



Distribution Point-of-Delivery Interconnection Process Guideline

Drivers of Need

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Revision 0: Tuesday, March 22, 2005

TABLE OF CONTENTS

1.0 INTRODUCTION 1

 1.1 Purpose1

 1.2 Application of Guideline1

 1.3 Modifications1

2.0 DRIVERS OF NEED..... 2

 2.1 Load Growth2

 2.2 Reliability.....3

 2.2.1 Unsupplied Load3

 2.2.2 Distribution Feeder Loading.....5

 2.2.3 Reliability Measures5

 2.3 Technical and Operational Considerations6

 2.3.1 Voltage.....6

 2.3.2 Economic Comparison6

 2.3.3 Motor Starting6

 2.3.4 Operating Flexibility6

 2.3.5 System Optimization and Efficiency7

 2.3.6 Power Quality.....7

 2.4 Siting.....8

3.0 DISTRIBUTED GENERATION 9

1.0 Introduction

1.1 Purpose

This guideline describes the Distribution Facility Owners (DFO's) fundamental drivers that determine the need to add or modify existing transmission facilities.

DFO's will use this Guideline to assist in presenting need drivers to be included with interconnection proposals for modifications to existing and the addition of new facilities.

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 intended solely for purpose of supporting the AESO's Distribution Point-of-Delivery interconnection process to assist DFOs in identifying the need to add or modify existing transmission facilities. AESO endorsement must be obtained prior to filing the Need with the AEUB for approval.

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 to the guideline;
- b) manage all changes to this guideline;
- 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 Drivers of Need

This document captures the various drivers that identify the need to add or modify existing transmission facilities.

The drivers of need can be grouped into five categories:

1. Load Growth
2. Reliability
3. Technical and Operational Considerations
4. Siting
5. Distributed Generation.

2.1 Load Growth

Load growth that results in the capacity of existing equipment to be exceeded is one of the primary reasons for the need to add or modify facilities.

Load forecasting is a practice used in the electric industry to predict future loading which will drive the need to add or modify facilities.

An annual summer/winter peak demand load forecast for each main distribution feeder and Point-Of-Delivery (POD) substation forms the basis of all planning assessments in the current year.

Distribution facilities are planned and designed to meet the expected peak demand on each feeder and POD with minimal consideration for diversity or peak load duration.

For existing facilities, load growth is determined by DFOs by extrapolating the historical load into the future and by adding any specifically identified new and/or major loads. If Distributed generation (DG) is present on the distribution feeders, this generation is assumed not to be available for purposes of planning, due to the lack of control of the generation and the uncertainty that the generation will be present during the feeder peak loading condition.

For proposed development in areas where no electrical facilities exist, the load forecast is developed using typical load density expectations as shown in Table 2-1. This method has proven to be accurate over the long term. The precise timing of a development can be uncertain depending on economic conditions and the timing of sales. However, the DFO, working closely with the end-use customers, can establish a year by year load forecast.

Table 2-1 Load Density

Classification of Load	Load Density (MVA/square mile)
Residential (Urban)	6 to 7
Light Commercial / Industrial	12 to 18
Heavy Commercial / Industrial	27 to 40

Sources of information such as plans of the Province, County, Municipality, Towns, Cities and/or local industrial or commercial developers that would give an indication of potential future development in the area, are used in developing a load forecast.

Distribution Facility Owners (DFOs), Transmission Facility Owners (TFOs), and the AESO, all have an “obligation to serve”. Hence, facilities (transmission lines, substations and feeders) must be in place in a timely manner to serve the needs of the customers. Therefore, DFOs, TFOs, and the AESO need to be proactive in meeting the future needs of the customers.

When the expected load in any given year is forecast to exceed the capacity of the existing equipment, new or modified facilities will be planned and installed before the equipment limitation is reached. To do this effectively, the TFO, the DFO and the AESO must consider the time required to obtain the various approvals required and to design and construct the facilities. (Currently this is a two to three year process). Refer to the AESO Interconnection Process Guideline, Standards of Service.

2.2 Reliability

2.2.1 *Unsupplied Load*

It is recognized that power interruptions will occur from time to time. However, Planners must recognize that certain contingencies can occur and that load will be interrupted with restoration of load having to occur in an acceptable amount of time.

“Unsupplied Load” means the load not served after any automatic or manual switching operations have been carried out after the occurrence of a first contingency

An unsupplied loading issue can occur when the capacity demand of a POD exceeds a level where transformation capacity can supply the forecasted load, or where the DFO's N-1 contingency restoration practices are not met.

N-1 contingencies include but are not limited to:

- loss of the transmission line supply to a POD;
- loss of the largest transformer at the POD;
- loss of an interconnected distribution line from the same POD or from adjacent PODs;
- loss of transformers at adjacent PODs; and
- loss of a distribution breaker or distribution bus.

In assessing the N-1 contingencies, consideration is given to:

- the probability of the event occurring,
- the duration of the event,
- the consequences of the event,
- the repair time (which could include the use of a mobile transformer),
- switching times,
- size of the load,
- number of customers affected,
- type of load (residential, commercial, industrial, irrigation),
- environmental consequences either from the event itself or the impact on customers (e.g. flaring),
- location (remote site)
- an economic evaluation of the cost of possible solutions in determining the most cost effective solution.

Major element failures with long repair times affecting large numbers of customers usually drive a need for facilities.

In an Urban area, Unsupplied Load (see definition above) must be restored. A balance between the time required to restore service and the cost of

facilitating the restoration of service must be achieved. Service may not be restored to all customers simultaneously following an outage. The intent is to reduce to an acceptable level the number of customers who remain out of service due to an outage while other restoration measures are deployed or the repair work is undertaken. In an Urban area, most load would typically be restored by switching of transmission and/or Distribution devices.

In a rural area, Unsupplied Load (see definition above) must also be restored. A balance between the time required to restore service and the cost of facilitating the restoration of service must be achieved. Service may not be restored to all customers simultaneously following an outage. The intent is to reduce to an acceptable level the number of customers who remain out of service due to an outage while other restoration measures are deployed or the repair work is undertaken. In a rural area, load would typically be restored by switching of transmission and/or Distribution devices. However, it is recognized that the switching times may be longer in a rural area compared to an urban area. It is also recognized that other non-switching activities such as the use of a mobile transformer or on-site generation may be used to restore load, and may be the most cost effective solution found when conducting the economic evaluation. Refer to the AESO Interconnection Process Guideline, Standards of Service."

2.2.2 *Distribution Feeder Loading*

Main three phase distribution feeders are planned and designed for full mutual backup capability over peak loading conditions through the switching of load to an adjacent feeder. The capability to supply future load growth should also be taken into account. Wherever possible, feeder loading limits are set that support service to customers and provide backup through feeder ties to nearby feeders or appropriate load transfer to adjacent transmission facilities. Refer to the AESO Interconnection Process Guideline, Standards of Service.

2.2.3 *Reliability Measures*

The SAIDI and SAIFI indices are calculated for each distribution feeder. The definition of SAIDI and SAIFI are as follows:

System Average Interruption Duration Index (SAIDI)

This index is defined as the system average interruption duration for customers served per year.

$$\text{SAIDI} = \frac{\text{Total Customer-Hours of Interruptions}}{\text{Total Customers Served}}$$

System Average Interruption Frequency Index (SAIFI)

This index is defined as the system average number of interruptions per customer served per year.

$$\text{SAIFI} = \frac{\text{Total Customer-Interruptions}}{\text{Total Customers Served}}$$

The five year average SAIDI and SAIFI numbers are compared to the average of all the particular DFO's feeders, and to the urban average. For distribution feeders with performance that is worse than average, potential solutions are investigated. Solutions may be distribution, transmission or a combination of transmission and distribution. Distribution solutions such as tree trimming, bird protection and lightning protection should also be investigated. Refer to the AESO Interconnection Process Guideline, Standards of Service.

2.3 Technical and Operational Considerations

2.3.1 Voltage

Distribution planners assess the need for voltage support to ensure that customers have acceptable voltage at their utilization point in accordance with CSA Standard CAN3-C235-83 Preferred Voltage Levels for AC Systems, 1 to 50,000 volts.

2.3.2 Economic Comparison

Refer to the AESO Interconnection Process Guideline, Economic Evaluation of Alternatives to conduct an economic comparison of viable alternatives.

2.3.3 Motor Starting

Starting a motor may cause a voltage fluctuation on the system. A planning assessment should be conducted to be aware of potential power quality impacts, voltage flicker, and to be proactive in identifying concerns to existing customers. New facilities or modified facilities (customer, distribution or transmission) may need to be considered to be able to start the motor.

2.3.4 Operating Flexibility

The system needs to be designed so that customer outages (both frequency and duration) can be held to an acceptable level for maintenance outages and within acceptable switching times for unplanned outages. Refer to the AESO Interconnection Process Guideline, Standards of Service. This can be accomplished through the placement of normal open points, switches, OCRs, and sectionalizers on distribution feeders and through switchgear configuration at the POD.

2.3.5 ***System Optimization and Efficiency***

The addition of transmission facilities may present opportunities to minimize overall (combined transmission and distribution) end-customer delivery costs by reducing losses and improving system optimization.

Occasionally, facility modifications or additions may allow the salvage of facilities expected to require significant maintenance. Similarly, losses may be reduced by circuit re-terminations or other measures. The economics of any proposal brought forward must demonstrate the carrying cost of capital invested is less than the avoided maintenance or loss savings, in accordance with the AESO's Interconnection Process Guideline, Economic Evaluation of Alternatives.

2.3.6 ***Power Quality***

a) Harmonic Guidelines

To ensure that harmonics produced by a customer do not unduly annoy or interfere with other customers, the system should be planned and designed to meet the requirements as defined in IEEE 519, Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.

b) Voltage Fluctuation Guidelines

Voltage fluctuations will result from voltage variations caused by low power factor loads imposing visible and irritating voltage fluctuations on lighting circuits.

The voltage flicker limit curve is shown in the AESO Alberta Interconnected Electric System Interconnection Standard and is applicable at the POD low voltage bus.

Individual DFOs may have their own standards for expected voltage performance at customer delivery points, and the obligations by the customer for maintaining voltage within acceptable limits. It should be used by planners when designing modifications to distribution systems, when adding new customer loads, or when reviewing feeders for adequacy.

Customers should design their facilities to meet the voltage flicker guidelines as required by the DFO providing them service.

2.4 Siting

With the rapid approach of urban development into an area, it is necessary to provide visibility of future system expansion intentions at an early stage. From an urban planning perspective, it is desirable to have the necessary utility infrastructure, including electrical facilities, either in place, or at a minimum, identified in area plans of various municipal planning authorities prior to significant land development. As land development progresses, it will become increasingly difficult to site transmission facilities.

3.0 Distributed Generation

Distributed generation may be added to a distribution feeder. When the amount of distributed generation exceeds the load on that feeder, the power may flow onto the transmission system. There could be the case that the generation on the feeder causes transmission equipment to be overloaded. This may become a driver of need.