Answers to Farm Stray Voltage Questions

What is Farm Stray Voltage?

Electrical distribution systems and electrical systems on farms, homes and businesses are typically grounded to the earth via a connection to the neutral point of the power system. This is required to promote safety and reliability. Grounding of these electrical systems results in some amount of electrical current flowing through the earth. The current flow will have a very small voltage associated with it and present at the points where the system is connected to ground. This voltage is called neutral-to-earth voltage (NEV). When the NEV is found between two points that may be contacted simultaneously by an animal (animal contact points), it is frequently called "farm stray voltage" or "tingle voltage".

What Causes Farm Stray Voltage?

Multiple electrical sources may cause farm stray voltage:

1. On-Farm Sources

   Various equipment and/or wiring related issues in On-Farm power systems may cause farm stray voltage such as; incorrect wiring, unbalanced farm loads, poor equipment grounding, defective equipment, electrical load with high harmonic currents, voltages from telephone lines or gas pipelines, etc.

2. Off-Farm Sources
   For safety reasons, when Kitchener-Wilmot Hydro supplies power to a farm, Kitchener-Wilmot Hydro's neutral system is always connected to a farm's grounding system. While this bond is necessary to protect people and animals from shocks caused by electrical faults and lightning strikes, it may also result in or contribute to the farm stray voltage if NEV is present.

Can Farm Stray Voltage Be Totally Avoided?

No. In a properly functioning On-Farm power system and Kitchener-Wilmot Hydro’s distribution system, load cannot always be balanced perfectly and NEV will always exist between the neutral conductors and the earth, causing farm stray voltage. However, it is possible to take measures and mitigate the magnitude and impacts of farm stray voltage.

How Much Can Farm Stray Voltage Affect the Farm Operation?

The mere presence of stray voltage does not necessarily affect livestock. What is important, is the level of stray voltage present between two livestock contact points, which causes animal contact current flowing through the livestock. Much research has been done to determine the level of stray voltage needed to affect dairy cattle in different ways.

The United States Department of Agriculture has found that the level of animal contact current that elicits the first signs of awareness by livestock is 1 to 3 milliamps (mA), with no milk production loss in this range. Moderate behavioural changes in livestock are expected in the range of 3 to 6 mA. Research has shown no significant changes in feed/water consumption or milk production for currents at or below 4 mA. When current levels were tested at 1.5 times the amount that caused behavioural response, a short-term reduction in water/feed intake and milk production was noticeable only in some livestock.

What is the Current Limit for Animal Contact Current in Ontario?

According to Appendix H of the Distribution System Code by Ontario Energy Board, the current threshold for animal contact current is 2 milliamps, which is equivalent to an animal contact voltage of 1.0 volt for an animal (like a cow) with body resistance of 500 ohms. If the threshold is exceeded, the contribution to animal contact current from Kitchener-Wilmot Hydro’s distribution system should not be more than 1 milliamp (0.5 volt). Investigation is required to determine the animal contact current and Kitchener-Wilmot Hydro’s contribution.

How Do I Know if My Farm Has a Stray Voltage Problem?

Most of the research associated with farm stray voltage has been focused on dairy cows. The reported symptoms exhibited by dairy cows that are thought to be affected by farm stray voltage include:

1. Reluctance to enter milking parlour or stall
2. Reduced water or feed intake
3. Nervous or aggressive behaviour
4. Uneven and incomplete milkout
5. Increased mastitis
6. Lowered milk production
7. Reduced growth

The above symptoms may also result from other non-electrical farm factors such as disease, poor nutrition, unsanitary conditions or milking equipment problems. Farmers should consider and investigate all possibilities when attempting to resolve these symptoms.

Who Shall I Contact if a Farm Stray Voltage Problem is Suspected?

If you think you have a Stray Voltage problem, please contact Kitchener-Wilmot Hydro:

Kitchener-Wilmot Hydro Inc.
301 Victoria Street South
Kitchener, Ontario, N2G 4L2
Phone: 519-745-4771
Fax: 519-745-0643

Our office hours are Monday to Friday 8:30 AM to 4:30 PM.

Kitchener-Wilmot Hydro will schedule a site visit, if warranted, and perform the appropriate measurements to determine if farm stray voltage is present on your farm.

For further information, please see document entitled "Kitchener-Wilmot Hydro – Farm Stray Voltage Customer Response Procedure".

What are the Common Remedies for Farm Stray Voltage?

In the event that Kitchener-Wilmot Hydro's contribution to farm stray voltage exceeds the limits, Kitchener-Wilmot Hydro will implement mitigative solutions to lower its farm stray voltage contribution to within prescribed levels, using one or more of the following methods:

1. Repair any loose, corroded or other high resistance connections
2. Load balancing
3. Improve Grounding
4. Re-sizing Neutral Conductors
5. Isolation of Neutrals
6. Convert single-phase circuit to three-phase circuit

The particular solution will depend on Kitchener-Wilmot Hydro’s equipment servicing the farm, the extent of the problem and other technical factors.

Where can I learn more about Stray Voltage?

For additional information on the effects of stray voltage on livestock see the links below.

- Ontario Ministry of Agriculture, Food and Rural Affairs: Ministry of Agriculture Stray Voltage Link
- University of Wisconsin: University of Wisconsin Website link
- United States Department of Agriculture, Handbook 696, "Effects of Electrical Voltage/Current on Farm Animals; How to Detect and Remedy Problems".