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 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 (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:

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

Power System Stability

S2017.0529.GO

29 - 31 May 2017

Training facilities at DIgSILENT GmbH in Gomaringen

INTRODUCTION

The seminar introduces the participant to the tools and techniques commonly used in practice for stability studies. Single-machine and Multi-machine power systems are studied, using steady state, timedomain and frequency-domain techniques. This three-day course provides a comprehensive overview about the dynamic models of elements and all the stability types: Transient Stability, Oscillatory Stability, Voltage Stability, and Frequency Stability. Each topic above includes a theoretical backgroundand a practical part where participants acquire hands-on experience in the use of DIgSILENT 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 stability analysis of networks. 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 **Introduction to Power System Stability**
Fundamentals of power system stability. Classification according to IEEE: rotor angle, voltage and frequency stability. Simulation tools for the analysis of stability problems: load flow, RMS simulation and modal analysis.

10:00h **Models of Network Elements**
Review of the network components with a major impact on system stability. Models in PowerFactory: synchronous machine, asynchronous machine, doubly-fed induction generator, load, PWM converter, static generator and external grid.

10:30h **Coffee break**

11:00h **Exercise: Handling**
Synchronous machine model in PowerFactory based on manufacturer data. RMS simulation in PowerFactory: initial conditions, definition of variables, events definition and results visualisation.

12:30h **Lunch break**

13:30h **Dynamic Controllers**
Dynamic controllers for excitation systems and prime movers in conventional generation. Templates for non-conventional generation (e.g. wind, solar, batteries). Theoretical approach and modelling in PowerFactory.

15:00h **Coffee break**

15:30h **Exercise: Effect of Controllers**
Influence of dynamic controllers in a synchronous machine. Analysis and optimisation of the step response of an automatic voltage regulator (avr). Evaluation of the dynamic response of the speed controller and the power system stabiliser (pss).

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

DAY 2

09:00h **Transient Stability**
Fundamentals of transient stability. Equal Area Criterion. Methods for improving transient stability problems.

10:00h **Exercise: Transient Stability in Single-Machine-Infinite-Bus (SMIB)**
Critical clearing time calculation. Visualisation and analysis of results. Effect of changing the initial point of operation.

10:30h **Coffee break**

11:00h **Exercise: Transient Stability in a Multi-Machine Network**
Critical clearing time calculation using a DPL script. Effect of the inertia and the impedance of the system on the transient stability problems. Calculation of the transfer limits.

12:30h **Lunch break**

13.30h **Oscillatory Stability (small signal)**
Description of the linearisation methods. Oscillatory stability in time and frequency domain analysis. Modal analysis and eigen value plot. Methods to improve small signal stability.

14:30h **Exercise: Oscillatory Stability in a Single-Machine-Infinite-Bus (SMIB)**
Identification of the local mode of a single machine connected to an infinite bus. Analysis done in time and frequency-domain analysis. Impact of the AVR and PSS.

15:00h **Coffee break**

15:30h **Exercise: Oscillatory Stability in a Multi-Machine Network**
Identification of critical oscillation modes in a multi-machine network using modal analysis. Evaluation of the type of oscillation (local, inter-area). Methods to efficiently increase the damping. Impact of different network configurations on the oscillation modes.

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

DAY 3

09.00h **Voltage Stability**
Fundamentals. Causes and contributing factors in voltage stability problems. Classification of the voltage stability and tools used in every case: steady state and dynamic.

10:00h **Exercise: Steady State Voltage Stability**
Calculation of busbars sensitivities, PV & QV curves considering contingencies, effect of modifying the load size and power factor.

10:30h **Coffee break**

11:00h **Exercise: Dynamic Voltage Stability**
Study of voltage stability in the time domain analysis, RMS simulation. Effect of the load modelling, motors contribution and AVR dynamic response.

12:30h **Lunch break**

13:30h **Frequency Stability**
Fundamentals. Definition of the different stages of the frequency stability analysis and factors contributing in each stage: inertia, regulation actions and primary reserve, under frequency load shedding.

15:00h **Coffee break**

15:30h **Exercise: Frequency Stability in a Multi-Machine Network**
Frequency stability after generators outages. Effect of primary control, load modelling, inertia, areas separation and load shedding. Comparison between different methods to improve frequency stability.

17:00 **End of the training course**

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