

# Applied Power Quality: Harmonics, Unbalance & Sags



A professional development course in power engineering presented by the Australian Power Quality and Reliability Centre, School of Electrical, Computer and Telecommunications Engineering, University of Wollongong.

## Course Objectives

The rapidly increasing installation of electronic equipment such as digital controls, computers and sensitive process control equipment has increased the susceptibility of utility customers to supply disturbances. In addition, the application of power electronic equipment with its higher energy efficiency and more effective control features has in turn often increased the level of disturbances that might affect customer equipment. Electricity supply businesses need to have an ongoing awareness of problems and solutions in the power quality area.

This course is an advanced course which builds on the introductory course, Quality of Electrical Supply, and is designed to expand the coverage of selected power quality topics in order to give participants practical skills in the analysis and mitigation of specific problems. The selected topics for this course are:

- Harmonics
- Voltage unbalance
- Voltage sags and interruptions
- Power electronic mitigation techniques
- Power quality monitoring and reporting

Following the course, participants will be able to:

- Calculate distortion levels, evaluate resonance problems, apply the standard AS/NZS 61000.3.6 and determine the effectiveness of mitigation methods.
- Apply symmetrical component theory to the calculation of unbalance factors, understand the effects of unbalance on various loads and appreciate the essentials of IEC 61000-3-13 Technical Report on voltage unbalance.
- Determine sag depth at a site depending on fault location or motor start characteristics.
- Assess candidates for sag mitigation and determine whether they should be applied within the plant or network.
- Understand how power electronic devices can be used to mitigate power quality problems.

- Learn a PQ monitoring methodology covering disturbances to be measured, how they should be characterised and reported, and their acceptable levels.

Participants will learn advanced analysis techniques and methods of improving power quality by both network and plant modifications. Course participants will have the opportunity to develop their knowledge and skills through discussion and laboratory sessions.

## Who Should Attend?

Utility specialists, consultants, engineers and senior technical staff who wish to advise customers on power quality concerns, or who service large customers or who wish to understand aspects of network design, construction and maintenance techniques for maximising quality of supply.

The course assumes the participants will have an understanding of phasor calculations, simultaneous equations and Fourier analysis.

## About the Speakers

**Professor Danny Sutanto** is Professor of Power Engineering in the School of Electrical, Computer and Telecommunications Engineering. His research interests include power electronic applications in industry and electrical transmission and distribution networks.

**Professor Sarath Perera** is Technical Director of the Australian Power Quality and Reliability Centre and teaches in the School of Electrical, Computer and Telecommunications Engineering. His research interests include power quality, EMC and power system simulation techniques.

**Dr Phil Ciufu** is a Senior Lecturer in the School of Electrical, Computer and Telecommunications Engineering. His areas of research include AC machine analysis and control, power system analysis, smart grids and distributed generation.

**Dr Vic Smith** is a Research Engineer with the Australian Power Quality and Reliability Centre at the University of Wollongong.

His research interests include investigation and modelling of power quality phenomena.

**Mr Sean Elphick** is a Professional Officer with the Australian Power Quality and Reliability Centre at the University of Wollongong. He is active in the areas of power quality monitoring and data analysis.

**Professor Robert Barr** is principal of Electric Power Consulting Pty Ltd and has dealt with a wide range of power quality and general electricity industry problems.

**Professor David Sweeting** is principal of Sweeting Consulting Services specialising in HV electrical distribution and power quality reviews for distributors and customers.

**Professor Peeter Muttik** is Chief Engineer Systems with AREVA T&D Australia Ltd and has wide experience in power systems analysis and design including substations and high power electronics.

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## Course Outline

### Day 1

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- **Harmonics:** Overview of harmonics and Fourier analysis, definitions, estimation of harmonic currents due to load types, effect of system impedance, modelling harmonic loads, resonance effects, standards including AS/NZS 61000.3.6, practical mitigation techniques.
  - **Voltage unbalance:** Sequence components, IEEE & IEC standard definitions of unbalance factor, load behaviour, IEC 61000-3-13 Technical Report.

### Day 2

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- **Power electronic mitigation techniques:** Application of power electronic systems to the mitigation of voltage problems in distribution systems.
  - **Voltage sags:** Application of symmetrical components to fault calculations, sag characterisation, sag aggregation, equipment susceptibility, assessing sag distribution, influence of network design, practical mitigation techniques.
  - **Power quality monitoring and reporting:** Monitoring imperatives, characterising events, instrumentation, benchmarking practices, site indices.

## Enquiries

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