



4 3 R D A N N U A L

Minnesota Power Systems Conference



November 6-8, 2007

Continuing Education and Conference Center

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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 6, 2007

GENERAL SESSION

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

Moderator: Jon Wahlgren

Co-Moderators: Roger Simundson, Gerry Steffens

7:15	Check-in Continental Breakfast	10:00	Break
8:15	Welcome <i>Jon Wahlgren, Otter Tail Power Company</i>	10:30	A Minnesota First: Great River Energy's New LEED Platinum Certified Headquarters Building <i>Gary Connett, Great River Energy</i>
8:30	Reforming the National Undergraduate Curriculum in Electric Energy Systems <i>Ned Mohan, University of Minnesota</i>	11:15	Big Stone II Permitting and Transmission Progress <i>Steve Schultz, Otter Tail Power Company</i>
9:15	Transportation Alternative Fuels and Impacts They Will Have on the Electric Utility <i>Presenter to be announced</i>	12:00	Lunch

CONCURRENT SESSIONS

1:00 – 4:15 p.m.

SUBSTATION

Moderator: Tom Guttormson

Co-Moderators: Mark Harvey, Steve Mohs

1:00	New Current Sensor Technology for Substation Protection and Metering Applications <i>Martin Bishop, Cooper Power Systems</i>
1:45	Online Diagnoses of Aging Transformers <i>Wesley Knuth, Apparatus Engineering/ESP&E, Salt River Project</i>
2:30	Break
2:45	Transient Recovery Voltage Concerns for Current Limiting Reactor Applications <i>Tom Dagenais, American Transmission Company</i>
3:30	Corrosive-Sulfur Problems in Power Transformers and Shunt Reactors <i>Paul Griffin, Doble Engineering Company</i>
4:15	Adjourn

UTILITY INDUSTRY FUTURES

Moderator: Chuck Healy

Co-Moderators: Dave Peterson, Dave VanHouse

1:00	Advanced Wind Machines <i>Amir Mikhail, Clipper Windpower, Inc.</i>
1:45	Minnesota Wind Integration Study <i>Matthew Schuerger, Energy Systems Consulting Services, LLC</i>
2:30	Break
2:45	Advances in Photovoltaic Device Technology <i>Michael Ropp, South Dakota State University</i>
3:30	The Future of Cellulose-Based Ethanol: Limitations and Impacts <i>William Gibbons, South Dakota State University</i>
4:15	Adjourn

EXHIBITOR RECEPTION

4:15-6:00 p.m.

Wednesday, November 7, 2007

CONCURRENT SESSIONS

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

DISTRIBUTION AUTOMATION/COMMUNICATIONS

Moderator: Dan Nordell

Co-Moderators: Ed Cannon, Craig Turner

- 7:30 Continental Breakfast
- 8:30 Distribution Fault Location from the Substation
Tom Short, EPRI
- 9:15 Fault Detection, Sectionalize and Restoration
Byron Flynn, GE Energy
- 10:00 Break
- 10:30 DPC Increases Service and Reduces Costs with
Telecommunications Project
Ed West and Ken Graves, Dairyland Power Cooperative
- 11:15 Wireless Communication Systems for Utilities
Dan Nordell, Xcel Energy
- 12:00 Lunch

DELIVERY SYSTEMS I

Moderator: Mike Steckelberg

Co-Moderators: Cassie Polman, Gerry Steffens

- 7:30 Continental Breakfast
- 8:30 NERC Compliance Panel
*Greg Pieper, Xcel Energy, Roger Simundson, Minnesota
Power, and Joe Knight, Great River Energy*
- 9:15 EHV and HV Transmission Line Land Surveying
Considerations
Brian Long and Gary Ness, Ulteig Engineers, Inc.
- 10:00 Break
- 10:30 Equipment Design Studies Using EMTP
*Rao Atmuri and Bruno Bisewski, Teshmont
Consultants LP*
- 11:15 Ethanol Plants and Electricity
Josh Mulder, Fagan Engineering
- 12:00 Lunch

Wednesday, November 7, 2007

CONCURRENT SESSIONS

1:00 – 4:15 p.m.

DELIVERY SYSTEMS II

Moderator: Nathan Germolus
Co-Moderators: Al Haman, Chuck Healy

- 1:00 Arc-Flash Hazards—A 12.5 kV Distribution System Case Study
Al Haman, STAR Energy Services, LLC
- 1:45 Railroad and Pipeline Electromagnetic Compatibility Issues with High Voltage Electric Transmission Circuits
Robert Allen, ARK Engineering & Technical Services, Inc.
- 2:30 Break
- 2:45 Electromagnetic Compatibility of Active Implantable Medical Devices
Wes Clement, Medtronic, Inc.
- 3:30 Impact of Unbalanced Load on Distribution Transformers
Mike Hennes, Minnkota Power Cooperative
- 4:15 Adjourn

RELAYING

Moderator: Mark Gutzmann
Co-Moderators: Mark Harvey, Cassie Polman

- 1:00 Weston 4 Generator Interim Operation Relaying Requirements
Hari Singh, American Transmission Company
- 1:45 Considerations for Using Harmonic Blocking and Harmonic Restraint Techniques on Transformer Differential Relays
Ken Behrendt, Schweitzer Engineering Labs
- 2:30 Break
- 2:45 Advanced Multi-terminal Current Differential Protection and Applications
Roger Hedding, ABB, Inc.
- 3:30 Application and Commissioning of Multifunction Digital Transformer Relays
Charles Mozina, Beckwith Electric
- 4:15 Adjourn

PROJECT MANAGEMENT

Moderator: Denny Branca
Co-Moderators: Steve Mohs, Philip Spaulding

- 1:00 Step-In EPC Wind Interconnection Projects
Jim Hanson, Consulting Engineers Group
- 1:45 Arrowhead Substation 230/345 kV Expansion: A Civil Engineering Perspective
Ron Gullicks, Minnesota Power
- 2:30 Break
- 2:45 Southwest Minnesota 825 MW Wind Project-Implementation
Sheldon Silberman, Xcel Energy
- 3:30 OGS to Montezuma Storm Rebuild
Vicki Schneider, Ulteig Engineers, Inc. and Mark Ryan, Alliant Energy
- 4:15 Adjourn

Thursday, November 8, 2007

CONCURRENT SESSIONS

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

TUTORIAL 1

THE MAKING OF A TRANSFORMER – PART II

Moderator: Al Haman

Co-Moderators: Larry Brusseau, Chuck Healy

7:30 Continental Breakfast

8:30 The Making of a Transformer, Part II
Jin Sim, Waukesha Electric

10:00 Break

10:30 The Making of a Transformer, Part II (continued)
Jin Sim, Waukesha Electric

12:00 Adjourn

TUTORIAL II

INTRODUCTION TO POWER SYSTEM DYNAMICS

Moderator: Nathan Germolus

Co-Moderators: Dave Hoops, Mike Steckelberg

7:30 Continental Breakfast

8:30 Introduction to Power System Dynamics
Michael Marz, American Transmission Company

10:00 Break

10:30 Introduction to Power System Dynamics (continued)
Michael Marz, ATC

12:00 Adjourn

Topic Descriptions

GENERAL SESSION

Reforming the National Undergraduate Curriculum in Electric Energy Systems

Ned Mohan, University of Minnesota

This presentation will describe an Integrated Electric Energy Systems Curriculum for Sustainable Growth for undergraduates in power. This curriculum has been developed by funding from NSF, NASA, and the Office of Naval Research (ONR). As a result, the student enrollments have seen a four-to-five fold increase.

Through a \$1.23 million grant from the United States Navy and substantial support from EPRI and American Electric Power (AEP), this curriculum is now being proactively disseminated in 175 universities nationwide. This presentation will describe the main characteristics of this curriculum and how its adoption can absolutely prevent the predicted shortage of engineers for the power industry.

Transportation Alternative Fuels and Impacts They Will Have on the Electric Utility

Presenter to be announced.

This presentation will discuss the impacts that transportation-related fuels will have on the electric utility industry. Learn about current technology and plans for the future.

A Minnesota First: Great River Energy's New LEED Platinum Certified Headquarters Building

Gary Connett, Great River Energy

Construction is well underway for Great River Energy's new headquarters in Maple Grove, Minnesota. The 166,000 square foot office building will provide a workplace for more than 350 employees and will be one of only a handful of newly constructed buildings in the world that will meet the LEED (Leadership in Energy and Environmental Design) platinum level certification. By following the LEED guidelines for sustainable design, Great River Energy is constructing a cost-effective, high-performance workplace that aspires to be a model of environmental stewardship and sound business practices, and can serve as a living, visual showcase for others. Gary will review some of the innovative features of the new building including renewable energy production, geothermal heating and cooling, water use and rainwater collection, and daylight harvesting.

Big Stone II Permitting and Transmission Progress

Steve Schultz, Otter Tail Power Company

This presentation will review the Big Stone II generation and transmission projects and the necessary permits to build this project. We will look at timelines and manpower issues. There will be time for discussion both during and after the presentation.

SUBSTATION

New Current Sensor Technology for Substation Protection and Metering Applications

Martin Bishop, Cooper Power Systems

This paper presents high precision printed circuit board (PCB) Rogowski coil (RC) characteristics, designs, and applications for advanced protection, control, and metering systems with new multifunction relays. RC current sensors offer an alternative to conventional current transformers for measurement of power system currents for protection and metering use. The paper will present an overview of the RC sensor designs and characteristics. Several novel protection system applications will be discussed with a review of the performance of the systems after several years of use.

Online Diagnoses of Aging Transformers

Wesley Knuth, Apparatus Engineering/ESP&E, Salt River Project

Although failure rates of power transformers remain rather low, penalty on system stability and costs compel that effort be made to detect incipient faults at an early stage, thereby allowing an orderly outage and repairs to be performed. Online monitoring can play a major role in this endeavor.

Proper modeling of winding hottest spot temperature is critical for sound management of transformer aging and life extension. Older transformers tend to pick up moisture from various sources and detrimental effects of moisture in insulation are well known. However, assessment of moisture content in winding insulation and pressboard barriers remains challenging. Reduction of cooling efficiency can go undetected for years if the transformer is normally loaded below rated values; cautious operation requires that such condition be detected and corrected before an emergency condition occurs. Field experience is presented on the application of Hydran M2 on a 600MVA transformer and opportunities for improvement are discussed.

Transient Recovery Voltage Concerns for Current Limiting Reactor Applications

Tom Dagenais, American Transmission Company

Although adding a current limiting reactor (CLR) can be a prudent alternative to reconductoring or rebuilding a transmission line that would otherwise overload, it will increase the possibility that breaker transient recovery voltage (TRV) withstand capabilities will be exceeded. This could lead to breaker misoperation or even failure. This presentation discusses the TRV analysis and mitigation techniques used for recent CLR applications at ATC in light of the recent changes to the IEEE "Application Guide for Transient Recovery Voltage for AC High-Voltage Circuit Breakers" (C37.011).

Corrosive-Sulfur Problems in Power Transformers and Shunt Reactors

Paul Griffin, Doble Engineering Company

Corrosive sulfur in oil has become a problem in electric apparatus where failures have occurred in large power transformers and shunt reactors. The problem is complex, but recent investigations are providing a better understanding to help avoid problems in the future. Test methods for oils are being developed, and there is some evidence that power factor measurements might be helpful in detecting deposition in apparatus. Mitigation methods for existing and developing problems are under investigation.

UTILITY INDUSTRY FUTURES

Advanced Wind Machines

Amir Mikhail, Clipper Windpower, Inc.

The presentation will include the latest advances in wind energy concepts and technology. The status of wind energy world-wide will be discussed. The latest technological developments in the wind energy field will be presented.

Minnesota Wind Integration Study

Matthew Schuerger, Energy Systems Consulting Services, LLC

In May of 2005 the Minnesota Legislature adopted a requirement for a Wind Integration Study of the impacts on reliability and costs associated with increasing wind capacity to 20 percent of Minnesota retail electric energy sales by the year 2020. The study was completed in December 2006. The study background, key issues, objectives, methods, and primary results will be presented.

Advances in Photovoltaic Device Technology

Michael Ropp, South Dakota State University

Photovoltaic (PV) device technology continues to advance, and prices continue to fall. In this presentation, some of these recent advancements will be discussed. Silicon PV, thin-film PV, organic PV, and so-called "third generation" PV will all be included. Throughout, the aim will be to help electric power engineers answer the overriding question – that of when, if ever, PV will be cost-competitive with other sources of electricity – in light of these technical achievements and the new state of the art.

The Future of Cellulose-Based Ethanol: Limitations and Impacts

William Gibbons, South Dakota State University

Producing ethanol from cellulosic biomass presents several logistical and technical hurdles that corn-based ethanol did not prevent. While a broad range of potential biomass sources can be sustainably produced, issues related to harvest, storage, transportation, and costs must be overcome to supply processing facilities. Biomass is also much more difficult to process into ethanol, compared to corn, due to its structural composition and structure. Several novel pretreatment and conversion approaches will be described. If these hurdles can be overcome, the impact on rural economies will be substantial, including a demand for skilled employees with a broad cross section of skills.

DISTRIBUTION AUTOMATION/COMMUNICATIONS

Distribution Fault Location from the Substation

Tom Short, EPRI

Some basic impedance-based, fault-location methods are evaluated on utility measurement data with known fault locations. The main finding is that reasonably accurate fault locations are possible on a wide range of distribution circuits with either feeder-level or bus-level substation monitoring. Another important finding described is how monitoring can be used to estimate the parameters of the fault arc. This can improve fault locations and help with accident investigations, equipment failure forensics, and other hazards related to the power and energy created by the arc.

Fault Detection, Sectionalize, and Restoration

Byron Flynn, GE Energy

This presentation describes PacifiCorp Distribution Automation Pilot System for three substations and six overhead and underground feeders. Automation schemes include Fault Detection, Localization, Isolation, and Load Restoration. The automation algorithms safely minimize the fault exposure and duration which significantly reduces the SAIDI performance metric for the customers on those feeders. The system communicates using a secure broadband Ethernet radio system supporting peer-to-peer communications, access by multiple masters, and remote access for maintenance. This paper and presentation will review the system architecture, automation functionality, and PacifiCorp's system operational

experience. Plans for future expansion and additional functionality also will be discussed.

DPC Increases Service and Reduces Costs with Telecommunications Project

Ed West and Ken Graves, Dairyland Power Cooperative

Dairyland was facing these issues: termination of analog cell phone services, desire for supervisory control and data acquisition (SCADA) at distribution substations, installation of automatic meter reading systems that required communication to all substations. Dairyland was spending \$1 million a year on telecom-leased services and physical and cyber security requirements from the North American Electric Reliability Council and the Federal Energy Regulatory Commission. Dairyland solved these issues by designing, assembling, and testing cabinets for its distribution substations. The cabinets provide reliable real-time visibility of the substation meters, breakers, regulators and capacitor banks, as well as communications for Automatic Meter Reading to Dairyland and its member cooperatives. It provides for both physical and cyber security of the substation communications equipment and data circuits. The solution will pay for itself through a reduction in telecommunication costs.

Wireless Communication Systems for Utilities

Dan Nordell, Xcel Energy

New advances in radio technology are presenting utilities with unprecedented opportunities to improve substation and distribution communications. This paper discusses the use of both common-carrier and private-radio systems for wide-area and local-area utility applications.

DELIVERY SYSTEMS I

NERC Compliance Panel

Greg Pieper, Xcel Energy, Roger Simundson, Minnkota Power, and Joe Knight, Great River Energy

The 83 NERC reliability standards, that were recently approved by FERC, affect many areas including the planning, engineering, and operation of generation, transmission, and distribution facilities. As of June 18, 2007, failure to comply with these standards can result in fines from \$1,000 per day per violation to \$1 million per day per violation. This presentation will be conducted in a panel format, with panelists representing three Midwest utilities: Great River Energy, Minnkota Power Cooperative, and Xcel Energy. The audience will be able to compare and contrast the methods used to address the compliance requirements of the 83 NERC reliability standards, only one of which is a Critical Infrastructure Protection cyber security standard.

EHV and HV Transmission Line Land Surveying Considerations

Brian Long and Gary Ness, Ulteig Engineers, Inc.

Due to the large increase in the national need for transmission lines, there is an opportunity for new technologies in corridor land surveying projects. Items such as fixed wing aerial photography, fixed-wing lidar imagery, helicopter-gathered imagery, total robotics survey equipment, GPS, GIS, and legal data base information are being developed for these projects. This paper will provide an overview of the considerations in preparing a survey that includes massive amounts of data. The presentation will include examples of the type of data being collected and considerations involved in completing a large survey over an area that covers many square miles of territory.

Equipment Design Studies Using EMTP

Rao Atmuri and Bruno Bisewski, Teshmont Consultants LP

The design of any high voltage equipment has to take into consideration the overvoltages to which it is going to be subjected during its operational lifetime. These overvoltages could arise during energization and de-energization of high voltage transmission lines, transformers, shunt reactors, capacitors, etc. The phenomenon of overvoltages is investigated using electromagnetic transient programs by a detailed representation of the three-phase network by taking into consideration the distributed and lumped network elements, frequency dependent and non-linearity of network components, and instance of breaker operation. In this paper we have evaluated the switching surge flashover rate of the Arrowhead-Weston 345 kV, 230 mile. The paper describes the system modeling, the criteria for acceptable flashover rate, the calculations of the flashover rate from the tower critical flashover overvoltage (CFO), and overvoltages during energizations. The paper also deals with the breaker transient recovery voltage (TRV) and rate of rise recovery voltage (RRRV) of the 230 kV and 345 kV breakers at Arrowhead.

Ethanol Plants and Electricity

Josh Mulder, Fagan Engineering

This presentation discusses the electrical consumption of ethanol plants and includes: a brief overview of the state of ethanol production and the trends that we are seeing as a design build company; a discussion of the load profile of a typical ethanol plant, including a discussion of running load, peak demand, and power factor correction equipment; a discussion of the effects of power interruptions to plant operations, looking at things that can be done to deal with power interruptions; looking at add-on technologies to increase plant efficiency and reduce overall power consumption; and what things can we look forward to in the future.

DELIVERY SYSTEMS II

Arc-Flash Hazards—A 12.5 kV Distribution System Case Study

Al Haman, STAR Energy Services, LLC

The 2007 Edition of the National Electric Safety Code requires electric utilities to perform an assessment to determine hazards due to electrical arcs in the workplace. The study determines personal protective equipment requirements for workers who may become exposed to electrical arcs. This paper is a case study of a 12.5 kV rural distribution system in Central Minnesota. Study assumptions, methodology, and conclusions will be presented.

Railroad and Pipeline Electromagnetic Compatibility Issues with High Voltage Electric Transmission Circuits

Robert Allen, ARK Engineering & Technical Services, Inc.

When steel pipelines, metallic equipment, or railroads are located in a shared corridor with high voltage electric transmission circuits, the pipeline, equipment, and rails can incur high induced voltages and currents due to AC interference effects. This situation can cause a number of safety issues if not mitigated effectively. Some possible effects of this AC interference on these types of structures include the following:

- Personnel subject to electric shock up to a lethal level
- Damage to signal and communications equipment by exceeding rail-to-ground or rail-to-rail safe operating voltage limits
- False signaling of equipment such as GCP (Grade Crossing Predictor)

This presentation will include an overview of AC interference effects and modeling and analysis techniques, along with mitigation system design alternatives for existing and proposed joint facility corridors.

Electromagnetic Compatibility of Active Implantable Medical Devices

Wes Clement, Medtronic, Inc.

The continued development of new RF emitters and the effect on Active Implantable Medical Devices (AIMDs) are in constant scrutiny by the medical device industry. A brief background of implantable cardiac devices, specifically pulse generators and cardioverter defibrillators, will be provided, as well as a look at device function and patient perceptions during exposure to electromagnetic interference. Also discussed will be a review of the current implantable device minimum requirements and industry concerns. The presentation will conclude with known issues and recommendations regarding device interaction with electromagnetic fields developed by power lines.

Impact of Unbalanced Load on Distribution Transformers

Mike Hennes, Minnkota Power Cooperative

The primary function of the power transformer in the distribution substation is to provide voltage transformation. In some cases the transformer type is selected to provide or isolate a ground source or to provide phase shift correction. A brief review of typical distribution transformer types and the application of the Wye-Wye transformer is presented. The impact of unbalanced load is explored for the various transformer connections used in an interconnected distribution system.

RELAYING

Weston 4 Generator Interim Operation Relaying Requirements

Hari Singh, American Transmission Company

Weston 4 is a 550 MW fossil-fuel generator near Wausau, Wisconsin, that is expected to interconnect to the transmission system of American Transmission Company (ATC) in 2008. Because of construction timetables, the generator will be going into service before the transmission facilities determined to be required stability upgrades in the Midwest ISO large generator interconnection process can be placed in service. To maximize the generator output without compromising transmission system reliability, ATC has designed a protective relaying scheme for the interim operation of Weston 4 generator. The interim operation involves reduced output and/or tripping of the generator for specific events occurring under certain system conditions. This presentation describes the Weston 4 Interim Operation Relaying Requirements determined from angular stability simulations.

Considerations for Using Harmonic Blocking and Harmonic Restraint Techniques on Transformer Differential Relays

Ken Behrendt, Schweitzer Engineering Labs

The terms “harmonic restraint” and “harmonic blocking” are sometimes used interchangeably when talking about transformer differential protection. This paper explores the meanings of these terms and how these techniques are individually applied in modern transformer differential relays, including how these techniques affect the speed and security of transformer differential protection. The paper further compares these techniques using examples to show their response to several transformer inrush examples.

Advanced Multi-terminal Current Differential Protection and Applications

Roger Hedding, ABB, Inc.

Current differential relaying has long been an alternative to directional comparison relaying, especially for short line applications. Current transformer performance has always been one of the limiting factors in using a current differential scheme. Summing the current transformer currents before entering the relay deepens the problem. With the advent of multi-terminal current differential relays, individual currents can be kept isolated throughout the differential process, mitigating the problem. This paper describes differential relaying techniques and shows examples of how keeping currents separate helps solve real application problems.

Application and Commissioning of Multifunction Digital Transformer Relays

Charles Monzina, Beckwith Electric

The application of multifunction digital relays to protect power transformers has become a common utility practice. This paper will discuss the basics of transformer protection including polarity and ANSI and IEC phasing standards, slope, harmonic restraint, and communicating these properly to digital relays. These basics will hopefully be of value to newer protection engineers. Advancements in digital technology have provided many technical improvements but have also allowed relay manufacturers to include more relay functions within a single hardware platform as well as address more and more transformer winding configurations. This has increased complexity resulting in digital transformer relays requiring an Einstein to set and an Edison to commission. This paper will address these issues that the author believes are the major shortcoming of many existing digital transformer protective relays and has resulted in the improper setting of many digital transformer protection relays by less-experienced relay engineers.

PROJECT MANAGEMENT

Step-In EPC Wind Interconnection Projects

Jim Hanson, Consulting Engineers Group

A new phenomenon is impacting electric utilities throughout the Midwest as a direct impact of renewable wind farm interconnections. This phenomenon is Step-in Engineer, Procure and Construct contracts for the utility facilities required for the wind farm interconnection. Step-in usually occurs when the Interconnection Facilities Study identifies utility improvements needed to accommodate the renewable generation facility, and the utility cannot meet the timetable required in the Interconnection Agreement. The Interconnection Agreement gives the developer the option to "step in" and build those utility facilities. This paper will compare and contrast two recently completed Step-in projects; The Summit/Jeffers and Sleeping Bear/Fort Supply wind interconnection projects. It will discuss the step-in process, talk about utility standards, and provide some lessons learned for future step-in projects

Arrowhead Substation 230/345 kV Expansion: A Civil Engineering Perspective

Ron Gullicks, Minnesota Power

This session will discuss civil engineering aspects related to a major expansion of an existing electrical transmission substation. The session will focus on site development, earthwork, grading, erosion and sedimentation control, spill containment, foundation design, structural steel design, and construction.

Southwest Minnesota 825 MW Wind Project-Implementation

Sheldon Silberman, Xcel Energy

The Southwest Minnesota 825 MW Wind Project is one of the largest electric transmission infrastructure projects ever constructed in Minnesota costing over \$200 million. We have previously presented on the planning, permitting, and history of the project development. This presentation reviews some of the unique issues and comparison of approaches utilized to build various parts of the project including nearly 90 miles of new 345kV transmission, over 60 miles of new 115kV transmission, five new substations, and numerous changes to existing facilities.

OGS to Montezuma Storm Rebuild

Vicki Schneider, Ulteig Engineers, Inc. and Mark Ryan, Alliant Energy

On February 24 of this year a major ice storm moved through Iowa. The combination of freezing rain and high winds downed over 10,000 utility poles and left more than 270,000 Alliant Energy customers without power. One of the lines that suffered extensive damage was the 345kV OGS – Montezuma line, which is owned jointly with MidAmerican Energy. It had lost 81 of the 153 structures on the 36-mile line. Restoring this line is a job that would normally take years, yet the anticipated energized date was less than five months after the line was lost. Obstacles that were overcome along the way were land owner/easement issues, right-of-way concerns, archaeological sites, and disturbed soil conditions.

TUTORIALS

The Making of a Transformer, Part II

Jin Sim, Waukesha Electric

This paper will present general processes followed by most manufacturers of Power Transformers from the request for quote (RFQ) to shipping. Most of the manufacturing processes are for Core Form power transformers while several key processes for Shell Form transformers is also described. We will also show basic processes utilized to produce key raw materials used in Power Transformers; electrical steel for core, conductor material for windings, and insulation materials. Part II will have less coverage on materials to allow time for a special presentation on loading of the power transformers along with theoretical and functional life of a transformer as well as the role of moisture inside transformers on both.

Introduction to Power System Dynamics

Michael Marz, American Transmission Company

Normally the power system operates in a steady state condition where minute-to-minute load, generation, voltage, frequency, and power flow changes are almost imperceptible. When a significant disturbance occurs, such as a fault, critical equipment outage or the loss of a large load or generator, the power system enters a dynamic state. If the power system returns from this dynamic state to a new steady state condition, it is said to be stable. If it doesn't, it is said to be unstable. Using simple example calculations and real-world examples, this tutorial presents a basic overview of what occurs during the dynamic state to determine if a power system is stable or unstable. Ways of improving stability in both the long- and short-term are discussed.

Registration Information

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 conference center (lot S104) for \$5.50 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 Four Points Sheraton Hotel Minneapolis, 1330 Industrial Boulevard, Minneapolis. The rate is \$95, plus tax, for a single or double room. Participants are responsible for making their own lodging reservations. To make a reservation, call 612-331-1900 or 1-888-627-8129. To receive the special conference rate, identify yourself as a participant of the **Minnesota Power Systems Conference**. Or, make your reservation online at <http://www.starwoodmeeting.com/Book/mipsycon>. Reservations must be made by October 14. 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 arrive at the hotel.

REGISTRATION AND FEES

The fee for the conference is \$225 if received by October 22; if received after October 22 the fee is \$250. The conference fee includes all sessions, two luncheons, refreshments breaks, the exhibitor reception, and the conference proceedings. You are encouraged to register early to take advantage of the lower fee. If you cancel your registration by October 29, 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.

This year we are also providing you the opportunity to purchase a CD that will include the papers in the proceedings book along with PowerPoint presentations that speakers have granted permission to distribute. The CDs will be mailed to you approximately four weeks after the conference. If you wish to purchase a CD please check the appropriate box on the registration form and include payment with your conference fee.

EXHIBITOR RECEPTION

The exhibitor reception will be held on Tuesday, November 6, 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 1.5 CEUs. Participants who attend only Tuesday and Wednesday will receive 1.2 CEUs. One CEU is defined as 10 contact hours of participation in an organized continuing education experience under responsible sponsorship, capable direction, 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 Records Transcript Unit.

FOR FURTHER INFORMATION

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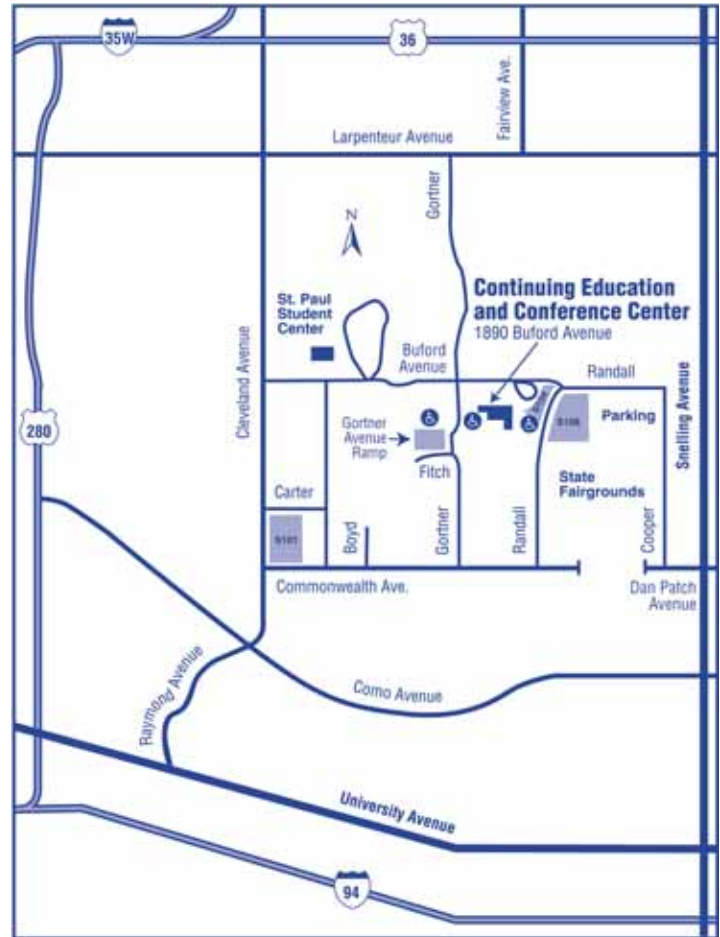
CALL FOR PAPERS FOR 2008 CONFERENCE

Deadline for title and abstract submission for MIPSYCON 2008 is January 15, 2008. Notification of acceptance will be mailed by June 2008. If you would like to be considered for the 2008 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, MN 55108, E-mail: cceconf4@umn.edu

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Continuing Education and Conference Center

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■ = Parking facilities
♿ = Handicapped access and parking

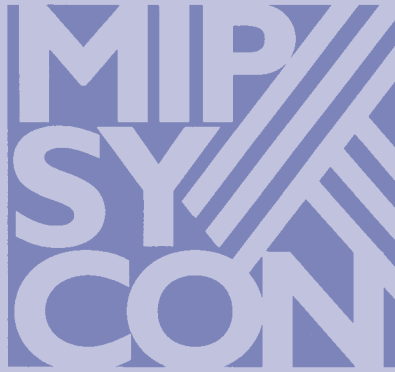
Directions

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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43rd Annual Minnesota Power Systems Conference

November 6-8, 2007

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