

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 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.

LUNCHESES

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



Harmonic Analysis

S2019.1127.GO



27 - 28 November 2019

Training facilities at DIGSILENT GmbH in Gomaringen

INTRODUCTION

The training course gives an overview of simulation techniques in DlgSILENT PowerFactory for the assessment of power quality with an emphasis on harmonic distortion and reviews recommended practice for harmonic mitigation in power systems. Special attention is drawn to the power quality characteristics of converter-connected generation, such as wind or solar generation and the assessment of harmonic emissions according to IEC standards.

Besides the theoretical review of main power quality concepts, multiple hands-on exercises will help the participant to familiarise with the simulation tools in PowerFactory for harmonic analysis.

WHO SHOULD ATTEND

The course is intended to utility engineers, power system operators, project developers, manufacturers, consultants and electrical engineers in general, interested in the assessment and mitigation of harmonic distortion issues in power systems.

The participants should be familiar with the basic handling of DlgSILENT PowerFactory. Experience with PowerFactory's frequency domain simulation functions is not required.

PROGRAMME

DAY 1

- 09:00 h** **Introduction to Harmonic Analysis**
Harmonic injections: balanced and unbalanced spectrums. Positive, negative and zero sequence injections. Harmonic load flow: calculation options. Total RMS values and total power. Power quality indices: HD, THD, THF, IT, TAD. Harmonic distortion diagrams and waveform plots. Harmonic distortion limits (IEC, IEEE, etc.).
- 10:30 h** **Coffee break**
- 11:00 h** **Exercise: Harmonic Load Flow Calculation**
Definition of harmonic sources in a transmission system. Harmonic load flow calculation. Assessment of the voltage and current distortion. Evaluation with regard to distortion limits. Bar plot diagrams, waveform plots. Assessment of power quality in the transmission system
- 12:30 h** **Lunch Break**
- 13:30 h** **Power System Modelling for Harmonic Analysis**
Modelling of overhead lines, cables, transformers, network equivalents, loads and other network elements for harmonic analysis. Frequency dependency of network elements. Resonance effects, parallel and series resonances in power systems
- 15:00 h** **Coffee break**
- 15:30 h** **Exercise: Impedance Frequency Sweep Analysis**
Balanced and unbalanced impedance frequency sweep calculation (handling, calculation options and result evaluation). Impedance plots. Assessment of series and parallel resonances. Modelling of frequency dependent models for overhead lines, cables and transformers using geometric models and frequency characteristics. Self and mutual network impedances.
- 17:00 h** **End of the first day**

DAY 2

- 09:00 h** **Harmonic Filters**
Application of harmonic filters in power systems. Modelling and specifications of single-tuned band pass filter, damped high pass filter, C-type filter. Design of filters for harmonic distortion mitigation.
- 09:45 h** **Exercise: Harmonic Filter Design**
Modelling of harmonic filters in PowerFactory. Selection and sizing of harmonic filters for grid connection compliance. Consideration of different operation scenarios of the network. Layout and design parameters of harmonic filters. Verification of filter ratings. Filter report and layout report.
- 12:30 h** **Lunch Break**
- 13:30 h** **Power quality assessment acc. to IEC**
Harmonic load flow calculation acc. to the IEC 61000 standard. Positive sequence harmonic spectrum. Summation laws for harmonic emission coordination with multiple sources. Assessment of flicker assessment emission level (IEC61400-27).
- 15:00 h** **Coffee break**
- 15:30 h** **Exercise: Power quality assessment of a wind park acc. to IEC standards**
Harmonic injection of the wind turbines. Calculation of voltage distortion at the point of common coupling. Consideration of background distortion. Design of harmonic filters. Assessment of the flicker emission of the wind park.
- 17:00 h** **End of the course**



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