

## COURSE DESCRIPTION

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# Power Quality – Identification, Causation and Mitigation

## Overview

This 3-day course begins with a focus toward power quality theory that will lead to the identification, causation and **mitigation** of PQ issues in a facility. You will first gain an understanding of power systems, then move on to PQ basics. The terminology and theories will be covered to lay the ground work for the application of those theories, for PQ event identification within a facility. Once those have been discussed, the 3rd day will focus on the mitigation of the issues discovered and discussed, prior. The instructor will utilize various training methodologies to communicate the PQ topics. A best practices list will be developed as well.

## Duration

3 Days (Tu-Th, 8am-4pm). *Please book departing flights for 6pm or later on the last day of class.*

## Who should attend

Anyone responsible for the power monitoring system in a facility from an engineering and analysis or reliability and uptime standpoint.

## Prerequisites

- ❑ Basic computer skills and experience with Microsoft Windows
- ❑ Basic metering terminology
- ❑ Experience with PME or other Power Monitoring software
- ❑ Electrical Engineering background or Power system experience
- ❑ Watch PQ videos on Karl's Corner ([http://www.pmutraining.com/pmutv.cfm?tv\\_id=1](http://www.pmutraining.com/pmutv.cfm?tv_id=1))

## Students will be able to

- Understand Power systems – “The Big Picture”
- Understand PQ basics
- Diagnose where PQ problems originate from
- Understand commonly used PQ terminology
- Understand current PQ standards
- View waveforms that represent PQ issues and understand **and practice** the process for analyzing such waveforms (local facility software can be used if PQ capability in software is available)
- Understand how PQ and reliability are connected
- Understand and explain about harmonics; what they are; where they come from; and the impact they have on equipment
- View harmonics and understand the thought process for analyzing such charts (local facility software can be used if harmonic capability in software is available)
- Understand and explain PQ fundamentals; how it works in specific equipment (VFDs, lighting, motors, process control equip, standby power generators, telecom, transformers, etc.)
- Understand and explain methods of mitigating power and PQ issues. Poor PF, harmonics, Flicker and voltage regulation.

## Agenda

### Day 1

#### Course Introduction

- Student and Instructor introductions and overview of course logistics
- Overview of course topics and agenda

#### Introduction to PQ

- Big Picture for generation, distribution, end user and three phase systems
- Mathematics review

#### PQ Basics

- Review definitions and standards and how they apply.
- Identify the 7 categories of IEEE 1159-2009.

## Day 2

### Digital Meter Basics

- Sampling, Aliasing and Accuracy.

### Power Quality and PME

- Workflow of PQ event display and analysis in hardware AND software.

### Waveform analysis basics

- Laying the foundation for identification and causation.

### Hands on lab sessions (mixed throughout day 2)

- Attendees give a number of waveform events in the PME software
- Attendees work through the identification and causation process.

### “Mid-term” Evaluation

- Short quiz attendees will complete

## Day 3

### Mitigation

#### Power Factor correction for linear loads

- Fixed compensation
- Automatic compensation
- LV vs MV compensation

#### Power Factor correction of non-linear loads

- Harmonic
- Resonance
- Use de-tuned or filtered capacitor bank in harmonic rich network

## **Harmonic Mitigation**

- Review of technology
- Line reactor and DC bus choke
- Passive and broadband filters
- 12 & 18 pulse rectifier technology
- Active harmonic filtering options (Accusine)

## **Flicker**

- Review of Accusine PFV+
- Review of hybrid VAR Compensator

## **Voltage Transients**

- Introduction
- Installation guides and review solutions

## **Chronic Voltage issues (>+/- 10%)**

- Introduction to Sure-Volt solution

## **Deep Voltage Sags**

- Introduction to the Sag Fighter

## **Case studies**

- Use and discussion

## **Course Summary**

- Answer any remaining questions
- Outline available resources for education going forward