TRAINING SEMINAR

Power System
Volt-VAr Optimisation (VVO)

Practical knowledge and technical expertise on Volt-VAr optimisation for efficient, stable and energy-efficient power system operation

Presented by **Dr Tuan Vu**
Volt-Var and Control Power Systems Consultants Pty Ltd

Introduction

As the energy landscape evolves with increasing integration of renewable energy sources and growing grid complexity, Volt-VAr Optimisation (VVO) has become a critical tool for ensuring efficient and stable power system operation. Effective management of voltage levels and reactive power can reduce system losses, improve voltage stability, lower peak demand, and enhance overall energy efficiency.

Seminar Overview

This comprehensive 3-day training course is designed to provide a thorough understanding of VVO principles, strategies, and advanced applications in modern power networks. Participants will explore both traditional Volt-VAr control methods and cutting-edge optimisation techniques that leverage automation, sensors, and intelligent control systems to achieve improved grid performance.

Through a combination of theoretical insights, practical case studies, and interactive discussions, this course will equip professionals with the technical knowledge and hands-on skills necessary to implement coordinated VVO strategies using capacitor banks, reactors, voltage regulators, STATCOMs, SVCs, and other advanced technologies.

Attendees will gain a good understanding of the technical, operational, and economic aspects of VVO, helping them to design and implement effective solutions tailored to their specific power system challenges. Whether you are working in utilities, renewable energy integration, power system planning, or grid automation, this course will provide valuable expertise to enhance your ability to optimise voltage and reactive power in modern power networks.

Seminar Presenter | Dr Tuan Vu

Dr. Tuan Vu

PhD, FIEAust, CPEng, RPEQ, APEC Engineer, IntPE(Aus)

Manager Power Systems / Principal Consultant

Volt-Var and Control Power Systems Consultants Pty Ltd

Dr. Tuan Vu is a highly experienced Power Systems Engineer with over 30 years of expertise in the electricity supply industry and energy consulting across Australia and internationally. His expertise spans high-voltage (HV) and extra-high-voltage (EHV) projects, generator and large load (including data centre) connections, power quality (harmonics), network planning, Renewable Energy Zones (REZs), system strength, voltage stability, reactive power control, wind, solar and battery energy storage system (BESS) integration, substation design, National Electricity Market (NEM) connections, power system studies, fault investigations, and FACTS technologies (SVCs and STATCOMs).

Dr. Vu has successfully led multidisciplinary teams in the delivery of high-voltage capital projects valued at over **AUD $300 million**. He is also an active representative of Standards Australia, contributing to IEC standards development and participating in several CIGRE Working Groups.

Learning Outcomes

By the end of this course, participants will be able to:

- Understand the fundamentals of Volt-VAr Optimisation (VVO), including the principles of voltage and reactive power control for efficient grid operation.
- Explore traditional and advanced VVO techniques, comparing conventional Volt-VAr control methods with modern, automated VVO solutions.
- Analyse the impact of VVO on system losses and efficiency, and understand how optimised voltage and reactive power control reduces energy losses and peak demand.
- Assess the role of VVO in integrating renewable energy, evaluating the challenges and benefits of VVO in a grid with high penetration of solar, wind, and battery storage.
- Design coordinated VVO control schemes, optimising capacitor banks, voltage regulators, reactors, STATCOMs, and SVCs for improved voltage stability.
- Understand the technical requirements for successful VVO implementation, including the role of SCADA, sensors, metering, automation, and communication infrastructure.
- Apply VVO strategies to real-world power systems through practical case studies on VVO implementation in distribution and transmission networks.
- Evaluate the financial and technical trade-offs of VVO deployment, including cost-benefit analysis, investment considerations, and risk management.

This course will equip participants with the knowledge and practical skills required to implement Volt-VAr Optimisation strategies effectively, ensuring improved voltage stability, reduced losses and enhanced grid efficiency.

Course Content

Day 1

Introduction	▪ Trends in electrical power systems ▪ Modern power systems – opportunities and challenges ▪ Traditional voltage control versus VVO ▪ What is VVO, and why is VVO recommended for modern power systems?
Volt-VAr Optimisation (VVO) Fundamentals	▪ Power flow equations, losses and voltage drop ▪ Power factor correction ▪ Harmonic currents and voltages ▪ Short circuit conditions ▪ Short circuit capacity / fault level, short circuit ratio (SCR) and effective short circuit ratio (ESCR) ▪ Voltage regulation and dynamic voltage control ▪ Voltage droop ▪ Tap changer instability ▪ Voltage stability, voltage collapse and voltage security ▪ Voltage control in distribution and transmission networks ▪ Generation, distribution, transmission networks and loads ▪ Reactive power compensation and control ▪ Static and dynamic characteristics of load components ▪ System strength ▪ Inertia ▪ Network Support and Control Ancillary Services (NSCAS) ▪ System response to power impacts ▪ Power plant response

Day 2

Voltage Control and Reactive Power Management	▪ Synchronous machines – generator P-Q capability curves ▪ Q-V curves for inverter-based resources (IBR), e.g. wind, solar and batteries ▪ On-load tap changer (OLTC) transformers ▪ Shunt capacitors and reactors ▪ FACTS devices (SVC and STATCOM) ▪ Voltage and reactive power control by IBR ▪ Grid-following inverters and phase-locked loops (PLL) ▪ Voltage changes, voltage fluctuation and flicker ▪ Power-electronic-based control system interactions ▪ Grid effects and resonances ▪ Harmonics and subharmonics ▪ Low-frequency oscillations (LFO) and sub-synchronous oscillations (SSO) ▪ Measurement equipment and sensors ▪ Positive sequence voltage regulation ▪ Negative sequence voltage control and load balancing ▪ Voltage profiles ▪ Over-voltages and under-voltages ▪ Improvement of steady-state stability and power transfer capacity ▪ Transient stability
Volt-VAr Control Equipment and Voltage Optimisation Control Schemes	▪ Volt-VAr control equipment ▪ Voltage and VAr control (VVC) ▪ Voltage optimisation (VO) ▪ Conservation Voltage Reduction (CVR) ▪ Transformer on-load tap changers (OLTCs) ▪ Line drop compensation for radial feeders ▪ LTC transformers and distribution voltage regulators ▪ System architecture – distributed versus centralised systems ▪ Controllable optimisation schemes: automatic voltage regulator (AVR), emergency voltage regulation (EVR), Q-optimisation, switchable shunts (capacitor banks and reactors), STATCOM and SVC ▪ VVO measurement and correction requirements: voltage measurements, power factor correction, voltage violation and correction

Day 3

Advanced DMS/EMS and Communication Infrastructure	▪ SCADA, monitoring and control requirements ▪ Communications infrastructure requirements
VVO Benefits and Challenges	▪ VVO benefits – power system performance and economic benefits ▪ VVO challenges – technical challenges ▪ Cost and implementation risks
System Integration, Testing, Deployment and Evaluation of VVO	▪ System integration ▪ Testing ▪ Deployment plan ▪ Life cycle management
VVO Use Cases	▪ Examination of VVO case studies
Relevant Guidelines and Standards for VVO	▪ Smart grid model and guidelines ▪ Framework for VVO in a distributed system ▪ Applicable standards and guidelines

Registration Fees and Details

Registration Contact	**Dr Tuan Vu** *Manager Power Systems / Principal Consultant* M: +61 407 372 483 E: admin@vvcpowersystems.com.au
Venue	Course to be conducted at Client's Office
Fees	$1,500 per person (minimum 10 participants), or $20,000 per course for 15 participants
Duration	3-day training seminar
Course Materials	Soft copies (PDF)

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