

# GRIDED

The Center for Grid Engineering Education

**FREEDM**  
SYSTEMS CENTER

## Distribution Volt-Var Planning and Control

### Course Description

This course is part of an educational library of short courses developed and offered by GridEd to address several evolving forces that will alter the fundamental operating characteristics of the electric grid, transforming it from a one-way central supply structure to one that has bidirectional power flows resulting from distributed energy resources (DER). Self-generating consumers or those with electric storage devices will alter the design requirements for the electric distribution system. This course focuses on voltage control and reactive power control with a special emphasis on integration of distributed generation.

The course includes several problem sessions where the class will work through real-world problems. We will focus on a few cross-cutting problems. For example, as we look at volt-var control, we can cover the response of different loads to voltage changes, voltage drop fundamentals, impact of reactive power, capacitor control, and regulator control.

The course will use several resources:

- [Electric Power Distribution Handbook](#), CRC Press, 2nd ed., 2014.
- <http://distributionhandbook.com>
- Class notes in OneNote format

### Who Should Attend

This course is intended for distribution engineers or engineers needing to learn about distribution systems with a background in electrical engineering. Students should have some familiarity with distribution systems and equipment.

### Registration Information

Class Date: August 28th, 2017; 8:00am – 5:00pm

PDH Available: 8 hours

Registration Fee:

- \$800 per person
  - 20% discount for organizations with three or more attendees
  - 25% discount for university professors\*
  - 75% discount for graduate students\*
- \*University IDs required to qualify for professor or graduate student discounts.

Location: North Carolina State University  
Ventures Place Building  
Power American - 2nd Floor 930 Main  
Campus Dr. Suite 200  
Raleigh, NC 27606

Registration at: <http://grided.epri.com/courses.html>

*Students need to bring: Students are encouraged to bring laptops or tablets (Apple or Android) to access online resources and to follow class notes. Wi-Fi access is provided. Notes will be provided electronically in Microsoft OneNote format. OneNote is available for free on many platforms, or students can access the web version.*

### For More Information

Amy Feser, [afeser@epri.com](mailto:afeser@epri.com), (865) 218-5909

### Course Instructor:

Tom Short, [tshort@epri.com](mailto:tshort@epri.com), (518) 288-8020

## Meet the Instructors



**Tom Short**, is a Technical Executive at the Electric Power Research Institute (EPRI). His responsibilities include leading research in the areas of distribution capacitor application, distribution efficiency and volt-var control, power quality, fault location, distribution reliability, application of distributed generation, and resiliency of overhead lines during storms. Short has led instruction of utility personnel in the areas of arc flash, lightning protection, distribution system design, and application of distributed generation. Short authored the book *Electric Power Distribution Handbook*, 2nd Edition. Prior to joining EPRI, Short performed utility studies in the areas of distribution lightning protection, power quality monitoring, transient simulations of lightning and switching impacts, ferroresonance, and reliability at Power Technologies, Inc. Short taught utility courses on distribution systems, lightning protection, relay application, power quality, and application of distributed generation. Short is a fellow of IEEE based on his work in distribution engineering. Short received his Bachelor's and Master's degrees in electrical engineering from Montana State University.

## Course Outline

### Day 1

- **Brief introduction to distribution systems**
  - Primary distribution configurations
  - Substations
  - Loads
  - Efficiency
  - Distribution planning
- **Changes in distribution systems**
  - Integration of distributed generation and storage
  - Electric vehicles and other load changes
  - Smart grid systems and technologies
- **Important basics of overhead and underground lines**
  - Impedances
  - Losses
  - Voltage drop
- **Problem session: DG impacts on voltage drop**
- **Voltage regulation**
  - Voltage drop basics
  - Voltage regulator basics
  - Conservation voltage reduction
  - Regulator issues
- **Capacitors and reactive power control**
  - Line losses and vars
  - Methods of capacitor control
  - Operational capacitor issues
- **Volt-var control**
  - Comparison of approaches
  - Monitoring and feedback
  - Planning
  - Integration and impacts of distributed generation
  - Smart inverter technologies
- **Problem session: Volt-var control**

June 2017

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### Electric Power Research Institute

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