Direct Testimony and Schedules
Betsy Coppock

Before the North Dakota Public Service Commission
State of North Dakota

In the Matter of the Application of Northern States Power Company
for Authority to Increase Rates for Electric Service in North Dakota

Case Nos. PU-10-657, PU-11-55, PU-11-557
Exhibit___ (BC-1)

Reliability Measurements and Performance Plan Implementation Testimony

September 17, 2012

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I. INTRODUCTION AND QUALIFICATIONS

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is Betsy Coppock. My business address is 1123 West 3rd Avenue, Denver, Colorado 80223.

Q. BY WHOM ARE YOU EMPLOYED AND WHAT IS YOUR POSITION?

A. I am a Principal Specialty Engineer within the Electric Distribution System Performance department for Xcel Energy Services Inc., the service company for the Xcel Energy Inc. holding company system. My department provides services to all of the utility operating company subsidiaries of Xcel Energy Inc, including Northern States Power Company. My resume is included as Exhibit___ (BC-1), Schedule 1.

Q. PLEASE SUMMARIZE YOUR QUALIFICATIONS AND EXPERIENCE.

A. I hold a Bachelors of Science Degree in Electrical Engineering from the University of Colorado. I am a licensed Professional Engineer in the State of Colorado. Since 1985 I have held several engineering positions at Xcel Energy and its predecessors in distribution, transmission, and generation. Since 2003 I have worked in Electric Distribution System Performance. My duties include monitoring the distribution system reliability performance. This includes monitoring Xcel Energy's year-to-year reliability performance using a number of industry standards, and comparing reliability performance between the different service areas of Xcel Energy and other utilities to develop programs to improve the reliability of our system.

Q. WHOM ARE YOU REPRESENTING IN THIS PROCEEDING?

A. I am testifying on behalf of Xcel Energy.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?

A. The purpose of my testimony is to discuss:

- methods used to measure the reliability of electric service to retail customers;
- methods used for normalization of reliability data;
- the historic reliability of the portion of the North Dakota electric distribution system served by the Company; and
- the Company's proposal for monitoring and reporting electric service unavailability from 2013 through 2015 as part of its Reliability Performance Plan ("RPP").

II. RELIABILITY MEASUREMENTS

Q. PLEASE EXPLAIN THE PRIMARY MEASUREMENTS OF ELECTRIC RELIABILITY USED IN THE ELECTRIC UTILITY INDUSTRY.

A. The utility industry relies primarily on three reliability indicators to measure electric system or subsystem performance:

- System Average Interruption Duration Index ("SAIDI");
- Customer Average Interruption Duration Index ("CAIDI"); and
- System Average Interruption Frequency Index ("SAIFI").

SAIDI measures how long the average customer is without power in a calendar year. This is calculated as follows:

$$\text{SAIDI} = \frac{\text{Total Customer Minutes of Sustained Outages}}{\text{Total Number of Customers Served}}$$

The measure is a product of both the frequency and duration of outages experienced by customers, such that SAIDI = CAIDI multiplied by SAIFI.

CAIDI is used by utilities to track and analyze outage restoration performance. CAIDI measures the average outage time a customer could expect to be without power if they experienced a sustained (more than five minutes long) outage.

$$\text{CAIDI} = \frac{\text{Total Customer Minutes of Sustained Outages}}{\text{Total number of Sustained Customer Interruptions}}$$

SAIFI measures how often the average customer experiences a sustained outage during a calendar year. SAIFI is calculated as follows:

$$\text{SAIFI} = \frac{\text{Total Number of Sustained Customer Interruptions}}{\text{Total Number of Customers Served}}$$

Q. ARE SAIDI, CAIDI, AND SAIFI INTERRELATED?

A. Yes. As I mentioned, SAIFI and CAIDI are factors of SAIDI. For example, if the average number of outages per customer (SAIFI) is 0.85 (i.e., less than one per year) and the average outage duration (CAIDI) is 100 minutes, then the average time a customer is without power for the year (SAIDI) will be 85 minutes.

Q. ARE THERE ANY OTHER RELIABILITY METRICS THAT UTILITIES USE?

A. Yes, some utilities employ a measurement known as Customers Experiencing Multiple Interruptions ("CEMI"). CEMI is simply a measurement of how many sustained outages an individual customer experiences in a given year. From that, utilities can also determine the percentage or number of individual customers who experience multiple outages in any given time period.

III. NORMALIZATION METHODS

Q. ARE ANY OUTAGES EXCLUDED FROM THE DATA USED TO DETERMINE THE RELIABILITY RESULTS OF THE INDICIES YOU DESCRIBED?

A. Yes. Certain major outage events, such as those caused by severe weather (lightning, high winds, ice, etc.), may be excluded from the data used to calculate SAIDI. Such events can result in a high number of interruptions, create conditions that require unusual restoration efforts, and typically impact many customers. These major events are unpredictable and outside of the normal operation, design, and performance of the power system, and cannot be cost-effectively mitigated. Including their effects in the reporting of a "base-level" SAIDI would not provide meaningful tracking of performance trends over time, nor be indicative of the Company's normal reliability of service. Exclusion of these events from base-level data is known as normalization.

In an effort to better compare reliability from year to year, normalization methods have been developed by utilities in an attempt to adjust for these random variations in reliability due to extreme weather and other largely uncontrollable events affecting the system. Normalization helps take major outage events out of the picture that could mask trends in daily operations and the effectiveness of reliability management. Ultimately, the "base-level" SAIDI data better reflects how a utility's investments and maintenance efforts are affecting service reliability on a day-to-day basis.

Q. HOW IS RELIABILITY DATA NORMALIZED?

A. Initially, utilities developed their own normalization methods, most of which used some statistical method for determining outage events that would be caused by the types of unusual events I just described and would therefore be outside of the normal data trends. These statistical methods were used to determine days which contain, on a cumulative level, events that are out of the norm. These days are known as Major Event Days ("MEDs"). MEDs were typically determined by either counting the number of events that occurred in any one day, the number of customers impacted, or multiplying the total number of customers experiencing outages by the durations of those outages in minutes in any one particular day ("Daily SAIDI"). Historically, utilities used different methodologies for calculating MEDs and therefore in normalizing their reliability data.

Q. HOW DOES THE COMPANY NORMALIZE ITS RELIABITY DATA?

A. The Company historically normalized its data using an internal method that excluded certain days based on the number of outage events in any one day. This method was used during the term of the PLUS performance-based rate plan in North Dakota (2001 – 2005) when the Company began reporting results to the Commission. We continue to use our internal normalization method to report our reliability results to the

Commission each year as part of our Annual Report of Regulated Earnings filed each May.

Q. HAS A STANDARDIZED NORMALIZATION METHOD BEEN DEVELOPED FOR THE INDUSTRY?

A. Yes. In December 2003, the Transmission and Distribution Committee of the Institute of Electrical and Energy Engineers ("IEEE"), voted and approved IEEE Standard 1366-2003, Guide for Electric Power Distribution Reliability Indices. This normalization method uses a statistical approach based on Daily SAIDI. This means that any calendar day with a Daily SAIDI that exceeds an annually established threshold would be excluded from reliability data, along with all outage events that occurred on that day and would not be used for the calculation of the normalized results for each reliability index.

Q. PLEASE EXPLAIN THE IEEE NORMALIZATION METHOD IN MORE DETAIL.

A. IEEE 1366-2003 provides detailed guidance for the definitions and method of normalizing results for key reliability indices, such as SAIDI. Specifically, the IEEE guidance uses the "beta method" to identify MEDs. The data is then segmented into two categories, baseline data and MED data. The baseline data is then used to calculate SAIDI values. As described earlier in my testimony, MEDs are days on which the electric distribution system's operational and/or design limits have been exceeded and are therefore excluded in calculating the base-level SAIDI score.

As discussed in more detail below, the Company is moving toward using the IEEE 1366-2003 method for various reporting needs, and as such proposes to use this normalization method for purposes of the RPP.

Q. PLEASE EXPLAIN THE "BETA METHOD" ADOPTED IN THE IEEE GUIDE.

A. The IEEE beta method uses Daily SAIDI values as an indicator of the severity or rarity of outages. The beta method identifies any day having a Daily SAIDI above a predetermined threshold as a MED.

Q. HOW IS THE THRESHOLD DETERMINED?

A. The Daily SAIDI threshold value in the beta method is known as "T_{MED}". T_{MED} is determined statistically, based on the historical Daily SAIDI values from the preceding five years. The threshold is specific to the utility system whose SAIDI is being measured, and is recalculated each year. It is expected, statistically, that between two to three days per year will be classified as MEDs.

Statistically, T_{MED} is equal to the anti-log of the five year average plus two and a half standard deviations of the logs of all of the Daily SAIDI values during the preceding five years. For more details please see Attachment D of the RPP application filed on June 1, 2012.

Q. EVEN THOUGH MEDS ARE EXCLUDED FROM THE BASELINE RESULTS, DO YOU STILL REVIEW OUTAGE DATA FROM THOSE DAYS?

A. Yes. The data from days that exceed the threshold are segmented from other days and are separately analyzed to understand and improve the impact on our system of a MED.

Q. IS THIS NORMALIZATION METHOD WIDELY ACCEPTED?

A. Yes. This normalization method has not yet been universally adopted, but the method is gaining widespread acceptance throughout the United States and Canada. The IEEE method is tracked in all areas of Xcel Energy and is already being reported in some jurisdictions. To be consistent with reliability reporting which began with the PLUS Plan in 2001, Xcel Energy has continued to use its internal method of normalization in the reliability information reported to the Commission each year in its Annual Report of Regulated Earnings. As opportunities present themselves, Xcel Energy is proposing that reporting to jurisdictions move to the IEEE-1366-2003 method.

Q. DO YOU ALSO PROPOSE NORMALIZING CEMI?

A. Yes. The Company proposes that outages caused by events outside our normal design parameters, such as those during MEDs and due to public damage events be removed from the total CEMI count.

IV. HISTORICAL RELIABILITY OF NORTH DAKOTA SYSTEM

Q. HOW RELIABLE HAS XCEL ENERGY'S SYSTEM BEEN IN NORTH DAKOTA AS MEASURED BY SAIDI?

A. The Xcel Energy system serving North Dakota has been very reliable when compared to other states served by the Company and compared to other Midwest utilities.

Q. ARE THE HISTORICAL RESULTS CALCULATED IN A MANNER CONSISTENT WITH THE APPROACH PROPOSED IN THE RPP?

A. The historical SAIDI results provided in the RPP petition were restated using the IEEE normalization method (i.e., excludes days in which the Daily SAIDI exceeds a certain threshold). In past years, SAIDI results were reported to the Commission using our internal normalization method which excludes from our baseline data those days when the number of outage events exceeded a certain threshold. While the changes in methodologies produces slightly different results, they do not materially change the overall reliability story. Our analysis of the two methods suggests that the IEEE methodology actually results in *less* days being excluded from the normalized SAIDI results than the internal method.

Q. PLEASE DISCUSS HOW NORTH DAKOTA'S RELIABILITY RESULTS COMPARED TO OTHER JURISIDICTIONS SERVED BY XCEL ENERGY.

A. Results from 2007 through 2011 are shown in Exhibit___ (BC-1), Schedule 2, and demonstrate that Xcel Energy's SAIDI performance in North Dakota generally met or exceeded the other three Midwestern states served by Xcel Energy in four of the last five years. North Dakota's very good performance in 2009 was eclipsed by an unusually terrific result in South Dakota.

Q. HOW DID THE COMPANY'S NORTH DAKOTA RELIABILITY RESULTS COMPARE TO OTHER COMPANIES IN THE MIDWEST?

A. Our North Dakota results compare very well to the results of the annual surveys conducted by the IEEE which comprises data from investor owned utilities, municipalities, and electric co-operatives who volunteer to participate and compares reliability indicator results among the utilities.. When Xcel Energy's North Dakota service is compared to other Midwestern utilities' reliability performance in 2009 and 2010, the reliability of the Company's service to our North Dakota customers compares very favorably. In 2009 our North Dakota area ranked 8th out of 27 utilities and in 2010 it ranked 12th. I note, however, that due to various differences in outage collection methods, transmission providers, and operating environments, each utility's reliability metrics are not always comparable and may not fully demonstrate the very good reliability of service the Company has achieved in North Dakota. But, the IEEE survey is the best information available.

V. IMPLEMENTATION OF RPP

Q. WHAT IS THE COMPANY PROPOSING IN ITS RPP?

A. As explained in more detail in our petition and in the Direct Testimony of Company witness Mr. David H. Sederquist, the Company is proposing a three-pronged RPP:

- A reward based on annual earnings if the Company exceeds a SAIDI Excellence Threshold of 58.8 minutes;
- A $50, one-time, annual credit to all customers experiencing more than three sustained outages (more than five minutes) during the year; and

- Reporting of reliability-based customer survey results.

I will be testifying regarding the implementation of the first two items which will encourage the Company to achieve improved reliability measured in terms of all of our North Dakota customers, while providing a credit to individual customers who may have experienced multiple sustained outages.

A. EXCELLENCE THRESHOLD

Q. HOW WILL THE COMPANY DETERMINE IF IT MEETS THE SAIDI EXCELLENCE THRESHOLD OF 58.8 MINUTES?

A. The Company records each sustained outage along with the length of outage and the number of customers impacted in our Outage Management System. The Company then calculates the Daily SAIDI for each day of the year (all outages are assigned only to the day the outage started on, even if the final restoration is completed on a subsequent day). All outages occurring on a day that meets or exceeds the T_{MED} are then normalized from the final calculations. T_{MED} is annually established based on the method I explained previously. SAIDI will then be again calculated on a monthly basis using the number of our customers in North Dakota at the end of each month. Each month's SAIDI value will be summed up at the end of the year to produce our annual SAIDI score.

For the purposes of calculating SAIDI, the Company also proposes to change the method for counting customers from one based on the number of premises served to a new method based on the number of meters. A premise is a single facility receiving service, such as a duplex, while the customer meter count method counts each meter at the duplex as a customer. Using meter counts instead of premise counts results in a slightly different SAIDI number, but again does not materially change the overall trends. We believe the meter count method is an improvement to our historic method.

Q. PLEASE EXPLAIN HOW THE PROPOSED EXCELLENCE THRESHOLD OF 58.8 MINUTES WAS CALCULATED.

A. The Excellence Threshold is based on the annual SAIDI results for each of the last five years (2007 through 2011) using the IEEE normalization method. First, we determined the average SAIDI of this five-year period to be 72.0 minutes. At the request of Staff, we then made an effort to estimate the improvement to our SAIDI score that could be expected from the installation of the Intelliteam switches on some feeders in the Fargo area, which we committed to install in our last rate case. We determined that a reasonable forecast of the impact of the Intelliteam switches would be about 2.8 minutes. We then reduced our five-year average SAIDI score by this amount, giving us an adjusted average SAIDI of 69.2 minutes. We then applied an additional 15 percent improvement to this adjusted average to establish the Excellence Threshold of 58.8 minutes. The 15 percent improvement establishes a "stretch goal" that will require the Company to improve its SAIDI performance to achieve that incentive.

Q. HOW DID YOU DETERMINE THE ESTIMATED IMPACT THE NEWLY INSTALLED INTELLITEAM SWITCHES WOULD HAVE ON SAIDI TO ESTABLISH THE EXCELLENCE THRESHOLD?

A. The mainline portion of the feeders in the Fargo area has ties to other feeders. The Intelliteam switches will improve restoration time for mainline feeder outages only. Based on these two facts, we used the following information and assumptions to make our calculation:

- In 2011, mainline events contributed to 47.3 percent of the outage minutes in our North Dakota SAIDI calculation;
- Approximately 16.3 percent of North Dakota customers are served from feeders that will be protected by an Intelliteam Switch; and
- We estimate that about 50 percent of the customers impacted by any mainline outage would be restored through the use of the Intelliteam switches rather than manual restoration.

Using this information and assumptions, we multiplied each annual SAIDI result from 2007 through 2011 by the above three ratios -- 47.3 percent, 16.3 percent, and 50 percent – to determine the proportion of SAIDI that would be eliminated due to the protective function of the Intelliteam switches. This calculation resulted in an average savings of 2.8 minutes. For more details on this calculation, please see Attachment C of the RPP application.

Q. HOW ACCURATE DO YOU THINK YOUR ESTIMATE IS OF THE IMPACT THE INTELLITEAM SWITCHES WILL HAVE ON SAIDI?

A. It is difficult to forecast with precision the reliability improvement we will obtain from the Intelliteam switches. There are a variety of reasons for this. First, we cannot predict which specific feeders will experience an outage. Second, we do not know how often these feeders will experience an outage. Third, we do not know how quickly manual switching efforts will take as a result of having the switches in operation. Importantly, the percentage of customers restored through the automation of the Intelliteam switches is dependent on several variables including the feeder that experiences the outage, the location of the problem on the feeder, and the number of ties to surrounding feeders. While we used recent (2011) data as a proxy, the percentage of total outages due to mainline events can vary from year to year. Lastly, during the first year or two of Intelliteam operation, there is a chance that we will encounter "start-up" issues with the equipment as we gain operational experience with the effects of the Intelliteam switches on or North Dakota system. All these factors contribute to the difficulty of developing a very accurate estimate of the impact that the Intelliteam switches will have on our SAIDI score.

Based on this, I believe that the 2.8 minute reduction in the proposed Excellence Threshold is a reasonable way to account for the installation of the Intelliteam switches that that will still appropriately incentive the Company to continue to improve its reliability performance. Even if the effect of the Intelliteam switches on SAIDI is an improvement slightly more or less than the predicted 2.8 minutes, the 15 percent additional "stretch" necessary to meet the Excellence Threshold will require the Company to take other actions to achieve the 58.8 minute SAIDI level.

B. Outage Credit

Q. How is the Company proposing to determine which customers experienced more than three sustained outages in a given year?

A. In order to enhance reliability and improve the Company's ability to identify pockets of localized reliability issues, if any, the Company proposes to credit all customers who experience more than three sustained interruptions during any single calendar year during the RPP term. Interruptions occurring on major event days or due to publicly caused damage will not count toward the credit trigger for many of the same reasons that we normalize our SAIDI scores. We propose to use the metric of CEMI (>3), where CEMI stands for "Customers Experiencing Multiple Interruptions" and the "(>3)" refers to the threshold – more than 3 interruptions.

Our Outage Management System tracks individual outages and the physical service locations, impacted by each outage. At the end of the year, all qualifying CEMI outages are then cross-referenced to the related customer accounts in the CRS system to link the impacted customers. Further manual auditing is performed to help ensure every customer that is eligible for $50 credit in that calendar year receives it.

Q. How did the Company determine that five minutes should constitute a sustained outage?

A. The five-minute threshold is consistent with IEEE 1366-2003 normalization standard. Momentary outages are not included in the reliability calculations so we can allow time for protective equipment and automatic equipment to complete their isolation process.

Q. CAN YOU EXPLAIN WHY CEMI SHOULD BE USED AS A RELIABILITY INDEX IN ADDITION TO SAIDI?

A. Yes. While the SAIDI metric is widely used and valuable in providing a broad measure of system reliability, it reflects a high-level, overall average view, and is not as effective in indicating the existence or location of local reliability issues where individual customer experience is substantially different from that of an average customer.

Q. DOES XCEL ENERGY TRACK CEMI AND PROVIDE SERVICE QUALITY CREDITS IN OTHER JURISDICTIONS?

A. Yes we do in both Minnesota and Colorado. However, customers in those states must experience more than *five* sustained outages in a calendar year before they qualify for the $50 credit.

C. Other Reliability Measurements

Q. WHY DIDN'T THE COMPANY PROPOSE TO USE CAIDI AND SAIFI IN THIS RPP?

A. Our objective – and Commission Staff's preference – in developing the RPP was to guard against unnecessary complexity while employing a broad, industry-accepted system reliability metric. SAIDI provides a comprehensive indicator that captures both outage frequency and duration measurement.

An interesting phenomena can occur with the CAIDI measure that gave us additional pause when we were determining appropriate metrics to use in our RPP. While CAIDI is generally a good overall indicator of how quickly service is being restored, it may not accurately reflect certain kinds of reliability improvements being made by a utility. For example, a utility may seek to improve reliability by focusing on restoring large feeder-level outages more quickly (to the point that they are no longer sustained outages). However, assuming the less impacting, non-feeder level (but longer) outages remain the same, than CAIDI can actually increase!

Q. HOW CAN MAKING IMPROVEMENTS TO REDUCE FEEDER-LEVEL OUTAGES INCREASE THE AVERAGE INTERRUPTION DURATION MEASURED BY CAIDI?

A. A good example is the Intelliteam switch project in Fargo. Currently, the Company is installing these high-tech automated switches on certain high-load feeders on its Fargo distribution system. When these switches operate during a mainline outage, the system is automatically segmented, power is rerouted, and large groups of impacted customers are back in service within seconds. Since the duration of most of the related customer interruptions will be far less than five minutes long, certain outages will no longer qualify as sustained outages. This reduces the frequency of outages (measured by SAIFI), but because there are now less customers experiencing *sustained* feeder-level interruptions, the remaining types of outages that typically take longer to restore and are not protected by the switches (those occurring on primary and other non-feeder lines) and would then constitute a larger majority of outage events and therefore have a greater impact on CAIDI.

The example in Exhibit___ (BC-1), Schedule 3 illustrates hypothetically how CAIDI in North Dakota could have been higher in 2011 than it actually was had the automated switches had been operational during the year.

VI. CONCLUSION

Q. DOES THIS CONCLUDE YOUR TESTIMONY?

A. Yes, it does.

Betsy Coppock, PE
Principal Specialty Engineer   Electric Distribution System Performance
Xcel Energy Services Inc.
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Current Responsibilities

Responsible for monitoring, analyzing, and reporting distribution system reliability performance. This includes monitoring Xcel Energy's and NSPM's year to year performance using a number of industry standards, comparing reliability between areas of Xcel Energy and other utilities and developing programs to improve the reliability of the system. My current focus areas are overhead system performance and supporting regulatory relationships relative to system reliability.

Previous Employment 1985-2003

Model Coordinator, Resource Management-Xcel Energy Services Inc.
Principal Planning Engineer, Transmission Reliability Assessment, -Xcel Energy Services Inc.,
New Century Energies, Public Service Company of Colorado
Engineer, Electric Distribution Planning, Public Service Company of Colorado

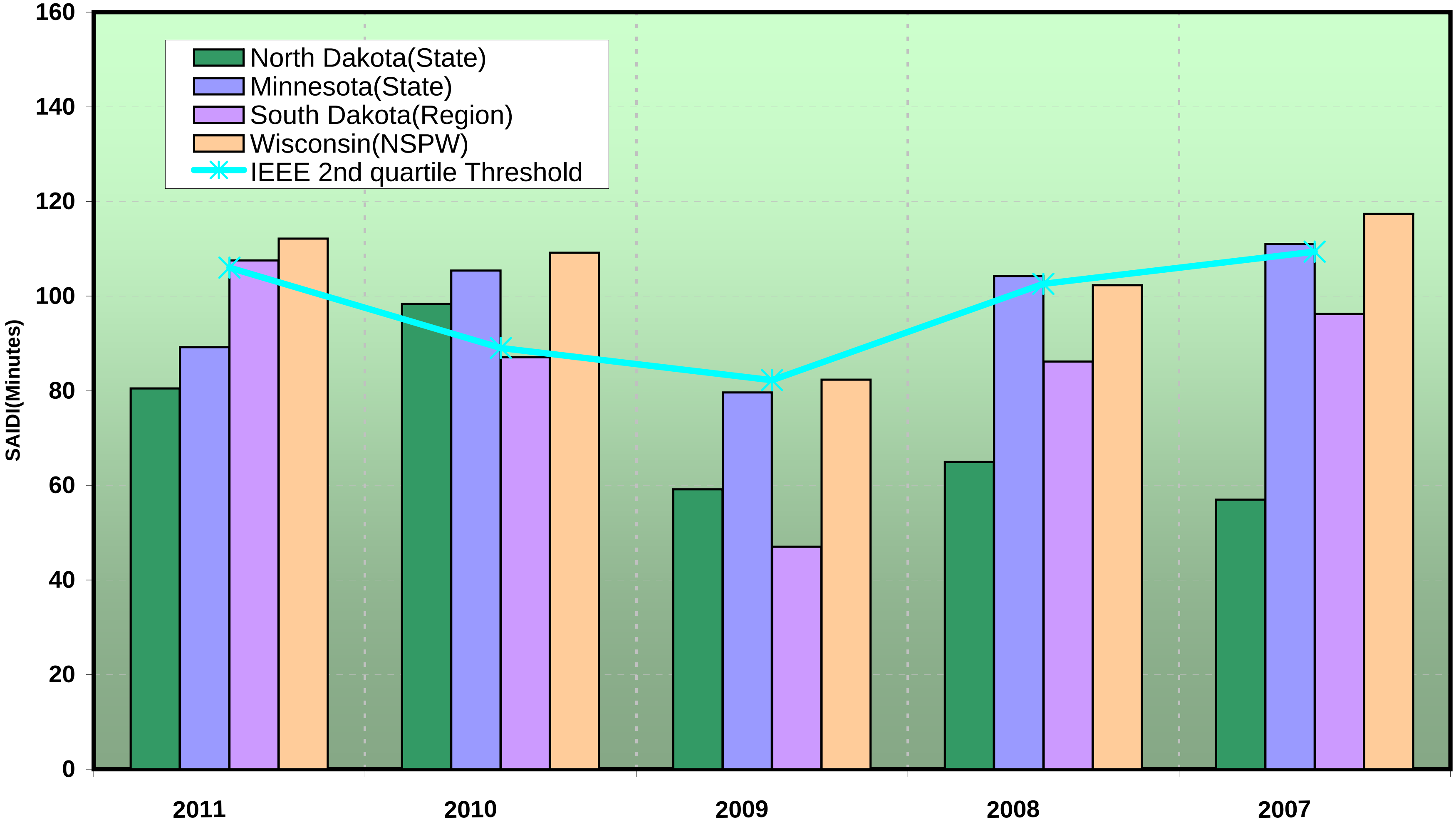
Education

University of Colorado, Boulder, Colorado
Bachelor of Science – Electrical Engineering
December 1984

Licensed Professional Engineer
State of Colorado - #29076

Reliability Results for Other Jurisdictions Served by Xcel Energy

2007-2011 System(All Levels) SAIDI
(IEEE Normalized)



Based on sustained outages only(> 5 minutes)
Meter Based Customer Counts

Example of how CAIDI can go up when reliability improves.

Outages in ND primarly are made up of Feeder level and overhead primary events.

Before Automated Switches are installed		Feeder	Overhead Primary	Total
Customer Minutes Out	CMO	2,113,385	1,667,064	3,780,449
Sustained Customer Interruptions	SCI	31,898	13,845	45,743
	CAIDI = CMO/SCI	66.3	120.4	82.6

As feeder CMO decreases, longer tap outages drive CAIDI higher

When automated switches are installed the # of customers affected by an outage on a feeder level could be reduced by 50%

	Feeder	Overhead Primary	Total
CMO	1,585,039	1,667,064	3,252,103
SCI	15,949	13,845	29,794
CAIDI = CMO/SCI	99.4	120.4	109.2