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# Power Quality, Harmonics Mitigation & Reactive Power Management

## INTRODUCTION

- This Power Quality, Harmonics Mitigation & Reactive Power Management training course provides an important insight into power quality issues including power harmonics, nonlinear loads, voltage symmetry, waveform analysis, and harmonics mitigation techniques.
- The ever increasing advancement of semiconductor-based power electronic devices and nonlinear loads, as well as rapid integration of non-conventional energy sources into grid networks can create harmful power quality issues in industrial systems and utility grids. To name a few, power electronic equipment, data servers, variable speed drivers, arc furnaces, big machines such as heavy-duty cranes, lifters, motor-driven conveyor belts, and large numbers of fluorescent lamps can cause catastrophic power quality issues in electrical power systems.
- Electric parameters such as frequency and voltage magnitude / waveform / symmetry are normally influenced by the variations of load during normal system operation. These characteristics are also affected by system disturbances - e.g. harmonic distortion and voltage fluctuations - generated by certain equipment, and also by electric faults such as arc flash or switching transient overvoltages.
- Voltage and frequency fluctuations as well as waveform distortion and power harmonics are major power quality problems. Therefore, continuous monitoring, detection, and recording of power quality indicators is required to ensure a safe, reliable, and cost-effective power network.

This training seminar on Power Quality, Harmonics Mitigation & Reactive Power Management will highlight:

- Power Quality (PQ) Major Concepts
- Power System Disturbances Due to PQ Issues
- Power System Voltage Reliability and Security
- Power Harmonics and the Associated Harmful Effects on Power Systems
- Uninterrupted Power Supply (UPS)
- Grounding Loops
- Harmonics Monitoring and Mitigation Techniques
- Surge Protection

## OBJECTIVES

At the end of this training seminar, you will learn to:

- Interpret and analyze power quality related incidents
- Explain how power quality issues can adversely affect power system reliability
- Explain harmonics mitigation techniques
- Discuss about grounding loops and bonding
- Discuss the criteria for harmonics filtering and mitigation

## TRAINING METHODOLOGY

- This Power Quality, Harmonics Mitigation & Reactive Power Management training course will be presented by means of Power Point slides through which all the required theory and equations will be provided. This training course also includes case studies where the participants are required to take part in class activities including system analysis, calculations, relay settings, etc. The instructor will also use training videos for better understanding of the participants. The participants will be progressively assessed during the course via quizzes, questions, assignments, and worked examples.

## ORGANISATIONAL IMPACT

On successful completion of this Power Quality, Harmonics Mitigation & Reactive Power Management, the organizational impact would be:

- Develop a structured approach and perception of power quality issues
- Ensure safe operation of electrical equipment and installations
- Become familiar with the destructive effects of power harmonics on electric networks
- Ensure sensible selection of surge protection devices
- Implement effective grounding and bonding
- Prevent unnecessary maintenance costs inflicted by power disturbances on electrical equipment

## PERSONAL IMPACT

- Participants from different sectors of engineering companies will enormously benefit from this training course because they will become quite familiar with:
  - An analytical approach to power quality
  - Voltage and frequency disturbances
  - Heavy-duty machinery and their effect on power quality
  - Voltage control and frequency control techniques
  - Reliable and secure power systems

## WHO SHOULD ATTEND?

- We encourage the staff involved in the operation, planning, design, and maintenance of power systems to attend this course. This training course is suitable to a wide range of professionals but will greatly benefit:
- Project Engineers / Managers
- Electrical Engineers / Technicians
- System Operators
- Design Engineers
- Asset Engineers / Managers
- Planning Engineers / Managers

## Course Outline

### Power Quality Overview

- Limitations of Electrical System Parameters
- Power Quality Definition
- Power Quality Assessment Measures
- Voltage Disturbance
- Frequency Disturbance
- Voltage Distortion
- Why we need to improve Power Quality?
- Power Factor
- Power Factor Compensation (PFC)
- Reactive Power Management

### Voltage Disturbances

- Voltage Sag
- Voltage Swell
- Voltage Flicker
- Voltage Fluctuations
- Voltage Abnormalities and Mitigation Techniques
- Electrical Noise
- Ground Loops
- Unbalanced Loads
- Voltage Asymmetry

### Power System Reliability

- Equipment Failure
- Power Interruptions
- Power System Reliability
- Power System Redundancy
- Power System Automation

## Power Harmonics

- Harmonics Definition and Components
- Linear vs. Nonlinear Loads
- Harmonics can cause Voltage Distortions
- Destructive Impacts of Harmonics on Power Systems
- Power System Tolerance to Harmonics
- Measurement of Power Harmonics Components
- Harmonics Control & Analysis
- Harmonic Filters
- Harmonics Mitigation Techniques

## Grounding Systems & Surge Protection

- Surge Definition and Causes
- Transient Overvoltages
- Power System Grounding Techniques
- Solidly Earthed
- Resistance Earthed
- Impedance Earthed
- Bonding of Grounding Systems
- Mitigation of Surges
- Surge Protection
- Lightning / Surge Arrestors

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