Training Title

POWER QUALITY, EARTHING & BONDING

Training Duration

5 days

Training Dates & Venue

REF EE036	Power Quality, Earthing & Bonding	5	23-27 September 2024	$6,500	Paris, France

Training will be held at any of the 4 or 5-star hotels. The exact venue will be informed once finalized.

Training Fees

- **$6,500 per participant for Public Training includes Materials/Handouts, tea/coffee breaks, refreshments & Lunch.**

Training Certificate

Define Management Consultancy & Training Certificate of course completion will be issued to all attendees.

TRAINING OVERVIEW

TRAINING DESCRIPTION

The increasing use of equipment sensitive to power system disturbances and the related economic aspects, the increasing awareness of power quality issues and deregulation have created a need for understanding the causes of these problems and the ways to solve. The course covers the Power quality issues, power frequency disturbances, electrical transients and earthing systems in electrical power systems. The course concerns the sources of distortion (loads) and the interaction between those and the propagation of the distortion in the power system. Effects on the power system are also indicated. Harmonics, its effects on electric power system and how to overcome are highlighted.

TRAINING OBJECTIVES

Upon the successful completion of this course, participants will understand and learn the following:-

- **Power Quality definitions and issues in electrical Power System.**
- **Voltage sag, voltage swing and power frequency disturbances**
- **Earthing methods, Bonding and static electricity affects on power quality**
- **Harmonics In Electrical Power Systems**
- **Power factor correction and Electromagnetic interferences and their consequences on power quality**

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- **Power quality improvement using Distributed Generators in distribution systems.**
- **Measuring and Solving Power Quality Problems**

WHO SHOULD ATTEND?

- **Electrical power generation systems and distribution engineers in utilities and industrial plants**
- **Managers of private electricity producers and large power consumers**
- **Substation engineers**
- **Consulting engineers**
- **Manufacturers of power equipment technicians and technologists**
- **Other technical personnel involved in the design, operation and maintenance of high/medium voltage substations**
- **Operations technicians**
- **Electrical maintenance technicians and supervisors**

TRAINING METHODOLOGY

A highly interactive combination of lectures and discussion sessions will be managed to maximize the amount and quality of information and knowledge transfer. The sessions will start by raising the most relevant questions, and motivate everybody find the right answers. The delegates will also be encouraged to raise their own questions and to share in the development of the right answers using their own analysis and experiences.

- **30% Lectures**
- **30% Workshops and work presentation**
- **20% Group Work& Practical Exercises**
- **20% Videos& General Discussions**

DAILY OUTLINE

1. Introduction to Power Quality

1.1. Definition of Power Quality
1.2. Power Quality Progression
1.3. Power Quality Terminology
1.4. Power Quality Issues
1.5. Susceptibility Criteria
1.6. Responsibilities of the Suppliers and Users of Electrical Power
1.7. Power Quality Standards

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2. Power Frequency Disturbance
   - 2.1. Common Power Frequency Disturbances
     - 2.1.1. Voltage Sags
   - 2.2. Cures for Low-Frequency Disturbances
     - 2.2.1. Isolation Transformers
     - 2.2.2. Voltage Regulators
     - 2.2.3. Static Uninterruptible Power Source Systems
     - 2.2.4. Rotary Uninterruptible Power Source Units
   - 2.3. Voltage Tolerance Criteria

3. Electrical Transients
   - 3.1. Transient System Model
   - 3.2. Examples of Transient Models and Their Response
   - 3.3. Power System Transient Model
   - 3.4. Types and Causes of Transients
   - 3.5. Examples of Transient Waveforms (Motor Start, Capacitor Switching, Voltage Notch, Neutral Voltage Swing, Sudden Application of Voltage, Self-Produced Transients)

4. Harmonics
   - 4.1. Definition of Harmonics
   - 4.2. Harmonic Number
   - 4.3. Odd and Even Order Harmonics
   - 4.4. Harmonic Phase Rotation and Phase Angle Relationship
   - 4.5. Causes of Voltage and Current Harmonics
   - 4.6. Individual and Total Harmonic Distortion
   - 4.7. Harmonic Signatures (Fluorescent Lighting, Adjustable Speed Drives, Personal Computer and Monitor)
   - 4.8. Effect of Harmonics on Power System Devices (Transformers, AC Motors, Capacitor Banks, Cables, Bus ways, Protective Devices)
   - 4.9. Guidelines for Harmonic Voltage and Current Limitation
   - 4.10. Harmonic Current Mitigation(Equipment Design, Harmonic Current Cancellation, Harmonic Filters)

5. Grounding and Bonding
   - 5.1. Shock and Fire Hazards
   - 5.2. National Electrical Code Grounding Requirements
   - 5.3. Essentials of a Grounded System
   - 5.4. Ground Electrodes
   - 5.5. Earth Resistance Tests
   - 5.6. Earth–Ground Grid Systems (Ground Rods, Plates, Ground Ring)

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- 5.7. Power Ground System
- 5.8. Signal Reference Ground
- 5.9. Signal Reference Ground Methods
- 5.10. Single-Point and Multipoint Grounding
- 5.11. Ground Loops
- 5.12. Electrochemical Reactions Due to Ground Grids
- 5.13. Examples of Grounding Anomalies or Problems

6. Power Factor

- 6.1. Active and Reactive Power
- 6.2. Displacement and True Power Factor
- 6.3. Power Factor Improvement
- 6.4. Power Factor Correction
- 6.5. Power Factor Penalty
- 6.6. Other Advantages of Power Factor Correction
- 6.7. Voltage Rise Due to Capacitance
- 6.8. Application of Synchronous Condensers
- 6.9. Static VAR Compensators

7. Electromagnetic Interference

- 7.1. Frequency Classification
- 7.2. Electrical Fields
- 7.3. Magnetic Fields
- 7.4. Electromagnetic Interference Terminology (Decibel (dB), Radiated Emission, Conducted Emission, Attenuation, Common Mode Rejection Ratio, Noise, Common Mode Noise, Transverse Mode Noise, Bandwidth, Filter, Shielding)
- 7.5. Power Frequency Fields
- 7.6. High-Frequency Interference
- 7.7. Electromagnetic Interference Susceptibility
- 7.8. EMI Mitigation
- 7.9. Cable Shielding to Minimize Electromagnetic Interference
- 7.10. Health Concerns of Electromagnetic Interference

8. Static Electricity

- 8.1. Tribo-electricity
- 8.2. Static Voltage Buildup Criteria
- 8.3. Static Model
- 8.4. Static Control
- 8.5. Static Control Floors
- 8.6. Humidity Control
- 8.7. Ion Compensation

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8.8. Static-Preventative Casters
8.9. Static Floor Requirements
8.10. Measurement of Static Voltages
8.11. Discharge of Static Potentials

9. Improvement Power Quality using Distributed Generators in Distribution Networks

10. Measuring and Solving Power Quality Problems

10.1. Power Quality Measurement Devices
10.1.1. Harmonic Analyzers
10.1.2. Transient-Disturbance Analyzers
10.1.3. Oscilloscopes
10.1.4. Data Loggers and Chart Recorders
10.1.5. True RMS Meters
10.2. Power Quality Measurements
10.3. Number of Test Locations
10.4. Test Duration
10.5. Instrument Setup
10.6. Instrument Setup Guidelines

NOTE:
Pre & Post Tests will be conducted
Case Studies, Group Exercises, Group Discussions, Last Day Review & Assessments will be carried out.

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