Using EMTP-RV software for simulation and analysis of power systems

Software oriented course
For beginner and intermediate trainees

In cooperation with Ecole Centrale de LILLE
www.ec-lille.fr
# Using EMTP-RV software for simulation and analysis of power systems

## Course objectives:

The objective of this course is to give to beginner and intermediate participants a good hands-on experience on the simulation and analysis of power systems transients in general.

The course is based on the usage of EMTP-RV (www.emtp.com) for demonstrating concepts and teaching through practical problem cases. EMTP-RV contributes greatly to the simplification of complex power system studies and to the visualisation and accurate simulation of large systems.

## Course structure:

- **The duration of the course is 4 days.**
- The course is presented in English.
- Each participant will have access to personal computer to learn about topics and to analyse available practical examples.
- The course starts at 9:00 a.m. and ends at 5:00 p.m. every day.

## Intended audience:

- They could be users of the software but also people who would like to discover how useful simulation can be for them.
- Professionals from Power Transmission, Distribution and Production companies,
- Professional engineers,
- Consultants,
- Post-graduated students.

## Instructors:

- **Sébastien DENNETIERE**
  RTE, FRANCE
- **Xavier GUILLAUD**
  Professor
  Ecole Centrale de Lille, FRANCE
- **Xavier LEGRAND**
  Electricité de France, FRANCE
- **Jean MAHSEREDJIAN**
  Professor
  Ecole Polytechnique de Montréal - Québec, CANADA

## Location

The course will take place in Ecole Centrale de LILLE - FRANCE

[www.ec-lille.fr](http://www.ec-lille.fr)

## Address:

Ecole Centrale de LILLE
Cité Scientifique
59651 VILLENEUVE D’ASCQ CEDEX
FRANCE

## Course Fees:

- **2000 Euros excl VAT for the 4 days**
- Participants will have to pay before the course.
- Payment will be made by bank transfer.
- Cancellation can be made according to POWERSYS General Conditions for training.

## Contact for course information and registration:

Corinne ROCHERIEUX
POWERSYS
Email: c.rocherieux@powersys.fr

## Hotels:

Pre-reservation have been made in 2 hotels:

1) **Hotel IBIS Lille Gares**
(located in the city center)

- 112 Euros per night for single room
- 8 Euros for breakfast + 0,9 Euro of tax per day

2) **Hotel ASCOTEL Lille Métropole**
(located near Ecole Centrale de Lille)

- 83 Euros per night per single room (standard room) or 103 Euros per night per single room (executive room)
- 13 Euros for breakfast + 0,75 Euro of tax per day

## More information about instructors at:


## Link for local information:

COURSE PROGRAM

Day 1  Introduction to power system transients and EMTP-RV
Day 2  Key component models in EMTP-RV
Day 3  Key component models in EMTP-RV
Day 4  Practical power systems studies in EMTP-RV

Day 1 - Monday, October 24
Introduction to power system transients and EMTP-RV

Theoretical backgrounds on transients and computational methods (JM)
- Fundamental notions on power system transients
- Load-flow, steady-state and time-domain solutions
- Theoretical analysis methods
- Computerized analysis methods
- Overview of simulation options and models in EMTP

Introduction to the graphical user interface EMTPWorks (SD - JM)
- How to create a simple circuit?
- General signals, 3-phase signal and bus
- Subcircuit creation and Hierarchical designs
- Control system design and interfacing with power system
- Simulation options
- Visualization options
- Symbol editor
- Password protection.
- Basic models
- Capacitor bank energization studies

Day 2 - Tuesday, October 25
Key component models in EMTP-RV

Line and cable models (XL)
- Basics on line theory
- PI circuit
- Constant parameter line and cable models with propagation delays
- Frequency dependant line and cable models
- Creation of line models from geometric and electrical data
- Validity limits of line and cable models
- Application examples

Transformer models (SD)
- Classification of models according to transformer types and frequency of transients
- Single phase units
- Saturation and hysteresis
- 3-phase models
- High frequency models
- From factory test report to EMTP models
- Application examples
Day 3 - Wednesday, October 26

*Key component models in EMTP-RV*

**Rotating Machines (XL - XG)**
- Synchronous generator
- Synchronous generator controls
- Induction machines
- Starting of induction machines

**Power electronics (XG)**
- Main devices: power electronics devices and control systems
- Simple power electronics circuits
- FACTS models
- HVDC LCC and VSC models
- Power electronics for wind generation: doubly fed induction machine and full-converter synchronous machine

**Advanced EMTP usage (JM)**
- Load-flow solution
- Statistical option
- Scripting in EMTPWorks
- Development of user-defined models

Day 4 - Thursday, 27 October

*Practical power systems studies in EMTP-RV*

**Insulation coordination study (XL)**

**Harmonic temporary overvoltage due to transformer switching (SD)**
- Transformer energization during power systems restoration, complete study example from data input to results analysis.
- Transformer switching in the vicinity of long EHV cable:
  - Transformer and cables modeling
  - Frequency analysis to determine dangerous networks topologies.
  - Countermeasures to limit temporary harmonic resonances and delayed zero crossings in circuit breakers

**Complete system studies (JM)**
- Load-flow solution and initialization of synchronous machines
- Temporary overvoltages to network islanding
- Ferroresonance and harmonic resonance
- Selection and usage of arresters
- Fault transients
- Statistical analysis of overvoltages
- Electromechanical transients

**DC links (XG)**
- Current and voltage control of a VSC
- Study of a point to point DC link
- Initialization of simulations
Day 4 - Thursday, 27 October

Advanced EMTP-RV usage - parallel workshops

- Statistical analysis and load-flow solution (SD - JM)
  - Detailed description of the statistical option and post processing analysis tools
  - Statistical study example
  - Load-flow calculation: theoretical basics and detailed description of EMTP-RV load-flow option
  - Study example: load-flow with synchronous generators, loads and load-flow constraints.
  - Results analysis and initialization of time-domain simulation.

- Scripting in EMTPWorks (XG - SD):
  - Quick introduction to JavaScript
  - EMTPWorks extensions to JavaScript
  - Device search methods, looking into subnetworks
  - Device attributes: Data and Methods
  - Changing data without opening a device
  - Scripting device data
  - Programming masks
  - Complete parametric study case:
    - Step-by-step analysis
    - Changing data
    - Rerunning
    - Scripting with MPLOT
EMTP-R V Software

POWERSYS is the worldwide commercializer of EMTP-RV
For additional information about EMTP-RV:
www.emtp.com

www.powersys-solutions.com