

1 Q Please state your name and address.

2

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

4

5 Q Please describe your background and experience.

6

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

18

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

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

7  
8 Q Please continue to describe your background and experience.

9  
10 A Since my firm's inception, I have specialized in power control in industry, municipalities,  
11 and motor control centers. I have worked with oscilloscopes for over 29 years. In recent  
12 years, I have focused more attention on power quality analysis and troubleshooting. An  
13 example of the type of work I perform in this area is the Dranetz-BMI Field Handbook  
14 for Power Quality Analysis (1998)<sup>1</sup> and the Dranetz BMI Handbook of Power Signatures  
15 (2<sup>nd</sup> Edition) (1997).<sup>2</sup>

16  
17 I also have extensive experience with thermography, power-quality analyzers (Dranetz  
18 4300 PQ Analyzer, Advantest Spectrum Analyzer, Reliable Power Meter, Dranetz PQ  
19 Pagers, Fluke VR1015 Event Recorders and the software associated with this equipment),  
20 ohm meters, meggers, surge testers, amp meters, digital and analog volt meters, power  
21 factor correction meters, and phase meters to name a few. I have trained electrical

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<sup>1</sup> Exhibit C-\_\_\_ (DAS-1).

<sup>2</sup> Exhibit C-\_\_\_ (DAS-2).

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

3  
4 I have been an electrician by training, education and experience, for over the past 25  
5 years, with a specialized background and experience in electronics. I have obtained  
6 training certificates from numerous organizations, including Allen Bradley Corporation,  
7 Square D, Cuttler-Hammer, The National Fire Protection Association, Inc. (the issuers of  
8 the NEC), and University of Wisconsin – Madison, College of Engineering. I founded  
9 Stetzer Electric with only \$400.00 in 1975, and built it into a multi-million dollar  
10 company today.

11  
12 Q Please describe Stetzer Electric and the work of your company?

13  
14 A. Stetzer Electric has three divisions which I manage and oversee. The sales and service  
15 division involves the sales and service of electrical equipment, the rewinding and repair  
16 of electronic motors, and equipment. We service a variety of equipment, including  
17 generators up to 3,000 horsepower.

18  
19 The predictive maintenance division involves the collection of waveforms and frequency  
20 spectrums, and the interpretation of waveforms and spectrums with state-of-the-art CSI  
21 data collectors. My technicians, all of whom have served as electronics technicians in the  
22 military, are certified by the Vibration Institute (a national organization devoted to  
23 enhancing the knowledge and understanding of vibration principles and techniques to

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

6  
7 My power quality and electrical contracting division involves industrial and commercial  
8 wiring and related factors, as well as power quality testing.

9  
10 Excluding clerical employees, 60% of my company's staff have served in the military.  
11 Many are serving or have served apprenticeships. Many of my employees have obtained  
12 training certificates from numerous organization, including Allen Bradley Corporation,  
13 Square D, Cuttler-Hammer, the National Fire Protection Association, Inc., the U.S.  
14 Occupational Safety and Health Administration, the U.S. Department of Labor, and  
15 University of Wisconsin – Madison, College of Engineering.

16  
17 Q What is the purpose of your testimony?

18  
19 A I am presenting evidence in support of the Michigan Attorney General's case against  
20 Consumers Energy Company. Specifically, I will be presenting readings and  
21 measurements taken on farms that clearly demonstrate the utility's electrical pollution,  
22 electrical poisoning, and power quality problems.

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<sup>3</sup> Exhibit C-\_\_\_ (DAS-3).

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

3

4 A Electrical pollution and electrical poisoning<sup>4</sup> is destroying the dairy industry and  
5 negatively impacting other livestock industries. This electrical pollution and poisoning is  
6 directly affecting the health of dairy cows and other livestock, thereby negatively  
7 impacting the economics of these farms. This in turn negatively impacts the entire farm  
8 community that depends on, and draws its livelihood from, the various dairy and other  
9 livestock farms.

10

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

12

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

20

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<sup>4</sup> Exhibit C-\_\_\_ (MG-8).

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

12  
13 Since my initial troubleshooting in 1997, I have taken measurements on farms in  
14 Michigan, Wisconsin, and Minnesota, and recorded the reactions, simultaneous with  
15 electrical activity, of more than 6,000 cows and some horses.

16  
17 I have also examined hundreds of miles of distribution lines, numerous distribution  
18 facilities and equipment, including many substations.

19  
20 Q Is there any such thing as "stray voltage"?

21  

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<sup>5</sup> 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).

1 A No.

2

3 Q Please explain.

4

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

16

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

18

19 A Ohm’s law states that voltage is equal to current times the resistance. This is shown in  
20 the Ohm’s formula,  $E \text{ (watts)} = I \text{ (current)} \times R \text{ (resistance)}$ .<sup>6</sup> Kirchhoff’s current law

21

22

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<sup>6</sup> See Exhibit C-\_\_\_ (DAS-9).

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

10  
11 Q Since there is no such thing as "stray voltage," what have you found at farms?

12  
13 A I have found measurable amounts of non-sinusoidal voltage waveforms riddled with  
14 harmonics and transients at "cow contact" points (per the Minnesota Science Advisor's  
15 Study), originating from the utility's grounded wye system. I have simultaneously  
16 recorded the electrical activity with animal reactions. This can be seen on the video I  
17 created entitled "*The Effects of Low Level Non-Linear Voltages and Frequencies Applied*  
18 *to Livestock.*"<sup>10</sup> There seemed to be no noticeable change in the electrical activity (and  
19 the animal's reactions) when the farm power was turned off at the main disconnect for  
20 the entire farm at the service pole. I also found measurable and dangerous amounts of  
21 current flowing down the utility's down ground.

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<sup>7</sup> See Exhibit C-\_\_\_ (DAS-9).

<sup>8</sup> See Exhibit C-\_\_\_ (DAS-9).

<sup>9</sup> Exhibit C-\_\_\_ (DAS-10).

<sup>10</sup> Exhibit C-\_\_\_ (DAS-11).



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

- 3
- 4           • Harmonics
- 5           • Transients
- 6           • Voltage sags
- 7           • Voltage swells
- 8

9           Some of these electrical phenomena have had economic impacts that directly relate to  
10          loss of production. Some of this loss of production is described in two papers I co-  
11          authored entitled "*Milk Production of Dairy Herd Decreased by Transient Voltage*  
12          *Events*,"<sup>11</sup> and "*Milk Production of Dairy Herds Decreased by Transient Voltage*  
13          *Events*,"<sup>12</sup> both of which have been or will be published and submitted for peer review.  
14          This loss of production has further been documented by expert Forensic Economist,  
15          Michael Behr, Ph.D.<sup>13</sup> Finally, the July 5, 1999 Industrial Edition of Fortune Magazine  
16          published an expose on the existence of dirty electricity and its affects on electrical and  
17  
18  
19  
20  
21

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<sup>11</sup> Exhibit C-\_\_\_ (DH-2).  
<sup>12</sup> Exhibit C-\_\_\_ (DH-3).  
<sup>13</sup> Exhibit C-\_\_\_ (DAS-12).

1 electronic equipment entitled “*Hot New Technologies for America’s Factories.*”<sup>14</sup>

2  
3 I have recorded and measured this electrical phenomena in Minnesota, Wisconsin, and  
4 Michigan. I also have taken measurements on farms in these states and recorded the  
5 reactions of more than 6000 cows and some horses simultaneous with the electrical  
6 activity.<sup>15</sup> The reactions are clearly correlated with electrical activity hoof-to-hoof, as  
7 measured using the protocol recommended by the Final Report of the Science Advisors  
8 to the Minnesota Public Utilities Commission.<sup>16</sup> The results in Minnesota, Wisconsin,  
9 and Michigan all involved the same power quality issues (harmonics, transients, sags, and  
10 swells), although the power quality in Michigan was measurably worse than in Minnesota  
11 and Wisconsin.

12  
13 Q What are harmonics and transients?

14  
15 A The Standard Handbook for Electrical Engineers (14<sup>th</sup> Edition) defines “harmonics” as  
16 follows:

17  
18 **Harmonics.** *Harmonic distortion* is a form of electrical noise. It  
19 is the superposition of signals at multiples of the fundamental  
20 power frequency on the power sine wave. Linear loads, those  
21 which draw current in direct proportion to the voltage applied, do  
22 not generate large levels of harmonics. Nonlinear loads draw  
23 current in pulses. These pulse currents create voltage drops  
24 throughout the system as a result of the current interacting with the  
25 system impedance. The voltage distortions created by nonlinear

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<sup>14</sup> Exhibit C-\_\_\_ (DAS-13).

<sup>15</sup> See Exhibit C-\_\_\_ (DAS-11).

<sup>16</sup> Exhibit C-\_\_\_ (DAS-14).

1 loads may create voltage distortion beyond the premise's wiring  
2 system, through the utility system, to another user. Concentrated  
3 loads which generate large levels of third harmonics can result in  
4 neutral current much higher than is normally encountered in  
5 circuits where the return current from the different phases cancel.  
6

7  
8 EC&M, The Magazine of Electrical Design, Construction & Maintenance, June 1999<sup>17</sup>

9 states:

10 We define harmonics as voltages or currents at frequencies that  
11 are a multiple of the fundamental frequency. In most systems, the  
12 fundamental frequency is 60 Hz. Therefore, harmonic order is  
13 120 Hz, 180 Hz, 240 Hz and so on. (For European countries with  
14 50 Hz systems, the harmonic order is 100 Hz, 150 Hz, 200 Hz,  
15 etc.)

16  
17 We usually specify these orders by their harmonic number or  
18 multiple of the fundamental frequency. For example, a harmonic  
19 with a frequency of 180 Hz is known as the third harmonic ( $60 \times$   
20  $3 = 180$ ). In this case, for every cycle of the fundamental  
21 waveform, there are three complete cycles of the harmonic  
22 waveforms. The even multiples of the fundamental frequency are  
23 known as even-order harmonics while the odd multiples are  
24 known as the odd-order harmonics.  
25

26  
27 For a good in-depth discussion and description of harmonics, its causes, effects, and  
28 evolution, see The Dranetz Field Handbook for Electrical Energy Management (1992)<sup>18</sup>  
29 and the Fluke Video "*Understanding & Managing Harmonics*" (1998).<sup>19</sup>  
30

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

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<sup>17</sup> Exhibit C-\_\_\_ (DAS-15).

<sup>18</sup> Exhibit C-\_\_\_ (DAS-16).

<sup>19</sup> Exhibit C-\_\_\_ (DAS-17).

1 add or subtract from the nominal waveform. See Dranetz BMI Handbook of Power  
2 Signatures (2<sup>nd</sup> Edition) (1997).<sup>20</sup>

3  
4 Q What power quality reports are you offering.

5  
6 A I am offering power quality reports from Michigan, Wisconsin, and Minnesota which all  
7 present the same type of power quality problems (harmonics, transients, sags, and swells)  
8 experienced at various farms. Attached are the following:

- 9
- 10 • Exhibit C-\_\_\_(DAS-19), Plaetz Farm Power Quality Report (MN)
  - 11 • Exhibit C-\_\_\_(DAS-20), Erickson Farms Power Quality Report (WI)
  - 12 • Exhibit C-\_\_\_(DAS-21), Bey-Far Farms Power Quality Report (WI)
  - 13 • Exhibit C-\_\_\_(DAS-22), Krueger Farm Power Quality Report (WI)
  - 14 • Exhibit C-\_\_\_(DAS-23), Pinter Farm Power Quality Report (WI)
  - 15 • Exhibit C-\_\_\_(DAS-24), VanDenBerg Farm Power Quality Report (MI)
  - 16 • Exhibit C-\_\_\_(DAS-25), Tenbrink Farm Power Quality Report (MI)
  - 17 • Exhibit C-\_\_\_(DAS-26), Arlyn Walt Dairy Power Quality Report (MI)
  - 18 • Exhibit C-\_\_\_(DAS-27), Jonseck Power Quality Report (MI)
  - 19 • Exhibit C-\_\_\_(DAS-28), Logan Mier Farm Power Quality Report (MI)
  - 20 • Exhibit C-\_\_\_(DAS-29), Ramthun Power Quality Report (MI)
  - 21 • Exhibit C-\_\_\_(DAS-30), Porter Horse Farm Power Quality Report (MI).
- 22

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<sup>20</sup> Exhibit C-\_\_\_ (DAS-18).

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

3

4 A Yes.

5

6 Q What are these problems on Consumers' distribution system?

7

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

20

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

22

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

4

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

7

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

10

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

13

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

20

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

23

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

3

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

9

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

16

17 Any electrical device connected to a power source is generally referred to as “load.” In  
18 the past, virtually all loads were known as linear. Linear loads are those that draw current  
19 in a smooth sinusoidal manner. This means the load draws the current through the entire  
20 voltage waveform, thereby causing little or no distortions. Today, however, a significant  
21 portion of the loads are non-linear. These non-linear loads include computers, fax  
22 machines, copiers, and many other electronic devices, as well as various utility  
23 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.

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



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

13  
14 In addition to the increase of the impedance of these lines due to the increase in  
15 temperature caused by the harmonics, the increase in frequency of the neutral current on  
16 the neutral wire will also decrease the impedance or ability of this wire to carry the  
17 neutral current through the "skin effect" discussed earlier.

---

<sup>21</sup> "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*

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

7  
8 Marek Samotyj, EPRI's manager for power quality, says the  
9 quality situation "will get worse before we'll be able to mitigate  
10 it." One reason is that EPRI expects 70% of all electricity  
11 produced in the U.S. annually to flow through electronic devices  
12 by 2002, vs. 30% today.<sup>22</sup>  
13

14  
15 In addition, as noted in EC&M, The Magazine of Electrical Design, Construction and  
16 Maintenance, June 1999, "With the exception of the incandescent light bulb, every load  
17 today creates harmonics."<sup>23</sup>

18  
19 Q What is the net effect of these power quality problems?

20  
21 A The net effect of these power quality problems is a significant amount of neutral current  
22 riddled with harmonics and transients being forced onto the earth, as the pathway back to  
23 the substation. This is dirty power<sup>24</sup> 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).

<sup>22</sup> See Exhibit C-\_\_\_ (DAS-13), page 2.

<sup>23</sup> Exhibit C-\_\_\_ (DAS-15).

<sup>24</sup> Exhibit C-\_\_\_ (DAS-13), page 3.

1 pollution<sup>25</sup> (when it impacts equipment) or electrical poisoning<sup>26</sup> (when it impacts living  
2 creatures).

3  
4 Q Does the National Electrical Safety Code sanction or authorize Consumers Energy's use  
5 of the earth as a continual or regular return pathway for a portion of its electrically  
6 polluted neutral current?

7  
8 A Absolutely not! The National Electrical Safety Code (NEC) specifically mandates that  
9 under normal circumstances and normal operations there can be no objectionable flow of  
10 current over the grounding conductor. **Current that leaves the utility's substation over  
11 the utility's wires should return to the utility's substation over the utility's own  
12 neutral wires!** Pursuant to accepted and good electrical standards, the intended purpose  
13 of a utilities grounding system is for safety purposes to deal with extraordinary and  
14 unusual circumstances such as lightning, faults, etc. The grounding system should not be  
15 used as an additional pathway for current to return to the substation.

16  
17 Section 9, entitled "*Grounding Methods for Electric Supply and Communication*  
18 *Facilities*" of the NEC, Rule 92D provides as follows:

19  
20 Current in Grounding Conductor  
21 Ground connection points shall be so arranged that under normal  
22 circumstances there will be no objectionable flow of current over  
23 the grounding conductor. If an objectionable flow of current  
24 occurs over a grounding conductor due to the use of multi-grounds,

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<sup>25</sup> See Exhibit C-\_\_\_ (MG-8).

<sup>26</sup> See Exhibit C-\_\_\_ (MG-8).

1 one or more of the following should be used:

- 2 (1) Abandon one or more grounds.
- 3 (2) Change location of grounds.
- 4 (3) Interrupt the continuity of the conductor between ground
- 5 connections.
- 6 (4) Subject to the approval of the administrative authority, take
- 7 other effective means to limit the current.

8 The system ground of the source transformer shall not be removed.  
9 The temporary currents set up under abnormal conditions while the  
10 grounding conductors are performing their intended protective  
11 functions are not considered objectionable. The conductor shall  
12 have the capability of conducting anticipated fault current without  
13 thermal overloading or excessive voltage buildup. Refer to Rule  
14 93C.

15  
16  
17 The NESC Handbook further elaborates on the “objectionable” flow of current over a  
18 grounding conductor. First of all, the Handbook points out that it is the utility’s  
19 responsibility to “identify and remedy” all objectionable flows. The utility is the one  
20 using the earth and private property as a pathway for its neutral current, and thus it is the  
21 utility who must identify and remedy these objectionable uses. Every farmer I have  
22 spoken to has specifically “objected” to the flow of the utility’s neutral current through  
23 their own private property.

24  
25 In addition, the Handbook identifies the dangers associated with the flow of the utility’s  
26 neutral currents specifically around dairy barns and dairy cows. The Handbook further  
27 warns of the need for “specific attention to limit damage to equipment or uncomfortable  
28 conditions for personnel or animals.”

29  
30 Section 92D of the NESC Handbook, 4<sup>th</sup> Edition (1997), entitled “*Current in Grounding*  
31 *Conductor*” provides as follows:

1 Rule 92D refers to actions required in the case of “objectionable”  
2 flows of current over a grounding conductor. The word  
3 “objectionable” is undefined in the NESC; it is left to the  
4 designer’s discretion, utilizing good design and operating practice,  
5 to appropriately identify and remedy the situation.  
6

7 Where multiple grounding is used, there generally will be some  
8 circulating current between the different ground connections.  
9 These currents may arise from unbalanced loads, improper  
10 connection or loss of ground wires, or other reasons. A fraction of  
11 an ampere, or even several amperes on circuits of large capacity,  
12 may not be a serious matter. **In other cases, however, such flow  
13 may be disturbing to the service, as is sometimes the case  
14 around dairy barns in which cows are connected to milking  
15 systems. It is recognized that interrupting the circulating  
16 current between the primary neutral and the secondary  
17 neutral may not solve the problems at dairy barns and may  
18 actually cause other problems.** Such problems are often related  
19 to National Electric Code (NEC) violations, unbonded building  
20 construction, and other building-related problems that produce  
21 voltage gradients at entrances or in building floors. While it is  
22 generally both infeasible and unnecessary to ascertain the  
23 circulating current flow at every ground location, **installations  
24 near areas that are often known to present specific problems  
25 (such as milking barns without adequate voltage gradient control,  
26 pipelines, electric railways, conduits, etc.) may need special  
27 attention to limit damage to equipment or uncomfortable  
28 conditions for personnel or animals.**  
29

30 The advantage in permanency and reliability, which results from  
31 the use of a number of grounds on a given circuit feeding a  
32 considerable area, will generally warrant the use of multiple  
33 grounds on alternating-current secondaries, notwithstanding the  
34 possible existence of a slight interchange of alternating current  
35 over these connections. Heating or electrolysis from such small  
36 alternating currents is generally negligible. A value of interchange  
37 current that would not be harmful with alternating current,  
38 however, might be sufficient to cause damage if it were direct  
39 current.  
40

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

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

14  
15 **An objectionable flow of current over a grounding conductor**  
16 **may be due to any one of several reasons.** For example, if  
17 electric railway returns are located in close proximity to water  
18 pipes or other grounds, part of the railway current may be carried  
19 through the supply conductors themselves from one ground  
20 connection to another. The result may be the deterioration and  
21 ultimate failure of such ground connections from electrolysis or  
22 drying of the ground.

23  
24 In this respect, it might be well to consider cases in which the high-  
25 voltage side of a distribution or station transformer is grounded.  
26 Where transformer banks consisting of three single transformers  
27 connected in wye on the high-voltage side have the neutral point  
28 grounded, a certain amount of current will flow in this ground  
29 connection because of the third-harmonic voltage present. This  
30 current may be of considerable magnitude unless proper methods  
31 are employed to control it. Methods of control are left to the  
32 designer.

33  
34 Station transformer banks may also have their secondary windings  
35 connected in wye and the neutral point grounded. In some older  
36 systems the neutral wire was not carried out of the station as the  
37 fourth wire of a three-phase system, as when the load supplied was  
38 almost exclusively a power load. In some systems, where lighting  
39 was supplied, it used to be an occasional practice to install a  
40 single-phase transformer so that one side of its primary winding  
41 was connected to one of the phase wires and the other side to the  
42 ground. **This resulted in a continual flow of earth current at all**  
43 **times, varying from the small excitation current under no-load**  
44 **conditions to a maximum at full load or under fault conditions.**  
45 If a made electrode was used, this flow of current could result in  
46 enough drying of the soil, in dry seasons, to cause the soil

1 immediately adjacent to the artificial ground to become  
2 nonconducting. As a result, the potential of the ground connection  
3 could be raised much above ground and even approach that of the  
4 line. It is evident that a very serious condition of hazard could be  
5 produced if the high-voltage potential is brought down to the  
6 ground line. Should a rain occur at such a time, there is danger of  
7 the pole burning because of current flow across the surface of the  
8 pole. ***Such a flow of current would be considered objectionable.***  
9

10 As a result of such problems, Rule 215C in the 4<sup>th</sup> Edition (1941)  
11 introduced the prohibition against ground returns in urban areas; it  
12 recommended against them in rural areas. They were prohibited in  
13 any location in the 6<sup>th</sup> Edition (1961); that prohibition has been  
14 retained in subsequent editions. Further, beginning in 1977, Rules  
15 96 and 97 required the neutral of a multigrounded *system* to be  
16 carried throughout the system. This allows transformer cases,  
17 cable sheaths, etc., to be connected directly to the neutral and  
18 enhance the operation of the system protection devices in the event  
19 of conductor failure, transformer winding failure, or cable failure.  
20

21 Objectionable direct current can generally be eliminated by  
22 following one of the procedures recommended in the rules by  
23 either omitting or changing ground connections. The prohibition  
24 of removing the system ground from the source transformer was  
25 added in the 1977 Edition.  
26

27  
28 (Bold added, italics in original).  
29  
30  
31

32 Q Has Consumers Energy, as well as other utilities, been put on notice as to the presence,  
33 proliferation, dangers, effects and impacts of nonlinear loads, harmonics, and transients?  
34

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

1 about the presence, proliferation, dangers, effects and impacts of non-linear loads,  
2 harmonics, and transients. These documents which are all readily available, are typically  
3 relied upon and utilized in the electric industry. These include the following:  
4

- 5 1. IEEE Recommended Practices and Requirements for Harmonic Control in  
6 Electrical Power Systems, Std 519-1992<sup>27</sup>  
7
- 8 2. IEEE Guide for Applying Harmonic Limits on Power Systems,  
9 P519A/D5, May 4, 1996<sup>28</sup>  
10
- 11 3. Article entitled “*Coping with Harmonics*” by Kenneth Price (originally  
12 published in Power Quality Assurance Magazine, Premier II, 1990),  
13 republished in Power Quality Solutions: Case Studies for  
14 Troubleshooters, Edited by Gregory J. Porter & J. Andrew Van Sciver  
15 (1999).<sup>29</sup>  
16
- 17 4. Article entitled “*Eliminating Harmonic Currents Using Transformers*” by  
18 Robert H. Lee (originally published in Power Quality Assurance  
19 Magazine, Sept.-Oct. 1991), republished in Power Quality Solutions:  
20 Case Studies for Troubleshooters, Edited by Gregory J. Porter & J.  
21 Andrew Van Sciver (1999).<sup>30</sup>  
22
- 23 5. Article entitled “*Remedies for Neutral Current Harmonics*” by P.  
24 Packebush and Dr. P. Enjeti (originally published in Power Quality  
25 Conference Proceedings, Sept. 1994), republished in Power Quality  
26 Solutions: Case Studies for Troubleshooters, Edited by Gregory J. Porter  
27 & J. Andrew Van Sciver (1999).<sup>31</sup>  
28
- 29 6. “*Harmonics*,” by Mark Waller (1994).  
30
- 31 7. “*Surges, Sags and Spikes*,” by Mark Waller (Revised 1<sup>st</sup> Edition, 1992).  
32 [Original Edition – 1989].  
33
- 34 8. The Dranetz Field Handbook for Electrical Energy Management, Dranetz  
35 Technologies, Inc. (1992).<sup>32</sup>  
36

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<sup>27</sup> Exhibit C-\_\_\_ (DAS-31).

<sup>28</sup> Exhibit C-\_\_\_ (DAS-32).

<sup>29</sup> Exhibit C-\_\_\_ (DAS-33).

<sup>30</sup> Exhibit C-\_\_\_ (DAS-34).

<sup>31</sup> Exhibit C-\_\_\_ (DAS-35).

<sup>32</sup> Exhibit C-\_\_\_ (DAS-16).



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9. *“In Tune with Power Harmonics”* by Fluke Corporation (1997).<sup>33</sup>
10. Fortune Magazine Industrial Edition article entitled *“Hot New Technologies for America’s Factories”* by Gene Bylinsky (July 5, 1999).<sup>34</sup>
11. Fluke Corporation Video entitled *“Understanding & Managing Harmonics”* (1998).<sup>35</sup>
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.<sup>36</sup>
14. EPRI Research Report entitled *“Error Correction Methods for Measuring Harmonics in Power Systems,”* Report TR-105215, dated Oct. 1995.<sup>37</sup>
15. EPRI Research Report entitled *“An Assessment of Distribution System Power Quality: Volumes 1-3,”* Report TR-106294-V2, dated May 1996.<sup>38</sup>
16. EPRI Research Report entitled *“The Distribution System Modeling Guide for Disturbances and Cold Load Pickup,”* Report TR-106297, dated Aug. 1996.<sup>39</sup>
17. EPRI Research Report entitled *“Distribution Grounding: Volume 1: Handbook,”* Report TR-106661-V1, dated Aug. 1996.<sup>40</sup>
18. EPRI Document entitled *“D-STATCOM: Custom Power Technology Protects Distribution System from Disturbances Caused by Customer Loads,”* Document PS-108084, dated Jan. 1997.<sup>41</sup>
19. EPRI Document entitled *“Reliability Benchmarking Methodology (RBM),”* Document PS-109080, dated Jan. 1997.<sup>42</sup>

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<sup>33</sup> Exhibit C-\_\_\_ (DAS-36).  
<sup>34</sup> Exhibit C-\_\_\_ (DAS-13).  
<sup>35</sup> Exhibit C-\_\_\_ (DAS-17).  
<sup>36</sup> Exhibit C-\_\_\_ (DAS-37).  
<sup>37</sup> Exhibit C-\_\_\_ (DAS-38).  
<sup>38</sup> Exhibit C-\_\_\_ (DAS-39).  
<sup>39</sup> Exhibit C-\_\_\_ (DAS-40).  
<sup>40</sup> Exhibit C-\_\_\_ (DAS-41).  
<sup>41</sup> Exhibit C-\_\_\_ (DAS-42).  
<sup>42</sup> Exhibit C-\_\_\_ (DAS-43).

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- 20. EPRI Document entitled “*Distribution News – September 1997 Articles.*”<sup>43</sup>
- 21. EPRI Research Report entitled “*Evaluation of Distribution System Capacitor Switching Concerns,*” Report TR-107332, dated Oct, 1997.<sup>44</sup>
- 22. EPRI Research Report entitled “*Study of Ground Currents in Proximity of Substations,*” Report TR-109272, dated Dec. 1997.<sup>45</sup>
- 23. EPRI Document entitled “*Solid State Flicker Controller,*” Document TO-111978, dated Oct, 1998.<sup>46</sup>
- 24. EPRI Research Report entitled “*Power System Disturbance Prediction,*” Report TR-111740, dated Dec. 1998.<sup>47</sup>
- 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 (2<sup>nd</sup> 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.**

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<sup>43</sup> Exhibit C-\_\_\_ (DAS-44).  
<sup>44</sup> Exhibit C-\_\_\_ (DAS-45).  
<sup>45</sup> Exhibit C-\_\_\_ (DAS-46).  
<sup>46</sup> Exhibit C-\_\_\_ (DAS-47).  
<sup>47</sup> Exhibit C-\_\_\_ (DAS-48).

1 Q In addition to violating the National Electric Safety Code by allowing “objectionable”  
2 current to flow into and onto private property, has Consumers Energy violated any other  
3 applicable rules?  
4

5 A Yes. Consumers Energy has violated a number of safety rules.  
6

7 Q Please explain.  
8

9 A By allowing neutral currents and voltages riddled with harmonics and transients to flow  
10 into and onto individual’s private property, Consumers has violated a number of the  
11 Michigan Public Service Commission’s rules designed to protect customers and their  
12 property, as well as the general public. In addition, Consumers Energy has violated these  
13 safety rules through its power quality problems involving harmonics, transients, voltage  
14 swells, and voltage sags. These MPSC safety rules include the following:  
15

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

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

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

18  
19                  Consumers’ use of the earth as a regular return pathway for its neutral current which is  
20                  riddled with significant and dangerous harmonics, transients, etc., its power quality  
21                  problems (harmonics, transients, voltage swells, and voltage sags) and its failure to  
22                  promptly and thoroughly investigate customer’s “stray voltage” complaints, has

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

3  
4    Q     Are there solutions to Consumers' electrical pollution and electrical poisoning problems?

5  
6    A     Yes. Exposure to Consumers' electrical pollution and poisoning resulting from the  
7           utility's poor power quality and its use of the earth as a continual and regular conducting  
8           pathway can be minimized, and, potentially even eliminated.

9  
10   Q     What are the solutions?

11  
12   A     Basically, what goes out on a wire from the utility's substations should return to the  
13           substation on a wire. In order to help ensure that electricity stays on the utility's wires  
14           (and out of and off the earth), a sufficiently sized neutral is an absolute must. At a  
15           minimum, the neutral wire should be sized at 200-225% of the current carrying capacity  
16           of the largest phase conductor.

17  
18           Secondly, there is a need to properly size the static line of any grounded wye  
19           transmission circuit, as this static line is a current carrying conductor. Wherever there is  
20           a grounded wye transmission circuit, there is a flow of current over the static line and  
21           grounds. Since this current contains some harmonics, which thereby compounds the  
22           utility's power quality problems, the size of the current carrying static line must be

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

3  
4 Thirdly, the ground rods that Consumers has installed in excess of those specified in the  
5 NESC should be removed. In order to safeguard its own system (at customer's and the  
6 public's expense), this utility has installed an excessive amount of ground rods, way  
7 beyond that specified in the NESC. These excessive ground rods have been installed in  
8 order to assist the utility in using the earth as the return pathway for its neutral current,  
9 rather than its own wires which are incapable of carrying the existing neutral currents  
10 riddled with harmonics and transients. All ground rods in excess of those specified in the  
11 NESC should be removed.

12  
13 Fourthly, the utility should install and utilize existing modern technology to reduce  
14 transients caused by the utility's own system and equipment, such as power factor  
15 correction capacitors, as well as system resonance.

16  
17 Finally, and most importantly, the Institute of Electrical and Electronics Engineers  
18 (IEEE) 519-1992 Recommended Practices and Requirements for Harmonic Control in  
19 Electrical Power Systems<sup>48</sup> should be adopted as a condition of service. This harmonic  
20 control standard was developed by electrical and electronic engineers specifically to  
21 ensure high power quality for all electric customers. This standard was specifically  
22 designed to deal with harmonic issues and the burgeoning expansion of harmonics due to

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<sup>48</sup> Exhibit C-\_\_\_ (DAS-31).

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

4  
5 Q Is your recommended solution of a 200%+ neutral a new or unique solution?

6  
7 A No. The proposed solution for installation of a 200%+ neutral has been widely accepted  
8 throughout the electrical and electronics industry as a way to deal with harmonics (except  
9 for those utilities who claim they don't have a "stray voltage" problem, or who allege that  
10 they have never heard of harmonics or transients). For example, a new 200%+ neutral  
11 has actually been installed and utilized by the Jackson Electric Cooperative in  
12 Wisconsin.<sup>49</sup> The presence of this new neutral has dramatically reduced the flow of  
13 neutral currents into the earth and put it back where it belongs – on the utility's neutral  
14 wire.

15  
16 In addition to this actual use of a 200%+ neutral, various publications, treatises, etc., have  
17 stressed the need for a 200%+ or oversized neutral especially where there are non-linear  
18 loads and the resulting harmonics. For example, to name a few:

- 19  
20 • *"In Tune With Power Harmonics,"* by Fluke Corporation (1998)<sup>50</sup>  
21  
22 • National Electric Code (which requires either a single 200%+ neutral or a  
23 separate neutral for each phase conductor in buildings where non-linear loads

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<sup>49</sup> Exhibit C-\_\_\_ (DAS-8).

<sup>50</sup> Exhibit C-\_\_\_ (DAS-36).

1 exist)

- 2
- 3 • “*Harmonics*,” by Mark Waller (1994)
  - 4
  - 5 • EC&M June 1999 article entitled “*Fundamentals of Harmonics*”<sup>51</sup>
  - 6
  - 7 • EC&M August 1999 article entitled “*Fundamentals of Harmonics – Part 3*”<sup>52</sup>
  - 8
  - 9 • CEE News, Power Quality Advisor Edition, February, 1999<sup>53</sup>
- 10

11

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

13

14 A Absolutely. First of all remember that this standard was developed by electric and

15 electronics engineers, some of whom work for or with electric utilities, for application

16 specifically on the electric utility system.

17

18 Secondly, the Wisconsin Public Service Commission has overhauled and adopted new

19 power quality rules dealing directly with harmonics and transients. As part of these

20 revisions, the Wisconsin Public Service Commission has specifically endorsed the IEEE

21 519 standard as the guideline to be used for corrective action, and submitted these

22 proposed rules to the Wisconsin Legislature.

23

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

25

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26

<sup>51</sup> Exhibit C-\_\_\_ (DAS-15).

<sup>52</sup> Exhibit C-\_\_\_ (DAS-50).

<sup>53</sup> Exhibit C-\_\_\_ (DAS-51).



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

9  
10 In the course of this testing, I have visited numerous farms in Michigan, Wisconsin, and  
11 Minnesota. The problems on all of these farms are the same – poor power quality  
12 involving harmonics, transients, voltage swells and sags, and earth currents. The only  
13 difference from farm to farm, as well as from state to state, has been the magnitude or  
14 amplitude of the measurements. The problems themselves, however, are the same.

15  
16 In my visits to the various farms, I have observed over 6,000 dairy cows and some  
17 horses. I have observed damaged cows with swollen joints, open sores, and other  
18 maladies, as well as aborted and deformed calves.<sup>54</sup> I have even observed aborted twin  
19 calves, one of which was fully developed while its twin was grossly deformed.

20 Ironically, the grossly deformed twin was the one directly in the current flow pathway  
21 between the cow's back legs. Is this absolute proof? Maybe not, but these are still my  
22 actual observations and real and undeniable events.

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<sup>54</sup> See Exhibits C-\_\_\_ (DAS-5), C-\_\_\_ (DAS-6), and C-\_\_\_(DAS-7) for further examples and pictures.

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

14  
15 Finally, virtually every farmer whose farm I have either visited or tested, as well as every  
16 farmer I have spoken to, are not greedy individuals seeking money from the utility.  
17 Rather, they are dedicated hard-working individuals who simply want to engage in the  
18 livelihood of dairy farming without outside influences like the utility’s electrical  
19 pollution and poisoning harming their cows and destroying the economics of their very  
20 livelihoods. To many of these individuals dairy farming is a way of life – it’s been their  
21 family livelihood for many generations, being passed down from fathers to sons.  
22 Contrary to the utility’s typical claims, these farmers have not suddenly “gotten stupid”

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<sup>55</sup> Exhibit C-\_\_\_ (DAS-5).

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

6  
7 One does not get into the dairy business to get rich – it’s hard work. A dairy herd has to  
8 be milked every single day, 365 days a year. Dairy herds don’t stop producing milk on  
9 holidays or during vacations. The farmers that I have visited and spoken to simply want  
10 the utility to clean up its electrical pollution and fix it’s system so they can run their  
11 farms and milk their cows without any destructive forces like the utility’s electrical  
12 pollution and poisoning destroying and interfering with their way of life.

13  
14 Q Do you have any final comments or observations?

15  
16 A I do not profess to be a doctor, nor have I had any training in medicine. Like any other  
17 person, however, I notice what I observe. A person does not have to be a mechanical  
18 engineer to see the consequences of an automobile collision, nor it is necessary to be a  
19 meteorologist to ascertain the destructiveness of a tornado.

20  
21 I have made hundreds of observations and captured hundreds of waveforms in homes,  
22 schools, and other locations. Invariably, the waveforms I capture seem to be related to  
23 the health and well being of people residing in these locations. This is perfectly

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

4  
5 Electricity is a recent innovation in human history. We “consume” it effortlessly, and  
6 make no concerted effort to determine whether it is being delivered safely. We assume  
7 that it is confined to wires and that it goes only where intended. As I have found on  
8 farms, this assumption is dangerously incorrect. In the areas I have visited, there is no  
9 systematic effort to measure the electrical forces, such as ground currents, in a region.  
10 Just the opposite is true – there is a concerted effort *not* to measure these forces.

11  
12 I can cite numerous observations in which I have noticed that human health appears  
13 related to the type of electrical forces that people experience on a daily basis. There is  
14 the waveform from a house where a 30-year old woman is experiencing symptoms of  
15 leukemia and worries about her two children, who always seem to be sickly – asthma,  
16 colds, wounds that heal slowly, if at all. The entire family is “tired” when they return  
17 home.

18  
19 There are waveforms from houses in which several members of a family have succumbed  
20 to brain tumors and aneurysms, and similar types of cancer. There is the village where 14  
21 residents – 4% of the population – died of cancers involving the groin area in just one  
22 year.

23

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

16  
17          These are serious situations and I do not raise them lightly. I know most people discount  
18          them as coincidences, think victims are looking for excuses or have succumbed to my  
19          suggestions or the placebo effect. I would like to believe the same except that I  
20          witnessed far, far too many “coincidences.” Indeed, several people who have spent any  
21          length of time with me can begin to discern the same patterns. Like me, they can start  
22          identifying the ailments after seeing the measurements, or can predict the measurements  
23          after hearing people describe their symptoms.

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

11

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

19

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

22

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

10  
11 History will judge us harshly if we fail to act now. I *know* what I have measured and  
12 witnessed. I want my testimony to reflect the fact that I did everything within my power  
13 to bring these conditions to the attention of humanity.

14  
15 When I first identified power quality as a problem on farms, I thought utilities would  
16 welcome my findings, which were completely consistent with what I had learned and  
17 practiced for more than two decades. Perhaps utilities serving rural areas simply were  
18 confused or had been misled, I thought. When I explained my findings, I thought they  
19 would immediately take corrective action. I was very naïve.

20  
21 In meeting after meeting, the utilities and their consultants professed ignorance of the  
22 basic concepts of harmonics, transients, and voltage sags and swells. I redoubled my

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

3  
4 I used to state that there wasn't an electrical problem that I couldn't solve. Now I say  
5 there isn't an electrical problem that I can't identify. It's an important and disturbing  
6 distinction.

7  
8 I now know that utilities are adamantly adhering to the concept of "stray voltage," even  
9 though the concept is founded on the ludicrous assumption that electricity behaves  
10 differently on farms than on other locations. I can only speculate as to their motives, but  
11 it appears they have calculated that it's cheaper to let livestock and farm families suffer  
12 than to correct the problem. Once having adopted this strategy, they steadfastly adhere to  
13 it, perhaps thinking that they can "outlast" the problem as thousands of dairy farms go out  
14 of business. Dairy cattle are the sentinel species since their behavior and health are  
15 closely monitored. Dairy farmers have long drawn inferences between the health and  
16 productivity of their cattle, and the electrical environment.

17  
18 During my work with power quality on farms, I have seen utilities deliberately alter the  
19 distribution system to affect the outcome of tests. In other words, by switching loads  
20 between substations or by recrimping neutral connections, they can –at least temporarily  
21 – distort the problem. These actions illustrate that utilities are fully aware of the problem  
22 and how to correct it.

23



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

7  
8 These patterns affect all dairy farmers in a region subjected to the same power quality.  
9 Milk production on herds increases and decreases in synchrony. The wounds and  
10 ailments inflicted on cows are consistent with those associated with exposure to high-  
11 frequency current. Cows are suffering to a horrible extent, day after day, month after  
12 month, year after year. They have no reprieve. Veterinarians say many cows appear to  
13 have been cooked from the inside out. Cows' immune systems collapse under the  
14 assault, and manifest a horrendous variety of symptoms. Some symptoms mimic other  
15 ailments but, in total, these cattle suffer from electrical poisoning. These livestock are  
16 subjected to grossly inhumane treatment because the utilities fail to correct power quality  
17 problems.

18  
19 People co-exist in this exact same environment (with electrical pollution and poisoning).

20  
21 The utilities and their representatives routinely twist the facts and dispense half-truths.  
22 They hide behind technical jargon. The training and instruments used by many utility

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

3  
4 In addition to suffering, dairy farmers also fall prey to self-professed “stray voltage”  
5 consultants who sell expensive and ineffective mitigation devices. These devices include  
6 the “ring of life,” which supposedly prevents ground currents from entering by encircling  
7 the farm with buried wire, isolation transformers and electronic grounding systems.  
8 These products are marketed with no government oversight whatsoever regarding their  
9 safety and effectiveness. Utilities often seem to work in concert with these consultants,  
10 who often give dangerous advice, such as to severe grounds. Farmers spend tens of  
11 thousands of dollars on these measures, to no avail.

12  
13 I am appalled and sickened by what I have witnessed. The lives of decent, honest people  
14 have been ruined by the utilities. The influence of utilities has corrupted research and  
15 distorted the truth. The actions of utilities are an affront to basic decency and morality,  
16 and, indeed, to democracy itself. Seemingly, nothing stands in the way of their economic  
17 power. I hope and pray that someone from these utilities will have the integrity to step  
18 forward and expose the truth.

19  
20 Q Does this conclude your testimony?

21  
22 A Yes it does.