A 2-Day Professional Development Seminar on

Voltage and Reactive Power Control in Power Systems

- using SVC and STATCOM



Who Should Attend

This seminar is specially designed to meet the learning requirements of those who seek to understand or further advance their knowledge in the areas of SVC and STATCOM strategies, planning, specification, design, installation, commissioning, operation and maintenance. This training seminar will be beneficial to:

- **Asset Strategy Engineers and Managers**
- **Procurement Specialists and Managers**
- **Network Planning Engineers**
- **Design Engineers**
- **Field Engineers and Technicians**
- **Technical Officers**
- **Commissioning Engineers**
- **Construction and Project Managers**
- **Power System O&M Engineers**
- **Power System Consultants**

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Introduction

Voltage and Reactive Power Control play critical roles in the electricity networks at all voltage levels whether within industrial, distribution or transmission systems. Fast and dynamically controlled reactive power plants such as Static Var Compensator (SVC) and STATCOM are often employed to control voltages, increase power transfer capability, improve system stability and provide fast voltage response and reactive power support to the network during and post fault events. SVC and STATCOM are often used to provide dynamic Volt-VAr supports to transmission interconnectors, electrified traction loads, advanced Volt-VAr Optimisation (VVO) systems in distribution systems and renewable generation sources such as solar and wind.

SVCs and STATCOMS require significant investment in cost, time and a comprehensive knowledge to plan, specify, design, operate and maintain them efficiently. Understanding the advantages and disadvantages of SVC and STATCOM and how they should be specified and applied in different network scenarios is vital in the planning process. Knowing what should be included or not to be included in the specifications can save utilities significant time and cost. Having the competent knowledge to specify equipment and systems requirements for different applications and network scenarios will enable the Distribution and Transmission Network Operators (DSO and TSO) to optimise the investment cost, risk and performance of SVC and STATCOM.

Seminar Overview

This seminar is specifically designed to provide the fundamental knowledge and comprehensive understanding of SVC and STATCOM capabilities and their applications. It will assist Industry, DSO and TSO personnel with the application knowledge of SVC and STATCOM used in industrial, distribution and transmission systems.

The main focus of this seminar is to provide managers, engineers and technicians with the essential knowledge and practical approach to plan, specify, build, operate and maintain SVC and STATCOM suitable for their network requirements.

Seminar Presenter

Tuan Vu, *B.E (Elec. Hons), M.E (Systems), FIEAust, CPEng, RPEQ*

Tuan has over 21 years of experience in the electricity supply industry. He is currently an Asset Strategies Engineer at Powerlink Queensland and has extensive knowledge and practical experience in Voltage Control and Reactive Power Plants (SVC and STATCOM), SCADA and Automation Systems, and covering a wide range of disciplines including technical specification, design, contract and project management, construction, commissioning, investigation and training.

Tuan was the Technical Project Manager, Technical Superintendent Representative and SVC Subject Matter Expert for 16 SVC projects with total project budget in excess of $145M. He successfully led a number of major technical investigation tasks identifying the major contributing factors to a wide range of equipment and power system faults associated with SVCs and STATCOMs

Tuan Vu is a Fellow Member of the Institute of Engineers Australia, a Chartered Professional Engineer, a Registered Professional Engineer of Queensland and an International Professional Engineer, Australia. He holds a Bachelor of Electrical Engineering (Honours), Master of Systems Engineering – Specialised in Large and Complex Electrical Systems, and is currently undertaking PhD research in the field of Power System Harmonics and Power System Network Modelling.

Tuan is a member of Standards Australia committees and Joint Standards Australia/New Zealand committees, and a member of IEC TC 57 / WG 10 (Australian Delegate). He presented a number of papers on the subjects of SCADA, Automation Systems, Power Systems Harmonics, Voltage and Reactive Power Control and SVC projects at CIGRE and CIRED conferences. Tuan currently delivers training courses and provides consultant services to utilities and industrial customers.

Seminar Content

DAY 1

1. Voltage Control and Reactive Power Compensation in Power Systems

- Concepts of Voltage Control using SVC and STATCOM
- Power System Improvements with Reactive Power Control
- Voltage Regulation (Positive Sequence Voltage Control)
- Load Balancing (Negative Sequence Voltage Control)
- Power Factor Correction
- Steady State Power Transfer Capacity
- Voltage Stability and Transient Stability
- Power System Oscillation Damping (POD)
- FACTS Controllers and Applications

2. Placement, Sizing and Characteristics of SVC and STATCOM

- Consideration for Placement and Sizing
- Voltage -Current (V/I) Characteristics – SVC versus STATCOM
- Steady State and Dynamic V/I Characteristics
- Slope / Droop in V/I Characteristics
- Case Study – SVC is used to Prevent Voltage Instability
- Harmonics, DC Offset and Negative Phase Sequence

3. Configurations and Implications – SVC vs. STATCOM

- Typical and Common Configurations
- SVC Thyristor Controlled Reactor (TCR)
- SVC Thyristor Switched Capacitor (TSC)
- STATCOM IGBT Power Modules
- Losses
- Harmonic Performance

4. Main Components of SVC and STATCOM

- Primary Systems (HV Plant)
- Power Electronic Switching (Thyristor versus IGBT)
- Thyristor Valves (TCR and TSC) – Heart of SVC System
  - Manufacturing, Components and Performance
  - Thyristor Valve Losses and Valve Cooling
  - Thyristor Triggering and Monitoring
- IGBT Power Modules and DC Capacitors (STATCOM)
  - Two, Three and Multi-Level IGBT Modules
- Cooling Systems
- Hardware Examples
- Secondary Systems (Control and Protection Systems)
- Auxiliary Systems

5. Applications of SVC and STATCOM

- Integration of Renewable Sources - Solar, Wind and Battery
- Distributed, Centralised Topologies
- Advanced Volt-VAr Optimisation (VVO) Schemes
- Solutions to Power Quality Issues – Flicker, Sag, Unbalance and Power Factor
- Applications for Industrial Systems
- Applications for Distribution Systems
- Applications for Transmission Systems

DAY 2

6. Control, Protection and Monitoring Systems

- Typical Functions of Sequence Control
- Start-Up, Shutdown Sequence and Emergency Shutdown
- Control Modes - Automatic and Manual
  - Control Schemes:
  - Voltage Regulation
  - Voltage Droop / Slope
  - Negative Phase Sequence Balance
  - Power Oscillation Damping (POD) Control
  - Stability Control
  - Q-Optimisation Schemes
  - Under and Over Voltage Schemes
- Degraded Mode
- Conventional AC Protection schemes
- SVC and STATCOM Specific DC Protection schemes

7. Major Component Ratings

- Verification of Major Components' Ratings
- Harmonic Voltage and Current Stresses
- Practical Exercise – Verify SVC Components' Ratings

8. Project Overview

- Specifications
- Project Schedule - Key Tasks, Durations and Milestones
- Design Reports
- Construction and Equipment Installation
- Inspection and Test Plans (ITPs)
- Commissioning Process – FAT and SAT
- Pre-Energisation Tests, Factory Acceptance Tests
- Post Energisation Tests

9. SVC and STATCOM Specifications

- Scope of Works
- Particular Specifications
  - Primary Plant
  - Secondary Systems – Hardware and software
  - Auxiliary Systems
  - Noise and Electromagnetic Interference Specification
  - Systems Tests
  - Operation, Maintenance , Training and Technical Support
- General Engineering Requirements
- Administration, Documentation and Construction Management
- Technical Schedules
- Commercial Conditions
- Sample Specifications.

10. Asset Management – Operation, Maintenance and Refurbishment

- Training and Specialist Skills
- Operation and Maintenance Knowledge
- Fault Investigations – Catastrophic Failures
- Spares and Inventories
- Refurbishment Plan – Secondary and Primary Systems