EMF ASSESSMENT

FOR THE

PROPOSED TRUMBULL SUBSTATION

Prepared for
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EXECUTIVE SUMMARY

The United Illuminating Company (UI) proposes to construct a new 115 kV electric power substation, named the Trumbull Substation. This substation will be 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.

The Connecticut Siting Council (CSC) has guidelines for applicants who wish to construct an electric substation facility. This report addresses Item VII, "M" of these guidelines, which pertains to electric and magnetic (EMF) fields. Item VII specifies that:

1) Measurements of existing electric and magnetic fields at site boundaries be performed, and that the data be extrapolated to normal and peak line loading conditions,
2) Calculations are performed of the EMF expected once the substation is constructed, during normal and peak line loading conditions, and
3) A statement is given describing consistency with the Council's current "<u>Electric and Magnetic Field Best Management Practices</u>".

This report contains the results of measurements and calculations of EMF produced by the existing transmission lines in the two corridors at the proposed substation boundary. The report also contains the calculated EMF for the proposed substation configuration at its boundary. Normal (15 GW) and peak (27.7 GW) loading conditions were specified by ISO New England.

The measured magnetic field at the proposed substation fence line ranged from about 1 to 71 mG, depending upon location. The measured electric field ranged from about 89 to 390 V/m. Measurements were performed to comply with CSC guidelines and to validate the modeling results based upon the UI transmission line and substation input data.

For the existing transmission line configuration, the highest calculated electric field was about 521 V/m. This calculated maximum (521 V/m) occurs at a nearby location to where the maximum measured electric field was recorded (390 V/m). The highest calculated magnetic field at the fence line for the existing configuration was approximately 36 mG for normal loading and 52 mG for peak loading. The highest values correspond to locations at the fence line where a 115 kV transmission line passes overhead.

Note that the measured magnetic field (of 71 mG) is higher than the calculated magnetic field for both normal loading (36 mG) and peak loading (52 mG) for the existing transmission line configuration. Peak loading does not necessarily correspond to the highest line loading or the highest magnetic field level; rather, peak loading designates a peak <u>system</u> loading which is independent of individual line loading conditions. Electric fields are related to power line voltage and do not change with the loading on the power line.

Calculations were also performed to evaluate future electric and magnetic field levels once the proposed substation is constructed and in operation. For the proposed substation configuration, the peak electric field was calculated to be approximately 768 V/m. Again, the highest electric field corresponds to those locations at the fence line where the 115 kV lines pass overhead.

The Pre-Middletown/Norwalk and Post-Middletown/Norwalk conditions were evaluated because the Middletown/Norwalk project has an impact on the loadings of the 115 kV transmission lines that serve the proposed Trumbull Substation. Since transmission lines are the primary EMF source (not the substation), it was decided to evaluate EMF levels with and without this other project. A review of 115 kV line loading reveals that the line loads go down (less EMF) after the Middletown/Norwalk project for the Weston, Old Town, and Devon lines for both Normal and Peak cases. For the Pequonnock circuits, there is a modest line loading increase for the Normal load case and a decrease in line loading for the Peak case. In general, the impact of the Middletown/Norwalk project is to reduce the 115 kV line loadings (lower EMF).

The 115 kV transmission line phasing arrangements are low-EMF designs due to optimum (or opposite) phasing that result in field cancellation. The project is consistent with the Connecticut Siting Council Best Management Practices for EMF because EMF levels were evaluated as required and in its use of low-EMF design optimum phasing of the 115 kV transmission lines.

The following tables summarize the results of the electric and magnetic field assessment performed along the proposed substation boundary:

Electric Field

	Calculated Electric Field	
Measurements	Existing Configuration	Proposed Substation Configuration
89 – 390 V/m	7 – 521 V/m	12 – 768 V/m

Magnetic Field

	Calculated Magnetic Field		
Measurements	May 7, 2003 Load	Normal Load	Peak Load
1 – 71 mG	0.9 – 71.9 mG	0.3 – 36.3 mG	0.4 – 51.9 mG

Calculated Magnetic Field			
"Pre-Middletown/Norwalk" Condition		"Post-Middletown/Norwalk" Condition	
Normal Load	Peak Load	Normal Load	Peak Load
1.1 – 61.2 mG	2.0 – 108.6 mG	0.9 – 41.4 mG	1.5 – 65.1 mG

All measured and calculated EMF levels for the existing transmission lines at the existing Trumbull Junction Substation location, as well as the calculated EMF levels once the proposed Trumbull Substation is in operation, are lower than the exposure guidelines provided by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) and the American Conference of Governmental Industrial Hygienists (ACGIH).

PROJECT EFFECT ON ELECTRIC AND MAGNETIC FIELDS

DESCRIPTION OF ELECTRIC AND MAGNETIC FIELDS

Electric Field

Any object with an electric charge on it has a voltage (potential) at its surface and can create an electric field. Electric fields exist in the region near electric charges and the field exerts a force on other electric charges placed in the field. At a given point in space, the ratio of force on a positive test charge (placed at the point) to the magnitude of the test charge, in the limit that the magnitude of the test charge goes to zero is defined as the electric field. The electric field strength (E-field) at a point in space is a vector defined by its space components along three orthogonal axes. For steady-state sinusoidal fields, each space component is a complex number or phasor. The magnitudes of the components are expressed by their rms values in volts per meter (V/m) or kilovolts per meter (kV/m). In a multi-phase environment, such as near a three-phase electric power line, the field is characterized as a vector rotating in a plane where it describes an ellipse whose semi-major axis represents the magnitude and direction of the maximum value of the electric field, and whose semi-minor axis represents the magnitude and direction of the field a quarter cycle later at its minimum value. Electric fields are easily shielded by most materials (such as those that make up buildings, trees, and fences).

Magnetic Field

Any object with an electric charge on it has a voltage (potential) at its surface and can create an electric field. When electrical charges move together (an electric current) they create a magnetic field that can exert forces on other electric currents. All currents create magnetic fields. Magnetic fields occur throughout nature and are one of the basic forces of nature. The strength of the magnetic field depends on the current (higher currents create higher magnetic fields), the configuration/size of the source, spacing between conductors, and distance (magnetic fields grow weaker as the distance from the source increases).

Magnetic fields can be static/unchanging in direction (caused by direct current, DC) or changing/alternating in direction (alternating current, AC). As an example, static magnetic fields occur in nature. The earth has a natural static magnetic field of approximately 550 mG in the Connecticut area. Some electrical devices operate on a DC system while others operate on an AC system. The magnetic field from AC sources (such as the electrical equipment of substations) differ from DC fields (like the earth) because the field is due to alternating currents (AC) and changes direction at a rate of 60 cycles per second or 60 Hertz. The measured and modeled magnetic fields in this report are from AC sources.

The characteristics of magnetic fields can differ depending on the field source. A magnetic field near an appliance (point source) decreases rapidly with distance away from the device. The magnetic field also decreases with distance away from line sources, such as power lines, but not as rapidly as it does with appliances. Transmission line magnetic fields attenuate at a rate that is inversely proportional to the distance squared, whereas magnetic fields from appliances attenuate at a rate proportional to the distance cubed. Substation equipment is a mixture of line and point sources. The dependence of the magnetic field vs. distance is very complex.

Magnetic fields cannot easily be shielded. Most materials (such as those that make up buildings, trees, or the ground) do not shield magnetic fields. Ferromagnetic materials (nickel, iron, and cobalt) are a special group of metals that can provide effective shielding. In some cases the magnetic field can also be shielded with materials that are conductive, like copper or aluminum. In other cases, layers of ferromagnetic and conductive materials are used together to provide shielding.

Units of Measure

Electric field values are reported in Volts per meter (V/m).

Magnetic flux densities (B) 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).

DESCRIPTION OF PROPOSED PROJECT

UI proposes to construct a new 115 kV electric power substation, named the Trumbull Substation. The substation will be located at the intersection of two existing 115 kV transmission line corridors.

Existing Configuration

In Trumbull, an existing 200-foot wide UI easement intersects an existing 110-foot wide CL&P easement. The UI easement, which is oriented north to south, intersects the CL&P easement, which is oriented east to west. There are two 115 kV transmission line circuits within each of these corridors. The proposed substation would be built in the southwest corner of this intersection. The layout of the existing configuration, with the proposed substation boundary (fence line), is shown in Figures 2 and 3.

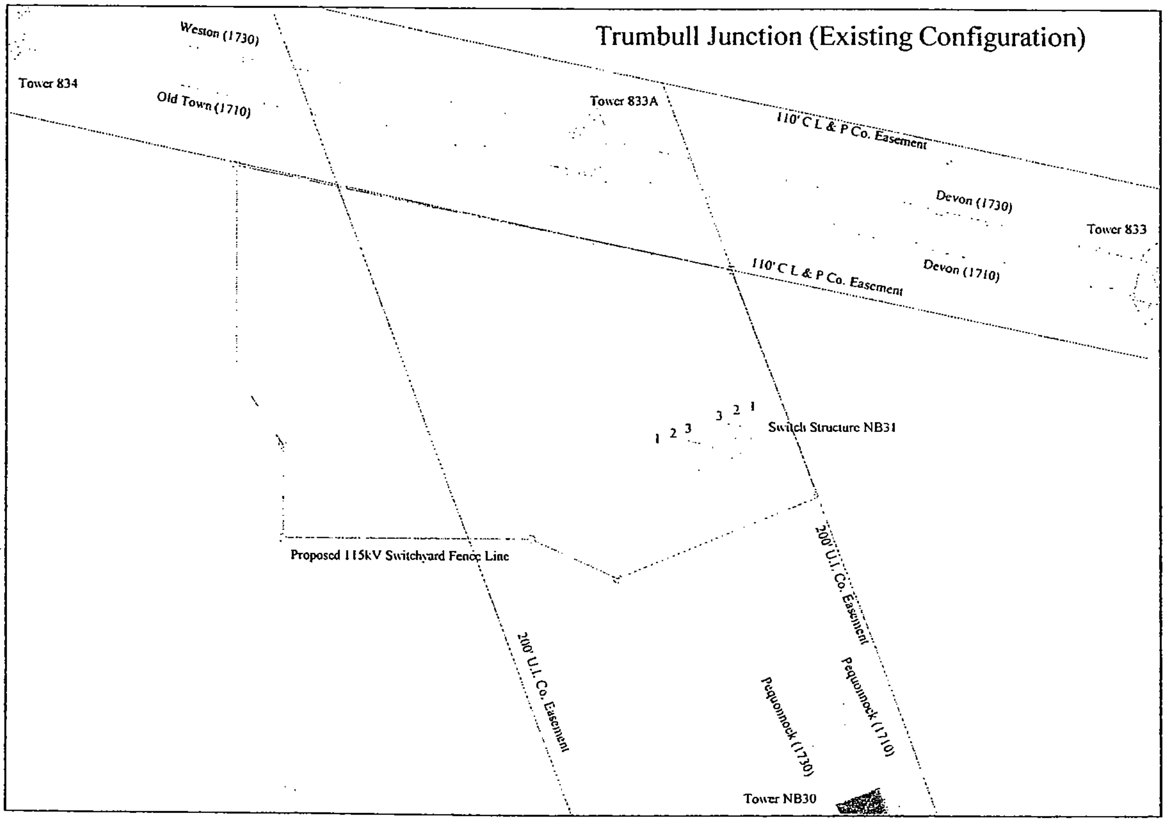

Figure 2. Diagram of the Existing Transmission Line Corridors at the Trumbull Junction with the Proposed Trumbull Substation Fence Line

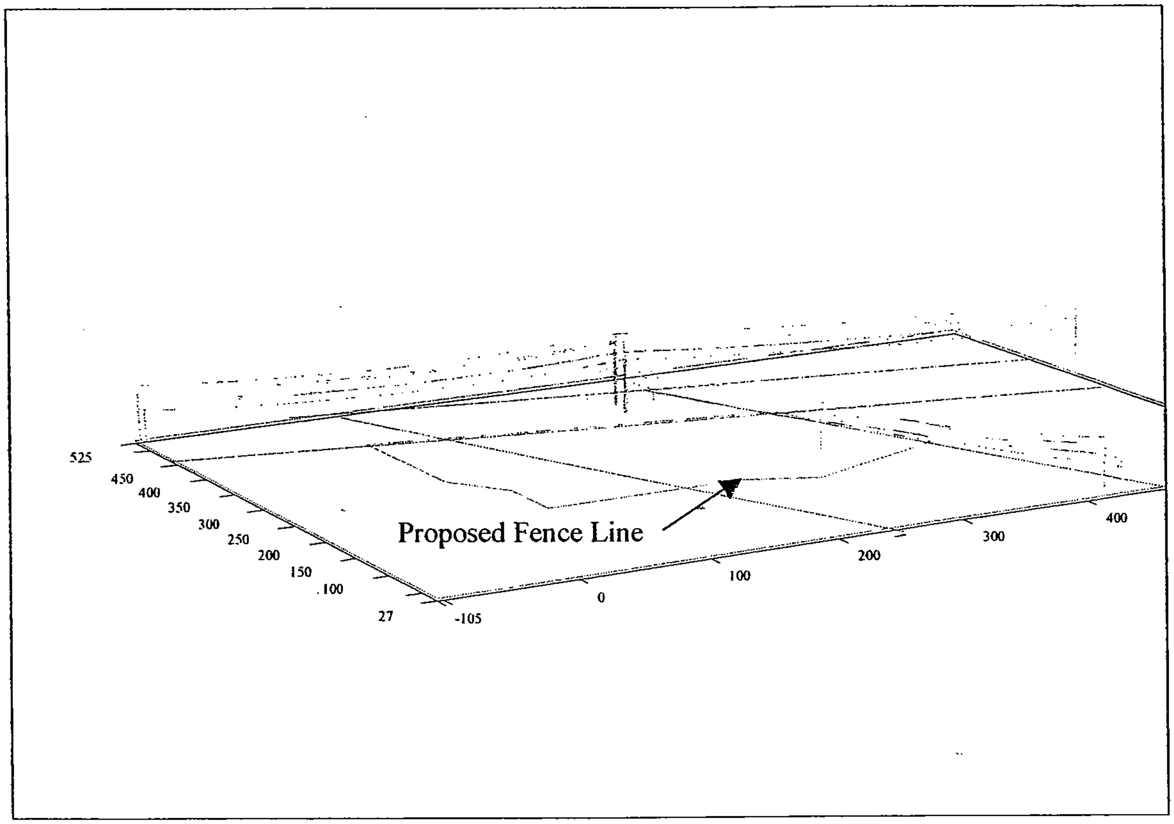

Figure 3. 3-D Diagram of the Existing Transmission Lines at Trumbull Junction with the Proposed Trumbull Substation Fence Line

Photographs of the existing 115 kV transmission lines and the proposed substation location are presented in Figures 4 through 9.

Figure 4 presents the Switch Tower NB 31, which is located within the existing UI easement and also within the proposed substation boundary. As shown in this photograph, each of the 115 transmission circuits is arranged in a horizontal phase configuration at the switch.

To the south of Switch Tower NB 31 is Tower NB 30, a double circuit vertical structure, as shown in Figure 5. This structure is within the UI easement but south of the proposed substation boundary.

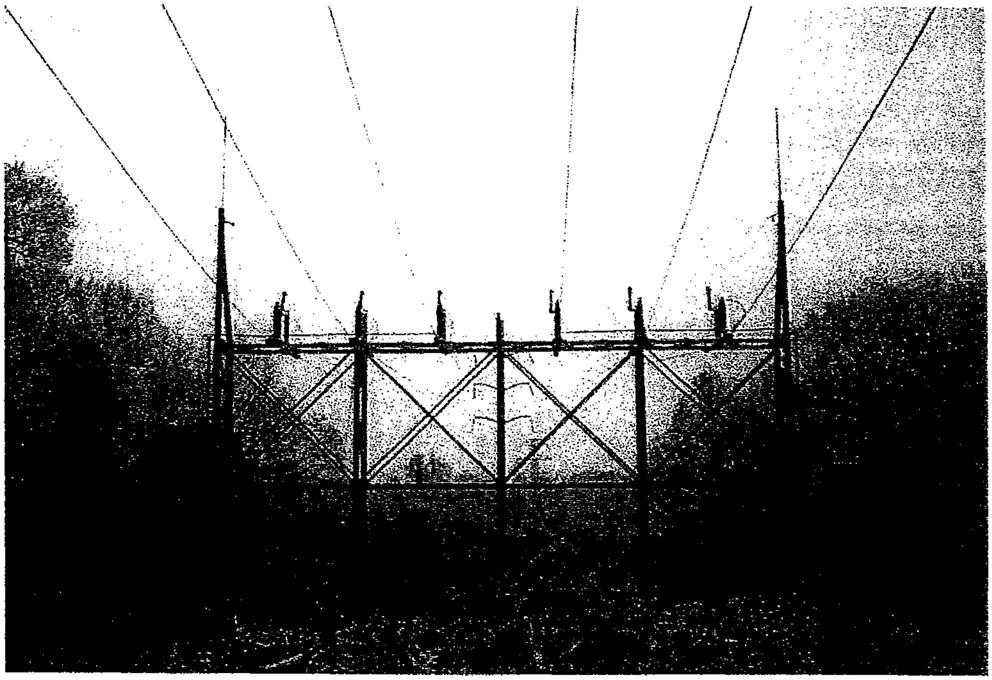

Figure 4. Photograph of Switch Tower NB 31
(located within the proposed substation boundary)

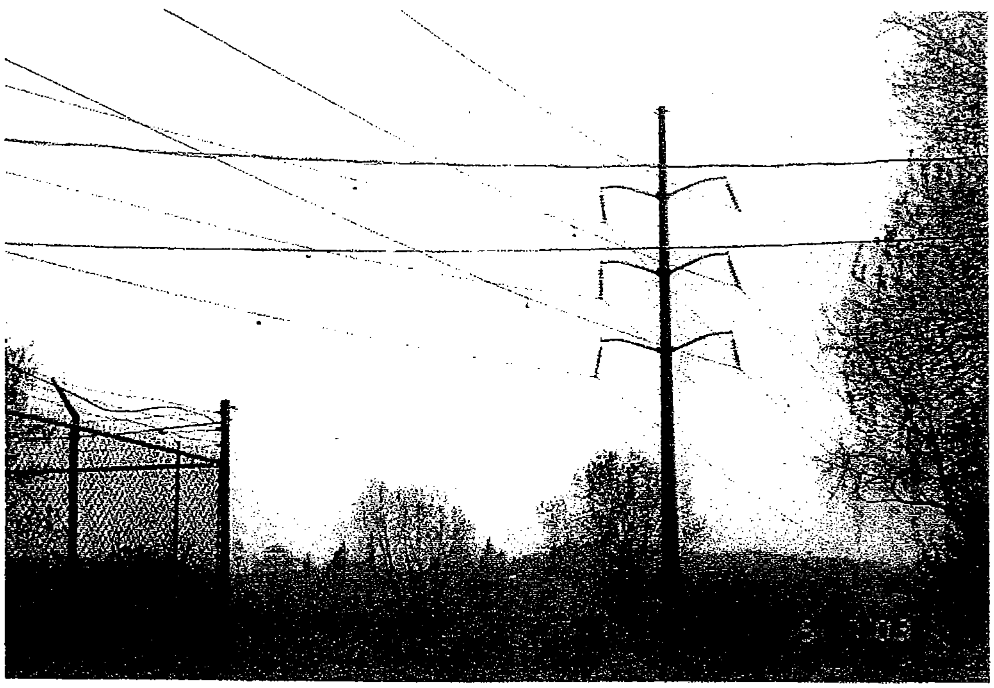

Figure 5. Photograph of Tower NB 30
(the structure south of Switch Tower NB 31)

The structure north of Switch Tower NB 31 is Tower 833A. This structure is located within the intersection of the UI and CL&P easements, but outside of the proposed substation boundary. Figure 6 presents a photograph of Tower 833A.

To the west of Tower 833A is a double circuit vertical structure, Tower 834, shown in Figure 7. Tower 834 is located within the CL&P easement, but outside of the proposed substation boundary.

To the east of Tower 833A is another double circuit vertical structure, Tower 833, shown in Figure 8. Tower 833 is located within the CL&P easement, but outside of the proposed substation boundary.

A photograph showing the general terrain where the proposed substation would be constructed is shown in Figure 9.

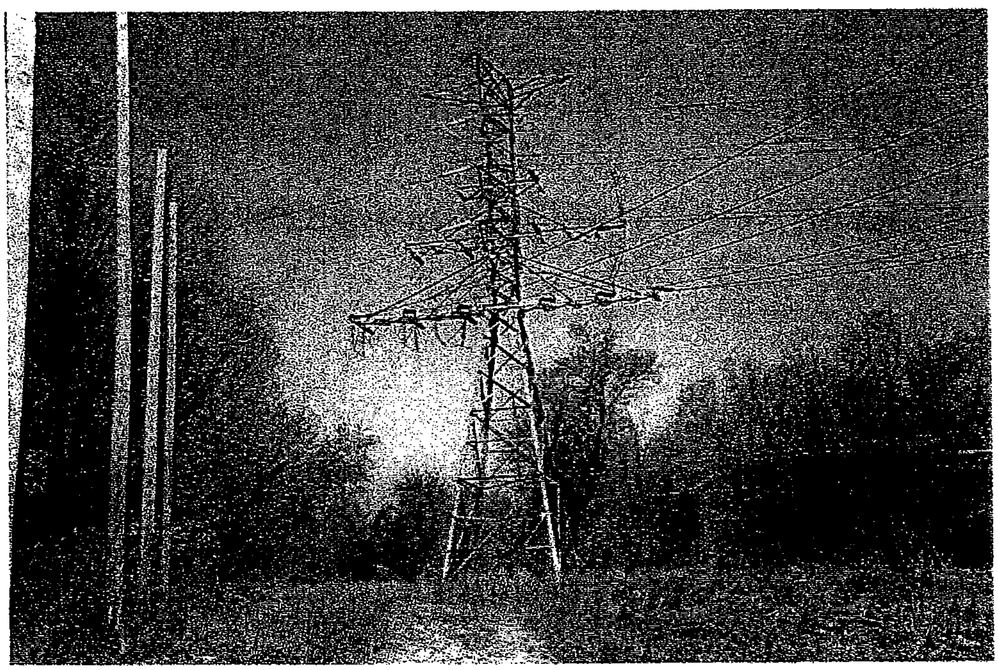

Figure 6. Photograph of Tower 833A
(the structure north of Switch Tower NB 31, and located at the intersection of the CL&P and UI easements outside of the proposed substation boundary)

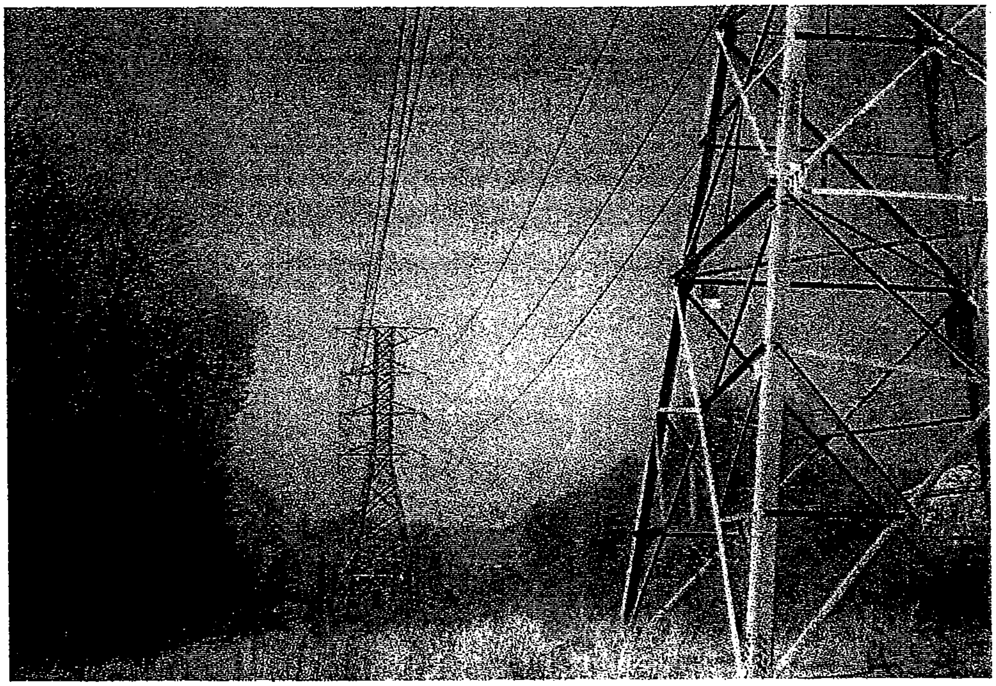

Figure 7. Photograph of Tower 834
(the structure west of Tower 833A)

Figure 8. Photograph of Tower 833
(the structure east of Tower 833A)

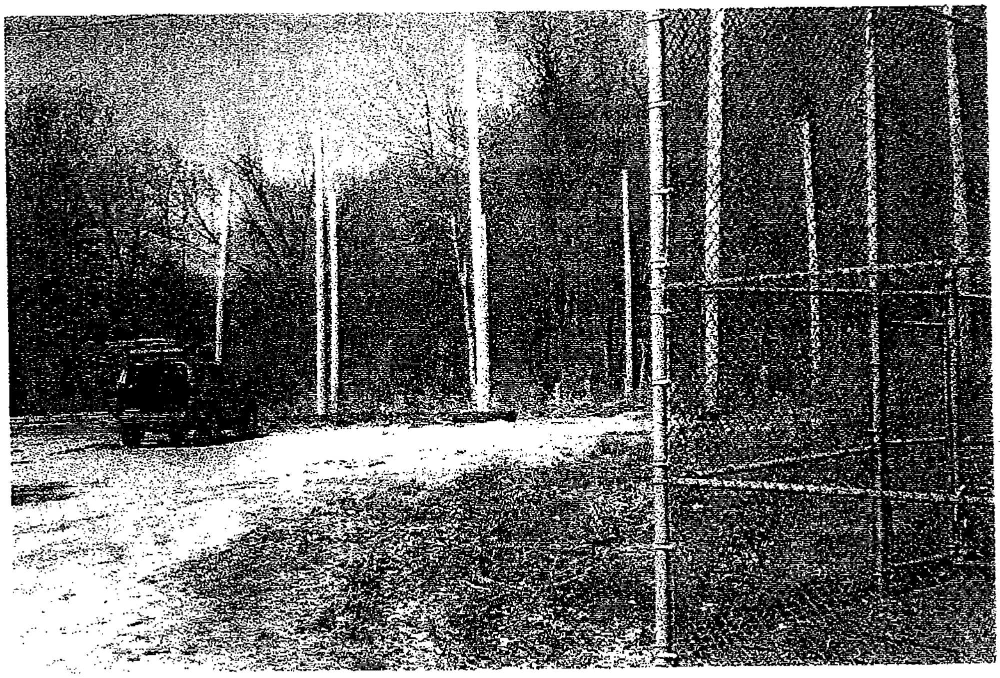

Figure 9. Photograph of the Terrain West of Switch Tower NB31
(where the proposed Trumbull 115 kV Substation would be constructed)

Proposed Configuration

The proposed Trumbull Substation would be built in the southwest corner of the intersection of the two 115 kV transmission line corridors. The proposed substation would have a three-position ring bus, fed by three 115 kV transmission lines. Two 115 kV transmission lines would enter the substation from the northern boundary (Line 1714 to Weston & Line 1730 to Devon, shown in Figure 10), while the third 115 kV transmission line would enter the substation from the southern boundary (Line 1713 to Pequonnock, shown in Figure 10).

The proposed substation would convert 115 kV electrical power to 13.8 kV electrical power for distribution. The 115 kV portion of the substation would be an open-air configuration (i.e. not contained within a building). The 115 kV transmission lines would enter the substation at a height of approximately 40-feet above ground level. The majority of the 115 kV buswork within the substation would be located at a height of approximately 16-feet above ground. There would be two transformers, Transformer "A" within the northern portion of the substation, and Transformer "B" within the southern portion. The 115 kV electrical power would be converted to 13.8 kV electrical power through these two transformers. The 13.8 kV power would then be routed through buswork into an indoor Switchgear Room. From the Switchgear Room, 13.8 kV electrical power would be routed underground to distribution feeders that exit the substation to the west.

Figures 10 and 11 present diagrams of the proposed Trumbull Substation configuration. Figure 10 presents an overall plan view of the proposed substation, while Figure 11 presents a three-dimensional view. The proposed routing of the 115 kV transmission lines into the substation is shown in Figures 10 and 11.

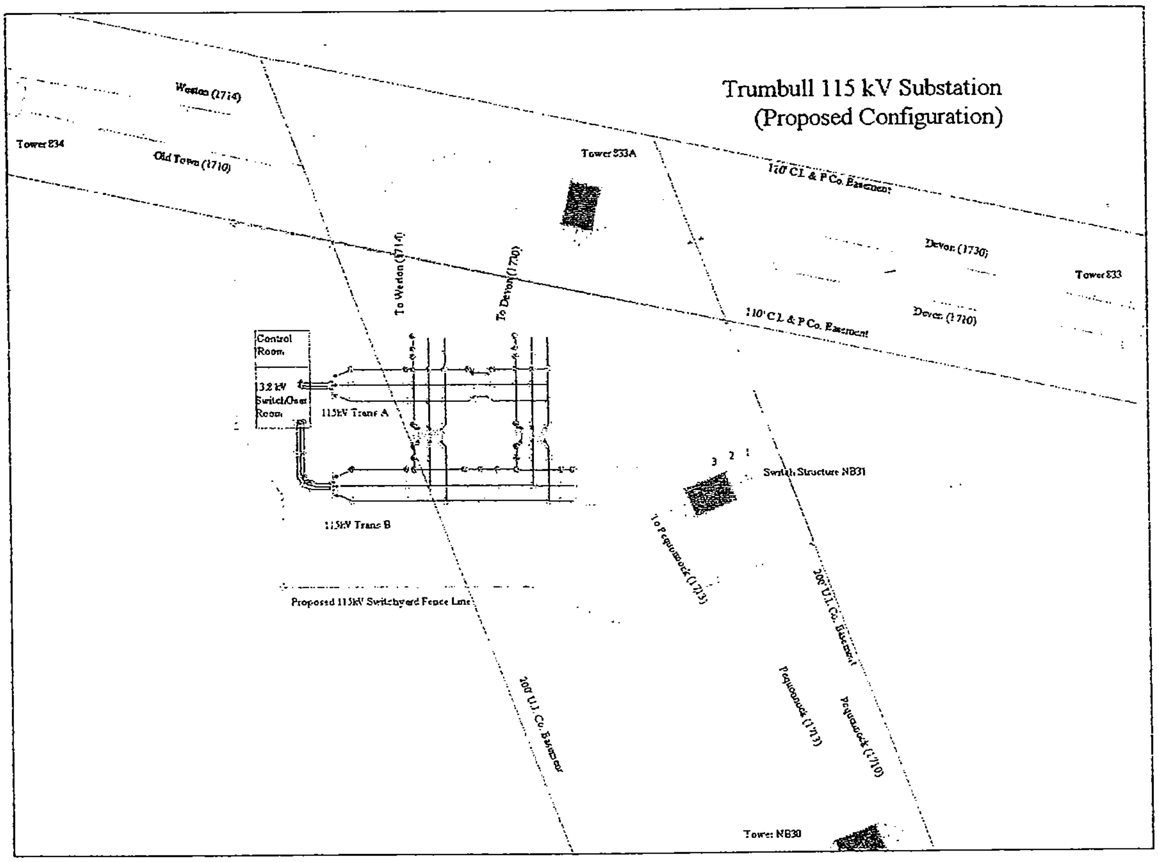

Figure 10. Diagram of the Proposed Trumbull 115 kV Substation
With 115 kV Transmission Line Feeds Into the Substation

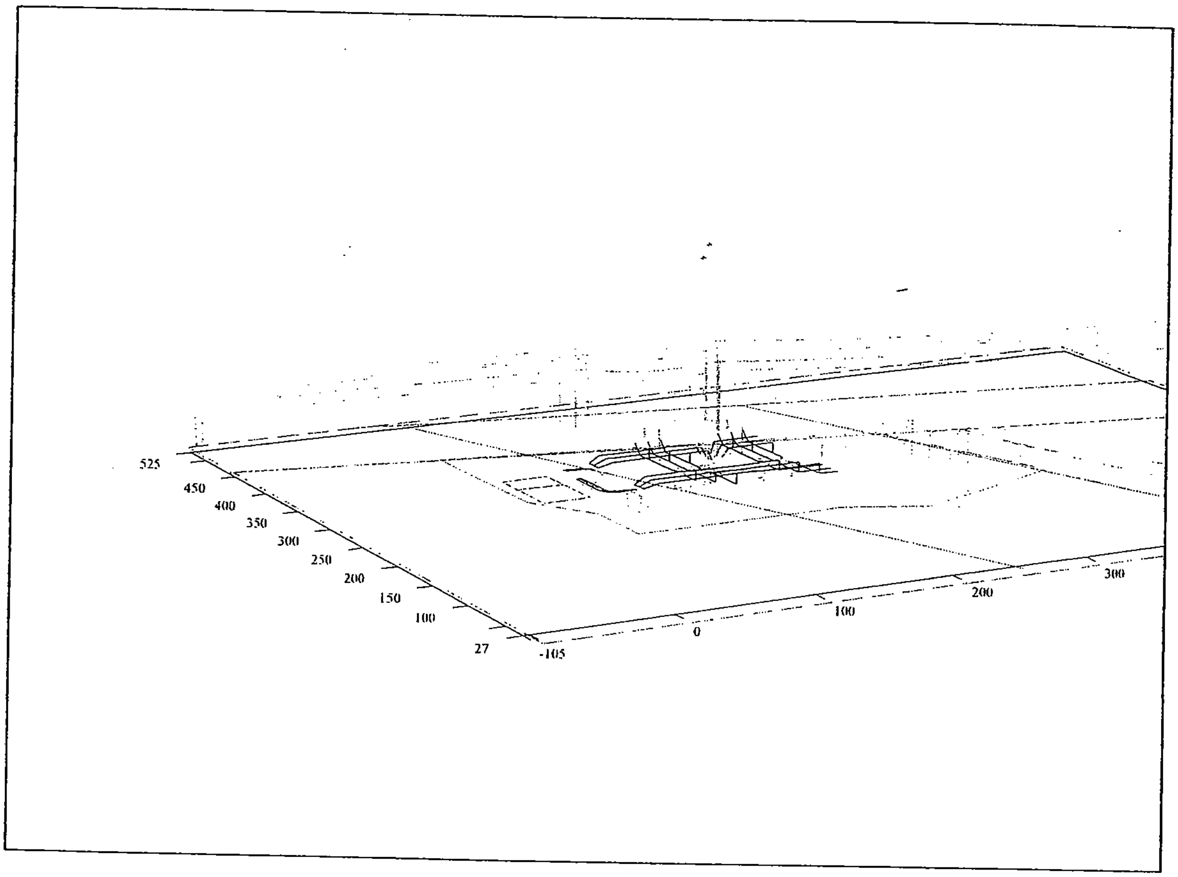

Figure 11. 3-D Diagram of the Proposed Trumbull 115 kV Substation
With 115 kV Transmission Line Feeds Into the Substation

SOURCES OF ELECTRIC AND MAGNETIC FIELDS IN THE TRUMBULL SUBSTATION

The proposed 115 kV Trumbull Substation would be located at the intersection of two existing transmission line corridors. Presently, two existing 115 kV transmission lines are located within the existing UI corridor and the existing CL&P corridor. These overhead power lines are existing sources of power-frequency electric and magnetic fields.

The design for the proposed 115 kV Trumbull Substation would include new 115 kV circuits to route power from the existing 115 kV transmission lines into the substation, the addition of buswork, two electric power transformers, circuit breakers, switchgear, and related auxiliary equipment. Each of these proposed facilities would potentially be new sources of power-frequency electric and magnetic fields.

Some substation equipment, such as transformers, switchgear, and auxiliary equipment, are enclosed within metal housings, which virtually eliminate any electric field from these sources. Other equipment, such as buswork and overhead circuits, would be a potential new source of electric field. Common objects (such as fences, walls, trees, and shrubs) would provide electric field shielding within the area near these objects.

Since magnetic fields are not easily shielded by common objects (as are electric fields), the proposed new substation equipment would be additional sources for magnetic fields. Some equipment, such as transformers and switchgear, act as "point sources" and the magnetic field will attenuate very quickly with distance away from these sources. Other equipment, such as buswork and overhead circuits, will have magnetic fields, which attenuate at a rate that is inversely proportional to the distance squared. In general substations are not a major source of EMF beyond the station fence or boundary. The primary EMF source is always the transmission lines that serve the substation.

METHODS FOR MEASURING ELECTRIC AND MAGNETIC FIELDS

Measurement Protocol

All electric field measurements were taken as spot measurements. Readings 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". The values were read from the LCD display on the meter and manually recorded. Spot measurement locations were selected on-site to characterize the electric field due to the overhead 115 kV transmission lines.

Magnetic field measurements were taken with a recording magnetic field meter. Field readings were recorded at a measurement height of 1 meter above the ground in accordance with IEEE Standards. The meter recorded magnetic field data once every 1.5 seconds. Magnetic field values were continuously recorded while traversing the proposed site boundary.

Instrumentation

An EMDEX II Magnetic Field Digital Exposure Meter was used to record the magnetic field levels. The EMDEX II is a computer-controlled, three axis, AC exposure meter. Each of the three-axis sensors was used to measure the magnetic field and the on-board computer calculated a resultant field value. The resultant field is the square root of the sum of the squares for all three orthogonal axes. The data was 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%.

An E-PROBE electric field sensor that is specially designed for performing electric field measurements with an EMDEX II meter was used to measure the electric field. The E-PROBE consists of two aluminum plates separated by 4 insulators, calibrated to produce an induced current that the EMDEX II meter can read and convert to determine an equivalent electric field measurement value. The E-PROBE has a range of 0.010 to 13 kV/m (10 to 13000 Volts per meter), with an accuracy of approximately +/- 5% and a resolution of approximately 1 V/m (this conforms to the IEEE Standard).

Calibration

All magnetic field instruments were calibrated using a 91 cm 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.

ELECTRIC AND MAGNETIC FIELD MEASUREMENT RESULTS

Two sets of field measurements were performed as part of this project assessment. The first set of measurements was performed at approximately 11:30 AM on May 7, 2003. Electric and magnetic field measurements were conducted at the proposed substation site on this date. An additional set of measurements was performed on May 31, 2005 to update the earlier measurements and to include additional measurement locations. The transmission line loadings on both occasions are summarized in Tables 1 and 2.

Electric Field

Electric field spot measurements were taken at the location of the fence line directly below the 115 kV conductors that pass overhead. The 1730 line and the 1710 line cross the substation fence line in two locations (in the south and the north). A total of six measurement points were selected for each fence crossing (one measurement directly under each of the conductors of the double circuit line), totaling 12 spot measurement points all together.

Along the southern boundary, the measured electric field ranged from about 100 V/m to 390 V/m, depending upon location. Along the northern boundary, the measured electric field ranged from about 89 V/m to 191 V/m. The existing electric field at the proposed substation fence line was due to the overhead 115 kV lines (1730 & 1710) that cross the proposed fence line from north to south (these circuits utilize 795 kcmil ACSR conductor, with a diameter of about 1.090 inches).

Magnetic Field

Magnetic field measurements were continuously recorded while traversing the perimeter of the proposed substation boundary. Figure 12 presents a diagram of the proposed substation boundary 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.

Figure 13 presents a magnetic field graph of these measurement results. As shown, the measured magnetic field at the proposed substation fence line ranged from about 1 to 71 mG, depending upon location. The various perimeter locations denoted along the measurement path in Figure 12 are presented in Figure 13 to identify measured magnetic field levels are various locations along the path. As shown in Figure 12, the highest recorded magnetic field levels occur between locations "C-3" to "C-4" and "C-5" to "C-6". These are the two locations where the 115 kV transmission lines are present overhead.

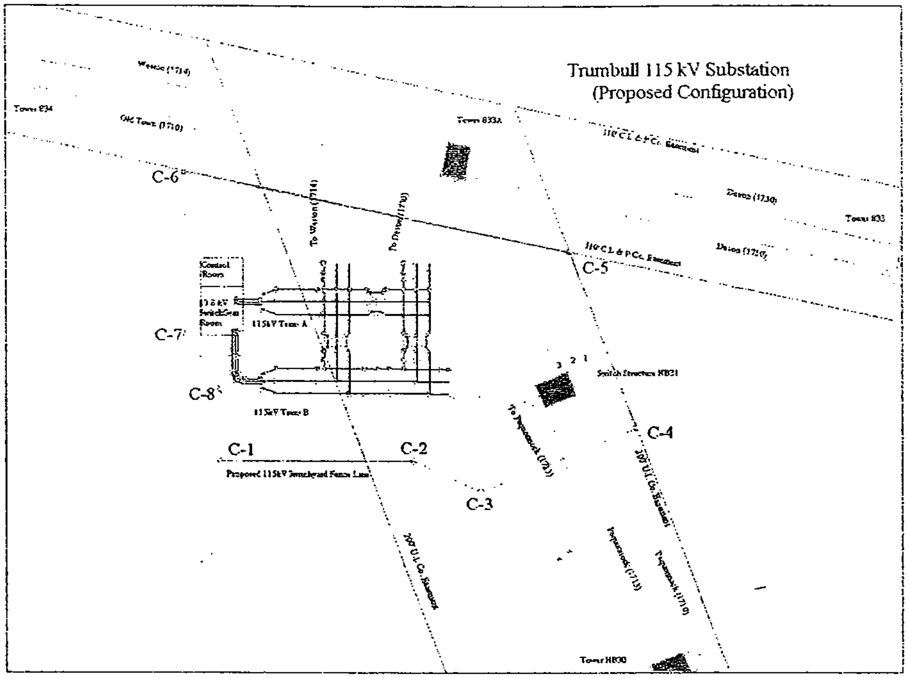

Figure 12. Diagram of Proposed Trumbull Substation Boundary with Magnetic Field Measurement Path

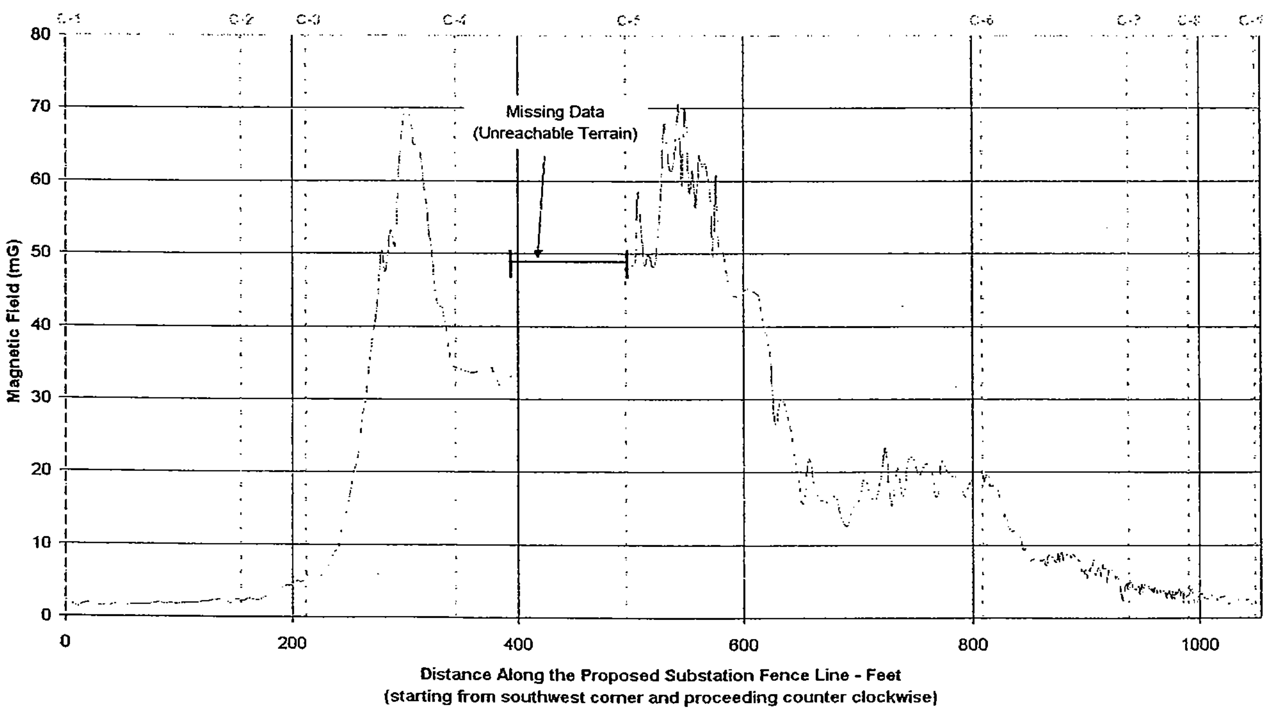

Figure 13. Measured Magnetic Field Along Proposed Substation Boundary

METHODS FOR CALCULATING ELECTRIC AND MAGNETIC FIELDS

Computer Modeling Software

Computer modeling software is often used to calculate electric and magnetic fields for various electric facility designs and loading conditions. Computer models can accurately predict electric and magnetic field levels for various configurations and can be easily modified to assess field changes due to different loading conditions or geometries.

The software program "SUBCALC", which is a module within EPRI's EMFWorkstation program, was used to perform these magnetic field calculations. SUBCALC models the magnetic fields in and around transmission and distribution substations. In addition to transmission lines, primary distribution lines, and underground cables, the user can "draw" in the substation equipment such as buses and circuit breakers. The top and side view perspectives allow drawing of conductors in three dimensions. SUBCALC can also model substation equipment such as power transformers and capacitor banks.

An Enertech Consultants in-house software product, capable of calculating electric field in three dimensions, was used for the electric field calculations.

Modeling Approach

Computer models were developed of the existing transmission line configuration at the proposed Trumbull Substation site. Field calculations were then performed for both normal and peak load conditions. These calculations were performed to compare with the field levels measured on May 7, 2003. The purpose for this comparison was to ensure that the transmission line geometry and loading information provided by UI and used to create the computer model was accurate and to validate the computer model.

Computer models were developed for the proposed Trumbull Substation configuration in normal (15 GW system model) and peak (27.7 GW system model) load conditions as specified by ISO New England. These models were developed for the purpose of calculating magnetic field levels and electric field levels at the fence line of the substation with the Trumbull Substation in operation. Again, these models were developed based upon drawings and facility information provided by UI. In the computer software, the low voltage cables were modeled from the two transformers into the 13.8 kV Switchgear Room.

UI Loading Information for the Computer Models

Since two sets of field measurements were conducted at the proposed substation site, analysis of the existing transmission line loading information involved two sets of load data. The first set of field measurements was performed at approximately 11:30 AM on the morning of May 7, 2003. Throughout the morning, UI monitored the load of the 1710 & 1730 lines at Trumbull Junction. Table 1 presents the loading of each of these circuits during the measurement period.

Table 1. Transmission Line Loading Information at Trumbull Junction During Field Measurements on May 7, 2003 at 11:30 AM

Line (#)	Station	Load Flow Direction	Load
1710	Old Town	Into the Substation	677 A
1730	Weston	Into the Substation	490 A
1710	Pequonnock	Out of the Substation	704 A
1710	Devon	Into the Substation	22 A
1730	Devon	Into the Substation	129 A
1730	Pequonnock	Out of the Substation	620 A

The second set of field measurements was conducted on the morning of May 31, 2005. During this measurement period, UI again monitored the load of the 1710 & 1730 lines at Trumbull Junction. Table 2 shows the loading of each of these circuits during this second measurement period. The loading values presented in Tables 1 and 2 were used in the computer model to calculate the magnetic field for the purpose validating the measured versus calculated electric and magnetic field values.

Table 2. Transmission Line Loading Information at Trumbull Junction During Field Measurements on May 31, 2005 at 10:00 AM

Line (#)	Station	Load Flow Direction	Load
1710	Old Town	Into the Substation	727 A
1730	Weston	Into the Substation	534 A
1710	Pequonnock	Out of the Substation	625 A
1710	Devon	Into the Substation	*
1730	Devon	Into the Substation	42 A
1730	Pequonnock	Out of the Substation	537 A

* data was not available from system control, but not required for model validation..

Transmission line loading for the existing configuration was also calculated for normal and peak loading conditions, as shown the Table 3.

Table 3. Existing Transmission Line Loading Information Used for Calculations at Trumbull Junction For Normal and Peak Loading Conditions

Line (#)	Station	Load Flow Direction	Normal Load	Peak Load
1710	Old Town	Into the Substation	661 A	1101 A
1730	Weston	Into the Substation	460 A	767 A
1710	Pequonnock	Out of the Substation	330 A	550 A
1710	Devon	Out of the Substation	333 A	555 A
1730	Devon	Out of the Substation	251 A	418 A
1730	Pequonnock	Out of the Substation	213 A	355 A

For the proposed Trumbull Substation computer model, magnetic field values were calculated for the normal (15 GW system load) and peak (27.7 GW system load) configurations. Loading values for each 115 kV line was based upon ISO New England normal and peak system loading conditions provided by UI. Two cases for each loading condition were considered:

1. "Pre-Middletown/Norwalk" – Loading conditions prior to completion of the Middletown/Norwalk Project, which is in progress.

2. "Post-Middletown/Norwalk" – Loading conditions after the Middletown/Norwalk Project is completed.

The Pre-Middletown/Norwalk and Post-Middletown/Norwalk conditions were evaluated because the Middletown/Norwalk project has an impact on the loadings of the 115 kV transmission lines that serve the proposed Trumbull substation. Since transmission lines are the primary EMF source (not the substation), it was decided to evaluate EMF levels with and without this other project. The normal and peak loading values used within the computer models for these two conditions were provided by UI and are shown in Table 4. Appendix C provides load flow diagrams of the "Pre-Middletown/Norwalk" and "Post-Middletown/Norwalk" conditions for normal and peak loading. As shown in Table 4, the 115 kV line loads go down (less EMF) after the Middletown/Norwalk project for the Weston, Old Town, and Devon lines for both Normal and Peak cases. For the Pequonnock circuits, there is a modest line loading increase for the Normal load case and a decrease in line loading for the Peak case. In general, the impact of the Middletown/Norwalk Project is to reduce the 115 kV line loadings (lower EMF).

Table 4. Summary of Loading Conditions Used for Computer Modeling

Power Line Name (Circuit Number)	Normal Load (Amps)			Peak Load (Amps)		
	Existing	"Pre-Middletown /Norwalk"	"Post-Middletown /Norwalk"	Existing	"Pre-Middletown /Norwalk"	"Post-Middletown /Norwalk"
Weston (1730/1714)	460	476	264	767	834	462
Old Town (1710)	661	700	520	1101	1164	796
Devon (1730)	251	186	46	418	580	278
Devon (1710)	333	231	132	555	650	371
Pequonnock (1730/1713)	213	368	296	355	358	288
Pequonnock (1710)	330	469	388	550	514	425

ELECTRIC AND MAGNETIC FIELD CALCULATION RESULTS

Existing Transmission Line Configuration

A computer model was created of the existing 115 kV transmission line configurations at Trumbull Junction. Figure 14 presents a diagram of the computer model for the existing transmission line configuration. Figure 15 presents a diagram of the existing 115 kV transmission lines with the phasing designations for each circuit. These phasing arrangements are low-EMF designs due to optimum (or opposite) phasing that result in field cancellation.

The vertices of the proposed Trumbull Substation boundary (fence line) are denoted as "C-1" through "C-8" in Figure 14. Calculation of the electric and magnetic fields were performed along the fence line at a height of 1 meter above ground. The starting reference point of the fence line is the southwest corner, labeled "C-1" in Figure 14. Calculated profiles start at this initial reference point and proceed around the fence line in a counter-clockwise direction, from the corner labeled "C-1" to the corner labeled "C-8".

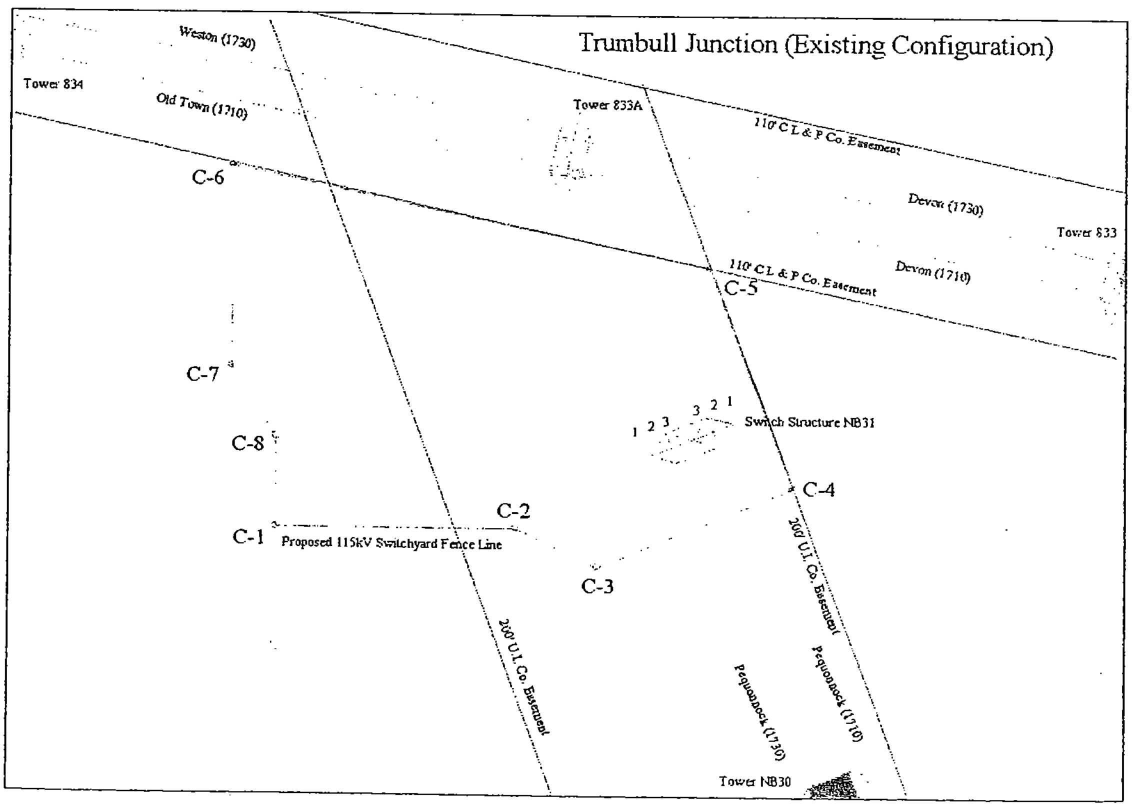

Figure 14. Computer Model of Existing 115 kV Lines at the Proposed Trumbull Substation

The electric field was calculated using an in-house software program developed by Enertech Consultants. This software is capable of calculating electric field in three dimensions. The results of the calculated versus measured values are shown in Figure 16. The electric field values show good correlation between the measured and calculated values. The maximum calculated electric field value at the fence line is approximately 515 V/m, at a location where the double circuit 115 kV lines pass overhead.

The calculated electric field for the existing configuration at normal and peak loading conditions is the same as that shown in Figure 16. Electric fields are due to the voltage of the conductors, and do not change under different loading conditions.

For magnetic fields, the field measurements recorded on May 7, 2003 were compared against calculated values. Figure 17 presents the results of the measured versus calculated magnetic field along the proposed substation perimeter. The loading values shown in Table 1 were used for the magnetic field calculations. The magnetic field measurements and calculations at the Trumbull Substation fence line generally compare well and have good correlation. There were, however, a few notable discrepancies in the comparison, especially between fence points "C-5" and "C-6". These discrepancies are most likely due to the amount of trees and brush in the measurement area, which prohibited walking at a steady pace and in a perfectly straight line along the proposed substation boundary. When comparing calculated and measured magnetic field values, the most critical parameter to match is the maximum field, which occurs directly underneath the transmission lines. For this comparison, these values match very well.

During the measurements, another small portion of the fence line near the NB31 Switch Structure was not reachable, due to a heavy amount of brush and trees that were present. Because of these obstacles, some of the measured values between fence points "C-4" and "C-5" are missing.

Magnetic field calculations for the existing configuration were also performed for normal and peak loading configurations (using the loading values presented in Table 3). The results of these magnetic field calculations are shown in Figures 18 and 19 for normal and peak loading respectively. Note that the measured magnetic field (of 71 mG) is higher than the calculated magnetic field for both normal loading (36 mG) and peak loading (52 mG) for the existing transmission line configuration. Peak loading does not necessarily correspond to the highest line loading or the highest magnetic field level; rather, peak loading designates a peak <u>system</u> loading which is independent of individual line loading conditions.

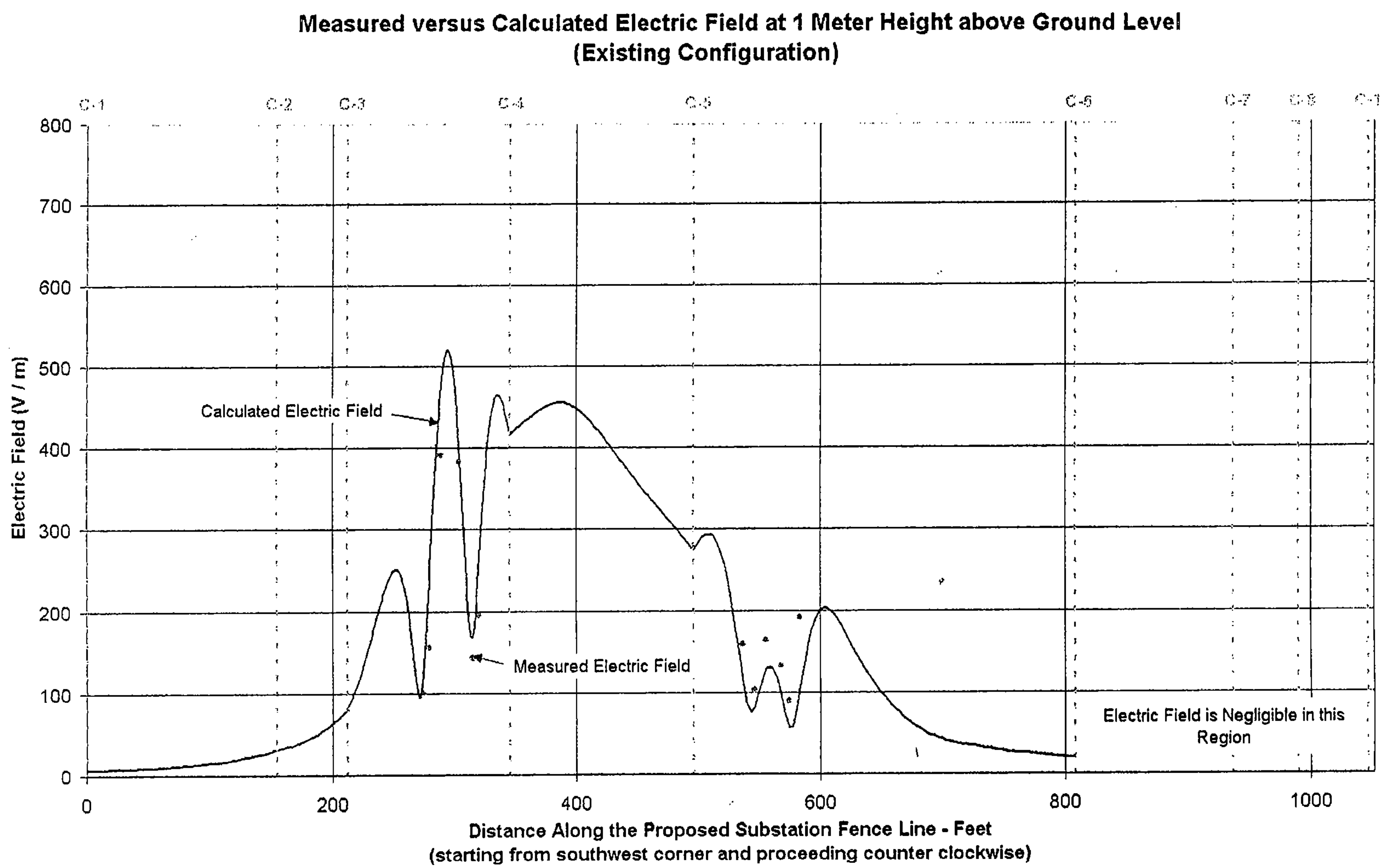

Figure 16. Comparison of Measured versus Calculated Electric Field Values Along the Proposed Trumbull Substation Fence Line For Measurements Conducted on May 7, 2003

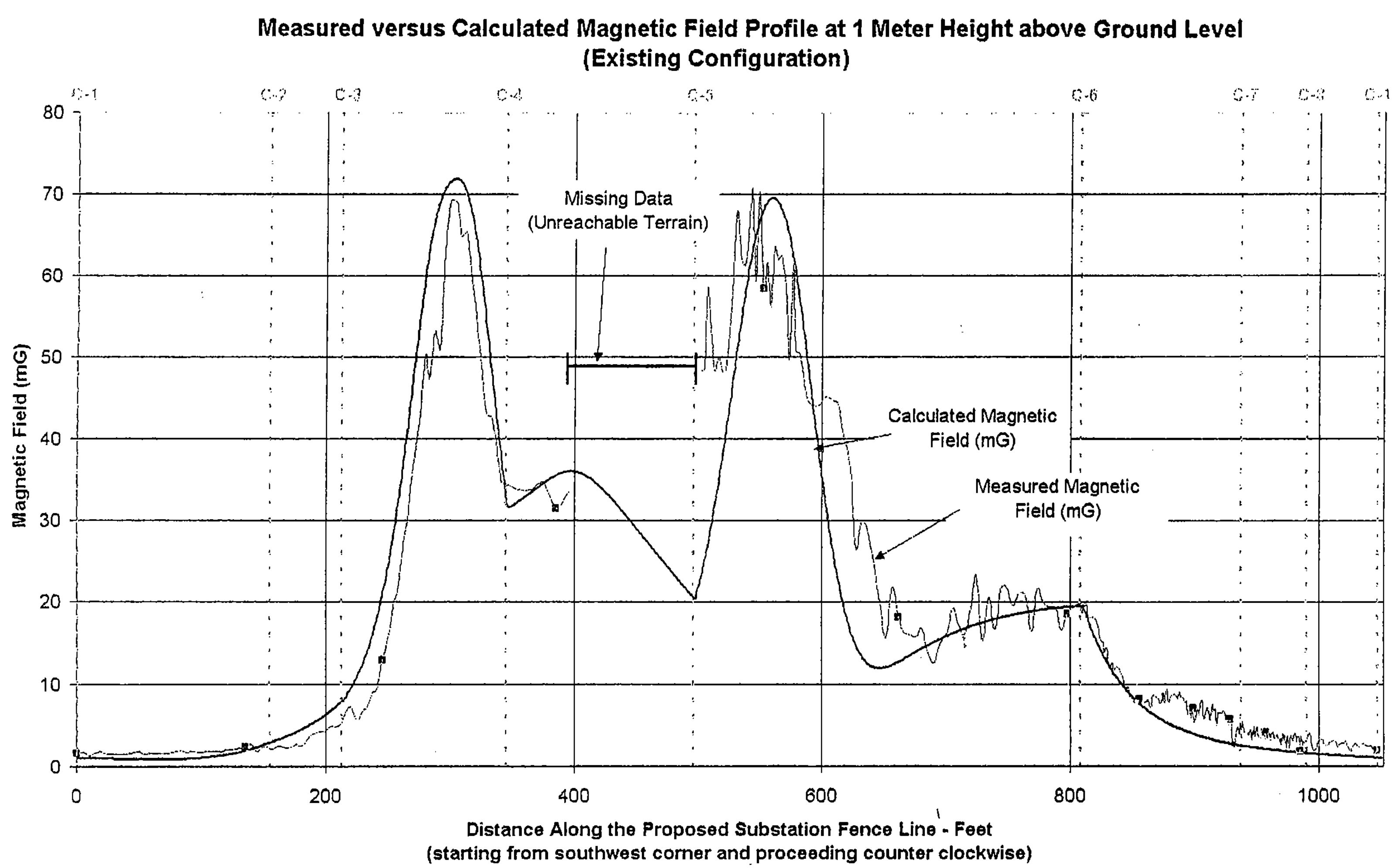

Figure 17. Comparison of Measured versus Calculated Magnetic Field Values Along the Proposed Trumbull Substation Fence Line For Measurements Conducted on May 7, 2003

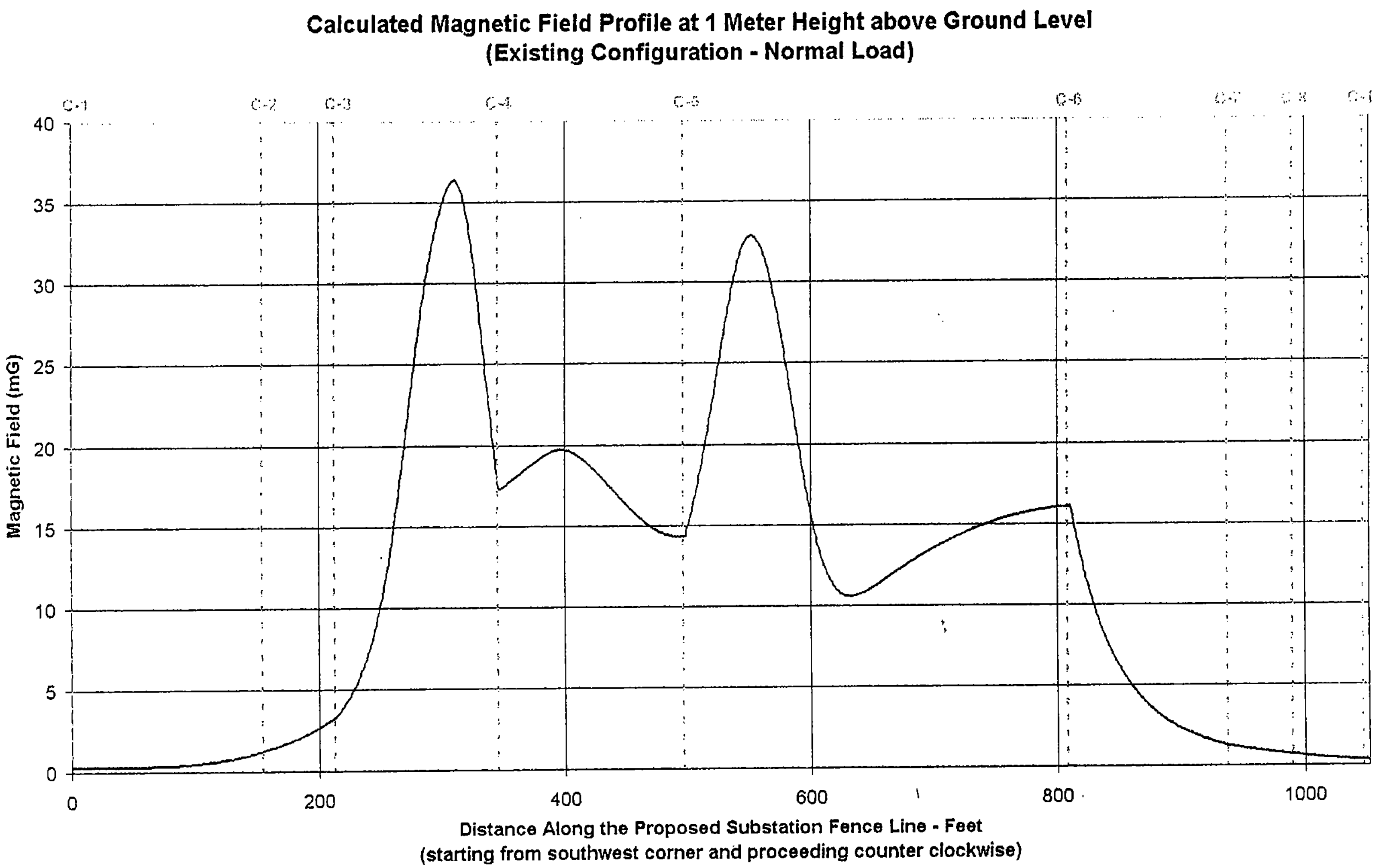

Figure 18. Calculated Magnetic Field for Normal Load Along the Proposed Trumbull Substation Fence Line (Existing Configuration)

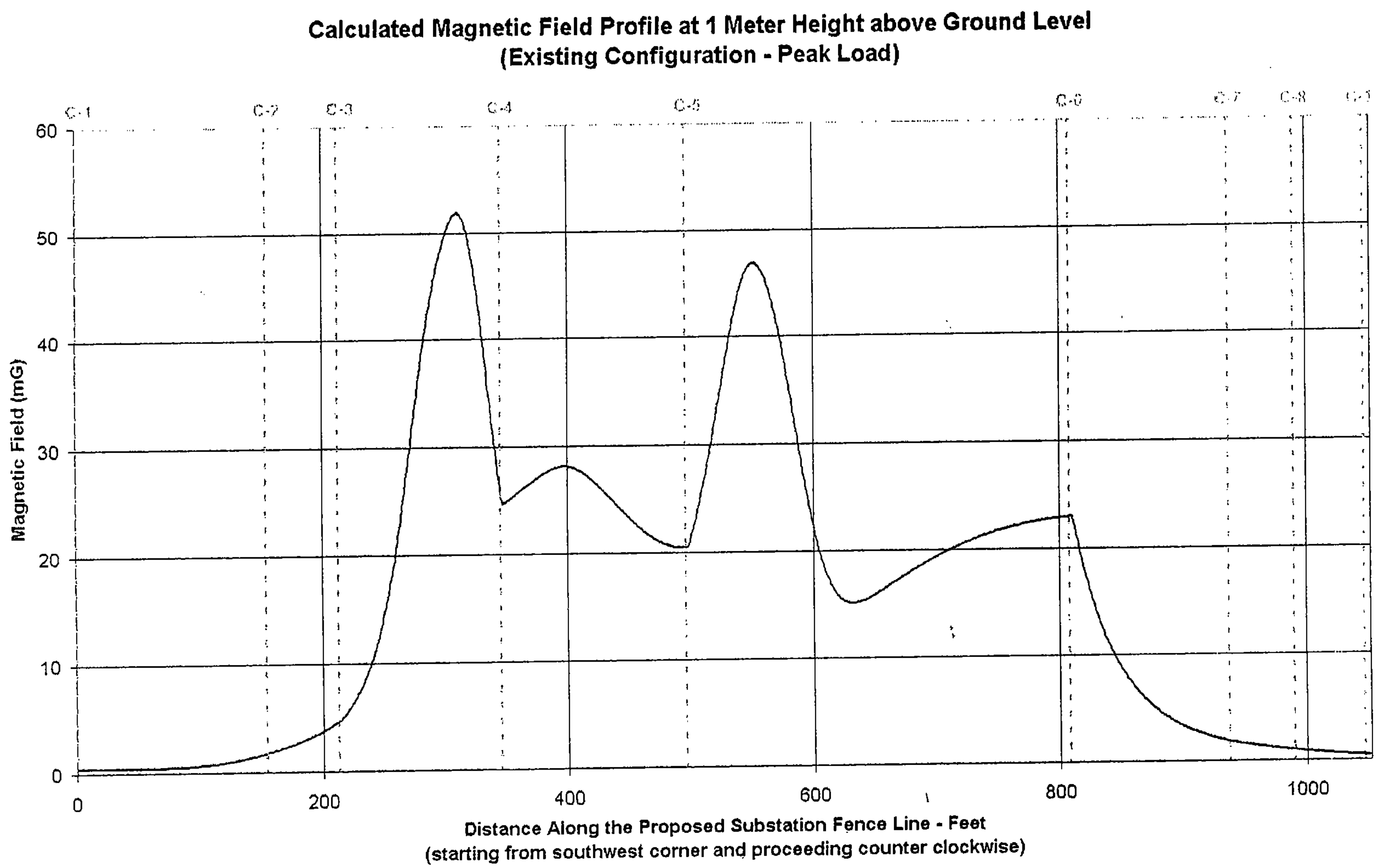

Figure 19. Calculated Magnetic Field for Peak Load Along the Proposed Trumbull Substation Fence Line
(Existing Configuration)

Proposed Trumbull Substation Configuration

Once modeling for the existing 115 kV transmission line configuration (no substation) had been performed and validated, the computer model was modified to include the proposed Trumbull Substation configuration. Changes to the transmission line routing, as well as the addition of new circuit connections and substation equipment, were incorporated into the computer model. Figure 20 presents a diagram of the computer model for the proposed Trumbull Substation configuration. The vertices of the proposed Trumbull Substation boundary (fence line) are again denoted as "C-1" through "C-8". Figure 21 presents a three-dimensional diagram of the proposed substation computer model.

In addition to the labeled fence line locations, four additional locations were identified. These four additional locations are labeled in Figure 20 as "D-1" through "D-4". Location "D-1" designates the end of the cul-de-sac on Wildflower Lane at the proposed substation driveway. Locations "D-2" through "D-4" denote the northern edge of the CL&P transmission line easement.

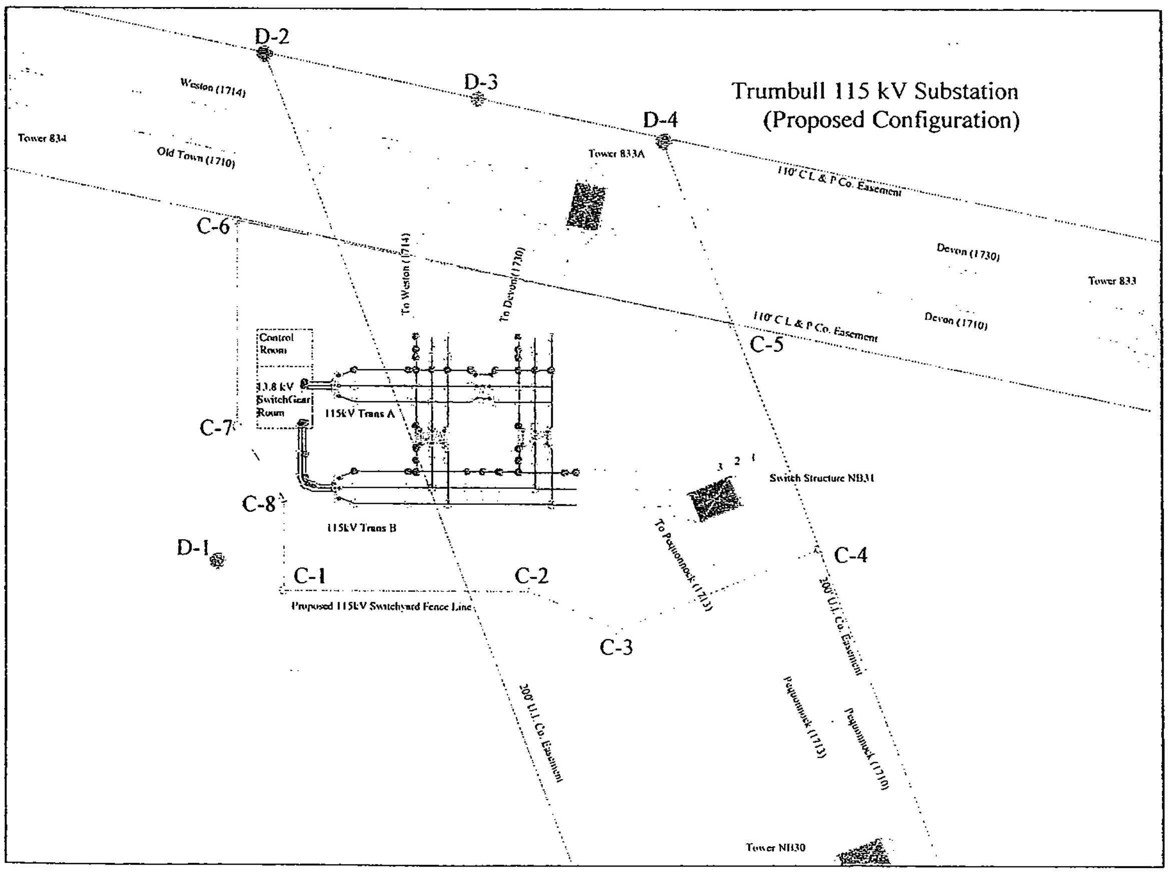

Figure 20. Computer Model for the Proposed Trumbull Substation

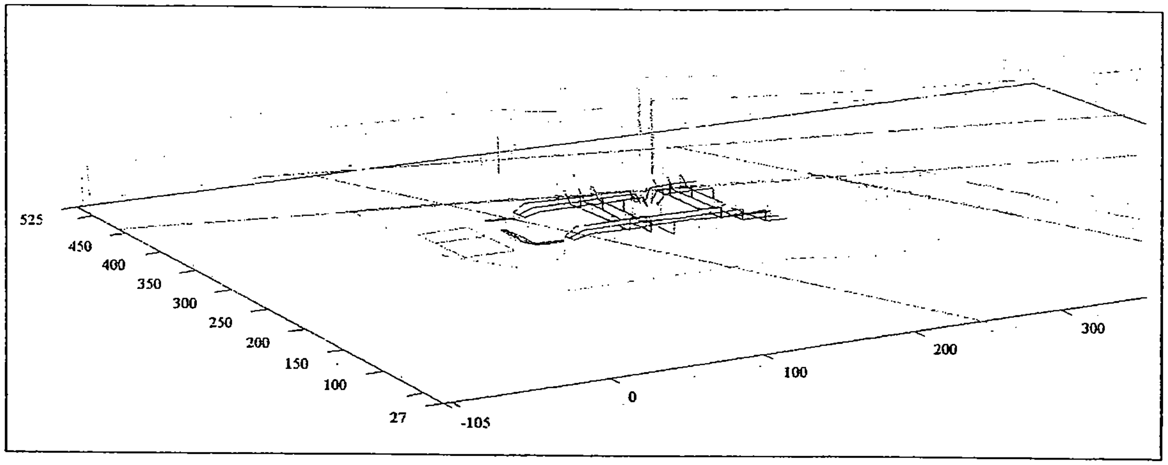

Figure 21. 3-D Diagram of the Proposed Trumbull Substation Computer Model

Electric field levels were calculated for the proposed substation configuration. Since the electric field is a function of voltage and not loading, only one electric field calculation was performed. The results of the calculations are shown in Figure 22. The highest calculated electric field value at the substation fence line is approximately 770 V/m, underneath of the 1714 115 kV transmission line as it enters the substation overhead. The electric field will be due primarily to the overhead 115 kV lines entering the substation. The electric field at the periphery of a substation produced by non-power line substation equipment is negligible.

The magnetic field for the proposed configuration was calculated for normal and peak loading conditions. The results of these magnetic field calculations are shown in Figures 23 and 24. Figure 23 presents the calculation results for the Existing, "Pre-Middletown/Norwalk", and "Post-Middletown/Norwalk" configurations under normal loading conditions. The highest calculated magnetic field values at the substation fence line are mainly due to the 1710, 1713, and 1714 circuits entering the substation (under normal loading, approximately 61 mG for the "Pre-Middletown/Norwalk" condition and approximately 41 mG for the "Post-Middletown/Norwalk" condition). The substation equipment itself does not contribute significantly to magnetic field levels along the perimeter of the proposed substation. As noted earlier, the transmission lines are the primary source of EMF. Existing configuration calculation results are also presented in Figure 23 (as a dashed line) for comparison.

Figure 24 presents the magnetic field calculation results for the Existing, "Pre-Middletown/Norwalk", and "Post-Middletown/Norwalk" configurations under peak loading conditions. Again, the highest magnetic field values at the substation fence line are mainly due to the 1710,1713, and 1714 circuits entering the substation (under peak loading, 108 mG for the "Pre-Middletown/Norwalk" condition and approximately 65 mG for the "Post-Middletown/Norwalk" condition). Existing configuration calculation results are again presented in Figure 24 (as a dashed line) for comparison.

The "peaks" in the field level plots of Figs. 23 and 24 between locations C-5 and C-6 are due to the new tap lines that connect the substation to the 115 kV transmission lines.

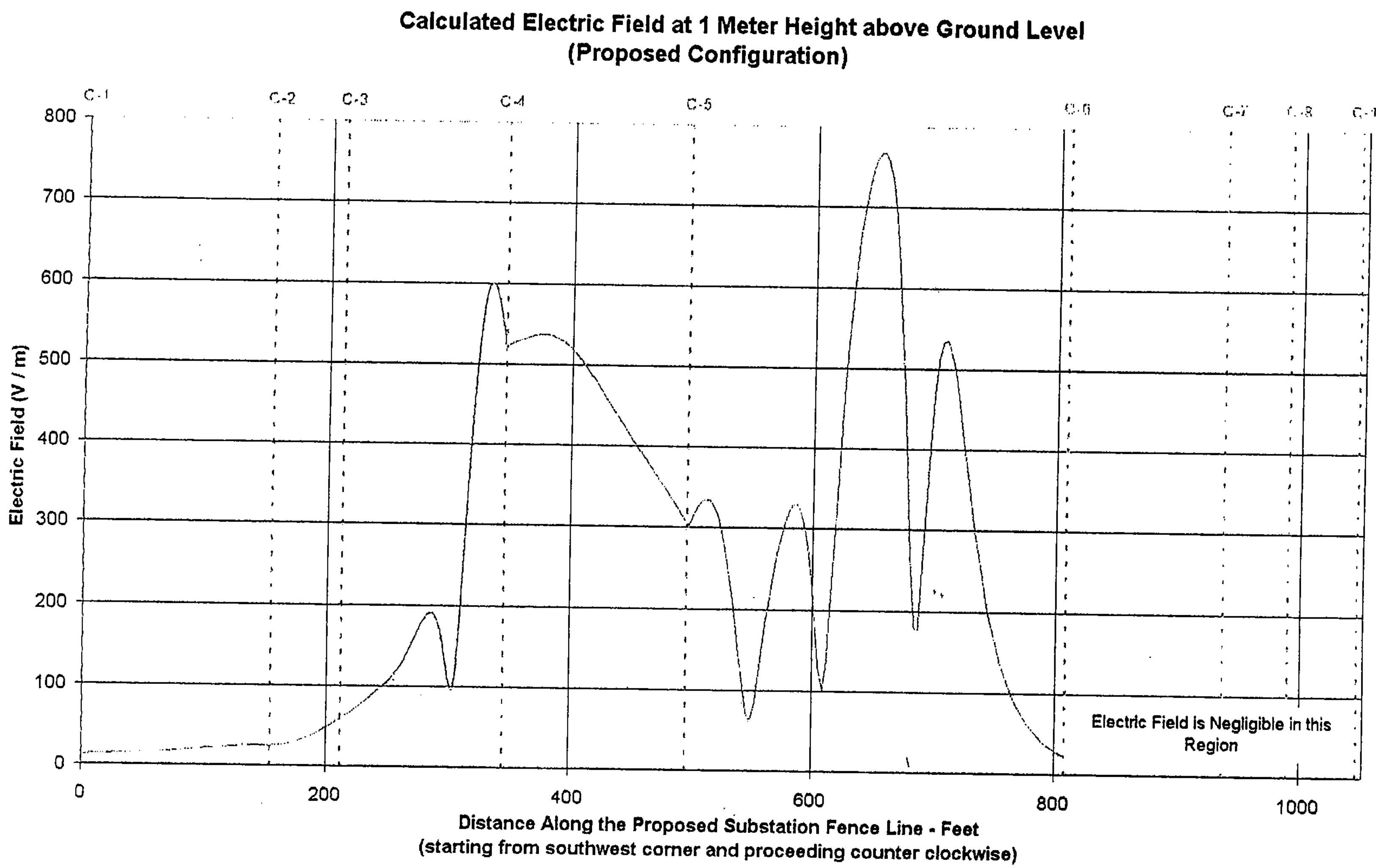

Figure 22. Calculated Electric Field Along the Proposed Trumbull Substation Fence Line
(Proposed Configuration)

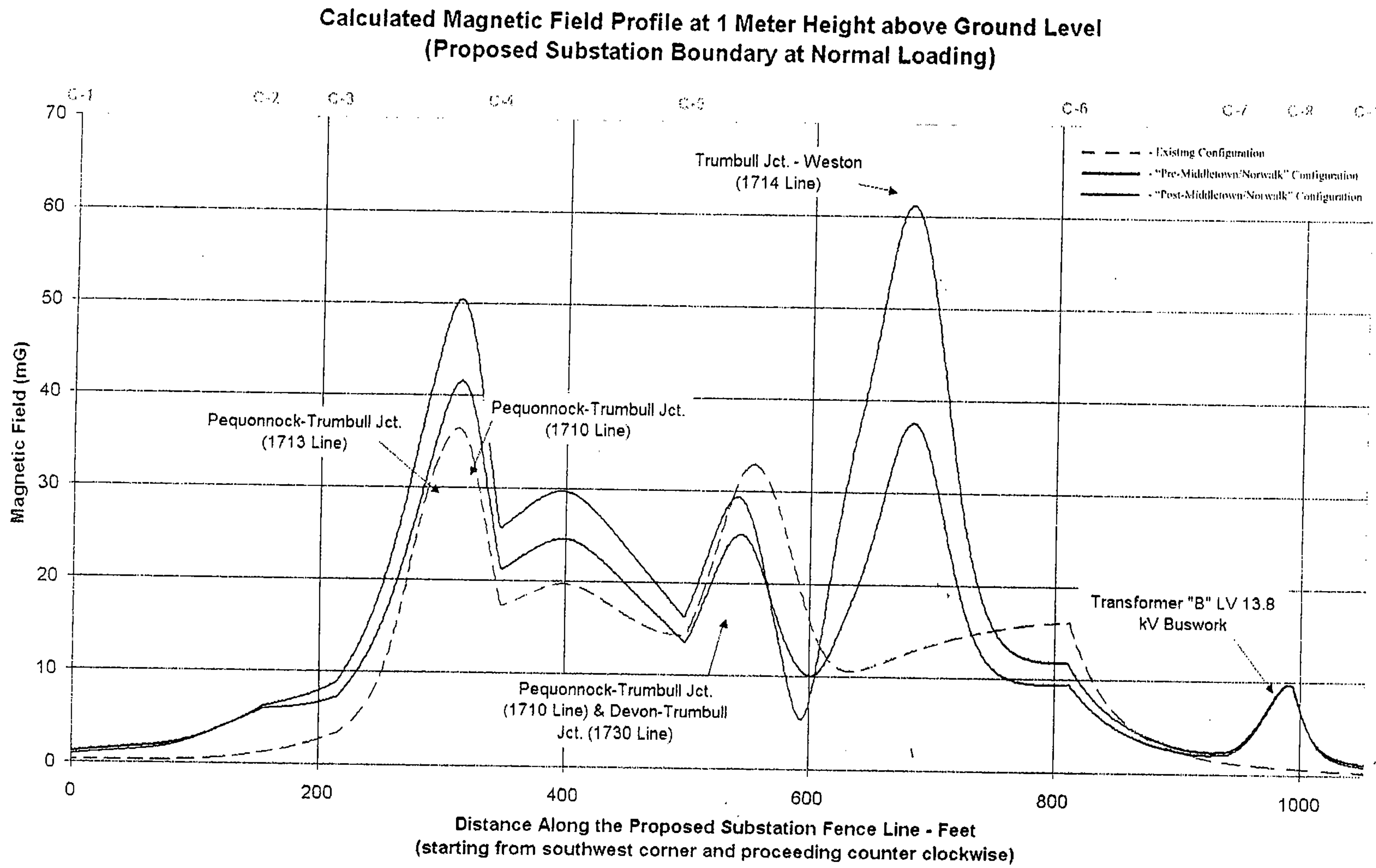

Figure 23. Calculated Magnetic Field Along the Proposed Trumbull Substation Fence Line
(Proposed Substation Boundary – Normal Loading)

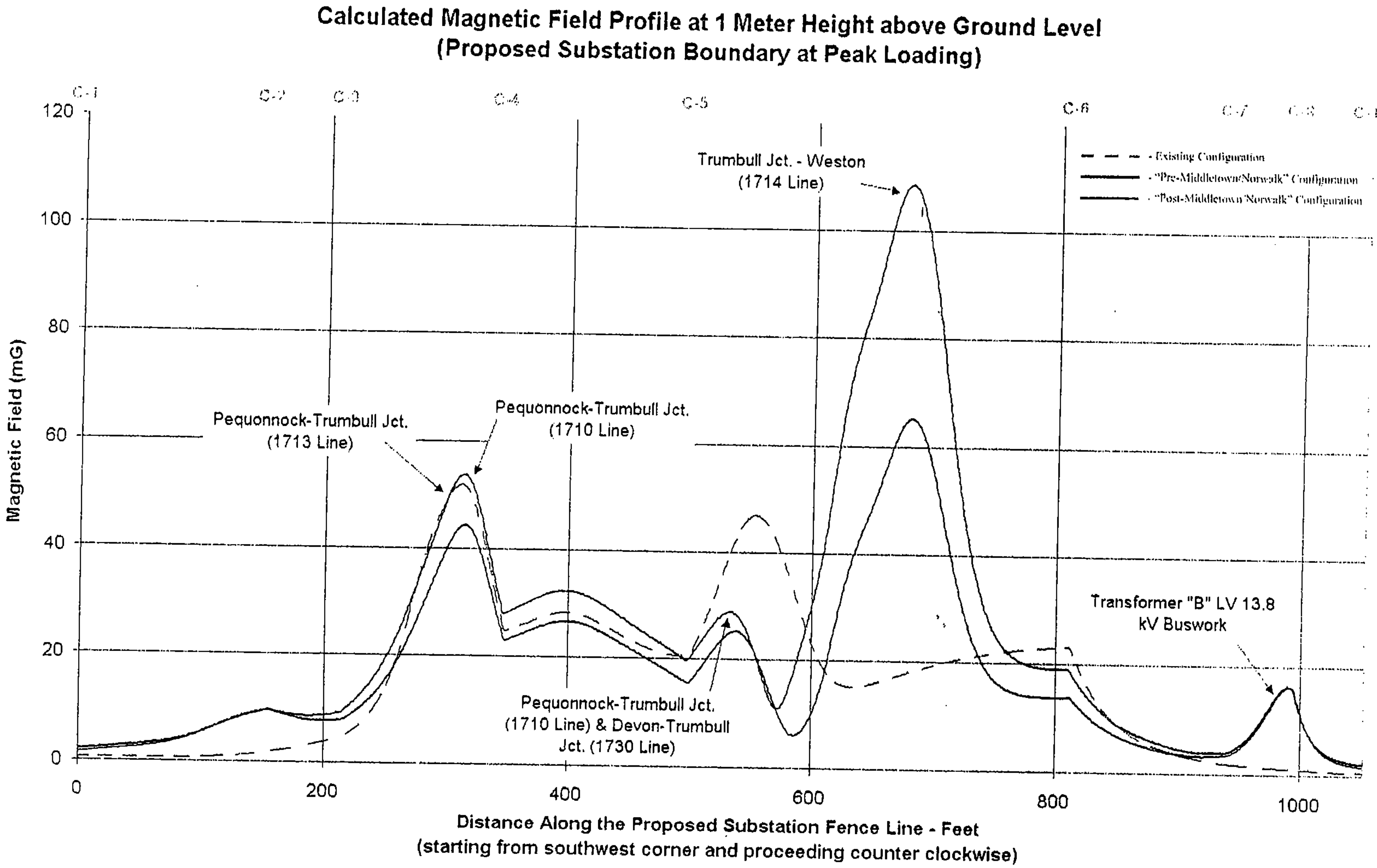

Figure 24. Calculated Magnetic Field Along the Proposed Trumbull Substation Fence Line
(Proposed Substation Boundary – Peak Loading)

Summary of Magnetic Field Calculation Results

A comparison of the magnetic field results for measured and calculated levels for the existing 115 kV transmission lines at Trumbull Junction was previously presented in Figure 17. Location points can be referenced in Figure 20.

Table 5 presents additional magnetic field calculation results for the existing and proposed Trumbull Junction configuration for normal and peak loading conditions. This table demonstrates that, in general, magnetic field levels are reduced after the Middletown/Norwalk is completed (one exception is the small areas under the short spans that tap into the new substation).

Table 5. Summary of Calculated Magnetic Field Levels for Existing and Proposed Conditions.

Reference point	Calculated Magnetic Field- mG					
	Normal Load			Peak Load		
	Existing	Pre-Middletown/ Norwalk	"Post-Middletown/ Norwalk	Existing	"Pre-Middletown/ Norwalk	"Post-Middletown/ Norwalk
Point "C-1" (Fence Corner)	0.3	1.2	0.9	0.4	2.0	1.5
Point "C-2" (Fence Corner)	1.2	6.1	5.7	1.8	9.6	9.6
Point "C-3" (Fence Corner)	3.5	8.8	7.2	4.8	9.4	8.2
Point "C-4" (Fence Corner)	17.3	26.0	21.3	24.7	28.1	23.1
Point "C-5" (Fence Corner)	14.3	16.3	13.8	20.5	20.2	15.7
Point "C-6" (Fence Corner)	16.1	11.5	9.4	23.0	18.2	13.5
Point "C-7" (Fence Corner)	1.2	2.4	2.1	1.8	4.0	3.4
Point "C-8" (Fence Corner)	0.7	9.5	9.4	1.0	16.0	15.9
Maximum Along the Entire Fence Line	37.0	61.0	41.0	52.0	108.0	65.0
Point "D-1" (Driveway)	0.5	0.9	0.7	0.6	1.6	1.1
Point "D-2" (Edge of CL&P Easement)	9.3	5.4	3.8	13.6	10.3	6.5
Point "D-3" (Edge of CL&P Easement)	9.5	8.7	6.3	13.7	13.2	8.3
Point "D-4" (Edge of CL&P Easement)	5.0	8.6	5.7	7.5	16.5	10.4

Two organizations have developed guidelines for occupational and public exposure to electric and magnetic fields: the International Commission on Non-Ionizing Radiation Protection (ICNIRP) and the American Conference of Governmental Industrial Hygienists (ACGIH). Tables 6 and 7 present a summary of the electric and magnetic field levels of these guidelines respectively.

The ICNIRP established these guidelines to provide protection against known adverse health effects. While the ICNIRP reviewed all of the scientific literature, the adverse effects on humans that were fully verified by a stringent evaluation were short term, immediate health consequences (such as nerve and muscle stimulation, shocks and burns, etc.).

The ACGIH established threshold limit values to which it is believed that nearly all workers may be exposed repeatedly without adverse health effects, based upon an assessment of available data from laboratory research and human exposure studies. The threshold limit values were developed as a guideline to assist in the control of health and safety hazards.

Both the ICNIRP and ACGIH guidelines are based on established adverse health effects (such as burns, shocks, nerve stimulation, etc.). Electric and magnetic field levels as specified in these guidelines, and which would cause these types of effects, are much higher than typical levels found in residential and most occupational environments.

Table 6. Summary of ICNIRP 50/60 Hz Exposure Guidelines

International Commission on Non-Ionizing Radiation Protection Guidelines		
Exposure (60 Hz)	Electric Field	Magnetic Field
Occupational:		
Reference Levels for Time-Varying Fields	8.333 kV/m (8,333 V/m)	4.167 G (4,167 mG)
Current Density for Head and Body	10 mA/m^2 (25 kV/m)	10 mA/m^2 (5 G)
General Public:		
Reference Levels for Time-Varying Fields	4.167 kV/m (4,167 V/m)	0.833 G (833 mG)
Current Density for Head and Body	2 mA/m^2 (5 kV/m)	2 mA/m^2 (1 G)

Table 7. Summary of ACGIH 60 Hz Exposure Guidelines

ACGIH Occupational Threshold Limit Values for Sub-Radio Frequency Fields	
Electric Field	Magnetic Field
Occupational exposures should not exceed: 25 kV/m (from 0 Hz to 100 Hz)	Occupational exposures should not exceed: 60 Hz : 10 G (10,000 mG)
Prudence dictates the use of protective devices (e.g. suits, gloves, insulation) in fields above 15 kV/m.	50 Hz : 12 G (12,000 mG)
For workers with cardiac pacemakers, maintain exposure at or below 1 kV/m.	For workers with cardiac pacemakers, the field should not exceed 1 G (1,000 mG).

The following tables summarize the results of the electric and magnetic field assessment performed along the proposed substation boundary:

Electric Field

	Calculated Electric Field	
Measurements	Existing Configuration	Proposed Substation Configuration
89 – 390 V/m	7 – 521 V/m	12 – 768 V/m

Magnetic Field

	Calculated Magnetic Field		
Measurements	May 7, 2003 Load	Normal Load	Peak Load
1 – 71 mG	0.9 – 71.9 mG	0.3 – 36.3 mG	0.4 – 51.9 mG

Calculated Magnetic Field			
"Pre-Middletown/Norwalk" Condition		"Post-Middletown/Norwalk" Condition	
Normal Load	Peak Load	Normal Load	Peak Load
1.1 – 61.2 mG	2.0 – 108.6 mG	0.9 – 41.4 mG	1.5 – 65.1 mG

The Pre-Middletown/Norwalk and Post-Middletown/Norwalk conditions were evaluated because the Middletown/Norwalk project has an impact on the loadings of the 115 kV transmission lines that serve the proposed Trumbull substation. Since transmission lines are the primary EMF source (not the substation), it was decided to evaluate EMF levels with and without this other project. A review of 115 kV line loading (Table 4) reveals that the line loads go down (less EMF) after the Middletown/Norwalk project for the Weston, Old Town, and Devon lines for both Normal and Peak cases. For the Pequonnock circuits, there is a modest line loading increase for the Normal load case and a decrease in line loading for the Peak case. In general, the impact of the Middletown/Norwalk project is to reduce the 115 kV line loadings (lower EMF).

The 115 kV transmission line phasing arrangements are low-EMF designs due to optimum (or opposite) phasing that result in field cancellation. The project is consistent with the Connecticut Siting Council Best Management Practices for EMF because EMF levels were evaluated as required and in its use of low-EMF design optimum phasing of the 115 kV transmission lines.

All measured and calculated EMF levels for the existing transmission lines at the existing Trumbull Junction Substation location, as well as the calculated EMF levels once the proposed Trumbull Substation is in operation, are lower than the exposure guidelines provided by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) and the American Conference of Governmental Industrial Hygienists (ACGIH).

REFERENCES

1. "Threshold Limit Values for Chemical Substances and Physical Agents", American Conference of Governmental Industrial Hygienists (ACGIH), Cincinnati, ISBN 1-88-2417-23-2, 1998

2. "Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (Up to 300 Ghz)", International Commission on Non-Ionizing Radiation Protection (ICNIRP), Health Physics, 74:494-522, 1988

3. "IEEE Standard Procedures for Measurement of Power Frequency Electric and Magnetic Fields from AC Power Lines", IEEE Std 644-1994, Institute of Electrical and Electronics Engineers, 1994

APPENDICES

Appendix A

Connecticut Siting Council

ELECTRIC SUBSTATION FACILITY

September 19, 2000

This application guide is to assist applicants in filing for a Certificate of Environmental Compatibility and Public Need (Certificate) from the Connecticut Siting Council (Council) for the construction of an electric substation facility. Such facilities are defined in General Statutes § 16-50i (a) (4).

Applicants should consult General Statutes §§ 16-50g through 16-50aa and Sections 16-50j-1 through 16-50z-4 of the Regulations of Connecticut State Agencies to assure complete compliance with the requirements of those sections. Where appropriate, statutory and regulatory references are noted below.

Pre-Application Process (General Statutes § 16-50l (e))

At least 60 days prior to the filing of any application with the Council, the applicant shall consult with the municipality in which the facility may be located and with any adjoining municipality having a boundary not more than 2500 feet from such facility concerning the proposed and alternative sites of the facility. Such consultation with the municipality shall include, but not be limited to good faith efforts to meet with the chief elected official of the municipality. At the time of the consultation, the applicant shall provide the chief elected official with any technical reports concerning the public need, the site selection process and the environmental effects of the proposed facility. The municipality may conduct public hearings and meetings as it deems necessary for it to advise the applicant of its recommendations concerning the proposed facility. Within 60 days of the initial consultation, the municipality shall issue its recommendations to the applicant. No later than 15 days after submitting the application to the Council, the applicant shall provide to the Council all materials provided to the municipality and a summary of the consultations with the municipality including all recommendations issued by the municipality.

I. Application to Municipal Agencies (General Statutes § 16-50x (d))

Municipal zoning and inland wetland agencies may regulate and restrict the location of an electric substation facility. Such action must be taken within 30 days of application filed with the Council. Orders made by the municipal zoning and inland wetland agencies may be appealed within thirty days by any party or municipality required to be served with a copy of the application.

II. Quantity, Form, and Filing Requirements (Regs., Conn. State Agencies § 16-50j-12)

A. Except as may be otherwise required, at the time applications are filed with the Council, there shall be furnished to the Council an original and 20 copies.

B. All filings from the applicant, parties, or intervenors must consist of an original and 20 copies, labeled with the docket number, properly collated and paginated, and bound.

C. Applications filed for the purpose of any proceeding before the Council shall be printed or typewritten on paper cut or folded to letter size, 8 1/2 by 11 inches. Width of margins shall be not less than one inch. The impression shall be on only one side of the papers, unless printed, and shall be double spaced, except that quotations in excess of five typewritten lines shall be single spaced and indented. Mimeographed, multigraphed, photoduplicated, or the like copies will be accepted as typewritten, provided all copies are clear and permanently legible. In accordance with the State Solid Waste Management Plan, all filings should be submitted on recyclable paper, primarily regular weight white office paper. Applicants should avoid using heavy stock paper, colored paper, and metal or plastic binders and separators.

D. Every original shall be signed by the applicant or by one or more attorneys in their individual names on behalf of the applicant. All applications shall be filed at the office of the Council, 136 Main Street, Suite 401, New Britain, Connecticut 06051. Service of all documents and other papers filed as applications, briefs, and exhibits, but not limited to those categories, shall be by personal delivery or by first class mail to the Council and all parties and intervenors to the proceeding, unless service has been waived.

E. Any exhibits, sworn written testimony, data, models, illustrations, and all other materials that the applicant deems necessary or desirable to support the granting of the application shall be attached to the application. In addition, annexed materials shall include such exhibits, sworn written testimony, and other data that any statute or regulations may require. The applicant may request that administrative notice be taken of and refer in the application to portions of other Council docket records and generic hearings or statements prepared by the Council as a result of generic hearings.

F. Applicants may present material in a sequence and format most appropriate for the particular proposal. To allow timely Council review, include with the application a copy of this form with page references for each item required in Section VII below.

III. Application Filing Fees (Regs., Conn. State Agencies § 16-50v-la)

The filing fee for an application is determined by the following schedule:

Estimated Construction Cost	Fee
Up to $5,000,000	0.05% or $1,000.00, whichever is greater;
Above $5,000,000	0.1% or $25,000.00, whichever is less.

All application fees shall be paid to the Council at the time an application is filed with the Council. Additional assessments may be made for expenses in excess of the filing fee. Fees in excess of the Council's actual costs will be refunded to the applicant.

IV. Proof of Service (General Statutes § 16-501 (b))

Each application shall be accompanied by proof of service of such application on:

A. The chief elected official, the zoning commission, planning commission, the planning and zoning commissions,and the conservation and wetlands commissions of the site municipality and any adjoining municipality having a boundary not more than 2500 feet from the facility;

B. The regional planning agency that encompasses the site municipality;

C. The State Attorney General;

D. Each member of the Legislature in whose district the facility is proposed;

E. Any federal agency which has jurisdiction over the proposed facility; and

F. The state departments of environmental protection, public health, public utility control, economic and community development, and transportation; the council on environmental quality; and the office of policy and management.

V. <u>Public Notice</u> (General Statutes § 16-501 (b))

Notice of the application shall be published at least twice prior to the filing of the application in a newspaper having general circulation in the site municipality or municipalities. The notice shall state the name of the applicant, the date of filing, and a summary of the application. The notice must be published in not less than ten point type.

VI. <u>Notice to Abutting Landowners</u>(General Statutes § 16-501 (b))

Notice of the application shall be sent by certified or registered mail to all abutting landowners of the proposed and alternative sites of the facility. Notice shall be sent at the same time that notice of the application is given to the general public.

The application shall be accompanied by an affidavit of notice to all abutting landowners and an affidavit of publication each time notice of application is published.

VII. <u>Contents of Application</u> (General Statutes § 16-501 (a) (1))

An application for a Certificate for the construction of an electric substation facility should include or be accompanied by the following:

A. A brief description and the location of the proposed facility, including an artist's rendering and/or narrative describing its appearance.

B. A statement of the purpose for which the application is being made.

C. A statement describing the statutory authority for such application.

D. The exact legal name of each person seeking the authorization or relief and the address or principal place of business of each such person. If any applicant is a corporation, trust association, or other organized group, it shall also give the state under the laws of which it was created or organized.

E. The name, title, address, and telephone number of the attorney or other person to whom correspondence or communications in regard to the application are to be addressed. Notice, orders, and other papers may be served upon the person so named, and such service shall be deemed to be service to the applicant.

F. A description of the proposed facility including:

1. Itemized estimated costs;
2. Comparative costs of alternatives considered;
3. Facility service life;
4. Bus and specifications;
5. Overhead take-off design, appearance, and heights, if any;
6. Length of interconnections to transmission and distribution;
7. Initial and design voltages and capacities;
8. Rights-of-way and accessway acquisition;
9. Transmission connections and distribution feeders; and
10. Service area.

G. A statement and full explanation of why the proposed facility is needed and how the facility would conform to a long-range plan for the expansion of the electric power grid serving the state and interconnected utility systems that would serve the public need for adequate, reliable, and economic service, including:

1. A description and documentation of the existing system and its limitations;
2. Justification for the proposed in-service date;
3. The estimated length of time the existing system is judged to be adequate with and without the proposed facility;
4. Identification of system alternatives with the advantages and disadvantages of each; and
5. If applicable, identification of the facility in the forecast of loads and resources pursuant to General Statutes § 16-50r.

H. A proposed site map at a scale no smaller than one inch = 40 feet and aerial photos of suitable scale showing the site, access, and abutting properties including proximity of the following:

1. Settled areas;
2. Schools and daycare centers;
3. Hospitals;
4. Group homes;
5. Forests and parks
6. Recreational areas;
7. Seismic areas;
8. Scenic areas;
9. Historic areas;
10. Areas of geologic or archaeological interest;
11. Areas regulated under the Inland Wetlands and Watercourses Act;
12. Areas regulated under the Tidal Wetlands Act and Coastal Zone Management Act;
13. Public water supplies;
14. Hunting or wildlife management areas; and
15. Existing transmission lines within one mile of the site.

I. A justification for selection of the proposed site including a comparison with alternative sites which are environmentally, technically, and economically practicable. Include enough information for a complete comparison between the proposed site and any alternative site contemplated.

J. Safety and reliability information, including:

1. Provisions for emergency operations and shutdowns; and
2. Fire suppression technology.

K. A description of the effect that the proposed facility would have on the environment, ecology, and scenic, historic, and recreational values, including effects on:

1. Public health and safety;
2. Local, state, and federal land use plans;
3. Existing and future development;
4. Roads;
5. Wetlands;
6. Wildlife and vegetation, including rare and endangered species, and species of special concern, with documentation by the Department of Environmental Protection Natural Diversity Data Base;
7. Water supply areas;
8. Archaeological and historic resources, with documentation by the State Historic Preservation Officer; and
9. Other environmental concerns identified by the applicant, the Council, or any public agency.

L. A statement explaining mitigation measures for the proposed facility including:

1. Construction techniques designed specifically to minimize adverse effects on natural areas and sensitive areas;
2. Special routing or design features made specifically to avoid or minimize adverse effects on natural areas and sensitive areas;
3. Establishment of vegetation proposed near residential, recreational, and scenic areas; and
4. Methods for preservation of vegetation for wildlife habitat and screening.

M. Justification that the location of the proposed facility would not pose an undue safety or health hazard to persons or property at the site of the proposed facility including:

1. Measurements of existing electric and magnetic fields (EMF) at site boundaries, and at boundaries of adjacent schools, daycare facilities, playgrounds, and hospitals, with extrapolated calculations of exposure levels during expected normal and peak normal line loading;
2. Calculations of expected EMF levels at the above-listed locations that would occur during normal and peak normal operation of the facility; and
3. A statement describing consistency with the Council's "Best Management Practices for Electric and Magnetic Fields," as amended.

N. A schedule of the proposed program for right-of-way or property acquisition, construction, rehabilitation, testing, and operation.

O. Identification of each federal, state, regional, district, and municipal agency from which approvals have been obtained or will be sought, copies of approvals received, and a schedule for obtaining approvals not yet received.

P. Bulk filing of municipal zoning, planning, planning and zoning, conservation, and inland wetland regulations and by-laws.

Q. Such information any department or agency of the state exercising environmental controls may, by regulation, require.

R. Such information the applicant may consider relevant.

VIII. Procedures

A. The Council will review and may reject the application within 30 days if it fails to comply with specific data or exhibit requirements or if the applicant fails to promptly correct deficiencies. (Regs., Conn. State Agencies §§ 16-50l-4 through 16-50l-5)

B. The Council and any party or intervenor to the proceeding may file exhibits and interrogatories requesting supplemental or explanatory materials. All filings will be subject to cross-examination and the Council's discretion for admission into the record. (General Statutes § 16-50o)

C. A public hearing must be held in the county of the proposed site, usually in the site municipality, with one session held after 6:30 p.m. for the convenience of the public. The Council's record must remain open for 30 days after the close of the hearing. (General Statutes § 16-50m)

D. The Council must render a decision within 180 days of receipt of the application, or within 12 months of receipt of the application if the application was incorporated with an application for an electric transmission line, extendible by 180 days upon consent of applicant. (General Statutes § 16-50p)

Appendix B

Electric and Magnetic Field Best Management Practices
February 11, 1993

Although scientific knowledge does not at this time permit firm judgments about possible health effects of 60 hertz electric and magnetic field (EMF) exposures from electric generation, substation and transmission facilities, the Connecticut Siting Council has adopted a cautious approach to the issue by adopting the following Best Management Practices. These practices are intended to recognize the latest information as well as effective technologies and management techniques on a project-specific basis to protect the public and maximize the efficiency of the electric generation, transformation, and transmission industry.

1. Administratively notice and recognize completed and ongoing scientific EMF research.

2. Require individual project-specific assessments of EMF.

3. Require detailed project-specific assessments of need and non-structural alternatives.
4. Require EMF assessments for project alternatives.
5. Require EMF assessments to consider exposure levels and durations with respect to existing and planned land uses.
6. Require baseline, preconstruction measurements of EMF during siting of new facilities.
7. Require post-construction measurement of EMF to extrapolate values for normal, peak, and maximum allowable continuous operating levels.
8. Require adoption and use of a uniform measurement protocol.
9. Solicit specific comments from the DEP, DPUC, and DOHS regarding EMF exposure during siting of new facilities.
10. Require consideration of low-EMF designs during the siting and construction of new facilities, including use of:

    a. Compact spacing;
    b. Optimum phasing of conductors; and
    c. Applicable and appropriate new field management technologies.

3. Consider project-specific exposure limits for EMF.
4. Recognize the possibility for future standards and consider conditioning approval on retrofitting or elimination of facilities to meet future federal and State standards.

All council proceedings are conducted at publicly noticed meetings and hearings offering full opportunity for participation and due process as afforded by federal and State law.

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Appendix C

LOAD FLOW PATTERNS FOR PROPOSED TRUMBULL SUBSTATION FACILITY

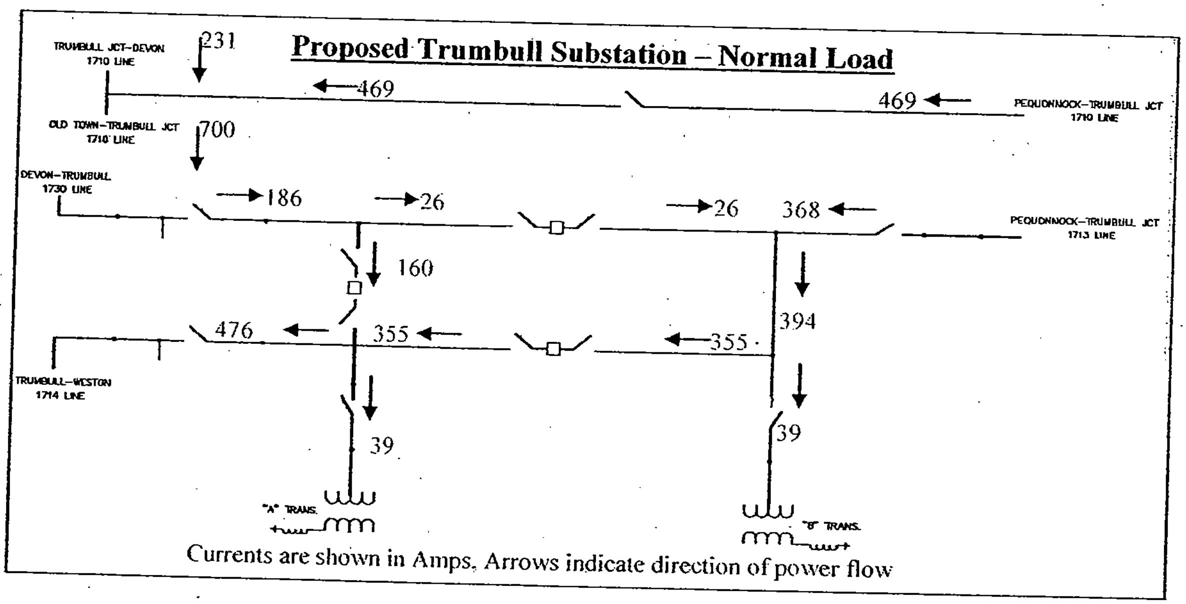

Figure C-1. Calculated Load Flow Patterns for the Proposed Trumbull Substation Normal 115 kV Loading for the "Pre-Middletown/Norwalk" Configuration

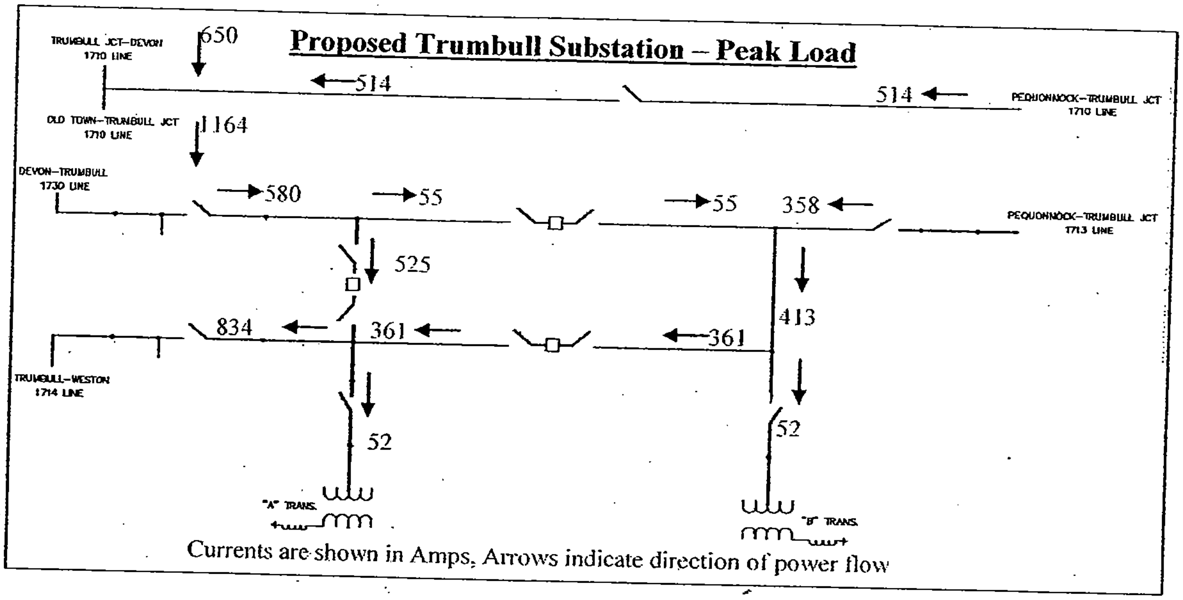

Figure C-2. Calculated Load Flow Patterns for the Proposed Trumbull Substation
Peak 115 kV Loading for the "Pre-Middletown/Norwalk" Configuration

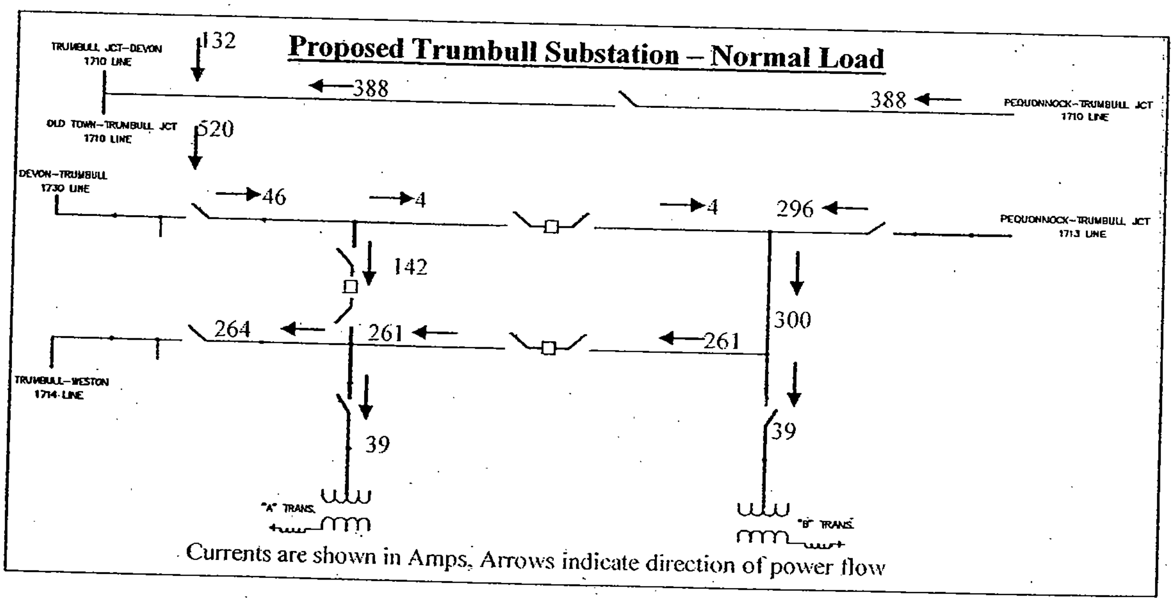

Figure C-3. Calculated Load Flow Patterns for the Proposed Trumbull Substation
Normal 115 kV Loading for the "Post-Middletown/Norwalk" Configuration

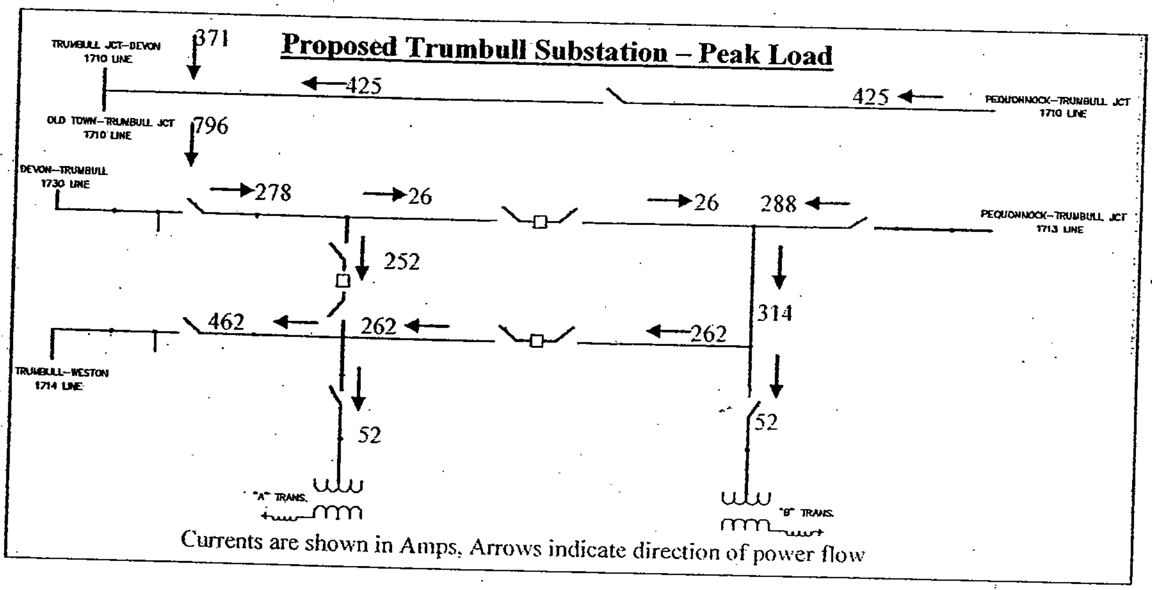

Figure C-4. Calculated Load Flow Patterns for the Proposed Trumbull Substation
Peak 115 kV Loading for the "Post-Middletown/Norwalk" Configuration