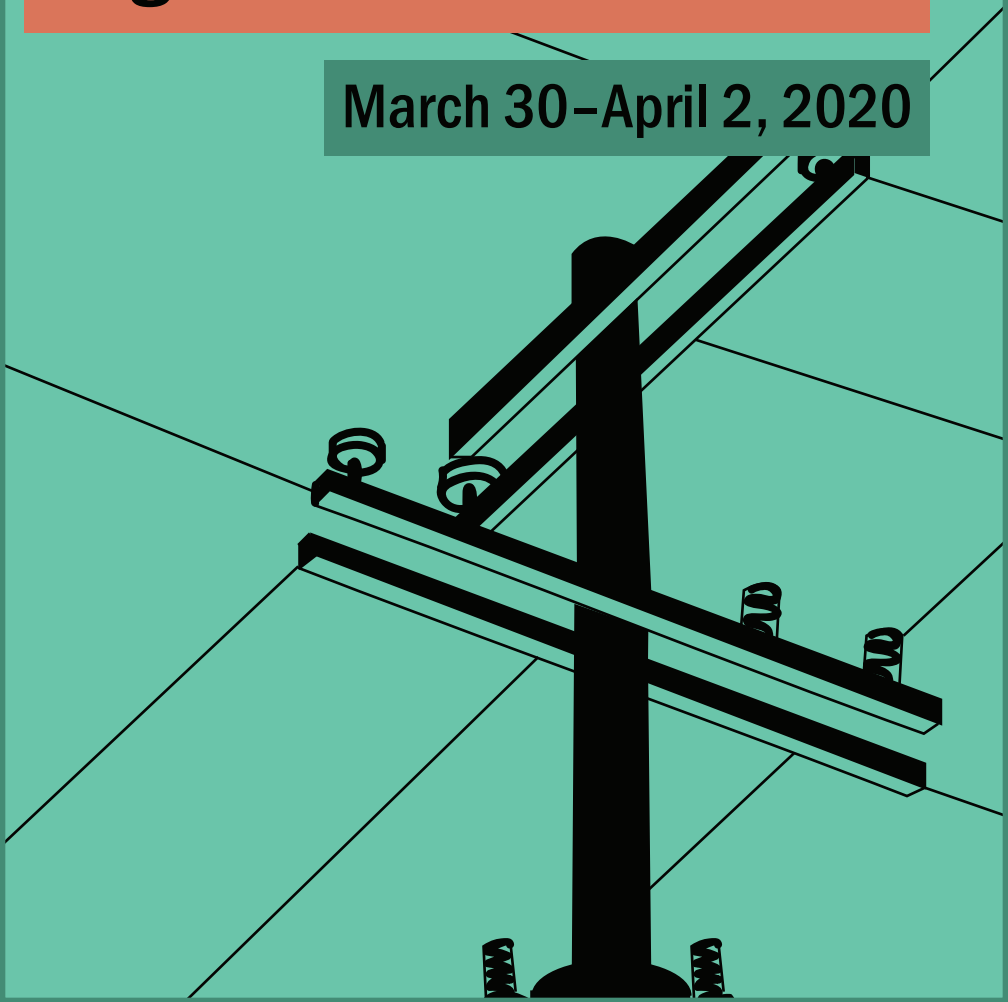
73rd Annual Conference for Protective Relay Engineers

March 30–April 2, 2020



Thanks to our Sponsors!

73rd Annual Conference for Protective Relay Engineers

Program Planning Committee

B. Don Russell, Chair	*Texas A&M University*
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Glenn Callaghan	*CenterPoint Energy*
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Derrick Haas	*Schweitzer Engineering Laboratories, Inc.*
Kevin W. Jones	*Xcel Energy*
Ken Swift	*Oncor*
Eric Udren	*Quanta Technology*
Craig G. Wester	*GE Grid Solutions*

Industry Exhibits

2300 Bethancourt Ballroom, Memorial Student Center (MSC)

The exhibit area will be open on the following days and times:

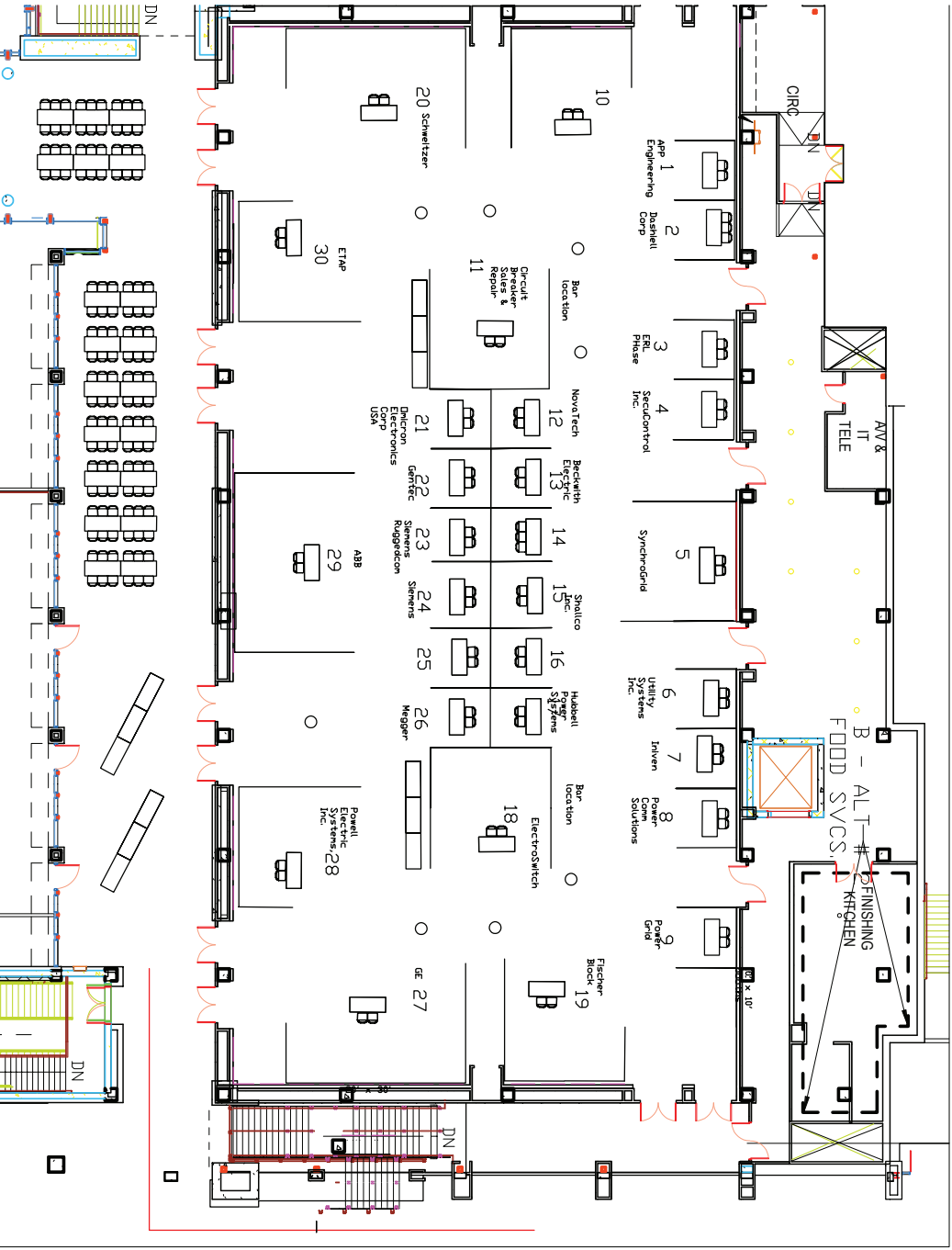
Monday: 4:00 pm – 7:30 pm
Tuesday: 12:00 pm – 1:30 pm & 5:00 pm – 7:30 pm
Wednesday: 12:00 pm – 1:30 pm

Lunch will be served at noon in the 2300 Bethancourt Ballroom on Tuesday and Wednesday.

Booth	Company
29	ABB Inc.
1	APP Engineering, Inc.
13	Beckwith Electric
11	Circuit Breaker Sales & Repair
2	Dashiell Corporation
18	Electroswitch
3	ERLPhase Power Technologies
30	ETAP
19	Fischer Block
27	GE Grid Solutions
22	Gentec
17	Hubbell Power Systems, Inc.
7	Iniven
26	Megger
12	NOVATECH LLC
21	OMICRON electronics Corp USA
28	Powell Electrical Systems, Inc.
9	Power Grid Engineering
8	PowerComm Solutions LLC
20	Schweitzer (SEL)
4	SecuControl Inc
15	Shallco
24	SIEMENS
23	Siemens-RUGGEDCOM
5	SyncrhoGrid
6	Utility Systems, Inc.

Exhibit Map

2300 Bethancourt Ballroom, Memorial Student Center (MSC)



Is your cap bank protection scheme reliable?

Impedance-based capacitor relay: the ideal complement to your voltage differential elements.

Capacitor banks are often protected using a voltage differential scheme.

While this scheme has proven to be effective for many cases, it may fail to catch some faults.

Moreover, this protection scheme only provides a differential voltage for the whole bank which does not help with maintenance.

One way to enhance the coverage of your protection scheme is to complement the voltage differential element with an impedance-based relay.

To learn how to improve the reliability of your capacitor bank protection and reduce maintenance costs with an impedance-based protection, simply send us an email at **alp@gentec.ca** and request a copy of our application note.

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Since 1959

Schedule Overview

73rd Annual Conference for Protective Relay Engineers

Monday	
8:00am–4:00pm	*Manufacturers' Pre-Conference Activities*
9:00am–4:00pm	*Pre-Conference Tutorial*
4:00pm–5:00pm	*Ethics Seminar*
4:00pm–7:30pm	*Reception and Exhibits in Bethancourt Ballroom*
Tuesday	
7:30am	*Registration*
8:00am–12:00pm	*Announcements and General Session I*
12:00pm–1:30pm	*Lunch and Exhibits in Bethancourt Ballroom*
1:30pm–5:00pm	*Parallel Paper Sessions: Testing and Trouble Shooting, Distribution, and Transmission*
5:00pm–7:30pm	*Reception and Exhibits in Bethancourt Ballroom*
Wednesday	
7:30 am	*Registration*
8:00am–12:00pm	*Announcements, General Session II, and Real World Session*
12:00pm–1:30pm	*Lunch and Exhibits in Bethancourt Ballroom*
1:30pm–5:00pm	*Parallel Paper Sessions: Substation, Communications & Integration, and Generation & Industrial*
Thursday	
8:00am –12:00pm	*Parallel Paper Sessions: General Session III and Inverter-Based Resources*

Pre-Conference Activities

Monday 8:00am–5:00pm

9am-4pm | Rudder Tower 601

IEEE Tutorial on the Protection of Synchronous Generators

The IEEE Tutorial on the Protection of Synchronous Generators has been updated by the IEEE Power System Relaying Committee. The tutorial covers fundamentals, fault protection, abnormal operating condition protection, offline and special operating mode protection, and system design. It provides context to the several IEEE Guides published on the subject. PSRC members will present the tutorial in this special offering.

9am-4pm | MSC 2406

GE Grid Solutions

Join GE for a no-charge technical seminar on generator protection fundamentals & applications, distribution protection & control applications and lessons learned from event/record analysis.

8:30am-4pm | MSC 2400

Schweitzer Engineering Laboratories (SEL)

Join us at the Texas A&M University Conference for Protective Relay Engineers and at our free technical seminar preceding the conference. We'll cover several new technologies and solutions from SEL, including time-domain protection capabilities, fast ways to mitigate wildfire risks, and advancements in generator protection. Discover how these technologies and more can make your power system faster, simpler, and safer.

1pm-4pm | MSC 2404

Power Grid Engineering

Join Power Grid Engineering for a free highlight of our 2020 Power Systems Training Seminars. This half-day seminar session will focus on Generator Fundamentals & Protection. All materials for this course will be provided. Seminar certificates with 3 training hours will be provided to those who pre-register. Topics coverd include:

-Generator Basics
-Unit One Line Diagram
-Recognize the Device Codes Used in Generator Protection
-IEEE Guide ot Generator Protection

Pre-Conference Activities

Monday 8:00am–5:00pm

1pm-4pm | Rudder Tower 501

ETAP

This free half-day technical seminar provides an overview of ETAP's latest Arc Flash, Model-Driven Electrical SCADA and Microgrid Controller modules for design and analysis as well as power distribution monitoring & control of operations.

1pm-4pm | Rudder Tower 410

SynchroGrid: Standardizing Transmission P&C Drawings and Relay Settings to Comply with PRC-027-1

In this free seminar, we will examine the requirements for PRC-027-1 and evaluate available best practices for accomplishing these requirements most effectively. We will then provide practical steps for establishing a utility-wide standardized development process for protection and control drawings and relay settings, empowering utilities to maintain consistency, increase reliability, and reduce errors. We will also introduce an automation tool which streamlines these processes, simplifying standardization and compliance.

4pm-5pm | Rudder Tower 601

Ethics in Engineering Practice

Join us for an ethics seminar to meet PDH requirements.
John W. Poston, Texas A&M University

4:00 pm–7:30pm Reception in Bethancourt Ballroom

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SEL

General Session I

Tuesday, March 31st | Rudder Theatre

Session Chair: Derrick Haas

7:30 am	**Registration**
	Coffee Sponsored by
8:00 am	**Announcements**
8:10 am	**Resetting Protection System Complexity** David E. Whitehead, Schweitzer Engineering Laboratories, Inc.
8:45 am	**Best of Both Worlds – Analog Principles Applied in a Digital Distance Relay** Bogdan Kasztenny, Schweitzer Engineering Laboratories, Inc.
9:20 am	**Impact of IEC 61850 Edition 2 on the Object Modeling of Complex Multifunctional Protection IEDs** Alexander Apostolov, OMICRON electronics
9:55 am	**Process Improvement of Distribution Protective Relay Coordination** Mehrdad Chapariha, Quanta Technology
10:30 am Refreshment Break	
10:50 am	**Process Bus Busbar Protection – A Stepping Stone Towards Digital Substation** Richard Hunt, GE Grid Solutions
11:25 am	**A Review of Best Practices for Installing and Commissioning Fiber-Based Communications for Long Term Reliability** Adrian Zvarych, Power Grid Engineering
12:00 pm Lunch and Exhibits in Bethancourt Ballroom	

Distribution Session

Tuesday, March 31st | MSC 2406A

Session Chair: Craig Wester

1:30 pm	**Recent Utility Experience with High Impedance Fault Detection** Mark Adamiak, Adamiak Consulting LLC
2:00 pm	**Preventing Distribution Circuit Caused Wildfire Ignition Using DFA Technology** B. Don Russell, Texas A&M University
2:30 pm	**Understanding Ground Fault Detection Sensitivity and Ways to Mitigate Safety Hazards in Power Distribution Systems** Normann Fischer, Schweitzer Engineering Laboratories, Inc.

3:00 pm Refreshment Break

3:30 pm	**High-Impedance Faults: Comparing Algorithms** Daniel Ransom, GE Grid Solutions
4:00 pm	**Can Compensated Networks be an Alternate Solution to Reduce the Risk of Ground Faults Causing Forest Fires?** Edgar Flores, ABB Inc
4:30 pm	**Adaptive Coordination Schemes to Reduce Fault Energy in Distribution Feeders Using Wireless Protection Sensors** David Keckalo, Schweitzer Engineering Laboratories, Inc.

5:00 pm–7:30pm Reception and Exhibits in Bethancourt Ballroom

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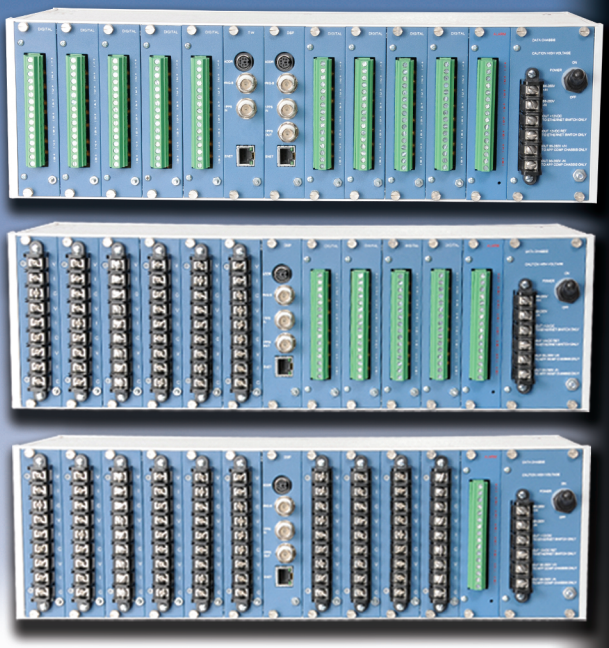
APP ENGINEERING

Always Staying Ahead of PRC Requirements

Disturbance Monitoring Equipment Exceeds PRC-002-02 Requirements



Multifunction
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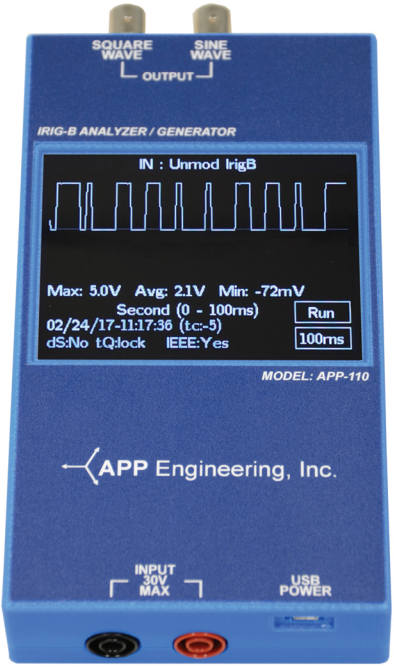

APP-110 IRIG-B ANALYZER/GENERATOR

DECODE AND ANALYZE IRIG-B TIMING SIGNALS

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, March 31st | MSC 2400

Session Chair: Kevin W. Jones

1:30 pm	**A Case Study: Pilot Protection Misoperations Due to Transmission Line Switching** Amit Somani, Schweitzer Engineering Laboratories, Inc.
2:00 pm	**Arc Resistance Coverage and Mho Expansion - The Devil is in the Details** Akram Saad, Patterson Power Engineers, LLC
2:30 pm	**Detecting and Locating Broken Conductor Faults on High-Voltage Lines to Prevent Autoreclosing Onto Permanent Faults** Arunabha Chatterjee, Schweitzer Engineering Laboratories, Inc.

3:00 pm Refreshment Break

3:30 pm	**Switch Onto Fault: Maintaining Dependability, Security, and Speed** Ryan McDaniel and Sujay Dasgupta, Schweitzer Engineering Laboratories, Inc.
4:00 pm	**Application of Automation-Based Tools for Efficient and Accurate Modeling of Transmission System Protection** Chris Bolton and Guanhua Wen, San Diego Gas & Electric and Quanta Technology
4:30 pm	**Improving Line Crew Dispatch Accuracy When Using Traveling-Wave Fault Locators** Bogdan Kasztenny, Schweitzer Engineering Laboratories, Inc.

5:00 pm–7:30pm Reception and Exhibits in Bethancourt Ballroom

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Testing and Troubleshooting Session

Tuesday, March 31st | MSC 2406 B

Session Chair: Eduardo Colmenares

1:30 pm	**A Troubleshooting Methodology for Issues Discovered During End-to-End Testing** Jose Ramon Garza, American Electric Power
2:00 pm	**Effect of Current Transformer Design on Magnetic Saturation and its Implications on Protection Schemes: Analysis and Testing** Sughosh R Kuber, Megger Dallas
2:30 pm	**Testing Transformer Differential Protection in Digital Substations – Use Cases & Results** Dinesh Baradi, ABB Inc.

3:00 pm Refreshment Break

3:30 pm	**Use of IEC 61850 Test Functionality to Implement Hot Standby Systems** Richard Hunt, GE Grid Solutions
4:00 pm	**Steps and Considerations to Create a Comprehensive Commissioning Test Plan for 230kv Substation Protection, Control, and Telecom Systems Upgrades** Dong Yao, Power Grid Engineering, LLC
4:30 pm	**Testing Bus Bar Protection Systems in a Fully Digital Substation** Harsh Vardhan, GE Grid Solutions

5:00 pm–7:30 pm Reception and Exhibits in Bethancourt Ballroom

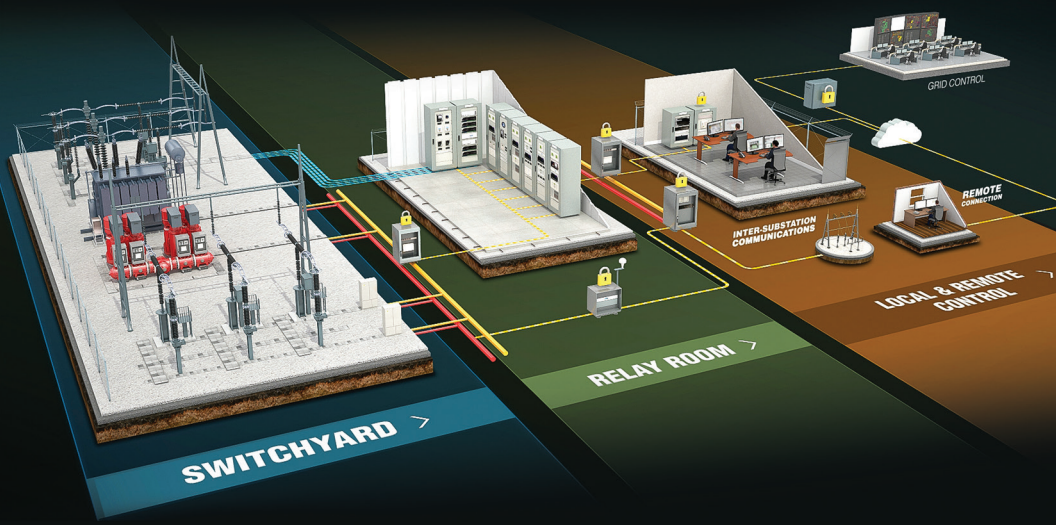
GE's Grid Solutions business provides mission critical protection, automation, control, monitoring, and diagnostic solutions for power system applications. From the point of generation to the end power consumer, GE's solutions enable more reliable, efficient and secure power systems.

Visit Us At Our Booth

Monday	4:00 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 Situation Awareness and Asset Utilization



GEGridSolutions.com/**GridAutomation**

General Session II

Wednesday, April 1st | Rudder Theatre

Session Chair: Genardo Corpuz

7:30 am	**Registration**
	Coffee Sponsored by SABER Power Services
8:00 am	**Complex Faults - Using High-Quality Waveform Data to Understand Faults That Misbehave** Carl Benner, Texas A&M University
8:40 am	**Event Investigation of 69 kV Double-Circuit Faults** Amanvir Sudan, Schweitzer Engineering Laboratories, Inc.

9:20 am Refreshment Break

Real World Session

Wednesday, April 1st | Rudder Theatre

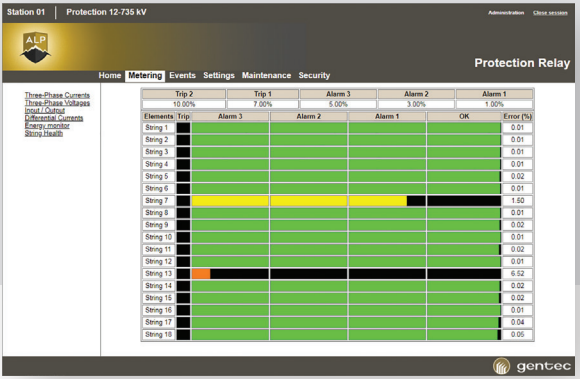
Session Chair: Genardo Corpuz

9:50 am	**AEP Misop Event of 2/23/2019** Phillip Lux, American Electric Power
10:15 am	**Finding Common Ground: A Case Study of Phantom Currents and Ground Loops** Matthew Boecker, Lower Colorado River Authority (LCRA)
10:40 am	**Assessment of a Misoperation on a Distance Protection Relay by Means of Line Impedance Measurement and System-Based Testing** Moritz Pikisch, OMICRON
11:05 am	**Extremely Fast Tripping for an Arc-Flash Event: A Field Case Analysis** Mohanraj Perumalsamy, Schweitzer Engineering Laboratories, Inc.
11:30 am	**AEP Outage Event of 3/20/2018** Bret Burford, American Electric Power

12:00 pm Lunch and Exhibits in Bethancourt Ballroom

Capacitor bank downtime?

Improve bank health monitoring with an impedance-based protection relay.



Capacitor bank downtime is frequent in fuseless shunt capacitor banks.

In most cases, it results from a protection element operating in the absence of an actual fault.

Those misoperations are often caused by the limited sensitivity of the voltage differential element compared to the voltage increase that results from a capacitor failure.

This situation leads to high maintenance costs when utilities have to investigate whether or not a problem is present within the bank.

To learn how to improve bank health monitoring and reduce maintenance costs with an impedance-based protection, simply send us an email at **alp@gentec.ca** and request a copy of our application note.

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Since 1959

Substation Session

Wednesday, April 1st| MSC 2406A

Session Chair: Ken Swift

1:30 pm	**The Response of a Transformer Differential Relay to Internal Faults While Influenced by Geomagnetically Induced Currents** Andrew Mattei, Baylor University/Brazos Electric Power Cooperative, Inc.
2:00 pm	**Case Study: Transformer Differential Incorrect Operation Due to System Grounding** JC Theron, GE Grid Solutions
2:30 pm	**Implementation of a New Algorithm to Detect Turn-to-Turn Faults in Shunt Reactors and Identify the Faulted Phase** Paul I Nyombi, Xcel Energy
3:00 pm Refreshment Break	
3:30 pm	**Using High-Resolution Oscillography to Improve the Performance of Controlled Switching for Transformers** Brett Hampson, Schweitzer Engineering Laboratories, Inc.
4:00 pm	**CVT Transients - Causes, Effects and Solutions** Ilia Voloh, GE Grid Solutions
4:30 pm	**Challenges Replacing Electro-Mechanical Transformer Differential Relays** Terrence Smith, GE Grid Solutions
5:00 pm Adjourn	

Generation & Industrial

Wednesday, April 1st | MSC 2406B

Session Chair: James Bowen

1:30 pm	**OOPS, Out-of-Phase Synchronization** Dale Finney, Schweitzer Engineering Laboratories, Inc.
2:00 pm	**Fast Load Shedding Scheme for Enhancing Reliability and Stability of Expanded Liquified Gas Plant** Barry Xu, GE Grid Solutions
2:30 pm	**Improvements in Generator Breaker Failure Protection During Low Fault Current Conditions** Matchyaraju Alla, Schweitzer Engineering Laboratories, Inc.

3:00 pm Refreshment Break

3:30 pm	**Lessons Learned From Generator Destructive Testing** Normann Fischer, Schweitzer Engineering Laboratories, Inc.
4:00 pm	**Improving Protection Applications for Modern Industrial Switchgear Systems** Benton Vandiver III, ABB Inc
4:30 pm	**Modernization of an Industrial Power Distribution and Automation System -Lessons Learned** Joe Xavier, ABB Inc.

5:00 pm Adjourn

Communication & Integration

Wednesday, April 1st | MSC 2400

Session Chair: Eric Udren

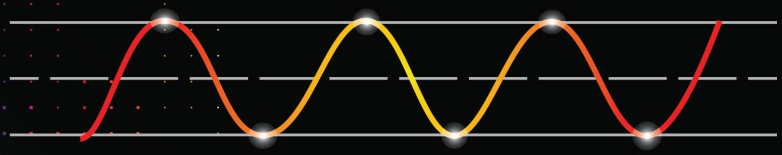
1:30 pm	**New Methods for Power Line Carrier Monitoring and Analysis–Real-World Examples and Implications for Protection System Reliability** Craig Palmer, PowerComm Solutions
2:00 pm	**Interoperability of Line Differential Protection** Joerg Blumschein, SIEMENS
2:30 pm	**Wide Area GOOSE and its Applications to System Integrity Protection Schemes** Alexander Apostolov, Omicron electronics

3:00 pm Refreshment Break

3:30 pm	**Centralized Protection and Control – Enhancing Reliability, Availability, Flexibility and Improving Operating Cost Efficiency of Distribution Substations** Joe Xavier, ABB Inc.
4:00 pm	**Experience with Point-to-Point Process Bus** JC Theron, GE Grid Solutions
4:30 pm	**Solving Performance and Cybersecurity Challenges in Substation and Industrial Networks With Software-Defined Networking** Tom Bartman, Schweitzer Engineering Laboratories, Inc.

5:00 pm Adjourn

Waveform capture



from every substation

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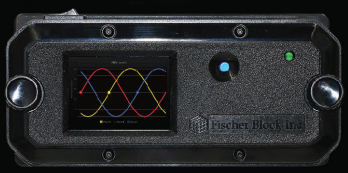

Inverter-Based Resources

Thursday April 2nd | MSC 2406A

Session Chair: Bret Burford

8:00 am	**Impact of Inverter-based Resources on Impedance-based Protection Functions** Mohammad Dadash Zadeh, ETAP
8:35 am	**Phase Angle Instability in Inverter-Based Resources: Impacts on Protective Relays** Sayyed Mohammad Hashemi, University of Toronto
9:10 am	**Protection of Partially Grounded Microgrid Interconnection Line using Residual Voltage Compensation** Yujie Yin, GE Grid Solutions

9:45 am Refreshment Break

10:20 am	**Misoperation of Line Differential Relay in the Presence of Low Rotational Inertia Due to Penetration of Wind Farms** Lalit Ghatpande, SynchroGrid
10:55 am	**Tutorial on Sub-synchronous Resonance Protection Applied to Inverter Based Renewables** Anderson Oliveira, ERLPhase Power Technolgies Ltd.
11:30 am	**Relay Protection Challenges Associated with Small Scale Solar Farms** Michael Sonnabend, NEI Electric Power Engineering Inc.

12:05 pm – Conference Ends

When a Fault Occurs, the Clock Starts Ticking

Shorten outage durations with the new wireless fault indication system from SEL.

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Visit Booth 20 to learn more about the SEL-FLT and SEL-FLR.

SEL SCHWEITZER ENGINEERING LABORATORIES

General Session III

Thursday April 2nd | MSC 2406B

Session Chair: Craig Wester

8:00 am	**CT Saturation – A Simulation Study of Different Detection and Blocking Algorithms** Ilia Voloh, GE Grid Solutions
8:35 am	**Simplifying PRC-026 Compliance With Practical Solutions You Least Expect** Michael Thompson, Schweitzer Engineering Laboratories, Inc.
9:10 am	**Determining CT Requirements for Generator and Transformer Protective Relays** Dale Finney, Schweitzer Engineering Laboratories, Inc.

9:45 am Refreshment Break

10:20 am	**Digital Instrument Transformers -Technology Advancements and New Opportunities** Mike Ramlachan, GE Grid Solutions
10:55 am	**International Drive Distribution Loop Protection, Lessons Learn and Improvement Project** Sebastien C. Billaut, Commonwealth Associates Inc.
11:30 am	**Auto-tuned Solution to Wide Area Coordination Issues of Distance and Directional Time Overcurrent Relay Settings** Joe Perez, SynchroGrid

12:05 pm – Conference Ends

SynchroGrid

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- Verifying the model accuracy by cross-checking data
- Identifying out-of-sequence, out-of-order, and CTI operations
- Uncovering weaknesses and limitations of relays
- Detecting correct sensitivity breaker failure & ground overcurrent pickups
- Generating user friendly, NERC-approved, report documentation

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Notes

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Thank you for attending this year's
Conference for Protective Relay Engineers.
Be sure to mark your calendars for next year!

Conference papers are available at
prorelay.tamu.edu/archive

74th Annual

Conference for Protective Relay Engineers

March 29 - April 1, 2021