A computer laboratory-based course covering power system transients from introductory to advanced levels

Analysis of Transients in Power Systems

May 21–24, 2012
Madison, Wisconsin

Essential information for:
- Power system analysts
- Transmission engineers
- Substation engineers
- Wind generation analysts
- Researchers
- Consultants

- Understanding power system transient phenomena
- Presenting EMTP-RV as a simulation tool
- Modeling power system equipment
- Conducting practical power system studies
- Assessing the validity of results

With the participation of Powersys Solutions
Course Highlights
- Introduction to EMTP-RV using examples
- Transmission and distribution case studies
- Power system stability studies, electromechanical oscillations
- Insulation coordination of a 230 kV transmission system
- Insulation coordination of a 230 kV GIS
- Synchronous and asynchronous machine models and associated controls
- Power system studies
- Wind generation studies

Course Background
Electromagnetic transients exist in power systems in many forms. They span the range from switching and lightning-induced traveling waves to power electronics systems to power quality to wind power generation. The accepted analysis tool for studying these phenomena is the Electromagnetic Transients Program (EMTP). Because of its worldwide use, it is generally considered to be the standard analysis tool.

In the late 1970s the need to formally educate EMTP users was recognized, and the University of Wisconsin–Madison began to offer summer short courses in the use of EMTP. This new course continues our mission of offering high-quality instruction in topics of importance to power industry professionals.

Course Objective
This course will provide beginning and intermediate students a good hands-on experience on the analysis and modeling of power system transients. The course is based on the usage of EMTP-RV for demonstrating concepts and teaching through practical problem cases. It contributes significantly to the simplification of complex power system studies and to the visualization of complex concepts.

Computer Exercises
The course will be taught in the computer laboratory using EMTP-RV. Attendance is limited, and each student will have his/her own computer. Students will receive time-limited (30 days) CDs of the current version of EMTP-RV. For more information on the EMTP-RV software package, please visit www.emtp.com or Powersys Solutions, www.powersys-solutions.com.

Who Should Attend
Engineering personnel familiar with the basics of electric power system analysis who need to get more in-depth knowledge of the analysis and simulation of power system transients in areas including:
- Insulation coordination of HV substations and transmission lines
- Rotating machines dynamics
- Application of power electronics and associated controls in power systems
- HVDC and FACTS equipment
- Power quality studies
- Wind power generation

Attendees with a limited understanding of power system transients will find that the case study approach will introduce the various families of transients in a manner that develops an in-depth understanding of the phenomena.

Attendees with a more detailed background in power system transients will find that this course will augment their knowledge by providing extended case study exercises to explore. Users of any EMTP-type program will benefit by increasing their knowledge of transient analysis and simulation.

Prior exposure to and experience with the EMTP is not required.
Course Outline

Monday, May 21
8:00 Registration
The Pyle Center
702 Langdon Street
Madison, WI

1 Theoretical Background on Transients in Power Systems: DeMarco
  • Classification of events
  • Time and frequency scales
  • Modeling limitations
  • Boundaries of accuracy

2 Numerical Methods for the Simulation of Transients: Mahseredjian
  • Load-flow
  • Steady-state
  • Frequency scan
  • Initialization
  • Time-domain

3 Introduction to EMTP-RV and EMTPWorks
   Using Examples: Mahseredjian
   • Overview: devices, pins and signals
   • Power and control devices
   • Device attributes
   • Basic scripting techniques
   • MPLOT and ScopeView

4 EMTP-RV Simulation Options: Mahseredjian
   • Steady-state analysis and initialization
   • Numerical methods in time-domain computations
   • Solution of nonlinear devices

5 Creation and Maintenance of Subnetworks: Mahseredjian
   • Subnetwork uniqueness
   • Masking
   • Hierarchical designs: from small systems to large scale problems
   • Symbol editor
   • Password protection

6 Creation and Maintenance of Libraries: Mahseredjian

7 Other Options: Mahseredjian
  • Available Libraries
  • Searching for devices
  • Error checking
  • Page setup, multipage designs

8 Basic Models: Switches, RLC Branches, Ideal Sources: Mahseredjian

Tuesday, May 22
9 The Library of Control Devices: Mahseredjian
   • Measuring devices: power, voltage, current
   • Periodic meters, transformation functions
   • User-defined modeling

10 Simulation of Control Systems: Mahseredjian
   • Initialization methods
   • Examples: mean-value model, measuring power with variable frequency, variable inductance model

11 Switching Device Models: Mahseredjian
   • Application examples
   • Simulation of power electronics devices
   • Power converters and switching devices, modeling issues
   • Line/self commutated systems

12 Input Impedance Computation: Mahseredjian

13 Transmission/Distribution Line Models: Mahseredjian
   • Theory and available models
   • Pi-section, constant parameter model, frequency dependent models
   • Corona model
   • Application examples

14 Three-phase Power-flow: Mahseredjian
   • Methodology and Setup Options
   • Initialization

15 Nonlinear devices: Mahseredjian
   • Modeling in steady-state and time-domain
   • Application examples

16 Transformer Models: Mahseredjian

17 Synchronous and Asynchronous Machine Models and Related Controls: Mahseredjian
   • Available models
   • Case setup, controls and initialization
   • Startup from 0 Hz

Wednesday, May 23
18 The Study of a Complete System: Mahseredjian
   • From load-flow to steady-state to time-domain
   • Initialization of machine controls
   • Switching transients
   • Temporary overvoltages

19 Power System Stability Studies: Electromechanical Oscillations: Mahseredjian
   • Exciter, governor and stabilizer models
   • Load model designs and applications
   • Transmission case study
   • Synchronous machine synchronization

20 Statistical Analysis Methods: Mahseredjian

21 IEEE-34 bus Distribution Test Case Study: Mahseredjian

22 Introduction to Power Quality Studies: Mahseredjian

Thursday, May 24
23 Insulation Coordination Principles: Mader
   • Voltage stresses within the system
   • Power frequency insulation and pollution
   • Lightning, switching and temporary overvoltages
   • Lightning arrester selection
   • Insulation coordination methodologies

24 Insulation Coordination of a 230 kV Transmission System: Mader
   • System setup
   • Power-flow and steady-state stability of the system
   • Statistical switching studies and line insulation
   • Temporary overvoltages, usage of line arresters and reclosing resistors
   • Ferroresonance and harmonic resonance
   • Lightning protection of substations

25 Practical Power System Studies: Mader
   • Insulation coordination of a 230-kV GIS
   • Transformer and capacitor bank switching
   • Temporary overvoltage cases – load rejection, self excitation, etc.
   • TRV studies
   • Breakers and switches
   • Breaker failure analysis with detailed arc model

26 Additional Studies: Mahseredjian
   • HVDC converters and systems
   • Wind generator models and wind parks
   • Integration of renewable resources

12:00 End of Lectures
1:00 Computer Lab Available for Continuing Case Studies
5:00 Final Adjournment

ENROLL ONLINE TODAY! Or visit our Web site
Personal Information
(Please print clearly.)

Name ________________________________________________________________
Title _________________________________________________________________
Company ______________________________________________________________
Address _______________________________________________________________
City/State/Zip __________________________________________________________
Phone (______) __________________ Fax (______) __________________
E-mail ________________________________________________________________

Four Easy Ways to Enroll

Course Information

☐ Please enroll me in Analysis of Transients in Power Systems
Course #N125 May 21–24, 2012 in Madison, Wisconsin  Fee: $2195

Enrollment is limited to 20 students. Enroll early!

☐ I cannot attend. Please send me information on related courses.

Fax: 800-442-4214
or 608-265-3448
Phone: 800-462-0876
or 608-262-1299 (TDD 265-2370)

Mail to:
Engineering Registration
The Pyle Center, Dept. 108
702 Langdon Street
Madison, Wisconsin 53706

Additional Enrollees

Name ________________________________________________________________
Title _________________________________________________________________
E-mail ________________________________________________________________

Name ________________________________________________________________
Title _________________________________________________________________
E-mail ________________________________________________________________

Billing Information

☐ Bill my company
☐ P.O. or check enclosed (Payable in U.S. funds to UW – Madison)

Cardholder's Name ____________________________________________________
Card No. ________________ Expires __________

UW# __________

Need to Know More?

Call toll free 800-462-0876 and ask for
Program Director: Willis F. Long
willis@engr.wisc.edu

Program Associate: Debbie Benell
benell@engr.wisc.edu
or e-mail custserv@epd.engr.wisc.edu

General Information

Fee of $2195 Covers Notebook, course materials, EMTP-RV CD, break refreshments, four lunches, and certificate. We do not publish proceedings. Course materials are distributed only to participants.

Cancellation If you cannot attend, please notify us by May 14, and we will refund your fee. Cancellations received after that date and no-shows are subject to the full fee. You may enroll a substitute at any time before the course starts.

Location The Pyle Center, 702 Langdon Street, Madison, Wisconsin. If you must be contacted during the course, phone messages may be left for you at 608-262-1122.

Earn Continuing Education Credit By participating in this course, you will earn 2.5 Continuing Education Units (CEU).

Accommodations

We have reserved a block of guest rooms (rates starting at $89, including parking and continental breakfast) at The Lowell Center, 610 Langdon Street, Madison, WI. Reserve a room on-line at epd.engr.wisc.edu/lodgingN125 or call 866-301-1753 or 608-256-2621. Room requests after April 23 will be subject to availability. Other fees and restrictions may apply.

We have reserved a second block of guest rooms (rates starting at $89, including continental breakfast, parking, and private airport taxi (a $30 value)) at The Campus Inn, 601 Langdon Street, Madison, WI. Reserve a room on-line at epd.engr.wisc.edu/lodgingBN125 or call 800-589-6285 or 608-257-4391 and indicate that you will be attending this course under group code 116129. Room requests after April 30 will be subject to availability. Other fees and restrictions may apply.