

POWERFACTORY

Power Transmission with HVDC

S2021.05.03.Online_HVDC.En

May 03rd - May 05th 2021

Online training course

The training course gives an overview of High-Voltage Direct Current (HVDC) transmission. Line-commutated converters (LCCs) and modular multi-level converters (MMCs) are addressed. Topologies and controls, steady-state, harmonic as well as dynamic behaviour are explained. The participants will learn how to model and analyse these systems in *PowerFactory*. Practical use case scenarios are investigated.

This training aims at enabling the participant to understand modern HVDC devices, diligently analyse a power network including HVDC and identify benefits as well as limitations.

WHO SHOULD ATTEND:

The course is intended for

- Utility engineers
- Power system operators
- Project Developers
- Manufacturers
- Consultants
- Electrical engineers in general

The participants should be familiar with the basic handling of *PowerFactory*. Experience with *PowerFactory*'s time domain and simulation functions is essential.

PRICE PER PARTICIPANT:

- 1,674.00€* (with valid maintenance contract)
- 1,905.00€* (without valid maintenance contract)
- 570.00€* (with valid student identification)

*Prices are exclusive of VAT

Training schedule

Central European Time (UTC +01:00)

DAY 1 - HVDC systems with LCCs

- 9:00 Introduction to HVDC**
Overview converter technologies, monopoles, bipoles. Basics of line-commutated converters (LCCs).
- 10:30 Coffee break**
- 11:00 Exercise: Model of six-pulse bridge in PowerFactory**
Introduction to the thyristor-based rectifier model, power flow setpoints, load flow analysis, timedomain simulation.
- 12:30 Lunch break**
- 13:30 Steady-state analysis of LCC-HVDC**
Steady-state behaviour, reactive power demand and compensation, typical harmonic spectra.
- 15:00 Coffee break**
- 15:30 Exercise: Steady-state model of LCC-HVDC in PowerFactory**
Implementation of an HVDC model, power flow setpoints, load flow analysis, reactive power compensation.
- 17:00 End of the first day**

DAY 2 - HVDC systems with LCCs

- 9:00 Dynamics**
Control schemes for rectifiers and inverters. Implementation in *PowerFactory*, firing angle and extinction angle control.
- 10:30 Coffee break**
- 11:00 Exercise: EMT simulation**
Influence of firing angle on steady-state operating point, reactive power demand, FFT analysis, response to system disturbances.
- 12:30 Lunch break**
- 13:30 Introduction to MMCs**
Voltage-sourced converter (VSC), modular multi-level converter (MMC), MMC with half-bridge topology, MMC with full-bridge topology, operation principles, modulation techniques, applications, steady-state control strategies, models in *PowerFactory*.
- 15:00 Coffee break**
- 15:30 Exercise: Steady-state studies**
Implementation of MMC-HVDC links into AC network models, application: 50 Hz grid, offshore link; load flow analysis, different control strategies.
- 17:00 End of the second day**

DAY 3 - HVDC systems with MMCs

- 9:00 Dynamic behaviour**
Dynamic control strategies (control for islanded and non-islanded operation), MMC internal controls, protection schemes (blocking mode, DC chopper), behaviour during network faults.
- 10:30 Coffee break**
- 11:00 Exercise: Dynamic behaviour**
Dynamics under normal operating conditions, response to network disturbances, DC overvoltage mitigation in offshore HVDC links.
- 12:30 Lunch break**
- 13:30 Exercise: Power system analysis**
Practical use case examples of power system analysis with HVDC systems.
- 15:00 Coffee break**
- 15:30 Faults in the DC link**
Response of half- and full-bridge MMC HVDC systems to DC link faults.
- 17:00 End of the training course**