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April 7, 2016

Ms. Patricia Van Gerpen, Executive Director
South Dakota Public Utilities Commission
State Capitol Building
500 East Capitol Avenue
Pierre, South Dakota 57501-5070

Re: Docket Number RM16-001 – In the Matter of the Adoption of Rules Regarding Stray Electrical Current and Voltage Remediation

Dear Ms. Van Gerpen:

Xcel Energy appreciates this opportunity to offer the following comments regarding the rule making and development of standards implementing South Dakota law around Stray Voltage.

Following are proposed updates/recommendations to rule numbers 20:10:39:10 (3), 20:10:39:45, 20:10:39:57, 20:10:39:58, and 20:10:39:59.

20:10:39:10 (3). **General requirements for stray voltage measuring and recording.** Equipment used for the measurement or testing of stray voltage, current, and resistance shall meet the following criteria:
A clamp-on ammeter, digital multi-meter with clamp-on device, or an in-line ammeter is used to measure current between two points. The meters must be capable of separating and independently measuring alternating current and direct current and capable of measuring the true-root mean square current. A ~~clamp on ammeter must have the required resolution and accuracy;~~ current measurement can be prone to erroneous results due to instrument wear and influences of surrounding radio frequency signals and electro-magnetic fields. If choosing to take current measurements, one must also measure the voltage across the 500 ohm

resistor to confirm the current measurement satisfies ohms law and meets the accuracy, resolution, and steady state requirements.

Xcel Energy believes this updated language should be included because current measurements in the 0-5 mA range in the field are difficult to achieve the required accuracy and resolution. This is especially the case in environments often encountered on farms. Until these issues and concerns are clearly resolved, a voltage measurement across the 500 ohm resistor must also be done to confirm the current measurement satisfies ohms law.

20:10:39:45: **Measurements used for the secondary neutral voltage drop test.** For the secondary neutral voltage drop test, the three voltages (cow contact voltage, primary neutral to reference voltage, and secondary neutral to reference voltage) are measured with the proxy load "off" and "on." "Calculated expected voltage drops are compared with measured voltage drops. If the measured and calculated voltage drops differ significantly, further investigation must be undertaken to determine the source of additional voltage drop within the circuit. Neutral current is measured and recorded with the proxy load "on."

In the hearing on March 28, 2016, the commission asked all parties to define what is considered "significantly" as stated in the rule. Xcel Energy is proposing to leave the language as it is stated for the following reasons:

- There may be cases where the length of conductor is very uncertain especially with underground feeders where the farmer is not sure on route taken with the conductors. There may also be situations where volt drop has little to no impact on stray voltage level such as with effective 4 wire systems or when the animals are confined on EPPs. Though there is a difference in calculated verses measured volt drop, the neutral is still well within safe and effective operating condition and has no potential of contributing to a stray voltage problem.
- There are other cases where the neutral is operating in a safe and effective manner but improvements in the connections or replacement of the neutral conductor will be very helpful in reducing the stray voltage levels at the animal contact areas.
- A percentage or quantifiable parameter to determine when to further investigate the sources of a neutral voltage drop will not fit all scenarios.

20:10:39:57: **Determination of any contributions to stray current or voltage for single phase dairies.**
The utility contribution to cow contact voltage or cow contact current is determined using the following formulas:
(1) Utility contribution to cow contact voltage= ((Vp48-Vp Half) *I* (Vp Full -Vp Half)) x (Vee Full -
Vee Half)+ Vee HALF; or

(2) Utility contribution to cow contact current= ((Vp48 -Vp HALF)/ (Vp FULL-Vp HALF)) x (Jee FULL
- Jee Half)+ Ice HALF.

The values determined are compared to the preventive action level.

As an alternative to the existing language, Xcel Energy is proposing the following in its place:

The utility contribution to cow contact voltage or cow contact current is determined using the following ~~formulas~~:

~~(1) Utility contribution to cow contact voltage= ((Vp48-Vp Half) *I* (Vp Full -Vp Half)) x (Vee Full -
Vee Half)+ Vee HALF; or~~

~~(2) Utility contribution to cow contact current= ((Vp48 -Vp HALF)/ (Vp FULL-Vp HALF)) x (Jee FULL
- Jee Half)+ Ice HALF.~~

Cow contact voltage or cow contact current are measured with the load box set at FULL LOAD (18-24 kW) and recorded with the farm off. This measurement represents the utility contribution to stray voltage or current.

The values determined are compared to the preventive action level.

Xcel Energy believes this updated language should be made because the proposed change eliminates on farm contributions from influencing the determination of the off farm contribution. This is also a much simpler approach and more widely accepted.

20:10:39:58: **Determination of any contributions to stray current or voltage for three-phase dairies.**
The utility contribution to cow contact voltage or cow contact current for dairies with three-phase balanced load service is determined by directly using the results of the load box test results for step 1 and step 2 as specified in§ 20:10:39:50.
The cow contact voltage measured during step 1 of the load box with the load box "off' and the dairy "on" will be the total cow contact voltage. The cow contact voltage measured during step 2 of the load box test with the load box "off' and the dairy "off' is the contribution to cow contact voltage from the utility or Vccutility. The contribution to cow contact voltage by the dairy is the difference between cow contact voltage and cow contact voltage from the utility. The formula is: Vccdairy =Vee -Vccutility.

As an alternative to the existing language, Xcel Energy is proposing the following in its place:
~~The utility contribution to cow contact voltage or cow contact current for dairies with three-phase balanced load service is determined by directly using the results of the load box test results for step 1 and step 2 as specified in§ 20:10:39:50.~~
~~The cow contact voltage measured during step 1 of the load box with the load box "off' and the dairy "on" will be the total cow contact voltage. The cow contact voltage measured during step 2 of the load box test with the load box "off' and the dairy "off' is the contribution to cow contact voltage from the utility or Vccutility.~~
~~The contribution to cow contact voltage by the dairy is the difference between cow contact voltage and cow contact voltage from the utility. The formula is: Vccdairy =Vee -Vccutility.~~

The utility contribution to cow contact voltage or cow contact current is determined by using the following:

Cow contact voltage or cow contact current, are measured with the farm off. This measurement represents the utility contribution to stray voltage or current.

The values determined are compared to the preventive action level.

Xcel Energy believes this updated language should be made because the proposed change eliminates on farm contributions from influencing the determination of the off farm contribution. This is also a much simpler approach and more widely accepted.

20:10:39:59: **Written report required - Copy to the dairy producer.** Within a reasonable period of time after completion of any tests required to be performed by the utility under this chapter, a qualified analyst shall prepare a written report. The report shall include a summary of the tests performed, a copy of the drawing of the dairy prepared pursuant to § 20:10:39:25, all of the data or results obtained from the tests, and an analysis of the data or results obtained from the tests. If remediation is required by SDCL 49-47-3, the report shall specify the actions taken or to be taken. The utility shall provide a copy of the written report to the dairy producer.

In the hearing on March 28, 2016, the commission asked all parties to define what is considered a "reasonable period of time" as stated in the rule. Xcel Energy believes a 30 day window to be an adequate amount of time to satisfy this rule.

The Company looks forward to having the opportunity to further explain these proposed changes should the commission require additional information.

If anyone has any questions, please contact me at 1-605-339-8303.

Sincerely,

Eric Pauli

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