

50th Annual **MINNESOTA POWER SYSTEMS CONFERENCE**

November 4-6, 2014

**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

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COLLEGE OF CONTINUING EDUCATION

UNIVERSITY OF MINNESOTA



Program Schedule

Tuesday, November 4, 2014

GENERAL SESSION

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

Moderator: Chuck Healy

Co-Moderators: Gerry Steffens, Al Haman, Larry Brusseau

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|------|--|-------|---|
| 7:00 | Check-in
Continental Breakfast | 10:00 | Emerging Issues and Trends as
Viewed from Washington, D.C.
<i>Jim Fama</i> , Edison Electric
Institute |
| 8:00 | Welcome
<i>Chuck Healy</i> , Electro Tech | 10:45 | Applied Professional Ethics for
Engineers
<i>Rand Park</i> , University of
Minnesota |
| 8:15 | Minnesota Discovery, Research,
and InnoVation Economy
(MnDRIVE): Robotics, Sensors,
and Advanced Manufacturing
<i>Mostafa Kaveh</i> , University of
Minnesota | 11:45 | Lunch |
| 8:45 | State-Based Wide-Area Control,
Protection, and Automation of
Electric Power Systems
<i>Edmund Schweitzer</i> , Schweitzer
Engineering Laboratories | | |
| 9:45 | Break | | |

CONCURRENT SESSIONS

1:00 - 4:15 p.m.

SUBSTATION

Moderator: Steve Mohs
Co-Moderators: Chuck Healy,
Greg Owen

- 1:00 System Neutral Grounding Methods
Rumyana Kreidler, Xcel Energy
- 1:45 Extracting Valuable Information from HV Circuit Breaker Testing
Charles Sweetser, OMICRON Electronics Corp.
- 2:30 Break
- 2:45 Power Factor Insulation Diagnosis -Demystifying Standard Practices
Dinesh Chhajer, Megger
- 3:30 Bus Protection Considerations for Various Bus Types
Steven Chase, Schweitzer Engineering Laboratories
- 4:15 Adjourn

UTILITY INDUSTRY FUTURES I

Moderator: Mike Steckelberg
Co-Moderators: Tom Guttormson,
Rick Johnson

- 1:00 Grid Friendly Solar PV Power Plant
Mahesh Morjaria, First Solar
- 1:45 Battery Storage of Wind Power in Luverne, Minnesota
Dan Girard, S&C Electric Company
- 2:30 Break
- 2:45 Simulation Study of a Dynamic VAR Compensator as a Solution to a Large Motor Start Problem
Michael Ropp, Northern Plains Power Technologies
- 3:30 Determining the Capacity Impacts of Plug-In Electric Vehicles on Xcel Energy's Distribution System
Chris Punt, Xcel Energy
- 4:15 Adjourn

DELIVERY SYSTEMS I

Moderator: Al Haman
Co-Moderators: Michael Marz,
Scott Hoberg

- 1:00 Fault Current Calculations and NEC Requirements
Dan Neeser, Eaton's Bussmann Business
- 1:45 An Overview of Restoration Issues and Black-Start Analysis
James Feltes, Carlos Grande-Moran, Siemens PTI
- 2:30 Break
- 2:45 Energy Storage Can Enable the Wider Deployment of Distributed Generation
Troy Miller, S&C Electric Company
- 3:30 Locating Faults by the Traveling Waves They Launch
Edmund Schweitzer, Schweitzer Engineering Laboratories
- 4:15 Adjourn

RELAYING I

Moderator: Greg Woodworth
Co-Moderators: Mythili Chaganti,
Michael Ebert

- 1:00 Distribution Bus Protection Upgrade Considerations When Integrating Distributed Generation
Ed Atienza, Schweitzer Engineering Laboratories
- 1:45 Protective Relaying Redundancy and Reliability
Roy Moxley, Siemens
- 2:30 Break
- 2:45 False Application of Reliable Relaying Principles—Revisited
Roger Hedding, ABB Inc.
- 3:30 Testing the Tester—Common Pitfalls Testing Microprocessor Based Protective Relays
Terrence Smith, GE Digital Energy/Multilin
- 4:15 Adjourn

EXHIBITOR RECEPTION

4:15-6:30 p.m.

Wednesday, November 5, 2014

CONCURRENT SESSIONS

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

**DISTRIBUTION AUTOMATION/
COMMUNICATIONS**

Moderator: Tom Guttormson

**Co-Moderators: Dan Nordell,
Michael Ebert**

- 7:30 Continental Breakfast
- 8:30 Design and Implementation of a Communication Network to Support Real-time Distribution Feeder Automation, SCADA Integration and Backhaul of Substation and Metering Data
Dan Murray, Siemens Industry, Inc.
- 9:15 Can a Grid Be Smart Without Communications? A Look at IVVC Implementation
David Aldrich, Beckwith Electric Company
- 10:00 Break
- 10:30 Adaptive Control Strategies and Communications for Utility Integration of Photovoltaic Sites
Darrin Kite, Schweitzer Engineering Laboratories, Inc
- 11:15 A Real-World Example of IT and Operations Alignment
Mark Peterson, Ron Schmitz, Great River Energy
- 12:00 Lunch

UTILITY INDUSTRY FUTURES II

Moderator: Philip Spaulding

**Co-Moderators: Gerry Steffens,
Larry Brusseau**

- 7:30 Continental Breakfast
- 8:30 Chemical Looping Clean Coal Technology
Herb Andrus, Alstom Power, Inc.
- 9:15 Great River Energy Distributed Generation Pilot Program
Robert Sandberg, Great River Energy
- 10:00 Break

PROJECT MANAGEMENT

Moderator: Denny Branca

**Co-Moderators: Mythili Chaganti,
Rick Johnson**

- 7:30 Continental Breakfast
- 8:30 Mackinac HVDC Construction and Testing
Michael Marz, American Transmission Company
- 9:15 The Center to Grand Forks 345 kV Transmission Line Project—Challenges, Hurdles, and Lessons Learned
Mike Hennes, Minnkota Power Cooperative
- 10:00 Break
- 10:30 Project Management for Chub Lake Substation
Greg Schutte, Great River Energy
- 11:15 Fox Valley Tornado Recovery
Nils Stenvig, American Transmission Company
- 12:00 Lunch

POWER GENERATION

Moderator: Scott Hoberg

**Co-Moderators: Dave Hoops,
Jim Hanson**

- 7:30 Continental Breakfast
- 8:30 Photovoltaics Outlook for Minnesota
Stephen Campbell, University of Minnesota
- 9:15 Effect of Fukushima on the Nuclear Power Industry
Jon Kapitz, Xcel Energy
- 10:00 Break

UTILITY INDUSTRY FUTURES II

(continued)

- 10:30 Renewable Energy Lessons Learned
Neil Kennebeck, Dairyland Power Cooperative
- 11:15 Solar Valuation - Process for Determining Economic Value
Doug Larson, Dakota Electric Association
- 12:00 Lunch

POWER GENERATION

(continued)

- 10:30 Synchronous Condensers for Transmission Systems—The Second Generation
Robert D’Aquila, General Electric
- 11:15 Cogeneration Plant Switchgear Replacement Improves Safety and Reliability While Maintaining Service to Critical Loads
Timothy Coyle, Power Consulting & Training, Inc; Rachel Mueller, Mayo Clinic
- 12:00 Lunch

CONCURRENT SESSIONS

1:00 - 4:15 p.m.

CIVIL-STRUCTURAL

Moderator: Mythili Chaganti
Co-Moderators: Rick Johnson, Jim Hanson

- 1:00 Panel Discussion on Industry Standards
Timothy Wachholz, Michael Anderson, Robert Molde, Michael Garrels, Xcel Energy; Marlon Vogt, Ulteig
- 1:45 Panel Discussion on Industry Standards *(continued)*
- 2:30 Break
- 2:45 Utility Scale Wind Turbine Foundation Performance Evaluation
Chris Kopchynski, Barr Engineering
- 3:30 Transmission Long Span Design
Duane Phillips, Stanley Consultants, Inc.
- 4:15 Adjourn

DELIVERY SYSTEMS II

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

- 1:00 Enhanced Multiple Contingency Screening and Cascading Analysis for NERC Compliance
Chengyue Guo, American Transmission Company
- 1:45 How MISO Studies Power Plant Retirements
Dave Duebner, MISO
- 2:30 Break
- 2:45 Designing For a Critical Load Using a Spot Network
Mark Faulkner, Eaton Corporation
- 3:30 Distribution Grid Management
Joseph LaCasse, Xcel Energy
- 4:15 Adjourn

CONCURRENT SESSIONS *(continued)*

1:00 - 4:15 p.m.

RELAYING II

Moderator: Greg Woodworth

**Co-Moderators: Wesley Hammitt,
Dave Hoops**

- 1:00 Get in Step with Synchronization – A Review of Synchronization
Daniel Ransom, Basler Electric Company
- 1:45 Transmission Line Automated Relay Coordination Checking
Garret Sarkinen, Xcel Energy;
Saman Alaeddini, Quanta Technology
- 2:30 Break
- 2:45 Operation and Protection of the Weak Transmission System in SE Colorado
Ernie Poggi, *Edward Mayer*, Xcel Energy
- 3:30 Special Considerations for Distribution Protection Coordination
Steve Turner, Beckwith Electric Co. Inc
- 4:15 Adjourn

METERING

Moderator: Dan Nordell

**Co-Moderators: Tom Guttormson,
Larry Brusseau**

- 1:00 A Panel Discussion of Revenue Metering, Arc Flash Hazards, and Mitigation
Tom Ernst, GE Digital Energy;
Dan Nordell, Xcel Energy
- 1:45 A Panel Discussion of Revenue Metering, Arc Flash Hazards, and Mitigation *(continued)*
- 2:30 Break
- 2:45 Interoperability in Smart Utility Networks
Phil Beecher, Wi-SUN Alliance
- 3:30 Power Quality Measurements from Smart Revenue Meters
Tom Cooke, EPRI
- 4:15 Adjourn

Thursday, November 6, 2014

CONCURRENT SESSIONS

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

TUTORIAL I

Moderator: Larry Brusseau, Co-Moderators: Jim Hanson, Mythili Chaganti

Insulation Coordination, *Steve Brewer*, Hubbell Power Systems

TUTORIAL II

Moderator: Denny Branca, Co-Moderators: Mike Steckelberg, Sairaj Dhople

Electric Drives 101 & Variable-Frequency Drives, *Ned Mohan*, University of Minnesota;
Robin Priestley, Rockwell Automation

TUTORIAL III

Moderator: Chuck Healy, Co-Moderators: Michael Marz, Dave Peterson

Distribution Planning, *Al Haman*, STAR Energy Services; *Tom Guttormson*, Connexus Energy; *Philip Spaulding*, Xcel Energy

- 7:30 a.m. Continental Breakfast
- 8:30 Tutorial Sessions
- 10:00 Break
- 10:30 Tutorial Sessions (continued)
- 12:00 Adjourn

Presentation Descriptions

GENERAL SESSION

Minnesota Discovery, Research, and InnoVation Economy (MnDRIVE): Robotics, Sensors, and Advanced Manufacturing *Mostafa Kaveh, University of Minnesota*

The University of Minnesota has launched a new initiative funded by the State of Minnesota called MnDRIVE. One of the focus areas is on Robotics, Sensors, and Advanced Manufacturing. This presentation will explore some possibilities of how Robotics, Sensors, and Advanced Manufacturing could impact and improve the electric utility industry. The presenter will welcome your ideas on the directions of this initiative.

State-Based Wide-Area Control, Protection, and Automation of Electric Power Systems *Edmund Schweitzer, Schweitzer Engineering Laboratories*

Today's stochastic sources (wind, solar) and increasing distances between generation and ever-stiffer loads present new power-system control challenges. Distributed state-based solutions may be the answer, and our presentation will explore the possibilities.

Emerging Issues and Trends as Viewed from Washington, D.C.

Jim Fama, Edison Electric Institute

Jim Fama, Vice President of Energy Delivery at the Edison Electric Institute, will provide a view of current issues and trends in the electric utility industry, covering a wide range of topics including transmission, generation and distribution investment, mergers, reliability, distributed generation, cyber and physical security, regulation and Congress.

Applied Professional Ethics for Engineers *Rand Park, University of Minnesota*

This presentation provides ethical theories and frameworks for professional engineers so that they can make ethically defensible decisions that balance rights, duties, benefits, and harms among multiple stakeholders in complicated situations.

SUBSTATION

System Neutral Grounding Methods *Rumyana Kreidler, Xcel Energy*

This presentation analyzes different methods of grounding, reasons to use those methods, and ground fault protection. It illustrates advantages and disadvantages of each method; where it is allowed by code, what impact it has on equipment, and what are the operational limitations.

Extracting Valuable Information from HV Circuit Breaker Testing *Charles Sweetser, OMICRON Electronics Corp.*

This easy-to-follow paper and presentation focuses on how diagnostic techniques can be applied to HV circuit breakers as part of the standard condition assessment protocol. The audience will be provided with an understanding, application, and analysis of these tests, supported by case studies validating the value that these diagnostic tests bring to HV circuit breaker testing.

Power Factor Insulation Diagnosis—Demystifying Standard Practices *Dinesh Chhajer, Megger*

This paper focuses on standard practices used for Power Factor (PF) testing in the field but the reason or logic behind them is rarely questioned. It is intended to explain the unusual PF testing facts and demystify those using case studies and field test results.

Bus Protection Considerations for Various Bus Types *Steven Chase, Schweitzer Engineering Laboratories*

This paper examines protection schemes and technologies for several common bus types. Advantages and disadvantages are discussed for each scheme.

UTILITY INDUSTRY FUTURES I

Grid Friendly Solar PV Power Plant

Mahesh Morjaria, First Solar

In this presentation we will describe features that enable utility-scale PV power plants to more easily connect to the grid and provide reliable and stable electricity. Such capability is essential for increasing solar contribution into an existing generation portfolio.

Battery Storage of Wind Power in Luverne, Minnesota

Dan Girard, S&C Electric Company

Integrating energy storage with wind-power helps match wind generation to demand and can create additional revenue streams. An 11.5-MW plant in Luverne, Minnesota, is one plant showing how this can be done.

Simulation Study of a Dynamic VAR Compensator as a Solution to a Large Motor Start Problem

Michael Ropp, Northern Plains Power Technologies

Starting of large motors presents significant challenges, especially on weaker power systems. This presentation and accompanying paper describe a simulation study to quantify the impact of starting of proposed new large motor load on a high-impedance feeder, and the use of a dynamic VAR compensator to mitigate the adverse motor start impacts. The results show a) the value of transient simulation in applications of this type; and b) the effectiveness of the dynamic VAR compensator as a solution to this problem.

Determining the Capacity Impacts of Plug-In Electric Vehicles on Xcel Energy's Distribution System

Chris Punt, Xcel Energy

With electric vehicle sales increasing across the world, their locations and subsequent electric capacity impacts need to be known. This presentation shows how Xcel Energy approached this development on their distribution system.

DELIVERY SYSTEMS I

Fault Current Calculations and NEC Requirements

Dan Neeser, Eaton's Bussmann Business

This presentation will focus on fault current calculations and associated NEC Requirements. The NEC (and in some instances OSHA) has requirements for the proper application of interrupting rating for overcurrent devices, short-circuit current ratings for equipment, marking of the maximum fault current on service equipment, and selective coordination of critical systems. New tools for the calculation of fault currents also will be shown.

An Overview of Restoration Issues and Black-Start Analysis

James Feltes, Carlos Grande-Moran, Siemens PTI

While modern power systems are highly reliable, extreme events can occur which may lead to a partial or total system blackout. Utilities have the responsibility to develop detailed restoration plans and procedures to restore the power system safely, efficiently, and as expeditiously as possible. This paper gives a brief overview of many of the issues involved in power system restoration and the analysis associated with developing black-start plans.

Energy Storage Can Enable the Wider Deployment of Distributed Generation

Troy Miller, S&C Electric Company

This presentation will focus on how the adoption of distributed energy storage can enable the wider deployment of Distributed Generation such as roof-top photovoltaic and small wind generation. It also will cover case studies around energy storage deployed in islanded networks, including the 1MW Catalina Island, the 2MW Santa Rita Jail, and the 4MW Yerba Buena projects, all located in California.

Locating Faults by the Traveling Waves They Launch

Edmund Schweitzer, Schweitzer Engineering Laboratories

This paper explains the physics of traveling waves (TWs) on power lines, reviews the theory of TWs, explains the foundations of various types of TW fault locators and discusses integration and field experience of TW fault locating in protection relays.

RELAYING I

Distribution Bus Protection Upgrade Considerations When Integrating Distributed Generation

Ed Atienza, Schweitzer Engineering Laboratories

Addition of distributed generation increases distribution feeder and bus fault current. This paper highlights distribution bus protection modifications or upgrades necessary to maintain coordination, minimize equipment damage, and prevent miss operations.

Protective Relaying Redundancy and Reliability

Roy Moxley, Siemens

The presentation discusses the elements of a redundant protection system and what that means in the microprocessor age. The mathematics of reliability is presented and applied to protection scheme logic.

False Application of Reliable Relaying Principles – Revisited

Roger Hedding, ABB Inc.

Twenty years ago the late Walt Elmore presented a paper on several principles used in protection that some assumed to be true, but were indeed false. How do these principles stand in light of modern microprocessor relays? Come and listen.

Testing the Tester – Common Pitfalls Testing Microprocessor Based Protective Relays

Terrence Smith, GE Digital Energy/Multilin

This paper will show common mistakes that are made when testing microprocessor based relays with unrealistic power system conditions. The paper also explains why these conditions are unrealistic and

explains how typical relay algorithms respond to these conditions. Unrealistic tests to be explored will include: a step change in frequency for under-frequency testing, absence of pre-fault conditions when testing distance elements, change in voltage phase when testing distance elements, improperly set zero sequence compensation factors in test set software, and improper phase direction on bus protection.

DISTRIBUTION AUTOMATION/ COMMUNICATIONS

Design and Implementation of a Communication Network to Support Real-time Distribution Feeder Automation, SCADA Integration and Backhaul of Substation and Metering Data

Dan Murray, Siemens Industry, Inc.

Wake Electric chose to implement a high-speed Fault Location, Isolation, and Service Restoration system (FLISR) to support a critical load from one of three power sources. The Wake FLISR system introduced a new dynamic in communication network design as it required high-speed, low latency, peer-to-peer communications between field devices. This paper describes how this system's network design requirements were addressed.

Can a Grid Be Smart Without Communications? A Look at IVVC Implementation

David Aldrich, Beckwith Electric Company

This paper focuses on an integrated volt/ VAR control (IVVC) system that is being installed at Georgia Power Company that does not require any communications to function.

Adaptive Control Strategies and Communications for Utility Integration of Photovoltaic Sites

Darrin Kite, Schweitzer Engineering Laboratories, Inc

The regulations governing distributed energy resource interconnection are currently under revision. This presentation will give an overview of proposed changes along with strategies for incorporating these resources into existing infrastructure.

A Real-World Example of IT and Operations Alignment

Mark Peterson, Ron Schmitz, Great River Energy

Advancement of technologies from analog to digital resulted in a need for better alignment between information technologies (IT) and operational technologies (OT). Great River Energy's path to IT/OT convergence, lessons learned, and realized benefits will be discussed.

PROJECT MANAGEMENT

Mackinac HVDC Construction and Testing

Michael Marz, American Transmission Company

The Mackinac back-to-back Voltage Source Converter HVDC went into service during July 2014. This presentation discusses project construction and testing challenges due to a compact schedule and unique control scheme.

The Center to Grand Forks 345 kV Transmission Line Project - Challenges, Hurdles, and Lessons Learned

Mike Hennes, Minnkota Power Cooperative

The challenge of building a 250-mile-long 345 kV transmission line in four years is discussed in this presentation. The project concept, permitting, public participation, material acquisition, contractor relationships, ROW process, and construction hurdles will be analyzed to share the lessons learned by the project team.

Project Management for Chub Lake Substation

Greg Schutte, Great River Energy

This presentation is an overview of the project management for Great River Energy's Chub Lake Substation. Construction of this CapX substation involved modifications to seven existing substations and five transmission lines, and coordination with four interconnected utilities.

Fox Valley Tornado Recovery

Nils Stenvig, American Transmission Company

In August 2013, a storm system through central Wisconsin generated a series of small tornadoes which caused catastrophic damage to major transmission lines, structures, and transmission substation equipment, leaving only one power transformer in service. This presentation will highlight the damages to the transmission system, as well as the emergency recovery efforts and processes to incrementally restore the system over the following hours, days, and months. Lessons learned will be shared as well.

UTILITY INDUSTRY FUTURES II

Chemical Looping Clean Coal Technology

Herb Andrus, Alstom Power, Inc.

Alstom Power Inc. is developing a Chemical Looping Process, utilizing Calcium Oxides as oxygen carriers to transport oxygen from air to the fuel, which has the potential to capture CO₂ from new and existing coal-fired power plants while maintaining high plant power generation efficiency. The presentation will report the technical and economic status of Alstom's development program.

Great River Energy Distributed Generation Pilot Program

Robert Sandberg, Great River Energy

The electric industry is evolving from central station power to more distributed generation (D.G) technologies. It is imperative that utilities such as Great River Energy understand the impact these technologies will have on the electric utility. Great River Energy has undertaken a pilot program to explore D.G technologies such as solar and micro CHP to understand both the economics and technical aspects of D.G.

Renewable Energy Lessons Learned

Neil Kennebeck, Dairyland Power Cooperative

This presentation is an overview of Dairyland Power Cooperative's renewable energy program with a focus on its successes and failures regarding types of technology and contract structure.

Solar Valuation - Process for Determining Economic Value

Doug Larson, Dakota Electric Association

The State of Minnesota has developed a methodology for utilities to calculate the value of solar energy generated by consumers. This presentation will review the development, components, and application of this solar valuation methodology.

POWER GENERATION

Photovoltaics Outlook for Minnesota

Stephen Campbell, University of Minnesota

This talk will discuss the status and outlook for photovoltaics (PV) technology and market growth as a result of the continued cost reduction associated with the PV learning curve. Grid parity is rapidly becoming reality in parts of the U.S. Implications for both distributed and utility-scale solar energy will be presented. Limitations and long-range concerns will be discussed.

Effect of Fukushima on the Nuclear Power Industry

Jon Kapitz, Xcel Energy

This presentation will describe the U.S. Nuclear Industry response to the March 11, 2011, accident at the Fukushima Dai-ichi nuclear power plant. The presentation will specifically address the changes at the Xcel Energy Monticello and Prairie Island Nuclear Generating Plants.

Synchronous Condensers for Transmission Systems - The Second Generation

Robert D'Aquila, General Electric

The wide-spread retirement of thermal units along with increased renewable generation require new sources of dynamic reactive power and short circuit strength. Modern synchronous condensers are the premium solution.

Cogeneration Plant Switchgear Replacement Improves Safety and Reliability While Maintaining Service to Critical Loads

Timothy Coyle, Power Consulting & Training, Inc; Rachel Mueller, Mayo Clinic

This presentation describes the replacement of medium voltage cogeneration switchgear for the Mayo Clinic campus in Rochester, Minnesota. It will discuss design, construction, and commissioning considerations used to maintain reliable service while replacing the equipment in place and upgrading protection schemes.

CIVIL-STRUCTURAL

Panel Discussion on Industry Standards

Timothy Wachholz, Michael Anderson, Robert Molde, Michael Garrels, Xcel Energy; Marlon Vogt, Ulteig

Presentations and Q&A session on current developments in ASCE Transmission and Substation Technical Committees, the IEEE Overhead Lines Subcommittee, and NESC code change proposals, including opportunities for industry participation.

Utility Scale Wind Turbine Foundation Performance Evaluation

Chris Kopchynski, Barr Engineering

Strain gages, tiltmeter, and settlement plates have been installed on a University of Minnesota wind turbine foundation in Rosemount, Minnesota. Data collected from this system is correlated with wind turbine SCADA data for foundation performance evaluation. The interim results will be presented.

Transmission Long Span Design

Duane Phillips, Stanley Consultants, Inc.

Presentation of the methods and approach associated with developing detailed design of long spans for transmission lines, focusing on structural design, foundations, and wire strength considerations.

DELIVERY SYSTEMS II

Enhanced Multiple Contingency Screening and Cascading Analysis for NERC Compliance

Chengyue Guo, American Transmission Company

ATC's enhanced approach for multiple element contingency screening and cascading analysis. This approach includes expanded tripping criteria and consideration of direct-consequential load loss, indirect-consequential load loss, and non-consequential load loss.

How MISO Studies Power Plant Retirements

Dave Duebner, MISO

How does MISO maintain system reliability when generators retire? We'll review the retirement study process used to determine potential reliability impacts, the alternatives development process, and System Support Resource agreements.

Designing For a Critical Load Using a Spot Network

Mark Faulkner, Eaton Corporation

This presentation describes how a basic spot network works and includes quick guides to use to design the most reliable power system infrastructure for critical loads.

Distribution Grid Management

Joseph LaCasse, Xcel Energy

This presentation will detail the concept of Grid Management, and how it will position Distribution Providers with the tools to meet energy delivery challenges now and in future years.

RELAYING II

Get in Step with Synchronization—A Review of Synchronization

Daniel Ransom, Basler Electric Company

This presentation is a review of power-system synchronizing and sync check—with some new developments, too. Be sure that you are closing the circuit breaker when both sources are in voltage, frequency, and phase coincidence.

Transmission Line Automated Relay Coordination Checking

Garret Sarkinen, Xcel Energy; Saman Alaeddini, Quanta Technology

This presentation demonstrates a process of preparing a system protection database for performing automated relay coordination for transmission lines. It reviews the protection modeling necessary for the studies, tools used to detect modeling errors, selecting the test criteria which the relay coordination is to be evaluated, automating relay coordination conditions, and evaluating the coordination results of the study.

Operation and Protection of the Weak Transmission System in SE Colorado

Ernie Poggi, Edward Mayer, Xcel Energy

This is a discussion of the impacts of a weak short circuit environment on a transmission system that is connected to wind generation and HVDC. Control interaction, unintended switching scenarios, and extreme low short circuit among other behaviors combine for a challenge for operations and protection considerations.

Special Considerations for Distribution Protection Coordination

Steve Turner, Beckwith Electric Co. Inc

This paper discusses special considerations for the proper coordination of feeder relays via the examination of some of the more onerous applications: Multiple Circuits Sharing Same Structures, Single-Pole Tripping, Fast Bus Tripping Schemes, and Overcurrent Pickup Coordination.

METERING

A Panel Discussion of Revenue Metering Arc Flash Hazards and Mitigation

Tom Ernst, GE Digital Energy; Dan Nordell, Xcel Energy

This panel discussion will explore real-life experiences related to arc flash issues involving revenue metering installations. Topics to be discussed include arc flash hazards and their mitigation (engineering, procedural and PPE), site and equipment design practices and employee training. There will also be a discussion of things to do and not to do that have resulted in both

good and bad outcomes. Panel members include Dan Nordell (Xcel Energy), Tom Ernst (GE Digital Energy) and several other key industry representatives

Interoperability in Smart Utility Networks *Phil Beecher, Wi-SUN Alliance*

The presentation describes the role of Industry Alliances in defining and verifying Interoperable standards-based Smart Utility Networks.

Power Quality Measurements from Smart Revenue Meters *Tom Cooke, EPRI*

This presentation summarizes the PQ measurement capabilities that presently exist in commercially available smart revenue meters, and assesses the potential benefits and challenges in implementing these measurements into distribution applications.

TUTORIAL I

Insulation Coordination *Steve Brewer, Hubbell Power Systems*

Voltage surge protection of equipment on the power system is critical to system reliability and cost controls. This presentation will cover how to select the proper selection of the surge arresters used in various application including the MCOV and type of arrester along with other considerations such as pressure relief

rating. Once the proper arrester selection has been determined the percent protective margin will be calculated between the arrester and the equipment being protected. The impact of lightning characteristics as well as line and ground lead impact will be included in the review.

TUTORIAL II

Electric Drives 101 and Variable-Frequency Drives *Ned Mohan, University of Minnesota; Robin Priestley, Rockwell Automation*

Variable-Frequency Electric Drives are essential in wind-turbines and in pumps/compressors in oil/gas industry spurred by fracking. This tutorial will present their operating principle requiring only basic EE concepts as prerequisites.

TUTORIAL III

Distribution Planning *Al Haman, STAR Energy Services; Tom Guttormson, Connexus Energy; Philip Spaulding, Xcel Energy*

The Distribution Planning tutorial will introduce concepts of short- and long-range planning for distribution delivery systems. Topics include planning criteria, load forecasts, system modeling, device ratings, and contingency planning for both rural and urban systems. Case studies will be evaluated.

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

The conference will be held at the Earle Brown Heritage Center,

6155 Earle Brown Drive, Brooklyn Center, MN, 55430.

A block of rooms have been reserved at the Embassy Suites Minneapolis – Brooklyn Center Hotel, 763-560-2700 or 1-800-362-2779 and the Minneapolis Boulevard Hotel, 763-566-8000 or 1-800-481-3556.

To receive the special conference rate of \$109, identify yourself as a participant of the Minnesota Power Systems Conference. The room block deadline is **October 10, 2014.**

REGISTRATION AND FEES

The fee for the conference is \$300 if received by October 20; if received after October 20 the fee is \$350. The conference fee includes all sessions, continental breakfasts, luncheons, refreshment breaks, and the exhibitor reception. If you cancel your registration by October 27 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 4, 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 beverages.

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. 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

612-624-3492
cceconf3@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
- 2015 Call for Presentations
- Conference papers and PowerPoints

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

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