

Post-Construction EMF Measurements
for the
Trumbull Substation

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June 20, 2008

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Introduction

The United Illuminating Company (UI) has constructed and energized a new 115/13.8 kV electric power substation, named the Trumbull Substation. This substation is located in Trumbull, Connecticut at the intersection of two existing transmission line corridors. Two 115 kV transmission lines within an existing UI corridor intersect two 115 kV transmission lines within an existing Connecticut Light & Power (CL&P) corridor. Pictures of the new substation are provided in Appendix A.

EMF measurements have previously been made in the general perimeter around the proposed substation wall and spot measurements were also made at a few discrete locations in the same general vicinity (see Appendix B). The purpose of this report is to provide post-construction measurements that were made in late May 2008 after the substation was energized.

Post-construction measurements were performed during the same season and month as the previous pre-construction measurements. The post-construction measurement transmission line loading conditions are similar, but not identical to the pre-construction measurement loading conditions or the projected Case #3 loading for post-construction magnetic field calculations. Comparisons of pre- and post-construction measurement and calculation values vary and will be affected by factors such as loading (magnitude and changes during measurements), direction of current flow, rephrasing of the CL&P lines, measurement location, and terrain changes (due to construction of the substation). Nevertheless, post-construction magnetic field measurements were performed during the same month and season under typical loading conditions, and are therefore representative measurement values.

Measurement Protocol

All measurements were taken at a height of 1 meter above ground level in accordance with IEEE Standard 644-1994 - "IEEE Standard Procedures for Measurement of Power Frequency Electric and Magnetic Fields from AC Power Lines".¹ Magnetic field measurements were taken with a recording magnetic field meter. The meter recorded magnetic field data once every 1.5 seconds. Magnetic field values were continuously recorded while traversing the perimeter outside the substation wall along a pathway that had previously been measured prior to construction.

Figure 1 presents a diagram of the Trumbull substation with the measurement path. Measurements were initiated at the southwest corner (location "C-1") and proceeded counter clockwise around the substation perimeter. Location markers "C-1" through "C-8" denote various perimeter locations which generally coincide with the substation wall

¹ - Specifically, paragraph 13(a) of the Siting Council's Decision and Order requires the submission of "pre- and post-construction electric and magnetic field measurements". Because only magnetic fields were a concern during this Docket, UI interprets the condition to require the submission of magnetic field measurements. If the Council desires information on electric fields, UI will provide those measurements separately.

line. In addition, spot measurements were made with a survey meter at several nearby locations that had also been previously measured (see Fig. 1: locations D-1 to D-4).

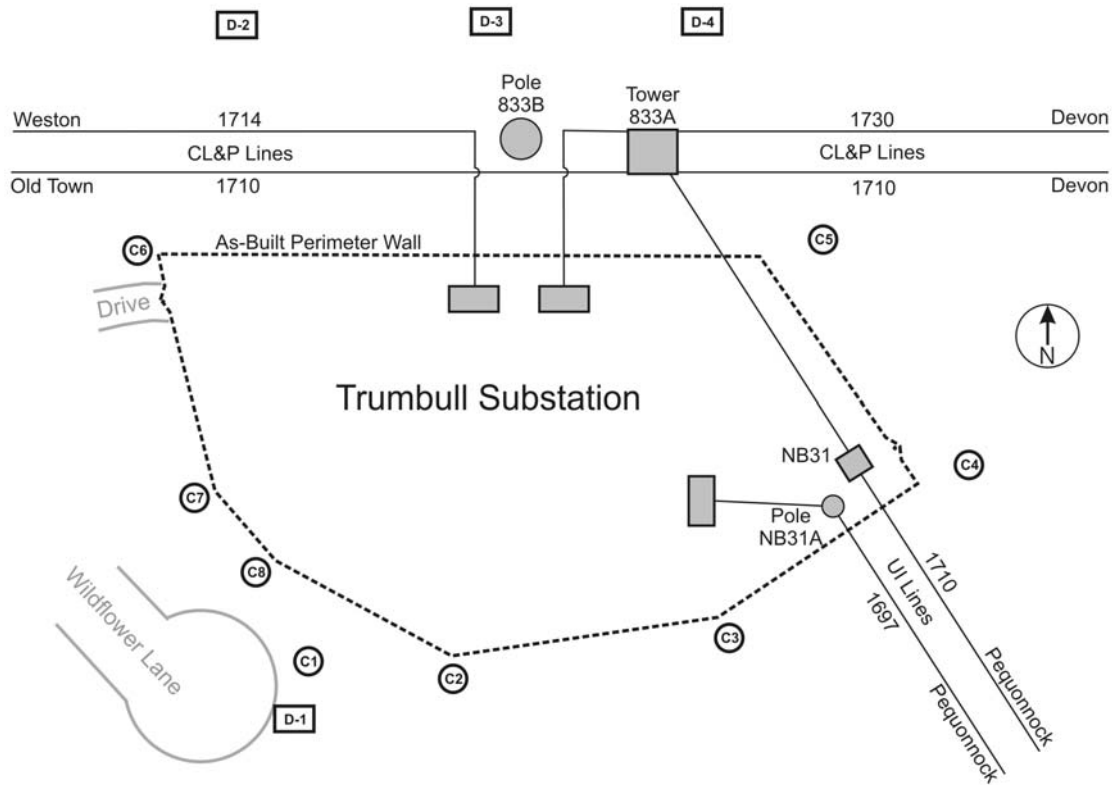


Figure 1. Trumbull substation layout sketch and measurement locations.

Instrumentation

An EMDEX II Magnetic Field Digital Exposure Meter was used to record the magnetic field levels around the substation perimeter. An EMDEX SNAP survey meter was used for spot measurements. The EMDEX II and EMDEX SNAP are computer-controlled, three axis, AC magnetic field meters. Each of the three-axis sensors is used to measure the magnetic field and the on-board computer calculates a resultant field value. The resultant field is the square root of the sum of the squares for all three orthogonal axes. The EMDEX II data were stored in the computer's memory and downloaded to a personal computer for analysis following the measurement session. The EMDEX II was setup to sample every 1.5 seconds. Event markers registered in the data denote measurement values that correspond to various site locations and distances of interest. The EMDEX II meter has a measurement range from 0.1 mG to 3000 mG (3 Gauss). Typical accuracy of the EMDEX II meter is +/-2%.

Calibration

All magnetic field instruments were calibrated using an 0.91 meter diameter Helmholtz coil in the Enertech research laboratory in accordance with IEEE Standards and traceable to NIST. Vertical magnetic fields were generated with magnitudes ranging from 0.5 mG to 2200 mG and with absolute accuracy's of +/-2% above 10 mG and +/- 15% at 1 mG.

Units of Measure

The measurements were made of the magnetic field. Magnetic flux densities are typically reported using units of gauss (G). However, it is usually more convenient to report magnetic field using milligauss (mG) which is equal to one-thousandth of a gauss (i.e., 1 mG = 0.001 G).

Measurement Results

The continuous measurements of magnetic field around the Trumbull perimeter wall are plotted in Figure 2. This is a graph of measurements along the path depicted in Figure 1 (C-1 to C-8). Measurements at specific locations (corners and D-1 to D-4) are summarized in Table 1 (both pre- and post-construction). Pre-construction measurements are also summarized in Appendix B.

As shown in Table 1, measured magnetic field levels at locations around the Trumbull Substation remained relatively constant or decreased after construction of the substation. These measured values (0.9 – 32.9 mG) are generally within the range of the calculated magnetic field levels (1.4 – 26.3 mG) estimated in the August 9, 2006 EMF Assessment Report (for Case #3: Post-Bethel/Norwalk scenario under normal loading conditions).

Table 2 presents a comparison of loading conditions associated with the pre-and post-construction measurements. As shown in Table 2, loading on the transmission lines varies somewhat between years due to loading demands in nearby areas. However, the overall loading for this area appears to remain moderately similar as seen in the transmission line loading values.

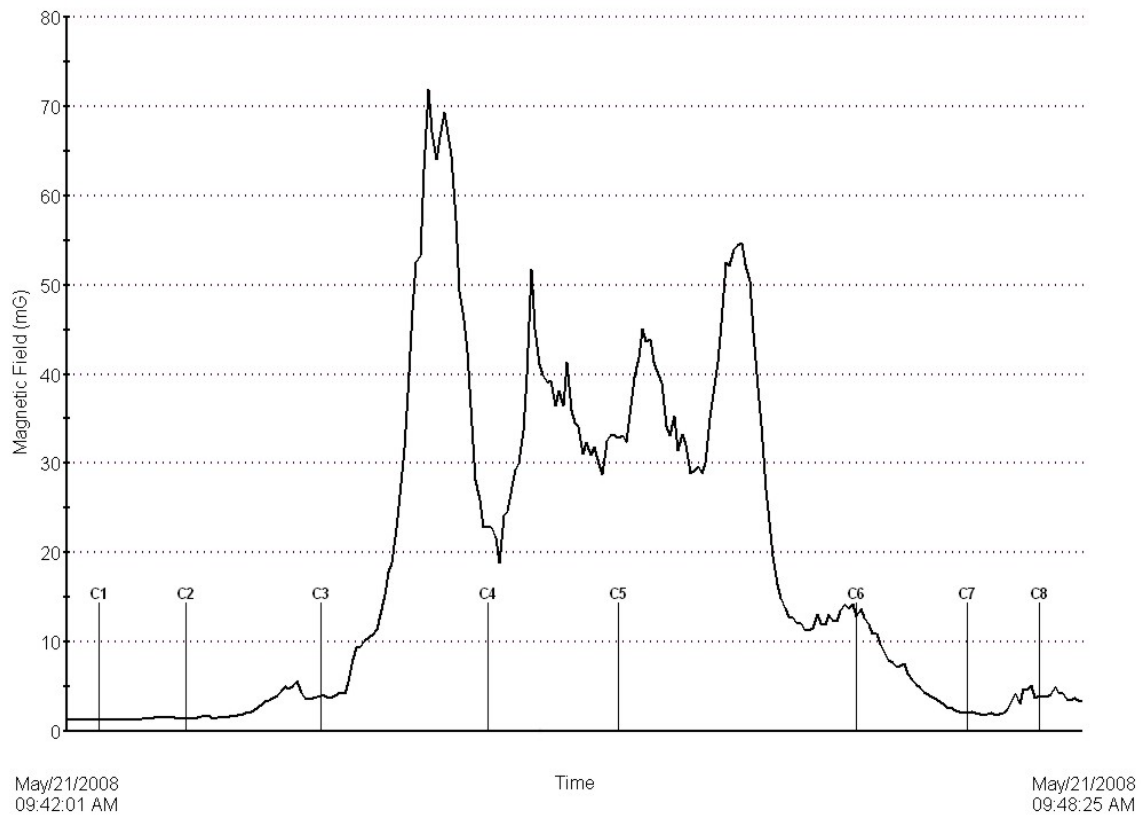


Figure 2. Continuous magnetic field measurements along substation perimeter path.

Table 1. Summary of pre- and post-construction magnetic measurements at locations.

Reference Point	Magnetic Field - mG		
	May 2003	May 2005	May 2008
Point C-1	1.7	---	1.29
Point C-2	2.8	---	1.41
Point C-3	4.8	---	3.93
Point C-4	34.6	---	22.9
Point C-5	48.4	---	32.9
Point C-6	19.0	---	12.9
Point C-7	4.8	---	2.08
Point C-8	3.2	---	3.97
Point D-1 (near curb)	---	2.5	0.9
Point D-2 (near edge of CL&P easement)	---	8.2	4.9
Point D-3 (near edge of CL&P easement)	---	7.6	7.7*
Point D-4 (near edge of CL&P easement)	---	4.5	2.0

* D-3 measurement in 2008 near new tap structure 833B due to access difficulty for easement edge.

Table 2. Summary of pre- and post-construction loading during magnetic measurements.

Old Circuit Name	New Circuit Name	Load – Amps		
		May 2003	May 2005	May 2008
1710 - Old Town	1710 - Old Town	677	727	662
1730 - Weston	1714 - Trumbull	490	534	530
1710 - Pequonnock	1710 - Pequonnock	704	625	572
1710 - Devon	1710 - Devon	-22	108	-90
1730 - Devon	1730 - Trumbull	129	42	30
1730 - Pequonnock	1697 - Trumbull	620	537	514

Direction of load flow in the same direction for all three years, except for the small load flow on the 1710 – Devon line (indicated by a negative load flow value).

APPENDIX- A

Post-Construction Photographs at Trumbull Substation



Figure A-1. Substation wall on north side of Trumbull substation.

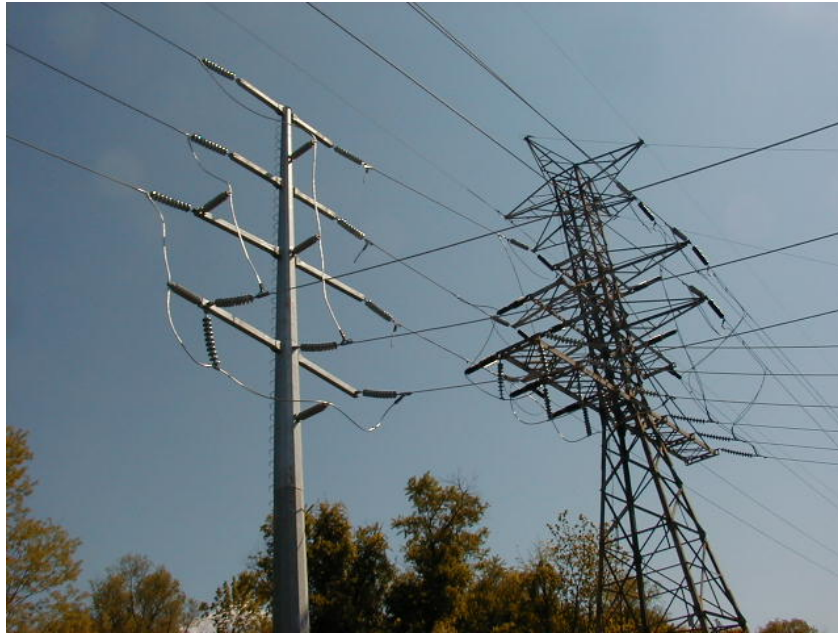


Figure A-2. Structures 833B (left) and 833A (right) on north side of substation.

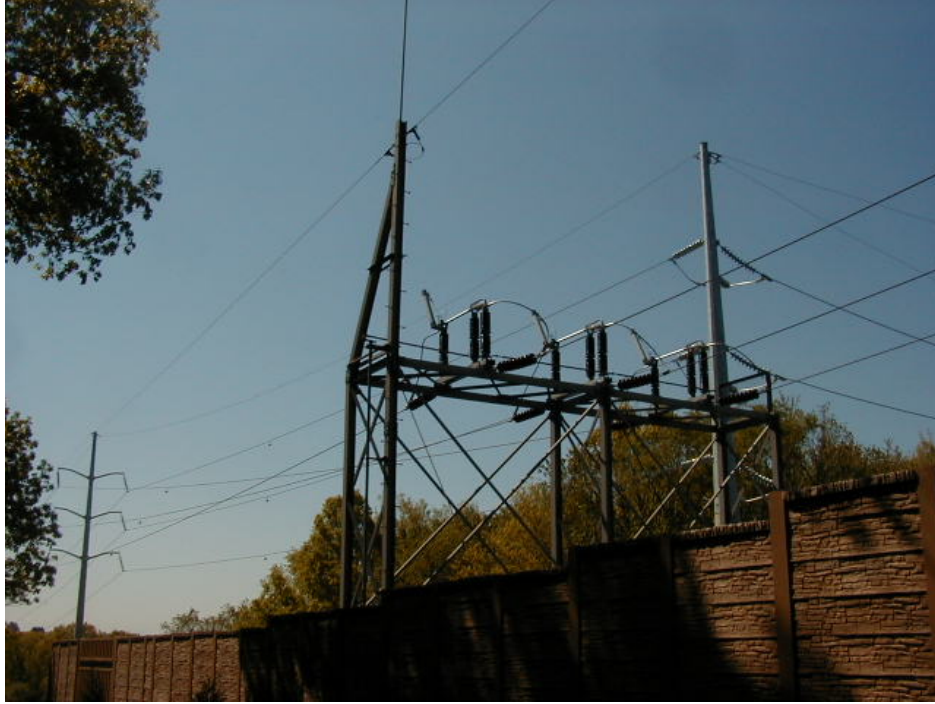


Figure A-3. East wall of substation with structures NB31 (left), NB31A (right) inside substation and NB 30 in the distance (south of Trumbull substation).



Figure A-4. Interior view of Trumbull substation north wall facing tap structures.

APPENDIX- B

Pre-Construction Magnetic Field Measurements from EMF Assessment Report

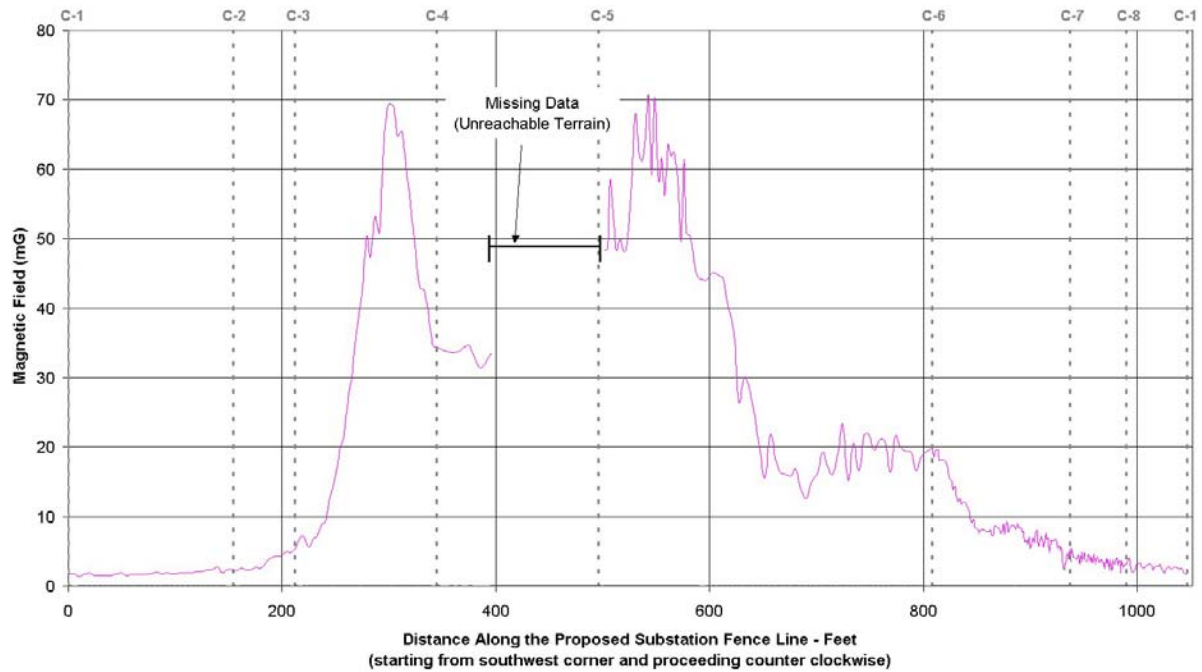


Figure B-1. Pre-construction magnetic field along proposed substation boundary.

Table B-1. Summary of pre-construction measurements at perimeter locations.

Reference Point	Measured Magnetic Field (mG)	
	May 7, 2003	May 31, 2005
Point "C-1"	1.7	---
Point "C-2"	2.8	---
Point "C-3"	4.8	---
Point "C-4"	34.6	---
Point "C-5"	48.4	---
Point "C-6"	19.0	---
Point "C-7"	4.8	---
Point "C-8"	3.2	---
Point "D-1" (near curb)	---	2.5
Point "D-2" (edge of CL&P easement)	---	8.2
Point "D-3" (edge of CL&P easement)	---	7.6
Point "D-4" (edge of CL&P easement)	---	4.5