Stray Voltage and Transmission Lines

Stray voltage is defined as: *a special case of voltage in which the neutral to earth voltage is present across points (generally grounded metal objects) in which a current flow is produced when an animal comes into contact with them. Stray voltages are low-level voltages and should be distinguished from painful shocks felt by humans*. (PSCW Docket # 05-EI-106) Adequate examples of these contact points are; water-cup to floor in a dairy barn, or watering tank to earth in a barnyard or pasture. Extensive research on the topic of stray voltage has repeatedly shown that the levels of current flow, through the animal, necessary to effect cow behavior must be relatively high, in the four to six milliampere range (Fick and Surbrook, MAEC). Commonly accepted sources of stray voltage include a variety of on-farm wiring problems and off-farm problems with high resistance wires and connections on the utility distribution system. In some rare cases a distribution system built directly under and parallel to a high voltage transmission line could become a source for elevated primary neutral currents. This induced current could result in high enough neutral to earth voltages which in turn might contribute to an excess of acceptable current in a cow contact area on an adjoining farm. Measurement of any voltages or current flow in livestock confinement areas can be achieved through established testing procedures with appropriate equipment as identified in PSCW Dockets # 05-EI-106 and # 05-EI-115. Mitigation of any such currents can also be achieved through a variety of proven and acceptable means such as additional grounding, or the installation of an equipotential plane or isolation if necessary.

Recent and historic alleged claims of adverse affects on livestock from EMF's, earth currents, transient voltage spikes, harmonics and other electrical phenomena, have not proven true nor have these claims withstood scientific scrutiny. EMF's on farms were routinely investigated by the PSCW Stray Voltage Analysis Team and not found that:

> ***"the data suggest that there is no correlation between the level of stray voltage recorded on the farm and the level of magnetic fields encountered as expected. There also appears to be no correlation between the level of magnetic fields recorded and either the somatic cell count or average milk production of the cows".*** (Dasho, Cook and Reines,1996 ASAE paper # 963071, Magnetic Field Measurements on Wisconsin Dairy Farms).

Transient voltages were also not found to have any substantial impact on animal behavior in research performed at the request of the PSCW and the Department of Agriculture Trade and Consumer Protection (PSCW Docket # 05-EI-108) by Dr. Reinemann and others,1996 (ASAE paper # 963087, Dairy Cow Sensitivity and Aversion to Short Duration Transient Currents). Further, earth currents and their alleged effects on dairy cattle were investigated by a team of independent nationally recognized scientific advisors at the request of the Minnesota Public Utilities Commission from December, 1994 through July, 1998. Their final report issued August, 1998 included three primary findings:

> ***"We have <u>not</u> found credible scientific evidence to verify the specific claim that currents in the earth or associated electrical parameters such as voltages, magnetic fields and electric fields, are causes of poor health and milk production in dairy herds."***
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> ***"At the present time, there is <u>no basis</u> for altering the PUC-approved standards by which electric utilities distribute power onto or in the vicinity of individual dairy farms."***
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> ***"There are many well-documented non-electrical factors that are known and accepted by the scientific community, and by most farmers as well, to cause dairy cow health and production problems. Among the most noteworthy factors are poor nutrition, poor cow comfort and hygiene, and low or no use of vaccinations and related preventive veterinary practices. These factors should always be address by those who want to improve performance of dairy herds."***

Additionally, claims that harmonics related to electrical distribution systems and transmission lines was recently addressed by the PSCW letter dated September, 7 1999. Such claims or allegations need to be based on sound investigative techniques by knowledgeable professionals. Clarification in this letter authored by M.A. Cook and R.S. Reines of the Public Service Commission of Wisconsin states that:

> ***"…harmonics are not generated by utilities. They are load specific. Non-linear loads can and do generate harmonic currents and any subsequent harmonic voltages. Mitigation methods are most effective at the source site of the harmonics – namely the customer's wiring."***

From the above stated evaluation of the impacts of electrical parameters associated with farms, and transmission lines it is prudent and responsible to expect that the real impacts to livestock operations would be minimal and quantifiable.

Induced Currents on Ungrounded Metal Objects and Pasture Fences

Concerns in regards to shocks derived from metal objects in the immediate vicinity of an overhead transmission line have been expressed. An ungrounded metal object under or very near to an energized transmission line may become charged with an electrical current similar to a static charge one might obtain by scuffing shoes through a carpet. Dissipation of such charges occur when contact is made with ground. This might happen when people, livestock or some other conductive material makes an effective electrical contact between ground and the charged object. The magnitude and strength of such a charge would be directly related to the mass of the ungrounded metal object and it's orientation to the line.

The WPSC experience with such concerns and agricultural customer complaints under the existing 345 Kv transmission line has been very limited. In the past nine years only three situations have arisen which required investigation on-site to mitigate the problem. In two cases the concern was addressed by providing a means of grounding for the objects in question. In the third situation, an under-built distribution line was partially relocated underground to solve the problem.

As for electric fences, if they are properly installed with the appropriate fencer grounding electrode system they should continue to function properly. When it is necessary to move or work on such fences, one should solidly ground the fence before attempting to do the needed maintenance. This can be achieved through the use of a simple ground rod with an insulated lead and a wire clamp attached. Additional, protection may be obtained by installing an approved lightning protection system on the fence which may also provide a means for ready discharge of induced current. Individuals should consult the installation instructions or the Midwest Rural Energy Council (formal known as the Wisconsin Farm Electric Council) publication for electric fences, Installation and Operation of Electric Fences, Cow Trainers and Crowd Gates.