

A 3-Day Professional Development Seminar on

PROTECTION OF HV & EHV TRANSMISSION SYSTEMS

Who Should Attend

Technical personnel who are involved in design, installation, operation and maintenance of protection system for HV & EHV transmission systems, such as

- ◇ Power System Consultants
- ◇ Power System O&M Engineers
- ◇ Power System Managers and Technical Officers
- ◇ Power System Protection Engineers
- ◇ Power System Planners
- ◇ Researchers

Organised By :



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Introduction

Protection of HV & EHV Electricity Transmission Systems is necessary to maximise safety for the public and electricity industry employees alike, to disconnect faulted plant from the system and to maintain quality of supply to customers. The modern trend is :

- ✦ To operate HV and EHV electricity transmission systems closer and closer to their limits of performance;
- ✦ Augmentation of the power system is often delayed whereby aging plant continues to service customers;
- ✦ Value engineered solutions are often implemented, to achieve the most cost effective provision of electricity supply to network participants.

Under these situations, the associated protection systems are required to meet the crucial requirements of being simultaneously coordinated, fast operating, secure and reliable. These requirements tend to be mutually exclusive, yet meeting them is fundamental to the National Electricity Rules (NER), which mandate the performance of protection systems to maintain power system stability and not restrain power flows within the transmission system network.

What You Will Learn From This Seminar?

This 3-day seminar focuses on meeting the National Electricity Rules (NER) via the implementation of unit and non-unit protection schemes to HV & EHV transmission systems.

Delegates will learn the principles of protection scheme selection, scheme configuration and the principles associated with the determination of relay settings. The difficulties associated with unique system configurations, such as mutually coupled and/or teed feeders, will also be explored.

Crucial Knowledge for :

- ◇ **Planning Engineers** to identify the protection implications associated with proposed schemes for augmentation of the power system.
- ◇ **Maintenance Engineers** to ensure that system protection is not compromised as plant is removed from service during maintenance.
- ◇ **Circuitry and Automation Design Engineers** to implement protection schemes which optimise power system performance.
- ◇ **Protection Application Engineers** to identify protection implications and to ensure design and setting principles meet the NER and provide the necessary levels of speed, security, reliability and safety.

Course Content

1 Differential Protection

1.1 High Impedance Differential Protection

- Basic principles
- Principles of relay setting determination
- Voltage and current relay based schemes
- Use of Ratio Correction CTs (RCCTs)
- Use of voltage limiting non linear shunt elements (Metrosils)
- Determination of primary operating current
- Application of Bus Zone Check schemes
- Back-up requirements
- Application of HZ schemes to other plant

1.2 Biased Differential Protection

- Effects of transformer turns ratio
- Effects of transformer phase shifts
- Effects of transformer zero sequence currents
- Determination of CT connections for older style relays
- Determination of relay configurations for microprocessor based relays
- Basic relay setting principles
- Biased differential protection of transformers including earthing transformers
- Biased differential protection of transformers with earthed delta windings

1.3 Application Of Biased Differential Schemes to Busbars

- Schemes types
- CT requirements
- Special features

1.4 Differential Protection of Feeders - Pilot Wire Schemes

- Application of summation transformers
- Application of pilot wire supervision
- Application of overcurrent and earth fault checking
- Application of unstabilising and intertripping

1.5 Differential Protection of Feeders - Current Differential Schemes

- Synchronisation of relays (ping pong)
- Principles of relay setting selection
- CT supervision
- Scheme applications

2 Distance Protection

2.1 Current Transformers

- Steady state performance
- Transient performance (1 + X/R) factor

2.2 Voltage Transformers

- Steady state performance
- Transient performance
- Electromagnetic VTs
- Capacitor VTs

2.3 Distance Relay Fundamentals

- Basic principles of operation
- Amplitude comparators
- Phase angle comparators
- Impedance and Mho characteristics
- Production of complex characteristics (Quad etc.)
- Load encroachment
- Detection of Multi phase faults
- Detection of Earth Faults (Ko residual compensation)

2.4 Protection Signalling

- Direct & Series Intertripping
- Distance acceleration
- Permissive intertripping (Underreaching schemes)
- Permissive intertripping (Overreaching schemes)
- Permissive intertripping (Unblocking schemes)
- Blocking schemes
- Directional earthfault schemes
- Use of Power Line Carrier (PLC systems)

2.5 Advanced Aspects of Distance Protection Design

- Mutual Coupling
 - . Underreaching effects
 - . Overreaching effects
 - . Adjacent feeder OOS & Earthed effects
- Distance Relays & Teed Feeders
- Distance Relays & Bridged feeders
- Distance Relays & Fault resistance
- VT supervision
- Polarisation
- Switch On To Fault (SOTF) performance
- Power Swing Blocking (PSB)

2.6 Basic Principles of Reach (Setting) Selection

- Zone 1
- Zone 2
- Back-up Zones
- Reverse Zones

Barrie Moor, *B.E (Elec), RPEQ*



Barrie commenced employment with the Southern Electric Authority of Queensland in 1973 as a Cadet Engineer, and has remained in the employment of SEAQ and its successors, the Queensland Electricity Generating Board, the Queensland Electricity Commission and presently with the Queensland Electricity Transmission Corporation (trading as Powerlink Queensland).

Barrie graduated from the Queensland Institute of Technology as a Bachelor of Electrical Engineering in 1977, receiving the Board of Professional Engineers prize and the John Kindler Memorial award during his studies.

Initially employed in the Transmission Planning Branch and then in the Substation Development Branch of the then QEGB, Barrie has been involved in Protection Design of Queensland's HV & EHV Transmission Systems since 1981. Within the Protection Design Team, Barrie has held various positions relating to the protection of the Southern, Central & Northern regions of the Queensland Transmission system, primarily pertaining to plant rated from 110kV to 330kV. Barrie also has extensive experience with the protection of large generating plants having had responsibility for the protection of generators at a number of Queensland's major power stations. From 2000 to 2007, Barrie filled the role of Senior Engineer Protection Design as team leader of Powerlink's Protection Design Team. Now in the role of Principal Consultant Substation Protection, Barrie provides specialist Protection Design and Fault Analysis services to support the Substation Design Teams, the Asset Management Group, and Asset Maintenance Groups within Powerlink.

Barrie has more than 15 years experience within Australia in the provision of university post graduate training on the design and implementation of HV & EHV Transmission Protection Systems and also has presented similar training internationally, including New Zealand, Singapore and Malaysia. Barrie has presented papers on Protection Design at a number of ESAA Summer Schools at the University of Queensland and filled the role of syndicate supervisor.

Barrie has RPEQ registration with the Board of Professional Engineers Queensland. He also represents Powerlink on CIGRE committee APB5, Power System Protection & Automation and is a corresponding member of Cigre and IET working groups on Protection Systems.

CPD Recognition

This training program is designed to meet the Continuing Professional Development (CPD) needs of participants. A Certificate of Attendance will be awarded at the end of the program. This serves as evidence of your personal and professional commitment to building your career.

Customised In-House Course Available

This program can be customised to suit the specific needs of your organisation at significant savings details. Please contact us on (02) 8448 2078 or email: Enquiry@cpdint.com.au for more details.