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 no 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

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 (i.e. vegetarian), please let us know with your registration.

TRAINING MATERIAL

Our training material is protected by copyright. Duplication or transfer are prohibited and require 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: _____

Participants' 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 DIgSILENT 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)

DIgSILENT SEMINAR

Electromagnetic Transient Analysis

S2017.0426.GO

26 - 28 April 2017

Training facilities at DIgSILENT 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.

PROGRAM

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. Tran sient recovery voltage: 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 **Switching transients on transmission lines**
Models for transient analysis: lumped and distributed (travelling waves) parameter models, constant and frequency dependent parameters. Line energisation transients. Stochastic switching.

15:00h **Coffee break**

15:30h **Exercise: Assessment of switching overvoltages in a mixed OHL/UC system**
Definition of an overhead line: tower and conductor types. Line constants. Line energisation: maximum transient overvoltages. Stochastic assessment. Overvoltage mitigation: definition of surge arresters. Protection characteristic. Energy duty.

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 currentsources.

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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