



EE172

Power System Harmonics Analysis, Mitigation & Solution Strategies

Course Introduction:

Power must be supplied that allows loads to operate effectively, regardless the size of the electrical system. Power disturbances often cross the meter boundary between electrical utility and user causing motor overheating, transformer failure, nuisance tripping, data corruption, light flickering and voltage sags and swells. More equipment is in use today than ever before that is sensitive to power quality problems: VFDs, PLCs, computers, electronic ballasts, data processing and medical equipment. These same loads are often the source of power quality problems. The ability to quickly identify, analyze and remedy power quality problems will help ensure metering accuracy, lengthen the life of electrical equipment and improve power system availability.

This course combines extensive field measurement and study experience to familiarize attendees with the terminology and concepts to evaluate power quality. The effects of harmonics on various power system components and methods of reducing excessive harmonics will also be addressed.

Course Objectives:

Upon successful completion of this course, the delegates will be able to:

- Apply and gain an in-depth knowledge on power system harmonics analysis including harmonics sources, impacts, measurements, mitigation and solution strategies
- Distinguish harmonics and power quality and demand for clear power
- Identify the harmonic distortion sources in industrial power systems and explain voltage disturbances
- Discuss the harmonics effects, common symptoms and the negative consequences
- Illustrate equipment grounding and power quality and define resilience, reliability and redundancy
- Develop solution strategy for harmonics and power quality
- Apply power filter topologies and identify harmonic reduction, mitigation and attenuation options
- Practice general passive and active filter design procedures
- Implement harmonics and power quality assessment, measurements and standards
- Use corrective actions and design solutions as well as the reactive energy compensation
- Apply investment analysis for PQ solutions and discuss tips, application considerations and design examples

Who Should Attend?

This course is designed for electric power utility engineers, power quality engineers, power system engineers, electrical inspection engineers, instrumentation and control engineers, planners, construction and project managers, consulting engineers, electrical technicians and other technical staff involved in power system harmonics and quality.

Course Outline:

Day 1:

Welcome & Introduction

Pre-test

- **Introduction to Harmonics and Power Quality and Demand for Clean Power**
 - Definitions and Concepts
 - Harmonics Analysis
 - Mathematical Representation
 - Important Terminology
 - Harmonic Distortion
 - Harmonic Frequencies
 - Harmonic Distortion Standards
- **Harmonic Distortion Sources in Industrial Power Systems Non-Linear Loads**
 - Non-Linear Loads
 - Electronic Variable Speed Drives
 - UPS
- **Voltage Disturbances**
 - Introduction to Unbalance
 - Predictive Maintenance
 - The Key to Power Quality
 - Voltage Dip Mitigation
 - Standard EN50160
 - Voltage Sags in Continuous Processes

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Day 2:

- **Harmonics Effects, Common Symptoms and Negative Consequences Harmonics – Why Worry?**
 - Effects of Harmonics on Electrical Equipment
 - Effects of Short Circuit Ratio on Harmonics
 - The Basics of Harmonic Resonance
 - The Cost of Harmonics and Poor Power Quality
 - Understanding Compatibility Levels
 - Interharmonics
 - Capacitors in Harmonic – Rich Environments
 - True RMS – The Only True Measurement
 - Passive Filters
 - Active Harmonic Conditioners

- Neutral Sizing in Harmonic Rich Installations
- **Equipment Grounding and Power Quality**
 - Earthing & EMC
 - A Systems Approach to Earthing
 - Earthing Systems
 - Fundamentals of Calculation and Design
 - Earthing Systems – Basic Constructional Aspects

Day 3:

- **Resilience, Reliability and Redundancy**
 - Improving Reliability
 - Resilient and Reliable Power System
- **Managing and Solution Strategy for Harmonics and Power Quality**
- **Power Filter Topologies**

Day 4:

- **Harmonic Reduction, Mitigation and Attenuation Options**
 - Chokes (AC Line or DC Link)
 - Passive Filters
 - Harmonic Trap
 - Hybrid Filters
 - High Pulse Count Rectification
 - Active Filters and Drive Front End
- **General Passive and Active Filter Design Procedures**
- **Harmonics and Power Quality Assessment, Measurements and Standards**

Day 5:

- **Corrective Actions and Design Solutions**
- **Reactive Energy Compensation**
- **Investment Analysis for PQ Solutions**
- **Tips, Application Considerations and Design Examples**

Post-Test

Presentation of Certificates

Course Certificate:

International Center for Training & Development (ICTD) will award an internationally recognized certificate(s) for each delegate on completion of training.

Course Methodology:

A variety of methodologies will be used during the course that includes:

- (30%) Based on Case Studies
- (30%) Techniques
- (30%) Role Play
- (10%) Concepts
- Pre-test and Post-test
- Variety of Learning Methods
- Lectures
- Case Studies and Self Questionnaires
- Group Work
- Discussion
- Presentation

Course Fees:

To be advised as per course locations. This rate includes participant's manual, and-Outs, buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

Course Timings:

Daily Course Timings:

08:00 - 08:20	Morning Coffee / Tea
08:20 - 10:00	First Session
10:00 - 10:20	Coffee / Tea / Snacks
10:20 - 12:20	Second Session
12:20 - 13:30	Lunch Break & Prayer Break
13:30 - 15:00	Last Session