Principles of Substation Design and Construction

February 8–10, 2016
Lake Buena Vista, Florida

October 17–19, 2016
Madison, Wisconsin

Gain valuable knowledge to help you:

- Develop reliable designs
- Control project costs
- Keep your project on schedule

- Designing foundations and structures
- Protective relaying basics
- Control and wiring diagrams
- Writing equipment specifications
- Grounding and ground grid design
- Managing environmental issues

ENROLL ONLINE TODAY!
Or visit our Web site
A Comprehensive Introduction to Substation Design

This introductory course in design fundamentals will guide you through a step-by-step study of the substation design and construction process. You will consider all phases, from initial site review and selection to substation start-up and commissioning.

What You Will Study

Starting from the initial project scope document, you will learn about:

- The project scope document and what it should contain
- Foundation, structure, and ground grid design
- Writing equipment specifications
- Substation layout and bus design
- Protective relaying and control basics
- Trip schematics and wiring diagrams
- Site and structure drawings
- Function and ratings of major substation equipment
- Auxiliary equipment and systems
- Substation automation and integration
- Working with the project manager
- Managing environmental and permitting issues
- Dealing effectively with the public

Who Should Attend

- Substation design engineers
- Consulting engineers
- Industrial, utility, or plant engineers
- Transmission and distribution line design engineers and technicians
- Project managers
- Construction supervisors
- Engineering technicians
- Managers of design engineering departments
- Electric utility engineers involved in distribution engineering, operations, or planning

If you are involved in the design, construction, or operation of medium- or high-voltage substations and distribution facilities, you will benefit from this course. Individuals recently assigned to a position in substation design will find this course especially valuable.

Learn Important Project Management Issues

You may either work with a project manager on your substation design projects or be asked to manage a substation design and construction project yourself. Attend this course and learn how to keep a substation project on time and on budget.

Course Instructors

Kevin Borgmeyer, PE, is manager of Substation Engineering at Alliant Energy in Madison, Wisconsin. He has been with Alliant Energy for more than 30 years, during which he has worked in a variety of engineering management positions. Borgmeyer has experience as a transmission and substation engineer and also as a senior system protection engineer, encompassing a wide engineering experience from substation siting and design to system protection design, substation integration, and commissioning. He graduated from Iowa State University with a BSEE degree.

Charles R. Hanson, PE, is the founder and owner of HANSON Engineering, LLC, a firm that provides structural engineering services to contractors, architects, owners, utilities, and government agencies. Previously, Hanson was a principal at a multi-discipline consulting engineering firm with offices in Madison and Milwaukee, where he was the chief structural engineer of the Madison office. His responsibilities included structural design of a wide variety of substation and building projects and project management for multi-discipline projects. Hanson is a member of the ASCE and the American Institute of Steel Construction. He earned his civil engineering degree from the University of Wisconsin–Platteville.

Sheldon I. Silberman, PE, is manager of engineering and design outsourcing in substation services at Xcel Energy in Minneapolis, Minnesota. In this role, Silberman manages all consulting services for the engineering and design of Northern States Power (NSP) substation and transmission line projects. He has been with Xcel Energy/NSP for more than 25 years, working in various engineering and management positions related to substation design, construction, and maintenance. Silberman received a BSEE degree in electric power systems from the University of Minnesota.

Valuable Take-Home References

You will receive extensive course materials that will serve as valuable references in your work.

Bring a Calculator for Classroom Exercises

Classroom problem-solving sessions will give you the opportunity to apply your new skills and reinforce your learning. Bring a calculator that can add, subtract, multiply, divide, and calculate square roots.

Earn Continuing Education Credit

By participating in this course, you will earn 20 Professional Development Hours (PDH) or 2.0 Continuing Education Units (CEU).
Course Outline

Day 1

7:15  Registration
7:45  Welcome
John A. Rakosny, PE
Program Director, Department of Engineering Professional Development
University of Wisconsin–Madison

8:00  Instruction Begins
1  Substation Types and Purposes
Sheldon Silberman, PE
Manager, Xcel Energy Inc.
• Fundamentals of power system operation
• Objectives of substation design

2  Overview of the Substation Design and Construction Process
Kevin Borgmeyer, PE
Manager, Alliant Energy
• Establishing the need for substation facilities
• The project scope document
• What it is and what it should contain
• Site selection and environmental issues
• Working with the project manager
• Engineering design
• Equipment specifications and drawings
• Specifying and procuring material and equipment
• Construction
• Testing, start-up, and commissioning
• Documenting field revisions

3  Initial Steps in the Design Process: Setting the Bounds for the Overall Project
Sheldon Silberman, PE
• Reviewing and understanding the project scope document
• Information to gather before the first site visit
• What to look for on the initial site visit
• Determining site adequacy for initial and future requirements
• Environmental, zoning, and public perception issues
• Construction and construction outage requirements
• Accessibility for construction and O&M equipment
• Ordering material/delivery date issues

Day 2

7:45  Instruction Continues
8  Substation Layout: Converting 1-line Diagrams to Physical Layouts
Sheldon Silberman, PE
• Substation components and required code clearances
• Bil., insulation coordination, and surge arresters
• Future expansion
• Access for O&M
• Design exercise

4 Site Selection and Design
Kevin Borgmeyer, PE
Sheldon Silberman, PE
• General requirements
• Environmental and permitting issues
• Site preparation
• Drainage and erosion protection
• Surface materials
• Roads and access

5 Permitting and Environmental Issues
Sheldon Silberman, PE
Kevin Borgmeyer, PE
• Acquiring necessary permits
• Zoning and ordinance restrictions
• Long-term site impacts
• Impacts during construction
• Runoff/stream pollution

6 Foundation Design
Chuck Hanson, PE
Founder and Owner, HANSON Engineering, LLC
• The site visit and what to look for
• Understanding soil test reports
• Slab on grade design example

7 Bus Designs for Reliability
Kevin Borgmeyer, PE
• Bus configurations and 1-line diagrams
• Forced and planned outage performance
• Cost-reliability comparisons

5:15  Adjournment

Day 3

7:45  Instruction Continues
12 Secondary Substation Equipment
Sheldon Silberman, PE
Kevin Borgmeyer, PE
• Surge arresters

9 Grounding and Ground Grid Design
Sheldon Silberman, PE
• Purpose of grounding
• Field-testing ground grid resistance and soil resistivity
• Materials and installation

10 Substation Structures
Sheldon Silberman, PE
• Choice of structure for substation designs
• Specifying a structure

11 Major Substation Equipment
Kevin Borgmeyer, PE
• Circuit breakers
• High-voltage and low-voltage switches
• Design exercise

5:15  Adjournment

13 Auxiliary Equipment and Systems
Sheldon Silberman, PE
Kevin Borgmeyer, PE
• AC/DC station power and control system supplies
• Insulated cables and raceways for power and control

14 Protective Relaying and Control
Kevin Borgmeyer, PE
• System protection objectives and philosophies
• Protective relaying schemes for major substation equipment
• Typical relay types and applications

15 Expansion and Upgrade of Existing Substations
Sheldon Silberman, PE
Kevin Borgmeyer, PE
• Feasibility and limitations

16 Commissioning and Start-Up
Sheldon Silberman, PE
• Purpose of commissioning and start-up

4:00  Final Adjournment

Past Participants Say...

“This is the fourth course I’ve taken from UW and I would recommend their courses to anyone. Always very helpful, especially the practical examples and real-world issues presented. Sheldon Silberman is very knowledgeable and personable! Kevin Borgmeyer is a great teacher; I hope some day I’ll know as much as he does (or even half that much)!”
Annette Jessen, Stations Structural Designer, Idaho Power Company, Boise, Idaho

“I can’t imagine that any organization could prepare a better introductory substation design course. All of the instructors were excellent.”
Dennis C. Spencer, Substation Designer, Lee County Electric Coop, North Ft. Myers, Florida

“I especially enjoyed the in-class exercises that put the student in the design environment.”
George Guirguis, Substation Engineer, City of Lake Worth Utilities, Lake Worth, Florida

“The substation layout session and the associated in-class exercise were excellent.”
Rick Borkowicz, PE, Engineering Manager, RMF Engineering, Baltimore, Maryland

“The reference materials you provided were excellent. It was extremely valuable having the instructors share real-world experiences. All the speakers were excellent. Well-prepared, goal-focused, well-versed, as well as being very personable.”
Steve Lacaire, Senior Service Engineer, Eaton Electrical Corp., West Boylston, Massachusetts

“This course exceeded my expectations. I anticipate using a majority of the material in the near future.”
Michael Wilson, Substation Design Engineer, Power System Engineering, Inc., Madison, Wisconsin
### Upcoming Related Courses in Madison and Florida

#### Fundamentals of Substation Equipment and Control Systems
- **January 18–20, 2016**
  - Lake Buena Vista, Florida
  - Course #R009
- **October 24–26, 2016**
  - Madison, Wisconsin
  - Course #R012
- **November 7–11, 2016**
  - Madison, Wisconsin
  - Course #R019

#### Design of Transmission Lines, Structures, and Foundations
- **February 22–26, 2016**
  - Lake Buena Vista, Florida
  - Course #R010
- **December 5–9, 2016**
  - Lake Buena Vista, Florida
  - Course #R011
- **October 24–26, 2016**
  - Madison, Wisconsin
  - Course #R019

#### Computerized Transmission Line Design: PLS-CADD Hands-On Training
- **February 15–19, 2016**
  - Lake Buena Vista, Florida
  - Course #R018
- **November 7–11, 2016**
  - Madison, Wisconsin
  - Course #R021
- **December 5–9, 2016**
  - Lake Buena Vista, Florida
  - Course #R022

### Need to Know More?
- **Program Director:** John A. Raksany, PE
  - jarraksany@wisc.edu
- **Program Associate:** Mary Danielson
  - mary.danielson@wisc.edu
- Or email custserv@epd.engr.wisc.edu

### General Information
- **Fee Covers:** Course materials, breaks, refreshments, lunches, and certificate.

### Cancellation
- If you cannot attend please notify us seven days prior to the course start, and we will refund your fee. Cancellations received after that date and no-shows are subject to a $150 administrative fee per course. You may enroll a substitute at any time before the course starts.

### Location and Accommodations
- **February Location:** Holiday Inn – In the Walt Disney World Resort, 1805 Hotel Plaza Blvd., Lake Buena Vista, FL. Phone messages: 407-828-8888.
- **February Accommodations:** Reserve a room (rates starting at $125) at Holiday Inn – In the Walt Disney World Resort, 1805 Hotel Plaza Blvd., Lake Buena Vista, FL online at epd.engr.wisc.edu/lodgingR010 or call 877-394-5765 and use group code PRI. Room requests after January 7 will be subject to availability. Other fees and restrictions may apply.
- **October Location:** The Pyle Center, 702 Langdon Street, Madison, WI. Phone messages: 608-262-1122.
- **October Accommodations:** Reserve a room (rates starting at $130, including shuttle) at Madison Concourse Hotel and Governor's Club, One West Dayton Street, Madison, WI online at epd.engr.wisc.edu/lodgingR011 or call 800-356-8293 or 608-257-6000 and use group code 470260. Room requests after September 18 will be subject to availability. Other fees and restrictions may apply.

### Additional Enrollees

### Billing Information
- **Bill my company**
- **P.O. or check enclosed** (Payable in U.S. funds to UW – Madison)
- **Cardholder's Name:**
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- **Exp.**
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- **Cardholder's Name:**
- **Card No.**
- **Exp.**

### Personal Information (Please print clearly.)
- **Name:**
- **Title:**
- **Company:**
- **Address:**
- **City/State/Zip:**
- **Phone:**
- **Fax:**
- **E-mail:**

### Other Fees and Restrictions
- Other fees and restrictions may apply.

### Enroll Online Today!
- **Internet:** http://epd.engr.wisc.edu
- **Phone:** 800-462-0876 or 608-262-1299 (TDD 265-2370)
- **Mail:** The Pyle Center
  - Attn: Engineering Registration
  - 702 Langdon Street
  - Madison, Wisconsin 53706
- **Fax:** 800-442-4214 or 608-265-3448

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**Course Information**
- Please enroll me in **Principles of Substation Design and Construction**
  - **Course #R010** February 8–10, 2016 in Lake Buena Vista, Florida  Fee $1495
  - **Course #R018** October 17–19, 2016 in Madison, Wisconsin  Fee $1495
- I cannot attend at this time. Please send me brochures on future courses.