Course description

**CHP181**
Advanced Protection in Transmission Networks – System Solutions

**Course goal**
The participants acquire in-depth knowledge about the protection setting calculation based on electrical power system studies. In addition they perform protection concepts and coordination studies. They have an awareness of protection problems associated with the operation of such systems and acquire the necessary analytical and mathematical skills for handling particular problems related to the protection schemes of complex transmission network configuration.

**Learning objectives**
- Refresh the symmetrical and related components in Power System
- Identify the state of the art of modern numerical protection devices
- Identify the extent of functional integration in modern protection devices transmission
- Study the protection on complex transmission network configurations
- Explain the techniques used for protection of line compensated with series capacitors
- Describe the impact of series compensated lines on protection of adjacent lines
- Be capable of power swing and Out-of-Step considerations on transmission lines
- Prepare a protection setting coordination study for double circuit lines in complex transmission network configurations
- Analyse the fundamental problems associated with multi-terminal and tapped lines.
- Evaluate basic protection schemes covering the above mentioned applications and proposals for adequate solutions to the protection problems

**Participants**
Design, planning, engineering and application engineers and consultants from the electricity supply industry, technical personnel from ABB companies.
Prerequisites:
- Engineering degree, technical college qualifications or equivalent. Basic knowledge of protection and substation automation as well as PC based data processing.
- Required courses or equivalent experience:
  - CHS003 Power System Analysis
  - CHP132 Protection for Transmission Lines
  - CHP133 Protection for Busbars, Circuit Breakers and Power Transformers

**Topics**
- Symmetrical and related components in power system
- General characteristics of a very large power system
  Characteristic, classification of power system stability, state transitions, transfer of power, series compensation, increased power transfer capability
- Line protection functions and advanced applications
  Improvements and properties in modern distance protection, measurement of distance, impact of fault impedance, apparent impedance and load encroachment, load compensation, distance relay characteristics and polarization, distance zones and phase selection, impedance loops calculation, full scheme operation, influence of load flow and fault resistance measurements.
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- Setting of distance zones
  *The setting cycle, grading charts for zone, effect of intermediate in-feeds, variation of the reach depending on the switching state of the system, Thévenin’s equivalent circuit, and reduction of existing network for investigation with NEPLAN Power System Analysis Tool*

- Line protection in complex transmission network configurations
  *Multi-circuit transmission lines, mutual coupling on parallel lines, classes of networks, setting considerations, multi-terminal and tapped lines, composed lines, modeling a complex network configuration, staged fault tests*

- Case studies with NEPLAN Power System Analysis Tool

- Power swing and out-of-step relaying
  *Energy transmission shown on two-machine mode, power transfer curves, system stability, power swing and out-of-step relaying, impedances seen by relays during power swing, loss of synchronism, conventional power swing detection, electrical quantities during swings, improved detection of power swing, out-of-step relaying, effect of a slipping generator, split of generator shaft, adaptive load shedding with islanding, advantages of the pole slip function*

**Method**
Lectures, demonstrations, exercises in system design, application and calculation.

**Duration**
5 days (until Friday noon)

**Register**
If you would like to enroll please contact us or use the following registration button

[→ Register]