

Utility Scale Solar Design

January 22–23, 2013 at Lake Tahoe, Nevada

Practical Course

This course is based on actual utility scale photovoltaic power systems and provides you with an excellent opportunity to learn about solar (photovoltaic) power systems from a professional engineer who has designed over 10 MW of operating solar power plants and over 300 MW in solar designs.

During the comprehensive and interactive course work you will learn:

- Vocabulary of the photovoltaic power system
- Magnetic Declination
- Irradiance
- Seasonal solar movement explained
- NEC labeling requirements
- Module mounting methods explained
- Inter-row spacing calculated for any latitude
- Module tilt versus area use explained
- Tracking systems and energy production
- Tracking systems and land use
- Energy production of fixed tilt versus tracking systems compared on a per acre basis
- Typical utility interconnections are reviewed (12kV, 35kV and 69kV)
- As-built plans reviewed for a 230 kW roof top system to a 10 MW tracker

Who Should Attend

You will benefit from this course if you work in the areas of planning, design, construction, operation and maintenance of photovoltaic (solar) power systems.

Engineers, technicians, designers, contractors, consultants, 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 hardware used in utility scale PV projects, drawings from actual operating systems serving 250kW, 1 MW, 10MW and drawings for a 300 MW fixed based system. Drawing packages 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 photovoltaic power system
- Learn about general planning, code/standard compliance and other considerations to apply in the development of a small to utility scale PV system
- Learn how to calculate inter-row shading for any latitude
- Calculate the PV DC summer operating voltage with accuracy not guesswork
- Understand the use and operation of various components in PV systems
- Determine what considerations go into the design and layout of utility scale PV systems
- Learn what factors are important to the proper operation and maintenance of utility scale PV systems
- Understand the principles and practices of utility interconnection requirements

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 photovoltaic power systems of any size
- ❖ 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, hydroelectric, combined cycle generation, diesel generation and lighting systems. He has been involved in electromagnetic policy creation and 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 Photovoltaic Power Systems

- Overview of solar power generation systems and components

Vocabulary of the Photovoltaic Industry

- Types of modules
- PV system components
- Irradiance
- Magnetic declination
- I-V curve
- Life-cycle cost

Path of Sun

- Understand how to predict the path of the sun at any time and any longitude or latitude and what this means for energy production and shading consideration

NEC Labeling Requirements

- Review NEC 690 requirements for labeling
- How to properly label your solar facility
- Thermodynamic equations for underground power lines

Module Tilt and Inter-Row Shading

- Calculate spacing to avoid inter-row shading for energy productive times for any location
- Analyze the interaction of module tilt, area used and energy production
- Be able to choose the best module tilt for your situation.

Module Mounting

- Roof mounting technics for ballast and fixed roof designs
- Ground mounting technics, both tracker and fixed
- Wind force on module calculations
- Snow loading calculations

Inverter Selection

- Temperature limitations
- Altitude limitations
- Cable limitations (AC and DC)
- MPPT limitations
- Parallel operation limitations
- Open circuit voltage limitations
- VAR production and limitations
- Communication
- Remote control

Operation and Maintenance

- Combiner box inspection
- Inverter maintenance
- Thermal inspection
- Tracker maintenance
- Module maintenance

Module Selection

- Review of all module parameters
- Explanations for VOC, V_{mp} , STC, PTC, TCV_{oc} , TCV_{mp} , TCV_{mp} , I_{mp} , I_{sc} , NOCT and how these parameters will drive the PV design
- Cell temperature calculation and irradiant heat gain explained
- Open circuit voltage calculation and maximum string voltage
- Maximum cell temperature and lowest string voltage

Array Design

- NEC 2011 changes increase safety
- Example of generating hourly output from PVWATTS and PVSYS and importing them into Excel
- STC to AC ratio discussed, hourly output and annual energy examples from PVSYS used to analyze the DC to AC ratio strategy
- Choosing combiner box size – economics of the size of combiner box and DC wiring is reviewed
- Voltage drop calculations, module to inverter
- Array grounding

Rooftop Design Considerations

- Fire codes and safety considerations
- Rooftop clearance examples
- Wind speeds on roofs
- As-built designs for rooftop PV

1 MW Tracker Design

- Review drawings of a 1 MW ground mount single axis tracker
- See fiber optic loss calculations and all hardware used for an operational monitoring and communication system

10 MW Tracker Design

- Review drawings of a 10 MW ground mount single axis tracker
- Review maintenance and fire road designs
- See communication routing for 20 inverters.

300 MW Fixed Design

- Review drawings of a 300 MW ground mount fixed base design.
- Review loss analysis from DC wiring up to the terminals of a 69kV substation
- See how to route the medium voltage power lines
- Review maintenance plans

PV System Hardware Review

- Review all hardware used in utility scale PV systems
- Review options in designs

Course Evaluation and Wrap-Up

Daily Schedule

Registration opens at 7:30 a.m. on the first day of the course. Class will begin at 8 a.m. the first day and continue until 5 pm. The second day class will be from 8:00 a.m. and continue until 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 **Utility Scale Solar Design**
January 22–23, 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.)



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:

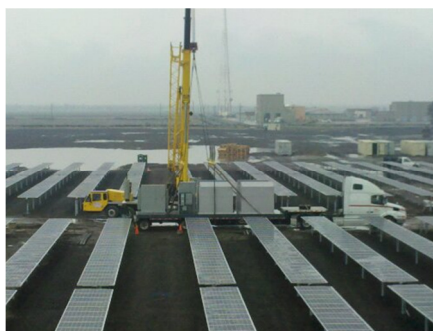
Reno, San Francisco, Lake Tahoe, Las Vegas, Anaheim, Seattle, Denver, Dallas, Orlando and San Juan, Puerto Rico.



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