Transmission Losses Assessment: 2007 Transmission Regulation and Stakeholder Consultation

Operations Forecasting

ALBERTA ELECTRIC SYSTEM OPERATOR

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Table of Contents

1.0 Introduction

The 2007 Transmission Regulation (T-REG) requires the AESO to make changes regarding the treatment of transmission losses. The AESO held four meetings with stakeholders from May to August 2007 to gather input informally on how to make changes to the loss factor Rule. Input has been posted on the AESO website. The input has been used to modify the Rule (9.2) and Appendix 7 prior to the formal consultation on the rule changes. Input from stakeholders during the formal process will then be considered in the changes to the Rule.

Specifically, the following high level rule changes, effective January 1, 2009, are envisioned:

- Loss factors for import, demand opportunity service, and generation will be calculated using the same methodology. An import loss factor will be assigned at the bus connecting to the AIES,
- Import and export will be treated separately from the AIES losses. The treatment results in a average loss recovery process on tie lines,
- Materiality of changes. If changes on the AIES occur resulting in a change to loss factors, a threshold for the recalculation of losses is required,
- The threshold for losses is increased from 2 times system average losses (charge) and one time system average (credit) to +/- 12 % losses, and
- Imports and exports will be applied in the base cases and utilized in the loss factor calculation.

Several other changes may be made to the Loss Factor Rule and Appendix based on experience gained from the last two years of using the Rule. These changes are not expected to be significant. The proposed changes may include modifications to the generic stacking order to best reflect generation data, confirming the use of historical data, and so on.

Further, this document discusses tie line losses (used commonly for import path losses and export path losses) and provides some possibilities for a losses recovery technique. This document can be used in conjunction with the modified Rule and Appendix provided to stakeholders. Stakeholders can respond using the comment matrix provided on October 1.

2.0 Change in Loss Factor Methodology for Tie and DOS

The 2007 T-Reg introduces a change in loss factor (LF) methodology for Tie lines and DOS loads in order to bring them in line with generator LF calculation. The changes are summarized in Table 1.

Table 1: Changes in LF methodology due to 2007 T-REG.

	T-REG, Effective Until 2008-12-31		**2007 T-REG Effective 2009-01-01**	
	Loss Factor	**Losses on Tie Path**	**Loss Factor**	**Losses on Tie Path**
STS	Average impact	Not applicable	Average impact	Not applicable
DOS	Total impact	Not applicable	Average impact	Not applicable
IOS	Total impact	Not applicable	Average impact	Yes

XTS/MTS	Not applicable	Not applicable	Not applicable	Unknown
XOS/MOS (EOS)	Total impact	Not applicable	Not applicable	Yes

The acronyms used in Table 1 are explained below:

STS – Supply Transmission Service

DOS – Demand Opportunity service

IOS – Import Opportunity service

XTS – Export Transmission service (firm)

MTS – Merchant Transmission service (firm)

XOS – Export Opportunity service

MOS – Merchant Opportunity service

EOS – XOS and MOS

3.0 T-REG implementation in LF calculation

The 2007 T-REG will not impact the calculation of Generator LF but will affect Opportunity Service (OS) LFs. Table 2 shows the change in LF treatment as a result of the 2007 T-REG.

Table 2: Change in LF treatment as a result of 2007 T-REG.

Item	Change	Proposed Treatment
Generator LF	No Change	Continue the existing process
Import LF	LF – average impact rather total impact Loss –average tie line loss	LF – treated as a generator at the AIES interface with tie path Loss – average tie path loss from the AIES interface to the border
Export LF	LF – does not apply Loss – average tie line loss	LF – no calculation required Loss – average tie path loss from the AIES interface to the border
DOS LF	LF –average impact rather total impact	LF – treated as negative generator

Currently, Alberta has inter-tie connections with British Columbia and Saskatchewan, respectively. These two connections are used for IOS and EOS. There is a proposed merchant line for MOS between Alberta and Montana known as MATL. (Other merchant opportunities may arise.) The existing and proposed tie connections are listed in Table 3.

Table 3: Proposed Loss Factor and Loss treatment for tie paths.

Tie Connection	Tie Path	AIES Interface	Import	Export
AB –BC	• 500 kV line between Langdon (Bus 158) and BC Border (Bus 90000). • 138 kV line between Pocatera (Bus 329) and Britt Tap (Bus 819). • 138 kV line between Coleman (Bus 232) and Natal (Bus 1501).	• Langdon • Pocatera • Coleman	• LF at AIES interface (weighted average of 3 interfaces) • Line Loss in Tie Path	• LF = 0 • Line Loss in Tie Path
AB – SK	McNeil Converter Station	McNeil (AB side)	• LF @ McNeil	• LF = 0

			• Line Loss in Tie Path	• Line Loss in Tie Path
AB - MT	Proposed 240 kV line between North Lethbridge to Montana	North Lethbridge	• LF @ North Lethbridge • Line and line Loss in tie path are not part of AIES	• LF = 0 • Line and line Loss in tie path are not part of AIES

Figure 1 shows the graphical presentation of 3 tie connections with neighboring jurisdictions.

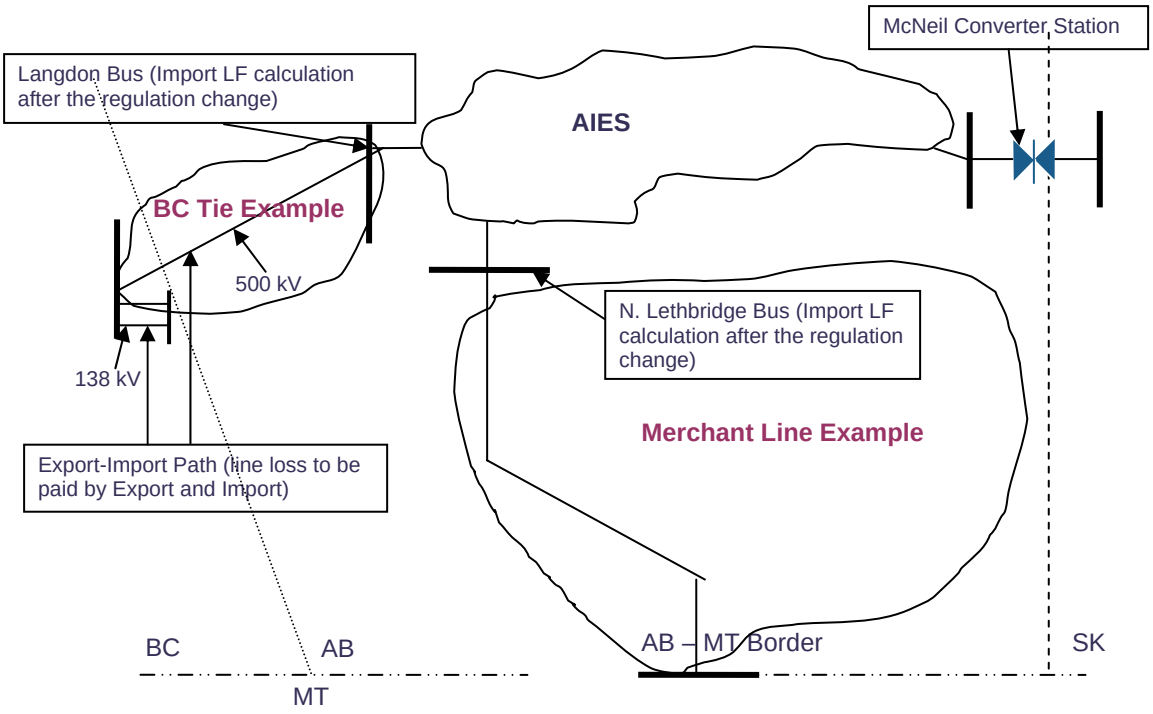

Figure 1: Tie connections with neighboring jurisdictions.

Based on these assumptions, loss factors for 2007 are re-calculated and the estimates are shown at:

http://www.aeso.ca/files/draft_2007-treg_20070619.pdf

4.0 Alberta - Saskatchewan McNeil Converter Losses

Data used in the preparation of the converter station loss curves is supplied by ATCO Electric. The data represents 15 minute data taken from Mar 01, 2000 to January 01, 2001. Figures 2-3 show the converter station loss as a function of import from Saskatchewan and export to Saskatchewan.

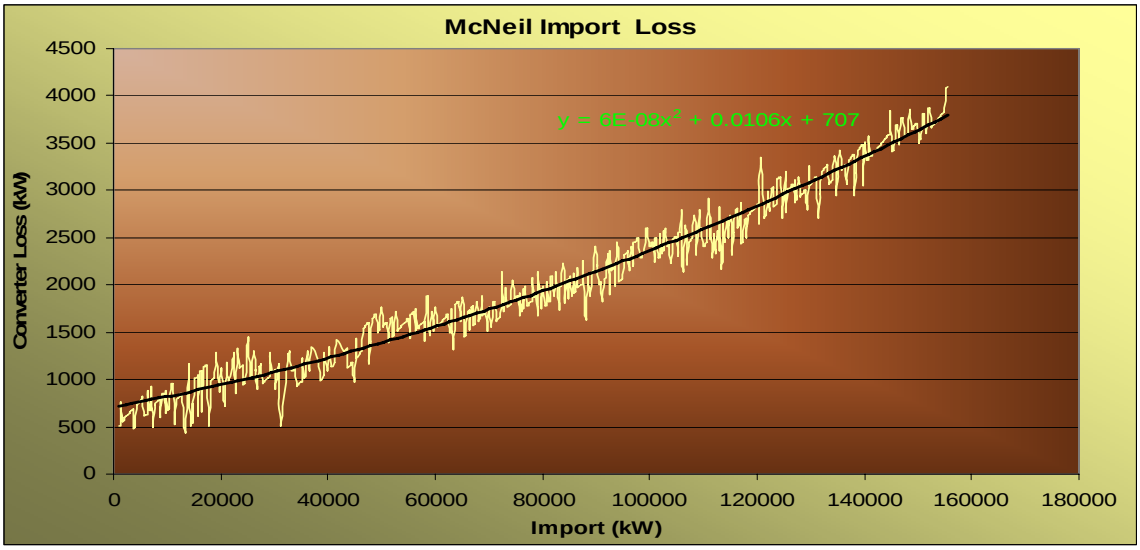

Figure 2: Converter loss vs. Saskatchewan import.

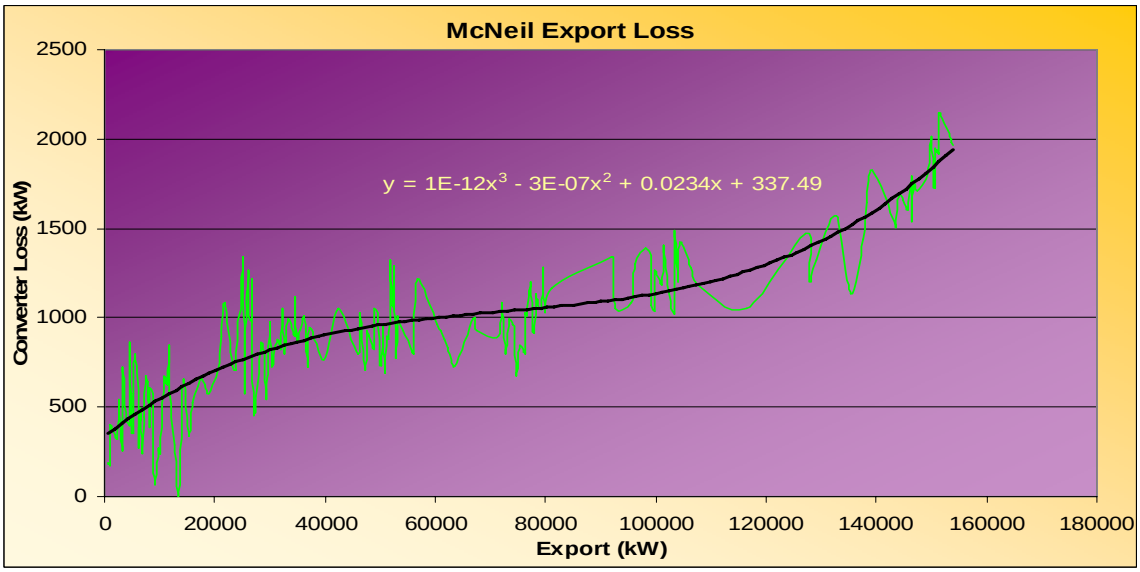

Figure 3: Converter loss vs. Saskatchewan export.

Based on the information above, tie line losses can be estimated based on the expected flow of power.

5.0 Alberta – British Columbia Tie Line Loss

The 2007 base cases used for the draft calculation of the 2009 T-REG scenario is considered for the BC tie flows and losses. The 2007 base case uses historical data from June 01, 2005 to May 31, 2007. BC tie flows and losses are presented in Table 1. Subsequent analysis in provided in Table 4.

Table 4: BC Tie Flows and Losses and Seasonal Load Duration Hours.

BC Tie	Winter			Spring			Summer			Fall		
	High	Medium	Low	High	Medium	Low	High	Medium	Low	High	Medium	Low
Tie Flow (MW)	-395.3	-110.8	69.9	-165.9	-144.4	-22.2	-330.1	-23.5	297.5	-381.4	-222.5	104.6
Loss (MW)	3.7	1.4	1.4	1.2	1.5	1.3	3	1	2	3.6	2.4	1.5
Duration (Hrs)	125	1150	885	50	1150	1007	25	2075	108	75	1075	1035

Table 4 shows the tie flow netted off Export and Import at the AIES interface and calculated from historical metered data and used in the 2007 loss factor calculation. It also shows line losses in the tie paths and duration of load scenarios used in loss factor bases cases. The negative sign means net import to Alberta.

The weighted average annual flow and loss can be calculated using the following equation:

$$\text{Average flow or loss} = \frac{\sum_{12\,\text{scenarios}} \text{absolute}(\text{Tie Flow or Loss} \times \text{Duration})}{\sum_{12\,\text{scenarios}} \text{Duration}}$$

6.0 Results for Tie Line Losses

The results of inter-tie treatment as described in this document are shown below. Information will be updated with the latest information where possible in the future.

Table 5 shows average historical McNeil Converter station loss.

Table 5: Average SK Tie Loss at the McNeil Converter station.

	Avg Loss
Avg Import	2.5%
Avg Export	2.3%

Table 6 shows the weighted average annual BC tie flow and the line losses netted for export or import.

Table 6: Weighted Average Annual BC Tie Flow and Loss.

	BC Tie
Avg Tie Flow (MW)	102.80
Avg Loss (MW)	1.50

Table 6 can be used as an example for recovering tie losses in the tie lines between Alberta and British Columbia. The average tie flow of 102.8 MW causes a loss of 1.50 MW of loss in the BC tie. The result can be used in two ways –

1. Apply 1.50 MW of loss to any and every AB-BC tie transaction, or
2. Apply a ratio of 1.50/102.8 (1.5%) to any AB-BC tie transaction.

7.0 Inter Tie Loss Recovery

This section gives a hypothetical example of the application of loss factors and loss charges for the recovery of tie line losses. The tie charges are made as per scheduled tie transactions at the border.

Figure 4 shows a hypothetical tie path and the interface to the AIES. Bus A represents the AIES interface while Bus B represents the border where the scheduled tie transactions are considered for trading and. Two scenarios are considered, 300 MW of scheduled import and export at the border for two different hours. The summary of hypothetical loss factors and the loss charges are shown in Table 7.

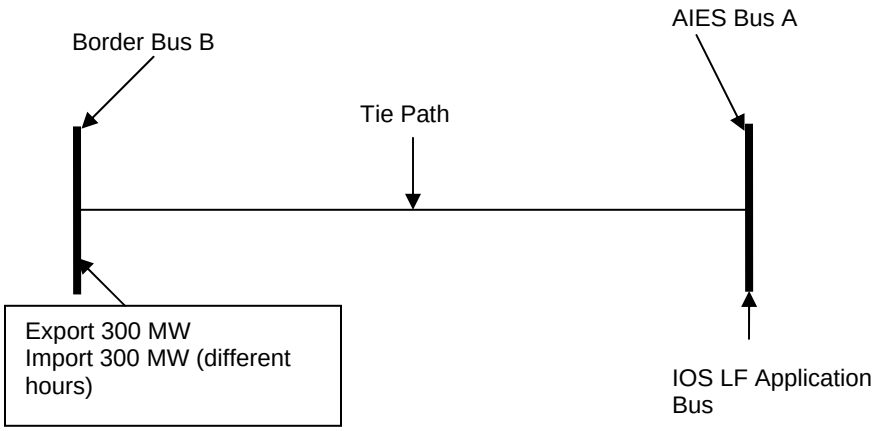

Figure 4: A hypothetical tie path.

Table 7: Loss data for a hypothetical tie path.

Transaction Type	Loss Factor (%)	Average Loss Charge (MW)	Average Tie Flow (MW)
Import	4.00	2.00	125
Export	Not applicable	2.00	125

Import Loss Recovery

An amount of 300 MW is scheduled for import at the border. The corresponding calculated scheduled import amount at the AIES Bus (A) is

$$\text{Scheduled Import at AIES Bus A} = \left(300 - 2 \times \frac{300}{125}\right) \text{ MW}$$

$$= 295.2 \text{ MW}$$

A loss factor of 4.00% will be applied on the calculated scheduled amount at the AIES Bus A. The total import loss is sum of tie line losses and application of loss factor on the calculated scheduled amount at the AIES Bus A.

$$\text{Total Import Loss } = 2 \times \frac{300}{125} + 295.2 \times 0.04 \text{ MW}$$

$$= 4.8 + 11.81 \text{ MW}$$

$$= 16.61 \text{ MW}$$

The total import loss can be expressed in terms of percentage of the scheduled Import amount at Border Bus B. This would be useful for the Transmission Settlement System (TSS). If the percentage is X_I and this can be calculated as:

$$\text{TSS Import LF, } X_I = \frac{16.61}{300} \times 100 \ \%$$

$$X_I = 5.54 \ \%$$

Export Loss Recovery

An amount of 300 MW is scheduled for export at the border. The corresponding calculated scheduled export amount at the AIES Bus (A) is

$$\text{Scheduled Import at AIES Bus A} = \left(300 + 2 \times \frac{300}{125}\right) \text{ MW}$$

$$= 304.8 \text{ MW}$$

Export will have no loss factor and hence they will pay for 4.8 MW of losses occurred in the tie path. The total export loss will be same as the loss charges applied to the export amount.

$$\text{Total Export Loss} = 2 \times \frac{300}{125} \text{ MW}$$

$$= 4.8 \text{ MW}$$

The total export loss can be expressed in terms of percentage of the scheduled Import amount at Border Bus B which is equal to percentage of tie path losses. The TSS loss percentage X_E can be calculated as:

$$\text{TSS Export LF, } X_E = \frac{4.8}{300} \times 100 = \frac{2}{125} \times 100 \ \%$$

$$X_E = 1.60 \ \%$$

Tie Loss Recovery Summary

The tie loss recovery mentioned in previous sections is summarized in Table 8.

Table 8: Summary of Tie Loss Recovery.

Transaction Type	**Scheduled Amount at (MW)**		**Loss calculated from (MW)**			**Settlement LF (%)**
	Bus B	Bus A	LF	Tie Path	Total	
Import	300	295.2	11.81	4.8	16.61	5.54
Export	300	304.8	-	4.8	4.8	1.60

8.0 Assumptions used in the 2007 T-Reg

The following assumptions should be noted regarding the 2007 T-Reg:

1. The document provides a guideline for understanding loss estimates on the tie paths and methodologies for calculations
2. Export will have no loss factor but it will pay for tie path losses.
3. Import will have loss factor in addition to the tie path loss payment.
4. Average path loss will be used for tie path loss estimation.
5. All calculations include the new charge and credit limits of +/-12%
6. BC Tie Flow is a path consisting of three line flows –
    a. 500 kV line between Langdon (Bus 158) and BC Border (Bus 90000).
    b. 138 kV line between Pocatera (Bus 329) and Britt Tap (Bus 819).
    c. 138 kV line between Coleman (Bus 232) and Natal (Bus 1501).
7. AESO tariff must recover tie line losses on the BC ties to the Alberta / BC border.
8. The calibration factor will be applied to loss factors quarterly

9.0 AESO Rule 9.2 and Appendix 7 – Suggestions for changes

The AESO suggests for the Alberta to BC inter-tie:

- The tie losses to BC be monitored on the 500 kV line and 138 kV lines
- The losses be charged at a rate of 1.50 MW/102.80 MW of transfer

The AESO suggests for the Alberta to Saskatchewan inter-tie:

- The tie losses to Saskatchewan be charged based on Table 5

For the Alberta tie lines, the data used will be gathered the same as the historical data accrued for generators (i.e. from June 1 to May 31 of the previous year.) If necessary, meters are configured (or added) so the flow at (a) Langdon and at the BC border, and (b) on the 138 kV AIES side of the McNeill station and the Saskatchewan border can be taken for purposes of gathering tie line average losses.