

UNIVERSITY OF MINNESOTA

3 9 T H A N N U A L



Minnesota Power Systems Conference

November 4-6, 2003

**Earle Brown Continuing Education Center
University of Minnesota, St. Paul Campus**

Cosponsored by:

Twin Cities Section of IEEE

College of Continuing Education,
University of Minnesota

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, delivery systems, project management, relaying, distribution automation and distributed resources.

Earn 16 Professional Development Hours for attending this program.



Program Schedule

Tuesday, November 4, 2003

GENERAL SESSION

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

Moderator: Dave Peterson

Co-Moderators: Philip Spaulding, Gerry Steffens, Craig Turner

7:15	Check-In Continental Breakfast	10:00	Break
8:15	Welcome <i>Dave Peterson, Dairyland Power Co-op</i>	10:30	TRANSLink's Crystal Ball <i>Clair Moeller, Xcel Energy</i>
8:30	Coping with a Changing Industry <i>Wayne Brunetti, Xcel Energy</i>	11:15	Your Friendly Family-owned Electric Company <i>Dave Dahlberg, Northwestern Wisconsin Electric Company</i>
9:15	New Reliability Requirements — Impact of New Legislation on Transmission Planning <i>Ken Wolf, Department of Commerce</i>	12:00	Lunch

CONCURRENT SESSIONS

1:00-4:15 p.m.

SUBSTATION

Moderator: Mike Klopp

Co-Moderators: Mark Harvey, Steven Mohs

1:00	Commissioning Tests for Substation Equipment and Systems: A Summary of Methods and Field Observations <i>Neil Stiller, Rochester Public Utilities</i>
1:45	Substation Grounding — Safety and Protection for the Next Generation <i>Michael Gassman, ERICO, Inc.</i>
2:30	Break

UTILITY INDUSTRY FUTURES

Moderator: Mike Klopp

Co-Moderators: Mark Harvey, Steven Mohs

2:45	Photovoltaics: Forgotten Renewable? <i>Michael E. Ropp, South Dakota State University</i>
3:30	Electricity Infrastructure Security <i>Massoud Amin, University of Minnesota Center for the Development of Technological Leadership and Electrical and Computer Engineering</i>
4:15	Adjourn

DELIVERY SYSTEMS I

Moderator: Nathan Germolus

Co-Moderators: Gerry Steffens, Ivars Vancers

1:00	Customer Focused Distribution Reliability Analysis <i>Scott Nickels, Rochester Public Utilities</i>
1:45	Meeting the Technology Challenge at Mid-Size Rural Electric Cooperatives <i>Al Haman, STAR Energy Services</i>
2:30	Break
2:45	Improving Your Outage Indices: Reliability Project Results on a Rural 12.5 kV Distribution System <i>Kevin Louis, Meeker Cooperative</i>
3:30	Abnormal Voltage and Outage Detection/Notification; Past, Present, and Future <i>Roger Simundson, Minnkota Power Cooperative</i>
4:15	Adjourn

EXHIBITOR RECEPTION

4:15-6:00 p.m.

Wednesday, November 5, 2003

CONCURRENT SESSIONS

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

PROJECT MANAGEMENT

Moderator: Denny Branca

Co-Moderators: Pat Hayes, Jon Wahlgren

- 7:30 Continental Breakfast
- 8:30 Arrowhead Weston Transmission Project Permitting Update
Bob Lindholm, Minnesota Power
- 9:15 How the New Biomass Plant in Downtown St. Paul is Interconnected/Protected
Mark Gutzmann and Joel Limoges, Xcel Energy
- 10:00 Break
- 10:30 Electric Facility Relocation Effort Necessitated by Downtown Minneapolis Light Rail Transit (LRT) Construction
Joe Mansur and James Kucera, Xcel Energy
- 11:15 Twin City Metro Emissions Reduction Project
Ron Elsner, Xcel Energy
- 12:00 Lunch

DELIVERY SYSTEMS II

Moderator: Al Haman

Co-Moderators: Roger Simundson, Mike Steckelberg

- 7:30 Continental Breakfast
- 8:30 Web-Enabled Demand Response Options
Roger Rognli, Cannon Technologies, Inc.
- 9:15 The 3M Composite Conductor: A New Solution for Eliminating Thermal Bottlenecks
Tracy Anderson, 3M
- 10:00 Break
- 10:30 Superconducting Cable Systems
David Lindsay, Southwire
- 11:15 Understanding Power System Stability
Rich Schaefer, Basler Electric
- 12:00 Lunch

CONCURRENT SESSIONS

1:00-4:15 p.m.

RELAYING

Moderator: Jon Wahlgren

Co-Moderators: Mark Harvey, Steven Mohs

- 1:00 Self-Testing Transmission Line Relay Panels
Tom Ernst, Minnesota Power
- 1:45 Relay Setting System Project — How to Change the World!
Joe Prenosil, Sheldon Silberman, and Paul Schommer, Xcel Energy
- 2:30 Break
- 2:45 The Impacts of High Fault Current and CT Rating Limits on Overcurrent Protection
Ken Behrendt, Schweitzer Engineering Laboratories, Inc.
- 3:30 Application Considerations for Transformer Differential Relays – What's With This Phase Compensation?
Roger Hedding, ABB Inc.
- 4:15 Adjourn

DISTRIBUTION AUTOMATION

Moderator: Dan Nordell

Co-Moderators: Ed Cannon, Tom Guttormson

- 1:00 VAR is Your Energy Going?
Craig Befus, S&C Electric
- 1:45 Protecting Your Capacitor Assets
Ron Murphy, Xcel North, Wally Pitts, RCCS
- 2:30 Break
- 2:45 The Role of Public Network Wireless Communications in DA
Joel Cannon, Cannon Technologies
- 3:30 Synchronous Capacitor Bank Switching to Minimize Power System Transients
Hari Singh, Cooper Power Systems
- 4:15 Adjourn

Thursday, November 6, 2003

CONCURRENT SESSIONS

8:30-11:45 a.m.

TUTORIAL

Moderator: Dan Nordell

Co-Moderators: Tom Guttormson, John Johanson

- 7:30 Continental Breakfast
- 8:30 Network Communications 101
Mark Adamiak, GE Multilin
Dan Nordell, Xcel Energy
- 10:00 Break
- 10:30 Network Communications 101 (*continued*)
- 11:45 Adjourn

DISTRIBUTED RESOURCES — WIND

Moderator: Mike Steckelberg

Co-Moderators: Brian Newell, Ivars Vancers

- 7:30 Continental Breakfast
- 8:30 FERC Small (below 20 megawatt) Generation, Interconnection Issues
Paul Lehman, Xcel Energy
- 9:15 IEEE 1547 — Standard for Interconnecting Distributed Resources with Electric Power Systems
Pratap Mysore, Xcel Energy
- 10:00 Break
- 10:30 Addition of Wind Generation to an Existing Distribution System
Tim Bartel, Minnkota Power Cooperative, Inc.
- 11:00 Wind Generation: Impacts on Grid PQ (Stability, Low Power Factor). How Much Can We Install Before Negative Grid Impacts Become Too Great?
Rick Gonzalez, Xcel Energy
- 11:45 Adjourn

11:45 Conference Adjourns

Topic Descriptions

GENERAL SESSION

Coping With a Changing Industry

Wayne Brunetti, Xcel Energy

After a challenging 2002, Xcel Energy began moving in the right direction in 2003 with a strong focus on its core utility businesses. Wayne Brunetti, Chairman, President and CEO, will discuss how Xcel Energy weathered unprecedented challenges — both in the industry and at home — and turned things around for the future.

New Reliability Requirements — Impact of New Legislation on Transmission Planning

Ken Wolf, Department of Commerce

There are a number of new requirements contained in 2003 legislation related to transmission planning. These requirements deal specifically with the transmission upgrades necessary to support the development of renewable energy resources, the ramifications of the intermittent nature of wind, and the transmission requirements in support of the MESABA iron range new coal technology proposal. These new requirements and their effect on the transmission and distribution systems will be discussed.

TRANSLink's Crystal Ball

Clair Moeller, Xcel Energy

This session will highlight the importance of the independent system operators, TRANSLink's role and current regulatory status.

Your Friendly Family-owned Electric Company

Dave Dahlberg, Northwestern Wisconsin Electric Company

Survival is tough in today's energy markets and it's even tougher trying to compete against the industry giants. This presentation will explore the history of a small family-owned electric utility, how we survive in the market, and how bigger isn't always better.

SUBSTATION

Commissioning Tests for Substation Equipment and Systems, A Summary of Methods and Field Observations

Neil Stiller, Rochester Public Utilities

Many substation designers and engineers don't have the opportunity to observe the construction and start-up testing necessary to commission new equipment with confidence. Testing substation equipment, such as CCVTs, power transformers, circuit breakers, switchgear, CTs, PTs, relays and controls is specialized work. It requires methodical processes, a clear understanding of the equipment, a knack for details, and a knowledge of the system that each component contributes to. These processes will be summarized in this presentation and paper. Examples of selected equipment will be discussed.

Substation Grounding — Safety and Protection for the Next Generation

Michael Gassman, ERICO, Inc.

In today's environment, many substations continue to remain in service past their original design life. Grounding, bonding, and their coordination are critical to the long term safety of workers and equipment life. Making the proper choices in substation design will lead to long term cost reduction.

UTILITY INDUSTRY FUTURES

Photovoltaics: Forgotten Renewable?

Michael E. Ropp, South Dakota State University

Photovoltaics (PV) is a technology often overlooked by utilities because of its high cost. However, given its many advantages over other technologies, its suitability to many applications, and its rapidly declining costs, PV may warrant a second look. This presentation will discuss the advantages of PV, examine some applications in which PV makes sense technically and economically today, and preview the technological future of PV.

Electricity Infrastructure Security

Massoud Amin, University of Minnesota
Center for Development of Technological Leadership and
Electrical and Computer Engineering

Virtually every crucial economic and social function depends on the secure, reliable operation of energy, telecommunications, transportation, financial, and other infrastructures. The specter of terrorism raises a profound dilemma for the electric power industry: how can we make the electricity infrastructure more secure without compromising productivity? Resolving this dilemma will require both short- and long-term technology development and deployment. This presentation will focus on a strategic vision extending to a decade or longer, that would enable more secure and robust systems operation, security monitoring, and efficient energy markets.

DELIVERY SYSTEMS I

Customer Focused Distribution Reliability Analysis

Scott Nickels, Rochester Public Utilities

The presentation will discuss the economic, marketing, and system reliability benefits of minimizing the sustained and momentary outage costs for industrial and large commercial customers when performing distribution feeder reliability studies. Comparisons will be made between the historical reliability analysis process and the Customer Focused Reliability Improvement Process pertaining to system infrastructure data requirements, customer outage cost data requirements, and recloser placement methodologies. A case study utilizing a metropolitan radial distribution feeder will be presented to examine the Customer Focused Reliability Improvement process and to quantify the potential yearly economic benefits to the customer.

Meeting the Technology Challenge at Mid-Size Rural Electric Cooperatives

Al Haman, STAR Energy Services

Implementation of technology at mid-size rural electric cooperatives can be difficult, due to staffing constraints and budget pressure. This paper provides a case study of four rural electric cooperatives in Minnesota and their approach to meeting the technology challenge. By using off the shelf software products, a common sense approach, and a little creativity, an 8,000 customer electric utility can enjoy the benefits of automated meter reading, geographic information systems, improved outage management, and better system planning.

Improving Your Outage Indices: Reliability Project Results on a Rural 12.5 kV Distribution System

Kevin Louis, Meeker Cooperative

Okay, you've done your SAIDI, SAIFI, CAIDI, and ASAI reports. Now what? Follow the four-year progression of a medium-sized distribution cooperative and its findings, pilot power quality project, and results. This presentation covers the compiling of data for accurate indices, overhead and underground outage trends, geographic pilot projects to reduce specific outages, results of outage indices after project completions, and payback on outage reduction projects.

Abnormal Voltage and Outage Detection/Notification; Past, Present, and Future

Roger Simundson, Minnkota Power Cooperative

The various methods of voltage monitoring, outage detection, and power problem notification will be described and compared. The methods described will range from manually read paper strip chart voltage recorders to newly available wireless web-based technology.

PROJECT MANAGEMENT

Arrowhead Weston Transmission Project Permitting Update

Bob Lindholm, Minnesota Power

The presentation will address permitting hurdles experienced over the past three years, explain present state/federal permitting challenges, and speculate when the line will actually be built. The project provides a lesson in patience and perseverance in permitting a transmission line to keep the lights on in the Midwest.

How the New Biomass Plant in Downtown St. Paul is Interconnected/Protected

Mark G. Gutzmann and Joel Limoges, Xcel Energy

The St. Paul Cogeneration Plant in downtown St. Paul, Minnesota, is a biomass-fired generation facility interconnected with Xcel Energy. This presentation will discuss the interconnection project between the St. Paul Cogeneration Plant and Xcel Energy including the construction and protection of the circuit.

Electric Facility Relocation Effort Necessitated by Downtown Minneapolis Light Rail Transit (LRT) Construction

Joe Mansur and James Kucera, Xcel Energy

The construction of Light Rail Transit (LRT) in Minneapolis necessitated the relocation of all underground utility facilities on 5th Street that serve the downtown Central Business District of Minneapolis. This paper covers the relocation of the electric facilities of Xcel Energy prior to the laying of rail in downtown.

Twin City Metro Emissions Reduction Project

Ron Elsner, Xcel Energy

The Minnesota Property Tax Reform Act of 2001 includes an "Emissions Reduction Rider" which encourages utilities to make voluntary emissions reductions and provides a mechanism for the utilities to recover the costs of qualifying voluntary emissions reduction projects outside of the traditional ratemaking process. In response to the Rider, Xcel Energy proposed a \$1 billion package of projects to be completed by 2009 at three of its generating plants to improve air quality in the Twin Cities metro area and beyond. This paper will discuss the process by which Xcel developed, analyzed, and assessed various technology options, describe the scope of the Proposal filed with the MPUC, and update the current status of the project.

DELIVERY SYSTEMS II

Web-Enabled Demand Response Options

Roger Rognli, Cannon Technologies, Inc.

The Internet is an incredible two-way communication tool. As such, it can be used not only to provide answers to demand response program participants' most frequently asked questions — "Was I controlled?" "Am I being controlled?" and "Will I be controlled?" — but also to give the program participants the ability to make real time choices with respect to their demand response control equipment.

The 3M Composite Conductor: A New Solution for Eliminating Thermal Bottlenecks

Tracy Anderson, 3M

Steel and aluminum have been used in overhead power cables for over 100 years. 3M has developed a new high strength, lightweight and low expansion conductor that can offer significant ampacity gains using existing structures without a visual change to the line. This presentation will introduce the conductor, laboratory test results, and field installation data. Application examples will also be given.

Superconducting Cable Systems

David Lindsay, Southwire

Southwire Company is a world leader in the development of High Temperature Superconducting cable systems. The current state of HTS cable technology, current projects, and application scenarios for these cables will be discussed.

Understanding Power System Stability

Rich Schaefer, Basler Electric

This paper reviews the behavior of the power system and the effect of transmission impedances, the generator, and the excitation system on the power system. Various types of power system stabilizers will be discussed and the performance of one type versus another.

RELAYING

Self Testing Transmission Line Relay Panels

Tom Ernst, Minnesota Power

The use of microprocessor-based relays has significantly reduced the life-cycle cost of routine preventative maintenance (PM). Internal self-testing features, inherent in microprocessor based applications, have reduced the scope of relay PM testing to verification of the inputs and outputs of the relay. This paper presents a method to automate the testing of those inputs and outputs, allowing maintenance personnel to focus their limited resources on troubleshooting and repair. In this application, the analog values within the relays are continuously compared to detect analog-digital converter failure and the critical relay digital inputs and outputs are periodically exercised to assure functionality. When coupled with a comprehensive breaker operations report, this system virtually eliminates the need for routine PM testing of transmission line relay panels.

Relay Setting System Project — How to Change the World!

Joe Prenosil, Paul Schommer and Sheldon Silberman, Xcel Energy

In the beginning there were fuses... Evolution brought about the relay, then complex protection schemes expected to adapt to dozens of conditions. Microprocessor-based systems today include multi-function devices requiring hundreds of settings that perform much more than the basic function of the early fuses. With this ever-increasing flexibility comes an ever-increasing need for documentation — both to provide initial settings based on engineering requirements, as well as documentation of as-built conditions for testing, maintenance and future enhancements. This presentation will demonstrate some of the techniques and tools utilized to move from a paper-based, distributed and broken engineering documentation process to a field-proven, technology-based solution using Xcel Energy's Relay Setting System Project as an example.

The Impacts of High Fault Current and CT Rating Limits on Overcurrent Protection

Ken Behrendt, Schweitzer Engineering Laboratories, Inc.

This paper discusses CT ratings used in utility and industrial applications where fault currents can exceed 200 times the CT primary current rating, causing severe saturation. The paper reviews the limitations of conventional digital filtering used in modern instantaneous overcurrent elements when presented with severely saturated waveforms. It also introduces proper digital measurement techniques in order to maintain speed and reliability when instantaneous overcurrent elements are applied with highly saturated current waveforms. It concludes with a CT selection criterion that assures secure operation.

Application Considerations for Transformer Differential Relays – What's With This Phase Compensation?

Roger Hedding, ABB Inc.

Transformer differential protection has migrated from electromechanical relays to microprocessor relays. This migration made differential relays more forgiving to install, but made them more complex to set. This paper reviews transformer differential relay protection fundamentals, then discusses some of the issues associated with transformer differential protection such as phase compensation.

DISTRIBUTION AUTOMATION

Reactive Power Management

VAR is Your Energy Going?

Craig Befus, S&C Electric

“VAR is Your Energy Going” will cover what several large utilities have implemented and learned about remote control and communications to distribution capacitor banks. What technology works well, and what does not? Is there one technology that fits all? When does it make sense to remotely control distribution feeder banks? What is driving the need for power factor improvement — the G&T, regulators, economics, penalties, etc.?

Protecting Your Capacitor Assets

Ron Murphy, Xcel Energy; Wally Pitts, RCCS

This paper presents considerations that are essential to effectively managing your capacitor assets. It reveals methods for assigning a dollar value to your capacitor assets. It reviews how capacitor switch automation has helped Xcel North improve return on investment from capacitors. It quantifies the value of on-time repairs and of in-service availability. It also introduces a new back-office analysis that reduces substation load data, giving planners and engineers a clearer understanding how their capacitor assets are performing.

The Role of Public Network Wireless Communications in DA

Joel Cannon, Cannon Technologies

The session will discuss the various common carrier networks and their evolving role in DA. Discussion will include updates on the data carrying and interface properties of various cellular and paging networks. Also addressed will be the cost of operation of the various media, security issues, suitability for various DA tasks, and the details associated with integrating them into the utility SCADA/EMS framework.

Synchronous Capacitor Bank Switching to Minimize Power System Transients

Hari Singh, Cooper Power Systems

The use of high voltage capacitors improves an electrical distribution system's efficiency and voltage level. However, switching the capacitors often yields damaging overvoltages on the electrical distribution system as high as 500 percent of normal. Overvoltages of this magnitude can cause adjustable speed drives, UPS systems, and other electronic devices to shut down or fail.

Reducing these transients requires precisely controlled switch timing. Repeatable switch timing is difficult to achieve with conventional mechanical devices. This paper discusses the technology and field demonstration of new voice-coil actuated vacuum-bottle switches which can produce precisely-controlled and repeatable zero-crossing operation.

TUTORIAL

Network Communications 101

Mark Adamiak, GE Multilin

Dan Nordell, Xcel Energy

The Internet has brought the concept of "Networking" into many aspects of how society works with the Utility Industry being no exception. Over the last several years, network-based products and solutions have been finding their way into utility applications to the point now where the substation design engineer needs to architect connections from the substation into the corporate network. In addition, the formal standardization of UCA in the IEC 61850 communication standard has propelled many manufacturers to announce implementations of this networking protocol in their protection, control, measurement, and monitoring products.

Network Communications 101 will present an overview of the goals of communication and address the concept of a protocol and a protocol model. Specifically, the seminar will address:

Communication Concepts

7-Layer Open System Interconnect model

UCA/IEC 61850 Substation Profile

Data Modeling: UCA/IEC 61850 Models

The concept of "services"

UCA/IEC 61850 Application Layer Services

Network and Transport Services: TCP/IP

Data Link Functionality: Ethernet Fundamentals

Network and Information Security

DISTRIBUTED RESOURCES - WIND

FERC Small (below 20 megawatt) Generation, Interconnection Issues

Paul Lehman, Xcel Energy

The Federal Energy Regulatory Commission is in the middle of a long process of formulating rules for the interconnection of generation to the delivery system. After they published a proposed set of rules and procedures for larger generators, they are finding the development of the same for smaller generators (20 megawatts and below) to be more of a challenge. This presentation brings out some of the issues that the FERC and all of the parties that are participating in the rule making have been wrestling with.

IEEE 1547 — Standard for Interconnecting Distributed Resources with Electric Power Systems

Pratap Mysore, Xcel Energy

The presentation will highlight the criteria and requirements for interconnection of distributed resources (DR) with electric power systems (EPS) as described in the recently published IEEE standard. Updates will be provided on the following documents related to IEEE 1547, which are under development: testing standard for equipment interconnecting distributed resources, application guide and guide for monitoring, information exchange, control of distributed resources.

Addition of Wind Generation to an Existing Distribution System

Tim Bartel, Minnkota Power Cooperative, Inc.

Minnkota connected a new 900 kW wind turbine to an existing 12.5 kV distribution feeder in July 2002. The generator uses a thyristor-based soft start feature to minimize the impact of startup on the power system. Recordings of starting events show the performance of the equipment, and the actual impact on the distribution system.

LOCATION AND ACCOMMODATIONS

The conference will be held at the Earle Brown Continuing Education Center on the St. Paul Campus of the University of Minnesota. Parking is available adjacent to the center in lot S104 for \$5.00 per day and in the Fairground lot S108 for \$3.25 per day.

Convenient lodging for out-of-town participants is available at the Four Points Sheraton Hotel Minneapolis, 1330 Industrial Boulevard, Minneapolis, 612-331-1900 or 1-800-777-3277. The rate is \$84, plus tax, for single or double room. Participants are responsible for making their own lodging reservations. To receive the special conference rate, please identify yourself as a participant of the Minnesota Power Systems Conference. Reservations must be made by October 14. After this date reservations will be accepted on a space and rate available basis.

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. You are encouraged to register early to take advantage of the lower fee.

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. 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 Earle Brown Center (the same location as the conference sessions). The exhibits will be displayed in the main ballroom and foyer. 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.

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 instructions. 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

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CALL FOR PAPERS FOR 2004 CONFERENCE

Deadline for title and abstract submission for MIPSYCON 2004 is *January 5, 2004*. Notification of acceptance will be mailed by *June 2004*. The deadline for final paper submission for accepted speakers is *August 14, 2004*.

If you would like to be considered for the 2004 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: ksyme@cce.umn.edu

Disability accommodations will be provided upon request. This publication is available in alternative formats upon request. Call 612-624-4938.

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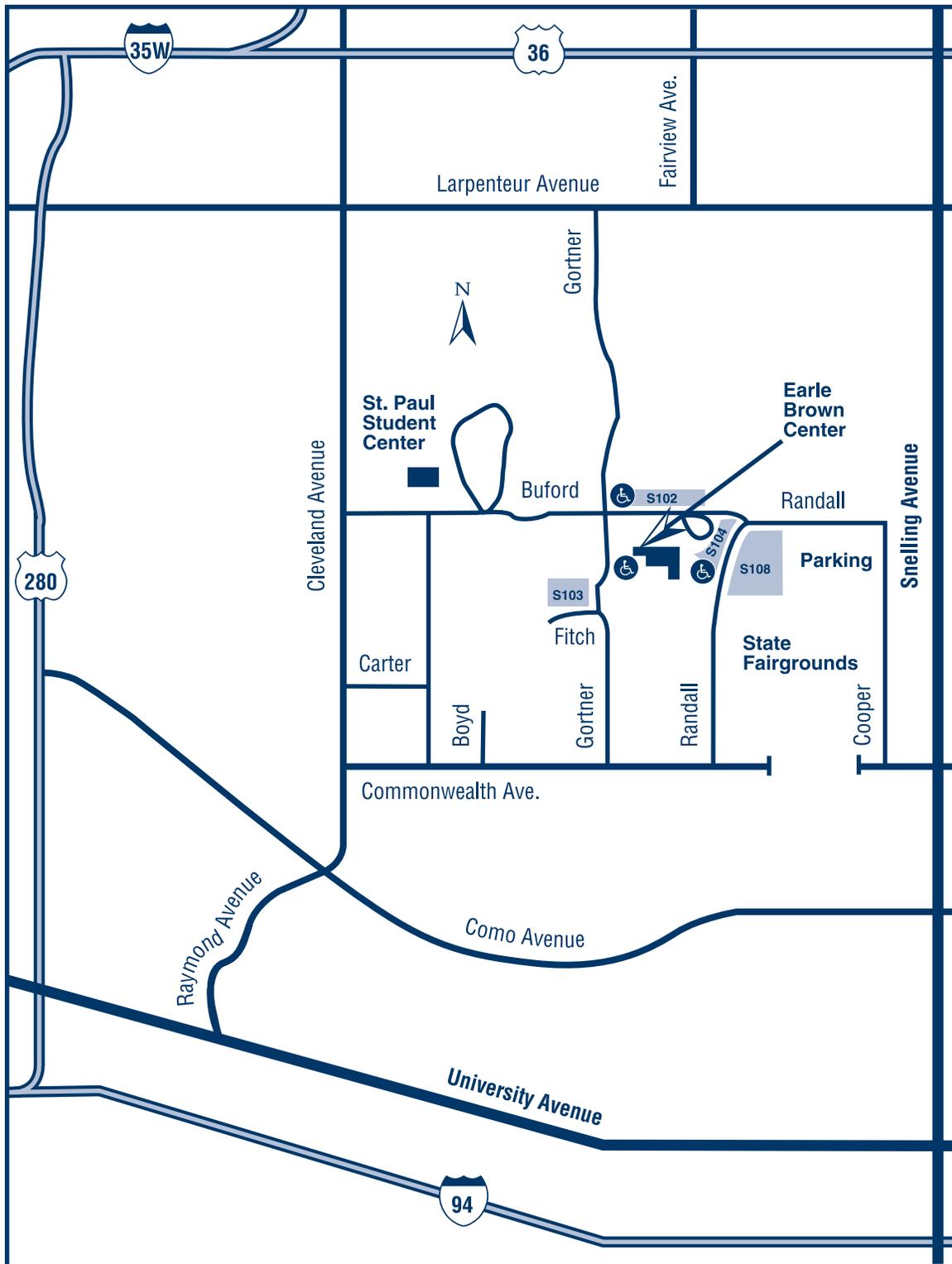
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From I-35 take Highway 36 exit and turn south on Cleveland Avenue to Larpenteur Avenue. Go left on Larpenteur to Gortner, turn right on Gortner and go to Buford. Turn left on Buford to the parking area.

 = Handicapped access and parking



2003 MIPSYCON PLANNING COMMITTEE

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Minneapolis, Minnesota

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Jon Wahlgren

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University of Minnesota
Department of Electrical Engineering
Minneapolis, Minnesota

* Planning Committee Chair

*In memoriam of Jack Thorson
1929 - 2003*

Name _____
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Company/Institution _____

Title/Position _____

Home Telephone Business Telephone

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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.

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www.cce.umn.edu/engineering/mipsycon.shtml