APPENDIX E

ELECTRIC AND MAGNETIC FIELD REPORT

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Exponent®

Electric- and Magnetic-Field Assessment

Fairfield to Congress Railroad Transmission Line 115-kV Rebuild Project

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Electric- and Magnetic-Field Assessment:

Fairfield to Congress Railroad Transmission Line 115-kV Rebuild

Prepared for

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Notice

At the request of The United Illuminating Company (UI), Exponent, Inc., modeled the electric and magnetic fields associated with the rebuild of 115-kilovolt transmission lines that extend within the Connecticut Department of Transportation railroad corridor from Catenary Structure B648S in the Town of Fairfield east to UI's Congress Street Substation in the City of Bridgeport, as well as within UI's right-of-way that connects the transmission lines along the railroad corridor to UI's Ash Creek Substation—all in Fairfield County, Connecticut (the Project). This report summarizes work performed to date and presents the findings resulting from that work. In the analysis, we have relied on geometry, material data, usage conditions, specifications, and various other types of information provided by UI. We cannot verify the correctness of these input data and rely on the client for the data's accuracy. UI has confirmed to Exponent that the summary of data provided to Exponent contained herein is not subject to Critical Energy Infrastructure Information (CEII) restrictions. CEII loading data have been redacted from this report. Although Exponent has exercised usual and customary care in the conduct of this analysis, the responsibility for the design and operation of the Project remains fully with the client.

The findings presented herein are made to a reasonable degree of engineering and scientific certainty. Exponent reserves the right to supplement this report and to expand or modify opinions based on review of additional material as it becomes available, through any additional work, or review of additional work performed by others.

The scope of services performed during this investigation may not adequately address the needs of other users of this report, and any re-use of this report or its findings, conclusions, or recommendations presented herein other than for permitting of this Project are at the sole risk of the user. The opinions and comments formulated during this assessment are based on observations and information available at the time of the investigation. No guarantee or warranty as to future life or performance of any reviewed condition is expressed or implied.

Executive Summary

To maintain the reliability of the bulk transmission grid in the region, the United Illuminating Company (UI) proposes to rebuild its existing single-circuit 115-kilovolt (kV) overhead transmission lines that are situated within the Connecticut Department of Transportation (CT DOT) Metro-North Railroad (MNR) corridor that extends across southern portions of the Town of Fairfield and City of Bridgeport in Fairfield County, Connecticut. UI's existing single-circuit 115-kv transmission lines are currently situated on UI-owned infrastructure (referred to as "bonnets") on top of railroad catenary structures that span the MNR tracks, and in some areas on monopoles or other structures adjacent to the CT DOT corridor.

As part of the Project, UI proposes to remove the 115-kV transmission lines currently supported on the existing railroad catenary structures and relocate these circuits to new steel monopole structures next to or in close proximity to the existing catenary structures. Where necessary, UI also will acquire additional easement beyond the existing CT DOT corridor boundary, as required by the National Electric Safety Code and UI transmission line design standards.

At the request of UI, Exponent, Inc. (Exponent) measured the 60-Hertz electric- and magnetic-field (EMF) levels associated with the existing 115-kV lines in the Project area (i.e., between Catenary Structure B648S in Fairfield and UI's Congress Substation in Bridgeport), as well as in areas adjoining the CT DOT corridor, including those where UI proposes to rebuild the 115-kV lines on single- or double-circuit monopoles on a new permanent easement. Exponent also modeled the transmission lines to calculate EMF for both existing and proposed configurations. For the purposes of this report, the EMF associated with the infrastructure specific to the operation of the MNR has not been modeled as it will not be changed and was evaluated via measurements on and around the CT DOT corridor.

The maximum modeled EMF levels at the standard evaluation height of 1 meter (3.28 feet) above ground decrease as a result of the Project, primarily due to the greater height of the conductors supported on new, taller monopoles compared to the height of the conductors on the catenary bonnet structures. The relocation of the transmission lines from the bonnets on the railroad catenary structures to monopoles farther from the railroad tracks, and in some cases outside the CT DOT corridor, however, means that the maximum EMF levels will generally shift away from the railroad tracks and hence increase in areas along the edge of and away from the CT DOT corridor. In this context, it is useful to note that over much of the Project route, the proposed magnetic-field levels at the edge of the *new* UI easement will be similar to or lower than the existing levels at the edge of the *existing* CT DOT corridor.

Exponent performed additional analyses to calculate magnetic-field levels at readily accessible locations at two recently constructed and now-occupied multi-story apartment buildings, that would be adjacent to the rebuilt 115-kV lines, one in Fairfield and one in Bridgeport. At the apartment building in Fairfield, magnetic field-levels were calculated to generally decrease at the side of the building closest to the CT DOT corridor as a result of the Project, except at the roof of the building. At the apartment building in Bridgeport, magnetic-field levels were calculated to increase at the side of the building closest to the rebuilt 115-kV line, with the largest increases at a height of 45 feet or more. UI is evaluating the viability of alternative designs for the rebuilt lines at these locations. Results of these calculations show that magnetic-field levels at all locations of these apartment buildings (including on the roof) would be far below international safety and health-based standards.

Although EMF levels increase in some portions of the route, all calculated EMF levels associated with the Project, including those at the apartment buildings near the southern CT DOT corridor edge, are far below international safety and health-based standards for EMF. The engineering design and other activities initiated by UI include elements consistent with the Connecticut Siting Council's EMF Best Management Practices.

Note that this Executive Summary does not contain all of Exponent's technical evaluations, analyses, conclusions, and recommendations. Hence, the main body of this report is always the controlling document.

Introduction

To maintain the reliability of the bulk transmission grid in the region, the United Illuminating Company (UI) proposes to rebuild its existing single-circuit 115-kilovolt (kV) overhead transmission lines that are currently situated on UI-owned infrastructure (referred to as "bonnets") on top of railroad catenary structures that span the Metro-North Railroad (MNR) tracks in the Town of Fairfield and City of Bridgeport, both in Fairfield County, Connecticut. The Connecticut Department of Transportation (CT DOT) owns the corridor within which the MNR tracks are aligned, as well as the railroad catenary structures, which support not only the UI bonnets and 115-kV lines, but also MNR signal, feeder, and communication lines critical to the operation of the trains. Most of the UI transmission line infrastructure on top of the railroad catenary structures is approximately 60 years old, whereas the railroad catenary structures that support the UI infrastructure are more than 100 years old.

Recent engineering analyses of these lines determined that the infrastructure supporting the transmission lines exhibit age-related physical limitations; therefore, to maintain the reliability and improve the resiliency of the bulk electric transmission grid in Fairfield County, the state of Connecticut, and the New England region, UI proposes to rebuild its existing single-circuit 115-kV overhead transmission lines in this area (the Project).

As part of the Project, UI proposes to remove the 115-kV transmission lines currently supported on the existing railroad catenary structures and relocate these circuits to new steel monopole structures next to or in close proximity to the existing catenary structures. UI also will remove other UI transmission line infrastructure within the CT DOT corridor (e.g., a steel lattice tower) and rebuild the transmission lines on new double- or single-circuit, self-supporting steel monopoles, aligned generally parallel to the MNR tracks and predominantly within the CT DOT-owned corridor. The Project will extend approximately 7.3 miles from Catenary Structure B648S, which is located along the CT DOT corridor just east of Sasco Creek in the southwestern portion of Fairfield to UI's Congress Street Substation, which is situated adjacent to the western bank of the Pequonnock River in Bridgeport. The Project also will rebuild two 115-kV lines along a 0.23-mile UI right-of-way (ROW) extending from the CT DOT corridor to

UI's Ash Creek Substation in Bridgeport and will connect the rebuilt 115-kV lines to UI's existing Resco, Pequonnock, and Congress Street substations.

UI further proposes to remove the existing lines and bonnets presently located on 157 railroad catenary structures owned by CT DOT and rebuild the transmission lines on new double- or single-circuit, self-supporting steel monopoles, aligned generally parallel to the MNR tracks, and where possible within or near the CT DOT railroad corridor. In total, 102 new single- or double-circuit monopoles will be installed to support the rebuilt 115-kV lines.

At the request of UI, Exponent, Inc. (Exponent) measured EMF levels associated with the operation of the existing 115- kV lines located on the railroad catenary structures in the Project area (i.e., between Catenary Structure B648S in Fairfield and UI's Congress Street Substation in Bridgeport), as well as in areas adjoining the CT DOT corridor, including those where UI proposes to rebuild the 115-kV lines on single-or double-circuit monopoles on a new permanent easement. In addition, Exponent measured EMF levels along the 0.23-mile existing UI ROW between the CT DOT corridor and Ash Creek Substation, where UI's three existing lattice steel towers will be replaced with single-circuit monopoles, in sets of two.

Exponent also calculated the expected EMF levels during the operation of the 115-kV lines following the rebuild on single-circuit vertical monopole structures located along the south side of the railroad tracks in Fairfield and on a combination of single- and double-circuit monopoles located along the rest of the Project route, with all monopoles principally along or near the CT DOT-owned corridor or—in the case of the short UI ROW to Ash Creek Substation—within the existing and proposed expanded ROW.

Along different portions of the route, the new monopoles will be offset by varying distances from the existing catenary structures based on the CT DOT corridor width and clearance requirements specified by the CT DOT and MNR. Many of the rebuilt structures will be rebuilt within the existing CT DOT corridor. Those new monopoles that will need to be located outside of the CT DOT corridor due to space or clearance limitations will generally be placed as close to the edge of the CT DOT corridor as practical. Where necessary, UI will acquire additional easement beyond the existing boundary of the CT DOT corridor, with the goal of maintaining electrical clearances as required by the National Electric Safety Code (NESC), UI transmission line design standards, and the Transmission Vegetation Management Operating Procedure (which is governed by North American Electric Reliability Corporation FAC-003-4 requirements). The configurations of the existing and proposed transmission lines are shown in Attachment A.

Additionally, at two locations along the proposed route, two recently constructed apartment buildings (now occupied) are in close proximity to the southern edge of the CT DOT corridor. At these two locations the rebuilt transmission lines are proposed to be rebuilt with less than the typical 18-feet of horizontal clearance (though in both locations the new transmission line conductors will be far above the top of the buildings, to ensure the new transmission line conductors maintain necessary clearances to adjacent property as mandated by the National Electrical Safety Code, as well as UI's standard design criteria.

This report describes the physical models and line loadings of the existing and rebuilt transmission lines, technical background, assessment criteria, calculation methods, and results. Attachment A provides a summary of the modeling configurations and loading. Attachments B and C provide tabular and graphical summaries of calculated results, respectively. Attachment D provides measurements of pre-construction EMF levels. Attachment E details calculations at two apartment buildings in close proximity to the CT DOT corridor. A calibration certificate for the meter used to measure electric and magnetic fields is provided in Attachment F.

Route Segments and Configurations

To calculate existing and proposed EMF levels associated with UI's existing and proposed 115-kV lines, Exponent used 18 separate models appropriate to the different transmission line configurations and the arrangement of UI's 115-kV transmission lines along the Project route.[1] The configurations of these segments are described in 18 individual models, labeled sequentially XS-1 through XS-18. While these cross sections are different enough to require modeling separately, they can be broadly categorized into five groups.

[1] Different models are required due to variation of the existing and proposed configurations along the route (e.g., transmission lines on only the southern railroad catenary support columns, on both the north and south catenary support columns, and on independent monopoles or lattice steel towers).

Group 1 Encompasses the majority (>70%) of the modeled route and includes the portions of the route in Fairfield and Bridgeport where the existing transmission lines on the southern catenary structures are proposed to be relocated to steel monopoles on the *south* side of the CT DOT corridor. (The existing transmission line located on monopoles and eight bonnets along the north side of the CT DOT corridor in these areas will not be modified as a result of this Project). Group 1 consists of modeling cross sections XS-1 through XS-7 and XS-9 through XS-13.

Group 2 Represents a very short portion of the route that consists of a single modeling cross section along UI's existing 0.23-mile ROW between the CT DOT corridor (in Fairfield), across Ash Creek to the existing Ash Creek Substation (in Bridgeport). Along this UI easement, the three existing double-circuit lattice structures (supporting two 115-kV lines) will be replaced with single-circuit vertical monopole structures, separating each 115-kV line. It consists of modeling cross section XS-8.

Group 3 Represents a very short portion of the route in Bridgeport where the two transmission lines (circuits on the north and south side of the CT DOT corridor), currently constructed on bonnets on the railroad catenary structures, will be rebuilt on double-circuit monopoles on the *north* side of the CT DOT corridor. It consists of modeling cross section XS-14.

Group 4 Consists of three separate portions of the route in Bridgeport where the two transmission lines currently supported on the north and south railroad catenary structures will be rebuilt on double-circuit monopoles on the *south* side of the CT DOT corridor. It consists of modeling cross sections XS-15 and XS-18.

Group 5 Consists of two contiguous portions of the route in Bridgeport where the two transmission lines that are currently situated on the north and south railroad catenary structures will be rebuilt on separate single-circuit monopoles, one on the north side of the CT DOT corridor and the other on the south side of the CT DOT corridor. Some of the northern proposed monopoles will be aligned along South Frontage Road, while the proposed southern monopoles will parallel the CT DOT corridor, resulting in the need for UI to acquire two separate permanent easements. The path of the two rebuilt transmission lines diverge along this portion of the route, so modeling is based upon a single representative cross section in those portions of the route. It consists of cross sections XS-16 and XS-17.

As noted above, Group 1 covers both the majority (>70%) of the modeled route as well as the majority (12 of 18) of the modeling cross sections (XS-1 through XS-7 and XS-9 through XS-13). The transmission lines located on the south side of the catenary structures in Group 1 are proposed to be relocated to steel monopole structures located on the south side of the CT DOT corridor, and occasionally outside of it. The differences between these cross sections involve variations in the monopole structure locations, the design of existing structures, and the widths of existing and proposed UI easements. Several dimensions vary through the modeled route as illustrated in Figure 1:

- Dimension I: Existing Pole Offset Distance from Existing Catenary Structure North Side
- Dimension II: Existing Distance from Existing Catenary Structure to CT DOT Corridor Boundary North Side
- Dimension III: New Pole Offset Distance from Existing Catenary Structure South Side
- Dimension IV: Existing Distance from Existing Catenary Structure to CT DOT Corridor Boundary South Side

Attachment A provides a summary of the configurations of the 18 models used to represent the various route segments, as well as a detailed description of the minimum and maximum values for Dimensions I through IV for each of the relevant modeling cross sections.[2] Each of the modeled cross sections is shown in Attachment A, Figure A-3 to Figure A-20. A map showing the locations of these different modeled route segments is shown below in Figure 2. More

[2] As described above, the transmission lines connect to multiple substations along the route; hence the electrical current flowing on the transmission lines also will vary along the route. The maximum loading appropriate to each modeling cross section was applied to conservatively overestimate magnetic-field levels in these locations (Attachment A).

detailed maps showing the location of each modeling cross section are shown in Attachment A, Figure A-1 and Figure A-2.[3]

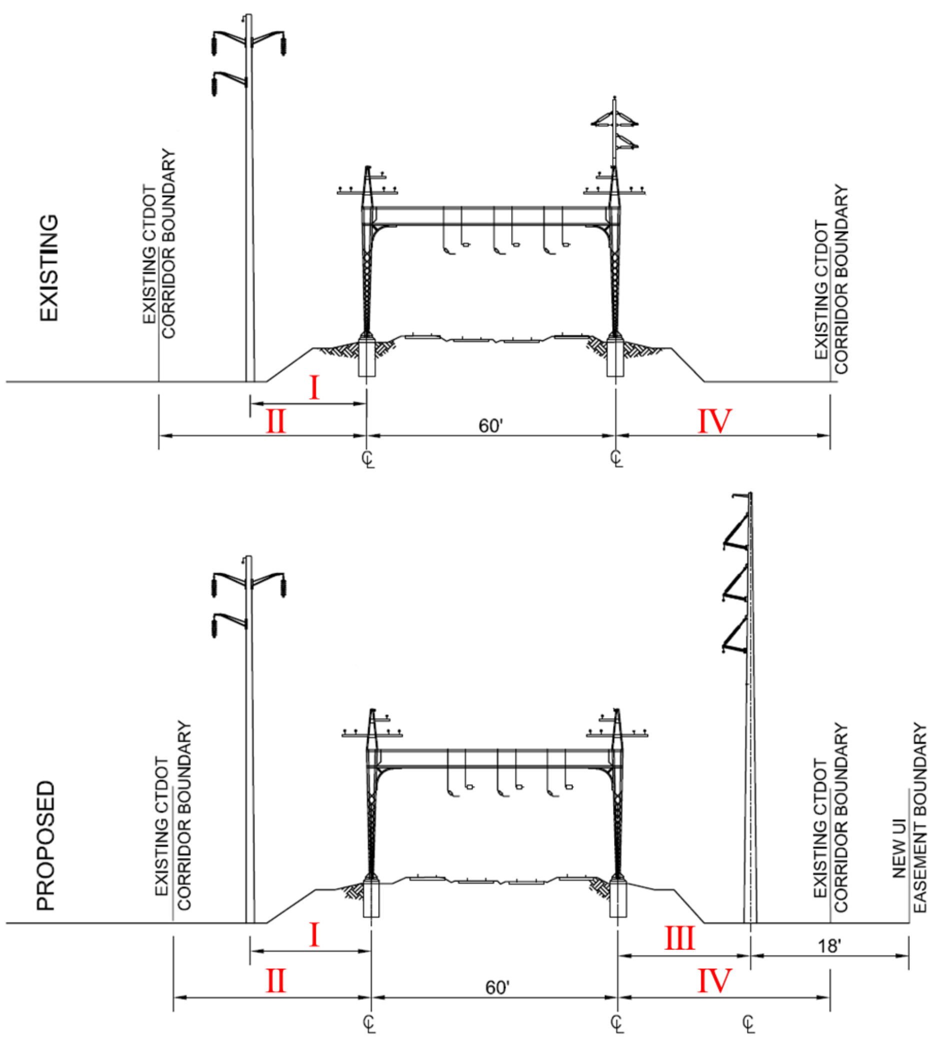

Figure 1. Existing and proposed configurations of the Project-related transmission lines and CT DOT catenary structure (view facing northeast) for XS–2.

Dimensions I, II, III, and IV vary throughout the route. A summary of the range of these distances, and depictions of other cross sections, can be found in Attachment A, Table A-1.

[3] Black lines in Figure 2 indicate route segments that were not modeled. The majority of the unmodeled portions are transition spans (e.g., between XS-1 and XS-3) that are not well modeled by the two-dimensional modeling methods typically employed for transmission lines. EMF levels at transition spans, however, are generally lower than the modeled configurations due to additional cancellation of changing phases. Additionally, the conservatively-selected modeling parameters of minimum distances and maximum loads will generally overestimate EMF levels. Spans adjacent to substations may differ somewhat from spans further from them but would require detailed three-dimensional modeling to evaluate. Additional unmodeled route segments include locations where the lines cross above roads and hence have much higher conductor clearances that result in lower EMF levels than calculated for other locations.

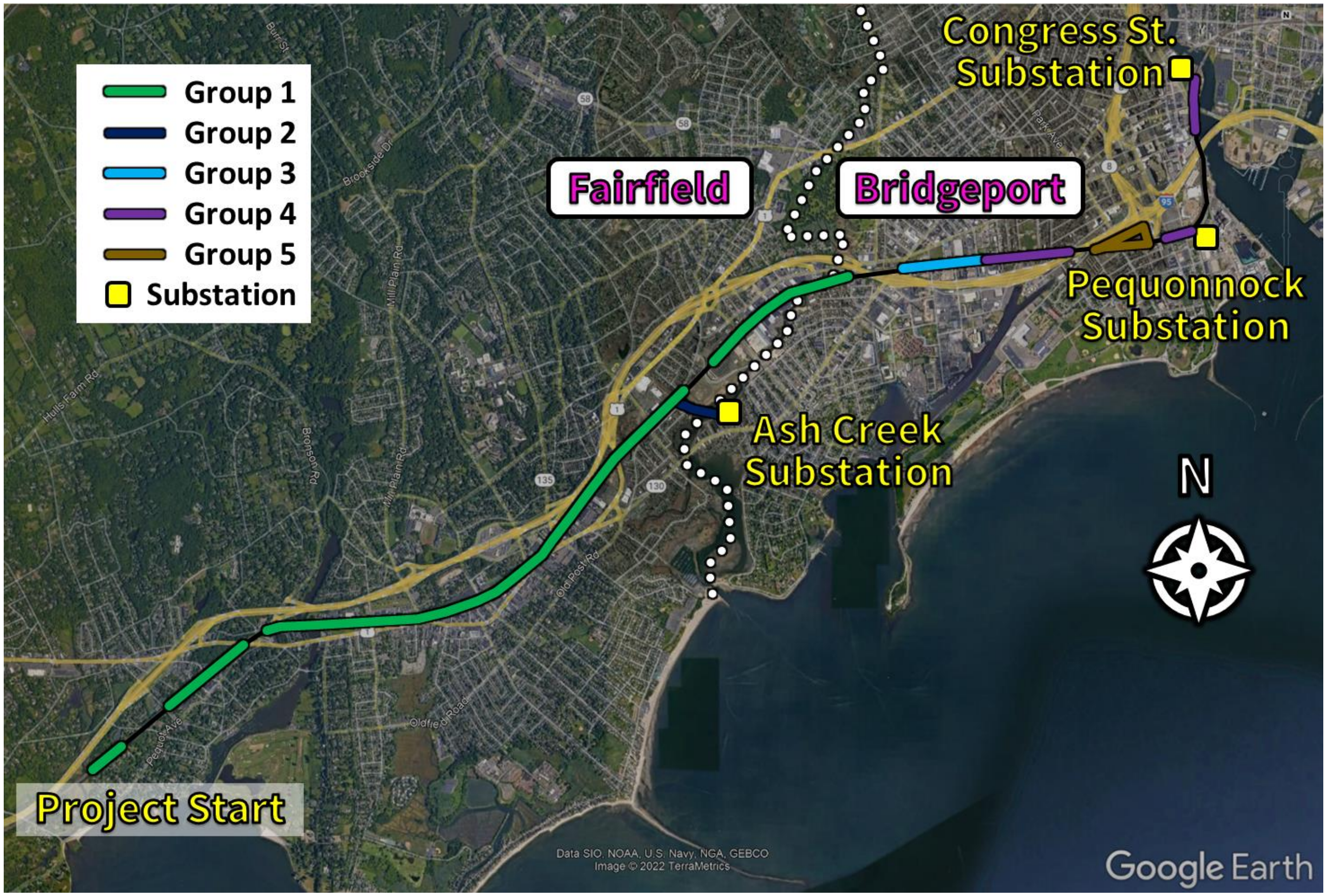

Figure 2. Project route map showing EMF modeling Groups.

The narrow black lines indicate areas where EMF modeling was not performed because the proposed design changes from one structure to the next; there are no residences or CSC statutory facilities near these locations. The white dots represent the boundary between Fairfield and Bridgeport.

Apartment Buildings

At two locations along the proposed Project route, the rebuilt 115-kV lines, as presently designed, would be in close proximity to recently constructed, multi-story apartment buildings (now occupied). The apartment buildings are constructed very close to the edge of the existing CT DOT corridor and present a situation where residents will have ready access to locations significantly above ground level in relatively close proximity to the Project's transmission lines. As a result, UI requested that Exponent evaluate magnetic-field levels at relevant heights of these apartment buildings in addition to the standard assessment height of 1 meter (3.28 feet) above ground required by the Connecticut Siting Council.[4]

Apartment Building in Fairfield

The three-story apartment building at 78 Unquowa Place in Fairfield is situated directly adjacent to the CT DOT corridor, near the 1430 Line (i.e., near new structures P689S-P690S). The existing 1430 Line adjacent to this building is constructed on catenary structures on the south side of the CT DOT corridor. The 1430 Line is currently proposed to be constructed on vertical monopoles within the CT DOT corridor. As shown in Figure 3, although the proposed structure's centerline will be closer to the apartment building, the davit arms will be situated away from the it toward the center of the CT DOT corridor, so the horizontal distance to the nearest conductor will decrease by only approximately 2 feet-4 inches from 15 feet-9 inches to 13 feet-5 inches. In addition, the minimum midspan conductor height will increase from 42 feet for the existing configuration to 79 feet-4 inches for the proposed configuration (well above the top of the building, which is 63 feet above ground level). UI is evaluating the viability of alternative designs for the rebuilt line at this location.

[4] "In accordance with industry practice, the calculation shall be done at the location of maximum line sag (typically mid-span), and shall provide MF values at 1 meter above ground level, with the assumption of flat terrain and balanced currents" (CSC BMP 2014, Section A, pg. 6).

Apartment Complex in Bridgeport

The recently constructed apartment complex (Windward Apartments) in Bridgeport is situated south of the railroad corridor within the block bounded by Park Avenue, Johnson Street, and Columbia Street, near new structures P758S-P759S. The apartment complex includes several existing and proposed buildings and a playground. In this area, UI's currently-proposed design aligns the 91001-1 Line in a single-circuit configuration south of Railroad Avenue and the elevated CT DOT corridor and the 1130 Line along a new UI easement to the north of the CT DOT corridor. In this location, the MNR tracks are elevated and the CT DOT corridor is too narrow to accommodate the rebuilt 115-kV lines, so the 91001-1 Line will be constructed on vertical monopoles as close to the CT DOT corridor as possible along the south side of Railroad Avenue. Most of the buildings of the apartment complex range from about 50 to 400 feet from the proposed line with one 55-foot-tall building near the intersection of Railroad Avenue and Park Avenue which is approximately 6 feet-8 inches (horizontally) from the proposed line.

As shown in Figure 4, the davit arms of the proposed structures will be situated away from the apartment complex toward the CT DOT corridor, and the horizontal distance from the nearest apartment building to the nearest conductor will decrease from approximately 37 feet-6 inches to 6 feet-8 inches, while the minimum midspan conductor height will increase from 43 feet-9 inches for the existing configuration to 75 feet-2 inches for the proposed configuration (well above the top of the 55-foot tall building). UI is evaluating the viability of alternative designs for the rebuilt line at this location.

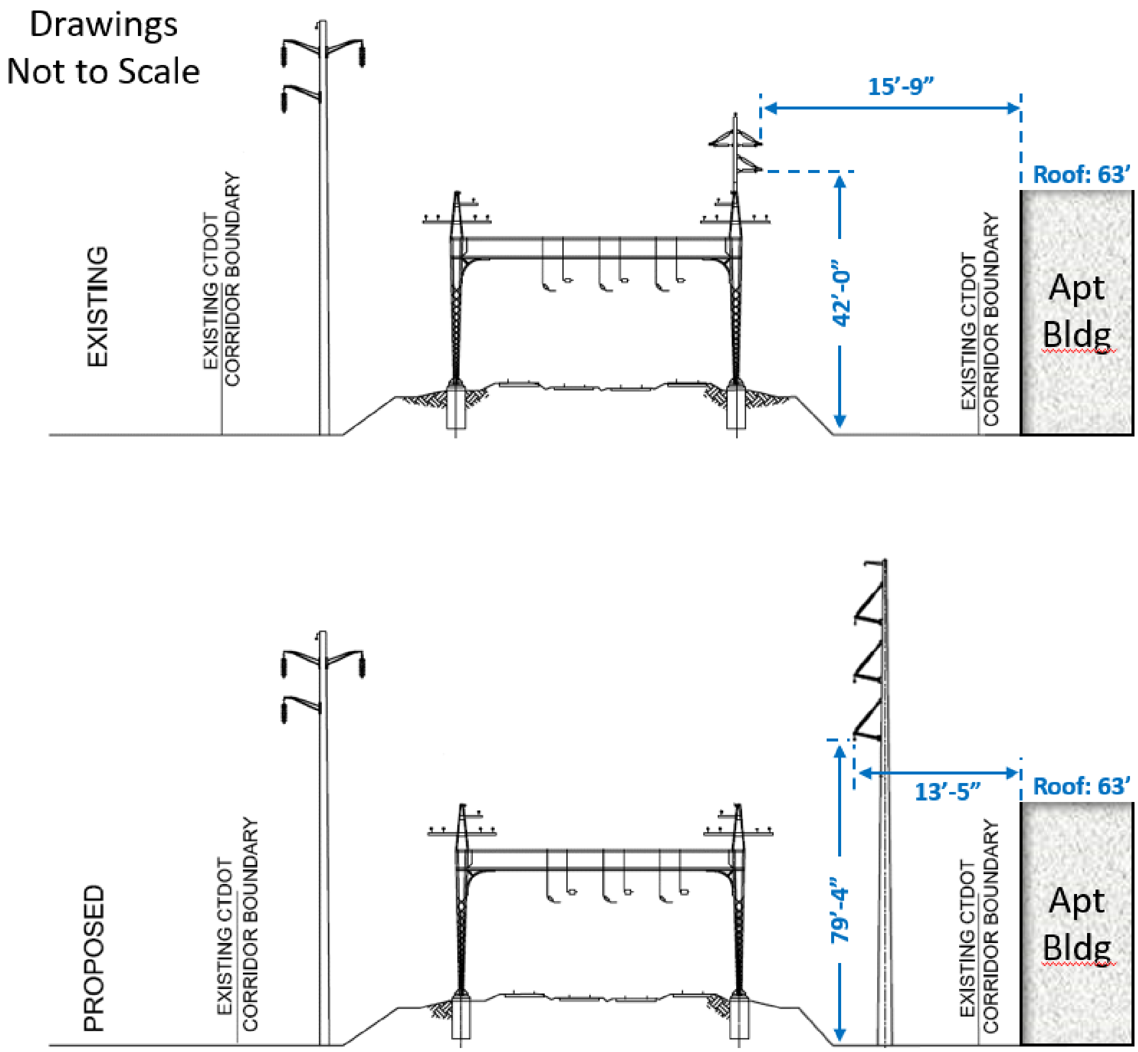

Figure 3. Existing and proposed configurations of the Project-related transmission lines and CT DOT catenary structure in a subsection of XS–2 at the apartment building along Unquowa Place in Fairfield (view facing northeast).

Proposed conductors will be approximately 2 feet closer (horizontally) to the apartment building and 37 feet higher at midspan.

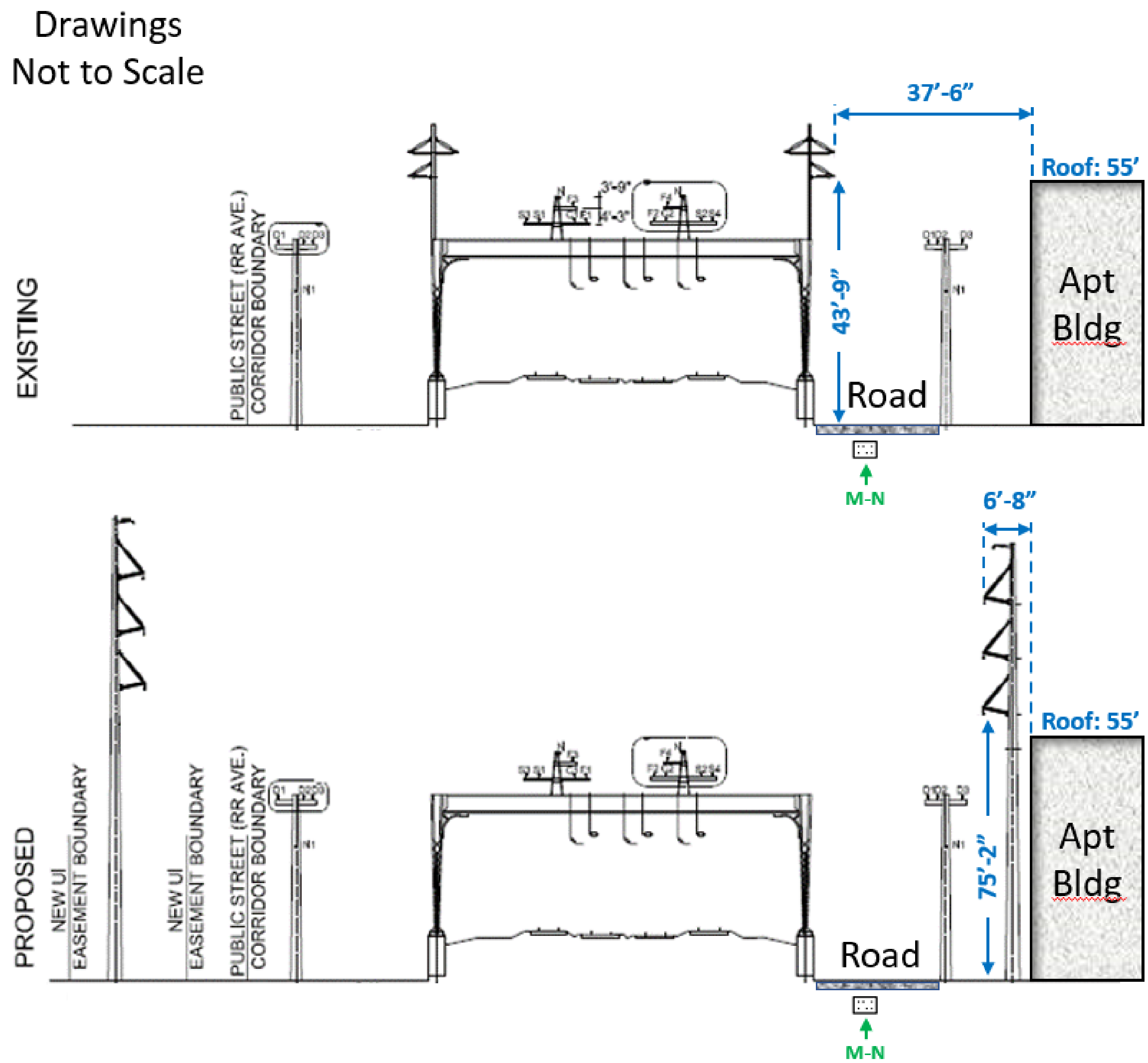

Figure 4. Existing and proposed configurations of the Project-related transmission lines and CT DOT catenary structure in a subsection of XS–17 at the apartment building along Railroad Avenue in Bridgeport (view facing northeast).

Proposed conductors will be approximately 31 feet closer (horizontally) to the apartment building and 31 feet higher at midspan. The Middletown-Norwalk 345-kV transmission line (M-N) is in the road between the CT DOT corridor and the apartment building and an existing distribution line runs down the sidewalk in front of the apartment building.

Technical Background

Magnetic Fields. The currents flowing in the conductors of transmission lines and substation bus work generate magnetic fields near the conductors. The strength of Project-related magnetic fields in this report are expressed as magnetic flux density in units of milligauss (mG), where 1 Gauss = 1,000 mG. These currents (and thus magnetic fields) vary in direction and magnitude with a 60-Hertz (Hz) cycle. The load currents—expressed in units of amperes (A)—vary with the demand for electricity from customers, so the magnetic fields generated around the conductors vary proportionately to the load. Therefore, measurements or calculations of the magnetic field present a snapshot at only one moment in time. On a given day, throughout a week, or over the course of months and years, the magnetic-field level can change depending upon the patterns of power demand on the bulk transmission system.

Electric Fields. The voltage on the conductors of transmission lines generates an electric field in the space between the conductors and the ground. Many objects are conductive—including fences, shrubbery, and buildings—and thus shield electric fields. In this report, electric-field levels calculated for the transmission lines are expressed in units of kilovolts per meter (kV/m)—1 kV/m is equal to 1,000 volts per meter.

Electricity is an integral part of our infrastructure (e.g., transportation systems) and our homes and businesses, and people living in modern communities are therefore surrounded by sources of EMF. Figure 5 depicts typical EMF levels measured in residential and occupational environments and EMF levels measured on or at the edge of distribution line and transmission line ROWs.

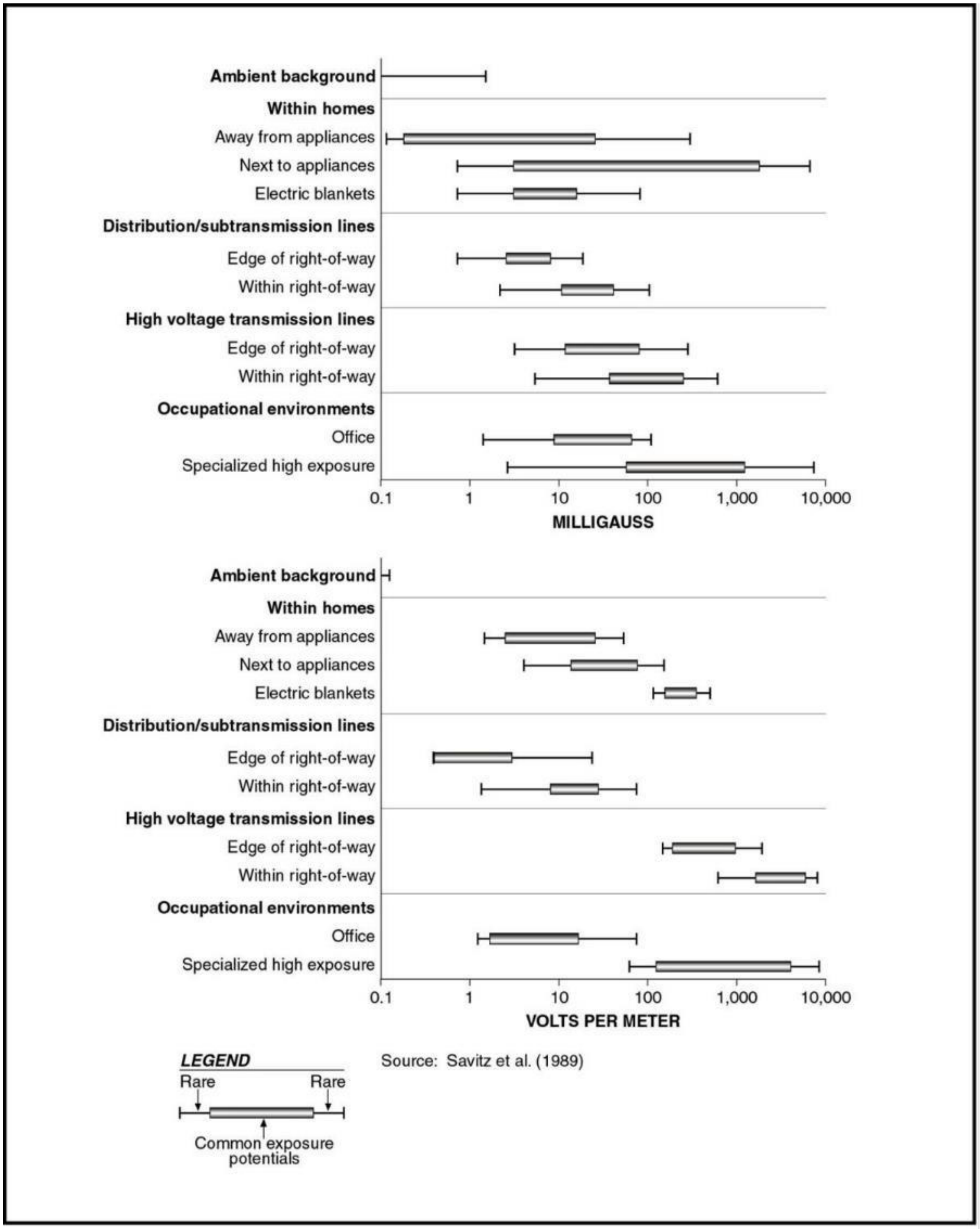

Figure 5. Electric- and magnetic-field levels in the environment.

Assessment Criteria

Neither the federal government nor the state of Connecticut has enacted standards for magnetic fields or electric fields from power lines or other sources at power frequencies, although the CSC has developed guidelines for the siting of new transmission lines as discussed in a subsequent section of this report.

Relevant health-based EMF assessment criteria include exposure limits recommended by scientific organizations. These exposure limits are included in guidelines developed to protect health and safety and are based upon reviews and evaluations of relevant health research. These guidelines include exposure limits for the general public recommended by the International Committee on Electromagnetic Safety (ICES) and the International Commission on Non-Ionizing Radiation Protection (ICNIRP) to address health and safety issues.[5]

In a June 2007 Factsheet, the World Health Organization (WHO) included recommendations that policy makers should adopt international exposure limit guidelines, such as those from ICNIRP or ICES (Table 1), for public and occupational exposure to EMF.[6]

Table 1. ICNIRP and ICES guidelines for EMF exposure at 60-Hz

	Exposure (60 Hz)	
	Electric Field	Magnetic Field
ICNIRP		
Occupational	8.3 kV/m	10 G (10,000 mG)
General Public	4.2 kV/m	2 G (2,000 mG)
ICES		
Occupational	20 kV/m	27.1 G (27,100 mG)
General Public	5 kV/m*	9.040 G (9,040 mG)

*Within power line rights of way, the guideline is 10 kV/m under normal load conditions.

5 International Committee on Electromagnetic Safety (ICES). IEEE Standard for Safety Levels with Respect to Human Exposure to Electromagnetic Fields 0 to 3 kHz. Piscataway, NJ: IEEE Std C95.1™-2019. IEEE Std C95.1™-2019/Cor2-2020; International Commission on Non-ionizing Radiation Protection (ICNIRP). Guidelines for limiting exposure to time-varying electric and magnetic fields (1 Hz to 100 kHz). Health Phys 99: 818-836, 2010.

6 World Health Organization (WHO). Fact Sheet No. 322: Electromagnetic Fields and Public Health – Exposure to Extremely Low Frequency Fields. Geneva, Switzerland: World Health Organization, 2007.

Connecticut Siting Council Best Management Practices

The CSC adopted "EMF Best Management Practices for the Construction of Electric Transmission Lines in Connecticut" (BMP) based upon a consensus of health and scientific agencies that the scientific evidence "*reflects the lack of credible scientific evidence for a causal relationship between MF [magnetic field] exposure and adverse health effects*."[7] Nevertheless, the CSC concluded that precautionary measures for the siting of new transmission lines in the state of Connecticut are appropriate and advocates "*the use of effective no-cost and low-cost technologies and management techniques on a project-specific basis to reduce MF exposure to the public while allowing for the development of efficient and cost-effective electrical transmission projects*."[8]

The Project does not involve the development of new transmission lines, but rather the relocation of existing 115-kV transmission lines within the CT DOT corridor and new UI easements. In addition, the Project includes no cost/low-cost design elements consistent with the CSC BMP, such as:

1. **Distance**: UI proposes to remove the existing transmission lines from the CT DOT catenary support columns and other existing legacy structures (e.g., lattice steel towers) and will rebuild the 115-kV facilities on monopole structures located closer to the edge of or outside of the CT DOT corridor, to maintain minimum clearance requirements from the existing MNR lines and infrastructure. Therefore, UI proposes to acquire new permanent easements, where necessary, to ensure the new transmission line conductors maintain necessary horizontal clearances to adjacent property, as mandated by the NESC and by UI's standard design criteria.

2. **Height of Support Structures**: The taller monopole structures will raise the heights of the rebuilt 115-kV transmission conductors compared to the heights of the 115-kV conductors on the existing catenary structures (which are about 60-80 feet [18-24 meters] tall, with the

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7 Connecticut Siting Council (CSC). Revised February 20, 2014. Electric and Magnetic Fields Best Management Practices for the Construction of Electric Transmission Lines in Connecticut. New Britain, CT: CSC, p. 3.

8 Ibid., p. 4

UI facilities on top of the bonnets) and will be higher than minimum clearances required by the NESC. The heights of the new monopoles along the Ash Creek ROW similarly will be taller than the existing lattice steel towers.

3. **Optimum Phasing**: Within the constraints of constructability (i.e., maintaining the same phasing between substations), UI has selected the phasing of the rebuilt lines to be optimal, minimizing Project-related EMF levels at the edge of CT DOT corridor or the new UI easement.

The CSC's EMF BMP guidance (CSC, 2014) expresses the CSC's interest in "*evidence of any new developments in scientific research addressing MF and public health effects or changes in scientific consensus group positions regarding MF*" (p. 5). Although the CSC's 2014 BMPs serve as the primary reference to new developments in EMF scientific research for this Project, Exponent notes that the Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR) of the European Union issued its opinion report in 2015 in which the Committee concluded that research published up to 2014 did not confirm any adverse health effects from EMF exposure. The SCENIHR review was the most comprehensive review completed since the WHO review in 2007 (WHO, 2007). The conclusions of the 2015 SCENIHR review are consistent with the conclusions expressed in the WHO report and the BMPs published in 2014.

Methods

EMF Measurements

Exponent collected electric-field and magnetic-field measurements along the existing CT DOT corridor and adjacent areas, which included residences and community facilities, on May 2 and May 22, 2022. The purpose of these measurements was to characterize existing EMF levels along the CT DOT corridor and adjacent areas under pre-Project conditions. The measurements were taken at a height of approximately 3.28 feet (1 meter) above ground in general accordance with the standard methods for measuring near power lines and measured with meters calibrated using IEEE methods, both described in IEEE Std. 644-2019.[9] Both electric-field and magnetic-field measurements are reported as the total field computed as the resultant of field vectors measured along vertical, transverse, and longitudinal axes[10] in accordance with IEEE Standard C95.3-2021 and IEEE Standard 644-2019.[11]

Results of these measurements are summarized in the Results section below with additional details provided in Attachment D.

EMF Modeling

Standard Approach

As noted above, for the majority of the Project route, Exponent evaluated EMF levels at a height of 1 meter (3.28 feet) above ground in accordance with industry standard practices (e.g., IEEE

9 Institute of Electrical and Electronics Engineers (IEEE). IEEE Standard Procedures for Measurement of Power Frequency Electric and Magnetic Fields from AC Power Lines (ANSI/IEEE Std. 644-2019). New York: IEEE, 2019.

10 Measurements along the vertical, transverse, and longitudinal axes were recorded as root-mean-square magnitudes. Root mean square refers to the common mathematical method of defining the effective voltage, current, or field of an alternating current system.

11 Institute of Electrical and Electronics Engineers (IEEE). IEEE Standard Procedures for Measurement of Power Frequency Electric and Magnetic Fields from AC Power Lines (ANSI/IEEE Std. 644-2019). New York: IEEE, 2019; Institute of Electrical and Electronics Engineers (IEEE). IEEE Recommended Practice for Measurements and Computations of Electric, Magnetic and Electromagnetic Fields with Respect to Human Exposure to Such Fields, 0 Hz-300 GHz (IEEE Std. C95.3-2021). New York: IEEE, 2021.

Std. C95.3-2021 and Std. 644-2019).[12] These calculations were performed used computer algorithms developed by the Bonneville Power Administration (BPA),[13] a division of the US Department of Energy, to calculate electric field and magnetic fields for the Project transmission lines.[14] These algorithms have been confirmed to accurately predict EMF levels measured near operating transmission lines.[15] The calculation models assume that each conductor is infinite in length, above an infinite flat earth, with no nearby conductive objects. In addition, they assume that the conductors are all parallel to each other at a fixed height above ground. These assumptions are made to ensure that all calculations are conservative e(i.e., that they will overestimate actual EMF levels). UI provided the data regarding voltage, current flow, phasing, and conductor configuration. For the purposes of this report, the EMF associated with the infrastructure specific to the operation of the MNR has not been modeled as it will not be changed and was evaluated via measurements on and around the CT DOT corridor.

All standard calculations conservatively assumed that the conductors were located at the minimum midspan conductor height for the respective span. For the existing catenary structures, this minimum midspan height was 23 feet above ground level, and for all other structures (i.e., both existing and proposed monopole structures), this minimum midspan height was 34 feet. In reality, both of these values are very conservative for most locations since every span will have an attachment height at structures that is greater, and for many spans the minimum midspan conductor height also is substantially greater.

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[12] Institute of Electrical and Electronics Engineers (IEEE). IEEE Standard Procedures for Measurement of Power Frequency Electric and Magnetic Fields from AC Power Lines (ANSI/IEEE Std. 644-2019). New York: IEEE, 2019; Institute of Electrical and Electronics Engineers (IEEE). IEEE Recommended Practice for Measurements and Computations of Electric, Magnetic and Electromagnetic Fields with Respect to Human Exposure to Such Fields, 0 Hz-300 GHz (IEEE Std. C95.3-2021). New York: IEEE, 2021.

[13] Bonneville Power Administration (BPA). 1991. Corona and Field Effects Computer Program. Portland, OR: BPA.

[14] Data on the loading and configuration of the MNR conductors were not available, so these conductors were not included in the models. EMF from the existing configurations (including from MNR conductors) were captured in existing measurements performed on May 2 and May 22, 2022, as summarized in Attachment D.

[15] *See* Chartier V and Dickson L. 1990. Results of Magnetic Field Measurements Conducted on Ross Lexington 230-kV Line. Report No. ELE-90-98. Portland, OR: Bonneville Power Administration; and Perrin N, Aggarwal R, Bracken T, Rankin R. 1991. Survey of Magnetic Fields near BPA 230-kV and 500-kV Transmission Lines. Portland, OR: Portland State University.

Approach at Apartment Buildings

Exponent performed modeling of magnetic-field levels at the two identified apartment buildings using the same BPA algorithms as in the standard modeling approach. However, instead of assuming that the conductors of all transmission lines were located at an absolute minimum midspan conductor height along the route, the models used the minimum midspan conductor height (at an operating temperature of 140 degrees Celsius [284 degrees Fahrenheit]) at the specific spans (both existing and proposed) of the adjacent transmission lines.

As discussed in relation to Figure 3 and Figure 4 above, the minimum midspan clearance for the transmission line spans adjacent to the apartment buildings are substantially higher above ground than the 23 feet (existing bonnets) and 34 feet (proposed monopoles) used in the standard modeling approach. This approach was used at these locations to provide a more accurate evaluation of magnetic-field levels at these locations.

Additionally, instead of evaluating magnetic-field levels only at a height of 1 meter (3.28 feet) above ground, modeling at the apartment buildings included assessment heights from ground level to 150 feet above ground (well above the tops of the apartment buildings).

Finally, at the apartment complex in Bridgeport, the modeling included two additional important contributors to the magnetic-field levels. The first is the existing overhead electric distribution line that is aligned along the south side of Railroad Avenue, directly adjacent to the apartment building; this distribution line would be beneath the conductors of the currently-proposed 115-kV transmission line on separate structures. The second is the existing Middletown-Norwalk 345-kV double-circuit underground duct bank, constructed near the center of Railroad Avenue.

The non-standard modeling assumptions used in the calculations near the two apartment buildings were made to provide a more holistic (and accurate) evaluation of the magnetic-field levels at these locations.

Loading

The flow of electrical current on conductors is commonly referred to as the load or loading. A summary of the loading for each model is provided in Attachment A, along with a summary of the process undertaken by UI to determine these loading levels based upon reports from the Independent System Operator of New England (ISO-NE). The current flows used for modeling are also summarized in a table available from Exponent upon request, consistent with Critical Energy Infrastructure Information (CEII) restrictions.

Results and Discussion

Measured EMF Levels

Exponent obtained EMF measurements within the CT DOT corridor (as close to the edges of the corridor as could be safely measured) and at or near the boundaries of the adjacent properties listed in Attachment D. Measured magnetic-field levels within the CT DOT corridor averaged between 5.9 and 27 mG.[16] Measured electric-field levels within the CT DOT corridor varied between less than 0.1 and 0.2 kV/m with a maximum measured level of 0.4 kV/m. EMF measurements in other areas within 300 feet of the CT DOT corridor had similar maximum recorded levels, but overall were generally lower than on the CT DOT corridor. The average measured magnetic field in these areas (outside the CT DOT corridor) varied from approximately 0.5 mG to 25 mG (primarily due to sources other than the UI transmission lines), and all electric-field levels were all less than 0.2 kV/m. Higher EMF levels were most often measured nearest to the transmission lines (or near distribution lines located outside the CT DOT corridor) and lower levels were measured away from transmission and distribution lines.

Attachment D provides both annotated aerial photographs of measurement locations and measured EMF values collected while walking within the existing CT DOT corridor and adjacent to residential properties. Table D- of Attachment D provides summary statistics for all obtained measurements.

Calculated EMF Levels

Exponent also modeled the EMF levels for the existing and proposed configurations of the 115-kV lines, assuming the peak and peak daily average load in 2022 and the projected peak and peak daily average load anticipated in 2029 after the Project is scheduled to be completed.

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16 Isolated magnetic-field levels reached up to 324 mG, corresponding to locations while walking across the railway from one side of the CT DOT corridor to the other. This observation is consistent with potential current flow related to railroad operation, though the source was not conclusively identified through measurements. Regardless, these maximum levels occurred near the center of the CT DOT corridor, far from the edge of the corridor or adjacent properties.

Overview of Calculations

An example of the graphical profiles for each modeled cross section is provided below in Figure 6 (magnetic field) and Figure 7 (electric field) for modeling cross section XS-2 (in Group 1) which represents more of the project route than any other single portion of the route. These figures provide a visual summary of the calculated results along with representations of the existing and proposed structures for illustrative purposes. These figures also show the graphical representations of the calculated magnetic- and electric-field levels on the same scale as the ICNIRP reference levels: 2,000 mG and 4.2 kV/m, respectively.[17] The scale of the graph on the right of the figures is magnified to illustrate the small differences between the calculated existing and proposed EMF levels.

Even directly beneath the transmission lines where EMF levels are highest, the maximum existing magnetic-field level anywhere along the route is more than 13-fold below the lowest health-based limit (i.e., the ICNIRP reference level). Farther from the transmission lines, at the existing and expanded UI easement boundary (where applicable) and beyond, EMF levels are still lower. All calculated EMF levels from the Project are far below accepted levels of exposure to the general public in ICNIRP or ICES standards.[18] For the purposes of this report, the EMF associated with the infrastructure specific to the operation of the MNR has not been modeled as it will not be changed and was evaluated via measurements on and around the CT DOT corridor.

Attachment B contains a tabular summary of magnetic-field levels at average and peak loading (Table B-1 to Table B-4) and electric-field levels (Table B-5 and Table B-6). Attachment C provides graphical profiles of magnetic-field levels (Figure C-1 to Figure C-18) and electric-field levels (Figure C-19 to Figure C-36) illustrating the EMF level along transects perpendicular to each segment of the Project route for existing and proposed conditions.

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[17] International Commission on Non-ionizing Radiation Protection (ICNIRP). Guidelines for limiting exposure to time-varying electric and magnetic fields (1 Hz to 100 kHz). Health Phys 99: 818-836, 2010.

[18] International Committee on Electromagnetic Safety (ICES). IEEE Standard for Safety Levels with Respect to Human Exposure to Electromagnetic Fields 0 to 3 kHz. Piscataway, NJ: IEEE Std C95.1™-2019. IEEE Std C95.1™-2019/Cor2-2020; International Commission on Non-ionizing Radiation Protection (ICNIRP). Guidelines for limiting exposure to time-varying electric and magnetic fields (1 Hz to 100 kHz). Health Phys 99: 818-836, 2010.

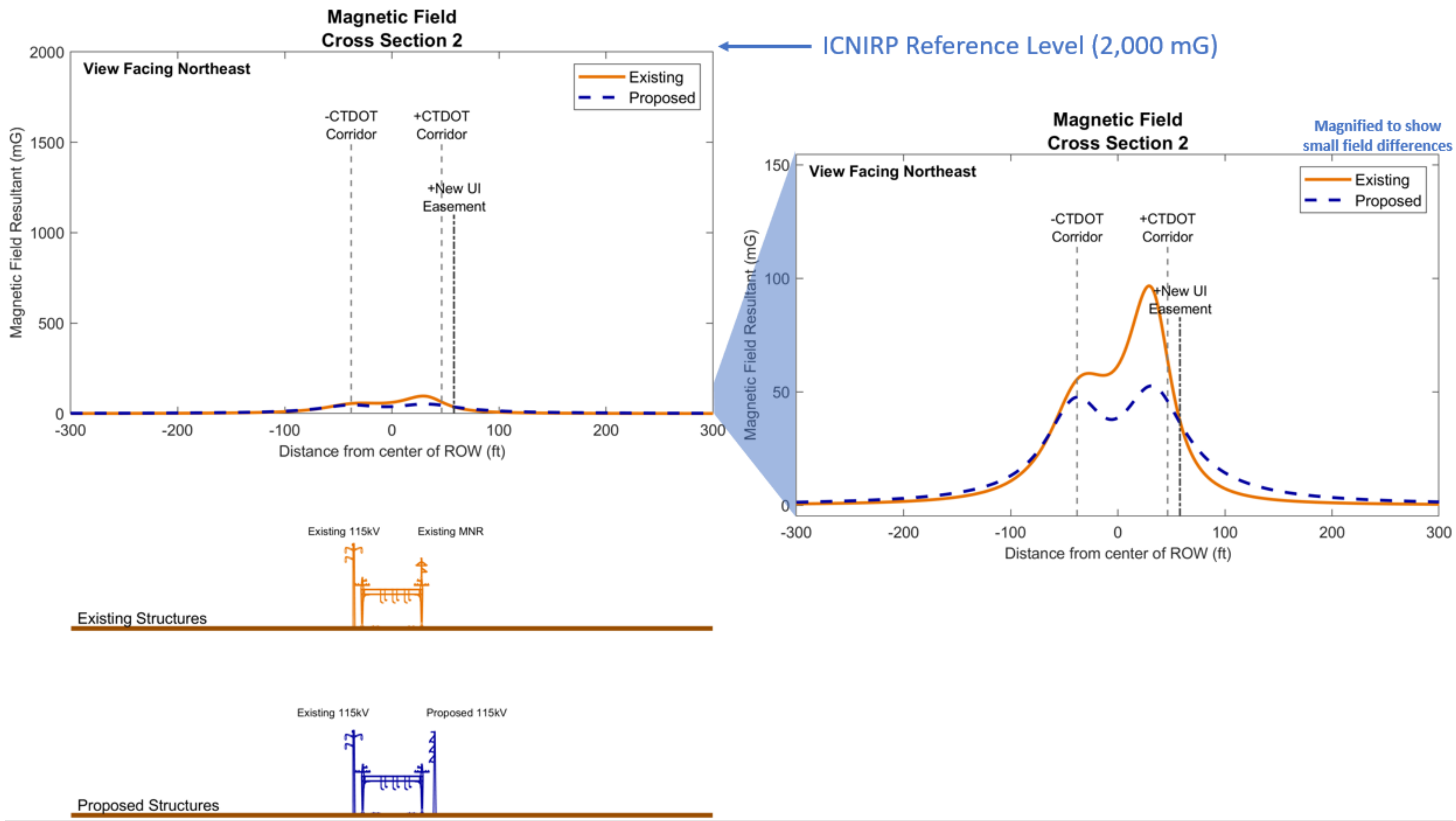

Figure 6. Magnetic-field levels in XS-2 compared to the ICNIRP limit of 2,000 mG.

The ICES limit for magnetic fields is 9,040 mG. Note the magnified scale of the figure on the right to illustrate the small differences in existing and proposed calculated field levels compared to ICNIRP limits. Attachment C includes a complete set of figures.

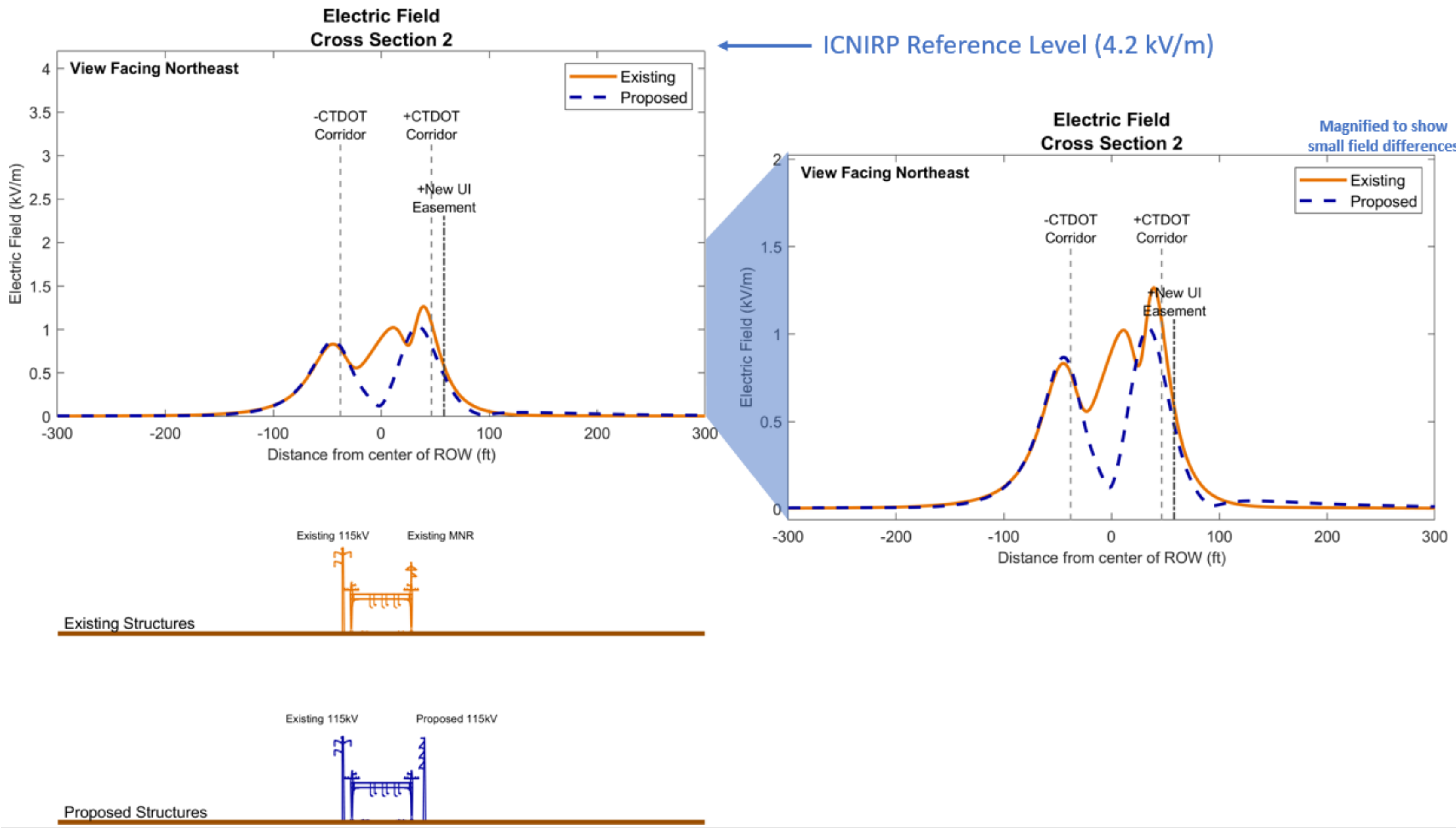

Figure 7. Electric-field levels in XS-2 compared to the ICNIRP limit of 4.2 kV/m.

The ICES limit for electric fields within a transmission line right of is 10 kV/m. Note the magnified scale of the figure on the right to illustrate the small differences in existing and proposed calculated field levels compared to ICNIRP limits. Attachment C includes a complete set of figures.

Results of Standard Modeling Approach (Groups 1 to 5)

Group 1 (new proposed single-circuit monopoles on the south side of the CT DOT corridor)

Group 1 includes modeling cross sections XS-1 to XS-7 and XS-9 to XS-13 and encompasses more than 70% of the modeled route. In this area, the existing 115-kV line is proposed to be relocated from the southern catenary structures onto independent monopoles located along or near the south side of the CT DOT corridor.

The EMF levels among the modeling cross sections of Group 1 differ quantitatively from one another but are qualitatively similar. EMF levels along the south side of the CT DOT corridor will increase slightly compared to existing levels while EMF levels on the north side of the CT DOT corridor (where UI's existing transmission line is supported principally on monopoles) will either decrease or not significantly increase compared to existing levels. Detailed results of each modeling cross section are provided in Attachment B (tabular summaries) and Attachment C (graphical depictions).

The result of the Project is that the maximum magnetic-field levels at average loading anywhere in Group 1 decrease from approximately 145 mG (in XS-9 through XS-12) to 91 mG or less and maximum electric-field levels decrease from approximately 1.3 kV/m to 1.1 kV/m (most of Group 1). This decrease in maximum EMF levels is due to both the greater conductor height and design of the monopole structures. As indicated above, however, EMF levels generally increase near the rebuilt transmission lines. The largest increase in EMF levels occurs in XS-7, on the south edge of the proposed UI easement. At this location, at average loading, the magnetic-field levels are calculated to increase from 19 mG to 49 mG and the electric-field levels to increase from 0.3 kV/m to 0.9 kV/m due to the relocation of the transmission line near the proposed UI easement edge. Exponent's analysis further showed that EMF levels for all cross sections of Group 1 decrease rapidly with distance such that within 100 feet of the proposed UI easement, the maximum increase compared to existing levels is approximately 5.3 mG for magnetic fields and < 0.1 kV/m for electric fields. Before and after the Project, all

EMF levels in Group 1 are calculated to be far below guideline levels established by ICNIRP and ICES.

Group 2 (paired single-circuit monopoles crossing Ash Creek)

Group 2 consists of XS-8 where the transmission lines will be relocated from lattice tower structures to pairs of separate steel monopole structures primarily located over Ash Creek. Here, the EMF fields both near the center of the ROW and at the ROW edges increase as a result of the Project. The maximum levels at average loading were calculated to increase from 76 to 100 mG for magnetic fields and 1.6 to 1.9 kV/m for electric fields. At the edge of the ROW, magnetic-field levels were calculated to increase from 57 mG to 74 mG and electric-field levels to increase from 0.7 kV/m to 0.8 kV/m. As in Group 1, EMF levels decrease rapidly with distance such that within 100 feet of the ROW edges, the maximum increase compared to existing levels is approximately 4 mG for magnetic fields and < 0.1 kV/m for electric fields. Before and after the Project, all EMF levels in Group 1 are calculated to be far below guideline levels established by ICNIRP and ICES.

Group 3 (new proposed double-circuit monopoles on the north side of the CT DOT corridor)

Group 3 consists of XS-14, a short portion of the route in Bridgeport where the two transmission lines (circuits on the north and south side of the CT DOT corridor), currently constructed on bonnets on the railroad catenary structures will be relocated to double-circuit steel monopole structures on the north side of the CT DOT corridor.

At average loading in Group 3, the maximum magnetic-field levels decrease from approximately 147 mG to 59 mG and the maximum electric-field levels decrease from 1.3 kV/m to 0.6 kV/m. On the southern edge of the public street boundary, Exponent calculated the magnetic-field levels to decrease significantly from 30 mG to 1.3 mG, and similarly, the electric-field levels to decrease from 0.3 to < 0.1 kV/m. Conversely, on the north side of the new UI easement, at average loading, calculations show magnetic-field levels increase from 8.8 mG to 29 mG and electric field levels to increase from < 0.1 kV/m to 0.3 kV/m as a result of the Project. However, magnetic field levels decrease rapidly with distance such that within

100 feet of the proposed UI easement, the maximum increase is 0.4 mG or less. The electric field is calculated to not change on the north side of the CT DOT corridor and to decrease by up to 0.3 kV/m on the south side of the CT DOT corridor. Before and after the Project, all EMF levels in Group 3 are calculated to be far below guideline levels established by ICNIRP and the ICES.

Group 4 (new proposed double-circuit monopoles on the south side of the CT DOT corridor)

Group 4 consists of XS-15 and XS-18 where the two transmission lines currently supported on railroad catenary structures on the north and south sides of the CT DOT corridor will be rebuilt on double-circuit monopoles on the *south* side of the CT DOT corridor. As with Group 1, UI proposes to acquire new easement (as necessary) to ensure the new transmission line conductors maintain necessary horizontal clearances to adjacent property.

As a result of the rebuild, the maximum magnetic-field levels at average loading in XS-15 decrease from approximately 141 mG to 54 mG and electric-field levels decrease from 1.3 kV/m to 0.6 kV/m. EMF levels on the north side of the CT DOT corridor will decrease significantly compared to existing levels and will increase slightly on the south side of the CT DOT corridor. The largest increase in magnetic-field levels occurs on the southern edge of the proposed UI easement in XS-15 where at average loading, calculations show an increase from 13 mG to 26 mG. At this location, electric fields were calculated to decrease by 0.3 kV/m. At 100 feet from the proposed UI easement to the south of the CT DOT corridor, the largest change occurs in XS-18 where the post-Project magnetic field levels *decrease* by about 0.1 to 1.5 mG compared to existing levels, while electric field levels *increase* by < 0.1 kV/m as a result of the Project. Before and after the Project, all EMF levels in Group 4 are calculated to be far below guideline levels established by ICNIRP and ICES.

Group 5 (monopoles outside both sides of CT DOT corridor)

Group 5 consists of XS-16 and XS-17. West of the I-95 crossing near Park Avenue and Railroad Avenue, the MNR tracks are elevated and the CT DOT corridor is too narrow to accommodate the rebuilt 115-kV lines. As a result, UI proposes to acquire new permanent easements for the single-circuit lines to be located on either side of the railroad corridor. The new easements will ensure that the new transmission line conductors maintain necessary horizontal clearances to adjacent property, as mandated by the NESC and by UI's standard design criteria. One of the two new easements will generally parallel the south side of South Frontage Road (north of the CT DOT corridor) and the other will generally parallel the south side of Railroad Avenue (south of the CT DOT corridor) as shown by the pink-shaded regions in Figure 8. Additional discussions regarding the residences, playground and apartment complex (shown in blue) are provided in the following sections.

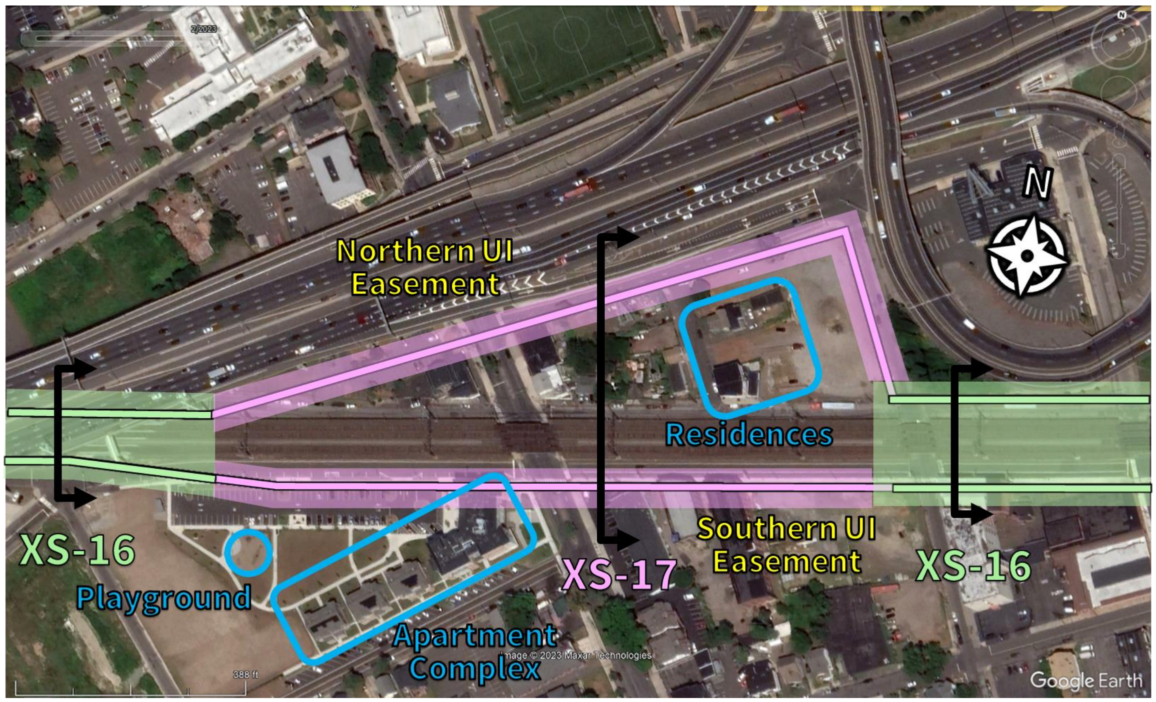

Figure 8. Aerial view showing the location of the currently proposed divergent UI easements in Bridgeport.

The maximum magnetic-field levels are similar throughout Group 5 and are calculated to decrease as a result of the Project from approximately 141 mG to approximately 80 mG at average loading. Electric-field levels are similarly calculated to decrease from 1.3 kV/m to 1.1 kV/m or less. EMF levels away from the CT DOT corridor, however, are calculated to increase consistent with that expected along the new UI easements.

At the both edges of the proposed UI easement in XS-16, magnetic-field levels are calculated to increase from approximately 13 mG to 51 mG and electric-field levels to increase from

0.1 kV/m to 0.5 kV/m due to relocation of the transmission lines from the catenary bonnets. As noted previously, EMF levels decrease rapidly with distance, so within 100 feet of the proposed UI easement, the maximum increase for magnetic fields is approximately 3.7 mG and for electric fields is < 0.1 kV/m as a result of the Project.

XS-17: North of the CT DOT corridor

At average loading along a representative portion of the proposed UI easement boundaries north of the CT DOT corridor, magnetic-field levels increase from approximately 1.1 mG or less to 75 mG or less and electric-field levels increase from < 0.1 kV/m to 0.5 kV/m. The increase in EMF is due to the relocation of the transmission lines to monopole structures up to several hundred feet from the existing catenary structure. Although field levels increase, since the north side of the proposed UI easement abuts I-95, the proposed transmission line structures are separated from any future developments by over 250 feet.

XS-17: South of the CT DOT corridor

The proposed UI easement would be located south of the CT DOT corridor (and the existing 115-kV lines on the southern catenary structures) by up to approximately 24 feet (i.e., to the south side of Railroad Avenue). Calculated magnetic-field levels at the proposed UI easement south of the CT DOT corridor increase from 13 mG to 57 mG, but decrease rapidly with distance, falling to less than 7.3 mG at 100 feet south the proposed UI easement edges. Additionally, with the exception of the newly-constructed apartment complex (within the block bounded by Park Avenue, Johnson Street, and Columbia Street) on the south side of the CT DOT corridor (see below), there are no identified residences or community facilities within 200 feet of the new UI easement.

Results of Modeling at Apartment Buildings

Apartment Building in Fairfield

As described in the Apartment Buildings Section of the Introduction, the apartment building in Fairfield is approximately 63 feet tall and although the conductors of the currently-proposed transmission line will be approximately 2 feet closer to the apartment building horizontally, the vertical clearance above the building will be more than 37 feet greater. Results of the existing and proposed magnetic-field levels *at the front edge of the building* (closest to the transmission lines) at average loading are shown in Figure 9. In this figure the magnetic-field level at every 5 feet above ground is shown for both existing (blue bars) and proposed (green bars) configurations. The net result of this change is that magnetic-field levels at the front edge of the building (closest to the transmission lines) are calculated to decrease at all stories of the building, except at the roof.

For instance, as shown in Figure 9, at average loading and a height of 45 feet above ground, the existing magnetic field is calculated to be the highest. This corresponds to the height of the existing conductors (which are between 42 and 48 feet) and the magnetic field is calculated to decrease from 129 mG to 39 mG for the proposed configuration. At the roof of the building, magnetic-field levels are calculated to increase from 80 to 101 mG at the front edge of the building. Similar to all other locations along the route, magnetic-field levels decrease rapidly with distance and at the back end of the building, magnetic-field levels are calculated to be less than 3 mG before and after the proposed Project. Although before and after the Project, all EMF levels at the apartment building are calculated to be far below guideline levels established by ICNIRP or the ICES, UI is evaluating the viability of alternative designs for the rebuilt line at this location. Additional analysis is provided in Attachment E.

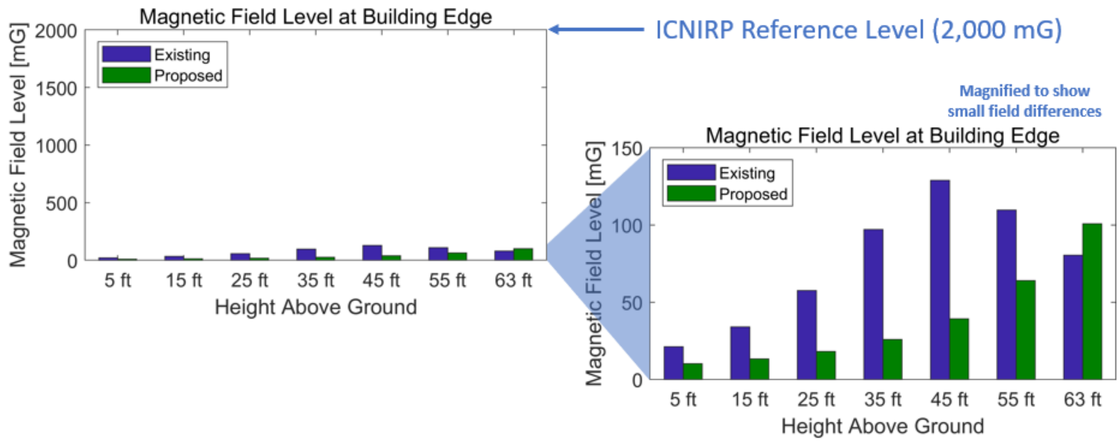

Figure 9. Magnetic-field level at 79 Unquowa Place compared to the ICNIRP limit of 2,000 mG.

The ICES limit for magnetic fields is 9,040 mG. The scale of the graph on the right of the figure is magnified to illustrate the small differences in existing and proposed calculated field levels compared to ICNIRP limits.

Apartment Complex in Bridgeport

The Windward apartment complex is shown by the blue rectangle in Figure 8. The building closest to the currently proposed transmission line is 55 feet tall and is at the north-east side of the rectangle near the intersection of Railroad Avenue and Park Avenue. Although the conductors of the currently-proposed transmission line will be approximately 30 feet closer to the apartment building horizontally, the vertical clearance above the building will be more than 30 feet greater. Also of importance in this area is the presence of a distribution line (conductors at a height of approximately 30 feet above ground with the nearest conductor approximately 10 feet horizontally from the building) and the underground 345-kV Middletown-Norwalk transmission line that is buried approximately 3 feet beneath the road, about 30 feet from the front edge of the building. Therefore, at ground level (and the standard evaluation height of 1 meter [3.28 ft] above ground), the magnetic-field level will be primarily determined by these two existing sources, as shown in Figure 10.[19] The figure shows that all Project-related

[19] Note that the modeling adjacent to the Bridgeport apartment building is part of XS-17, but the results are quite different than those shown in Attachment C, Figure C-17 and Figure C-35 because of the existing distribution and 345-kV transmission line. In addition, the actual transmission line conductor heights at this location, which are far greater than the minimum value assumed in the standard modeling approach, were used for the model to calculate EMF.

magnetic fields are a very small fraction of ICNRIP's 2,000 mG; the inset further shows that the highest magnetic-field level before and after the project will be immediately above the underground transmission line (in the middle of Railroad Avenue).

Additional analysis, shown in Figure 11, presents results of the existing and proposed magnetic-field levels at the front edge of the building (closest to the transmission lines) at greater heights above ground and at average loading. In this figure the magnetic-field level at every 5 feet above ground is shown for both existing (blue bars) and proposed (green bars) configurations. The net result of this change is that magnetic-field levels at the front edge of the building (closest to the transmission lines) are calculated to increase slightly as a result of the Project up to a height of about 35 feet, and then to increase more substantially at greater heights above ground, with the maximum increase at the roof of the building.

In particular, up to a height of about 35 feet above ground, the proposed Project is calculated to increase magnetic-field levels by approximately 5 mG or less compared to existing levels. At 45 feet above ground the magnetic-field levels are calculated to increase from approximately 49 mG to 75 mG, and at the roof magnetic-field levels are calculated to increase from about 48 mG to 140 mG. Similar to all other locations along the route, as well as the apartment building in Fairfield, magnetic-field levels decrease rapidly with distance, so at the back end of the building, magnetic-field levels are calculated to be less than 5 mG before and after the proposed Project. Although before and after the Project, all EMF levels at the apartment building are calculated to be far below guideline levels established by ICNIRP and ICES, UI is evaluating the viability of alternative designs for the rebuilt line at this location. Additional analysis is provided in Attachment E.

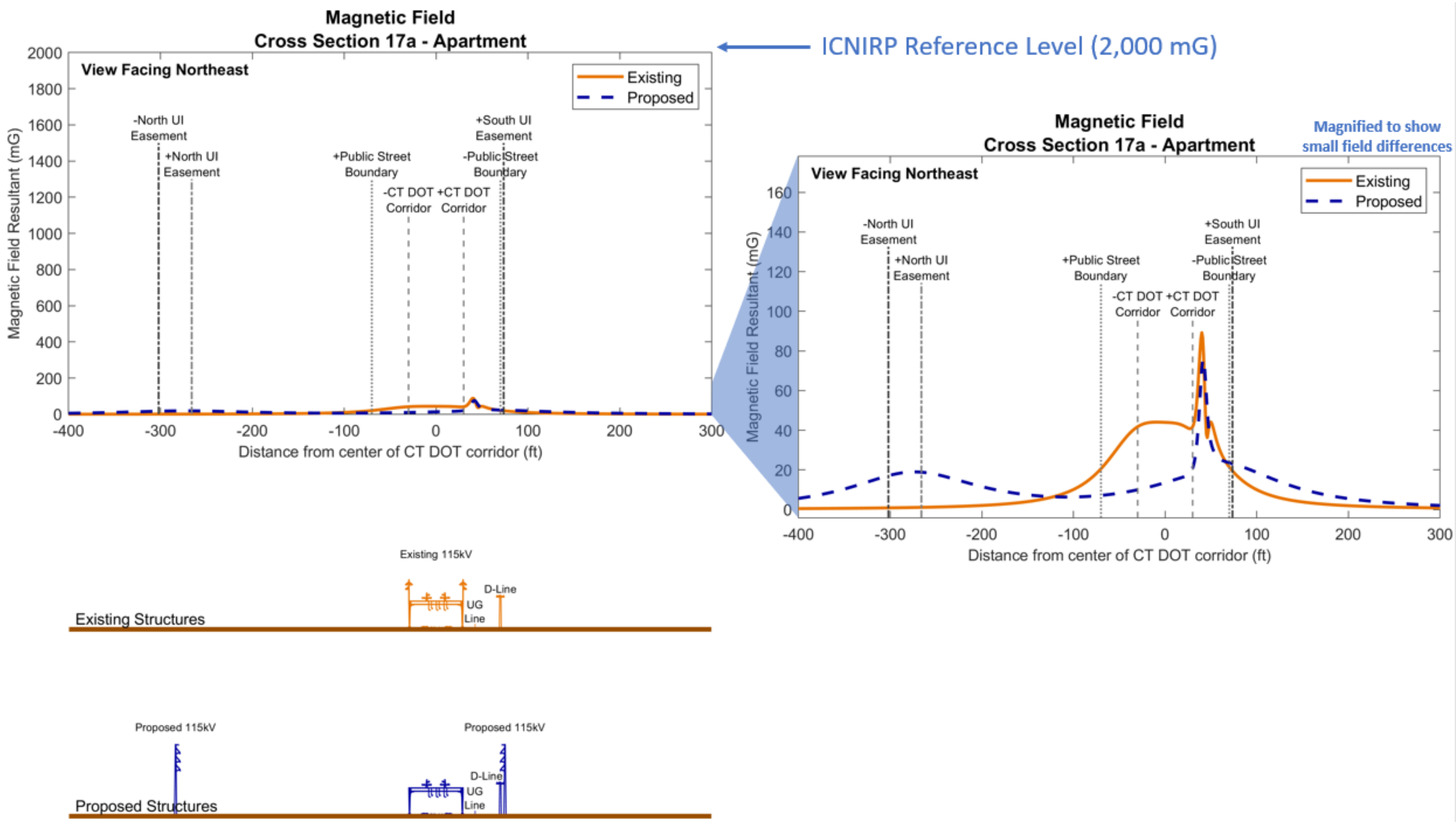

Figure 10. Magnetic-field levels at the apartment building in Bridgeport (at a height of 1 meter [3.28 ft] above ground) compared to the ICNIRP limit of 2,000 mG.

The ICES limit for magnetic fields is 9,040 mG. The scale of the graph on the right of the figure is magnified to illustrate the small differences in existing and proposed calculated field levels compared to ICNIRP limits.

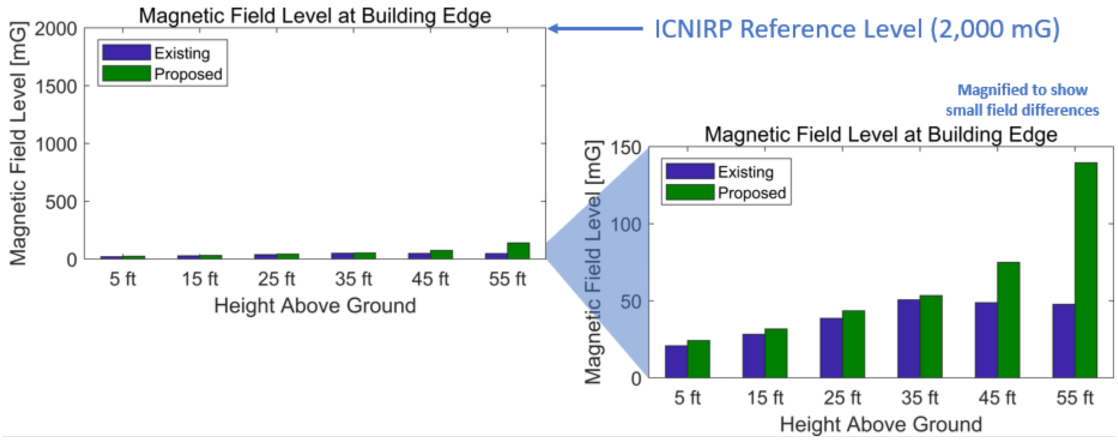

Figure 11. Magnetic-field level at the Windward apartment building near the intersection of Railroad Avenue and Park Avenue in Bridgeport compared to the ICNIRP limit of 2,000 mG.

Playground Within the Apartment Complex in Bridgeport

In the analysis of the new Windward apartment complex in Bridgeport, a new playground was identified, as shown by the blue circle in Figure 8. Modeling using the same approach as described above in relation to the apartment buildings (i.e., with actual existing and proposed conductor heights) show that the proposed Project will result in a relatively small change in magnetic-field levels at the playground.

Results of this modeling show that magnetic-field levels are calculated to increase by approximately 1.3 mG to 3.2 mG at the playground (depending on location in the playground) and that before and after the project magnetic-field levels will be about 6.5 mG or less. These calculated values are within the range of magnetic-field field levels measured near this location before the Project (*see* location R19 in Attachment D, Table D-2) which ranged from 2.6 mG to 97 mG (with an average of 11 mG). As in other portions of the route, all EMF levels at the playground are calculated to be far below guideline levels established by ICNIRP and ICES.

Residential Areas North of the CT DOT Corridor in XS-17

In the area north of the CT DOT corridor in XS-17, UI identified two residential buildings. These buildings are shown by the blue square in Figure 8 and applicable magnetic-field modeling results are shown on the left side of Figure 10 (i.e., the north side of the CT DOT corridor). North of the CT DOT corridor, along West Avenue between the CT DOT corridor and the new proposed permanent UI easements along South Frontage Road, there is one residence where the magnetic-field level is calculated to increase by approximately 13 mG to 17 mG (depending on the location within the building). One additional building, located at the intersection of West Avenue and Railroad Avenue within a mixed development zoning designation, is used for both residential and commercial purposes. At this building the magnetic-field level is calculated to decrease by approximately 3 mG or increase by up to approximately 5 mG (depending upon the location within the building). Before and after the Project, all EMF levels at these buildings are calculated to be far below guideline levels established by ICNIRP and ICES.

Conclusions

This report summarizes measurements and calculations of the EMF levels associated with the pre-Project configuration and post-Project configurations of the UI Fairfield to Congress 115-kV transmission lines. Elements of the Project design reduce magnetic-field levels, a goal consistent with design goals outlined in the CSC BMP (e.g., taller structures and optimal phasing). Additionally, all measured and calculated EMF levels associated with the Project were a far below limits recommended for the general public by international health-based standards (i.e., ICES and ICNIRP).

Pre-construction EMF measurements along the Project route were generally consistent with EMF levels calculated for the existing configurations of the transmission lines. Measured EMF levels outside the CT DOT corridor were generally lower than those measured inside the corridor, consistent with the rapid decrease in EMF levels with distance.

Where the new monopole structures are proposed to be constructed on the south side of the CT DOT corridor (Group 1 in Fairfield and Groups 4 and 5 in Bridgeport), there is a corresponding increase in EMF levels on the south side of the CT DOT corridor. Similarly, where the new monopole structures are proposed to be constructed on the north side of the CT DOT corridor (Groups 3 and 5 in Bridgeport), there is an increase in EMF levels on the north side of the CT DOT corridor. Along UI's 0.23-mile ROW that extends between the CT DOT corridor and the Ash Creek Substation (Group 2 at the boundary between Fairfield and Bridgeport), EMF levels increase on both sides of the ROW.

Although EMF levels outside the CT DOT corridor are calculated to increase in the vicinity of the new monopole locations, EMF levels will decrease on the CT DOT corridor. Additionally, all magnetic-field levels decrease rapidly with distance such that within 100 feet of the new UI easement, the maximum increase compared to existing levels is approximately 6.9 mG. Electric-field levels at the edges of the CT DOT corridor or proposed UI easements were calculated to be low (approximately 1.2 kV/m or less) before and after the Project.

Exponent also calculated magnetic-field levels at readily accessible locations above ground at two apartment buildings in Fairfield and Bridgeport adjacent the CT DOT corridor or proposed UI easement. At the Fairfield apartment building, magnetic field-levels were calculated to generally decrease at the side of the building closest to the CT DOT corridor as a result of the Project, except at the roof of the building. At the apartment building in Bridgeport, magnetic-field levels were calculated to increase at the side of the building closest to the CT DOT corridor with the largest increases at heights of 45 feet or more above ground. UI is evaluating the viability of alternative designs for the rebuilt lines at these locations.

In summary, the calculated EMF levels resulting from the Project, including those above ground at apartment buildings, will be a far below the reference levels recommended for the general public in international health-based standards (i.e., ICES and ICNIRP). The engineering design and other activities initiated by UI include design elements consistent with the CSC BMP.

Attachment A

Transmission Line Configurations and Loadings

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Transmission Line Configurations

Although only two 115-kV lines are aligned on the catenary structures or parallel the railroad tracks in any one location between Catenary Structure B648S and Congress Street Substation, UI identifies the transmission lines by six different circuit numbers (i.e., Lines 1430, 1130, 91001-2, 91001-2, 8809A, and 8909B) to designate the line segments in relation to substation connections.

Table A-1. Existing UI 115-kV lines, by line number and location

	Circuit No. Designation in Relation to MNR Tracks	
Portion of Route	**115-kV Line: North of the Railroad Tracks**	**115-kV Line: South of the Railroad Tracks**
Catenary Structure 648 – Ash Creek Substation	1130	1430*
Ash Creek Substation – Resco Tap (Ash Creek to Catenary Structure 737)	1130†	91001-2*
Ash Creek Substation – Resco Tap (Catenary Structure 737 to Resco Tap)	1130†	91001-2
Resco Tap – Pequonnock Substation	1130	91001-1
Pequonnock Substation – Congress Street Substation	8809A	8909B

* The 1430 and 91001-2 Lines diverge from the CT DOT corridor to connect to Ash Creek Substation along UI's 0.23-mile ROW. In this area, the 1430 and 91001-2 Lines are supported on three lattice steel towers in a double-circuit configuration.

† The existing portion of the 1130 Line will not be affected by the Project.

As a part of the Project, existing transmission lines will be removed and replaced by transmission lines on steel monopole structures with a greater minimum height from the ground located beside the existing catenary structures. The physical configurations of the transmission lines are similar throughout the route, with differences in the existing phasing of the transmission lines and with varying distances between the proposed transmission lines, the existing infrastructure, the configuration of the proposed infrastructure, and the boundaries of the new UI easement. Eighteen models were developed to conservatively evaluate EMF levels for all these variations: XS-1 through XS-18 (as shown in Attachment A, Figure A-1 and Figure A-2).

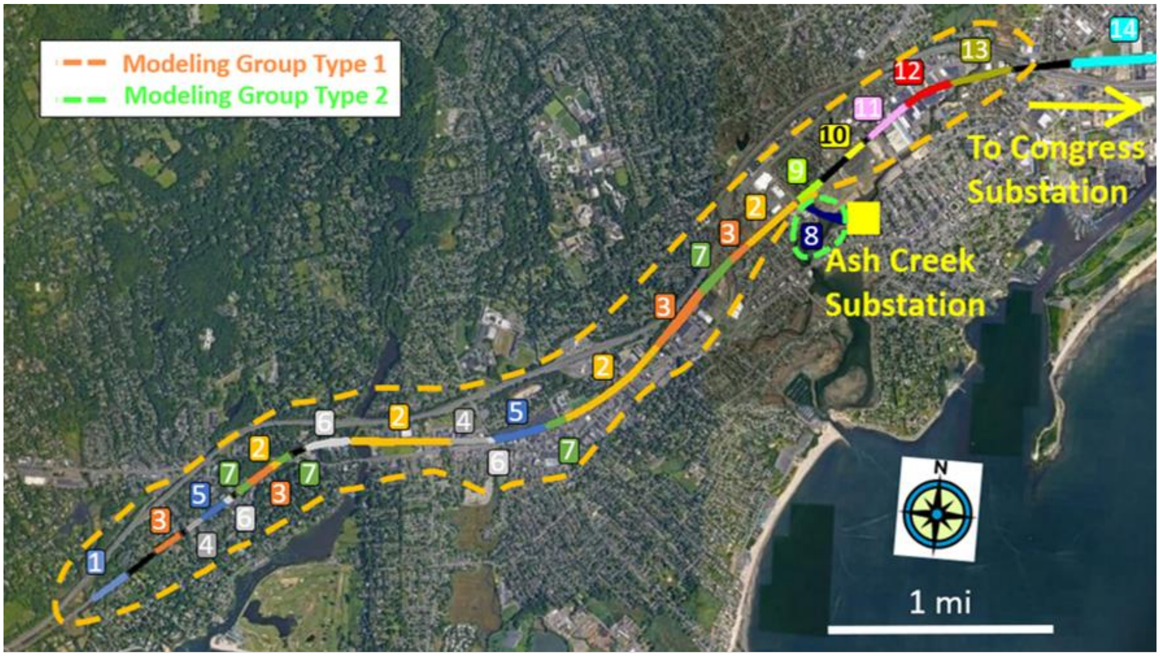

Figure A-1 Overview of the route segments containing modeled cross-sections along a portion of the Project route between Sasco Creek and east of the Ash Creek Substation, comprising Groups 1 and 2. Cross sections are indicated along the route by number labels and color.

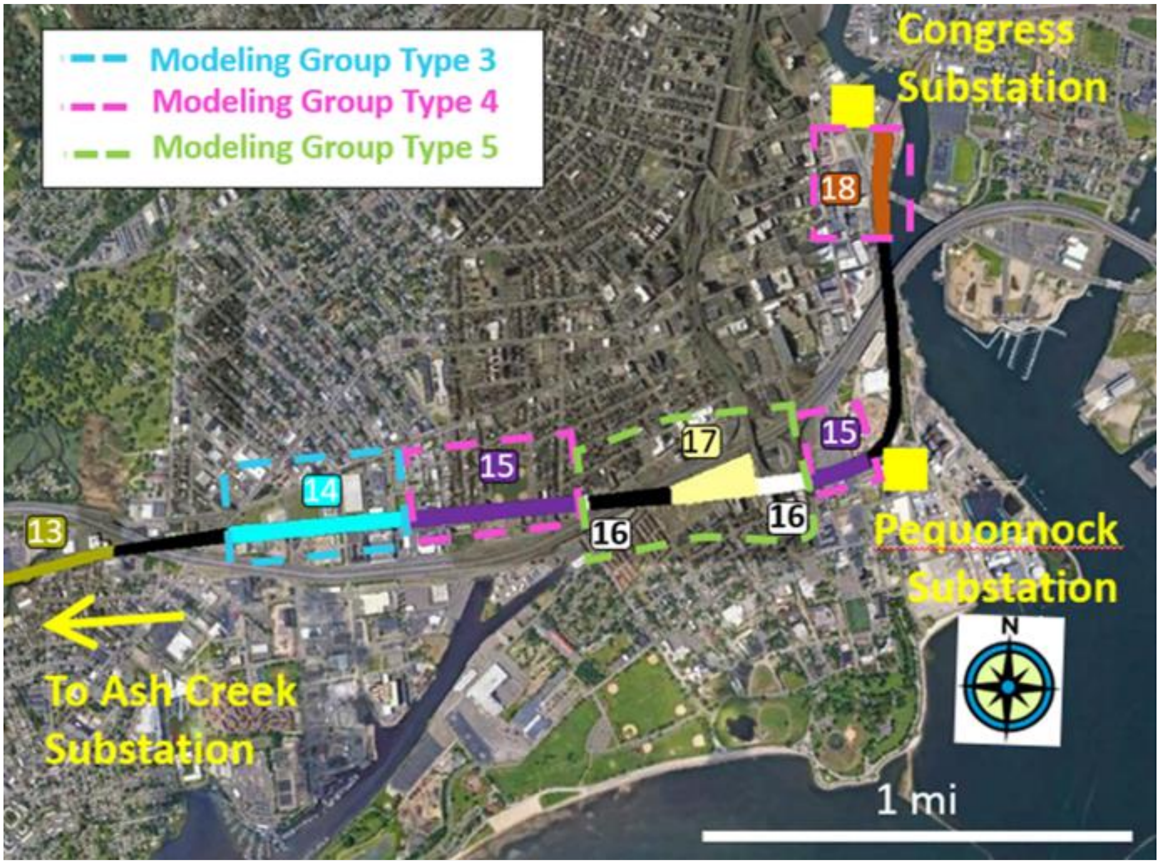

Figure A-2 Overview of the route segments containing modeled cross-sections along the Project route from Ash Creek Substation to Congress Substation, comprising Groups 3, 4, and 5. Cross sections are indicated along the route by number labels and color..

The primary differences among the modeled cross sections were: 1) the phasing of the existing transmission lines; 2) the separation distance between the new proposed structures and the existing catenary railroad structures; 3) the width of the existing CT DOT corridor (and new UI easement); and 4) the configuration of the new monopole structures. These dimensions are shown graphically in Figure 1 and a summary of the range of distances is summarized in Table A-1. During modeling, Exponent conservatively used the minimum distances between the existing structures and the existing CT DOT boundaries on both the north and south sides to represent the highest EMF levels at these boundaries. The location of the proposed structure, represented by dimension III (as shown in Figure 1 and detailed in Table A-2), was conservatively selected to minimize the distance between the proposed structure and the proposed easement boundary in order to conservatively overestimate EMF levels. The EMF calculations were performed for 18 models of route segments that are included together in Groups 1 through 5 of similar configurations.

XS-1 (in Group 1) represents portions of the Project route between Sasco Creek and the Ash Creek Substation, specifically, the portions bounded by structures P648S and P651S. The existing line to be relocated is constructed on top of railroad catenary structures, supported by metal bonnets. The proposed line is to be constructed on a steel monopole structure at the south side of the CTDOT corridor.

XS-2 (in Group 1) represents portions of the Project route between Sasco Creek and the Ash Creek Substation, specifically, the portions bounded by structures P665S; P673S and P679S; P689S and P698S; and P709S and P713S. The existing line to be relocated is constructed on top of railroad catenary structures, supported by metal bonnets. The proposed line is to be constructed on a steel monopole structure at the southern side of the UI easement.

XS-3 (in Group 1) represents portions of the Project route between Sasco Creek and the Ash Creek Substation, specifically, the portions bounded by structures P655S and P656S; P664S; P699S and P703S; and P708S. The existing line to be relocated is constructed on top of railroad catenary structures, supported by metal bonnets. The proposed line is to be constructed on a steel monopole structure at the south side of the UI easement.

XS-4 (in Group 1) represents portions of the Project route between Sasco Creek and the Ash Creek Substation, specifically, the portions bounded by structures P657S; and P680S and P681S. The existing line is constructed on top of railroad catenary structures, supported by metal bonnets. The proposed line is to be constructed on a steel monopole structure at the south side of the UI easement.

XS-5 (in Group 1) represents portions of the Project route between Sasco Creek and the Ash Creek Substation, specifically, the portions bounded by structures P659S; and P684S and P686S. The existing line is constructed on top of railroad catenary structures, supported by metal bonnets. The proposed line is to be constructed on a steel monopole structure at the south side of the CTDOT corridor.

XS-6 (in Group 1) represents portions of the Project route between Sasco Creek and the Ash Creek Substation, specifically, the portions bounded by structures P661S; and P668S and P671S. The existing line is constructed on top of railroad catenary structures, supported by metal bonnets. The proposed line is to be constructed on a steel monopole structure at the south side of the CTDOT Corridor.

XS-7 (in Group 1) represents portions of the Project route between Sasco Creek and the Ash Creek Substation, specifically, the portions bounded by structures P663S; P666S; P688S; and P704S and P706S. The existing line to be relocated is constructed on top of railroad catenary structures, supported by metal bonnets. The proposed line is to be constructed on a steel monopole structure at the south side of the CTDOT corridor.

XS-8 (in Group 2) represents the portion of the Project route that is the cut-in to the Ash Creek Substation, specifically, the portions bounded by structures P713ES-P713ES-2 and P714WS-P714WS-2. The existing line to be relocated is constructed on lattice tower structures. The proposed line is to be constructed on three sets of two steel monopole structures.

XS-9 (in Group 1) represents portions of the Project route between the Ash Creek and Pequonnock Substations, specifically, the portions bounded by structure P716S (Ash Creek). The existing line to be relocated is constructed on top of railroad catenary structures, supported by metal bonnets. The proposed line is to be constructed on a steel monopole structure at the south side of the UI easement.

XS-10 (in Group 1) represents portions of the Project route between the Ash Creek and Pequonnock Substations, specifically, the portions bounded by structure P716S. The existing line to be relocated is constructed on top of railroad catenary structures, supported by metal bonnets. The proposed line is to be constructed on a steel monopole structure at the south side of the CTDOT corridor.

XS-11 (in Group 1) represents portions of the Project route between the Ash Creek and Pequonnock Substations, specifically, the portions bounded by structures P721ES (Black Rock Turnpike) and P724S. The existing line to be relocated is constructed on top of railroad catenary structures, supported by metal bonnets. The proposed line is to be constructed on a steel monopole structure at the south side of the UI easement.

XS-12 (in Group 1) represents portions of the Project route between the Ash Creek and Pequonnock Substations, specifically, the portions bounded by structures P725S and P728S. The existing line to be relocated is constructed on top of railroad catenary structures, supported by metal bonnets. The proposed line is to be constructed on a steel monopole structure at the south side of the UI easement.

XS-13 (in Group 1) represents portions of the Project route between the Ash Creek and Pequonnock Substations, specifically, the portions bounded by structures P730S and P733S. The existing line to be relocated is constructed on top of railroad catenary structures, supported by metal bonnets. The proposed line is to be constructed on a steel monopole structure at the south side of the UI easement.

XS-14 (in Group 3) represents portions of the Project route between the Ash Creek and Pequonnock Substation, specifically, the portions bounded by structures P738N and P745N. The existing line to be relocated is constructed on top of railroad catenary structures, supported by metal bonnets. The proposed line is to be constructed on a double steel monopole structure at the northern side of the UI easement.

XS-15 (in Group 4) represents portions of the Project route between the Ash Creek and Pequonnock Substations, specifically, the portions bounded by structures P745S and P752S; and P762S and P765S. The existing line to be relocated is constructed on top of railroad catenary structures, supported by metal bonnets. The proposed line is to be constructed on a double steel monopole structure at the south side of the UI easement.

XS-16 (in Group 5) represents portions of the Project route between the Ash Creek and Pequonnock Substations, specifically, the portions bounded by structures P752N; and P760N and P762N. The existing line to be relocated is constructed on top of railroad catenary structures, supported by metal bonnets. The proposed line is to be constructed on steel monopole structures on both sides of the UI easement.

XS-17 (in Group 5) represents portions of the Project route between the Ash Creek and Pequonnock Substations, specifically, the portions bounded by structures P756N and P759N; and P756S and P760S. The existing line to be relocated is constructed on top of railroad catenary structures, supported by metal bonnets. The proposed line is to be constructed on steel monopole structures on both sides of the UI easement.

XS-18 (in Group 4) represents portions of the Project route between the Ash Creek and Pequonnock Substations, specifically, the portions bounded by structures P779S and P783S. The existing line to be relocated is constructed on top of railroad catenary structures, supported by metal bonnets. The proposed line is to be constructed on a double steel monopole structure at the south side of the UI easement.

Table A-3. Modeled transmission line segments, distances from old to new structures, and CT DOT corridor and proposed new UI easement boundaries

Route Section	Structure Numbers	Dimension I Existing Pole Offset Distance from Existing Catenary Structure (feet)	Dimension II Distance from Catenary structure to CT DOT Corridor Boundary North (feet)	Dimension III* New Pole Offset Distance from Existing Catenary Structure South (feet)	Dimension IV Distance from Catenary structure to CT DOT Boundary South (feet)
Sasco Creek to Ash Creek	P648S to P651S	3.5 – 4	6.5 – 7	17-19	39 – 39.5
Cross section XS-1 modeling parameters		3.5	6.5	19	39
Sasco Creek to Ash Creek	P652S to P654AS, P665, P673S to P679S, P689S to P698S, P709S to P713S	0 – 6	8 – 100	10 – 38	18 – 83
Cross section XS-2 modeling parameters		0	8	10	18
Sasco Creek to Ash Creek	P655S to P656S, P664S, P699S to P703S, P708S	2.5 – 9	27 – 100	19 – 51	16 – 21
Cross section XS-3 modeling parameters		2.5	27	19	16
Sasco Creek to Ash Creek	P657S, P680S to P681S	0 – 4	7 – 25	20 – 32	20 – 24.5
Cross section XS-4 modeling parameters		0	7	20	20
Sasco Creek to Ash Creek	P659S, P684S to P686S	0 – 4	7 – 100	6 – 10	48 – 77
Cross section XS-5 modeling parameters		0	7	9	48
Sasco Creek to Ash Creek	P661S, P668S to P671S, P682S	0 – 4	4 – 12	18 – 25	15 – 37.5

Route Section	Structure Numbers	**Dimension I** Existing Pole Offset Distance from Existing Catenary Structure (feet)	**Dimension II** Distance from Catenary structure to CT DOT Corridor Boundary North (feet)	**Dimension III*** New Pole Offset Distance from Existing Catenary Structure South (feet)	**Dimension IV** Distance from Catenary structure to CT DOT Boundary South (feet)
Cross section XS-6 modeling parameters		0	4	18	15
Sasco Creek to Ash Creek	P663S, P666AS, P688S, P704S to P706S	0 – 7	33.5 – 100	13 – 50	42.5 – 100
Cross section XS-7 modeling parameters		0	33.5	24.5	42.5
Ash Creek to Pequonnock	P716S	3	20	36	19
Cross section XS-9 modeling parameters		3	20	36	19
Ash Creek to Pequonnock	P719S	3	19	10	100
Cross section XS-10 modeling parameters		3	19	10	100
Ash Creek to Pequonnock	P721ES to P724S	2	19 – 28	17 – 19	12 – 19
Cross section XS-11 modeling parameters		2	19	17	12
Ash Creek to Pequonnock	P725S to P728S	0 – 6	25 – 28	10 – 19	17 – 21
Cross section XS-12 modeling parameters		0	25	10	17
Ash Creek to Pequonnock	P730S to P733S	0 – 3	27 – 34	12 – 15	20 – 21
Cross section XS-13 modeling parameters		0	27	12	20
Ash Creek to Pequonnock	P738N to P745N	0	40	46 – 48	42

Route Section	Structure Numbers	Dimension I Existing Pole Offset Distance from Existing Catenary Structure (feet)	Dimension II Distance from Catenary structure to CT DOT Corridor Boundary North (feet)	Dimension III* New Pole Offset Distance from Existing Catenary Structure South (feet)	Dimension IV Distance from Catenary structure to CT DOT Boundary South (feet)
Cross section XS-14 modeling parameters		0	40	46	42
Ash Creek to Pequonnock	P745S to P752S and P762S to P765AS	0	40	36 to 83	42
Cross section XS-15 modeling parameters		0	40	36	42
Ash Creek to Pequonnock	P752N and P760N to P762N	0	40	36 to 50	40
Cross section XS-16modeling parameters		0	40	36	40
Ash Creek to Pequonnock	P756N to P759N and P756S to P760S	0	40	45 to 317	42
Cross section XS-17 modeling parameters		0	40	45	42
Ash Creek to Pequonnock	P779S to P783S	0	22 to 23	30 to 40	19 to 23
Cross section XS-18 modeling parameters		0	22	30	19

* The new pole distance from the catenary structure was selected to conservatively minimize the distance between the new pole and the post-Project easement boundary.

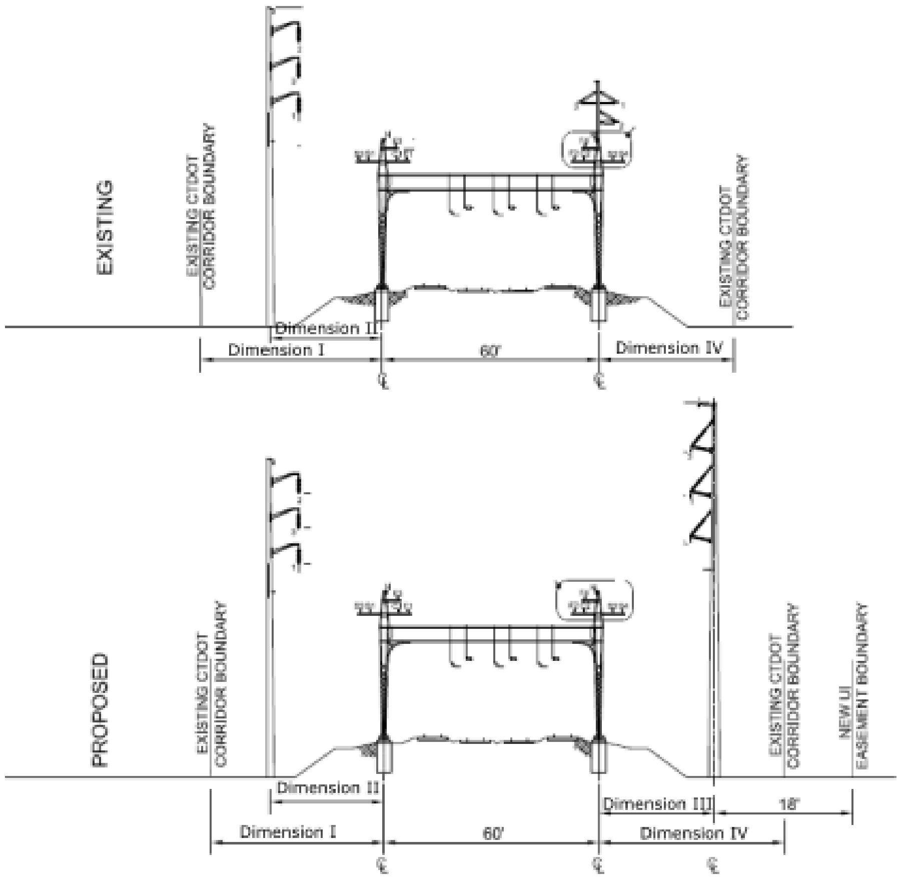

Figure A-3. Existing and proposed configuration for XS-1 in Group 1, corresponding to structures P648S to P651S.

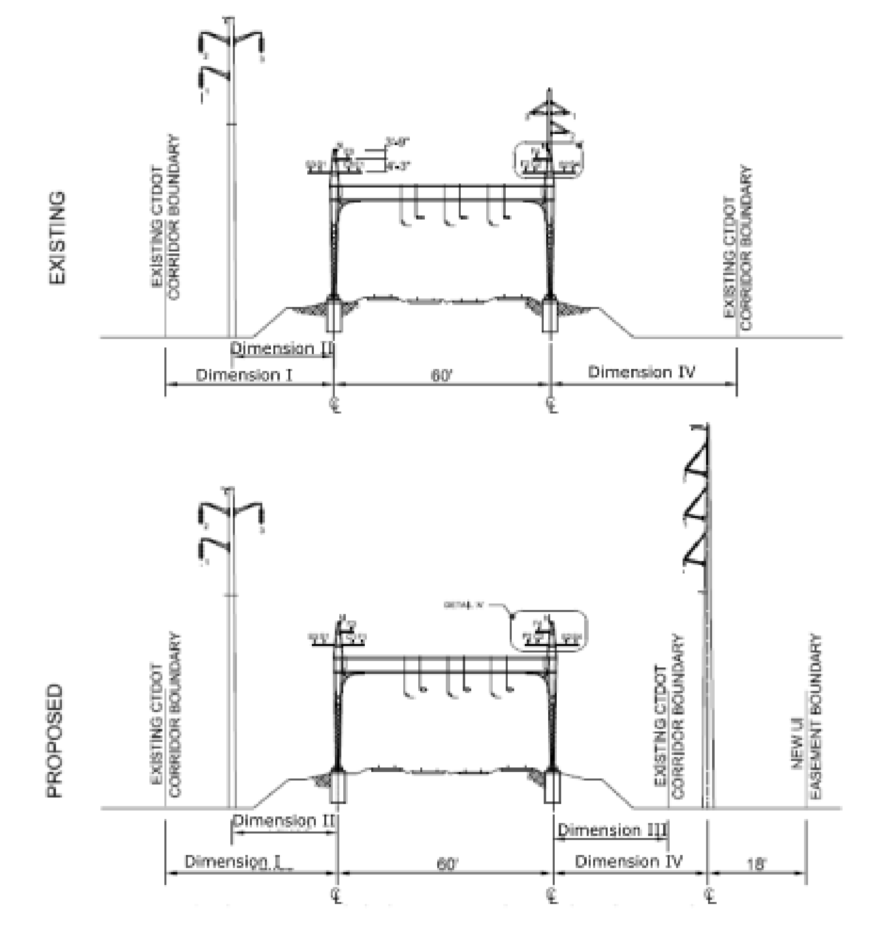

Figure A-4. Existing and proposed configuration for XS-2 in Group 1, corresponding to structures P665S, P673S-P679S, P689S-P698S, and P709S-P713S.

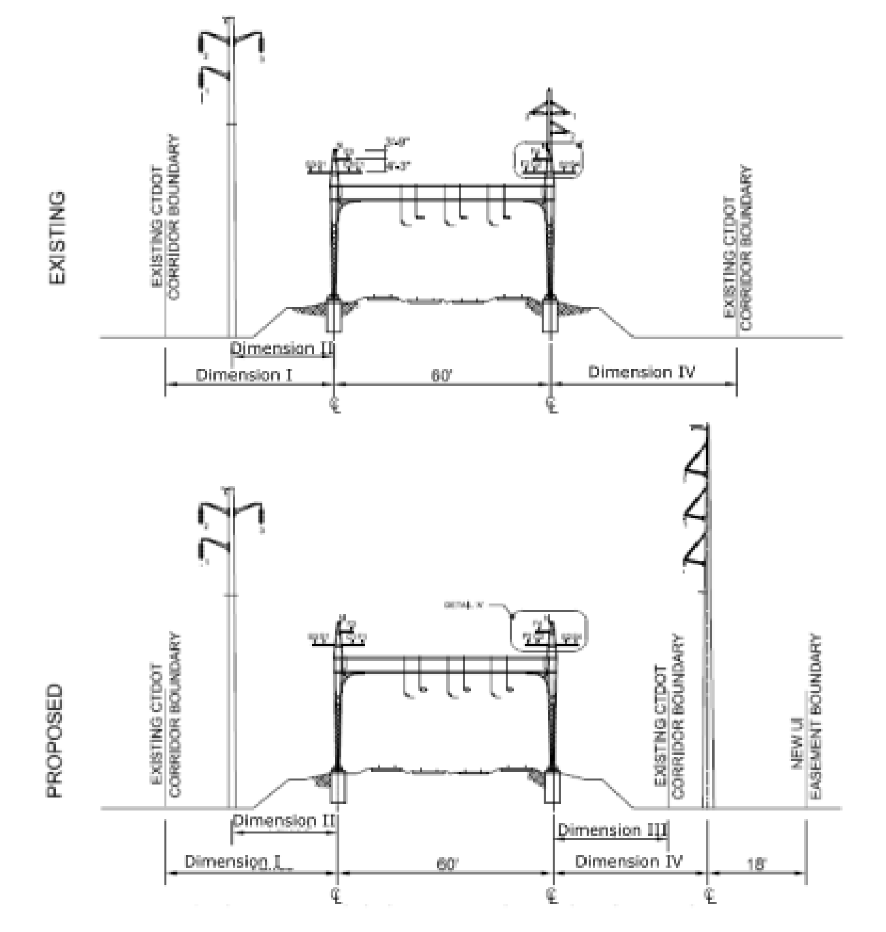

Figure A-5. Existing and proposed configuration for XS-3 in Group 1, corresponding to structures P655S, P656S, P664S, P699S-P703S, and P708S.

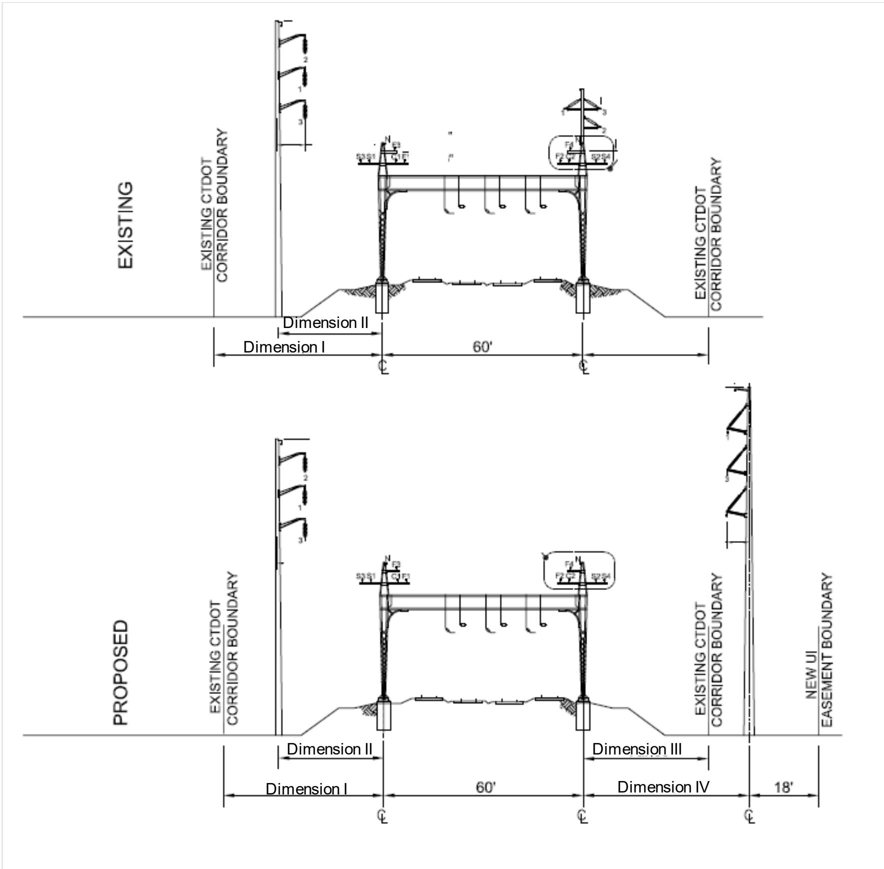

Figure A-6. Existing and proposed configuration for XS-4 in Group 1, corresponding to structures P657S and P680S-P681S.

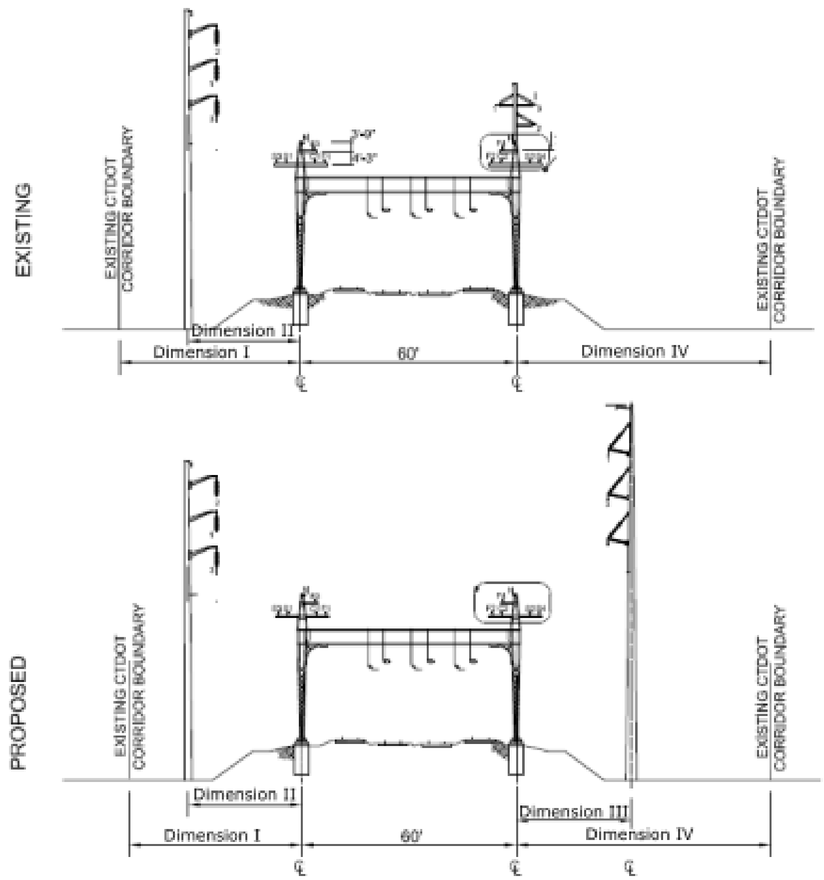

Figure A-7. Existing and proposed configuration for XS-5 in Group 1, corresponding to structures P659S and P684S-P686S.

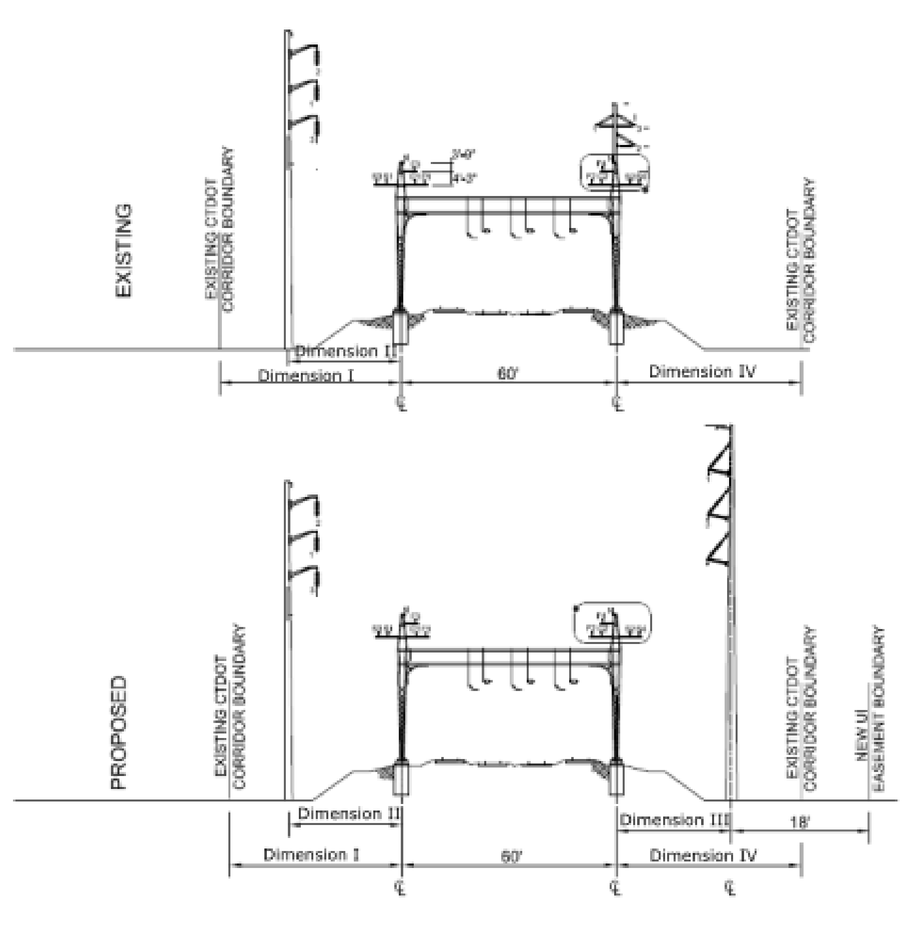

Figure A-8. Existing and proposed configuration for XS-6 in Group 1, corresponding to structures P661S, P668S-P671S, and P682S.

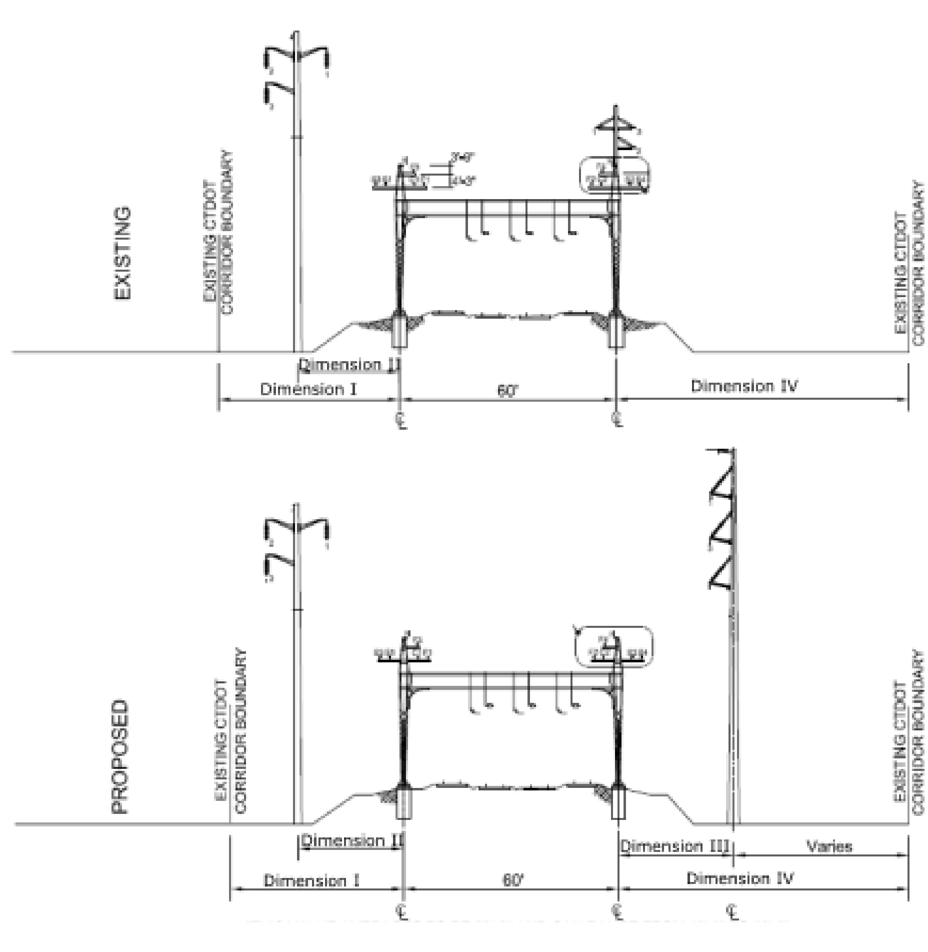

Figure A-9. Existing and proposed configuration for XS-7 in Group 1, corresponding to structures P663S, P666AS, P688S, and P704S-P706S.

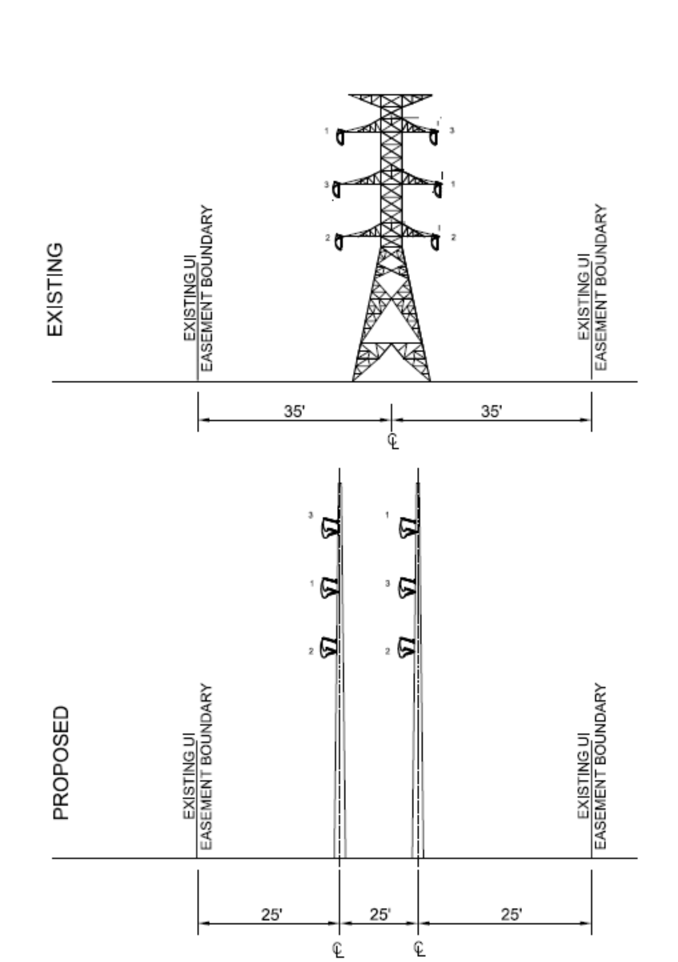

Figure A-10. Existing and proposed configuration for XS-8 in Group 2, corresponding to structures P713ES-P713ES-2 and P714WS-P714WS-2.

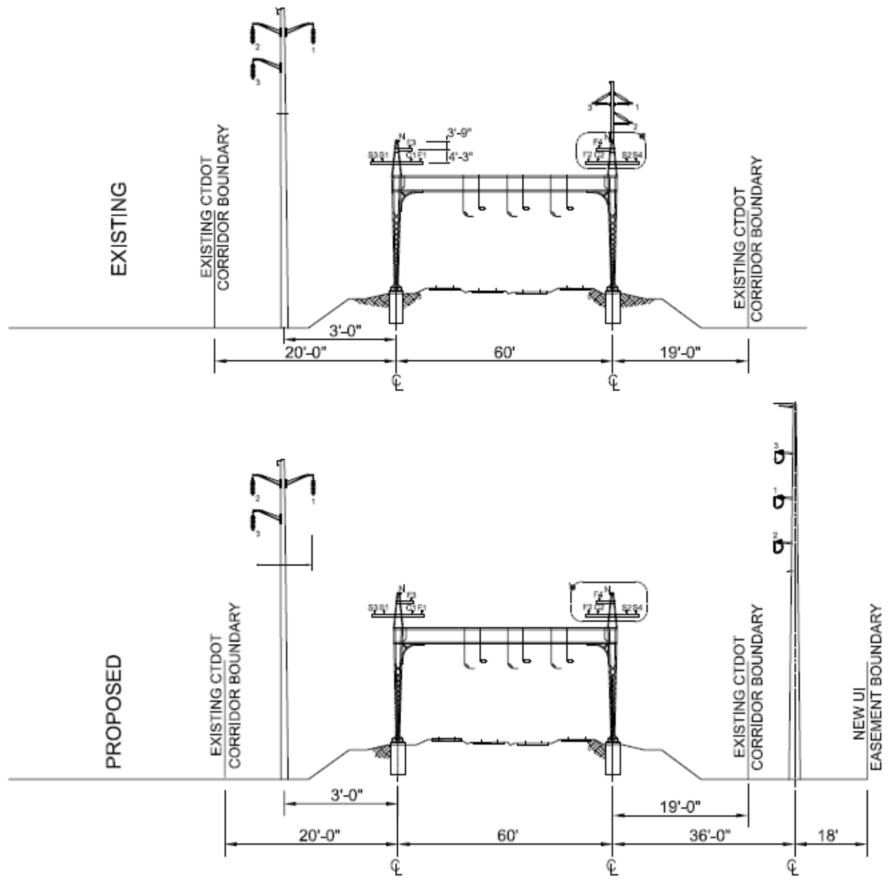

Figure A-11. Existing and proposed configuration for XS-9 in Group 1, corresponding to structure P716S.

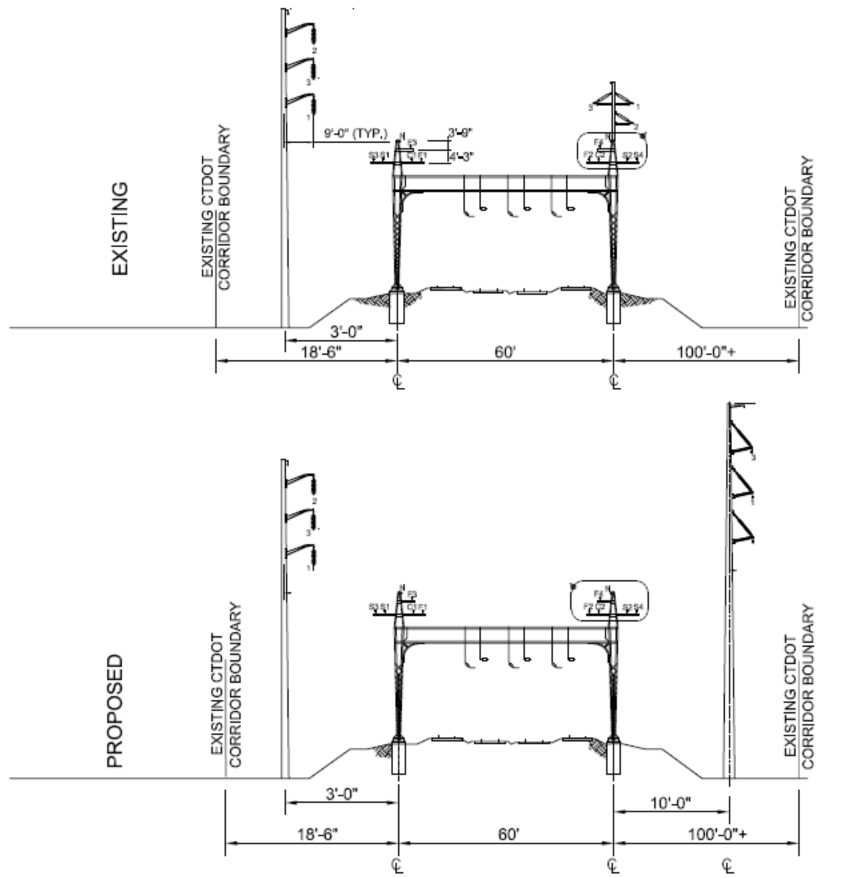

Figure A-12. Existing and proposed configuration for XS-10 in Group 1, corresponding to structure P719S.

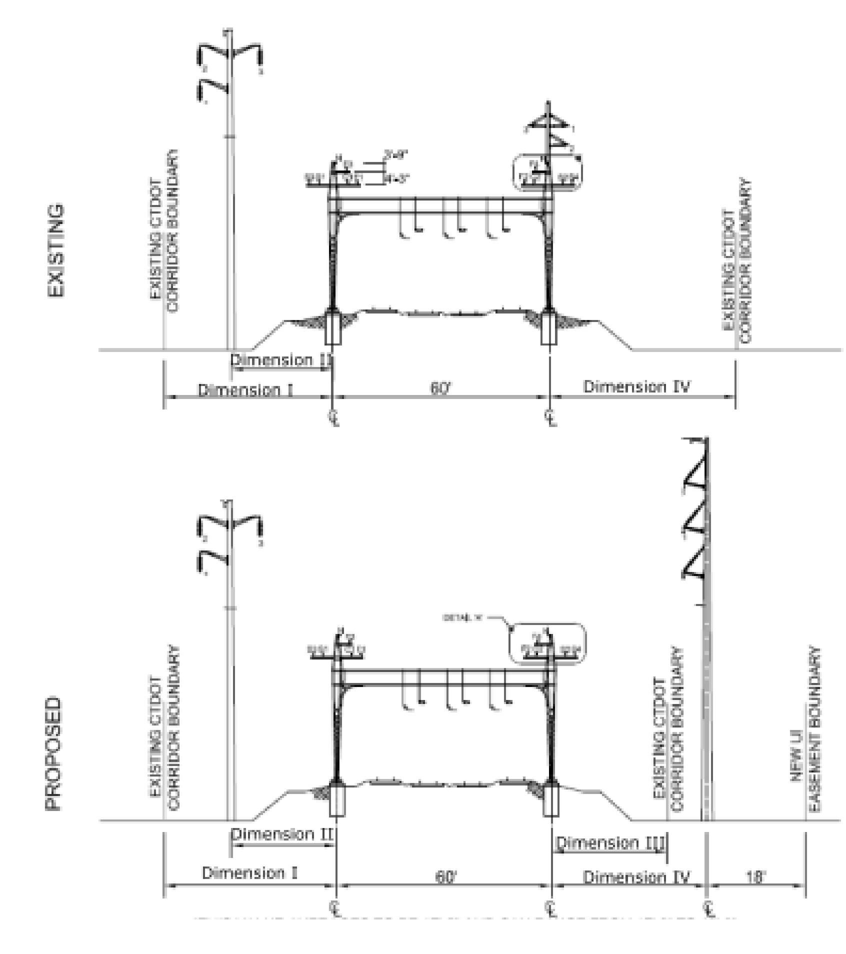

Figure A-13. Existing and proposed configuration for XS-11 in Group 1, corresponding to structures P721ES-P724S.

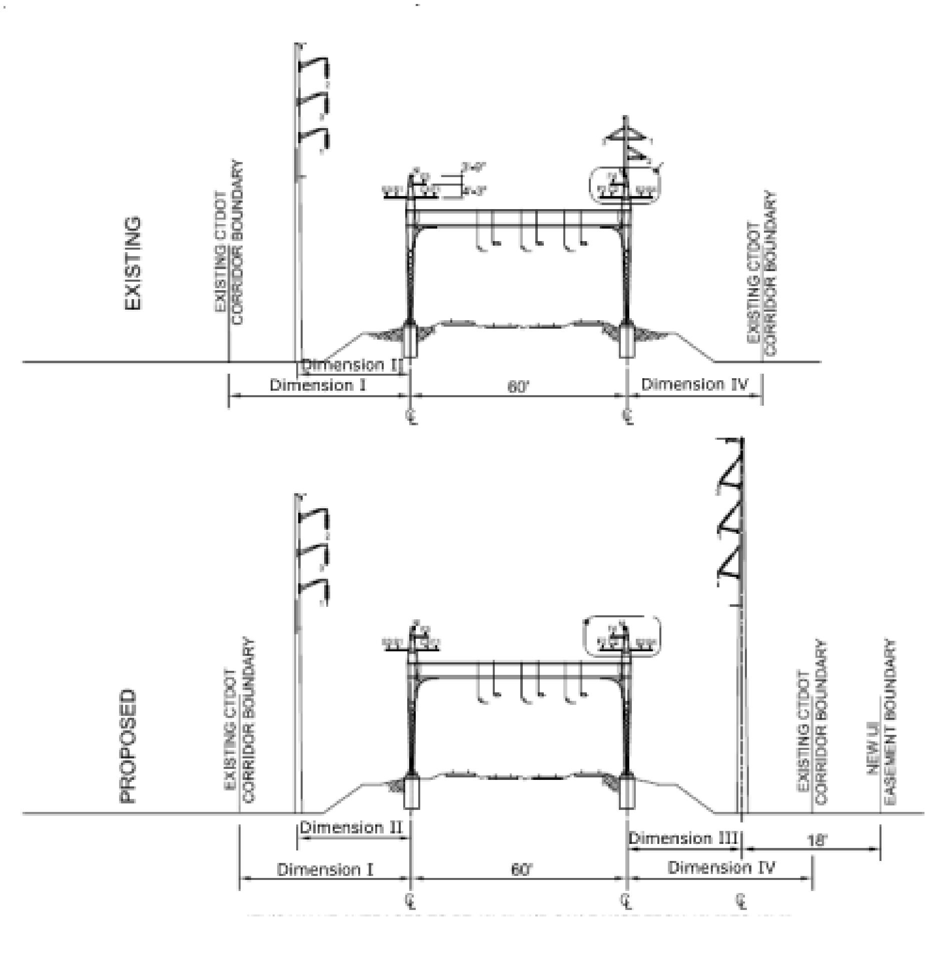

Figure A-14. Existing and proposed configuration for XS-12 in Group 1, corresponding to structures P725S-P728S.

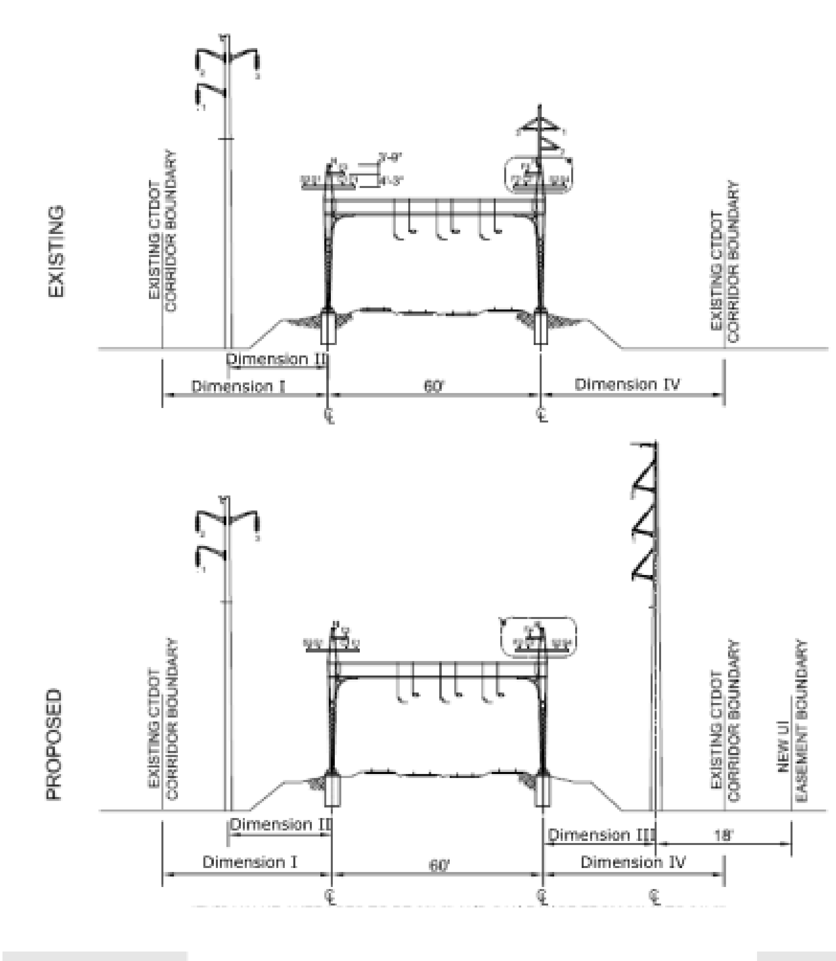

Figure A-15. Existing and proposed configuration for XS-13 in Group 1, corresponding to structures P730S to P733S.

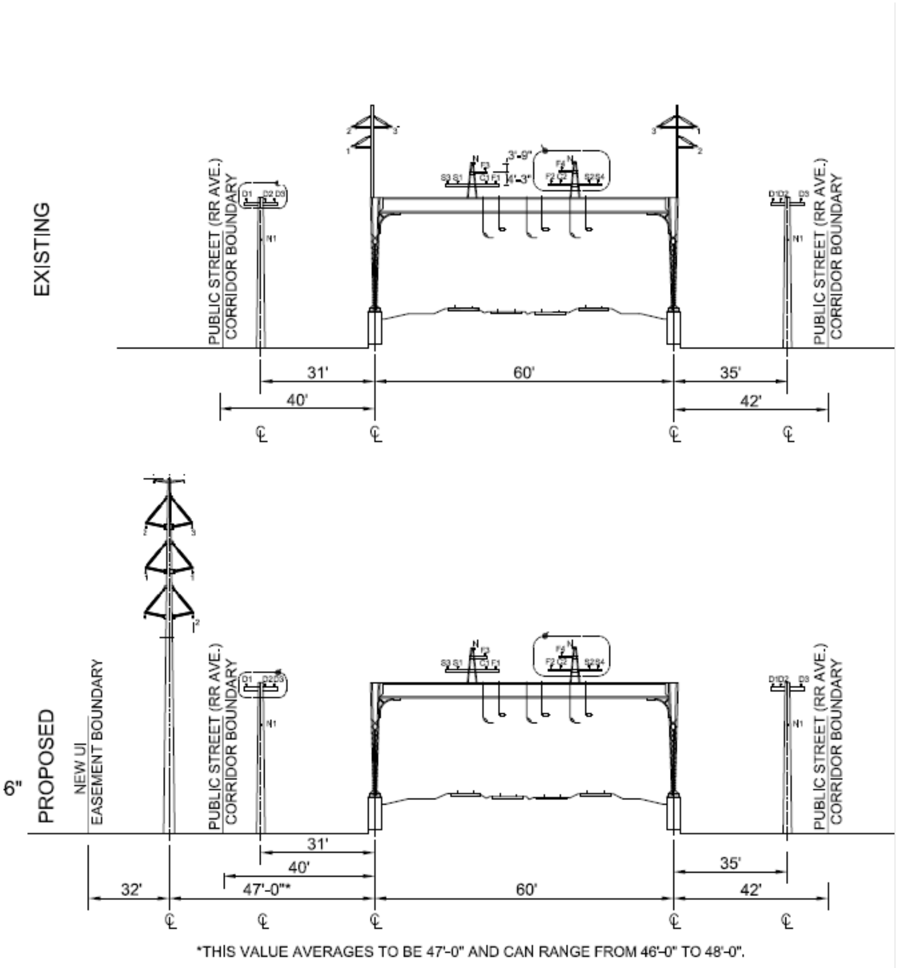

Figure A-16. Existing and proposed configuration for XS-14 in Group 3, corresponding to structures P738N-P745N.

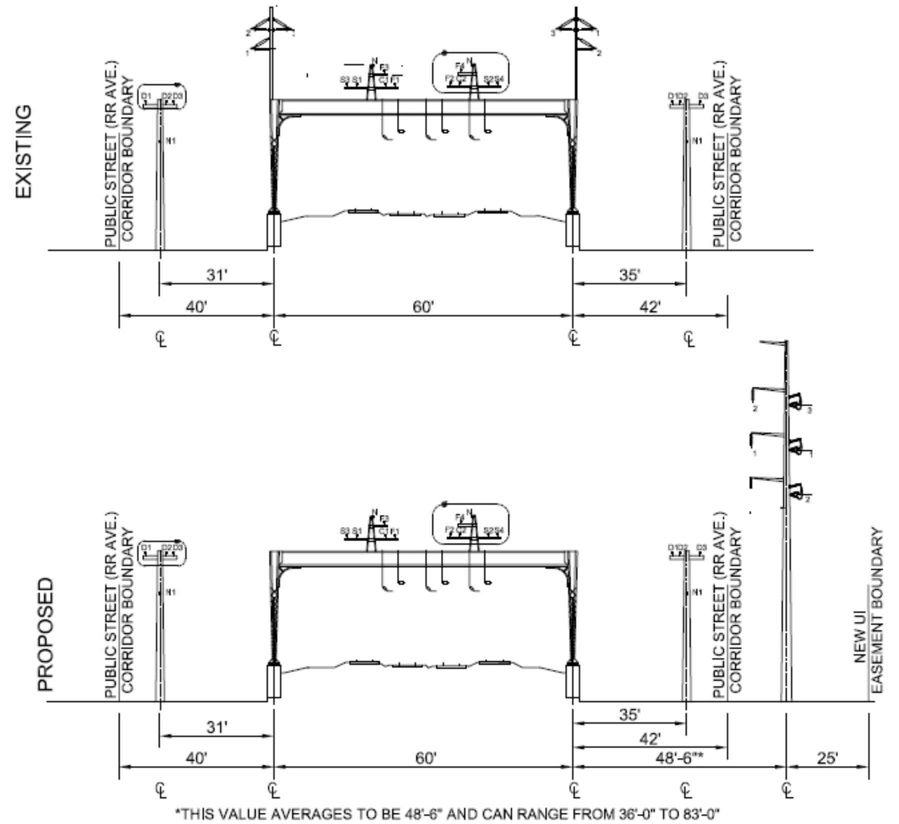

Figure A-17. Existing and proposed configuration for XS-15 in Group 4, corresponding to structures P745S-P752S and P762S-P765AS.

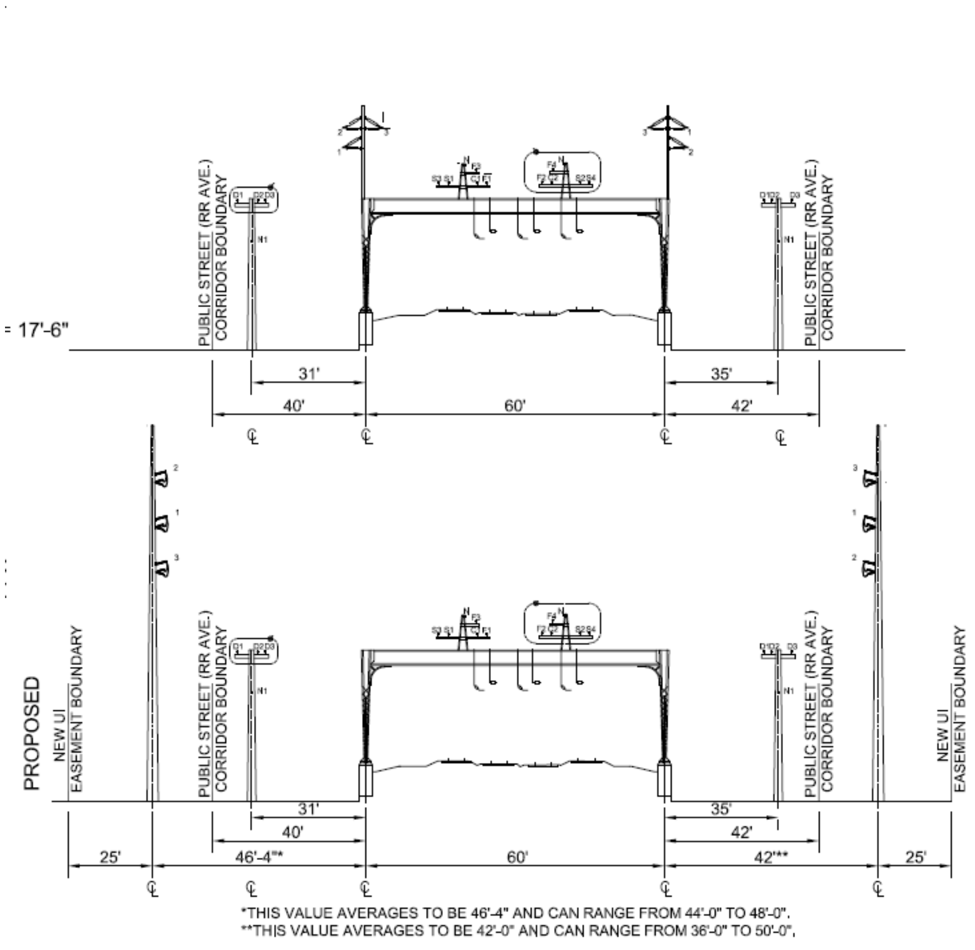

Figure A-18. Existing and proposed configuration for XS-16 in Group 5, corresponding to structures P752N and P760N-P762N.

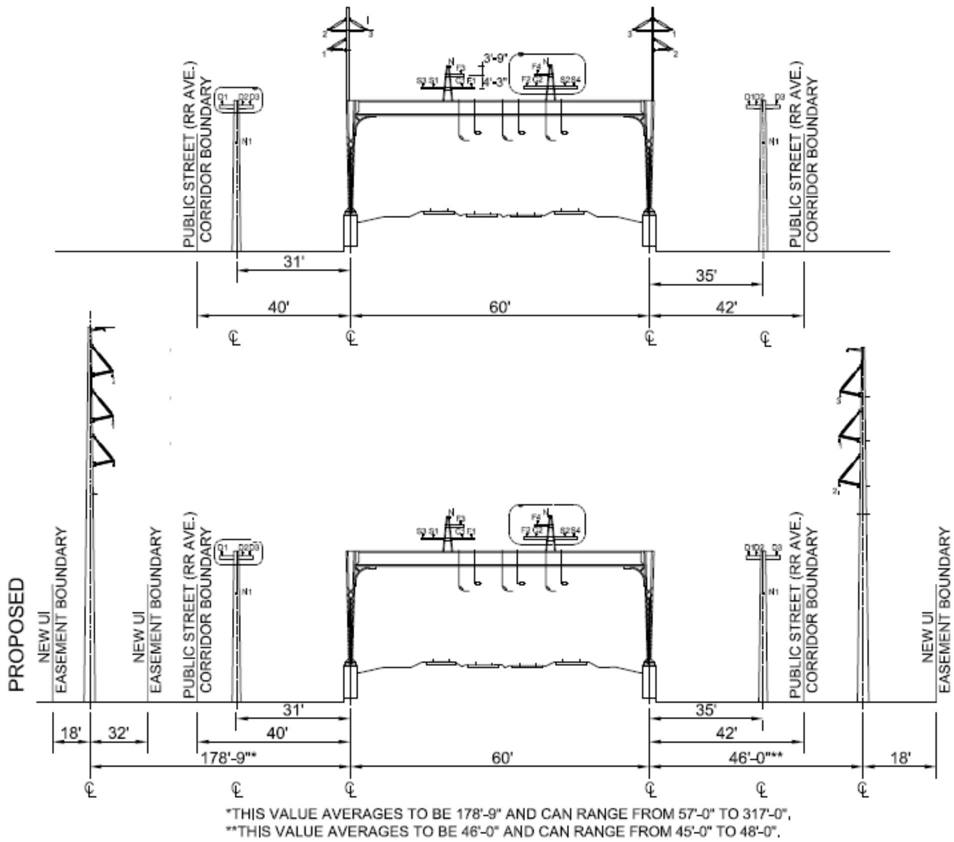

Figure A-19. Existing and proposed configuration for XS-17 in Group 5, corresponding to structures P756N-P759N and P756N-P760S.

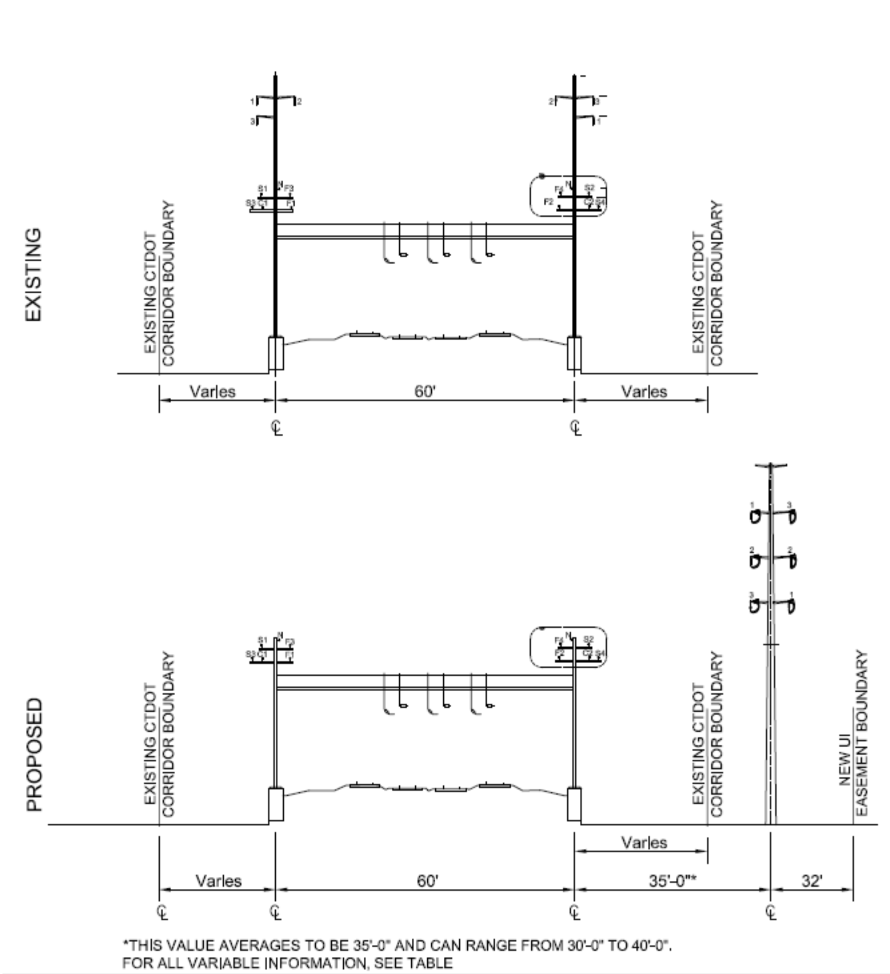

Figure A-20. Existing and proposed configuration for XS-18 in Group 4, corresponding to structures P779S-P783S.

Loading

UI Transmission Planning provided the pre- and post-Project loadings for the Project-related 115-kV transmission lines based on reports from ISO-NE as described below.

The CSC BMP requires that utilities provide calculations of EMF for "*pre and post project conditions, under: 1) peak load conditions at the time of application filing, and 2) projected seasonal maximum 24-hour average current load on the line anticipated within five years*" of the operational in service date.[20] The loading along the route varies as the transmission lines enter and exit various substations; hence magnetic-field levels also will vary along the route. The loading selected to calculate the magnetic fields from each model (XS-1 to XS-18) was the highest loading of any segment within the respective group.

Line loadings for existing and proposed conditions were provided by UI. The maximum average and peak loading values of transmission lines in each cross section were used in modeling, regardless of the other route segments.

Loading levels were provided to Exponent by UI. Excerpts from the power flow analysis supporting these load levels are quoted below.

> *Forecast values in the 2020 ISO-NE [Independent System Operator of New England] Capacity, Energy, Loads, and Transmission (CELT) Report were used to determine specific load levels … The ISO-NE CELT report forecasts load data for ten years (e.g. 2020-2029); consequently, load forecasts for the full five years after the final transmission line segment goes into service are not available … therefore the 2029 forecast provided in the CELT Report was the final year considered for this analysis*.[21]

[20] Connecticut Siting Council (CSC). Electric and Magnetic Fields Best Management Practices for the Construction of Transmission Lines in Connecticut (Revised February 20, 2014). New Britain, CT: Connecticut Siting Council, 2014, p. 6.

[21] Fairfield to Congress Transmission Line Rebuild EMF Power Flow Report, dated Feb. 2, 2022.

The analysis steps performed by UI for determining the peak daily average load (2025-2029) include:

- UI first "*[c]ollect[ed] actual hourly NE Load levels by using the ISO-NE SMD hourly data from the year prior to the CELT publication year … The 2020 CELT report is based on 2019 data and so this data was used to maintain consistency. The hourly data can be found here: http://www.iso-ne.com/isoexpress/web/reports/pricing/-/tree/zone-info*."
- Next, UI "*[d]etermine[d] the peak daily average load by finding the average load for each day of the year and then determining the single day with the highest value …*"
- Finally, "*[t]o estimate the value within 5 years of the project in-service date, [UI] scale[d] the actual maximum daily average load by the New England load growth rate from the data year until the projected load year. This can be deduced from the CELT report … Growth rate = (Projected system peak load)/(Data year peak load)*."

The specific loading values used in the calculations of magnetic fields are classified as CEII and available to the CSC upon request.[22]

[22] Note that only the peak loading of the existing 345-kV Middletown – Norwalk lines (i.e., Lines 3208 and 3291) was available at the time of modeling. As a result, the average loading of these two lines was assumed to be approximately 87% of the peak loading, consistent with the ratio of average to peak loading provided for the 115-kV transmission lines.

Attachment B

Calculated EMF Levels

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Table B-1. Magnetic-field levels (mG) at average loading

Cross section	Configuration	Location						
		–New UI Easement – 100 feet	–New UI Easement	–Existing UI Easement	Maximum	+Existing UI Easement	+New UI Easement	+New UI Easement + 100 feet
1	Existing	6.1	41	41	92	31	31	4.0
	Proposed	7.1	44	44	55	41	41	6.7
2	Existing	4.5	56	56	97	64	37	2.0
	Proposed	6.6	48	48	53	46	36	5.6
3	Existing	4.5	55	55	97	67	27	1.8
	Proposed	6.5	48	48	53	52	37	5.6
4	Existing	4.9	44	44	100	62	26	2.7
	Proposed	4.5	45	45	62	58	39	5.0
5	Existing	4.6	41	41	100	18	18	2.4
	Proposed	4.3	42	42	63	22	22	3.8
6	Existing	5.1	46	46	100	73	41	3.1
	Proposed	4.8	48	48	62	52	39	5.0
7	Existing	2.8	31	31	97	19	19	1.6
	Proposed	4.3	31	31	55	49	49	6.7
8	Existing	8.4	57	57	76	57	57	8.4
	Proposed	12.4	74	74	100	74	74	12.4
9	Existing	8.5	73	73	144	97	27	4.5
	Proposed	6.1	69	69	82	78	51	6.4
10	Existing	5.8	48	48	145	7.0	7.0	2.0
	Proposed	5.9	48	48	90	15	15	3.6
11	Existing	5.1	65	65	140	131	59	3.0
	Proposed	8.1	61	61	76	74	52	8.2

Cross section	Configuration	Location						
		–New UI Easement – 100 feet	–New UI Easement	–Existing UI Easement	Maximum	+Existing UI Easement	+New UI Easement	+New UI Easement + 100 feet
12	Existing	5.3	41	41	145	89	59	4.4
	Proposed	5.0	41	41	91	69	56	7.2
13	Existing	4.6	54	54	140	75	49	2.9
	Proposed	7.2	53	53	77	64	53	8.2
14	Existing	1.4	8.9	32	147	30	30	2.3
	Proposed	1.8	29	57	59	1.3	1.3	0.3
15	Existing	2.2	31	31	141	28	13	1.6
	Proposed	0.3	1.5	1.5	54	49	26	1.5
16	Existing	1.6	13	31	141	28	13	1.6
	Proposed	5.3	51	77	78	76	51	5.3
17	Existing	See Table B-2						
	Proposed							
18	Existing	1.5	23	23	95	21	5.7	0.8
	Proposed	0.1	0.6	0.6	28	28	14	0.8

Table B-2. Magnetic-field levels (mG) at average loading for XS-17*

Cross section	Configuration	Location								
		–New UI Easement I – 100 feet	–New UI Easement I	+New UI Easement I	+New Row I + 100 feet	–Existing UI Easement / - New UI Easement II	Max	+Existing UI Easement	+New UI Easement II	+New UI Easement II + 100 feet
17	Existing	0.3	0.8	1.4	6.3	31	141	28	13	1.6
	Proposed	7.3	57	75	9.2	6.5	81	81	57	7.3

*The proposed line of XS-17 is to be constructed on steel monopole structures on both sides of the MNR, with each structure associated with its own new UI easement. The monopole located north of the MNR is associated with UI easement I, and the monopole located south of the MNR with UI easement II.

Table B-3. Magnetic-field levels (mG) at peak loading

Cross section	Configuration	Location						
		–New UI Easement – 100 feet	–New UI Easement	–Existing UI Easement	Maximum	+Existing UI Easement	+New UI Easement	+New UI Easement + 100 feet
1	Existing	6.7	46	46	101	35	35	4.4
	Proposed	7.8	49	49	61	46	46	7.4
2	Existing	5.0	61	61	107	71	41	2.3
	Proposed	7.3	53	53	58	51	40	6.2
3	Existing	4.9	61	61	107	74	30	2.0
	Proposed	7.1	53	53	59	57	41	6.2
4	Existing	5.4	49	49	111	68	29	2.9
	Proposed	5.0	50	50	69	64	43	5.6
5	Existing	5.1	45	45	111	20	20	2.6
	Proposed	4.8	46	46	70	25	25	4.1

Cross section	Configuration	Location –New UI Easement – 100 feet	–New UI Easement	–Existing UI Easement	Maximum	+Existing UI Easement	+New UI Easement	+New UI Easement + 100 feet
6	Existing	5.7	51	51	111	81	45	3.4
	Proposed	5.3	53	53	69	58	43	5.5
7	Existing	3.1	34	34	107	21	21	1.8
	Proposed	4.8	35	35	61	54	54	7.4
8	Existing	9.3	64	64	84	64	64	9.3
	Proposed	14	82	82	110	82	82	14
9	Existing	9.6	83	83	165	111	31	5.1
	Proposed	7.0	78	78	94	90	58	7.2
10	Existing	6.6	54	54	166	8.0	8.0	2.2
	Proposed	6.1	55	55	102	17	17	4.1
11	Existing	5.8	74	74	160	150	67	3.5
	Proposed	9.2	69	69	86	84	60	9.4
12	Existing	6.1	47	47	166	102	67	5.1
	Proposed	5.7	46	46	104	79	64	8.2
13	Existing	5.2	62	62	160	86	56	3.3
	Proposed	8.2	60	60	87	73	60	9.3
14	Existing	1.6	10	37	167	34	34	2.6
	Proposed	2.0	34	66	67	1.5	1.5	0.3
15	Existing	2.6	36	36	162	33	15	1.8
	Proposed	0.4	1.8	1.8	63	56	30	1.7
16	Existing	1.8	15	36	162	33	15	1.8
	Proposed	6.1	59	89	90	88	59	6.1

Cross section	Configuration	Location: –New UI Easement – 100 feet	–New UI Easement	–Existing UI Easement	Maximum	+Existing UI Easement	+New UI Easement	+New UI Easement + 100 feet
17	Existing	See Table B-4						
	Proposed							
18	Existing	1.7	25	25	106	23	6.4	0.9
	Proposed	0.1	0.7	0.7	32	31	16	0.9

Table B-4. Magnetic-field levels (mG) at peak loading for XS-17*

Cross section	Configuration	Location: –New UI Easement I – 100 feet	–New UI Easement I	+New UI Easement I	+New UI Easement I + 100 feet	–Existing UI Easement / -New UI Easement II	Max	+Existing UI Easement	+New UI Easement II	+New UI Easement II + 100 feet
17	Existing	0.4	0.9	1.3	11	36	162	33	14	1.8
	Proposed	8.4	66	87	7.3	7.3	94	92	66	8.4

*The proposed line of XS-17 is to be constructed on steel monopole structures on both sides of the MNR, with each structure associated with its own new UI easement. The monopole located north of the MNR is associated with UI easement I, and the monopole located south of the MNR with UI easement II.

Table B-5. Electric field levels (kV/m)

Cross section	Configuration	Location –New UI Easement – 100 feet	–New UI Easement	–Existing UI Easement	Maximum	+Existing UI Easement	+New UI Easement	+New UI Easement + 100 feet
1	Existing	< 0.1	0.7	0.7	1.3	0.4	0.4	< 0.1
	Proposed	< 0.1	0.8	0.8	1.1	0.5	0.5	< 0.1
2	Existing	< 0.1	0.8	0.8	1.3	1.1	0.6	< 0.1
	Proposed	< 0.1	0.8	0.8	1.0	0.8	0.5	< 0.1
3	Existing	< 0.1	0.8	0.8	1.3	1.1	0.4	< 0.1
	Proposed	< 0.1	0.8	0.8	1.1	1.0	0.5	< 0.1
4	Existing	< 0.1	0.8	0.8	1.3	1.0	0.4	< 0.1
	Proposed	< 0.1	0.8	0.8	1.1	1.1	0.5	< 0.1
5	Existing	< 0.1	0.7	0.7	1.3	0.2	0.2	< 0.1
	Proposed	< 0.1	0.7	0.7	1.1	0.1	0.1	< 0.1
6	Existing	< 0.1	0.8	0.8	1.3	1.2	0.7	< 0.1
	Proposed	< 0.1	0.8	0.8	1.1	0.9	0.5	< 0.1
7	Existing	< 0.1	0.5	0.5	1.3	0.3	0.3	< 0.1
	Proposed	< 0.1	0.5	0.5	1.1	0.9	0.9	< 0.1
8	Existing	0.1	0.7	0.7	1.6	0.7	0.7	< 0.1
	Proposed	0.1	0.8	0.8	1.9	0.8	0.8	0.1
9	Existing	< 0.1	0.9	0.9	1.3	1.0	0.2	< 0.1
	Proposed	< 0.1	0.8	0.8	1.0	0.9	0.4	< 0.1
10	Existing	< 0.1	0.4	0.4	1.3	< 0.1	< 0.1	< 0.1
	Proposed	< 0.1	0.4	0.4	1.1	< 0.1	< 0.1	< 0.1
11	Existing	< 0.1	0.8	0.8	1.3	1.2	0.7	< 0.1
	Proposed	< 0.1	0.8	0.8	1.0	1.0	0.5	< 0.1

Cross section	Configuration	Location						
		–New UI Easement – 100 feet	–New UI Easement	–Existing UI Easement	Maximum	+Existing UI Easement	+New UI Easement	+New UI Easement + 100 feet
12	Existing	< 0.1	0.3	0.3	1.3	1.0	0.7	< 0.1
	Proposed	< 0.1	0.3	0.3	1.1	0.8	0.5	< 0.1
13	Existing	< 0.1	0.7	0.7	1.3	0.9	0.5	< 0.1
	Proposed	< 0.1	0.7	0.7	1.0	0.7	0.5	< 0.1
14	Existing	< 0.1	0.1	0.3	1.3	0.3	0.3	< 0.1
	Proposed	< 0.1	0.3	0.6	0.6	< 0.1	< 0.1	< 0.1
15	Existing	< 0.1	0.3	0.3	1.3	0.3	0.1	< 0.1
	Proposed	< 0.1	< 0.1	< 0.1	0.6	0.6	0.3	< 0.1
16	Existing	< 0.1	0.1	0.3	1.3	0.3	0.1	< 0.1
	Proposed	< 0.1	0.5	1.0	1.1	1.0	0.5	< 0.1
17	Existing	See Table B-6						
	Proposed							
18	Existing	< 0.1	0.4	0.4	1.4	0.3	0.1	< 0.1
	Proposed	< 0.1	< 0.1	< 0.1	0.6	0.6	0.4	< 0.1

Table B-6. Electric-field levels (kV/m) XS-17*

Cross section	Configuration	Location								
		–New UI Easement I – 100 feet	–New UI Easement I	+New UI Easement I	+New UI Easement I + 100 feet	–Existing UI Easement / -New UI Easement II	Max	+Existing UI Easement	+New UI Easement II	+New UI Easement II + 100 feet
17	Existing	<0.1	<0.1	<0.1	0.1	0.3	1.3	0.3	0.1	<0.1
	Proposed	<0.1	0.5	0.9	< 0.1	< 0.1	1.1	1.1	0.5	<0.1

*The proposed line of XS-17 is to be constructed on steel monopole structures on both sides of the MNR, with each structure associated with its own new UI easement. The monopole located north of the MNR is associated with UI easement I, and the monopole located south of the MNR with UI easement II.

Attachment C

Graphical Profiles of Calculated EMF

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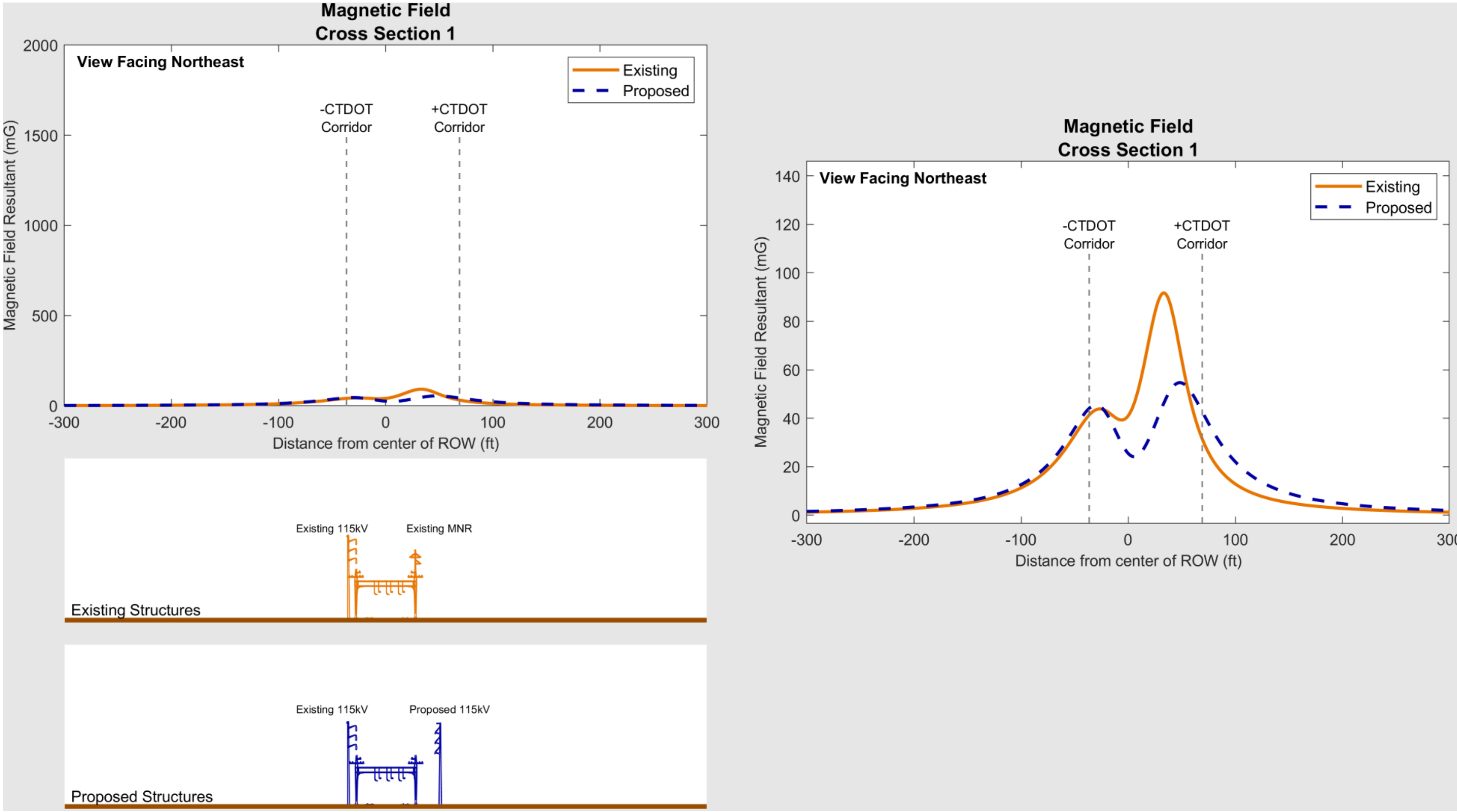

Figure C-1. Magnetic-field profile across XS-1 at average loading.

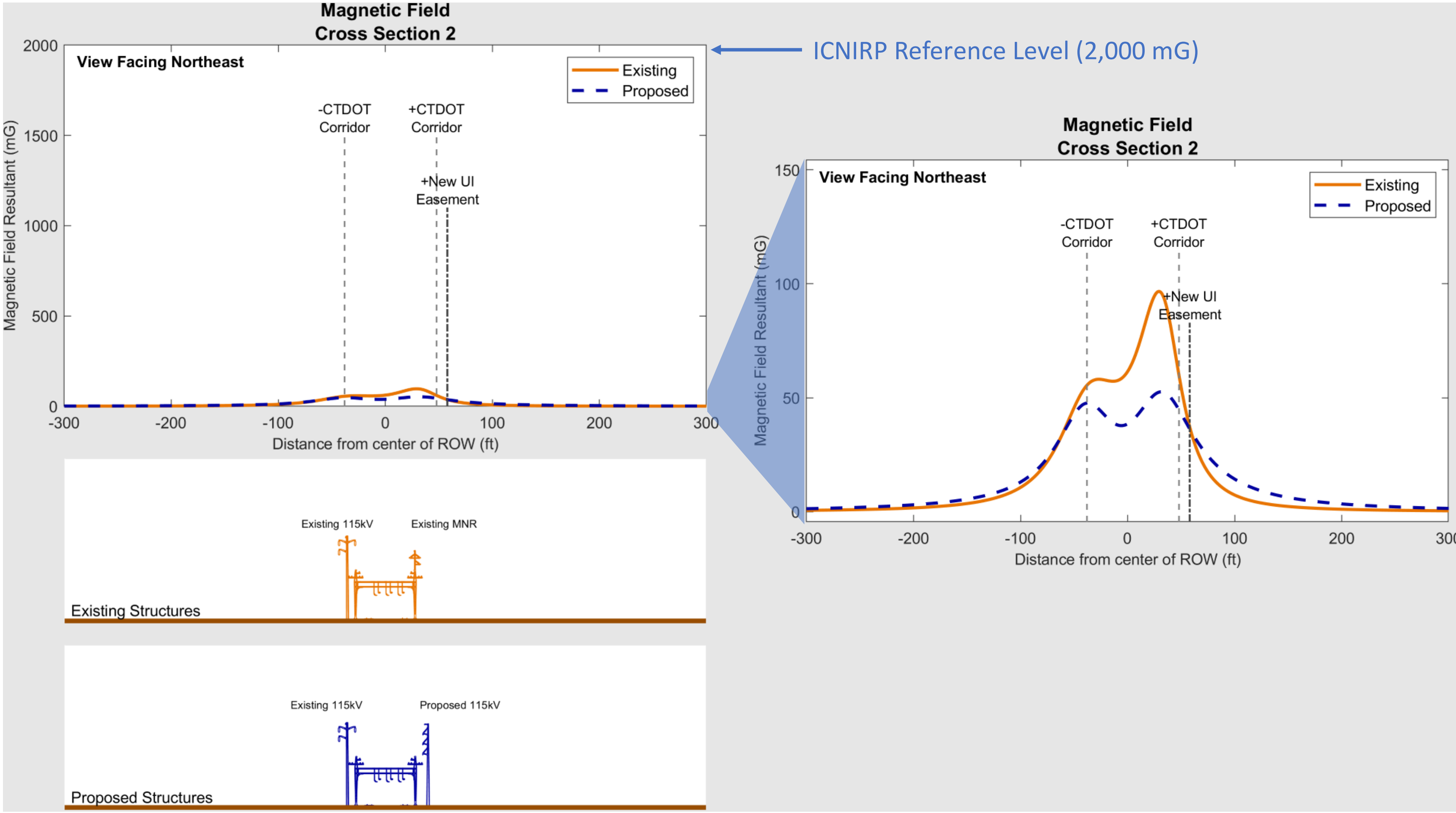

Figure C-2. Magnetic-field profile across XS-2 at average loading.

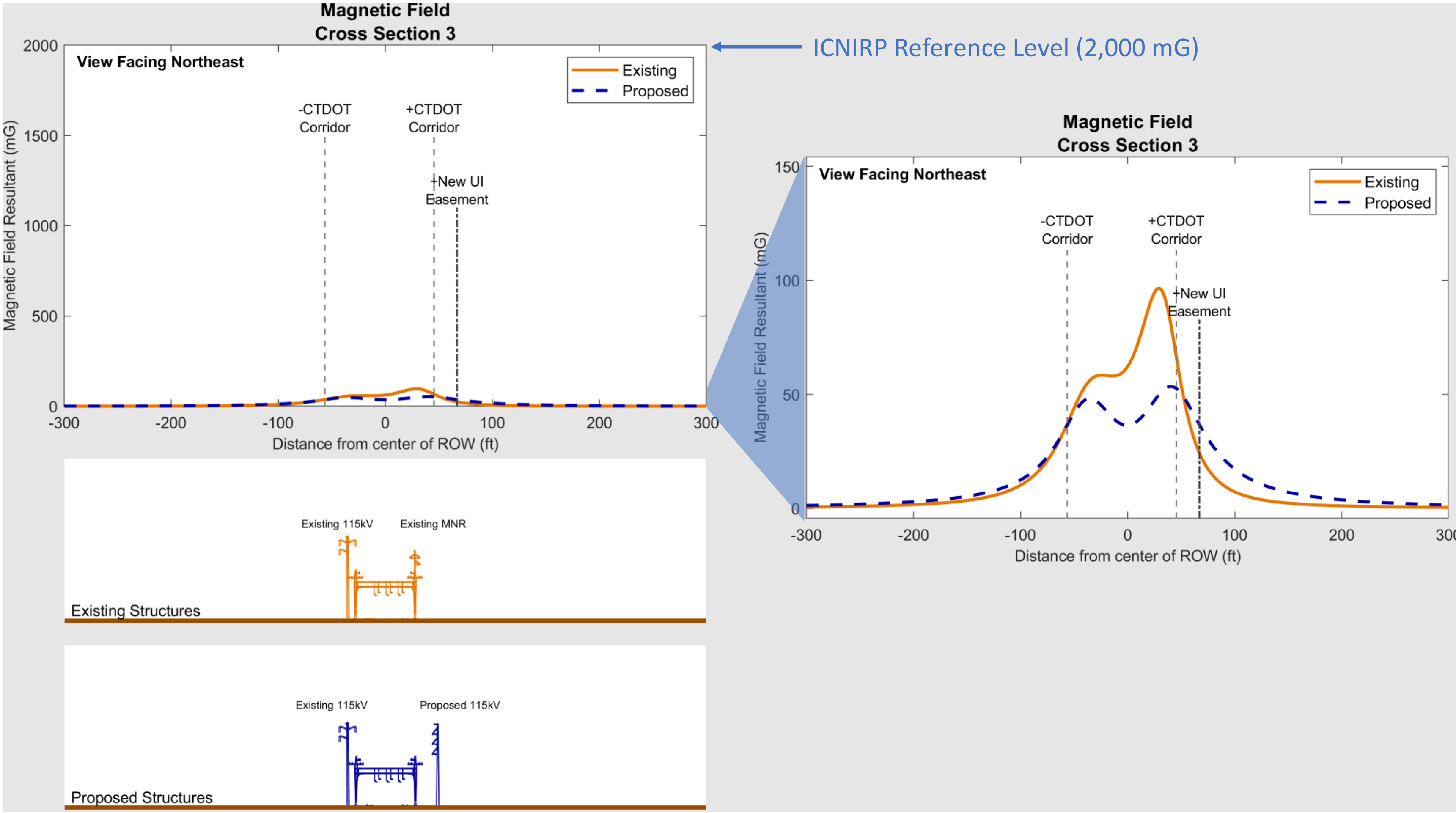

Figure C-3. Magnetic-field profile across XS-3 at average loading.

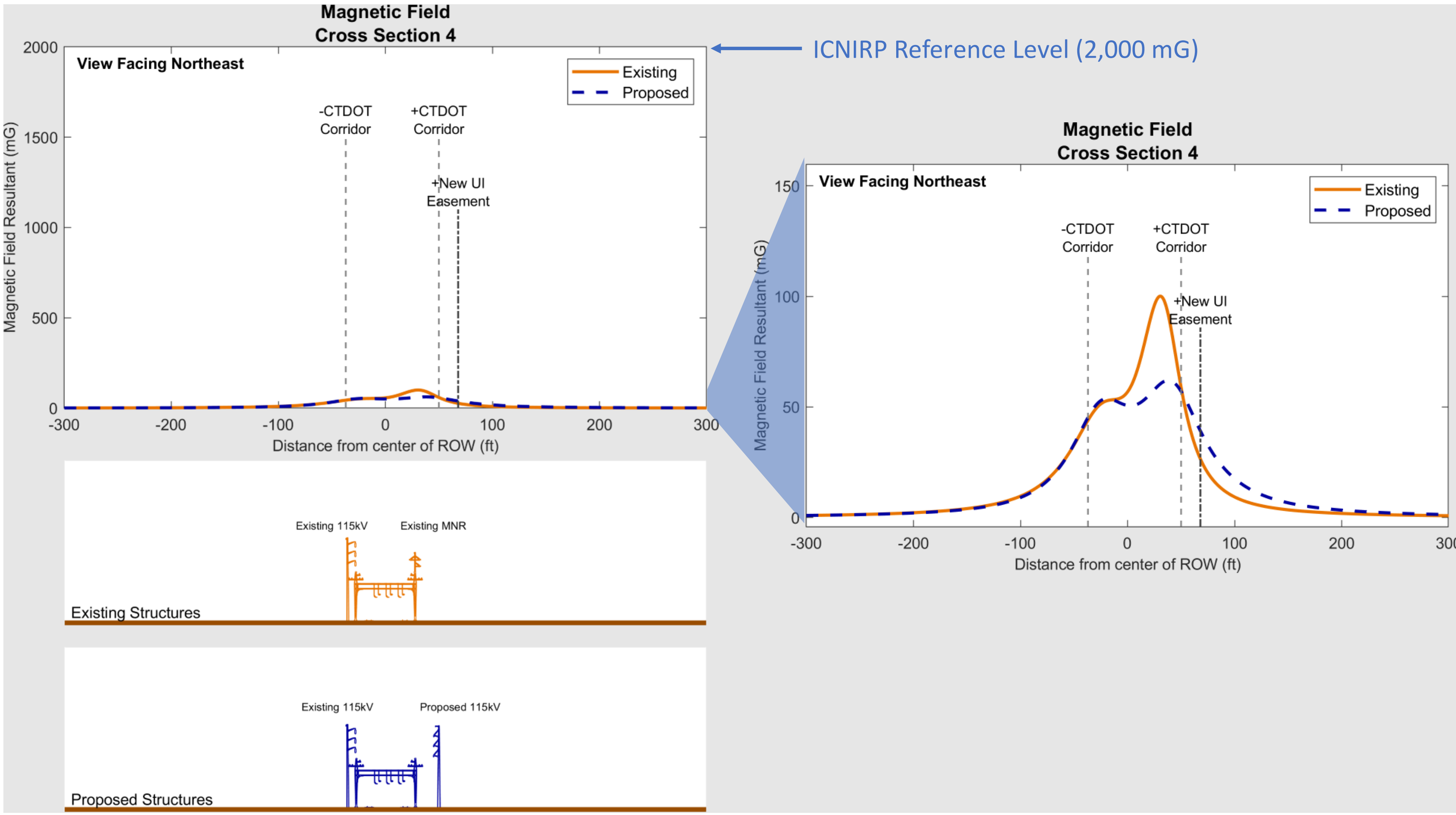

Figure C-4. Magnetic-field profile across XS-4 at average loading.

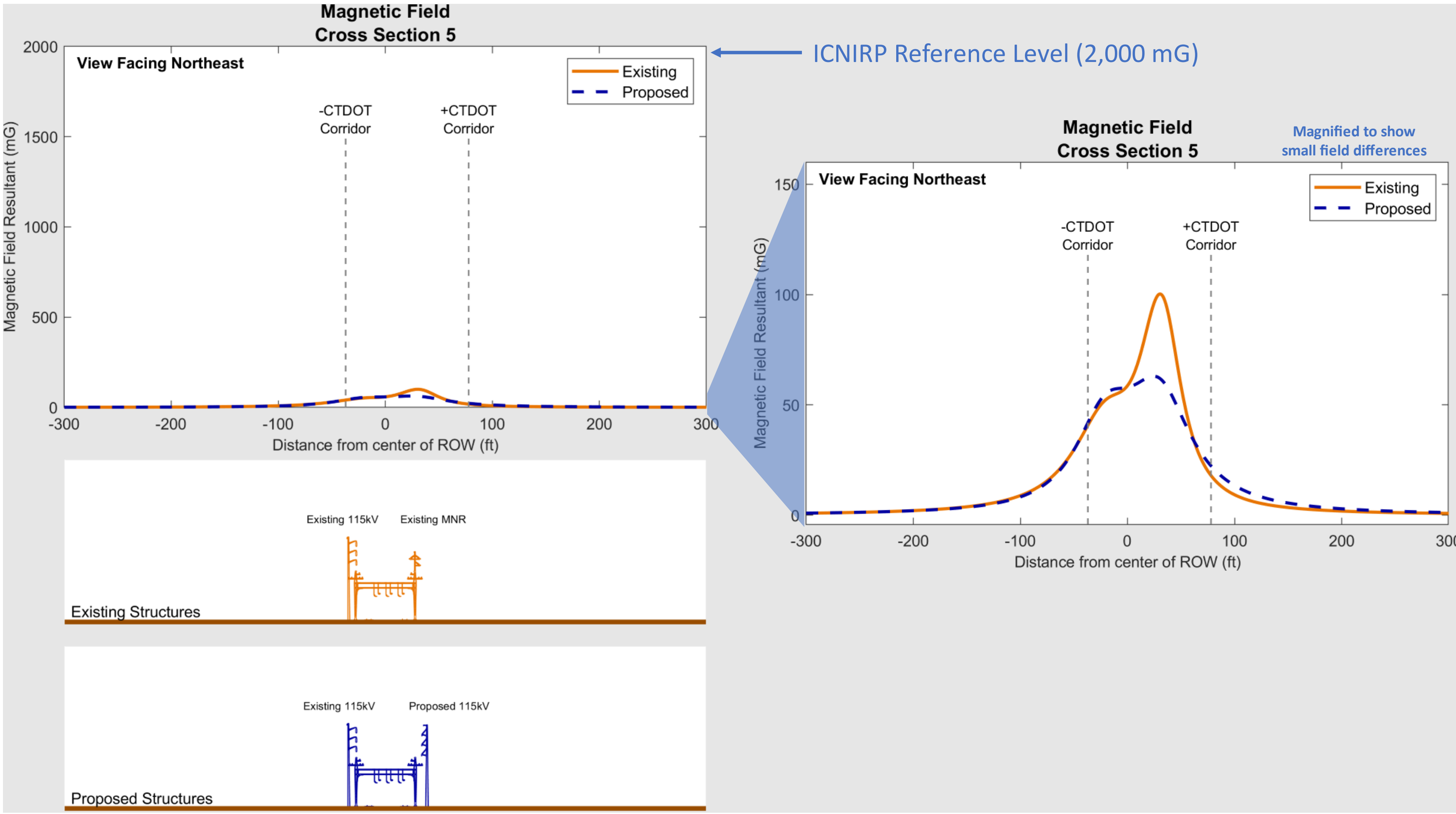

Figure C-5. Magnetic-field profile across XS-5 at average loading.

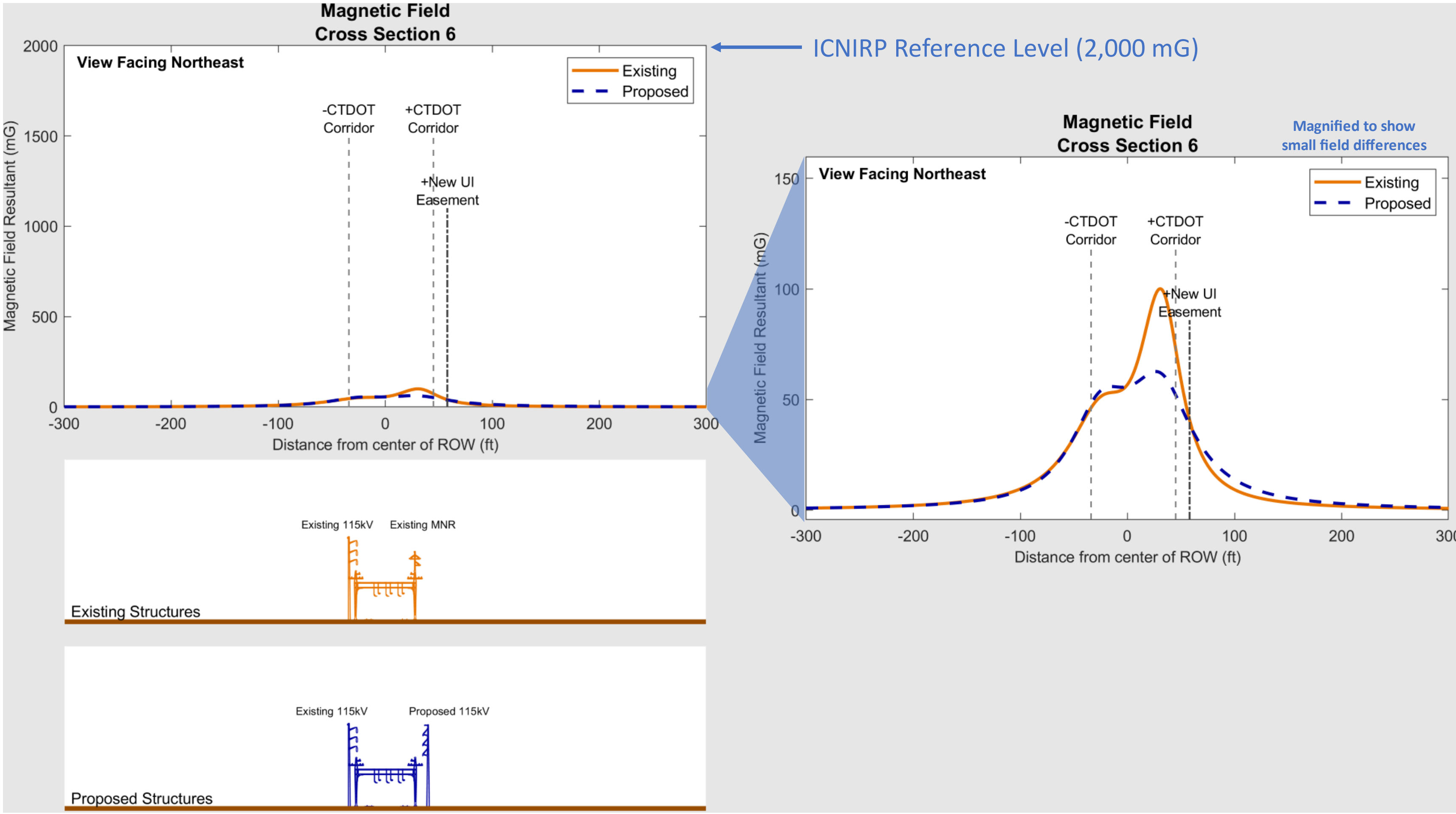

Figure C-6. Magnetic-field profile across XS-6 at average loading.

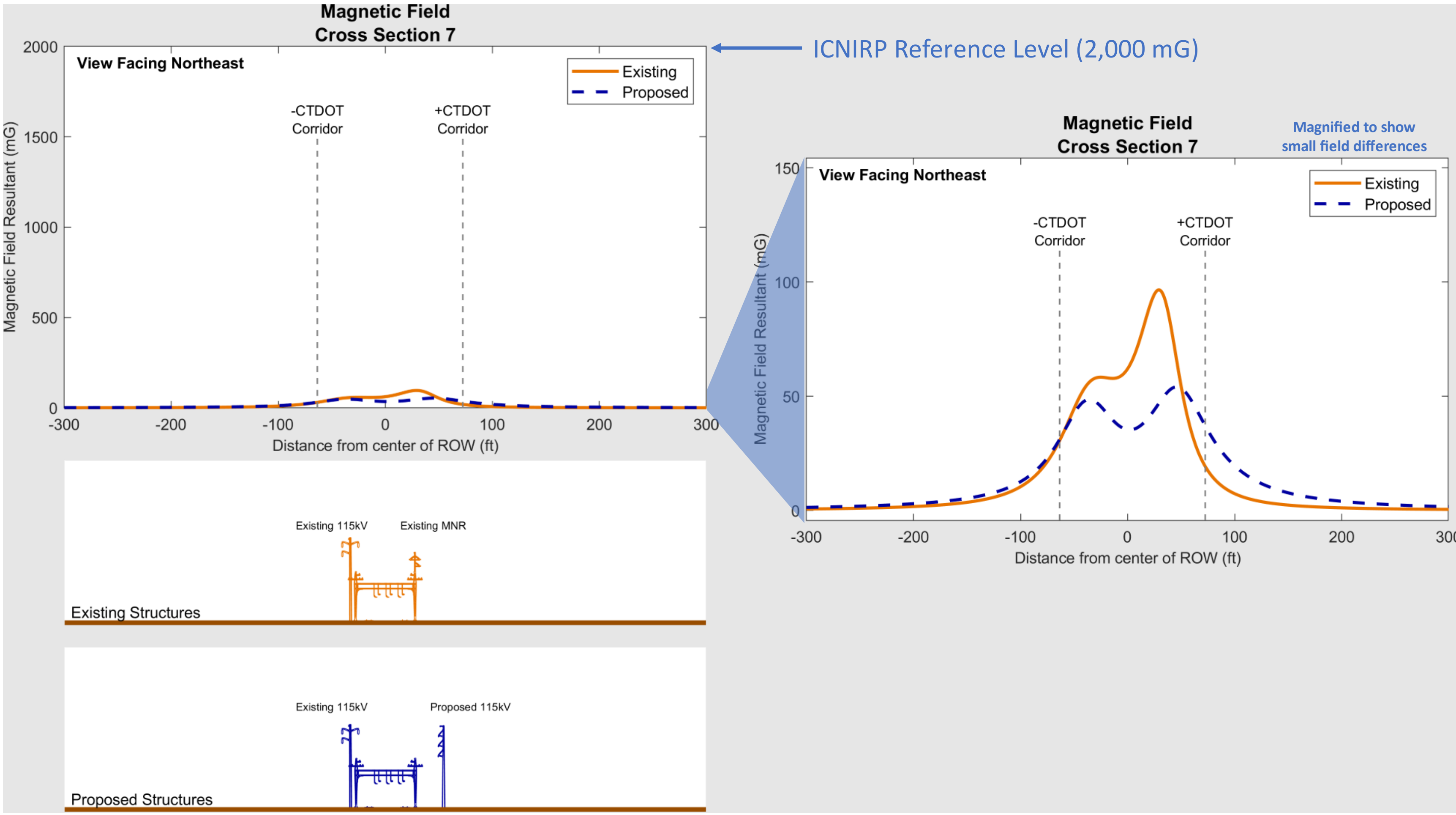

Figure C-7. Magnetic-field profile across XS-7 at average loading.

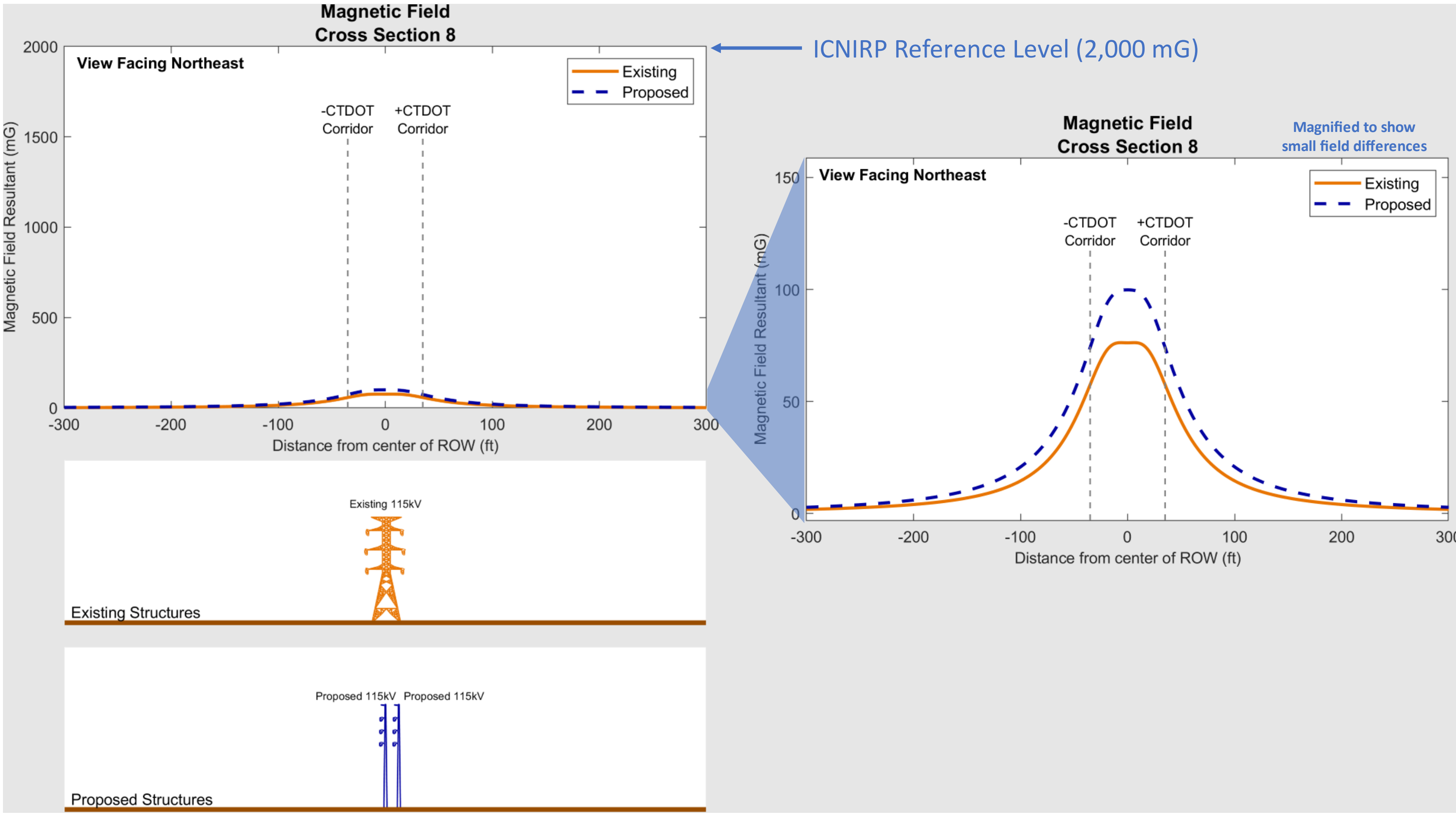

Figure C-8. Magnetic-field profile across XS-8 at average loading.

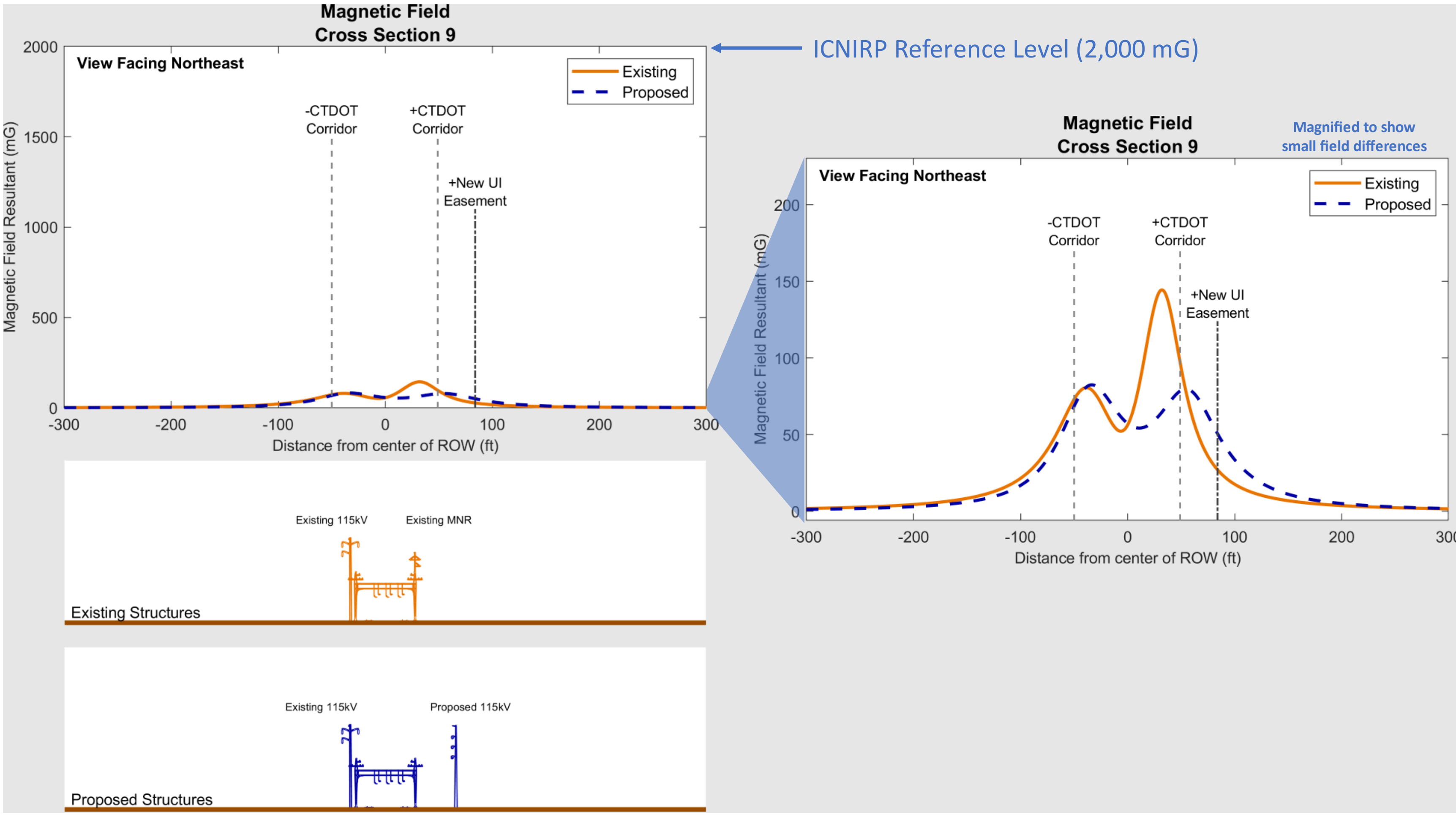

Figure C-9. Magnetic-field profile across XS-9 at average loading.

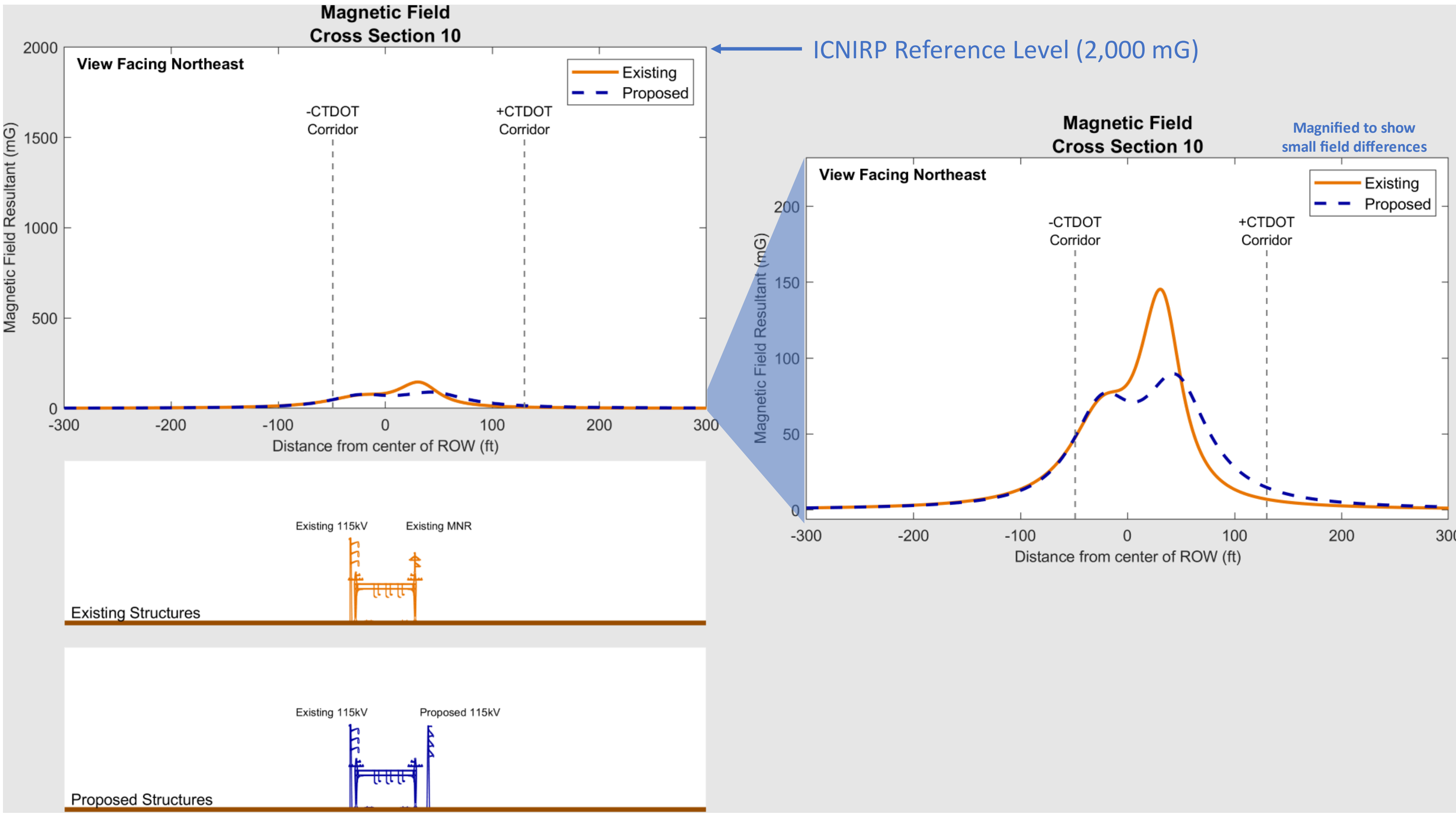

Figure C-10. Magnetic-field profile across XS-10 at average loading.

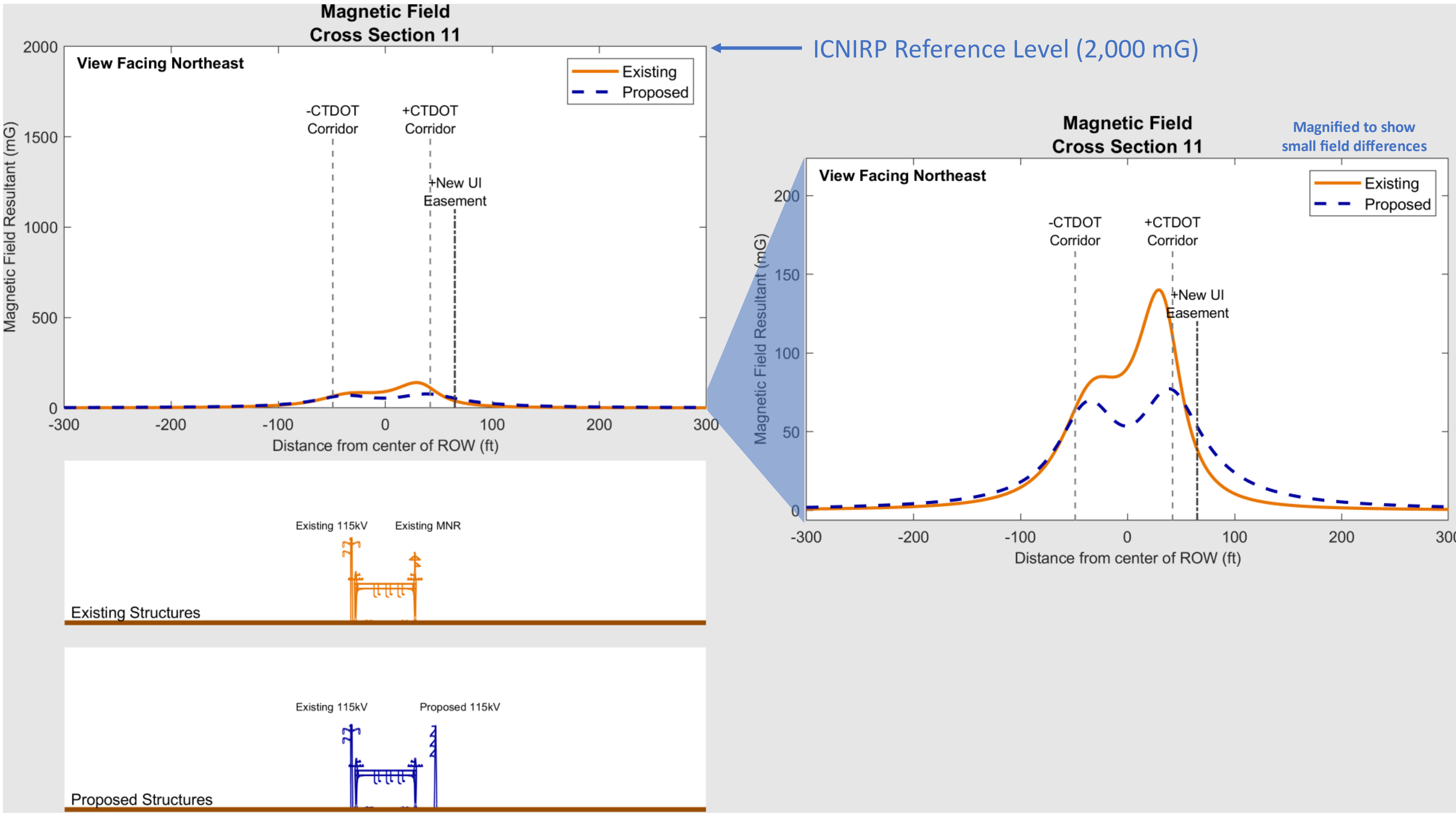

Figure C-11. Magnetic-field profile across XS-11 at average loading.

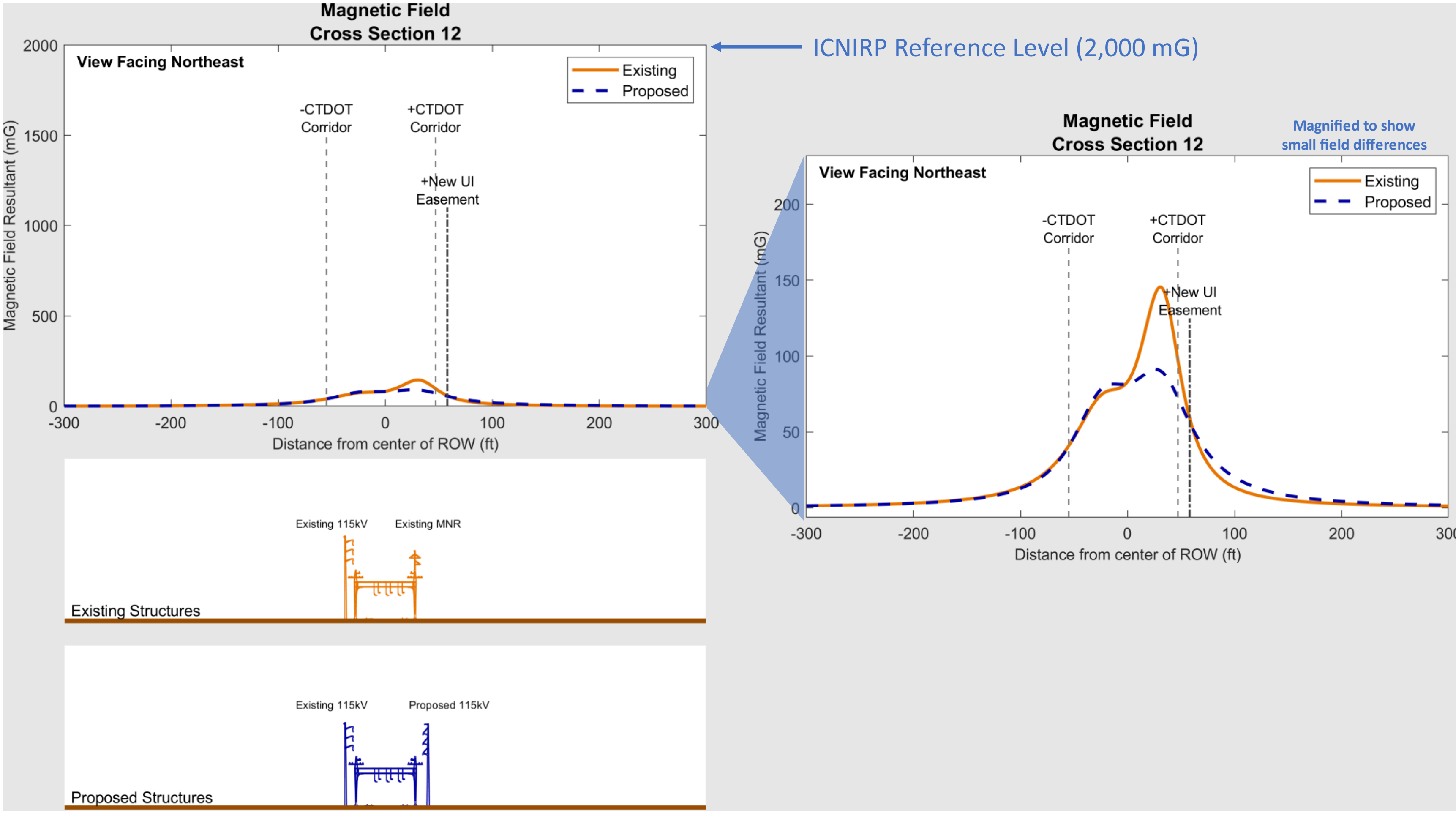

Figure C-12. Magnetic-field profile across XS-12 at average loading.

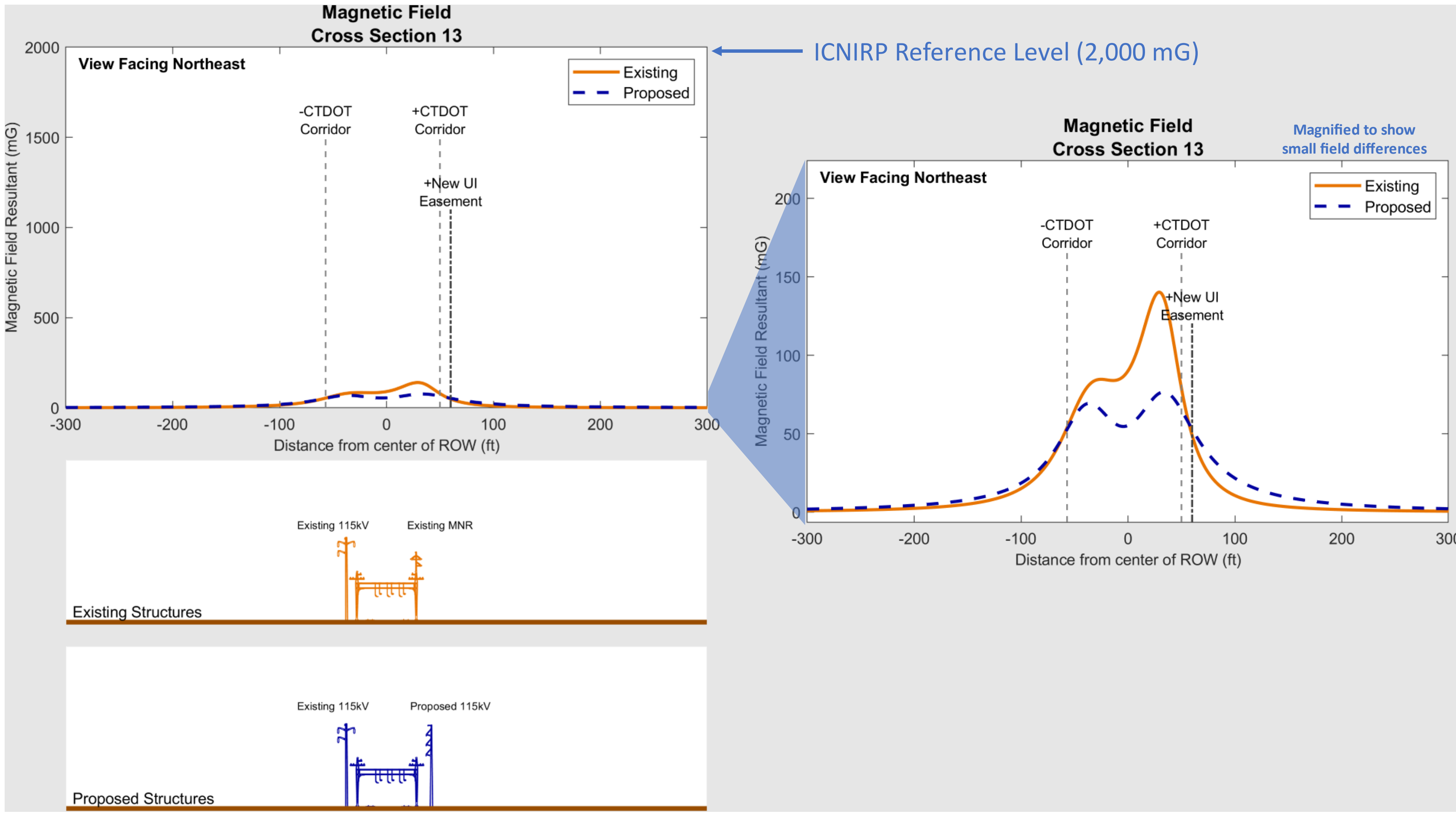

Figure C-13. Magnetic-field profile across XS-13 at average loading.

s

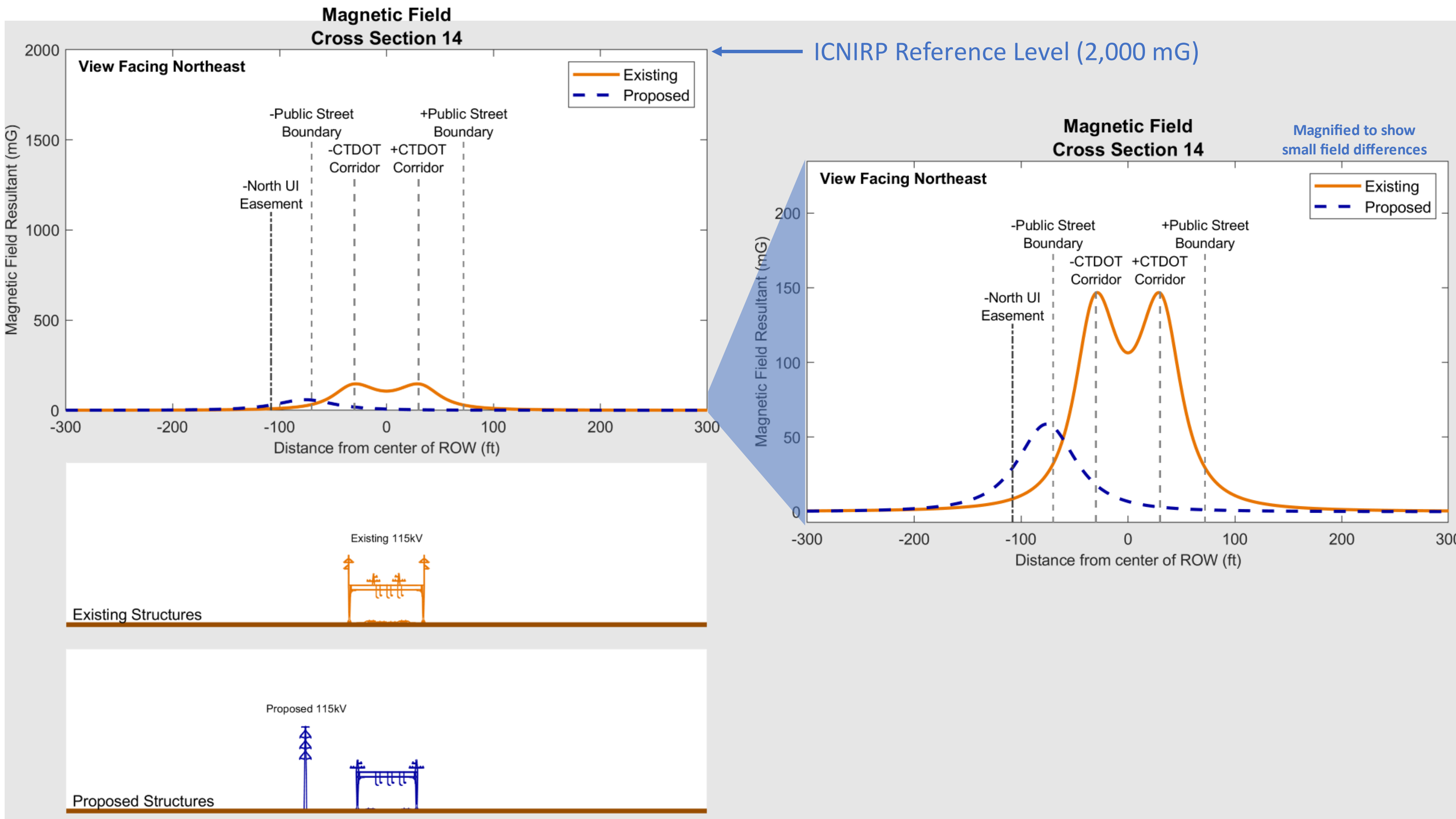

Figure C-14. Magnetic-field profile across XS-14 at average loading.

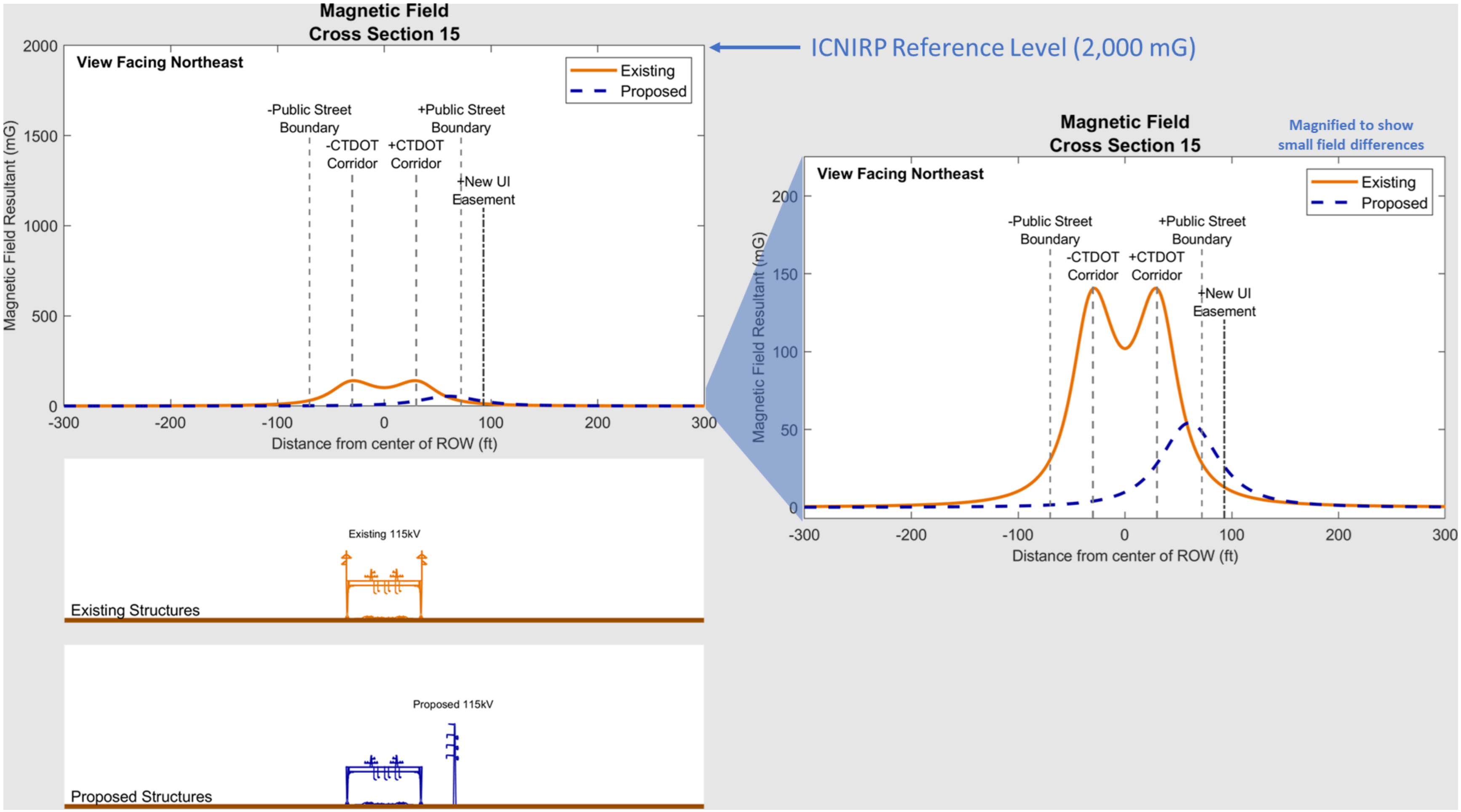

Figure C-15. Magnetic-field profile across XS-15 at average loading.

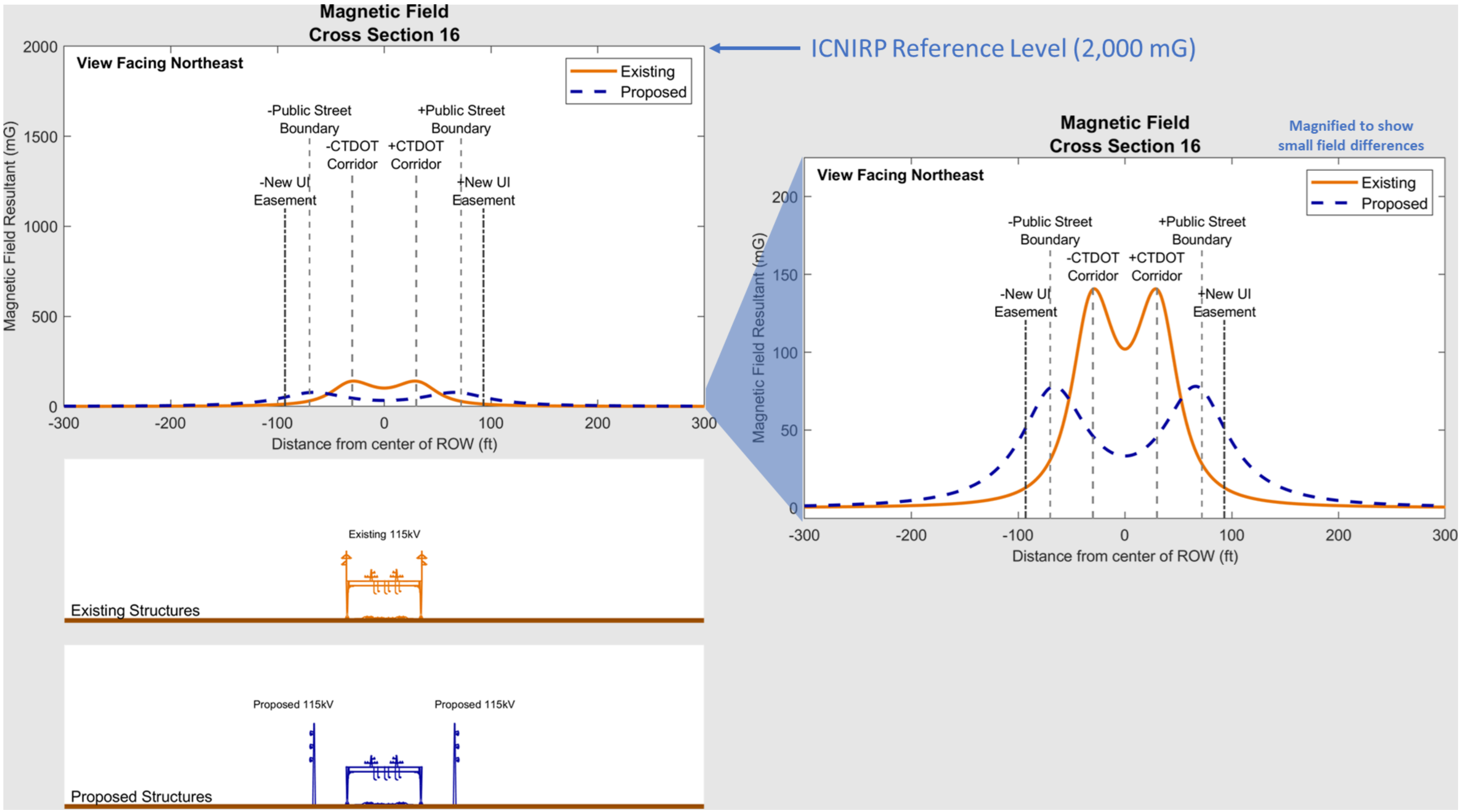

Figure C-16. Magnetic-field profile across XS-16 at average loading.

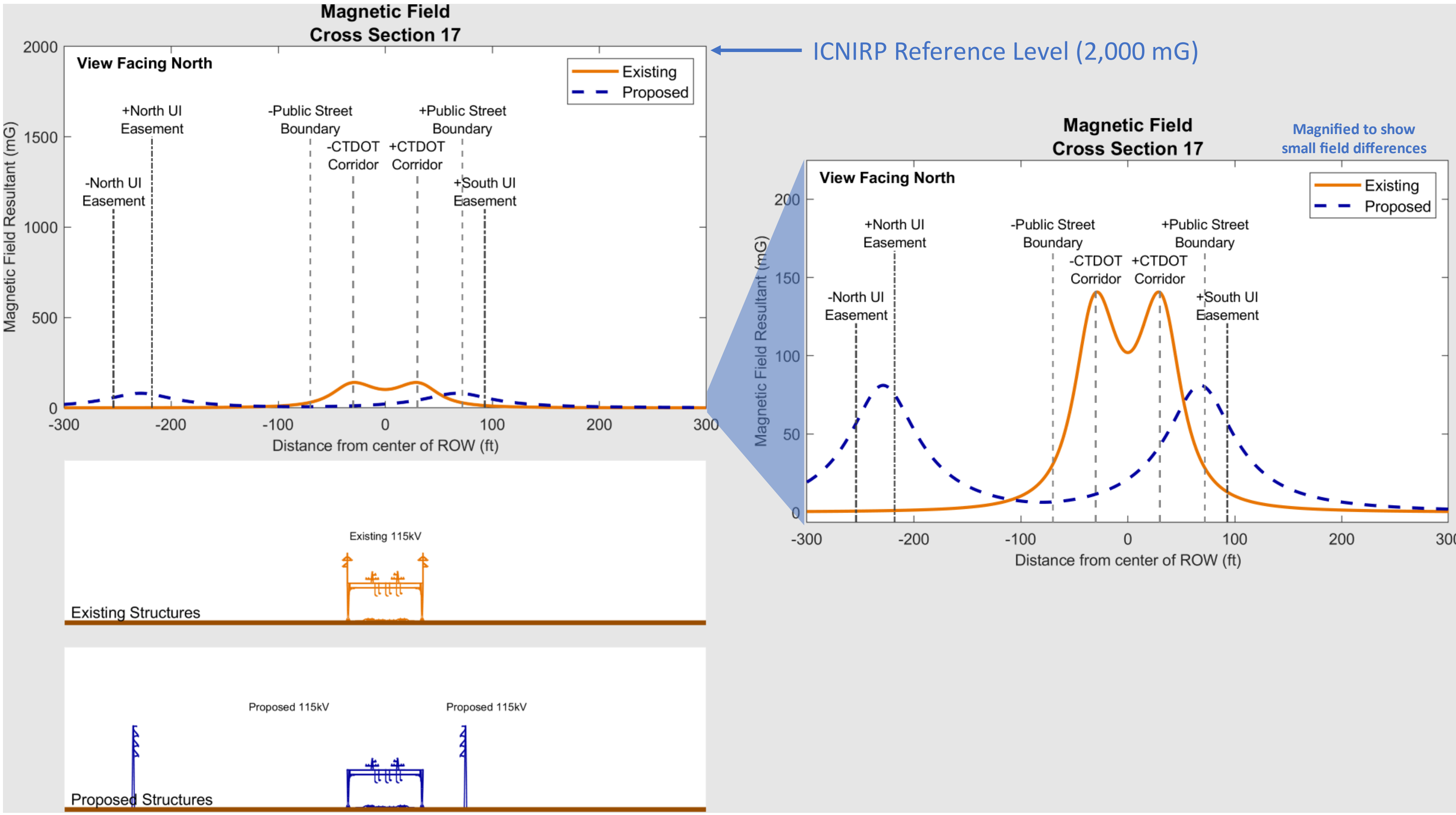

Figure C-17. Magnetic-field profile across XS-17 at average loading.

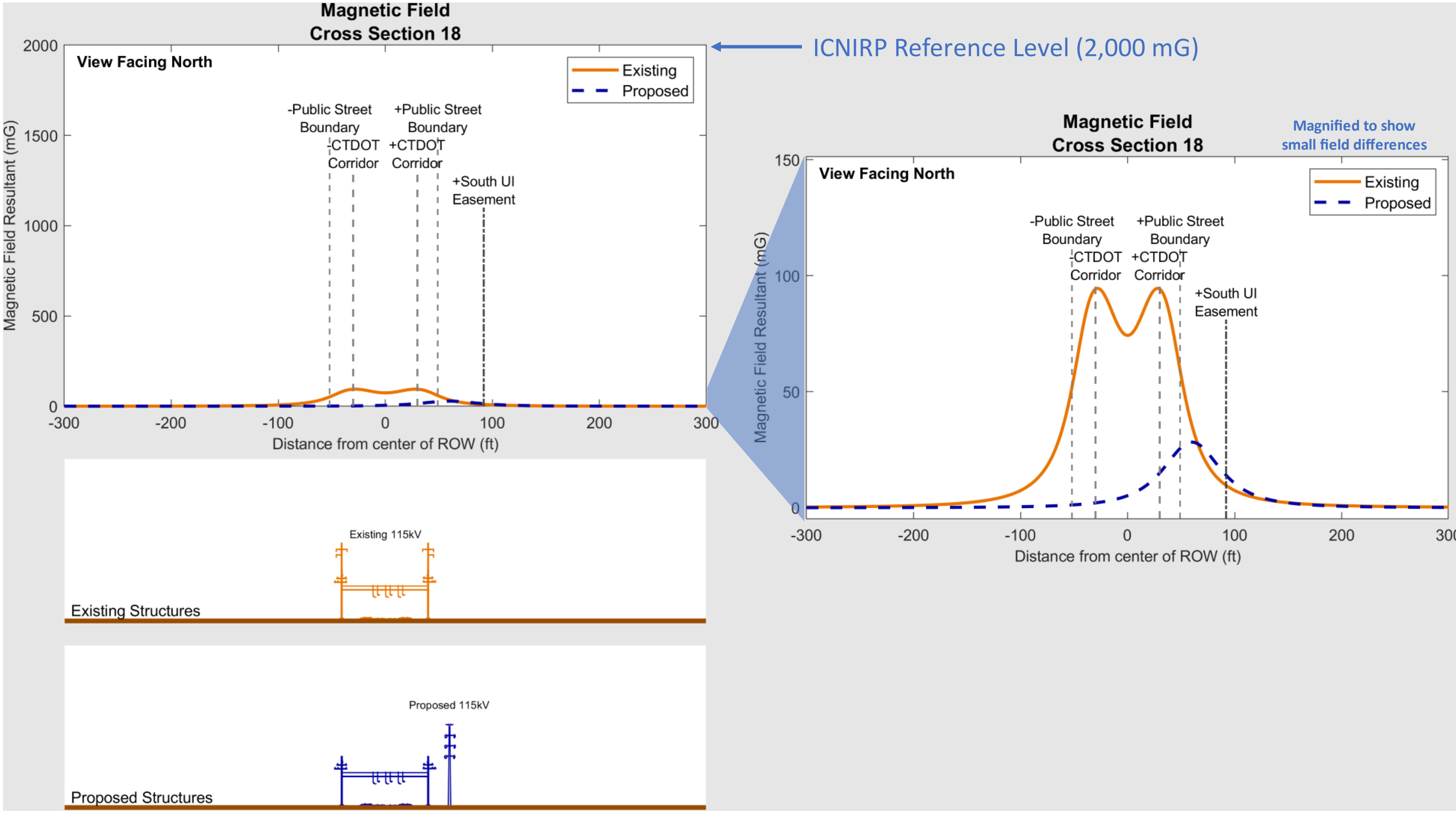

Figure C-18. Magnetic-field profile across XS-18 at average loading.

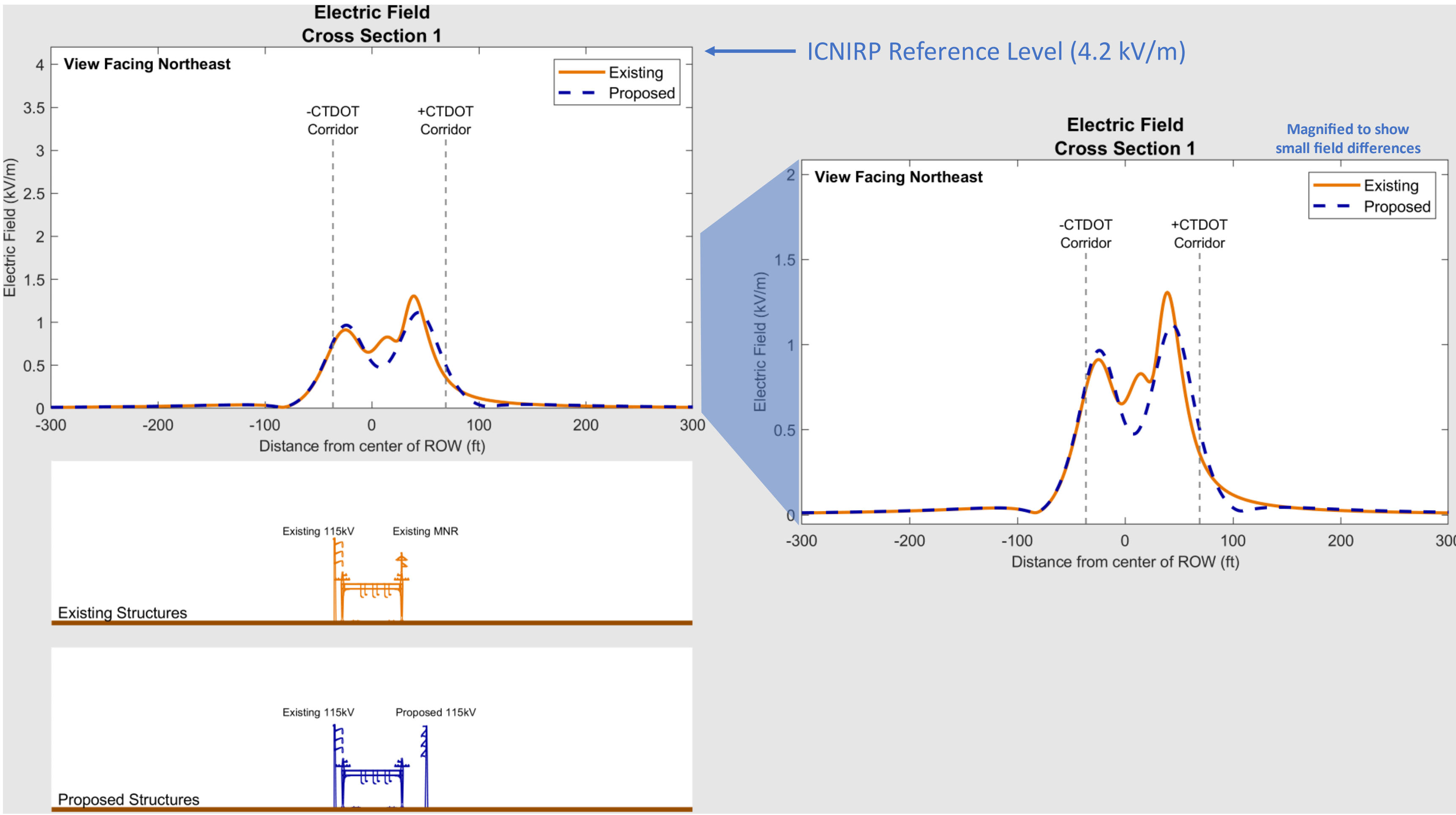

Figure C-19. Electric-field profile across XS-1.

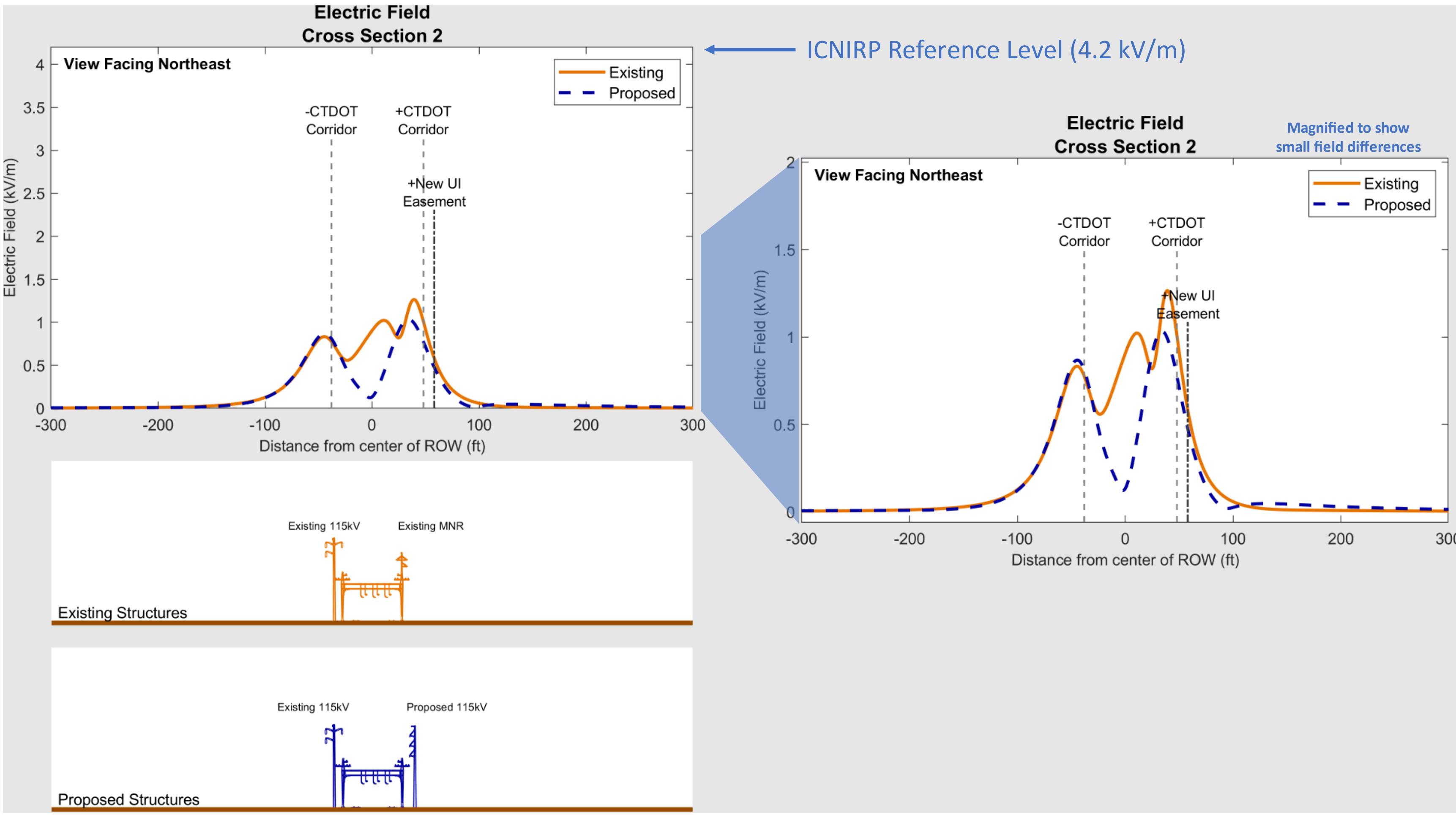

Figure C-20. Electric-field profile across XS-2.

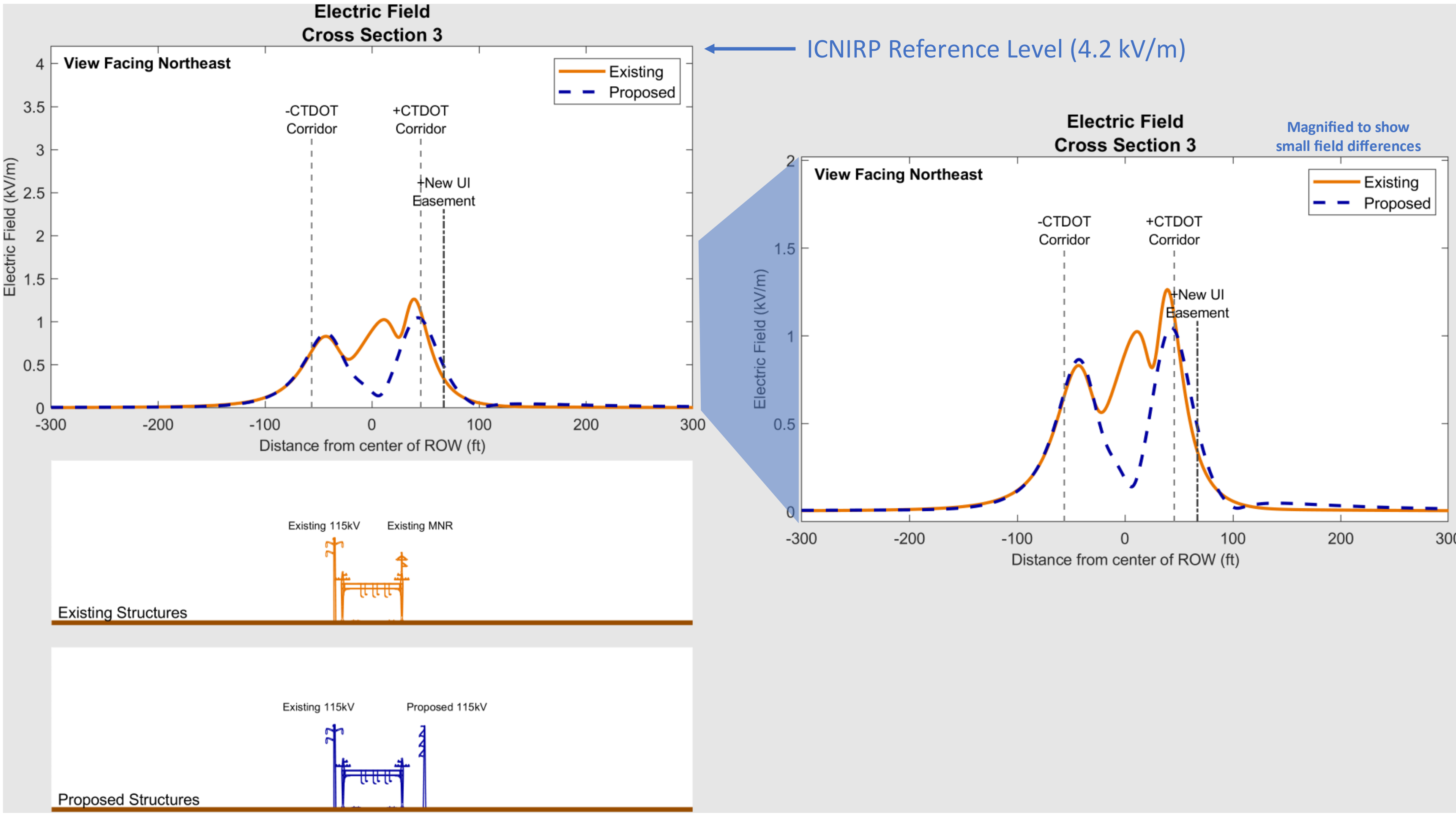

Figure C-21. Electric-field profile across XS-3.

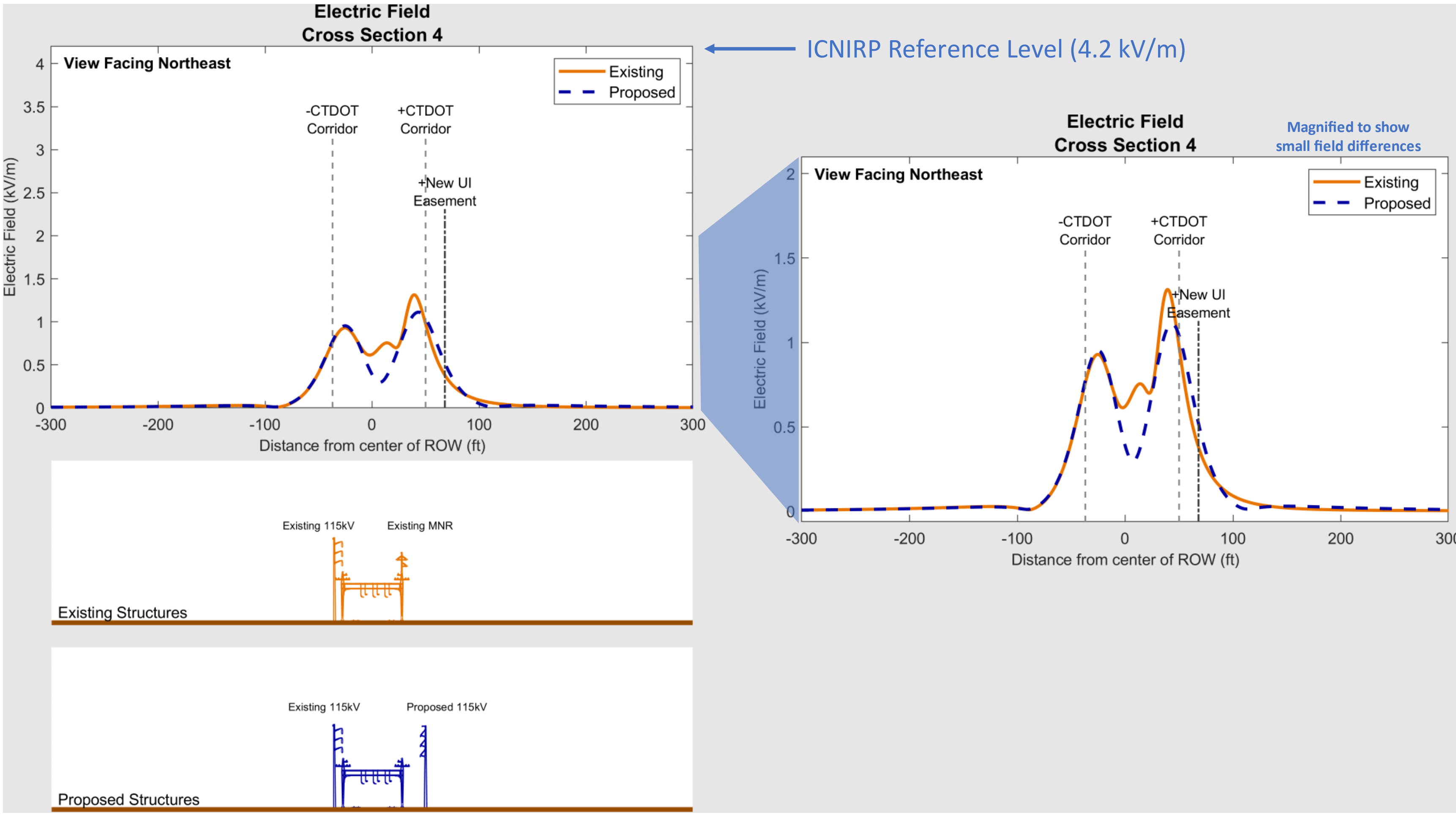

Figure C-22. Electric-field profile across XS-4.

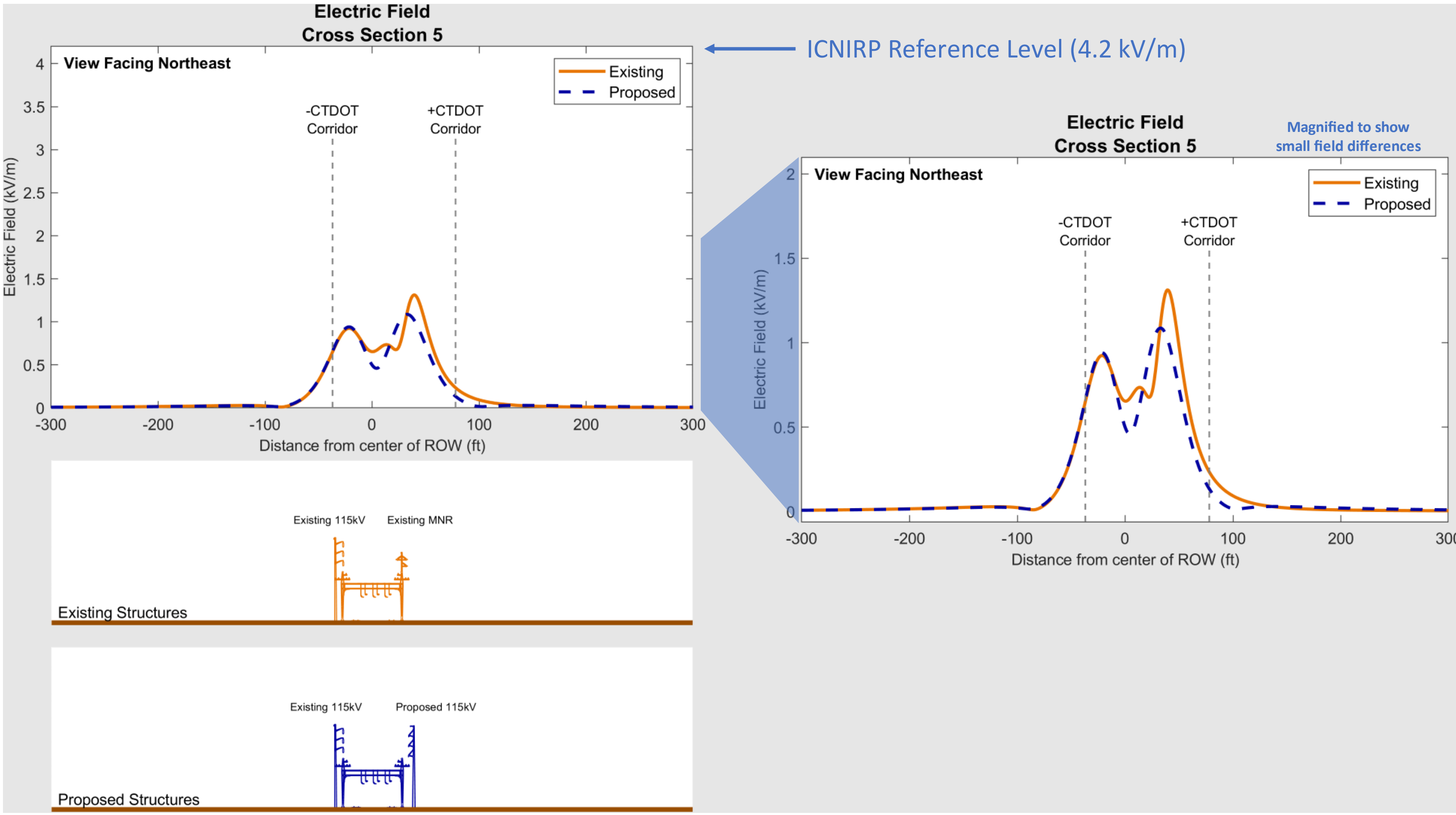

Figure C-23. Electric-field profile across XS-5.

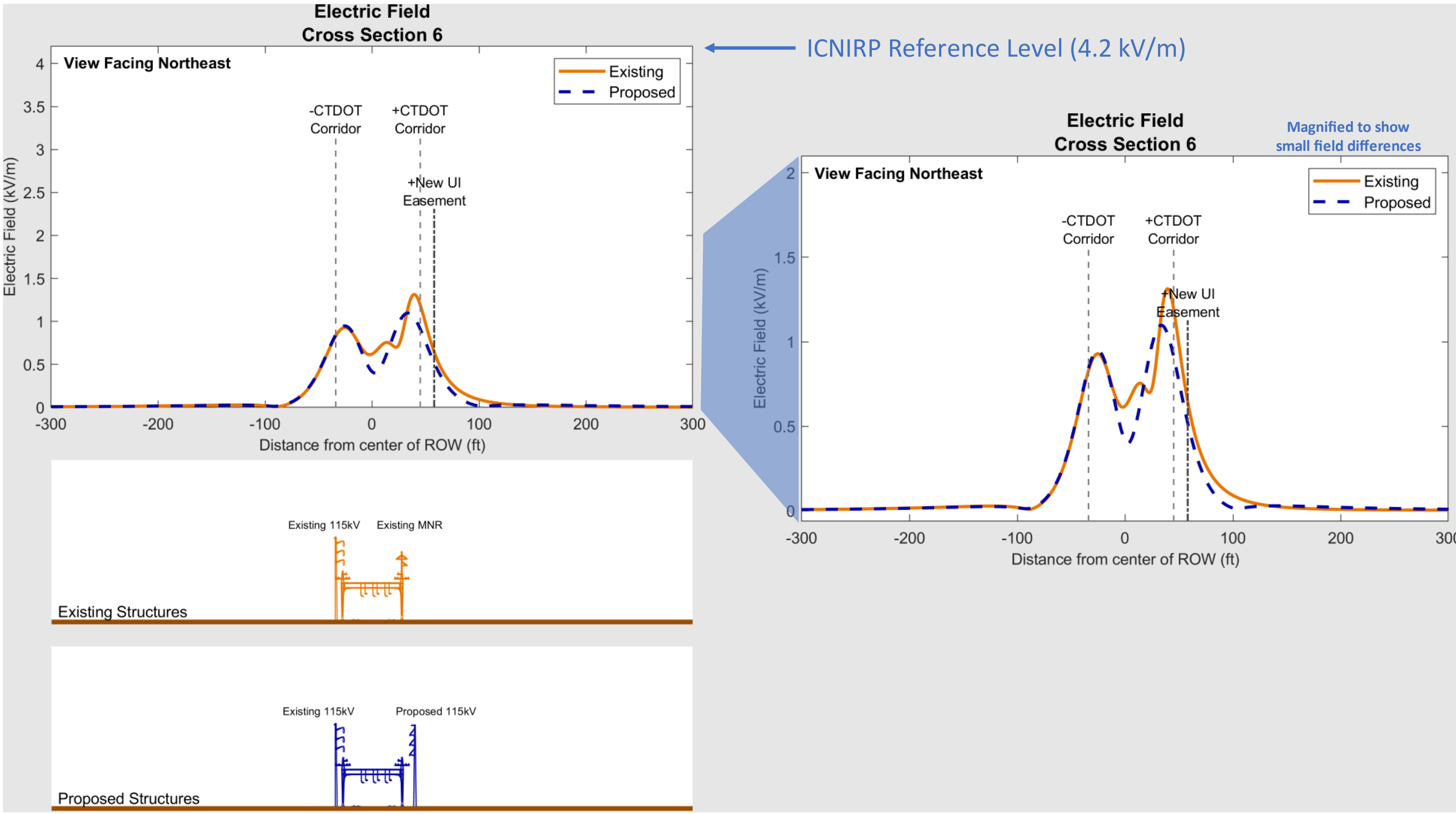

Figure C-24. Electric-field profile across XS-6.

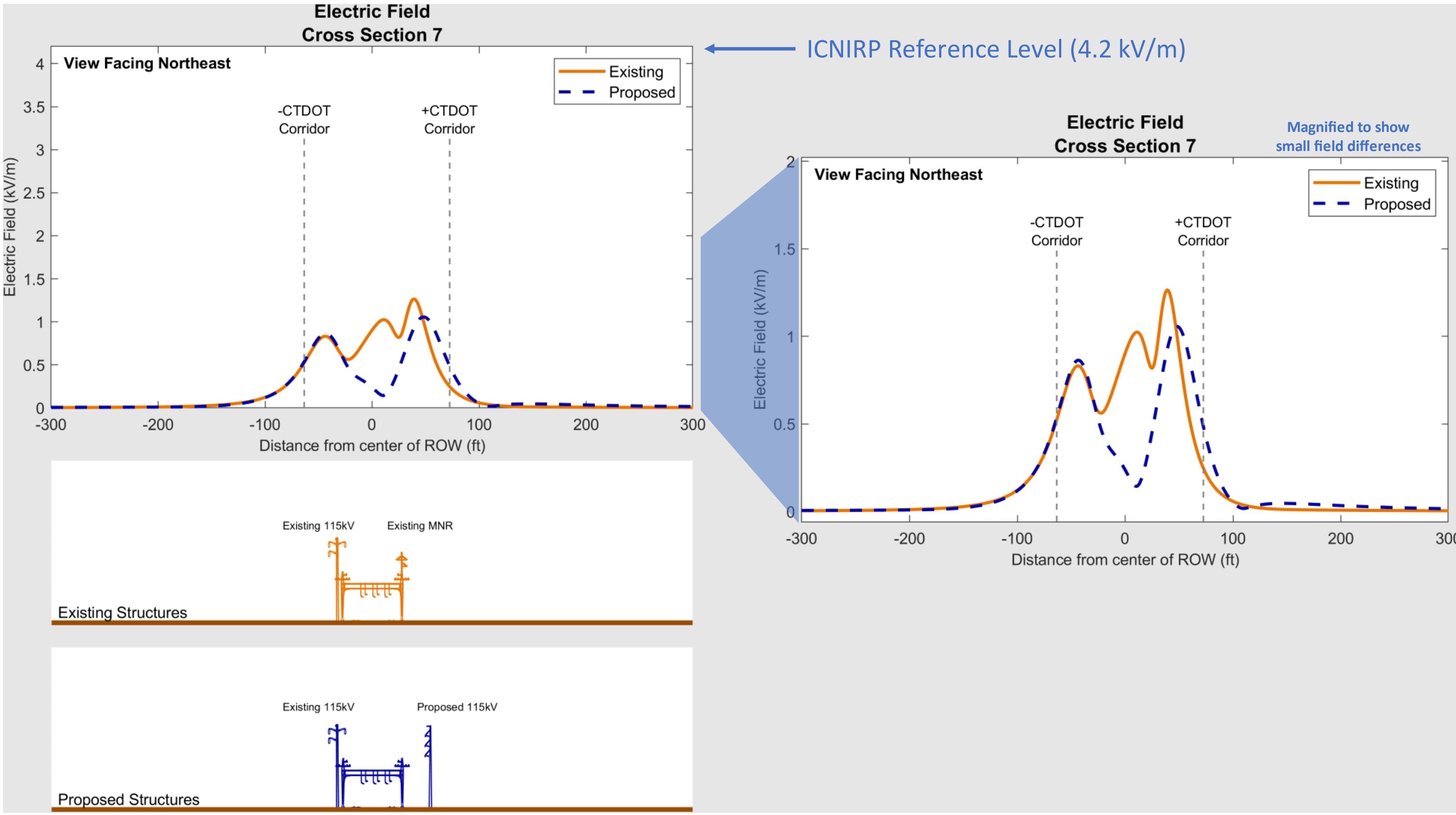

Figure C-25. Electric-field profile across XS-7.

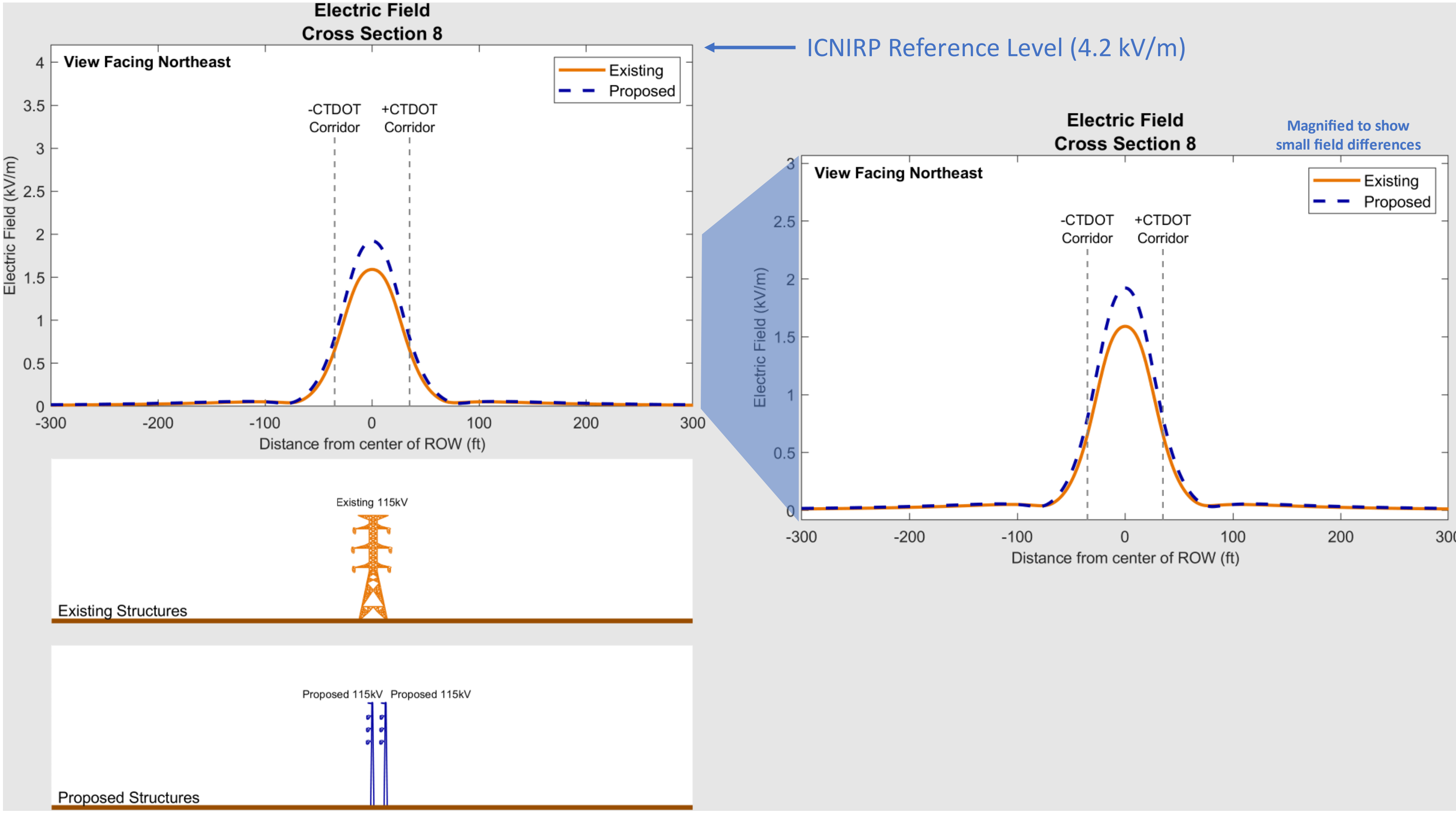

Figure C-26. Electric-field profile across XS-8.

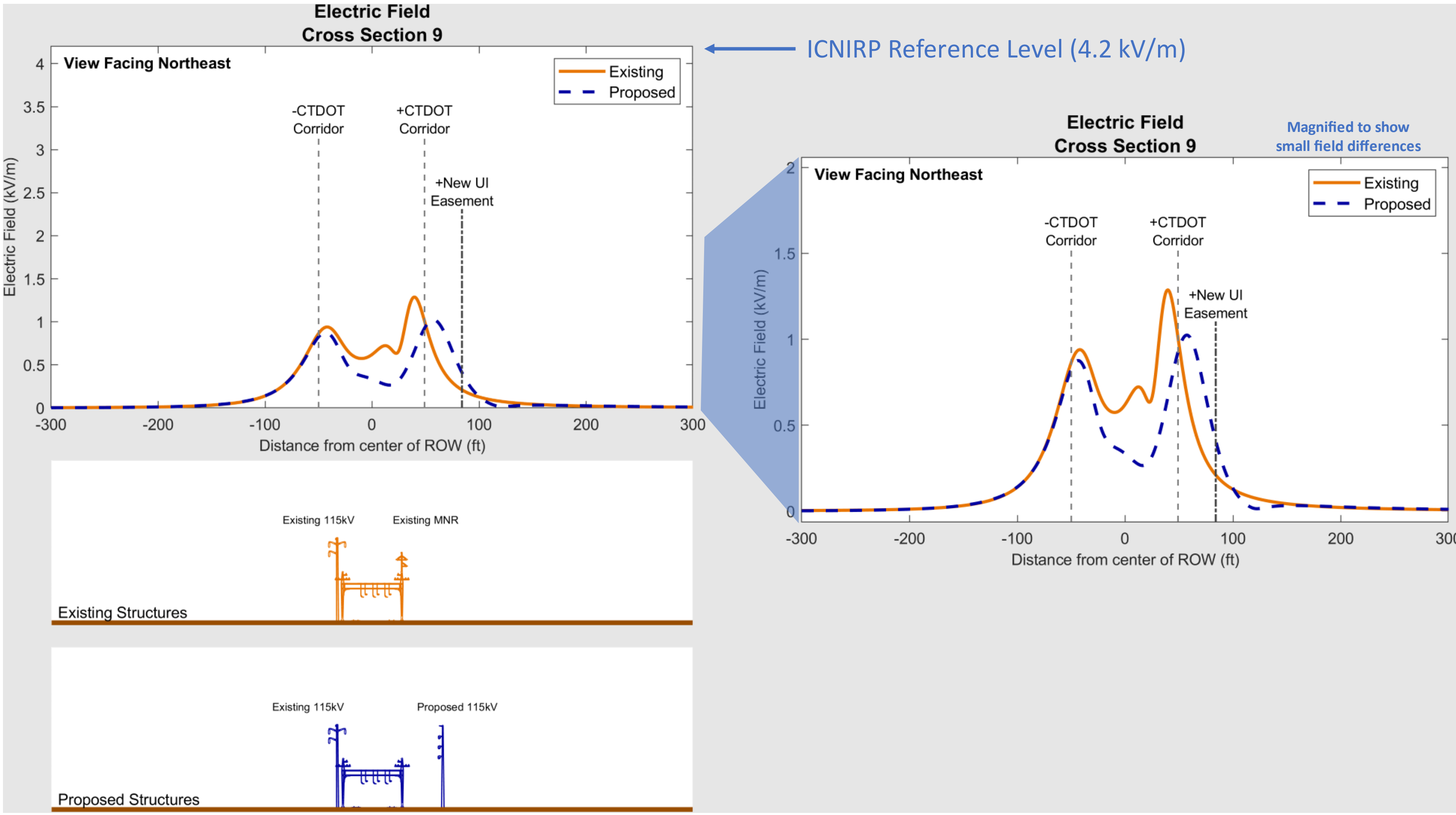

Figure C-27. Electric-field profile across XS-9.

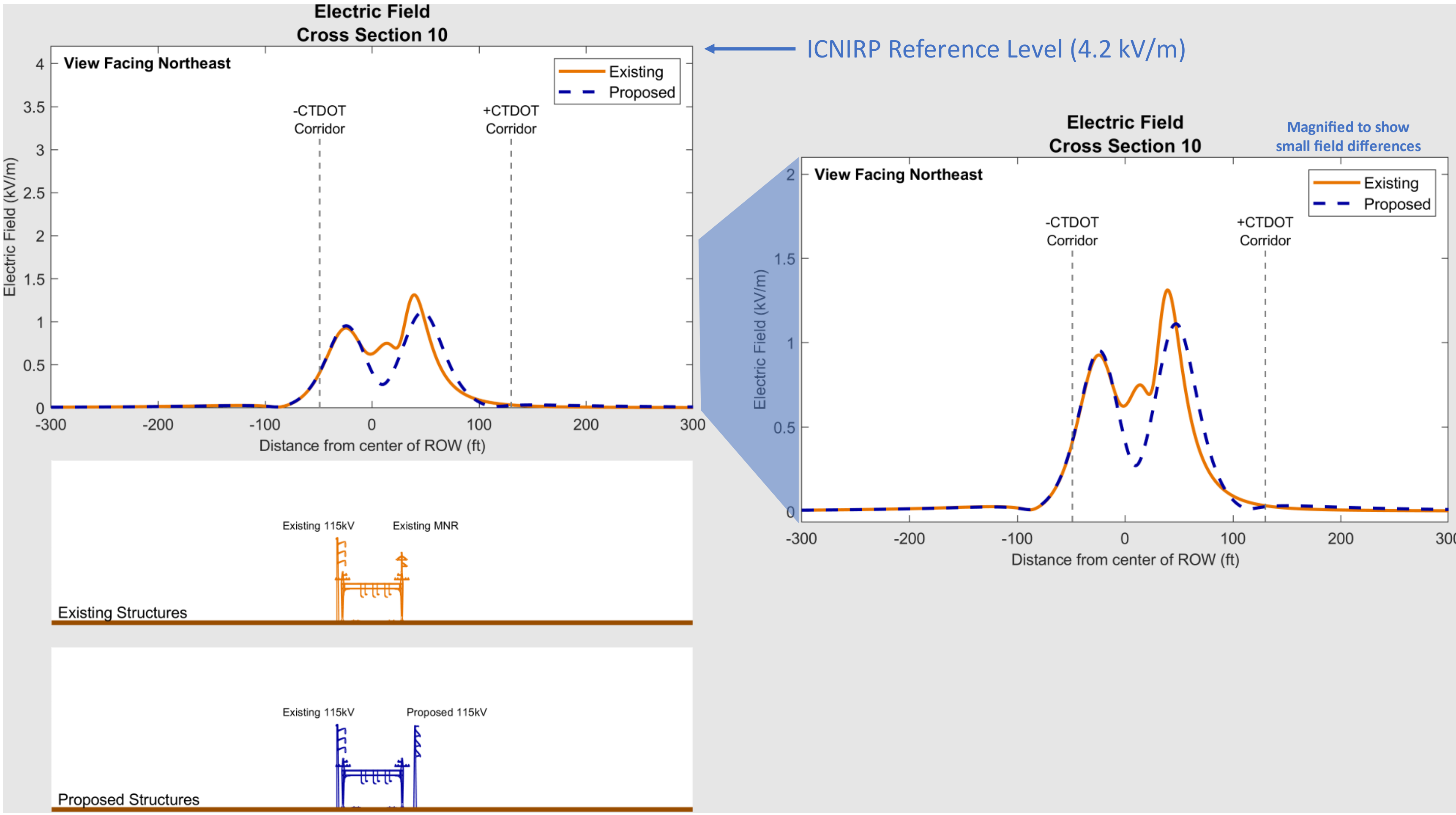

Figure C-28. Electric-field profile across XS-10.

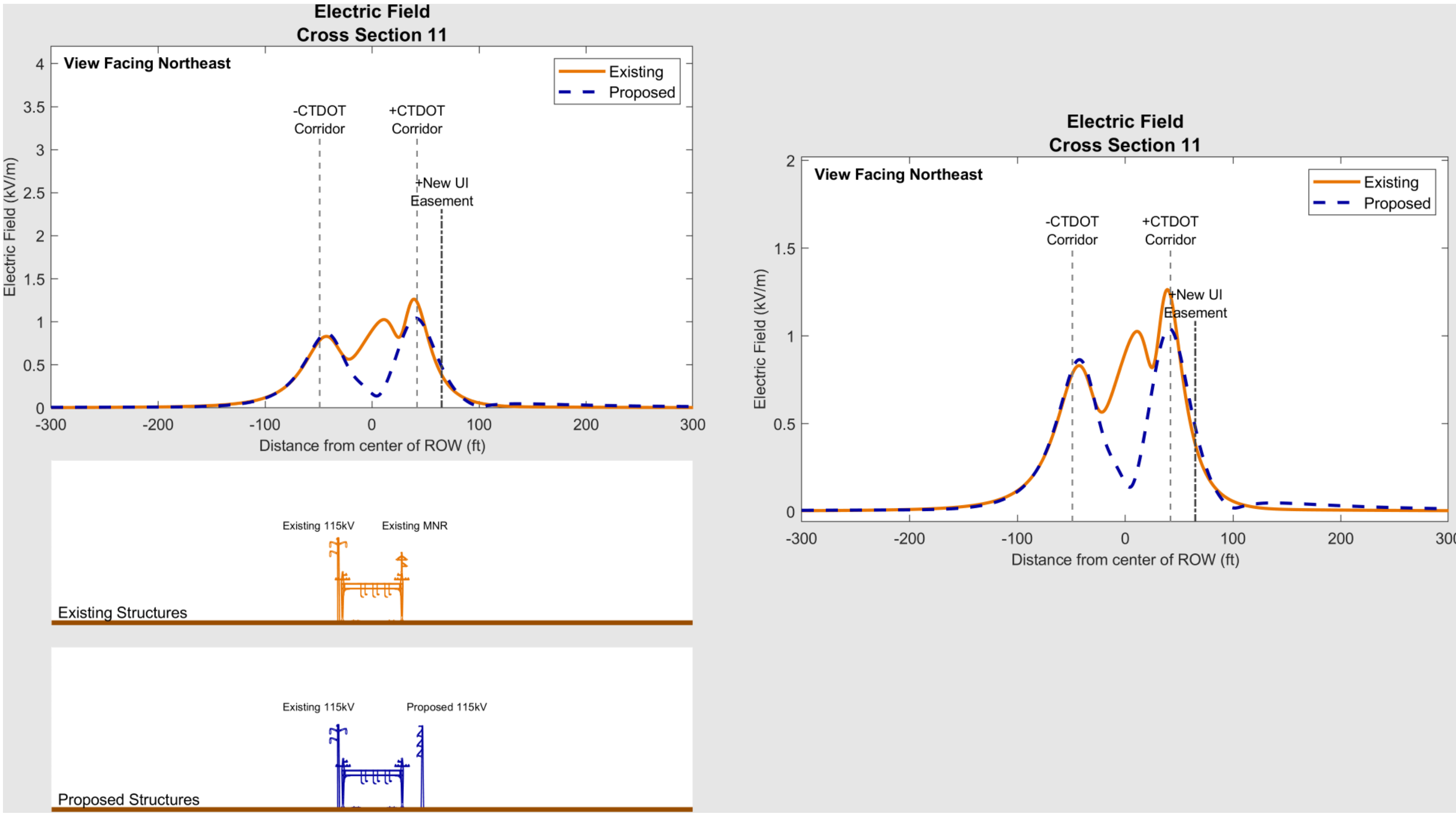

Figure C-29. Electric-field profile across XS-11.

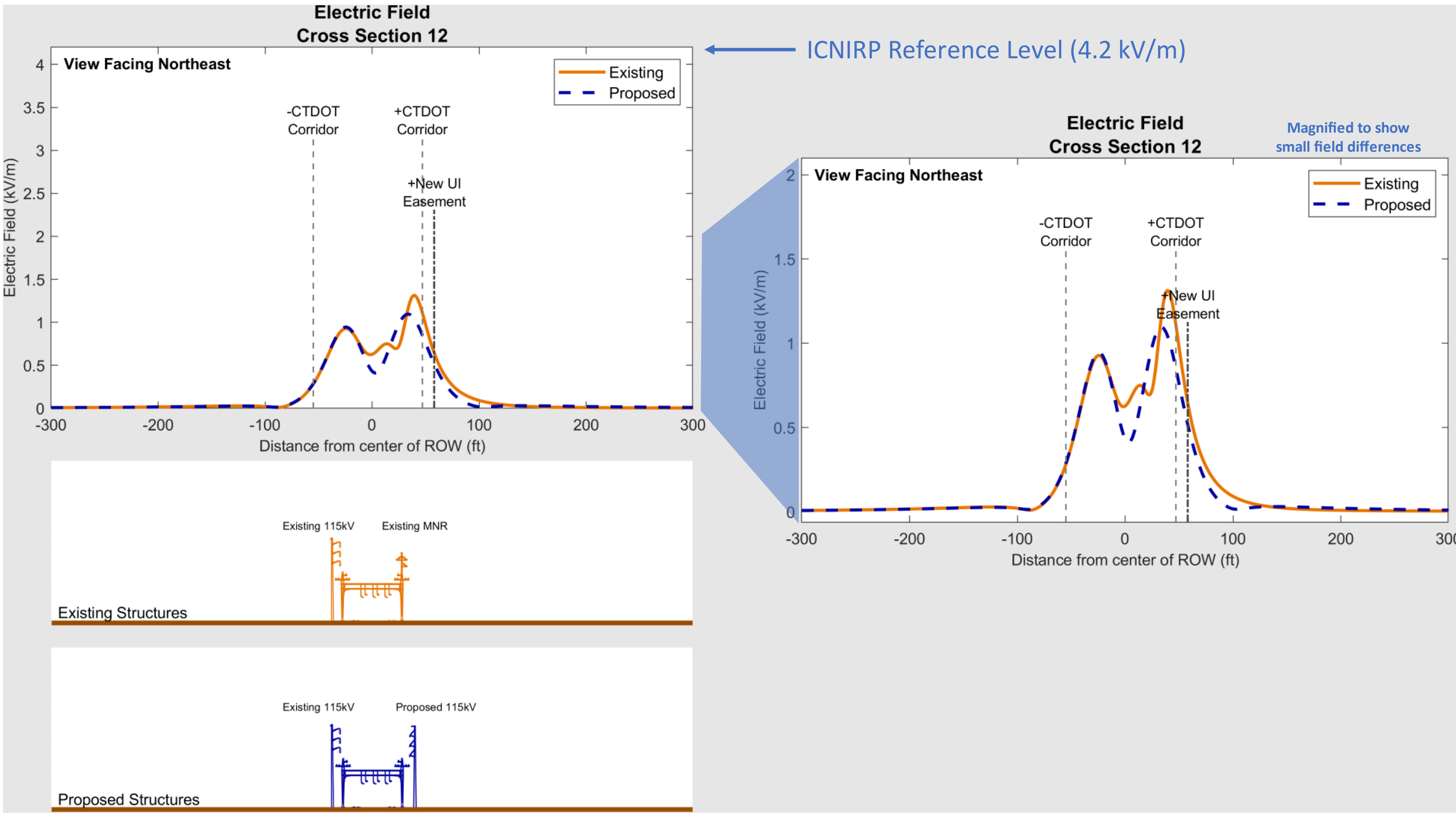

Figure C-30. Electric-field profile across XS-12.

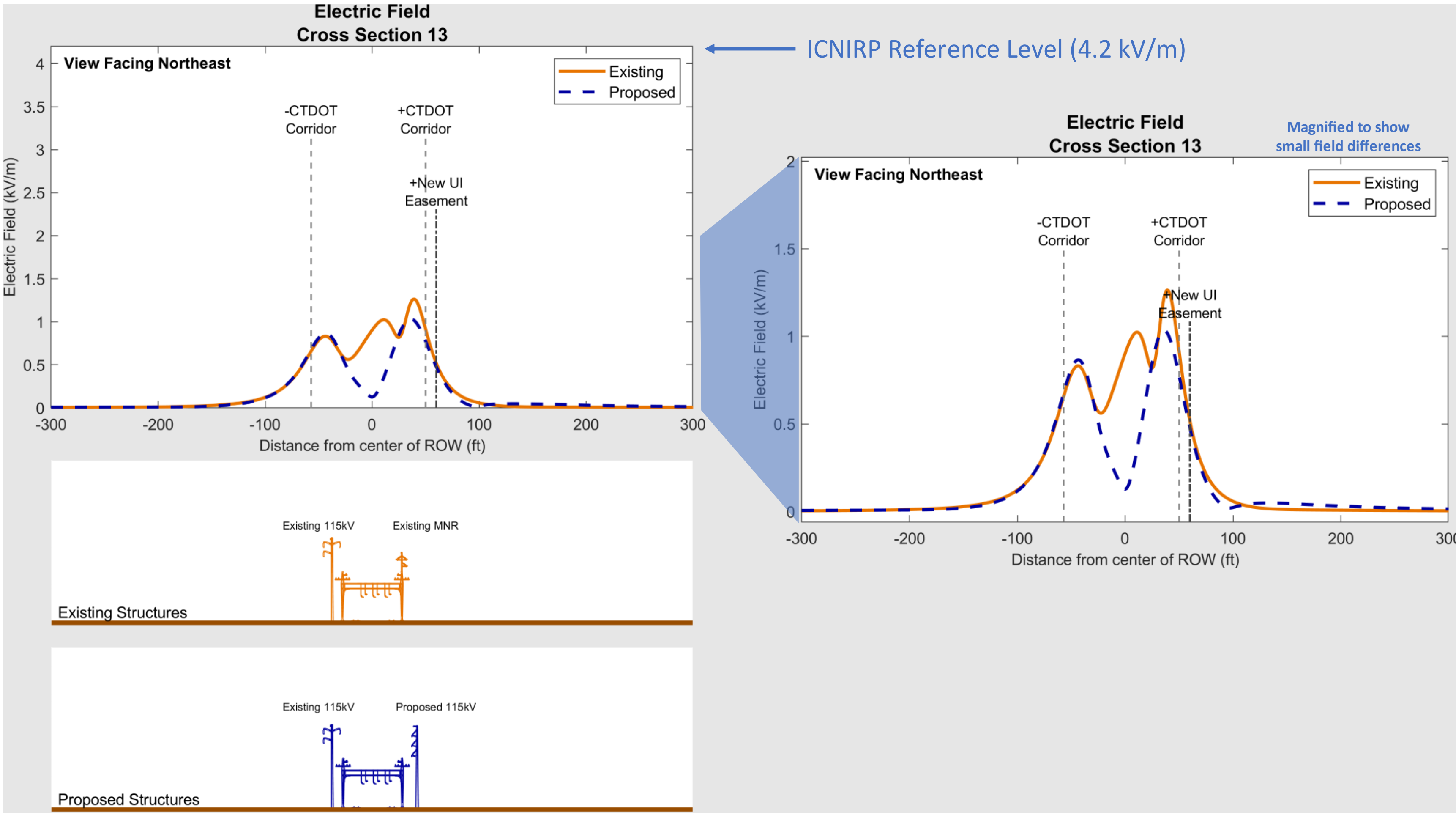

Figure C-31. Electric-field profile across XS-13.

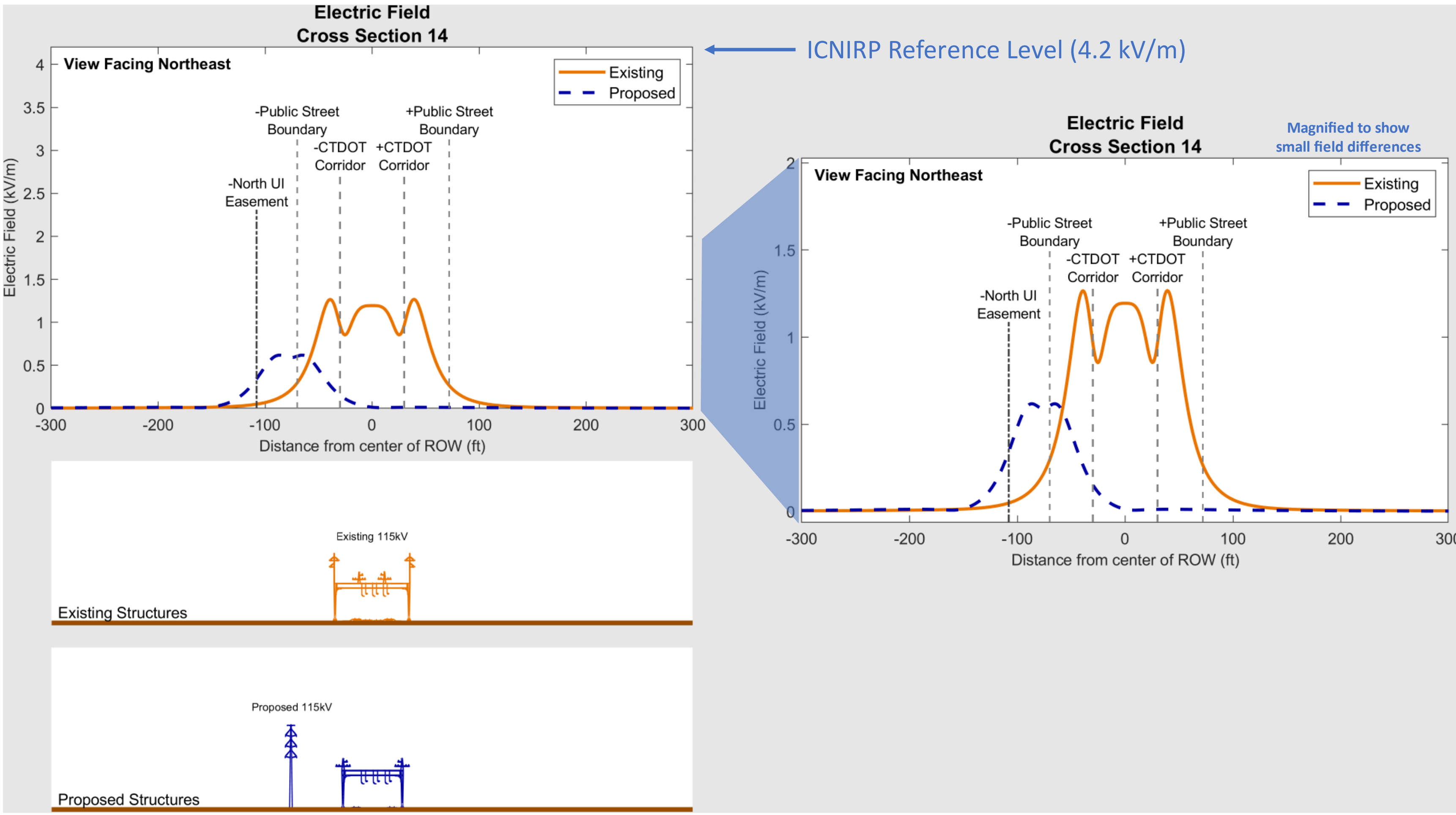

Figure C-32. Electric-field profile across XS-14.

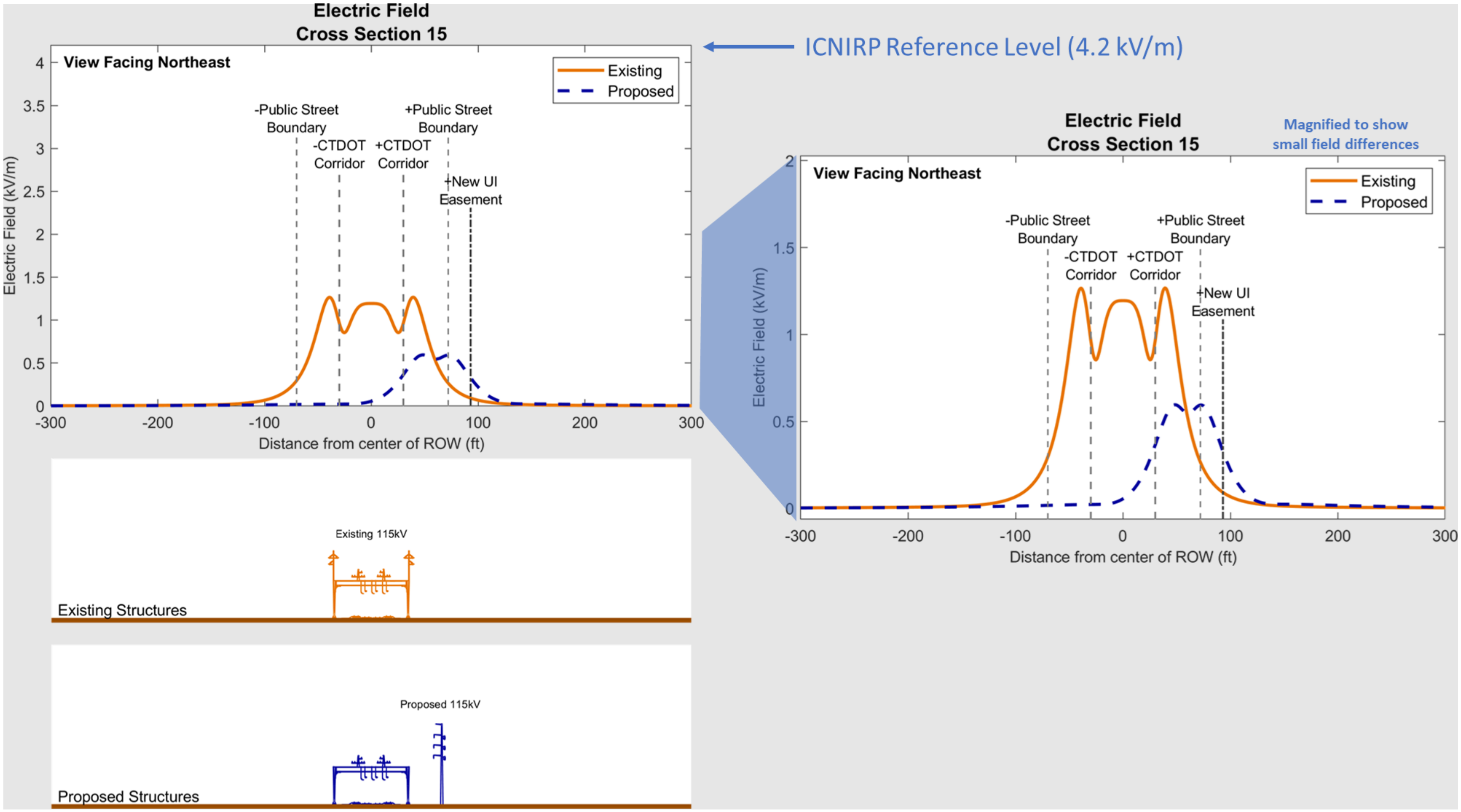

Figure C-33. Electric-field profile across XS-15.

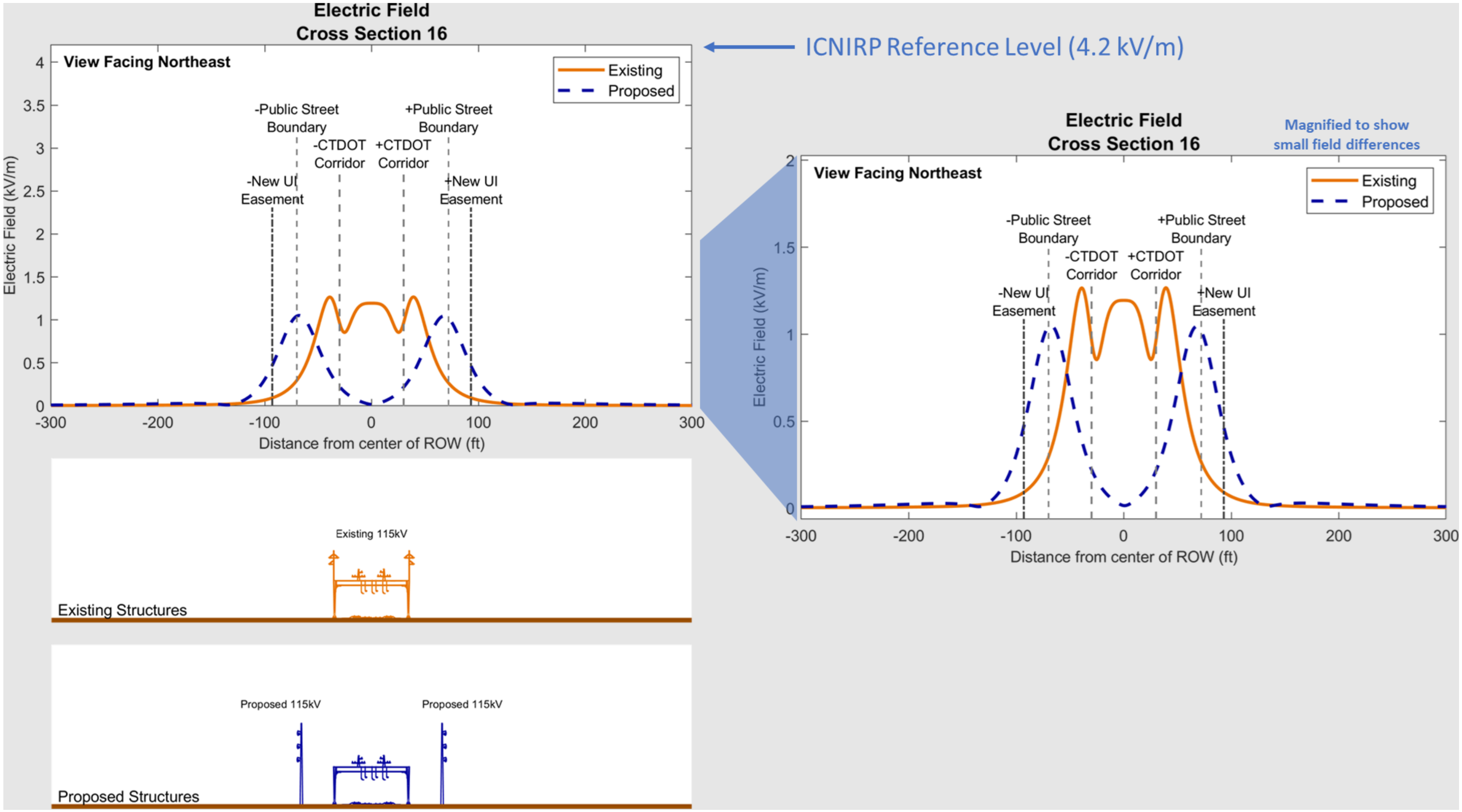

Figure C-34. Electric-field profile across XS-16.

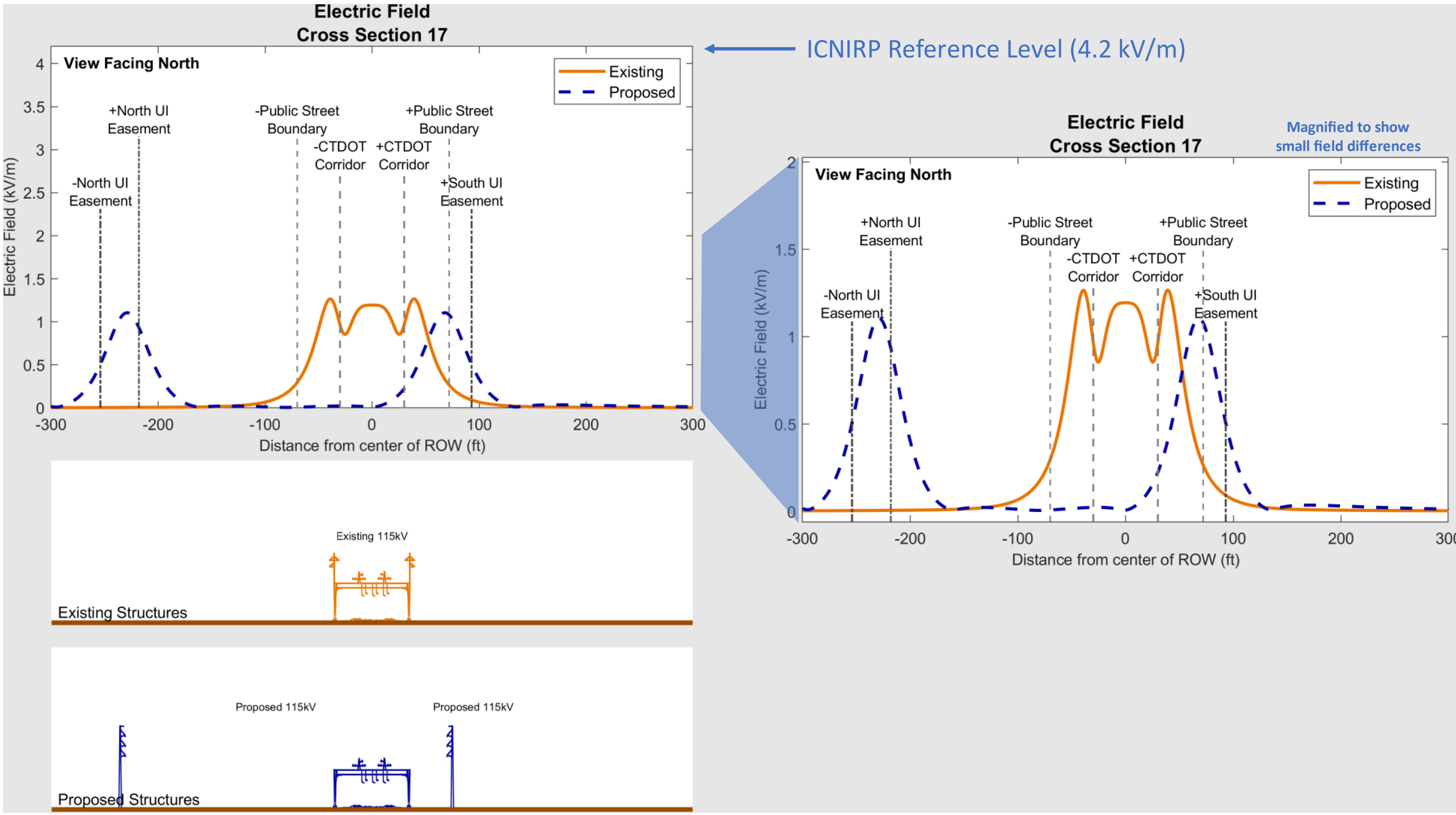

Figure C-35. Electric-field profile across XS-17.

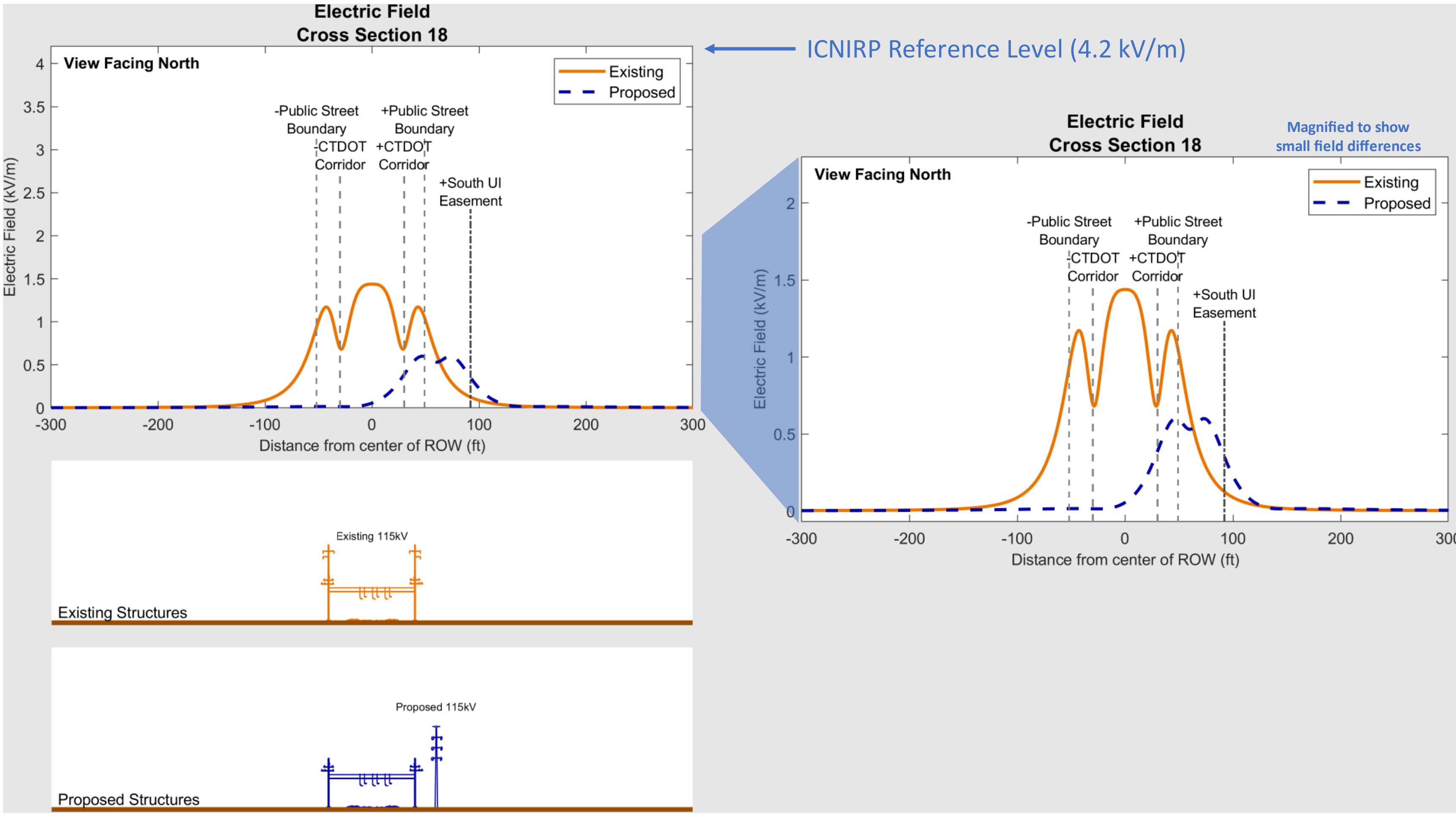

Figure C-36. Electric-field profile across XS-18.

Attachment D

Pre-Construction EMF Measurements

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Pre-Construction EMF Measurements

In accordance with CSC guidance,[23] measurements of EMF were taken at or near the edges of property boundaries, which included "*adjacent schools, daycare facilities, playgrounds, and hospitals (and any other facilities described in Conn. Gen. Stat. § 16-50l)*." Existing EMF levels at these locations were measured on June 28 and July 7, 2021. The measurements were taken at a height of approximately 1 meter (3.28 feet) above ground in general accordance with IEEE Std. 644-2019. Both electric fields and magnetic fields were expressed as the total field computed as the resultant of field vectors measured along vertical, transverse, and longitudinal axes.[24] The magnetic field was measured in units of mG by orthogonally-mounted sensing coils whose outputs were logged by a digital recording meter (EMDEX II) manufactured by Enertech Consultants. The electric field was measured in units of kV/m with a single-axis field sensor attachment for the same EMDEX II meter. These instruments meet the IEEE instrumentation standard for obtaining accurate field measurements at power line frequencies. The meters were calibrated by the EMDEX LLC by methods like those described in IEEE Std. 644-2019. A calibration certificate is provided in Attachment F.

The locations identified by UI for measurements are summarized in Table D-1, and were grouped together for ease of measurements (non-residential areas are highlighted in blue). Areas with residences within 100 feet of the new structure are indicated with highlighted text. Figure D-1 depicts the CT DOT corridor and measurement locations overlaid on Google Earth satellite imagery. Along this route, Exponent collected electric-field and magnetic-field measurements along the existing CT DOT corridor where safely accessible. Close-up depictions of these route sections are provided in Figure A-1 and Figure A-2 In Figure D-1 the GPS-tracked measurement path walked along the northern-end of the proposed route is overlaid

23 Connecticut Siting Council (CSC). 2016. Application Guide for an Electric Substation Facility. New Britain, CT: CSC.

24 Measurements along the vertical, transverse, and longitudinal axes were recorded as root-mean-square magnitudes. Root mean square refers to the common mathematical method of defining the effective voltage, current, or field of an alternating-current system.

in pink. Data were also collected along additional paths in pink and at spot measurements depicted as blue pushpins.

Table D-1. Locations identified for measurements by UI*

Location Name	Category	Location Address	Measurement Area (Table D-)	Model XS Number	Distance from New Line (feet)
Wakeman Boys and Girls Summer Camp	Day Care	385 Center St, Southport, CT 06890	C1	XS-3	North Side 105 to 590
Southport Congregational Preschool	Day Care	1365, 524 Pequot Ave, Southport, CT 06890	C2	XS-5	South Side 160 to 350
Palmer's Neck	Parks & Recreation	Post Rd, Southport, CT 06890	C3	XS-6	South Side 210 to 465
Cajal Academy	School	303 Linwood Ave, Fairfield, CT 06824	C4	XS-2	North Side 75 to 145
Sportsplex Camp	Youth Camp	85 Mill Plain Rd, Fairfield, CT 06824	C6	XS-2	North Side 70 to 180
Gymnastics and Cheerleading Academy FFLD	Youth Camp	85 Mill Plain Rd suites, Fairfield, CT 06824	C7	XS-4	North Side 70 to 225
Tomlinson Middle School	School	200 Unquowa Rd, Fairfield, CT 06824	C8	XS-2	North Side 155 to 550
Jennings Park	Parks & Recreation	Post Rd, Fairfield, CT 06824	C9	XS-2	South Side 55 to 245
Great Oaks Charter School – Bridgeport	School	375 Howard Ave, Bridgeport, CT 06605	C10	XS-14	South Side 60 to 475
Went field	Parks & Recreation	Bridgeport, CT 06605	C11	XS-15	North Side 83 to 545
New Beginnings Family Academy	School	184 Garden St, Bridgeport, CT 06605	C12	XS-16	North Side 50 to 300
Mercy Learning Center	School	637 Park Ave, Bridgeport, CT 06604	C13	XS-17	North Side 250 to 370
Jaime A Hulley Childcare Center	School	460 Lafayette St, Bridgeport, CT 06604	C14	XS-16	South Side 90 to 270
Playground	Playground	504 Railroad Ave, Bridgeport, CT 06605	R19	XS-17	South Side 60 to 130
Residential Area 1	Residential	South Gate ln Southport, CT	R1	XS-1	North Side 90 to 335
Residential Area 2	Residential	Westford Dr Southport, CT	R2	XS-1	North Side 75 to 240
Residential Area 3	Residential	Westway Rd & Pequot Ave Southport, CT	R3	XS-3, XS-4	North Side 85 to 405
Residential Area 4	Residential	Station Street & Pequot Ave Southport, CT	R4	XS-5, XS-6	South Side 65 to 315
Residential Area 5	Residential	John St Southport, CT	R5	XS-5, XS-6	North Side 50 to 325
Residential Area 6	Residential	Pequot Ave Southport, CT	R6	XS-3, XS-2	South Side 50 to 405
Residential Area 7	Residential	Bronson Rd Southport, CT	R7	XS-6	North Side 60 to 245
Residential Area 8	Residential	Linwood Ave Fairfield, CT	R8	XS-2	North Side 105
Residential Area 9	Residential	Linwood Ave Fairfield, CT	R9	XS-2	North Side 125 to 175
Residential Area 10	Residential	Bungalow Ave Fairfield, CT	R10	XS-4, XS-6	South Side 240 to330

Location Name	Category	Location Address	Measurement Area (Table D-)	Model XS Number	Distance from New Line (feet)
Residential Area 11	Residential	Ludlowe Rd Fairfield, CT	R11	XS-5	North Side 230 to 310
Residential Area 12	Residential	Unquowa Pl Fairfield, CT	R12	XS-2	South Side 235 to 330
Residential Area 13	Residential	Hillcrest Rd Fairfield, CT	R13	XS-2	North Side 160 to 255
Residential Area 14	Residential	Kings Highway & Ardmore St Fairfield, CT	R14	XS-3, XS-2	South Side 50 to 356
Residential Area 15	Residential	Kings Highway Fairfield, CT	R15	XS-9	North Side 125 to 225
Residential Area 16	Residential	Orland St & Bryant St Bridgeport, CT	R16	XS-13	South Side 120 to 380
Residential Area 17	Residential	Railroad Ave Bridgeport, CT	R17	XS-15	North Side 73 to 250
Residential Area 18	Residential	Railroad Ave & Black Rock St Bridgeport, CT	R18	XS-16	North Side 72 to 320
Residential Area 19	Residential	Railroad Ave & Lafayette St Bridgeport, CT	R19	XS-16	North Side 72 to 320

* Non-residential areas are highlighted in blue

Measurements in each of the areas identified in Table D-1 are identified graphically in Figure D-2 to Figure D-17. Table D-2 provides a statistical summary of the EMF measurements performed.

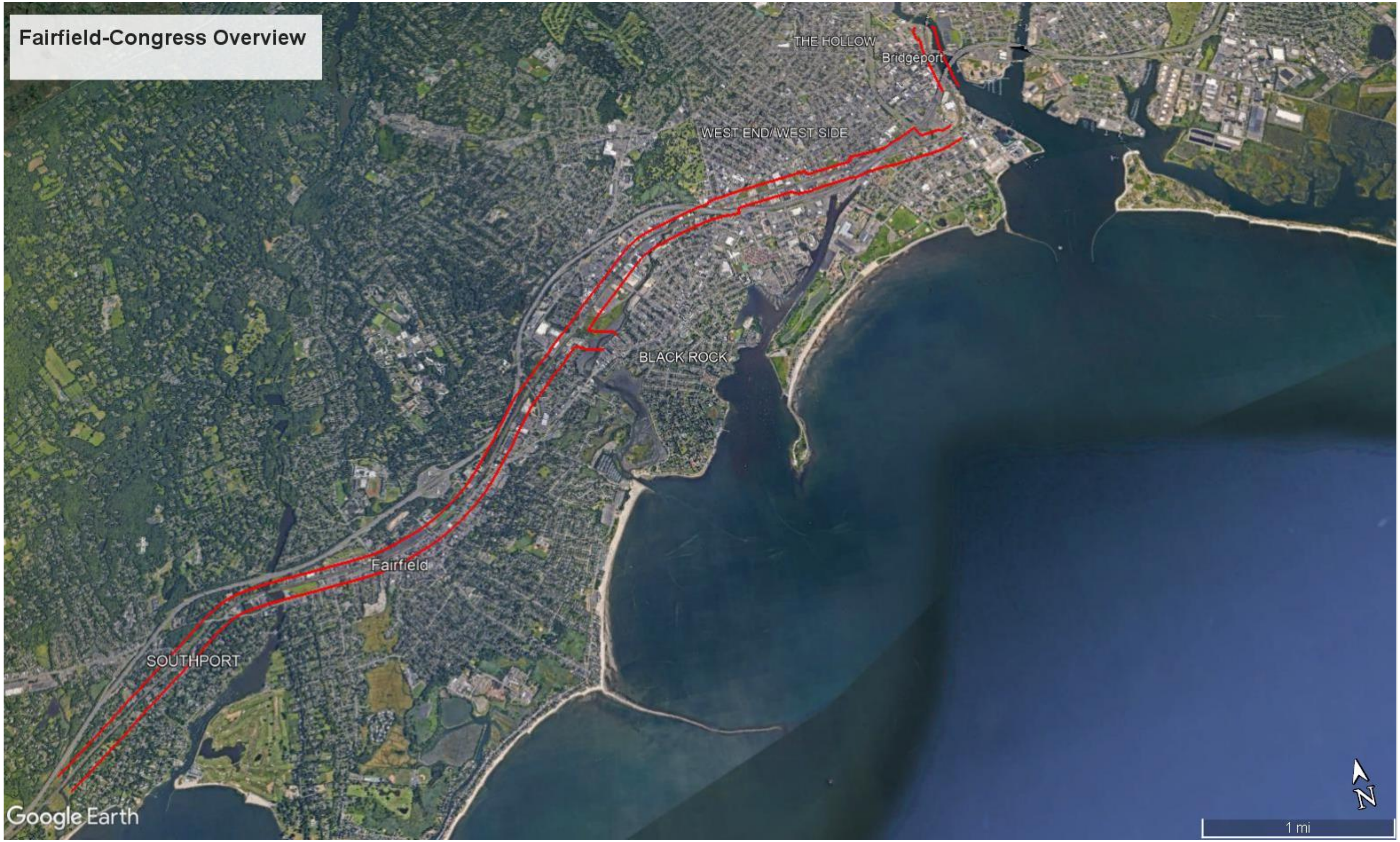

Figure D-1. Google Earth satellite mapping of the transmission line / CT DOT corridor between Sasco Creek and Congress substation. A 300-foot clearance around the proposed transmission line is indicated by the red lines. The following figures show subsections of the route where measurements were taken.

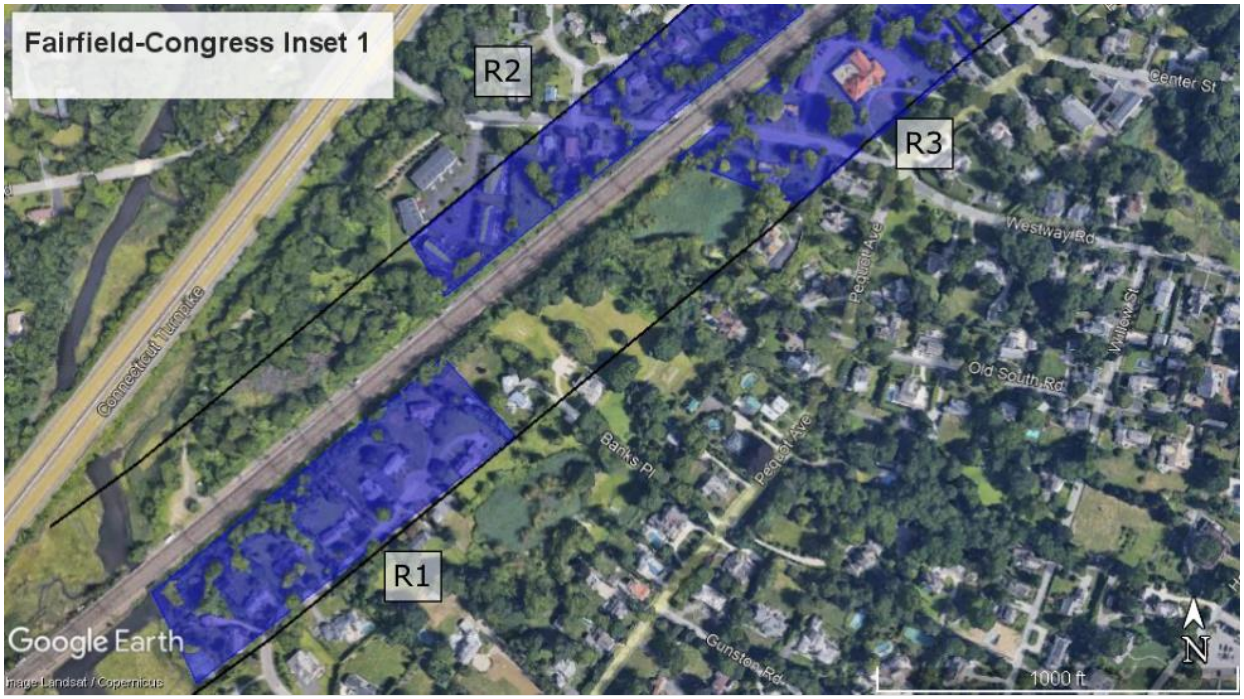

Figure D-2. Measurement areas along the transmission lines. Black lines show the distance of 300 feet from the proposed transmission line. Blue areas are residential, and yellow areas are community facilities.

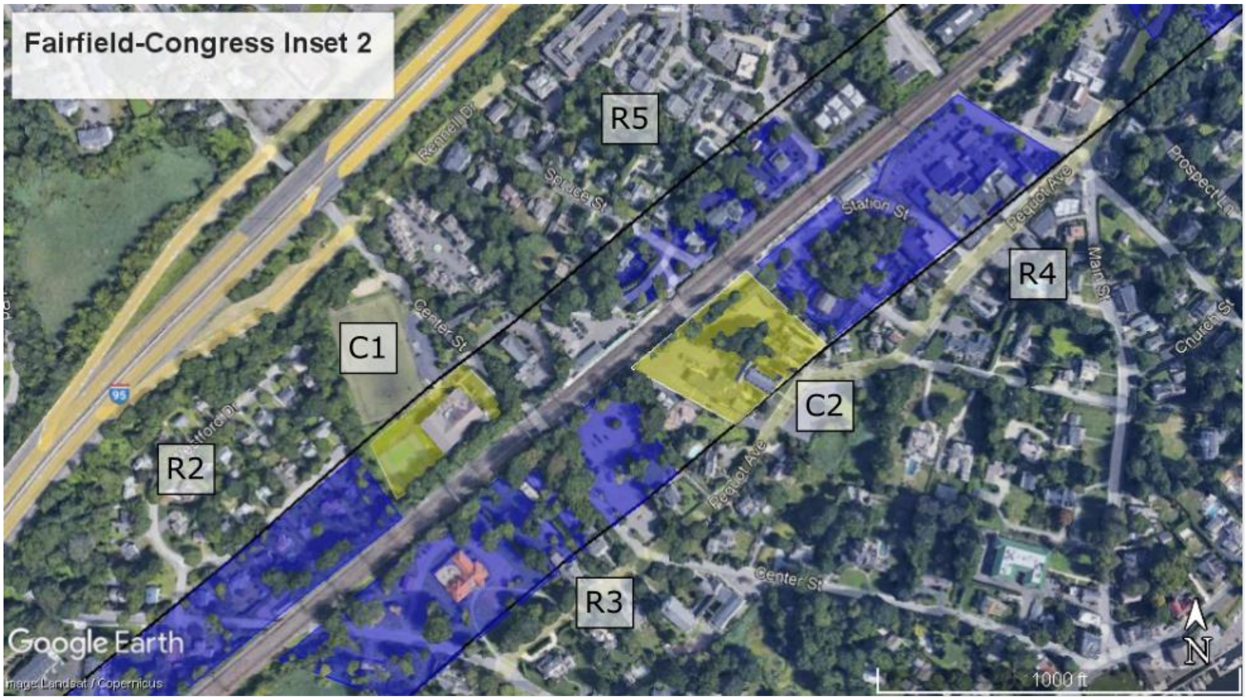

Figure D-3. Measurement areas along the transmission lines. Black lines show the distance of 300 feet from the proposed transmission line. Blue areas are residential, and yellow areas are community facilities.

Figure D-4. Measurement areas along the transmission lines. Black lines show the distance of 300 feet from the proposed transmission line. Blue areas are residential, and yellow areas are community facilities.

Figure D-5. Measurement areas along the transmission lines. Black lines show the distance of 300 feet from the proposed transmission line. Blue areas are residential, and yellow areas are community facilities.

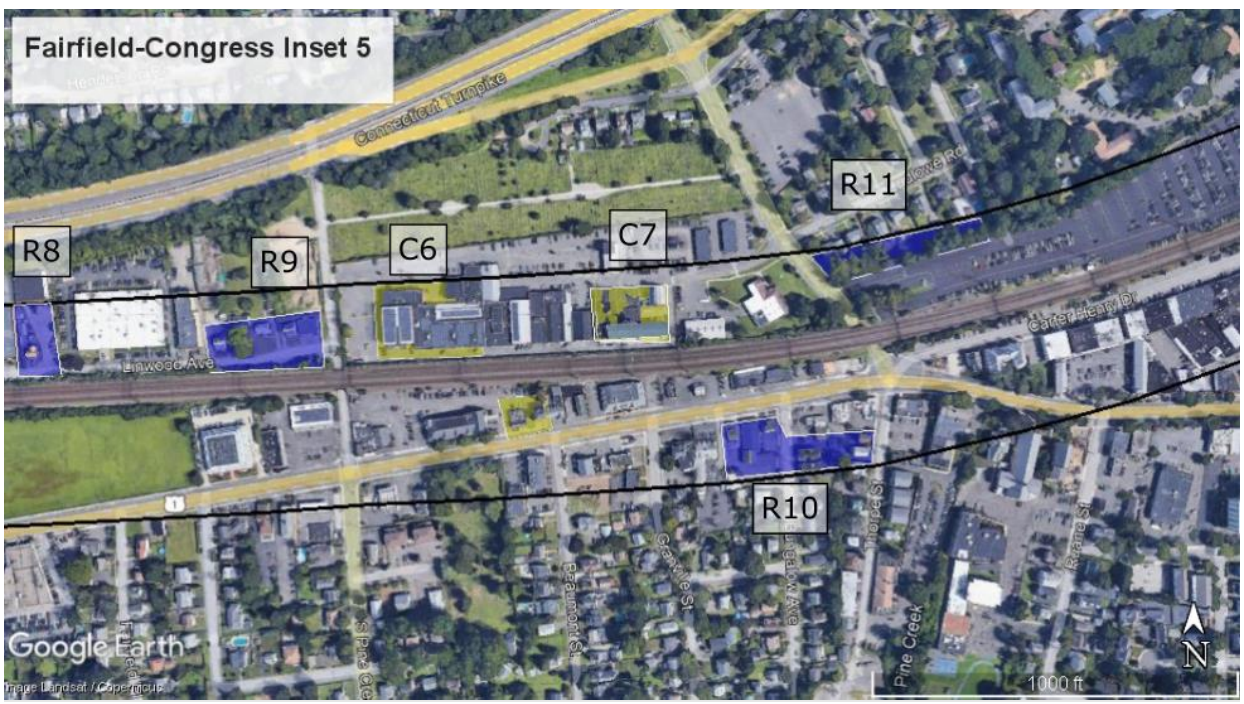

Figure D-6. Measurement areas along the transmission lines. Black lines show the distance of 300 feet from the proposed transmission lines. Blue areas are residential, and yellow areas are community facilities.

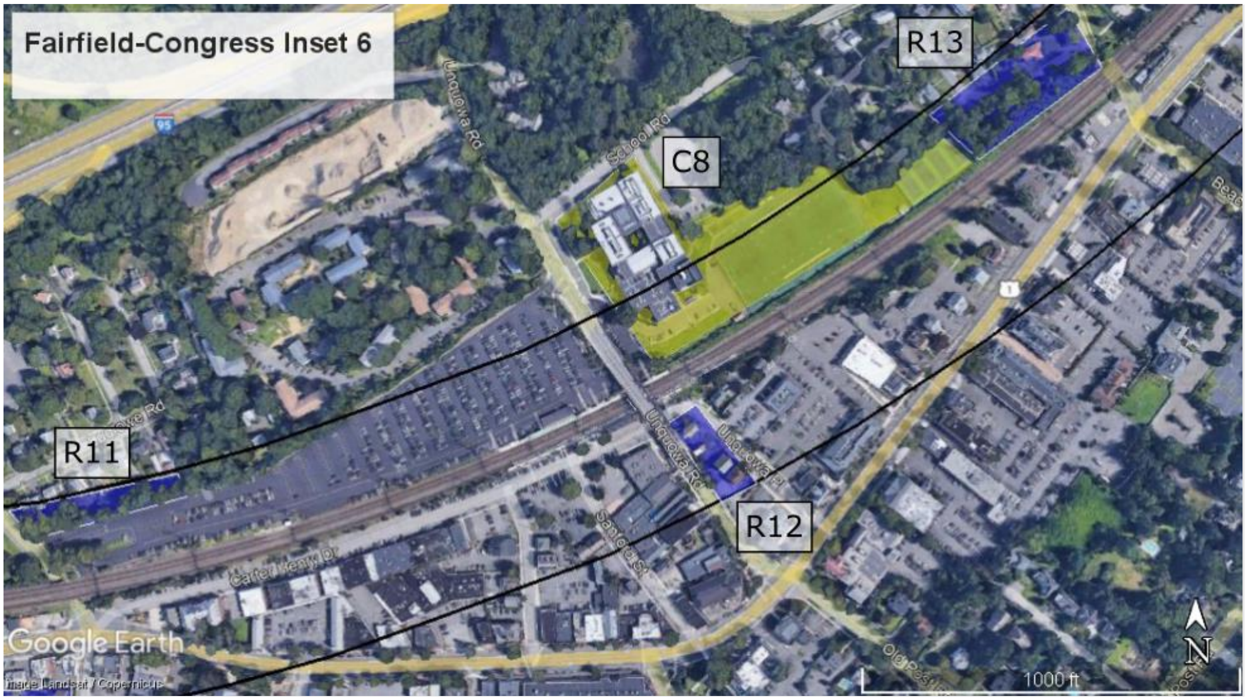

Figure D-7. Measurement areas along the transmission lines. Black lines show the distance of 300 feet from the proposed transmission line. Blue areas are residential, and yellow areas are community facilities.

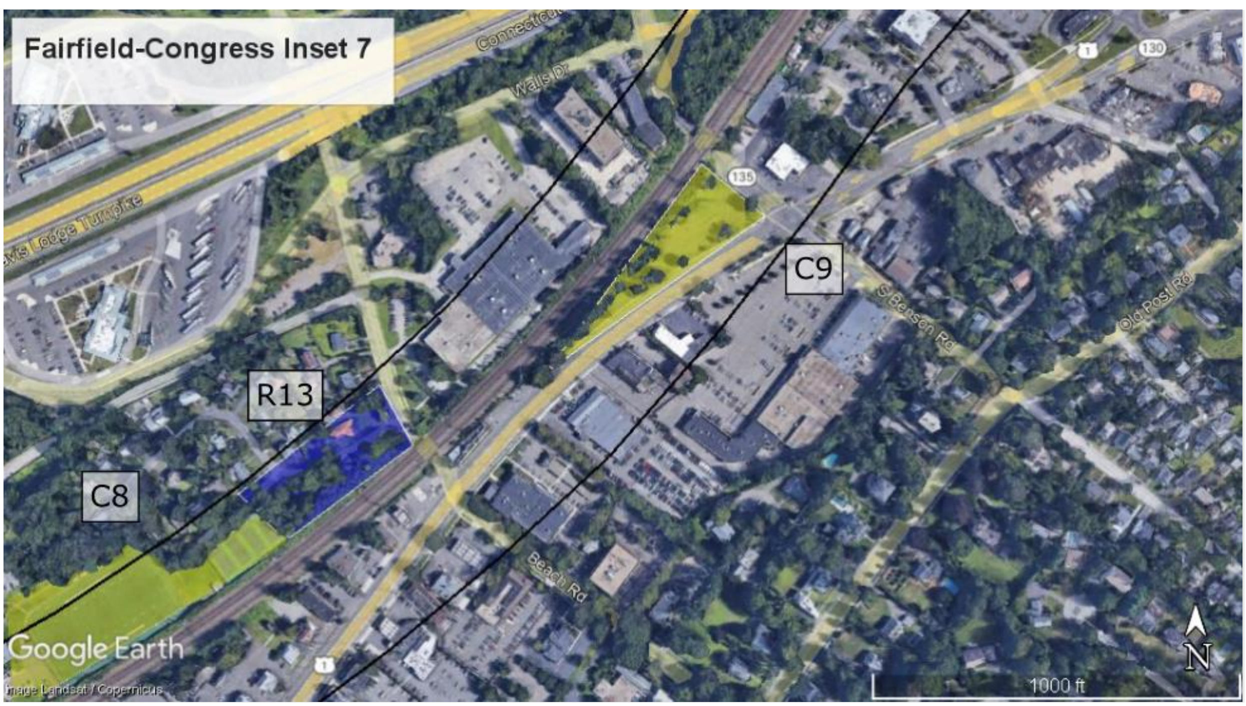

Figure D-8. Measurement areas along the transmission lines. Black lines show the distance of 300 feet from the proposed transmission line. Blue areas are residential, and yellow areas are community facilities.

Figure D-9. Measurement areas along the transmission lines. Black lines show the distance of 300 feet from the proposed transmission line. Blue areas are residential, and yellow areas are community facilities.

Figure D-10. Measurement areas along the transmission lines. Black lines show the distance of 300 feet from the proposed transmission line. Blue areas are residential, and yellow areas are community facilities.

Figure D-11. Measurement areas along the transmission lines. Black lines show the distance of 300 feet from the proposed transmission line. Blue areas are residential, and yellow areas are community facilities.

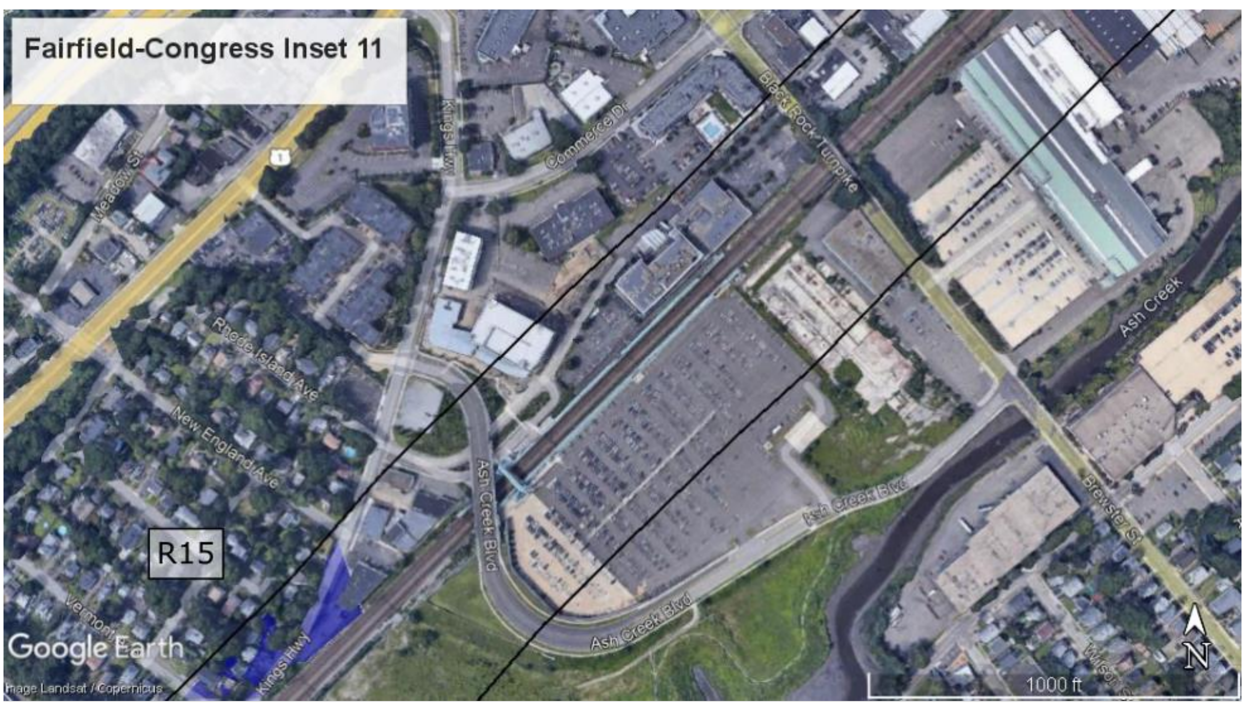

Figure D-12. Measurement areas along the transmission lines. Black lines show the distance of 300 feet from the proposed transmission line. Blue areas are residential, and yellow areas are community facilities.

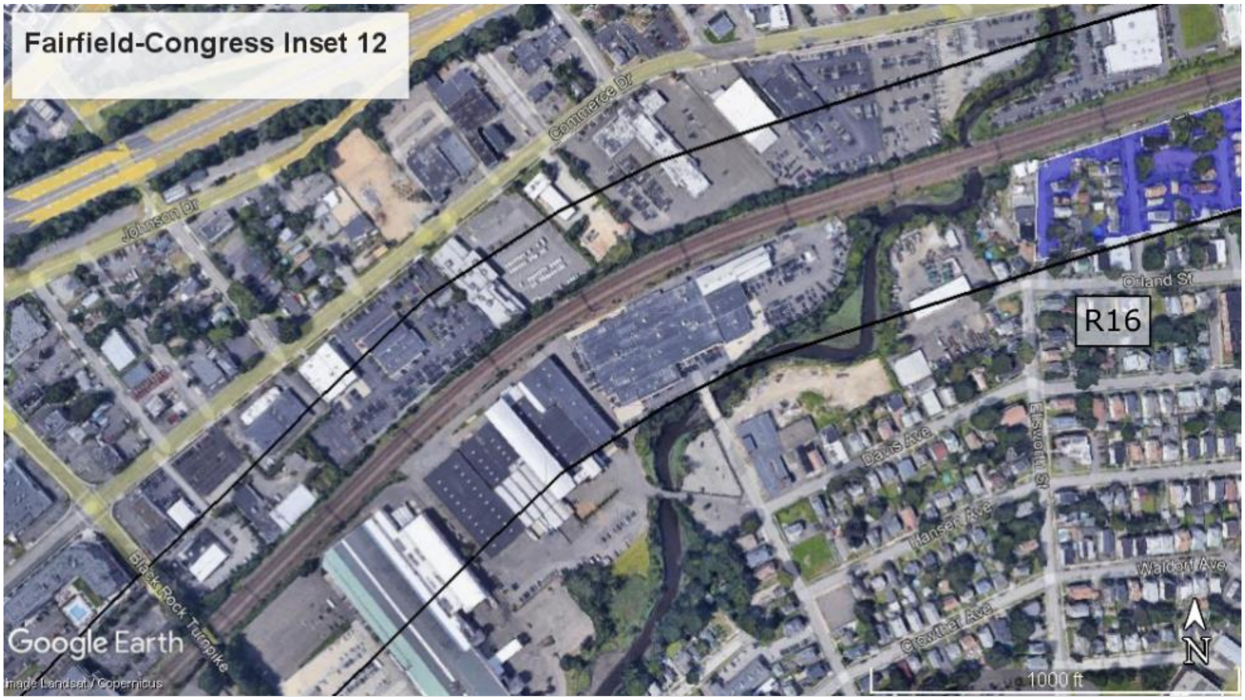

Figure D-13. Measurement areas along the transmission lines. Black lines show the distance of 300 feet from the proposed transmission line. Blue areas are residential, and yellow areas are community facilities.

Figure D-14. Measurement areas along the transmission lines. Black lines show the distance of 300 feet from the proposed transmission line. Blue areas are residential, and yellow areas are community facilities.

Figure D-15. Measurement areas along the transmission lines. Black lines show the distance of 300 feet from the proposed transmission line. Blue areas are residential, and yellow areas are community facilities.

Figure D-16. Measurement areas along the transmission lines. Black lines show the distance of 300 feet from the proposed transmission line. Blue areas are residential, and yellow areas are community facilities.

Figure D-17. Measurement areas along the transmission lines. Black lines show the distance of 300 feet from the proposed transmission line. Blue areas are residential, and yellow areas are community facilities.

Table D-2. Measured magnetic fields and electric fields along the northern and southern sections of the planned route and at measurement locations 1–26 and P1–P8

		Measured magnetic field (mG)			Measured electric field (kV/m)		
Location	**Locations covered**	**Min**	**Mean**	**Max**	**Min**	**Mean**	**Max**
Corridor North 1	Approximately S. Gate Lane to Kings Highway & Vermont Ave	7.9	18	51	<0.1	<0.1	0.1
Corridor North 2	Approximately Kings Highway & Vermont Ave to Fairfield Ave	2.0	17	135	<0.1	0.2	0.4
Corridor North 3	Approximately Fairfield Ave to Broad St	1.2	23	159	<0.1	0.1	0.2
Corridor South 1	Approximately S. Gate Lane to Kings Highway & Vermont Ave	0.5	27	324	<0.1	<0.1	0.1

Location	Locations covered	Measured magnetic field (mG)			Measured electric field (kV/m)		
		Min	**Mean**	**Max**	**Min**	**Mean**	**Max**
Corridor South 2	Approximately Kings Highway & Vermont Ave to Fairfield Ave	1.1	23	258	<0.1	<0.1	0.1
Corridor South 3	Approximately Fairfield Ave to Broad St	0.8	5.9	23	<0.1	<0.1	0.1
R1	South Gate Ln	0.4	0.5	0.7	<0.1	0.1	0.2
R2	Westford Dr, nearby Apartments	0.3	1.7	8.2	<0.1	<0.1	0.1
R3	Westway & Pequot	0.3	1.5	5.3	<0.1	<0.1	<0.1
R4	Station Street	0.9	5.6	11	<0.1	<0.1	0.1
R5	John Street	2.3	3.8	6.9	<0.1	<0.1	0.1
R6	Pequot Ave	1.4	5.5	9.1	<0.1	<0.1	<0.1
R7	Bronson Rd	0.3	0.9	1.6		<0.1§	
R8	Linwood	3.4	4.5	6.5		<0.1§	
R9	Linwood	2.6	4.1	6.0		<0.1§	
R10	Bungalow Rd	1.7	1.8	1.8		<0.1§	
R11	Ludlowe Rd	2.9	2.9	3.0		<0.1§	
R12	Unquowa	0.6	0.6	0.7		<0.1§s	
R13	Hillcrest Street	0.7	1.6	2.5		<0.1§	
R14	King's Highway	0.8	1.9	6.2	<0.1	<0.1	<0.1

Location	Locations covered	Measured magnetic field (mG)			Measured electric field (kV/m)		
		Min	Mean	Max	Min	Mean	Max
R15	King's Highway & Vermont Ave	2.0	24	147	<0.1	<0.1	<0.1
R16	Orland St & Bryant St	2.2	6.1	12	<0.1	0.1	0.2
R17	Railroad Ave	4.1	6.1	9.7	<0.1	<0.1	<0.1
R18	Railroad Ave	3.4	8.5	18	<0.1	<0.1	<0.1
R19	Railroad Ave	2.6	11	97	<0.1	<0.1	<0.1
C1	Wakeman Club entrance to sidewalk	0.18	1.7	9.6	<0.1	<0.1	<0.1
C2	Southport Congregational Preschool	0.5	2.3	7.1	<0.1	<0.1	0.1
C3	Palmer's Neck	1.1	1.2	1.5		<0.1§	
C4	Cajal Academy and Linwood St	1.6	5.9	11		0.1§	
C6 & C7	Sportsplex Camp and Gymnastics Camp	2.5	6.9	21	<0.1	<0.1	<0.1
C8	Tomlinson Middle School & fields	0.6	3.0	5.7	0.1	0.2	0.2
C9	Jennings Park	1.5	3.1	6.1		<0.1§	
C10	Great Oaks Charter School	13	25	85		0.1§	
C11	Went Field	2.2	3.3	5.0	<0.1	<0.1	<0.1
C12	New Beginnings Family Academy	2.6	4.6	8.3	<0.1	<0.1	<0.1
C13	Mercy Learning Center	3.3	6.3	15	<0.1	<0.1	<0.1

Location	Locations covered	Measured magnetic field (mG)			Measured electric field (kV/m)		
		Min	Mean	Max	Min	Mean	Max
C14	Jaime A Hulley Childcare Center	4.5	9.5	20	<0.1	<0.1	<0.1

‡ The electric field was not measured at this location.

§ Maximum and minimum value statistics were not provided for these locations because only a single electric-field measurement was obtained.

Attachment E

Magnetic Field Calculations at Apartment Buildings

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Magnetic Field Calculations at Apartment Buildings

As described in the body of the report, at two locations along the proposed Project route, the rebuilt 115-kV lines, as presently designed, would be in close proximity to recently constructed and now occupied multi-story apartment buildings. The apartment buildings are constructed very close to the edge of the existing CT DOT corridor and the multi-story buildings present a situation where residents will have ready access to locations significantly above ground level in relatively close proximity to the Project's transmission lines. The Section titled Results of Modeling at Apartment Buildings in the body of the report describe magnetic-field levels at the nearest edge of the apartment buildings at average loading. The discussion below provides additional context of magnetic-field levels at peak loading throughout the whole area near the transmission lines as well as at peak loading.

Apartment Building in Fairfield

A two-dimensional model of magnetic-field levels is shown below in Figure E-1. The top and bottom plots show the 2-dimensional magnetic field for the existing and currently-proposed configurations, respectively. The model extends several hundred feet to both sides of the CT DOT corridor and from ground level up to a height of 150 feet above ground. The colors in the figure shows the strength of the magnetic field on a logarithmic scale where yellow shows areas where the magnetic field is greater than 1,000 mG (i.e., only in very close proximity to the individual conductors) and the dark blue shows areas where the magnetic field is less than 1 mG.

Comparison of the existing and proposed plots show that the conductors of the currently-proposed transmission line are very slightly closer to the edge of the building (by approximately 2 feet) but are substantially higher above ground. Specifically, the proposed conductors would be at least 16 feet above the top of the building compared to about 20 feet below the top of the building. The net result is that the currently-proposed Project would reduce magnetic-field levels at the front of the building at most heights above ground, but would slightly increase magnetic-field levels at the roof of the building.

Similar to Figure 9 in the body of the report (for average loading), Figure E-2 shows results of the existing and proposed magnetic-field levels at the front edge of the building (closest to the transmission lines) at greater heights above ground at *peak* loading. Similar to the results at average loading, the magnetic-field levels at the front edge of the building (closest to the transmission lines) are calculated to *decrease* at all levels of the building, except at the roof. At the front edge of the building on the roof, magnetic-field levels are calculated to increase from 90 mG to 111 mG. Similar to all other locations along the route, magnetic-field levels decrease rapidly with distance, and at the back end of the building, magnetic-field levels are calculated to be 3.1 mG before and after the proposed Project.

Apartment Building in Bridgeport

A two-dimensional model of magnetic-field levels is shown below in Figure E-3, similar in format to Figure E-1. Comparison of the existing and proposed plots show that the conductors of the currently-proposed transmission line are approximately 30 feet closer to the edge of the building and approximately 30 feet higher above ground (43 feet-9 inches for the existing conductors compared to 75 feet-2 inches for the proposed conductors). The net result of this change is that magnetic-field levels at the front edge of the building (closest to the transmission lines) are calculated to increase slightly as a result of the Project up to a height of about 35 feet, and then increase more substantially at greater heights above ground, with the maximum increase at the roof of the building.

As shown in Figure E-4, up to a height of about 35 feet above ground, the proposed Project is calculated to increase the magnetic-field levels by approximately 6 mG or less compared to existing levels. At 45 feet above ground, the magnetic-field level is calculated to increase from approximately 58 mG to 84 mG, and at the roof, magnetic-field levels are calculated to increase from about 56 mG to 160 mG. Similar to all other locations along the route, magnetic-field levels decrease rapidly with distance, and at the back end of the building, magnetic-field levels are calculated to be less than 6 mG before and after the proposed Project.

Although before and after the Project, all EMF levels at both apartment buildings are calculated to be far below guideline levels established by ICNIRP or the ICES, UI is evaluating alternative configurations of the rebuilt lines at these locations.

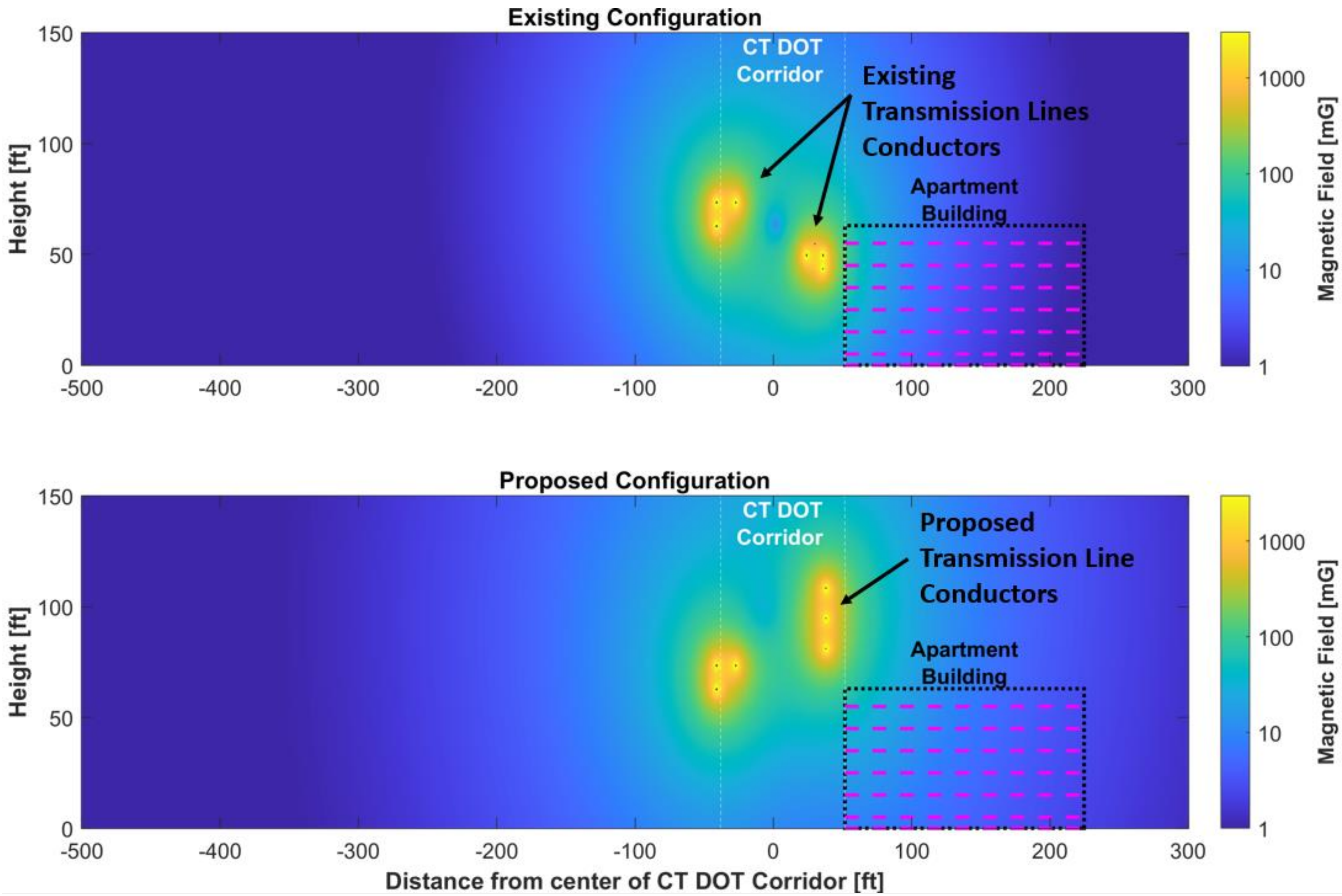

Figure E-1. Magnetic-field levels above ground at 79 Unquowa Place in Fairfield. Top: existing configuration. Bottom: currently-proposed configuration.

The CT DOT corridor is shown by vertical white lines. The strength of magnetic field is shown on a logarithmic scale with light yellow (i.e., immediately around the conductors) showing values of 1,000 mG or greater and dark blue showing 1 mG or less. Magenta lines show the heights of 5, 15, 25, 35, 45, 55 and 63 ft (roof) above ground.

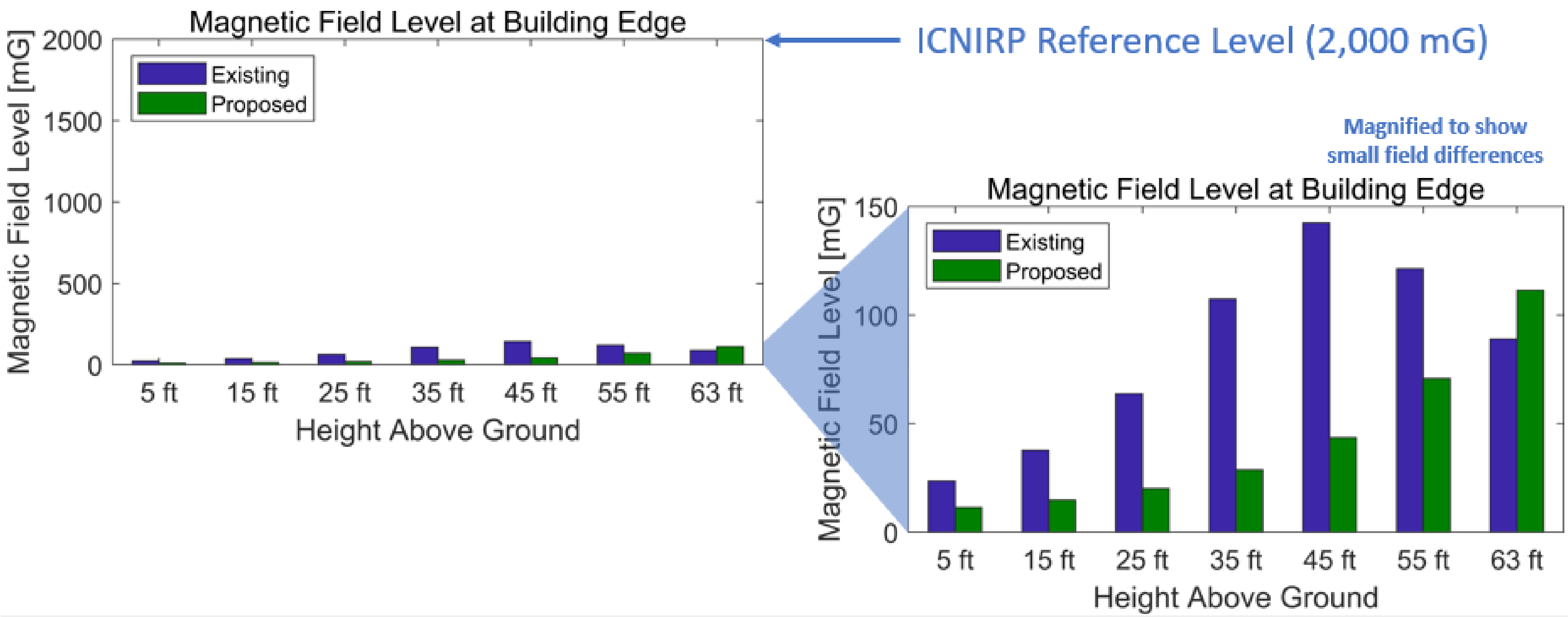

Figure E-2. Magnetic-field level at 79 Unquowa Place in Fairfield compared to the ICNIRP limit of 2,000 mG.

The ICES limit for magnetic fields is 9,040 mG. The scale of the graph on the right of the figure is magnified to illustrate the small differences in existing and proposed calculated field levels compared to ICNIRP limits.

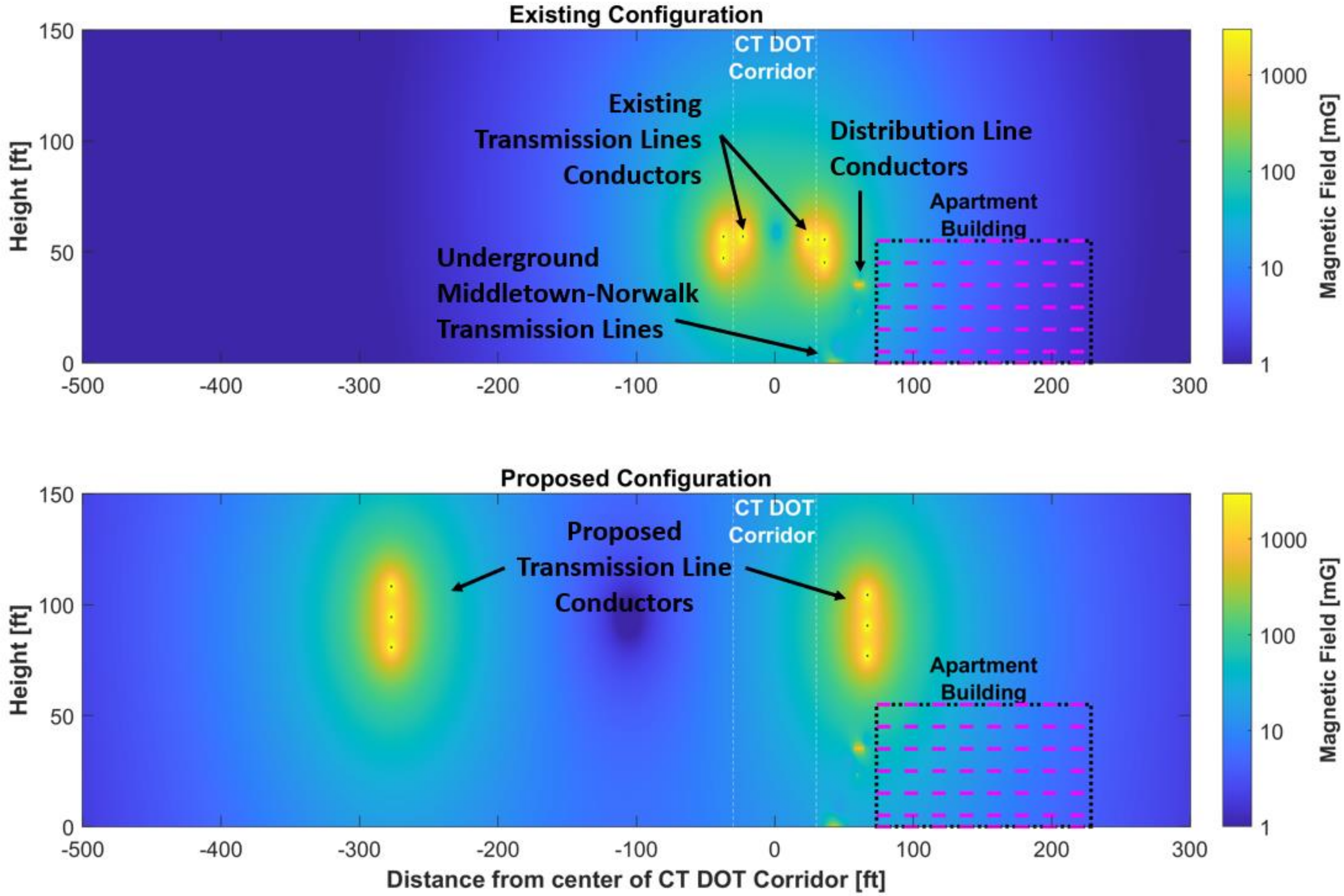

Figure E-3. Magnetic field levels above ground at Windward apartment building in Bridgeport. Top: existing configuration. Bottom: currently-proposed configuration.

The CT DOT corridor is shown by vertical white lines. The strength of magnetic field is shown on a logarithmic scale with light yellow (i.e., immediately around the conductors) showing values of 1,000 mG or greater and dark blue showing 1 mG or less. Magenta lines show the heights of 5, 15, 25, 35, 45 and 55 ft (roof) above ground.

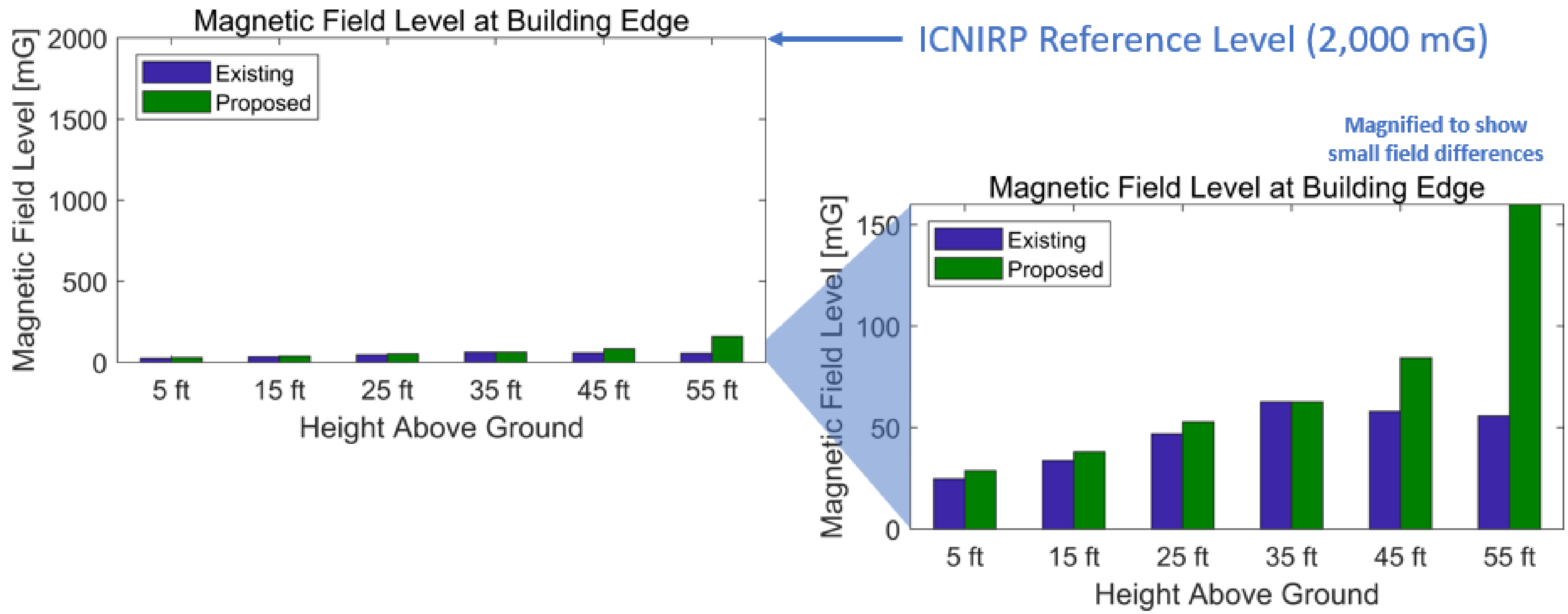

Figure E-4. Magnetic-field level at Windward apartment building in Bridgeport compared to the ICNIRP limit of 2,000 mG.

The ICES limit for magnetic fields is 9,040 mG. The scale of the graph on the right of the figure is magnified to illustrate the small differences in existing and proposed calculated field levels compared to ICNIRP limits.

Attachment F

Calibration Certificates

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Certificate of Calibration

The calibration of this instrument was controlled by documented procedures as outlined on the Certificate of Testing Operations and Accuracy Report using equipment traceable to N.I.S.T., ISO/IEC 17025:2017(E), and ANIZ540-1 COMPLIANT.

Instrument Model: EMDEX II - Standard

Frequency: 60 Hz

Serial Number: 1134

Date of Calibration: 03/19/2021

Re-calibration suggested at one year from above date.

Calibration Inspector: H. Christopher Hooper

EMDEX LLC
1356 Beaver Creek Drive
Patterson, California 95363
(408) 866-7266

Certificate of Calibration

The calibration of this instrument was controlled by documented procedures as outlined on the Certificate of Testing Operations and Accuracy Report using equipment traceable to N.I.S.T., ISO/IEC 17025:2017(E), and ANIZ540-1 COMPLIANT.

Instrument Model: EMDEX II - Standard

Frequency: 60 Hz

Serial Number: 3074

Date of Calibration: 03/10/2022

Re-calibration suggested at one year from above date.

EMDEX LLC

Calibration Inspector: H. Christopher Hooper

EMDEX LLC
1356 Beaver Creek Drive
Patterson, California 95363
(408) 866-7266