



ELECTRICAL POWER

Systems Quality & Troubleshooting

Course Introduction:

Power quality determines the fitness of Electrical Power to consumer devices. Synchronization of the voltage frequency and phase allows electrical systems to function in their intended manner without significant loss of performance or life. The term is used to describe electric power that drives an electrical load and the load's ability to function properly.

Without the proper power, an electrical device (or load) may malfunction, fail prematurely or not operate at all. There are many ways in which electric power can be of poor quality and many more causes of such poor quality power.

The electric power industry comprises electricity generation (AC power), electric power transmission and ultimately electricity distribution to an electricity meter located at the premises of the end user of the electric power. The electricity then moves through the wiring system of the end user until it reaches the load. The complexity of the system to move electric energy from the point of production to the point of consumption combined with variations in weather, generation, demand and other factors provide many opportunities for the quality of supply to be compromised.

The primary function of the power quality standards is to define and set limits for normal operation, and to define the terminology used to describe PQ disturbances. The survey is a methodical systematic investigative process used to successfully resolve power quality concerns. The process is effective, but very meticulous and requires a disciplined and up-front effort at the start during the information gathering stage for successful PQ enhancement.

Course Objectives:

Delegates will gain a detailed appreciation of the following:

- Alternative forms of generation and embedded generation - carbon emission limiting, etc.
- Power flow optimization for 'real power' and use of a of FACTS devices to improve system operation, including DSM approach
- New CT and VT optical transducers and protection system using micro processor relays
- Non linear loads and injected Harmonics, at the PCC (point of common coupling)
- Diagnostic monitoring of plant and in particular GIS substations
- High speed fault limiters and thermal monitoring systems for cables

Who Should Attend?

This course is intended for Designers, Engineers, and Technicians. Professionals involved with the planning, operation and maintenance of small to large scale power networks, from around 11kV, upwards. Professionals from the Distribution Companies, Power Utilities, Engineering Professionals

in the Electricity Supply Industry and Petrochemical Companies who have to deal with aspects of generation, transmission and distribution should be interested in learning how to handle increased demand, how to drive the system harder, but safely, and with increased reliability, security and monitoring.

Course Outline:

Module (01) Power Quality Problems

- 1.1 Importance of Power Quality (PQ)
- 1.2 Voltage Unbalance
- 1.3 Frequency Variations
- 1.4 Voltage Fluctuations
- 1.5 Short /Long Duration Voltage Variation
- 1.6 Transients
- 1.7 Waveform Distortions

Module (02) Power Quality in Electrical Power Supply

- 2.1 Role of Capacitors in Quality Control
- 2.2 Factors Affecting Quality
- 2.3 Transient Switching
- 2.4 Steady State Variations
- 2.5 Effect of Under Voltage on Loads
- 2.6 Prescribed Limits for Voltage Regulation
- 2.7 Harmonic (Generation and Harmful Effect)
- 2.8 Radio Frequency Interference
- 2.9 Electromagnetic Interference
- 2.10 Telephone Interference
- 2.11 The Remedies-Against Flickers
- 2.12 Neutral Grounding System

Module (03) Cost of PQ Justification for Capital Costs

- 3.1 Interruptions and Outages
- 3.2 Duration of an Outage
- 3.3 Causes for Unplanned Failure of Power Systems
- 3.4 Remedial Measures
- 3.5 Basis for Outage Costs
- 3.6 Methods of Calculating Losses
- 3.7 Cost Element
- 3.8 Harmonics (Surveying, Indices & Mitigation)
- 3.9 Consumer Side
- 3.10 Costing of Harmonics

Module (04) Loads Power Factors Correction for PQ

- 8.1 Power Factor Fundamentals
- 8.2 PF dependence on Currents & Powers Components
- 8.3 Causes of Low Power Factors
- 8.4 Unfavorable Effects of Loads Low Power Factors
- 8.5 Power Factor Correction
- 8.6 Techniques for Power Factor Compensation
- 8.7 Individual Compensation
- 8.8 Group Compensation & Central Compensation
- 8.9 Compensation by Static VAR Compensators
- 8.10 Available Capacitor Sizes and Specification Items
- 8.11 Harmonics Consideration
- 8.12 Power Factor Influences on Power Quality
- 8.13 Case Studies

Module (05) Distribution System Reliability

- 5.1 Introduction to System Reliability
- 5.2 What Does Reliability Mean to Customers?
- 5.3 Does Reliability Mean To The Utility ?
- 5.4 What Does Reliability Mean to Distribution Planners?
- 5.5 Reliability Concepts , Principles And Mathematics
- 5.6 Practical Approach For P. S Reliability Studies

Module (06) Detection and Recording of PQ Events

- 6.1 Power Quality Voltage Variation Event Definitions
- 6.2 Voltage Variation Detection And Recording
- 6.3 Feeder Relay Functions That Can Be Used For Power
- 6.4 Quality Event Detection
- 6.5 Disturbance Recorder
- 6.6 Use of Specialized Power Quality Monitoring
- 6.7 Power Quality Events Recording Functions
- 6.8 Impact Of Harmonics On Power Factor & Capacitors
- 6.9 Elimination Of Resonance
- 6.10 Harmonic Filters
- 6.11 Types Of Passive Filter Systems
- 6.12 Theory Of Reactor Based Harmonic Filters

Module (07) Recommended Practices for Utilities

- 7.1 Abnormal Conditions for Harmonic Problems
- 7.2 Voltage Distortion Limits
- 7.3 Limits of Interference with Communication Circuits

Module (08) Recommended Practices for Individuals

- 8.1 Development of Current Distortion Limits
- 8.2 Limits on Commutation Notches
- 8.3 Current Distortion Limits
- 8.4 Transformer Heating Considerations
- 8.5 Probabilistic Application of Harmonic Distortion Limits
- 8.6 Flicker and Limits of Flicker
- 8.7 Compensation for Flicker

Module (09) Evaluating New Harmonic Sources

- 9.1 Identifying Harmonic Analysis Objectives
- 9.2 Developing Initial System Model
- 9.3 Performing Harmonic Measurements
- 9.4 Performing Detailed Simulations
- 9.5 Developing Solutions to Harmonic Problems

Module (10) Complete System Restoration Exercises

- 10.1 Example of Large Industrial Plant Furnished at Transmission Voltage 115 kV
- 10.2 Example of Several Users on Single Distribution Feeder

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 Certificate:

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

Course Fees:

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

Course Timings:

Daily Course Timings:

08:30 - 08:50	Morning Coffee/Tea
08:50 - 10:20	First Session
10:20 - 10:40	Recess (Coffee/Tea/Snacks)
10:40 - 12:20	Second Session
12:20 - 12:40	Recess (Coffee/Tea/Snacks)
12:40 - 14:30	Last Session

