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August 26, 2016

Chairman Asim Haque
Ohio Power Siting Board
Public Utilities Commission of Ohio
180 East Broad Street, 11th Floor
Columbus, Ohio 43215

Re: PUCO Case No. 16-1759-EL-BLN, Request for Expedited Treatment: In the Matter of the Letter of Notification for the 5680-138kV Todhunter to Nickel Rebuild Project

Dear Chairman Haque:

Please amend the Letter of Notification referenced above to reflect the following response to Ohio Administrative Code Rule 4906-6-05(B)(9)(b):

B(9)(b) Electric and Magnetic Fields

For electric power transmission lines that are within one hundred feet of an occupied residence or institution, the production of electric and magnetic fields during the operation of the proposed electric power transmission line. The discussion shall include:

B(9)(b)(i) Calculated Electric and Magnetic Field Strength Levels

Electric and magnetic field strength calculations are shown in the report attached to this letter.

B(9)(b)(ii) Design Alternatives

A discussion of the applicant's consideration of design alternatives with respect to electric and magnetic fields and their strength levels, including alternate conductor configuration and phasing, tower height, corridor location, and right-of-way width.

Design alternatives were not considered due to electric and magnetic fields (EMF) and their strength levels. Transmission lines, when energized, generate EMF. Laboratory studies have failed to establish a strong correlation between exposure to EMF and effects on human health. However, some people are concerned that EMF have impacts on human health. Due to these concerns, EMF associated with the new circuits was calculated as set forth in the attached report. The EMF was computed assuming the highest possible EMF values that could exist along the proposed transmission line. Normal daily EMF levels will operate below these maximum load conditions.

Sincerely,

Jeanne W. Kingery
Associate General Counsel

Cc: Patrick Donlon
Raymond Strom
John Whitis
Robert Holderbaum

ELECTRIC AND MAGNETIC FIELDS

TODHUNTER TO NICKEL 138 kV REBUILD

Prepared for:

DUKE ENERGY

Prepared by:

Connect With Confidence
Commonwealth associates, inc.

ELECTRIC AND MAGNETIC FIELDS

TODHUNTER TO NICKEL 138 kV REBUILD

Prepared for:

DUKE ENERGY

Prepared by:

Stephen S. Miller, P.E.
Katherine J. Klaus

Responsible Engineer:

Richard D. Cook, P.E.
Principal Engineer
Electrical Systems

At the Offices of:
Commonwealth Associates, Inc.
P.O. Box 1124
Jackson, Michigan 49204-1124

August 24, 2016
0386.0635\300

TABLE OF CONTENTS

EXHIBITS

INTRODUCTION

Commonwealth Associates, Inc. was contracted by Duke Energy to perform calculations for Electric and Magnetic Fields for the proposed rebuild and reconductoring of the existing Todhunter to Nickel 138 kV transmission line. The transmission line extends from the Duke Todhunter 345-138 kV Substation located near Monroe, Ohio, traversing ESE for 3.35 miles to the Duke Nickel 138 kV Substation located east of I-75 on Union Road. The transmission line is within a 180 foot Right-of-way (ROW), which includes, on the north side of the ROW, an additional 69 kV transmission line. Each of these two transmission lines are centered on their own abutting 90 foot ROWs with 45 feet to the north and south Edges-of-Right-of-way (EROW) from the respective 69 and 138 kV center lines. The 69 kV line is energized from Todhunter Sub to where the ROW crosses SR 63 (Exhibits 3 and 4) and is de-energized from SR 63 to Nickel Sub and will be dismantled in the near future (Exhibits 1 and 2).

The proposed rebuild and reconductored 138 kV transmission line:

- Connects to the existing Todhunter 345-138 kV substation
- Extends 3.35 miles ESE to the Nickel 138 kV Substation
- Centered in 180 ROW
- 138 kV Phase Conductors will be upgraded to 954 kcmil ACSR Rail
- 138 kV Phase conductors are rated 1585 Amps winter normal and 1263 Amps emergency
- 69 kV Phase Conductors are 477 Pelican
- 69 kV Phase Conductors; we used a normal maximum 69 kV rating of 400 Amps
- Both the 138 kV and the 69 kV are on identical H-Frame structures
- Topped with two shield wires; one a 7#8 AWG and the other an OPGW shield wire
- Minimum for conductor height, Hmin = 34 feet
- Span-to-span conductor sag is 27 feet
- Average conductor height, Havg = 43 feet

Ohio Power Siting Board (OPSB) Chapter 4906-15-06 (2) (a) requires that applicants for electric power facilities shall calculate the electric and magnetic field strength levels for the transmission line at minimum conductor height measured at one meter above ground, both under the conductors and at the EROW for:

(i) Winter normal conductor rating (1585 Amps)
(ii) Emergency Line Loading (1263 Amps)
(iii) Normal Maximum loading (500 Amps)

The applicant shall provide a typical calculated profile of the electric and magnetic field strengths.

SUMMARY OF RESULTS

The following table describes the Electric and Magnetic Fields; giving both peak (maximum) values within the planned ROW and values at the edge of the ROW (EROW).

			138 kv Peak Inside ROW	**138 kV EROW (South)**	**69 and 138 kV Peak Inside ROW**	**69 and 138 kV EROW (South)**
		Based On	**Hmin = 34'**	**Hmin = 34'**	**Hmin = 34'**	**Hmin = 34'**
Electric Field	(kV/m)	144.9 kV	0.749	0.419	0.749	0.418
Magnetic Field – Winter Normal	(mG)	1585 Amps	146.05	48.64	142.98	49.29
Magnetic Field - Emergency	(mG)	1263 Amps	116.38	38.76	113.68	39.39
Magnetic Field - Normal	(mG)	500 Amps	46.07	15.34	44.29	15.93

CALCULATIONS

The calculations for Electric and Magnetic Fields profiles were made using the TRALIN module of the CDEGS program.

The voltage dependent Electric Field calculations were performed assuming that the line was operating at an ANSI maximum of 1.05% of nominal voltage (138*1.05 = 144.9 kV). The current dependent Magnetic Field calculations were performed assuming the phase conductors were loaded to either their winter or summer normal rated current carrying capacity (1585 or 1263 Amps respectively).

Coordinates used for calculations were based on the tangent structure and are shown below and in Exhibit 5. The first number in each set is the horizontal distance in feet from the center line of the structure/right-of-way. The second number is the lowest height above level ground for the rebuilt 138 kV line.

138 kV H-Frame Configuration

Phase C	**Phase B**	**Phase A**	**Shield Wire 1**	**Shield Wire 2**
Hmin = 34'				
(8.25', 34')	(0.00', 34')	(-8.25', 34')	(-10.39', 57.00')	(10.39', 57.00')

Note the 69 kV H-Frame configuration is identical except for being centered laterally at -90 feet (south to north) from the 138 kV H-Frame configuration.

ELECTRIC FIELD RESULTS

The High Voltage (HV) lines of the 138 kV Transmission Line create an electric field in the vicinity of the 138 kV conductors. The AC electric field reaches a maximum level of almost 0.75 kV/m under the 138 kV conductors within the ROW. Because the H-Frame configuration on the vertical poles is not symmetrically positioned relative to the ground, the electric field is also mildly asymmetrical at the measurement point one meter above ground. As shown in Exhibit 1, beyond SR 63, where the 69 kV line is de-energized, the 138 kV driven electric field at the south EROW is 0.419 kV/m and on the north EROW it is 0.034 kV/m; we reported the larger south-side value in the table on page 2. Exhibit 3 shows the results for the combined 69 and 138 kV Transmission Lines.

MAGNETIC FIELD RESULTS

The Magnetic Field for the 138 kV Transmission Line was calculated with phase conductors carrying either their full winter normal of 1585 or emergency current of 1263 or normal maximum loading of 500 Amps respectively. The current in the phase conductors of the 138 kV Transmission Line creates a magnetic field in their vicinity.

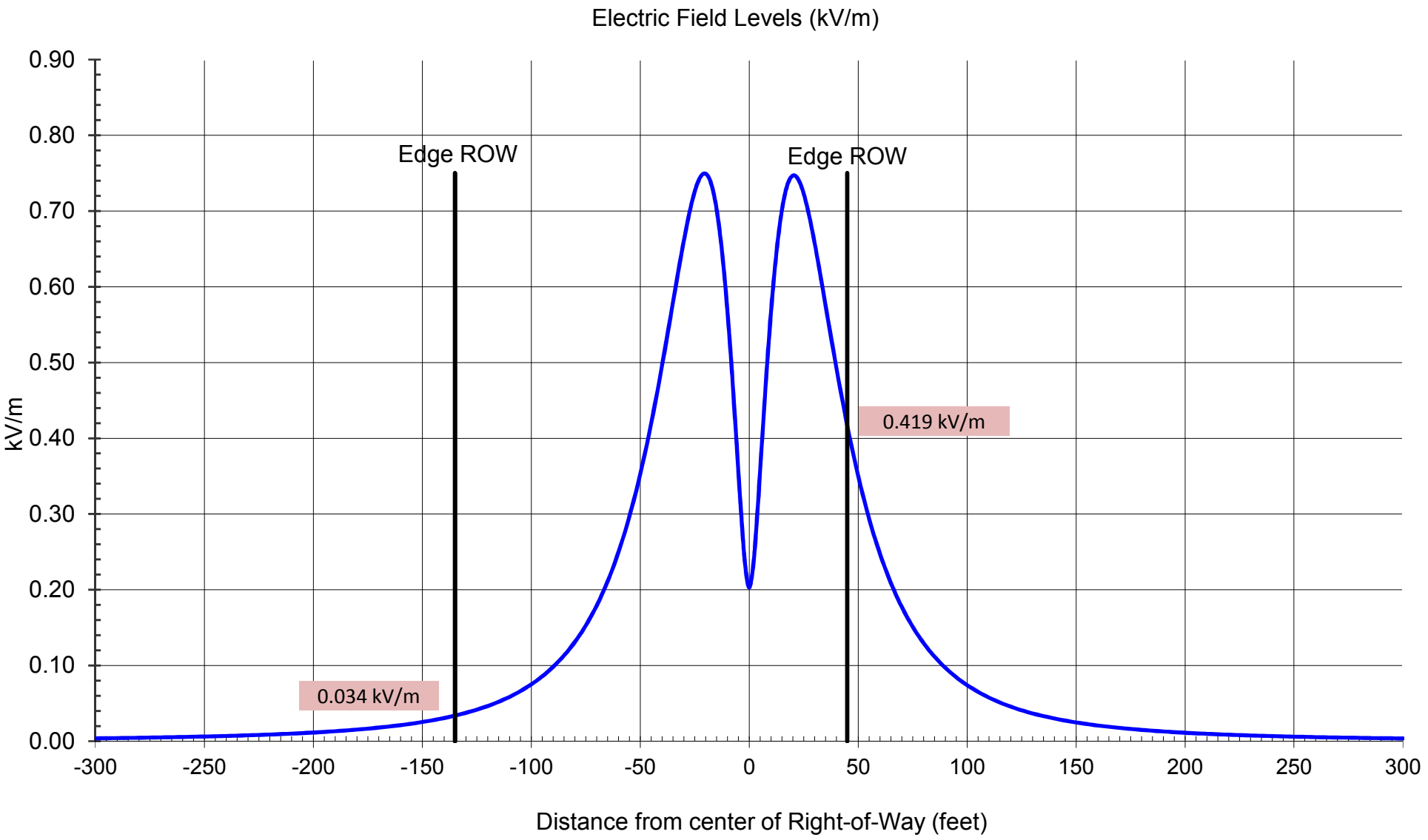
Under the 138 kV phase conductors within the ROW for the portion of the line east of SR 63 where the 69 kV circuit is de-energized (Exhibit 2), the AC magnetic field reaches a maximum level of 146 mG (milligauss) for 1585/winter normal, 117 mG for 1263/emergency loading and 46 mG for 500/normal maximum loadings. The magnetic field at the south EROW closest to the 138 kV line is 49 mG for 1585/winter normal, 39 mG for 1263/emergency and 16 mG for 500/normal maximum.

Under the 138 kV phase conductors within the ROW for the portion of the line west of SR 63 where the 69 kV circuit is energized sharing the ROW with the proposed 138 kV rebuild (Exhibit 4), the AC magnetic field reaches a maximum level of 143 mG (milligauss) for 1585/winter normal and 114 mG for 1263/emergency loading and 45 mG for 500/normal maximum loadings. The magnetic field at the south EROW closest to the 138 kV line is 50 mG for 1585/winter normal, 40 mG for 1263/emergency and 16 mG for 500/normal maximum.

EXHIBIT 1

138 kV Electric Field Profile

Exhibit 1
138 kV Transmission Line H-Frame
Rail



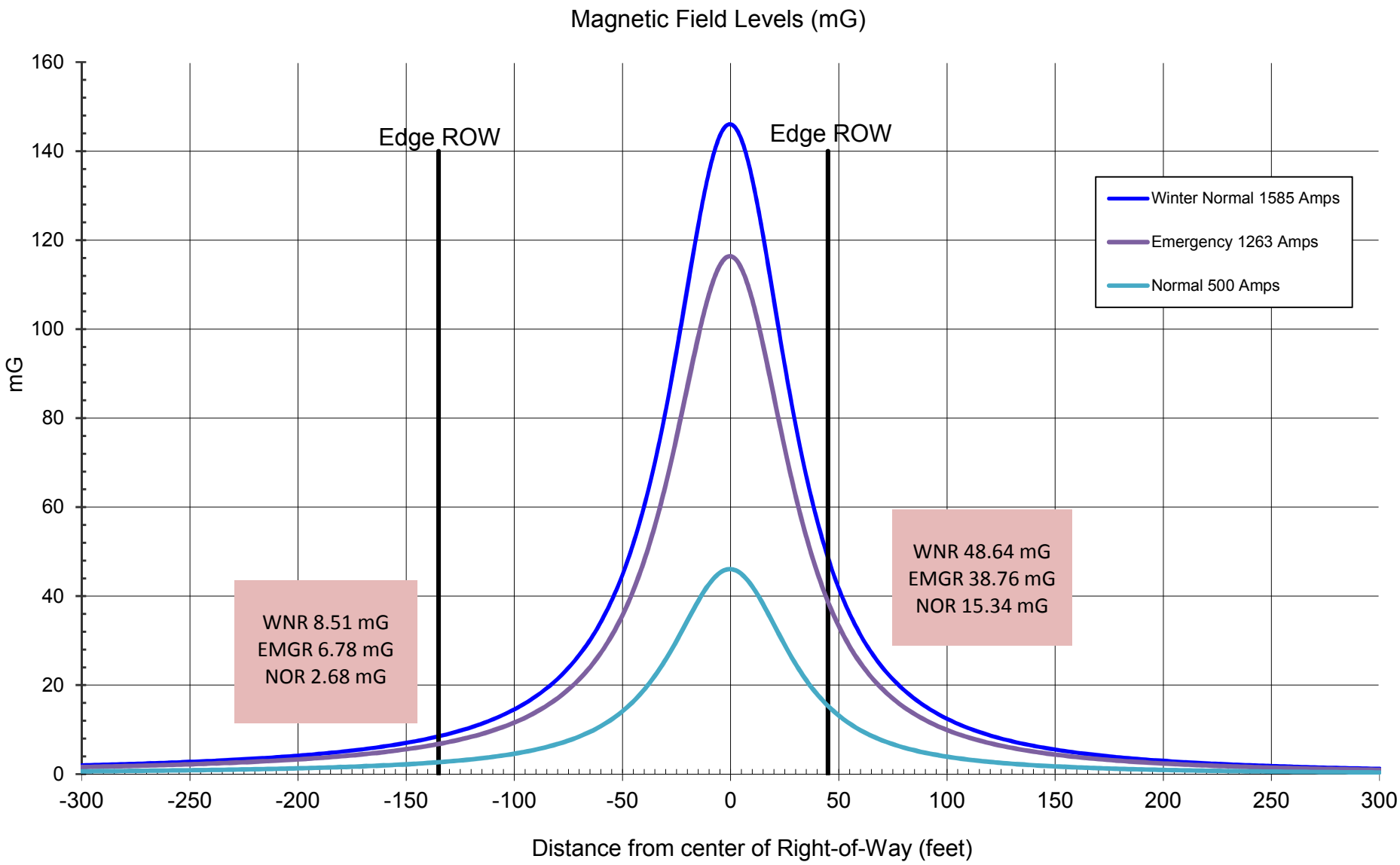
T:\DATA\From Shared RDC\Duke\EMF\Exhibit 1.xls

Commonwealth Associates, Inc.

EXHIBIT 2

138 kV Magnetic Field Profile

Exhibit 2
138 kV Transmission Line H-Frame
Rail



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Commonwealth Associates, Inc.

EXHIBIT 3

69 kV and 138 kV Electric Field Profile

Exhibit 3
69 kv Pelican ACB and
138 kV Rail ABC Transmission Line H-Frame

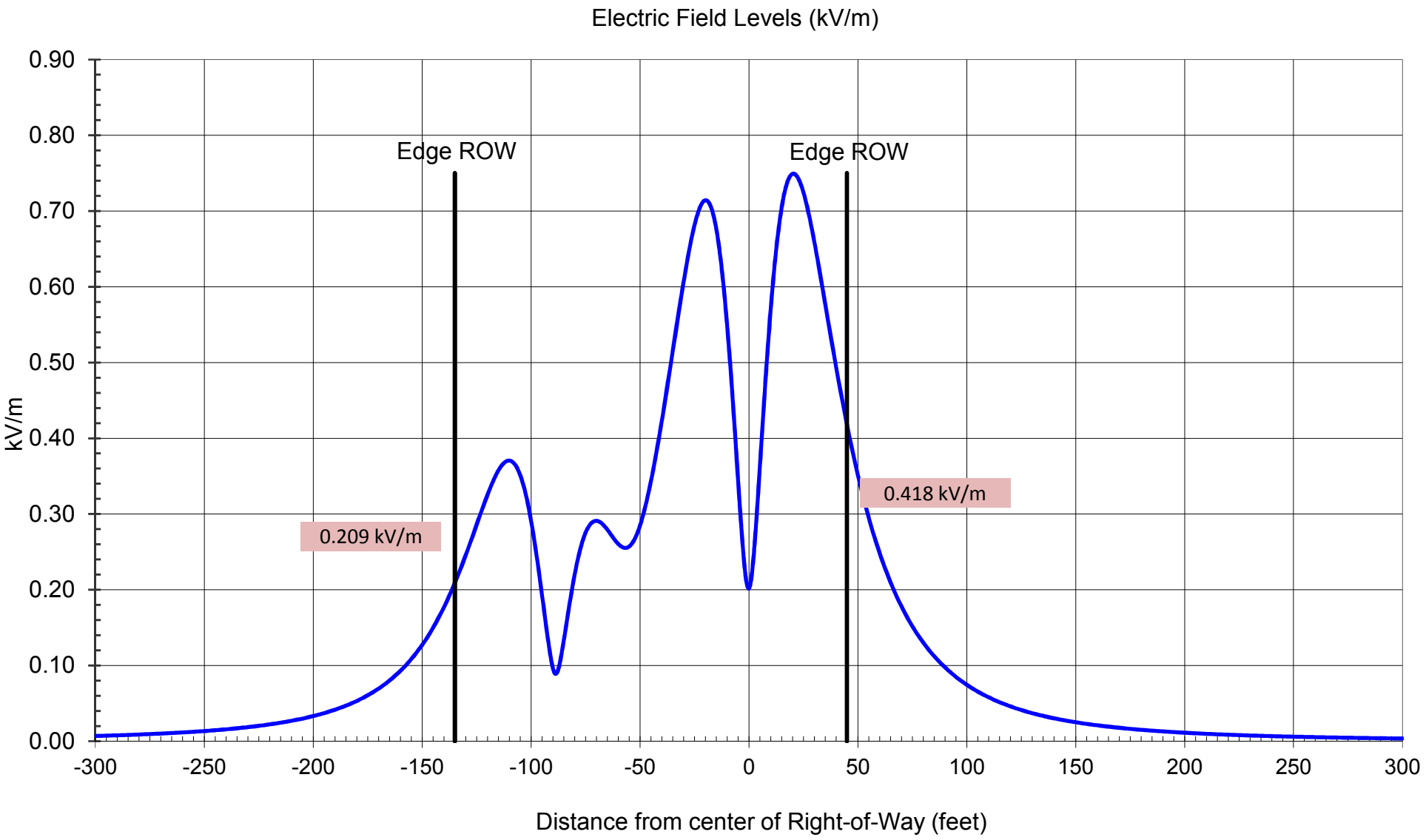
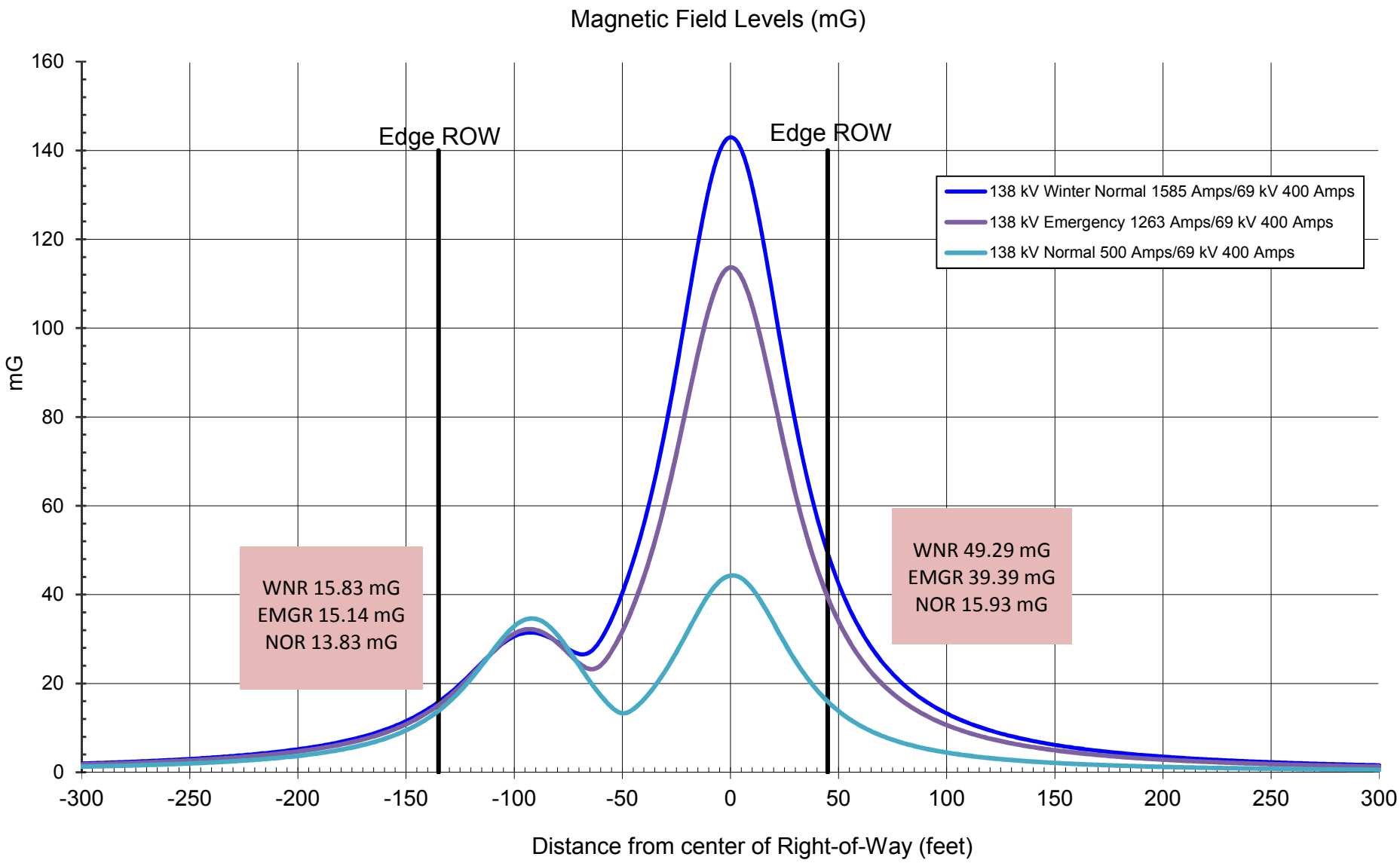


EXHIBIT 4

69 kV and 138 kV Magnetic Field Profile

Exhibit 4
69 kV Pelican ACB and
138 kV Rail ABC Transmission Line H-Frame



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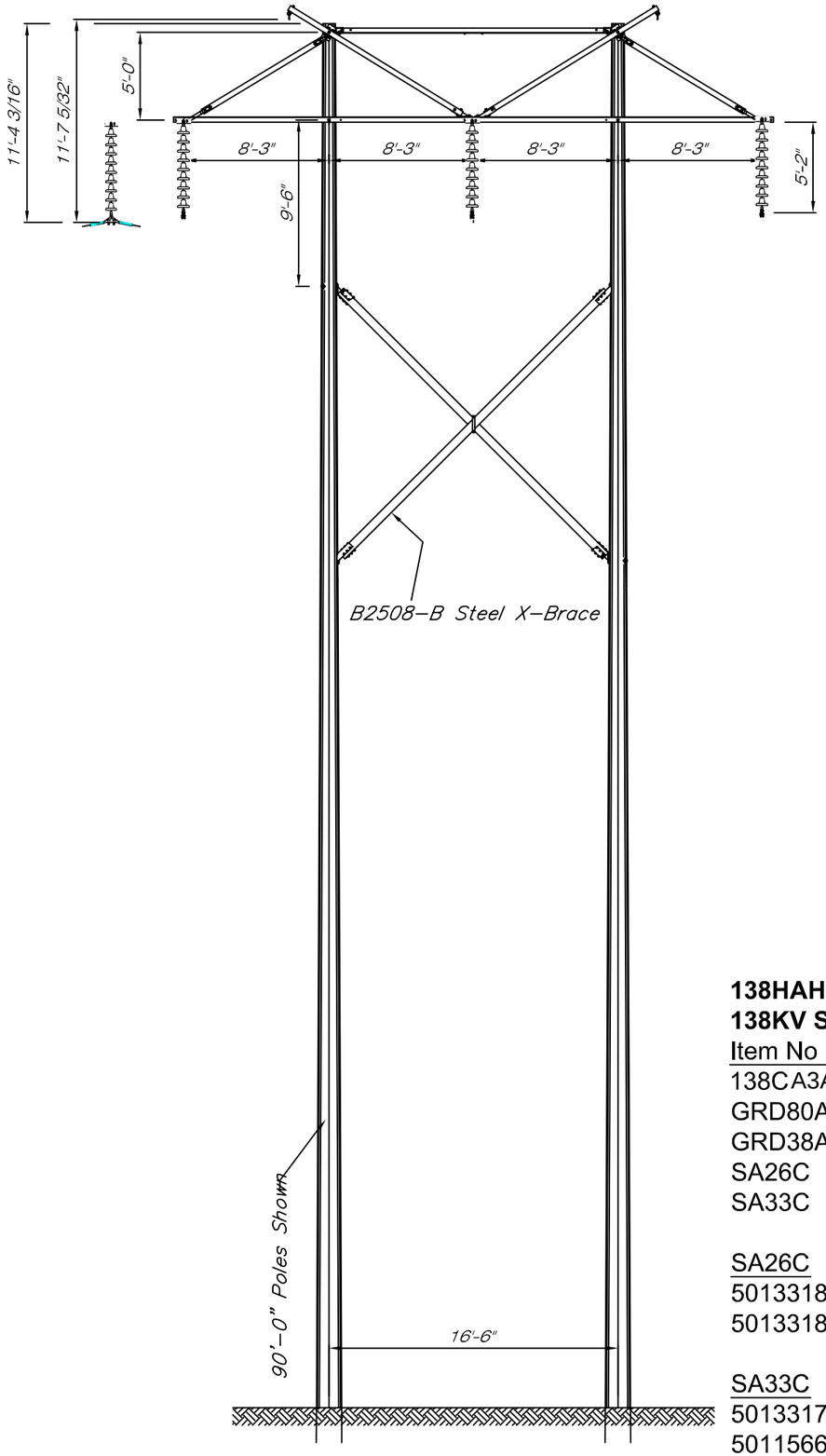
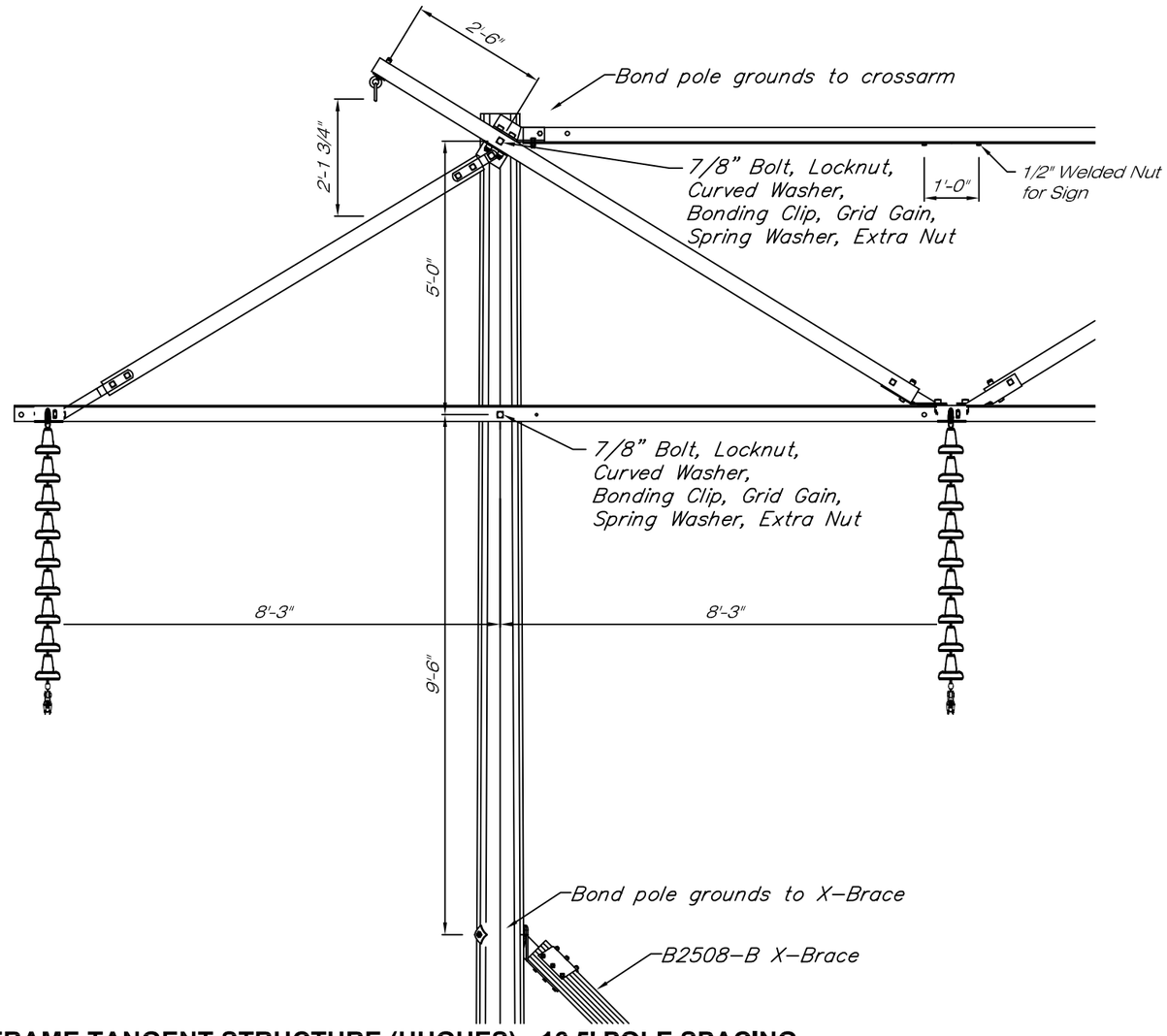
Commonwealth Associates, Inc.

EXHIBIT 5

138 kV and 69 kV Transmission H-Frame Configuration





138HAH2B

138KV STEEL H FRAME TANGENT STRUCTURE (HUGHES) - 16.5' POLE SPACING

Item No	Quanity	Description
138CA3A	3	138KV Suspension Insulator Assembly
GRD80A	2	Overhead Ground Wire Suspension Assembly
GRD38A	1	Structure Grounding for 138KV / 230KV "H" Frame Structures
SA26C	1	138KV Single Steel H frame truss assembly
SA33C	1	138KV Steel "X" brace for 16.5' pole spacing H frame structure

SA26C

50133184	1	Assy:Steel truss,16.5' spacing
50133187	1	Kit, Steel truss mounting, 138KV, 16.5' spacing

SA33C

50133176	1	Brace, X, Steel, 6" X 4" X 3/16"
50115666	1	Kit, X-Brace Mounting Hardware

Duke Energy®

INDEX **138kV H-Structure- 16.5' Pole spacing**

DETAIL **138kV H-Structure using Hughes Bros. Steel Crossarm Truss C4676-P and B2508-B X-Brace**

DATE **06/21/09** | LOCATION **Lafayette, IN/Various**

DRAWN | ENGINEER

ELECTRIC TRANSMISSION & DISTRIBUTION LINE ENGINEERING

Sheet #1 of 1

DWG NO **36879**