Exponent Electrical Engineering & Computer Science

Old Town Substation Rebuild Project

Electric and Magnetic Field Report

Old Town Substation Rebuild Project

Electric and Magnetic Field Report

Prepared for

The United Illuminating Company
180 Marsh Hill Rd.
Orange, CT 06477

Prepared by

Exponent
17000 Science Drive
Suite 200
Bowie, MD 20715

June 5, 2020

1909495.000 - 2051

Contents

Limitations

At the request of The United Illuminating Company (UI), Exponent modeled the electric and magnetic field changes associated with the rebuild of the Old Town Substation in the City of Bridgeport, Fairfield County, Connecticut. This report summarizes work performed to date and presents the results of 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 this input data and rely on the client for the data's accuracy. 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. UI has confirmed to Exponent that the data contained herein are not subject to Critical Energy Infrastructure Information restrictions.

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 outside of the permitting process, 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

The United Illuminating Company (UI) proposes to rebuild the Old Town Substation (the Project), located in the City of Bridgeport, Fairfield County, Connecticut. The new substation will be rebuilt (on UI property) adjacent to and encompassing the site of the existing substation. The rebuilt substation will include new 115-kV switchyard equipment as well as modifications to the three 115-kV overhead transmission lines, two of which connect to the existing substation. All three lines, designated A, B and C, which extend on an existing right-of-way (ROW) through the Old Town Substation, are owned by The Connecticut Light and Power Company d/b/a Eversource Energy (Eversource). The Eversource Line C and Line B that presently connect to the existing substation will be modified and rerouted slightly to connect to line terminals at the rebuilt substation. The Eversource Line A (which presently bypasses the existing substation) will be re-routed through the rebuilt substation yard as a provision for a future connection.

Exponent, Inc. (Exponent) measured the 60-Hertz electric- and magnetic-fields (EMF) levels associated with the pre-Project configuration. Exponent also modeled EMF levels for both the pre- and post-Project configurations of the 115-kV lines entering and exiting the substation and for the proposed buswork and rerouted transmission line along the northern side of the substation.

Along the transmission line ROW edges, calculated electric and magnetic field levels are 0.6 kV/m and 37 mG (at average loading) or less, respectively. Currently, there are no existing power lines in the vicinity of the new bus structure; after completion of the Project, the calculated electric and magnetic field levels at UI's property line will be less than 0.2 kV/m and 18 mG (at average loading), respectively. The EMF levels will decrease rapidly with distance such that 100 feet beyond any ROW edge or UI property line, EMF levels are less than 0.1 kV/m and 5.5 mG, respectively.

The calculated EMF levels associated with the Project are far below international safety- and health-based standards for EMF. The engineering design and other activities initiated by UI

demonstrate compliance with the Connecticut Siting Council's EMF Best Management Practices regarding EMF.

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

The United Illuminating Company (UI) proposes a rebuild of the Old Town Substation (the Project), located in the City of Bridgeport, Fairfield County, Connecticut. The existing Old Town Substation, more than 50 years old, is located on a 0.9-acre parcel of UI-owned land at 280 Kaechele Place in northwest Bridgeport. In a right-of-way (ROW) that extends east-west through the existing substation site, there are three 115-kV overhead transmission Lines— Line A, Line B, Line C owned by The Connecticut Light and Power Company d/b/a Eversource Energy (Eversource). Two of these transmission lines (Line B and Line C) are connected to the existing substation while Line A by-passes the substation; all lines are supported on approximately 105-foot-tall steel lattice steel structures.

The Project will be rebuilt on presently undeveloped, UI-owned property northeast and adjacent to the existing substation at 312 and 330 Kaechele Place. The new substation will occupy approximately 2.25 acres, including all the existing 0.9-acre substation parcel. In addition, the Project will include minor modifications to link the new substation to the lines that presently connect to the existing Old Town Substation. The rebuilt substation will include new 115-kV and 13.8-kV switchyard equipment, a new control enclosure and a 13.8-kV switchgear enclosure, as well as modifications and re-routing of the 115-kV overhead transmission Line B and Line C that presently connect to the existing substation. Line A (which presently bypasses the existing substation) will be re-routed through the rebuilt substation yard as a provision for a future connection. The nearest residence north of the substation on Sequoia Road will be more than 200 feet from the proposed fence of the expanded substation.

Exponent, Inc. (Exponent) measured the 60-Hertz electric- and magnetic-fields (EMF) levels associated with the pre-Project configuration. Exponent also modeled the EMF levels associated with the pre-Project and post-Project configurations of the 115-kV lines along profiles around the site and the magnetic fields from substation buswork based on the design information provided by UI. The EMF levels were evaluated for peak daily average (average) and peak line loadings. This report summarizes the measurement and modeling methods and results.

EMF Sources and Characteristics

Sources that generate, transmit, or use electricity produce electric and magnetic fields (EMF). Electricity travels as current from distant generating sources on high-voltage transmission lines, to substations, then on to local distribution lines, and finally to our homes and workplaces for consumption. All things connected to our electrical system—power lines; wiring in our homes, businesses, and schools; and all electric appliances and machines—are sources of EMF. In North America, the vast majority of electricity is transmitted as alternating current (AC) at a frequency of 60 cycles per second measured in Hertz (Hz), i.e., 60 Hz. The EMF from these AC sources is commonly referred to as power-frequency or extremely low frequency EMF.

Electric fields

Electric fields are produced when voltage is applied to electrical conductors and equipment. The electric field is expressed in units of volts per meter (V/m) or kilovolts per meter (kV/m), where 1 kV/m is equal to 1,000 V/m. The electric-field level increases as the voltage increases. Electric fields are present even when an appliance is turned off if it is still connected to the power source.

Since grounded conducting objects such as buildings, fences, and trees easily block electric fields, the major sources of exposure to electric fields indoors are appliances, equipment, and machines within homes, offices, and factories. Transmission lines, distribution lines, and other power-related infrastructure are the major source of electric fields outdoors. Electric fields emanate radially outward from the charged conductor and terminate at any other conducting object. Electric fields are vector quantities meaning that they have both a magnitude and direction.

Magnetic fields

Magnetic fields are the result of the flow of electric currents through wires and electrical devices. The strength of a magnetic field is expressed as magnetic flux density in units called gauss (G) or milligauss (mG), where 1 G = 1,000 mG.[1] In general, the strength of a magnetic field depends on characteristics of the source, including the arrangement and separation of the conductors increases as the current increases. Magnetic field levels also depend on the amount of current flowing through the lines. Since power demand varies on a given day, throughout a week, or over the course of months and years, the magnetic field produced by the transmission line can also vary. Unlike electric fields, magnetic fields are not easily blocked by most objects. Like electric fields, magnetic fields are vector quantities described by both their magnitude and direction.

EMF Characteristics

The intensity of both electric fields and magnetic fields diminishes with increasing distance from the source. In the case of transmission lines, electric and magnetic fields generally decrease with distance from the conductors in proportion to the square of the distance. Since line voltage is quite stable and does not change very much over time, electric-field levels are also stable. Magnetic-field levels, however, can vary depending on load conditions (i.e., the currents flowing in a conductor).

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 1 depicts typical magnetic-field levels measured in residential and occupational environments, compared to levels measured on or at the edge of transmission line ROWs.

[1] Scientists also refer to magnetic flux density at these levels in units of microtesla (μT). Magnetic flux density in mG units can be converted to μT by dividing by 10 (i.e., 1 mG = 0.1 μT).

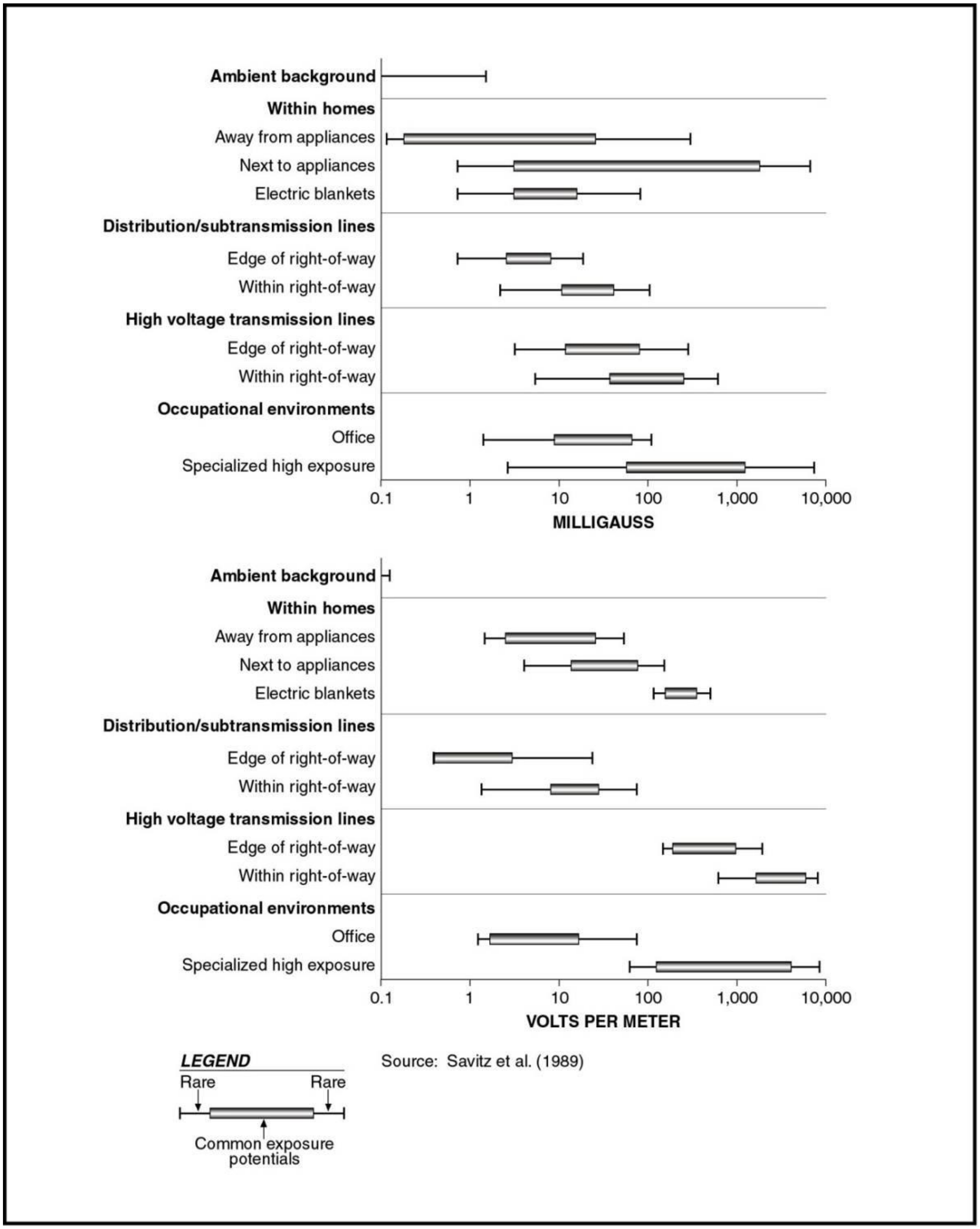

Figure 1. Electric- and magnetic-field levels in the environment.

On-Site EMF Sources

The purpose of this assessment is to characterize the EMF levels at nearby locations of interest, including the residences to the north of the substation along Sequoia Road (more than 200 feet from the proposed substation fence) as well as the businesses and residences to the west and southwest of the substation in the vicinity of Kaechele Place (approximately 90 feet or more from the proposed substation fence). The important sources of EMF are therefore the transmission lines east and west of the substation as well as the rerouted transmission lines and new buswork on the north side of the substation. EMF from additional substation components such as transformers, switchgear, circuit breakers, and underground distribution duct banks decrease much more rapidly with distance than those from bus work and transmission lines and so were not included in the modeling.

A schematic representation of the Old Town Substation site, the existing and new equipment within it, and the Eversource transmission line ROW is shown in Figure 2. To describe how the rebuilt substation will change levels of EMF, three representative cross-sections were selected that included components that affect EMF levels at the site boundaries. Distribution circuits associated with the rebuilt substation will consist of duct lines and splice chambers, which will be buried on UI property, as well as beneath local roads. Since the existing distribution duct banks and overhead pole lines are not expected to change significantly as a result of the Project, they were not included in the EMF models.

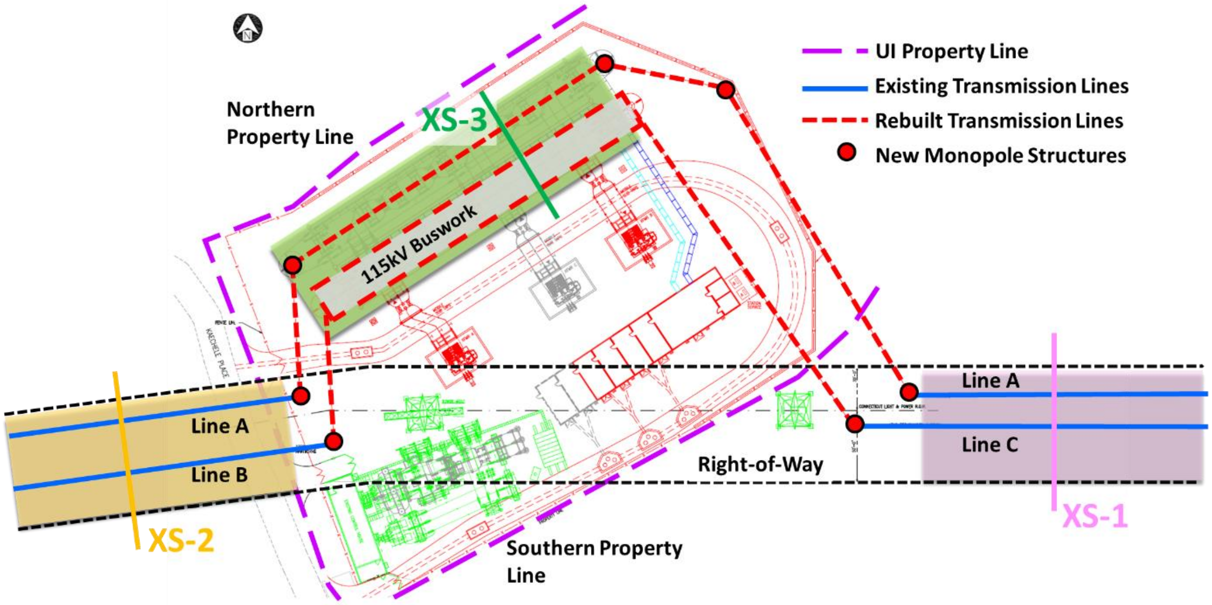

Figure 2. Proposed site plan for the rebuilt Old Town Substation annotated with locations of three modeled representative cross-sections.

XS-1 (East of the substation)

In this cross-section (shaded pink in Figure 2), Line A and Line C are supported on a lattice structure in a double-circuit configuration, 30 feet from the northern edge of an 80-foot-wide ROW. The configuration of lines in this cross-section will not be modified because of the Project.[2]

XS-2 (West of the substation)

In this cross-section (shaded orange in Figure 2), Line A and Line B are supported on a double-circuit lattice structure 30 feet from the northern edge of the 80-foot-wide ROW. This cross section is similar to XS-1, but the conductors of both lines will have a lower clearance above ground and the horizontal spacing between the two transmission lines will be less than that in

[2] The existing lattice structure supporting Line A and Line C adjacent to the substation on the east side is being replaced by two new monopoles as part of the Project. The line configurations are expected to be similar even when supported on replaced structures and therefore, the expected EMF levels in this area will be similar.

XS-1. In other respects, the structure in this cross-section will not be modified because of the Project.

XS-3 (Relocated Lines & New Bus Structure)

In this cross-section (shaded green in Figure 2), new monopole structures will be installed approximately 40 feet south of the northern property line of the substation to support the re-routed Line A. A new horizontal 115-kV bus structure will be constructed approximately 76 feet south of the northern property line of the substation to accept the Line C. The complete load of the Line C will enter the bus and then portions of the load will be transferred to two new proposed transformers. To conservatively overestimate magnetic field levels, the bus has been modeled with the complete Line C load along its entire length. EMF levels were evaluated along both the northern and southern UI property lines which are located 76 feet north and approximately 200 feet south of the bus structure, respectively.

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 Connecticut Siting Council (Council, CSC) has developed guidelines for siting new transmission lines as discussed in a subsequent section of this report.

In absence of any federal or state standards, EMF levels can be assessed based on assessment criteria, including the exposure limits, recommended by two scientific and health organizations: (1) the International Committee on Electromagnetic Safety (ICES) and (2) the International Commission on Non-Ionizing Radiation Protection (ICNIRP). The exposure limits summarized in Table 1 were developed to protect health and safety and are based upon reviews and evaluations of relevant health research.

The World Health Organization has made the recommendation that policy makers should adopt international exposure limit guidelines, such as those from ICNIRP or ICES (Table 1), for exposure to EMF. (WHO, 2007)

Table 1. ICNIRP (2010) and ICES (2019) 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 ROWs, the guideline is 10 kV/m.

The CSC has 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"* (CSC, 2014, p. 3). 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"* (CSC, 2014, p.4).

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). For this project, the CSC's 2014 BMPs serve as the primary reference to new developments in EMF scientific research. However, Exponent notes that in 2015, the Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR) of the European Union issued its opinion report in which the Committee concluded that research published up to 2014 did not confirm any adverse health effects of EMF exposure. The SCENIHR review was the most comprehensive of the reviews 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.

Although the EMF BMP explicitly applies to transmission lines, not substations, Exponent applied the spirit of these BMPs as interpreted for a substation. The Project does not involve the development of new transmission lines, but rather the relocation of existing 115-kV transmission lines within the substation property and small shifts within the Eversource ROW only. For this reason, the EMF levels from these transmission lines post-Project are expected to be similar to the pre-Project EMF levels. Exponent considers the Project as consistent with the CSC's EMF BMP for "no cost/low-cost" design because:

- The Project is not sited adjacent to statutory (community) facilities with the exception of Elton Rogers Woodland Park, an undeveloped municipal park. The Eversource ROW traverses east-west through the park; the southeastern boundary of the substation abuts the westernmost portion of the park.
- The new Old Town Substation will be located adjacent to and will encompass the existing substation property, and the proposed terminations of overhead transmission

lines are expected to have essentially no effect on the calculated magnetic field at the closest residences (which are located north of the substation, along Sequoia Road and south of the substation along Kaechele Place).

- The rebuilt substation and reconfiguration of the existing 115-kV transmission lines are sufficient to achieve the standards for adequate, safe, and reliable service without constructing a new substation in a different location and attendant transmission lines, which would be new sources of EMF.
- The Project includes new structures only on UI property within the substation and within Eversource ROW adjacent to the substation on the east side. The re-routed Line A in XS-3 will be rebuilt on vertical monopole structures approximately 40 feet from the northern property line. The existing structures in XS-1 and XS-2 are dual circuit lattice structures and are proposed to remain in place (unchanged). The conductor heights of all transmission lines are far greater than would be required by the National Electrical Safety Code (NESC).
- The two transmission lines in XS-1 and XS-2 supported by dual circuits lattice structures are optimally phased and are not proposed to be altered as a result of this Project.

Methods

EMF Modeling

EMF levels were calculated using computer algorithms developed by the Bonneville Power Administration, an agency of the U.S. Department of Energy (BPA, 1991). These algorithms have been shown to accurately predict EMF levels measured near transmission lines. The electric fields and magnetic fields were calculated as the resultant of x, y, and z field vectors. Exponent calculated electric- and magnetic-field levels at 1 meter (3.28 feet) above ground, in accordance with IEEE Std. C95.3.1-2010 and IEEE Std. P644/D7-2019, as the root-mean-square value of the field ellipse at each location along a transect perpendicular to the transmission centerlines.

The inputs to the program are data regarding voltage, current flow, phasing, and conductor configurations. UI provided Exponent with data regarding the conductor position, size, voltage, and phasing of the pre-Project and post-Project circuits. The values of EMF associated with the transmission lines were calculated along profiles perpendicular to the transmission lines at the point of lowest conductor sag (mid-span), i.e., closest to the ground. The transmission line conductors were assumed to be positioned at maximum sag for the entire distance between structures and over flat terrain. An overvoltage condition of 5% was used for calculating electric fields from the transmission lines. These modeling assumptions are made to ensure that the calculated values represent the maximum expected EMF values for the cases analyzed.

The electric field calculations are not affected by loading values. Magnetic field calculations were performed at peak daily average (average) and peak loading values for the current peak load year (2020) and the in-service date of (2023). For pre-Project and post-Project calculations, 2020 and 2023 loading values are used, respectively.[3]

[3] The pre-Project and post-Project loadings are projected to not change significantly.

EMF Measurements

To assess EMF from existing sources under pre-Project conditions, Exponent took measurements at the proposed boundaries of the existing substation site, at locations along the points where existing and proposed 115-kV lines connect to the substation, and along nearby streets. These measurements were performed on January 6, 2020 and all field levels were measured at a height of 3.28 feet (ft) (1 meter [m]) above ground using instruments meeting IEEE Std. 1308-1994 (R2010) for obtaining accurate field measurements at power line frequencies and calibrated by EMDEX, LLC, using methods like those described in IEEE Std. 644-2019. The measurements were taken and reported as the root mean square value of the field in accordance with IEEE Std. C95.3.1-2010 and IEEE Std. P644/D7-2019. Figure A1 in Appendix A illustrates the location of EMF measurement paths.

Results

Measured EMF Levels

Measurements indicate that the highest field levels measured around the existing Old Town Substation were from the overhead transmission lines passing through the substation and existing distribution lines exiting the substation. The main results for magnetic fields are summarized in Table A.1 in Appendix A. The measurements of electric fields were less informative because of interference from the dense vegetation surrounding much of the proposed site. The magnetic field levels measured around the existing substation fence are generally similar to those measured along Main Street (State Route 111, located approximately 300 feet to the west of the existing substation fence) and somewhat higher than those along Sequoia Road, located more than 400 feet to the north of the existing substation fence.

Additional magnetic-field measurements starting at the existing substation fence and moving perpendicularly away from the substation to the north indicate magnetic-field levels (primarily due to the existing transmission line) fall to less than 2 mG within approximately 60-65 feet of the existing substation fence. This indicates that the measured magnetic fields at residences along Sequoia Road, more than 400 feet to the north of the perimeter of the existing substation fence are due to existing local sources (such as underground distribution lines and electrical service for local residents) and not due to the substation.

Modeling results (discussed in the following section) show that this will continue to be the case after the Old Town Substation is rebuilt, when the nearest residence north of the rebuilt substation will be still be more than 200 feet from the proposed substation fence.

Modeled EMF Levels

The calculated pre- and post-Project electric-field levels, magnetic-field levels at average loading, and magnetic-field levels at peak loading from transmission lines and rebuilt substation structures are summarized in Appendix B, Table B.1, Table B.2, and Table B.3, respectively.

Appendix C includes graphic profiles of the calculated electric-field levels (Figure C1 through Figure C3) and magnetic-field levels at average loading (Figure C4 through Figure C6). The calculated EMF levels associated with the Project are far below international safety- and health-based standards for EMF.

Transmission Lines

In cross-sections, XS-1 and XS-2 (east and west of the substation, respectively) the structures are unchanged, and the pre-Project and post-Project loadings are projected to not change significantly. Therefore, the EMF levels in XS-1 and XS-2 are calculated to not change at the ROW-edge as a result of the Project. The electric and magnetic field levels at the edge of ROW for these cross-sections are less than 0.6 kV/m and 37 mG at average loading, respectively. At peak loading, magnetic field levels are somewhat higher, 57 mG or less.

The nearest structures west of the substation (XS-2) are businesses (approximately 15 feet from the ROW edge). The nearest residences west and southwest of the substation (in the vicinity of Kaechele Place) are approximately 120 feet from the XS-2 ROW and approximately 90 feet from the substation fence. The magnetic field levels at these locations are not calculated to change by more than 0.1 mG as a result of this project.

Substation and Relocated Transmission Lines

In the remaining modeled cross-section (XS-3), field levels are calculated to increase from the existing configuration (where no transmission lines presently exist) because of the new substation bus and the relocated Line A. At the property lines of the proposed substation to the north and south and beyond, calculated electric and magnetic field levels are 0.2 kV/m and 18 mG or lower, respectively. These field levels are even lower than the levels at the ROW edges of either XS-1 or XS-2.

Conclusion

This report summarizes measurements and calculations of the EMF levels associated with the pre-Project configuration and post-Project configurations of the substation and the 115-kV lines. These calculations were performed using methods accepted within the scientific and engineering community and that have been found to match well with measured values.

EMF levels for the cross-sections XS-1 and XS-2 (east and west of the substation, respectively) containing existing 115-kV transmission lines will not increase as a result of the Project because the voltages and line configuration in these cross-sections are unchanged, and the pre-Project and post-Project loadings are anticipated to not change significantly. The rebuilding of the substation will alter local EMF levels on site but after the completion of the Project, electric and magnetic field levels at the UI property lines (XS-3) to the north and south of the substation and beyond were calculated to be 0.2 kV/m and 18 mG, respectively or less. Pre-construction magnetic-field levels measured along Sequoia Road (more than 200 feet north of the proposed substation boundary) are due to existing local sources (such as underground distribution lines and electrical service for local residents) and not due to the existing substation. Modeling results show that this will continue to be the case after expansion of the new substation.

In XS-1 and XS-2 (east and west of the substation, respectively), the primary sources of EMF are the existing transmission lines connecting to and passing through the substation. The configurations of these transmission lines are proposed to not change, and the pre-Project and post-Project loadings are projected to not change significantly. Therefore, the EMF levels at adjacent buildings (in the vicinity of Kaechele Place) are calculated to not change as a result of the Project.

The calculated EMF levels associated with the Project are far below international safety- and health-based standards for EMF. The engineering design and other activities initiated by UI demonstrate compliance with the CSC’s EMF Best Management Practices.

References

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

Connecticut Siting Council (CSC). Petition 754 - Best Management Practices for Electric and Magnetic Fields. February 14, 2014.

Institute of Electrical and Electronics Engineers (IEEE). IEEE Recommended Practice for Instrumentation: Specifications for Magnetic Flux Density and Electric Field Strength Meters - 10 Hz to 3 kHz (IEEE Std. 1308-1994, Reaffirmed 2010). New York: IEEE, 1994/2010.

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 to 100 kHz. (IEEE Standard C95.3.1-2010). New York: IEEE, 2010.

Institute of Electrical and Electronics Engineers (IEEE). Approved Draft Standard Procedures for Measurement of Power Frequency Electric and Magnetic Fields from AC Power Lines (IEEE Std. P644/D7). New York: IEEE, 2019.

Institute of Electrical and Electronics Engineers (IEEE). IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 0 kHz to 300 GHz. (C95.1-2019). New York, NY: IEEE, 2019.

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

Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR). Opinion on Potential Health Effects of Exposure to Electromagnetic Fields (EMF). Brussels, Belgium: European Commission, 2015.

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.

Appendix A

Measured Levels of Electric and Magnetic Fields

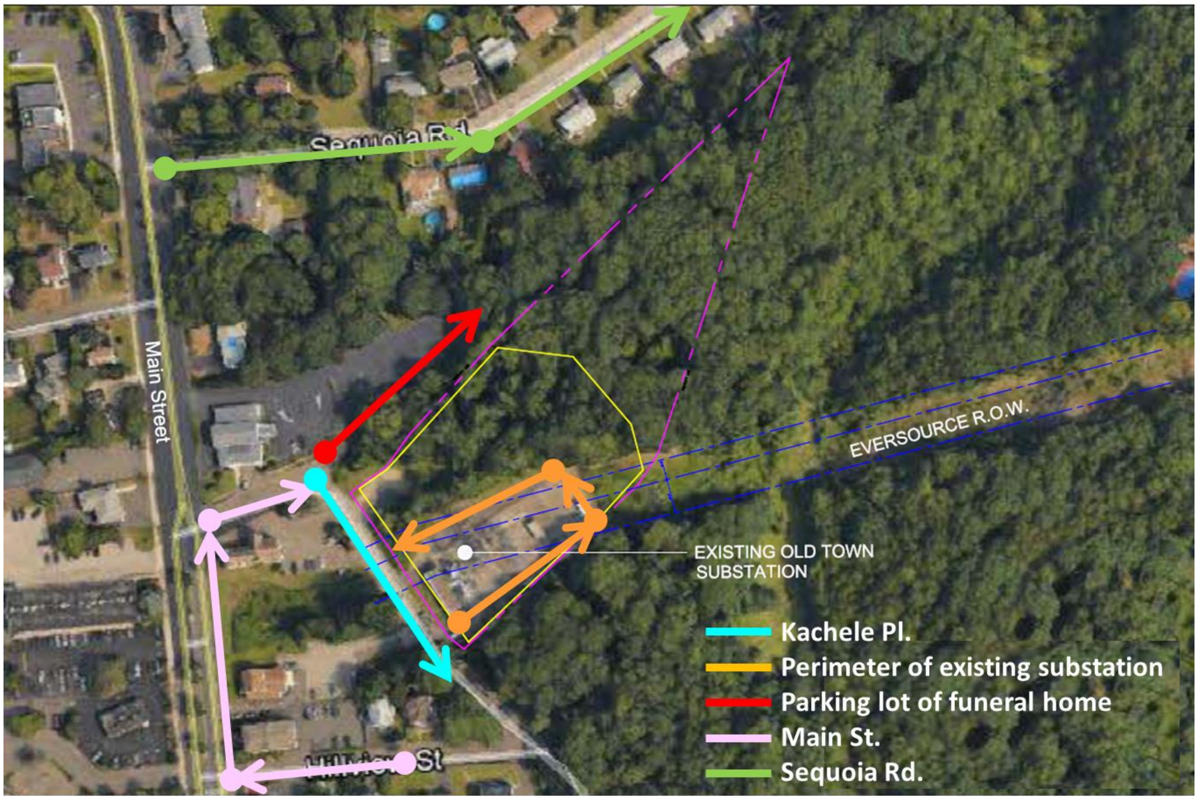

Figure A1. EMF Measurement paths around Old Town Substation.

Table A.1. Measurements of existing magnetic field levels (mG)

Measurement Path	Min	Mean	Max
Kachele Pl. (in front of substation)	2.5	8.1	17
Perimeter of existing substation	4.2	7.9	16
Parking lot of adjacent funeral home	0.2	0.5	3.4
Main St.	1.5	6.5	15
Sequoia Rd.	0.4	1.4	5.6

Appendix B

Calculated Levels of Electric and Magnetic Fields

Table B.1. Electric-field levels (kV/m) at 1 meter above ground

Section	Configuration	100 feet from South ROW edge	South edge of ROW	Max on profile	North edge of ROW	100 feet from North ROW edge
XS-1	Pre-Project	< 0.1	0.2	0.4	0.4	< 0.1
	Post-Project	< 0.1	0.2	0.4	0.4	< 0.1
XS-2	Pre-Project	< 0.1	0.2	1.4	0.6	< 0.1
	Post-Project	< 0.1	0.2	1.4	0.6	< 0.1
Section	**Configuration**	**100 feet from Southern Property Line**	**Southern Property Line**	**Max on profile**	**Northern Property Line**	**100 feet from Northern Property Line**
XS-3	Post-Project	< 0.1	< 0.1	3.7	0.2	< 0.1

Table B.2. Magnetic-field levels (mG) at 1 meter above ground at average loading

Section	Configuration	100 feet from South ROW edge	South edge of ROW	Max on profile	North edge of ROW	100 feet from North ROW edge
XS-1	Pre-Project	1.3	10	22	15	1.5
	Post-Project	1.3	10	22	15	1.5
XS-2	Pre-Project	4.0	22	47	37	5.5
	Post-Project	3.9	21	47	37	5.4
Section	**Configuration**	**100 feet from Southern Property Line**	**Southern Property Line**	**Max on profile**	**Northern Property Line**	**100 feet from Northern Property Line**
XS-3	Post-Project	0.7	1.4	216	18	3.0

Table B.3. Magnetic-field levels (mG) at 1 meter above ground at peak loading

Section	Configuration	100 feet from South ROW edge	South edge of ROW	Max on profile	North edge of ROW	100 feet from North ROW edge
XS-1	Pre-Project	4.5	26	43	23	1.7
	Post-Project	4.5	26	43	23	1.7
XS-2	Pre-Project	7.0	40	79	57	8.8
	Post-Project	7.0	40	79	57	8.8
Section	**Configuration**	**100 feet from Southern Property Line**	**Southern Property Line**	**Max on profile**	**Northern Property Line**	**100 feet from Northern Property Line**
XS-3	Post-Project	1.2	2.5	453	28	4.7

Appendix C

Graphical Profiles of Calculated Electric and Magnetic Fields

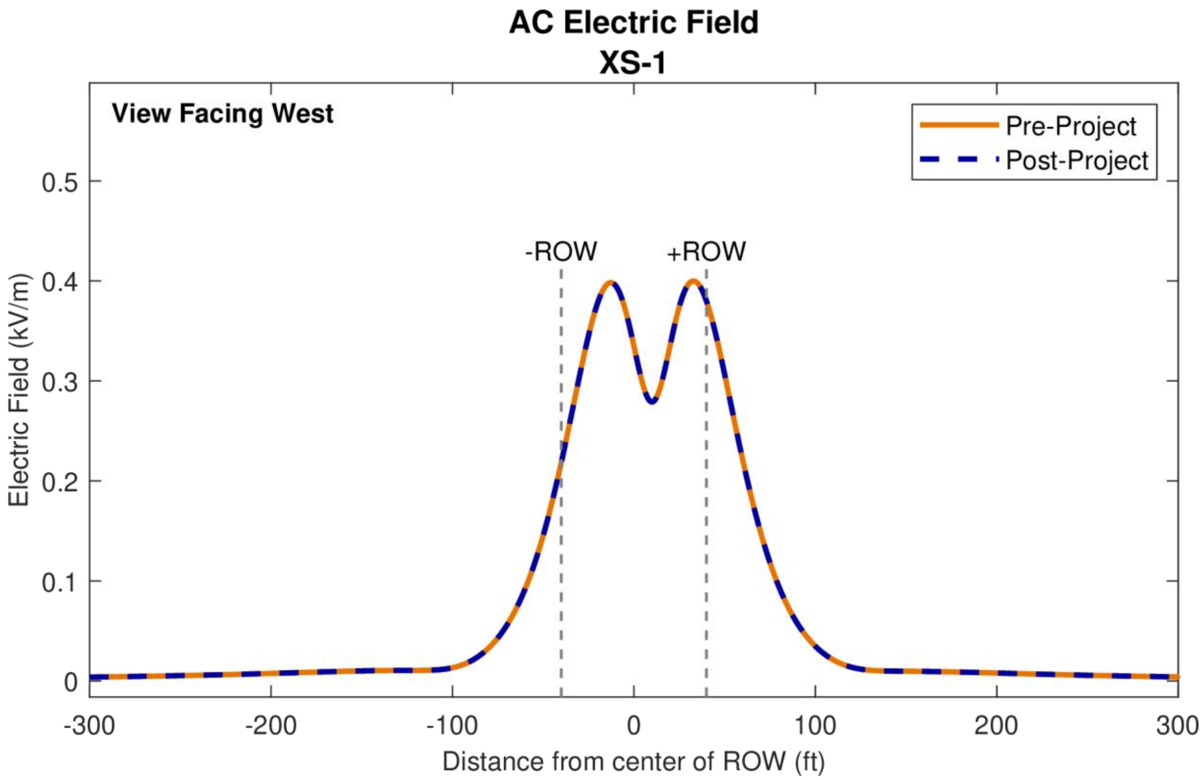

Figure C1. Calculated electric-field profile for pre-Project and post-Project configurations of transmission lines in XS-1 (east of the substation).

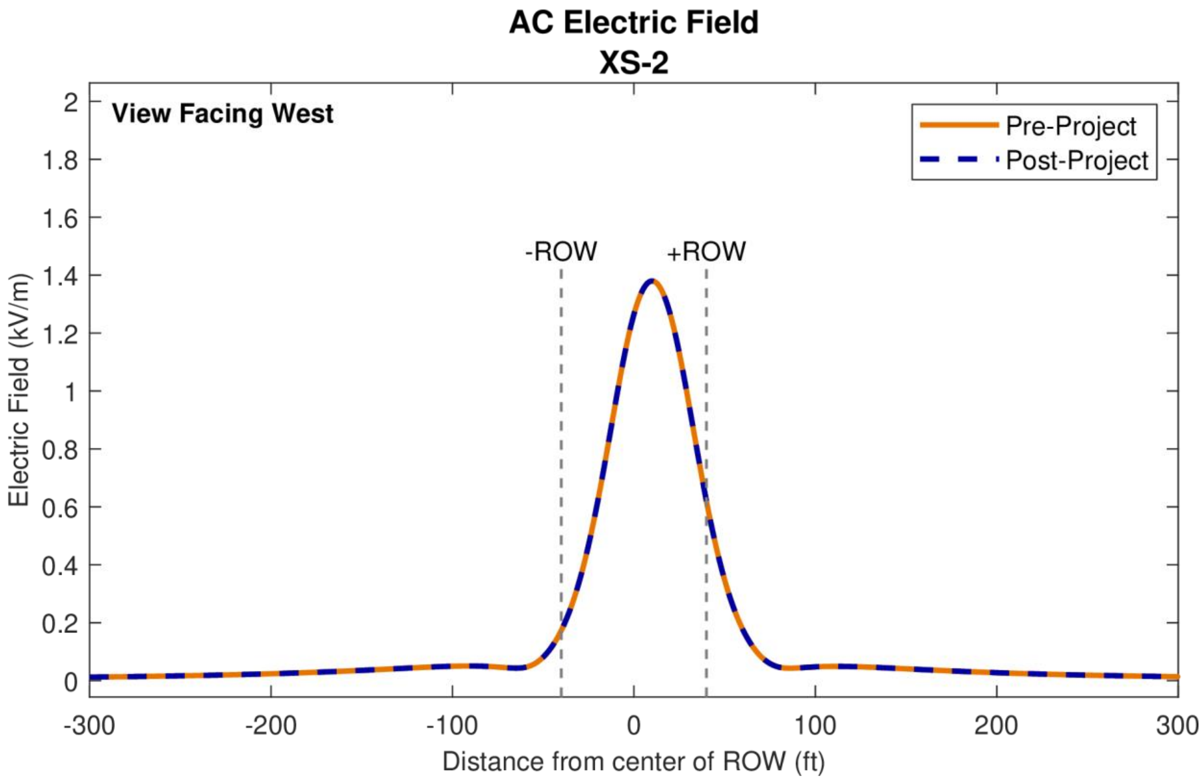

Figure C2. Calculated electric-field profile for pre-Project and post-Project configurations of transmission lines in XS-2 (west of the substation).

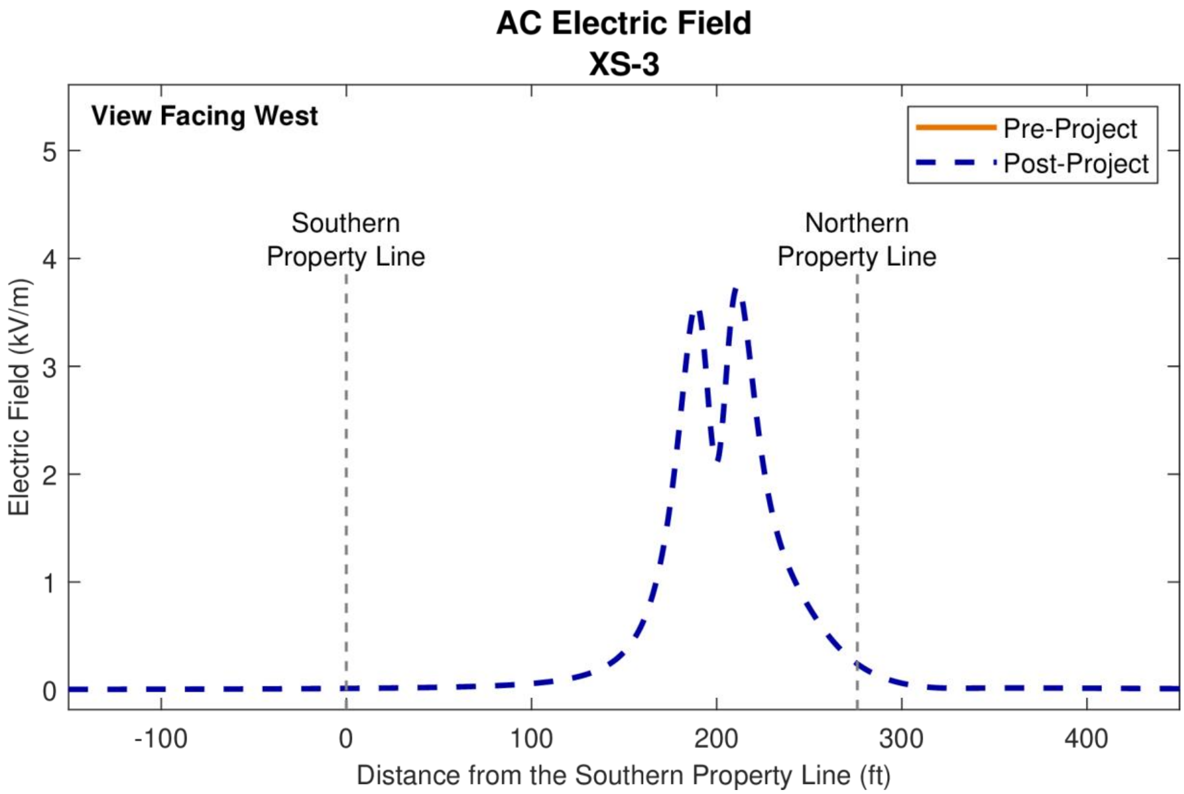

Figure C3. Calculated electric-field profile for post-Project configurations of relocated transmission lines and new bus structure in XS-3.

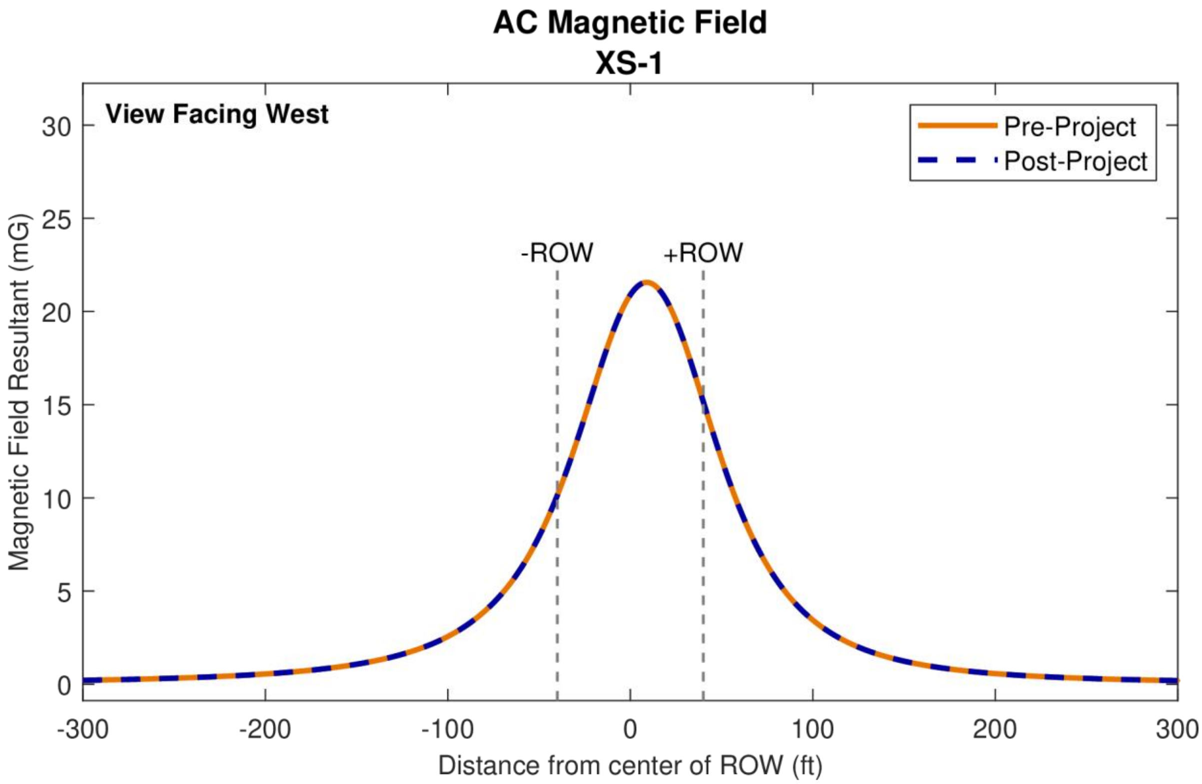

Figure C4. Calculated AC magnetic-field profile at average loading for pre-Project and post-Project configurations of transmission lines in XS-1 (east of the substation).

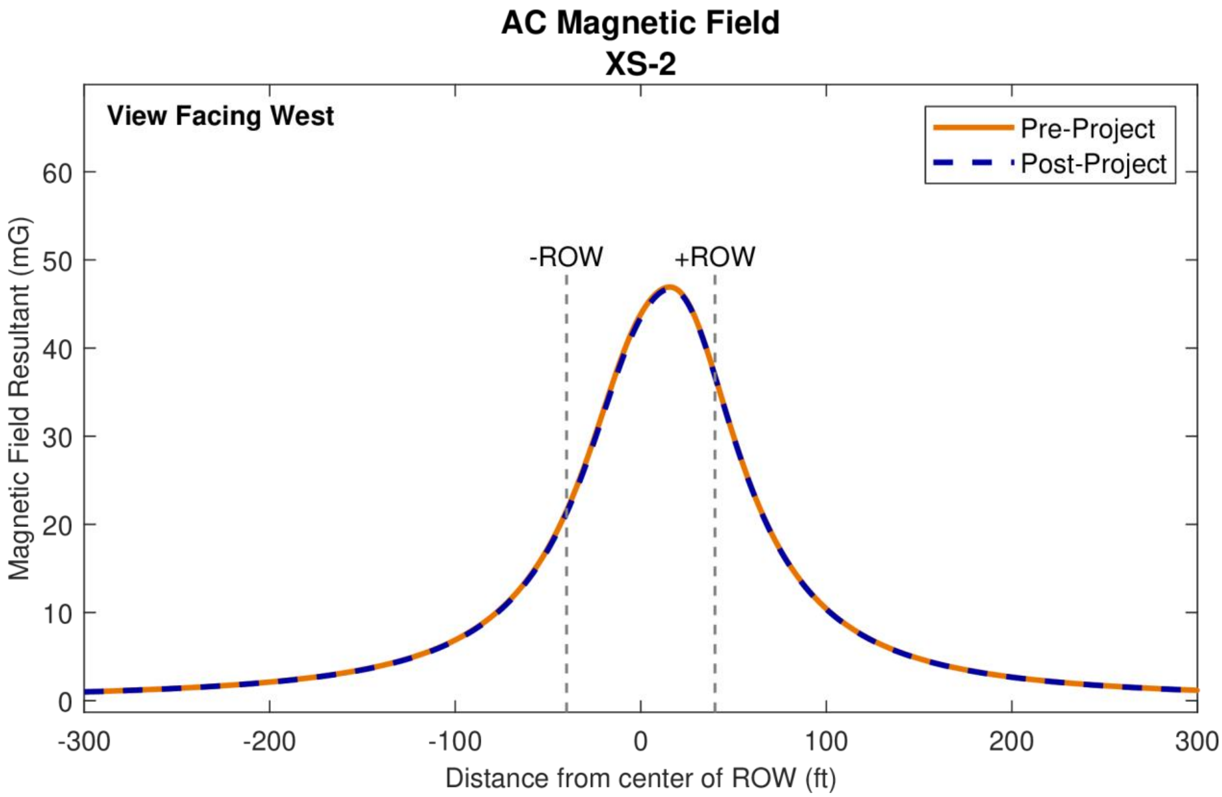

Figure C5. Calculated AC magnetic-field profile at average loading for pre-Project and post-Project configurations of transmission lines in XS-2 (west of the substation).

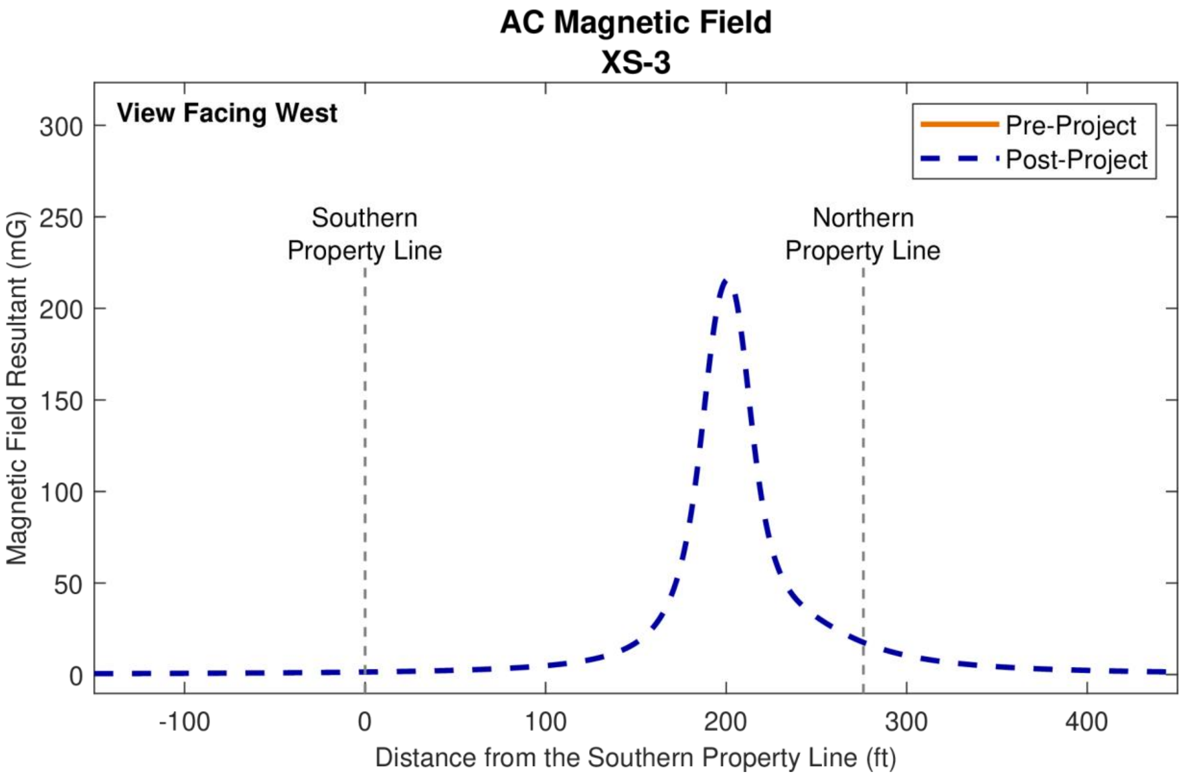

Figure C6. Calculated AC magnetic-field profile at average loading for post-Project configurations of relocated transmission lines and new bus structure in XS-3.