



# brainfiller®

Your International Source for  
Electrical Power Training

## Power Factor and Harmonic Analysis

1 Day

0.8 CEUs



This 1 Day class shows you how to perform a power factor study and a harmonic analysis. Many electric utility companies have rate structures that provide a strong economic incentive to correct power factor. However, correcting power factor without considering harmonics can have devastating consequences. Learn how to analyze harmonics and design properly tuned/filtered capacitor banks. See how to properly apply IEEE 519 and how the strength of the source can impact the results. Many in class problems to show you how to perform the study.

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

- Training manuals containing many examples
- Jim's K-factor calculation worksheets
- Jim's harmonic filter design worksheets
- Technical articles
- Many calculation examples and problems
- 8 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**

### **Power Factor and Harmonic Analysis**

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#### **DAY ONE**

##### **POWER FACTOR CORRECTION**

kW, kVA, kvar, PF Concepts. Leading and Lagging, Current Flow, Inductive Loads, PF and Load Magnitude, Vectors, Current and Voltage Angles

##### **POWER FACTOR CALCULATIONS**

Determining Var Requirements, Sizing the Capacitor, Switching Steps and Location at the Load vs. Closer to the Source, Capacitor Control

##### **UTILITY RATE STRUCTURE AND ANALYSIS**

Reviewing Utility Bills, Utility Rate Structure, Peak Demand, Demand and Power Factor Based Rates, Utility Rates in a Deregulated World

##### **HARMONICS**

Concept of Harmonics, Harmonic Spectrum, Sources of Harmonics, Non-Linear Loads, Harmonic Current Flow, Fourier Analysis, Graphical Representations of Harmonic Waveforms

##### **HARMONIC RELATED PROBLEMS**

Capacitor Failure, Fuse Interruptions, Equipment Over Heating, Metering Errors, Circuit Breaker Mis-Operation, Zero Crossing Issues

##### **RESONANCE**

Determining Parallel and Series Resonance, Effect of Source Impedance, Effect of Capacitor Size, Effects on Resonance, Impedance vs. Frequency Scans, Approximations of Parallel Resonance, Example Calculations of the Effect of Resonance Conditions

##### **EVALUATING HARMONICS**

Resonance Calculations, Total Harmonic Distortion (THD) Calculations, Effect of Parallel Resonance on THD, Effect of Source Strength on THD, Harmonic Sources and THD, Example Calculations of Source Impedance vs. THD

##### **IEEE 519**

Voltage and Current Distortion Limits, Point of Common Coupling, Enforcement of IEEE 519, Ratio of Load vs. Strength of the Utility System to Determine Limitations, Common Mis-Applications

**Continued...**



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### **Power Factor and Harmonic Analysis**

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**...Continued**

#### **THIRD HARMONICS**

Switched Mode Power Supplies, 3rd Harmonics and Neutrals, Over sizing Neutrals, The use of Delta-Wye K-Factor Transformers, Over sizing Neutrals

#### **CORRECTION OF HARMONIC RELATED PROBLEMS**

Capacitor Operating Restrictions, Filtered Capacitor Banks, Over sizing Neutrals, Detuning Capacitor Banks

#### **HARMONIC FILTER DESIGN**

Tuning Frequency, Series Resonance, Sizing the Reactor, Evaluating the Capacitor Adequacy, Capacitor Voltage Stress, Filter Design Examples

#### **CASE PROBLEM**

Design of a 5th Harmonic Filter Tuned to the 4.7th



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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 many examples
- Jim's K-factor calculation worksheets
- Jim's harmonic filter design worksheets
- Technical articles
- Many calculation examples and problems
- 8 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.