



# brainfiller®

Your International Source for  
Electrical Power Training

## Protective Relaying Part 1 and 2

2 Days

1.6 CEUs



This class shows you how to work with protective relays and determine optimal settings for protection and coordination. The Class begins with the basics of overcurrent relays and moves on to more advanced topics including differential protection, generator protection, transformer protection and more. The Class includes many of the more common relay functions such as overcurrent, synch check, reverse power, differential protection schemes, frequency as well as many other relay functions and schemes.

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

- Training manuals containing over 250 pages
- Many relay setting example problems
- Current transformer saturation worksheets
- Technical articles
- Transformer differential relaying worksheets
- 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**

### **Protective Relaying Part 1 and Part 2**

#### **DAY ONE**

##### **INTRODUCTION**

Overcurrent Protection Concepts, Relay Coordination Data Requirements, Selective Coordination Principles, Zones of Protection, Minimizing Outages / Maximizing Reliability

##### **SHORT CIRCUIT CONSIDERATIONS**

Three Phase and Line-to-Ground Faults, Short Circuit Calculations, Effect of Current Magnitude on Relay Settings, Relay Reach to End of Line

##### **OVERCURRENT RELAY PROTECTION SCHEMES**

Time Current Graphs, Induction Disk Relay, Solid State / Digital Relays, Current Transformer Selection, Circuit Breaker, ANSI Protective Device Numbers

##### **CURRENT TRANSFORMERS**

Polarity Markings, Current Transformer Saturation, Excitation Curves, Saturation Calculation Worksheets and Example Problems, Burden, CT Accuracy Class, CT Size vs. Saturation

##### **OVERCURRENT RELAYS**

Amp Tap Settings, Time Dial Settings, Instantaneous Settings, Relay Time Margins, Safety Margins, Electro-Mechanical Induction Disk Over Travel, Drawing Time Current Curves

##### **COORDINATION OF RELAYS**

Curve Shapes and Characteristics, Inverse, Very Inverse, Extremely Inverse Characteristics, Coordinating Relays with Other Relays, Determining Optimal Settings, Relay Setting Problems

##### **RELAYS FOR CONDUCTOR PROTECTION**

National Electrical Code Requirements, Conductor Damage Curves, Determining Relay Settings for Conductor Protection, Short Circuit Protection

##### **GROUND FAULT PROTECTION RELAYS**

Residually Connected Relay Scheme, Zero Sequence Relay Schemes, Effect of Delta Wye Transformer Connection on Coordinating Ground Fault Relays



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## **Course Agenda**

### **Protective Relaying Part 1 and Part 2**

#### **DAY TWO**

##### **INTRODUCTION**

Types of Protection Schemes, Protecting Equipment, Design Criteria, Protection Standards and Defining Protection Requirements, Necessary Data for Determining Appropriate Settings

##### **DIRECTIONAL RELAYS**

Relay Operating Principles, Use of Directional Relays, Polarizing Input, Use in Network Systems

##### **TRANSFORMER PROTECTION WITH RELAYS**

NEC Article 450, Magnetic Inrush Current, ANSI C57 Thru Fault Curve, ANSI Transformer Protection Requirements, Adjustments for Transformer Winding Configuration

##### **DIFFERENTIAL PROTECTION CONCEPTS**

Overcurrent Differential Relays, Percentage Differential Relays, Bus Differential Relays, Current Transformer Selection, Saturation Issues, Current Transformer Polarity

##### **TRANSFORMER DIFFERENTIAL PROTECTION**

Differential Protection, Percentage Differential Protection, Slope Settings, Delta-Wye Phase Shift Adjustments, Sizing Current Transformers to Compensate for Delta Connected Current Transformers

##### **MOTOR PROTECTION**

Motor Protection Requirements, Motor Starting Characteristics, Motor Short Circuit Protection, Overload Protection, Motor Safe Stall Time

##### **LOAD SHEDDING**

Local Generation, Loss of Utility, Back Feeding the Utility, Frequency Relays, Reverse Power Relays

##### **GENERATOR PROTECTION**

Protection Requirements, 51V Relays, Generator Sub Transient Reactance, Short Circuit Decrement Curves, Synch Check Relay, Frequency, Reverse Power and Other Relay Functions, Generator Protective Schemes and Settings



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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:

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- Training manuals containing over 250 pages
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- Current transformer saturation worksheets
- Technical articles
- Transformer differential relaying worksheets
- 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.