



EUCI Presents a Course on:

POWER FLOW IN ELECTRIC POWER NETWORKS

September 27-28, 2010 • Hyatt Regency Vancouver • Vancouver, BC Canada



EUCI is authorized by IACET to offer 1.4 CEUs for this program.

OVERVIEW

Determining the flow of power in an electric power network is perhaps the most fundamental of analysis problems for an electric power system designer or operator. From knowledge of the customer power demand at each substation and of the power to be supplied by each generator, the Power Flow Analysis finds the flow of real and reactive power through each transmission line. With this information:

- A designer can determine if a transmission network is adequate or needs modifying
- An operation planner can find the most economical assignment of power to be supplied by each generator
- A system operator can be provided with a display of current voltages and line flows in a control center
- Software designers can build such applications as state estimation, optimal generation allocation, and contingency analysis
- Power flow analysis is ubiquitous in a power system enterprise.

This course will provide students with a basic understanding of what determines the flow of power in each line of a network. We will learn how lines and networks are modeled and how this model is stated in a mathematical form that permits successful computation for even the largest of today's systems. And we will learn the techniques that accomplish these solutions in a surprisingly short time for on-line applications in control centers. Numerical examples will occur throughout the course using small systems that will allow the student to grasp the concepts without being overwhelmed by detail.

WHAT YOU WILL LEARN

Participants will demonstrate how to represent a system of any size in a concise mathematical form. They will then identify how this model is used to compute all the voltages and line flows in a system using reliable algorithms. We will explore the two basic algorithms employed for this calculation as well as the variations that permit rapid, on-line solutions. Further material will illustrate how the power flow solution is used in almost all aspects of system design and control.

TARGET AUDIENCE

- Power engineers wishing a refresher course
- Electric utility engineers with degrees not in power systems
- System operators
- Engineers in industry producing power system hardware and software
- Technology managers in the utility industry
- Electric utility consultants

IACET



EUCI has been approved as an

Authorized Provider by the International Association for Continuing Education and Training (IACET), 1760 Old Meadow Road, Suite 500, McLean, VA 22102. In obtaining this approval, EUCI has demonstrated that it complies with the ANSI/IACET Standards which are widely recognized as standards of good practice internationally.

As a result of their Authorized Provider membership status, EUCI is authorized to offer IACET CEUs for its programs that qualify under the ANSI/IACET Standards.

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Requirements for Successful Completion of Program

Participants must sign in/out each day and be in attendance for the entirety of the course to be eligible for continuing education credit.

Instructional Methods

Case studies, PowerPoint presentations, and classroom exercises will be used.

PROGRAM AGENDA

MONDAY, SEPTEMBER 27, 2010

Registration and Continental Breakfast: 8:00 – 8:30 a.m.

Session I: 8:30 a.m. – 12:00 p.m.

Power Flow Calculations Essential in Power System Networks

- Networks provide reliability
- Mechanisms of power flow and synchronism
- Role of control centers

Modeling Electric Energy Networks for Power Flow Calculations

- Transmission line models
- Creating the bus admittance matrix, Y_{bus}
- Including transformers and generators
- Manipulating Y_{bus}

Group Luncheon: 12:00 – 1:00 p.m.

Session II: 1:00 – 5:00 p.m.

The Power Flow Problem Defined

- Modeling power flow at a bus
- Model of power flow on entire network
- Bus types
- The equations and the unknowns

Numerical Methods for Solving the Power Flow Problem

- Gauss-Sidel algorithm
 - Concept
 - Applied to power flow

TUESDAY, SEPTEMBER 28, 2010

Continental Breakfast: 8:00 – 8:30 a.m.

Session III: 8:30 a.m. – 12:00 p.m.

Numerical Methods - Continued

- Newton-Raphson algorithm
 - Concept
 - Applied to power flow

Implementation Issues

- Convergence
- Sparsity

Group Luncheon: 12:00 – 1:00 p.m.

Session IV: 1:00 – 4:00 p.m.

Power Flow - Enhancements and Modifications

- State estimator
- Modified Jacobian
- Decoupled power flow
- Fast-decoupled power flow
- DC Power flow
- Control applications

Open Discussion

INSTRUCTOR

Mark J. Damborg, Professor Emeritus, Department of Electrical Engineering, University of Washington

Mark J. Damborg received his B.S. degree in Electrical Engineering from Iowa State University in 1962 and his M.S. and Ph.D. from the University of Michigan in 1963 and 1969, respectively. He was a Fulbright Fellow at the Delft Technological University in Delft, Netherlands, 1966-67. Since 1969, Professor Damborg has been on the electrical engineering faculty at the University of Washington where his interests concentrate on control systems and power systems. He was with the Division of Electric Energy Systems, U.S. Department of Energy, 1977-78, and served as Associate Dean of Engineering, University of Washington, 1994-97.

Professor Damborg's recent research, teaching and curriculum development topics include static and dynamic analysis of power systems (e.g. power flow, fault analysis and transient stability) as well the mathematical foundations of system theory. He has also developed and taught short courses for practicing engineers on topics concerning power system analysis and operations.

PROCEEDINGS

The proceedings of the course will be published and one copy will be distributed to each registrant at the course.

COURSE LOCATION

A room block has been reserved at the Hyatt Regency Vancouver 655 Burrard Street, Vancouver, BC, V6C 2R7, for the nights of September 27-28, 2010. Room rates are \$199.00 CAD single/double guest rooms plus applicable tax. Call 604-683-1234 for reservations and mention the EUCI conference to get the group rate. Make your reservations prior to September 14, 2010. There are a limited number of rooms available at the conference rate. Please make your reservations early.

REGISTRATION INFORMATION

REMEMBER, EVERY 4TH REGISTRANT IS FREE

For instant registration, call (201) 871-0474 or fax the Registration Form to (253) 663-7224.

Register 3, Send 4th Free!!

Any organization wishing to send multiple attendees to these conferences may send 1 FREE for every 3 delegates registered. Please note that all registrations must be made at the same time to qualify.

All cancellations received on or before August 27, 2010 will be subject to a \$195 processing fee. Written cancellations received after this date will create a credit of the tuition (less processing fee) good toward any other EUCI conference or publication. This credit will be good for six months. In case of conference cancellation, Electric Utility Consultants' liability is limited to refund of the conference registration fee only. For more information regarding administrative policies such as complaint and refunds, please contact our offices at 3(201) 871-0474.

EUCI reserves the right to alter this program without prior notice.

MAIL DIRECTLY TO:

The Power Marketing Association (PMA)
P.O. Box 2303
Falls Church, VA 22042

FAX TO: (253) 663-7224
PHONE: (201) 871-0474

PLEASE REGISTER THE FOLLOWING

- Power Flow in Electric Power Networks, September 27-28, 2010: US\$1495 plus 12% HST (US\$1674.40),
Early Bird on or Before September 17, 2010: US\$1295 plus 12% HST (US\$1450.40)

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(direct email, colleague, speaker(s), etc.)

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