WIND ENERGY SYSTEMS LICENSING ORDINANCE

The Town Board of the Town of Chilton, Calumet County, Wisconsin, does ordain as follows:

WIND ENERGY SYSTEMS LICENSING ORDINANCE

I. FINDINGS OF FACT.

A. These regulations are adopted under the authority granted pursuant to Wis. Stats. 66.0401, which provides:

> Wis. Stat. § 66.0401 (2002)
> Regulation relating to solar and wind energy systems.
>
> 1. AUTHORITY TO RESTRICT SYSTEMS LIMITED. No county, city, town, or village may place any restriction, either directly or in effect, on the installation or use of a solar energy system, as defined in s. 13.48(2)(h) l.g., or a wind energy system, as defined in s. 66.0403(1)(m), unless the restriction satisfies one of the following conditions:
>
> a. Serves to preserve or protect the public health or safety.
>
> b. Does not significantly increase the cost of the system or significantly decrease its efficiency.
>
> c. Allows for an alternative system of comparable cost and efficiency.

B. It is necessary and appropriate to protect the Niagara Escarpment, which is a unique geological formation. Regarding the protection of the Niagara Escarpment and other important natural resources and natural areas in the Town of Chilton, the Town Board incorporates by reference the East Central Wisconsin Regional Planning Commission's *Outdoor Recreation and Open Space Plan for East Central Wisconsin, March 1977* (currently being updated), the 2005 *Calumet County Outdoor Recreation Plan*, and the 2006 Wisconsin Department of Natural Resources Report *Land Legacy Report*.

C. The geological features of the Niagara Escarpment make the groundwater more susceptible to degradation by blasting and related industrial/commercial construction activity because the soil is unable to perform its normal filtration process due to the numerous cracks in the bedrock. Unregulated wind energy systems may have an adverse, direct impact on local drinking water resources.

D. The Town Board finds that Wind Energy Systems operating in the Town require special licensing by the Town in order to protect and preserve the health, safety, and welfare of the citizens of the Town and people in general. In this regard, the

Town Board adopts and incorporates by reference a recent report issued by the National Research Council entitled *Environmental Impacts of Wind-Energy Projects*, May 2007 ("2007 NRC Report"). The Town Board further finds that the Calumet County Wind Energy Ordinance is insufficient to protect the public health and safety of Town residents and property owners.

E. Licensing is a legitimate and reasonable means of accountability to ensure that the construction of and operation by employees of Wind Energy Systems comply with reasonable regulations and to ensure that operators and employees do not allow their establishments to be hazardous to the public health or safety.

F. It is not the intent of this ordinance to significantly increase the cost of the system or significantly decrease the efficiency of any Wind Energy System proposed to be located in the Town.

II. PURPOSE AND INTENT.

Based upon the findings stated above, it is the intended purpose of the Town to regulate Wind Energy Systems to promote the health, safety, and general welfare of the citizens of the Town and to establish reasonable and uniform regulations for the operation thereof so as to control potentially dangerous effects of these Systems on the community.

III. DEFINITIONS.

The following terms have the meanings indicated:

A. “Aerodynamic Sound” means a noise that is caused by the flow of air over and past the blades of a WES.

B. “Ambient Sound” Ambient noise encompasses all sound present in a given environment, being usually a composite of sounds from many sources near and far. It includes intermittent noise events, such as, from aircraft flying over, dogs barking, wind gusts, mobile farm or construction machinery, and the occasional vehicle traveling along a nearby road. These transient events are all part of the ambient sound environment but are not to be considered part of the background sound unless they were present for at least 90% of the time.

C. “Ampacity” means the current carrying capacity of conductors or equipment expressed in Amperes.

D. “Ampere” means the basic unit measuring the quantity of electricity.

E. “Anemometer” means a device for measuring the speed and direction of the wind.

F. "Applicant" means the individual or business entity that seeks to secure a license under this section of the Town municipal code.

G. “A-Weighted Sound Level” A measure of over-all sound pressure level designed to reflect the response of the human ear, which does not respond equally to all frequencies. It is used to describe sound in a manner representative of the human ear’s response. It reduces the effects of the low and high frequencies with respect to the medium frequencies. The resultant sound level is said to be A-weighted, and the units are dBA. Sound level meters have an A-weighting network for measuring A-weighted sound levels (dBA). Also, the weighted sound level by the use of the A metering characteristic and weighting specified in ANSI Specifications for Sound Level Meters, S1.4-1983 for Type 1 instruments.

H. “Background Sound” refers to the sounds that would normally be present at least 90% of the time. The background sound is heard during lulls in the ambient sound environment when transient sounds are not present. Background sound level (dBA) is the sound level present for at least 90% of the time during a period of observation that is representative of the typical soundscape and at least a duration of ten (10) minutes to an hour or longer as appropriate to characterize the site. It is defined by the L_{90} descriptor. It may be considered to be the quietest 6 minutes during an hour. Background sound levels vary during different times of the day and night. The background sound levels of most interest are those during the quieter periods of the day which are often the late evening, nighttime, and early morning hours. Background sound levels and 1/1 or 1/3 octave band sound pressure levels should be determined for conditions where the wind speed is less than five (5) mph at the surface and microphone.

I. “Blade Passage Frequency” (BPF) means the frequency at which the blades of a turbine pass a particular point during each revolution (e.g. lowest point or highest point in rotation) in terms of events per second. A three bladed turbine rotating at 28 rpm would have a BPF of 1.4 Hz. [E.g. ((3 blades times 28rpm)/60 seconds per minute = 1.4 Hz BPF)]

J. “Blade Glint” means the intermittent reflection of the sun off the surface of the blades of a single or multiple WES(s).

K. "Board" means the Town Board for the Town of Chilton, Calumet County, Wisconsin.

L. “Decibel (dB)” A dimensionless unit which denotes the ratio between two quantities that are proportional to power, energy or intensity. One of these quantities is a designated reference by which all other quantities of identical units are divided. The sound pressure level (Lp) in decibels is equal to 10 times the logarithm (to the base 10) of the ratio between the pressure squared divided by the reference pressure squared. The reference pressure used in acoustics is 20 MicroPascals.

M. "Employee" Any and all Persons, including but not limited to "operators," who work in or at, or render any services directly related to operation of Wind Energy Systems.

N. “Frequency” The number of oscillations or cycles per unit of time. Acoustical frequency is usually expressed in units of Hertz (Hz) where one Hz is equal to one cycle per second.

O. "Good Utility Practice" means any of the practices, methods and acts with respect to the safe operation of the Wind Energy System Facility ("WESF") engaged in or approved by a significant portion of the electric utility industry and, in particular, those portions of the industry with experience in the construction, operation and maintenance of wind turbines during the relevant time period; or any of the practices, methods and acts which, in the exercise of reasonable judgment in light of the facts known at the time the decision was made, could have been expected to accomplish the desired result at a reasonable cost consistent with good business practices, reliability, safety and expedition. Good Utility Practice is not intended to be limited to the optimum practice, method, or act to the exclusion of all others, but rather to be acceptable practices, methods or acts generally accepted in the region.

P. “Height” means the total distance measured from the grade of the property as existed prior to the construction of the wind energy system, facility, tower, turbine, or related facility at the base to its highest point.

Q. **“**Hertz (Hz)” Frequency of sound expressed by cycles per second.

R. “High Voltage Electrical Termination” means connecting of conductors to a device or system where the voltage exceeds 600 volts.

S. “Impulsive Sound” refers to short-term acoustical impulses typically lasting less than one second each. It may be the only sound emitted from a noise source or it may be a component of a more complex sound. For evaluation of wind turbines, impulsive sound includes swishing or thumping sounds.

T. “Low Frequency Sound” refers to sounds with energy in the lower frequency range of 0 to 100 Hz. The sounds in the frequency range of 20 Hz and below are of most interest for this type of noise. Low Frequency Noise is deemed to be unsafe when the difference between a C-weighted sound pressure level and an A-weighted sound pressure level is greater than 20 decibels at any measurement point outside or inside a noise sensitive receptor site, residence, or other occupied structure. E.G. C-A>20 dB.

U. “Measurement Point (MP)” means location where sound and/or vibration measurements are taken such that no significant obstruction blocks sound and vibration from the site. The Measurement Point should be located so as to not be near large objects such as buildings and in the line-of-sight to the nearest turbines. Proximity to large buildings or other structures should be twice the largest dimension of the structure, if possible.

V. “Measurement Wind Speed” For measurements conducted to establish the background sound levels and 1/1 or 1/3 octave band sound pressure levels the

wind speed at the microphone's Measurement Point shall be 5 mph or less. For measurements conducted to establish the post-construction sound level and 1/1 or 1/3 octave band sound pressure levels (measurements required in Section F. and the Appendix) the wind speed at the microphone's Measurement Point shall not exceed 10 mph and the wind speed at the WES blade height shall be at or above the nominal rated wind speed. For purposes of enforcement, the wind speed at the WES blade height shall be selected to reproduce the conditions leading to the enforcement action.

i. For purposes of models used to predict the sound levels and sound pressure levels of the WES to be submitted with the Application the Wind Speed shall be the speed that will result in the worst-case sound levels and 1/1 or 1/3 octave band sound pressure levels in the community adjacent the nearest WES. For purpose of the models the wind direction shall consider the dominant wind direction for the seasons from the late Spring to Early Fall. If other wind directions may cause levels to exceed those of the predominant wind direction , these levels and conditions shall be included in the Application.

W. "Mechanical Noise" means sound produced as a byproduct of the operation of the mechanical components of a WES(s) such as the gearbox and generator.

X. "Noise" means any unwanted sound. Not all noise needs to be excessively loud to represent an annoyance or interference.

Y. "Octave" The interval between two sounds having a frequency ratio of two. There are 8 octaves on the keyboard of a standard piano.

Z. "Octave Band" A segment of the frequency spectrum separated by an octave.

AA. "Octave Band Level" The integrated sound pressure level of only those sine-wave components within a specified octave band interval.

BB. "Operator" means the Person who is designated on the license application to be the Person in charge of the daily operation of the premises and who is to be the Wind Energy Systems contact Person for the municipality.

CC. "Person" means an individual, proprietorship, corporation, association, partnership, limited liability entity, or other legal entity.

DD. "Project Boundary" means the external property boundaries of parcels owned by or leased by the WES developers.

EE. "Property Line" means the recognized and mapped property parcel boundary line.

FF. “Pure Tone” A sound for which the sound pressure is a simple sinusoidal function of the time, and characterized by its singleness of pitch. Pure tones can be part of a more complex sound wave that has other characteristics.

GG. “Safe Clearance” a distance of 1.1 times the height of the total height of the structure

HH. “Sensitive Receptor” means places or structures intended for four (4) season human habitation, whether inhabited or not, public parks, state and federal wildlife areas, the manicured areas of recreational establishments designed for public use, including but not limited to golf courses, camp grounds and other non-agricultural state or federal licensed businesses.

These areas are more likely to be sensitive to the exposure of the noise, vibration, shadow or flicker, etc. generated by a WES or WESF. These areas include, but are not limited to: schools, daycare centers, elder care facilities, hospitals, places of seated assemblage, non-agricultural businesses and residences.

II. “Setback” means the minimum allowable horizontal distance from a given point or line of reference, such as a thoroughfare right-of-way, water line, or prospective line to the nearest vertical wall or other element of building or structure.

JJ. “Setback Area” means the land base that falls within a specified setback.

KK. “Shadow Flicker” means the effect when the blades of an operating wind energy conversion unit pass between the sun and an observer, casting a readily observable, moving shadow on the observer and his/her immediate environment.

LL. “Shadow Flicker and Blade Glint Zone” means the land area that falls within the setback for shadow flicker or blade glint.

MM. “Sound” A fluctuation of air pressure which is propagated as a wave through air

NN. “Sound Power” The total sound energy radiated by a source per unit time. The unit of measurement is the watt. Abbreviated as L_w.

OO. “Sound Pressure” The instantaneous difference between the actual pressure produced by a sound wave and the average or barometric pressure at a given point in space.

PP. “Sound Pressure Level (SPL)” 20 times the logarithm, to the base 10, of the ratio of the pressure of the sound measured to the reference pressure, which is 20 micronewtons per square meter. In equation form, sound pressure level in units of decibels is expressed as SPL (dB) = 20 log p/pr.

QQ. “Spectrum” The description of a sound wave's resolution into its components of frequency and amplitude.

RR. "Stray Voltage" means neutral-to-earth voltage measured from the electrical system neutral and/or any structure bonded to this neutral to earth that adversely affects humans or animals.

SS. “Tonal sound (sometimes Pure Tone)” A sound for which the sound pressure is a simple sinusoidal function of the time, and characterized by its singleness of pitch. Tonal sound can be simple or complex.

TT. "Wind Energy Systems" means equipment that converts and then stores or transfers energy from the wind into usable forms of energy on a large, industrial scale for commercial. or utility purposes. Small scale wind systems of less than 170 feet in height with a 60-foot rotor diameter and a nameplate capacity of less than 100 kilowatts or less are exempt from this definition and the provisions of this Ordinance.

UU. "Wind Energy Systems Facility" or "Facility" means all of the land and equipment used by the wind energy system and its support facilities including the wind turbine, tower, access roads, control facilities, meteorological towers, maintenance and all power collection and transmission systems.

VV. "Wind Energy System Tower" means any structure that is designed and constructed primarily for the purpose of supporting the Wind Turbine.

WW. "Wind Energy System Tower Site" means the land area encompassing a tower and all related equipment, structures paved or graveled areas, safe clearance areas, fencing and other items used in connection with said tower.

XX. "Wind Turbine" or "Turbine" means a mechanical device which captures the kinetic energy of the wind and converts it into electricity. The primary components of a wind turbine are the blade assembly, electrical generator and tower.

IV. LICENSING

A. **License Required**.

From and after the effective date of this Ordinance, no Wind Energy Systems shall be operated or maintained in the Town without first obtaining a license to operate issued by the Town. However, small scale wind systems of less than 170 feet in height with a 60-foot rotor diameter and a nameplate capacity of less than 100 kilowatts are exempt from the provisions of this Ordinance.

B. **Effect of Other Licenses**.

The fact that a Person possesses any other valid license or permit required by law, does not exempt that Person from the requirement of obtaining a Wind Energy Systems license under this Section.

C. **Non-assignability of Licenses**.

The license is not assignable or transferable to any other Person, without the express prior written consent of the Town, such consent not to be unreasonably withheld; provided, however, the Licensee may assign the License once to a new entity, upon notice to the Town, if the Licensee submits an affidavit demonstrating the following:

The new entity is wholly owned by the Licensee.

The new entity is properly formed and authorized to do business in Wisconsin.

The written assignment requires the new entity to assume all of the Licensee's rights, duties and obligations under the License including but not limited to the letter of credit requirements and the certificate of insurance requirements.

V. LICENSE APPLICATION PROCEDURE FOR WIND ENERGY SYSTEMS

A. Any Person desiring to secure a Wind Energy Systems license shall file an application together with two additional copies of the application with the Town Clerk.

B. The application shall be on a form provided by the Town Clerk.

C. The following information shall be required of each Applicant, and must be provided under oath or affirmation:

1. Name, address, and phone number.

2. If the Applicant is a corporation, partnership, limited liability company or limited liability partnership, the application shall include the name of the business entity; the date of incorporation, registration or organization; the state in which the entity was incorporated, registered or organized; the name and address and home numbers of the registered agent where applicable; the names and addresses of all officers and directors; operating or managing partners or general partners; managing members or managers, whichever is applicable for the particular form of business entity.

3. Name and address of any other current or past Wind Energy Systems operated by the Applicant whether in this State or any other State or District within the United States.

4. Name, address and phone number of an individual who is responsible for the day-to-day operation of the facility, who will be deemed the Operator for purposes of this section, and who will be the contact Person for the municipality.

5. A statement that the Applicant is familiar and in compliance with the provisions of this section of the Town's municipal code, including the responsibility to reimburse all reasonable costs and professional fees associated with the processing, examination and analysis of the proposed facility.

D. Each application shall be accompanied by:

1. A site plan which meets all the requirements of this Section and applicable provisions of the Calumet County Zoning Code pertaining to Land Use Permits, as well as any additional site specific requirements of the Town Board and/or the Town engineers in accordance with the technical requirements in this ordinance. Each application shall be accompanied by a site plan of the Wind Energy System Tower Site(s), including total acreage occupied by the facility. The application shall also be accompanied by a detailed map of the area showing parcel boundaries, individual Wind Turbine locations and accessory structures such as transmission lines and substations. The applicant shall also provide details of expected production of the project for each season or month.

2. Additional information regarding the: make and model of the turbines, Sound Power Levels (L_w) for each octave band from the Blade Passage Frequency up through 10,000 HZ, and a projection showing the expected sound pressure levels in each of those octave bands for all areas within and to 1 mile from the project boundary for the wind speed and direction that would result in the worst case WES sound emissions. The projection may be by means of computer model but shall include a description of all assumptions made in the model's construction and algorithms. If the model does not consider the effects of wind direction, geography of the terrain, and the effects of reinforcement from coherent sounds or tones from the turbines these should be identified and other means used to adjust the model's output to account for these factors. These results may be displayed as a contour map of the predicted levels, but should also include a table showing the predicted levels at noise sensitive receptor sites and residences within the model's boundaries. The predicted values may include dBA values but shall also include the non-weighted octave band levels in the data tables.

3. The Town reserves the right to require the preparation of (a) a pre-construction noise survey for each proposed Wind Turbine locations conducted per procedures provided in the Appendix showing background sound levels (L_{90}) and 1/1 or 1/3 octave band sound pressure levels (L_{90}) during quiet periods of the day and/or night over a reasonable period of time (not less than 10 minutes of sampling) prior to approval for the final layout and construction, and (b) an environmental study evaluating the impact the project may have in the vicinity of the proposed Wind Turbine sites.

    a. If any proposed wind farm project locates a WES within 1/3 mile of a sensitive receptor these studies are mandatory. The pre-construction baseline studies shall be conducted by firms selected by the town board.

    b. The town board shall hire an independent consultant to conduct the sound and vibration study for the town as specified in this licensing ordinance. However, the applicant shall be responsible for paying the consultant fees and costs associated with conducting the study. These fees and cost shall be negotiated with the consultant and determined prior to any work being done on the study. The applicant shall be required to pay 100% of these fees and costs directly to the town, before the study is commenced by the consultant. Receipt of payment does not imply acceptance.

4. Each application shall be signed by the Applicant.

5. Each application shall be accompanied by payment of nonrefundable application fee to be determined from time to time by separate resolution of the Town Board. Filing of the application does not occur until this fee has been paid. Receipt of payment does not imply acceptance.

6. The Town Clerk shall date the filing of the application on the face of the application.

7. Upon receipt of the application, the Town Clerk shall distribute a copy of the application to the Town Board, Building Inspector and Town Fire Departments.

8. The Town Board may refer the application to the Town engineer or a qualified consulting engineer for further review. The reasonably necessary costs associated with the engineering review shall be the responsibility of the applicant, in accord with the terms of this ordinance.

9. The Town Board may, but shall not be obligated, to refer the application to the appropriate committee for review and recommendation.

10. The Town Board may, but shall not be obligated to refer the application to a public hearing for purposes of receiving public comment.

11. Following review, the Town Board shall either grant the license or deny the application after reviewing the application for compliance with the licensing standards found in this ordinance and under state law. A license may be granted with conditions.

12. If the license is granted by the Town Board, then the Town Clerk shall issue the license on the next business day. A license may be revoked at any time by the Town Board for good cause, after first providing the Licensee with a hearing. If substantial construction has not begun within one year of the issuance of the license, the license shall expire and the Licensee shall be required to re-apply for a new license. The preceding one year deadline may be extended if the Licensee is able to demonstrate that the delay in construction is caused by circumstances beyond the Licensee's reasonable control. However, the Licensee shall not be excused from the preceding deadline if the delay arises from the Licensee's negligence or failure to reasonably anticipate ascertainable events or its failure to utilize commercially reasonable alternate solutions.

13. If the Town Board decides to deny the application for a license, the Board shall immediately notify the Applicant in writing of the reasons for denial. Such notice shall be sent to the Applicant within 5 days of the decision by certified mail, return receipt requested.

14. Any Applicant or other person aggrieved by such a decision of the Town Board, including any resident or owner of property in the Town, shall be entitled to immediately appeal the Board's decision in circuit court. Such an appeal must be made within 30 days of the date of the written decision by the Board. The Town explicitly elects not to be governed by Chapter 68, Wisconsin Statutes, and to provide the review procedures described in this Section.

15. Each license issued for a Wind Energy System shall state on its face the name of the licensee, the name of the establishment, the street address of the establishment, the date of issue of the license and its expiration date.

VI. TECHNICAL REQUIREMENTS FOR LICENSING

This ordinance is intended to promote the safety and health of the community through licensing regarding the design, construction and operation of Wind Energy Systems. It is recognized that the requirements herein are neither exclusive, nor exhaustive. In instances where a health or safety concern is identified with regard to any application for a Wind Energy System, additional and/or more restrictive conditions may be included in the license to address such concerns. All rights are reserved to impose additional restrictions as circumstances warrant. Such additional or more restrictive conditions may include,

without limitation (a) greater setbacks, (b) more restrictive noise limitations, or (c) additional groundwater or surface water protections.

A. Design.

Each Wind Turbine shall consist of a tower, generator(s), nacelle and blades. Each WESF site must have access roads, underground transmission cabling to connect the generators to local utility electric distribution lines, and underground fiber optic lines. The application shall disclose the nature and type of the proposed Wind Turbine to be installed. Detailed product literature shall accompany the application. Each Wind Turbine shall also comply with the following design requirements (a) Wind Turbines shall be painted a non-reflective, non-obtrusive. color; (b) at each WESF site, the design of the buildings and related structures shall, to the extent reasonably possible, use materials, colors, textures, screening and landscaping that will blend the WESF to the natural setting and the existing environment; (c) Wind Turbines shall not be artificially lighted, except to the extent required by the FAA or other applicable authority; strobe or other intermittent lights are prohibited; lighting shall be in accordance with the Town's lighting ordinance; (d) Wind Turbines shall not be used for displaying any advertising, except for reasonable identification of the manufacturer or operator of the WESF; and (e) electrical controls and control wiring and power-lines must be wireless or not above ground, except where wind farm collector wiring is brought together for connection to the transmission or distribution network, adjacent to that network.

B. Blasting.

Licensee shall not undertake any blasting in connection with the construction of the Facility unless Applicant shall have notified the Town and submitted a blasting plan consistent with applicable laws and regulations. The blasting plan must be reviewed and approved by the Town Board before any blasting may take place. The plan shall provide, at a minimum, (a) all blasts must comply with the State ground vibration limitations; (b) flyrock traveling in the air or along the ground must remain in the controlled blasting area site owned or controlled by the applicant; (c) all blasting must be performed by or under the direct supervision of a State-licensed blaster; (d) a blasting log for each blast will be kept on-site at the WESF office for not less than 5 years, and copies of the required blasting log will be promptly submitted to the Town upon its request; (e) a resident call list must be established for the purpose of notifying neighbors at homes in the vicinity of the WESF of eminent blasting activity. This call list must be maintained and utilized on a "request basis only" for all residents in the vicinity of the WESF who asked to be notified prior to any blast; and (f) the storage of explosives will be accordance with Chapter Comm. 7 of the Wisconsin Administrative Code.

C. Communications Interference.

Any WES shall be sited and operated so that they do not interfere with television, internet service, telephone (including cellular and digital), microwave, satellite (dish), navigational, or radio reception to neighboring areas. The applicant and/or operator of the facility shall be responsible for the full cost of any remediation necessary to provide equivalent alternate service or correct any problems; including relocation or removal of the facility caused or exacerbated by the operation of such equipment and any and all related transmission lines, transformers, and other components related thereto. The owner/operator of the WES shall respond within 24 hours to any request for a communications interference investigation by a property owner within the municipal boundaries of the Township of Chilton. Testing shall commence within 48 hours of the request. Owner/operator is responsible for eliminating the interference within 72 hours from testing.

D. Emergency Procedures.

Licensee shall be required to immediately cease operations for the duration of any Emergency. Emergency shall mean a proven condition or situation caused by the WES or WESF that presents an imminent physical threat of danger to life or significant threat to property.

1. Twenty-Four Hour/Seven Day a Week Emergency Contact Number**:** Any operator/owner of a WES shall furnish the Town Clerk with an emergency contact number to be made public for the purpose of information the operator/owner of an emergency situation.

2. Rescue, Fire and Hazard Protection: Owner/operator shall assure that the WES complies with the following fire control and Prevention measures and incurs associated costs.

    a. Fireproof or fire resistant building materials and buffers or fire retardant landscaping.

    b. Fire fighting and rescue services, including programs and costs associated with equipment and training, for local fire protection and rescue personnel.

    c. The owner/operator shall be responsible for compliance with all laws applicable to the generation, storage, clean up, transportation and disposal of hazardous wastes generated during any phase of the project's life.

E. Groundwater Protection.

Licensee shall operate the Facility so as not to cause groundwater contamination in violation of applicable law. Nothing contained in the license is intended to authorize or permit any degradation of the quantity or quality of the groundwater in connection with the WESF. Furthermore, no wells may be drilled within 1.1 times the height of the wind energy system tower or the safe clearance, whichever is greater. In addition, the Licensee shall complete a plan for managing surface water runoff to prevent pollution of groundwater through sinkholes and infiltration through the soil and underlying bedrock in the vicinity of each Wind Turbine site.

F. Sound and Vibration.

1. Sound Regulations Compliance: A WESF shall be considered in violation of the conditional use permit unless the applicant demonstrates that the project complies with all sound level limits. Sound levels in excess of the limits established in this ordinance shall be grounds for the Town Chairperson or his/her designee to order immediate shut down of all non-compliant WES's.

2. Post Construction Sound and Vibration Measurements: Within twelve months of the date when the project is fully operational, and within two weeks of the anniversary date of the pre-construction background noise measurements, repeat the existing sound and vibration environment measurements taken before the project approval. Post-construction sound level measurements shall be taken both with all WES's running and with all WES's off. At the discretion of the Town, the Pre-construction background sound levels (L_{90}) can be substituted for the "all WES's off' tests if a random sampling of 10% of the pre-construction study sites shows that background L_{90} conditions have not changed more than +/- 5 dB (A and C). Report post-construction measurements to the Town Board (available for public review) using the same format as used for the pre-construction sound and vibration studies. Post construction noise studies shall be conducted by a firm chosen by the Town of Chilton. Costs of these studies are to be reimbursed by the Licensee.

3. Setbacks: The Town Board may impose a setback that exceeds the other setbacks set out in this ordinance if it deems that such greater setbacks are necessary to protect the public health, safety, and welfare of the community.

4. Audible Sound Standard: The audible sound emitted by WES operations shall not be greater than 5 dBA above the background noise level (L_{90}) for the quietest period of the day measured during the pre-build noise study. Procedures are provided in Appendix A. All measurements must be taken

using procedures meeting American National Standard Institute Standards including: ANSI S12.18-1994 (R 2004) American National Standard Procedures for Outdoor Measurement of Sound Pressure Level and (ANSI) S12.9-Parts 1-5:

- Part 1: American National Standard Quantities and Procedures for Description and Measurement of Environmental Sound.
- Part 2: Measurement of Long-Term, Wide-Area Sound.
- Part 3: Short-Term Measurements with an Observer Present.
- Part 4: Noise Assessment and Prediction of Long-Term Community Response.
- Part 5: Sound Level Descriptors for Determination of Compatible Land Use.

Measurements must be taken with qualified acoustical testing instruments meeting ANSI Type 1 standards, and Class 1 filters. The windscreen recommended by the instrument's manufacturer must be used and measurements conducted only when wind speeds are less than 10 mph at the microphone. The microphone must be located at a height of 1.2 to 1.5 meters from the ground.

5. Minimum Sound Standard: The ambient or background noise shall not be considered lower than 30dBA for measuring purposes, even when referencing measurements to be taken at the quietest period of the day throughout this ordinance.

6. Low Frequency Sound or Infrasound: No low frequency sound or infrasound from wind turbine operations shall be created which causes the sound pressure level both within the project boundary at any sensitive receptor and within a one-mile radius beyond the project boundary to exceed the following limits:

Band No.	1/3 Octave Band Center Frequency (Hz)	Limits for 1/3 Octave Bands	Limits for 1/1 Octave Bands
1	1.25 and below	65	
2	1.6	65	
3	2	65	70
4	2.5	65	
5	3.15	65	
6	4	65	70
7	5	65	
8	6.3	65	
9	8	65	70
10	10	65	
11	12.5	61	
12	16	61	65
13	20	61	
14	25	60	
15	31.5	58	63
16	40	58	
17	50	58	
18	63	55	61
19	80	53	
20	100	52	
21	125	50	55

Measurements must be conducted in accordance with the ANSI standards and conditions referenced in Rule 4 and the Appendix to this License.

7. Pure Tone Penalty: In the event audible noise due to wind turbine operations contains a steady pure tone, such as a whine, screech, or hum, the standards for Audible Sound shall be reduced by five (5) dB(A). A pure tone is defined to exist when: the one-third octave band sound pressure level in the band, including the tone, exceeds the arithmetic average of the sound pressure levels on the two (2) contiguous one-third octave bands by five (5) dB(A) for center frequencies of 500 Hz and above, and eight (8) dB(A) for center frequencies between 160 and 400 Hz, and by fifteen (15) dB(A) for center frequencies less than or equal to 125 Hz.

8. Repetitive, Impulsive Sound Penalty: In the event the audible noise due to wind turbine operations contains repetitive impulsive sounds, the permitted sound pressure level for Audible Sound (Rule 4) shall be reduced by five (5) dB.

9. Pure Tone and Repetitive, Impulsive Tone Penalty: In the event the audible noise due to wind turbine operations contains both a pure tone and repetitive impulsive sounds, the standards for Audible Noise (Rule 4) shall be reduced by a total of seven (7) dB.

10. Operations – Low Frequency Noise: A WES that emits sound (or causes structural or human body vibration) with strong low-frequency content where the time-average C-weighted sound level exceeds the A-weighted sound level by at least 20 dB when measured inside a structure and adversely affects the subjective habitability or use of any existing dwelling unit, hospital, school, library, nursing home, or other sensitive noise receptor shall be deemed unsafe and must be shut down immediately. Exceedances of any of the limits of the Table in VI. F. 5. will also be considered as proof that the WES is unsafe and must be shut down immediately.

G. Setbacks.

1. The following setbacks and separation requirements shall apply to all Wind Energy Systems.

    a. Each Wind Energy System shall be set back from the nearest sensitive receptor, a distance no less than one thousand (1000) feet.

    b. Municipal Boundaries: Each Wind Energy System shall be sited at least 1000 feet from the nearest boundary of all sewer service planning areas or sewer service boundary, or, 1,000 feet from an incorporated municipal boundary, whichever is greater. The setback shall be determined by utilizing the area or boundary existing at the time of the permit application.

    c. Property Lines: Each Wind Energy System shall be set back from the nearest property line a distance of no less than 1.1 times its Total Height, unless appropriate easements are secured from adjacent property owners for a lesser setback. The easement must be recorded with the Register of Deeds.

    d. Public Roads: Each Wind Energy System shall be set back from the nearest public road a distance of no less than 1.1 times its Total Height, determined at the nearest boundary of the underlying right-of-way for such public road.

    e. Park and Wildlife Area: Each Wind Energy System shall be set back a distance of no less than 1,000 feet from a “Park and Wildlife Area” as designated in the Calumet County Outdoor Recreation Plan as adopted at the time of the permit application.

H. Public Roads.

1. Road Analysis. The licensee applicant shall reimburse the Township for any and all repairs and reconstruction to Township roads resulting directly from the construction of the WESF. A qualified independent third party or other qualified person, agreed to by the Township and permit applicant, and paid for by the permit applicant, shall be hired to pre-inspect the roadways to be used during construction. This third party shall be hired to evaluate, document, and rate the roads condition prior to construction of the WESF, and again 30 days after the WESF is completed. Any road damage done by the permit applicant or one or more of its contractors or subcontractors shall be repaired or reconstructed at the licensee applicant's expense.

2. Construction, Repair, Replacement and Decommissioning Notification. The licensee applicant shall provide the Township with written notice of completion of construction, repair, replacement or decommissioning within 30 days after the WESF construction, repair, replacement or decommissioning is complete. Determination as to how the roads should be repaired or reconstructed, within Wisconsin Department of Transportation standards for counties and townships, or township standards if they exist, must be completed before the WESF is commissioned.

3. Payment for Damages. At the end of the WESF construction, repair, replacement or decommissioning, the Township Board of Supervisors will negotiate the percentage of road repair or reconstruction costs that will be paid by the licensee applicant based on the independent third party's evaluations. The repair or reconstruction costs will be based on the cost of the repair at the time the work is actually done. Actual work on the road repair or reconstruction will occur at the earliest possible time.

4. Road Damage. Any road damage caused by the permit holder or their agents during the construction, repair, replacement or decommissioning of any WES's during the life of the project shall be paid for by the permit holder per the above language.

5. Emergency Road Repairs. In the event a hazardous road condition exists that is not promptly corrected by Licensee, the Town Chairperson or his/her designee may order emergency road repairs be performed by qualified contractors, and Licensee shall promptly reimburse the Town for reasonable emergency road repair costs. Licensee shall assure funding of the Road Repair Obligations by a letter of credit or guaranty from a contractor of Applicant. Weather permitting, the final road repair shall be completed to the reasonable satisfaction of the Town Chairperson or his/her designee within six (6) months after completion of construction,

repair, replacement or decommissioning of the Facility, or as soon thereafter as weather conditions permit.

H. Shadow Flicker or Blade Glint.

The facility shall be designed such that shadow flicker or blade glint will not fall on, or in any existing sensitive receptor. Shadow flicker or blade glint expected to fall on a roadway or a portion of a residence or business property may be acceptable under the following circumstances:

1. The flicker or glint will not exceed 90 seconds per day with a 10 hour maximum per year; and

2. The flicker or glint will fall more than 100 feet from an existing residence or business property; or

3. The traffic volumes are less than 500 vehicles per day on the roadway.

4. The flicker or glint shall not fall onto an intersection.

5. If shadow flicker or blade glint exceeds any of the conditions listed in this Section, the source WES's shall be shut down until the flicker or glint problem is remedied.

I. Definition of Participating and Non-Participating.

For purposes of this Ordinance, "Participating" shall mean a property owner or property (including a residence) that is subject to an agreement, authorization or lease with Licensee to place Wind Turbines upon or near such property. "Non-Participating" shall mean all property owners or property (including a residence) which are not Participating property owners or property.

J. Spacing and Density.

A Wind Turbine must be separated from every other Wind Turbine by a sufficient distance so that it does not interfere with the other Wind Turbine.

K. Identification of Individual Wind Energy System.

1. Each WES shall be identified by its own address marker or sign posted at the right-of-way of the road which the WES access drive enters that road. This sign shall be of the same signage as that currently in use by the township for addresses and should include the WES's address, owner/company and the 24 emergency access numbers.

2. No advertising material or signage other than warning, equipment information or indicia of ownership shall be allowed on the Wind

Turbines. This prohibition shall include the attachment of any flag, decorative sign, streamers, pennants, ribbons, spinners or waving, fluttering or revolving devices, but not including weather devices.

L. Stray Voltage.

1. The owner/operator of the WES shall respond within five (5) business days to any request for a stray voltage investigation by a property owner within the project boundary and a one-mile radius beyond the project boundary.

2. The tests shall be performed by a mutually acceptable Wisconsin certified stray voltage investigator.

3. The tests shall be performed according to PSCW Phase II Stray Voltage Testing Protocol identified in PSC STAFF REPORT: The Phase II Stray Voltage Testing Protocol by Richard S. Reines and Mark A. Cook Rural Electric Services Public Service Commission of Wisconsin February 1999. See Appendix B.

4. Testing shall commence within ten (10) working days of the request. If testing cannot be initiated within ten (10) days, the WES(s) in question shall be shut down until the testing can be started.

5. The investigation shall be provided to the property owner at no cost up to a maximum of two investigations within a 12-month period. See Appendix B.

6. At no time shall the operation of a WES increase the measured cow contact voltage (Vcc) or primary neutral to remote voltage (Vpm) on a livestock facility within the project boundary and a one-mile radius beyond the project boundary, above the maximum pre-construction levels.

7. The owner/operator agrees to abide by all rules, procedures, standards, and reporting established by the PSCW for stray voltage and related electrical phenomena.

8. Owner/operator is responsible for mitigating within five (5) working days from determination any net increase in cow contact voltages (Vcc) or primary neutral to remote voltages (Vpn) attributed to the operation of the WES. If corrections cannot be initiated within five (5) working days, the WES in question shall be shut down until the voltages in question are mitigated.

9. A copy of the test results shall be sent to the property owner, PSCW Rural Electric Power Services staff and the Planning and Development Department within thirty (30) days of test completion.

M. Reporting and Complaint Resolution Procedure.

Licensee/operator/owner shall report to the Town as follows:

1. Extraordinary Events. Within 24 hours of any extraordinary event, licensee/operator/owner shall notify the Town. "Extraordinary events" shall include tower collapse, catastrophic turbine failure, unauthorized entry to the tower base, thrown blade or hub, any injury to a Facility worker or other person that requires emergency medical treatment, or other event that in licensee's/operator's/owner's opinion reasonably impacts the public health and safety of the Town.

2. Complaints. The licensee/operator/owner of the WESF shall, a the licensee's/operator's/owner's expense and in coordination with the Town develop a system for logging and investigating all complaints related to the operational standards set forth in Sections VI.B, D, E, F, H, L, and VIII.B. If the Town determines that it is reasonably necessary, it may undertake an investigation of the alleged operational violation by a qualified individual mutually acceptable to the Town and the owner of the WESF. The reasonable cost and fees incurred by the Town in retaining said qualified individual shall be reimbursed by the owner of the WESF. After the investigation, if the Town Board reasonably concludes that operational violations are shown to be caused by the WESF, the licensee/operator/owner shall use reasonable efforts to mitigate such problems on a case-by-case basis including measures such as planting trees and installing awnings.

N. Inoperable and Unsafe WESF's; Site Reclamation; Decommission.

1. Inoperable: A WESF shall be deemed inoperable if it has not generated power for the preceding two calendar quarters equal to at least 50% of the previous twelve months average production, and shall be promptly dismantled and removed from the property.

2. Unsafe: Any WESF that is found to present an imminent physical threat of danger to life or significant threat of damage to property shall be immediately shut down and repaired or otherwise made safe and certified so by a Wisconsin professional engineer prior to resumption of operation.

    a. If a serious adverse unforeseen impact develops due to the operation of one or more WES that has a serious detrimental effect on the affected municipality or a particular resident, the affected municipality or particular resident has a right to request the Town Chairperson or his/her designee to order the cessation of the operation of the WES(s) in question until the situation has been corrected.

b. Within 24 hours of an occurrence of a tower collapse, turbine failure, fires, thrown blade or hub, collector or feeder line failure, injured WES's worker or private person, the owner/operator shall notify the Town Board.

3. Reclamation: Advance payment for WESF site reclamation and restoration is to be placed in joint escrow account or surety bond purchased from an A or better rated bond company, the amount to be determined by the appropriate municipal governing authorities to be sufficient with a minimum of $50,000 bond per turbine posted with the Town for a bond life of 30 years to be renewed upon expiration of the 30 year limit to have the WESF fully removed and all components properly disposed of and the land returned to its original state should such structures become abandoned, dangerous, or not in compliance with this ordinance. Such financial security shall be kept in full force and effect during the entire time while a WESF facility exists or is in place. Such financial security shall be irrevocable and non-cancelable until such time as appropriate municipalities certify that reclamation and restoration are complete and release the obligation.

4. Removal and Site Restoration. The owner/operator shall remove all equipment associated with the WES's and restore the site to its original condition at the end of the permit or when any WES is deemed inoperable or unsafe. The restoration shall include removal of all materials above and four feet below ground; road repair, if any; and all re-grading and re-vegetation necessary to return the subject property to the condition existing prior to establishment of the WESF. The restoration shall reflect the site-specific character including topography, vegetation, drainage, and any unique environmental features and shall be completed within one year. The owner/operator shall incur all costs associated with implementing the removal and site restoration plan.

VII. INSURANCE AND INDEMNIFICATION

A. Insurance.

All licensees shall maintain the following insurance coverages commencing upon construction of the facility.

1. Licensee shall, at its expense, maintain a broad form comprehensive coverage policy of public liability insurance insuring Applicant and Participating Landowners against loss or liability caused by Applicant's occupation and use of the Property under the Lease, in an amount not less than Five Million Dollars ($5,000,000) of combined single limit liability coverage per occurrence, accident or incident, which has a commercially reasonable deductible. The Town shall be named as an additional insured on the policy.

2. Worker's compensation coverage in an amount required by Wisconsin law. Applicant shall require subcontractors and others not protected under its insurance to obtain and maintain worker's compensation and employers' liability insurance.

3. Certificates of insurance evidencing compliance with these requirements shall be provided upon request of the Town. The insurer will provide notice to the Town in the event there is a lapse in coverage exceeding thirty (30) days. All policies other than worker's compensation shall be written on an occurrence and not on a claim-made basis.

B. Defense of Land Use Decision and Indemnity.

1. Defense of Land Use Decision.

In addition to the indemnification described below, Licensee shall reimburse the Town its reasonable attorneys' and expert's fees incurred in defending any legal actions brought by third parties challenging the legality or enforceability of this ordinance or any portion thereof, or the issuance of a License by the Town pursuant to this ordinance. If the Town seeks reimbursement, it shall notify Licensee in writing promptly upon discovering any claim entitling it to a land use defense reimbursement, but in no event later than 120 days after receiving written notice of any action, lawsuit, proceeding, investigation or other claim against it which may give rise to a claim for a land use defense reimbursement. Licensee shall not be obligated to reimburse the Town with respect to any such liability, action or claim if the Town fails to notify Licensee thereof in accordance with the provisions of this section in sufficient time including, without limitation, any responsive motion or answer to a complaint, petition, notice, or other legal, equitable action or claim, but only insofar as such knowing failure to notify Licensee has actually resulted in prejudice or damage to Licensee. With respect to any third party action, lawsuit, proceeding, investigation or other claim which is subject to reimbursement under this section, Licensee shall be entitled to assume and control (with counsel of its choice) the defense of such action, lawsuit, proceeding, investigation or other claim at Licensee's expense; provided, however, that the Town shall be entitled to participate in the defense of such claim and to employ counsel of its choice for such purpose (the fees and expenses of such separate counsel to be borne by the Town) and to assert against any third party any and all cross claims and counterclaims the Town may have, subject to Licensee's consent, which consent shall not be unreasonably withheld. If Licensee elects to assume the defense of any such claim, it may settle such claim in its sole discretion so long as either (i) such settlement provides an unconditional release of the Town, or (ii) Licensee shall obtain the prior written consent of the Town, which consent shall not be unreasonably withheld. If Licensee elects to assume the defense of any

claim, the Town shall fully cooperate with Licensee and its counsel in such defense.

2. Indemnification.

Licensee shall defend, indemnify and hold harmless the Town and its officials, employees and agents from and against any and all claims, demands, losses, suits, causes of action, damages, injuries, costs, expenses and liabilities whatsoever, including reasonable attorneys' fees (such liabilities together known as "Liability") arising out of Licensee's selection, construction, operation and removal of the Wind Turbines and affiliated equipment including, without limitation, Liability for property or personal injury (including death), whether said Liability is premised on contract or on tort (including without limitation strict liability or negligence). This general indemnification shall not be construed as limiting or qualifying the Town's other indemnification rights available under law.

VIII. STANDARDS

A. Construction Standards.

WES(s) shall be constructed in compliance with Good Utility Practice for Wind Turbines. In the event after inspection by a qualified expert in Good Utility Practice, the Town concludes that any of the Wind Turbines were not constructed in compliance with Good Utility Practice or constitutes a danger to persons or property, then upon notice being provided, Licensee shall have 90 days to bring the non-compliant Wind Turbine(s) into compliance with such standards. If 90 days is insufficient time to cure the non-compliance, Licensee shall present a plan to the Town describing the reason for the delay and the time frame for the cure to be put in place. Failure to bring such non-compliant Wind Turbine(s) into compliance or failure to provide a plan for compliance within 90 days shall constitute grounds for the Town to request removal of said Wind Turbine(s) at Licensee's expense.

B. Performance Standards.

Any Wind Energy System or Wind Energy System Facility shall be operated and maintained consistent with Good Utility Practice for comparable facilities.

C. State and Federal Standards.

Construction of WES(s) shall meet or exceed current standards and regulations, if any, of any other agency of the state or federal government with the authority to regulate wind powered generators. If such standards and regulations are changed and retroactive application is required for the change, then Licensee shall bring the Wind Turbine(s) into compliance with such applicable revised standards and

regulations within 6 months of the effective date of such standards and regulations, unless a different compliance schedule is permitted by the controlling state or federal agency or approved by the Town. A Determination of No Hazard for each Wind Turbine must be obtained from the FAA as a condition precedent for the installation of each turbine.

D. Wind Turbine Safety Standards.

Licensee shall comply with the following safety standards:

1. All wiring between the Wind Turbines and the substation shall be underground;

2. The outside of Wind Turbines shall not be climbable;

3. All access doors to the towers and electrical equipment shall be locked; and

4. Appropriate warning signage shall be placed on each tower, all electrical equipment, and all entrances.

IX. REPAIR AND REPLACEMENT

Licensee shall be authorized to repair and replace the wind turbine generator and associated equipment consistent with Good Utility Practice during the Term of this License as needed to keep the Facility in good repair and operating condition. However, no such repair or replacement shall entitle Licensee to any extension of the Term of this License, even if it extends the useful life of the Facility. If Licensee desires to extend the term of this License in the future, Licensee shall be required to apply for such extension or amendment of this License in accordance with the terms of this ordinance.

X. PROCEDURES FOR ALTERATION OR REVOCATION OF LICENSED PREMISES.

A. Amendment.

Following the granting of a license any licensee who wishes to materially alter any aspect of the licensed premises which was required to be described in the building plan or site plan required under this Section, shall apply to the Town Board for an amendment to the license. The application shall explain the nature of the alteration and the reasons therefore and include a non-refundable application fee. The Applicant shall pay the reasonably necessary engineering expenses, if any, associated with the review. The Town Board shall act on the amendment application consistent with the terms of this ordinance.

B. Revocation of License.

Each of the following occurrences shall constitute a violation of the terms and conditions of this License (a "Violation") and any such Violation shall be grounds for revocation of this License (whatever the reason for such an event of default and whether it shall be voluntary or involuntary or be effected by operation of law or pursuant to any judgment, order or regulation) after the expiration of the notice and cure period and revocation hearing as set forth below:

1. if Licensee abandons the wind turbine generators located on the Premises for a period of one year or more; or

2. if Licensee fails to observe or perform any material condition or provision of this License for a period of 30 days after it has received written notice of such failure from the Town; provided, however, that a Violation shall not occur if Licensee commenced performance of such obligation within such 30-day period and is diligently proceeding to complete such performance; or

3. if there is a material failure by Licensee to comply with any statute, regulation, rule, or license administered by any federal, state or county department, agency, or commission directly related to the operation of the wind turbine generator, and if Licensee fails to cure the material failure to comply for a period of 30 days after the date Licensee receives written notice of such failure from the Town or the federal, state or local governmental body or agency with jurisdiction; provided, however, that a Violation shall not occur if Licensee commences performance of such obligation within such 30-day period and is diligently proceeding to complete such performance.

C. Hearing.

The Town shall not revoke any License without first providing Licensee a hearing and the right to respond, including the right to present evidence regarding any defenses or extenuating circumstances (such as Applicant's prompt commencement of remedial measures that cannot reasonably be concluded within 30 days) regarding the alleged Violations.

D. Judicial Review.

Licensee shall have the right to appeal any revocation to Circuit Court within 30 days of the date of the revocation.

XI. LICENSE EXPIRATION

Unless the Town Board authorizes a different term based upon analysis of the useful life of the Wind Energy Systems Facility, every license issued pursuant to this Section will terminate upon the expiration of thirty years from the date of Issuance.

XII. FEES AND EXPENSES

A. Tax Hold Harmless.

The parties acknowledge that the shared revenue payments payable to the Town under current state law may be revised or revoked by future Legislatures. In the event that the shared revenue payments payable to the Town are eliminated by the Legislature, Licensee will pay to the Town an amount not less than $1,667 per megawatt per year for Wind Turbines actually installed and operating within the Town. Such payments shall be on an annual basis and payable on the 180th day after notice from the Town of Licensee's obligation to pay under this paragraph. Licensee's obligation to make such payments shall cease if the State adopts or implements a new mechanism to replace the shared revenue payments, to the extent that the new payment mechanism produces revenue not less than the revenue payable under the predecessor program.

The parties acknowledge that the shared revenue payments referenced above are paid to the Town directly by the State of Wisconsin, not Licensee. Regardless, Licensee agrees to supplement the Town's annual shared revenue payments actually received by an amount equal to the annual percentage change of the Consumer Price Index as of January 1 of each calendar year beginning on the first January following the date that the Town receives its first payment. For purposes of this escalator clause, the Consumer Price Index means the U.S. Department of Labor, Bureau of Statistics, Consumer Price Index for the United States, All Urban Consumers, all items, unadjusted index.

B. Reimbursement of Fees and Costs.

Licensee/operator/owner agrees to reimburse the Town's actual reasonable fees and costs incurred in the preparation, negotiation, administration and enforcement of this Ordinance, including, without limitation, the Town's attorneys' fees, engineering and/or consultant fees, Town Board meeting and hearing fees and the costs of public notices. The preceding fees are payable within thirty (30) days of invoice. Unpaid invoices shall bear interest at the rate of 1% per month until paid. The Town may recover all reasonable costs of collection, including attorneys' fees.

C. Enforcement, Violations and Penalties.

1. Enforcement authority shall be the responsibility of the Town Chairperson or his/her designee. See Appendix C.

2. Violations. It shall be unlawful to construct, install, reconstruct, substantially repair, improve, extend, enlarge, relocate, or convert any WES in violation of the provisions of this Ordinance. It shall also be unlawful to fail to obtain wind access permits as required by this ordinance.

3. There shall be penalties for any person, owner/operator, landowner, firm, association, corporation or representative agent who fails to comply with the provisions of this Ordinance or orders from the Town Chairperson or his/her designee. Upon written notification from the Town Chairperson or his/her designee, the initial penalty may be to cease operation of the application WES(s) and/or a fine of not less than $1,000 per occurrence for the first day. This penalty shall be doubled from that of the previous day for each day of continued violation. Calumet County shall also be entitled to other relief including a temporary or permanent injunction, costs and reasonable attorney fees.

4. Excessive or continued violations of this ordinance may result in the revocation of the WES permit and required removal of the WES and/or WESF.

XIII. MISCELLANEOUS PROVISIONS

A. Parcels with Existing Buildings and/or Sanitary Permits.

Any parcel of land having a valid building or sanitary permit on file on the date of the issue of the licensing agreement, shall be treated the same as any existing residence, business property or sensitive receptor under this licensing agreement and all provisions of the licensing agreement shall be enforced.

XIV. SEVERABILITY

If any section, clause, provision or portion of this ordinance is adjudged unconstitutional or invalid by a court of competent jurisdiction, such judgment shall not affect the remainder of this ordinance.

XV. EFFECTIVE DATE

This ordinance shall take effect upon passage and posting or publication as provided by law.

Adopted _____ of _____, 2007.

Town of Chilton, Calumet County, Wisconsin.

_____	_____
Town Chairperson	Supervisor
_____	_____
Supervisor	Clerk

Appendix A

Town of Chilton Measurement Protocol for Sound and Vibration Assessment of Proposed and Existing Wind Energy Systems

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Introduction

The potential sound and vibration impact associated with the operation of wind powered electric generators is often a primary concern for citizens living near proposed wind energy systems (WES(s)). This is especially true of projects located near homes, residential neighborhoods, businesses, schools, and hospitals. Determining the likely sound and vibration impacts is a highly technical undertaking and requires a serious effort in order to collect reliable and meaningful data for both the public and decision makers.

This protocol is based in part on criteria published in the Standard Guide for Selection of Environmental Noise Measurements and Criteria.[1] and the Public Service Commission of Wisconsin publication Measurement Protocol for Sound and Vibration Assessment of Proposed and Existing Electric Power Plants (February 2002).[2] It also includes by reference the procedures of American National Standards S12.9 - Quantities and Procedures for Description and Measurement of Environmental Sound, and S12.18 and S12.19, for the measurement of sound pressure level and impulse sound outdoors.

The purpose is to first, establish a consistent and scientifically sound procedure for evaluating existing background levels of audible sounds and Low Frequency Sound in a WES project area, and second to use the information provided by the Licensee in its Application showing the predicted over-all sound pressure levels in terms of dBA, dBC and dBZ (linear) over the frequency range from the Blade Passage Frequency through at least 10,000 HZ and the corresponding 1/1 or 1/3 Octave Band sound pressure levels for the same frequency range. These values shall be presented in graphic contours of the iso-levels and in tabular form at sufficient sites to permit comparison of the baseline results to the predicted levels. This comparison will use the level limits of VI. F. 4 and 5 to determine the likely impact that operation of a new wind energy system project will have on the existing environment. If the comparison demonstrates that the WES project will not exceed any of the level limits for over-all or 1/1 or 1/3 Octaves the project will be considered to be within allowable limits for safety and health. If the Licensee submits only partial information required for this comparison the burden to establish the operation as meeting safety and health limits will be on the Licensee.

Third, if the project is approved, this Appendix covers the study needed to compare the post-build sound levels to the predictions and the baseline study. The level limits in VI. F. 4 and 5 apply to the post-build study. In addition, if there have been any complaints about WES sound or low frequency noise emissions by any resident of an occupied dwelling that property will be included in the post-build study for evaluation against the rules of VI F..

The characteristics of the proposed WES project and the features of the surrounding environment will influence the design of the sound and vibration study. Site layout, types of WES(s) selected and the existence of the significant local sound and low frequency noise sources and sensitive receptors should be taken into consideration when designing a sound and vibration study. It will be necessary to have a qualified independent consultant conduct the pre-construction background and post-construction sound (and vibration) studies

Instrumentation

All instruments and other tools used to measure audible sounds and low frequency noise shall meet the requirements for ANSI Type 1 performance and accuracy. Measurements shall be made with a manufacturer's approved wind screen protecting the microphone and only when winds are less than 10 mph at the microphone that has been designed to maintain the Type 1 accuracy requirements. The microphone shall be located at a height of 1.2 to 1.5 meters for all tests unless circumstances require a different measurement position. In that case the reasons shall be documented and include any adjustments needed to make the results correspond to the preferred measurement location.

Measurement of the Existing Sound and Vibration Environment

An assessment of the proposed WES project areas existing sound and vibration environment is necessary in order to predict the likely impact resulting from a proposed project. The following guidelines must be used in developing a reasonable estimate of an area's existing sound and vibration environment. All testing is to be performed by an independent acoustical testing engineer or other qualified noise consultant approved by the Town Board. The WES applicant may file objections detailing any concerns it may have with the Town Board's selection. These concerns will be addressed in the study. Objections must be filed prior to the start of the noise study. All measurements are to be conducted with industry certified testing equipment[4]. All test results must be reported to the Town Board.

Sites with No Existing Wind Energy Systems

Sound level measurements shall be taken as follows:

The results of the model showing the predicted worst case sound emissions of the proposed WES project will be overlaid on a map of the project area. A grid comprised of one (1) mile boundaries (each grid cell is one square mile) will be used to identify between five (5) to ten (10) measurement points. The grid shall extend to 2500 feet beyond the perimeter of the project boundary. The measurement points will be selected to represent the noise sensitive receptor sites that will be most likely to be negatively affected by the WES project's sound emissions. These sites may include sites adjacent to occupied dwellings or other noise sensitive receptor sites and, if deemed appropriate by the Town of Chilton, the inside occupied structures. Sites shall be selected to represent the locations where the background soundscapes reflect the quietest locations of the sensitive receptor sites. Background sound levels and sound pressure levels shall be obtained according to the definition provided in the WIND ENERGY SYSTEMS LICENSING ORDINANCE definitions and generally recognized acoustical testing practice and standards.

All properties within the proposed WES project boundaries will be considered for this study.[5]

One test shall be conducted during period defined by the months of April through November with the preferred time being the months of June through August. Unless directed otherwise by the Town of Chilton the season chosen for testing will represent the background soundscape for other seasons. At the discretion of the Town of Chilton, tests may be scheduled for other seasons.

All measurement points (MPs) shall be located in consultation with the Town staff and property owner(s) and such that no significant obstruction (building, trees, etc.) blocks sound and vibration from the nearest proposed WES site.

Duration of measurements shall be a minimum of ten continuous minutes for each criterion at each location. The duration must include at least 6 minutes that are not affected by transient sounds from non-nature sources. Longer durations such as 30 minutes or one (1) hour are preferred to improve the reliability of the L_{90} values.

The tests at each site selected for this study shall be taken during the expected 'quietest period of the day or night' as appropriate for the site. For the purpose of determining background sound characteristics the preferred testing time is from 8pm until 4 am. If circumstances indicated that a different time of the day should be sampled the test may be conducted at the alternate time if approved by the Town of Chilton.

Sound level measurements must be made on a weekday of a non-holiday week.

Measurements must be taken at 1.2 to 1.5 meters above the ground and at least 15 feet from any reflective surface[3].

For each Measurement Point and for each measurement period, provide each of the following measurements:

1. Un-weighted octave-band analysis (from Blade Passage Frequency up to 16, 31.5, 63, 125, 250, 500, 1K, 2K,4K, and 8K Hz and over-all linear or dBZ level)
    a. L_{Aeq}, L_{10}, L_{50}, and L_{90}, in dBA
    b. L_{Ceq} , L_{10}, L_{50}, and L_{90}, in dBC
    c. L_{Zeq}, L_{10}, L_{50}, and L_{90}, in dBLinear (sometimes referred to as 'Z' weighting)

2. A narrative description of any intermittent sounds registered during each measurement.

3. A narrative description of the steady sounds that form the background soundscape.

4. Wind speed and direction at the Measurement point, humidity and temperature at time of measurement will be included in the documentation,

Measurements taken when wind speeds exceed 5 mph at the microphone location will not be

considered valid for this study. A windscreen of the type recommended by the monitoring instrument's manufacturer meeting Type 1 standards must be used for all data collection.

Provide a map and/or diagram clearly showing:

1. The layout of the project area, including topography, the project boundary lines[5], and property lines

2. The locations of the Measurement Points.

3. The minimum and maximum distance between any Measurement Points

4. The location of significant local sound and vibration sources

5. The distance between all MPs and significant local sound vibration and sources

6. The location of all sensitive receptors including but not limited to: schools, day-care centers, hospitals, residences, residential neighborhoods, places of worship, and elderly care facilities.

Sites with Existing Wind Energy Systems

Two complete sets of sound level measurements must be taken as defined below:

1. One set of measurements with the wind generator(s) off unless the Town of Chilton elects to substitute the sound data collected for the background sound study as permitted in Section VI. F. 2 of the License.

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2. One set of measurements with the wind generator(s) running with wind speed at hub height sufficient to meet nominal power output or higher. Conditions should reflect the worst case sound emissions from the WES project.

Sound level measurements shall be taken as follows:

1. At all properties within the proposed WES project boundaries that were selected for the background sound study. Additional points may be added at the discretion of the Town of Chilton. [5]

2. One test shall be conducted during period defined by the months of April through November with the preferred time being the months of June through August. Unless directed otherwise by the Town of Chilton the season chosen for testing will represent the background soundscape for other seasons. At the discretion of the Town of Chilton, tests may be scheduled for other seasons.

3. All measurement points (MPs) shall be located in consultation with the Town of Chilton

and property owner(s) and such that no significant obstruction (building, trees, etc.) blocks sound and vibration from the nearest proposed WES site.

4. Duration of measurements shall be a minimum of ten continuous minutes for each criterion at each location. The duration must include at least 6 minutes that are not affected by transient sounds from non-nature sources. Longer durations such as 30 minutes or one (1) are preferred to improve the reliability of the L_{90} values.

5. The tests at each site selected for this study shall be taken during the expected worst-case WES sound emissions as appropriate for the site. For the purpose of determining sound characteristics when WES are operating, the preferred testing time is from 8pm until 4 am. If circumstances indicated that a different time of the day should be sampled the test may be conducted at the alternate time if approved by the Town of Chilton.

6. Sound level measurements must be made on a weekday of a non-holiday week.

7. Measurements must be taken at 1.2 to 1.5 meters above the ground and at least 15 feet from any reflective surface[3].

For each Measurement Point and for each measurement period, provide each of the following measurements:

1. Un-weighted octave-band analysis (from Blade Passage Frequency up to 16, 31.5, 63, 125, 250, 500, 1K, 2K,4K, and 8K Hz and over-all linear or dBZ level)
    a. L_{Aeq}, L_{10}, L_{50}, and L_{90}, in dBA
    b. L_{Ceq}, L_{10}, L_{50}, and L_{90}, in dBC
    c. L_{Zeq}, L_{10}, L_{50}, and L_{90}, in dBLinear (sometimes referred to as ‘Z’ weighting)

2. A narrative description of any intermittent sounds registered during each measurement.

3. A narrative description of the steady sounds that form the ambient with WES operating soundscape.

4. Wind speed and direction at the Measurement point, humidity and temperature at time of measurement will be included in the documentation,

Measurements taken when wind speeds exceed 10 mph at the microphone location will not be considered valid for this study. A windscreen of the type recommended by the monitoring instrument’s manufacturer meeting Type 1 standards must be used for all data collection. If measurements must be conducted with wind speeds in excess of 10 mph at the microphone to meet the worst-case requirement for WES sound emission, the method used to isolate the microphone from the effects of wind and turbulence must be approved by the Town of Chilton and meet procedures generally recognized as appropriate by acoustical standards for measurement under those conditions.

Provide a map and/or diagram clearly showing:

1. The layout of the project area, including topography, the project boundary lines[5], and property lines

2. The locations of the Measurement Points.

3. The minimum and maximum distance between any Measurement Points

4. The location of significant local sound and vibration sources

5. The distance between all MPs and significant local sound vibration and sources

6. The location of all sensitive receptors including but not limited to: schools, day-care centers, hospitals, residences, residential neighborhoods, places of worship, and elderly care facilities.

Sound level Estimate for Proposed Wind Energy Systems

In order to estimate the sound and vibration impact of the proposed WES project on the existing environment an estimate of the sound and vibration produced by the proposed WES(s) under worst-case conditions for producing sound emissions must be provided. This study may be conducted by a firm chosen by the WES operator with oversight provided by the Town Board. The qualifications of the firm should be presented along with details of the procedure that will be used, software applications, and any limitations to the software or prediction methods.

Provide the manufacturer's sound power level (L_w) characteristics for the proposed WES(s) operating at full load for Blade Passage Frequency up to 16, 31.5, 63, 125, 250, 500, 1K, 2K,4K, and 8K Hz and over-all linear or dBZ level. Include an unweighted octave-band from Blade Passage Frequency up to 16, 31.5, 63, 125, 250, 500, 1K, 2K,4K, and 8K Hz and over-all linear or dBZ level. Sound pressure levels predicted for the WES(s) at full operation and at maximum sound power output shall be provided for distances of 500, 1000, 1500, 2000, 2500 feet from the WES(s).

Estimate the sound levels for the proposed WES(s) in dBA, dBC and dBZ at distances of 500, 1000, 1500, 2000, 2500 feet from the WES(s). For projects with multiple WES(s), the combined sound level impact for all WES(s) operating at full load must be estimated.
The above two requirements should be presented in a table that includes the impact of the WES operations on all residential and other noise sensitive receiving locations within the project boundary. To the extent possible, the tables should include the sites tested in the background study.

Provide a contour map of the expected sound level from the new WES(s), using 5 dBA increments created by the proposed WES(s) extending out to a distance of 2500 feet from the

project boundary.

Determine the impact of the proposed sound and vibration from the WES project on the existing environment. The results should anticipate the receptor sites that will be most negatively impacted by the WES project and to the extent possible provide data for each MP that are likely to be selected in the background sound study (note the sensitive receptor MPs):

1. Report expected changes to existing sound levels for L_{Aeq}, L_{10}, L_{50}, and L_{90}, in dBA
2. Report expected changes to existing sound levels for L_{Ceq}, L_{10}, L_{50}, and L_{90}, in dBC
3. Report expected changes to existing sound levels for L_{Zeq}, L_{10}, L_{50}, and L_{90}, in dBZ
4. Report the predicted sound pressure levels for each of the 1/1 or 1/3 octave bands included in the table of VI.F.5 of the License and those not included up to the 8000 Hz octave band.
5. Report all assumptions made in arriving at the estimate of impact, any limitations that might cause the sound levels to exceed the values of the estimate, and any conclusions reached regarding the potential effects on people living near the project area.
6. Include an estimate of the number of hours of operation expected from the proposed WES(s) and under what conditions the WES(s) would be expected to run. Any differences from the information filed with the Application should be addressed.

Post-Construction Measurements

Post Construction Measurements should be conducted by a qualified noise consultant selected by and under the direction of the Town. The requirements of this Appendix for Sites with Existing Wind Energy Systems shall apply

1. Within twelve months of the date when the project is fully operational, and within two weeks of the anniversary date of the Pre-construction ambient noise measurements, repeat the existing sound and vibration environment measurements taken before the project approval. Post-construction sound level measurements shall be taken both with all WES(s) running and with all WES(s) off except as provided in Section VI.F. 2 of the License.
2. Report post-construction measurements to the Town Board using the same format as used for the background sound (and vibration) study.

[1] Standard Guide for Selection of Environmental Noise Measurements and Criteria (Designation E 1686-96). July 1996. American Society for Testing and Measurements.

[2] Measurement Protocol for Sound and Vibration Assessment of Proposed and Existing Electric Power Plants. February 2002. Public Service Commission of Wisconsin.

[3] Environmental Noise Guidelines: Wind Farms. (ISBN 1 876562 43 9). February 2003. Environment Protection Authority, Adelaide SA.

[4] The Public Service Commission of Wisconsin Staff acknowledges that few sound level meters are capable of measurement of the 16 Hz center frequency octave band. However, because noise complaints from the public most likely involve low frequency noise associate with proposed WES [power plants], we encourage applicants to pursue the collection of this important ambient noise data. If obtaining the 16 Hz and lower data presents a problem contact PSCW Staff prior to collection of any field ambient measurement data.

[5] Project Boundary: A continuous line encompassing all WES(s) and related equipment associated with the WES project.

REFERENCES

- **ANSI S12.9-1988/Part 1 (R 2003)** American National Standard Quantities and Procedures for Description and Measurement of Environmental Sound, Part 1.
- **ANSI S12.9-1992/Part 2 (R 2003)** American National Standard Quantities and Procedures for Description and Measurement of Environmental Sound, Part 2: Measurement of Long-Term, Wide-Area Sound.
- **ANSI S12.9-1993/Part 3 (R 2003)** American National Standard Quantities and Procedures for Description and Measurement of Environmental Sound, Part 3: Short-Term Measurements with an Observer Present.
- **ANSI S12.9-2005/Part 4** American National Standard Quantities and Procedures for Description and Measurement of Environmental Sound, Part 4: Noise Assessment and Prediction of Long-Term Community Response.
- **ANSI S12.9-1998/Part 5 (R 2003)** American National Standard Quantities and Procedures for Description and Measurement of Environmental Sound, Part 5: Sound Level Descriptors for Determination of Compatible Land Use.
- **ANSI S12.9-2000/Part 6 (R 2005)** American National Standard Quantities and Procedures for Description and Measurement of Environmental Sound, Part 6: Methods for Estimation of Awakenings Associated with Aircraft Noise Events Heard in Homes.
- **ANSI S12.17-1996 (R 2006)** American National Standard Impulse Sound Propagation for Environmental Noise Assessment.
- **ANSI S12.18-1994 (R 2004)** American National Standard Procedures for Outdoor Measurement of Sound Pressure Level.

PSC STAFF REPORT:
The Phase II Stray Voltage Testing Protocol

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Public Service Commission of Wisconsin
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BACKGROUND

The State of Wisconsin first investigated the concept of stray voltage (SV) in the early 1980's. The topic was relatively new to the country at that time, but many farm operators expressed a concern to Wisconsin government officials about the as-yet not well documented effects of stray voltage. Many methods have been used over the intervening years to acquire electrical and other data relevant to the effects of small voltages and currents in animal confinement areas. Through a long and sometimes arduous process, basic scientific techniques of data acquisition were applied to the process of SV investigation. While stray voltage measurements have been taken on dairy farms for many years, the number, types, and interpretation of these measurements can vary greatly. Depending on the investigator making the measurements, any number of different quantities can be recorded at different times of the day, using a wide variety of data acquisition equipment and using various protocols for the equipment's connection into the barn environment (for instance, the concern with the length of test leads was studied in 1996). As a result of these activities, the output of any specific measurement process may or may not generate the valuable or critical information needed for determining the character of the stray voltage present or its source. If the data is not collected with a minimum protocol that ensures its veracity, it should not be used to make economic decisions. The following discussion is offered to outline a specific protocol for obtaining a coherent set of measurements which, when used together, should provide SV investigators with a method useful in determining the character, conditions, and source of any stray voltage present on single- or multiple-service dairy farms. This test protocol is not mandatory in Wisconsin, but is routinely performed by investor-owned and other utilities prior to a visit by the Rural Electric Power Services (REPS) team of the Public Service Commission of Wisconsin (PSCW). As predecessor to the Phase II investigation, the Phase I investigation was developed in Wisconsin for first-time visits by utility SV investigative personnel, dairy field-men, veterinarians, and other dairy trade allies to "spot-check" for possible stray voltage at a small number of cow contact areas. It is also used to assess the basic characteristics of the farm's electrical system and the utility distribution system in the vicinity of the farm.

The PSCW, in its 1989 docket 05-EI-106, proposed a battery of tests for SV investigators whose goal is to determine the source of the stray voltage. The test set consists of a load box test, a secondary neutral test, and an equipment signature test, as well as the basic procedure of setting the cow contact measuring points. One must also determine the source resistance for each such point and determine if any cow contact voltages can be found above the "level of concern." From the 1996 PSCW docket 05-EI-115, the "level of concern" is defined as 2.0 milliamps, alternating current (AC), 60 Hertz (Hz), rms (root mean square), steady-state or 1.0 volt, AC, 60 Hz, rms, steady-state across a 500-ohm resistor in the cow contact area[1]. The State of Wisconsin deems that this level of voltage/current is an amount of electricity where some form of mitigative action is taken on the farmer's behalf, although only some small percentage of cows may actually perceive its presence. The "level of concern" is not a damage level. Instead, it is a very conservative, pre-injury level, below the point where moderate avoidance behavior is likely to occur and well below where a cow's behavior or milk production would be harmed. The “level of concern” refers only to the exposure of farm animals in a confinement area to electricity from off-farm or on-farm electrical supply systems and not to any farm personnel in the same area. The “level of concern” is further broken down into two parts. The first part is a 1-milliamp contribution from the utility, at which level mitigative

[1]“Steady-state” is defined by the Institute of Electrical and Electronics Engineers (IEEE) as “the value of a current or voltage after all transients have decayed to a negligible value.”

action must be taken by that utility to reduce its contribution to below the 1-milliamp level. The second part is a 1-milliamp contribution from the farm system, at which level mitigative action should be taken by the farmer. Numerous studies at the University of Wisconsin and other quality research institutions have documented avoidance behaviors in the range of 3 to 6 milliamps of current flowing through the cow. This response assumes that the cow comes into contact with conductive objects that have different voltages and that this voltage difference causes sufficient current to flow through the cow. The exact methodology and the value of the data gathered by the aforementioned tests were not further explained in the docket nor were the techniques for analyzing the data. This paper is offered to expand on the concepts presented in docket 05-EI-106.

PURPOSE AND FORM

The Phase II protocol was developed to provide SV investigators with a tool to collect a reasonable set of data useful in the analysis of the quantity and "quality" of stray voltage that may be present under a variety of conditions, and the source of such stray voltage. The farm customer should expect that a written comprehensive SV investigation report be provided to him/her as the final result of a thorough investigation. It should contain reliable, scientifically-derived numbers indicating where any significant levels of stray voltage were found on his/her farmstead and the physical mechanisms whereby those voltages arose. The utilities, in their ongoing mission to assist farm customers to the best of their ability, need to employ consistent testing methods applied by well-trained personnel. With the Phase II protocol, farms may be inter-compared on a level playing field and test results from the same farm taken a number of times over a period of years may be compared against each other with some statistical confidence. Lastly, regulatory agencies, such as the PSCW, charged with collecting the utilities' test summaries, need to be assured that the data collection methodology was independent of the specific equipment used or the specific personnel performing the tests.

Phase II testing is intended to determine AC, 60 Hz, rms, steady-state animal contact voltages on livestock farms. Unfortunately, some farms in Wisconsin have modified electrical system wiring so that it no longer meets the safe operating provisions of the National Electrical Code (NEC). In these cases, the PSCW advises utility personnel to critically assess their risk in beginning a SV investigation on such a farm. If the situation warrants, they may inform the farm customer that SV testing will not continue until the electrical system is brought into compliance with the NEC. That code specifies the minimum wiring requirements for a safe electrical system. The PSCW rules in effect for SV investigations refer strictly to the 60 Hz fundamental voltage or current and not to any harmonic content that may or may not be present in addition to the fundamental frequency. Other electrical phenomena that are not specifically included in the PSCW orders are medium frequency transients (>3 kHz) and RF-source transients (>500 kHz) induced from sources outside the distribution power system including currents in the earth. While these transients can be measured with the proper equipment, there is no defined "level of concern" for these phenomena in the PSCW dockets dealing with stray voltage. In a joint venture of the state of Wisconsin with the state of Minnesota in 1998, a study was conducted that concluded that "no credible scientific evidence supports the claim that currents in the earth or associated electrical parameters such as voltages, magnetic fields and electric fields, are causes of poor health and milk production in dairy herds." Therefore, utilities in Wisconsin have been specifically instructed by the PSCW to monitor AC, rms, 60 Hz, steady-state cow contact voltages to properly determine animal exposure.

The Phase II protocol consists of six data input forms to record the results of a set of five individual electrical tests of the farm/distribution power system network. The main form also provides an area to record background information that is important for the overall understanding of the farm/utility electrical system. Typical forms are found in Appendix A of this paper. These were developed by the PSCW as prototypical and the physical layout of each specific form is somewhat arbitrary. Also included are instruction sheets and diagrams for the uniform wiring and arrangement of the test equipment. It is important to emphasize that this protocol creates a set of data records useful in analyzing SV on multiple service as well as single service farms. However, multiple electric service farms may require other specialized tests to be devised as needed. Each electrical service must be tested individually per the Phase II protocol. Load box testing is not affected by multiple service situations as long as each is tested independently. The stray voltage investigator needs an extensive knowledge of multi-service interactions to fully understand and interpret the data and to draw the proper conclusions. There have been rare instances where neighboring farms have influenced testing on the subject farm, both through the power system and

other utility systems and through the earth. In some cases, a well-trained and experienced SV investigator can easily determine that a simple and solvable condition exists which obviates the direct need for the more extensive Phase II testing.

THE PHASE II FORMS

Appendices A-1a and A-1b are used for documenting the basic background information and animal contact set-up protocol. The information recorded, such as the existing mitigation devices present at the time of the visit, the basic character of the distribution system, and the farm production data, are important in the end analysis of the data and as an historical record of the farm. After a cow contact point is established, the all-important source resistance check is made and recorded. This value should be less than 500 ohms to ensure that the cow contact current/voltage is both meaningful and worst-case. From the PSCW database, the average source resistance in the cow contact area on nearly 3,500 Wisconsin dairy farms is 192 ohms. A second source resistance check is made just prior to tear down to ensure that the original value has not changed significantly over the period of testing. A voltage ratio (VR) test is included to determine if the selected reference rod location is too close to (under the influence of) the distribution or secondary electrical system. The voltage ratio calculated should be greater than 80 percent and less than 120 percent of the measured primary neutral to reference voltage to indicate correct reference rod placement.

Secondly, a load box test is performed and the data logged into the load box test forms (Appendices A-2a, A-2b, and A-2c). This is the most basic test to determine how much the primary system might be contributing to cow contact voltage levels. The load box should be a non-inductive 240-volt rated heater-type load in the range of 18-kilowatt (kW) to 25-kW. If the farm is found in an isolated condition, two load box tests should be performed. The first test records the "as-found" (isolated) condition and the second test records the bonded (non-isolated) condition. It is also important that the main electrical panel serving the animal confinement area be adequately bonded, according to all applicable codes, to the metallic water line/barn metal system. If the metallic water line/barn metal system was not bonded in the "as found" condition, testing in both the bonded and non-bonded condition may be needed.[2] The load box test is performed in four or five stages depending on the type of load box used. First, the background activity of the distribution system from the farm's point of common coupling is recorded with the 240-volt load box de-energized and the farm shut off. The load box can be either a split 9-kW/18-kW (or a split 12.5 kW/25-kW) type that is turned on half, then full or just an 18-kW (25-kW) type. (The PSCW has found that an 18 kW load box is usually adequate to create a worst-case scenario for most small to moderate sized farms). The data is recorded for this load-box-on, farm-off section. Then the farm is turned on in addition to the full load box to record the conditions under maximum electrical impact. Lastly, the load box is turned off and the data recorded representing the background electrical activity of the functioning farm. The types of data typically collected are primary line current (Ip), primary neutral current (Ipn), secondary neutral current (Isn), net secondary neutral current (Isn-net),[3] voltages from primary neutral to reference (Vp), secondary neutral to reference (Vs), and the voltage values at cow contact (Vcc). The cow contact point is selected so as to measure the greatest (meaning worst case) voltage value. The difference in voltage from the primary neutral to the secondary neutral is also recorded (Vps). It is interesting to note that, for over 3,000 dairy farms in Wisconsin, the average primary neutral to reference voltage is 1.39 volts while the average secondary neutral to reference voltage is 1.27 volts (the source of these voltages was not determined). Vp is measured at the bottom of the transformer pole where the primary neutral is connected to its ground rod. Vs is measured at the main electrical service panel of the animal confinement area where the connection is made to the grounding electrode system. Calculations are made as indicated on the form for various resistances, the K-factor and the current return ratio (CR).

The forms in Appendices A-3a, A-3b, and A-3c log the results of a set of secondary neutral voltage drop tests. Secondary neutral voltage drop has been found to be the main on-farm source of stray voltage in Wisconsin. This test is used to determine the source and impact of each secondary service on the farm. For this test, a proxy load of known characteristics, such as a 120-volt rated hair dryer or paint peeler drawing about 10 - 15 amps AC

[2]Note: Extreme caution must be exercised when working on or near equipment and metal structures that are not bonded, because injury or death may occur.

[3] This is recorded by using a current clamp simultaneously around both secondary phase wires and the neutral wire.

rms, is used to create a known and stable neutral current and subsequent voltage drop for each neutral serving a main panel, sub panel, or end of service area. It is important that all other service entrance main disconnects be turned off at this time so the impact of just one service at a time can be determined. The data collected for each such service are neutral wire gauge, exact length of neutral wire, neutral current measured, voltage drop measured, and Vcc, the primary neutral to reference voltage (Vp), and secondary neutral to reference voltage (Vs) at both ends of the circuit. It is important to have the last three voltages measured both before and after the hair dryer load is turned on so that just the difference, found by subtraction, is seen. Ohm's Law is used to calculate the expected neutral voltage drop, based on the measured current and calculated neutral conductor resistance. This can then be compared with the actual recorded voltage drop either as a difference in voltage to reference measured at each end of the circuit or the voltage drop directly measured from one end of the circuit to the other.

Appendices A-4a and A-4b are used to log the data generated by a signature test where individual pieces of major current-drawing electrical equipment are started and stopped at specific times and for specific intervals to determine their impact on the farm's electrical system. Additionally, a proxy load can be used to provide the signature of a long-run circuit that has a 120-volt outlet associated with its far terminus. The signature test is best accomplished shortly after the load-box test when minimal farm electrical activity exists and only one service at a time is energized. For this test, the person recording the data should be in contact (via voice or radio) with the person controlling each load device. He/she must also have a watch or other timing device in synchronization with a recording voltmeter so the data recorded can be properly interpreted. A digitizing data recorder is usually used during this test with the sample interval set to 1 second. The data recorder should be set to monitor a minimum of four data points: voltages from primary neutral to remote reference (Vp), secondary neutral to remote reference (Vs), primary neutral to secondary neutral (Vps), and the cow contact voltage (Vcc). The physical locations monitored are the same as for the load box test. For each piece of electrical equipment for which a signature is desired, the type and location are noted along with the start and stop times, usually separated by 15 or 20 seconds. For clarity, the start times should ideally be on an even minute, half minute or quarter minute. If a piece of equipment is discovered in a running condition, a stop and then restart is performed and the condition annotated (via an asterisk, e.g.) to make proper sense of the sequence in stop and start times.

The forms shown in Appendices A-5a and A-5b are used to record the results of a “primary profile” test that may be performed either during a morning milking or an evening milking or when the electrical activity on the primary distribution system is likely to be at a maximum. This test uses a meter or meters that measure both ground rod resistance and ground rod current at one time. The primary system ground rods for three-fourths of a mile on each side of the farm (if possible) are measured. It is best to start at one end point and work towards the other, if possible, and include such branch circuits or sections thereof that may be within the needed sphere. This may be the case if the farm is not on a linear segment of distribution system. It is important to note the condition of each pole, if out of the ordinary, as well as other devices present such as transformers, capacitor banks, telephone pedestals, or broken ground connections as well as the farm tap pole or transformer pole. This test should ideally record the ground rods of a minimum of about 13 or 14 poles over 1.5 miles. The investigator should then use Ohm's Law to calculate the primary neutral to earth voltage, which exists at each pole.

The form, Appendix A-6a, is used to summarize the results from a long term (“24-hour”) monitoring test where the investigator places a recording voltmeter for about 24 hours to cover at least two milking periods. The four channel assignments are the same as in the signature test described previously. The report form suggests the proper settings and the data to be collected. The “average rms” report graph from the recording voltmeter is the most useful in determining if the steady state level of concern has been exceeded at any time during the recording interval.

DATA ANALYSIS

The greatest benefit of using the results of the Phase II forms is in the overall analysis of the farm and utility electrical systems. In the every day life of dairy farming in Wisconsin, the two should be considered one single system that work together enabling the dairy farmer to perform all the tasks necessary to get his/her product to market in the most efficient, cost-effective manner. Even if the cow contact voltages/currents are found to be below the present “level of concern,” many useful suggestions for improving either the farm wiring system or the

utility distribution system can be offered with proper analysis of the data collected. This proactive approach to SV investigation is meant to avoid future concerns as both the farm electrical system and utility system increase in age or are modified by the normal growth of either system. It has been noted in the past that it is better to prevent possible stray voltage from occurring than to deal with the unmitigated consequences at a later date.

The data collected via the Phase II protocol is intentionally wide ranging to provide some means of cross-checking data, much like the accountant who cross-checks a double-entry bookkeeping system. By examining the primary profile, the load box test, the signature test, and the secondary neutral voltage drop test, the operational characteristics of the primary electrical system, the secondary electrical system, and the individual components of each is revealed. The "24-hour" test should demonstrate that each side of the system has a specific impact on the overall operation of the farm at specific times of day. If the farm is to be isolated in the future, Phase II testing can offer some predictions on the consequent impact to the primary neutral voltage in the area of the farm and to the secondary neutral and cow contact voltages on the farm under the conditions of isolation.

The primary profile should reveal that most primary neutral to earth voltages found in the region of the farm's tap or transformer pole are similar in magnitude to the primary neutral to reference data from the load box test. It is best to graph the data versus consecutive poles to see if a specific pattern indicates an area that may need attention (see Appendices A-5c, A-5d and A-5e). The average value of distribution system ground rod current in Wisconsin from over 3.355 poles measured, is 41 milliamps. The average ground rod resistance is 78 ohms. The average primary neutral to earth voltage calculated is 1.05 volts. Because the primary profile data are taken at a time of nearly maximum electrical activity on the primary system, the influence of neighboring farms can often be seen. It is sometimes the case where one farm's electrical troubles are passed on via a common interconnection by the utility from the previous or subsequent farm on the distribution system. In these cases, a recording device may be set on various points of the primary system to monitor contributions in voltage and current from other sources. In the proper interpretation of the primary profile data, care must be exercised in including the possible contributions of capacitor banks, other transformers and telephone systems to the neutral voltages. A parallel communications system (telephone or cable-access television) interconnected with the distribution system neutral can create a large ground loop and consequently larger than expected neutral voltages or currents.

Load box testing ideally confirms that nearly zero volts should exist between the primary neutral to reference voltage (Vp) and the secondary neutral to reference voltage (Vs) for a non-isolated farm with farm loads off ($Vps \approx 0$). If this is not the condition recorded, an unintended condition of semi-isolation may exist. This may take the form of a high resistance connection between the primary and secondary neutrals. For farms that are intentionally isolated, the secondary neutral to reference voltage with the farm off should ideally be 8 to 10 times less than the primary neutral to reference voltage, to indicate that the isolation device is effectively doing its job. The currents and voltages should increase in a logical progression as one adds more load in each step of the load box test. If a current or voltage decreases when more electrical load is added, phase or interference conditions could be assumed. If there is no corresponding linear increase in voltage and current for a linear increase in the applied load, phase shift or power factor interference may be indicated. Most obvious is the direct impact of the neutral voltage on the cow contact. Because the farm's electrical loads are disconnected, the direct connection between the two neutral systems is the lowest impedance path from the primary neutral to the cow contact area. In Wisconsin, when the voltage at cow contact exceeds 0.5 volts during the full load test, action by the utility is mandated. From the calculated values, the primary neutral resistance should ideally be less than 0.75 ohms, but can reasonably range from about 0.1 to about 3.5 ohms. The farm neutral resistance should ideally be less than 2.0 ohms, but can reasonably range from about 0.3 to about 5.0 ohms. The total system resistance should ideally be less than 0.5 ohms, but can reasonably range from about 0.05 to about 2.5 ohms. The K-factor should ideally be less than 33 percent, but typically may range from 5 percent to 85 percent. The lower this number is, the less impact neutral voltages will have in the cow contact area. The CR should ideally be 66 percent or more. The range is typically about 35 percent to 90 percent. The typical ranges referred to above are based on PSCW REPS team experience. When the farm loads are turned back on, in addition to the full load box being on, the effects of combined secondary neutral voltage drops can be seen. The cow contact voltage may increase or may decrease, depending on the phase of the dominant farm loads drawing current at that time.

The secondary neutral voltage drop test provides data on the calculated drop and the actual measured drop for each major service on the farm. If the measured value of the drop differs from the calculated value, some condition may exist in that circuit that needs attention (e.g. a poor connection or splice). The effect of each service on the cow contact voltage can also be seen. In the overall farm system, the various voltage drops connected to the primary/secondary neutral/ground system may add to or subtract from the neutral to earth voltage at the point of common coupling to influence the readings with the farm on. This is because the service generating the voltage may be either in-phase or out-of-phase with other source voltages. There may also be some minor phase shifting due to the fact that there are complex impedances, not just pure resistances, involved in most circuit load devices. When these undesirable additional voltage drops are found and minimized, the calculated and measured voltage values should agree. Sometimes the actual and calculated values are in agreement but both are larger than desired for the service being measured. Only experience with typical secondary electrical systems can provide information on what the overall value should ideally be, but many times, the neutral conductor size is smaller than required, resulting in excessive secondary neutral voltage drop. Each service neutral on a farm is a potential source of stray voltage. Because each service is characterized at a standard load in this test, the relative impact of each at the cow contact area can be gauged. It is important to remember that this is a 120-volt test and is not characterizing 240-volt loads at each service. Only 120-volt loads use unbalanced secondary current carried by the neutral. Because the 120-volt load may be connected to one hot phase or the other as the test progresses, the total effect may add to or subtract from the combined cow contact voltage.

The signature test is analyzed by examining the impact of each major electrical device and circuit in the farm system. The SV investigator should annotate significant contributions to the cow contact voltage (Vec) from the electrical system device or circuit under investigation. The test may indicate a certain piece of electrical equipment generates excessive neutral voltage when it is running or may generate excessive voltage drop upon start up. Most motors use 2 to 8 times their normal running current for several cycles to as much as a full second during a start-up operation. If the signature displays currents and voltages in excess of those expected for the size of the load energized, a condition needing attention may be indicated. The effect of the individual start, run, and stop cycle can also be seen at the cow contact area. Many times it is important to "stage" the signatures to re-create normal operational conditions on the farm. The investigator may ask the farm operator to start a number of pieces of electrical equipment that normally all run at the same time so that the total cumulative effect on the neutral may be recorded. The stopping sequence will be the reverse of the starting sequence. The effect of 240-volt rated devices can be seen which ideally should not affect the secondary neutral voltage except by its common coupling to the primary neutral voltage. It is especially important to include the operation of fencers, trainers, and crowd gates during the signature test. These electronic devices generate very high voltage, low to moderate current signals as a part of their normal operation. Great care must be taken in the installation of these devices such that the high voltage does not couple into animal contact areas at points where it is not intended. The signature library developed during this test may provide interpretative information to some charts resulting from the "24-hour" test and will be valuable as an historic record to gauge any change in operational characteristics of loads for future investigations.

The "24-hour" test can be viewed in a number of different ways. The "average rms" report should be the only source of values used to determine if the cow contact voltages or currents exceed the "level of concern" in addition to the load box test data. Using the "average rms" voltage graph, the investigator can visually track the effects of both the primary and the secondary neutral to reference voltages on the cow contact voltage. The ratio between the secondary neutral to reference voltage (Vs) and the cow contact voltage (Vec), defined as the K-factor, should be a relatively constant proportion which agrees with the value derived in the load box test. The channel recording the difference in voltage between the primary and the secondary neutral to reference voltage should be close to zero for a non-isolated farm and be a larger voltage for an isolated farm. The software used to view graphs allows enlargement of selected portions for more detailed analysis. This tool lets the SV investigator determine the exact voltage levels recorded and the exact duration of specific events. The 'maximum rms report' (non-steady state) may be useful in determining if any faulting condition or transient activity exists which may require further investigation. It should be used for diagnostic and research purposes only. This is because this report logs the single highest rms voltage value reached during the recording interval, usually set at 10 seconds. There is only one 60 Hz. cycle which reaches maximum among the 600 cycles of the recording interval, but the data point is plotted as if all 600 cycles were at this level. If this higher voltage cycle occurs once in each successive data recording

interval, the entire graph appears to present data at a much higher level than actually exists. Therefore, the data from this report must be viewed selectively with the aforementioned interpretation in mind. As mentioned in the signature test section above, the operation of specific equipment used during the daily milking and feeding cycles should be discernable on the "24-hour" test report graph.

CONCLUSIONS

The Phase II protocol can be a very useful format for collecting and documenting data relative to stray voltage investigations on single and multiple electrical source dairy farms. The data acquired can be used to record the amount of AC, 60 Hz, rms, steady state stray voltage found during the investigation and the specific conditions under which it is present. An experienced SV investigator may use the Phase II information to suggest the source of such stray voltage and offer mitigation methods based on scientifically collected data that will properly address the situation.

There are many valid tests that produce useful information in a stray voltage inquiry. The five tests within the Phase II protocol may be basic to any SV investigation and can be used during a comprehensive stray voltage inquiry if the source of stray voltage has not previously been identified. Load testing for on- or off-farm contributions is typically not part of an initial or preliminary (Phase I) stray voltage inquiry. If the source has been determined by some other valid means, such as but not limited to data supplied by a recording voltage meter, a competent SV investigator may deem that a portion of or perhaps all of these five tests may not be required. Stray voltage testing and diagnostic procedures and protocols continue to be utilized on a case-by-case basis for the type of inquiry desired. More often than not, the site-specific characteristics of a SV investigation will require some flexibility on the part of the SV investigator and generally preclude the mandatory use of uniform tests in all situations. This flexibility of investigators is critical during preliminary testing to produce the most satisfactory results as quickly as possible.

STRAY VOLTAGE PHASE II
DATA INPUT FORM

DATE(S):_____

Cow Contact above L.O.C.? **Y N** If Yes, Cow Contact Location: _____

Farm customer: _____ Recorded by:_____

File No: _____ Utility:_____Type: Muni IOU Coop

Miles to substation:_____ Grounds/mile _____ End of Line? **Y N**

Primary Line Voltage:_____Transformer KVA:_____ Primary Service 1 2 3 4

Conductor size: _____ Neutral size: _____

(AS FOUND) FARM ATTRIBUTES:		COMMENTS:
EPP	**Y N**	
EGS	**Y N**	
4-WIRE	**Y N**	
ISOL XFMR	**Y N**	
NEUT ISOL	**Y N**	

HERD SIZE ____ MILK PRODUCTION_____lbs DHI? **Y N** SCC (x1,000) ____

SOURCE RESISTANCE CHECK #1: (SET-UP)

R_{shunt} = Ω

Vwo=_____ Vw= _____ Rsource=[(Vwo-Vw)xRshunt]/Vw = ☐

SOURCE RESISTANCE CHECK #2: (TAKE-DOWN)

Vwo=_____ Vw= _____ Rsource=[(Vwo-Vw)xRshunt]/Vw = ☐

Vr TEST

Ipg meas =_____mA Rpg meas = _____ Ω

Vpncalc = Ipg meas x Rpg meas= _____ mV **Vr = Vp / Vpncalc =** ☐

Vp (from load box test) = _____ mV

PHASE II DATA INPUT INSTRUCTIONS

ITEM	EXPLANATION
1	Enter date(s) of testing period.
2	LOC = Level of Concern exceeded?, i.e. ≥ 1 volt (2 mA) in cow contact area.
3	Exact location of any SV above LOC.
4	Customer name.
5	Name of person recording data.
6	File reference number.
7	Name of utility serving farm.
8	Type of utility (IOU = Investor Owned Utility).
9	Circuit miles from farm to substation.
10	Number of grounds per mile average for 3/4 mile each side of farm.
11	Check if end-of-line customer (This is a customer who is the last one on a radial distribution feeder or the last one served by a tap off the main feeder located more than 0.5 mile from the source distribution facility where it goes in two different directions.)
12	Primary line voltage to neutral serving farm transformer (4,800, 7,200, 14,400, etc).
13	Farm transformer kVA rating (note multiple transformers separately).
14	Type of service: 1 = single phase, 2 = two phase, 3 = three phase, 4 = multiple phases.
15	Phase conductor size and wire type (#8 CW, 1/0 ACSR, #4 CU, etc.)
16	Same for neutral conductor size and type.
17	Circle if attribute present at this time: EPP = Equi-Potential Plane, EGS = Electronic Grounding System, 4-wire =4 or 5 wire secondary system, ISOL XFMR = Isolation Transformer, NEUT ISOLATOR = Primary/Secondary isolation device present (Note type: Ronk, Dairyland, etc.).
18	Record any useful comments about devices present (i.e. “EGS not working or disconnected”).
19	Note farm characteristics of milking herd size, rolling herd average production, if on DHI and the present somatic cell count.
20	Record shunt resistor value and data from two source resistance measurements: one just after setting the cow contact point and the other just before tear down.
21	Voltage ratio test to see if the reference rod is under the influence of the farm/primary electrical system. Measure farm primary pole ground resistance and current. (If main disconnect is within 30 feet of this ground rod, use the next existing rod back towards the substation). Calculate primary neutral voltage and compare to value measured by load box test with load box off, farm on. If the two values are within 20 percent (hi or lo), reference rod is in the correct location.

LOAD BOX TEST

DATE: _____ Customer Name: _____

	FARM OFF:			FARM ON:	
TIME:					
Condition:	**NO LOAD**	**½ LOAD**	**FULL LOAD**	**FULL LOAD**	**NO LOAD**
Ip	**A**	**A**	**A**	**A**	**A**
Ipn	**A**	**A**	**A**	**A**	**A**
lsn	**A**	**A**	**A**	**A**	**A**
Isn net	**A**	**A**	**A**	**A**	**A**
Vp	**V**	**V**	**V**	**V**	**V**
Vs	**V**	**V**	**V**	**V**	**V**
Vps	**V**	**V**	**V**	**V**	**V**
Vcc	**V**	**V**	**V**	**V**	**V**
	(lo)		**(hi)**		

CALCULATIONS (FARM OFF): **SUMMARY:**

$$Rt = \frac{Vp\ hi - Vp\ lo}{Ip\ hi - Ip\ lo} = \_\_\_\_\_ = \quad \Omega$$

$$Rp = \frac{Vp\ hi - Vp\ lo}{Ipn\ hi - Ipn\ lo} = \_\_\_\_\_ = \quad \Omega$$

$$Rf = \frac{Vs\ hi - Vs\ lo}{Isn\ hi - Isn\ lo} = \_\_\_\_\_ = \quad \Omega$$

$$K = \frac{Vcc\ hi}{Vs\ hi} = \_\_\_\_\_ = \quad \%$$

$$Cr = \frac{Ipn\ hi}{Ip\ hi} = \_\_\_\_\_ = \quad \%$$

LOAD BOX TEST INSTRUCTIONS

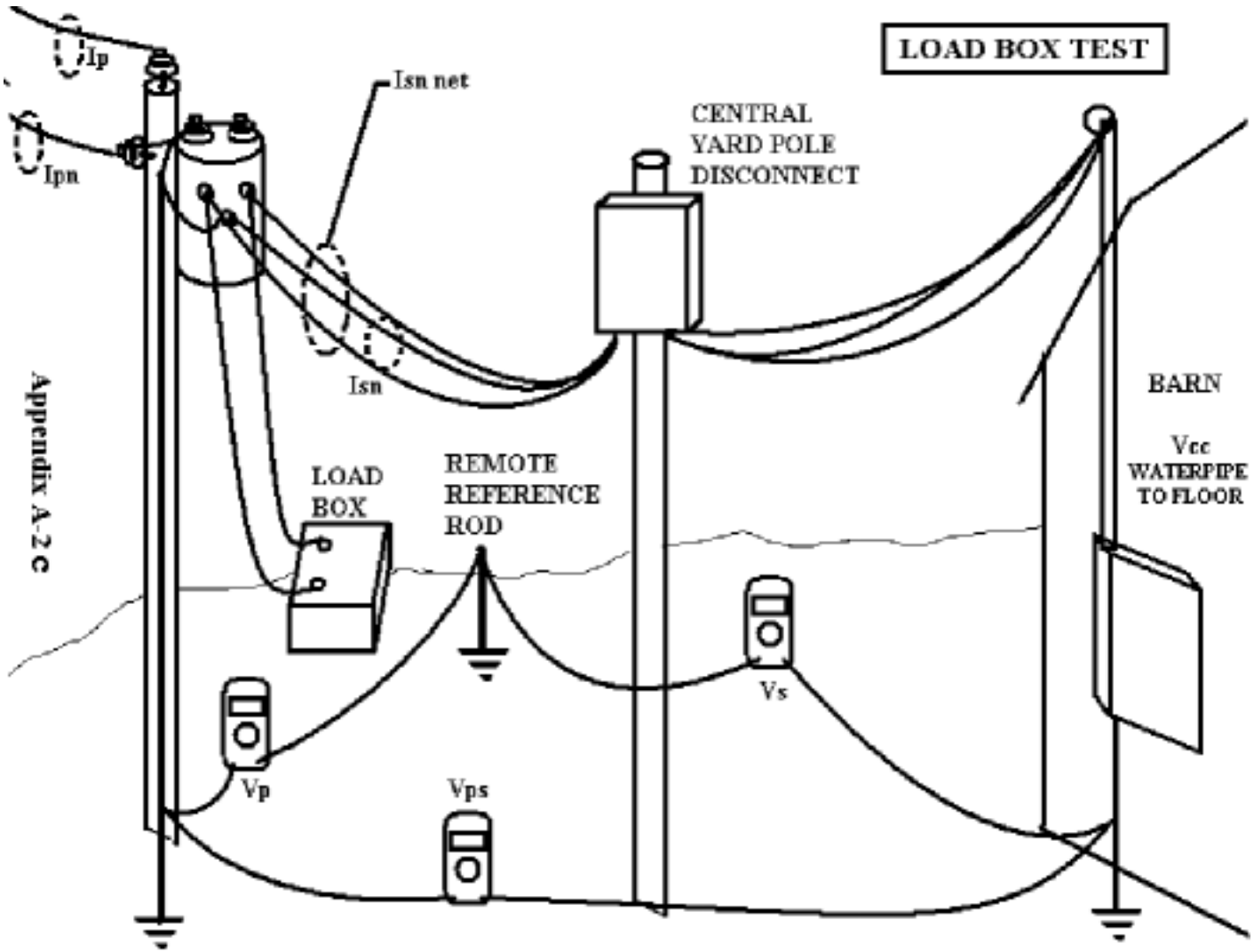
Note 1: Testing may be accomplished by a single 18/25 kW load box or a dual element 9/18 or 12.5/25 kW load box. The difference between full load and no load measurements is used in most calculations. There must be a continuous metallic bond between the main disconnect's neutral/grounding electrode system and the barn water pipe/stanchion structures.

Note 2: If the farm is found in an isolated condition, two load box tests must be performed: an isolated test and a non-isolated test.

Note 3: If the farm is served by a three-phase system, measure and record only the farm-off, load box off column and the farm-on, load box off column or test only one phase of the three.

ITEM	EXPLANATION
1	Enter date and customer name.
2	Attach load box to the 240-volt secondary side of transformer. With load box off, shut off all electrical service to farm and record time. Measure and record 7 data points as follows: Ip = current on primary phase line,* Ipn = current on primary neutral line, Isn = current on secondary neutral line, Vp = voltage from primary pole ground rod to remote reference rod, Vs voltage from barn's main disconnect neutral/ground electrode system to remote reference rod, Vps = voltage between last two points, Vcc cow contact area voltage
3	If dual element load box is used, turn on first half of load box, record time and 7 data points. If using a single load box, skip this step.
4	Turn on full load box, record time and 7 data points.
5	Turn all electrical service to farm back on. Record time and 7 data points and one additional data point of the net current on all three secondary wires from transformer (2 phase wires and the neutral wire grouped together).
6	Turn off load box and record time and 8 data points.
7	Transfer the appropriate numbers to the formula section and calculate the total system resistance , Rt, the primary system resistance, Rp, the farm resistance, Rf, the K-factor, and the primary current ratio, CR.
8	Care must be taken when performing this test. If the transformer is located on the distribution right-of-way, the phase and neutral currents must be measured both upstream (towards the substation) and downstream of the transformer.

* The primary phase current may be calculated using the measured secondary current of the load box and the known transformer ratio. (e.g for a 100 amp @ 240 volt secondary load box with a 30:1 transformer ratio, the primary phase current at 7,200 volts would be 3.3 amps.)


LOAD BOX TEST
Ip
Ipn
Isn net
Isn
CENTRAL
YARD POLE
DISCONNECT
BARN
Vcc
WATERPIPE
TO FLOOR
LOAD
BOX
REMOTE
REFERENCE
ROD
Vp
Vps
Vs
Appendix A-2 c

SECONDARY NEUTRAL VOLTAGE DROP TEST

Test performed by: _____ Date: _____

Customer name: _____

(All other farm loads must be off. Use only one load per circuit)

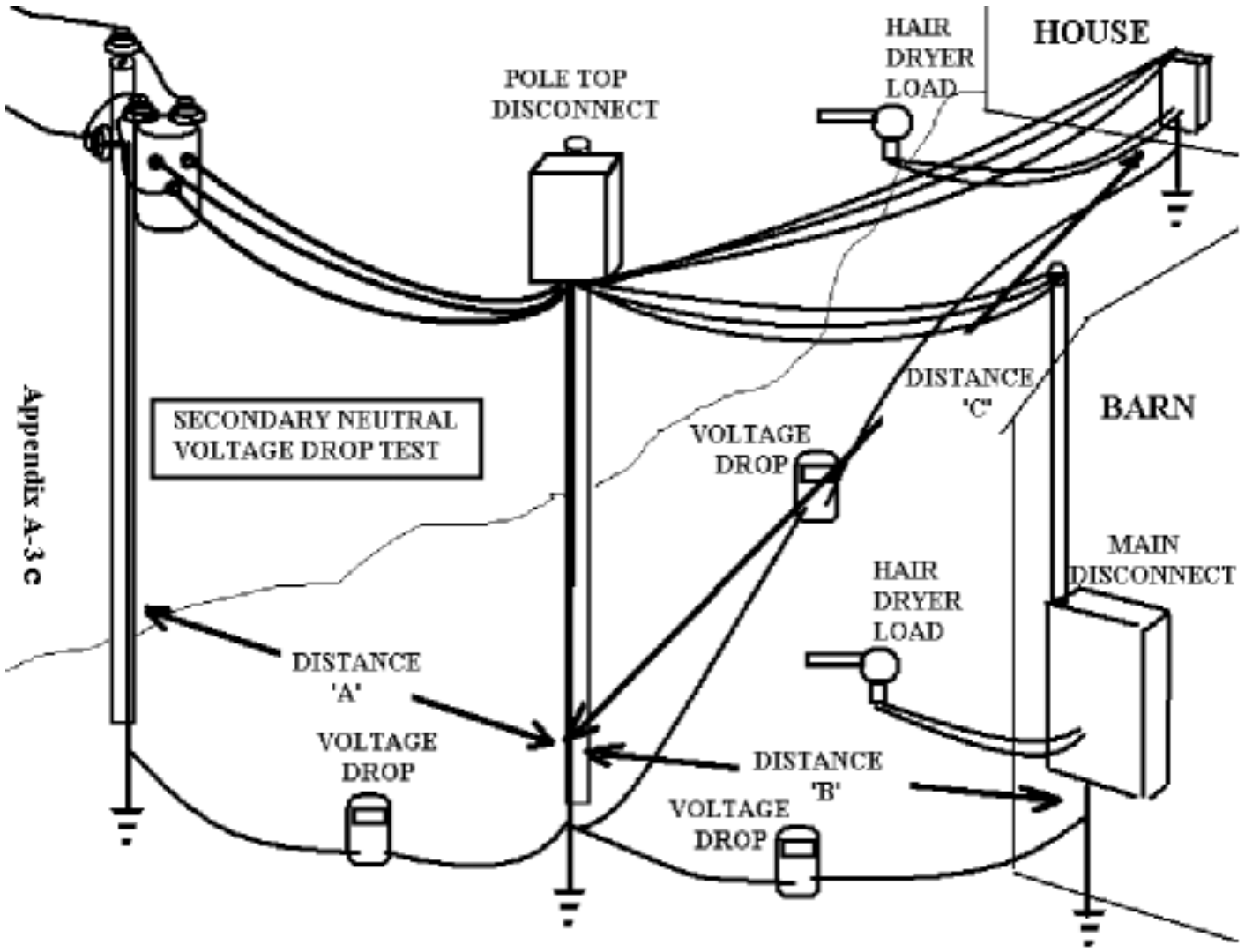
	SITE:	1	2	3	4	5	
	Site Location:						**UNITS**
A.	Circuit neut. wire gauge						
B.	Wire length (in 100's ft.)						100 ft
C.	Ω/100ft.						Ω
D.	Total Q (B times C)						Ω
E.	Measured neut. Current						A
F.	Calculated voltage drop (D times F)						V
G.	Measured voltage drop						V
H	Percent difference ({|G-F|}/G *100)						%
	Vp load off						V
	Vs load off						V
	Vcc load off						V
	Vp load on						V
	Vs load on						V
	Vcc load on						V

SECONDARY NEUTRAL VOLTAGE DROP TEST INSTRUCTIONS

ITEM	EXPLANATION
1	Enter names of those performing test
2	Enter date test is performed
3	Enter customer name
4-8	Describe load site location, neutral wire gauge, neutral wire length (in 100's of feet), resistance per 100 feet (see table below), measured neutral current, measured voltage drop, Vp, Vs and Vcc for load off and load on.
9-13	Calculate the total circuit resistance. Calculate, using Ohm's Law, the expected neutral voltage drop. Calculate the absolute value of the difference and divide by the measured voltage drop. Express this as a percentage. If the two values (measured voltage drop and calculated voltage drop) do not agree, further investigation is warranted to discover the reason for the discrepancy. Prioritize your investigation to look at the largest percentage difference cases first.

Resistance Chart (Ohms per 100 feet)

MATERIAL				MATERIAL		
GAUGE	AL	CU		GAUGE	AL	CU
14	0.42	0.26		2	0.027	0.016
12	0.26	0.16		1	0.021	0.013
10	0.17	0.10		1/0	0.017	0.010
8	0.11	0.064		2/0	0.013	0.008
6	0.67	0.041		3/0	0.011	0.006
4	0.34	0.020		4/0	0.008	0.005


Appendix A-3 c
SECONDARY NEUTRAL
VOLTAGE DROP TEST
POLE TOP
DISCONNECT
HAIR
DRYER
LOAD
HOUSE
DISTANCE
'C'
BARN
VOLTAGE
DROP
MAIN
DISCONNECT
HAIR
DRYER
LOAD
DISTANCE
'A'
VOLTAGE
DROP
DISTANCE
'B'
VOLTAGE
DROP

SIGNATURE TEST FORM

Customer Name: _____ Date: _____

	Type of Load	Location	Time On	Time Off	(*)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					
31					
32					
33					
34					
35					

SIGNATURE TEST FORM INSTRUCTIONS

ITEM	EXPLANATION
1	Enter the date the test is performed.
2	Enter the customer's name.
3	Enter the description of the load for which the signature will be recorded (If using a hair dryer, note it as HD).
4	Enter the location of the load.
5	Note the time of turn-on and time of turn-off. Equipment should be on for a period of not less than 10 seconds. If equipment is found in the on condition, turn it off then turn it back on and note the event with a star in the right column to make sense of the difference in on and off time events.
6	Repeat for all major circuits and pieces of equipment (both 120 volt and 240 volt). Some equipment may normally be operated in sequence. Start each piece at 15-second intervals until all are running, then turn off in reverse order in 15-second intervals.

PRIMARY PROFILE DATA FORM

Customer name:_____ Date: _____
Test performed by: _____

Record the current (Ipg) and the resistance (Rpg) of each ground rod in a linear pattern ¾ ths of a mile on each side of the farm's tap/transformer pole. Calculate, using Ohm's Law, the primary neutral to earth voltage (Vpne) for each pole. Use the notes section to annotate the condition of each pole and if the pole has a transformer, capacitor bank, recloser, arrestor, telephone pedestal or CATV device, etc. attached.

POLE #	POLE ID #	Ipg (mA)	Rpg (Ω)	Calc. Vpne (V)	Notes
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
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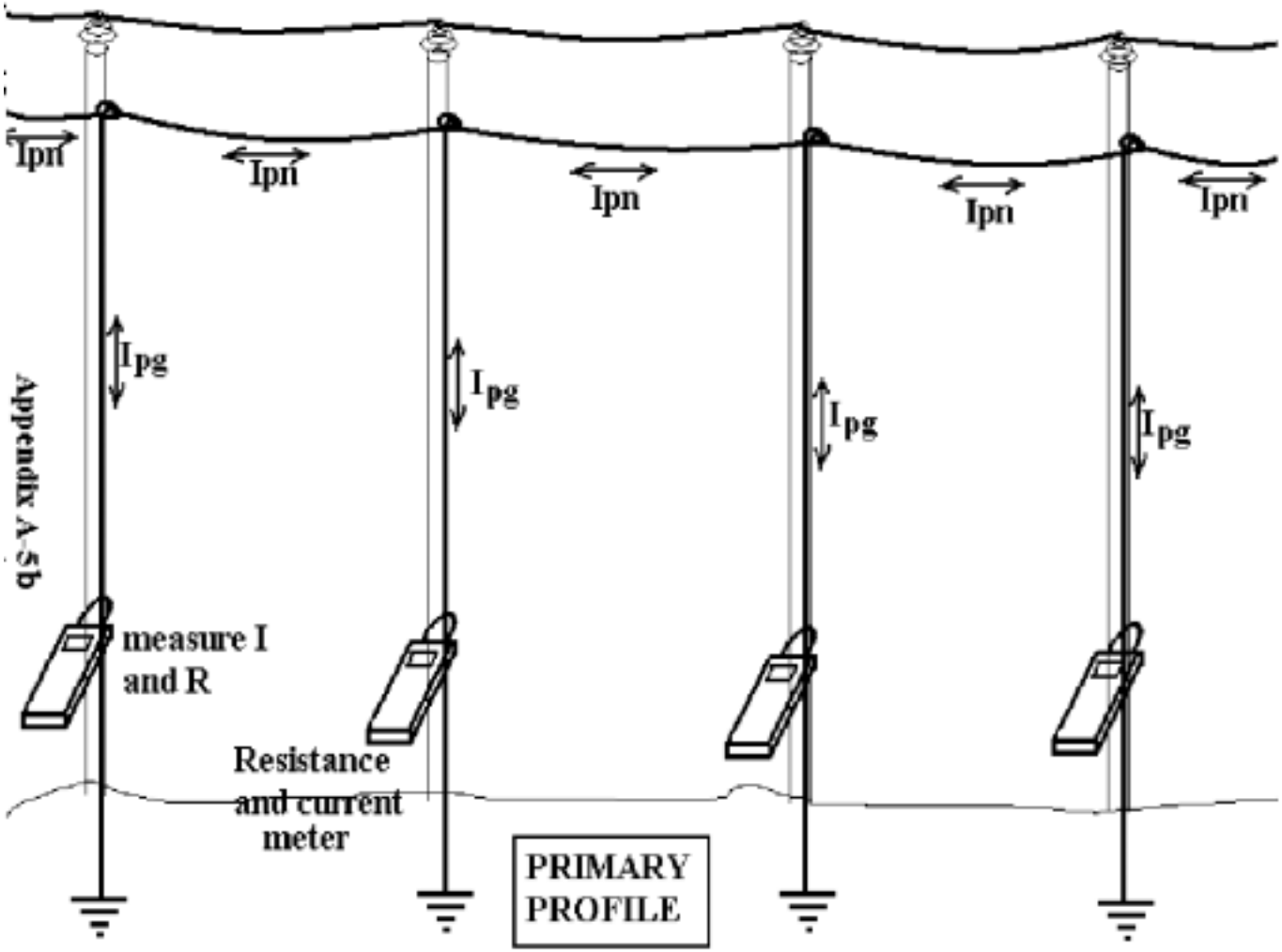
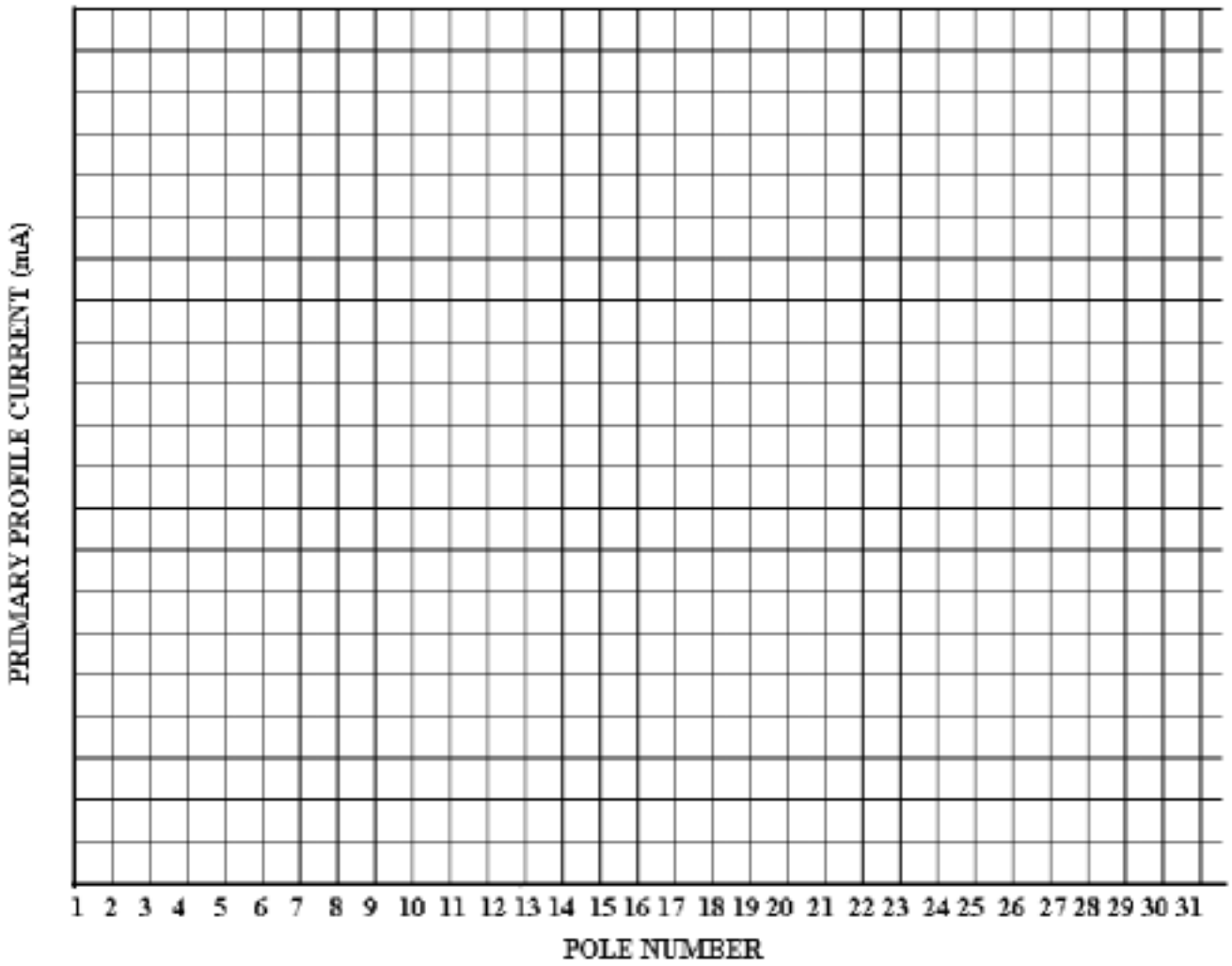
21					
22					
23					
24					
25					
26					


Ipn
Ipn
Ipn
Ipn
Ipn
Ipg
Ipg
Ipg
Ipg
Appendix A-5b
measure I
and R
Resistance
and current
meter
PRIMARY
PROFILE



Appendix A-5 C

PRIMARY PROFILE RESISTANCE (ohms)

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

POLE NUMBER

Appendix A-5d

PRIMARY PROFILE VOLTAGE (volts)

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

POLE NUMBER

Appendix A-5e

"24-HOUR" TEST REPORT FORM

Customer name: _____ Date: _____

Start time: _____ Stop time: _____

Measure the following points with a long term digitizing data recorder: Vp from the primary pole ground rod to remote reference, Vs from the barn's main disconnect panel neutral/ground electrode, Vps between the previous two points, and Vcc, the cow contact voltage.

Data Recorder Settings and Assignments:

Waveform capture: OFF, Impulse capture: ON, Record min RMS: NO, Record RMS: YES, Record max RMS: YES, Record time: Maximum, RMS Storage interval: 10 Sec.

Channel	Variable	Inputs	Lower RMS	Upper RMS	Impulse
Red	**Vp**	**ON**	**OFF**	**OFF**	**15 V.**
Black	**Vs**	**ON**	**OFF**	**OFF**	**15 V.**
Blue	**Vps**	**ON**	**OFF**	**OFF**	**15 V.**
White	**Vcc**	**ON**	**OFF**	**ON, 3V.**	**10 V.**

After recording the data, analyze the reports section and record the following for the number of occurrences of each type of event. The first is from the excedence report and the second two are from the out-of-limits report.

1. VOLTAGE LEVEL: exceeding 1.0 v. RMS max. Occurrences: ☐

2. VOLTAGE LEVEL: exceeding 3.0 v. RMS max. Occurrences: ☐

3 IMPULSE VOLTAGE LEVEL:
exceeding 10.0 v. PEAK max.
(For a time duration of 130 microseconds
to 16.67 milliseconds.) Occurrences: ☐

Additional comments:

APPENDIX C

Town of Chilton Wind Energy System Ordinance Appendix C

Complaint and Resolution Procedure

Everyone involved with any phase of the WESF is responsible for ensuring an expeditious and equitable resolution of all complaints. It is therefore necessary to establish a uniform method for documenting and handling complaints related to the WESF project. As a part of the application, the applicant shall submit to the Town Chairperson or his/her designee the procedures to be used to receive and respond to complaints regarding wind energy systems (WES) and related facilities.

Definitions:

Complaint: A written, signed, and dated statement presented by a person expressing dissatisfaction, resentment, or discontent as a direct result of the WESF and related facilities. Complaints do not include requests, inquiries, questions, or general comments.

Substantial complaint: A complaint, if substantiated, could result in permit modification, suspension, or cessation of WESF operation pursuant to the applicable provisions of this Ordinance. Substantial complaints shall include health and/or safety concerns, or identification of violation(s) of the WESF conditional use permit.

Person or Complainant: An individual, partnership, joint venture, private or public corporation, association, firm, public service company, cooperative, political subdivision, municipal corporation, government agency, public utility district, or any other entity, public or private, however organized.

Requirements:

The applicant/owner/operator shall report to the Town Chairperson or his/her designee all complaints received concerning any part of the WESF construction or operation in accordance with the following:

1. Complaints received by the applicant/owner/operator concerning the WESF conditional use permit for site preparation, construction, operation, cleanup and restoration, and status of the resolution of such complaints shall be reported in a uniform and timely manner (within 5 business days). All substantial complaints shall be reported the same day received or on the following working day for complaints received after working hours. Such reports are to be directed to the Town Clerk at (920) 849-4720.

2. The reporting shall encompass a description of the complaint(s) and the frequency of similar complaints.

3. The applicant/owner/operator shall document all complaints by maintaining a record of all applicable information concerning the complaint, including the following:

    a. Name of the applicant and WESF project.
    b. Name of complainant, address, and phone number.
    c. Precise property description or tract numbers (where applicable).
    d. Nature of complaint.
    e. Weather conditions related to the complaint (if applicable).
    f. Response given.
    g. Name of person receiving complaint and date of receipt.
    h. Name of person reporting complaint to the Planning and Development Department, and phone number.
    i. Complaint resolution and date.

4. The applicant/owner/operator shall assign an individual to summarize complaints for transmittal to the Town Chairperson or his/her designee.

5. All substantial complaints shall be investigated on site and the complainant and Town Chairperson or his/her designee shall be invited to attend any such investigations.

6. The procedures shall be used for all complaints received by the applicant/owner/operator.

Complaints Received by the Town Chairperson or his/her designee or the Town Clerk

Copies of complaints received directly from aggrieved persons regarding site preparation, construction, operation, maintenance, cleanup and restoration, shall be promptly sent to the Applicant.

Complaint Resolution Certification

The Town Chairperson or his/her designee shall certify in writing to all parties involved the complaint resolution. In the absence of a mutually acceptable resolution, it shall be the authority of the Town Chairperson or his/her designee to resolve the complaint or take action as authorized per Section XII.D of this ordinance.