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Magnetic Fields Near Transformers

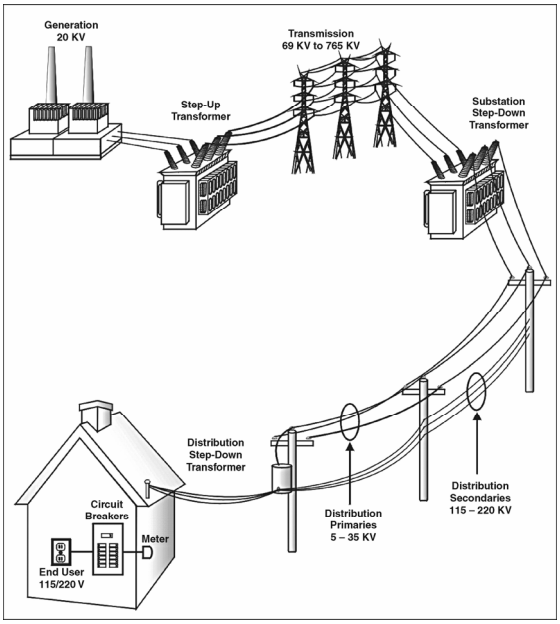

Figure 1 *A typical transmission and distribution system*

Background

Power lines transport electrical energy from a generating source, such as a fossil fuel, hydroelectric, or nuclear power plant; a wind farm; or a solar field, to homes and businesses.

In a well-known analogy comparing the power system to a water system, *voltage* refers to the electrical pressure and *current* to the flow of electricity. Magnetic fields are produced by electric current, and always decrease in intensity as a person moves away from the current-carrying source. Magnetic fields at typical environmental levels are expressed in units of *milligauss* (mG) or *microtesla* (μT) (1μT = 10 mG). A nationwide survey of nearly 1000 residences conducted by the Electric Power Research Institute (EPRI) in the 1990s reported that 5% of residences have average magnetic fields that exceed 3 mG (10% exceed 2.1 mG).

On its trip from the generating station to its final destination in homes and businesses, electric power is progressively converted from higher to lower voltage (Figure 1). This conversion occurs in *substations*, where the power is relayed from high-voltage *transmission lines* to lower voltage *distribution lines*, which then feed local neighborhoods. Within neighborhoods and other localities, the distribution voltage is converted to the voltage at wall electrical outlets that powers lights, appliances, and other electrical equipment.

Transformers are responsible for the voltage conversion that enables energy-efficient movement of electricity along its route from source to consumer. Transformers are familiar sights; either as pole- or pad-mounted units (Figures 2 and 3). Other than power company workers, people are not likely to spend much time near pad-mounted transformers and, at street level, do not get close to pole-mounted transformers. Nevertheless, incidental exposure to magnetic fields from pad-mounted units is possible given their locations in publicly accessible areas, and some people reside in apartments located near pole-mounted units.

Figure 2 *Pole-mounted transformer (left)*
Figure 3 *Pad-mounted transformer (right)*

EPRI Research

To address questions about magnetic field exposure levels near transformers, EPRI conducted a measurement survey of rep-resentative pad- and pole-mounted units. The main results are:

- As expected, higher magnetic field levels are measured near transformers with high *power ratings* (a measure of power capacity) than transformers with lower ratings.
- The magnetic fields directly adjacent to a transformer enclosure are considerably greater than those typically found in residences, although similar levels may occur near certain appliances (hair dryers, for example).

- As distance from a transformer increases, field levels sharply decrease. At 10–15 feet horizontally from a trans-former, measured magnetic field levels are less than 3 mG, which is within the typical range of residential levels. At ground level beneath a pole-mounted transformer, magnet-ic fields diminish to the background levels found in homes.

The magnetic field profile in Figure 4 shows how quickly the magnetic field level drops with distance from the edge of a pad-mounted transformer with a power rating of 750 kilovolt-amperes (kVA). Although the magnetic field right next to this unit was about 900 mG, the field measured close to a unit with a much lower power rating of 75 kVA was only 18 mG.

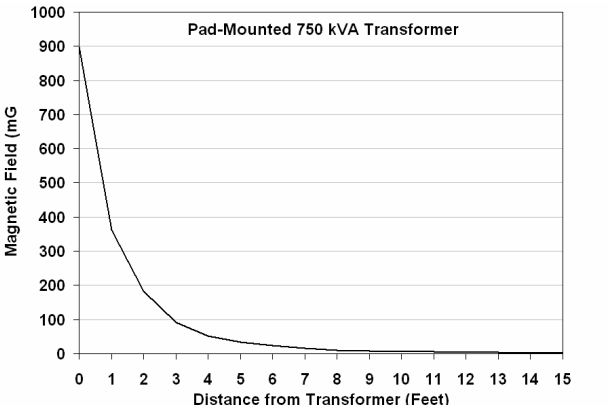

Figure 4 *Horizontal magnetic field profile near a pad-mounted transformer*

In the EPRI survey, measurements for pad-mounted units were taken in public areas, whereas measurements for pole-mounted units required a laboratory setting (Figure 5). However, the same general theme applies to results for these units.

Figure 5 *Laboratory measurement of the vertical magnetic field profile near a pole-mounted transformer*

Figures 6 and 7 show horizontal and vertical magnetic field profiles for 100% loading of a 50-kVA transformer. In locations that are accessible only to power company linemen, the fields are high compared to residential levels, but in publicly accessible areas, the fields are typical of those found in homes. For units loaded at 25% capacity, which is more representative of actual conditions, the fields are at least 60% lower.

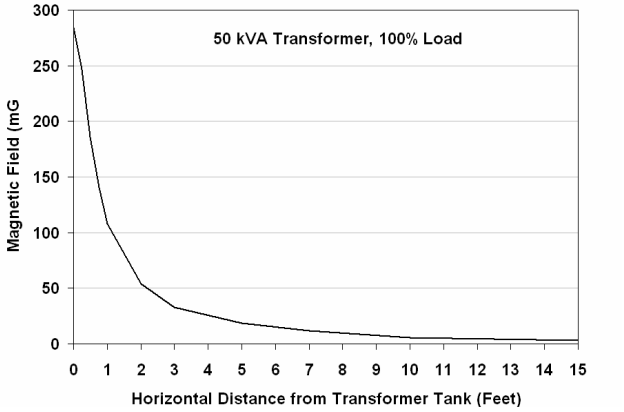

Figure 6 *Horizontal magnetic field profile near a pole-mounted transformer*

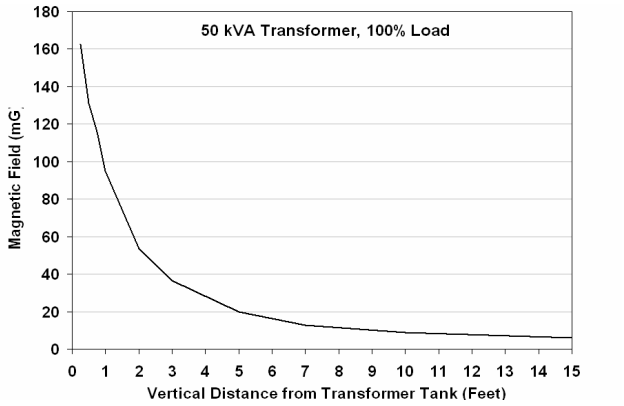

Figure 7 *Vertical magnetic field profile near a pole-mounted transformer*

Summary

Transformers play an indispensable role in enabling efficient transport of electrical energy from the generating source to the consumer. Transformer units do produce magnetic fields that very close to the units are greater than typical residential fields. Within approximately 10–15 feet away, however, these fields diminish rapidly to background levels.

Contact Information

For more information, contact the EPRI Customer Assistance Center at 800.313.3774 (askepri@epri.com).

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