Power Quality in Electrical Systems
Course Outline

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## Overview

<table>
<thead>
<tr>
<th>COURSE:</th>
<th>Power Quality in Electrical Systems</th>
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</thead>
<tbody>
<tr>
<td>SPEAKERS:</td>
<td>Alexander Kusko, Sc.D., P.E., Exponent, Natick MA and Marc Thompson, Ph.D., Exponent, Natick MA and Worcester Polytechnic Institute, Worcester MA</td>
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<tr>
<td>DATE:</td>
<td>Tuesdays, 6-8 PM; April 5, 12 and 26</td>
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<tr>
<td>LOCATION:</td>
<td>Lexington Sheraton Inn, 727 Marrett Rd., Lexington, MA</td>
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Class #1 - Hour #1 (4/5/05, MT)
Introduction to Power Quality

• Definition of power quality
  – Sag, swell, transients, harmonics, flicker, voltage imbalance, frequency deviation, etc.

• Examples of poor power quality
  – Voltage distortion
  – Capacitor failures
  – Flicker
  – High frequency conducted and radiated EMI

• Sources of poor power quality
  – Non-linear loads, arcing devices, load switching, motor startup, etc.

• Relevant standards
  – IEEE Std. 519 and 1159
Class #1 - Hour #2 (4/5/05, AK)
Introduction to Voltage Distortion

• Voltage distortion
  – Definitions - sag, harmonic
  – Causes - utility, lighting, harmonic currents, nonlinear loads, commutation

• Harmonics
  – Definition
  – Fourier analysis
Class #2 - Hour #1 (4/12/05, MT)
Harmonic Current Sources

- Single-phase rectifiers
  - Inductor filter
  - Capacitor filter
- Three-phase rectifiers
  - Inductor filter
  - Harmonics
- Switching converters
Harmonic Current Effects

- IEEE 519
  - Current paths
  - Harmonic voltage
- Resonance
  - Frequency
  - Capacitor failure
  - Voltage distortion
Class #3 - Hour #1 (4/26/05, AK)  
Correction for Power Quality

- Harmonic currents
  - Power factor correction
  - Filters --- differential and common-mode
  - 12-pulse rectifiers

- Voltage distortion
  - UPS/E. Gen
  - Surge suppressors
  - CV transformers
Class #3 - Hour #2 (4/26/05, MT)
Power Quality Measurements

• Quantitative
  – Harmonic voltages
  – Harmonic currents

• Commercial equipment
  – Dranetz, Hioki, AEMC
  – LISNs