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44TH ANNUAL
Minnesota Power Systems Conference

MPSYSCON

November 4-6, 2008

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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. Newly created and redesigned concurrent sessions include substations, utility industry futures, distribution automation/communications, delivery systems, project management, and relaying.

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UNIVERSITY OF MINNESOTA

Program Schedule

Tuesday, November 4, 2008

GENERAL SESSION

8:15 a.m.-12:00 noon

Moderator: Tom Guttormson
Co-Moderators: Mike Steckelberg, Gerry Steffens, Jon Wahlgren

7:15 Check-in
Continental Breakfast

8:15 Welcome
Tom Guttormson, Connexus Energy

8:30 The Future Electric Utility
Mark Dudzinski, General Electric

9:15 Web-Based Continuing Education of Power Engineers
Ned Mohan, University of Minnesota

10:00 Break

10:30 Vehicle-to-Grid (V2G) Technology
A representative from V2G research group,
University of Delaware

11:15 Global Warming Legislation and Potential Impacts on Electric Utilities
Mike Cashin, Minnesota Power

12:00 Lunch

CONCURRENT SESSIONS

1:00 – 4:15 p.m.

SUBSTATION

Moderator: Steve Mohs
Co-Moderators: Gerry Steffens, David Hoops

1:00 Native Versus Imported Soils for Electrical Substation Yards
Marisol Velilla, Ulteig

1:45 The Value of a Proactive Transformer Condition Assessment Program
Greg Bennett, Xcel Energy

2:30 Break

2:45 Disconnect Switch Mounted Interrupting Devices — How to Choose What to Use When and Where
David Childress, Southern States, LLC

3:30 Considerations for Substation Grounding and Ground Grid Design
Sheldon Silberman and *Joe Gravelle*, Xcel Energy

4:15 Adjourn

UTILITY INDUSTRY FUTURES

Moderator: Mike Jensen
Co-Moderators: Dave Peterson, Dave VanHouse

1:00 Energy Sense – Making Sense on the U.S. and Our Energy Picture
Tom Butz, Power System Engineering

1:45 Status of Nuclear Power in the U.S. and FPL's Decision to Permit New Reactor
William Maher, Florida Power and Light Company

2:30 Break

2:45 Experimental NaS Battery Energy Storage System
Dan Girard, S & C Electric

3:30 Heat Recovery Generation Technology
Kip Waddell, Ormat

4:15 Adjourn

EXHIBITOR RECEPTION

4:15-6:00 p.m.

Wednesday, November 5, 2008

CONCURRENT SESSIONS

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

DISTRIBUTION AUTOMATION/COMMUNICATIONS

Moderator: Denny Branca
Co-Moderators: Roger Simundson, Mark Gutzmann

7:30 Continental Breakfast

8:30 Inside the Cloud – Network Communications Basics for the Relay Engineer
Solveig Ward, RFL Electronics, Inc.

9:15 Cellular Telephone Applications for Electric Metering
Dan Inman, Minnkota Power Cooperative and
Dan Nordell, Xcel Energy

10:00 Break

10:30 Securing SCADA Communications Following NERC CIP Requirements
Mira Zafirovic-Vukotic, RuggedCom, Inc.

11:15 Using IEC 61850 Methods for RTU Replacement and Distributed Automation
Mike Dood, Schweitzer Engineering Laboratories, Inc.

12:00 Lunch

DELIVERY SYSTEMS I

Moderator: Chuck Healy
Co-Moderators: Philip Spaulding, Jeff Schoenecker

7:30 Continental Breakfast

8:30 Transmission Studies to Meet the Minnesota Renewable Energy Standards and Dispersed Generation
Jared Alholinna, Great River Energy and
Tim Rogelstad, Otter Tail Power Company

9:15 Queue Process Reform at the Midwest ISO
Durgesh Manjure, Midwest ISO

10:00 Break

10:30 The Why and When of Higher Voltage Transmission Lines
Richard Gonzalez and *Jeffrey Norman*,
Xcel Engineering, Inc.

11:15 Residential CFL Load Characteristics
Chuck Pentek, Rochester Public Utilities

12:00 Lunch

Wednesday, November 5, 2008

CONCURRENT SESSIONS

1:00 – 4:15 p.m.

DELIVERY SYSTEMS II

Moderator: Al Haman
Co-Moderators: Larry Brusseau, Jeff Schoenecker

1:00 Alternative Power System Architecture for Optimal Integration of Renewable and Distributed Resources
Michael Ropp, South Dakota State University

1:45 The Impact of Harmonics on Medium Voltage Distribution Systems
Brian Prokuda, Keweenaw Power Systems, Inc.

2:30 Break

2:45 Coordinating Distribution Volt/Var Management Equipment
Tom Jauch, Beckwith Electric Co.

3:30 Digital TV Conversion and Electric Utility Infrastructure Interference Issues
Tom Hendricks, Lockard & White, Inc.

4:15 Adjourn

PROJECT MANAGEMENT

Moderator: Jim Hanson
Co-Moderators: Roger Simundson, Pat Hayes

1:00 Two Critical Operations Projects that "Don't Come Along Very Often!" – 1) Restoring Feeder Circuits Outaged by the I-35W Bridge Collapse and 2) Keeping the Lights on for the Republican National Convention
Joel Limoges and *James Nash*, Xcel Energy

1:45 Langdon Wind Farm Project
Grant Gunderson and *Josie Olson*, Minnkota Power Cooperative and *Rick Johnson,* Otter Tail Power

2:30 Break

2:45 Minnesota Power's Installation of Power Cable Under St. Louis Bay
Michelle Robbins and *Jon Peterson*, Minnesota Power

3:30 Minnesota Power's Mobile Radio Upgrade
Steve White, Minnesota Power

4:15 Adjourn

RELAYING

Moderator: Nathan Germolus
Co-Moderators: Mark Harvey, David Hoops

1:00 Lessons Learned Analyzing Transmission Faults
David Costello, Schweitzer Engineering Laboratories, Inc.

1:45 Performance of Relaying During Wide – Area Stressed Conditions
Pratap Mysore, Xcel Energy and
Damir Novosel, Quanta Technology LLC

2:30 Break

2:45 Perspectives of Substation Design Based on Functionality of Modern Relays
Roger Hedding, ABB, Inc.

3:30 Designing Copper Wiring Out of High Voltage Substations
Steven Hodder, GE Multilin

4:15 Adjourn

Thursday, November 6, 2008

CONCURRENT SESSIONS

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

TUTORIAL 1
SMART GRID PANEL

Moderator: Denny Branca
Co-Moderators: Jim Hanson, Mike Steckelberg

7::30	Continental Breakfast
8:30	Smart Grid Panel *Wanda Reder*, S&C Electric, Inc.; *Joel Cannon*, Cannon Technologies-Cooper Power Systems; *Bahman Hoveida*, Open Systems International, Inc.; *Michael Lamb*, Xcel Energy; *Edward Schweitzer*, Schweitzer Engineering Laboratories, Inc.
10:00	Break
10:30	Smart Grid Panel (continued)
12:00	Adjourn

TUTORIAL II
RELAY 101

Moderator: Dave Peterson
Co-Moderators: Mark Gutzmann, Jon Wahlgren

7:30	Continental Breakfast
8:30	Relay 101 *Tom Ernst*, Minnesota Power
10:00	Break
10:30	Relay 101 (continued)
12:00	Adjourn

Topic Descriptions

GENERAL SESSION

The Future Electric Utility

Mark Dudzinski, General Electric

There is a lot of uncertainty for electric utilities. Fuel prices, green house gas regulations, opposition to new nuclear and coal generation, difficulty permitting transmission, Renewable Portfolio Standards, advancing technology, the rising cost of electricity, and other uncertainties combine to make forecasting the future difficult. This presentation will look at several possible future scenarios. It will explore trends that transcend all likely future scenarios and demonstrate how these trends will combine to define the future electric utility. One inescapable conclusion is that the Smart Grid will be required to manage the future generation mix and the new relationship with a utility's customers.

Web-Based Continuing Education of Power Engineers

Ned Mohan, University of Minnesota

Through a $1.23 million grant from the Navy, we at the University of Minnesota are actively disseminating the curricular reform in the area of Electric Energy Systems education. Our goal is to reach 175 schools nationwide in five years. In parallel to this Navy-funded project that is aimed at academia and the future crop of graduates, we have established a Center for Innovation in Electric Energy Systems Education (CI-EESE), supported by utilities, ISOs, and Industry, to develop online course modules aimed at practicing engineers. These online courses are unique, as will be described in this presentation, by their tight coupling to textbooks that are written by us to-the-point for these courses, use of software-based laboratories, and online assessments to grant continuing education credits that mean something.

Vehicle-to-Grid (V2G) Technology

A representative from V2G research group, University of Delaware

The presentation will focus on the potential costs and benefits of Vehicle-To-Grid (V2G) implementation on the existing electrical grid. V2G allows bi-directional flow of electricity to and from a parked electric vehicle. The prototype vehicle in use at the University of Delaware is currently responding to real time commands from the PJM (the regional ISO) AGC signal. This technology will effectively serve ancillary service markets and potentially increase the efficiency of the grid from generator to substation.

Global Warming Legislation and Potential Impacts on Electric Utilities

Mike Cashin, Minnesota Power

Various legislative measures for addressing climate change have been proposed at both the federal and state level. The key areas being addressed by climate legislation will be explored, along with their prospective impacts on the energy sector. Policy measures that can influence the cost impact on electric utilities and their customers will be identified.

SUBSTATION

Native Versus Imported Soils for Electrical Substation Yards

Marisol Velilla, Ulteig

Advantages and disadvantages of constructing substation yards with engineered native cohesive soils instead of imported granular soils are described in this presentation. Topics include cost savings and construction schedule impacts, storm water management and structural design effects, and potential long-term surfacing performance considerations.

The Value of a Proactive Transformer Condition Assessment Program

Greg Bennett, Xcel Energy

This presentation explains the Transformer Condition Assessment (TCA) process in use at Xcel Energy since 1999. It shows how the TCA process prioritizes maintenance through its use of condition codes. It explains how TCA uses multiple indicators of problems from different non-intrusive test technologies to trigger maintenance for families of equipment. Finally, it shows how the TCA process employs a multi-disciplinary team of in-house transformer condition assessment experts who assign condition codes that aid in repair or replace decisions.

Disconnect Switch Mounted Interrupting Devices — How to Choose What to Use When and Where

David Childress, Southern States, LLC

This presentation covers the correct selection and proper application of the many disconnect switch mounted interrupting devices; including standard arcing horns, quick break whip type arcing horns, single bottle vacuum interrupters, multi-bottle vacuum interrupters, and single gap per phase SF6 gas interrupters. The types of currents that disconnect switches may see and be called upon to interrupt in various different applications, as well as the current magnitudes and how these magnitudes can be determined, will be covered as will which of the available devices can perform these interrupting functions for various system voltages and current magnitudes. Videos of successful and, more spectacularly, unsuccessful performance of disconnect switch mounted interrupting devices will be a key and integral part of the presentation and an invaluable tool to clearly show what can go wrong when the wrong choice is made. For each successful and unsuccessful operation what went right and what went wrong will be addressed. Attendees should find after viewing this presentation that they have a much more comprehensive understanding of the correct selection and proper application of these disconnect switch mounted interrupting devices, thus saving disconnect switch damage and possible system outages which can occur when the wrong device is chosen for the wrong function.

Considerations for Substation Grounding and Ground Grid Design

Sheldon Silberman and *Joe Gravelle,* Xcel Energy

Substation engineers and designers have a variety of conditions to consider in designing an effective substation ground grid. This requires a little more than throwing some copper into the ground. This presentation will discuss considerations Xcel Energy applies for effective substation ground grid design and some of the variables that affect these considerations. Topics will include: touch and step potential concepts; effects of fault current magnitudes and duration; soil resistivity; grid impedance; surface material; and other variables that affect the design of a substation ground grid. The discussion will cover major ground grid components, layout considerations, and connections for different types of equipment and materials. Personal protective grounding component selection and some safety issues resulting from copper theft will also be discussed.

UTILITY INDUSTRY FUTURES

Energy Sense – Making Sense on the U.S. and Our Energy Picture

Tom Butz, Power System Engineering

Energy is the lifeblood for the American and global economy. Electric energy is a key element of the total energy picture. We hear information almost every day concerning increasing energy prices and the impact on our economy. There is increasing pressure to burn cleaner fuels, increase utilization of renewable energy, and reduce the dependence on foreign sources of energy. This presentation is designed to provide a useful snapshot of our current and projected sources and uses of energy and present ideas on viable energy alternatives. Information is presented to provide a comprehensive energy picture, rather than the typical sound bites and 10,000 foot suggestions we hear nearly every day.

Status of Nuclear Power in the U.S. and FPL's Decision to Permit New Reactor

William Maher, Florida Power and Light Company

FPL has a responsibility to prepare and invest now to meet the future energy needs of their customers in Florida. As the nation's leader in conservation, they have been able to offset the building of 12 plants through customers' participation in their programs; but conservation alone will not meet Florida's electrical needs in the future. Recognized as one of the country's cleanest and environmentally conscious energy producers, FPL has committed to providing clean energy solutions. Consequently, FPL believes that any serious effort to meet growing demand of electricity and combat global climate change will be incomplete without the one energy source that is abundant, dependable, and 100 percent emission free: nuclear energy. Nuclear power is an essential part of FPL's balanced portfolio that will include renewables such as wind and solar to diversify and maximize energy resources, as well as protect the environment and our economy.

Experimental NaS Battery Energy Storage System

Dan Girard, S & C Electric

Developing ways to deal with the intermittency of wind energy can help utilities increase the use of renewable power in their grids. This presentation shows how the use of a small amount of stored energy in a sodium sulfur (NaS) battery system can be applied to greatly improve the amount of wind energy that can be firmly dispatched on a daily basis.

Heat Recovery Generation Technology

Kip Waddell, Ormat

Introduction to Ormat field-proven technology for recovering low and medium temperature heat sources to generate electricity with Organic Rankine Cycle (ORC)-based power systems. Presentation will include discussion of the technical and economic fundamentals for ORMAT Geothermal and Recovered Energy Generation (REG) applications, including exhaust gas from compressor stations and other energy-intensive industries.

DISTRIBUTION AUTOMATION/COMMUNICATIONS

Inside the Cloud – Network Communications Basics for the Relay Engineer

Solveig Ward, RFL Electronics Inc.

This paper addresses basic communications network technology and explains the differences between Ethernet, TCP/IP, T1 and SONET with respect to relaying applications. The paper also discusses interconnection of legacy serial devices to Ethernet networks and presents test results that compare the performance of TDMoIP (Time Division Multiplexing over IP) with Ethernet GOOSE communications according to the IEC 61850 standard.

Cellular Telephone Applications for Electric Metering

Dan Inman, Minnkota Power Cooperative and
Dan Nordell, Xcel Energy

Minnkota Power Cooperative delivers and meters electric energy at approximately 200 distribution substations. The location of these substations varies from cities to extremely rural areas. Since the majority are rural, establishing communications to these rural sites, using microwave or leased lines, is not practical due to the high cost. Cellular communications has provided a reliable and affordable alternative. Minnkota began using analog cellular communication for metering data retrieval 14 years ago, and continues to use it for communications with crews (cellular phones), reporting for power quality issues (DCI's), monitoring and controlling of remote switches and mobile substations (RTU's), and back up emergency communications. With the announcement from the FCC stating all analog cellular coverage will need to be converted from analog to digital by February 18, 2008, we have spent the past two years transitioning from analog to digital communications for Minnkota's various cellular applications.

Xcel Energy is in the process of fielding advanced electricity meters which use both external and embedded cellular modems

for data communication. This technology offers exciting opportunity for affordable utility device communication but can be challenging to deploy due to its unique characteristics and the idiosyncrasies of cellular providers. This paper is a "lessons learned" tutorial for utility engineers who would like to employ this technology.

Securing SCADA Communications Following NERC CIP Requirements

Mira Zafirovic-Vukotic, RuggedCom, Inc.

Electric utilities require secure network and control system communications that conform to the recommendations of the NERC (North America Electric Reliability Corporation) CIP (Critical Infrastructure Protection) cyber security framework for identification and protection of critical cyber assets to support reliable operation of the bulk electric system. This paper summarizes the major technological requirements of secure control networks and illustrates solutions for control networks and equipment, SCADA data, and communications that are a foundation for conformance to the regulatory security requirements and industry standards for control network operation, like NERC CIP, IEC, and NIST. It also introduces the newly developed IEC 62351 security standard for SCADA data and communication protocols. The paper also includes guidelines and requirements for secure network equipment that form a technological foundation for secure SCADA system and network equipment planning, as well as a sound basis for network security management. Secure communications equipment and network communication methods are addressed in the paper.

Using IEC 61850 Methods for RTU Replacement and Distributed Automation

Mike Dood, Schweitzer Engineering Laboratories, Inc.

This paper chronicles a recent project of replacing pad-mounted switch RTUs with IEC 61850-compatible, scalable programmable automation controllers (PAC) by a utility distribution group. New functionality was added and tested, including wireless Ethernet connections between the switchgear and remote control center, as well as peer-to-peer communications between switchgear locations to support remote automation with coordinated protection and autorestoration schemes. Switchgear is an integral part of the utility's 15 kV underground distribution expansion. The increase in the number and size of switchgear makes remote monitoring and control, local automation, peer-to-peer coordination, and remote engineering access critical for system reliability. To meet all their requirements, the utility chose and tested a solution that included I/O support for multiple CT and PT inputs, battery monitoring capabilities, a wide range of discrete and analog input types, and control outputs. Along with a variety of I/O, an easily scalable solution was necessary to support the different I/O requirements for each switch type. This paper discusses the process developed to engineer, configure, and diagnose IEC 61850 GOOSE messages communicating status, alarms, analog measurements, and controls.

DELIVERY SYSTEMS I

Transmission Studies to Meet the Minnesota Renewable Energy Standards and Dispersed Generation

Jared Alholinna, Great River Energy and
Tim Rogelstad, Otter Tail Power Company

The presentation will describe the scope, study methods, and findings of the Minnesota Dispersed Renewable Generation study as required by the Next Generation Energy Act of 2007. The objective of the Dispersed Renewable Generation (DRG) Study was to assess effects on the transmission system with the installation of 600 MW of dispersed renewable generation throughout Minnesota. Between July 2007 and June 2008, the study team progressed through the study milestones of substation data collection and modeling, substation site screening, short list system analysis and, lastly, an analysis of the resulting final list of potential DRG sites.

Queue Process Reform at the Midwest ISO

Durgesh Manjure, Midwest ISO

During the last couple years or so, the Midwest ISO has been inundated with requests for generator interconnection. This unprecedented surge is primarily driven by renewable energy mandates across various states. The sheer volume of interconnection requests coupled with a constrained transmission system has resulted in delays in getting interconnection requests processed. While the interconnection process has been working as designed, the design itself is not working in the current public policy and energy market environment. Therefore, in the face of a growing queue backlog the Midwest ISO initiated an effort to address the issues raised by stakeholders, with the goal of identifying improvements to the existing Generator Interconnection process (FERC Order 2003). This collaborative effort involved participation from a broad range of stakeholders such as generation developers, transmission owners, load-serving entities, and state regulatory staff. The primary goal here has been to identify solutions to reduce cycle time and increase certainty through the interconnection process. Through this effort a revised generator interconnection tariff/process has been formulated, which will be filed at the FERC by the second quarter of 2008.

The Why and When of Higher Voltage Transmission Lines

Richard Gonzalez and *Jeffrey Norman,* Excel Engineering, Inc.

With the aid of PowerWorld, this presentation will describe the reasoning behind selection of optimal voltage levels for high-capacity, long-distance power transfer facilities. Strategic, economic, and technical considerations will be explained with regard to how they address four basic questions: Should I build the line at a higher voltage? Should I build the line as a double circuit? Should I series compensate the line? What reactive needs does this line present?

Residential CFL Load Characteristics

Chuck Pentek, Rochester Public Utilities

What are the effects on the electrical grid from an extensive deployment of residential compact fluorescent lamp (CFL) retrofits? Energy Star's minimum requirement for a CFL's power factor is an average of 10 samples tested must be greater than 0.5. Rochester Public Utilities' CFL measurements will focus on PF and harmonic distortion. Electrical grid energy savings and changes in reactive requirements will be measured at five Rochester residences.

DELIVERY SYSTEMS II

Alternative Power System Architecture for Optimal Integration of Renewable and Distributed Resources

Michael Ropp, South Dakota State University

Small-scale autonomous power systems, including microgrids and minigrids, generally rely on generators that possess little or no stored energy, such as rotating generators whose rotational inertia is small or inverter-based systems that generally contain only enough storage to smooth any double-frequency power ripple. At the same time, most of these generators are limited in the rate at which they can increase their output power (ramp rate). Unfortunately, many of the loads connected to these systems have power demand profiles that ramp very quickly. This incompatibility between ramp rates leads to difficulty in regulating the voltage in such power systems. Normally, some type of energy storage is used to make up the difference between a load's fast ramp and a generator's slower response. However, the storage is deployed using a philosophy that places the responsibility for voltage regulation entirely on the generators. Thus, the generators are required to include the storage, or in some other way to produce a ramp rate equal to whatever may be required to keep voltage transients within bounds. In this paper, an alternative approach will be explored: that of adopting a power system standard that limits the ramp rate of any load, in much the same way as IEEE-519 limits the harmonic currents a load can draw. This paper will explore whether such a standard could ultimately lead to lower customer costs, even though the costs of individual load equipment would increase.

The Impact of Harmonics on Medium Voltage Distribution Systems

Brian Prokuda, Keweenaw Power Systems, Inc.

This paper discusses harmonic distortion on medium voltage systems. Harmonic distortion on these systems differ from that on low voltage systems because of the impact of natural resonances due to distributed capacitance from overhead lines, cable insulation capacitance, surge capacitors, and other sources. Also, the use of shunt capacitors for voltage support and power factor correction can lead to resonance and harmonic amplification problems. Impact on the system, analysis, and mitigation techniques will all be discussed. Summaries from case studies are included from interference with customer loads to concerns with wind generators.

Coordinating Distribution Volt/Var Management Equipment

Tom Jauch, Beckwith Electric Co.

This presentation will illustrate the advantages of coordinating distribution system volt/var management equipment such as transformer LTC (Load Tap Changers), line and substation voltage regulators, and pole-top and substation capacitor banks. System examples of how proper use and coordination of this equipment can decrease both additional equipment costs and continuing operating costs will be given, as well as energy conservation aspects. The presentation will address several tapchanger control features, their correct usage and their impact on voltage profile and quality, system losses, and power factor penalty charges. Common errors in volt/var management equipment application will be discussed, as well as the corrective actions which may be taken.

Digital TV Conversion and Electric Utility Infrastructure Interference Issues

Tom Hendricks, Lockard & White, Inc.

We are presently in the midst of a change from analog to digital television. This change will be "almost" complete in the U.S. on February 17, 2009; Canada is scheduled for August 2011. According to the FCC, digital television will provide "…better picture and sound quality." It certainly is different. In this paper we will briefly contrast the current NTSC analog air interface to the new ATSC digital signal. We will then discuss the various known impairments to television reception from the electric utility and how these are impacted by the change to digital modulation. We will also discuss impairments to the electric utility from television transmitters and how the utility is impacted.

RELAYING

Lessons Learned Analyzing Transmission Faults

David Costello, Schweitzer Engineering Laboratories, Inc.

This session will present a collection of lessons learned through event analysis

Performance of Relaying During Wide–Area Stressed Conditions

Pratap Mysore, Xcel Energy and
Damir Novosel, Quanta Technology LLC

The presentation is based on an IEEE Power Systems Relaying Committee working group report that was produced in response to the importance of addressing protection performance during wide-area disturbances. Key issues presented will be the behavior of protection functions during dynamic operating conditions, lessons learned from studying recent wide-area perturbations, analysis of operational history of protection performance during stressed system conditions, and, finally, methods available for implementing protective relay functions to prevent further propagation of system-wide disturbances.

Perspectives of Substation Design Based on Functionality of Modern Relays

Roger Hedding, ABB, Inc.

The increased functionality in modern relays can yield benefits in the design of the primary system. Several examples will be discussed where the primary system design is changed due to the use of modern relays. With multi terminal differential protection, utilities might choose to have three or more terminals in their networks without the need for forming new loop-in and out substations or breakers. In major breaker-and-a-half stations, using 61850 IED's could calculate the currents in bus bars between each diameter by which the operator could be alerted on overloading of bus bar sections — meaning bus bar sizing could be more economical. New relay technology allows deciding CT locations for transformer protections and why "Tee" zone protection is not needed (and hence saving of a current transformer) in dual breaker installations. Other examples will be discussed.

Designing Copper Wiring Out of High Voltage Substations

Steven Hodder, GE Multilin

There is a substantial cost associated with copper wiring in a substation that includes design, documentation, construction, commissioning, and troubleshooting of tens of thousands of individual terminations. Given the bandwidth of fiber media and comparable cost of fiber versus copper on a per signal basis, the potential for plug-and-play assembly of fiber-based architectures for next generation protection and control solutions is often viewed as eliminating copper wiring and replacing it with fiber communications. The IEC 61850 Process Bus and GOOSE standards provide the foundation on which one can now build such a fiber-based protection and control architecture. This paper presents a practical open-standard (IEC 61850 based) architecture for a fiber-based P&C system that fits the task of protection and control by drawing from the universal topology rules of substation design.

PROJECT MANAGEMENT

Two Critical Operations Projects that "Don't Come Along Very Often!" – 1) Restoring Feeder Circuits Outaged by the I-35W Bridge Collapse and 2) Keeping the Lights on for the Republican National Convention

Joel Limoges and *James Nash,* Xcel Energy

Xcel Energy had two major events in 2007/2008. In late 2007, the I-35W bridge over the Mississippi collapsed. This tragedy was unprecedented and, obviously, Xcel was unable to plan for it. In late 2008, St Paul hosted the Republican National Convention. This event was "planned for"; in fact, preparations began almost 18 months prior. This presentation will explain how Xcel Energy responded in different fashions to these events.

Langdon Wind Farm Project

Grant Gunderson and *Josie Olson,* Minnkota Power Cooperative and *Rick Johnson*, Otter Tail Power

The Langdon Wind Project is a 159 MW wind generating facility located in northeastern North Dakota and was developed by FPL Energy in 2007. Minnkota Power Cooperative and Otter Tail Power are the recipients of the power produced by the facility. Construction of the Langdon Wind facilities was performed on a fast track. Otter Tail Power, acting as a consultant to FPLE, performed a design/build on the 34.5 kV / 115 kV collector substation and the 10-mile, 115 kV generator interconnection line. Minnkota Power designed and constructed additional transmission facilities including a 115 kV ring buses addition at two separate substations, and a 35-mile, 115 kV transmission line. All of this work was accomplished in a single construction season that began in June and ended in December of 2007. The large scope of work, short construction timeline, acquisition of right-of-way, and timely procurement of material and equipment posed major challenges to this project. This presentation will discuss key issues relating to project management that were essential to the success of the project.

Minnesota Power's Installation of Power Cable Under St. Louis Bay

Michelle Robbins and *Jon Peterson,* Minnesota Power

When Minnesota Power lost our back-up source of power to Park Point (a 10-mile long peninsula on the bay of Lake Superior) through a cable fault, we were challenged to find a route to the end of Park Point, where we have a critical need for power to two major water pumps. Our current feed goes along Duluth's Aerial Lift Bridge. Should we attach another feed along the bridge leaving us vulnerable in one location? Should we try to go under the pier in the canal? Finally we decided to use an old abandoned 5,000 foot water pipe from 1939 that ran from Superior to Park Point. A major concern of using this pipe was to pull cable through the two sets of (2) 45 degree bends in the pipe, at each end. We knew the pipe was usable for water, but would we be able to run cable through it? This presentation talks about the obstacles faced "crossing the bay."

Minnesota Power's Mobile Radio Upgrade

Steve White, Minnesota Power

Minnesota Power (MP) is currently operating a mobile radio system, authorized by the FCC in the 450MHz band that has been in place, with minor changes and additions, since 1976. On February 25, 2003, with modifications on December 23, 2004, the FCC released their narrow-banding mandate effectively creating double the number of the available channels (narrowband) but at half of the previous channel plan bandwidth (wideband). As part of the mandate, wideband equipment can no longer be built, imported or sold in the U.S. after January 1, 2011. On January 1, 2013, all wideband equipment MUST be taken out of service. The majority of the equipment in MP's mobile radio system is not capable of narrowband operation

TUTORIALS

Smart Grid Panel

Wanda Reder, S&C Electric, Inc.; *Joel Cannon,* Cannon Technologies-Cooper Power Systems; *Bahman Hoveida,* Open Systems International, Inc.; *Michael Lamb,* Xcel Energy; *Edward Schweitzer,* Schweitzer Engineering Laboratories, Inc.

What is a smart grid? By whose definition? One of the realities of this hot topic is that you can't find two people who can agree on what is a smart grid. This tutorial will take a crack at revealing what the future smart grid may look like. We've assembled a panel of industry experts to share their thoughts and to engage the audience in a thoughtful dialogue session. Three of the panelists are entrepreneurs, who have succeeded in our industry because their respective visions aligned with the demands of their customer bases: Ed Schweitzer, founder of Schweitzer Engineering Laboratories, Inc., Joel Cannon, founder of Cannon Technologies, Inc., and Bahman Hoveida, founder of Open Systems International, Inc. Joining them are: Wanda Reder, S&C, Inc., who has made significant contributions both on the utility and supplier side of this industry, and is serving as the current president of IEEE; and Michael Lamb, Xcel Energy, who has been active in defining his utility's vision for a smart grid, and they are currently building a smart city in Boulder, Colorado. Each panelist will have an opening presentation, in which he or she will speak to the future smart grid from their perspective. Following this, we will open the format so the audience can engage the panelists and explore together where our industry may be heading. Please join us for this exciting opportunity to participate in discussion with some of the true leaders of our industry!

Relay 101

Tom Ernst, Minnesota Power

This tutorial is aimed at the engineer who is new to protective relaying or looking for a high-level refresher. It will be interactive with the audience and will cover the basic application principles of protective relaying including zones of protection, coordination, and back-up protection. A brief review of basic power systems theory including single-phase and three-phase systems and symmetrical components will be provided. Current, voltage, differential and distance/impedance relaying will be discussed from an application perspective with thoughts on electro-mechanical versus microprocessor-based implementation. Real-life examples will be provided.

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. Newly created and redesigned concurrent sessions include substations, utility industry futures, distribution automation/communications, delivery systems, project management, and relaying.

LOCATION AND ACCOMMODATIONS

The conference will be held at the Continuing Education and Conference Center, 1890 Buford Avenue, on the St. Paul campus of the University of Minnesota. Parking is available adjacent to the Center (lot S104) for $6.00 per day and in the Fairground lot (S108) for $3.75 per day. Please see map for details.

Convenient lodging for out-of-town participants is available at the Radisson Hotel Roseville, 2540 North Cleveland Avenue, Roseville, MN 55113. The rate is $99, plus tax, for a single or double room. Participants are responsible for making their own lodging reservations. To make a reservation, call 651-636-4567 or 1-800-333-333. To receive the special conference rate, please identify yourself as a participant of the **Minnesota Power Systems Conference.** Reservations must be made by October 12, 2008. After this date reservations will be accepted on a space and rate available basis. The hotel will provide free van transportation for participants to and from the Continuing Education and Conference Center. Please indicate your transportation needs when you make your reservations.

REGISTRATION AND FEES

The fee for the conference is $225 if received by October 20; if received after October 20 the fee is $250. The conference fee includes all sessions, two luncheons, refreshments breaks, the exhibitor reception, and the conference proceedings book and CD. You are encouraged to register early to take advantage of the lower fee. If you cancel your registration by October 24, 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.

EXHIBITOR RECEPTION

The exhibitor reception will be held on Tuesday, November 4, from 4:15-6:00 p.m. at the Continuing Education and Conference Center (the same location as the conference sessions). 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 1.6 CEUs. Participants who attend only Tuesday and Wednesday will receive 1.3 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.

FOR FURTHER INFORMATION

Kay Syme
College of Continuing Education, University of Minnesota
Phone: 612-624-4938
Fax: 612-624-6225
E-mail: cceconf4@umn.edu

CALL FOR PAPERS FOR 2009 CONFERENCE

Deadline for abstract submission for MIPSYCON 2009 is January 16, 2009. Notification of acceptance will be mailed by June 2009. If you would like to be considered for the 2009 program, please submit an abstract of approximately 300 words to: Kay Syme, College of Continuing Education, University of Minnesota, 352 Classroom Office Building, 1994 Buford Avenue, St. Paul, Minnesota 55108, E-mail: cceconf4@umn.edu

Disability accommodations will be provided upon request. This publication is available in alternative formats upon request. Call 612-624-4938. The University of Minnesota is committed to the policy that all persons shall have equal access to its programs, facilities, and employment without regard to race, color, creed, religion, national origin, sex, age, marital status, disability, public assistance status, veteran status, or sexual orientation.

Continuing Education and Conference Center

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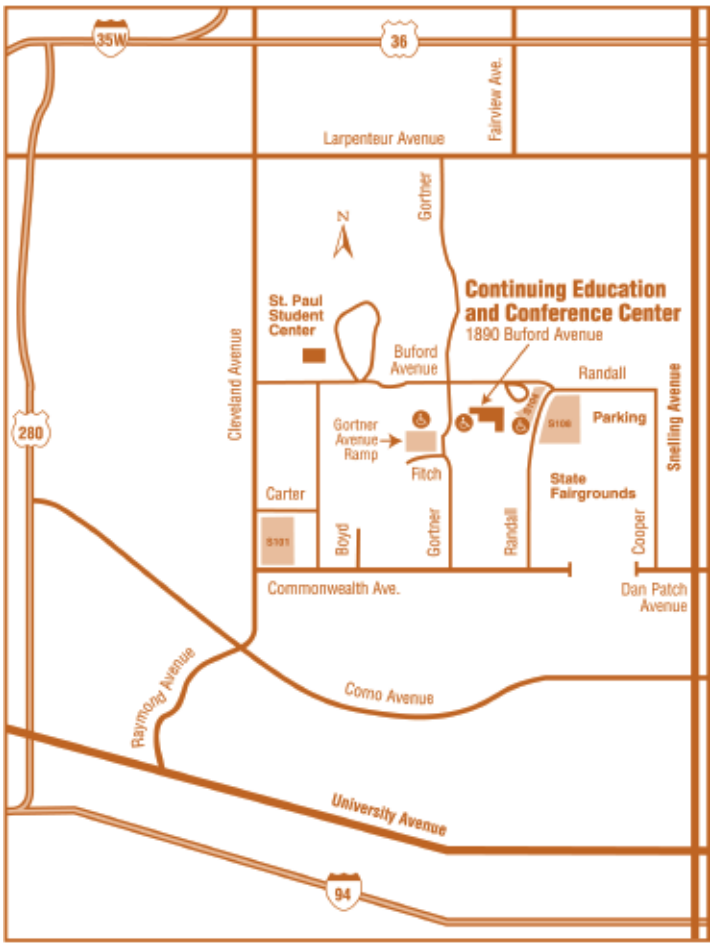

= Parking facilities
= Handicapped access and parking

Directions

From I-694: Take 35W south to the Cleveland Avenue exit (Note: exit to the left). Follow Cleveland Avenue to Larpenteur Avenue. Go east (left) on Larpenteur to Gortner, turn south (right) on Gortner and go to Buford Avenue. Turn east (left) on Buford Avenue.

From I-35W: Take the Highway 36 exit and turn south on Cleveland Avenue to Larpenteur Avenue. Go east (left) on Larpenteur to Gortner, turn south (right) on Gortner and go to Buford Avenue. Turn east (left) on Buford Avenue.

From downtown St. Paul: Go west on I-94 to Snelling Avenue. Go north on Snelling Avenue to Larpenteur Avenue. Go west (left) on Larpenteur to Gortner, turn south (left) on Gortner and go to Buford Avenue. Turn east (left) on Buford Avenue.

From downtown Minneapolis: Go east on I-94 to MN-280, exit number 236. (Note: exit to the left). Merge onto MN-280 north. Exit at Larpenteur Avenue. Take Larpenteur east (right) to Gortner (3rd traffic light). Turn south (right) on Gortner and go to Buford Avenue. Turn east (left) on Buford Avenue to the parking area.

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**Planning Committee Chair*

44th Annual Minnesota Power Systems Conference

November 4-6, 2008

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

Business Address (Street/P.O. Box) State ZIP

E-mail Fax

Company/Institution Title/Position

Daytime Telephone Home Telephone

☐ **I do not want to be listed on the participant list.**

Conference Fee

☐ Enclosed is $225 in full payment of the conference registration fee (received by October 20).

☐ Enclosed is $250 in full payment of the conference registration fee (received after October 20).

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).

Credit Card Number _____ Expiration Date _____

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Fax to (with credit card information):

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Minnesota Power Systems Conference

November 4-6, 2008

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