WHO SHOULD ATTEND THE PGE POWER SYSTEMS SEMINARS?

- Electric Power Utility Engineers
- Test Engineers
- Protection & Control Engineers & Graduate Students
- Relay Technicians
- University Power System Educators
- Engineers Seeking PDH’s

Register online at powergridengineering.com/seminars
Power Grid Engineering, LLC (PGE) is happy to welcome you to our series of training seminars as we share our experience, knowledge and excitement about power systems to industry professionals. When I began teaching the Relay Philosophies course in 2001, I did so by trying to answer all the “big picture” questions that I had when I was new to the industry; I could have titled the class, “Everything I Wish Someone Had Taught Me My First Year On The Job.” Since then, hundreds of utility company professionals have completed Power Systems 101: Relay Philosophies I. Attendees have stated that the class helped them understand Protection & Control better than other classes they have previously taken.

In 2012, responding to feedback from the Power Systems 101 class, we created PGE Power Systems 102: Relay Philosophies II which covers a new set of topics including generator theory and protection and SCADA systems (just to name a few), but with the same “big picture” approach. Several team members helped me create this second class and each brings their own set of stories, experiences and industry expertise to the sessions.

Our course curriculum continues to evolve based on our attendees needs and requests. Between the two seminars offered, we cover a variety of complex topics, but in an easy and interactive way, so that even non-Protection & Control professionals can understand.

At the end of each seminar day, PGE host evening networking activities where we get to know each other and develop new business connections and relationships with other industry professionals.

Lastly, PGE seminars afford you the opportunity to earn professional development hours (32 PDH/week-long seminar) to be applied to continuing your education or maintaining your professional engineering license.

To learn more about Power Grid Engineering and our Power Systems seminars, visit us at powergridengineering.com or email me at mwright@powergridmail.com.

We hope you’ll join us for one of our unique four-day seminars.

Sincerely,

MICHAEL J. WRIGHT, PE
President, Power Grid Engineering
Program Director, PGE Power Systems Seminar Series
PGE's Power Systems 101 Seminar is geared toward answering many of the big picture questions about Protection & Control. This class is beneficial for hands-on field technicians, new protection & control engineers and other utility company staff that want to know more about how a power system works.

**101 SESSIONS**

1: **SUBSTATION LAYOUTS & PROTECTION ZONE DIAGRAMS / 4 PDH**
- Transmission System overview
- Types of Generation
- What is a Fault?
- Substation Layouts
- Protection Zone Diagrams

2: **FUNCTIONAL DIAGRAM EXERCISE / 4 PDH**
- Hands-on Functional Diagram
- Line Protection
- Bus Protection
- Transformer Protection
- Breaker Failure
- Lockouts

3: **CURRENT TRANSFORMERS / 4 PDH**
- CT Basics
- Ratios
- CT Classes T & C
- CT Ratings
- Saturation Current and Curves
- Equivalent Circuits
- CT Testing
- IEEE Standards

4: **BREAKER CONTROL / 4 PDH**
- Mechanical operation
- Trip Circuits
- Close Circuits
- Anti-Pump Circuits
- Reclosing
- Specifications & Ratings
- Alarms
- IEEE Standards

5: **DIFFERENTIAL / 4 PDH**
- Types of Bus Differentials
- KCL Theory
- Differential CT Circuits
- Calculating Current in Differential Circuits
- Mismatched CT’s
- Rolled CT’s
- CT Polarity
- High Impedance Differential Application
- IEEE Standards

6: **TRANSFORMER PROTECTION / 4 PDH**
- Transformer Theory
- Equivalent Circuit
- Types of Transformers
- Transformer Losses
- Transformer Ratings
- Tap Changes
- IEEE Standards

7: **LINE PROTECTION / 4 PDH**
- Physical Characteristics of Transmission Lines
- MHO Circle
- Theory of Impedance Protection
- Zones of Protection
- POTT, PUTT, DCB, & DCUB End-to-End Schemes
- Reliability & Security
- IEEE Standards

8: **BREAKER FAILURE / 4 PDH**
- Breaker Failure Initiates
- Current Requirements
- Breaker Position
- Critical Clearing Time
- System Stability
- Various Breaker Failure Logic Schemes
- Trip & Lockout Theory
- IEEE Standards

“This seminar broadened my knowledge of protection & control systems such as protection zones, single line of functionality, power transformers, current transformers, relay and much more. Michael helped me better understand power systems and I am looking forward to attending future classes.”

LAKE MARY, FL: M – TH, FEBRUARY 8-11, 2016 / 32 PDH / $725
CHARLOTTE, NC: M – TH, JUNE 6-9, 2016 / 32 PDH / $725
PGE’s Power Systems 102 Seminar is a stand-alone class that has been specifically developed for engineers, engineering technicians and field relay technicians. It aims to provide attendees with a strong basis of knowledge in relay protection philosophy and design theory. Power Systems 102 is a week long course that has been approved for PDH.

“The four day seminar really helped me understand the philosophy of protective relaying. After completing the seminar I had a better understanding of protection zones. As a drafter, it helped me better understand schematics drawings.”

102 SESSIONS

1: GENERATOR THEORY / 4 PDH /
- Types of Generators • Steam Turbines • AC Generators
- Synchronous Generators • Parts of Generators
- Power Plant Efficiency

2: GENERATOR PROTECTION / 4 PDH /
- Stator, Rotor, Field, overcurrent, Distance, Differential Protection
- Sub-Harmonic Injection • Stator Ground Fault Protection
- IEEE Standards

3: CAPACITOR BANKS / 4 PDH /
- What is a Capacitor Bank? • Types of Capacitor Banks
- Capacitor Bank Configurations • Capacitor Bank Design
- Modern Protection Considerations & Applications
- Capacitor Bank Protection Based on IEEE Standards

4: REACTOR BANKS / 2 PDH /
- Ferranti Effect • Types of Reactor Banks • Reactor Bank Control
- Reactor Bank Protection • IEEE Standards

5: UNDERFREQUENCY / 2 PDH /
- Basic Function of Underfrequency • Power System Dynamic
- Example of Application • NERC Guidelines • Historic Examples

6: DC SYSTEMS / 4 PDH /
- DC Theory • Battery Theory • Battery Sizing • Battery Chargers
- DC Panels • Dual Battery Systems • Redundancy
- Testing and Maintenance Practices

7: DISTRIBUTION PROTECTION / 4 PDH /
- Layouts: Main-Tie-Main, Main-Main, High Density
- Protective Devices – 50, 51, 67, etc. • Distribution networks
- Feeder Level Regulation vs. Bus Level Regulation
- Distributed Generation • Reclosing Practices • Hot Line Tag
- Coordination with Downstream Devices • Distance to Fault • Smart Grid

8: OVERVIEW OF ELECTRIC UTILITY COMMUNICATION SYSTEMS / 4 PDH /
- Timeline of Electric Utility Industry Communications Milestones
- Substation Communication Critical Performance needs

9: POWER LINE CARRIER / 2 PDH /
- Types of Power Line Carriers (ON-OFF, FSK) & Relay Applications
- Power Line Carrier System Components
- Phase-Ground Coupling vs Phase-Phase Coupling
- PLC Performance Evaluation Exercise • IEEE Standards

10: SCADA SYSTEMS / 2 PDH /
- Overview • Dual Master and NERC Rules
- Scan Rate Requirement Considerations • Scan Rates
- Physical Port Connections • Serial vs Ethernet • DNP 3 Protocol Primer
- Data Transfer IED & SCADA Master • Smart Grid Impacts
PGE’s Relay Commissioning 103 Seminar is geared toward answering Fundamental questions about Field Commissioning of Protection and Control Equipment. This class is beneficial for hands-on field technicians, new protection & control engineers and other utility company staff that want to know more about Field Testing. This class assumes a knowledge of topics covered in PGE 101 and PGE 102.

103 SESSIONS

1: INTRODUCTION TO POWER SYSTEMS AND PROTECTIVE RELAYING / 2 PDH /
- Power System faults and abnormal conditions
- Basic fault calculations and relay settings • Relay applications
- Standards references and documentation

2: TECHNICAL TOOLS / 2.5 PDH /
- Trigonometry • Phasors in relay circuits • 3 phase power systems
- Power system grounding

3: INSTRUMENT TRANSFORMERS / 2 PDH /
- Potential transformers
- Grounding and shielding of instrument transformer circuits
- Current transformer testing

4: RELAY DESIGN AND BASIC ELEMENTS / 2 PDH /
- Operational features • Ratings • 15 basic element characteristics

5: CONTROL CIRCUITS / 3 PDH /
- Contacts • Sneak circuits • Battery testing • Finding grounds

6: TRANSFORMER PROTECTION AND CONTROL / 1.5 PDH /
- Testing overcurrent, differential and sudden pressure
- Testing voltage regulation and paralleling
- Emergency replacement of transformers

7: TESTING POWER LINE CARRIER / 2 PDH /
- Test procedures for line traps, tuners, transmitters and receivers

8: REDUNDANT SYSTEMS / 1 PDH /
- Primary and Backup • Dual Trip Coil • Dual Battery • Physical Isolation

9: COMMISSIONING TESTS; SAFETY, MANUAL AND AUTOMATIC TESTING OF CT’S AND RELAYS / 3 PDH /
- Testing methodology • Field testing philosophies
- Field checks on instrument transformers
- Relay programming and testing

10: COMMISSIONING TESTS; TESTING CIRCUITS, WIRING AND FUNCTIONAL TESTS / 4 PDH /
- Point to point drawing check • Wire Checking • AC Circuit Testing • Functional Tests

11: COMMISSIONING TESTS; IN SERVICE-readings / 4 PDH /
- Phasing Tests • In Service Readings

12: COMMISSIONING TESTS; COMMISSIONING NUMERICAL RELAYS / 1.5 PDH /
- Dynamic Characteristics • Programmable Logic • In Service Readings
- Diagnosing Abnormal Conditions

13: COMMISSIONING; PROJECT MANAGEMENT / 1.5 PDH /
- Pre-job engineering • Critical Path • Outage Planning • Typical Jobs

14: MAINTAINING RELAY SYSTEMS / 1 PDH /
- What tests to perform • Nuclear Power Plants
- Reviewing Relay Operations

15: ANALYZING RELAY EVENTS / 1 PDH /
- Troubleshooting • Case Histories
MICHAEL J. WRIGHT, PE

Michael began teaching Protection & Control Philosophy in 2000 for Progress Energy. In 2001, he developed a 40-hour curriculum designed to explain the macro view of Protection & Control. For more than a decade, Michael has provided instruction and training in relay philosophies. He serves on the Education Advisory Board at the University of Florida and Valencia College and was formerly an adjunct professor at Valencia College.

Michael is co-founder and president of Power Grid Engineering, and founded the company with partners Andre Uribe and William Durie, PE in 2007. He has led the company for six years and currently has a staff of 100 employees performing power engineering services throughout the United States.

ADRIAN G. ZVARYCH, PE

Adrian began his career in 1982 as a field Protection & Control engineer, where he quickly began mentoring engineer interns. Since that point, he has made significant contributions in utility fiber networks and is recognized as a bridge builder between IT-Telecom and Protection & Control teams. He has developed training courses and presentation materials including topics in substation communications, power line carrier design and application, fiber optic network design and grounding and bonding for communications equipment. He has prepared and delivered countless technical presentations to audiences including protection & control, SCADA, IT and Telecom engineers and technicians in formal classrooms and on-site settings. Adrian is actively contributing to the IEEE Working Group H09 related to substation communications, and serves as PGE’s principal communications engineer.

MIKE YOUNG, PE

Mike Young received his MBA from Rollins College in 1983 and BSET from Purdue University in 1971. Mr. Young began his testing career in 1969 and after graduation joined Wisconsin Electric Power Company as a Relay Engineer for two years, and Florida Power Corporation as a Field Relay Supervisor for 21 years. He authored the text “Protective Relaying for Technicians” currently being revised for reprinting. He worked as Principal Application Engineer for Basler Electric for 8 years, during which time he authored technical papers presented to numerous conferences and has been published by IEEE and NETA.

Since 2002 Mr. Young has been Owner and President of North Idaho Relay Consulting. He continues writing and presenting Protective Relay training programs, commissioning and testing of Protective Relaying Systems and performing Engineering peer review for protective relay designs.
PROFESSIONAL DEVELOPMENT HOURS
Each participant completing the course successfully will earn PDHs. A certificate of completion, showing the accumulated PDHs earned, will be provided at the end of the course.

SEMINAR HOTEL INFORMATION

LAKE MARY, FL
Orlando Marriott Lake Mary
1501 International Parkway, Lake Mary, Florida 32746

CHARLOTTE, NC
Courtyard Charlotte City Center
237 South Tryon Street, Charlotte, NC 28202

AUSTIN, TX
Renaissance Austin Hotel
9721 Arboretum Blvd, Austin, TX 78759

CANCELLATIONS AND REFUNDS
If you must cancel your registration and it is 10 or more business days prior to the course start date, you may choose to substitute a person, transfer to another course, or receive a full refund. Cancellations must be received in writing.

If you must cancel your registration and it is less than 10 business days prior to the course start date, you may choose to substitute a person. (Refund or course transfer within 10 days of the course start date are not permitted.)

ON-SITE PROGRAMS
We can tailor our courses to your needs and bring them to a location of your choice. If you are interested in this on-site program service, contact Sarah Faehnle at 877-819-1171 x-348 or SFaehnle@powergridmail.com.