OAH No. 3-2500-21662-2, MPUC Dkt No. IP6701/WS-08-1233

STATE OF MINNESOTA

OFFICE OF ADMINISTRATIVE HEARINGS

FOR THE MINNESOTA PUBLIC UTILITIES COMMISSION

IN THE MATTER OF THE APPLICATION BY AWA GOODHUE WIND, LLC

FOR A SITE PERMIT FOR A LARGE WIND ENERGY CONVERSIONS SYSTEM FOR A 78 MW

WIND PROJECT IN GOODHUE COUNTY

DIRECT TESTIMONY

OF

PAUL (PETE) MALAMEN

VICE PRESIDENT/SR. PROJECT MANAGER

CONSULTING ENGINEERING GROUP, INC.

ON BEHALF OF

AWA GOODHUE, LLC

JANUARY 28, 2011

DIRECT TESTIMONY OF PAUL MALAMEN

TABLE OF CONTENTS

BEFORE THE MINNESOTA PUBLIC UTILITIES COMMISSION

DIRECT TESTIMONY OF PETE MALAMEN

I. INTRODUCTION AND QUALIFICATIONS

Q: Please state your name and business address.

A: My name is Paul (Pete) Malamen. My business address is: 21210 Eaton Ave # C, Farmington, MN 55024-7949. I am testifying on behalf of AWA Goodhue, LLC.

Q: By whom are you employed and what is your position?

A: I am employed by Consulting Engineers Group, Inc., a subsidiary of Dakota Electric Association. I am a Vice President and Senior Project Manager at CEG in Farmington. CEG has a staff of 10, including four professional electrical engineers. Dakota Electric Association is a member-owned, nonprofit electric utility serving parts of Dakota, Goodhue, Scott, and Rice counties in Minnesota.

Q: Please describe your educational background.

A: I received a Masters of Science degree in Electrical Engineering from the University of Minnesota in 1973 and a Bachelor of Arts degree from St. Olaf College in 1971.

Q: Have you taken any specialized courses related to electric power engineering?

A: Yes, most of my classes at the University of Minnesota concentrated on electric power generation, load flow and electric power system analysis.

Q: Are you a registered professional engineer?

A: Yes, I am a registered professional engineer in the state of Minnesota and have been since 1983.

Q: What has been your employment history?

A: I worked for McLeod Cooperative Power Association from 1978 to 1985 as the System Engineer for the Cooperative. In 1985, I went to work for Earth Energy Systems, a subsidiary of Control Data Corporation that was involved in wind development. From 1986 to 1989, I worked at ABB as a system engineer designing and testing load management systems. I went to work for Minnesota Valley Electric Cooperative from 1989 to 1990 as the Operations Manager and supervised all engineering and construction of the Cooperative's distribution and substation facilities. From 1990 to 1999, I worked at HDR, Inc. as a project engineer designing substations, distribution and transmission lines and doing distribution system studies. In 1999, I joined Consulting Engineers Group where I presently work as a Project Manager supervising the design and construction of wind farm substation and collection systems.

Q: Have you had any involvement with stray voltage issues?

A: Yes, I have. I first became involved with stray voltage in 1980 at McLeod Cooperative Power and was involved in investigating causes of stray voltage for the utility until I left in 1985. I was also involved with stray voltage issues at Minnesota Valley Electric Cooperative.

Q: Have you had any involvement with wind projects?

A: Yes, I have worked on several wind projects in Minnesota and been involved in interconnection issues for over 1000 megawatts of wind development around the region. For example, in Minnesota I have worked on the design of the 345/34.5 kV substation for the Lakefield Wind Project in Jackson County. I have worked with Carstenson Contracting on the design and construction of the Community Wind Project in Lincoln County. I also have recently worked on the design and construction of the Danielson Wind Project in Meeker County and the collection and feeder lines for the Adams Wind Project also in Meeker County.

Q: What is the purpose of your testimony today?

A: The purpose of my testimony is to explain what is generally referred to as stray voltage in the context of animal confinement areas and to explain why I believe stray voltage will not be a problem with the Goodhue Wind Project. I will also describe how tests for stray voltage at a farm are conducted and present cost and time estimates for performing stray voltage tests.

Q: Please summarize your testimony.

A: Stray voltage is a term that has been used to describe neutral-to-earth voltages that occur in animal confinement areas where grounded neutral systems are used to supply electric power such as that provided by Xcel Energy or rural electric cooperatives. Stray voltage is not caused by transmission lines, or by wind turbines, or the collection feeder lines that are part of a wind project because wind projects are entirely separate from the systems that provide electricity to nearby farms and do not use a grounded neutral conductor to carry any part of the normal load current. A complete stray voltage test costs approximately $3000 to $5000 and takes about 24 hours to do.

II. STRAY VOLTAGE

Q: What is stray voltage?

A: The following definition from the Public Service Commission of Wisconsin is a well-accepted explanation of stray voltage.

> **Stray Voltage (SV)** – … is defined as a natural phenomenon that can be found at low levels between two contact points in any animal confinement area where electricity is grounded. Electrical systems - including farm systems and utility distribution systems - must be grounded to the earth by code to ensure continuous safety and reliability. Inevitably, some current flows through the earth at each point where the electrical system is grounded and a small voltage develops. This voltage is called neutral-to-earth voltage (NEV). When a portion of this NEV is measured between two objects that may be simultaneously contacted by an animal, it is frequently called stray voltage. Stray voltage is not electrocution and is not DC, ground currents, EMFs or earth currents. It only refers to farm animals that are confined in areas of electrical use and not to humans.

This definition is found in a 2002 Glossary of Terms available at:

http://psc.wi.gov/utilityInfo/electric/documents/strayVoltage/glossary.pdf

Q: What does that mean in laymen's terms?

A: At normal homes and farms served by a single phase electrical service provided by the utility, the neutral or grounded conductors are all connected together at the service point (i.e., at the service point at which the farm grounding system is connected to the utility's grounding system). As the electrical load at the account increases, the return current to the substation increases and, depending on the resistance of the grounds, small voltages between the neutral or grounding conductor and an isolated ground rod can be measured. This is the neutral to earth voltage or "stray voltage." I include a depiction of how stray voltage may occur in AWA Ex. 4-A.

Also, since the National Electrical Code requires all equipment to be grounded, all metal parts in a barn are generally connected to this "neutral or ground conductor" and therefore the same voltage can be transferred to the equipment in a barn. This means that when a dairy cow touches a nearby object like a metal pipe while the cow's feet are on the ground, there can be a small voltage across the cow's body and a small current can flow through the animal from one point (the earth) to a second point (the pipe). The voltage difference between the two points will not be very large, usually less than 1 or 2 volts. What the animal reacts to is not the voltage, but the current that is associated with the voltage difference.

Q: What causes this neutral-to-earth voltage to occur?

A: This neutral-to-earth voltage can be caused by electrical problems on the farm or by the interconnection with the utility lines or by both. Most neutral to earth voltage problems, however, are caused by wiring problems on the farm. It is important to note that these conditions

have been identified over the last few decades on farm sites where no wind farms are operating or even contemplated.

III. STRAY VOLTAGE AND WIND PROJECTS

Q: Is stray voltage an issue with wind projects?

A: No, the operation of wind projects does not result in the creation of stray voltage on nearby farms.

Q: Why not?

A: Wind projects do not result in the creation of stray voltage at nearby farms, because the wind project collection system is a "separately derived system" from the electrical system on the farm under the definition of a "separately derived system" in the National Electrical Code and does not generate any ground or neutral currents like a normal electrical distribution system.

Wind project collection systems will have none of its electrical current flow through nearby farms because the farm receives their power from an entirely separate electrical distribution system provided by the local utility. The wind project will have its own substation and transformers.

Each wind turbine has a ground wire installed for safety purposes. This equipment ground is part of the same type of underground cable that is used generally in the electric industry, including that used by the local distribution utility. This equipment ground ties together all the groundings at each turbine that is part of the wind project. Three cables will be installed in a trench for the three-phase collection system. There also will be a fiber optic cable installed in the trench for communication purposes.

There are no ground currents generated in the wind farm collection system because of the type of transformer used at each turbine. Under normal operation, there is no intentional current

in this ground wire, either when the turbine is not operating or when it's operating at its maximum generation. Without a current in the ground wire, there can be no neutral-to-earth voltage (stray voltage) on the wind farm collection system or put on the distribution system in the area. *See* AWA Ex. 4-A. All current flow is in the insulated underground conductors.

Q: Are you aware of any stray voltage concerns developing at other wind projects?

A: I try to keep advised of developments in the wind industry, and I am not aware of any stray voltage complaints being filed with regard to any wind project in Minnesota, or in the entire country for that matter.

IV. STRAY VOLTAGE TESTING

Q: How do you test for stray voltage?

A: The basic method used to test for stray voltage is to measure the voltage between grounded neutral or equipment ground conductor at the barn's electrical service panel and an isolated ground rod placed away from other electrical equipment. A recording voltmeter with the appropriate voltage range is used to measure this voltage over time. Instantaneous voltage readings can also be taken. The voltage needs to be recorded over time, for at least 24 hours (i.e., over two milking periods) because the voltage will change over time as the electrical load on the farm and on the same distribution circuit goes up and down. To get a complete picture, voltages need to be recorded at more than one electrical service panel, such as the electrical service entrance to the farm. Cow contact voltages can also be measured (i.e., voltages from metal equipment the cow may touch and the feet area). A complete test includes a load test where a known load (i.e., 20 kW electric heater) is connected to the farm wiring and without an electrical connection between the farm and the utility. In order to do this test, linemen from the utility need to be present.

Q: What do stray voltage tests normally show?

A: Stray voltage tests normally show a small amount of voltage, usually less than a volt or two (AC), that is between the grounded neutral or equipment ground conductor on the farm and an isolated ground rod. Currents can be measured by putting a 500 ohm resistor in the circuit, which in effect acts like a cow's body. The voltages and currents are small enough that they cannot be felt by humans. Stray voltage tests are purely physical measurements of voltage and do not attempt to determine whether the stray voltage has any effect on the animals.

Q: Does a stray voltage test determine the source of the current or voltage?

A: No, simply measuring the voltage across two points does not tell you why there is voltage between the grounded neutral conductor and the isolated ground rod. Additional tests are required to make that determination. Problems or causes are normally found by inspection and/or process of elimination.

Q: Is it necessary to test for stray voltage in a wind farm project area?

A: In my opinion, no. As I said above, I have not heard about any stray voltage problems being linked to wind farm operations. Also, for a wind farm to cause "neutral-to-earth" voltage rise on the farm or utility neutral, there needs to be some way for the wind farm to cause steady state current to flow in the neutral conductor of the utility. This is not possible.

Q: How much does it cost to do a stray voltage test?

A: A complete "stray voltage" test will take two people from 16 to 24 man hours on site with specialized equipment and then time to write a report and summarize the data. The estimated cost is on the order of $4,000 per farm. In addition, coordination needs to be done with the local utility and there may be some charges incurred there.

Q: Is there any cost savings in doing numerous stray voltage tests at many farms?

A: Not really. A stray voltage test will cost pretty much the same regardless of whether you drive out to one site or to a hundred sites.

Q: How many feedlots are in the project area and within one mile of the permit boundary?

A: According to data AWA Goodhue obtained from Goodhue County in October 2010, there are approximately 200 feedlots within the project area and within one mile of the permit boundary.

Q: How much time would it take to run a stray voltage test at two hundred different sites?

A: As I explained above, the voltage needs to be recorded over at least a 24 hour period. The person doing the test needs to visit with the property owner to get an understanding of electrical wiring on the farm and to explain what the tests show. These sites will have to be revisited at the end of the testing period to collect the equipment and then summarize the finding in short report. My best estimate is that it would take a minimum of 20 weeks for two testing crews to do the actual stray voltage tests at 200 different locations (assumes 10 hours per day). This does not include time to write reports. Reports and documentation will add another two to three weeks.

V. GOODHUE COUNTY PROJECT

Q: What has been your involvement with the AWA Goodhue wind project?

A: CEG has contracted with Carstensen Contractors (the selected general contractor for the AWA Goodhue project) to design and build the electrical collection system, substations and transmission line for the project.

Q: Is there anything unique about the AWA Goodhue wind project as compared to other wind projects in Minnesota?

A: There is nothing unique about this project that I am aware of. The wind turbines, the collection system, the substations, the transformers, are all similar or identical to what is in operation at other wind projects in the state.

Q: Is there anything unique about Goodhue County that makes farms in the area more susceptible to stray voltage?

A: There are no factors that I am aware of that make farms and feedlots in Goodhue County unique from the standpoint of stray voltage. Stray voltage has been more of a concern with dairy farms than with other types of feedlots but as far as agricultural operations go in Goodhue County, I can identify no factors that make the county unique from that standpoint.

VI. CONCLUSION

Q: Does this conclude your testimony?

A: Yes it does.