STATE OF CONNECTICUT

CONNECTICUT SITING COUNCIL

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January 5, 2005

TO: Parties and Intervenors

FROM: S. Derek Phelps, Executive Director

RE: **DOCKET NO. 272** - The Connecticut Light and Power Company and The United Illuminating Company application for a Certificate of Environmental Compatibility and Public Need for the construction of a new 345-kV electric transmission line and associated facilities between the Scovill Rock Switching Station in Middletown and the Norwalk Substation in Norwalk, Connecticut. This includes construction of the Beseck Switching Station in Wallingford, East Devon Substation in Milford, and Singer Substation in Bridgeport and modifications to the Scovill Rock Switching Station and the Norwalk Substation and certain interconnections.

Please be advised the Connecticut Siting Council (CSS) will be taking Administrative Notice of the Council's Electric and Magnetic Field Best Management Practices for the Construction of Electric Transmission Lines in Connecticut, dated December 21, 2004.

Enclosed please find a copy of this document for your review.

SDP/FOC

Enclosure

Electric and Magnetic Field Best Management Practices For the Construction of Electric Transmission Lines in Connecticut

December 21, 2004

The Connecticut Siting Council (Council) recognizes that the potential for health effects from exposure to electric and magnetic fields (EMF) remains a concern among various members of the public. Studies conducted from the 1970's to date have presented conflicting conclusions regarding exposure to EMF from electric transmission lines. To address this concern, the Council, in accordance with Public Act 04-246, has reviewed and revised its "Best Management Practices for the Construction of Electric Transmission Lines in Connecticut" to provide the latest information to the public regarding technological advancements in transmission line siting and construction to reduce incidental exposure to EMF.

The most common EMF concerns are associated with the 60 hertz fields associated with electric transmission and, to a lesser extent, distribution lines. In addition to these sources, other sources of EMF include substations, transformers, household electrical wiring, electrical tools, and household appliances such as hair dryers, televisions, and microwave ovens. Generally, the most concern has to do with magnetic fields rather than electric fields. Electric fields decrease with distance from the source and can be effectively reduced by material shielding. Magnetic fields (MF) also decrease with distance from the source but can penetrate most materials. Average background levels of magnetic fields in most homes range from 0.4 to 3 milligauss (mG) (NIEHS, 2002).

MF levels under transmission lines vary greatly fluctuating throughout the day depending on the current flowing through the lines. MF levels under transmission lines can range from 8 to 130 mG, depending on the current, height, and distance from the lines. Magnetic fields from transmission lines attenuate with distance and achieve levels similar to background levels found inside or outside the home at a distance of approximately 200-300 feet from the power line depending on the current in the line.

In Connecticut, existing and proposed transmission lines are designed to carry 69, 115 or 345 kilovolts (kV) of electricity. Primary distribution lines typically carry less than 69 kV and have much lower MF values. This document presents guidelines for proposed electric transmission lines and not other sources of MF.

Health Effects from MF

A recent review of scientific studies and literature by the Connecticut Department of Public Health (DPH) concludes there is no definitive scientific evidence that demonstrates an association between EMF exposure and an increase in health risks. The DPH has produced an EMF Health Concerns Fact Sheet, updated in January 2004 that incorporates the latest scientific research and conclusions from national and international health panels.

Although the DPH concludes that there is no definitive link between adverse health effects and EMF exposure, the DPH cites a scientific review by the National Institute of Environmental Health Sciences (NIEHS) in 1999 which concludes EMF exposure cannot be recognized as entirely safe due to some evidence that EMF exposure may pose a childhood leukemia hazard. However, the NIEHS only recommends "continued education on ways of reducing exposures" rather than aggressive regulatory measures. Among reviews by other study groups, including the International Agency for Research on Cancer (IARC) (2001), the Japan EMF Research Program (2001) and the Health Council of the Netherlands ELF Electromagnetic Fields Committee (2003), the general conclusion is that there is inconsistent evidence regarding exposure to MF and adverse health effects. IARC classified MF as "possibly carcinogenic to humans" based upon pooled analyses of data from several studies. IARC further states there is limited evidence supporting an association between childhood leukemia and high residential MF strengths.

It is important to note that there are no state or federal health-based exposure standards for extremely low frequency MF, the type associated with 60-hertz fields, although several states have established EMF standards to prevent an increase in MF beyond levels that presently exist along transmission line right-of-ways. Health-based exposure standards have not been established due to the lack of scientific evidence demonstrating a causal relationship or clear dose response between MF exposure and health effects.

Policy of the Connecticut Siting Council

Until further research can definitively prove or disprove an association between MF and adverse health effects, the Council recommends a policy of prudent avoidance when siting future electric transmission lines. These measures attempt to avoid or minimize exposure to magnetic fields above existing levels whenever reasonable, practical, and cost effective siting and engineering solutions exist. These measures may not be suitable or applicable in all cases.

MF Best Management Practices

The Connecticut Siting Council has adopted the following Best Management Practices relating to the construction of new electric transmission lines in the State. These practices are intended for use by public service utilities and the Council when considering the installation of new electric transmission lines. Such practices are based on the policy of prudent avoidance and include the following: a review of recent scientific MF health exposure research; use of engineering controls and proven, reliable technology to reduce MF exposures; and pre and post construction testing of MF along the transmission line route.

The application of these recommended practices should be applied to proposed transmission lines located immediately adjacent to locations where children are likely to spend considerable amounts of time including residential areas, public and private schools, licensed youth camps, public playgrounds, and licensed day care facilities. A case-by-case approach in the application of these practices should be used when the transmission line route is immediately adjacent to other types of development such as commercial and industrial areas, hospitals, and nursing homes.

I. Review of Ongoing and Completed MF Health Exposure Research

The Council recognizes the uncertainty surrounding the health effects from MF exposure. This uncertainty makes the task of siting new transmission lines extremely difficult. However, to ensure the Council is apprised of new developments in MF research, the Council will require that all electric transmission line applications contain a thorough review of the most recent completed studies regarding the health effects of MF exposure as well as a listing, including a brief description of all ongoing research projects related to MF exposure, to the degree possible.

In addition, specific studies that review all of the research to date will be administratively noticed by the Council for any electric transmission line siting proceeding in order to refer to scientific conclusions based on a broad spectrum of research when considering an application. Recent reviews include the National Institute of Environmental Health Sciences of the National Institutes of Health, Working Group Report in 1998, the conclusions of the IARC in 2001, and the Health Council of the Netherlands, ELF Electromagnetic Fields Committee, Electromagnetic Fields: Annual Update 2003.

The Council will continue to seek comment from the DPH for each transmission line application. The Council recognizes the DPH as the Connecticut agency with the charge of protecting the health and safety of the public. The Council notes that at this time that the DPH has not set any health-based standards for exposure to MF from transmission lines. As stated in the DPH's latest Fact Sheet on EMF, there is no current scientific evidence clearly demonstrating an increased health risk associated with exposure to EMF but uncertainties warrant an approach of prudent avoidance.

II. Pre and Post Construction MF Measurements

When designing a transmission line project, an applicant shall provide design alternatives and pre-construction estimates of MF resulting from each alternative. Preconstruction MF measurements can be obtained using mathematical modeling under a variety of current flows under normal loading, defined as 70 percent of the peak load, and peak loading conditions during winter and summer weather conditions.

As part of this determination, the applicant should provide the Council with information regarding the presence of areas of interest, defined as residential areas, public and private schools, licensed youth camps, public playgrounds, licensed day care facilities, hospitals, and licensed nursing homes within 300 feet of the proposed transmission line. MF values should be calculated perpendicular from the proposed location of the transmission line to the areas of interest at intervals of 25 feet.

In the case where the existing modified or new proposed right-of-way is not of sufficient width to achieve background levels at the edge of the right-of-way and the transmission line is adjacent to the areas of interest, the applicant should present feasible design options that reduce MF values for these specific areas. MF values should also be provided for each of these design options at 25-foot intervals perpendicular from the proposed transmission line. This will allow for an evaluation of how MF levels differ between alternative power line configurations. The intent of presenting various design options is to achieve conditions resulting in a no net increase in existing MF levels where possible. Factors in selecting a specific design are related to the exposed receptors (ages, number potentially exposed, length of time potentially exposed), cost of the design, practicality, and the overall reduction of MF achieved.

If a transmission line is approved adjacent to an area of interest where the projected MF values in the area are above background levels, the Council will recommend periodic testing of MF levels from various areas within the specific area of interest. For example, if a public or private school is located within 300 feet of a transmission line and MF reduction designs project higher than background values for MF at the school, then MF testing should be conducted from areas of the school grounds that are within 300 feet on the transmission lines including the parking areas, recreational areas, and from within the school, if applicable.

Buffer Zones

As enacted by the General Assembly in Section 4 of Public Act No. 04-246, a buffer zone in the context of transmission line siting is deemed to minimally be the distance between the proposed transmission line and the edge of the utility right-of-way. Buffer zone distances may also be guided by the standards presented in the National Electrical Safety Code (NESC) published by the Institute of Electrical and Electronic Engineers. These standards provide for the safe installation, operation, and maintenance of electrical conductors including clearance requirements from vegetation, buildings and other natural and man-made objects that may arise in the right-of-way area. The safety of power line workers and the general public are considered in the NESC standards.

In addition to the NESC standards, the Council will consider a buffer zone for proposed transmission line projects based on MF levels at the edge of the right-of-way. MF levels for a proposed transmission line within an existing right-of-way would be based on MF levels attained at the edge of the existing right right-of-way. If there is no existing transmission line, a right-of-way will be established based on the guidelines of the NESC. In this case, the right-of-way would serve as the buffer zone. MF values for the buffer zone would be based on the values obtained from pre-construction mathematical models and post-construction measurements at the edge of the right-of-way.

A similar approach has been established by New York State and Florida. In 1991, the New York Public Service Commission established an interim policy that requires new high voltage transmission lines be designed so that the maximum magnetic fields at the edge of the right-of-way, one meter above ground, do not exceed 200 mG if the line were to operate at its highest continuous current rating. This 200 mG level represents the maximum calculated magnetic field level for 345 kV lines now in operation in New York State.

The Florida Environmental Regulation Commission established a maximum magnetic field limit for transmission lines and substations in 1989. The MF limits established ranged from 150 mG to 250 mG, depending on the voltage size of the transmission line. These limits were based on the MF produced by existing lines of various voltage sizes. The Council will consider how these and other states have handled EMF limits on new transmission lines.

III. Engineering Controls

The Council will examine the following Engineering Controls to limit public MF exposure when considering an electric transmission line application: distance, conductor separation, vertical configuration, optimum phasing, and underground installation. Any change in power-line design will affect the line impedance, corona performance, mechanical behavior, system performance and cost of the line. The Council must consider all of these factors in relation to the overall reduction of MF achieved when using such controls.

Distance

MF exposure from transmission lines, or any electrical source, is directly related to distance with increasing distance resulting in lower MF exposure. In most transmission line situations background levels of MF (0.4 mG to 3, mG) can be achieved at a distance of 200-300 feet from the transmission line. To achieve such MF levels, the feasibility of establishing a wider right-of-way must be considered. Due to Connecticut's suburban nature where acquisition of rights on many parcels at market rates would be required, it may be difficult or even cost prohibitive to achieve such a wide right-of-way. An attempt should be made to acquire such a wide right-of-way to prevent encroachment from suburban development into areas adjacent to the transmission line where MF levels can routinely exceed background levels.

The Council will recommend that towns define lot setbacks or lot sizes for properties adjacent to transmission lines to prevent new construction and development from constraining future use or expansion of facilities in an existing right-of-way. A parallel goal would be to prevent new residential or school construction from being built too close to existing transmission lines. This will allow for towns to be an active participant in the decision making process and will improve the ability of communities to manage future growth and protect community resources.

Another method of reducing MF levels at the edge of a right-of-way is by increasing the height of the towers supporting the conductors. The main drawbacks of this approach are an increase in the cost of supporting structures and the potential detrimental visual effects.

Conductor Separation

MF can be reduced by decreasing the distance between the conductors. The MF produced by the closer conductors interact with each other and result in a canceling effect. However, placing the conductors closer together has practical limits. The distance between the conductors must be sufficient to maintain adequate electrical clearance at all times. One drawback of a close conductor installation is the need for more support structures per mile resulting in a higher installation cost and increased visual impact.

Vertical Configuration

The arrangement of conductors on support towers influences MF. In all cases, conductors arranged in a horizontal pattern will have greater MF levels than conductors arranged in a vertical configuration. This is due to the wider spacing between the conductors typical of H-frame designs being closer to the ground. Due to the reduced MF levels, the Council may mandate the construction of vertical tower designs for all new applications.

Optimum Phasing

Optimum phasing involves using a vertical configuration and double circuits to reduce magnetic fields. Typically, electric transmission line designs utilize a three-phase system with each phase carried by one conductor or a bundle of conductors. Utilities use the letters A, B, and C to denote the three-phase circuit, with each letter representing one conductor phase. A double circuit design places two circuits on one structure. The two circuits would be installed in an A-B-C and C-B-A vertical configuration. This arrangement of optimum phasing reduces MF through partial cancellation, reducing MF by up to fifty percent.

Underground Installation

Installing transmission lines underground in a close conductor arrangement will reduce MF but not eliminate them. The design of an underground transmission system places the conductors extremely close together inside a cable installed three to five feet below ground. The magnetic field is reduced by the phase cancellation effect resulting from the closeness of the conductors inside the cable. However, magnetic fields can be very high directly over the line. Nevertheless, the magnetic field on either side of the line diminishes greatly with increased distance when compared to an overhead transmission line design.

Lengthy high-voltage underground transmission lines can be problematic due to the operational limits posed by the inherent design. The insulating materials do not allow for efficient cooling of the conductors. The capacity of the line can also be reduced from the high capacitive charging current of such systems. This, in turn, may have a significant impact on the electrical behavior of a transmission system and its operational reliability. Underground lines are costly and difficult to repair, leading to longer outages than an overhead design. The cost to install underground lines can be anywhere from two to ten times the cost of installing an overhead transmission line.

The Council recognizes the operational issues and other concerns regarding the reliability of lengthy underground transmission lines and further understands such research regarding the feasibility of operating underground transmission lines is ongoing. Thus where such underground construction designs are considered to address MF concerns, the Council will require the latest technological and feasibility information regarding underground transmission lines in any new application. New developments in underground technology will be incorporated into these Best Management Practices as they occur.

References

Blaschinski, Ellen, MBA, RS, Division of Environmental Health, Connecticut Department of Public Health, Correspondence to the Connecticut Siting Council, March 15, 2004.

Commonwealth Associates, Inc. and IIT Research Institute, Electric and Magnetic Fields (EMF) RAPID Program Engineering Project 8: FINAL REPORT, Evaluation of Field Reduction Technologies, Volume 1 (Report) and Volume 2 (Appendices), 1997.

Ginsberg, Gary, Ph.D, Connecticut Department of Public Health, Correspondence to the Connecticut Siting Council, May 6, 2004.

Health Council of the Netherlands: ELF Electromagnetic Fields Committee. Electromagnetic fields: Annual Update 2001, 2001.

Health Council of the Netherlands: ELF Electromagnetic Fields Committee. Electromagnetic fields: Annual Update 2003, 2004.

Johnson, G.B., Power Research Engineering, Field Management Technologies, EMF Engineering Symposium, 1998.

Minnesota State Interagency Working Group on EMF Issues, A White Paper of Electric and Magnetic Field (EMF) Policy and Mitigation Options, 2002.

National Institute of Environmental Health Sciences, Electric and Magnetic Fields Associated with the Use of Electric Power, June 2002.

National Institute of Environmental Health Sciences, Report on Health Effects from Exposure to Power-Line Frequency Electric and Magnetic Fields, 1999.

National Institute of Environmental Health Sciences, Assessment of Health Effects from Exposure to Power-Line Frequency Electric and Magnetic Fields, Working Group Report, 1998.

National Research Council, Research on Power Frequency Fields Completed Under the Energy Policy Act of 1992, 1999.

Public Service Commission of Wisconsin, EMF –Electric and Magnetic Fields Brochure.

Public Service Commission of Wisconsin, Underground Electric Transmission Lines Brochure.

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NOTICE OF SERVICE

I hereby affirm that a photocopy of this document was sent to each Party and Intervenor on the service list dated December 21, 2004.

Dated: January 5, 2005

Lisa Fontaine
Custodian of Docket No. 272