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IEEE Recommended Practice for Monitoring Electric Power Quality

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IEEE-SA Standards Board

Abstract: This recommended practice encompasses the monitoring of electrical characteristics of single-phase and polyphase ac power systems. It includes consistent descriptions of conducted electromagnetic phenomena occurring on power systems. This recommended practice describes nominal conditions and deviations from these nominal conditions that may originate within the source of supply or load equipment or may originate from interactions between the source and the load. Also, this recommended practice discusses power quality monitoring devices, application techniques, and the interpretation of monitoring results.
Keywords: assessment, compatibility, dip, distortion, electromagnetic phenomena, harmonics, imbalance, instruments, monitoring, power quality, rms variation, sag, swell, transient, unbalance

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Figure 20 reprinted with permission from Dranetz-IBM [B6].

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Introduction

This introduction is not part of IEEE Std 1159-2009, IEEE Recommended Practice for Monitoring Electric Power Quality.

This recommended practice encompasses the monitoring of electrical quality of single-phase and polyphase ac power systems. It is important that all power quality monitors, as well as users of monitors and monitoring data, use consistent terminology and definitions of power quality phenomena. Therefore, this recommended practice provides consistent descriptions of electromagnetic phenomena occurring on power systems. It describes nominal conditions of the power supply and of deviations from these nominal conditions that may originate within the power supply or in the load equipment or may originate from interactions between the source and the load.

Monitoring and measurements can be utilized for power system performance studies as well as compatibility assessment. Brief, generic descriptions of load susceptibility to deviations from nominal power supply conditions are presented to identify which deviations may be of interest. Further, this recommended practice discusses the selection of appropriate measuring instruments, limitations of these instruments, application techniques, and the interpretation of monitoring results.

While there is no implied limitation on the voltage rating of the power system being monitored, signal inputs to monitoring instruments are generally limited to 1000 V ac root mean square (rms) or less. Instrument transformers and attenuators enable the use of monitoring equipment on a wide range of voltages and currents. Typically, the frequency ratings of the ac power systems being monitored are in the range of 45 Hz to 450 Hz. Some monitors can also acquire dc signals from the load or control system to assist in the interpretation of load response to deviations from the nominal. The interpretation of dc signals is beyond the scope of this recommended practice. It is also recognized that these instruments may perform monitoring functions for environmental conditions (e.g., temperature, humidity, high-frequency electromagnetic radiation); however, the scope of this recommended practice is limited to conducted electrical parameters derived from ac voltage or current measurements, or both.

The definitions presented and used in this recommended practice are intended solely for characterizing common electromagnetic phenomena to facilitate communication between various sectors of the power quality community. The definitions are not intended to represent performance standards or equipment tolerances. For example, electric power providers (e.g., electric utilities) may utilize different thresholds for undervoltage and overvoltage in the supply from the descriptions in Table 2. On the other hand, sensitive equipment may malfunction due to electromagnetic phenomena that lie within the thresholds of the Table 2 criteria.

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IEEE Recommended Practice for Monitoring Electric Power Quality

1. Overview

1.1 Scope

This recommended practice encompasses the monitoring of electrical characteristics of single-phase and polyphase ac power systems. It includes consistent descriptions of conducted electromagnetic phenomena occurring on power systems. This recommended practice presents definitions of nominal conditions and deviations from these nominal conditions that may originate within the source of supply or load equipment or may originate from interactions between the source and the load. Also, this recommended practice discusses measurement techniques, application techniques, and the interpretation of monitoring results.

1.2 Purpose

The use of equipment that causes and is susceptible to various electromagnetic phenomena has heightened the interest in power quality. An increase in operational problems has led to a variety of attempts to describe the phenomena. Because different segments of the technical community have used different terminologies to describe these electromagnetic events, this recommended practice provides users with a consistent set of terms and definitions for describing these events. An understanding of how power quality events impact the power system and end-use equipment is required in order to make monitoring useful. Proper measuring techniques are required to safely obtain useful, accurate data. Appropriate location of monitors, systematic studies, and interpretation of results will enhance the value of power quality monitoring. The purpose of this recommended practice is to assist users as well as equipment and software manufacturers and vendors by describing techniques for defining, measuring, quantifying, and interpreting electromagnetic disturbances on the power system.

2. Normative references

The following referenced documents are indispensable for the application of this recommended practice (i.e., they must be understood and used; therefore, each referenced document is cited in text and its relationship to this recommended practice is explained). For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments or corrigenda) applies.

No normative references apply to this recommended practice.

3. Definitions

For the purposes of this recommended practice, the following terms and definitions apply. *The Authoritative Dictionary of IEEE Standards Terms* [B18][1] should be referenced for terms not defined in this clause.

3.1 flicker: Impression of unsteadiness of visual sensation induced by a light stimulus whose luminance or spectral distribution fluctuates with time.

3.2 fundamental (component): The component of an order 1 (e.g., 50 Hz, 60 Hz) of the Fourier series of a periodic quantity.

3.3 imbalance (voltage or **current):** The ratio of the negative sequence component to the positive sequence component, usually expressed as a percentage. *Syn:* **unbalance (voltage** or **current)**

3.4 impulsive transient: A sudden nonpower frequency change in the steady-state condition of voltage or current that is unidirectional in polarity (primarily either positive or negative).

3.5 instantaneous: When used to quantify the duration of a short-duration root-mean-square (rms) variation as a modifier, refers to a time range from 0.5 cycles to 30 cycles of the power frequency.

3.6 interharmonic (component): A frequency component of a periodic quantity that is not an integer multiple of the frequency at which the supply system is operating (e.g., 50 Hz, 60 Hz).

3.7 long-duration root-mean-square (rms) variation: A variation of the rms value of the voltage or current from the nominal for a time greater than 1 min. The term is usually further described using a modifier indicating the magnitude of a voltage variation (e.g., undervoltage, overvoltage, voltage interruption).

3.8 momentary interruption: A type of short-duration root-mean-square (rms) voltage variation where the complete loss of voltage (<0.1 pu) on one or more phase conductors is for a time period between 0.5 cycles and 3 s.

3.9 root-mean-square (rms) variation: A term often used to express a variation in the rms value of a voltage or current measurement from the nominal. *See:* **sag**, **swell**, **momentary interruption**, **temporary interruption**, **sustained interruption**, **undervoltage**, **overvoltage**.

[1] The numbers in brackets correspond to the numbers of the bibliography in Annex C.