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REVISIONS: UPDATED LEGAL ACKNOWLEDGEMENT FORM. FD MAR '16

DESIGNED J. AGNOLIN	RECOMMENDED  F. DENNERT	ACCEPTED  G. REIMER	ENGINEER OF RECORD 	NOTICE FROM THE EXECUTIVE VICE PRESIDENT TRANSMISSION AND DISTRIBUTION AND CUSTOMER SERVICE		
DISTRIBUTION STANDARDS 		ISSUED: MAR 2016 REPLACES: MAY 2004 ORIGINALLY ISSUED: NOV 1980				PAGE 1 OF 2

Scope

This manual is one of a series containing standards for construction of the BC Hydro electrical distribution plant within the service area of BC Hydro. A new distribution plant shall be designed, constructed, owned, operated, maintained and repaired to these standards.

Purpose of Standards

BC Hydro objectives require standardization to:

- a) Ensure uniform safety requirements comply with BC statutes and regulations.
- b) Provide uniform system reliability.
- c) Provide uniform operating practices.
- d) Permit economic bulk purchasing of materials.
- e) Achieve optimum life cycle cost of plant construction.
- f) Effect efficient quality assurance.

Responsibility

The Distribution Standards Department prepares these standards and verifies that specified plant and procedures will perform adequately under all normally expected conditions encountered throughout the province of British Columbia. These standards are approved by Professional Engineers. It is the responsibility of BC Hydro Managers to ensure that the standards are followed unless abnormal conditions are encountered that require variations. These variations should be kept to a minimum and their performance shall be the responsibility of the Professional of Record in charge of the project, who will record and seal the variation based on satisfactory qualifications and experience to do so. As per the latest revision of the BC Hydro Distribution Owner's Engineer Guide, these variations must be accepted by BC Hydro's Owner's Engineer.

Use of Stock Materials

The electrical distribution plant covered by these standards is built using stock materials approved by a Professional Engineer as required by law. The use of non-stock materials for special and unusual situations must be approved by Distribution Standards or the BC Hydro Engineer responsible for the project.

Revisions to Manual

These standards are revised from time to time to improve the safety, performance, workability, cost effectiveness or appearance of the plant. The existing plant built to previous standards need not be updated unless so specifically advised by BC Hydro. When maintenance or other work, such as voltage conversion or conductor change is being done, updating plant to current standards is encouraged.

Mailing Addresses

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Suggestions for changes in the manual, or required changes of address may be made on the pre-addressed comment sheet included in the Manual and with each issue of revision.

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ES55 Design Standards

Q1-04 – Customer Apparent Power Assessment

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Scope

This document demonstrates how to assess a customer's apparent power for the purpose of determining their low-voltage (LV) or medium-voltage (MV) network emission limits.

Definitions

These terms are used in this section:

Term	Definition
Steady-State Voltage	State of average r.m.s. voltage which is maintained after all transient effects have subsided.
$U_{r.m.s.(1/2)}$	Value of the r.m.s. voltage measured over 1 cycle, commencing at a fundamental zero crossing and refreshed each half-cycle.
$U_{r.m.s.(1)}$	Value of the r.m.s. voltage measured over 1 cycle, commencing at a fundamental zero crossing and refreshed each full-cycle.
Rapid Voltage Changes	Changes in fundamental frequency r.m.s. voltages with duration between 1 and 60 cycles and magnitude less than the sag/swell threshold (10%).
Public Network	Low or medium voltage networks are considered 'public' when they serve, or are intended to serve, more than one customer from the same transformer.
Private Network	Low or medium voltage networks are considered 'private' when they serve, and are only intended to serve, one customer from a dedicated transformer.
Electromagnetic Disturbance	Any electrical or magnetic characteristic, either conducted or radiated, that affects the normal operation of equipment, or causes unwanted sensory experiences for people.
Compatibility Level	The specified maximum electromagnetic disturbance expected to be impressed on a device, equipment, or system operated in a particular environment under normal conditions.
Emission Level	The level of a given electromagnetic disturbance emitted from a particular device, equipment or system.
Low Voltage (LV)	Describes networks with rated voltage $0\text{ V} < U_n \leq 1,000\text{ V}$.
Medium Voltage (MV)	Describes networks with rated voltage $1,000\text{ V} < U_n \leq 35,000\text{ V}$.

Application

Q1 is intended for application by distribution planning engineers, regional engineers, designers and power quality engineers to support calculation methods described in Sections Q3 and Q4.

Q1-04 specifies how to assess a customer's apparent power for the purpose of determining their power quality emission limits.

Customer Apparent Power Assessment (S_i)

A customer's apparent power (S_i) is used in various Q3 and Q4 standards for calculating their share of network resources. Apparent power levels are important since they influence prescribed emission limits for customers connected to or requesting connection to BC Hydro's public supply network.

Acceptable methods for determining a customer's apparent power are shown below for both existing and new customers.

Existing Customers

When a customer is already operating, their emission limits may be required to assess their performance during a power quality investigation. During this scenario, a customer's apparent power should be assessed using actual power measurement.

Whenever possible, average hourly measured power consumption should be used to assess a customer's maximum apparent power (S_i) for the sake of applying emission limits.

Acceptable methods for determining S_i from measurement data are discussed below in order of preference.

Revenue Metering Data

If load data is available from the customer's smart meter, then a full year of power consumption history should be assessed to determine their maximum hourly average apparent power.

When a full year of historical data is not available, at least one full week of measured data can be used if it is known to reflect the customer's normal operation.

Smart metering historical data can be obtained from the Field Device Operations group when the meter has good communications, or can be directly downloaded on site. These two options are discussed further below.

Field Device Operations Group

A customer's historical loading data can be obtained from BC Hydro's Field Device Operations group by sending a request to:

MDMSOperationsTeam.BCHydro@bchydro.com

The email request should include the following details:

- Meter ID number;
- Date range (1-year is recommended);
- Metering quantities (phases, voltages, kilowatts, kilovars), and
- Justification to receive private metering data.

Direct Download

When data is not available through the Field Device Operations group, then BC Hydro's Power Quality group or local meter technicians can obtain smart meter historical data through direct download on site.

Send your direct download request to:

PowerQuality@bchydro.com

Power Factor

Apparent power is required to determine a customer's emission limits, though revenue metering data is provided as real power quantities. It follows that the customer's power factor must be known to convert real power (kW) to apparent power (kVA) for assessment of emission limits.

When reactive power consumption is not available from a customer's smart metering data then the customer type can be used to determine an appropriate power factor. Values from Table 1 shall be used to look up power factor for all subsequent calculations wherever the acronym 'PF' appears in an equation:

Table 1 – Power factor by customer type

Customer Type	RCI	PF
Residential	R	1.00
Commercial	C	0.96
Industrial	I	0.94
Non-Buildings	N	0.99
Temporary	Q	0.92

For application of Table 1 customer site codes are available in BC Hydro's GIS system; Table 2 can be used to determine the appropriate RCI to use based on the customer's site code:

Table 2 - Customer RCI look-up by site code

Site Code RCI									
1	C	11	C	21	R	31	I	41	R
2	C	12	C	22	I	32	I	42	R
3	C	13	C	23	I	33	I	43	R
4	C	14	C	24	I	34	I	44	R
5	C	15	C	25	I	35	R	45	R
6	C	16	C	26	I	36	R	46	R
7	C	17	I	27	I	37	R	47	R
8	C	18	C	28	I	38	R	48	R
9	C	19	N	29	Q	39	R	49	R
10	C	20	C	30	C	40	R	50	R

Apparent Power Calculation

One of the following two methods is used to determine a customer's maximum apparent power:

- 1) When only real power (kW) quantities are available, apparent power is approximated for each hourly interval as follows:

$$S = \frac{P}{PF} \quad (\text{EQ 1})$$

Where: S = average hourly apparent power (kVA).

P = average hourly real power (kW).

PF = power factor value from Table 1.

- 2) When both real (kW) and reactive (kVAR) power quantities are provided, apparent power is calculated for each hourly interval as follows:

$$S = \sqrt{P^2 + Q^2}^* \quad (\text{EQ 2})$$

Where: S = average hourly apparent power (kVA).

P = average hourly real power (kW).

$Q =$ average hourly reactive power (kVAR).

* S values are assessed using P and Q from the same hourly intervals.

After repeating the calculations above for each hourly interval, the maximum value of S (kVA) during the whole recording period is used as S_i for determining customer emission limits.

Billing History

Where it is not possible or practicable to determine the customer's maximum apparent power using smart metering data, then the installation's peak billing demand over the previous one-year period shall be used, or the maximum period available if the customer has been operating less than one year.

Billing peak demand can be obtained from billing information available in AHR, or from BC Hydro's GIS software. A customer's apparent power demand is assessed as follows for each billing period:

$$S = \frac{P}{PF} \quad (\text{EQ } 3)$$

Where: $S =$ maximum demand apparent power (kVA).

$P =$ maximum demand real power (kW).

$PF =$ power factor value (from bill or Table 1).

After repeating the calculations above for each billing period, the maximum value of S (kVA) during the whole assessment period is used as S_i for determining customer emission limits.

Portable Metering Data

In the rare case when historical smart metering data and billing data is not available, temporary power quality meters may be used to record power consumption during a period of the customer's normal operation lasting at least one full week.

The maximum recorded average hourly apparent power (kVA) during the whole recording period is used as S_i for determining customer emission limits.

New or Expansion Customers

When a customer requests a new connection or an update to their previously agreed maximum load, then power measurement is not an option for assessment of the customer's apparent power. Customer stated apparent power must then be used for assessment as discussed below.

Electric Service Agreements (ESA or ESI)

Customer ESA (MV network) or ESI (LV network) stated apparent power is used to assess their emission limits.

Since customer stated apparent power can vary significantly from actual apparent power, BC Hydro will provide two examples of emission limits:

- 1) Emission limits assessed at 50% of the customer's stated apparent power.
- 2) Emission limits assessed at 100% of the customer's stated apparent power.

Note that customer emission limits, when they are being checked for compliance, are assessed using the customer's actual maximum apparent power (kVA). The customer must be informed of this when potential emission limits are communicated.