51st Annual
MINNESOTA POWER SYSTEMS CONFERENCE
November 10–12, 2015

• We’ve Moved to a New Location •

Saint Paul RiverCentre
175 W Kellogg Boulevard
Saint Paul, 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
# Program At A Glance

## TUESDAY, NOVEMBER 10, 2015

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<td>Distributed Generation and Electric Rates</td>
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<td>Drones Promise Faster, Easier Inspection</td>
<td>Robots for Energized Transmission Line Work</td>
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<td>Storm Restoration of a 500 kV Line–Challenges &amp; Successes</td>
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<td>Integrating Solar Energy</td>
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### Thursday, November 12, 2015

7:30 a.m. Registration and Continental Breakfast

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<td>8:30</td>
<td>Methods to Reduce Arc-Flash Hazards</td>
<td>Project and Construction Management Techniques</td>
<td>Shunt Capacitor Banks—Specifications, Applications, and Best Practices for Protection and Switching</td>
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Noon Adjourn
GENERAL SESSION

8:00 a.m.–noon
Moderator: Michael Marz
Co-Moderators: Michael Ebert, Larry Brusseau, Al Haman

Welcome and Opening Remarks
Michael Marz, American Transmission Company

Leadership in the Ever-Changing Energy Landscape
Timothy Rogelstad, Otter Tail Power Company
Change in the electrical energy landscape continues to accelerate. Utility leadership is needed to navigate this change, and this presentation will discuss how we lead the way to the future.

Construction of the Minnesota Multipurpose Stadium
Kevin Dalager, M.A. Mortenson; Larry Heinsch, Gephart Electric - Build 23; Scott Smith, Parsons Electric - Build 23
The construction of the Minnesota Multipurpose Stadium is underway on the eastern edge of downtown Minneapolis. This presentation will provide an overview of the construction, special challenges on site, expectations from stakeholders, and unique electrical installations implemented.

Delivering Electric Power to the Bakken
Matthew Stoltz, Basin Electric Power Cooperative
This presentation will describe how development of the Bakken oil field impacts the area transmission system. Transmission operational optimization and facility additions will be described in detail.

Business Ethics: Lessons from an $8.5 Million Fraud
Nathan Mueller, Consultant
Mr. Mueller will present the ethical lessons learned professionally and personally from embezzling $8.5 million and being sentenced to 97 months in federal prison.

CONCURRENT SESSIONS
1:00–4:15 p.m.

SUBSTATION
Moderator: Chuck Healy
Co-Moderators: Steve Mohs, Rick Johnson

3D Coming to a Substation Near You
John Scott, Burns & McDonnell
This presentation will be an in-depth analysis of the benefits and challenges of migrating your existing design processes to a 3D design process. We will demonstrate migration from 2D CAD and Raster Image work flows to 3D and Intelligent 3D.
Evaluating Dielectric Condition in SF6 Gas Breakers
Linda Nowak, Doble Engineering
The object of this presentation is to review test techniques which have been developed for SF6 gas circuit breakers for evaluating their dielectric condition.

Experiences with Mobile Substation Installations
Bill Hansen, Xcel Energy
This presentation will provide an overview of mobile substations and how they are installed, including considerations for sizing, settings, and siting. It will also highlight some lessons learned: what has worked well and not so well.

System Upgrades for Phase Angle Regulating Transformers
Benjamin Fameree, Kenneth Sletten, Minnesota Power
This presentation examines the replacement of all eight motor drives for two-phase angle regulating transformers operating in series, including an upgrade of the equipment controls for remote monitoring and diagnostic analysis. The audience will be provided with an understanding of the planning, implementation, and commissioning of both projects taking place in International Falls, MN.

UTILITY INDUSTRY FUTURES I
Moderator: Mike Steckelberg
Co-Moderators: Larry Brusseau, Philip Spaulding

Performance Analysis of 258 kW AC Solar Demonstration Project
John Aiton, Andy Bergrud, Great River Energy
Detailed performance comparisons of three equipment manufacturers and production data will be presented. Lessons learned regarding design, procurement, and construction will also be discussed.

Hometown BioEnergy: On Peak Power Generation from Waste
Benjamin Simmons, Avant Energy
Hometown BioEnergy generates sustainable energy on peak power from food and agricultural processing wastes. The project supports Minnesota Municipal Power Agency’s compliance with MN Renewable Energy Standard. Operational in 2013, the 8 MW distributed generation facility was designed with on-site gas storage, enabling “dispatch flexibility” to maximize revenue generation.

Distributed Generation and Electric Rates
Tom Nigon, STAR Energy Services LLC
Electric cooperatives are reviewing their rates because of the growth in solar distributed generation. Topics covered are strategies to reduce cost shifting including the development of a residential demand rate.

Drones Promise Faster, Easier Inspection
Jon Cavote, United Dynamics Advanced Technologies Corporation
“United Aerobotics” process patented aerial drone inspections provide pathway to high-quality evaluation at reduced costs. Case studies present working proof of inspection performance and accuracy.

DELIVERY SYSTEMS I
Moderator: Al Haman
Co-Moderators: Will Lovelace, Scott Hoberg

Xcel Energy Field Area Network
Kyle Grossmann, Dan Nordell, Xcel Energy
Xcel Energy is demonstrating a Field Area Network (FAN) architecture which is intended to
extend the corporate data network using two additional standards-based and interoperable
tiers (WiMAX and Wi-SUN) beyond the substation to support communication to a variety of
field devices including Electric Distribution Automation (SCADA), Fault Locators, High-Speed
Distribution Switching (Relaying), Gas Transmission and Distribution, Street Lighting, and both
Electric and Gas Advanced Meter Infrastructure (AMI). A proof-of-concept project is being
fielded in the Denver Metro area which will be a blueprint for future Xcel Energy field
communications.

Meeting the Challenges in Regional Transmission Planning and Development
Douglas Brown, Siemens
FERC Order 1000 reformed electric transmission planning and cost allocation requirements for
transmission providers. This presentation provides an overview of Order 1000 and looks at
eamples of developing and evaluating transmission plans to meet regional reliability,
economic, and public policy needs.

Distribution Grid Resiliency Structure Testing, Results, and Learnings
David Flaten, Xcel Energy
Xcel Energy and EPRI simulated trees falling on a three-mile, out-of-service 1950s-era line.
Results of structure and conductor failures are discussed along with potential mitigation
measures.

Robots for Energized Transmission Line Work
Bryan Rushing, Quanta Technology
This presentation will explore past experience with ground-based robots and the current types
of robots available in the industry. We will look at the basics of robots suspended from
transmission lines and the basics of unmanned aerial vehicles. Additionally, we will explore
methods to estimate benefits of energized work and the future of transmission line robotics.

RELAYING I

Moderator: Neil Stiller
Co-Moderators: Dave Bisel, Greg Owen

Life Lessons from the Power System
R. Benjamin Kazimier, Basler Electric Company
Life Lessons from the Power System explores the basic principles of relay protection design
and relay protection commissioning, while reflecting upon lessons learned.

A Practical Guide to Performing Wide-Area Coordination Analysis
Bipasha Barman, Power Engineers Inc.
The presentation will cover the analysis methodology and selecting an approach to performing
a wide-area coordination study. Topics such as (i) subset boundaries, (ii) calculation
spreadsheets, and (iii) looped system and multiterminal line examples will be presented to
show the challenges, considerations, and choices the protection engineer may be faced with
in this type of study.

Transmission Line Automated Relay Coordination Checking
Garret Sarkinen, Xcel Energy
This presentation is a follow-up to the previous year’s presentation which focused on the
automation mechanics of evaluating the sensitivity and selectivity of transmission line
protective relay settings. Now the focus is on some of the key findings of that automated relay
coordination study.
Improving Reliability and Security of System Protection
Steve Turner, Beckwith Electric Company
Citing a NERC report on the dramatic rise in misoperations due to complex programming and testing of numerical protection relays, this paper provides examples of actual misoperations and illustrates results.

EXHIBITOR RECEPTION
4:15–6:30 p.m.

WEDNESDAY, NOVEMBER 11, 2015

CONCURRENT SESSIONS
8:30 a.m.–noon

DISTRIBUTION AUTOMATION/COMMUNICATIONS
Moderator: Jay Morris
Co-Moderators: Tom Guttormson, Dan Nordell

Antenna Systems – The Weak Link in High Data Throughput Wireless Data Communications Systems
Mike Larson, Larson Data Communications, Inc.
A growing number of utilities are experiencing poor radio link performance issues when fielding new generation radio systems, which are operating at ever-increasing over-the-air data throughput rates, made possible by ever-increasingly complex modulation schemes. The issue may be under-performing radio equipment, but often, the issues are the result of less-than-optimal antenna selection and mounting location.

Hacking SCADA Networks – Awareness and Prevention
Matthew Cowell, Phoenix Contact
This presentation will offer discussion on the threats facing industrial controls and SCADA systems with suggestions on how to prevent future incidents (including brief live demonstration).

What Protection Engineers Need to Know About Networking
Mark Adamiak, GE Grid Automation
This presentation explores the network architecture of the modern protection and control systems including protective relays. Lessons learned from real projects will also be presented.

Securing Communications for SCADA and Critical Industrial Systems
Kevin Carson, Schweitzer Engineering Laboratories, Inc.
This presentation details the threats that SCADA and industrial control systems face, how to detect and counter those threats, and how to apply countermeasures, new technologies, and safe practices to these systems.

PROJECT MANAGEMENT
Moderator: Denny Branca
Co-Moderators: Greg Woodworth, Jake Bernhagen

Storm Restoration of a 500 kV Line – Challenges & Successes
William Pim, Xcel Energy
Overview of the development of a dedicated restoration plan for a remote 500 kV transmission line and subsequent successful execution of the plan to rapidly replace a downed tower.
Birch Lake Dam Rebuild
Kyle Maher, Minnesota Power
This project discusses the challenges of rebuilding a dam such as the Birch Lake Dam, a timber crib storage reservoir dam, within the compressed construction season in Northern Minnesota.

Leveraging the Power of GIS Technology for Asset Management – Pole Replacement Tracking Tool
Scott Hafner, Xcel Energy; Dan Haglund, Ulteig, Inc.
This presentation focuses on real-time Web and mobile mapping application for pole replacement tracking. This application is used by designers, project managers, and construction crews from multiple internal and external work groups to manage 3,000 annual pole replacements.

Challenges of Urban Construction – Minneapolis-Hiawatha Corridor Project
Joseph Samuel, Nathan Steward, Xcel Energy
This presentation will highlight challenges Xcel Energy overcame in permitting and constructing two new substations and installing 1.5 miles of double-circuit 115 kV underground transmission line in an urban area of Minneapolis, MN.

UTILITY INDUSTRY FUTURES II
Moderator: Michael Marz
Co-Moderators: Mike Steckelberg, Chuck Healy

Lessons Learned in Implementing Battery Systems Controls in Low-Inertia Systems
Michael Ropp, Dustin Schutz, Northern Plains Power Technologies
This presentation will discuss two case studies in which battery-inverter systems are used in low-inertia power systems, including issues encountered and mitigation strategies. One case study is a whole-feeder microgrid; the other is a diesel-based system with heavy photovoltaic penetration.

Risk of Unintentional Islanding in the Presence of Multiple Inverters or Mixed Generation Types
Chris Mouw, Scott Perlenfein, Northern Plains Power Technologies
Based on extensive experience, two key situations have been identified in which unintentional islanding of distributed energy resources can still occur. This presentation discusses modern anti-islanding, these two cases and potential mitigation strategies, and the use of modeling in solving this problem.

Integrating Solar Energy
Mark Ahlstrom, WindLogics/NextEra Energy
Solar generation is growing rapidly. This presentation discusses the latest solar integration issues and NERC activities on essential reliability services for solar and other renewables.

MISO Dynamic Stability Limited Interface Limit Calculation
Raja Thappetaobula, Midcontinent Independent System Operator (MISO)
MISO has implemented real-time dynamic limit calculation on Stability Limited Interfaces. Limits are being calculated in the near real time using the current system conditions. By taking advantage of the capabilities of the Real-Time Stability Limit Calculation Tool we can reliably maximize system use.
POWER GENERATION
Moderator: Scott Hoberg
Co-Moderators: Dave Bisel, Greg Owen

Traditional and Emerging Emissions Control for Baseload Generation Stations
Greg Owen, Basin Electric Power Cooperative
This presentation provides an overview of present and future emissions control methods utilized at baseload generation stations, including an engineering perspective of associated materials, power consumption, control, and cost.

Low SCR Wind Generation Instability Identification and Mitigation
Will Lovelace, Minnkota Power Cooperative, Inc.; Jerry Martínez, General Electric
Instability may result from high penetration of power electronic-based generation such as wind into a relatively weak system. This presentation describes historical events resulting from a low SCR (Short Circuit Ratio) and some low-cost control changes employed as mitigation.

Spiritwood Station’s Unique Design Features
William Gallagher, Great River Energy
North Dakota’s newest coal-fired, combined heat- and power-generating station was presented with fuel, ash, steam, and water challenges. This session discusses how those challenges were met.

Minnesota Power Laskin Energy Center Gas Conversion
Jodi Piekarski, Kristopher Spenningsby, Minnesota Power
Minnesota Power has recently converted its Laskin Energy Center from coal to natural gas. This presentation will cover the project from origination through start-up focusing on scope development, design, permitting, and construction.

CONCURRENT SESSIONS
1:00–4:15 p.m.

CIVIL-STRUCTURAL
Moderator: Rick Johnson
Co-Moderators: Chuck Healy, Steve Mohs

Conductor Dynamics: Practical Information for Design Engineers
Paul Springer, Southwire
While vibration theory can be daunting, the practical rules are not. This presentation is designed to help the transmission engineer know whether they need dampers, and if so, what the right questions are to get fair value for the investment in vibration protection.

Foundation Design and Construction Challenges with Shallow Bedrock
Nathaniel Roth, Sargent & Lundy
Foundation design and construction can be extremely challenging with shallow bedrock. This presentation will explore viable foundation types, as well as the potential challenges faced during construction.

Lessons Learned from Failures
Peter Catchpole, Power Engineers, Inc.
By using examples, we will explore the various types of failures and the value of studying them. Additionally, we will discuss how to study and learn from the lessons of failures.
Study of Galloping Mitigation
Jay Quint, Burns & McDonnell
Galloping is large amplitude oscillations which impact the operation of a transmission line. This discussion will review the available devices used to control galloping.

DELIVERY SYSTEMS II
Moderator: Greg Woodworth
Co-Moderators: Dave Peterson, Philip Spaulding

Transition from SPS to RAS – What Will Really Change?
Hari Singh, Xcel Energy
Apparent versus actual changes in NERC’s new Remedial Action Scheme (RAS) definition are delineated. Rationales for explicitly excluding certain corrective actions from the RAS “umbrella” are discussed.

Downtown East Distribution System
Andy Dammel, Xcel Energy
Xcel Energy redesigned its distribution system in downtown Minneapolis to provide cost-effective and reliable service to the Vikings Stadium and surrounding developments. This presentation explains how that was accomplished.

Transmission Planning for Physical Security of Critical Electricity Infrastructure
Frank McElvain, Siemens PTI
An effective CIP-014-2 grid criticality study adds key insight to assure reliability. Presentation will provide unique perspectives on reliability coordination, planning, and the military to maximize insights from a CIP-014-2 criticality evaluation.

Meeting Minnesota Energy Efficiency Requirements with Utility Projects
Aaron Vander Vorst, Minnkota Power Cooperative, Inc.
This presentation introduces use of utility-scale projects to meet MN Conservation Improvement Program energy efficiency requirements. It will also cover the introduction to CIP, lessons learned, and creative identification of projects during system planning and design.

RELAYING II
Moderator: Dave Bisel
Co-Moderators: Michael Ebert, Jake Bernhagen

Methods for Testing Transformer Differential Relays Applied to Delta-Grounded Wye Transformers Using Single-Phase Test Currents
Thomas Ernst, GE Digital Energy; Craig Talbot, Minnesota Power
A method is discussed for testing transformer differentials applied to D/GWye transformers using one-phase currents based on three-line and nameplate diagrams. This confirms correct settings by simulating SLG Y-side loading.

Transmission Line Setting Calculations – Beyond the Cookbook
Dan Heidfeld, Schweitzer Engineering Laboratories
This paper looks at various commonly used transmission line protective elements and points out characteristics to look for where deviations from cookbook guidelines are required.

Paralleling CTs for Line Current Differential Applications: Problems and Solutions
Jason Young, Schweitzer Engineering Laboratories
This presentation discusses complications that can arise from paralleling CTs and relay design improvements that add security to these applications. Event reports are shown to illustrate problems and solutions.
CT Saturation Tolerance for 87L Applications
Terrence Smith, GE Digital Energy
This paper explores requirements for the line current differential function (87L) with regard to the tolerance to current transformer (CT) saturation. Typically, requirements provided by manufacturers or standards are to eliminate CT saturation completely by proper sizing of CTs, which is not always practical.

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

Advantages of Two-Way AMI/Demand Response Systems
Danielle Thompson, Eaton Corporation; Brad Lingen, Missouri River Energy Services
This presentation will explain the implementation of the MRES hosted multimunicipal member DR and AMI programs across four states using Eaton’s DR/AMI solution.

Minnesota Power’s Smart Grid Investment Grant Impacts: Past, Present, and Future
Daniel Gunderson, Tina Koecher, Minnesota Power
This presentation will focus on Minnesota Power’s Smart Grid Investment Grant Award, including how the Advanced Metering Infrastructure (AMI) deployment and Distribution Automation investment shaped the vision for a better customer experience. An overview of the project execution, lessons learned, and how those lessons are shaping the future strategic direction for Minnesota Power will be discussed.

Achieving Interoperability in a World of Standards Compliance
Dan Nordell, Xcel Energy
The buzzword of the day for vendors is to declare that their systems are “standards based”. What utilities need and want is “interoperability”. Standards compliance is a necessary but not sufficient component in achieving interoperability. This talk will examine what is needed to achieve true interoperability and help the audience become more discerning as they discuss this important issue with their vendors.

What to Do with All That 2-Way End-Device Data
Joe Childs, Eaton Corporation
This session reviews the value assessment of utilizing two-way data, and addresses some of the challenges of managing the abundance of data available. Discussion will occur about optimizing the data received through AMI, load management, and volt-var control applications.

THURSDAY, NOVEMBER 12, 2015

CONCURRENT SESSIONS
8:30 a.m.–noon

TUTORIAL I
Moderator: Tom Guttormson
Co-Moderators: Greg Owen, Will Lovelace

Methods to Reduce Arc-Flash Hazards
David Bisel, Mike Merow, Schweitzer Engineering Laboratories
This tutorial discusses protective relaying methods used to reduce arc-flash hazards in switchgear, MCCs, and overhead distribution lines. Methods discussed include maintenance mode activation of instantaneous overcurrent settings, bus differential relaying, and high-speed light detection with optical sensors. Background information on arc flash and the
standards driving calculations will be covered. Application and installation examples are shown, along with an exercise on implementing instantaneous settings for maintenance mode.

**TUTORIAL II**

Moderator: Larry Brusseau  
Co-Moderators: Michael Marz, Greg Woodworth

*Project and Construction Management Techniques*  
Duane Phillips, Stanley Consultants, Inc.

Travel through a typical power delivery project work scope to introduce and develop project and construction processes and skills. Included will be industry best-practice techniques and considerations for specifically developing project and construction plans.

**TUTORIAL III**

Moderator: Denny Branca  
Co-Moderators: Steve Mohs, Chuck Healy

*Shunt Capacitor Banks – Specifications, Applications, and Best Practices for Protection and Switching*  
Pratap Mysore, HDR Inc.

The tutorial provides insight into basics of shunt capacitor bank specifications, applications, and protection. Issues associated with switching transients and use of current limiting reactors with latest industry information are also covered.

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**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 and serves as a forum for power engineers to meet with their colleagues from other utilities to discuss mutual concerns.

**LOCATION AND ACCOMMODATIONS • New Location •**

Due to overwhelming popularity the conference has moved to a NEW LOCATION WITH A LARGER VENUE, the Saint Paul RiverCentre, 175 W Kellogg Boulevard, Saint Paul, Minnesota. Parking is available for a fee in the RiverCentre parking ramp, which is located on Kellogg Boulevard across the street from RiverCentre.

A block of rooms has been reserved at the Crowne Plaza Saint Paul-Riverfront, 651-292-1900 and the Holiday Inn Saint Paul Downtown, 651-225-1515.

To receive the special conference rate of $155 for the Crowne Plaza Saint Paul-Riverfront and $125 for the Holiday Inn Saint Paul Downtown, identify yourself as a participant of the Minnesota Power Systems Conference. The room block deadline is October 8, 2015.

**REGISTRATION AND FEES**

The fee for the conference is $375 if received by October 26; if received after October 26 the fee is $425. The conference fee includes all sessions, continental breakfasts, luncheons, refreshments breaks, and the exhibitor reception. If you cancel your registration by November 2 a refund, minus $30, will be issued. If you cancel after this date you will not be eligible for a refund.
EXHIBITOR RECEPTION
The exhibitor reception will be held on Tuesday, November 10, from 4:15–6:30 p.m. Conference attendees are invited to attend this reception to view the exhibits, meet the exhibitors, and enjoy some hors d’oeuvres and a cash bar.

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.

PROGRAM INFORMATION
612-624-4754  cceconf2@umn.edu

REGISTRATION INFORMATION
612-625-2900  cceinfo@umn.edu

ADDITIONAL INFORMATION
Visit the conference website – www.cce.umn.edu/mnpowersystems – for additional information on:
• Exhibitor information and registration
• 2016 call for presentations
• Conference papers and PowerPoint presentations

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

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* Planning Committee Chair
# Registration

## 51st Annual Minnesota Power Systems Conference

November 10–12, 2015

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## Conference Fee
- $375, Conference Participant Early Fee (received by October 26).
- $425, Conference Participant Fee (received after October 26).
- $200, Speaker Fee (if attending entire conference).

## Meal Options
- I am requesting vegetarian lunches.
- I am requesting gluten-free lunches.

## Tutorial Options
- I plan to attend the “Methods to Reduce Arc-Flash Hazards” Tutorial
- I plan to attend the “Project and Construction Management Techniques” Tutorial
- I plan to attend the “Shunt Capacitor Banks – Specifications, Applications, and Best Practices for Protection and Switching” Tutorial
- I don’t plan to attend the Tutorials

## 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/Novus
  - American Express

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## 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):**
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College of Continuing Education
201 Coffey Hall
1420 Eckles Ave
Saint Paul, MN 55108

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

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