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

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

LUNCHES
Lunches are included in the course 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

COURSE FEES:
For DIgSILENT Users with valid guarantee or maintenance period reduced course fees apply. Included in the course 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

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.

PRICE PER PARTICIPANT
Euro **1,118.00 plus VAT** (**with** valid maintenance agreement)
Euro **1,270.00 plus VAT** (**without** valid maintenance agreement)
Euro **381.00 plus VAT** (with valid student ID)

DIgSILENT TRAINING

Grid Connection of Renewable Generation

S2020.0514.GO

14 - 15 Mai 2020
Training facilities at DIgSILENT GmbH in Gomaringen

INTRODUCTION

The seminar introduces the participant to the tools and techniques commonly used in practice for the analysis of grid integration of renewables in the power system with focus on wind power and photovoltaics (PV). This two-day course provides a systematic approach for performing a grid compliance study, by covering the following topics:

- Steady-state behaviour with consideration of grid code requirements
- Short-circuit calculation
- Harmonic analysis according to IEC61000
- Dynamic simulation for fault behaviour

Each topic above includes a theoretical background and a practical part in which participants acquire hands-on experience in the use of PowerFactory.

Although most of the exercises are based on wind power applications, due to the similiarities between wind power and photovoltaics in terms of grid connection studies, the same exercises can be tailored for solar power as well.

WHO SHOULD ATTEND

The course is intended for consultants, engineers working for manufacturers or project development in the field or wind/solar power, utility engineers, power system operators and electrical engineers in general, interested in the grid integration of renewables in the power system. Participants should be familiar with the basic handling of DIgSILENT PowerFactory.

PROGRAMME

DAY 1

09:00h **Wind Energy Basics and Turbine Generator Concepts**
The various types of wind turbine generators (Type 1 to 4) are introduced. The advantages and disadvantages of each type are explained, with focus on the active/reactive power regulation capabilities.

10:30h **Coffee break**

11:00h **Exercise: Building a wind farm model**
Setting up a 50 MW wind farm based on fully rated wind turbine (WT) models. Getting acquainted with the WT templates in the global library. Definition of the PQ capability of a single WT.

11:30h **Grid code compliance in steady-state study**
Overview of typical grid code requirements specified for renewable generation. Steady-state requirements: voltage control, P-Q and V-Q capability at point of connection.

12:00h **Exercise: Reactive Power Capability**
Grid code compliance in terms of reactive power provision at the PoC. Identification of the V-Q and P-Q Wind Farm capability and comparison with given grid code requirements. Design the reactive power compensation unit.

12:30h **Lunch break**

13:30h **Power Quality Assessment**
Fundamentals. Harmonic load flow according to IEC 61000-3-6. Overview of the calculation procedure. Definition of IEC harmonic sources in PowerFactory. Voltage flicker assessment according to IEC 61400-21. PowerFactory: Harmonic load flow handling.

14:30h **Exercise: Power Quality Assessment acc. to IEC 61400-21**
Evaluate the power quality of a wind farm according to IEC 61400-21, including calculation of voltage distortion due to harmonics injections, relative change in voltage due to switching operations in the wind farm and the flicker severity during continuous and switching operations.

15:00h **Coffee break**

15:30h **Short-Circuit Analysis**
Learn about the options PowerFactory offers to consider short-circuit contribution from wind turbines according to different standards and with focus on IEC 60909 and the proprietary "Complete Method".

16:00h **Exercise: Short-Circuit in a Wind Farm**
Verification of equipment ratings using the IEC 60909 method (worst case/planning stage behaviour). Verification of thermal ratings of a MV cable. Verification of the dynamic voltage support function of the individual wind turbine using the "Complete Method" (operational behaviour).

17:00h **End of the first day**

DAY 2

09:00h **Dynamic Simulation of Wind Turbines and Introduction of the Dynamic Model of a WT with fully rated converter**
Dynamic Simulation Fundamentals. Handling in PowerFactory. Get familiar with the PowerFactory dynamic models designed for fully rated converter WTs, with focus on IEC models, their structure, control block diagrams and supported functionality.

10:30h **Coffee break**

11:00h **Exercise: WT with fully rated Converter**
Use a WT (fully rated converter based) to perform a dynamic short-circuit study according to the German VDE-AR-N 41xx or the ENTSO-E regulations. Learn how to test dynamic controllers and apply different controller settings (e.g. K factor for LVRT).

12:30h **Lunch break**

13:30h **Introduction of the Dynamic DFIG Model**
Get familiar with the PowerFactory dynamic models for a doubly-fed induction generator (DFIG) wind turbine, with focus on IEC models, their structure, control block diagrams and supported functionality.

14:30h **Exercise: DFIG with resynchronization**
Develop an aggregated DFIG WT farm model based on IEC 61400-21, connect it to a transmission network and adjust ratings. Use it to perform a short-circuit study according to the German grid code and technical guidelines. Learn how a DFIG WT reacts during a fault and adjust settings.

15:00h **Coffee break**

15:30h **Photovoltaic (PV) Systems**
Fundamentals: Solar cell technologies; P-V/I-V curves; DC system layouts; PV inverter types; PV power plant layouts. Load Flow models for PV systems. The "Photovoltaic System" built-in model for steady-state analysis. Dynamic Models for PV systems. Other solar energy sources.

16:00h **Exercise: Fault analysis on a LV feeder with photovoltaics**
Learn how to use the generic PV template, add it to an LV network. Study the steady-state voltage profile of the feeder. Perform a dynamic simulation and monitor the PV inverter behaviour during faults. Adapt PV system ratings and apply various operational settings.

17:00h **End of the seminar**

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