



Texas A&M University

**69th Annual
Conference for
Protective Relay Engineers
April 4 - April 7, 2016**

<http://engineering.tamu.edu/prorelay>

Program Planning Committee

B. Don Russell, Chair
Texas A&M University

James Bowen
Aramco Services Company

David Costello
Schweitzer Engineering Laboratories

David Daigle
Entergy Services, Inc.

Rafael Garcia
Oncor Electric Delivery

Kristian Koellner
Lower Colorado River Authority

Heidt Melson
Xcel Energy

Van Tseng
Centerpoint Energy

Eric Udren
Quanta Technology, LLC

Craig Wester
GE Grid Solutions, LLC

Robert Wilson
ABB Inc.

Industry Exhibits:

Twenty-six manufacturers will exhibit in the Bethancourt Ballroom of the Texas A&M University Memorial Student Center. The exhibit area will be open on the following days and times:

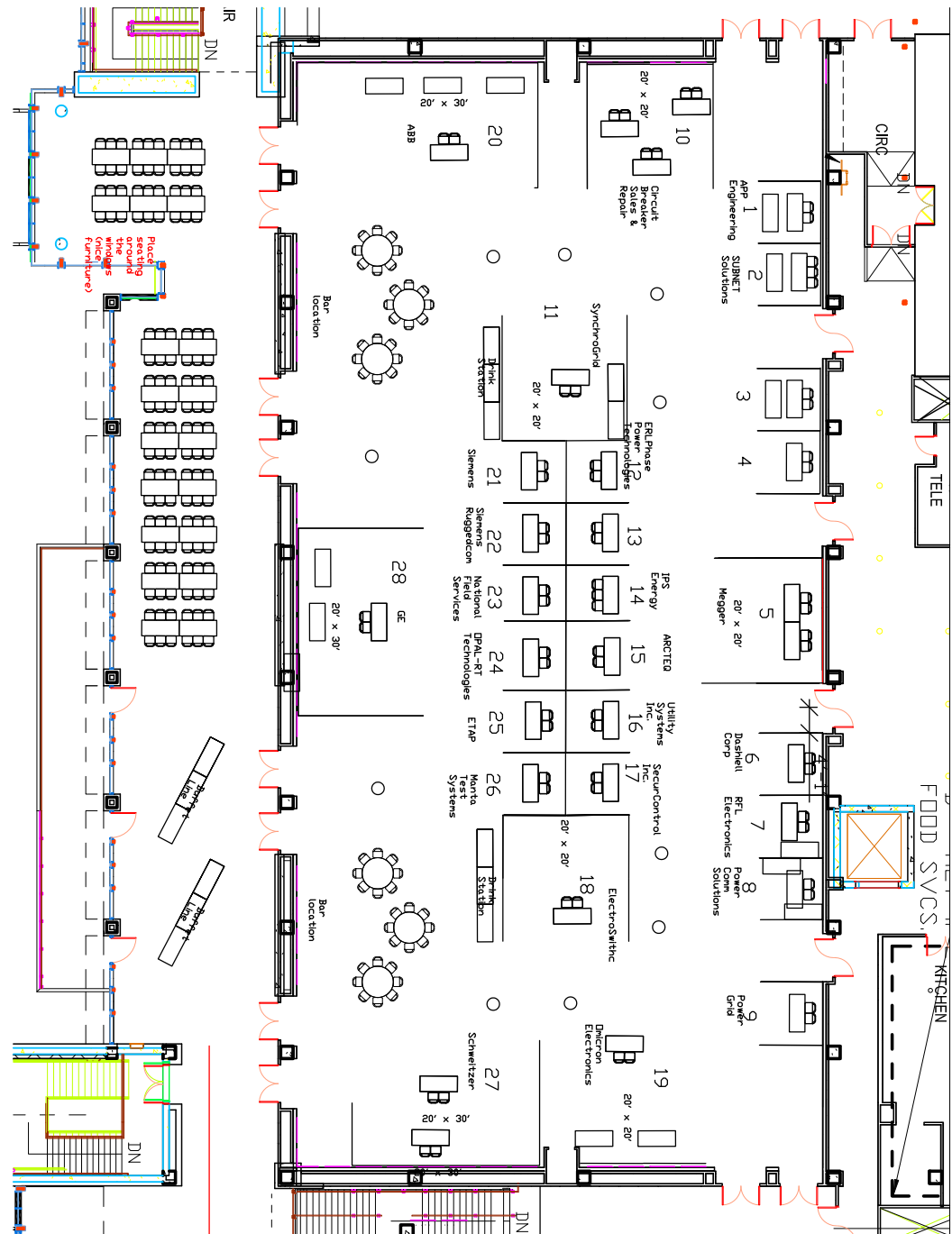
Monday 5:00 pm – 7:30 pm

Tuesday 12:00 pm – 1:30 pm and 5:00 pm – 7:30 pm

Wednesday 12:00 pm – 1:30 pm

Lunch will be served at noon in the exhibit area on Tuesday and Wednesday.

Company Name	Location
ABB Inc.	Booth 20
AMETEK Power Instruments	Booth 13
APP Engineering, Inc.	Booth 1
ARCTEQ Relays Ltd.	Booth 15
Circuit Breaker Sales & Repair, Inc.	Booth 10
Dashiell Corporation	Booth 6
ElectroSwitch Corporation	Booth 18
ERLPhase Power Technologies Ltd.	Booth 12
ETAP	Booth 25
GE Grid Solutions, LLC	Booth 28
IPS-Energy USA, Inc.	Booth 14
Manta Test Systems Inc.	Booth 26
Megger	Booth 5
National Field Services	Booth 23
OMICRON electronics	Booth 19
OPAL-RT Technologies	Booth 24
Power Grid Engineering	Booth 9
PowerComm Solutions, LLC	Booth 8
RFL Electronics Inc.	Booth 7
Schweitzer Engineering Laboratories, Inc.	Booth 27
SecuControl Inc.	Booth 17
Siemens	Booth 21
Siemens RUGGEDCOM	Booth 22
SUBNET Solutions Inc.	Booth 2
SynchroGrid	Booth 11
Utility Systems Inc.	Booth 16



Manufacturers' Pre-Conference Activities: Monday, April 4

GE Grid Solutions, LLC

Monday, April 4, 2016

8:00 am – 4:00 pm

Memorial Student Center (MSC), Room 2406A & 2406B,
Texas A&M University, College Station, TX

This GE technical seminar will cover modern equipment monitoring and diagnostics, reliable power system architectures, modern communications protocols and lessons learned through event analysis. Seminar certificates with 7 training hours will be provided to attendees. Lunch will be provided. There is no charge to attend this technical training session.

Power Grid Engineering

Monday, April 4, 2016

1:00 pm – 4:00 pm

Rudder Tower, Room 701,
Texas A&M University, College Station, TX

Join Power Grid Engineering for a FREE highlight of our Power Systems Training Seminar. The session will focus on the fundamentals of Line Protection including: 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.

OPAL-RT Technologies

Monday, April 4, 2016

1:00 pm - 2:00 pm

Memorial Student Center (MSC), Room 2404,
Texas A&M University, College Station, TX

Maxim Beaudoin will be doing an introduction of OPAL-RT Technologies followed by Shijia Li who will be presenting the following content:

- Capabilities
- Example of 8 applications
- Demonstration: Distance relay type testing according to IEC 60255-121

Shijia Li graduated from Zhejiang University, China with a B.Eng in 2012. In 2015, she obtained her M.Eng degree in electrical engineering from McGill University, Canada, where she worked on distributed generation interconnection protection and IEC 61850. After graduation she joined OPAL-RT Technologies as a power system studies and test specialist. She has been focusing on power system protection applications using real-time simulators, Phasor Measurement Unit (PMU) testing and applications as well as communications protocols for power systems.

Schweitzer Engineering Laboratories, Inc.

Monday, April 4, 2016

8:00 am – 4:00 pm

Memorial Student Center (MSC), Room 2400,
Texas A&M University, College Station, TX

Top SEL technical experts will explain solutions to important challenges engineers face supporting our modern electric grid. High performance, reliability, security, and new innovations will all be highlighted during the seminar. The afternoon will offer three concurrent breakout sessions on topics covering event analysis, automation and integration, and modern techniques to protect generators and motors.

Siemens

Monday, April 4, 2016

10:00 am – 12:00 pm; 2:00 pm - 4:00 pm

Memorial Student Center (MSC), Room 2405,
Texas A&M University, College Station, TX

Industrial Load Optimization & Fast Motor Bus Transfer

Because of the nature of many industrial processes, power system continuity and source restoration are critical functions. This session presents power management solutions to balance load and generation during disruptions and transfer systems addressing the unique problems of motor busses.

Feeder Automation

Applying advanced controls to distribution systems has been shown to have the highest benefit for the lowest cost in terms of customer focused metrics. This session will show how feeder automation is configured from simple systems to multi-sourced and looped.

Merging Unit and 61850 Technology

The use of Ethernet (not Internet) based communications within the substation reduces costs, increases standardization, and aids in system integration. Applying the new Merging Unit technology will be explained with security and communications issues discussed.

Smart Protection

By going beyond “time-dial and pickup” we can use protection to reduce primary equipment costs, save on maintenance and improve reliability. New capabilities and their system impact will be presented.



Relion® advanced protection & control. The ideal choice for every application.



The Relion® product family offers the widest range of products for power systems protection, control, measurement and supervision. ABB's leading edge technology, global application knowledge and experienced support network ensures complete confidence that your system performs reliably - in any situation. Designed to seamlessly consolidate functions, Relion relays are smarter, more flexible and more adaptable than any other relay in the market. For more information, visit www.abb.com/relion.

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Pre-Conference Special Offerings: Monday, April 4

TUTORIALS

Each of the two tutorials is 1.3 hours long and will occur back-to-back.

Monday, April 4, 1:00 pm - 4:00 pm
Location: Rudder Tower, Room 601

Moderator: Rafael Garcia, ONCOR Electric Delivery

C37.114, IEEE Guide for Determining Fault Location on AC Transmission and Distribution Lines

Presenter: Joe Mooney, Power Engineers

This guide outlines the techniques and application considerations for determining the location of a fault on ac transmission and distribution lines. The document reviews traditional approaches and the primary measurement techniques used in modern devices: one-terminal and two-terminal impedance-based methods and traveling wave methods. Application considerations include: two- and three-terminal lines, series-compensated lines, parallel lines, untransposed lines, underground cables, fault resistance effects, and other power system conditions, including those unique to distribution systems.

IEEE/PSRC Report on End Of Useful Life Assessment of Protection and Control Devices

Presenter: Suparat (Poom) Pavavicharn, Basler Electric

This tutorial will discuss the issue of end-of-useful life of protection and control devices by first defining what it means including all attributing factors to the end-of-useful life process. This tutorial will examine reasons why a device may no longer be useful, possible ways to determine useful life of a device, why knowing the useful life of a device is important, and how to extend the useful life of a device.

PROFESSIONAL ENGINEERING ETHICS **Ethics in Engineering Practice**

Monday, April 4, 4:00 pm - 5:00 pm
Location: Rudder Tower, Room 601

Join us for an ethics seminar to meet PDH requirements.

Reception in Bethancourt Ballroom following sessions:

Monday and Tuesday from 5:00 pm - 7:30 pm

Lunch in Bethancourt Ballroom following sessions:

Tuesday and Wednesday from 12:00 pm - 1:00 pm

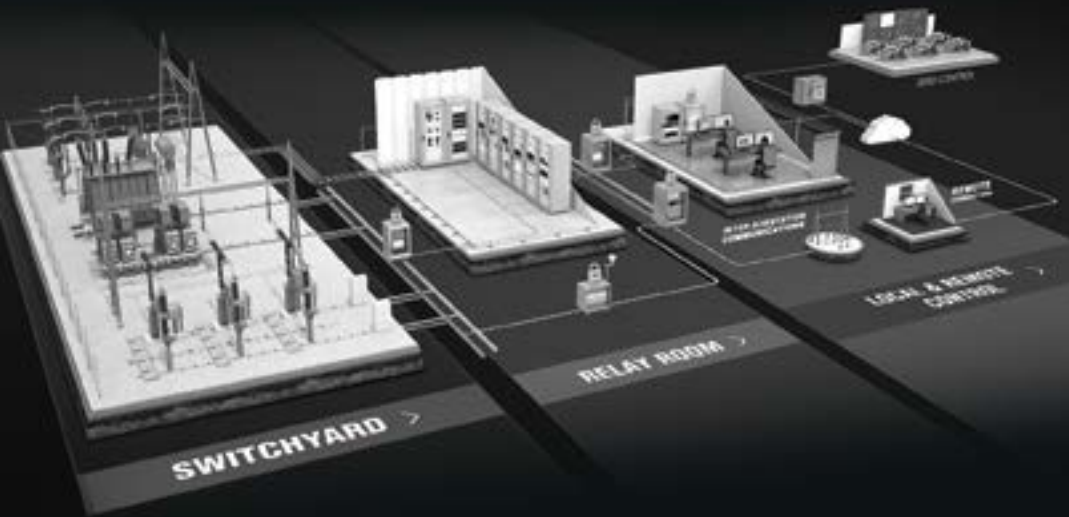


GE's Grid Solutions business provides mission critical protection, control, monitoring, and diagnostic solutions to enable reliable, efficient and secure distribution and use power from the point of generation to the end power consumer.

Stop by the Grid Solutions booth #28

Monday 5:00 pm to 7:30 pm
 Tuesday Noon to 1:30 pm and 5:00 pm to 7:30 pm
 Wednesday Noon to 1:30 pm

INTELLIGENT DIGITAL SUBSTATIONS Increasing Substation Situational Awareness



GEGridSolutions.com

General Session

Tuesday, April 5

Rudder Theater

Session Chair: David Costello

7:30 am	Registration
8:00 am	Announcements B. Don Russell, Conference Chair
8:10 am	Protection & Controls Analytics for a Reliable Grid Qasim Aziz, CenterPoint Energy
8:50 am	How We Learn That <i>It Depends</i> in Protective Relaying Heather Malson, Power Grid Engineering, LLC Munira Masoud, Schweitzer Engineering Laboratories
9:30 am	Catching Falling Conductors in Midair - Detecting and Tripping Broken Distribution Circuit Conductors at Protection Speeds Kamal Garg, Schweitzer Engineering Laboratories William O'Brien, San Diego Gas & Electric Company Eric Udren, Quanta Technology, LLC
10:10 am	Refreshment Break
10:40 am	Maximizing Line Protection Reliability, Speed, and Sensitivity Karl Zimmerman, Schweitzer Engineering Laboratories
11:20 am	Application of Line Differential Protection Scheme for Radial Transmission and Distribution Lines Iliia Voloh, GE Grid Solutions, LLC
12:00 pm	Lunch and Vendor Exhibits



Designing the Future of Substation Cybersecurity

Protect your critical networks from today's threats with SEL solutions.

True cybersecurity requires a combination of people, process, and technology. At SEL, our defense-in-depth philosophy and commitment to building security-aware cultures lead to the most secure and compliant solutions. Backed with years of experience, our Engineering Services team will:

- **Assess regulatory requirements** to document and resolve risks and gaps in power system infrastructure.
- **Identify and analyze cyber threats** to minimize impact on substation operations.
- **Review substation cybersecurity operations** to provide sensible security solutions.
- **Design and implement solutions** to enhance and protect mission-critical power systems.

Take the first step to substation security and compliance by visiting with an SEL expert in **Booth #27** today!



Distribution Session

Tuesday, April 5

Memorial Student Center 2406A

Session Chair: Craig Wester

1:30 pm	Considerations for Connecting Photovoltaic Solar Plants to Distribution Feeders Galina Antonova, ABB Inc.
2:00 pm	Solutions to Common Distribution Protection Challenges Jeremy Blair, Schweitzer Engineering Laboratories
2:30 pm	University Implements Distribution Automation to Enhance System Reliability and Optimize Operations Payal Gupta, Schweitzer Engineering Laboratories Tyler Hjorth, Texas A&M University
3:00 pm	Refreshment Break
3:30 pm	Requirements and Methods for Reducing Fault Clearing Times in Smart Grids Alexander Apostolov , OMICRON Electronics
4:00 pm	Reducing System Losses and Implementing Self-Healing to Minimize Impacts of Faults in Distribution Networks Doug Voda, ABB Inc.
4:30 pm	Improved Fault Location on Distribution Circuits Using Advanced Inputs Michael Lattner, United Cooperative Services Wayne Carr, Milsoft Utility Solutions Carl Benner, Texas A&M University
5:00 pm	Reception and Exhibits

APP Engineering

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Equipment that
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Requirements**

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**80 Event
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Channels**



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Booth 1 at the Conference for Protective Relay Engineers

APP Engineering 5234 Elmwood Ave Indianapolis IN, 46203
Ph:317-536-5300 F:317-536-5301 www.appengineering.com

Transmission Session

Tuesday, April 5

Memorial Student Center 2400

Session Chair: Rafael Garcia

1:30 pm	Improved Understanding of Actual System Events Using Synchrophasor Visualization Roy Moxley, Siemens
2:00 pm	Analysis of a Differential and Overcurrent Operation on a 345kV High Voltage Line Reactor Joe Perez, SynchroGrid
2:30 pm	Practical Considerations When Protecting Mutually Coupled Lines Michael Thompson, Schweitzer Engineering Laboratories
3:00 pm	Refreshment Break
3:30 pm	Relay Loadability Challenges Experienced in Long Lines Joe Perez, SynchroGrid
4:00 pm	Performance of Time-Domain Line Protection Elements on Real-World Faults Venkat Mynam, Schweitzer Engineering Laboratories
4:30 pm	Voltage and Current Inversion Challenges When Protecting Series-Compensated Lines - A Case Study Normann Fischer, Schweitzer Engineering Laboratories
5:00 pm	Reception and Exhibits

SIMPLER Relay Settings
 Drawing Standardization
 System Protection Design
 Relay Mis-Operation Analysis



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- Intelligent detection of protection zones
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Generation Session

Tuesday, April 5

Memorial Student Center 2406B

Session Chair: Heidt Melson

1:30 pm	Subsynchronous Oscillation Detection Using Microprocessor Relays Roger Hedding, ABB Inc.
2:00 pm	Protection System for a Wind Generation Plant in Panama: Challenges and Solutions Héctor Altuve, Schweitzer Engineering Laboratories
2:30 pm	Using Loadability Studies to Comply with NERC PRC-025-1 Steve Nollette, Emerson Network Power
3:00 pm	Refreshment Break
3:30 pm	Challenges in Application of Distance Relays under Power Swing Conditions Zhiying Zhang, GE Grid Solutions, LLC
4:00 pm	Capturing Generator Rotor Angle and Field Quantities - SDG&E Experience and Approach to Using Nontraditional Generator Measurements Kamal Garg, Schweitzer Engineering Laboratories
4:30 pm	Understanding Generator Stator Ground Faults and Their Protection Schemes Donald Fentie, Schweitzer Engineering Laboratories
5:00 pm	Reception and Exhibits

Tutorial Session

Basics of Transmission Line Protection

Tuesday, April 5

Rudder Tower, Room 301

1:30 - 5:00 pm	Mike Ramlachan - GE Grid Solutions, LLC Terrance Smith - GE Grid Solutions, LLC This session will cover the basics of transmission line protection including distance protection, tele-protection schemes and line current differential. Topics will include transmission line fundamentals, distance protection fundamentals, pilot aided schemes, and stepped distance.
3:00 - 3:30 pm	Refreshment Break

General Session

Wednesday, April 6

Rudder Theater

Session Chair: Kristian Koellner

7:30 am	Registration
8:00 am	Announcements B. Don Russell, Conference Chair
8:10 am	Line Protection Response to a Three-Phase Intercircuit Fault Edsel Atienza, Schweitzer Engineering Laboratories
8:45 am	Mayflower EHV Substation - Tornado Restoration David Daigle, Entergy Services, Inc
9:20 am	Refreshment Break
Real World Experiences Session Chair: Kristian Koellner	
9:50 am	Man-Made Faults - Line Protection Operation for an Unintended Phase Cross-Connect Condition Jon Larson, Schweitzer Engineering Laboratories
10:10 am	Zone-1 Ground Distance Element Mis-Operation for External Fault Kevin Jones, Xcel Energy
10:30 am	Ground Fault Protection: When Good Things Happen to Bad Faults Andrew Mattei, Brazos Electric Cooperative
10:50 am	Whose FAULT is it? Gene Corpuz, Lower Colorado River Authority
11:10 am	The Language of "Squiggly Lines" Bret Burford, American Electric Power
11:30 am	Post Energization Commissioning via Event Reports Martin Moon, Relay Application Innovation, Inc.
12:00 pm	Lunch

Industrial Session

Wednesday, April 6

Memorial Student Center 2406A

Session Chair: James Bowen

1:30 pm	A Review of Intertie Protection Terrence Smith, GE Digital Energy
2:00 pm	Safety Considerations for AC Motor Thermal Protection Matt Proctor, GE Digital Energy
2:30 pm	Busbar Protection: A New and Reliable Approach Vincent Duong, ABB Inc.
3:00 pm	Refreshment Break
3:30 pm	Performance of CTs and Relays at Low Frequencies Umar Khan, GE Energy Management
4:00 pm	Why Test Switches Still Matter Glenn Goldfarb, ABB Inc.
4:30 pm	Stabilizing the Differential Protection of Transformers Supplied with High Charging Circuit Zhiying Zhang, GE Grid Solutions, LLC

Testing Session

Wednesday, April 6

Memorial Student Center 2406B

Session Chair: Bob Wilson

1:30 pm	Remote Maintenance Testing of Protection Devices and Schemes – Why We Need It and How We Can Do It? Alexander Apostolov, OMICRON Electronics
2:00 pm	Why Testing Digital Relays is Becoming So Difficult! Part 3 – Advanced Feeder Protection Benton Vandiver, OMICRON Electronics
2:30 pm	How Transformer DC Winding Resistance Testing Can Cause Generator Relays to Operate Ritwik Chowdhury, Schweitzer Engineering Laboratories
3:00 pm	Refreshment Break
3:30 pm	Advancements in Technology and the Challenges Posed to Electrical Testing of Protective Relays and Controls Eric Beckman, National Field Services
4:00 pm	Moving the Focus from Relay Element Testing to Protection System Testing Christopher Pritchard, OMICRON Electronics

Substation Session

Wednesday, April 6

Memorial Student Center 2400

Session Chair: Van Tseng

1:30 pm	A Solution to Sensitivity Challenges for the Protection of Large Fuseless Capacitor Banks Tom Ernst, GE Grid Solutions, LLC
2:00 pm	Protection and Control System Impacts from the Digital World Steven Kunsman, ABB Inc.
2:30 pm	Making Complex Protection and Control Systems Easy to Maintain Rich Hunt, GE Grid Solutions, LLC
3:00 pm	Refreshment Break
3:30 pm	Do CTs Like DC? Performance of Current Transformers With Geomagnetically Induced Currents Bogdan Kasztenny, Schweitzer Engineering Laboratories
4:00 pm	Modern Protection of Three-Phase and Spare Transformer Banks Faridul Katha Basha, Schweitzer Engineering Laboratories
4:30 pm	Auto-Reclose Scheme in a Ring Substation Configuration German Gutierrez, ISA Intercolombia

Tutorial Session

The Electrical Load List: Developing a Load List and Its Impact on Equipment Sizing

Wednesday, April 6

Rudder Tower, Room 301

1:30 - 5:00 pm	Mark Leyton - BP Exploration & Production Assembling the electrical load list is the first electrical step whether working on a green field or brown field project. From the load list, the one line diagrams are generated. The load list is used to determine sizing and identify long lead items such as a fully populated and functioning power control room with associated SWGR, MCC's, bus duct for the various step-down transformers, relays, etc. This tutorial will cover how to find and diagnose the initial data to create an electrical load list, how that data is used to size and rate equipment, and the part the load list plays in electrical studies to ensure proper specifying and buying of equipment.
3:00 - 3:30 pm	Refreshment Break

General Session

Thursday, April 7

Memorial Student Center 2406A/B

Session Chair: Eric Udren

8:00 am	Does Every Millisecond Really Count? – A Comparison of Protection Based Arc Flash Mitigation Techniques Chris Burnette, GE Industrial Solutions Terrence Smith, GE Grid Solutions, LLC
8:35 am	Millisecond, Microsecond, Nanosecond: What Can We Do With More Precise Time? Edmund O. Schweitzer III, Dave Whitehead, Greg Zweigle, Veselin Skendzic and Cody Tews, Schweitzer Engineering Laboratories, Inc.
9:10 am	How Do We Fix the Network Model When It Doesn't Match Reality? Benton Vandiver, OMICRON Electronics
9:45 am	Refreshment Break
10:20 am	Understanding the Dynamic Mho Distance Characteristic Donald Fentie, Schweitzer Engineering Laboratories, Inc.
10:55 am	Detection of Time Spoofing Attacks on GPS Synchronized Phasor Measurement Units Andrew K. Mattei and W. Mack Grady, Baylor University P. Jay Caspary, Southwest Power Pool Scott A. McBride, Idaho National Laboratory
11:30 am	Not All Differentials are the Same: How Different Percent Differential Relay Algorithm Methods Can Impact Relay Settings and Performance Matt Proctor and Lubomir Sevov, GE Grid Solutions, LLC

Communications Session

Thursday, April 7

Memorial Student Center 2400

Session Chair: David Daigle

8:00 am	Speed and Security Considerations for Protection Channels Ken Fodero, Schweitzer Engineering Laboratories
8:35 am	The Importance of Testing Smart Grid IEDs Against Security Vulnerabilities Anca Cioraca, GE Grid Solutions, LLC
9:10 am	Securing Communications for SCADA and Critical Industrial Systems Tom Bartman, Schweitzer Engineering Laboratories
9:45 am	Refreshment Break
10:20 am	Wide Area Protection & Control Using High-Speed and Secured Routable GOOSE Mechanism Mital Kanabar, GE Grid Solutions, LLC
10:55 am	Smart Substation for the French Power Grid Ravindranauth Ramlachan, GE Grid Solutions, LLC
11:30 am	IEC 61850 Multivendor Station and Process Bus Substation Design Joshua Bonfoglio, Entergy Services, Inc.



69th Annual Conference for Protective Relay Engineers
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979.845.7912 office

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Conference papers are available at
<http://prorelay.tamu.edu/archive.php>

70th
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April 2 - April 6, 2017