025</td>
<td>4.5</td>
<td>3.1</td>
<td>5.542+ j17.227</td>
<td>0.029102+ j0.090457</td>
<td>11.554+ j40.803</td>
<td>0.060670+ j0.214255</td>
</tr>
<tr>
<td>Benbow 397S</td>
<td>138</td>
<td>141.0</td>
<td>1.022</td>
<td>4.4</td>
<td>3.5</td>
<td>6.144+ j17.626</td>
<td>0.032263+ j0.092553</td>
<td>6.116+ j31.902</td>
<td>0.032117+ j0.167516</td>
</tr>
<tr>
<td>Edson 58S</td>
<td>138</td>
<td>142.3</td>
<td>1.031</td>
<td>8.4</td>
<td>7.6</td>
<td>3.015+ j9.348</td>
<td>0.015831+ j0.049086</td>
<td>3.410+ j12.565</td>
<td>0.017906+ j0.065977</td>
</tr>
<tr>
<td>Bickerdike 39S</td>
<td>240</td>
<td>260.3</td>
<td>1.084</td>
<td>6.5</td>
<td>6.8</td>
<td>5.771+ j22.521</td>
<td>0.010020+ j0.039099</td>
<td>1.056+ j21.020</td>
<td>0.001833+ j0.036493</td>
</tr>
<tr>
<td>Deer Hill 1012S</td>
<td>138</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

7.2. Post-Connection

Short circuit studies were performed using the 2015WP and 2023WP scenarios to determine the fault levels in the system after the Project addition. Post-connection short circuit analysis results for 2015 and 2023 are summarized below in Table 15 and Table 16 respectively.

The results are preliminary for the system conditions anticipated at the time of the Project addition. Any future customer connections or system reinforcements that are carried out after the Project will result in changes to the short-circuit levels. Single phase and three phase fault currents were calculated at Benbow 397S, Marlboro 348S, Edson 58S, Bickerdike 39S and Deer Hill 1012S.
### Table 15: Summary of Short-Circuit Current Levels – Post-Connection (Year 2015)

<table>
<thead>
<tr>
<th>Substation Name and Number</th>
<th>Base Voltage (kV)</th>
<th>Pre-Fault Voltage</th>
<th>Pre-Fault Voltage (pu)</th>
<th>3-Φ Fault (kA)</th>
<th>1-Φ Fault (kA)</th>
<th>Positive Sequence Thevenin Source Impedance (R1+jX1) (pu)</th>
<th>Positive Sequence Thevenin Source Impedance (R1+jX1) (pu)</th>
<th>Zero Sequence Thevenin Source Impedance (R0+jX0) (pu)</th>
<th>Zero Sequence Thevenin Source Impedance (R0+jX0) (pu)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marlboro 348S</td>
<td>138</td>
<td>141.3</td>
<td>1.024</td>
<td>4.5</td>
<td>3.1</td>
<td>5.554+ j17.236</td>
<td>0.029163+ j0.090507</td>
<td>11.588+ j40.908</td>
<td>0.060847+ j0.214806</td>
</tr>
<tr>
<td>Benbow 397S</td>
<td>138</td>
<td>140.7</td>
<td>1.019</td>
<td>4.3</td>
<td>3.5</td>
<td>6.260+ j17.775</td>
<td>0.032872+ j0.093336</td>
<td>6.145+ j32.184</td>
<td>0.032266+ j0.168996</td>
</tr>
<tr>
<td>Edson 58S</td>
<td>138</td>
<td>142.4</td>
<td>1.032</td>
<td>8.4</td>
<td>7.6</td>
<td>3.011+ j9.361</td>
<td>0.015809+ j0.049154</td>
<td>3.409+ j12.565</td>
<td>0.017903+ j0.065980</td>
</tr>
<tr>
<td>Bickerdike 39S</td>
<td>240</td>
<td>260.3</td>
<td>1.085</td>
<td>6.5</td>
<td>6.8</td>
<td>5.768+ j22.541</td>
<td>0.010014+ j0.039133</td>
<td>1.055+ j21.028</td>
<td>0.001832+ j0.036507</td>
</tr>
<tr>
<td>Deer Hill 1012S</td>
<td>138</td>
<td>141.2</td>
<td>1.023</td>
<td>5.3</td>
<td>3.7</td>
<td>4.103+ j14.916</td>
<td>0.021544+ j0.078326</td>
<td>8.933+ j34.025</td>
<td>0.046908+ j0.178668</td>
</tr>
</tbody>
</table>

### Table 16: Summary of Short-Circuit Current Levels – Post-Connection (Year 2023)

<table>
<thead>
<tr>
<th>Substation Name and Number</th>
<th>Base Voltage (kV)</th>
<th>Pre-Fault Voltage</th>
<th>Pre-Fault Voltage (pu)</th>
<th>3-Φ Fault (kA)</th>
<th>1-Φ Fault (kA)</th>
<th>Positive Sequence Thevenin Source Impedance (R1+jX1) (pu)</th>
<th>Positive Sequence Thevenin Source Impedance (R1+jX1) (pu)</th>
<th>Zero Sequence Thevenin Source Impedance (R0+jX0) (pu)</th>
<th>Zero Sequence Thevenin Source Impedance (R0+jX0) (pu)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marlboro 348S</td>
<td>138</td>
<td>141.0</td>
<td>1.022</td>
<td>5.0</td>
<td>3.3</td>
<td>4.807+ j15.770</td>
<td>0.025242+ j0.082808</td>
<td>11.607+ j40.655</td>
<td>0.060949+ j0.213479</td>
</tr>
<tr>
<td>Benbow 397S</td>
<td>138</td>
<td>139.1</td>
<td>1.008</td>
<td>4.6</td>
<td>3.6</td>
<td>5.747+ j16.674</td>
<td>0.030177+ j0.087556</td>
<td>6.153+ j32.150</td>
<td>0.032311+ j0.168817</td>
</tr>
<tr>
<td>Edson 58S</td>
<td>138</td>
<td>142.2</td>
<td>1.030</td>
<td>10.1</td>
<td>8.5</td>
<td>2.302+ j7.851</td>
<td>0.012090+ j0.041226</td>
<td>3.424+ j12.279</td>
<td>0.017982+ j0.064476</td>
</tr>
<tr>
<td>Bickerdike 39S</td>
<td>240</td>
<td>260.9</td>
<td>1.087</td>
<td>10.1</td>
<td>9.5</td>
<td>3.105+ j14.717</td>
<td>0.005390+ j0.025551</td>
<td>1.384+ j18.038</td>
<td>0.002404+ j0.031316</td>
</tr>
<tr>
<td>Deer Hill 1012S</td>
<td>138</td>
<td>140.5</td>
<td>1.018</td>
<td>5.8</td>
<td>3.9</td>
<td>3.436+ j13.653</td>
<td>0.018045+ j0.071691</td>
<td>8.950+ j33.865</td>
<td>0.046994+ j0.177823</td>
</tr>
</tbody>
</table>
8. Summary and Conclusion

Fortis submitted a SASR to the AESO for a POD substation to address distribution service concerns in the Edson area. The new POD “Deer Hill 1012S substation,” located at NW-28-55-18-W5, is recommended and will include one 138/25 kV 25/33/42 MVA LTC transformer and three 25 kV feeder breakers.

After considering distribution and transmission alternatives, the preferred alternative is to build a new substation in the Edson area. Fortis has indicated that the DTS capacity at the new POD will be 7.2 MW. The expected in-service date for this project is February 1, 2016.

Preferred Alternative for the Deer Hill 1012S substation includes:

- Install a new substation with 138/25 kV 25/33/42 MVA LTC transformer connected to transmission line 854L via in/out configuration.
- Build two new 138 kV transmission lines, of approximately 1 km each, to feed the new substation.

This ESR describes the system performance studies that assessed the impact of the new Deer Hill 1012S substation, and the associated load, on the transmission system. Load flow and short circuit studies were performed for the system prior to and following the recommended developments being connected to identify any system constraints. Voltage stability studies were also performed following connection of the recommended development.

Power flow results confirm that the load increase associated with the recommended development will not cause thermal overloads or voltage violations to the study area under Category A or Category B conditions for 2015 and 2016 years.

Voltage stability analysis (PV) results indicate that the voltage stability margins of the study area system, with the recommended development, meet the AESO requirements.

The connection assessment performed for Deer Hill 1012S substation addition indicates that the recommended development will not adversely impact the transmission system.
ATTACHMENT A

Pre-Connection: Power Flow Analysis

Before Adding the Deer Hill 1012S Substation
Table 1: Summary of Pre-Connection System Performance – 2015WP

<table>
<thead>
<tr>
<th>Contingency</th>
<th>Thermal Overloads</th>
<th>% of Overload</th>
<th>Voltage Violation</th>
<th>Figure in Attachment A</th>
</tr>
</thead>
<tbody>
<tr>
<td>N-0: Normal Operation</td>
<td>None</td>
<td>--</td>
<td>None</td>
<td>A-1</td>
</tr>
<tr>
<td>N-1: 854L Benbow 397S to Bickerdike 39S</td>
<td>None</td>
<td>--</td>
<td>None</td>
<td>A-2</td>
</tr>
<tr>
<td>N-1: 671L Bickerdike 39S to Edson 58S</td>
<td>None</td>
<td>--</td>
<td>None</td>
<td>A-3</td>
</tr>
<tr>
<td>N-1: 7L90 Fox Creek 741S to Little Smoky 813S</td>
<td>None</td>
<td>--</td>
<td>None</td>
<td>A-4</td>
</tr>
<tr>
<td>N-1: 973L Bickerdike 39S to Sundance 310P</td>
<td>None</td>
<td>--</td>
<td>None</td>
<td>A-5</td>
</tr>
<tr>
<td>N-1: 720L Fox Creek 347S to Benbow 397S</td>
<td>None</td>
<td>--</td>
<td>None</td>
<td>A-6</td>
</tr>
</tbody>
</table>

Table 2: Summary of Pre-Connection System Performance – 2016SP

<table>
<thead>
<tr>
<th>Contingency</th>
<th>Thermal Overloads</th>
<th>% of Overload</th>
<th>Voltage Violation</th>
<th>Figure in Attachment A</th>
</tr>
</thead>
<tbody>
<tr>
<td>N-0: Normal Operation</td>
<td>None</td>
<td>--</td>
<td>None</td>
<td>A-7</td>
</tr>
<tr>
<td>N-1: 854L Benbow 397S to Bickerdike 39S</td>
<td>None</td>
<td>--</td>
<td>None</td>
<td>A-8</td>
</tr>
<tr>
<td>N-1: 671L Bickerdike 39S to Edson 58S</td>
<td>None</td>
<td>--</td>
<td>None</td>
<td>A-9</td>
</tr>
<tr>
<td>N-1: 7L90 Fox Creek 741S to Little Smoky 813S</td>
<td>None</td>
<td>--</td>
<td>None</td>
<td>A-10</td>
</tr>
<tr>
<td>N-1: 973L Bickerdike 39S to Sundance 310P</td>
<td>None</td>
<td>--</td>
<td>None</td>
<td>A-11</td>
</tr>
<tr>
<td>N-1: 720L Fox Creek 347S to Benbow 397S</td>
<td>None</td>
<td>--</td>
<td>None</td>
<td>A-12</td>
</tr>
</tbody>
</table>
DEER HILL 1012S PRE-CONNECTION - DIAGRAM A-9
N-1: 671L BICKERDIKE 39S TO EDSON 58S
WED, JUL 02 2014  15:35
POST Connection: Power Flow Analysis

After Adding the Deer Hill 1012S Substation
# Table 1: Summary of Post Connection System Performance – 2015WP

<table>
<thead>
<tr>
<th>Contingency</th>
<th>Thermal Overloads</th>
<th>% of Overload</th>
<th>Voltage Violation</th>
<th>Figure in Attachment B</th>
</tr>
</thead>
<tbody>
<tr>
<td>N-0: Normal Operation</td>
<td>None</td>
<td>--</td>
<td>None</td>
<td>B-1</td>
</tr>
<tr>
<td>N-1: 854L Deer Hill 1012S to Bickerdike 39S</td>
<td>None</td>
<td>--</td>
<td>None</td>
<td>B-2</td>
</tr>
<tr>
<td>N-1: 685L Deer Hill 1012S to Benbow 397S</td>
<td>None</td>
<td>--</td>
<td>None</td>
<td>B-3</td>
</tr>
<tr>
<td>N-1: 671L Bickerdike 39S to Edson 58S</td>
<td>None</td>
<td>--</td>
<td>None</td>
<td>B-4</td>
</tr>
<tr>
<td>N-1: 7L90 Fox Creek 741S to Little Smoky 813S</td>
<td>None</td>
<td>--</td>
<td>None</td>
<td>B-5</td>
</tr>
<tr>
<td>N-1: 973L Bickerdike 39S to Sundance 310P</td>
<td>None</td>
<td>--</td>
<td>None</td>
<td>B-6</td>
</tr>
<tr>
<td>N-1: 720L Fox Creek 347S to Benbow 397S</td>
<td>None</td>
<td>--</td>
<td>None</td>
<td>B-7</td>
</tr>
</tbody>
</table>

# Table 2: Summary of Post Connection System Performance – 2016SP

<table>
<thead>
<tr>
<th>Contingency</th>
<th>Thermal Overloads</th>
<th>% of Overload</th>
<th>Voltage Violation</th>
<th>Figure in Attachment B</th>
</tr>
</thead>
<tbody>
<tr>
<td>N-0: Normal Operation</td>
<td>None</td>
<td>--</td>
<td>None</td>
<td>B-8</td>
</tr>
<tr>
<td>N-1: 854L Deer Hill 1012S to Bickerdike 39S</td>
<td>None</td>
<td>--</td>
<td>None</td>
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<tr>
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<td>--</td>
<td>None</td>
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<tr>
<td>N-1: 720L Fox Creek 347S to Benbow 397S</td>
<td>None</td>
<td>--</td>
<td>None</td>
<td>B-14</td>
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</table>
Bus - Voltage (kV/pu)
Branch - MW/Mvar
Equipment - MW/Mvar

N-1: 854L DEER HILL 1012S TO BICKERDIKE 39S
WED, JUL 02 2014 15:57

P1515: 2016SP Fortis Deer Hill 1012S Substation
P1515: 2016SP Fortis Deer Hill 1012S Substation

DEER HILL 1012S PRE-CONNECTION - DIAGRAM B-10
N-1: 1148L DEER HILL 1012S TO BENBOW 397S
WED, JUL 02 2014  15:57
ATTACHMENT C

Post-Connection: Voltage Stability Analysis
<table>
<thead>
<tr>
<th>Operation Conditions</th>
<th>2015 WP Forecasted load (MW)</th>
<th>105% Margin (MW)</th>
<th>Meets Voltage Criteria?</th>
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<tbody>
<tr>
<td>N-0: Normal Operation</td>
<td>252.2</td>
<td>264.8</td>
<td>YES</td>
</tr>
<tr>
<td>N-1: 854L Deer Hill 1012S to Bickerdike 39S</td>
<td>252.2</td>
<td>264.8</td>
<td>YES</td>
</tr>
<tr>
<td>N-1: 685L Deer Hill 1012S to Benbow 397S</td>
<td>252.2</td>
<td>264.8</td>
<td>YES</td>
</tr>
<tr>
<td>N-1: 7L90 Fox Creek 741S to Little Smoky 813S</td>
<td>252.2</td>
<td>264.8</td>
<td>YES</td>
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<tr>
<td>N-1: 973L Bickerdike 39S to Sundance 310P</td>
<td>252.2</td>
<td>264.8</td>
<td>YES</td>
</tr>
<tr>
<td>N-1: 720L Fox Creek 347S to Benbow 397S</td>
<td>252.2</td>
<td>264.8</td>
<td>YES</td>
</tr>
</tbody>
</table>
2015WP-Post-Project: Bickerdidke 39S 138 kV Bus Voltage (bus # 88)

- **N-G: Normal Operation**
- **N-1: 854L Deer Hill 1012S to Bickerdike 39S**
- **N-1: 1148L Deer Hill 1012S to Benbow 397S**
- **N-1: 7L90 Fox Creek 741S to Little Smoky 813S**
- **N-1: 973L Bickerdike 39S to Sundance 310P**
- **N-1: 720L Fox Creek 347S to Benbow 397S**
2015WP-Post-Project-: Edson 58S 138 kV Bus Voltage (bus # 20)

Incremental Study Area (MW)

Bus Voltage (pu)

N-G: Normal Operation

N-1: 854L Deer Hill 1012S to Bickerdike 39S

N-1: 1148L Deer Hill 1012S to Benbow 397S

N-1: 7L90 Fox Creek 741S to Little Smoky 813S

N-1: 973L Bickerdike 39S to Sundance 310P

N-1: 720L Fox Creek 347S to Benbow 397S
### Cost Breakdown Formats - Requirements TS43

**Project Name:** Deer Hill 1012S  
**Date:** 22-Jan-15  
**Accuracy:** +20 / -10%

<table>
<thead>
<tr>
<th></th>
<th>System Portion</th>
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<th>Capital Maintenance</th>
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<td><strong>Owner Costs</strong></td>
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<td><strong>Distributed Costs</strong></td>
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<td></td>
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<tr>
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<td>$ -</td>
<td>$ -</td>
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<td><strong>Total-Salvage</strong></td>
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<td>$ -</td>
<td>$ -</td>
</tr>
<tr>
<td><strong>Other Costs</strong></td>
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<tr>
<td>AFUDC</td>
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<td>$ 385,000</td>
<td>$ -</td>
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<tr>
<td>E&amp;S</td>
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<td><strong>Total-Other Costs</strong></td>
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APPENDIX C PARTICIPANT INVOLVEMENT PROGRAM (PIP)
1.0 Participant Involvement Program (PIP)

From September 2014 to March 2015, the AESO conducted a Participant Involvement Program (PIP) to assist in preparing its Deer Hill 1012S Substation Needs Identification Document (NID). The AESO directed transmission facility owner (TFO), AltaLink Management Ltd. (AltaLink), to assist the AESO in providing notification in accordance with NID14 and Appendix A2 of Alberta Utilities Commission Rule 007.

1.1 Stakeholder Notification

The AESO’s PIP was designed to notify and provide information to all occupants, residents and landowners within 800 metres of the proposed development, as well as to other interested parties, including the following government bodies, agencies and other stakeholder groups (Stakeholders):

- Industry Canada
- Nav Canada
- Transport Canada, Civil Aviation
- Alberta Culture and Tourism
- Alberta Environment and Sustainable Resource Development (AESRD), Fish and Wildlife Division
- Alberta Environment and Sustainable Resource Development (AESRD), Public Lands Division
- Alberta Environment Sustainable Resource Development - Parks
- Alberta Transportation
- Town of Edson, Engineering and Planning
- Yellowhead County
- Alliance Pipeline Ltd.
- Bonavista Energy Corporation
- Chevron Canada Limited
- Long Run Exploration Ltd.
- Pulse Seismic Inc.
- Tourmaline Energy (formerly Santonia Energy Inc.)
- Semcams ULC
- Shell Canada Limited
- Velvet Energy Ltd.
From September 2014 to February 2015, the AESO used a variety of methods to notify stakeholders on the need for the Deer Hill power plant connection. The AESO developed a one-page need overview document that described the need for the proposed transmission development. A copy of this document was posted to the AESO website at http://www.aeso.ca/transmission/31624.html on January 15, 2015. A copy of the need overview is included as Attachment 1.

The need overview was also included with AltaLink’s project-specific information package mailed on October 1, 2014 to the Stakeholders noted above. Attachment 2 includes a copy of AltaLink’s brochure.

To ensure that Stakeholders had the opportunity to provide feedback, the AESO also provided stakeholders with a dedicated, toll-free telephone line (1-888-866-2959) and a dedicated email address (stakeholder.relations@aeso.ca). AESO contact information, along with the AESO’s mailing address (2500, 330 5th Ave, SW, Calgary) and website address (www.aeso.ca), and a privacy statement that described how the AESO honours Alberta’s Personal Information Protection Act, were included on the need overview related to this application.

As directed by the AESO, the TFO was prepared to direct any inquiries or concerns about the project need to the AESO. The TFO has indicated that Stakeholders have not identified any concerns or objections with the need for the proposed transmission development.

1.1 Public Notification

Most recently, the AESO published a Public Notification of NID Filing to the AESO website at http://www.aeso.ca/transmission/31624.html on February 18, 2015 and in the Stakeholder Newsletter on February 19, 2015. Copies of the Public Notification of NID Filing and the Stakeholder Newsletter posting have been included as Attachment 3 and 4, respectively.

1.2 Concerns and Objections Raised

The AESO has received no indication of concern or objections from any party about the need for the proposed transmission development.
1.3 List of Attachments

- Attachment 1 – AESO Need Overview
- Attachment 2 – AltaLink’s Information Brochure – “Deer Hill 1012S Substation Project” (September 2014)
- Attachment 3 – AESO Public Notice of NID Filing (AESO Website Posting)
- Attachment 4 – AESO Stakeholder Newsletter Posting
Attachment 1 – AESO Need Overview
Why is this transmission development needed?

FortisAlberta Inc. (FortisAlberta) has applied to the Alberta Electric System Operator (AESO) for additional transmission capability to meet growing demand in the Edson area. FortisAlberta's request can be met by building the new Deer Hill 1012S substation, including one 138/25 kV transformer, two 138 kV breakers, four 25 kV breakers and a telecommunications tower.

The Alberta Electric System Operator (AESO) is processing FortisAlberta’s request, including providing information to landowners, occupants, residents and agencies in the Edson area that may be near the proposed transmission development. The AESO intends to apply to the Alberta Utilities Commission (AUC) for approval of this need in the spring of 2015. The AESO's needs identification document (NID) application will be available on the AESO’s website at www.aeso.ca/8969.html at the time of its application to the AUC.

Who is the AESO?

Alberta’s transmission system, sometimes referred to as the Alberta Interconnected Electric System (AIES), is planned and operated by the AESO. The transmission system comprises the high-voltage lines, towers and equipment (generally 69kV and above) that transmit electricity from generators to lower voltage systems that distribute electricity to cities, towns, rural areas and large industrial customers.

The AESO’s role is to maintain safe, reliable and economic operation of the AIES. The AESO’s planning responsibility includes determining the need for transmission system development and the manner in which that need is met. The AESO is also mandated to facilitate the interconnection of qualified market participants to the AIES. The AESO is regulated by the AUC and must apply to the AUC for approval of its NID.

How is AltaLink involved?

AltaLink Management Ltd. (AltaLink) is the transmission facilities owner (TFO) in the Edson area. While the AESO is responsible for identifying that transmission system development is needed, AltaLink is responsible for detailed siting and routing, constructing, operating and maintaining the associated transmission facilities. The AESO has directed AltaLink to provide information to stakeholders on this need and to file a facility proposal application with the AUC, which will include a detailed description and location of the proposed transmission development.

Further Information

The AESO appreciates your views on the need for transmission system development and your comments are encouraged. If you have any questions or suggestions regarding the need for the proposed transmission connection in the Edson area or the AESO’s application regarding this need, please contact:

Marina Lakhani  
AESO Stakeholder Relations  
1-888-866-2959  
stakeholder.relations@aeso.ca  
2500, 330 – 5th Avenue SW  
Calgary, Alberta T2P 0L4

The AESO is committed to protecting your personal privacy in accordance with Alberta’s Personal Information Protection Act. Any personal information collected by the AESO with regard to this project may be used to provide you with further information about the project, may be disclosed to the Alberta Utilities Commission (and as a result, may become public), and may also be disclosed to AltaLink as the legal owner of transmission facilities in your area. If you have any questions about how the AESO will use and disclose your personal information, please contact us at 1-888-866-2959 or at stakeholder.relations@aeso.ca
Attachment 2 – AltaLink’s Information Brochure – “Deer Hill 1012S Substation Project” (October 2014)
Electric system improvements near you
Deer Hill 1012S Substation Project

PLEASE NOTE:
AltaLink’s transmission system efficiently delivers electricity to 85% of Albertans. Dedicated to meeting the growing need for electricity, AltaLink connects Albertans to renewable, reliable and low-cost power. With a commitment to community and environment, AltaLink is ensuring the transmission system will support Albertans’ quality of life for years to come. Learn more at www.altalink.ca.

You are receiving this newsletter because you are near the Deer Hill 1012S Substation Project and we want your input.

Alberta has grown significantly in recent years and the demand for electricity has increased. Transmission system reinforcements are required to make sure residents continue to have a reliable supply of electricity for years to come.

We are providing you with:

• project details
• maps of the proposed project sites
• information about how you can provide your input
• the project schedule

DEFINITIONS
Transmission
Transmission lines make up Alberta’s electric highway, linking the places where power is generated to your community where power is used. Transmission lines transport large amounts of power over long distances from power plants across the province. The transmission system connects diverse sources of power generation including wind, high-efficiency coal, natural gas and more.

CONTACT US
1-877-267-1453
stakeholderrelations@altalink.ca
Visit us online at www.altalink.ca/regionalprojects
Project details

AltaLink is proposing to build a new substation, called Deer Hill 1012S, approximately 30 kilometres (19 miles) northwest of Edson in Yellowhead County. The substation will require a fenced area of approximately 80 x 90 metres (260 x 295 feet). The proposed substation will be located on Crown land leased by AltaLink.

The Deer Hill Substation project includes:

• one new 138/25 kV (kilovolt) transformer
• two new 138 kV circuit breakers
• a new switchgear and control building with four 25 kV circuit breakers
• a new telecommunications tower
• approximately 60 metres (200 feet) of 138 kV transmission lines to connect the proposed Deer Hill Substation to the existing 854L transmission line

We have identified one proposed location for the substation located at SW-33-55-18-W5. This location is in close proximity to the existing transmission line in the area, which would allow the proposed substation to connect to the electric grid with a lower overall impact to the area. This proposed substation location also has access from an existing road and has low residential, agricultural and environmental impacts.

Please see the detailed photo map included with this package to view the proposed substation location.
Substation selection

When identifying substation location options, AltaLink takes several factors into consideration in an effort to find sites with a low overall impact. Some of the factors we take into consideration include:

- agricultural
- residential
- environmental
- electrical
- cost
- visual
- special considerations

Please let us know what other factors are important to you so we can consider them when refining substation options.

Line connection

A short portion of 138 kV (kilovolt) transmission line will be required to connect the proposed substation to the existing transmission line in the area, called the 854L line. There will be both deadend structures and tangent structures and they will be either one pole or two pole structures. Some of the structures may look similar to the ones pictured on the right.

The structures will:

- be approximately 13 - 25 metres (45 - 85 feet) tall
- be approximately 8 - 12 metres (26 - 40 feet) wide
- have a right-of-way width of approximately 20 metres (67 feet)

Modifications may be required to some structures, including guy wires that anchor the structures to the ground.

Additionally, a temporary line may be constructed in the proposed project area to accommodate construction and prevent outages.

DEFINITIONS

Right-of-way

The right-of-way is a strip of land required for the construction and safe operation of a transmission line. A right-of-way refers to the physical space a transmission line encompasses including areas on either side of the line. The majority of the right-of-way can still be used by the landowner. Buildings cannot be placed on the right-of-way, but can be built up to the edge of the right-of-way.

Some structures will look similar to the one pictured above.
Telecommunications tower

We are proposing to install a telecommunications tower within the proposed Deer Hill Substation fenced area to support equipment that transmits data to our system control centre.

Telecommunications towers allow AltaLink to monitor the operation of the electric system and ensure the safety and reliability of the system for our customers. The proposed new telecommunications tower:

- will be approximately 65 metres (215 feet) tall
- will have a triangular base of approximately six to seven metres (20-23 feet)
- will be self-supporting
- will be located within the substation fence line in the Northeast corner
- may be painted and have aircraft lighting to comply with Transport Canada’s requirements

The height of the proposed tower may vary based on further detailed engineering.

Radio Frequency (RF)

Telecommunication towers use Radio Frequency (RF) signals to transmit and receive information. The point-to-point signals travel along a focused path at low power levels and are well below recommended safety limits. A licensed telecommunications tower will not impact any other licensed telecommunication frequencies such as cellular, over-the-air television, satellite, radio, or GPS.

The radio installation described in this notification will be installed and operated on an ongoing basis so as to comply with Health Canada’s Safety Code 6, which defines safe levels of radio frequency (RF) exposure. To ensure the structural adequacy of the tower, the design and installation will follow industry standards and sound engineering practices.

Project schedule

<table>
<thead>
<tr>
<th>Event</th>
<th>Timeline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Notify and consult with stakeholders</td>
<td>Fall 2014</td>
</tr>
<tr>
<td>File application with Alberta Utilities Commission (AUC)</td>
<td>Winter 2015</td>
</tr>
<tr>
<td>Start construction if project is approved</td>
<td>Summer 2015</td>
</tr>
<tr>
<td>Construction complete</td>
<td>Winter 2016</td>
</tr>
</tbody>
</table>

DID YOU KNOW:
According to the Canadian Electricity Association, Canada’s electricity grid was built for a population of about 20 million, but is today servicing around 35 million people. Provinces across Canada, including Alberta, are working to reinforce their aging electric systems so they can continue to provide customers with reliable power.
Electric and Magnetic Fields (EMF)

AltaLink recognizes that people have concerns about exposure to Electric and Magnetic Fields (EMF) and we take those concerns very seriously. Everyone in our society is exposed to EMF from many sources, including:

- power lines and other electrical facilities
- electrical appliances in your home
- building wiring

National and international organizations such as Health Canada and the World Health Organization have been conducting and reviewing research about EMF for more than 40 years. Based on this research, these organizations have not recommended the general public take steps to limit their everyday exposure to EMF from high voltage transmission lines. If you have any questions about EMF please contact us.

Website: www.altalink.ca/emf
Email: emfdialogue@altalink.ca
Toll-free phone number: 1-866-451-7817

Providing your input

We will contact landowners, residents and occupants near the proposed substation project to gather input and address questions or concerns.

After the consultation process is complete we will file an application with the Alberta Utilities Commission (AUC). The AUC will review the application through a process in which stakeholders can participate.

We will notify stakeholders when we file the application and again once the AUC has reached a decision about the project. To learn more about the AUC process and how you can become involved, please refer to the brochure included in this package titled *Public Involvement in Needs or Facilities Applications*.

Other projects in your area:

<table>
<thead>
<tr>
<th>Project name</th>
<th>Description</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vista Coal Transmission Development</td>
<td>AltaLink is proposing to upgrade its transmission system in the Hinton area to connect Coalspur Mines Ltd.’s approved Vista Coal 270S substation to Alberta’s electric system.</td>
<td>Project approved</td>
</tr>
</tbody>
</table>
INCLUDED IN THIS INFORMATION PACKAGE:

- Project map
- AUC brochure: Public Involvement in Needs or Facilities Applications
- AESO Need Overview Document

Contact us

To learn more about the proposed project please contact:

**ALTALINK**

1-877-269-5903 (toll free)
E-mail: stakeholderrelations@altalink.ca
Website: www.altalink.ca/regionalprojects

**Industry Canada**

1-800-328-6189 (toll-free in Canada)
Website: http://strategis.ic.gc.ca/antenna

To learn more about Alberta’s electric system and the need for the project, please contact:

**ALBERTA ELECTRIC SYSTEM OPERATOR (AESO)**

1-888-866-2959
E-mail: stakeholder.relations@aeso.ca

*The Alberta Electric System Operator (AESO) is an independent, not-for-profit organization responsible for the safe, reliable and economic planning and operation of the provincial transmission grid. For more information about why this project is needed, please refer to the AESO’s Need Overview included with this package, or visit www.aeso.ca. If you have any questions or concerns about the need for this project you may contact the AESO directly.*

To learn more about the application and review process, please contact:

**ALBERTA UTILITIES COMMISSION (AUC)**

780-427-4903 (toll-free by dialing 310-0000 before the number.)
E-mail: consumer-relations@auc.ab.ca

**Let’s talk transmission**

www.facebook.com/altalinktransmission

www.twitter.com/altalink
Attachment 3 – AESO Public Notification of NID Filing (AESO Website Posting)
The Alberta Electric System Operator (AESO) advises you that it intends to file a Needs Identification Document (NID) for the connection of the Deer Hill 1012S Substation with the Alberta Utilities Commission (AUC) on or after March 6, 2015.

FortisAlberta Inc. (FortisAlberta) has applied to the Alberta Electric System Operator (AESO) for additional transmission capability to meet growing demand in the Edson area. FortisAlberta’s request can be met by building the new Deer Hill 1012S substation, including one 138/25 kV transformer, two 138 kV breakers, four 25 kV breakers and a telecommunications tower.

The grey square on the map indicates the approximate location of the new Deer Hill 1012S substation, which is at SW and SE-33-55-18W5. In a separate application called a Facility Application, AltaLink Management Ltd. (AltaLink), the transmission facility owner (TFO) in the Edson area, will describe the specific upgrades to be performed and request AUC approval to construct and operate the specific transmission facility.

The AESO and AltaLink Management Ltd. (AltaLink) presented this need to stakeholders, including residents, occupants and landowners, from October 2014 to March 2015. The AESO has considered feedback gathered from stakeholders, and technical and cost considerations, and will apply to the AUC for approval of the need for this transmission development. Once filed, the NID will be posted on the AESO website at http://www.aeso.ca/transmission/31624.html

Please visit our website, www.aeso.ca for more information, or contact the AESO at 1-888-866-2959 or stakeholder.relations@aeso.ca
Attachment 4 – AESO Stakeholder Newsletter Posting
Deer Hill Substation in the Edson area – Notice of NID Filing

FortisAlberta Inc. has applied to the AESO for additional transmission capability to meet growing demand in the Edson area. FortisAlberta’s request can be met by building the new Deer Hill 1012S substation, including one 138/25 kV transformer, two 138 kV breakers, four 25 kV breakers and a telecommunications tower.

The AESO will be filing Deer Hill Substation 1012S Connection NID application with the Alberta Utilities Commission on or after March 6, 2015, recommending that the Commission approve this NID.

The AESO has posted the public notification for its NID filing on its website for the Deer Hill Substation Connection. Please click here to view the document or visit the AESO website at www.aeso.ca and follow the path Transmission > Needs Identification Documents > Deer Hill Substation 1012S Connection to see all the relevant documents, including the NID once it is filed with the AUC.
APPENDIX D  INFORMATION REGARDING RULE 007, SECTION 6.1 - NID13
January 19, 2014

Alberta Electric System Operator
Suite 2500
330 – 5th Avenue SW
Calgary, Alberta, T2P 0L4

Attention: Marina Lakhani, Project Manager

Dear Marina Lakhani:

RE: Confirmation that the seven AUC Rule 007 NID 13 aspects are being addressed in AltaLink’s Deer Hill 1012S Substation Facility Application

The 7 major aspects of AUC Rule 007 NID 13 are addressed throughout AltaLinks’ Facility Application (FA) where applicable, and each major aspect is specifically addressed in the sections of the Facility Application outlined below:

1. **Agricultural Impact**
   Is addressed in the FA in Section 4 (AltaLink’s Route Determination Process), Section 3 (Project Details), and Section 12 (Electrical Considerations).

2. **Residential Impact**
   Is addressed in the FA in Section 3 (Project Details), Section 4 (AltaLink’s Route Determination Process), Section 12 (Electrical Considerations) and Section 9 (Visual Impact).

3. **Environmental Impact**
   Is addressed in the FA in Sections 4 (AltaLink’s Route Determination Process) and 10 (Environmental Evaluation).

4. **Cost**
   Is addressed in the FA in Section 14 (Economic Assessment).

5. **Electrical Considerations**
   Is addressed in the FA in Section 3 (Project Details).

6. **Visual Impact**
   Is addressed in the FA in Section 9 (Visual Impact).

7. **Special Constraints**
   Is addressed in the FA in Section 12 (Electrical Considerations).

This Project is not located within the plan boundaries of a regional land use plan in force.

If you have any questions or require clarification regarding the information contained herein, please contact me by telephone at (403) 387-8282, or by email to brittany.wickham@altalink.ca

Sincerely,

Brittany Wickham
Right-of-Way Planner
AltaLink Management Ltd.
Need for Development

Edson Area

Transmission Facility Upgrades

February 4, 2015

<table>
<thead>
<tr>
<th>Name</th>
<th>Signature</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reviewed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grant Wiens</td>
<td>[Signature]</td>
<td>Feb 4, 2015</td>
</tr>
<tr>
<td>Engineering Manager, Special Projects</td>
<td>[Signature]</td>
<td>Feb 4, 2015</td>
</tr>
<tr>
<td>Approved</td>
<td>Octavia</td>
<td></td>
</tr>
<tr>
<td>Richard Bahry</td>
<td>[Signature]</td>
<td>Feb 4, 2015</td>
</tr>
<tr>
<td>Director, Engineering</td>
<td>[Signature]</td>
<td>Feb 4, 2015</td>
</tr>
</tbody>
</table>
EXECUTIVE SUMMARY

In the event of an n-1 contingency at the Benbow 397S substation there could be in excess of 17.0 MVA of unsupplied load in 2016. This violates FortisAlberta restoration criteria. The load growth in the Edson area results in low voltage on one distribution feeder from the Benbow 397S substation. As well, the load growth in the area causes one distribution feeder from the Edson 58S substation to exceed FortisAlberta feeder loading criteria within the next ten years.

After investigating the available alternatives to address the concerns for distribution service, the recommended development is to install one new substation in the area complete with one 138/25 kV 25/33/42 MVA source transformer and three 25 kV feeder breakers and build three 25 kV distribution feeders from the substation.

The recommended development has an estimated distribution capital cost (2014, ±30%) of $5.4 million. This does not include the cost for transmission upgrades.

An estimate for the transmission system capital cost will be provided by the Transmission Facility Owner.

The requested in-service date for the recommended facility upgrades is February 1, 2016.

Upon completion of this transmission system upgrade FortisAlberta is prepared to execute a DTS contract for the new POD for 7.2 MW.
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1 Project Description

1.1 Background

The Edson 58S substation is located in the Town of Edson, approximately 200 km west of the City of Edmonton. The substation and its five 25 kV distribution feeders supply the town of Edson and the rural and industrial services west and north of the town. Located approximately 60.0 km north of Edson is the Benbow 397S substation. Benbow 397S serves industrial loads with its four 25 kV distribution feeders. There is currently a project to install one new 25 kV feeder breaker at the Benbow 397S substation in 2014 (refer to AESO project #1382). See Appendix A, Figure A-1 for the 2014 distribution system of the area.

The load growth in the Edson area results in low voltage on feeder 397S-2114L from the Benbow 397S substation. In the event of an n-1 contingency at the Benbow 397S substation there could be in excess of 17.0 MVA of unsupplied load in 2016. If not addressed, this unsupplied load will grow to over 22.0 MVA by year 2022. As well, the load growth in the area causes distribution feeder 58S-153LW from the Edson 58S substation to exceed 13.0 MVA within the next ten years. This violates FortisAlberta feeder loading standards.

1.2 Proposal

After considering the alternatives available to address the existing service concerns for the distribution system supplied by the Edson 58S and Benbow 397S substations, the recommended development is to install one new substation at NW28-55-18-W5M complete with one 138/25 kV 25/33/42 MVA LTC source transformer and three 25 kV feeder breakers and build three 25 kV distribution feeders from the substation.

The recommended development has an estimated distribution capital cost (2014, ±30%) of $5.4 million. This does not include the cost for transmission upgrades.

An estimate for the transmission system capital cost will be provided by the Transmission Facility Owner.

The requested in-service date for the recommended facility upgrades is February 1, 2016.

Upon completion of this transmission system upgrade FortisAlberta is prepared to execute a DTS contract for the new POD for 7.2 MW.

2 Criteria and Assumptions

The analysis and development for this Need document have been conducted based upon the following criteria and assumptions.
2.1 Criteria

The normal maximum load on a FortisAlberta 25 kV distribution feeder is 13.0 MVA.

The acceptable amount of unsupplied load under n-1 conditions is 0 MVA. In order to satisfy the restoration criterion, back-up capacity must be available subject only to switching time.

Under normal operations, the load on substation equipment shall not exceed the equipment rating.

2.2 Load Forecast

Table 2-1 provides historical and forecast peak load for the substations and feeders in the Edson area. The load forecast is based on current knowledge of expected development trends and new load additions.
### Need for Development
Edson Area

<table>
<thead>
<tr>
<th>Sub No Feeder</th>
<th>Capacity</th>
<th>TR</th>
<th>MVA</th>
<th>PF or S</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
<th>Year 6</th>
<th>Year 7</th>
<th>Year 8</th>
<th>Year 9</th>
<th>Year 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>059S Edson (T1)</td>
<td>25/33/42</td>
<td>95%</td>
<td>W</td>
<td>16.1</td>
<td>16.1</td>
<td>18.4</td>
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<td>18.6</td>
<td>18.9</td>
<td>19.6</td>
<td>19.4</td>
<td>19.7</td>
<td>19.8</td>
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<tr>
<td>059S 334LW</td>
<td>T1</td>
<td>95%</td>
<td>W</td>
<td>8.1</td>
<td>9.6</td>
<td>10.2</td>
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<td>10.5</td>
<td>10.9</td>
<td>11.2</td>
<td>11.4</td>
<td>11.9</td>
<td>11.5</td>
<td>12.0</td>
</tr>
<tr>
<td>058S 377LE</td>
<td>T1</td>
<td>95%</td>
<td>W</td>
<td>8.8</td>
<td>8.2</td>
<td>8.6</td>
<td>8.9</td>
<td>8.2</td>
<td>9.0</td>
<td>9.0</td>
<td>9.1</td>
<td>9.1</td>
<td>9.2</td>
<td>9.1</td>
</tr>
<tr>
<td>058S Edson (T2)</td>
<td>25/33/42</td>
<td>91%</td>
<td>W</td>
<td>22.1</td>
<td>21.1</td>
<td>22.5</td>
<td>23.9</td>
<td>24.7</td>
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<td>26.0</td>
<td>26.5</td>
<td>26.9</td>
<td>27.3</td>
</tr>
<tr>
<td>059S 153LW (Load)</td>
<td>T2</td>
<td>88%</td>
<td>W</td>
<td>9.7</td>
<td>9.3</td>
<td>9.8</td>
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<td>13.3</td>
<td>13.8</td>
</tr>
<tr>
<td>059S 155LE</td>
<td>T2</td>
<td>92%</td>
<td>W</td>
<td>8.2</td>
<td>8.2</td>
<td>8.2</td>
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<td>8.4</td>
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<tr>
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<td>W</td>
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<td>6.0</td>
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<td>5.5</td>
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<td>6.1</td>
<td>6.2</td>
<td>6.3</td>
<td>6.4</td>
</tr>
<tr>
<td>058S Total Station</td>
<td>T2</td>
<td>92%</td>
<td>W</td>
<td>33.0</td>
<td>29.2</td>
<td>37.2</td>
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<td>40.2</td>
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<tr>
<td>207S Pinedale</td>
<td>15/20/25</td>
<td>94%</td>
<td>W</td>
<td>18.0</td>
<td>18.1</td>
<td>17.4</td>
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<td>20.8</td>
<td>20.4</td>
<td>20.9</td>
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<tr>
<td>207S 2247L (155L)</td>
<td>15/20/25</td>
<td>96%</td>
<td>W</td>
<td>8.5</td>
<td>8.0</td>
<td>7.8</td>
<td>8.2</td>
<td>8.1</td>
<td>8.6</td>
<td>8.8</td>
<td>9.0</td>
<td>9.2</td>
<td>9.4</td>
<td>9.5</td>
</tr>
<tr>
<td>207S 2229L (369L)</td>
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<td>93%</td>
<td>W</td>
<td>9.6</td>
<td>10.4</td>
<td>10.4</td>
<td>9.9</td>
<td>9.9</td>
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<td>11.9</td>
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<td>12.0</td>
<td>12.5</td>
</tr>
<tr>
<td>207S Elbow</td>
<td>T2</td>
<td>15/20/25</td>
<td>93%</td>
<td>W</td>
<td>32.9</td>
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<td>19.3</td>
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<td>207S (Energize 2013)</td>
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<td>W</td>
<td>32.9</td>
<td>29.2</td>
<td>29.3</td>
<td>32.7</td>
<td>26.0</td>
<td>23.9</td>
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<td>19.3</td>
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<td>T2</td>
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<td>W</td>
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<td>27.7</td>
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<td>207S 220LN</td>
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<td>93%</td>
<td>W</td>
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<td>9.8</td>
<td>12.4</td>
<td>12.1</td>
<td>3.4</td>
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<td>5.1</td>
<td>5.9</td>
<td>6.7</td>
<td>7.4</td>
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<tr>
<td>207S (to T1 2013)</td>
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<td>93%</td>
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<td>7.0</td>
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<td>7.4</td>
<td>6.9</td>
<td>6.8</td>
<td>7.4</td>
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<td>8.1</td>
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<td>8.9</td>
<td>9.3</td>
</tr>
<tr>
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<td>93%</td>
<td>W</td>
<td>5.4</td>
<td>4.3</td>
<td>6.1</td>
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<tr>
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<td>T2</td>
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<td>W</td>
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<td>4.8</td>
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<td>6.4</td>
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<td>7.3</td>
<td>7.4</td>
<td>7.1</td>
<td>7.6</td>
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</tr>
<tr>
<td>207S 415L (2014)</td>
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<td>93%</td>
<td>W</td>
<td>5.5</td>
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<td>6.8</td>
<td>6.4</td>
<td>6.1</td>
<td>7.1</td>
<td>7.3</td>
<td>7.4</td>
<td>7.1</td>
<td>7.6</td>
<td>8.0</td>
</tr>
<tr>
<td>207S Total Station</td>
<td>T2</td>
<td>93%</td>
<td>W</td>
<td>25.1</td>
<td>27.3</td>
<td>29.3</td>
<td>27.7</td>
<td>28.0</td>
<td>37.3</td>
<td>40.8</td>
<td>41.2</td>
<td>42.4</td>
<td>43.2</td>
<td>43.6</td>
</tr>
<tr>
<td>406S Fickle Lake</td>
<td>15/20/25</td>
<td>97%</td>
<td>W</td>
<td>8.0</td>
<td>7.8</td>
<td>7.6</td>
<td>8.6</td>
<td>8.4</td>
<td>9.5</td>
<td>9.7</td>
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<tr>
<td>406S 163L</td>
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<td>9.9</td>
<td>10.0</td>
<td>10.2</td>
<td>10.4</td>
</tr>
</tbody>
</table>

3 Existing System

Table 3-1 provides an overview of relevant load and transformer capacity in the subject area. See Appendix A, Figure A-1 for a simplified sketch of the distribution systems connected to these substations.
### Need for Development

#### Edson Area

<table>
<thead>
<tr>
<th>Transformation Installed Capacity</th>
<th>Edson 585</th>
<th>Pinedale 2075</th>
<th>Benbow 3975</th>
<th>Fickle Lake 4065</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1 138/25 kV 25/33/42 MVA LTC Transformer</td>
<td>T1 138/25 kV 15/20/25 MVA LTC Transformer</td>
<td>T1 (energized 2013) 138/25 kV 15/20/25 MVA Transformer</td>
<td>T1 138/25 kV 15/20/25 MVA LTC Transformer</td>
<td></td>
</tr>
<tr>
<td>T2 138/25 kV 25/33/42 MVA LTC Transformer</td>
<td>VR1 (energized 2013) 25 kV 15/20/25 MVA Regulator</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Peak Station Load (2012/2013 winter peak) | 35.3 MVA | 17.7 MVA | 28.0 MVA | 8.4 MVA |

| Available Capacity (N-0) | 84.0 MVA | 25.0 MVA | 67.0 MVA | 25.0 MVA |

| Firm Transformation Capacity (N-1) | 42.0 MVA | 0 MVA | 25.0 MVA | 0 MVA |


---

### 4 Alternatives Analysis

The following alternatives were considered and are described in Sections 4.1 and 4.2.
Alternative 1  Distribution Upgrades and Load shifting

Alternative 2  Upgrades at Existing Substations

Alternative 3  Install one new substation at NW28-55-18-W5M

4.1  Alternative 1 – Distribution Upgrades and Load shifting

4.1.1  Description

Distribution upgrades and load shifting alone cannot eliminate the n-1 unsupplied load at Benbow 397S. The closest substation to Benbow 397S is Edson 58S; the distance via roads between the substations is approximately 78.0 km. This distance is too great for utilizing distribution lines to transfer sufficient load under contingency situations.

As well, load shifting and distribution upgrades do not provide an effective long-term solution for the low voltage condition on feeder 397S-2114L. This alternative would have higher distribution capital costs and require further distribution upgrades after ten years. This alternative also results in leaving existing load at the end of long 25 kV lines and would not provide a robust and reliable distribution service.

As a result of this, the load forecast and costs were not developed for this alternative.

4.2  Alternative 2 – Upgrades at Existing Substations

4.2.1  Description

Upgrades at Edson 58S substation and associated distribution lines would resolve exceeding the feeder load criteria on Edson 58S feeder 153LW but would not provide an effective long-term solution for the low voltage condition on feeder 397S-2114L and would not resolve the n-1 unsupplied load at Benbow 397S substation. As stated in the Alternative 1 analysis above, the distance between the two substations is too great to enable Edson 58S substation to provide sufficient back-up supply to Benbow 397S substation.

Installing a third transformer at Benbow 397S substation and upgrading associated distribution lines would resolve the n-1 unsupplied load at the substation but it would not provide an effective long-term solution for the low voltage condition on feeder 397S-2114L. As stated in the Alternative 1 analysis above, the distribution upgrades would consist of high distribution capital costs and require further distribution upgrades after ten years. This alternative would result in higher capital costs in the long term relative to the preferred alternative of installing a new source substation in the area.
Upgrading the existing T1 transformer-VR1 regulator pair at Benbow 397S substation and associated distribution lines alone would not resolve the n-1 unsupplied load at the substation. There is insufficient transformation capacity to provide back-up supply to Benbow 397S substation. As described above, distribution line upgrades do not provide an effective long-term solution for the low voltage condition on feeder 397S-2114L.

As a result of this, the load forecast and costs were not developed for this alternative.

4.3 Alternative 3 – Install one new substation at NW28-55-18-W5M

4.3.1 Description

In 2016 at NW28-55-18-W5M:

- Install one new substation with one 138/25 kV 25/33/42 MVA LTC transformer and three 25 kV feeder breakers

- Build three 25 kV distribution feeders from the new substation

- Upgrade T1 transformer & VR1 regulator pair with one 138/25 kV 25/33/42 MVA LTC transformer at the Benbow 397S substation (to be in separate, future application)

Refer to Appendix B, Figure B-1, for the simplified SLD showing the recommended system development.

All 25 kV overhead conductors exiting the substation and distribution feeder ties shall be 477 MCM. All underground feeder cables 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 appropriately 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.

4.3.2 Load Forecast

The load forecast for the distribution facilities resulting from this alternative is provided in Table 4-3.
4.3.3 Cost Estimate

The estimated transmission capital cost for Alternative 3 will be provided by AltaLink Management Ltd, the Transmission Facility Owner.

The distribution capital cost for Alternative 3 is estimated at:

2016  $5.4 million (2014$, ±30%)
5 Alternatives Assessment
The following sections present the technical and economic assessment of the alternatives considered:

Alternative 1  Distribution Upgrades and Load shifting
Alternative 2  Upgrades at Existing Substations
Alternative 3  Install one new substation at NW28-55-18-W5M

5.1 Technical Analysis

5.1.1 Alternative 1 – Distribution Upgrades and Load Shifting
As discussed in the Alternatives Analysis section above, distribution upgrades and load shifting cannot eliminate the n-1 unsupplied load at Benbow 397S nor do they provide an effective long-term solution for the low voltage condition on feeder 397S-2114L. Therefore, this is not an acceptable alternative.

5.1.2 Alternative 2 – Upgrades at Existing Substations
As discussed in the Alternatives Analysis section above, upgrades at existing substations alone do not provide an effective long-term solution for the low voltage condition on feeder 397S-2114L. Therefore, this is not an acceptable alternative.

5.1.3 Alternative 3 – Install one new substation at NW28-55-18-W5M
This alternative resolves the low voltage condition on Benbow 397S feeder 2114L. As shown in Table 4-2, this alternative addresses the capacity issues of Edson 58S feeder 153LW. The T1 transformer-VR1 regulator pair upgrade at Benbow 397S will be applied for in a separate, future application. This alternative enables FortisAlberta to provide robust and reliable distribution service to existing and future customers in the Edson area. This alternative is technically acceptable.

5.2 Economic Analysis
Table 5-2 summarizes the order of magnitude (2014$, ±30%) capital cost estimates of all alternatives.
Table 5-2: Capital Cost Estimates of Alternatives Considered

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternative 1: Load Shifting</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Alternative 2: Upgrades at Existing Substations</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Alternative 2: Install one new substation at NW28-55-18-W5M</td>
<td>TBD</td>
<td>$5.4</td>
<td>TBD</td>
</tr>
</tbody>
</table>

6 Conclusion/Recommendation

After considering the alternatives available to address the existing distribution service concerns in the Edson area, Alternative 3 is recommended. This involves installing a new substation at NW28-55-18-W5M with one 138/25 kV 25/33/42 MVA LTC source transformer complete with three 25 kV feeder breakers and building three 25 kV distribution feeders from the substation. This alternative addresses both the capacity and reliability requirements of the area at a reasonable cost. This alternative enables FortisAlberta to provide robust and reliable distribution service to existing and future customers in the Edson area.

The recommended development has an estimated distribution capital cost (2014, ±30%) of $5.4 million. This does not include the cost for transmission upgrades.

An estimate for the transmission system capital cost will be provided by the Transmission Facility Owner.

The requested in-service date for the recommended facility upgrades is February 1, 2016.

Upon completion of this transmission system upgrade FortisAlberta is prepared to execute a DTS contract for the new POD for 7.2 MW.
Appendix A- 2014 Distribution System

Figure A-1: Simplified sketch of the existing facilities in the Edson Area
Appendix B – Alternative 3: New substation at NW28-55-18-W5M

Figure B-1: Alternative 3 – Install one new substation at NW28-55-18-W5M

Legend:
- 25kV Substation

Transfer 1.4 MVA from 58S-153LW and Benbow 2114K to NEW-4010L

Install one (1) new substation at NW28-55-18-W5M with one (1) 138/25kV 25/33/42 MVA LTC transformer and three (3) 25 kV feeder breakers

Transfer 1.7 MVA from 58S-153LW to NEW-6003L

New Substation at NW28-55-18-W5M
New substation with one 42 MVA transformer and three 25 kV feeder breakers

DATE: Jan 2014
BY: JT
SLD NO: SLD-EA02

FORTIS ALBERTA
Distribution Asset Management

February 26, 2014
Page 11 of 11
Transmission Planning Criteria - Basis and Assumptions

Version 1.0
1. **Introduction**

This document presents the reliability standards, criteria, and assumptions to be used as the basis for planning the Alberta Transmission System. The criteria, standards and assumptions identified in this document supersede those previously established.

2. **Transmission Reliability Standards and Criteria**

The AESO applies the following Alberta Reliability Standards to ensure that the transmission system is planned to meet applicable performance requirements under a defined set of system conditions and contingencies. A brief description of each of these standards is given below:

1. **TPL-001-AB-0: System Performance Under Normal Conditions**
   - Category A represents a normal system condition with all elements in service (N-0). All equipment must be within its applicable rating, voltages must be within their applicable ratings and the system must be stable with no cascading outages. Under Category A, electric supply to load cannot be interrupted and generating units cannot be removed from service.

2. **TPL-002-AB-0: System Performance Following Loss of a Single BES Element**
   - Category B events result in the loss of any single element (N-1) under specified fault conditions with normal clearing. The specified elements are a generating unit, a transmission circuit, a transformer or a single pole of a direct current transmission line. The acceptable impact on the system is the same as Category A with the exception that radial customers or some local network customers, including loads or generating units, are allowed to be disconnected from the system if they are connected through the faulted element. The loss of opportunity load or opportunity interchanges is allowed. No cascading can occur.

3. **TPL-003-AB-0: System Performance Following Loss of Two or More BES Elements**
   - Category C events result in the loss of two or more bulk electric system elements (sequential, N-1-1 or concurrent, N-2) under specified fault conditions and include both normal and delayed fault clearing. All of the system limits for Category A and B events apply with the exception that planned and controlled loss of firm load, firm transfers and/or generation is acceptable provided there is no cascading.

4. **TPL-004-AB-0: System Performance Following Extreme BES Events**
   - Category D represents a wide variety of extreme, rare and unpredictable events, which may result in the loss of load and generation in widespread areas. The system may not be able to reach a new stable steady state, which means a blackout is a possible outcome. The AESO needs to evaluate these events, at its discretion, for risks and consequences prior to creating mitigation plans.

5. **FAC-014-AB-2: Establishing and Communicating System Operating Limits**
   - The AESO is required to establish system operating limits where a contingency is not mitigated through construction of transmission facilities.

2.1 **Thermal Loading Criteria**

The AESO Thermal Loading Criteria require that the continuous thermal rating of any transmission element is not exceeded under normal and post-contingency operating conditions. Thermal limits are

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1 A complete description of these standards are given in: AESO. Alberta Reliability Standards. Available from [http://www.aeso.ca/rulesprocedures/17004.html](http://www.aeso.ca/rulesprocedures/17004.html)
assumed to be 100% of the respective normal summer and winter ratings. Emergency limits are not considered in the planning evaluations.

2.2 Voltage Range and Voltage Stability Criteria

The normal minimum and maximum voltage limits as specified in the following table are used to identify Category A system voltage violations, while the extreme minimum and maximum limits are used to identify Category B and C system violations. Table 1-1 presents the acceptable steady state and contingency state voltage ranges for the AIES. Table 1-2 provides voltage stability criteria used to test the system performance.

Table 1-1: Acceptable Range of Steady State Voltage (kV)

<table>
<thead>
<tr>
<th>Nominal Voltage</th>
<th>Extreme Minimum</th>
<th>Normal Minimum</th>
<th>Normal Maximum</th>
<th>Extreme Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>475</td>
<td>500</td>
<td>525</td>
<td>550</td>
</tr>
<tr>
<td>240</td>
<td>216</td>
<td>234</td>
<td>252</td>
<td>264</td>
</tr>
<tr>
<td>260 (Northeast &amp; Northwest)*</td>
<td>234</td>
<td>247</td>
<td>266</td>
<td>275</td>
</tr>
<tr>
<td>144</td>
<td>130</td>
<td>137</td>
<td>151</td>
<td>155</td>
</tr>
<tr>
<td>138</td>
<td>124</td>
<td>135</td>
<td>145</td>
<td>152</td>
</tr>
<tr>
<td>72</td>
<td>65</td>
<td>68.5</td>
<td>75.5</td>
<td>79</td>
</tr>
<tr>
<td>69</td>
<td>62</td>
<td>65.5</td>
<td>72.5</td>
<td>76</td>
</tr>
</tbody>
</table>

Table 1-2: Voltage Stability Criteria

<table>
<thead>
<tr>
<th>Performance Level</th>
<th>Disturbance (1)(2)(3)(4) Initiated by: Fault or No fault DC Disturbance</th>
<th>MW Margin (P-V method) (5)(6)(7)</th>
<th>MVAr Margin (V-Q method) (6)(7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Any element such as: One Generator One Circuit One Transformer One Reactive Power Source One DC Monopole</td>
<td>≥5%</td>
<td>Worst Case Scenario(8)</td>
</tr>
<tr>
<td>B</td>
<td>Bus Section</td>
<td>≥5%</td>
<td>50% of Margin Requirement in Level A</td>
</tr>
</tbody>
</table>


2.3 Transient Stability Analysis Assumptions

Standard fault clearing times as shown in Table 1-3 are used for the new facilities or when the actual clearing times are not available for the existing facilities. Double line-to-ground faults are applied for the Category C5 events with normal clearing times. Single line-to-ground faults are applied for Category C6 to C9 events with delayed clearing times as depicted in Table 1-4 and Table 1-5.

### Table 1-3: Fault Clearing Times

<table>
<thead>
<tr>
<th>Nominal</th>
<th>Near End</th>
<th>Far End</th>
</tr>
</thead>
<tbody>
<tr>
<td>kV</td>
<td>Cycles</td>
<td>Cycles</td>
</tr>
<tr>
<td>500</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>240</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>144/138</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>with telecommunications</td>
<td></td>
<td></td>
</tr>
<tr>
<td>144/138</td>
<td>6</td>
<td>30</td>
</tr>
<tr>
<td>without telecommunications</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 1-4: Stuck Breaker Clearing Times for Lines

<table>
<thead>
<tr>
<th>Fault Clearing Time</th>
<th>Fault Clearing Time</th>
<th>Fault Clearing Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>138/144 kV</td>
<td>240 kV</td>
<td>500 kV</td>
</tr>
<tr>
<td>Near End</td>
<td>Far End</td>
<td>2nd Ckt (for C5 and C7 Only)</td>
</tr>
<tr>
<td>----------</td>
<td>--------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>15</td>
<td>24</td>
<td>24</td>
</tr>
</tbody>
</table>

Table 1-5: Stuck Breaker Clearing Times for Transformers

<table>
<thead>
<tr>
<th>Fault Clearing Time (Cycles)</th>
<th>Fault Clearing Time (Cycles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>240/138 kV</td>
<td>500/240 kV</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>Fault on 240 kV Side</td>
<td>Fault on 138 kV Side</td>
</tr>
<tr>
<td>2nd Ckt (for Breaker Fail)</td>
<td>2nd Ckt (for Breaker Fail)</td>
</tr>
<tr>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td>138 kV Side</td>
<td>138 kV Side</td>
</tr>
<tr>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>240 kV Side</td>
<td>240 kV Side</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>2nd Ckt (for Breaker Fail)</td>
<td>2nd Ckt (for Breaker Fail)</td>
</tr>
<tr>
<td>24</td>
<td>5</td>
</tr>
<tr>
<td>500 kV Side</td>
<td>500 kV Side</td>
</tr>
<tr>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>240 kV Side</td>
<td>240 kV Side</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>2nd Ckt (for Breaker Fail)</td>
<td>2nd Ckt (for Breaker Fail)</td>
</tr>
<tr>
<td>14</td>
<td>14</td>
</tr>
</tbody>
</table>