Public Service Commission of Wisconsin

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Joseph P. Mettner, Commissioner
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610 North Whitney Way
P.O. Box 7854
Madison, WI 53707-7854

February 22, 1999

To The Person Addressed

Re: Ungrounded Transformer Installations

This letter is being written to clarify concerns that have been brought to my attention about proper installation and placement of non-utility, customer-owned, ungrounded transformers that are intended to isolate grounding systems. Two areas of concern need to be addressed:

1. Is bonding from the utility transformer's secondary to the customer's electrical service equipment required?

In general, the rules regarding service application and installation are covered in utilities' filed tariffs and other rules under the regulatory jurisdiction of the Public Service Commission of Wisconsin. When questions are raised regarding non-standard service or installations not clearly addressed by tariff or rule, Commission staff will make interpretations to address these issues.

Recently, some electrical contractors have requested utility service that is not normally associated with agricultural wiring. If the utility offers the type of service requested, and it is considered safe and acceptable by the utility, it can be provided. Regardless of the type of secondary service offered, on agriculture facilities, an equipment grounding or grounded conductor shall be installed with the service ungrounded conductors for reasons of safety. This conductor may or may not be a current carrying conductor, but it shall be available, permanent, and electrically continuous. This interpretation does not apply to primary-to-secondary bonding and grounding covered in the National Electric Safety Code, Article 97.

2. Can an ungrounded, customer-owned, fixed transformer be installed at ground or grade level?

The code that regulates this issue is under the jurisdiction of the Department of Commerce. I have spoken with Mr. Joe Hertel of that Department several times regarding this issue. He assures me that electrical contractors are never to install ungrounded transformers (intended to isolate the primary and secondary grounding systems) at grade level.

Equipment that is not grounded is clearly addressed in the National Electric Code (NEC). Section 250-110 explains the rules for all fixed electrical equipment likely to become energized.

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250-110. Equipment Fastened in Place or Connected by Permanent Wiring Methods (Fixed).
Exposed noncurrent-carrying metal parts of fixed equipment likely to become energized shall be grounded under any of the following conditions:

(1) Where within 8 ft (2.44 m) vertically or 5 ft (1.52 m) horizontally of ground or grounded metal objects and subject to contact by persons.
(2) Where located in a wet or damp location and not isolated.
(3) Where in electrical contact with metal
(4) Where in a hazardous (classified) location as covered by Articles 500 through 517
(5) Where supplied by a metal-clad, metal-sheathed, metal-raceway, or other wiring methods that provide an equipment ground, except as permitted by Section 250-85, Exception No. 2 for short sections of metal enclosures
(6) Where equipment operates with any terminal at over 150 volts to ground

The one main exception to these rules that applies to the ungrounded transformer installation is as follows:

Exception No. 2 Distribution apparatus, such as transformers and capacitor cases, mounted on wooden poles, at a height exceeding 8-ft (2.44 m) above ground or grade level.

(Note) The 5-ft (1.52 m) horizontal rule in 250-110 (1) must also be applied.

The most common argument used to justify grade level installations of these units is that they are bonded on either the line or load side of the customer-owned transformer, and therefore, are "effectively" bonded. The NEC states in Article 250-2 (d) the earth shall not be used as the sole equipment grounding conductor or fault current path.

When the transformer is bonded to only one side of the circuit, fault current imposed on the equipment must use earth as its sole fault current path. This can be an extreme hazard. Article 250-2 (d) states that the fault current path shall be **permanent and electrically continuous**, shall be capable of safely carrying the maximum fault likely to be imposed on it, and shall have sufficiently low impedance to facilitate the operation of overcurrent devices under fault conditions.

The transformer must be properly grounded or installed under the minimum standards in NEC 250-110 Exception No. 2. This allows the contractor to install the ungrounded transformer, but keeps the unit from being exposed to persons when a fault is imposed on the ungrounded equipment.

This letter should not be interpreted as a method to discourage installation of ungrounded equipment on the customer's facility, but rather as a measure to ensure standardized installations and to promote safety for utility staff and its customers.

I hope this letter clears up the confusion surrounding this issue. If you have questions, please call me at (608) 267-6718.

Sincerely,

Mark A. Cook, Electrical Inspector
Stray Voltage Program Manager
Rural Electric Power Services

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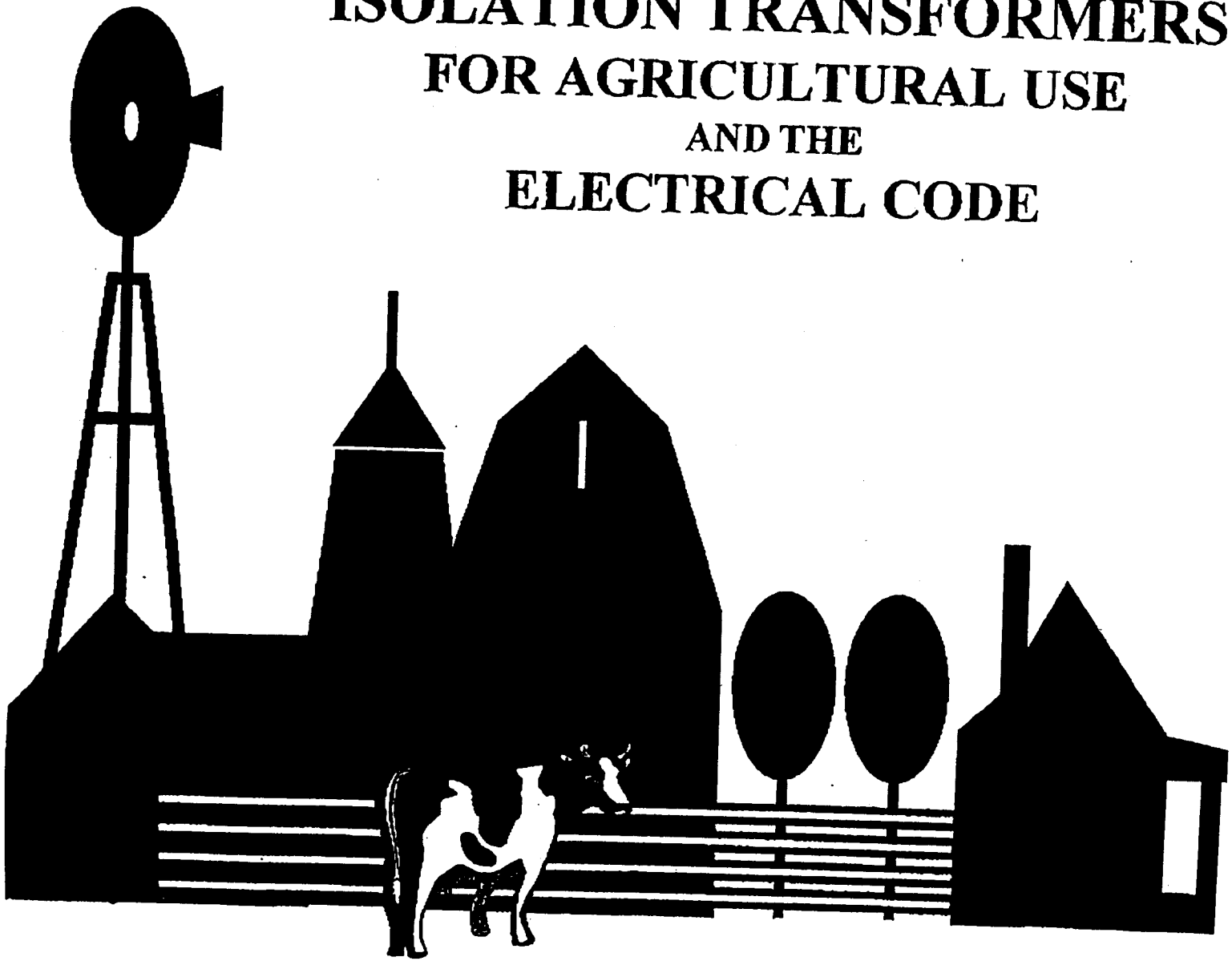
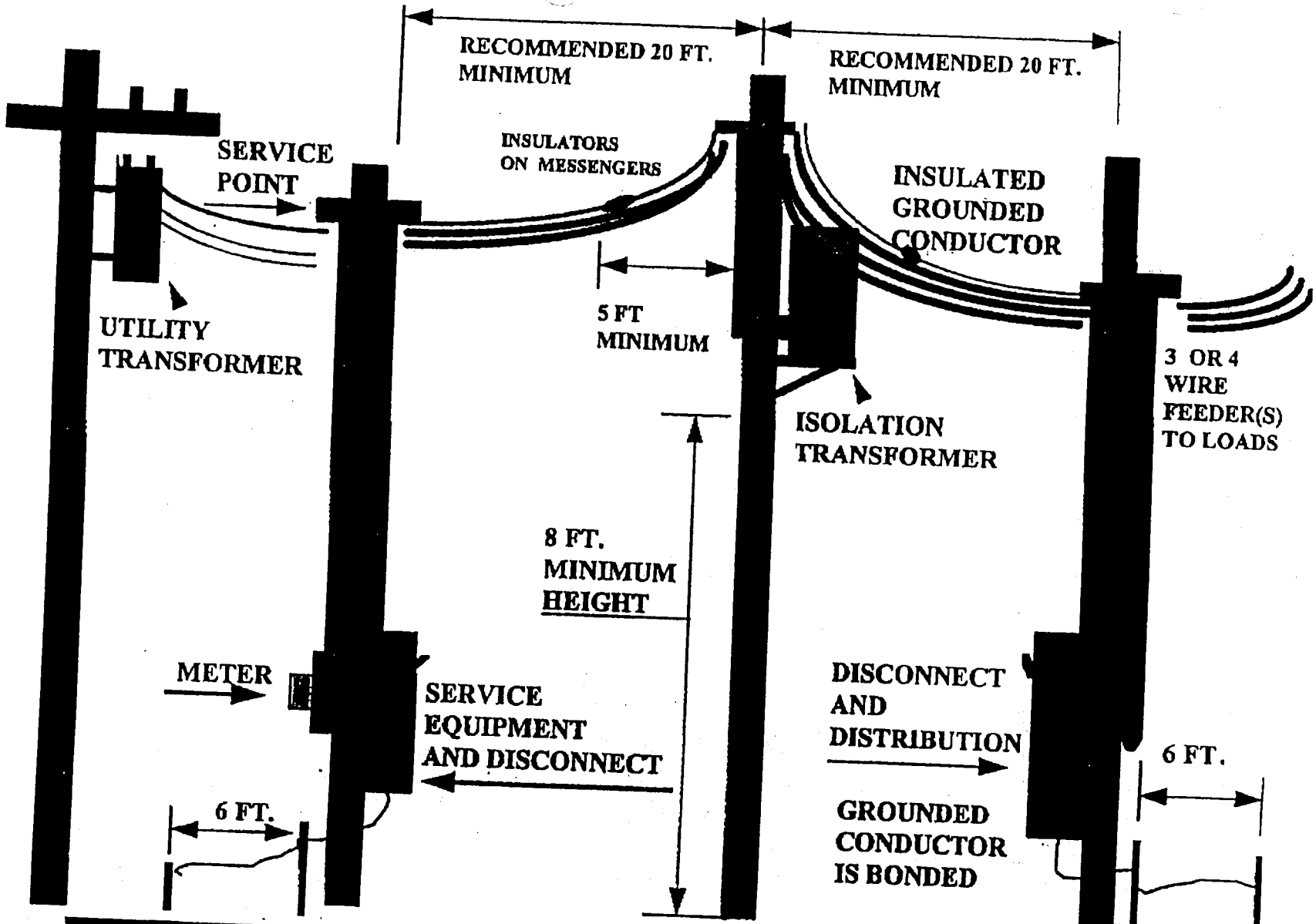
Enclosure

cc: Brian Guenther, NSP
Chuck DeNardo, WEPCO
Marty Jacobi, MGE
William Johnson, WP&L
Steve Schott, WPS
Kenyon Kies, WUA
Dave Jenkins, WECA
Steve Sauer,DATCP
Dr. John Roberts, DATCP
Joe Hertel, COMM
James D. Loock, PSC Chief Engineer
Richard Reines, PSC Engineer

ISOLATION TRANSFORMERS FOR AGRICULTURAL USE AND THE ELECTRICAL CODE





ISOLATION TRANSFORMERS for AGRICULTURE

ISOLATION TRANSFORMERS

The installation of isolation transformers involves equipment that is not grounded and is addressed by Section 250-42 of the National Electrical Code.

250-42. **Equipment Fastened in Place or Connected by Permanent Wiring Methods (Fixed).** Exposed noncurrent-carrying metal parts of fixed equipment likely to become energized shall be grounded under any of the conditions in (a) through (f) below.

(a) **Vertical and Horizontal Distances.** Where within 8 feet (2.44 m) vertically or 5 feet (1.52m) horizontally of ground or grounded metal objects and subject to contact by persons.

(b) **Wet or Damp Locations.** Where located in a wet or damp location and not isolated.

(c) **Electrical Contact.** Where in electrical contact with metal.

(d) **Hazardous (Classified) Locations.** Where in a hazardous (classified) location as covered by Articles 500 through 517.

(e) **Wiring Methods.** Where supplied by a metal-clad, metal-sheathed, metal-raceway, or other wiring method that provides an equipment ground, except as permitted by Section 250-33 for short sections of metal enclosures.

(f) **Over 150 Volts to Ground.** Where equipment operates with any terminal at over 150 volts to ground.

Exception No. 1: Enclosures for switches or circuit breakers used for other than service equipment and accessible to qualified persons only.

Exception No. 2: Metal frames of electrically heated appliances, exempted by special permission, in which case the frames shall be permanently and effectively insulated from ground.

Exception No. 3: Distribution apparatus, such as transformer and capacitor cases, mounted on wooden poles, at a height exceeding 8 feet (2.44m) above ground or grade level.

Exception No. 4: Listed equipment protected by a system of double insulation, or its equivalent, shall not be required to be grounded. Where such a system is employed, the equipment shall be distinctively marked.

ISOLATION TRANSFORMERS for AGRICULTURE

The installation of an isolation transformer must comply with the State Electrical Code Vol. 2. The attached sheet indicates code sections that apply to equipment that is not grounded. All electrical wiring is required to comply with the Electrical Code in effect at the time of installation. These notes do not cover all aspects of the installation of isolation transformers but serve to indicate those Sections that are significantly applicable to this type of installation. **All installations should be undertaken by qualified individuals that understand the hazards involved.**

In order to achieve isolation; no electrical bonding can be done in or on the transformer. Compliance with the code indicates that all ungrounded metal (transformer case, raceways, or support structure) must be located at a vertical height of 8 feet or more and a horizontal distance of 5 feet from ground or grounded metal objects. It is possible to mount the transformer above the distribution equipment but this would require an increase in the height to meet the 8 foot separation from ground and grounded metal. The sketch indicates insulators placed in the messengers at a distance to provide a 5 foot horizontal clearance from grounded metal.

Grounding (grounding electrodes) must be provided at the service and again at the distribution panel on the transformer secondary. The grounding electrode can consist of a made electrode or rod and is supplemented with an additional rod unless the resistance to ground is 25 Ohms or less. These electrodes are required to be spaced not less than 6 feet apart. NEC Sections 250-81, 83 and 84 are applicable.

The transformer is a separately derived system that is covered by NEC 250-26. This Section requires that a bonding jumper, sized in accordance with 250-79(d) for the derived phase conductors, shall be used to connect the equipment grounding conductors of the derived system to the grounded conductor. This connection is allowed at any point on the separately derived system from the source (transformer) to the first system disconnecting means or overcurrent device. The isolation of the transformer leaves the first disconnect as the only allowable point for this bonding to occur.

Primary and secondary protection is required for the transformer. The applicable Section of the NEC for transformer protection is 450-3(b).

Additional information is contained in the State and National Electrical Codes. The Department of Commerce, Safety and Buildings Division provides consultants that can answer specific questions.