Arc Flash Hazard Analysis

June 13–15, 2007
Madison, Wisconsin

- ✓ *NFPA 70E, IEEE 1584, and NESC 410A3 Standards*
- ✓ *Arc flash calculations*
- ✓ *Safe work practices*
- ✓ *Personal protective equipment*
- ✓ *Arc-resistant switchgear*
- ✓ *Coordination with faster trip times*

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THE UNIVERSITY of WISCONSIN MADISON

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432 North Lake Street Madison, Wisconsin 53706

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THE UNIVERSITY of WISCONSIN MADISON

COLLEGE OF ENGINEERING ■ DEPARTMENT OF ENGINEERING PROFESSIONAL DEVELOPMENT

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Arc Flashes Pose Serious Hazards

The National Fire Protection Association (NFPA) defines an arc flash as "a dangerous condition associated with the release of energy caused by an electric arc." Five to ten arc flash explosions occur daily in electrical equipment in the United States. Injuries from arc flash events range from minor to life threatening to fatal. An arc flash event can, in addition, cause serious equipment damage, resulting in an interruption of facilities operation.

An arc flash is essentially an electrical short circuit through the air. In an arc flash incident, concentrated radiant energy explodes outward, resulting in pressure waves, a high-intensity flash, and a superheated ball of gas. The potential for physical injury is extreme.

Ensure Worker Safety

New industry standards establish safe practices to protect electrical workers from the hazards of shock, electrocution, arc flash, and arc blast. These standards include:

- OSHA 29 Code of Federal Regulations Part 1910, Subpart S
- NFPA 70-2005, National Electrical Code
- NFPA 70E-2004, Standard for Electrical Safety Requirements for Employee Workplaces
- IEEE Standard 1584-2002, Guide for Performing Arc Flash Hazard Calculations
- NESC 410A3, which requires that by January 1, 2009, a potential arc exposure assessment shall be performed

At this course you will examine these standards, gain an understanding of their significance, and learn how to apply them in your workplace.

Prepare for NESC 410A3

The 2007 revision of the National Electric Safety Code includes flame retardant clothing as a requirement. Rule 410A3 states, "Effective January 1, 2009, the employer shall ensure that an assessment is performed to determine potential exposure to an electric arc for employees who work on or near energized parts or equipment. If the assessment determines a potential employee exposure greater than 2 cal/cm2 exists, the employer shall require the employee to wear clothing or a clothing system that has an effective rating at least equal to the anticipated level of arc energy." Section 8 of this course will include an open discussion on this topic. Attendees are encouraged to bring examples of the preliminary steps taken by their organizations to meet this new requirement.

Learn How to Perform Arc Flash Calculations

Arc flash calculations estimate incident energy exposure from potential arc sources. A bolted fault creates high current that flows through the network. Traditional fault studies are used to select equipment that can withstand and interrupt these short circuit currents. Arcing faults follow a path through a vapor between two conducting materials. The arcing fault current is smaller than a bolted fault current, but the potential for human injury is much greater. Arc flash calculations follow the NFPA 70E 2004 and IEEE 1584-2002 methods for determining arc flash hazard distance and incident exposure energy. These calculations incorporate short circuit calculations, empirical equations, and protective device operating times.

Attend and Benefit

This course will assist plant and design engineers responsible for assuring a safe work environment in industrial electrical distribution systems. This includes plant, facility, and corporate electrical engineers dealing with one or more company distribution systems and consulting and utility engineers dealing with clients' systems. Utility engineers with responsibilities for NESC compliance will become familiarized with arc flash hazard analysis. Experienced electrical contractors will also benefit from this course.

Note: Please bring a calculator as it will be helpful in solving classroom examples and problems.

Course Faculty

Steven R. Potter, P.E.
Principal
SRP Engineering
Pasadena, California

Michael A. Aimone, P.E.
Senior Electrical Engineer
Washington, D.C.

Larry Ray, P.E.
Manager
Power Systems Engineering
Square D/Schneider Electric
Raleigh, North Carolina

Benny E. May, P.E.
Manager, Electrical Engineering
AVO Electrical Engineering Services
Dallas, Texas

Vladimir Ostrovsky
Director, International Training
W. H. Salisbury
Skokie, Illinois

Program Director

Willis F. Long, P.E.
Professor Emeritus
Department of Engineering Professional Development
University of Wisconsin–Madison

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Course outline inside...

Arc Flash Hazard Analysis

June 13–15, 2007
Madison, Wisconsin

Course Outline

Wednesday, June 13

8:00 Registration
The Pyle Center
702 Langdon Street
Madison, Wisconsin

8:20 Introduction to the Program: Bill Long
- Welcoming remarks
- What you can expect to learn

1. An Overview of Fault Current Analysis: Mike Aimone
- Fault current sources
- Short circuit current parameters
- Actual fault types
- Balanced fault analysis
- Impedance diagrams
- Fault current calculations

2. An Introduction to Arc Flash Calculations: Steve Potter
- Causes of electrical flash events
- Why perform arc flash studies
- Who should perform arc flash calculations

3. Relevant Arc Flash Standards: Mike Aimone
- OSHA 29
- NFPA 70-2005
- NFPA 70E-2004
- IEEE Standard 1584-2002
- NESC 410A3
- Significance of standards

4. Arc Flash Calculation Procedure: Steve Potter
- Arc flash equations
  - arcing fault current
  - incident energy
  - arc flash boundary
  - default values

Thursday, June 14

5. Calculation Methodology: Steve Potter
- Overview of protective device coordination
- Understanding time-current curves
- Fault current vs. energy released
- Calculating with uncertainty
- Protective device trip time

6. Arc Flash Calculations Continued: Steve Potter
- Accumulated energy
- Minimum and maximum faults
- Use of tolerances
- Current limited devices

7. Computer Demonstration of Arc Fault Calculations: Steve Potter
- Data needed
- Options available
- Typical calculations

8. NESC 410A3 Requirements: Benny May
- Potential exposure assessment
- Clothing requirements
- Implementing a safety program
  - case study of utility switchyard (161 kV)
  - case study of industrial refinery facility (44 kV-13.8 kV-4160 V-480 V)
  - implementing the site-specific plan

9. Personal Protective Equipment: Ostrovsky
- Determining PPE requirements
- Hazard risk categories
- Characteristics of clothing and other equipment
- Clothing and other equipment available for inspection

Friday, June 15

10. Equipment Issues Relating to Arc Flash Hazards: Larry Ray
- Overview of electrical equipment
- How to reduce arc flash levels
- Fuse-protected vs. non-fuse-protected circuit breakers
- Arc-resistant switchgear
- Effective data collection
- Arc flash label issues
- Safety: the overriding concern

12:00 Final Adjournment

Daily Schedule

8:00 Coffee and conversation
8:30 Class session
9:30 Break–coffee and rolls
9:50 Class session
10:50 Break
11:00 Class session
12:00 Lunch
1:00 Class session
2:15 Break—soft drinks
2:30 Class session
3:30 Break
3:45 Class session
5:00 Adjournment

Related Courses

Protection of Industrial and Commercial Electric Power Distribution Systems
March 26–29, 2007, Madison, Wisconsin
Course #H707

Introduction to Right-of-Way for Utility Engineers, Technicians, and Managers
May 1–2, 2007, Madison, Wisconsin
Course #J078

Electrical Systems Design for the Non-Electrical Engineer
May 7–11, 2007, Madison, Wisconsin
Course #J061

Dynamic Reactive Power Control
May 15–18, 2007, Madison, Wisconsin
Course #J105

Modern Power System Protection: Applications and Performance Analysis
June 4–8, 2007, Madison, Wisconsin
Course #H710

Communications for Power System Protection and Automation
June 11–14, 2007, Madison, Wisconsin
Course #H711

Analysis of Transients in Power Systems
June 18–21, 2007, Madison, Wisconsin
Course #J052

2007 EEI Transmission and Wholesale Markets School
July 9–13, 2007, Madison, Wisconsin
Course #H955

Understanding Power System Dynamic Behavior
July 17–20, 2007, Madison, Wisconsin
Course #J204

Enroll online today! http://epd.engr.wisc.edu/webH712

Companion Course

Be sure to watch for our companion course, *Coordination of Industrial and Commercial Electric Power Distribution Systems*. Offered September 11–14, 2007, the course focuses on systematic, step-by-step procedures for completing comprehensive coordination studies. Participants spend time practicing and applying learned concepts and using state-of-the-art coordination software to illustrate solutions for real-world problems. For additional information contact program director Willis Long, 800-462-0876 or 608-262-1199, or e-mail willis@epd.engr.wisc.edu.

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- At reduced per-person cost
- Tailored to your needs

To inquire about this on-site course or other courses that we can bring to your site, call 800-462-0876 and ask for Corporate Education Director Carl Vieth (608-263-7424 direct). Or see http://epd.engr.wisc.edu/onsite

Need to Know More?

Call toll free **800-462-0876** and ask for

Program Director:
Willis F. Long, P.E.
willis@engr.wisc.edu

Program Associate:
Debbie Benell
benell@engr.wisc.edu

Or e-mail **custserv@epd.engr.wisc.edu**

General Information

Fee Covers Notebook, course materials, continental breakfasts, break refreshments, two lunches, and certificate. We do not publish proceedings. Course materials are distributed only to participants.

Cancellation If you cannot attend, please notify us by June 6, and we will refund your fee. Cancellations received after this date and no-shows are subject to a $150 administrative fee. You may enroll a substitute at any time before the course starts.

Location The course will be held at 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.

Accommodations We have reserved a block of sleeping rooms for course participants at The Campus Inn, 601 Langdon Street, Madison, Wisconsin, at the special rate of $99/single or $114/double. To reserve a room, please call 608-257-4391 or toll free 800-589-6285 by May 22 and indicate that you will be attending this course under group code 51875. Your enrollment confirmation will include other hotel/motel information.

Continuing Education Units Earn 1.8 continuing education units (CEU) when you attend this course.

Four Easy Ways to Enroll

Phone:
800-462-0876 or
608-262-1299 (TDD 265-2370)

Internet:
http://epd.engr.wisc.edu/webH712

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

Fax:
800-442-4214 or 608-265-3448

Course Information

Please enroll me in **Arc Flash Hazard Analysis**

❑ **Course #H712** June 13–15, 2007 in Madison, WI Fee: $995

❑ I cannot attend at this time. Please send me brochures on future courses.

Note: Enrollment is limited.

Personal Information (Please print clearly.)

Name _____

Title _____

Company _____

Address _____

City/State/Zip _____

Phone (_____) _____ Fax (_____) _____

E-mail _____

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)

❑ MasterCard ❑ VISA ❑ American Express

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Card No. _____ Expires _____

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❑ Please check the box if you are a person with a disability and desire special accommodations. A customer service representative will contact you. Requests will be kept confidential.