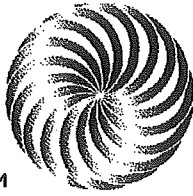


**aeso**

ALBERTA  
ELECTRIC  
SYSTEM  
OPERATOR



# Distribution Point-of-Delivery Interconnection Process Guideline

## Evaluation of Transmission versus Distribution Alternatives for Large Customers

	Name	Signature	Date
AESO Approved	Fred Ritter, P.Eng	<i>F. Ritter</i>	2005-03-23
AESO Approved	Neil Brausen, P.Eng	<i>Neil Brausen</i>	2005-03-23
AESO Management	Neil Millar, P.Eng.	<i>Neil Millar</i>	2005-03-30

Revision 0: Wednesday, March 23, 2005

**Distribution Point-of-Delivery Interconnection Process Guideline - Evaluation of  
Transmission versus Distribution Alternatives for Large Customers**

---

**TABLE OF CONTENTS**

<b>1.0</b>	<b>INTRODUCTION .....</b>	<b>1</b>
1.1	Purpose .....	1
1.2	Application of Guideline .....	1
1.3	Modifications .....	1
<b>2.0</b>	<b>TRANSMISSION VERSUS DISTRIBUTION .....</b>	<b>2</b>
2.1	Load addition from a single large customer (no large motor).....	2
2.1.1	Study Methodology .....	3
2.1.2	Load Growth Potential .....	3
2.2	Load addition from a single customer with a large motor (s).....	3
2.2.1	Motor Starting Study .....	4
2.2.2	Load Growth Potential .....	5
	<b>APPENDIX I. ....</b>	<b>6</b>

## **1.0 Introduction**

### **1.1 Purpose**

This guideline describes the methodology to be used by the Distribution Facility Owner (“DFO”) and/or Transmission Facility Owner (“TFO”) to identify if the interconnection proposal for a larger new customer should be a Distribution Proposal or a Transmission Proposal.

This guideline is intended solely for the purpose of supporting the AESO’s customer interconnection process to arrive at proposed interconnection concepts that are optimized on a technical and economic basis. It will not in any way address or determine the AESO’s facility cost allocation between system and customer, nor will it be used in any way as a guideline in applying the AESO approved tariffs and investment policy.

This guideline is intended to facilitate documentation of the project need and the evaluation done to support the need, in alignment with the interconnection process. The interconnection process has a requirement for AESO endorsement and AEUB approval of the project need.

### **1.2 Application of Guideline**

This Guideline is a reference for other Interconnection Process Guidelines. Because this Guideline is used by various TFO’s and DFO’s with different planning and operating environments, it is recognized that differences may occur.

The AESO expects that any deviations from this Guideline will be documented, explained and supported by the TFO’s and/or DFO’s as part of the proposal(s) submitted to the AESO.

### **1.3 Modifications**

In respect to this Guideline the AESO will:

- a. seek the input and feedback of affected parties prior to making changes or additions;
- b. manage all changes;
- c. make this guideline publicly available via the AESO website;
- d. periodically and within five (5) years of the effective date shown on the cover page review this guideline.

## **2.0 Transmission versus Distribution**

Selection of the appropriate transmission or distribution alternative to serve a single large customer involves a number of quantitative and qualitative assessments. There is no single rigid rule that will dictate a transmission versus a distribution solution.

Economic comparison, technical viability, reliability concerns, design and construction constraints, as well as impact on existing customers, are some of the factors considered in arriving at the best overall solution.

During the planning process, system deficiencies are identified based on a forecast of the expected load growth and application of relevant capacity and operational practices, guidelines and criteria. System expansion projects are proposed, either distribution or transmission, that will ensure that customer needs and expectations will be met now and into the future.

This document discusses the considerations that should be investigated before deciding if the best solution is a transmission or distribution solution.

This discussion is divided into two categories:

1. Load addition from a single large customer (no large motor).
2. Load addition from a single customer with a large motor(s).

### **2.1 Load addition from a single large customer (no large motor)**

Large customers should approach the DFO for a connection of a new load at a given location. A process must be followed to determine the most cost effective method of supplying the customer either from the distribution system or from the transmission system.

Load flow studies can be conducted to determine if the new load can be supplied from either:

1. The existing distribution system, or
2. By building a new distribution feeder from an existing substation.

Load flow studies will be conducted by the DFO to determine if this new load can be supplied within acceptable voltage and ampacity limitations.

## **Distribution Point-of-Delivery Interconnection Process Guideline - Evaluation of Transmission versus Distribution Alternatives for Large Customers**

---

### **2.1.1 Study Methodology**

The closest distribution feeder to this new load should be selected. In the load flow model, the necessary distribution facilities are modeled to connect the new load to the existing distribution system.

In the load flow model, ensure that the new load can be added to the feeder peak load and all the distribution facilities can supply this new load within acceptable voltage and ampacity limitations. Also, ensure that the existing substation facilities have the capability to support this new load.

If ampacity or voltage limitations exist in the model, upgrade the affected components so the new load can be supplied.

If after upgrading all the components in the model, the new load can not be supplied from the upgraded distribution system, a new distribution feeder from the existing substation may be another option.

In the load flow model, add a new substation low voltage breaker and a new distribution feeder directly to the new load. If the new feeder can supply the load, then a distribution solution is preferred. The substation equipment should also be assessed in determining the supply to the new load. If a new distribution feeder can not supply the load with acceptable voltage and ampacity, then a transmission solution should be explored.

An economic evaluation of all the alternatives should be conducted including the line losses involved. As well, the expected load growth in the area should be considered, so that distribution facilities, with limited capability, are not installed now, that may not meet the future needs of the load in the area.

### **2.1.2 Load Growth Potential**

As part of the study into the potential solutions to the large customer load request, the DFO may undertake an investigation into the load growth potential in the area. A study can be undertaken into the potential future load activity in the area to determine if there may be an increase in the electrical demand on the distribution system. If the study indicates strong activity in the area, a transmission solution may be desirable. If the study indicates a very limited activity in the area, then a distribution solution may be preferred.

### **2.2 Load addition from a single customer with a large motor (s)**

Customers with a single large motor or several large motors should approach the DFO for a connection of a new load at a given location. A process must be followed to determine the most cost effective method of supplying the customer either from the distribution system or from the transmission system.

## **Distribution Point-of-Delivery Interconnection Process Guideline - Evaluation of Transmission versus Distribution Alternatives for Large Customers**

---

In addition to meeting the requirement of the running load of the motor or motors, the impact of starting the motor or motors must also be investigated.

The running load of the motor or motors can be investigated using the same method as described in Section 2.1.

However, the motor starting study must investigate the voltage fluctuation associated with motor starting.

### **2.2.1 *Motor Starting Study***

Motor starting studies should be undertaken to assess the ability of the new customer to start the motor that is proposed to be connected to the distribution system and the effect the motor start will have on other distribution customers. The customer is responsible and the DFO will ensure that the voltage fluctuation associated with motor starting by one customer does not create problems for other customers. Voltage fluctuation during motor starting shall not exceed the DFO's standards for fluctuation as specified in the AESO Interconnection Process Guide, Standards of Service.

To determine how significant of an impact the motor starting will have on the distribution system, the DFO will model typical characteristics of the motor to determine what limit on inrush current is necessary to limit the voltage fluctuation to the DFO's standard. Most DFO's use a loadflow modeling tool to assess the impact of motor starting.

The first step is to attempt to start the motor with across the line starting. When across the line starting indicates a voltage fluctuation greater than the DFO's standard, motor starting aids are evaluated to ensure that the customer has a reasonable chance to start the motor. Voltage reduction and/or inrush current limiting techniques are evaluated such as the use of an autotransformer or a Variable Frequency Drive (VFD). If voltage reduction techniques alone do not look promising, the following distribution system improvements options are to be evaluated. The following alternatives in lieu of installing motor starting aids should also be investigated:

- reconductoring the existing feeder;
- reconductoring the existing feeder and installing a series capacitor;
- the addition of a new feeder;
- the addition of a new distribution feeder and series capacitor, and finally
- a transmission option.

## **Distribution Point-of-Delivery Interconnection Process Guideline - Evaluation of Transmission versus Distribution Alternatives for Large Customers**

---

DFO's use generic assumptions regarding motor data. Motor data required for modeling purposes includes: horsepower, voltage rating, locked rotor power factor (assume 0.25 if not given), locked rotor current (assume 600% of rated if not given), power factor and efficiency. DFO's will also use the system impedance at the service transformer for this calculation.

Typically, motors will start with a voltage drop of 30% or less from their rated voltage at their terminals. Voltage drop at the transformer is then limited to 20% of the rated motor voltage. This allows for another 10% drop on the customer's secondary from the transformer secondary to the motor terminals.

After the study is complete, the results should be summarized. Table 1 in Appendix A is a sample of the results of one DFO's study. The options considered as shown in Table 1 should be investigated and shown in the results of the study. Table 1 is an example of the results of one DFO's study and are for illustrative purposes only. It is recognized that each DFO has different voltage fluctuation guideline.

An economic evaluation of all the alternatives should be conducted including the line losses involved using the AESO Distribution Point-of-Delivery Interconnection Process Guideline – Economic Evaluation. As well, the expected load growth in the area should be considered, so that distribution facilities, with limited capability, are not installed now, that may not meet the future needs of the load in the area.

### **2.2.2 Load Growth Potential**

As part of the study into the potential solutions to the large motor load request, the DFO may undertake an investigation into the load growth potential in the area. A study can be undertaken into the potential future load activity in the area to determine if there may be an increase in the electrical demand on the distribution system. If the study indicates strong activity in the area, a transmission solution may be desirable. If the study indicates a very limited activity in the area, then a distribution solution may be preferred.

**Distribution Point-of-Delivery Interconnection Process Guideline - Evaluation of  
Transmission versus Distribution Alternatives for Large Customers**

---

**APPENDIX I.**

**Table 1**

This is a sample of one DFO's study results and is for illustrative purposes only. Each DFO's results may vary. It is recognized that each DFO has different voltage fluctuation guidelines. The results shown in this study example are measured at the customer's primary on a 120 volt base. Results may be expressed in per unit values if so desired.

<b>Options Considered</b>	<b>Motor Starting Voltage Fluctuation (%)</b>	<b>Motor Starting Voltage Fluctuation (%) Guideline</b>	<b>Steady State Voltage with motor running</b>	<b>Steady State Voltage with motor running Criteria</b>
Existing Distribution System (across the line start)	11% Unacceptable	<5%	116 volts Acceptable	>115 volts
Existing Distribution System (VFD start)	9% Unacceptable	<5%	118 volts Acceptable	>115 volts
New Distribution Feeder (across the line start)	8% Unacceptable	<5%	118 volts Acceptable	>115 volts
New Distribution Feeder (VFD start)	5% <b>Acceptable</b>	<5%	118 volts Acceptable	>115 volts
New Distribution Feeder with a series capacitor (Across the line start)	4.4% <u><b>Acceptable</b></u>	<5%	118 volts Acceptable	>115 volts
New Distribution Feeder with a series capacitor (VFD start)	3 % Acceptable	<5%	118 volts Acceptable	>115 volts