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Power Quality Coordination

Introduction

The use of electronic devices and digital equipment in both industrial and domestic applications has dramatically increased in recent years. These devices are both instigators and victims of power quality phenomena and the spread of their use has pushed Power Quality issues to the forefront of the power transmission and distribution concerns.

This course provides an introduction to all aspects of Power Quality (PQ) issues including mitigation strategies. It introduces the audience to PQ definitions, limitations, applicable standards as well as techniques used for PQ analysis of Power Systems. Various kinds of PQ problems such as voltage sags, interruptions, transients, flickers and harmonics and their effect on the load/system equipment are examined.

The course is designed to help attendees to understand causes, effects and means of addressing different power quality problems. It introduces them to methods of modeling and simulation of power systems for PQ study purposes. These methods are demonstrated using case studies of actual power quality problems.

What you will learn

This PQ tutorial introduces a practical approach to maintain electromagnetic compatibility (EMC) between equipment as described in IEC standards for disturbances below 9 kHz. Addressed issues include PQ environment, emission, equipment immunities, disturbance origins, disturbance predictions and assessments.

Audience

This tutorial has been developed for a wide range of practitioners from industrial and utility electrical engineers responsible to design the power system.

Supplied material

This tutorial includes 170 pages of technical notes complemented with 83 pages of Power Point presentations.

Course Outline

- Basic concept of compatibility
  - Definition of terms used in the standards
  - Basic concept of compatibility

- Introduction to low-frequency disturbance phenomena
  - Harmonics;
  - Inter-harmonics;
  - Voltage fluctuations;
  - Voltage dips and short supply interruptions
  - Voltage unbalance;
  - Power frequency variation;
  - D.C. Components.

- Compatibility levels:
  - Voltage fluctuations and flicker;
  - Harmonics;
  - Inter-harmonics;
  - Voltage distortions above the 50^{th} harmonic;
  - Voltage dips and short supply interruptions
  - Voltage unbalance;
  - Transient over-voltages;
  - Power frequency variation;
  - D.C. Components.

- Emission levels in the power system of industrial plants :
  - Harmonics;
  - Inter-harmonics;
  - Voltage unbalance;
  - Voltage changes;
  - Voltage dips.

- Limits of voltage changes, voltage fluctuations and flicker :
  - Assessment of a relative voltage change;
  - Assessment of the short-term flicker value (PST);
    - Introduction to the flicker-meter
    - Simulation method
    - Analytical method
  - Assessment of long-term flicker value (PLT)
  - Limits.

- Limits of voltage harmonic emission :
    - Assessment of emission levels;
        - Assessment of harmonic injection from distorting loads
        - Assessment of harmonic impedance
    - Summation laws;
    - Stages of distorting loads connection approval
    - Limits.

- Introduction to immunity standards:
    - Electrostatics discharge;
    - Radiated, Radio-Frequency, Electromagnetic field;
    - Fast transient/burst disturbances;
    - Surge disturbances;
    - Power frequency magnetic field disturbance;
    - Voltage dips, short interruption and voltage variations;
    - Oscillatory waves transient disturbances;
    - Voltage fluctuation disturbance;
    - Common mode disturbances;
    - Ripple on DC input port;
    - Voltage unbalance;
    - Frequency variation.

INSTRUCTOR

Roger Bergeron, ing.

After graduating with a B.SC. Degree in Electrical Engineering from Sherbrooke University in 1974, he spent the next five years building up his knowledge and acquiring experience in private corporations such as Québec Iron and Titanium, where he was involved in technical studies related to 600-V and 13.2-kV industrial power distribution system. In 1980, he joined the technical division of the operation department of Hydro-Québec's Maisonneuve Region and carried out many power-flow, short-circuit, harmonic and flicker studies involving digital simulation. Since 1982, he was working for the Electrical Apparatus Department of IREQ. In the scope of his activities there, he led many research programs involving worker safety, power quality and power system design. He is also the convener of CSA 577.4 on EMC low voltage compatibility for Canadian Standard and being the convener of IEC77A WG1 TF2 on harmonic measurement standard from 1999 to 2007 (IEC 61000-4-7).