Underground Power Line Design

January 23–24, 2013 at Lake Tahoe, Nevada

Practical Course

This course is based on actual power systems and provides you with an excellent opportunity to learn about underground electrical distribution systems from a professional engineer who has spent his career as an engineer, manager and consultant in the utility industry.

During the comprehensive and interactive course work you will learn:

- Selecting system voltages
- Cable insulation types and thickness
- Underground operation and maintenance
- Underground system components and equipment
- Ampacity and pulling calculations
- Soil and duct temperatures and earth thermal resistivity
- Sheath losses, charging current and thermal runaway
- Trench design
- Medium-voltage protection: fuses, breakers and relays

Who Should Attend

You will benefit from this course if you work in the areas of planning, design, construction, operation and maintenance of medium-voltage underground electrical distribution systems in a solar, wind, EPC, utility or institutional setting.

Engineers, technicians, designers, contractors, consultants, line workers, electricians, inspectors or supervisors will benefit from this course.

As-Built and Bid Ready Handouts and Examples

Your learning experience will include lectures, review of drawings from actual operating systems serving solar, wind and electric utilities. Drawing packages of actual medium voltage systems will also be part of the materials handed out to the class.

Learning Objectives

Upon completion of this course you will:

- Understand the types of components that comprise a medium voltage electrical underground distribution system
- Learn about general planning, code/standard compliance and other considerations to apply in the development of an electrical underground distribution system
- Learn how to create calculated ampacity tables tailored for your system instead of using generic tables that can lead to failures
- Design medium voltage power lines with no more guess work
- Understand the use and operation of various components in underground electrical distribution systems
- Determine what considerations go into the design and layout of underground electrical distribution systems
- Learn what factors are important to the proper operation and maintenance of underground electrical distribution systems
- Understand the principles and practices of fusing and protection of underground systems

Continuing Education Credit

This course provides 1 Continuing Education Unit (CEU) and 10 Professional Development Hours (PDH).

Special Features of this Class

- ❖ Specific understandable presentations to increase your fundamental knowledge of underground medium voltage power systems
- ❖ Instruction by a knowledgeable and experienced professional
- ❖ Interaction with others who work in this area
- ❖ Review real-world designs and calculations
- ❖ Practical information you can put to work immediately
- ❖ Valuable reference materials

Expert Instruction

Charles Cunha, PE has spent 29 years in the electrical power industry. He has been responsible for the design, installation, operation and maintenance of electrical substations, transmission lines, distribution lines and generation facilities. His experience also includes work with industrial and military facilities, solar, wind, combined cycle generation, diesel generation and lighting systems. He has been involved in electromagnetic field measurements, calculations and public presentations.

Charles holds a BSEE from the California State University, Fresno. He is licensed in California, Nevada and the US Virgin Islands.

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Course Topics

Course Introduction
- CWC Engineering, Inc. and course Instructor
- Course objectives, schedule, notebook and format
- Course participants' sharing of objectives, questions and problems

Introduction to Underground Distribution
- Overview of underground distribution systems and components

Voltage Selection
- Voltage selection with new substations
- Voltages of interfacing utility
- Existing system voltage
- Guide for large-scale solar or wind project voltage selection
- 300 MW solar application medium voltage project design review with handouts of actual design
- One line review of 240 MW wind project voltage selection, ratings and loading practices

Load Factor
- Load factor description and definition
- Load factor calculation
- Load factor importance in ampacity

Cable Thermodynamics
- Cable losses and heat generation
- Cable insulation temperature limits
- Thermodynamic equations for underground power lines

Earth Thermal Resistivity
- Heat transfer through soil
- Soil thermal resistivity
- Moisture and soil thermal resistivity

Soil Ambient Temperature
- Soil ambient temperature importance
- Dependence on local average air temperature

Conductor Temperature Limitations
- Insulation types
- Insulation temperature limits

Operation and Maintenance
- Cable inspections
- Termination inspections
- Thermal inspection

Emergency Loading
- Maximum conductor temperature
- Maximum time limit
- When not to use

Charging Current
- Calculations for cable charging current
- Example for 12 kV cable
- Example for 60 kV cable

Amps to Per Unit Conversion
- Calculations for per unit conversion
- Example for 12 kV amps to per unit amps

Sheath Losses
- Calculations for cable charging current
- Example for 12 kV cable
- Example for 60 kV cable

Ampacity Calculations
- Limitations of published tables
- IEEE 835 Cable Amapcity Book
- Correction for soil ambient temperature example
- Correction for soil thermal resistivity example
- Thermal backfill and lowering your thermal resistivity
- Correction for load factor example
- Number of circuits per trench

Trench Design
- Conduit selection
- Trench depth
- Number of circuits in trench

Pull/Splice Box Design
- NEC and NESC box sizing
- Lid considerations
- Example calculations
- Utility splice box examples

Conduit System Design
- Conduit type
- Pull tape and pull rope
- Pulling speed
- Conduit size determination
- Number of bends
- Bending radius

Cable Pulling Calculations
- Cable-to-conduit coefficient of friction
- Cable and jacket ambient temperature limitation for installation
- Calculations for cable maximum pulling tension
- Weight correction factor
- Sidewall bearing pressure
- Pulling tension examples

Pad-Mounted and Submersible Equipment
- Junction box and junction bar
- Elbows, T-bodies and splices
- Padmounted switches and breakers
- Fusing and faulted circuit indicators

As-Built Plans for Medium Voltage Systems
- Actual electric utility subdivision and commercial development designs
- Medium voltage designs of wind and solar

Course Evaluation and Wrap-Up

Daily Schedule

Registration opens at 12:30 p.m. on the first day of the course. Class will begin at 1 p.m. the first day and continue until 5 pm. The second day class will be from 8:00 a.m. and continue until 5 p.m. with adjournment for a one hour lunch at 12 noon.

The daily schedule will include morning and afternoon refreshment breaks.

How to Enroll

Fax:
916-914-2493

Mail to:

CWC Engineering, Inc.
PO Box 5251
El Dorado Hills, CA 95762

Internet:
www.cwceng.com
Email: staff@cwceng.com

Course Information

❑ Please enroll me in **Underground Power Line Design Class**
January 23–24, 2013 at Lake Tahoe, NV.. Fee: $750

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 CWC Engineering, Inc.)
❑ MasterCard ❑ VISA ❑ AMERICAN EXPRESS

Cardholder's Name _____

Card No. _____ Expires _____

Upcoming Courses

For additional information go to www.cwceng.com.

2013 Classes Include:

- Utility Scale Solar Design
- Underground Power Line Design
- Overhead Pole Line Design (wood and steel)
- Electric Utility Maintenance
- Electric Utility Reliability Improvements.

Locations for Upcoming Classes:
Reno, San Francisco, Lake Tahoe, Las Vegas, Anaheim, Seattle, Denver, Dallas, Orlando and San Juan, Puerto Rico.

Need to Know More?

Call **916-934-0208 or**
email staff@cwceng.com

General Information

Fee Covers Course materials, break refreshments, certificate, continuing education credits (CEU/PDH) and rosters. Hotel accommodations are not included in the enrollment fee.

Please bring a calculator to the course to enhance your learning experience.

Cancellation If you cannot attend, please notify us by January 8, 2013 and we will refund your fee. Cancellations received after this date will be subject to a $150 administrative fee. You may enroll a substitute at any time before the course starts

Location This course will be held at the Harrah's Lake Tahoe, 15 Hwy 50, Stateline, NV 89449
www.harrahslaketahoe.com

Accommodations: Contact Harrah's Lake Tahoe at 1-800-427-7237