



## Safe Grounding Systems: Understanding, Designing & Testing 3-Day Training Course

This grounding training course is an intensive program in fundamental grounding principles and the practice of grounding system design and testing. It has been developed and is delivered by leading specialists in grounding, all with significant utility experience and a sound understanding of real-world power systems.

Participants will develop an understanding of the science behind grounding, the mechanisms through which grounding does its job, the grounding-related hazards and risks that can be created, and an ability to manage those risks through effective design, testing and supervision.

**Safearth is an internationally recognized specialist, providing accurate and dependable services and solutions in grounding and lightning protection.**

Safearth has designed and tested thousands of grounding and lightning protection systems and has been a key contributor to the national and international development of grounding theory and practice. Now you too can learn from our specialists and develop your own understanding and experience to support your business.

## Who Should Attend?

This in-depth course is designed for electrical engineers, project engineers, maintenance managers, asset managers, HV specialists, consultants, regulators and other technical staff responsible for power system or other assets that rely on grounding systems for their safe and correct operation.

A solid background in substation design, maintenance, or operations is recommended.

## Course Deliverables

This course will provide participants with valuable knowledge and skills to support or review grounding system design, testing and supervision associated with the electricity supply infrastructure and industrial installations.

It will also address the complex mechanisms of inductive and conductive interaction between substation and powerline grounding systems and metalwork. Finally, it will investigate techniques for solving problems found in grounding system design, using both empirical and analytical computer-based techniques.

## Course Objective

This 3-day course provides a comprehensive review into the complexities of grounding system design, performance and life-cycle management through the application of theoretical and practical sessions.

The course is structured to provide a proper understanding of principles, an insight into common techniques and some experience of measurement and testing methods. It includes lectures, demonstrations and student participation, with practical examples and case studies.

## Pricing

The standard price for this course varies depending on the delivery location. Discounts are available for group bookings. Payments can be made by credit card, direct deposit or purchase order. Further information is available on our website: [safearth.com/training-usa](http://safearth.com/training-usa)

To ensure each student is sufficiently able to interact with the instructors and hands-on demonstrations, class sizes are limited to 24 attendees.

## Presenters



**Keith Wallace**  
Engineering Director  
- Americas

An industry leader in power system grounding, electrical safety, and live line work rules. His experience includes being a contributing member to multiple IEEE standards and having played a significant role in the development of the National Electric Safety Code. Keith has conducted numerous electrical investigations and grounding system tests across the USA, and has delivered training and technical presentations globally.



**Bryan Beske**  
Principal Engineer

A specialist in grounding and lightning protection design for power lines and substations, and mitigation design of induced voltages. His professional experience includes 18 years with a transmission utility and, since 2006, being an active contributing member to many industry standards including IEEE Std 80, 81, 998, and CIGRE Technical Brochure 839. Bryan has delivered training domestically and internationally.



**Stephen Palmer**  
Managing Director

With expertise including power, heavy industry, mining, and rail, he played a key role in developing EG-0, the Australian power system grounding guide, and is an active member of five IEEE PES Substation committees. Stephen is also involved in CIGRE working groups and has presented at numerous conferences, including for ENA, Engineers Australia, CIGRE, IEEE, and CEATI.

Note: courses are typically presented by two of the above, however, Safearth may substitute a presenter when necessary.

# What You Will Learn During This Course

## Grounding Fundamentals

- What is grounding?
- Why do we ground?
- What are the varieties, components, and descriptions?
- Historical approaches – What has changed and why?

## Soil Resistivity

- What are the varying electrical properties of soil?
- How can I measure them?
- How can I recognize inadequate test results?
- How do I use results to analyze and estimate grounding performance?

## Ground Grid Resistance

- What happens when current flows into the ground?
- What constitutes grid resistance?
- How can I estimate and measure it?
- How do grounding systems interfere with each other?
- What effects exist and how can they cause errors?
- Does Ohms law exist in three dimensions?

## Surface Potentials During Ground Fault

- How and where do voltages appear?
- What are touch, step and transfer voltages?
- How do I manage these voltages through design?
- What is Ground Potential Rise (GPR)?
- How can I measure GPR, and touch, step & transfer voltages?

## Ground Current and Humans

- How does current effect humans?
- Is there a safe level of current or voltage?
- Are all humans the same?
- How can I determine the risk?

## Safety Criteria

- What are safe, allowable, or tolerable voltages?
- How should I calculate them?
- What safety criteria does IEEE 80 recommend or require?
- How does the designer affect the tolerable voltages?
- Do I eliminate, accept or manage risks?
- What can be done to improve safety?

## Standards & Legal Obligations

- IEEE Std 80 – Grounding Design
- IEEE Std 81 – Grounding Testing
- IEEE Std 837 – Grounding Connectors
- IEEE Std 998 – Substation Lightning Protection
- NESC – National Electrical Safety Code
- NFPA 70 – National Electric Code

## The Ground Fault Circuit

- What are the sources of ground fault?
- Where does ground fault current actually flow?
- Are connections to other grounding systems helpful or hazardous?
- What is inductive coupling and how does it guide current flow?
- What can be done during design to change or manage current flow?

## Alternate Paths and Current Splits

- What's different between a grounding grid and grounding system?
- Where else can current flow?
- Does it really matter?
- What governs the distribution of current into all available paths?
- What guidance does IEEE 80 and IEEE 81 provide on determining current splits?
- How can good design improve safety and performance outcomes?

## What Participants Say

"Course material was presented in a straightforward, easy to understand manner."

"When we asked questions, they had answers."

"The presentations were interesting and to the point."

## Failure Modes of Grounding Systems

- What can possibly go wrong?
- How much does a failure cost?
- Can we detect and prevent failures?
- Can we design to minimize failures?
- Does IEEE 81 provide guidance to detect failures?
- What are the pros and cons of Integrity Testing methods?

## Transients

- Should transients be considered in grounding grid design?
- Do transients matter?
- What additional hazards do they introduce?
- Is there design guidance for transients?
- Should lightning protection grounding be bonded to the grid?

## Grounding System Design, Maintenance and Operations

- What is the design process?
- How long does a grounding system last?
- Is the grounding system de-energized?
- Can ground grid testing be performed safely?
- Fall of Potential method – what is it and what does it tell me?
- What is the grid resistance goal?
- What tests should I be performing?
- What test instruments will I need?

## About Safearth Training

Safearth's specialists have been at the forefront of grounding on the world stage for more than 30 years, and have trained hundreds of professionals around the world.

Our American-based trainers are all grounding experts with substantial experience in design, standards, testing and practical application. We know about real-world problems and constraints, and have provided thousands of solutions, in design, testing and refurbishment of assets across all industries.

Safearth staff continue to serve as volunteers and members of the working groups responsible for many of the key grounding-related standards including IEEE 80, IEEE 81, IEEE 998, IEEE 837, IEEE 1268 and IEEE 1246. Safearth staff also contribute to industry-leading international groups including CIGRE, CIRED, and IEC.

All of our training courses include a balance of theoretical background and practical application. Safearth uses all major grounding computer programs, including Safearth's own software tools, and include their application to real-world examples.

For detailed course information, or to apply for a course, visit [safearth.com/training-usa](http://safearth.com/training-usa)

## Other Safearth Training Courses

Safearth offers a wide range of public and customized courses to suit your needs, including:

- Safe Grounding Systems: Advanced Integrity Testing – 1 day
- Safe Grounding Systems: Advanced Performance Testing – 3 days
- Safe Grounding Systems: Temporary Protective Grounding Fundamentals – 2 days
- Lightning Protection Systems: Direct Strike Shielding Design for Substations – 1 day
- Customized training available upon request

## More About Safearth

Safearth is a specialist engineering group providing world-recognized expertise in all areas relating to grounding systems.

Safearth provides products and services for the design, specification, installation support and commissioning of new grounding systems, as well as ongoing testing and refurbishment support for existing systems.

Our experience extends to all areas of power generation, reticulation and use, including substations, transmission and distribution systems, power stations, industrial plants and mining operations.

As well as our training services, we also offer:

### Consulting

Safearth can provide engineering support for all your grounding needs, including design, condition testing, performance testing, policy and standards development, incident investigation and asset management.

### Instruments

We design and build grounding test instruments with a focus on robust and reliable measurements of new and in-service grounding systems.

Why not tell us what you need?



### United States

Alabama, Wisconsin  
877-8 GROUND

### Canada

Alberta  
877-8 GROUND

### Australia

Global head office  
+61-2-4940-3900

Trusted provider of valuable solutions in every aspect of grounding system management for more than 30 years.

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