

Stray voltages

Survey of the different stray voltage practices from different utilities and under different jurisdictions in North America

May 2006

CEATI



Overview

- ◆ 25 years of activity researching and mitigating stray voltage
- ◆ Action of legislature to answer need of farmer
- ◆ Technical consensus?
- ◆ Information trail
- ◆ Litigation
- ◆ What is part of a good program?
- ◆ Conclusion

The last 25 years

- ◆ This survey was funded by CEATI (www.ceati.com) Power Quality Interest Group and wishes to give a snapshot of stray voltages in North America today
- ◆ Lots of work was done in the last 25 years
 - Now, publications covering different aspects related to stray voltage are abundant
 - Technical and regulatory information on the stray voltages are readily available on the Web

Past Legislative Actions Answering Needs of Farmers

- ◆ **Mandate research team to address the subject and to understand the phenomena**
- ◆ **Create structure to pilot the research needs and to ensure that the conclusions of the research will be implemented to solve the problem**
- ◆ **Legislate on the protocol and value of concern for Cow Contact Voltage**

Technical Consensus?

- ◆ **Definition of stray voltage: the wording may change but the connotation in the research community and the legislation are equivalent**
 - low voltage (less than 10 volts)
 - appearing between two points that may be contacted by a cow making a pathway for the current to travel in the body of the animal
 - The predominant cause of that voltage is related to ground currents traveling to return to the feeder
- ◆ **Stray voltage is a side-effect of the multi-grounded systems used in North America**
- ◆ **In the United States stray voltages and touch voltage definitions are sometimes misinterpreted**

Technical Consensus?

- ◆ **High value utility contribution to NEV is an indication of degrading ground system that needs to be addressed for security reasons regardless if it is causing stray voltages**
- ◆ **NEV may contribute to stray voltages but it is not correlated to stray voltage in the milking parlor**
 - High NEV does not necessarily translate to high stray voltage
- ◆ **Some utilities isolate the neutrals (primary and secondary transformer neutrals) to help find the source of stray current**
 - Some utilities prefer to work on reducing NEV to correct stray voltage
- ◆ **In most intervention and typically before isolation on demand is granted, the farm's electrical system has to be inspected and when necessary modified to complies with applicable codes (often reported, situations existed that where life threatening for human)**

Technical Consensus?

- ◆ **The level of concern is 2 mA; using 500 Ω resistance as a model for the cow, this translates to 1 Volt**
 - The utility are often to limit is contribution to 1 mA
 - The remaining 1 mA account for sources in the farm
- ◆ **The cows are sensitive to stress which may be responsible for any symptoms attributed to stray voltages**
 - Source of stress are multiple
- ◆ **Stress is the sum of many factors and stray voltages are just one of these factors**
- ◆ **Reducing the stray voltage under the level of concern may not be sufficient to answer the problem at the farm as it may come from a combination of more than one cause**

Instrumentation

- ◆ Instrumentation is more accurate and less expensive now than 20 years ago which helps to disseminate good measurement practice
- ◆ Guides are available which address exclusively the needed instrumentation, discuss the precision of the instrument and the way to use it
- ◆ Measurement protocols exist that show some difference in detail but they have in common the essential part to achieve good evaluation of stray voltage and identification of the sources

Survey results

◆ Number of utilities surveyed

- 3 In the US
- 5 In Canada

◆ NEV limits

- 10 Volts to 1Volt

most frequently 5V

◆ Stray voltage limits

- 5 Volts to less than 1V

most frequently 1V

Survey results

◆ Trend by area / country

- Recent legal decisions in some states may result in jurisprudence for the rest of North America
- The problem is now spreading out of rural areas and will necessitate a larger coordinated effort

Map of data collected on WWW

More information on data in each cell are part of the final report

	Max NEV at primary transformer	Max cow contact voltage	Neutral isolation	Description of cost recovery	Legislation on stray voltage	Measurement protocol	Survey of milk industry	Who investigates on farms	Important court decisions	Guides or Literature on Stray Voltage	investigation of other then 60 Hz
Ontario											
British Columbia											
Wisconsin											
Idaho											
Pennsylvania											
MREC											
Vermont											
Minnesota											
Michigan											
PGEC											
Québec											
South Dakota											

Litigation

◆ 2002 Wisconsin Appellate Court

- For the first time in Wisconsin, an appellate court has rejected each argument from the utility that unless you can measure harmful voltage at points of cow contact, you could not collect damages ⁽¹⁾

◆ 2003 Wisconsin State Supreme Court

- The Wisconsin state Supreme Court recently ruled that a utility can be held responsible for harming the health of a dairy herd with stray voltage even though state-recommended voltage tests failed to find potentially damaging levels where the animals congregated ⁽¹⁾

(1) http://www.ecmweb.com/news/electric_wisconsin_utility_found/index.html

Litigation

- ◆ **More case are focusing on non traditional stray voltage**
 - ground or earth currents, impulses, transients, harmonics, radio frequencies and/or other electrical phenomena (other than 60 Hertz, steady-state “stray voltage”)
 - The “contact current” theory suggests that imperceptible electrical exposures (i.e. touch and step potentials) received during the normal course of our lives (e.g. bathtub faucet to drain) may create internal electric fields large enough to have biological consequences. (2)
 - Investigation of the “contact current” theory is presently a major focus of EPRI’s Environmental Health Assessment Target. (2)
- **Can good legislation be an answer to litigation?**

(2) http://www.eei.org/meetings/nonav_meeting_files/nonav_2004-10-10-ec/Prothero.ppt

Litigation

- ◆ As pointed in the previous slide, the litigation way is definitely not the easiest or most profitable way
- ◆ Litigation arises often from a lack of communication which translates in customer loss of confidence in the utility
- ◆ From past judgments, the utility was liable when the judge or jury concluded to a lack of response from the utility when prompted by the farmer to inspect the distribution line near its premise for ground current
- ◆ There will always be people asking for no current in the ground around their property. However, as jurisprudence negating this right becomes more abundant, those people may be more easily convinced to look for a real solution in place of litigation

Available information

- ◆ Continuous spread Nation wide of broadband access to the Internet makes it easier to distribute information
- ◆ Some jurisdictions or organizations have are highly using the web resulting in easy access to the documentation like those used in the preparation of this report
- ◆ Research result and other technical paper are mostly presented to specialist conference on stray voltage.
 - It was pointed that this information should be known by specialist that have an impact on cow health and performance through specific channels
 - nutritionist, veterinary, milking robot distributor, farm electrician, etc.

What is part of a good stray voltage program?

◆ **Technical support to customer**

- The team mandated to address the problem has to be multidisciplinary
- Role of all parties is well defined
- Measurement methodology are well described
- Instrumentation characteristics well defined

◆ **Information**

- Template are available for the measure and other data to record
- The data relative to any intervention, communication related to stray voltage shall be logged at best at a centralized administrative unit

What is part of a good stray voltage program?

◆ Communication

- The communication with the customer is very important. The customer must understand the nature of the problem and the actions as they are ongoing
- The reaction time to answer a stray voltage inquiry should be in days not in weeks
- A structure is in place to disseminate the information on stray voltage and the program to all party member
- A report relative to the action done and the result as measured shall be transmitted to the customer

Conclusion

- ◆ The maintenance of the ground system of the distribution grid is an important part in reducing the stray voltages phenomenon.
- ◆ The farmer's electrical installation is a potential source of stray voltage witch is also a candidate for regular maintenance to help reduce the occurrence of stray voltage problem
- ◆ The training of skilled personnel has to be planned for the long term.
- ◆ The research phase will, in time, fade out with the need for disseminating information, communication, knowledge, training and program administration shall continue in a foreseeable future.
- ◆ A repository of data related to stray voltage may be a good help to maintain the knowledge base accessible to the largest base of organization, and individuals

Conclusion

- ◆ **The subject of stray voltage is not likely to disappear soon**
- ◆ **Survey results**
 - Importance to listening to customer's preoccupations
 - Reduce the NEV or Isolation of neutrals (primary and secondary transformer neutrals) are used practices
- ◆ **Keep an eye on**
 - Legislation decision
 - Stray Voltages going out of the farm
 - Definition of stray voltages