



## **Farming - Stray voltage and ground current: Separating fact from fiction**

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Common sense tells us that water and electricity don't mix. Still, unfortunately, our livestock barns are by nature a damp environment, dependent on electricity for fans, feeding equipment, lights, water pumps, heaters and milk coolers. It is critical to ensure that electrical equipment is in good condition and that corrosion does not allow current to "leak" from the wiring system and onto the grounding system. Fortunately, a new understanding of how electricity can "leak" from the utility supply and on-farm systems and new monitoring technology can help us better detect and mitigate (in many cases) this longstanding problem.

### **What is stray voltage?**

The delivery and use of electricity causes stray voltage. A voltage differential may be measured between two conductive surfaces. Examples of conductive surfaces include flooring, metal stabling, milk pipelines, and water bowls. This voltage is known as animal contact voltage, stray voltage or tingle voltage. If the voltage level is high enough, it may affect livestock behaviour and health. For dairy cows, for example, this can express as; nervousness, uneven milk production, increased inflammation in their udders, reluctance to eat feed or drink water and reproductive issues. In severe cases, it may impact people working in barns, and animals may die. While most cases are reported on dairy farms, beef, swine, equine, and other species must be aware of the issue that can impact animals where electricity, metal penning and moisture are part of the housing systems.

### **What causes stray voltage?**

Stray voltage can originate from a utility's electrical distribution system or the farm's electrical equipment. There are both off-farm (utility and neighbours) and on-your-farm sources to consider:

#### ***On-farm sources:***

- Poor or faulty wiring – poor connections, damaged conductors that leak electricity to the ground
- By nature, water heaters and heated water bowls are at high risk of leaking electricity into the water system or trough.
- Grounding and bonding issues with damp/wet electrical connections
- Motors or pumps with wet wires leak electricity through the metal frame to the ground
- Overloaded circuits or panels

- Variable frequency drives and pumps with improper EMI filters or the correct shielded cabling.
- Improperly installed electrical equipment - incorrect wires, open neutrals or grounding

### **Off-farm sources:**

The utility supply wires and distribution system (resistance in overhead lines, bad splice joins, imbalanced loads and undersized primary neutral wires) are the primary cause of off-farm contribution. Voltages occasionally come into the farm from utility systems, including telephone or gas lines. Defective equipment at your neighbours can also leak electricity into the ground, impacting your farm. Problems with an electric fence or faulty well pump can affect nearby farms.

Where voltage (or current) levels are above accepted thresholds, investigations usually find a combination of two or more contributing factors. New monitoring equipment can help measure this risk in real time and help us determine the root causes.

The Ontario Energy Board requires local distribution companies (LDC) to investigate where a livestock farm customer provides the distributor with information that reasonably indicates that farm stray voltage may adversely affect the operation of the customer's farm. The LDC is required to mitigate their stray voltage contribution if the animal contact current (ACC) exceeds 2.0 mA or animal contact voltage (ACV) exceeds 1.0 V. These investigations have also determined that the customer's electrical system could be the cause of the problem with deteriorated wiring/equipment or non-code compliant installations found on the farm.

### **Concerns about testing:**

Testing on Ontario farms has noted harmful animal impacts at levels below these thresholds used by regulators and that testing procedures do not always duplicate the actual barn conditions of where an animal would sit, stand or lay. Lorne Lantz, a Wellesley area electrical technician, comments, "Concrete is a poor conductor of electricity (unless wet and dirty) that common testing procedures do not adequately duplicate what a cow in an actual barn might be experiencing."

Measuring these ground currents and stray voltage problems poses a myriad of problems as voltage problems may not be present at the time of testing and may only appear when specific loads are on the utility delivery system (large farm or factory down the line) powers cycles on or off to different equipment, (water heater, milk cooler et.), other times of the day or even with vary with season and ground moisture. Investigating problems requires experienced specialists using several testing procedures and data loggers to take measurements over several days to track intermittent incidents.

### **How would I know if I have an issue?**

Have you noticed flickering lights? Animals jump if you turn on a pump or switch on any specific piece of equipment. Animals react when the water heater, milk cooler or other equipment cycles? Have you experienced shocks or tingles when you touch the equipment, your hands are wet, or you have a cut on your hand? These are symptoms of electrical leakage on the farm and require investigation with the help of a qualified electrician with experience in farms and tingle voltage.

*Additionally, animal symptoms may include:*

- Decreased feed and water intake (get a shock every time you touch a bowl or trough)
- Reduced milk production – high somatic cell counts - uneven and incomplete milk out
- Reluctance to enter the milking parlour/barn
- Nervousness and aggressive behaviour
- Unexplained mortalities
- Less than expected rate of weight gain
- Increased somatic cell count
- Lameness in feet and legs, sores that will not heal
- Impact on reproduction: False heats, increased abortion rates, birth defects, drop in conception

### ***On-farm actions: Testing***

There are many electrical technicians and licenced electricians with testing experience that can help assess your farm. Testing must be done from various reference points and between the equipment and a reference ground stake away from the barn. Hydro One also has a response team with experience in testing that can set up monitoring equipment to test for current over several days.

### ***On-farm actions: Monitoring***

AgriVolt (and others) offers new technological solutions for monitoring your electrical network by detecting electrical faults that can cause stray voltages.

These solutions offer continuous monitoring and rapid notification to guide you toward the appropriate intervention. Rapid detection of electrical faults helps prevent unwanted stress and discomfort within your herd.

*What can I do if voltage is detected?*

- Work with a professional electrician with experience in this area to test your farm equipment and systems.
- Mitigation equipment filters, blockers Dairyland Filter and Hammond Filters (If you have a blocker, make sure you have a monitor to measure any on-farm sources)
- Look at new technology to neutralize return currents at 60 Hz from sources external and internal to the livestock building.

### ***What are some of the solutions to ground currents?***

*On the utility side:*

- Examples include: Upping the voltage from 4,800 to 16,200 volts has reduced the current and helped on some lines managed by Waterloo North Hydro

- Checking lines for a balance of loads
- Reducing resistance points like splices (a section near a forest might have many splice repair joins)
- Farms have reported improvements with technology from Agrivolt systems that have been shown to detect on-farm faults and block primary neutral current.
- Ensure Variable Frequency Drives (VFD) used on dairy vacuum pumps, TMR mixers, and big ceiling fans have the proper shielded cable and filters; do not assume they were correctly installed.

The farming community has had its working group on ground current/stray voltage for several years, working with farmers, general farm organizations and utilities, researching and advocating this problem. In 2022, Ontario's Energy Minister, Todd Smith, formed the Stray Voltage Working Group to focus on the issue.

Members include the Ontario Federation of Agriculture, Christian Farmers Federation of Ontario, Dairy Farmers of Ontario, Ontario Energy Board, Hydro One Networks, Electrical Safety Authority, Electricity Distributors Association, and Electrical Contractors Association of Ontario, as well as observers from the Ontario Ministry of Agriculture, Food and Rural Affairs, Ministry of Energy and Ministry of Government and Consumer Services.

The solutions to ground currents and stray voltage concerns on farms will involve farmers, veterinarians, electrical contractors, equipment suppliers, Hydro One and all other electrical distribution system components to ensure proper installation and maintenance of equipment to minimize electrical leakage.

The full report and recommendations can be found at:

<https://www.farmfoodcareon.org/wp-content/uploads/2023/03/SVWG-Report-2023.pdf>

Link to Hydro One Stray voltage resources:

[https://www.hydroone.com/requestaservice\\_/Documents/Stray%20Voltage\\_ENGLISH.pdf](https://www.hydroone.com/requestaservice_/Documents/Stray%20Voltage_ENGLISH.pdf)

If you are experiencing some of these concerns, ask your local electrician about their experience in testing.

For more information, contact Bruce@farmfoodcare.org at 519 837 1326 ext. 292