

INFORMATION

Please complete and sign the registration form 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 seminar: at no cost
Up to 2 weeks before the seminar: 50% of the seminar fee
After the 2 weeks' period: 100% of the seminar fee

DlgSILENT 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 DlgSILENT GmbH.

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

LUNCHESES

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 DlgSILENT 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 DlgSILENT 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: _____

For how long have you been using PowerFactory regularly?

New user > 1 year > 2 years > 5 years

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

PRICE PER PARTICIPANT

Euro **1,452.00 plus VAT** (with valid licence or maintenance agreement)
Euro **1,650.00 plus VAT** (without valid licence or maintenance agreement)
Euro **495.00 plus VAT** (with valid student ID)

DlgSILENT SEMINAR



Electromagnetic Transient Analysis

S2017.1115.GO.EMT



15 - 17 November 2017

Training facilities at DlgSILENT GmbH in Gomaringen

INTRODUCTION

The course gives an overview of electromagnetic transients in power systems and the simulation techniques available in DigSILENT PowerFactory for their assessment. As such, it provides the participant with the necessary background to understand complex transient mechanisms in the power systems while emphasising the models required for EMT-type simulations. The course introduces the different transient categories, from temporary, over switching up to lightning transients, in the sequence typically required for an insulation coordination study. Besides the review of the theoretical fundamentals, multiple hands-on exercises will assist the participant to familiarize with the EMT-simulation in PowerFactory.

WHO SHOULD ATTEND

The course is intended for utility engineers, power system operators, project developers, manufacturers, consultants and electrical engineers in general, interested in the analysis of electrical transients in power systems. Participants should be familiar with the basic handling of DigSILENT PowerFactory. Experience with PowerFactory's time domain simulation functions is not required and will be introduced in the course.

PROGRAMME

DAY 1

- 09:00h Fundamentals**
Transient phenomena in power systems. Classification of overvoltages acc. to IEC60071: temporary, slow-front, fast-front and very fast-front transient overvoltages. RMS versus EMT simulations. The EMT solver in PowerFactory. Handling: definition of simulation events and result variables. Visualisation of simulation results. Fast Fourier analysis.
- 10:00h Switching inductive loads**
Fundamentals. Transformer inrush current. Saturation characteristics of magnetizing reactance. Residual flux. Harmonic content of inrush currents. Resonance overvoltages excited by inrush currents.
- 10:30h Coffee break**
- 11:00h Exercise: Transformer inrush currents**
Energization of a transformer in a weak network. Determination of maximum inrush current. Decaying DC component. Voltage dip during energization. Assessment of typical grid code compliance. Mitigation of inrush currents.

- 12:30h Lunch Break**
- 13:30h Switching capacitive loads**
Fundamentals. Inrush current and switching overvoltage during energization of capacitor banks. Back to back connections. Mitigation of inrush currents.
- 15:00h Coffee break**
- 15:30h Exercise: Energisation of a filter bank**
Natural oscillation frequencies. Simulation of inrush currents and maximum transient overvoltages in a filter bank. Back-to-back energisation of a second filter bank.
- 17:00h End of the first day**

DAY 2

- 09:00h Interruption of small inductive currents**
Overview of abnormal switching transients, trapped energy and current chopping. Transient recovery voltage (TRV): dielectric strength of circuit breaker after contact opening. Arc re-ignition. Suppression (or chopping) and recovery overvoltages. Voltage escalation following abnormal switching.
- 10:30h Coffee break**
- 11:00h Exercise: Reactor drop out**
Assessment of switching overvoltages due to reactor drop out. Vacuum circuit breaker model. Current chopping.
- 12:30h Lunch break**
- 13:30h Line models for electromagnetic transients**
Overhead line models and cable systems. Lumped and distributed parameter models. Constant and frequency dependent parameters. Travelling wave effects.
- 14:00h Exercise: Modelling of overhead lines and cable systems**
Definition of overhead line and cable systems. Analysis of lumped and distributed parameter line models. Comparison of constant and frequency dependent parameters.
- 15:00h Coffee break**
- 15:30h Line Switching in a mixed OHL/cable system**
Line energisation: maximum transient overvoltages. Deterministic and stochastic assessment. Overvoltage mitigation: surge arresters and pre-insertion resistors. Protection characteristic. Energy duty.

- 16:00h Exercise: Assessment of switching overvoltages in a mixed OHL/cable system**
Maximum transient overvoltages based on deterministic and stochastic approach. Modelling of surge arresters and pre-insertion resistors. Stochastic switching.
- 17:00h End of the second day**

DAY 3

- 09:00h Lightning transients**
Fundamentals of transient phenomena and its interaction with the power system. Modelling of relevant power system components for lightning transient analysis: impulse sources, line/cable surge impedances, tower footing impedances, dielectric strength of isolators. Surge arresters. Stray capacitance of transformer.
- 10:30h Coffee break**
- 11:00h Exercise: Model setup for lightning analysis**
Definition of the overhead line model for lightning analysis. Phase conductors and earth wires. Line couplings. Model of the footing impedance. Voltage controlled switches to represent the flashover. Impulse current sources.
- 12:30h Lunch Break**
- 13:30h Exercise: Assessment of lightning overvoltages**
Determination of the lightning performance of a transmission line. Simulation of direct strikes. Strikes to the earth wires. Back flashover.
- 15:00h Coffee break**
- 15:30h Exercise: Mitigation of lightning overvoltages**
Overvoltage mitigation: selection of surge arresters. Lightning protection characteristic. Energy duty. Lightning overvoltages under consideration of surge arresters.
- 17:00h End of the course**



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