

# 70<sup>th</sup> Annual Conference for Protective Relay Engineers

April 3 - 6, 2017 | [prorelay.tamu.edu](http://prorelay.tamu.edu)



Texas A&M University

# Program Planning Committee

**B. Don Russell, Chair**  
Texas A&M University

**David Costello**  
Schweitzer Engineering Laboratories, Inc.

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**James E. Bowen**  
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**Rafael Garcia**  
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**Brian Clowe**  
CenterPoint Energy

**Kevin W. Jones**  
Xcel Energy

**Eduardo Colmenares**  
ABB Inc.

**Eric Udren**  
Quanta Technology

**Genardo T. Corpuz**  
Lower Colorado River Authority

**Craig G. Wester**  
GE Grid Solutions

## Conference App

check in, view conference program, and more



[guidebook.com/g/relayconference2017](http://guidebook.com/g/relayconference2017)

# Industry Exhibits

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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:

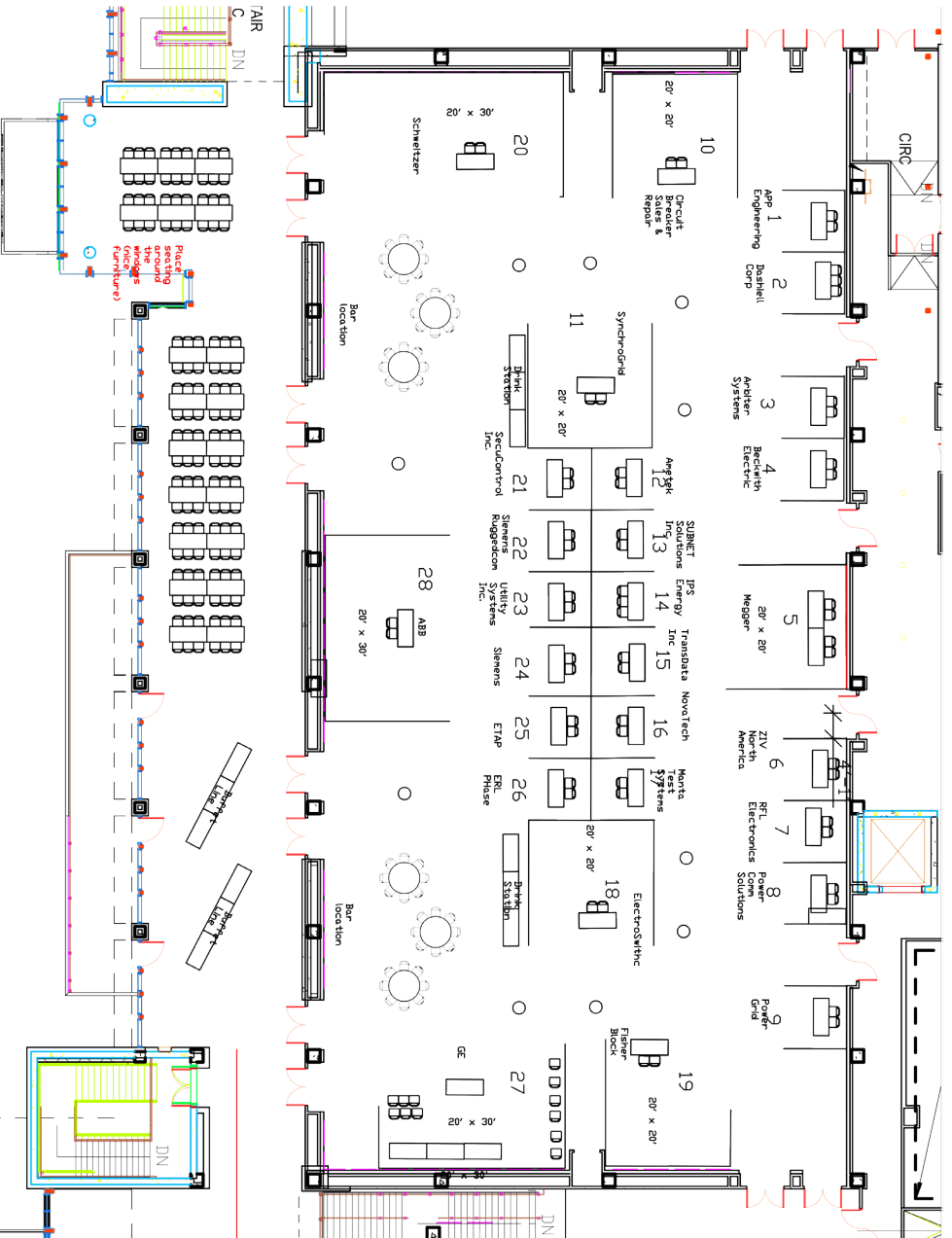
**Monday 4:00 pm - 7:30 pm**

**Tuesday 12:00 pm - 1:30 pm & 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.

ABB Inc.	Booth 28
AMETEK Power Instruments	Booth 12
APP Engineering, Inc.	Booth 1
Arbiter Systems	Booth 3
Beckwith Electric	Booth 4
Circuit Breaker Sales & Repair, Inc.	Booth 10
Dashiell Corporation	Booth 2
ElectroSwitch Corporation	Booth 18
ERLPhase Power Technologies Ltd.	Booth 26
ETAP	Booth 25
Fischer Block	Booth 19
GE Grid Solutions, LLC	Booth 27
IPS-Energy USA, Inc.	Booth 14
Manta Test Systems Inc.	Booth 17
Megger	Booth 5
NovaTech, LLC	Booth16
POWER Grid Engineering	Booth 9
PowerComm Solutions, LLC	Booth 8
RFL Electronics Inc.	Booth 7
Schweitzer Engineering Laboratories, Inc.	Booth 20
SecuControl Inc.	Booth 21
Siemens	Booth 24
Siemens RUGGEDCOM	Booth 22
SUBNET Solutions, Inc.	Booth 13
SynchroGrid	Booth 11
TransData, Inc.	Booth 15
Utility Systems Inc.	Booth 23
ZIV North America	Booth 6



Monday, April 3

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# Manufacturers' Pre-Conference Activities

## ETAP

9:00 am - 5:00 pm | Rudder Tower, Room 501

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### Morning session:

Overview of ETAP Power System Analysis Software

New features in ETAP 16.1 Release

Star™ - Overcurrent Protection & Coordination

ETAP Star provides intelligent tools to analyze system protection and selectivity including troubleshooting false trips and evaluating protective device mis-coordination.

StarZ™ Distance Relay Protection & Coordination Analysis

ETAP StarZ offer capabilities to include sliding fault analysis and detailed impedance relay (21) modeling for transmission and distribution protection and coordination.

### Afternoon session:

Intelligent Load Shedding - ILSTM

ETAP ILS predicts the optimal load shedding scenario based on actual system dynamics.

Fault Location, Isolation and Service Restoration - FLISR

ETAP FLISR solution minimizes outage disruption by enabling faster fault detection, location prediction, isolation and optimal restoration through use of network model and real time data acquired from protective devices, fault indicators, meters and customer reports.

## GE Grid Solutions

8:00 am - 4:00 pm | Memorial Student Center (MSC), Room 2406

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This GE technical seminar will cover advanced transformer protection, advanced motor protection, substation automation and lessons learned from event/record analysis.

Seminar certificates with 5.5 training hours will be provided to attendees. Lunch will be provided. There is no charge to attend this technical training session.

## Schweitzer Engineering Laboratories, Inc.

8:00 am - 4:00 pm | Memorial Student Center (MSC), Room 2400

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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 a range of topics.

## **Siemens**

10:00 am - 4:00 pm | Memorial Student Center (MSC), Room 2405

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### **“Reliability, Safety, Simplicity”**

Come learn about Innovative Solutions from Siemens for Protection and Control that maximize Reliability and Safety. Siemens will be conducting a tutorial session to teach attendees about the following topics and how they are handled using Siemens' SIPROTEC and SICAM product families.

- Arc Flash Protection and Mitigation
- Innovative Relay Applications
- Sm@rtgear from Siemens
- Network Design
- Cyber Security
- Siemens Distribution Feeder Automation (SDFA)

Attendees will receive a training certificate and gift for attending the tutorial as well as 6 CEU's for attending the full session. Refreshments and lunch provided. We hope you can join us for this informative session and learn about these exciting technology offerings from Siemens.

## **SynchroGrid**

1:00 pm - 4:00 pm | Rudder Tower, Room 410

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SynchroGrid will provide an in-depth course that discusses conventional methods and practices for setting a SEL-421 relay as well as recent advances in the automation of settings development. The attendee will be guided through the process of using ASPEN to perform simulations, entering data in equations, and exporting the final settings to an RDB. They will also be shown how to automate this process, making relay setting development simpler, faster, and more accurate. A free settings calculation spreadsheet will be provided to all who attend.

## **Power Grid Engineering**

1:00 pm - 4:00 pm | Rudder Tower, Room 701

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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 and Security, IEEE Standards.

Monday, April 3

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# Pre-Conference Special Offerings

## Tutorials

### **Quality Assurance in Protection and Control Design**

Moderator: Eric Udren, Quanta Services | Presenter: Michael Wright, Power Grid Engineering, LLC

1:00 pm - 4:00 pm | Rudder Tower, Room 601

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Throughout the electric utility industry, the drive to maximize quality assurance practices has gained increased prominence. These practices mitigate common errors frequently encountered in engineering design packages, specific to Protection and Control (P&C) design. This tutorial will illustrate industry practices to be applied in a Quality Assurance Program for P&C design drawing packages and encourage the attendee to incorporate these practices into their organization's Quality Assurance Program.

## Professional Engineering Ethics Seminar

### **Ethics in Engineering Practice**

4:00 pm - 5:00 pm | Rudder Tower, Room 601

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Join us for an ethics seminar to meet PDH requirements.

### **Reception in Bethancourt Ballroom following sessions:**

Monday from 4:00 pm - 7:30 pm | Sponsored by Schweitzer Engineering Laboratories

Tuesday from 5:00 pm - 7:30 pm | Sponsored by GE Grid Solutions, LLC

### **Lunch in Bethancourt Ballroom following sessions:**

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

Tuesday, April 4

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# General Session

Rudder Theatre | Session Chair: Kevin W. Jones

7:30 am	<b>Registration</b>
8:00 am	<b>Announcements</b> David Costello
8:10 am	<b>Protection Challenges for North America's First Combined Cable/Overhead Double-Circuit 500 kV Transmission Line With Mutual Coupling</b> Jordan Bell, Schweitzer Engineering Laboratories
8:50 am	<b>Entergy's Record Flooding Across Our Grid</b> Darryl Champagne, Entergy
9:30 am	<b>Life Cycle Considerations for Microprocessor Relays</b> Michael Kleman, ABB, Inc.

*10:10 am Refreshment Break*

10:40 am	<b>Real-Time Circuit Breaker Health Diagnostics</b> Robert Schloss, Schweitzer Engineering Laboratories
11:20 am	<b>Novel Approach to Relay Setting Development</b> Joe Perez, Synchrogrid LLC

*12:00 pm Lunch and Vendor Exhibits - Bethancourt Ballroom*

*Tuesday's Lunch Sponsored by **ABB, Inc.***



Tuesday, April 4

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# Distribution Session

Memorial Student Center, Room 2400 | Session Chair: Craig Wester

1:30 pm	<b>Advanced Monitoring Tools to Improve Distribution System Visibility and Reduce Faults and Outages</b> Thomas Ellis, Bluebonnet Electric Cooperative Kim Bender, Bluebonnet Electric Cooperative Carl Benner, Texas A&M University
2:00 pm	<b>Implementing a Microgrid Using Standard Utility Control Equipment</b> Andy Gould, Schweitzer Engineering Laboratories
2:30 pm	<b>Apply a Wireless Line Sensor System to Enhance Distribution Protection Schemes</b> David Keckalo, Schweitzer Engineering Laboratories

*3:00 pm Refreshment Break*

3:30 pm	<b>Predicting the Prospective Fault Level on Distribution Grids and Its Impact on Protective Relaying</b> Joao Jesus, GE Grid Solutions
4:00 pm	<b>The Necessity and Challenges of Modeling and Coordinating Microprocessor Based Thermal Overload Functions for Device Protection</b> Karl Smith, ABB, Inc.
4:30 pm	<b>Utility Implements Communications-Assisted Special Protection and Control Schemes for Distribution Substations</b> Dharmendra Prajapati, Schweitzer Engineering Laboratories

*5:00 pm Reception and Exhibits - Bethancourt Ballroom*

Tuesday, April 4

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# Generation Session

Memorial Student Center, Room 2406B | Session Chair: Eduardo Colmenares

1:30 pm	<b>Catastrophic Relay Misoperations and Successful Relay Operation</b> Drew Welton, Beckwith Electric Company
2:00 pm	<b>Protection Issues Related to Pumped Storage Hydro (PSH) Units</b> Dale Finney, Schweitzer Engineering Laboratory Joe Uchiyama, US Bureau of Reclamation
2:30 pm	<b>Open Phase Detection for Power Transformers Using VT Triggered Optical CTs and IEC 61850-9.2LE Compliant Relays</b> Mike Ramlachan, GE Grid Solutions

*3:00 pm Refreshment Break*

3:30 pm	<b>Generator Motoring Protection - Are You Protected?</b> Michael Thompson, Schweitzer Engineering Laboratories
4:00 pm	<b>Advanced Generator Protection and Monitoring Using Transducer Measurements</b> Dale Finney, Schweitzer Engineering Laboratories
4:30 pm	<b>Implementation and Field Experience of Redundant 100% Generator Stator Ground Fault Protection</b> Mike Ramlachan, GE Grid Solutions

*5:00 pm Reception and Exhibits - Bethancourt Ballroom*

Tuesday, April 4

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# Substation Session

Memorial Student Center, Room 2406A | Session Chair: Rafael Garcia

1:30 pm	<b>Enhanced Fault Location Method for Shunt Capacitor Banks</b> Ilia Voloh, GE Grid Solutions
2:00 pm	<b>Lessons Learned in Static VAR Compensator Protection</b> Aaron Findley, POWER Engineers, Inc.
2:30 pm	<b>Methods and Benefits to the Application of Ultra-High-Speed Transformer Protection</b> Roy Moxley, Siemens

*3:00 pm Refreshment Break*

3:30 pm	<b>Transformer Tank Rupture - A Protection Engineer's Challenge</b> Roger Hedding, ABB, Inc.
4:00 pm	<b>Beyond the Nameplate - Selecting Transformer Compensation Settings for Secure Differential Protection</b> Ariana Hargrave, Schweitzer Engineering Laboratories
4:30 pm	<b>A Novel Method for Turn to Turn Fault Detection in Shunt Reactors</b> Zhiying Zhang, GE Grid Solutions

*5:00 pm Reception and Exhibits - Bethancourt Ballroom*

# Cybersecurity Session

Rudder Tower, Room 301 | Session Chair: David Costello

1:30 pm	<b>Ukraine Cyber-Induced Power Outage: Analysis and Practical Mitigation Strategies</b> Jess Smith, Schweitzer Engineering Laboratories
2:00 pm	<b>Securing IEDs Against Cyber Threats in Critical Substation Automation and Industrial Control Systems</b> Eroshan Weerathunga, GE Grid Solutions
2:30 pm	<b>Cyber Security - Security Strategy for Distribution Management System and Security Architecture Considerations</b> Timothy Vittor, ABB, Inc.

*3:00 pm Refreshment Break*

3:30 pm	<b>Cyber Security Panel</b> Presenters will reconvene after the break for questions.
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*5:00 pm Reception and Exhibits - Bethancourt Ballroom*

Wednesday, April 5

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# General Session

Rudder Theatre | Session Chair: Brian Clowe

7:30 am	<b>Registration</b>
8:00 am	<b>Transmission Interconnection: Lessons Learned from a Recent Event at an Acquired Generating Plant</b> Lokoko Kitenza, Pacific Gas and Electric Company
8:40 am	<b>Fault Coverage of Memory Polarized Mho Elements with Time Delays</b> Jason Hulme, Black & Veatch

*9:20 am Refreshment Break*

# Real World Experiences

Rudder Theatre | Session Chair: Brian Clowe

9:50 am	<b>A Current Story - When Primary Met Secondary</b> Genardo Corpuz, Lower Colorado River Authority
10:10 am	<b>Microprocessor Relay Directional Change During Current Reversal</b> Micheal Davis Jr, CenterPoint Energy
10:30 am	<b>Fault and Outage Avoided through Proactive Detection of Distribution Conductor on Wooden Crossarm, Using DFA Technology</b> Dr. Comfort Manyame, Mid-South Synergy Electric Cooperative
10:50 am	<b>What Time is it? GPS Clocks, Leap Seconds, and the Impact on Synchrophasor Data</b> Andrew Mattei, Brazos Electric Corp
11:10 am	<b>Voltage Potential Device Impact on Negative Sequence Directionality</b> Sophie Gray, CenterPoint Energy
11:30 am	<b>Out of Step Strikes Again</b> Derlin Campbell, Xcel Energy

*12:00 pm Lunch and Vendor Exhibits - Bethancourt Ballroom*

# Testing Session

Memorial Student Center, Room 2406B | Session Chair: Genardo T. Corpuz

1:30 pm	<b>Injected Waveforms and Their Effect on Protection Element Response</b> Eugenio Carvalheira, OMICRON Energy
2:00 pm	<b>Commission Testing Methods for Protection Systems</b> Thomas Ernst, GE Grid Solutions
2:30 pm	<b>If You Cannot Test It, You Cannot Use It - IEC 61850 GOOSE System Designed With Testing in Mind</b> Anne Atalay, Schweitzer Engineering Laboratories
<i>3:00 pm Refreshment Break</i>	
3:30 pm	<b>A Practical Guide of Troubleshooting IEC 61850 GOOSE Communication</b> Wei Huang, ABB, Inc.
4:00 pm	<b>Commissioning Process and Acceptance Testing of a Sub-Harmonic Protection Relay</b> René Midence, ERL Phase Power Technologies
4:30 pm	<b>Hard to Find Maintenance Tips for Electromechanical Relays</b> Glenn Goldfarb, ABB, Inc.

# Transmission Session

Memorial Student Center, 2400 | Session Chair: David Daigle

1:30 pm	<b>Summary Paper for C37.243 IEEE Guide for Application of Digital Line Current Differential Relays Using Digital Communication</b> Nef Torres, CenterPoint Energy
2:00 pm	<b>Considerations in Choosing Directional Polarizing Methods for Ground Overcurrent Elements in Line Protection Applications</b> Meyer Kao, Patterson Power Engineers
2:30 pm	<b>Performance Comparison Between Mho Elements and Incremental Quantity-Based Distance Elements</b> Brian Smyth, Schweitzer Engineering Laboratories
<i>3:00 pm Refreshment Break</i>	
3:30 pm	<b>Adaptive Autoreclosure to Increase System Stability and Reduce Stress to Circuit Breakers</b> Jörg Blumschein, Siemens
4:00 pm	<b>Evaluating the Impact of Increasing System Fault Currents on Protection</b> Ilia Voloh, GE Grid Solutions
4:30 pm	<b>Using Superimposed Principles (Delta) in Protection Techniques in an Increasingly Challenging Power Network</b> Patricia Horton, GE Grid Solutions

# Communications Session

Memorial Student Center, 2406A | Session Chair: Eric Urden

1:30 pm	<b>The Advantages of Continuous Monitoring of Power Line Carrier (PLC) Channels Applied with Protection Systems</b> Roger Ray, PowerComm Solutions
2:00 pm	<b>Case Study: Protective Relaying over IP/MPLS Myth to Facts</b> Michael Nunez, Lower Colorado River Authority
2:30 pm	<b>Micro Processor Based Advanced Bus Protection Scheme Using IEC 61850 Process Bus (9-2) Sampled Values</b> Rene Midence, ERLPhase Power Tech
<i>3:00 pm Refreshment Break</i>	
3:30 pm	<b>Case Study/Overview of Applying an IEC 61850 Parallel Redundant Protocol Communications Network on a University Campus Power Distribution and Generating System</b> Ken Schapkohl, ABB, Inc.
4:00 pm	<b>Teleprotection Solutions with Guaranteed Performance Using Packet Switched Wide Area Communication Networks</b> Ramon Bächli, ABB, Inc.
4:30 pm	<b>Implementing a Modern, Secure Relay Integration Solution with your Existing IEDs</b> Derrick Mack, SUBNET Solutions, Inc.



Wednesday, April 5

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# Bus Protection Session

Rudder Tower, Room 301 | Session Chair: Craig Wester

1:30 pm **Bus Protection Fundamentals**

Terrence Smith, GE Grid Solutions

2:15 pm **Bus Protection Application Challenges**

JC Theron, GE Grid Solutions

*3:00 pm Refreshment Break*

3:30 pm **Unrestrained Low-Impedance Bus Differential - Should I Use It?**

Thomas Ernst, GE Grid Solutions

4:15 pm **High-Speed Reclosing, Switching Surges, and Bus Differential Protection Security - A Case Study**

Ryan McDaniel, Schweitzer Engineering Laboratories

Thursday, April 6

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# General Session

Memorial Student Center, Room 2400 | Session Chair: Kevin W. Jones

8:00 am **New Smart Multi-Ended Line Current Differential Solution for Power Networks**  
Joao Jesus, GE Grid Solutions

8:35 am **New Possibilities for Testing Travelling Wave Fault Location Functions in the Field**  
Eugenio Carvalheira, Omicron Energy

9:10 am **Breaking Paradigms in Control Building Design**  
Robert Frye, Tennessee Valley Authority

*9:45 am Refreshment Break*

10:20 am **Integrating Synchrophasors and Oscillography for Wide-Area Power System Analysis**  
Michael Rourke, Schweitzer Engineering Laboratories

10:55 am **Understanding Design, Installation, and Testing Methods That Promote Substation IED Resiliency for High-Altitude Electromagnetic Pulse Events**  
Travis Mooney, Schweitzer Engineering Laboratories

11:30 am **Choose Simplicity for a Better Digital Substation Design**  
Scott Wenke, Schweitzer Engineering Laboratories

# Industrial Session

Memorial Student Center, Room 2406 | Session Chair: Jim Bowen

8:00 am	<b>Negative-Sequence Overcurrent Considerations for Induction Motor Loads</b> Aadityaa Padmanabhan, Schweitzer Engineering Laboratories
8:35 am	<b>Considerations for Implementing a Zone-Selective Interlocking Scheme on Medium and Low Voltage Systems</b> Matt Proctor, GE Grid Solutions
9:10 am	<b>Improved Industrial Plant Reliability and Safety Enabled by Real-Time Distribution Circuit Diagnostics</b> Carl Benner, Texas A&M University
<i>9:45 am Refreshment Break</i>	
10:20 am	<b>Lessons Learned from NERC CIP Applied to Industrial Facilities</b> Matt Proctor, GE Grid Solutions
10:55 am	<b>Continuous Monitoring in Electrical Assets to Predict Thermal Incidents</b> Shelly Degrate, Powell Electrical Systems, Inc.