52nd Annual MINNESOTA POWER SYSTEMS CONFERENCE

November 8–10, 2016

Saint Paul RiverCentre
175 W Kellogg Boulevard
Saint Paul, Minnesota

Download the conference mobile app!
See page 12 for details.

Sponsored by:
College of Continuing Education, University of Minnesota
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IEEE, Power and Energy Society, Twin Cities Chapter

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COLLEGE OF CONTINUING EDUCATION
UNIVERSITY OF MINNESOTA
# Program At A Glance

**TUESDAY, NOVEMBER 8, 2016**

- **7:00 a.m.** Registration and Continental Breakfast

## General Session – Grand Ballroom

- **8:00** Welcome and Opening Remarks
- **8:15** Clean Power: Now and in the Future
- **9:00** Lessons from GridEx and Ukraine
- **9:45** Break
- **10:15** The Impact of Digital Technology on the Future of Transmission & Distribution
- **11:00** The Ethical Practice of Engineering: Case Studies from Administrative and Court Actions

## Noon

- **Lunch – Grand Ballroom**

### Substation Room 1 - Utility Industry Futures I Ballroom A - Delivery Systems I Room 4 - Relaying I Ballroom E

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<td>Code, Standards, Specifications, &amp; Promises—Why Details Matter in Steel Pole and Tower Fabrication</td>
<td>Consolidated Edison’s Experience with Online Monitoring and Mitigation of Geomagnetic Disturbances</td>
<td>I Bought It But Do I Have To Use It? AKA: My Favorite Function Is The One I Turned Off!</td>
<td>Automating the OMS with the DMS—How to Get There</td>
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<td>Dirt and Steel: The Need for Geotechnical and Structural Collaboration</td>
<td>Interharmonics: What They Are, Where They Come From and What They Do</td>
<td>A Current Story—When Primary Met Secondary</td>
<td>AMI Deployment at a Rural Electric Cooperative</td>
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<td>The Dirt on Soil Investigations</td>
<td>History and Application of the MN Stray Voltage Guide</td>
<td>Applications of Automated Protective Relay Testing</td>
<td>Measuring the Bakken: Metering and Monitoring Power Consumption in Western ND and Eastern MT</td>
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<td>River Bank Foundation Design</td>
<td>40 Ohm Ground Fault Impedance—Still Applicable?</td>
<td>Avoiding Dangerous Relay Testing Practices</td>
<td>Meter Data Everywhere, Is It All the Same?</td>
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**WEDNESDAY, NOVEMBER 9, 2016 (continued)**

**THURSDAY, NOVEMBER 10, 2016**

7:30 a.m. Registration and Continental Breakfast

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GENERAL SESSION – Grand Ballroom
8:00 a.m.–noon
Moderator: Michael Ebert
Co-Moderators: Scott Hoberg, Larry Brusseu, Douglas Brown

Welcome and Opening Remarks
Michael Ebert, AMEC Foster Wheeler

Clean Power: Now and in the Future
Mac McLennan, CEO, Minnkota Power Cooperative, Inc.
This talk covers the challenges of generation decision making with ever-changing rules and societal expectations including the challenges of meeting the needs in a carbon-managed world.

Lessons from GridEx and Ukraine
David Halla, Senior Advisor, Critical Infrastructure & Protection Group, Johns Hopkins University
How lessons learned from NERC's biannual exercise, GridEx, and the cyber-attack on Ukraine’s distribution system, increase resilience in the North American grid.

The Impact of Digital Technology on the Future of Transmission & Distribution
Rick Bush, Strategic Director, Transmission & Distribution World; Jim Dukart, Videographer, Transmission & Distribution World
We are rapidly moving to a digital future. This requires we re-envision what makes up our delivery system. It also requires that we re-envision how we equip the next generation workforce.

The Ethical Practice of Engineering: Case Studies from Administrative and Court Actions
Kodi Verhalen, Associate, Briggs and Morgan
Model Rules, Codes of Ethics, and Minnesota Rules of Professional Conduct will be reviewed. The presentation will then analyze several administrative actions by state boards of licensure, followed by several court cases where a PE’s actions or a PE’s license were the primary focus.

CONCURRENT SESSIONS
1:00–4:30 p.m.

SUBSTATION – Room 1
Moderator: Steven Mohs
Co-Moderators: Bethlyn Cummings, Brianna Swenson

Implementation Considerations for Electronic and Physical Substation Security Improvements for CIP-014
Robert Hope, Burns & McDonnell
CIP-014 has ushered in an atmosphere where the threat environment and those mitigating security measures can be new to utilities. Detailed preplanning and execution are key to overall implementation success.
Physical Security Challenges and Responses for High Voltage Transformers

James McIver, Siemens Transformers USA

Several “resilient transformer” approaches have been developed in cooperation with participating transmission owners. Increased interaction between asset owner and manufacturer can achieve enhanced physical security using modified power transformers.

Substation Yardstone Resistivity—Is it Really 3,000 Ohm-Meters?

Bryan Beske, American Transmission Company; John Edlebeck, Coleman Engineering Company

A review of current industry standards and practices, identifying and quantifying material properties that impact yardstone resistivity, and review of testing results from over 100 samples will be presented.

A Case Study for Substation Lightning Risk Evaluation

Stephen Chuang, AMEC Foster Wheeler

A sample substation is presented for risk evaluation analysis of lightning strikes to unshielded sections. Approaching the design from a practical perspective of using existing or minimal lightning shielding structures to achieve substantial but not complete coverage will also be discussed.

UTILITY INDUSTRY FUTURES I – Ballroom A

Moderator: Mike Steckelberg
Co-Moderators: Will Lovelace, Michael Marz

Electric Grid Resiliency Panel

Scott Adams, American Transmission Company; Mike Jensen, Xcel Energy; Kristian Ruud, MISO; Kenneth Barry, EPRI

A resilient grid is designed to prevent and recover from extensive natural or man-made outages. The panelists will define “Electric Grid Resiliency” and what is being done to improve it.

Grid Energy Storage Overview

Steve Emling, MEPPi

This presentation will review the market and policy drivers for energy storage, as well as different energy storage technologies and how they can be used to solve both emerging and traditional grid challenges.

Future Grid

Tessa Haagenson, Great River Energy

Customer desires, environmental regulations, market changes, and new technologies are reshaping the electric utility industry, with words like Future Grid, the Integrated Grid, Grid Modernization, and Re-regulation. Utility generation, transmission, distribution, and information technology systems will all play a part in these changes.

Resource Reliability in a Changing Environment

Thomas Butz, Power System Engineering

Resource Reliability is currently defined primarily using peak load and capacity. With changes in the resource mix and the potential impact of the Clean Power Plan (CPP), how do we know that the system will maintain and even improve reliability?

DELIVERY SYSTEMS I – Room 4

Moderator: Al Haman
Co-Moderators: Philip Spaulding, Denny Branca
Advanced Grid Intelligence & Security Initiatives at Xcel Energy
Brian Amundson, Xcel Energy
Xcel Energy will discuss its vision, strategy, and initial steps to modernize the electric distribution grid. This initiative is essential to accommodate higher penetration of distributed resources and enable advanced functionality.

The Use of Sensors for Distribution and Substation Applications
Dan Lysaker, Xcel Energy
Distribution sensor technology and usage has grown tremendously in recent years. This presentation will explore the various sensor technologies and use-cases across the electric utility industry and at Xcel Energy.

Using a Geographic Information System to Create a Load Flow Model
James Pachan, STAR Energy Services
Electrical distribution and transmission system models are important tools for utility engineers. Exporting the electrical connectivity data from a GIS system into Milsoft’s WindMil engineering analysis software can greatly improve model accuracy and save the engineer time.

Generating Asset Health Indices Which Are Both Useful and Auditable
Tony McGrail, Doble Engineering
This presentation reviews the derivation of practical asset health indices and some of the pros and cons in their development. Demonstrating a justifiable index is key to extracting value — whether in terms of maintenance, replacement, or rate case development.

RELAYING I – Ballroom E
Moderator: Dave Bisel
Co-Moderators: Jake Bernhagen, Michael Ebert

Understanding the Dynamic Mho Distance Characteristic
Donald Fentie, Schweitzer Engineering Laboratories, Inc.
The dynamic properties of the mho element are explored using familiar phasor diagrams and visual aids. Real-time expansion is explored for a variety of fault types and locations.

Resistance Coverage of Memory Polarized Distance Elements
Pratap Mysore, HDR Engineering, Inc.
This paper presents calculations to determine the actual resistance coverage at any fault location on the lines protected by memory polarized distance elements. The paper also discusses the dependence of the resistance coverage on the source to line impedance ratio (SIR) and the type of fault.

Phase Rolling and the Impacts on Protection
Denglin (Dennis) Tang, Burns & McDonnell
The presentation will show the impacts of the phase-rolling event (phases swapped by mistake). The analytical study will also be presented due to the lack of such analysis tool/software in the market.

High-Speed Communication-Assisted Tripping and Sectionalizing for Distribution Systems
Steve Turner, Beckwith Electric Company
Demonstrates communication-assisted tripping and sectionalizing to quickly isolate faults, reduce clearing times, and simplify complex coordination. Implementation of schemes for distribution systems are included and operational history highlights impact on reliability of utility distribution networks.

EXHIBITOR RECEPTION – Exhibit Hall A (Lower Level)
4:30–7:00 p.m.
CONCURRENT SESSIONS
8:30 a.m.–noon

DISTRIBUTION AUTOMATION/COMMUNICATIONS – Ballroom E

Moderator: Tom Guttormson
Co-Moderators: Rick Johnson, Dan Nordell

Pattern Detection in Distribution Networks Using Complex Event Processing
Foued Barouni, Eaton Corporation
This presentation will introduce a novel approach for spatiotemporal pattern detection in a distribution grid using Complex Event Processing. With this approach, a user will have a better capability to detect interesting situations. An Outage Management System will simultaneously correlate events reported by different Sensors and enhance the user’s decision capabilities.

NERC CIP in the Real World on a Real Budget
Eric Stranz, Siemens Digital Grid
Protection and Control System cost-effective design strategies for network isolation, access points, and device security with consideration to NERC CIP V5 (from enterprise to process).

The Importance of Testing Smart Grid IEDs against Security Vulnerabilities
Mark Adamiak, GE Energy Connections
The subject of cyber security is vast and it covers many aspects. This paper focuses on one of these aspects — IED firmware system testing from the security point of view.

Wireless Technology and Application
Paul Mercier, Phoenix Contact
This presentation will show you the different types of wireless technologies available, how they can be deployed in industrial applications, and different aspects to consider when looking to deploying a wireless system.

PROJECT MANAGEMENT – Room 4

Moderator: Greg Owen
Co-Moderators: Bethlyn Cummings, Chuck Healy

Mississippi River Crossing — CapX2020
Grant Stevenson, Xcel Energy
Construction of the CapX2020 Mississippi River crossing required special project management focus including work from barges, special design considerations and managing risks not typically experienced in transmission line construction.

Project Management Advice — Panelists Share Their Insights (the ‘Good’ and the ‘Bad’!)
Kelly Bloch, Xcel Energy; Cassie Polman, Great River Energy; Jason Hoskins, Ulteig Engineers, Inc.; Denny Branca, Eaton Corporation
Why do some projects run smoothly and others struggle? Often, project management is the key differentiator. Panelists will share their advice and experiences in managing electric utility projects. Each panelist represents a different stakeholder’s point of view: IOU Utility PM, Public Power PM, Consulting Engineering PM, and Technology Supplier PM.

Southern Minnesota Service Territory Sale
Kristi Robinson, STAR Energy Services LLC
In 2015 Alliant Energy sold its Minnesota electric distribution assets to 12 distribution cooperatives. The intricacies of the sale, the regulatory process, and the operational coordination for the transfer of service providers took communication, hard work, and
patience. This presentation will discuss this historic service territory transfer for 45,000 electric consumers in southern Minnesota.

**Minnesota Power Restoring Thomson Hydro... for the Next Century**
*Christopher Rousseau, Minnesota Power*

Constructed between 1905 and 1907, the Thomson Hydro Station was devastated by a significant flood event in 2012. This presentation will briefly revisit the flood event and specifically focus on the restoration efforts to reconstruct the 72MW station, including civil, mechanical, electrical, and geotechnical engineering specialties.

**UTILITY INDUSTRY FUTURES II – Ballroom A**
*Moderator: Michael Marz*
*Co-Moderators: Jay Morris, Douglas Brown*

**Transmission Utility’s Use of GIS**
*Andy Schmidt, Great River Energy*

GIS has helped the utility with better decision making, project collaboration, maintenance, and future system planning. GIS use is presented with focused on location based analysis, collaboration, visualization, and communication.

**Detailed Simulation Studies as a Solution to 21st-Century Power System Challenges**
*Michael Ropp, Northern Plains Power Technologies*

This presentation will discuss the use of detailed time-domain computer modeling of distribution circuits and low-inertia power systems as part of the solution to a number of pressing issues brought on by distributed resources, new reliability requirements, and proliferation of low-inertia systems.

**Distribution System Demand Management with Microgrids**
*Edward Buck, Eaton Corporation*

Microgrid technologies under development allow optimal management of diverse, islandable distribution systems. This discussion covers the application of these technologies in addressing geographically distributed loads and sources specifically for resiliency.

**Designing Volturnus, a Small Hydro Technology**
*Ted Christopher, Verterra*

Volturnus uniquely harnesses the untapped energy of rivers to produce electricity efficiently and cost-effectively, without the construction of a dam. Learn step-by-step how it was designed.

**POWER GENERATION – Room 1**
*Moderator: Scott Hoberg*
*Co-Moderators: Will Lovelace, Dave Bisel*

**Camp Ripley Solar Partnership**
*Kristopher Spenningsby, Minnesota Power*

The Minnesota National Guard and Minnesota Power have partnered on a 10 MW solar project located at Camp Ripley. This presentation will discuss the Project and the Partnership.

**Columbia Energy Center Air Quality Control System Retrofit**
*Bob Newell, Alliant Energy*

The Columbia Energy Center is comprised of two nominally rated 525 MW units, built in the 1970’s. Due to the Wisconsin Mercury Rule and a settlement agreement with the US EPA, new SO2 and mercury controls were required to be installed and operational by January 1, 2015. This presentation outlines the development and execution of the project and operational history since start-up of the new equipment.
Coordination of Controls of Renewable Power Plants to Meet Steady State and Dynamic Response Requirements for Voltage Control and Reactive Power Supply

Daniel Feltes, Siemens Power Technologies International

This paper addresses the control of voltage and reactive power using as an example an actual wind facility consisting of four wind farms and demonstrates the coordination of the controls including OLTC taps, capacitor banks, and the wind farm controllers.

Deer Creek Station—Combined Cycle Generation

Gavin McCollam, Basin Electric Power Cooperative

Brief history and lessons learned from the design and construction of the Deer Creek Station, Basin Electric’s only combined cycle power generation facility.

CONCURRENT SESSIONS

1:00–4:30 p.m.

CIVIL-STRUCTURAL – Ballroom A

Moderator: Rick Johnson
Co-Moderators: Brianna Swenson, Bethlyn Cummings

Codes, Standards, Specifications, & Promises—Why Details Matter in Steel Pole and Tower Fabrication

Wesley Oliphant, ReliaPOLE Inspection Services Company

This presentation will focus on the potential significant structural reliability consequences when steel pole and tower suppliers fail to comply with codes, standards, and specifications, and even their own promises of certain performance when fabricating poles and towers for transmission lines.

Dirt and Steel: The Need for Geotechnical and Structural Collaboration

Marlon Vogt, Ulteig Engineers

Successful utility projects rely on both solid foundations and properly designed structures. Projects benefit when both disciplines collaborate. This presentation will illustrate the benefits of collaboration with relevant case studies.

The Dirt on Soil Investigations

John Edlebeck, Coleman Engineering Company

Subsurface soil investigations are not limited to characterizing subsurface soils for foundation design. A subsurface investigation, if properly developed, can offer much more to support not only the foundation engineering, but also grounding design and construction bidding.

River Bank Foundation Design


The presentation of design alternatives for transmission structure foundation installation in proximity of river banks and poor soil conditions will be discussed. In addition, there will be a walkthrough review of the mechanisms behind foundation design in poor soil conditions, a review of several examples of geotechnical conditions, and discussion on alternatives related to river crossing design.
Consolidated Edison’s Experience with Online Monitoring and Mitigation of Geomagnetic Disturbances
Gary Hoffman, Advanced Power Technologies
This paper will discuss the theory behind how these systems operate and the performance of these GMD monitoring systems at Consolidated Edison, and will provide actual results and the implementation of IEEE Std C57.163-2015 “Guide for Establishing Power Transformer Capability while under Geomagnetic Disturbances” in the deployment of Consolidated Edison’s solution.

Interharmonics: What They Are, Where They Come From and What They Do
Michael B. Marz, American Transmission Company
Interharmonics are increasing to levels of concern without adequate industry guidelines. This presentation discusses the definition of interharmonics, their sources, and how they impact power systems.

History and Application of the MN Stray Voltage Guide
Al Haman, STAR Energy Services
This presentation offers basic principles of stray voltage on dairy farms and introduces the 2015 MN Stray Voltage Guide. Testing protocols and highlights within the Guide will be discussed.

40 Ohm Ground Fault Impedance — Still Applicable?
Tom Guttormson, Connexus Energy
40 ohms has been used to represent ground fault resistance when calculating minimum distribution system fault currents. This presentation will review publications and testing to vet the continuing viability of this standard.

I Bought It But Do I Have to Use It? AKA: My Favorite Function is the One I Turned Off!
Tom Ernst, GE Grid Solutions
Microprocessor relays were labeled multifunction with their introduction in the ’80s, mainly because they were packaged multiphase and multizone. But with today’s products it seems like “multi” should be changed to “mega”. Do you really need all that stuff and, if not, how do you decide what to use and what to set aside?

A Current Story—When Primary Met Secondary
Swagata Das, Schweitzer Engineering Laboratories, Inc.
This presentation describes the analysis and resulting investigation that occurred when a CT secondary wire made contact with a transformer bushing, causing an outage at a 138 kV substation.

Applications of Automated Protective Relay Testing
Josh LaBlanc, Minnesota Power
In this presentation we will discuss the application of automation in microprocessor protective relay maintenance and commissioning testing. Applications, design, and testing program benefits will be discussed along with Minnesota Power’s lessons learned from implementation and use of automated relay testing.
Avoiding Dangerous Relay Testing Practices
Scott Cooper, OMICRON
Legacy test methods frequently utilize unrealistic stimuli and disable programmed logic, bypassing the most common cause of digital relay mis-operations in the field. This presentation discusses relay technology and testing strategies based on the technology of the device under test.

METERING – Room 1
Moderator: Jay Morris
Co-Moderators: Tom Guttormson, Dan Nordell

Automating the OMS with the DMS—How To Get There
Jim Weikert, Power System Engineering, Inc.
The session will lay out a path which you can follow to expand from traditional operations to bring together SCADA, GIS, and AMI data through new OMS and DMS tools.

AMI Deployment at a Rural Electric Cooperative
Scott Krueger, Runestone Electric Association
This presentation will summarize the events that started REA looking at AMI systems, the decision process to select a system, experience to-date installing the equipment, and the benefits the system has been able to deliver.

Measuring the Bakken: Metering and Monitoring Power Consumption in Western ND and Eastern MT
Jeremy Mahowald, Upper Missouri Power Cooperative
In an area of intense oil and gas growth, there was a need for increasing data, accuracy, speed, and security. A case study on transmission metering and power measurement will cover the solutions needed to measure the Bakken.

Meter Data Everywhere, Is It All the Same?
Paul Smith, GE Energy Connections
There are many sources of power system data. This paper compares and contrasts the different methods of collecting power system data and examines why we have redundant sources.

THURSDAY, NOVEMBER 10, 2016

CONCURRENT SESSIONS
8:30 a.m.–noon

TUTORIAL I – Room 4
Moderator: Michael Marz
Co-Moderators: Mike Steckelberg, Brianna Swenson

Transmission Lines and Power Flow Analysis
Greg Mowry, University of St. Thomas
In this tutorial a brief overview of AC Steady State analysis will be presented followed by an introduction to long and short transmission lines, 2-bus and multi-bus power flow analysis, and stability.
TUTORIAL II – Room 1
Moderator: Tom Guttormson
Co-Moderators: Neil Stiller, Will Lovelace

Predictive Maintenance for Improved Grid Performance
John Lauletta, Exacter, Inc.
Predictive Maintenance replaces run-to failure as an effective and cost-saving strategy for improved overhead and underground grid management. Predictive Maintenance requires conditions-based metrics to provide prioritized actionable information. This Tutorial will discuss the measurement of grid conditions, the analytics behind Predictive Maintenance, and case studies demonstrating the measureable circuit performance improvement.

TUTORIAL III – Ballroom A
Moderator: Larry Brusseau
Co-Moderators: Dave Peterson, Dave Bisel

Relaying 101
Thomas Ernst, GE Grid Solutions
This tutorial is aimed at the engineer who is new to protective relaying or is looking for a high-level refresher. It will be interactive with the audience and will cover the basic application principals of protective relaying including zones of protection, coordination, and back-up protection. Real-life examples will be provided.

General Information

GUIDEBOOK MOBILE APP
The Minnesota Power Systems Conference has gone mobile! Attendees can plan their days with a personalized schedule and browse concurrent sessions, exhibitors, and venue maps. The app is compatible with iPhones, iPads, and Android devices. Windows Phone and Blackberry users can access the same information via the mobile site: http://guidebook.com/guide/67020

iOS and Android users:
• Download ‘Guidebook’ from the Apple App Store or the Android Marketplace
• Scan the following image with your mobile phone’s QR-Code reader

WI-FI INFORMATION
Saint Paul RiverCentre’s public Wi-Fi signal is called “RC_FreeWifi” and can be accessed in all areas of the complex. Connect to the signal and then review and accept the terms on the page that auto populates.
CONTINUING EDUCATION UNITS (CEUs)
Participants who attend the entire conference will receive 1.5 University of Minnesota, College of Continuing Education CEUs. Participants who attend only Tuesday and Wednesday will receive 1.2 CEUs. One CEU is defined as 10 contact hours of participation in an organized continuing education experience. A CEU certificate will be sent to each participant after the conference. A permanent record of CEUs earned will be maintained by the University of Minnesota Office of Admissions and Record Transcript Unit.

ADDITIONAL INFORMATION
Visit the conference website – cce.umn.edu/mnpowersystems for additional information on:
• 2017 call for presentations
• Conference papers and PowerPoints

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