Q Please state your name and address.

A Dave Stetzer, 520 W. Broadway Street, Blair, Wisconsin.

Q Please describe your background and experience.

A In December 1970, after graduating from high school, I entered the United States Air Force. From February through November 1971, I attended electronics school at Keesler Air Force Base in Biloxi, Mississippi, which was known as the world's number one electronics school. During this training I was given a top-secret military clearance, as much of the electronic equipment was and still remains highly classified. At this school I completed training as a ground radio communications electronics technician and was assigned to the 676 Radar Squadron, Antigo Air Force Station, Antigo, Wisconsin. As a ground radio communications electronics technician I diagnosed and repaired a variety of electronic equipment, including PC boards, Klystron tubes and integrated circuits, as well as highly classified military electronic equipment employing among other things, spectrum analyzers, oscilloscopes, signal generators, and digital frequency counters.

In February 1972, I received an assignment to go to Vietnam. To this end, I was sent to KY8-38 Crypto School at Lackland Air Force Base in San Antonio, Texas. My top-secret military clearance was upgraded to include crypto access. Upon completion of this training, I returned to the 676 Radar Squadron at Antigo Air Force Station pending my November port call to Vietnam. My assignment to Vietnam was subsequently changed

due to the official ending of the war in September 1972. My permanent duty station remained the 676 Radar Squadron. My duties continued as before, with the additional tasks of diagnosing, maintaining, and repairing highly classified crypto electronic equipment. Upon the completion of my tour of duty, I received an honorable discharge from the United States Air Force. In 1975, I founded Stetzer Electric, Inc. I am the president of this company.

Q Please continue to describe your background and experience.

A Since my firm's inception, I have specialized in power control in industry, municipalities, and motor control centers. I have worked with oscilloscopes for over 29 years. In recent years, I have focused more attention on power quality analysis and troubleshooting. An example of the type of work I perform in this area is the Dranetz-BMI Field Handbook for Power Quality Analysis (1998)[1] and the Dranetz BMI Handbook of Power Signatures (2nd Edition) (1997).[2]

I also have extensive experience with thermography, power-quality analyzers (Dranetz 4300 PQ Analyzer, Advantest Spectrum Analyzer, Reliable Power Meter, Dranetz PQ Pagers, Fluke VR1015 Event Recorders and the software associated with this equipment), ohm meters, meggers, surge testers, amp meters, digital and analog volt meters, power factor correction meters, and phase meters to name a few. I have trained electrical

[1] Exhibit C-___ (DAS-1).
[2] Exhibit C-___ (DAS-2).

engineering interns through various universities and have offered apprenticeship training to electricians.

I have been an electrician by training, education and experience, for over the past 25 years, with a specialized background and experience in electronics. I have obtained training certificates from numerous organizations, including Allen Bradley Corporation, Square D, Cuttler-Hammer, The National Fire Protection Association, Inc. (the issuers of the NEC), and University of Wisconsin – Madison, College of Engineering. I founded Stetzer Electric with only $400.00 in 1975, and built it into a multi-million dollar company today.

Q Please describe Stetzer Electric and the work of your company?

A. Stetzer Electric has three divisions which I manage and oversee. The sales and service division involves the sales and service of electrical equipment, the rewinding and repair of electronic motors, and equipment. We service a variety of equipment, including generators up to 3,000 horsepower.

The predictive maintenance division involves the collection of waveforms and frequency spectrums, and the interpretation of waveforms and spectrums with state-of-the-art CSI data collectors. My technicians, all of whom have served as electronics technicians in the military, are certified by the Vibration Institute (a national organization devoted to enhancing the knowledge and understanding of vibration principles and techniques to

measure and analyze machine vibrations). We can evaluate the condition and severity of defects in rotating equipment utilizing various electronic equipment which convert vibrations to electrical waveforms for diagnostic purposes. This includes defects involving balance, alignment, resonance, rolling element bearings, rotors, shaft alignment, sleeve bearings, and hydraulic and aerodynamic forces.[3]

My power quality and electrical contracting division involves industrial and commercial wiring and related factors, as well as power quality testing.

Excluding clerical employees, 60% of my company's staff have served in the military. Many are serving or have served apprenticeships. Many of my employees have obtained training certificates from numerous organization, including Allen Bradley Corporation, Square D, Cuttler-Hammer, the National Fire Protection Association, Inc., the U.S. Occupational Safety and Health Administration, the U.S. Department of Labor, and University of Wisconsin – Madison, College of Engineering.

Q What is the purpose of your testimony?

A I am presenting evidence in support of the Michigan Attorney General's case against Consumers Energy Company. Specifically, I will be presenting readings and measurements taken on farms that clearly demonstrate the utility's electrical pollution, electrical poisoning, and power quality problems.

[3] Exhibit C-___ (DAS-3).

Q Why are you testifying in support of the Michigan Attorney General's case against Consumers Energy Company?

A Electrical pollution and electrical poisoning[4] is destroying the dairy industry and negatively impacting other livestock industries. This electrical pollution and poisoning is directly affecting the health of dairy cows and other livestock, thereby negatively impacting the economics of these farms. This in turn negatively impacts the entire farm community that depends on, and draws its livelihood from, the various dairy and other livestock farms.

Q Please describe your initial experience relative to electrical testing on farms?

A In late 1997, I reluctantly agreed to troubleshoot a so-called "stray voltage" problem on a farm affiliated with the Associated Milk Producers, Inc. I identified the problem as ground currents originating from a neighboring farm, due to the utility's inadequate neutral. I called this to the attention of the appropriate utility. I was surprised and appalled by the utility's failure to address the problem, its repeated distortion of the nature of the problem and its failure to take remedial action. This was the beginning of my work with dairy farms.

[4] Exhibit C-___ (MG-8).

Unfortunately, I have seen this same pattern of abuse (blame the farmer),[5] confrontation and refusal to either fully and promptly investigate the matters, or even attempt to solve the problem by virtually every utility serving the farms I have visited. The articles in Exhibit C-___ (DAS-5), Exhibit C-___ (DAS-6), and Exhibit C-___ (DAS-7) illustrate the hostility and barriers farmers face in seeking to obtain satisfaction and resolutions to the utility's electrical pollution and poisoning. The same antics occur in Michigan towards farmers, only the names have changed. The one welcome exception has been the Jackson Electric Cooperative, a Wisconsin electric utility which assisted its customers and upgraded its distribution system to eliminate the problems. The history of these problems and the cooperative's affirmative response and solutions are discussed in the LaCrosse Tribune article attached in Exhibit C-___ (DAS-8).

Since my initial troubleshooting in 1997, I have taken measurements on farms in Michigan, Wisconsin, and Minnesota, and recorded the reactions, simultaneous with electrical activity, of more than 6,000 cows and some horses.

I have also examined hundreds of miles of distribution lines, numerous distribution facilities and equipment, including many substations.

Q Is there any such thing as "stray voltage"?

[5] See the agricultural journal Dairy Today, March 1993, article entitled "Before You Sue" where Consumers Energy's retained veterinarian, Don Sanders, is quoted as identifying the utility's strategy of painting the farmer as a "bad person" and "bad manager" – the "dregs of the dairy world." Exhibit C-___ (DAS-4).

A No.

Q Please explain.

A There is no such thing as stray voltage. In fact the term "stray voltage" is not even a term recognized in electrical engineering manuals or electrical standards. Rather it's a term coined by utilities. There are clearly stray dogs and cats. One does not know where they are coming from or where they are going. Electricity is entirely different. **Electricity does not stray!** Electricity is governed by the laws of physics, Ohm's law, Kirchhoff's laws, etc. Electric currents flow through any and all available paths, including wires, objects and the earth, whichever offers the paths of least resistance in proportion to the relative resistance (or impedance) between them. If one of the paths of least resistance is the earth, electricity will flow through the earth back to the utility's substation to complete the circuit, rather than flowing over the utility's own neutral wires. Thus, electricity does not stray, rather it merely flows in accordance with the laws of physics.

Q Please describe some of the laws and principles that govern electricity.

A Ohm's law states that voltage is equal to current times the resistance. This is shown in the Ohm's formula, E (watts) = I (current) x R (resistance).[6] Kirchhoff's current law

[6] See Exhibit C-___ (DAS-9).

provides that current flowing from a source (or rod) must return to that source.[7] Kirchhoff's voltage law provides that the voltage drops around any closed loop must equal the applied voltages.[8] Electric current will take any and all available paths in proportion to the relative resistance (or impedance) between them (i.e., the path of least resistance). The principles of skin effect provide that as the frequency of the alternating current increases so does the impedance (or opposition to current flow). As such, the AC current is forced to flow toward the outer part of the conductor (toward or on the skin or surface of the wire) which effectively decreases the cross-sectional area of the conductor available to that current and thus increases the impedance or resistance.[9]

Q Since there is no such thing as "stray voltage," what have you found at farms?

A I have found measurable amounts of non-sinusoidal voltage waveforms riddled with harmonics and transients at "cow contact" points (per the Minnesota Science Advisor's Study), originating from the utility's grounded wye system. I have simultaneously recorded the electrical activity with animal reactions. This can be seen on the video I created entitled "*The Effects of Low Level Non-Linear Voltages and Frequencies Applied to Livestock*."[10] There seemed to be no noticeable change in the electrical activity (and the animal's reactions) when the farm power was turned off at the main disconnect for the entire farm at the service pole. I also found measurable and dangerous amounts of current flowing down the utility's down ground.

[7] See Exhibit C-___ (DAS-9).
[8] See Exhibit C-___ (DAS-9).
[9] Exhibit C-___ (DAS-10).
[10] Exhibit C-___ (DAS-11).

Essentially, I've found and recorded electrical phenomena that deal specifically with poor power quality supplied or caused by the utility including:

- Harmonics
- Transients
- Voltage sags
- Voltage swells

Some of these electrical phenomena have had economic impacts that directly relate to loss of production. Some of this loss of production is described in two papers I co-authored entitled "*Milk Production of Dairy Herd Decreased by Transient Voltage Events*,"[11] and "*Milk Production of Dairy Herds Decreased by Transient Voltage Events*,"[12] both of which have been or will be published and submitted for peer review. This loss of production has further been documented by expert Forensic Economist, Michael Behr, Ph.D.[13] Finally, the July 5, 1999 Industrial Edition of Fortune Magazine published an expose on the existence of dirty electricity and its affects on electrical and

[11] Exhibit C-___ (DH-2).
[12] Exhibit C-___ (DH-3).
[13] Exhibit C-___ (DAS-12).

electronic equipment entitled "*Hot New Technologies for America's Factories*."[14]

I have recorded and measured this electrical phenomena in Minnesota, Wisconsin, and Michigan. I also have taken measurements on farms in these states and recorded the reactions of more than 6000 cows and some horses simultaneous with the electrical activity.[15] The reactions are clearly correlated with electrical activity hoof-to-hoof, as measured using the protocol recommended by the Final Report of the Science Advisors to the Minnesota Public Utilities Commission.[16] The results in Minnesota, Wisconsin, and Michigan all involved the same power quality issues (harmonics, transients, sags, and swells), although the power quality in Michigan was measurably worse than in Minnesota and Wisconsin.

Q What are harmonics and transients?

A The Standard Handbook for Electrical Engineers (14th Edition) defines "harmonics" as follows:

> **Harmonics**. *Harmonic distortion* is a form of electrical noise. It is the superposition of signals at multiples of the fundamental power frequency on the power sine wave. Linear loads, those which draw current in direct proportion to the voltage applied, do not generate large levels of harmonics. Nonlinear loads draw current in pulses. These pulse currents create voltage drops throughout the system as a result of the current interacting with the system impedance. The voltage distortions created by nonlinear

[14] Exhibit C-___ (DAS-13).
[15] See Exhibit C-___ (DAS-11).
[16] Exhibit C-___ (DAS-14).

> loads may create voltage distortion beyond the premise's wiring system, through the utility system, to another user. Concentrated loads which generate large levels of third harmonics can result in neutral current much higher than is normally encountered in circuits where the return current from the different phases cancel.

EC&M, The Magazine of Electrical Design, Construction & Maintenance, June 1999[17] states:

> We define harmonics as voltages or currents at frequencies that are a multiple of the fundamental frequency. In most systems, the fundamental frequency is 60 Hz. Therefore, harmonic order is 120 Hz, 180 Hz, 240 Hz and so on. (For European countries with 50 Hz systems, the harmonic order is 100 Hz, 150 Hz, 200 Hz, etc.)
>
> We usually specify these orders by their harmonic number or multiple of the fundamental frequency. For example, a harmonic with a frequency of 180 Hz is known as the third harmonic (60 x 3 = 180). In this case, for every cycle of the fundamental waveform, there are three complete cycles of the harmonic waveforms. The even multiples of the fundamental frequency are known as even-order harmonics while the odd multiples are known as the odd-order harmonics.

For a good in-depth discussion and description of harmonics, its causes, effects, and evolution, see The Dranetz Field Handbook for Electrical Energy Management (1992)[18] and the Fluke Video "*Understanding & Managing Harmonics*" (1998).[19]

Transients are voltages and currents of short duration, typically less than one-half a cycle, and possibly of larger amplitude than that of the normal steady state. These will either

[17] Exhibit C-___ (DAS-15).
[18] Exhibit C-___ (DAS-16).
[19] Exhibit C-___ (DAS-17).

add or subtract from the nominal waveform. See Dranetz BMI Handbook of Power Signatures (2nd Edition) (1997).[20]

Q What power quality reports are you offering.

A I am offering power quality reports from Michigan, Wisconsin, and Minnesota which all present the same type of power quality problems (harmonics, transients, sags, and swells) experienced at various farms. Attached are the following:

- Exhibit C-___(DAS-19), Plaetz Farm Power Quality Report (MN)
- Exhibit C-___(DAS-20), Erickson Farms Power Quality Report (WI)
- Exhibit C-___(DAS-21), Bey-Far Farms Power Quality Report (WI)
- Exhibit C-___(DAS-22), Krueger Farm Power Quality Report (WI)
- Exhibit C-___(DAS-23), Pinter Farm Power Quality Report (WI)
- Exhibit C-___(DAS-24), VanDenBerg Farm Power Quality Report (MI)
- Exhibit C-___(DAS-25), Tenbrink Farm Power Quality Report (MI)
- Exhibit C-___(DAS-26), Arlyn Walt Dairy Power Quality Report (MI)
- Exhibit C-___(DAS-27), Jonseck Power Quality Report (MI)
- Exhibit C-___(DAS-28), Logan Mier Farm Power Quality Report (MI)
- Exhibit C-___(DAS-29), Ramthun Power Quality Report (MI)
- Exhibit C-___(DAS-30), Porter Horse Farm Power Quality Report (MI).

[20] Exhibit C-___ (DAS-18).

Q Have your inspections and testing revealed problems on Consumers Energy's distribution system?

A Yes.

Q What are these problems on Consumers' distribution system?

A The problem is Consumers Energy has not kept up with the changing loads on its distribution circuits or the changing characteristics of these loads. In addition, the utility has not followed sound electrical engineering practices. These include improperly sized neutrals, inappropriate down grounds, and others. The utility has also not kept up with technology or followed the recommendations of their own funded research, such as the reports, studies, etc., put out by the Electrical Power Research Institute ("EPRI"), as well as the recommendations, warnings, and standards identified in the National Electric Safety Code, trade journals, manuals, and educational matters of the power quality industry, etc. These failures have manifested themselves into significant and extremely dangerous power quality issues on the utility's distribution system including non-linear loads, harmonics, transients, voltage sags and swells, and large amounts of ground currents.

Q What is the central issue on Consumers' distribution system?

A The essential problem is that the utility is using the earth as the return pathway for its electricity or neutral current, back to the substation, rather than its own neutral wire. This is occurring because of a number of factors including the following:

1) a decrease in the ability of the neutral wire to conduct current due to degradation of the wires; and

2) an increase in the impedance of the neutral wire due to the changing characteristics of loads from linear to non-linear.

Q Please explain the decrease in the neutral wire's ability to carry neutral currents back to the substation due to degradation of the wires?

A The neutral wire's ability to carry neutral current back to the substation has decreased due to a number of factors including (a) aging of these wires, (a) corrosion on the wires and splices, (c) various stress on these wires including heat, weather, etc., (d) poor connections, (e) lack of or inadequate maintenance, tree-trimming, etc., and (f) circuit overloading. These factors are somewhat interrelated and have effectively reduced the ability of the neutral wire to carry the same amount of current as originally designed.

Q Please explain the increase in the impedance of the neutral wire due to the changing characteristics of loads from linear to non-linear.

A Impedance is essentially the total opposition to current flow in a circuit where alternating current is flowing. Impedance generally takes into account five elements:

1. The length of the conductor,
2. The size of the conductor,
3. The material of the conductor,
4. The temperature of the conductor, and
5. The frequency of the current on the conductor.

In a given neutral wire, the length, size, and material of the conductor will essentially remain the same. The temperature and frequency of the current on the neutral conductor, however, will vary. The temperature of the conductor will vary depending, obviously, upon the weather, as well as the frequency of the current on the conductor. The frequency will vary depending on the types of loads on the distribution circuit – linear or non-linear.

Any electrical device connected to a power source is generally referred to as "load." In the past, virtually all loads were known as linear. Linear loads are those that draw current in a smooth sinusoidal manner. This means the load draws the current through the entire voltage waveform, thereby causing little or no distortions. Today, however, a significant portion of the loads are non-linear. These non-linear loads include computers, fax machines, copiers, and many other electronic devices, as well as various utility equipment including capacitors, solid state monitoring and switching devices, and

transformers. A non-linear load draws current only during a controlled portion of the incoming voltage waveform. This distorts the waveforms, and these distortions cause "harmonics." Harmonics are voltages or currents at frequencies that are multiples of the fundamental frequency. In the U.S.A. (as well as Consumers Energy's system) the fundamental frequency is 60 cycles per second, or 60 Hz. As such, harmonics are multiples of this, i.e., 120 Hz (2 x 60), 180 Hz (3 x 60), and so forth. Table 1 lists these harmonics orders.

Order	Frequency in Hz (or Cycles per Second)
Fundamental	60
2nd	120
3rd	180
4th	240
5th	300
6th	360
7th	420
8th	480
9th	540
10th	600
11th	660
12th	720
13th	780
14th	840
15th	900
16th	960
17th	1020
18th	1080
19th	1140
20th	1200
21st	1260

Since non-linear loads (as well as various utility equipment) create these harmonics or frequencies that are multiples of the fundamental frequency, the net result are neutral currents that oscillate at a great rate of speed, i.e., higher multiples of the 60 cycles per

second. The utility's distribution system was constructed based on a 60 Hz or 60 cycles per second current (i.e., the fundamental). With the presence of these neutral current harmonics on the neutral wire, electrons are now oscillating back and forth at three to nine times this fundamental rate (i.e., 180 to 540 cycles per second) and sometimes even higher (reaching the radio frequency range of 30 kHz to 300 MHz where the oscillations reach 30,000 to 300,000,000 cycles per second).[21] The net result is additional heat and an increase in the temperature of the neutral wires. Since temperature is one factor that affects the impedance of the utility's wires, an increase in temperature of the neutral wire effectively increases the utility's neutral wire's impedance or, stated another way, effectively reduces its ability to carry the neutral current back to the substation. In this instance, the current will be forced to return to the substation over an alternative pathway, i.e., the earth, through the utility's overabundant ground rods.

In addition to the increase of the impedance of these lines due to the increase in temperature caused by the harmonics, the increase in frequency of the neutral current on the neutral wire will also decrease the impedance or ability of this wire to carry the neutral current through the "skin effect" discussed earlier.

[21] "These frequencies can be in the radio frequency (RF) range, and, as such, can introduce harmful effects associated with spurious RF." IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems, IEEE Std 519-1992 at page 39. Exhibit C-___ (DAS-31). See also, "*Biological Effects and Health*

Unfortunately, the utility has a 1930's to 1950's electric distribution system designed for generally linear loads, whereas today, a significant portion of the existing load is non-linear. And the situation is not expected to get any better as the proliferation of non-linear levels is projected to increase significantly. In fact, the utility's own funded research organization EPRI, has warned about the escalating proliferation of non-linear loads:

> Marek Samotyj, EPRI's manager for power quality, says the quality situation "will get worse before we'll be able to mitigate it." One reason is that EPRI expects 70% of all electricity produced in the U.S. annually to flow through electronic devices by 2002, vs. 30% today.[22]

In addition, as noted in EC&M, The Magazine of Electrical Design, Construction and Maintenance, June 1999, "With the exception of the incandescent light bulb, every load today creates harmonics.[23]

Q What is the net effect of these power quality problems?

A The net effect of these power quality problems is a significant amount of neutral current riddled with harmonics and transients being forced onto the earth, as the pathway back to the substation. This is dirty power[24] or more appropriately stated, it's electrical

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Implications of Radiofrequency Radiation," by Sol M. Michaelson and James C. Lin (1987), and "*Electromagnetic Fields and the Life Environment*," by Karel Marha, Jan Musil, and Hana Tuha (1971).

[22] See Exhibit C-___ (DAS-13), page 2.

[23] Exhibit C-___ (DAS-15).

[24] Exhibit C-___ (DAS-13), page 3.

pollution[25] (when it impacts equipment) or electrical poisoning[26] (when it impacts living creatures).

Q Does the National Electrical Safety Code sanction or authorize Consumers Energy's use of the earth as a continual or regular return pathway for a portion of its electrically polluted neutral current?

A Absolutely not! The National Electrical Safety Code (NESC) specifically mandates that under normal circumstances and normal operations there can be no objectionable flow of current over the grounding conductor**. Current that leaves the utility's substation over the utility's wires should return to the utility's substation over the utility's own neutral wires!** Pursuant to accepted and good electrical standards, the intended purpose of a utilities grounding system is for safety purposes to deal with extraordinary and unusual circumstances such as lightning, faults, etc. The grounding system should not be used as an additional pathway for current to return to the substation.

Section 9, entitled "*Grounding Methods for Electric Supply and Communication Facilities*" of the NESC, Rule 92D provides as follows:

> Current in Grounding Conductor
> Ground connection points shall be so arranged that under normal circumstances there will be no objectionable flow of current over the grounding conductor. If an objectionable flow of current occurs over a grounding conductor due to the use of multi-grounds,

[25] See Exhibit C-___ (MG-8).
[26] See Exhibit C-___ (MG-8).

one or more of the following should be used:

(1) Abandon one or more grounds.

(2) Change location of grounds.

(3) Interrupt the continuity of the conductor between ground connections.

(4) Subject to the approval of the administrative authority, take other effective means to limit the current.

The system ground of the source transformer shall not be removed. The temporary currents set up under abnormal conditions while the grounding conductors are performing their intended protective functions are not considered objectionable. The conductor shall have the capability of conducting anticipated fault current without thermal overloading or excessive voltage buildup. Refer to Rule 93C.

The NESC Handbook further elaborates on the "objectionable" flow of current over a grounding conductor. First of all, the Handbook points out that it is the utility's responsibility to "identify and remedy" all objectionable flows. The utility is the one using the earth and private property as a pathway for its neutral current, and thus it is the utility who must identify and remedy these objectionable uses. Every farmer I have spoken to has specifically "objected" to the flow of the utility's neutral current through their own private property.

In addition, the Handbook identifies the dangers associated with the flow of the utility's neutral currents specifically around dairy barns and dairy cows. The Handbook further warns of the need for "specific attention to limit damage to equipment or uncomfortable conditions for personnel or animals."

Section 92D of the NESC Handbook, 4th Edition (1997), entitled "*Current in Grounding Conductor*" provides as follows:

Rule 92D refers to actions required in the case of "objectionable" flows of current over a grounding conductor. The word "objectionable" is undefined in the NESC; it is left to the designer's discretion, utilizing good design and operating practice, to appropriately identify and remedy the situation.

Where multiple grounding is used, there generally will be some circulating current between the different ground connections. These currents may arise from unbalanced loads, improper connection or loss of ground wires, or other reasons. A fraction of an ampere, or even several amperes on circuits of large capacity, may not be a serious matter. **In other cases, however, such flow may be disturbing to the service, as is sometimes the case around dairy barns in which cows are connected to milking systems. It is recognized that interrupting the circulating current between the primary neutral and the secondary neutral may not solve the problems at dairy barns and may actually cause other problems**. Such problems are often related to National Electric Code (NEC) violations, unbonded building construction, and other building-related problems that produce voltage gradients at entrances or in building floors. While it is generally both infeasible and unnecessary to ascertain the circulating current flow at every ground location, **installations near areas that are often known to present specific problems** (such as milking barns without adequate voltage gradient control, pipelines, electric railways, conduits, etc.) **may need special attention to limit damage to equipment or uncomfortable conditions for personnel or animals**.

The advantage in permanency and reliability, which results from the use of a number of grounds on a given circuit feeding a considerable area, will generally warrant the use of multiple grounds on alternating-current secondaries, notwithstanding the possible existence of a slight interchange of alternating current over these connections. Heating or electrolysis from such small alternating currents is generally negligible. A value of interchange current that would not be harmful with alternating current, however, might be sufficient to cause damage if it were direct current.

If the protective ground connection normally carries current, it is part of a closed circuit. As a result, this *can* be an undesirable type of ground for a number of reasons under certain circumstances. Direct current, in particular, may cause electrolytic damage if it is not confined wholly to the metallic circuit and the utilization devices designed for use with the direct current. Multiple grounds

from a neutral wire of a dc, three-wire circuit may, if the dc circuit is unbalanced, cause earth currents and produce electrolytic damage by reason of such earth currents. Even alternating current, if in large amounts or continued for long periods, may unnecessarily deteriorate the ground connection. However, such a current could only result from a fault or from excessive unbalancing of three-wire, ac circuits with multiple ground connections, and such unbalancing would be expected to soon be detected and corrected. With made electrodes, the surrounding soil may be dried under such conditions. This condition can be serious and, with dc neutrals, might result in corrosive destruction of the grounding wire and loss of the protection afforded by the made electrode.

An objectionable flow of current over a grounding conductor may be due to any one of several reasons. For example, if electric railway returns are located in close proximity to water pipes or other grounds, part of the railway current may be carried through the supply conductors themselves from one ground connection to another. The result may be the deterioration and ultimate failure of such ground connections from electrolysis or drying of the ground.

In this respect, it might be well to consider cases in which the high-voltage side of a distribution or station transformer is grounded. Where transformer banks consisting of three single transformers connected in wye on the high-voltage side have the neutral point grounded, a certain amount of current will flow in this ground connection because of the third-harmonic voltage present. This current may be of considerable magnitude unless proper methods are employed to control it. Methods of control are left to the designer.

Station transformer banks may also have their secondary windings connected in wye and the neutral point grounded. In some older systems the neutral wire was not carried out of the station as the fourth wire of a three-phase system, as when the load supplied was almost exclusively a power load. In some systems, where lighting was supplied, it used to be an occasional practice to install a single-phase transformer so that one side of its primary winding was connected to one of the phase wires and the other side to the ground. **This resulted in a continual flow of earth current at all times, varying from the small excitation current under no-load conditions to a maximum at full load or under fault conditions**. If a made electrode was used, this flow of current could result in enough drying of the soil, in dry seasons, to cause the soil

immediately adjacent to the artificial ground to become nonconducting. As a result, the potential of the ground connection could be raised much above ground and even approach that of the line. It is evident that a very serious condition of hazard could be produced if the high-voltage potential is brought down to the ground line. Should a rain occur at such a time, there is danger of the pole burning because of current flow across the surface of the pole. ***Such a flow of current would be considered objectionable.***

As a result of such problems, Rule 215C in the 4th Edition (1941) introduced the prohibition against ground returns in urban areas; it recommended against them in rural areas. They were prohibited in any location in the 6th Edition (1961); that prohibition has been retained in subsequent editions. Further, beginning in 1977, Rules 96 and 97 required the neutral of a multigrounded *system* to be carried throughout the system. This allows transformer cases, cable sheaths, etc., to be connected directly to the neutral and enhance the operation of the system protection devices in the event of conductor failure, transformer winding failure, or cable failure.

Objectionable direct current can generally be eliminated by following one of the procedures recommended in the rules by either omitting or changing ground connections. The prohibition of removing the system ground from the source transformer was added in the 1977 Edition.

(Bold added, italics in original).

Q Has Consumers Energy, as well as other utilities, been put on notice as to the presence, proliferation, dangers, effects and impacts of nonlinear loads, harmonics, and transients?

A Yes. Numerous Codes, National Organizations of Electrical and Electronic Engineers, utility founded research organizations, trade journals and publications, instrumentation manufacturers' manuals, handbooks, and educational materials, electronic and electrical handbooks and textbooks, and other research publications have identified and warned

about the presence, proliferation, dangers, effects and impacts of non-linear loads, harmonics, and transients. These documents which are all readily available, are typically relied upon and utilized in the electric industry. These include the following:

1. IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems, Std 519-1992[27]

2. IEEE Guide for Applying Harmonic Limits on Power Systems, P519A/D5, May 4, 1996[28]

3. Article entitled "*Coping with Harmonics"* by Kenneth Price (originally published in Power Quality Assurance Magazine, Premier II, 1990), republished in Power Quality Solutions: Case Studies for Troubleshooters, Edited by Gregory J. Porter & J. Andrew Van Sciver (1999).[29]

4. Article entitled "*Eliminating Harmonic Currents Using Transformers*" by Robert H. Lee (originally published in Power Quality Assurance Magazine, Sept.-Oct. 1991), republished in Power Quality Solutions: Case Studies for Troubleshooters, Edited by Gregory J. Porter & J. Andrew Van Sciver (1999). [30]

5. Article entitled "*Remedies for Neutral Current Harmonics*" by P. Packebush and Dr. P. Enjeti (originally published in Power Quality Conference Proceedings, Sept. 1994), republished in Power Quality Solutions: Case Studies for Troubleshooters, Edited by Gregory J. Porter & J. Andrew Van Sciver (1999). [31]

6. "*Harmonics*," by Mark Waller (1994).

7. "*Surges, Sags and Spikes*," by Mark Waller (Revised 1st Edition, 1992). [Original Edition – 1989].

8. The Dranetz Field Handbook for Electrical Energy Management, Dranetz Technologies, Inc. (1992).[32]

[27] Exhibit C-___ (DAS-31).
[28] Exhibit C-___ (DAS-32).
[29] Exhibit C-___ (DAS-33).
[30] Exhibit C-___ (DAS-34).
[31] Exhibit C-___ (DAS-35).
[32] Exhibit C-___ (DAS-16).

9. "*In Tune with Power Harmonics*" by Fluke Corporation (1997).[33]

10. Fortune Magazine Industrial Edition article entitled "*Hot New Technologies for America's Factories*" by Gene Bylinsky (July 5, 1999).[34]

11. Fluke Corporation Video entitled "*Understanding & Managing Harmonics*" (1998).[35]

12. Fluke Corporation Video entitled "*Power Quality Troubleshooting*" (1998).

13. EPRI Research Report entitled "*Harmonics and Electrical Noise in Distribution Systems, Volume 1: Measurements and Analyses,*" Report EL/EM-4290-V1, dated Oct. 1985.[36]

14. EPRI Research Report entitled "*Error Correction Methods for Measuring Harmonics in Power Systems,*" Report TR-105215, dated Oct. 1995.[37]

15. EPRI Research Report entitled "*An Assessment of Distribution System Power Quality: Volumes 1-3,*" Report TR-106294-V2, dated May 1996.[38]

16. EPRI Research Report entitled "*The Distribution System Modeling Guide for Disturbances and Cold Load Pickup,*" Report TR-106297, dated Aug. 1996.[39]

17. EPRI Research Report entitled "*Distribution Grounding: Volume 1: Handbook,*" Report TR-106661-V1, dated Aug. 1996.[40]

18. EPRI Document entitled "*D-STATCOM: Custom Power Technology Protects Distribution System from Disturbances Caused by Customer Loads,*" Document PS-108084, dated Jan. 1997.[41]

19. EPRI Document entitled "*Reliability Benchmarking Methodology (RBM),*" Document PS-109080, dated Jan. 1997.[42]

[33] Exhibit C-___ (DAS-36).
[34] Exhibit C-___ (DAS-13).
[35] Exhibit C-___ (DAS-17).
[36] Exhibit C-___ (DAS-37).
[37] Exhibit C-___ (DAS-38).
[38] Exhibit C-___ (DAS-39).
[39] Exhibit C-___ (DAS-40).
[40] Exhibit C-___ (DAS-41).
[41] Exhibit C-___ (DAS-42).
[42] Exhibit C-___ (DAS-43).

20. EPRI Document entitled "*Distribution News – September 1997 Articles.*"[43]

21. EPRI Research Report entitled "*Evaluation of Distribution System Capacitor Switching Concerns,*" Report TR-107332, dated Oct, 1997.[44]

22. EPRI Research Report entitled "*Study of Ground Currents in Proximity of Substations,*" Report TR-109272, dated Dec. 1997.[45]

23. EPRI Document entitled "*Solid State Flicker Controller,*" Document TO-111978, dated Oct, 1998.[46]

24. EPRI Research Report entitled "*Power System Disturbance Prediction,*" Report TR-111740, dated Dec. 1998.[47]

25. The Dranetz-BMI Field Handbook for Power Quality Analysis (1998).

26. The Dranetz Field Handbook for Electrical Energy Management (1992).

27. The Dranetz BMI Handbook of Power Signatures (2nd Edition) (1997).

28. Power System Harmonic Analysis, by Jos Arrillaga, Bruce C. Smith, Neville R. Watson, and Alan R. Wood (1997).

In addition, Exhibit C-___ (DAS-49) entitled "Power Quality Research" contains a further presentation of excerpts from some of these publications and documents.

This information is vital, as all of these documents, books, and publications are just a few of the items that I personally obtained in my search for the truth concerning non-linear loads, harmonics, and transients, and the utility's power quality problems.

[43] Exhibit C-___ (DAS-44).
[44] Exhibit C-___ (DAS-45).
[45] Exhibit C-___ (DAS-46).
[46] Exhibit C-___ (DAS-47).
[47] Exhibit C-___ (DAS-48).

Q In addition to violating the National Electric Safety Code by allowing "objectionable" current to flow into and onto private property, has Consumers Energy violated any other applicable rules?

A Yes. Consumers Energy has violated a number of safety rules.

Q Please explain.

A By allowing neutral currents and voltages riddled with harmonics and transients to flow into and onto individual's private property, Consumers has violated a number of the Michigan Public Service Commission's rules designed to protect customers and their property, as well as the general public. In addition, Consumers Energy has violated these safety rules through its power quality problems involving harmonics, transients, voltage swells, and voltage sags. These MPSC safety rules include the following:

- MPSC Rule 406 (R 460.3406) requires Michigan utilities to **service and maintain** the utility's equipment used on a customer's premises.
- MPSC Rule 407 (R 460.3407) requires Michigan utilities to **promptly and thoroughly investigate all complaints** concerning equipment owned by the utility.
- MPSC Rule 501 (R 460.3501) requires Michigan utilities to construct, install, maintain, and operate their electric plant (including all distribution lines, substations, and facilities) pursuant to accepted **good engineering**

practices in the industry to ensure continuity of service, **a good quality of service, and safety of people and property**.

- MPSC Rule 502 (R 460.3502) imposes on Michigan utilities the standards of accepted good standards that are contained in parts 1, 2, and 3 and sections 1, 2, 3, and 9 of the National Electrical Safety Code, 1997 Edition.
- MPSC Rule 701 (R 460.3701) requires that the standard frequency for alternating currents systems be 60 Hz, and that this frequency must be maintained so as to permit **the satisfactory operation of customer's electric clocks**.
- MPSC Rule 702 (R 460.3702) requires that Michigan utilities maintain their distribution voltages with 5% above or below their nominated voltages (i.e., @ 120 volts $\pm$ 6 volts, or 114-126 volts; at 240 volts $\pm$ 12 volts, or 228-252 volts).
- MPSC Rule 801 (R 460.3801) requires Michigan utilities to exercise **reasonable care to reduce the hazards** to which its employees, **customers, and the general public may be subjected**.

Consumers' use of the earth as a regular return pathway for its neutral current which is riddled with significant and dangerous harmonics, transients, etc., its power quality problems (harmonics, transients, voltage swells, and voltage sags) and its failure to promptly and thoroughly investigate customer's "stray voltage" complaints, has

compromised the safety of customers, their property (including dairy cows and other livestock), and the general public, in direct violation of these safety rules.

Q Are there solutions to Consumers' electrical pollution and electrical poisoning problems?

A Yes. Exposure to Consumers' electrical pollution and poisoning resulting from the utility's poor power quality and its use of the earth as a continual and regular conducting pathway can be minimized, and, potentially even eliminated.

Q What are the solutions?

A Basically, what goes out on a wire from the utility's substations should return to the substation on a wire. In order to help ensure that electricity stays on the utility's wires (and out of and off the earth), a sufficiently sized neutral is an absolute must. At a minimum, the neutral wire should be sized at 200-225% of the current carrying capacity of the largest phase conductor.

Secondly, there is a need to properly size the static line of any grounded wye transmission circuit, as this static line is a current carrying conductor. Wherever there is a grounded wye transmission circuit, there is a flow of current over the static line and grounds. Since this current contains some harmonics, which thereby compounds the utility's power quality problems, the size of the current carrying static line must be

similarly properly sized. The size of this static line should be sized such that this line offers a lower impedance path than that of the earth.

Thirdly, the ground rods that Consumers has installed in excess of those specified in the NESC should be removed. In order to safeguard its own system (at customer's and the public's expense), this utility has installed an excessive amount of ground rods, way beyond that specified in the NESC. These excessive ground rods have been installed in order to assist the utility in using the earth as the return pathway for its neutral current, rather than its own wires which are incapable of carrying the existing neutral currents riddled with harmonics and transients. All ground rods in excess of those specified in the NESC should be removed.

Fourthly, the utility should install and utilize existing modern technology to reduce transients caused by the utility's own system and equipment, such as power factor correction capacitors, as well as system resonance.

Finally, and most importantly, the Institute of Electrical and Electronics Engineers (IEEE) 519-1992 Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems[48] should be adopted as a condition of service. This harmonic control standard was developed by electrical and electronic engineers specifically to ensure high power quality for all electric customers. This standard was specifically designed to deal with harmonic issues and the burgeoning expansion of harmonics due to

[48] Exhibit C-___ (DAS-31).

the explosion of non-linear loads. This standard coupled with the other recommendations discussed above (especially the 200%+ neutral) will help mitigate and/or potentially even eliminate Consumers' power quality problems.

Q Is your recommended solution of a 200%+ neutral a new or unique solution?

A No. The proposed solution for installation of a 200%+ neutral has been widely accepted throughout the electrical and electronics industry as a way to deal with harmonics (except for those utilities who claim they don't have a "stray voltage" problem, or who allege that they have never heard of harmonics or transients). For example, a new 200%+ neutral has actually been installed and utilized by the Jackson Electric Cooperative in Wisconsin.[49] The presence of this new neutral has dramatically reduced the flow of neutral currents into the earth and put it back where it belongs – on the utility's neutral wire.

In addition to this actual use of a 200%+ neutral, various publications, treatises, etc., have stressed the need for a 200%+ or oversized neutral especially where there are non-linear loads and the resulting harmonics. For example, to name a few:

- "*In Tune With Power Harmonics*," by Fluke Corporation (1998)[50]
- National Electric Code (which requires either a single 200%+ neutral or a separate neutral for each phase conductor in buildings where non-linear loads

[49] Exhibit C-___ (DAS-8).
[50] Exhibit C-___ (DAS-36).

exist)

- "*Harmonics,*" by Mark Waller (1994)
- EC&M June 1999 article entitled "*Fundamentals of Harmonics*"[51]
- EC&M August 1999 article entitled "*Fundamentals of Harmonics – Part 3*"[52]
- CEE News, Power Quality Advisor Edition, February, 1999[53]

Q Is there any support for the application of IEEE 519-1992?

A Absolutely. First of all remember that this standard was developed by electric and electronics engineers, some of whom work for or with electric utilities, for application specifically on the electric utility system.

Secondly, the Wisconsin Public Service Commission has overhauled and adopted new power quality rules dealing directly with harmonics and transients. As part of these revisions, the Wisconsin Public Service Commission has specifically endorsed the IEEE 519 standard as the guideline to be used for corrective action, and submitted these proposed rules to the Wisconsin Legislature.

Q During your farm visits and inspections what things did you observe?

[51] Exhibit C-___ (DAS-15).
[52] Exhibit C-___ (DAS-50).
[53] Exhibit C-___ (DAS-51).

A First of all, I have to stress that I don't have theories, I have readings – actual measurements on farms, based on accepted and established electrical and electronic standards. I started out troubleshooting this so-called "stray voltage" problem, by taking actual measurements with my oscilloscope and other meters to determine and evaluate the electrical phenomena. I did not have any preconceived notion of what I would find, where I would find it, or anything else. I simply took readings and measurements based upon my electrical and electronics background and training, and on the established electric and electronic standards.

In the course of this testing, I have visited numerous farms in Michigan, Wisconsin, and Minnesota. The problems on all of these farms are the same – poor power quality involving harmonics, transients, voltage swells and sags, and earth currents. The only difference from farm to farm, as well as from state to state, has been the magnitude or amplitude of the measurements. The problems themselves, however, are the same.

In my visits to the various farms, I have observed over 6,000 dairy cows and some horses. I have observed damaged cows with swollen joints, open sores, and other maladies, as well as aborted and deformed calves.[54] I have even observed aborted twin calves, one of which was fully developed while its twin was grossly deformed. Ironically, the grossly deformed twin was the one directly in the current flow pathway between the cow's back legs. Is this absolute proof? Maybe not, but these are still my actual observations and real and undeniable events.

[54] See Exhibits C-___ (DAS-5), C-___ (DAS-6), and C-___(DAS-7) for further examples and pictures.

In addition, I have also observed stressed cows, cows reluctant to enter certain spaces, including barns and milking parlors, and even cows reluctant to drink water, such that they lap at the water instead of sucking it up as they normally do. I have seen numerous cows fall over dead for no apparent reason. I have observed cows whose entire sides and muscles spasm uncontrollably. The articles from the Wisconsin LaCrosse Tribune accurately highlight and describe a few of the conditions that I have personally observed on farms in Wisconsin, Minnesota, and Michigan.[55] These symptoms and impacts are not limited to Wisconsin; they appear everywhere I have found "dirty power." These conditions and circumstances even exist on farms that are extremely well-run and managed – farms where the farmer has dairy cows under constant expert veterinarian care, has a nutritionist and feed expert continually supervising all food intake, and has even completely rewired all electrical systems in his barns, milking parlor, etc., to be completely and fully up-to-code.

Finally, virtually every farmer whose farm I have either visited or tested, as well as every farmer I have spoken to, are not greedy individuals seeking money from the utility. Rather, they are dedicated hard-working individuals who simply want to engage in the livelihood of dairy farming without outside influences like the utility's electrical pollution and poisoning harming their cows and destroying the economics of their very livelihoods. To many of these individuals dairy farming is a way of life – it's been their family livelihood for many generations, being passed down from fathers to sons. Contrary to the utility's typical claims, these farmers have not suddenly "gotten stupid"

[55] Exhibit C-___ (DAS-5).

or become bad farmers. They know what they are doing, and have done so for many years. They rely on the professional expertise of veterinarians, nutritionists, feed experts, etc., to assist them. They utilize modern technology as well as advancements in nutrition and feed to achieve the greatest potential results. They simply want to get back to doing what they do best – engage in dairy farming.

One does not get into the dairy business to get rich – it's hard work. A dairy herd has to be milked every single day, 365 days a year. Dairy herds don't stop producing milk on holidays or during vacations. The farmers that I have visited and spoken to simply want the utility to clean up its electrical pollution and fix it's system so they can run their farms and milk their cows without any destructive forces like the utility's electrical pollution and poisoning destroying and interfering with their way of life.

Q Do you have any final comments or observations?

A I do not profess to be a doctor, nor have I had any training in medicine. Like any other person, however, I notice what I observe. A person does not have to be a mechanical engineer to see the consequences of an automobile collision, nor it is necessary to be a meteorologist to ascertain the destructiveness of a tornado.

I have made hundreds of observations and captured hundreds of waveforms in homes, schools, and other locations. Invariably, the waveforms I capture seem to be related to the health and well being of people residing in these locations. This is perfectly

consistent with what farmers have observed in their herds for years: there is no reason whatsoever that forces affecting cattle should not also similarly affect other life forms in the same vicinity. It would defy logic to expect otherwise.

Electricity is a recent innovation in human history. We "consume" it effortlessly, and make no concerted effort to determine whether it is being delivered safely. We assume that it is confined to wires and that it goes only where intended. As I have found on farms, this assumption is dangerously incorrect. In the areas I have visited, there is no systematic effort to measure the electrical forces, such as ground currents, in a region. Just the opposite is true – there is a concerted effort *not* to measure these forces.

I can cite numerous observations in which I have noticed that human health appears related to the type of electrical forces that people experience on a daily basis. There is the waveform from a house where a 30-year old woman is experiencing symptoms of leukemia and worries about her two children, who always seem to be sickly – asthma, colds, wounds that heal slowly, if at all. The entire family is "tired" when they return home.

There are waveforms from houses in which several members of a family have succumbed to brain tumors and aneurysms, and similar types of cancer. There is the village where 14 residents – 4% of the population – died of cancers involving the groin area in just one year.

There are young, seemingly healthy couples who cannot conceive, and those who have conceived only when they have lived for some time at another location. There are children who, like their parents, complain of headaches and stomach problems. Treatment for mental depression is common in these “polluted” environments, as are chronic muscle and joint pains, rashes, tiredness, insomnia, watery eyes. Many of these ailments are so common that people accept them as “normal.” Only when it is called to their attention do they start to notice the connection with changes in their electrical environment. Most think such a hypothesis is preposterous until they conduct their own experiments over weeks, months and years, and observe how they feel in certain locations and at certain times. They, too, suffer in unison. Several times, I have placed an oscilloscope in homes. Residents monitor how they feel and, invariably, the worse they feel, the higher the level of electrical pollution and poisoning. In one instance, a farmer monitored an oscilloscope and compared notes with a neighbor whom he barely knew several miles away. The same pattern was evident: when his cows seemed to be the most uncomfortable, the other person miles away felt worse.

These are serious situations and I do not raise them lightly. I know most people discount them as coincidences, think victims are looking for excuses or have succumbed to my suggestions or the placebo effect. I would like to believe the same except that I witnessed far, far too many “coincidences.” Indeed, several people who have spent any length of time with me can begin to discern the same patterns. Like me, they can start identifying the ailments after seeing the measurements, or can predict the measurements after hearing people describe their symptoms.

These are not trivial health concerns. There has been some research on the detrimental effects of human exposure to electricity. For example, see "*Electrical Stimulation and Electropathology*," by J. Patrick Reilly (1992), and "*Applied Bioelectricity*," by J. Patrick Reilly (1998). I have no interest in raising these disturbing "coincidences," and am reluctant to say anything whatsoever about human health concerns because I know that doing so will subject me to severe ridicule. Researchers far more educated than I am have been disparaged and bullied, and their careers ruined because they made similar observations. There has been a massive effort to discredit researchers studying this topic whose findings do not coincide with the interests of utilities. It is often difficult to obtain copies of their studies. One must often order them from an overseas distributor.

I do not know of anyone who has systematically measured the electrical environment with an oscilloscope in as many locations as I have. My findings can easily be validated and verified by using an oscilloscope and repeating the measurements at these locations. In spite of the gravity of my charges, no one has done so because, I believe, they know that my readings are accurate and that my suspicions warrant further investigation. They will not allow this to happen. Instead, they insist on impugning my motives and qualifications.

I have only one simple request: Let *independent and qualified* researchers *openly* repeat my measurements. Why hasn't this been done?

I wish I had not recognized these disturbing coincidences. I wish that there were other explanations for the suffering I witness daily. I have trouble accepting the fact that these problems are inflected on humans by other humans. It is difficult for me to believe people are capable of such actions, particularly following a century in which we witnesses the Holocaust, Stalin's purges and Mao's depraved state-imposed famines. Most of those victims suffered from forces beyond their control. This is not the case with electrical pollution and poisoning. We know how to correct the problem. The cost of doing so would be a pittance compared to the pain and suffering that results from failing to do so.

History will judge us harshly if we fail to act now. I ***know*** what I have measured and witnessed. I want my testimony to reflect the fact that I did everything within my power to bring these conditions to the attention of humanity.

When I first identified power quality as a problem on farms, I thought utilities would welcome my findings, which were completely consistent with what I had learned and practiced for more than two decades. Perhaps utilities serving rural areas simply were confused or had been mislead, I thought. When I explained my findings, I thought they would immediately take corrective action. I was very naïve.

In meeting after meeting, the utilities and their consultants professed ignorance of the basic concepts of harmonics, transients, and voltage sags and swells. I redoubled my

efforts to explain, always with the same result. They denigrated my findings and my competence. They ridiculed the plight of farmers.

I used to state that there wasn't an electrical problem that I couldn't solve. Now I say there isn't an electrical problem that I can't identify. It's an important and disturbing distinction.

I now know that utilities are adamantly adhering to the concept of "stray voltage," even though the concept is founded on the ludicrous assumption that electricity behaves differently on farms than on other locations. I can only speculate as to their motives, but it appears they have calculated that it's cheaper to let livestock and farm families suffer than to correct the problem. Once having adopted this strategy, they steadfastly adhere to it, perhaps thinking that they can "outlast" the problem as thousands of dairy farms go out of business. Dairy cattle are the sentinel species since their behavior and health are closely monitored. Dairy farmers have long drawn inferences between the health and productivity of their cattle, and the electrical environment.

During my work with power quality on farms, I have seen utilities deliberately alter the distribution system to affect the outcome of tests. In other words, by switching loads between substations or by recrimping neutral connections, they can –at least temporarily – distort the problem. These actions illustrate that utilities are fully aware of the problem and how to correct it.

Certain patterns are evident in the damage inflicted by poor power quality. For example, farmers routinely report increased death losses and herd health problems following periods of increased electrical consumption. For example, losses are higher following weekends, holidays and special events. This same pattern is evident following changes in weather conditions that affect ground currents. For example, losses often increase when the ground thaws or following a heavy rainfall.

These patterns affect all dairy farmers in a region subjected to the same power quality. Milk production on herds increases and decreases in synchrony. The wounds and ailments inflicted on cows are consistent with those associated with exposure to high-frequency current. Cows are suffering to a horrible extent, day after day, month after month, year after year. They have no reprieve. Veterinarians say many cows appear to have been cooked from the inside out. Cows' immune systems collapse under the assault, and manifest a horrendous variety of symptoms. Some symptoms mimic other ailments but, in total, these cattle suffer from electrical poisoning. These livestock are subjected to grossly inhumane treatment because the utilities fail to correct power quality problems.

People co-exist in this exact same environment (with electrical pollution and poisoning).

The utilities and their representatives routinely twist the facts and dispense half-truths. They hide behind technical jargon. The training and instruments used by many utility

employees responsible for “stray voltage” investigations are outdated. Moreover, utility employees who do discern the truth are threatened and demoted.

In addition to suffering, dairy farmers also fall prey to self-professed “stray voltage” consultants who sell expensive and ineffective mitigation devices. These devices include the “ring of life,” which supposedly prevents ground currents from entering by encircling the farm with buried wire, isolation transformers and electronic grounding systems. These products are marketed with no government oversight whatsoever regarding their safety and effectiveness. Utilities often seem to work in concert with these consultants, who often give dangerous advice, such as to severe grounds. Farmers spend tens of thousands of dollars on these measures, to no avail.

I am appalled and sickened by what I have witnessed. The lives of decent, honest people have been ruined by the utilities. The influence of utilities has corrupted research and distorted the truth. The actions of utilities are an affront to basic decency and morality, and, indeed, to democracy itself. Seemingly, nothing stands in the way of their economic power. I hope and pray that someone from these utilities will have the integrity to step forward and expose the truth.

Q Does this conclude your testimony?

A Yes it does.