QUANTA TECHNOLOGY
A QUANTA SERVICES COMPANY

REPORT

Marici Gen-Tie Line EMF Study Report

PREPARED FOR

Dashiell

DATE

August 14, 2025
(Version 1.1)

PREPARED BY

Grant Wollam, PE
GWollam@Quanta-Technology.com
229.869.7067

Farbod Jahan, PE
Farbod@Quanta-Technology.com
919.334.3035

Internal Project #US25TT129

REPORT CONTRIBUTORS

- Farbod Jahanbakhsh
- Grant Wollam
- Solmaz Nazaralizadeh

VERSION HISTORY

VERSION	DATE	DESCRIPTION
1.0	May 30, 2025	Initial Submission
1.1	August 14, 2025	Updated per customer comments

REVIEW HISTORY

VERSION	WRITTEN BY	DATE	REVIEWED BY	DATE
1.0	Grant Wollam	05/30/2025	Farbod Jahan	05/30/2025
1.1	Grant Wollam	08/14/2025	Farbod Jahan	08/14/2025

Executive Summary

Quanta Technology has performed the electromagnetic field, radio interference, audible noise, and corona loss study for the Marici 230 kV Gen-Tie Line using Bonneville Power Administration (BPA) modeling software.

The project involves a single-circuit 230 kV transmission line in Los Angeles, California, extending approximately 22 meters.

This report presents the findings of the study conducted for the 230 kV single-circuit transmission line operating at the maximum voltages (1.05 pu). The study evaluates the electric field, magnetic field, radio interference, audible noise, and corona loss of the transmission line.

Abbreviations and Acronyms

Table 1. Abbreviations and Acronyms

TERM	DEFINITION
ACSR	Aluminum conductor steel-reinforced cable
AN	Audible noise
EF	Electric field
EMF	Electromagnetic field
IEEE	Institute of Electrical and Electronics Engineers
INIRC-IRPA	International Commission on Non-ionizing Radiation Protection
MF	Magnetic field
MPE	Maximum permissible exposure
NJCEC	New Jersey Clean Energy Corridor
NJDEP	Department of Environmental Protection Compliance and Enforcement for the State of New Jersey
OHGW	Overhead ground wire
OPGW	Optical ground wire
RI	Radio interference
ROW	Right of way
SLD	Single-line diagram
TVI	Television Interference

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 Introduction

Quanta Technology has performed the electromagnetic field (EMF), radio interference (RI), audible noise (AN), and corona loss study for the Marici 230 kV Gen-Tie Line using Bonneville Power Administration (BPA) modeling software.

The project involves a single-circuit 230 kV transmission line in Los Angeles, California, extending approximately 22 meters. The consists of double-bundle ACSR Mockingbird phase conductor (2034.5 kcmil) and is equipped with dual 48-fiber CentraCore OPGW shield wires and 7 No.7 Alumoweld overhead ground wire.

The modeled segment includes two dead-end steel monopole structures (POCO and POLE1) with an estimated span of 22 meters between poles and pole heights of 105 ft and 140 ft, respectively. Mid-span conductor sag was estimated using standard tension assumptions for ACSR Mockingbird.

The east property line shared with the Walnut Substation is 11 feet 2 inches from the nearest portion of the gen-tie line, and the southern public facing property line is 55 feet 11 inches from the nearest portion of the gen-tie line. The site plan is included in Appendix C.

The analysis was performed under conditions outlined in Section 2.1.1. This report presents the findings of the study conducted for the 230 kV single-circuit transmission line operating at the maximum voltages (1.05 pu). The study evaluates the electric field (EF), magnetic field (MF), radio interference (RI), audible noise (AN), and corona loss of the transmission line.

This report summarizes the results of the study conducted for the proposed 230 kV line operating at its maximum rated voltage. The assessment includes the evaluation of EF, MF, RI, and AN level at the edge of the ROW.

2 Modeling and Methodology

2.1 Gen-Tie Line Modeling

This study models a 230 kV single-circuit transmission line located in Los Angeles, California, with a total line length of approximately 22 meters. These specifications reflect actual site parameters provided by the project engineer and ensure realistic modeling in the BPA software environment.

Figure 1 and Figure 2 show the tower geometry of the transmission line for "Pole 1" and "POCO" tower, respectively. Figure 3 shows the poles and gen-tie line via Google Earth. Figure 4 shows the Tower's engineering drawings provide by Dashiell.

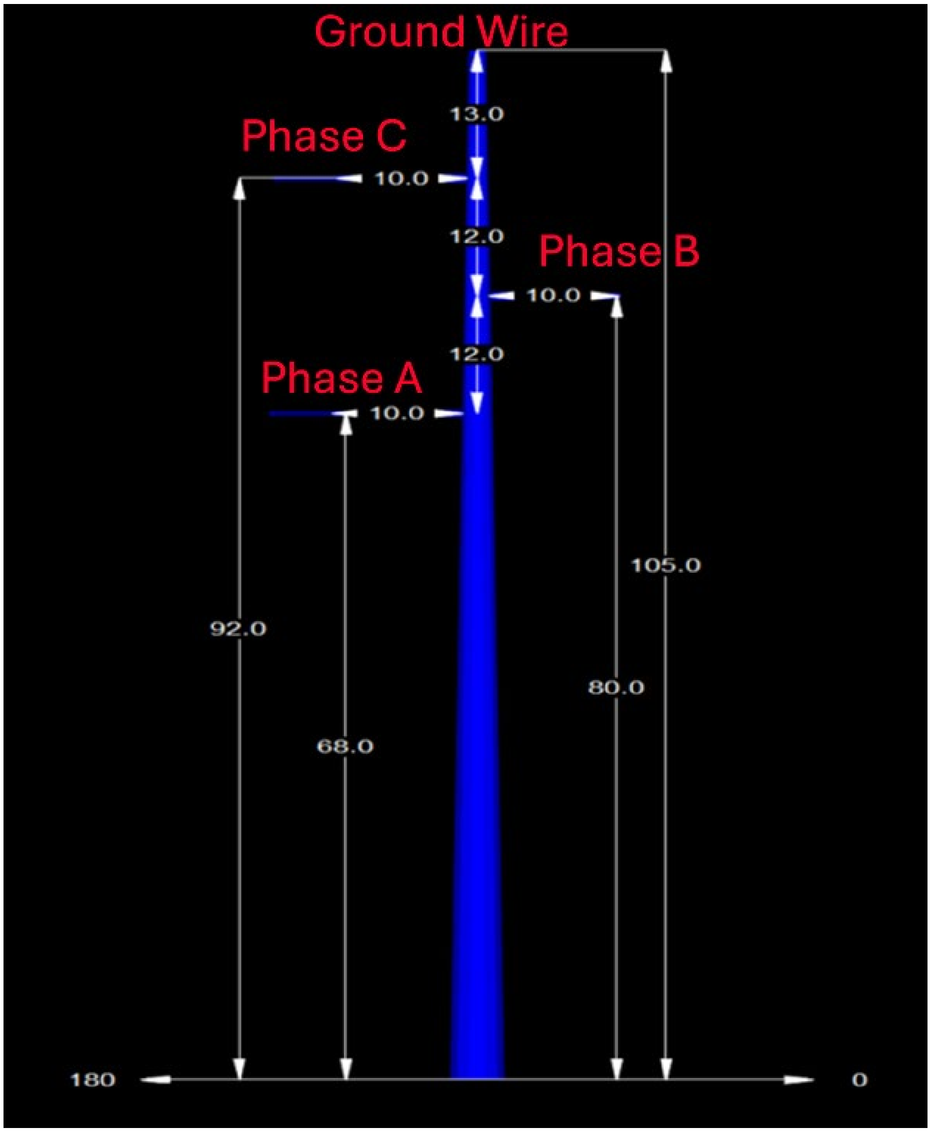

Figure 1. Pole 1 Dimensions

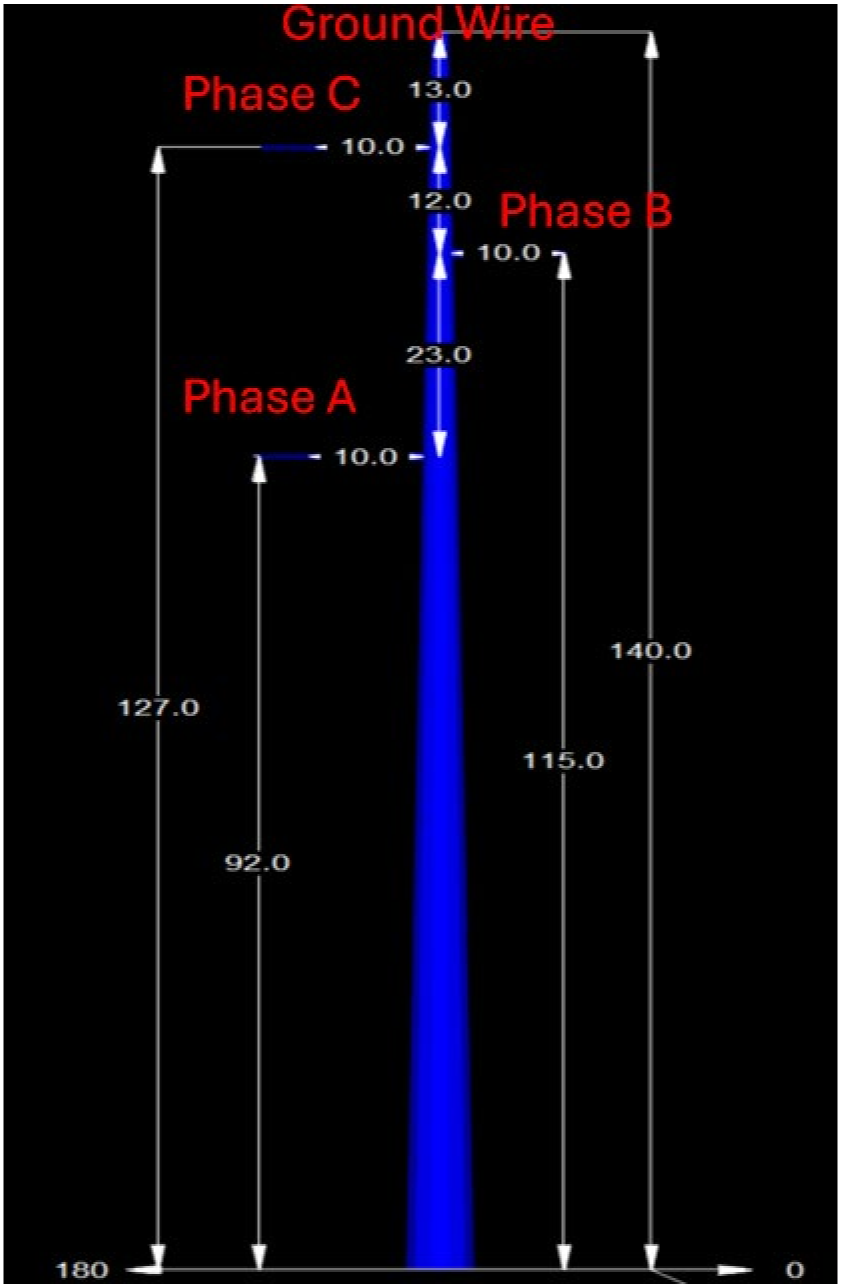

Figure 2.POCO Dimensions

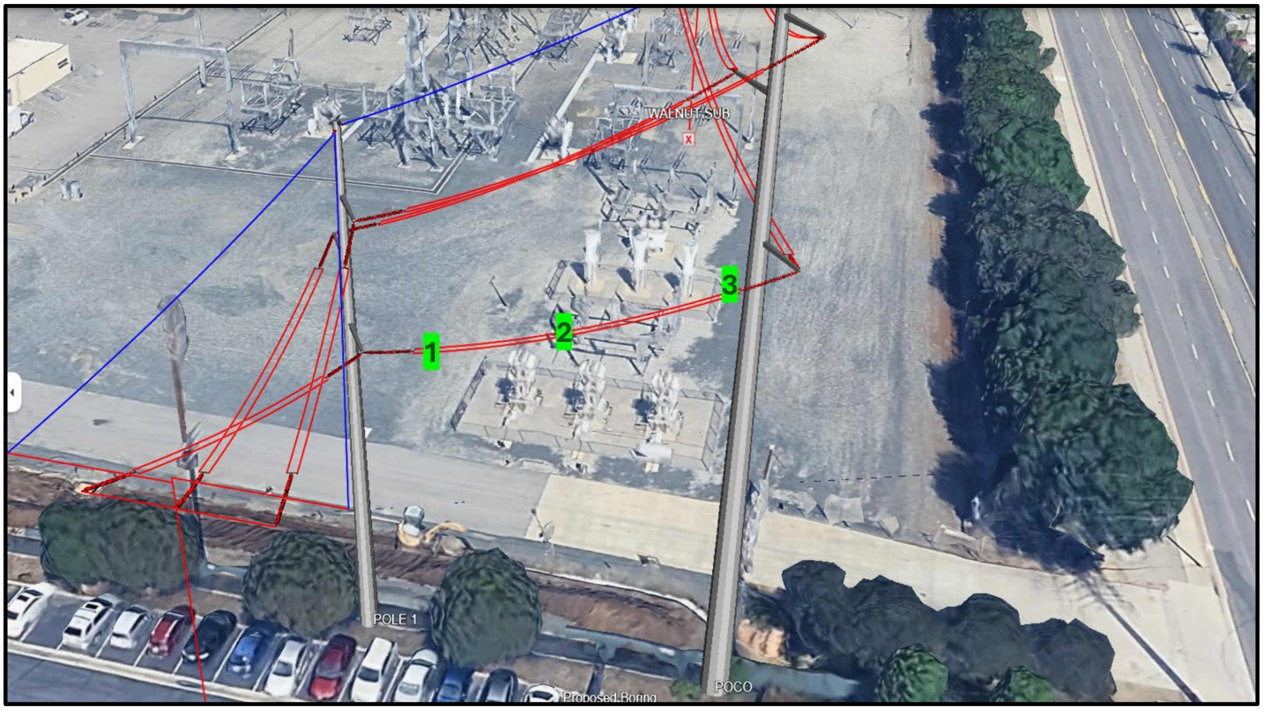

Figure 3. Google Earth Image of the Marici Gen-Tie Line

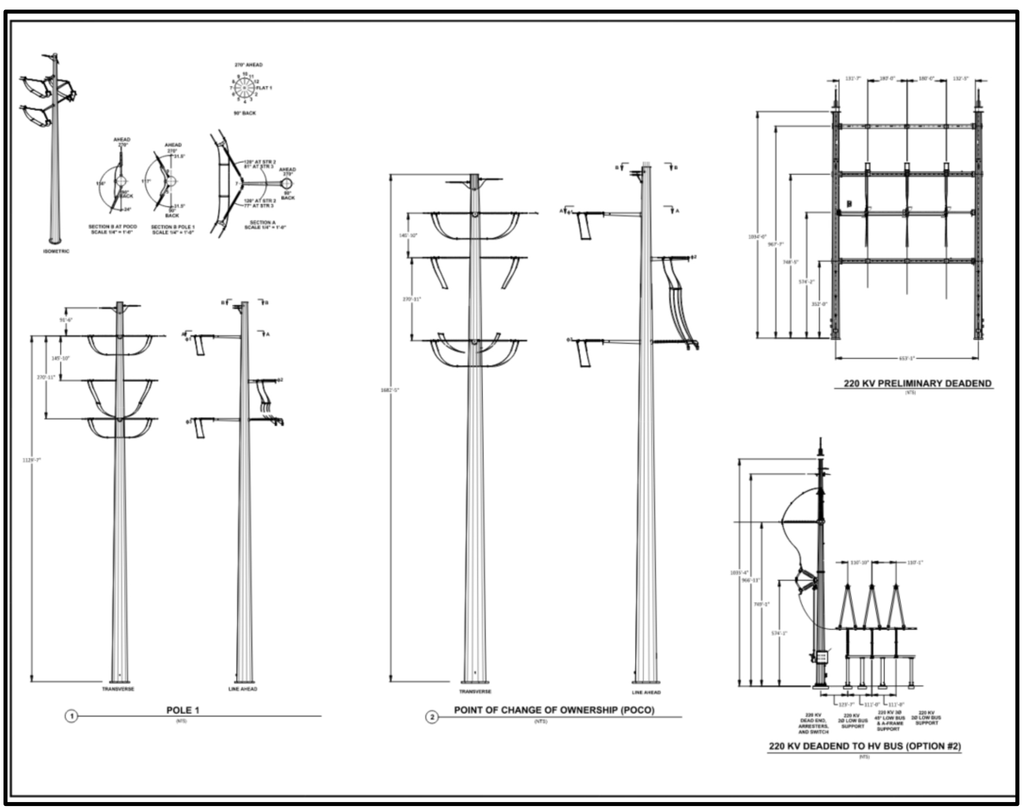

Figure 4. 230 kV Marici Tower Dimensions

These structural and geometric parameters were extracted from Dashiell engineering documentation and validated via geospatial analysis using Google Earth, as illustrated in Figure 3**Error! Reference source not found.**. It is important to note that while the BPA Corona and Field Effects Program inherently assumes symmetric pole heights and therefore applies mid-span sag at the geometric center of the span, the actual installation features asymmetrical pole elevations. Based on the verified site-specific data, Figure 3 confirms that the vertical heights of the phases differ significantly across the two structures, thereby invalidating the assumption of symmetric mid-span clearance. Accordingly, to ensure conservative and realistic modeling, this study adopts the lowest vertical conductor clearance—68 feet (Phase A)—as the reference height for electromagnetic field, audible noise, and radio interference analyses. This approach aligns with industry best practices for worst-case exposure modeling under adverse weather conditions, as stated in Section 2.1.1, in full compliance with BPA simulation standards.

Three locations are modeled across the gen-tie line and are named Point 1, 2, and 3, which are displayed in Figure 3. However, only the worst-case results are displayed in Section 3. All the results are included in Appendix B.

Table 2. Modeled Parameters for Point 1

LINE PHASE	LG VOLTAGE (KV)	HORIZONTAL DISTANCE FROM THE CENTER (FT)	CONDUCTOR HEIGHT (FT)	CONDUCTORS PER PHASE (BUNDLE)	BUNDLE SPACING (IN)	LINE CURRENT (AMPS)	CONDUCTOR TYPE
Phase A	139.4	-10	68	2	18	1005	2034.5 kcmil Mockingbird ACSR
Phase B	139.4	10	80	2	18	1005	
Phase C	139.4	-10	92	2	18	1005	
Ground wire	NA	0	105	1	NA	0	No.7 Alumoweld

Table 3. Modeled Parameters for Point 2

LINE PHASE	LG VOLTAGE (KV)	HORIZONTAL DISTANCE FROM THE CENTER (FT)	CONDUCTOR HEIGHT (FT)	CONDUCTORS PER PHASE (BUNDLE)	BUNDLE SPACING (IN)	LINE CURRENT (AMPS)	CONDUCTOR TYPE
Phase A	139.4	-10	80	2	18	1005	2034.5 kcmil Mockingbird ACSR
Phase B	139.4	10	97	2	18	1005	
Phase C	139.4	-10	109.50	2	18	1005	
Ground wire	NA	0	122.50	1	NA	0	No.7 Alumoweld

Table 4. Modeled Parameters for Point 3

LINE PHASE	LG VOLTAGE (KV)	HORIZONTAL DISTANCE FROM THE CENTER (FT)	CONDUCTOR HEIGHT (FT)	CONDUCTORS PER PHASE (BUNDLE)	BUNDLE SPACING (IN)	LINE CURRENT (AMPS)	CONDUCTOR TYPE
Phase A	139.4	-10	92	2	18	1005	2034.5 kcmil Mockingbird ACSR
Phase B	139.4	10	115	2	18	1005	
Phase C	139.4	-10	127	2	18	1005	
Ground wire	NA	0	140	1	NA	0	No.7 Alumoweld

2.1.1 Assumptions

The following assumptions are used for the study.

- Wind speed: 11.7 ft/s = 8 mph
- Ground conductivity: 1 mmhos/m
- Rain rate: 0.3 in/hour
- Altitude: 305 ft
- Electric field sensor height: 2 meters (6.56 ft)
- Right of Way (ROW): 180 ft
- Phase max current: 1,005 Amp
- Phase voltage: 1.05 PU (241.5kV L-L)

2.2 Methodology

The information below summaries the theory and limits for each calculated value along with further assumptions for these calculations.

1. **Electric Field:** The intensity of the EF is measured 2 meters above the ground [1]. In the study, the conductor height is assumed to be the minimum clearance to the ground. According to the Institute of Electrical and Electronics Engineers (IEEE) Standard C95.6, under normal load conditions, for the public, the maximum permissible exposure (MPE) to electric fields is 10 kV/m, and MPE outside the line right of way (ROW) is 5 kV/m [2].
2. **Magnetic Field:** The intensity of the MF is measured 2 meters above the ground [1]. In the study, the conductor height is assumed to be the minimum clearance to the ground. Based upon the technical research, the International Commission on Non-Ionizing Radiation Protection (ICNIRP) has made a series of recommendations for limiting EMF exposure to human beings: public exposure to magnetic fields should be limited to 2,000 mG (200 mT) (ICNIRP 2010). The International Commission on Non-ionizing Radiation Protection (INIRC-IRPA) recommends a public exposure MF guideline of 1 gauss [3].
3. **Audible Noise:** The audible noise is measured 2 m above the ground. In the study, the conductor height is assumed to be the minimum clearance to the ground [1]. The U.S. Department of Housing and Urban Development Noise Guidebook Chapter 2 (24 CFR Section 51.101(a)(8)) recommends that exterior areas of frequent human use follow the EPA guideline of 55 dBA L_{dn}. However, the same Section 51.101(a)(8) indicates that a noise level of up to 65 dBA L_{dn} could be considered acceptable [4].
4. **Radio Interference:** The RI antenna is placed 2 m above the ground. In this study, the conductor height is assumed to be the minimum clearance to the ground. There is no specific RI environmental limit applicable to this study.[1]

3 EMF Study Results

3.1 Electric Field

The electric field at the sensor height (2 meters) is displayed as a function of lateral distance from the center of the lines.

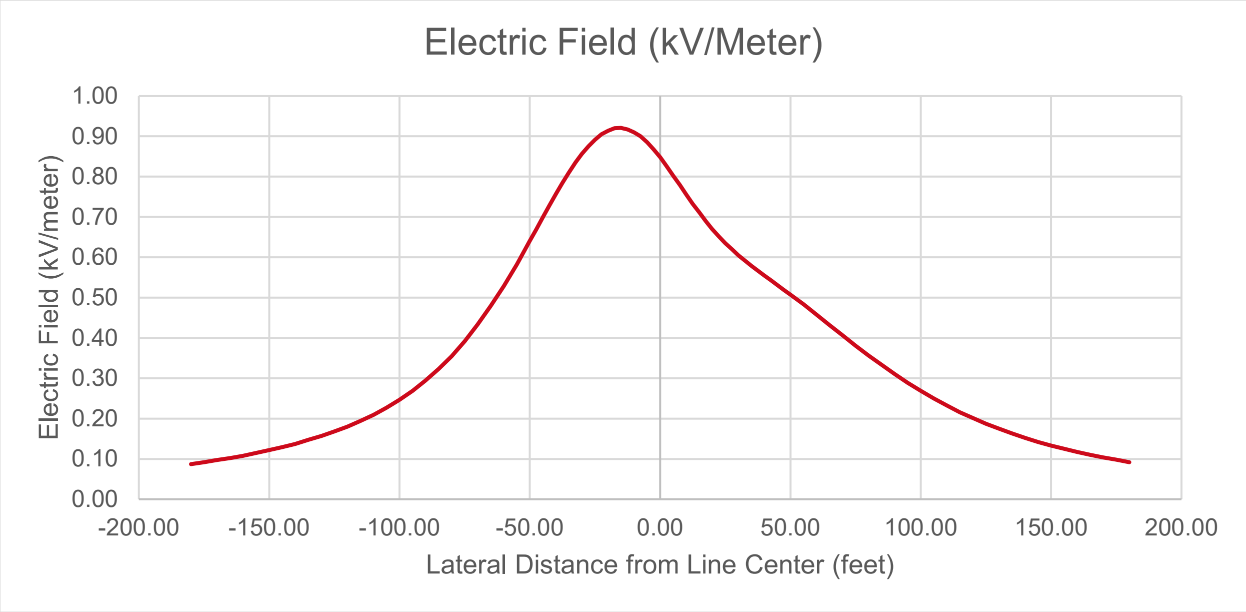

Figure 5. Electric Field Results

3.2 Magnetic Field

The magnetic field at the sensor height (2 meters) is displayed as a function of lateral distance from the center of the lines.

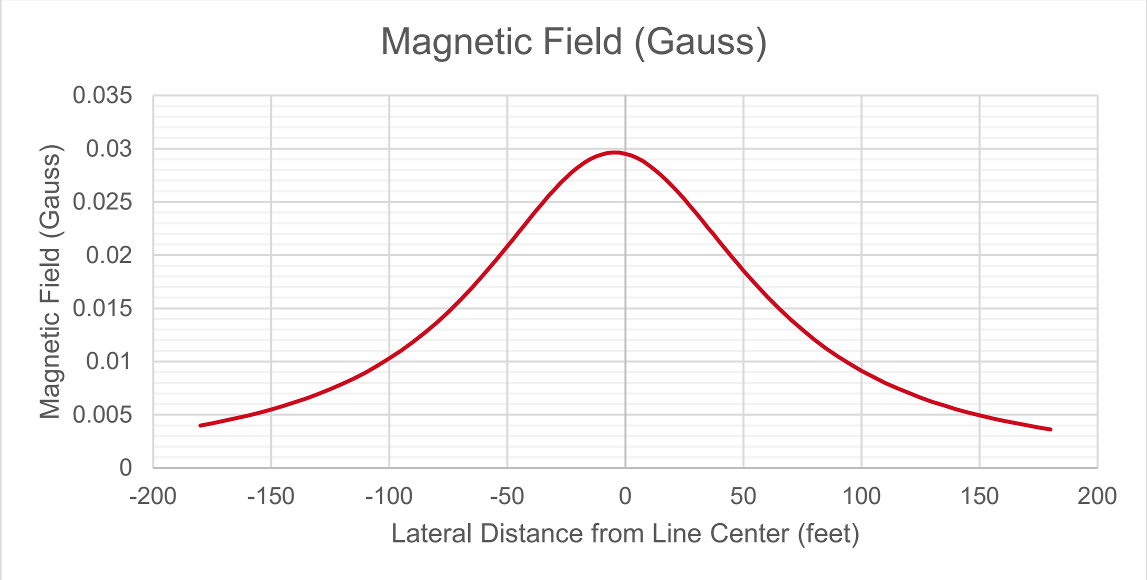

Figure 6. Magnetic Field Results

3.3 Audible Noise

The audible noise at the sensor height (2 meters) is displayed as a function of lateral distance from the center of the lines.

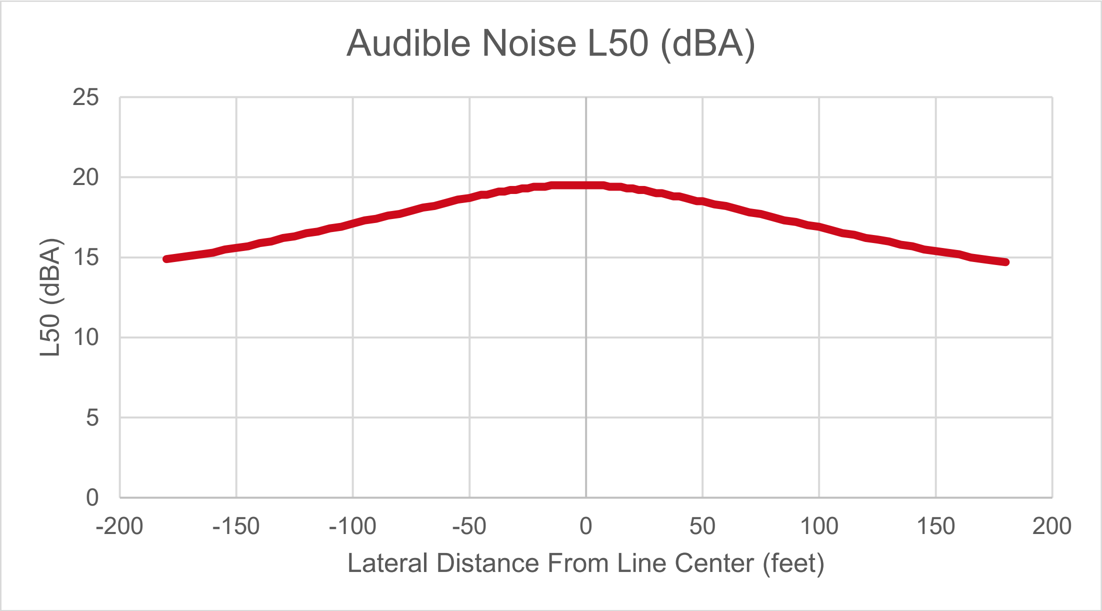

Figure 7. Audible Noise Results

3.4 Radio Interference

The Radio Interference at the sensor height (2 meters) is displayed as a function of lateral distance from the center of the lines.

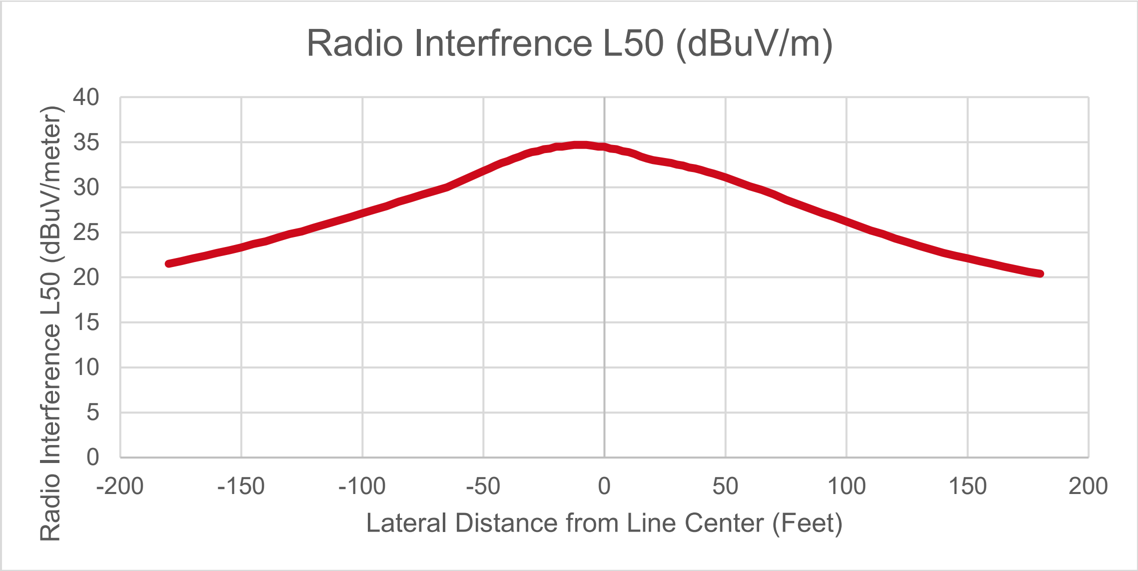

Figure 8. Radio Interference Results

3.5 Corona Loss

The conductor surface gradient and corona loss of the transmission line are calculated and summarized in Table 5.

Table 5. The Conductor Surface Gradient and Corona Loss

LINE PARAMETERS	VOLTAGE (KV)	MAXIMUM GRADIENT (KV/CM)	CORONA LOSSES (KW/MI)
Phase A	139.4	8.38	0.835
Phase B	139.4	8.36	0.824
Phase C	139.4	8.47	0.895

4 Conclusion

The results displayed in Section 3 of the report provide the electric field, magnetic field, audible noise, radio interference, and corona loss values at distances respective of the center of the line and 2 meters above the ground level. These results show that the limits described in Section 2.2 are not exceeded for the Marici Gen-Tie Line.

5 References

[1] "IEEE Standard Procedures for Measurement of Power Frequency Electric and Magnetic Fields From AC Power Lines," IEEE Std 644-1994, 1995.

[2] "IEEE Standard for Safety Levels With Respect to Human Exposure to Electromagnetic Fields, 0-3 kHz," IEEE Std C95.6-2002 , 2002.

[3] "International Commission on Non-Ionizing Radiation Protection (ICNIRP). Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz)," International Commission on Non-Ionizing Radiation Protection. Health Phys., 1998.

[4] U. S. D. o. H. a. U. D. E. P. Division., The noise guidebook: a reference document for implementing the Department of Housing and Urban Development's noise policy., Washington, D.C.: The Division., 1985.

[5] "ICES-004 — Alternating Current High Voltage Power Systems," Industry Canada, 2013.

[6] I. C. o. N.-I. R. Protection., "ICNIRP statement on the “Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz)," *Health physics 97,* vol. 3, pp. 257-258, 2009.

[7] EPRI, AC Transmission Line Reference Book—200 kV and Above, Third Edition, Institute, Electric Power Research , December, 2005.

[8] M. S. F. a. W. C. Farzaneh, Electrical design of overhead power transmission lines., McGraw-Hill Education, 2012.

Appendix A: Gen-Tie Line Information

N14601T
ENGINEERING SCOP

N14601T - CEI -
Marici 230kV Gen-Ti

Appendix B: Additional Results

(Open as text file – notepad, etc.)

Point 1

Point 2

Point 3

Appendix C: Site Plan