

<h1>Tech Notes</h1>	Document:	TN – GENL – 2- APQ	
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	Page:	1 of 1	

PCC, TDD, and THD

PCC = Point of Common Coupling (or Point of Common Connection)

The PCC is a point in the electrical system where multiple customers or multiple electrical loads may be connected. According to IEEE-519, this should be a point which is accessible to both the utility and the customer for direct measurement. Although in many cases the PCC is considered at the metering point, service entrance or facility transformer, IEEE-519 states that “within an industrial plant, the PCC is the point between the non-linear load and other loads.”

PCC at service entrance, metering point or facility transformer

It will generally be easier to meet harmonic distortion limits when the PCC is considered at the metering point, facility transformer or service entrance. In most cases, the current flowing at this point represents a combination of pure fundamental current flowing to linear loads and both fundamental and distorted current flowing to non-linear loads. The distortion current will often be a smaller percentage of the total (combined) fundamental current at this point.

PCC within the plant and between the non-linear and linear loads

Considering the PCC at the equipment will often meet the IEEE-limits both at this point and also at a PCC near the service entrance. The IEEE-519 limit at this point, which is essentially at the input to the non-linear loads, is often 12%, 15% or even 20% THD-I. The ratio of short circuit current to load current is typically much larger at this PCC, which typically has less total load, than at the metering point, where the entire plant load is connected. Usually, if the THD limit is met at each non-linear load within the plant, the TDD limits at the service entrance will also be met. Even though the THD limits are typically lower for the PCC considered near the utility metering point, the overall THD at this PCC may be considerably lower if there are additional linear loads in the plant that share the power source.

THD = Total Harmonic Distortion

The ratio of the root-mean-square of the harmonic (voltage or current) content to the root-mean-square of the fundamental quantity, expressed as a percent of fundamental. THD typically refers to instantaneous measurement of harmonic distortion at an individual piece of equipment or group of loads, based on the actual fundamental current that is flowing during the measurement. THD is the typical measurement made with handheld harmonic analyzing equipment which takes a snapshot of the system power quality.

$$THD = \sqrt{\frac{\text{sum of squares of amplitudes of all harmonics}}{\text{square of amplitude of fundamental}}} \cdot 100\%$$

For calculation of THD related to individual pieces of equipment such as variable frequency drives (VFD), prior to installing equipment, the fundamental current can be determined by the motor nameplate data.

TDD = Total Demand Distortion

The total root-sum-square harmonic current distortion, in percent of the maximum demand load current (15 or 30 minute demand).

$$TDD = \sqrt{\frac{\text{sum of squares of amplitudes of all harmonics}}{\text{square of maximum demand load current}}} \cdot 100\%$$

When the point of common coupling (PCC) is considered at the service entrance or utility metering point, IEEE-519 recommends that the maximum demand load current (I_L) be calculated as the average current of the maximum demand for the preceding 12 months. To calculate TDD for new construction, prior to installation of equipment, one may use good engineering judgments to estimate the expected maximum demand load current. A conservative approach is to use the summation of the FLA ratings of all motors and other loads as the maximum demand load current.