

INFORMATION

Please complete and sign registration and return either via fax +49 7072-916 888 or a scanned copy via electronic mail to: c.koenig@digsilent.de. Upon submission of your registration you will receive an acknowledgement of receipt and invoice. Final confirmation will be established after receipt of payment.

Without this confirmation your registration is not valid. By our written confirmation your registration becomes legally binding.

CANCELLATIONS

Up to 8 weeks before the course: at no cost
Up to 2 weeks before the course: 50% of the course fee
Less than 2 weeks before the course: 100% of the course fee

DIGSILENT reserves the right to cancel a seminar due to insufficient participants up to 4 weeks before the beginning of the seminar. In the event that an already confirmed seminar needs to be cancelled due to force majeure, participants will be informed as soon as possible and already paid seminar fees will be reimbursed. Further claims like travel expenses or hotel cancellation fees are excluded from this practice if the cancellation of the seminar is not due to a grossly negligent behaviour of DIGSILENT GmbH.

Detailed information about how to get to DIGSILENT will be sent along with the confirmation.

LUNCHES

Lunches are included in the seminar fees. If you have any special requirements (e.g. vegetarian), please let us know with your registration.

TRAINING MATERIAL

Our training material is protected by copyright. Duplication or transfer is prohibited and requires the written consent of DIGSILENT GmbH.

ACCOMMODATION

We recommend booking your accommodation in one of the hotels listed below:

- Hotel Alznauer Hof, Raiffeisenstr. 2, 72810 Gomaringen
- Hotel Arcis, Bahnhofstr. 10, 72810 Gomaringen
- Hotel Nehrener Hof, Bahnhofstr. 57, 72147 Nehren
- Hotel Domizil, Wöhrdstr. 5-9, 72072 Tübingen

SEMINAR FEES:

For DIGSILENT Users with valid guarantee or maintenance period reduced seminar fees apply. Included in the seminar fees are training material, coffee breaks and lunches.

REGISTRATION

Company:

Department:

VAT No.:
(European Community)

First name:

Last name:

Street:

Zip Code:

City:

Country:

E-Mail address:

Participant's name:

Invoicing address:
(if different)

Signature:

Including day 1 yes

For how long have you been using PowerFactory regularly?

New user > 1 year > 2 years > 5 years

LUNCH non-vegetarian vegetarian
(please select an option)

By submitting the form you agree to the storage and use of your data to process your inquiry at DIGSILENT GmbH.

DIGSILENT TRAINING

SILENT
DIG

HVDC

S2019.1209.GO



09 – 12 December 2019

Training facilities at DIGSILENT GmbH in Gomaringen

INTRODUCTION

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 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 aimed at utility engineers, power system operators, project developers, manufacturers, consultants and electrical engineers in general, interested in HVDC devices and their application in power systems. The participants should be familiar with the basic handling of DlgSILENT PowerFactory. Experience with PowerFactory's time domain and frequency domain simulation functions is recommended but not mandatory. For participants who are not familiar with PowerFactory or the functions mentioned, the optional first day is recommended.

PROGRAMME

DAY 1 (optional)

09:00h Network Model Management

Introduction to the PowerFactory fundamental concepts, functionality, handling and terminology. Network Model, Libraries, Study Cases. Types and Elements. Working with the Graphical editor, Data Manager and Network Model Manager.

10:30h Coffee Break

11:00h Exercise: Network Model Management

Modifying network models using the Graphical Editor, Data Manager and Network Model Manager. Entering data with the modular concept of load flow, short circuit, RMS, EMT pages of elements. Working with the Global and Project Libraries. Results visualisation in the single line diagram and Network Model Manager. Balanced and unbalanced load flow calculation.

12:30h Lunch Break

13:30h Introduction to Time Domain Simulation

Calculation of Initial Conditions with balanced and unbalanced systems. Definition of Variables and Simulation Events. Results visualisation.

14:00h Exercise: Handling of time domain RMS/EMT simulation

Simulation of a near-to-generator short circuit using RMS and EMT time domain simulation. Definition of result variables and simulation events. Results visualisation and analysis.

15:00h Coffee Break

15:30h Advanced Handling with PowerFactory

Fast Fourier Transform (FFT) of EMT simulations. Result files. Templates. Composite and Common DSL models.

17:00h End of the first day

DAY 2 HVDC SYSTEMS WITH LCC

09:00h Introduction to HVDC

Overview converter technologies, monopoles, bipoles. Basics of line-commutated converters (LCCs).

10:30h Coffee break

11:00h Exercise: Model of a six-pulse bridge in PowerFactory

Introduction to the thyristor-based rectifier model, power flow setpoints, load flow analysis, time-domain simulation.

12:30h Lunch break

13:30h Steady-state analysis of LCC-HVDC

Steady-state behaviour, reactive power demand and compensation, typical harmonic spectra, harmonic filters.

15:00h Coffee break

15:30h Exercise: Steady-state model of LCC-HVDC in PowerFactory

Implementation of an HVDC model, power flow setpoints, load flow analysis, reactive power compensation.

17:00h End of the second day

DAY 3 HVDC SYSTEMS WITH LCC/MMC

09:00h Dynamics

Control schemes for rectifiers and inverters. Implementation in PowerFactory, firing angle and extinction angle control.

10:30h Coffee break

11:00h Exercise: EMT simulation

Influence of firing angle on steady-state operating point, reactive power demand, FFT analysis, response to system disturbances.

12:30h Lunch break

HVDC systems with MMCs

13:30h Introduction to MMCs

Voltage-sourced converter (VSC), modular multi-level converter (MMC), MMC with halfbridge topology, MMC with full-bridge topology, operation principles, modulation techniques, applications, steady-state control strategies, models in PowerFactory.

15:00h Coffee break

15:30h Exercise: Steady-state studies

Implementation of MMC-HVDC links into AC network models, application: 50 Hz/60 Hz link, embedded link in 50 Hz grid, offshore link; load flow analysis, different control strategies.

17:00h End of the third day

DAY 4 HVDC SYSTEMS WITH MMCS

09.00h 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.

10.30h Coffee break

11.00h Exercise: Dynamic behaviour, Part1

Dynamics under normal operating conditions, response to network disturbances, DC overvoltage mitigation in offshore HVDC links.

12.30h Lunch break

13.30h Exercise: Dynamic behaviour, Part2

Behaviour of half- and full-bridge MMC HVDC systems in cases of faults in the DC link.

15.00h Coffee break

15.30h Exercise: Power System Analysis

Practical use case examples of power system analysis with HVDC systems.

17.00h End of the seminar

PRICE PER PARTICIPANT

With valid licence or maintenance agreement

Euro 1,677.00 plus VAT

Without valid licence or maintenance agreement

Euro 1,905.00 plus VAT

With valid student ID

Euro 572.00 plus VAT

INCLUDE OPTIONAL DAY 1

With valid licence or maintenance agreement

Euro 2,235.00 plus VAT

Without valid licence or maintenance agreement

Euro 2,540.00 plus VAT

With valid student ID

Euro 762.00 plus VAT



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