



# brainfiller®

Your International Source for  
Electrical Power Training

## Medium Voltage Power Systems

2 Days

1.6 CEUs



The backbone of many electric power systems is the medium voltage distribution system. Typically operating at voltages ranging from 2,400 to 34,500 Volts, voltage stress, corona, surges and protection of equipment all create unique challenges in design, equipment selection, operation and engineering. This 2 day class by Jim Phillips, P.E. takes you through the basics of medium voltage power systems including components, equipment, design and operation problems as well as protection of medium voltage systems.

### What you ***WILL*** receive:

- Training manuals containing almost 200 pages
- Jim's current transformer saturation worksheets
- Jim's differential relaying worksheets
- Technical articles
- Many calculation examples and problems
- 16 hours of Continuing Education Credit



### What you ***WILL NOT*** receive:

- A commercial to sell you products or equipment
- A sales pitch to sell engineering study services
- A class that is just an overview or teaser

### What is so special about Jim Phillips' Power System Class?

Jim is not only one of the most popular and sought after instructors in the industry, he is also directly involved with the development of industry standards and practices. He is a member of the IEEE working group that develops *IEEE Std. 1584<sup>tm</sup>, IEEE Guide for Performing Arc Flash Hazard Calculations*. With a career spanning 30 years and having taught over 2000 training programs to people from all seven continents, Jim draws from his vast experience in the industrial, commercial and utility fields.



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## Course Agenda Medium Voltage Power Systems

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### DAY ONE

#### **MEDIUM VOLTAGE SAFETY**

Electrocution at Low vs. Medium Voltage, Arc Flash, Qualified Person, Approach Boundaries

#### **TYPES OF MEDIUM VOLTAGE SYSTEMS**

Utility and Industrial One lines, Reliability Requirements, Overhead and Underground Systems, Regulated Systems

#### **MEDIUM VOLTAGE CABLE**

Copper vs. Aluminum Design, Voltage Ratings  
Insulation Ratings, 100%, 133%, 173% Insulation Levels, Shielding Requirements, Electric Fields, Terminating MV Conductors, Orientation of Overhead Lines

#### **MEDIUM VOLTAGE SUBSTATION TRANSFORMERS**

Core and Coil Design, Aluminum and Copper Windings  
Tank Construction, Loss Evaluation, Efficiency, Regulation

#### **SPOT NETWORKS**

Spot Network Design, Network Protectors, Network Protector Relay Operation, Directional Protection Requirements

#### **PARTIAL DISCHARGE**

Corona, Surface Tracking, Voltage Stress, Sensing Partial Discharge, Component Failure

#### **GROUNDING MEDIUM VOLTAGE SYSTEMS**

Resistance Grounding, Solid Grounding, Ungrounded Delta Charging Current, Effect of Ground Faults on Delta Voltage

#### **SURGE PROTECTION**

Lightning and Switching Surges, Classes of Surge Arresters  
MCOV Ratings - (Maximum Continuous Operating Voltage)  
TOV - (Maximum Temporary Over Voltage Capability), Protective Characteristics, Surge Arrester Selection, Energy Capability, Effect of Grounding on Arrester Selection, Insulation Coordination,



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## **Course Agenda**

### **Medium Voltage Power Systems**

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#### **DAY TWO**

##### **CURRENT TRANSFORMER APPLICATIONS**

Ratings, Selection Process, Accuracy, Saturation, Excitation Curves, Burden Calculation, Momentary Ratings

##### **MEDIUM VOLTAGE CIRCUIT BREAKERS**

Vacuum, Air, Oil, SF6 Designs, Symmetrical Interrupting Rating, K-Rated Voltage Factor, Close and Latch Capability

##### **RECLOSERS**

Application on Feeder Circuits, Recloser Settings  
Continuous Current and Interrupting Ratings

##### **MEDIUM VOLTAGE FUSES**

Medium Voltage Switches, Load Rating, Close and Latch Rating, Short Time Rating, Expulsion vs. Current Limiting Fuse Characteristics, E and R Rated Fuses, Fuse Cutouts

##### **MEDIUM VOLTAGE PROTECTION CONCEPTS**

Medium Voltage Protection, Relays, Circuit Breakers, R and E rated Fuses, Short Circuit vs. Overcurrent Protection

##### **DISTRIBUTION FEEDER PROTECTION**

Protection with Fuses - 300%, Overcurrent Protection with Relays - 600%, Short Circuit Damage Characteristics, Relay "Reach" for End of Line Faults

##### **ROTATING MACHINERY PROTECTION**

Requirements, Decrement Curves, Thermal Damage Curves, Reactive, Capability Curves, Differential Protection

##### **MEDIUM VOLTAGE MOTOR CONTROLLERS**

Protection Requirements, Motor Management Relays, Circuit Breaker Protection, Relaying, Class R Rated Fuses

##### **TRANSFORMER PROTECTION**

ANSI C57 Thru Fault Curves, Impact of Transformer Winding Configuration, Overview of Differential Protection, Inrush and Harmonic Restraint



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## **On Site Training Have This Course at Your Location!**

Hold this class at your location for a greater savings. For an all inclusive fee you receive the following for each attendee:

### **What you *WILL* receive:**

- Training manuals containing almost 200 pages
- Jim's current transformer saturation worksheets
- Jim's differential relaying worksheets
- Technical articles
- Many calculation examples and problems
- 16 hours of Continuing Education Credit

**Call Brenda at 800-874-8883 or  
e-mail at: [brenda@brainfiller.com](mailto:brenda@brainfiller.com)  
for an On-Site Training Proposal!**

**Plan Ahead - Jim's schedule usually  
fills up months in advance!**





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## Jim Phillips, P.E.

Member of IEEE 1584 *IEEE Guide for Performing Arc Flash Hazard Calculations*

Vice - Chairman of Task Group - *IEEE 1584.1 Guide for the specification of scope and deliverable requirements for an arc-flash hazard calculation.*

Member of IEC 61482-1-2 Determination of arc protection class of material and clothing by using a constrained and directed arc (box test)

Author of the book: *Complete Guide to Arc Flash Hazard Calculation Studies*

Is a regular contributor to Electrical Contractor

Founder of the internationally known website: [www.ArcFlashForum.com](http://www.ArcFlashForum.com)

For 30 years, Jim has been helping tens of thousands of people around the world understand electrical power systems design, safety, theory and applications. Having taught over 2000 seminars during his career to people from all seven continents (Yes Antarctica is included!), he has developed a reputation for being one of the best trainers and public speakers in the industry.

Jim does not just talk about arc flash and electrical safety - he is part of the development of the arc flash standards! He is also the instructor that has taught other instructors in the industry. Jim is a member of the IEEE 1584 Committee - *IEEE Guide for Performing Arc Flash Hazard Calculations*. He is Vice-Chairman of the IEEE Task Group - IEEE 1584.1 "Guide for the specification of scope and deliverable requirements for an arc-flash hazard calculation study in accordance with IEEE 1584"

Jim literally wrote the book about arc flash studies with his book titled: ***Complete Guide to Arc Flash Hazard Calculation Studies*** available from [brainfiller.com](http://brainfiller.com) and [Amazon.com](http://Amazon.com) He also wrote "How to Perform an Arc Flash Study in 12 Steps" published by NFPA.

In addition to being a regular contributor to Electrical Contractor Magazine, he was one of the main contributors for the NEC Digest. He has authored many articles published in Europe and is a regular speaker at conferences around the world.

Jim earned a BS Degree in Electrical Engineering from the Ohio State University. His career began with Square D Company's Power System Analysis Group where he was responsible for system studies, power system software development and training at their engineering programs.

Later, Jim was in charge of the studies group of the System Protection Section of Ohio Edison Company. He was part of the adjunct faculty for Stark State College where he taught evening classes in electrical power systems.

Jim is a Registered Professional Engineer, with experience that includes everything from planning transmission systems, to design and analysis of industrial, commercial and utility power systems, cogeneration plant design, expert witness and forensic analysis.

Jim continues to travel the globe typically flying over 150,000 miles a year to work with various U.S. and international standards organizations and speak at many conferences and training events.