

Training Content

Power Transmission with VSC/MMC HVDC

DAY 1

MODULE 1: VSC/MMC HVDC – Fundamentals and steady-state operation

Introduction to VSC/MMC

1 1/2 h

Application cases, point-to-point HVDC links, multi-terminal HVDC systems; voltage-sourced converter (VSC), modular multi-level converter (MMC), MMC with half-bridge or full-bridge submodules, operation principles, modulation techniques; steady-state control strategies.

Coffee break

VSC/MMC HVDC - Models in *PowerFactory*

1 1/2 h

Modelling aspects, *PowerFactory*'s built-in components for VSC/MMC HVDC, model templates in the global *DlgSILENT* library, available variants for different configurations and applications.

Q&A session

Lunch break

Exercise: Steady-state studies

1 1/2 h

Implementation of an MMC HVDC link into an AC network model, application: embedded link in 50 Hz grid; load flow analysis, different control strategies.

Coffee break

MODULE 2: VSC/MMC HVDC – Controls and dynamics

Controls and dynamic behaviour

1 1/2 h

Dynamic control strategies (control for islanded and non-islanded operation, grid-following and grid-forming controls), upper level controls, lower level controls, protection schemes (P/DC voltage droop, DC chopper, converter blocking), behaviour during network faults.

Q&A session

DAY 2

Faults in the DC link

1/2 h

Response of half- and full-bridge MMC HVDC systems to DC link faults.

Small signal analysis and power quality aspects

1 h

VSC/MMC HVDC system small signal stability analysis in the frequency-domain.

Aspects for power quality assessment of power systems with VSC/MMC.

Coffee break

Exercise: Dynamic behaviour

1 1/2 h

HVDC link to offshore wind park: dynamics under normal operating conditions, response to AC network faults, DC overvoltage mitigation in the offshore HVDC link.

HVDC interconnector: response to AC network faults, DC overvoltage mitigation.

Q&A session

Lunch break

Exercise: Power system analysis

1 1/2 h

Practical use case examples of power system analysis with an HVDC system: 50 Hz/60 Hz HVDC interconnector, response to frequency events (frequency sensitive mode), contribution to power oscillation damping.

Coffee break

Exercise: Impedance-based stability analysis

1 1/2 h

Analysis of the HVDC connection to an offshore wind park (OWP)

Q&A session

Time Schedule (Central European Time)

Full-Day	Time
First 90 minutes block	9:00
Coffee break	10:30
Second 90 minutes block	10:45
Q&A session	12:15
Lunch break	12:30
Third 90 minutes block	13:30
Coffee break	15:00
Fourth 90 minutes block	15:15
Q&A session	16:45
End of the training day	17:00



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