

49th Annual **MINNESOTA POWER SYSTEMS CONFERENCE**

November 5-7, 2013

**Earle Brown Heritage Center
6155 Earle Brown Drive
Brooklyn Center, Minnesota**

Sponsored by:
College of Continuing Education, University of Minnesota

Co-sponsored by:
IEEE, Power and Energy Society, Twin Cities Chapter

www.cce.umn.edu/mnpowersystems

COLLEGE OF CONTINUING EDUCATION

UNIVERSITY OF MINNESOTA

MIP SYM CONF

Program Schedule

Tuesday, November 5, 2013

GENERAL SESSION

8:00 a.m.-12:00 noon

Moderator: Mythili Chaganti

Co-Moderators: Dan Nordell, Gerry Steffens, Greg Woodworth

- | | | | |
|------|---|-------|---|
| 7:00 | Check-in
Continental Breakfast | 10:15 | Mayo Clinic Expansion and Its
Impact on the Utility Grid
<i>Randy Anderton</i> , Rochester
Public Utilities; <i>Doug Holtan</i> ,
Mayo Clinic |
| 8:00 | Welcome
<i>Mythili Chaganti</i> , Xcel Energy | 11:00 | Engineering Ethics: How Does It
Fit Into Professional Engineering?
<i>Dr. Allen Jones</i> , South Dakota
State University |
| 8:15 | The Politics of Keeping the
Lights On
<i>Glenn English</i> , NRECA, Retired | 12:00 | Lunch |
| 9:00 | April 9, 2013 Ice Storm Panel
<i>Scott Hain</i> , Worthington Public
Utilities; <i>Dick Pursley</i> , Great River
Energy; <i>Darrel Yohnk</i> , ITC
Transmission; and <i>Todd Sarkinen</i> ,
Xcel Energy | | |
| 9:45 | Break | | |

CONCURRENT SESSIONS

1:00 - 4:15 p.m.

SUBSTATION

Moderator: Chuck Healy
Co-Moderators: Steven Mohs,
Greg Woodworth

- 1:00 Analysis of Substation Asset Life Decisions: Replacement or Refurbishment?
Tony McGrail, Doble Engineering Co
- 1:45 Considerations for Rewinding Power Transformers
Neal Kranich, Jordan Transformer
- 2:30 Break
- 2:45 Engineering Considerations for New Substation Siting – IEEE1127 Working Group
Joe Gravelle, Pamela Rasmussen, Xcel Energy
- 3:30 Transformer Failure Analysis on Three Failures at Xcel Energy Substations – Chisago, Harrison & Fifth Street
Mike Bocovich, Xcel Energy
- 4:15 Adjourn

UTILITY INDUSTRY FUTURES

Moderator: Rick Johnson
Co-Moderators: Scott Hoberg,
Mike Steckelberg

- 1:00 Power Grid Geomagnetic Disturbance (GMD) Modeling with Transformer Neutral Blocking and Live Grid Testing Results
Thomas Overbye, University of Illinois; *Fred Faxvog*, Emprimus
- 1:45 Distributed Visibility – How Energy Companies Are Expanding Communications Beyond the Office
Weston Sylvester, Cisco
- 2:30 Break
- 2:45 A Highly Redundant, Low-voltage Solar Topology
Dallas Meyer, tenKsolar
- 3:30 EPA Impacts on Generation Reserves
Ryan Westphal, Midwest Independent System Operator (MISO)
- 4:15 Adjourn

PROJECT MANAGEMENT

Moderator: Denny Branca
Co-Moderators: Larry Brusseau,
Al Haman

- 1:00 CapX Brookings to Hampton Project
Mark Anderson, Great River Energy
- 1:45 Arrowhead to Western 345 kV Line History and Commissioning Experience
Dave Herbst, Realtime Utility Engineers; *Sasan Salem*, Quanta Technologies
- 2:30 Break
- 2:45 Aerial Saw Side Trimming
Dave Paskowski, Haverfield Aviation; *Fletcher Johnson*, Xcel Energy
- 3:30 Minnesota Power 2012 Flood Recovery
Christopher Rousseau, Minnesota Power
- 4:15 Adjourn

METERING

Moderator: Tom Guttormson
Co-Moderators: Mythili Chaganti,
David Hoops

- 1:00 Ungrounded Services: Why, How, and Metering
Raymond Mauya, Dan Nordell, and Erik Sutliff, Xcel Energy
- 1:45 Use of High-Accuracy Current Transformers in Metering Applications
Frank Lopez, GE
- 2:30 Break
- 2:45 Harmonic Effects on Electricity Metering
Bill Hardy, Power Measurements; *Dan Nordell*, Xcel Energy EMC
- 3:30 The Seven Elements of Power Quality
John Carroll, Power Monitors, Inc
- 4:15 Adjourn

EXHIBITOR RECEPTION

4:15-7:00 p.m.

Wednesday, November 6, 2013

CONCURRENT SESSIONS

8:30 a.m.-12:00 noon

**DISTRIBUTION
AUTOMATION/COMMUNICATIONS**

**Moderator: Tom Guttormson
Co-Moderators: Chuck Healy,
Rick Johnson**

- 7:30 Continental Breakfast
- 8:30 Engineering your Substation Network for Protective Relaying, Automation, and SCADA
James Bougie, ABB
- 9:15 Video Monitoring Solutions for Electric Utilities
Angelo Rizzo, Systems with Intelligence
- 10:00 Break
- 10:30 Practical AMI-Demand Response Applications Using Wireless-RF Technologies
Paul Heintl, Michael Sharp, Eaton's Cooper Power Systems
- 11:15 Layered Intelligence for Grid Network Control
Michael Edmonds, S&C Electric Company
- 12:00 Lunch

DELIVERY SYSTEMS I

**Moderator: Michael Marz
Co-Moderators: Dave Peterson,
Philip Spaulding**

- 7:30 Continental Breakfast
- 8:30 Lessons Learned in Wind Generation
Dale Osborn, Midcontinent Independent System Operator, Inc. (MISO)
- 9:15 Geomagnetic Disturbances and the Transmission Grid
David Wojtczak, American Transmission Company
- 10:00 Break
- 10:30 LiDAR Analysis of the Transmission System
Jim McGuire, Great River Energy; John Leahy, XP-RS
- 11:15 Transformer Loading Evaluation Using Enhanced Condition Monitoring
Tony McGrail, Doble Engineering
- 12:00 Lunch

RELAYING I

**Moderator: Michael Ebert
Co-Moderators: David Hoops, Greg Owen**

- 7:30 Continental Breakfast
- 8:30 Design and Testing of System Integrated Protection Schemes (SIPS)
Adi Mulawarman, Xcel Energy
- 9:15 What's Happening at the Power Systems Relaying Committee, What Is It, and Why Is It Important to You?
Roger Hedding, ABB
- 10:00 Break
- 10:30 Impact, Analysis, and Monitoring of Geomagnetically Induced Currents on Transformers
Terrence Smith, GE Digital Energy
- 11:15 CVT Transients Revisited – Distance, Directional Overcurrent, and Communications-Assisted Tripping Concerns
David Costello, Schweitzer Engineering Laboratories
- 12:00 Lunch

CONCURRENT SESSIONS

1:00-4:15 p.m.

POWER GENERATION

Moderator: Mike Steckelberg

**Co-Moderators: Jim Hanson,
Scott Hoberg**

- 1:00 Wind Induced Coal Cycling Costs
Liam Noailles, Xcel Energy
- 1:45 Net Metering – Rate Issues and Options
John Gasal, Connexus Energy
- 2:30 Break
- 2:45 Wind Plant Harmonics Issues
Dave Mueller, EnerNex
- 3:30 Advanced Multivariable Control for Industrial Wind Turbines
Peter Seiler, University of Minnesota
- 4:15 Adjourn

DELIVERY SYSTEMS II

Moderator: Warren Hess

**Co-Moderators: Al Haman,
Michael Marz**

- 1:00 Shunt Reactor Switching Transients at High Compensation Levels
Salil Sabade, Himanshu Bahirat, Michigan Technological University; Mythili Chaganti, Xcel Energy
- 1:45 A Guide to Establish an Arc Flash Safety Program for Electric Utilities
Illanchezhian (Ilan) Balasubramanian, Craig Clarke, Eaton Electrical Services and Systems
- 2:30 Break
- 2:45 Energy Measurement for Mobile Substations
Dan Nordell, Raymond Mauya, Xcel Energy
- 3:30 Volt-Var Optimization
Jason Lombardo, S&C Electric Company
- 4:15 Adjourn

RELAYING II

Moderator: Wesley Hammitt

Co-Moderators: Michael Ebert, David Hoops

- 1:00 Transmission Line Impedances Using Known Event Data
Greg Smelich, Schweitzer Engineering Laboratories
- 1:45 Open Phase Conditions in Transformers - Analysis and Protection Algorithm
Amir Norouzi, GE Digital Energy
- 2:30 Break
- 2:45 IEEE guide "C37.99-2012- Guide for the Protection of Shunt Capacitor Banks"
Pratap Mysore, HDR Engineering
- 3:30 Application of Multi-function Motor Protection Relays to Variable Frequency Drive Connected Motors
Thomas Ernst, GE Digital Energy
- 4:15 Adjourn

Thursday, November 7, 2013

CONCURRENT SESSIONS

8:30 a.m.-12:00 noon

TUTORIAL I

Moderator: Greg Woodworth

**Co-Moderators: Jim Hanson,
Scott Hoberg**

- | | |
|-------|--|
| 7:30 | Continental Breakfast |
| 8:30 | Enabling Renewable Generation
<i>Douglas Brown, Siemens PTI</i> |
| 10:00 | Break |
| 10:30 | Enabling Renewable Generation
(continued) |
| 12:00 | Adjourn |

TUTORIAL II

Moderator: Larry Brusseau

**Co-Moderators: Mythili Chaganti,
David Hoops**

- | | |
|-------|---|
| 7:30 | Continental Breakfast |
| 8:30 | Transmission Design 102
<i>Duane Phillips, Stanley
Consultants</i> |
| 10:00 | Break |
| 10:30 | Transmission Design 102
(continued) |
| 12:00 | Adjourn |

TUTORIAL III

Moderator: Denny Branca

Co-Moderators: Tom Guttormson, Chuck Healy

- | | | | |
|------|--|-------|--------------------------------------|
| 7:30 | Continental Breakfast | 10:00 | Break |
| 8:30 | Power Electronics 101
<i>Ned Mohan, University of
Minnesota</i> | 10:30 | Power Electronics 101
(continued) |
| | | 12:00 | Adjourn |

Presentation Descriptions

GENERAL SESSION

The Politics of Keeping the Lights On
Glenn English, NRECA, Retired

Over the course of the past 40 years, political decisions have caused major changes in how we generate electric power in the United States. For people uninformed about how these decisions are made and the politics behind them, this can be a very frustrating and confusing business to be in. This presentation will discuss the impact politics has regarding consumer costs and the ability to meet the power needs of the country. It will also examine how to effectively influence the discussion.

April 9, 2013 Ice Storm Panel

*Scott Hain, Worthington Public Utilities;
Dick Pursley, Great River Energy; Darrel
Yohnk, ITC Transmission; and Todd Sarkinen,
Xcel Energy*

Representatives from Xcel Energy, Great River Energy, ITC Transmission, and Worthington Municipal Utilities will discuss the challenges and restoration efforts after one of the worst ice storms in decades hit portions of southeastern South Dakota and southwestern Minnesota on April 9, 2013. The presentation will focus on impacts and restoration efforts in Sioux Falls, Worthington, and the transmission system serving the area.

Mayo Clinic Expansion and its Impact on the Utility Grid

*Randy Anderton, Rochester Public Utilities;
Doug Holtan, Mayo Clinic*

This presentation will discuss the impacts to the electric grid related to Mayo Clinic's expansion plans over the next 20 years in Rochester, Minnesota. The Destination Medical Center (DMC) envisions close to 6 billion dollars of expansion within Rochester over the next 20 years. Rochester Public Utilities (RPU) and Mayo Clinic will present a vision of this expansion and how RPU plans to accommodate the associated electric load growth.

Engineering Ethics: How Does It Fit Into Professional Engineering?

Dr. Allen Jones, South Dakota State University

Professional engineers frequently encounter varied ethical situations. This presentation focuses on how ethical situations are resolved using varied methods and practical ideas.

SUBSTATION

Analysis of Substation Asset Life Decisions: Replacement or Refurbishment?

Tony McGrail, Doble Engineering Co

The presentation focuses on decisions as they relate to substations, whether it is justifiable to replace or refurbish a large asset. This presentation will consider the risk of each avenue, focusing on transformers, factoring in real world case studies and experiences.

Considerations for Rewinding Power Transformers

Neal Kranich, Jordan Transformer

The presentation will investigate and discuss the pros and cons of taking advantage of the redesign and remanufacture of existing power transformers in today's environment.

Engineering Considerations for New Substation Siting – IEEE1127 Working Group

*Joe Gravelle, Pamela Rasmussen,
Xcel Energy*

This presentation will review many of the variables that should be considered for applications requiring new substation site selection. The presentation will be focused toward the substation engineering and design perspective. This presentation will be based on a recently revised and balloted IEEE 1127 - Guide for the Design, Construction, and Operation of Electric Power Substations for Community Acceptance and Environmental Capability.

Transformer Failure Analysis on Three Failures at Xcel Energy Substations – Chisago, Harrison & Fifth Street

Mike Bocovich, Xcel Energy

Three different transformer failure investigations within Xcel Energy will be presented. Each transformer failure, analysis, and lessons learned are uniquely different. Safety aspects and interpretation of data available for analysis will also be discussed.

UTILITY INDUSTRY FUTURES

Power Grid Geomagnetic Disturbance (GMD) Modeling with Transformer Neutral Blocking and Live Grid Testing Results

*Thomas Overbye, University of Illinois;
Fred Faxvog, Emprimus*

This presentation describes the modeling of GMDs in power flow and transient stability studies. Also new design and production developments for a transformer GIC neutral blocking system, Solid GroundTM, will be described.

Distributed Visibility – How Energy Companies are Expanding Communications Beyond the Office

Weston Sylvester, Cisco

This session will discuss how Electric Utilities are gaining positive Return on Investment and productivity increases by expanding the reach of their networks beyond the four walls of the office. We will discuss what works (and what doesn't); including the topics of connectivity,

redundancy, reliability, and manageability; pros and cons of a public vs. private network; security (both cyber and physical); considerations and challenges of managing networks that sometimes contain millions of nodes, with different physical locations; and the impact of automating mission critical applications.

A Highly Redundant, Low-voltage Solar Topology

Dallas Meyer, tenKsolar

A highly efficient PV electrical topology is presented using highly redundant, low-cost components. The fault-tolerance of the entire system including the cells, electronics, and interconnections allows for 25-year performance with no required maintenance. System efficiency gains including the use of spectroscopic reflectors which enhance the optical efficiency, also allow a best-in-class leveled cost of energy (\$/kWh).

EPA Impacts on Generation Reserves

Ryan Westphal, Midwest Independent System Operator (MISO)

This presentation will be investigating the impacts on generation reserves at MISO from EPA regulations and current market trends.

PROJECT MANAGEMENT

CapX Brookings to Hampton Project

Mark Anderson, Great River Energy

The CapX2020 Brookings to Hampton Project consists of 250 miles of new 345kV transmission line, nine substations and improvements to the existing underlying system. In conjunction with other CapX2020 projects, the Brookings team developed innovative strategies for supplier and contractor pricing designed to be transparent, foster collaboration, equitably share project risk and rewards, and maximize continuity of construction to meet the schedule milestones, saving a projected \$30 million. The project has faced challenges in securing labor and materials. Engineering and construction challenges included placing structures in environmentally sensitive river bottoms, quadruple circuiting on select structures, co-existing in close proximity to various types of roads, and resolving issues with other existing infrastructure such as

pipelines and telecommunications. The Brookings Project will be providing insights into the project execution approach that has been utilized and present key lessons learned to date.

Arrowhead to Western 345 kV Line History and Commissioning Experiences

Dave Herbst, Realtime Utility Engineers; Sasan Salem, Quanta Technologies

The Arrowhead to Weston 345 kV 220 Mile 345 kV line was the largest project in ATC history. The history of the need for this line and its evolution will be discussed. An unexpected coupled line resonance condition that delayed final energization will also be analyzed.

Aerial Saw Side Trimming

Dave Paskowski, Haverfield Aviation; Fletcher Johnson, Xcel Energy

The Air Saw is used for Transmission and Distribution. What the Air Saw cuts in a day would take weeks for ground crews at one-third the cost.

Minnesota Power 2012 Flood Recovery

Christopher Rousseau, Minnesota Power

The presentation will provide a summary of the challenges faced by Minnesota Power during the 2012 flood event, and the storm's impacts on our century old Thomson hydro station. The presentation will also provide an overview of flood recovery and reconstruction efforts to restore power generation at the MP Thomson hydro station for the next hundred years.

METERING

Ungrounded Services: Why, How, and Metering

Raymond Mauya, Dan Nordell, and Erik Sutliff, Xcel Energy

Industrial customers are more frequently requesting electric services which are ungrounded so that they can have an orderly shutdown of their processes in the event of a fault rather than experiencing an abrupt electrical failure when a protective device operates. This paper discusses the reasons behind such customer requests and Xcel Energy's response both in terms of service connection and creating a safe and reliable metering package.

Use of High-Accuracy Current Transformers in Metering Applications

Frank Lopez, GE

Discuss how to calculate for burden, the impact burden has on accuracy. What are the different accuracy ratings and metering applications.

Harmonic Effects on Electricity Metering

*Bill Hardy, Power Measurements;
Dan Nordell, Xcel Energy EMC*

An ever-increasing fraction of electric energy is being consumed through power electronics. These systems typically create current waveforms which are non-sinusoidal in nature and are not friendly to power systems and to electricity meters - particularly to the definition of "power factor." This paper will discuss the nature of these waveforms, their impacts on power systems and electricity metering, and recent meter standards efforts to characterize and normalize these effects.

The Seven Elements of Power Quality

John Carroll, Power Monitors, Inc

The three Case Studies I use are practical examples of Power Quality and include a recent study on a residential Solar Photovoltaic System and its impact on the utility voltage delivery supply.

DISTRIBUTION AUTOMATION/ COMMUNICATIONS

Engineering your Substation Network for Protective Relaying, Automation, and SCADA

James Bougie, ABB

With today's modern substations being installed with LAN systems and Ethernet based protocols, the automation engineers need to design these systems for the tasks these communications systems are being used. There are multiple things that need to be considered including the application, security, and reliability. This paper will cover the various applications and propose the best solutions for these applications.

Video Monitoring Solutions for Electric Utilities

Angelo Rizzo, Systems With Intelligence

Video systems have the versatility to be used for a wide range of applications within

electrical substations, power plants, and other critical infrastructure. Although typically used for security, video systems can also be used for equipment monitoring, asset management, process control, safety, and substation automation. In each application, improved operations and valuable information can be obtained by automatically analyzing the content of the video through video analytic software algorithms. In this presentation, we present several real-world scenarios where video systems can, and have played, an important role in monitoring and optimizing electric utility operations.

Practical AMI-Demand Response Applications Using Wireless-RF Technologies

Paul Heintl, Michael Sharp, Eaton's Cooper Power Systems

Utilities are taking advantage of the benefits of wireless-RF Smart Grid technologies. This presentation covers several utility applications in AMI and Demand Response and provides an overview of this technology.

Layered Intelligence for Grid Network Control

Michael Edmonds, S&C Electric Company

Over the last few years we have seen increasing capability in terms of processing power and communication pathways in the distribution grid. As new layers of intelligence evolve in the grid, how will this look in the future? What can be done today? These are areas that this paper will address using actual examples.

DELIVERY SYSTEMS I

Lessons Learned in Wind Generation

Dale Osborn, Midcontinent Independent System Operator, Inc. (MISO)

The Midwest Independent System Operator (MISO) efforts on transmission planning and wind integration in the last decade provide key lessons on how to expand wind generation while supporting a robust and efficient energy market. MISO now has over 10,000 MW of wind connected within their footprint and recently approved \$5.2 billion of 'multi-value' transmission projects (MVP's) that will help deliver up to 21,000 MW more wind energy and other significant benefits to the MISO system.

Geomagnetic Disturbances and the Transmission Grid

David Wojtczak, American Transmission Company

A brief history of developments regarding Geomagnetic Disturbances (GMD) in the electric utility industry will be followed by a discussion of ATC's strategy to address Geomagnetically Induced Currents (GIC) on its system. This presentation will discuss measurement methods for real-time monitoring of GIC, modeling efforts for planning and preparation and the installation of a neutral blocking device to mitigate the effects of GIC.

LiDAR Analysis of the Transmission System

Jim McGuire, Great River Energy; John Leahy, XP-RS

LiDAR Analysis of the Transmission System will begin by explaining Great River Energy's need for LiDAR, which is primarily a result of the NERC Alert issued in October of 2010. The presentation will then transition into the capabilities of LiDAR and GRE's experience in using and working with the data.

Transformer Loading Evaluation Using Enhanced Condition Monitoring

Tony McGrail, Doble Engineering

Loading of transformers to nameplate value and beyond has been the subject of loading guides and standards, to provide a means to determine the loss of life of a transformer based on thermal, moisture, and oxygen considerations. Automated analysis and "what if?" applications of these guides will be discussed.

RELAYING I

Design and Testing of System Integrated Protection Schemes (SIPS)

Adi Mulawarman, Xcel Energy

Examples of System Integrated Protection Schemes encompass Special Protection Schemes, Remedial Action Schemes, and other safety nets that provide reasonable countermeasures to slow and/or stop cascading outages.

What's Happening at the Power Systems Relaying Committee, What Is It, and Why Is It Important to You?

Roger Hedding, ABB

The Power Systems Relaying Committee is one of the technical committees with PES. It has been in existence for over 75 years. It's the steward and creator of all IEEE standards and guides pertaining to protective relays. Relays have changed over 75 years from a simple electromechanical relay to complex IED's that do much more than protection. This presentation will talk about the evolution of PSRC to meet these changes, review recent work, and discuss what the future brings.

Impact, Analysis, and Monitoring of Geomagnetically Induced Currents on Transformers

Terrence Smith, GE Digital Energy

This paper first gives good educational material for P&C engineers by investigating the influences of GIC on transformers and other equipment, and particularly the effect on the system protection will be discussed in detail. Then, the GIC effects on transformers and capacitors are demonstrated by simulating GIC applied to the transformer. Based on analysis of the simulated results, principles of monitoring techniques are discussed. The mitigation techniques and countermeasures in relays are presented as well.

CVT Transients Revisited – Distance, Directional Overcurrent, and Communications-Assisted Tripping Concerns

David Costello, Schweitzer Engineering Laboratories

Several classic papers explain the fundamentals of capacitive voltage transformer (CVT) design, operation, and transient response. Because this continues to be a problem in real applications, this paper revisits documented field cases using event data in hopes of shedding new light on this known problem. We investigate the CVT transient effect on directional element stability, directional overcurrent applications, and various communications-assisted protection schemes.

POWER GENERATION

Wind Induced Coal Cycling Costs

Liam Noailles, Xcel Energy

Public Service Company of Colorado studied the potential cycling costs associated with increased wind penetration to help the resource planning and resource acquisition process.

Net Metering – Rate Issues and Options

John Gasal, Connexus Energy

The number of customers with distributed generation (DG) is expected to increase in the future. Cost shifting associated with net metering will be reviewed. Possible rate redesign options to mitigate the cost shifting will be presented.

Wind Plant Harmonics Issues

Dave Mueller, EnerNex

It is important that wind plant generation maintain power quality levels on the transmission network. One of the most important concerns is that the power electronic system in modern wind turbines does not introduce harmonics concerns on the power system. The presentation will cover some of the Standards (IEEE 519, IEEE 1547, IEC 61400-21), and it will include practical field case histories involving resonance interactions.

Advanced Multivariable Control for Industrial Wind Turbines

Peter Seiler, University of Minnesota

This talk will focus on advanced control methods for wind turbines. The objective is to mitigate structural and drivetrain loads while increasing power capture.

DELIVERY SYSTEMS II

Shunt Reactor Switching Transients at High Compensation Levels

Salil Sabade, Himanshu Bahirat, Michigan Technological University; Mythili Chaganti, Xcel Energy

The paper presentation addresses various aspects involved when considering the installation of reactor banks at a substation with high levels of capacitive compensation. The paper illustrates a case study simulated

in the Alternate Transients Program (ATP/EMTP) to demonstrate current chopping, restrike, and re-ignition phenomenon associated with reactor bank switching.

A Guide to Establish an Arc Flash Safety Program for Electric Utilities

Illanchezhian (Illan) Balasubramanian, Craig Clarke, Eaton Electrical Services and Systems

Aspects of developing an arc flash safety program for utilities will be discussed including arc flash assessment, training of employees, and arc flash mitigation to name a few.

Energy Measurement for Mobile Substations

Dan Nordell, Raymond Mauya, Xcel Energy

Mobile Substations are field-configurable to deliver a wide range of voltages from either a Wye or a Delta source. Energy metering is typically designed specifically for the voltage and configuration of a service type. This is not possible when the configuration is not known ahead of time, as is the case with a mobile substation. This paper presents a novel approach to achieving a "universal" metering installation for mobile substations to enable accurate measurement without prior knowledge of the configuration.

Volt-Var Optimization

Jason Lombard, S&C Electric Company

Voltage regulation and system efficiency are two issues facing today's utilities. Utilities are tackling these issues by deploying Volt-Var Optimization Systems to manage voltage and system efficiency across the distribution system. This presentation will describe these technologies in detail as well as the benefits they enable when deployed.

RELAYING II

Transmission Line Impedances Using Known Event Data

Greg Smelich, Schweitzer Engineering Laboratories

This presentation will discuss how to use event data from an internal fault to validate

transmission line impedances for use in system models and protective relays.

Open Phase Conditions in Transformers - Analysis and Protection Algorithm

Amir Norouzi, GE Digital Energy

This paper provides an analysis of transformer's response to open phase conditions considering winding configurations and core construction. Algorithms are presented for identification and protection of open phase in transformers.

IEEE guide "C37.99-2012- Guide for the Protection of Shunt Capacitor Banks"

Pratap Mysore, HDR Engineering

The presentation focuses on the latest additions and modifications in the guide such as the theory and analysis of unbalance methods and setting examples using the modified unbalance tables.

Application of Multi-function Motor Protection Relays to Variable Frequency Drive Connected Motors

Thomas Ernst, GE Digital Energy

This paper reviews the application of motor protection with VFDs. Typical VFD protection functions are reviewed. Applications include relays located on the source or motor side of the VFD, with and without bypass switches.

TUTORIAL I

Enabling Renewable Generation

Douglas Brown, Siemens PTI

This tutorial will look at the integration of renewable energy sources into the electrical grid. We will look at the fundamental characteristics of a variety of renewable energy sources, review present integration practices and trends, and look at specific transmission projects to illustrate state-of-the art solutions.

TUTORIAL II

Transmission Design 102

Duane Phillips, Stanley Consultants

This tutorial will walk through the electrical design considerations associated with transmission line design. This is intended to be a follow-up to the Txm Design 101 presented at MIPSYCON in 2012, and will take a more in-depth approach to the electrical study work required for detailed transmission line design. Electrical Studies: Design Criteria, Interconnection, Transient Response (TRV), Transient Overvoltage (TOV), Economic Conductor, Insulation Coordination, Parallel Circuit, Induction, and Grounding.

TUTORIAL III

Power Electronics 101

Ned Mohan, University of Minnesota

This tutorial will present basic concepts in power electronics that are useful to power engineers in understanding, for example, the following: grid-interconnection of renewables such as solar and wind, supplying reactive-power to support grid voltages, controlling the flow of power on transmission lines, and the use of power electronics in adjustable-speed motor drives.

Disability accommodations will be provided upon request. This publication is available in alternative formats upon request. Call 612-624-3492.

The University of Minnesota shall provide equal access to and opportunity in its programs, facilities, and employment without regard to race, color, creed, religion, national origin, gender, age, marital status, disability, public assistance status, veteran status, sexual orientation, gender identity, or gender expression.

General Information

ABOUT THE CONFERENCE

This conference provides electric utility engineers and consultants the opportunity to stay abreast of today's power system technology. The conference emphasizes the unique challenges faced by electric utilities in the Midwest. The conference also serves as a forum for power engineers to meet with their colleagues from other utilities to discuss mutual concerns. Concurrent sessions include substations, utility industry futures, metering, distribution automation/communications, power generation, delivery systems, project management, relaying and two tutorials.

LOCATION AND ACCOMMODATIONS

The conference will be held at the Earle Brown Heritage Center, 6155 Earle Brown Drive, Brooklyn Center, MN, 55430. For directions, please visit their website – www.earlebrown.com. The Earle Brown Heritage Center is located near the intersection of I-94/694 and Shingle Creek Parkway. There is ample free parking surrounding the facility.

Convenient lodging for out-of-town participants is available at the Embassy Suites Minneapolis – Brooklyn Center Hotel, 6300 Earle Brown Drive, Brooklyn Center, MN 55430. The rate is \$109, plus tax, for a 1 King Suite or 2 Queen Suite. Participants are responsible for making their own lodging reservations. To make a reservation, call 763-560-2700 or 1-800-362-2779. To receive the special conference rate, please identify yourself as a participant of the Minnesota Power Systems Conference. Reservations must be made by **October 20, 2013**. After this date reservations will be accepted on a space and rate available basis. The hotel is next to the Earle Brown Heritage Center and parking is free.

REGISTRATION AND FEES

The fee for the conference is \$275 if received by October 21; if received after October 21 the fee is \$325. The conference fee includes all sessions, continental breakfasts, luncheons, refreshments

breaks, and the exhibitor reception. You are encouraged to register early to take advantage of the lower fee. If you cancel your registration by October 28 a refund, minus \$30, will be issued. If you cancel after this date you will not be eligible for a refund. A full refund will be issued if the conference is cancelled by the University of Minnesota.

CONFERENCE PAPERS AND POWER POINT PRESENTATIONS

Conference presentation papers, from speakers who have submitted papers, can be found on the conference website, www.cce.umn.edu/mnpowersystems

Presentation Power Points, from speakers who are willing to have their Power Points posted, will be available for a limited time after the conference on the conference website, www.cce.umn.edu/mnpowersystems

EXHIBITOR RECEPTION

The exhibitor reception will be held on Tuesday, November 5, from 4:15-7:00 p.m.. Exhibitors will display brochures and small equipment. All conference attendees are invited to attend this reception to view the exhibits, meet the exhibitors, and enjoy some hors d'oeuvres and beverages.

CONTINUING EDUCATION UNITS (CEUs)

Participants who attend the entire conference will receive 1.5 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 under responsible sponsorship, capable directions, and qualified instruction. 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.

PROGRAM INFORMATION

Emily Strong
College of Continuing Education
University of Minnesota
612-624-3492
cceconf3@umn.edu

REGISTRATION INFORMATION

612-625-2900
cceinfo@umn.edu

CALL FOR PAPERS FOR 2014 CONFERENCE

Deadline for abstract submission for
MIPSYCON 2014 is March 3, 2014.

Notification of acceptance will be sent
by June 2014. If you would like to be
considered for the 2014 program, please
submit an abstract of approximately 300
words on line at [www.cce.umn.edu/
mnpowersystems](http://www.cce.umn.edu/mnpowersystems).

EXHIBITOR INFORMATION AND REGISTRATION

If you are interested in having a display
at the exhibitor reception on November 5,
2013, and you would like more information
and registration materials go to [www.
cce.umn.edu/mnpowersystems](http://www.cce.umn.edu/mnpowersystems) left-hand
link, Exhibitor Information.

2013 MIPSYCON Planning Committee

Denny Branca

Eaton Corporation
Plymouth, Minnesota

Larry Brusseau

MAPPCOR
Roseville, Minnesota

* Mythili Chaganti

Xcel Energy
Minneapolis, Minnesota

Sairaj Dhople

University of Minnesota
Minneapolis, Minnesota

Michael Ebert

AMEC
Minneapolis, Minnesota

Kristi Fischer

University of Minnesota
St. Paul, Minnesota

Catherine Flannery

University of Minnesota
St. Paul, Minnesota

Tom Guttormson

Connexus Energy
Ramsey, Minnesota

Al Haman

STAR Energy Services
Alexandria, Minnesota

Wesley Hammitt

ABB Inc.
White Bear Lake, Minnesota

Jim Hanson

Consulting Engineers Group
Farmington, Minnesota

Chuck Healy

Electro Tech
Minneapolis, Minnesota

Warren Hess

HDR
Minneapolis, Minnesota

Scott Hoberg

Minnesota Power
Duluth, Minnesota

David Hoops

GE Energy
Huron, South Dakota

Rick Johnson

Otter Tail Power Company
Fergus Falls, Minnesota

Michael Marz

American Transmission
Company
Waukesha, Wisconsin

Steve Mohs

Burns & McDonnell
Minneapolis, Minnesota

Dan Nordell

Xcel Energy
Minneapolis, Minnesota

Greg Owen

IEEE PES Twin Cities
Chapter Chair
Minneapolis, Minnesota

Dave Peterson

Dairyland Power Cooperative
LaCrosse, Wisconsin

Philip Spaulding

Xcel Energy
Maple Grove, Minnesota

Mike Steckelberg

Great River Energy
Maple Grove, Minnesota

Gerry Steffens

Consultant
Rochester, Minnesota

Emily Strong

University of Minnesota
St. Paul, Minnesota

Greg Woodworth

Siemens Energy
Minnetonka, Minnesota

*Planning Committee Chair

Registration

49th Annual Minnesota Power Systems Conference

187475 kf

November 5-7, 2013

Please print or type

Name (Last) (First) (M.I.)

Business Address (Street/P.O. Box) City State Zip

E-mail

Company/Institution Title/Position

Daytime Telephone Home Telephone

Conference Fee

- Enclosed is \$275 in full payment of the conference registration fee (received by October 21).
- Enclosed is \$325 in full payment of the conference registration fee (received after October 21).

Meal Options

- I am requesting vegetarian lunches. I am requesting gluten-free lunches.

Tutorial Options

- I plan to attend the "Challenges Enabling Renewable Generation to the Grid" Tutorial
- I plan to attend the "Transmission Design 102" Tutorial
- I plan to attend the "Power Electronics 101" Tutorial

Method of Payment

- Enclosed is a check or money order payable to the University of Minnesota.
- The fee will be paid by my employer. Enclosed is a purchase order.
- Payment should be charged to my credit card (check one).
- Visa MasterCard Discover American Express

Credit Card Number Security Code

Expiration Date Name as printed on card (please print)

Signature of cardholder

How to Register

Register Online:

www.cce.umn.edu/mnpowersystems
The most secure form of registration

Fax to (with credit card information):

612-624-5359

This fax will be received in a secure location.

Mail to (with credit card information):

CCE Registration
20 Ruttan Hall
1994 Buford Ave
Saint Paul, MN 55108-6039

If your check is returned because of insufficient funds or closed account, or because you have made a stop payment request, you will be charged a check handling fee of \$20

The information on this form is private data, used to identify and locate you, obtain payment, and enable instructors to better know their audience. Name, address, and payment method are mandatory. Information on this form may be shared with instructors and program co-sponsors.

Continuing Professional Education
University of Minnesota
352 Ruttan Hall
1994 Buford Avenue
St. Paul, MN 55108

Nonprofit Org.
U.S. Postage
PAID
Twin Cities, MN
Permit No. 811



49th Annual
**MINNESOTA POWER
SYSTEMS CONFERENCE**

November 5-7, 2013