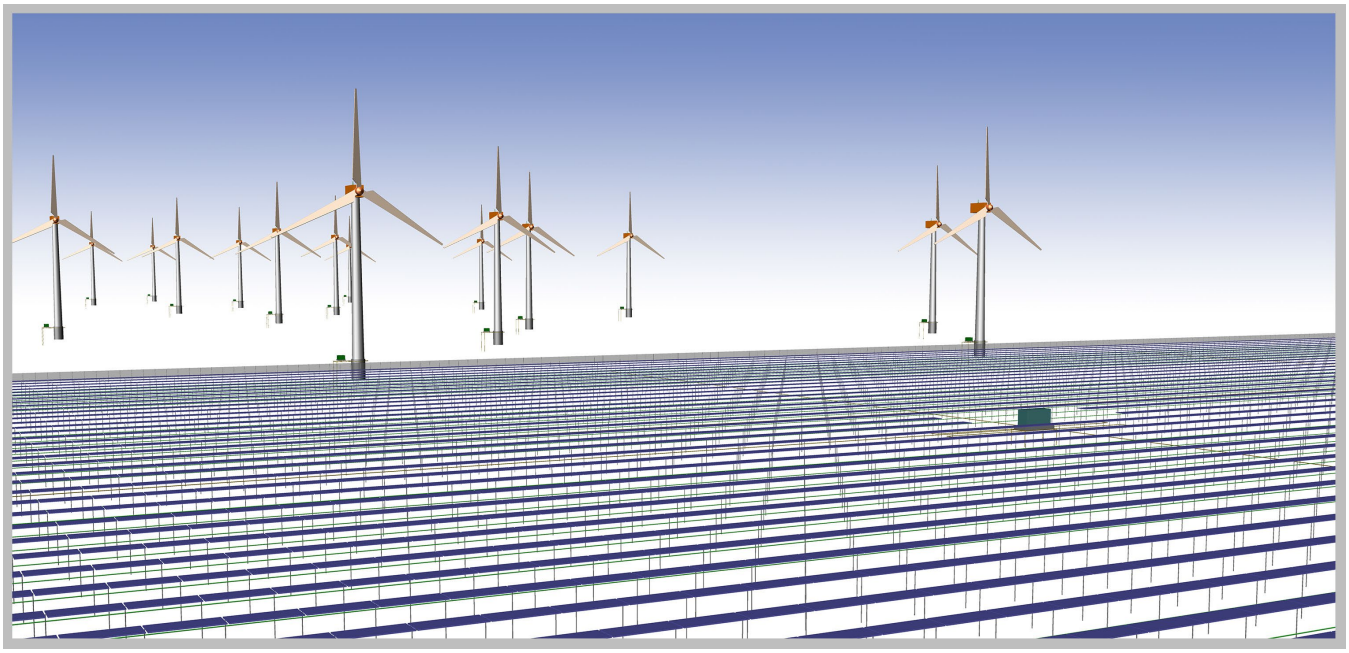
Ground Design
for Solar and Wind Energy Facilities

Course Date: March 12-13, 2026



Course Objectives

The objective of the training session is to provide comprehensive coverage of grounding design procedures for utility scale PV plants, wind farms, and collector substations, and the use of computer programs to implement the design procedures. Numerous examples will be worked in class using the program WinIGS. Participants will receive a temporary one-month license of the program WinIGS to continue exercises.

Scope

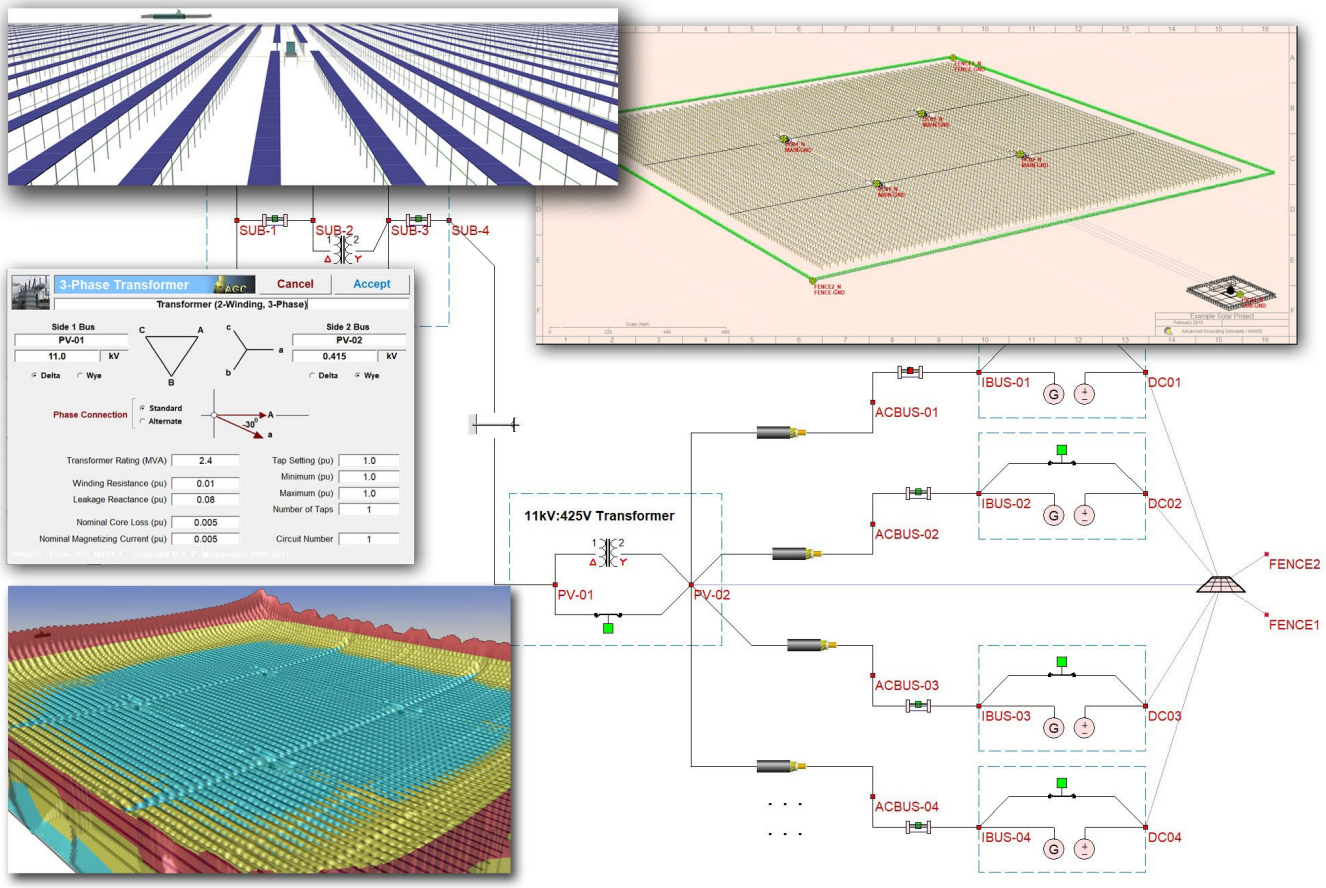
In recent years PV and wind projects have accelerated. These systems must be grounded for safety, provide reference for protection and communications and protection against lightning. Because these systems are geographically extensive, their design presents challenges in meeting standards at reasonable costs. Some of these systems also present unique challenges as they are installed on the top of landfills or mountains.

This course will comprehensively cover PV and wind farm grounding system design procedures for safety and lightning protection. It will start with a simplified coverage of the basic principles in grounding design and follow with a step-by-step design procedure. It will explore soil characterization, modeling requirements, and data preparation procedures for PV, wind and collector substations ground system design and lightning shielding. You will have the opportunity to discuss practical examples and see demonstrations of design procedures. Furthermore, options will be discussed for controlling ground potential rise, touch, and step voltages, as well as quantify the

influence of grounding systems on nearby pipes, fences, and buildings with the use of the WinIGS program. By the end of the course, you will be able to design PV, wind, and collector substation ground systems and lightning shielding to minimize the risk from lightning overvoltages.

Throughout the course, the design procedures will be demonstrated with numerous examples of wind farm and PV plant ground designs using the program WinIGS which simulates and visualizes maximum ground potential rise, touch and step voltages, split factors, and ground voltage distributions across wind and PV plant areas. Participants will be provided with a one-month license of the software that they can perform exercises and gain experience with ground design of wind and PV systems, and collector substations.

The course is taught by the developers of the program WinIGS.



Who Should Attend

This course is designed for electric power utility engineers involved in the design of substations and electrical installations. It is also intended for consulting and manufacturing engineers and engineers with substation equipment supply companies. University power system educators and graduate students will also benefit from exposure to these important topics. **Prerequisites**: Participants should have an engineering degree or equivalent experience.

Course Topics

Grounding System Design Principles

Factors Affecting Grounding System Performance

IEEE Standard 80 Design Procedures
IEEE Standard 81 Testing Procedures
IEEE Standard 998 Design Procedures

Special Considerations for Wind Farm Grounding

Special Considerations for PV plant grounding

Soil Characterization

System Modeling for Grounding Design

WinIGS Program General Organization
- Features Overview, Program Modes, File Organization, Hardware Requirements

Understanding what information is required to create a file on WinIGS
- Step by step instructions on creating a WinIGS file

The Network Editor
- Network Elements & Parameters (Lines, Transformers, Sources, etc.)
- Connection Properties
- Layered Organization using The Substation Element
- Adding Geographic Information

WinIGS Libraries
- Conductor Library
- The Cable Library & Cable Library Editor
- Transmission Line Tower Library
- Computation of Transmission Line Parameters

The Grounding Editor – Part I
- Soil resistivity measurements – all options
- Creating a soil model
- Export/import soil models between WinIGS and WinSGM

The Grounding Editor – Part II
- Navigating in the 3-D Editor Space
- Creating Grounding Systems (Ground Conductors, Connectors, etc)
- Adding Civil Elements (Buildings, Electrical Equipment, Fences etc)
- Importing Drawings and other Images
- Importing and Exporting DXF files
- Creating Design Drawings

Network Modeling Options

- Transmission lines – options and importance.
- Distribution lines – options and important parameters

Network Analysis Options

- Base Case, Fault Analysis, Maximum Ground Potential Rise, GPR & Fault Current vs Fault Location, Port Thevenin Equivalent, Frequency Scans and Coefficient of Grounding.
- Examples

Basic design requirements for PV plant grounding

PV array grounding
Inverter grounding
Collector substation grounding
Integrated grounding system modeling and analysis

Basic design requirements for Wind farm grounding

Wind turbine system grounding
Wind farm interconnection system
Collector substation grounding
Integrated grounding system modeling and analysis

Grounding Reports

- Resistance, Maximum Ground Grid Current, Resistive Layer Effects, Allowable Touch & Step Voltages, Equipotential Plots & Graphs, Point to Point Impedance, Bill of Materials
- Examples

Ground Design for Lightning

Lightning Shielding Design
Low Ground Surge Impedance Designs
PV plant design for lightning protection
Wind Turbine System design for lightning protection

Lightning Shielding Analysis

Data Requirements, Analysis Options, LSA Reports, Examples

Course Materials

The following material will be used during the short course presentations:

- Extensive class notes.
- Meliopoulos*, WinIGS Training Guide,* September 2019.
- Meliopoulos, WinIGS Manual, September 2019, electronic copy.

A copy of the class notes and the training guide will be given to all participants. The WinIGS manual will be provided in electronic form within the WinIGS program.

Continuing Education Units

Participants who successfully complete this program will earn 1.6 Continuing Education Units (CEUs). An official transcript of CEUs earned will be provided within 45 days of the completion of the course.

Instructors

A. P. (Sakis) Meliopoulos, Professor of Electrical & Computer Engineering at Georgia Tech, is the course administrator. He joined the Georgia Tech faculty in 1976. His special expertise is in the areas of fault analysis and simulation of power systems, advanced instrumentation for monitoring and protection of power systems, electromagnetic transients, multi-physics modeling and stress analysis, stress analysis, harmonics, grounding and surge protection. He is the leader in the development of the Harmonic Measurement System, which is based on synchronized measurements, the principal inventor of the Smart Ground Multimeter, the WinIGS program and its extensions, the Fault Distance Indicator and the Open Conductor Detector. These software and hardware products are presently used by the industry. He is the author of the books *Power System Grounding and Transients*, Marcel Dekker, Inc, 1988, *Application of Time-Synchronized Measurements in Power System Transmission Networks*, Springer, 2014, Section 27, *Lightning and Overvoltage Protection*, of the Standard Handbook for Electrical Engineers, McGraw Hill, 1993, holds three patents and published over 350 technical papers. Dr. Meliopoulos is the Chairman of the Georgia Tech Protective Relaying Conference and a Fellow of the IEEE.

George Cokkinides obtained a Ph.D. degree at the Georgia Institute of Technology in 1985. He joined the faculty of Electrical and Computer Engineering at the University of South Carolina in 1985. He has been with Georgia Institute of Technology since 2000. His research interests are focused in power system grounding and protection, multi-physics modeling and stress analysis, power electronics applications, power system harmonics, and measurement instrumentation.

Course Fee and Registration

The course is offered at **$1,500.00 prior to February 9, 2026**. **After February 9, 2026, the course fee is $1,700.00.** Training, course materials and a one-month software license of **WinIGS** are included in the course fee.

Three Ways to Register

☎ **CALL** (512) 636-1448 between 8:00AM – 5PM, Eastern Time

EMAIL your registration to deeanne@ap-concepts.com

MAIL registration request and payments to:
Advanced Power Concepts
P. O. Box 49116
Atlanta, Georgia 30359

Please be prepared to provide your name, address, company/affiliation, email and phone contact information.

Payment

Payment Options: (1) check, (2) direct deposit. In case of **direct deposit**, you will receive information for a direct transfer upon registration. Make **checks payable** to Advanced Power Concepts.

You will receive an email confirming your registration.

You are encouraged to register early to take advantage of "Early Bird" fee. Payment must be received **by February 9, 2026** "Early Bird" fee of **$1,500.00** is inclusive of instruction, materials and one-month software license. **After February 9, 2026**, registrations will be accepted at **$1,700.00.**

Registration Questions?

DeeAnne Abernathy
APC Event Coordinator
Email: deeanne@ap-concepts.com
Phone: (512) 636-1448

Course Dates

March 12-13, 2026
9:00AM – 5:00 PM daily EST

Online Instruction

The course will be taught online. Course delivery details will be provided to attendees in registration phase.

Course Substitutions, Cancellations, and Refund Policy

Substitutions

Substitutions can be made prior to the beginning of the course. Please contact DeeAnne Abernathy, APC Event Coordinator, to make the substitution and to provide contact information for the substitute.

Cancellations

All cancellation requests by the attendee must be received more than 10 business days prior to the event start date to be eligible for a refund less a $100 processing fee. Substitutions may be made prior to the beginning of the seminar. “No shows” are not eligible for a refund. If the course is cancelled due to low enrollment or for some other administrative reason, you will receive an e-mail notification and a full refund.