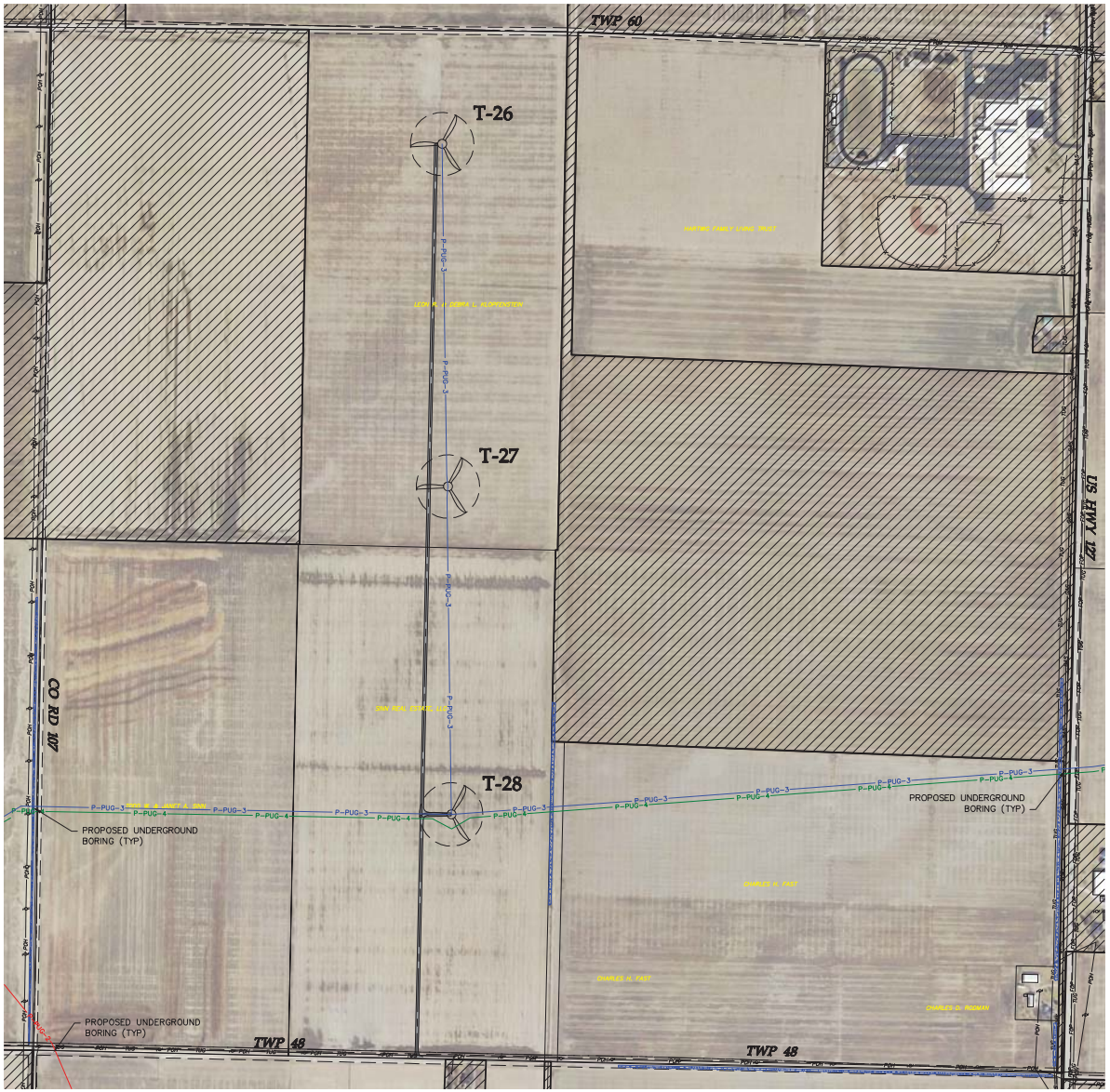

LEGEND

- TURBINE LOCATION
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- P-PUG-1 — PROPOSED CIRCUIT 1
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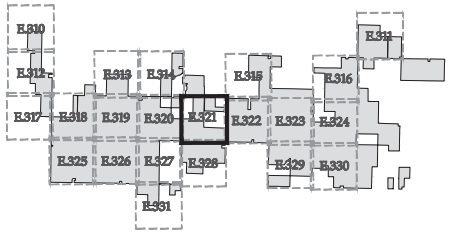
- P-PUG-3 — PROPOSED CIRCUIT 3
- P-PUG-4 — PROPOSED CIRCUIT 4
- DELINEATED WETLAND
- NON-PARTICIPATING PROPERTY



KEY MAP

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Fax (952) 937-5822 Eden Prairie, MN 55344
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Drawn:	MC
As-Built Drawing:	

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3900 E. White Ave
Clinton, IN 47842

Trishe Wind Ohio, LLC
c/o Starwood Energy Group, LLC
5 Greenwich Office Park, 2nd Floor
Greenwich, CT 06831

0' 300' 600' 900'

Northwest Ohio Wind Project

Paulding County, Ohio

Electrical Site Plan

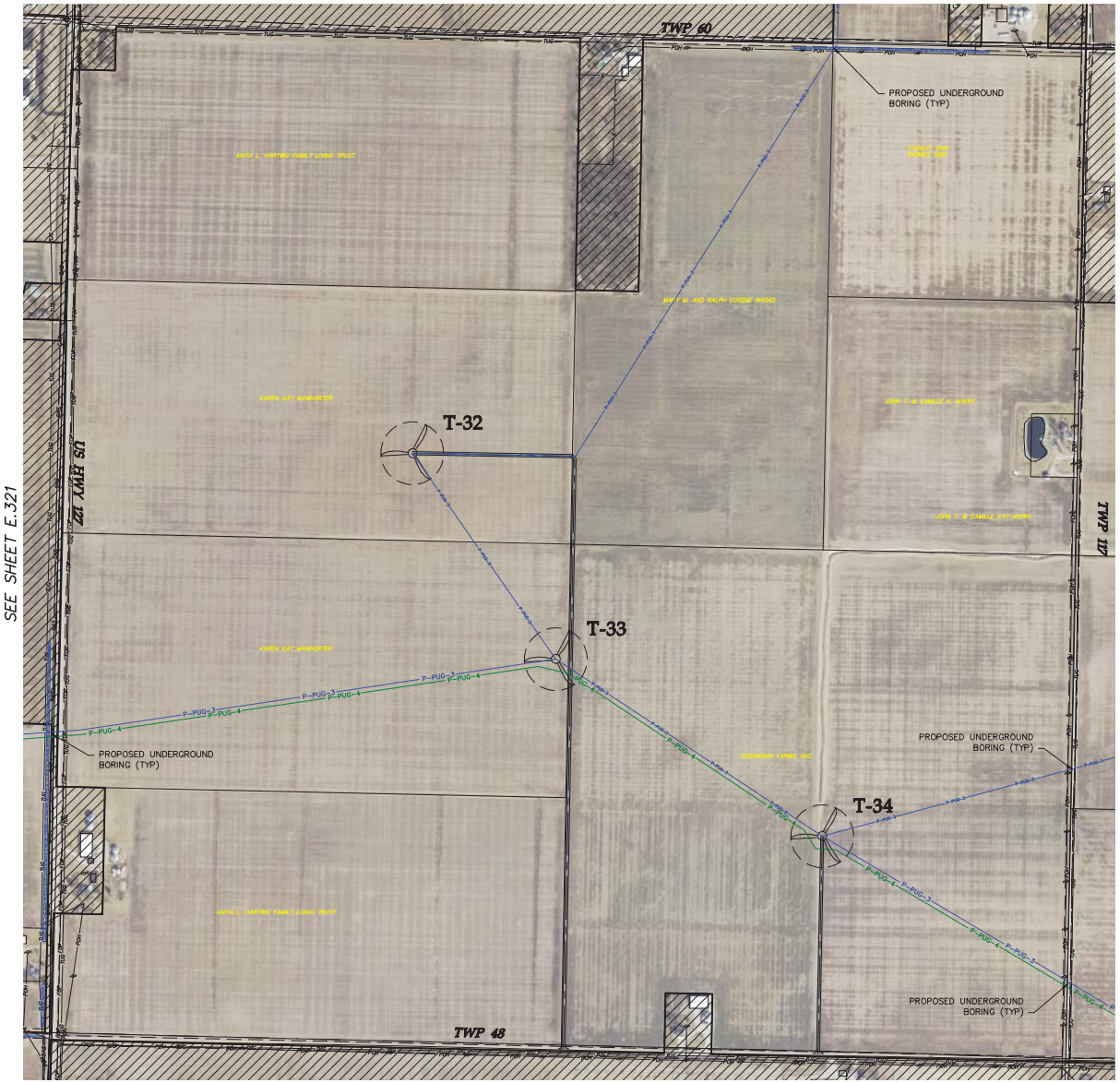
Not For Construction

Array Date: 09/14/2017

Date: 09/27/17

Sheet: E.321

0007186_Electrical Site Plans.dwg



LEGEND

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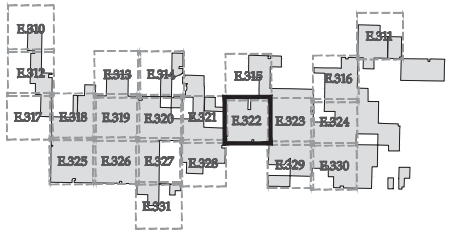

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Sheet: E.322

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LEGEND

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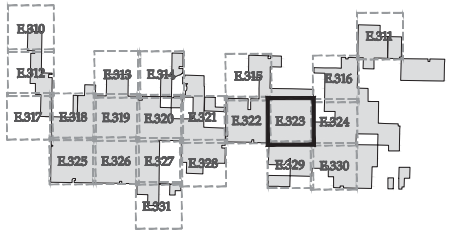
- T-XX — TURBINE NUMBER
- P-PUG-1 — PROPOSED CIRCUIT 1
- P-PUG-2 — PROPOSED CIRCUIT 2
- P-PUG-3 — PROPOSED CIRCUIT 3
- P-PUG-4 — PROPOSED CIRCUIT 4
- DELINEATED WETLAND
- NON-PARTICIPATING PROPERTY



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Electrical Site Plan

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Array Date: 09/14/2017

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Sheet: E.323

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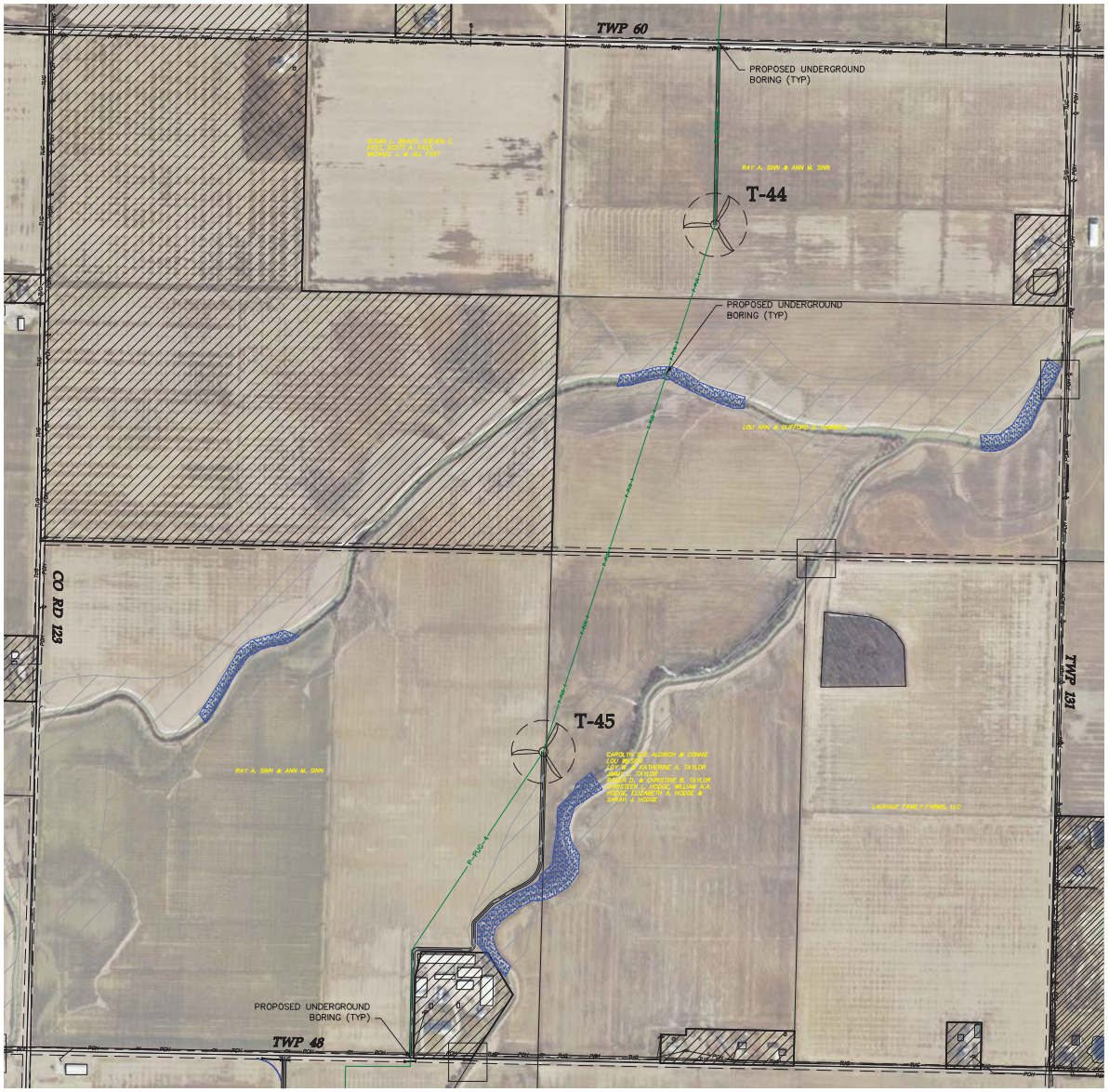

LEGEND

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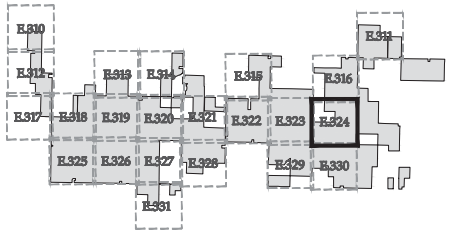

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Drawn:	JMC
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Electrical Site Plan

Not For Construction

Array Date: 09/14/2017

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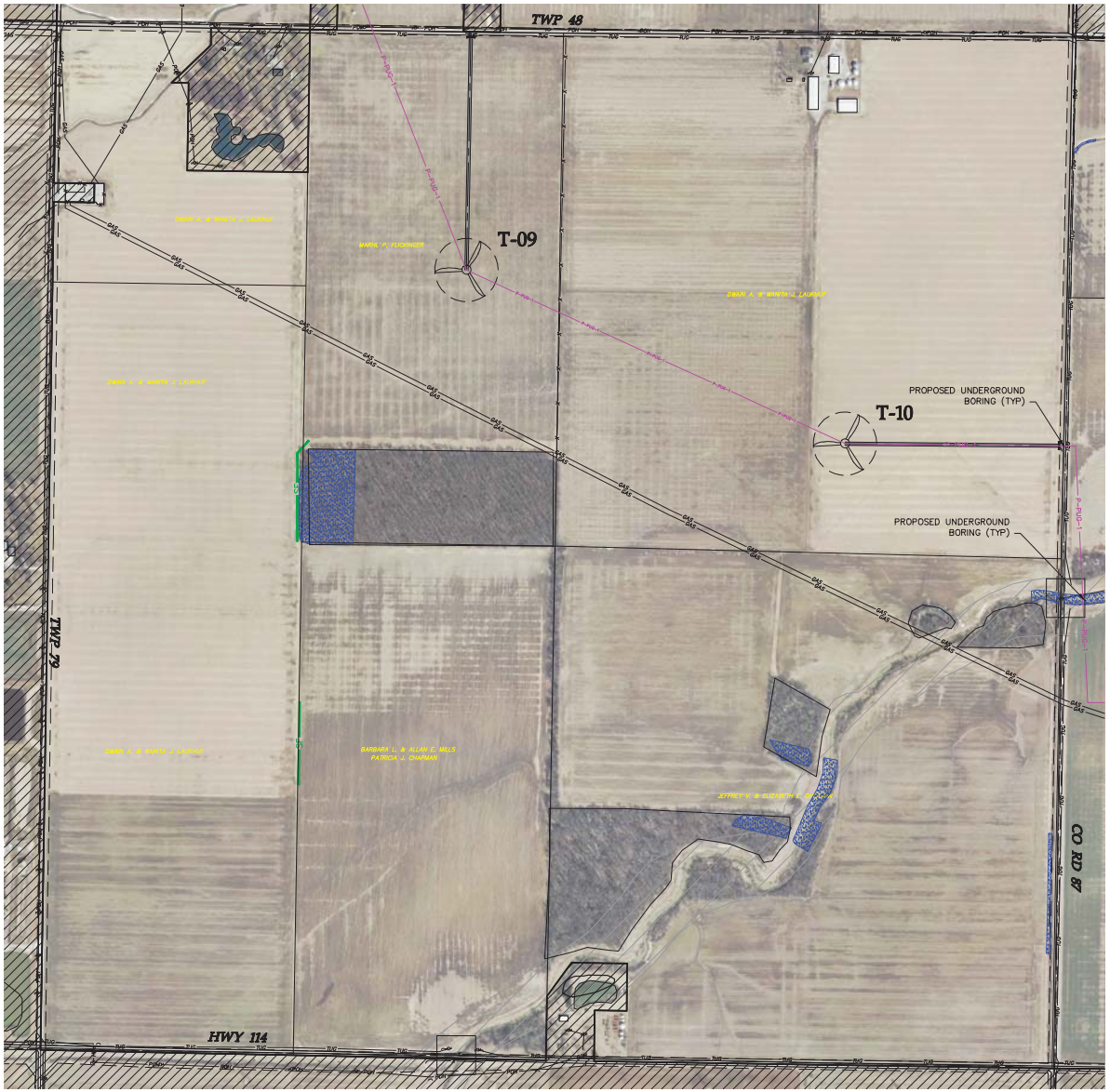
Sheet: E.324

0007186_Electrical Site Plans.dwg



LEGEND

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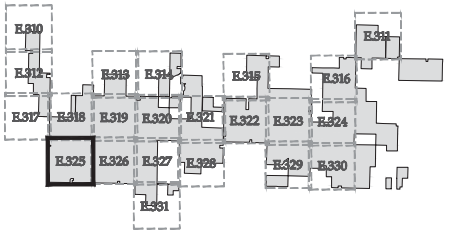

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Paulding County, Ohio

Electrical Site Plan

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Array Date: 09/14/2017

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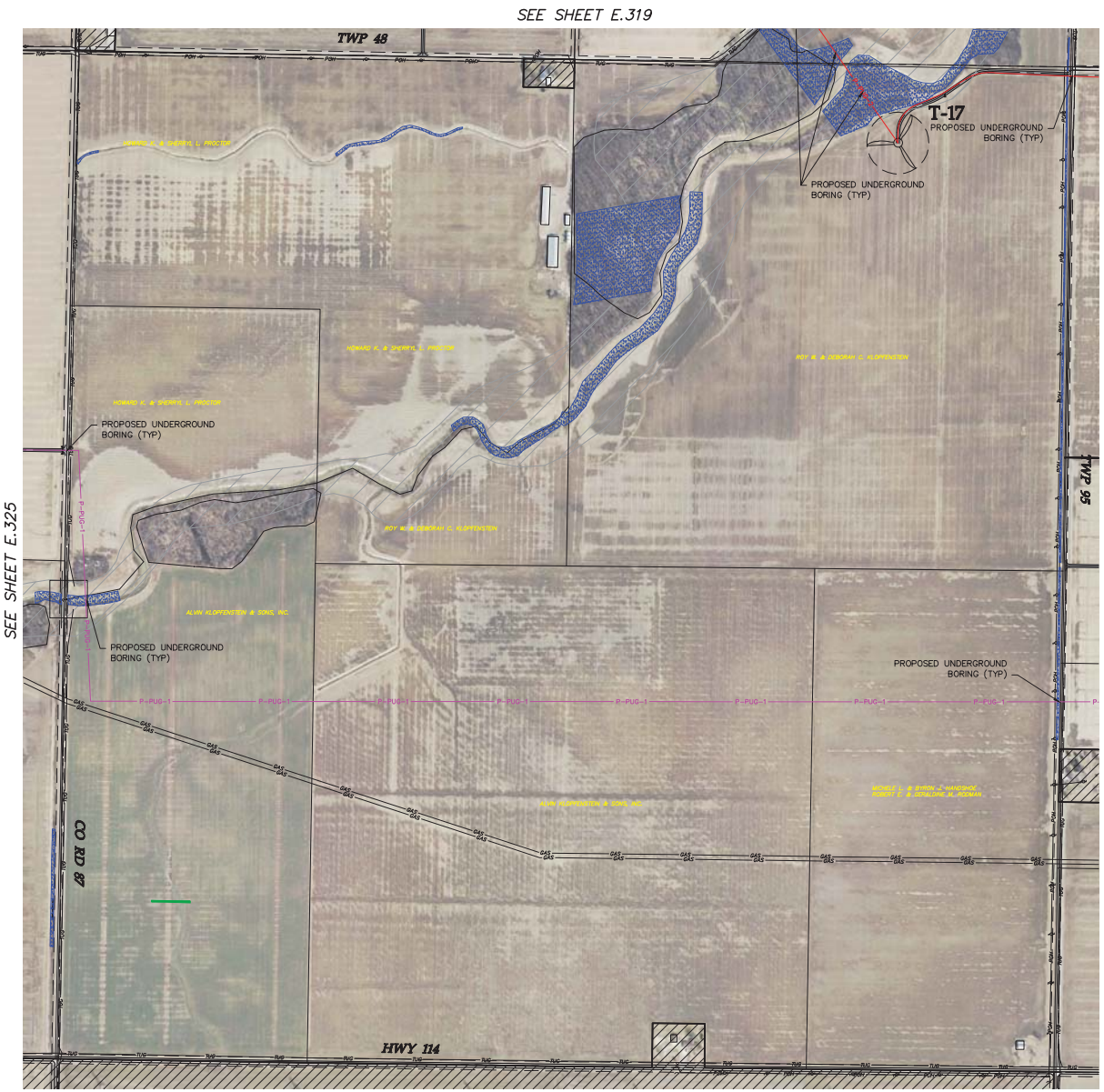

LEGEND

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- P-PUG-1 — PROPOSED CIRCUIT 1
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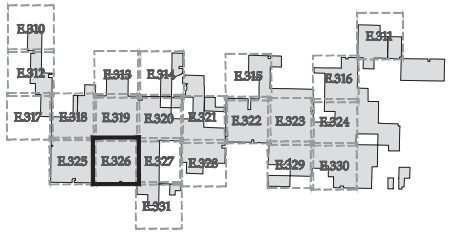

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Paulding County, Ohio

Electrical Site Plan

Not For Construction

Array Date: 09/14/2017

Date: 09/27/17

Sheet: E.326

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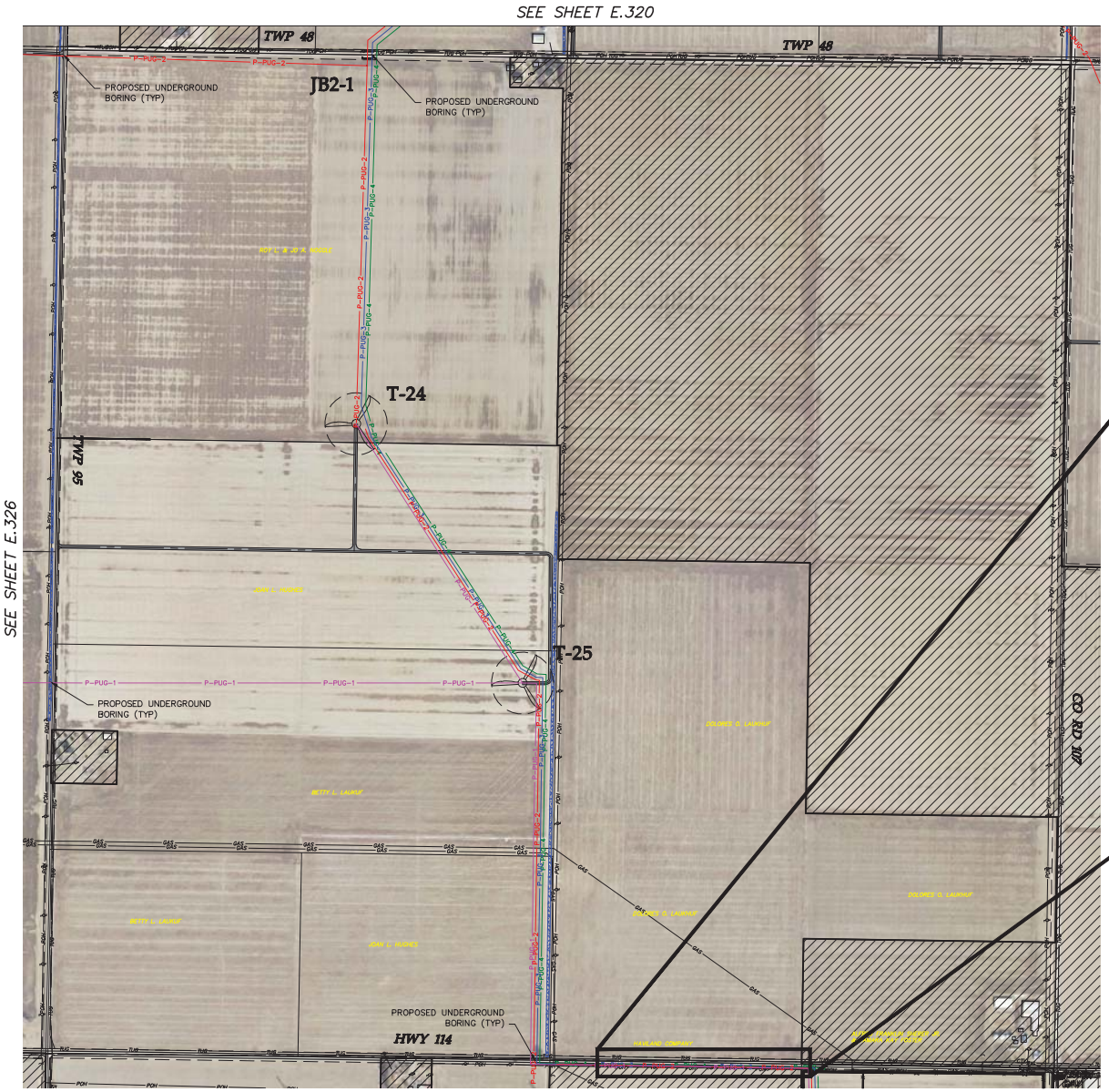

LEGEND

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- P-PUG-3 — PROPOSED CIRCUIT 3
- P-PUG-4 — PROPOSED CIRCUIT 4
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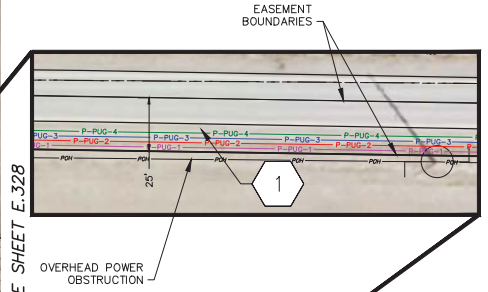
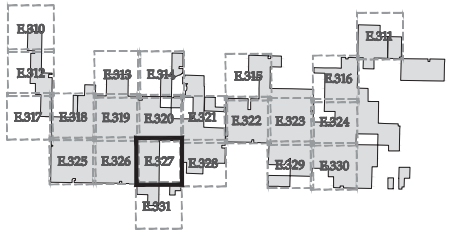
KEY NOTES

1. 34.5KV COLLECTOR CIRCUITS 1,2,3 AND 4 CONTAINED WITHIN 25' EASEMENT ON SOUTH SIDE OF HWY 114 FOR EAST TO WEST RUN.





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Checked: AMS
Drawn: MC
As-Built Drawing:

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Paulding County, Ohio

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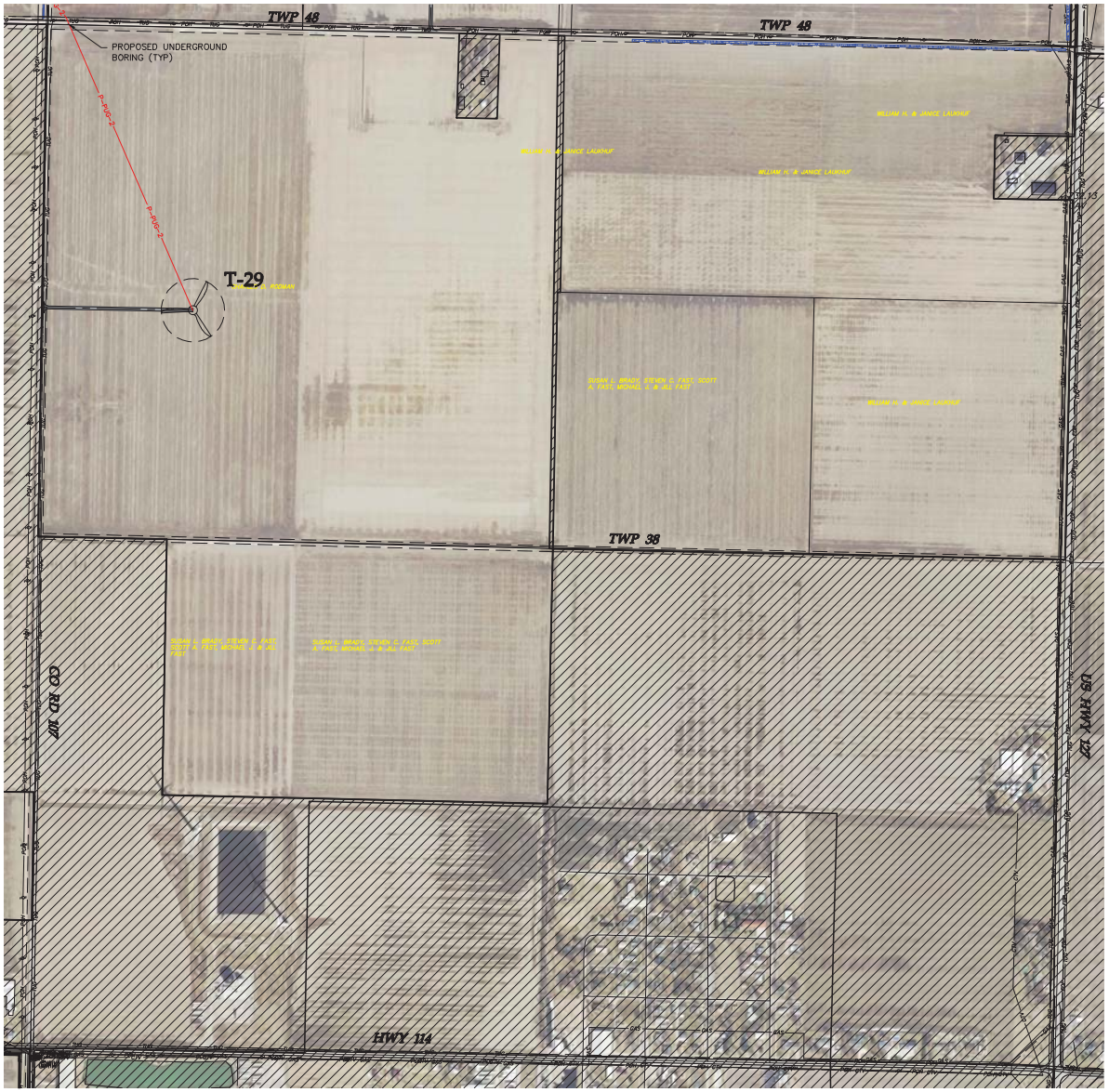
Array Date: 09/14/2017
Date: 09/27/17
Sheet: E.327

0007186_Electrical Site Plans.dwg

SEE SHEET E.321



SEE SHEET E.327

LEGEND

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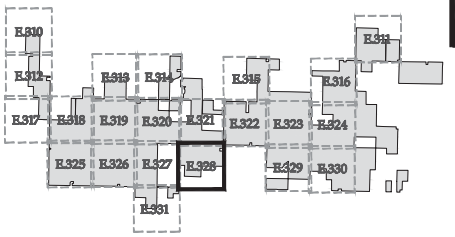

KEY MAP

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Checked:	AMS
Drawn:	MC
As-Built Drawing:	

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Clinton, IN 47842

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c/o Starwood Energy Group, LLC
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Greenwich, CT 06831

N

0' 300' 600' 900'

Northwest Ohio Wind Project

Paulding County, Ohio

Electrical Site Plan

Not For Construction

Array Date: 09/14/2017

Date: 09/27/17

Sheet: E.328

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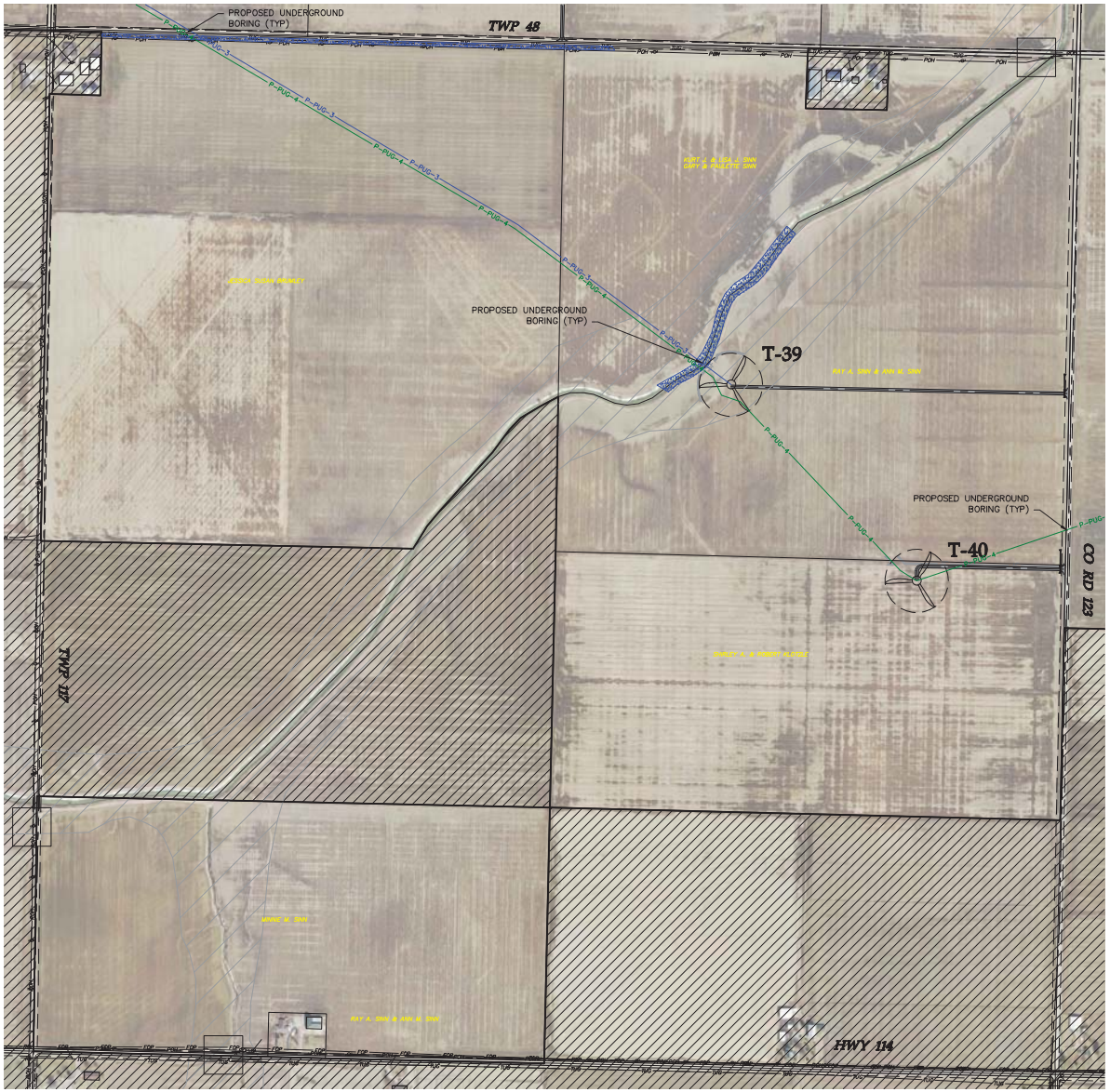

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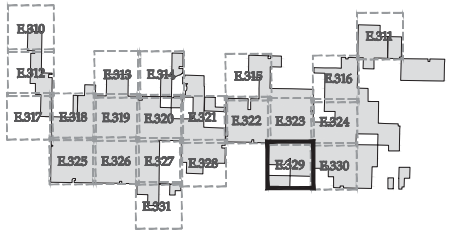

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Electrical Site Plan

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Array Date: 09/14/2017

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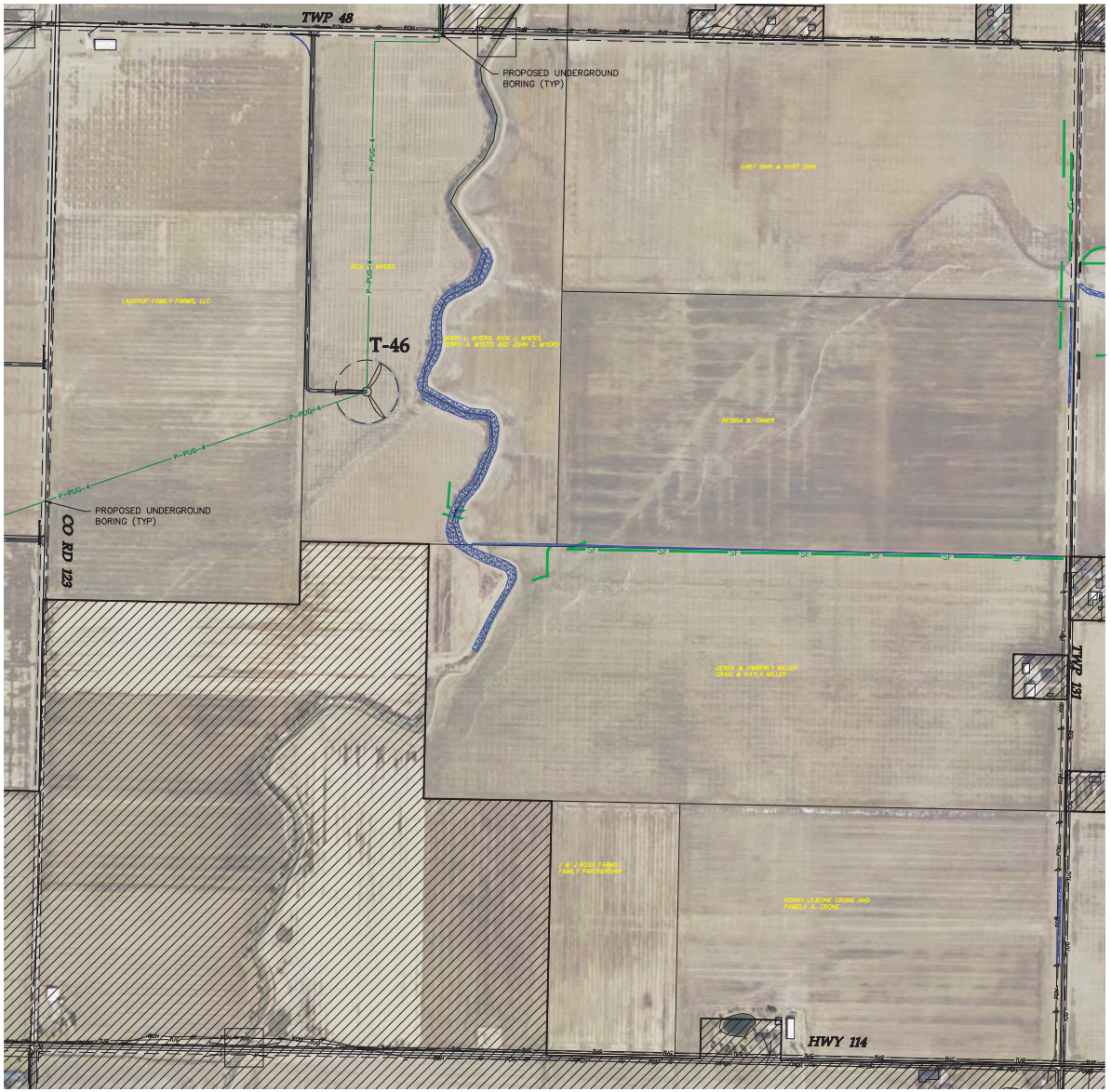

LEGEND

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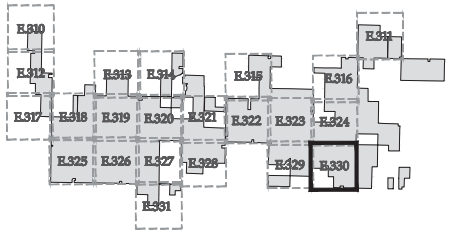

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Paulding County, Ohio

Electrical Site Plan

Not For Construction

Array Date: 09/14/2017

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Sheet: E.330

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LEGEND

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KEY MAP

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As-Built Drawing:	

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Electrical Site Plan

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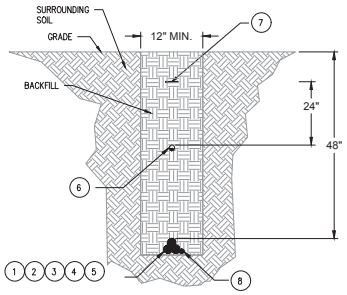

1 Typical MVAC & FO Trench
NTS

MATERIAL LIST

ITEM	QTY	UNIT	DESCRIPTION		
1	A/R	FT	CABLE, 35 KV URD 1/0 AWG AL, 2/3 CN – 11 #14 CU		
2	A/R	FT	CABLE, 35 KV URD 4/0 AWG AL, 1/2 CN – 15 #12 CU		
3	A/R	FT	CABLE, 35 KV URD 500 KCMIL AL, 1/3 CN – 16 #12 CU		
4	A/R	FT	CABLE, 35 KV URD 1000 KCMIL AL, 1/6 CN – 16 #12 CU		
5	A/R	FT	CABLE, 35 KV URD 1250 KCMIL AL, 1/6 CN – 20 #12 CU		
6	A/R	FT	CABLE, 12 COUNT SM (9/125) FIBER OPTIC, IN 1.25" LOOSE TUBE INNERDUCT		
7	A/R	FT	UG UTILITY RED WARNING TAPE		
8	A/R	FT	⅞ COPPER CLAD STEEL, 40% CONDUCTIVITY		

GENERAL NOTES

1. EACH CIRCUIT CONSISTS OF 3–1/0 AWG AL, 4/0 AWG AL, 500 KCMIL AL, 750 KCMIL AL, 1000 KCMIL AL, OR 1250 KCMIL AL MEDIUM VOLTAGE CABLES (1 PER PHASE).
2. EXCLUDE HEAVY STIFF CLAY, ROCKS, OR OTHER UNDERSTANDABLE BACKFILL WITHIN 12 INCHES OF CABLES
3. POWER CABLES INSTALLED IN TRIPLEX CONFIGURATION.
4. COMPACT NATIVE SOIL TO BE (TBD) STANDARD PROCTOR DENSITY FOR ALL TRENCH WORK UNLESS OTHERWISE SPECIFIED.
5. NO ENGINEERED BACKFILL REQUIRED.
6. WARNING TAPE TO HAVE WHITE TEXT STATING "CAUTION BURIED HIGH VOLTAGE LINE BELOW".

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Drawn: MC
As-Built Drawing:

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Paulding County, Ohio

Medium Voltage Trench Details

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Array Date: 09/14/2017
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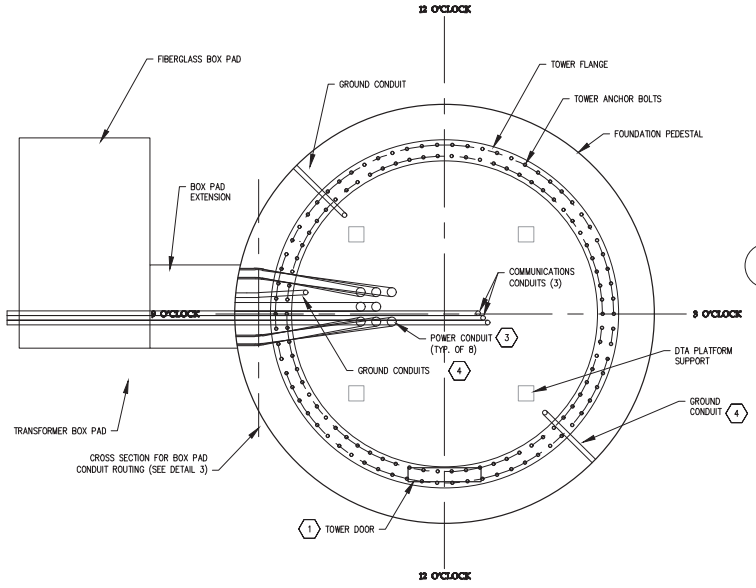
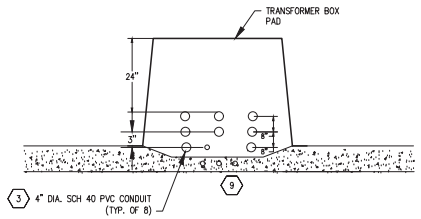
Sheet: E400

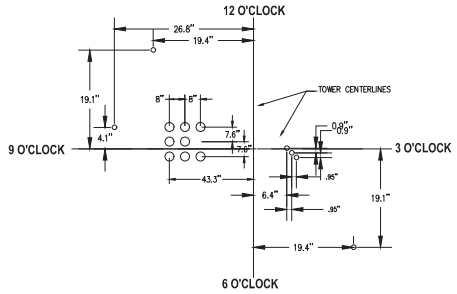
0007186_E400_Trench Details.dwg



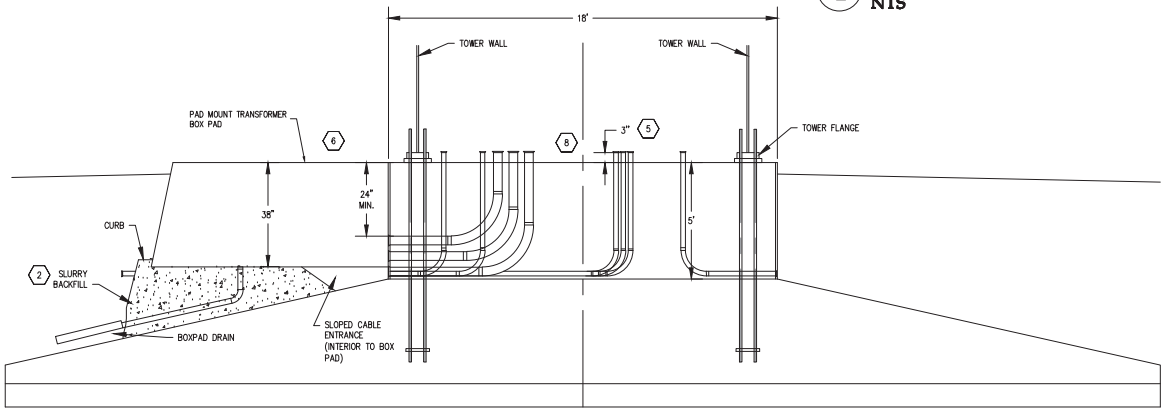
1 Plan View - Turbine Conduits
NTS



3 Section View - Conduit Arrangement
NTS



4 Plan View - Conduit Layout
NTS



2 Section View - Foundation Elevation
NTS

MATERIAL LIST

ITEM	QTY	UNITS	DESCRIPTION		
1	80	FT	4" PVC CONDUIT SCH. 40		
2	110	FT	2" PVC CONDUIT SCH. 40		
3	8	EA	4" PVC CONDUIT SCH. 40, 90 DEGREE SWEEP, 24" RADIUS		
4	6	EA	2" PVC CONDUIT SCH. 40, 90 DEGREE SWEEP, 12" RADIUS		
5	16	EA	4" PVC COUPLING		
6	12	EA	2" PVC COUPLING		
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					

GENERAL NOTES

1. PREVENT CONCRETE FROM ENTERING ALL OPEN CONDUIT ENDS.
2. ALL SPARE CONDUITS SHOULD BE SEALED WITH FLAME RETARDED FOAM AND CAPPED. ALL FLOATING CONDUCTORS IN CONDUIT SHALL BE ENCAPSULATED IN FLAME RETARDED FOAM TO PREVENT RODENT AND MOISTURE DAMAGE. FOAM SHALL BE INSTALLED IN A NEAT AND WORKMAN LIKE MANNER.
3. FOR BOXPAD DRAIN, INSTALL PERFORATED 6" SCH. 40 PVC SUMP SURROUNDED BY 6" OF CLEAN UNIFORM 2" WASHED STONE INSIDE OF GEOFABRIC.
4. ALL CONDUIT ENDS TO BE FITTED WITH BELL ENDS.

KEY NOTES

1. CENTER OF TOWER DOOR AT 6 O'CLOCK POSITION (FACING ACCESS ROAD).
2. SLURRY BACKFILL – 1000 PSI, 8 INCH SLUMP. FILL TO 2 INCHES ABOVE BOX PAD FLANGE. TOP OF SLURRY SHALL BE FLUSH WITH TOP OF DRAIN PIPE/CAP TO PREVENT WATER FROM ACCUMULATING WITHIN BOX PAD.
3. RUN ONE SET PHASE CONDUCTORS A,B,C, AND NEUTRAL IN EACH OF THE EIGHT 4 INCH CONDUITS.
4. SEE TURBINE GROUNDING SHEET E.411 FOR ADDITIONAL GROUNDING INSTRUCTIONS.
5. THE CONDUITS SHALL BE TRIMMED TO WITHIN 3 INCH OF THE TOP OF THE CONCRETE SURFACE NO LATER THAN 2 DAYS AFTER THE INSTALLATIONS OF CONCRETE. DEBUR THE ENDS OF THE CONDUIT. SLOPE ALL CONDUIT TOWARDS THE OUTSIDE OF THE FOUNDATION AT APPROXIMATELY A 2% SLOPE.
6. THE TRANSFORMER BOX PAD SHALL BE SET SO THAT THE FACE OF THE EXTENSION IS FLUSH WITH THE TOP EDGE OF THE PEDESTAL.
7. THE TRANSFORMER VAULT DRAIN MUST BE INSTALLED WITH DRAIN CAP FLUSH WITH TOP OF SLURRY MAT.
8. TOWER DRAIN PIPE LOCATION TBD
9. COMMUNICATION CONDUITS INSTALLED IN SLURRY BACKFILL. TWO COMMUNICATION CONDUITS TYPICALLY REQUIRED. THREE CONDUITS REQUIRED AT TURBINES 07, 15, 22, 25, 28, 33, 34 AND 49.

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Designed: RV
Checked: AMS
Drawn: MC
As-Built Drawing:

Revisions
#	DATE	DESCRIPTION
A	09/27/17	30% plans

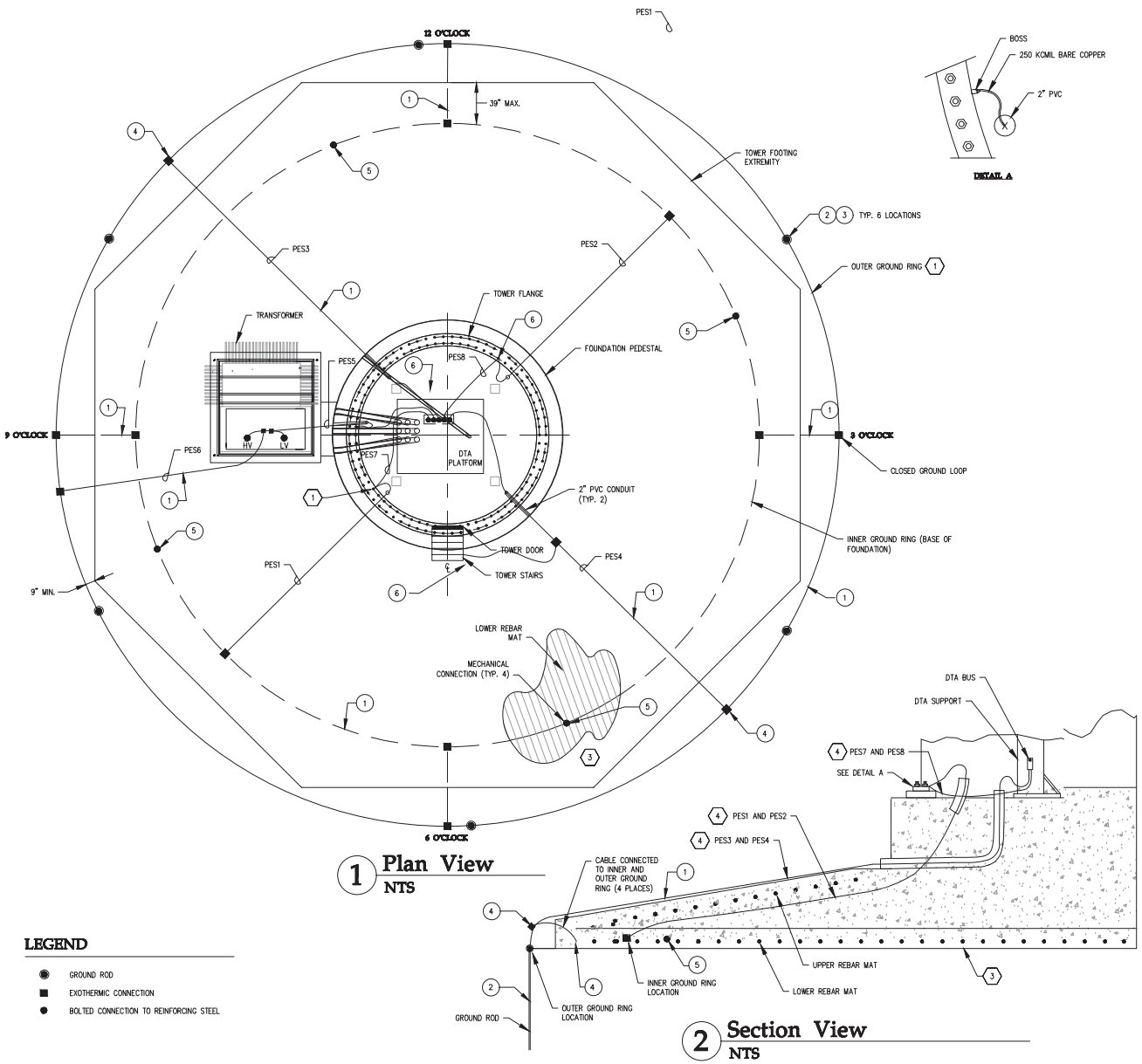
Prepared for:
WHITE an @IEA company
3900 E. White Ave
Clinton, IN 47842

Trishe Wind Ohio, LLC
c/o Starwood Energy Group, LLC
5 Greenwich Office Park, 2nd Floor
Greenwich, CT 06831

Northwest Ohio Wind Project
Paulding County, Ohio

Below Grade Work GE
2.5-116 Turbines

Not For Construction
Array Date: 09/14/2017
Date: 09/27/17
Sheet: E.410
0007186_E400_Turbine Conduit and Gnd.dwg



1 Plan View
NTS

2 Section View
NTS

LEGEND

- GROUND ROD
- EXOTHERMIC CONNECTION
- BOLTED CONNECTION TO REINFORCING STEEL

MATERIAL LIST

ITEM	QTY	UNITS	DESCRIPTION		
1	590	FT	250 KCMIL BARE CU WIRE		
2	6	EA	GROUND ROD, 5/8" X 8', 13 MIL CU CLAD		
3	6	EA	EXOTHERMIC CONNECTOR 5/8" CU ROD TO 250 KCMIL BARE CU		
4	16	EA	EXOTHERMIC CONNECTOR 250 KCMIL BARE CU TO 250 KCMIL BARE CU		
5	4	EA	BOLTED CONNECTOR, #10 REBAR TO 250 KCMIL BARE CU		
6	8	EA	COMPRESSION LUG, 250 KCMIL CU TO 1 HOLE		

GENERAL NOTES

1. PROVIDE SUFFICIENT CONDUCTOR LENGTH SO CONNECTORS CAN BE MADE WITH SLACK.
2. INSTALL GROUND GRID AS SHOWN. OUTER GROUND RING TO BE INSTALLED AT BASE OF FOUNDATION. PROVIDE EXOTHERMIC WELD CONNECTIONS FOR ALL GROUND ROD AND GROUNDING CABLE CONNECTIONS EXCEPT WHERE NOTED.
3. AFTER INSTALLATION OF GRID AND PRIOR TO CONNECTION OF COLLECTOR CABLES, MEASURE GROUND/EARTH GRID RESISTANCE. IF RESISTANCE IS GREATER THAN 10 OHMS, INSTALL ADDITIONAL GROUND GRID IN 10 FEET SUCCESSIVE STEPS CONCENTRIC FROM PREVIOUS GRID. CONNECT TO PREVIOUS SECTION AT FOUR LOCATIONS AND INSTALL FOUR GROUND RODS WITH EACH SECTION.
4. REMOVE PAINT COATINGS, IF PRESENT, AT ALL GROUND CONNECTION LOCATIONS.
5. CONDUIT STUB OUTS NEAR TOWER FLANGE TO BE 6 INCH FROM FLANGE (EDGE TO EDGE).
6. GROUND CABLE IS PERMITTED TO LAY ON FOUNDATION.

KEY NOTES

(1) GROUNDING CABLE CONNECTING INNER GROUND LOOP TO INTERIOR TOWER FLANGE – TYPICAL 2 LOCATIONS (SEE DETAIL A).

(2) ALL GROUNDING CABLES SHALL BE 250 KCMIL BARE COPPER.

(3) MECHANICALLY BOLT INNER GROUNDING RING TO BOTTOM REINFORCING STEEL MAT OF FOUNDATION (NO EXOTHERMIC WELDS). USE FOUR EQUALLY SPACED CONNECTIONS.

(4) PES1 AND PES2:
CONNECTS THE GROUNDING RING INSIDE THE FOUNDATION (CONNECTED TO THE BOTTOM REINFORCING BARS) TO THE INTERIOR TOWER BASE FLANGE BOSSES.
PES3 AND PES4:
CONNECTS THE DTA PLATFORM BUS BAR TO THE OUTER GROUND RING LOCATED IN THE SOIL. ISOLATE PES3 AND PES4 FROM THE CONCRETE AND REINFORCING BARS BY INSTALLING THEM INSIDE 2" SCH. 40 PVC DUCTS.
PES5:
CONNECTS THE PADMOUNT TRANSFORMER GROUND BUS WITH THE DTA PLATFORM BUS BAR.
PES6:
CONNECTS THE GROUNDING RING OUTSIDE THE FOUNDATION TO THE TRANSFORMER GROUND.
PES7 AND PES8:
CONNECTS THE DTA PLATFORM BUS BAR TO TOWER INTERIOR BOTTOM FLANGE.

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As-Built Drawing:

Revisions:

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Northwest Ohio Wind Project
Paulding County, Ohio

Turbine Grounding - Spread Foundation GE 2.5-116

Not For Construction
Array Date: 09/14/2017
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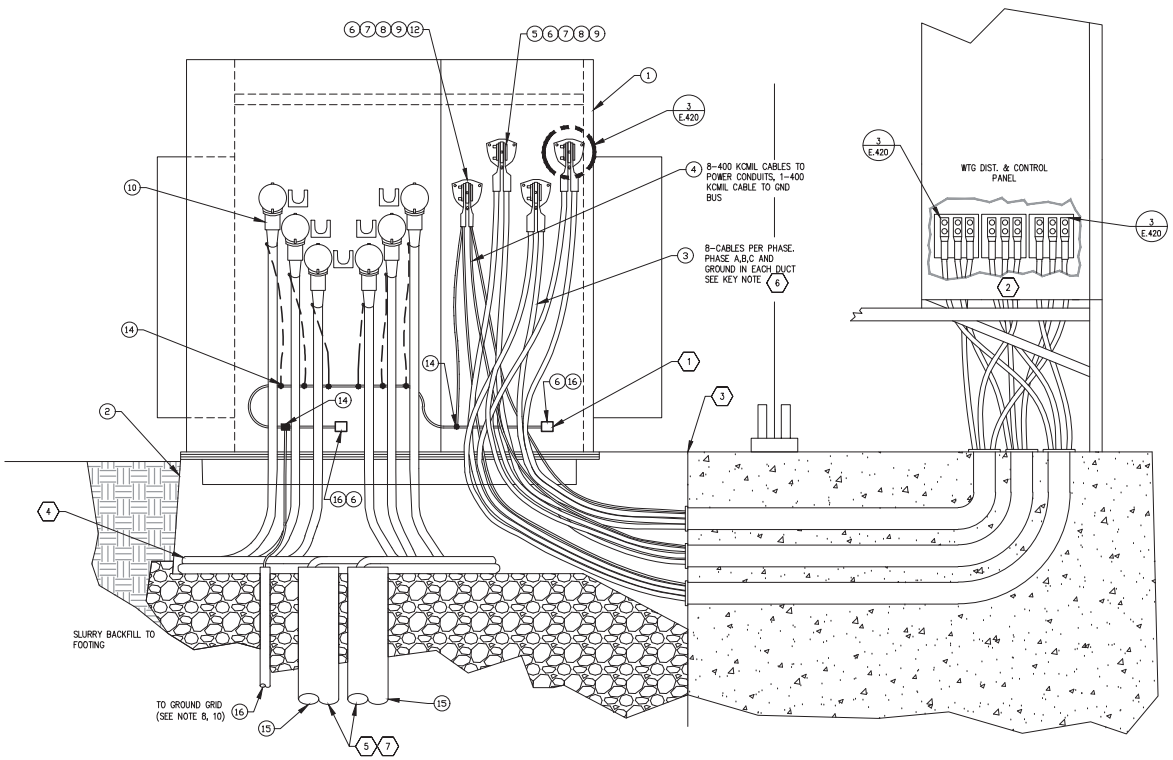
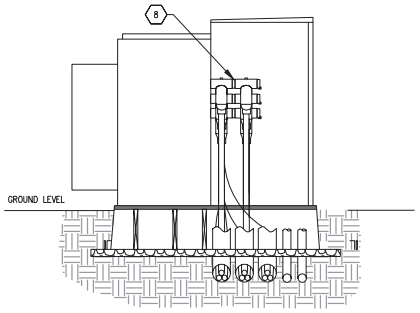
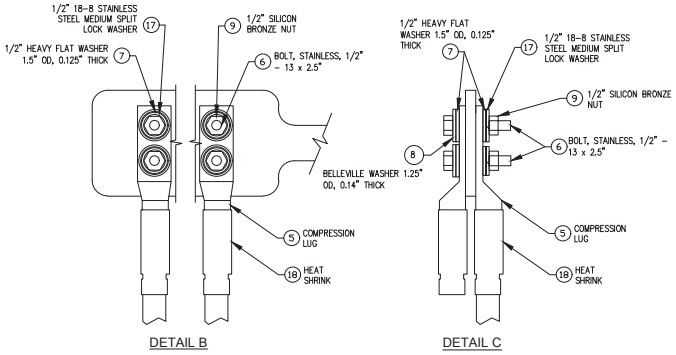
0007186_E400_Turbine Conduit and Gnd.dwg



1 Step-Up Transformer - Front View
NTS



2 Step-Up Transformer - Side View
NTS



3 Termination Detail
NTS

MATERIAL LIST

ITEM	QTY	UNIT	DESCRIPTION	MFG.
1	1	EA	PAD MOUNTED TRANSFORMER	–
2	1	EA	BOX PAD ## INCH X ## INCH X 36 INCH	–
3	###	FT	1000 KCMIL AL STR. CABLE, 2 KV, RHW-2	–
4	###	FT	400 KCMIL BARE CU STR. CABLE, S.D.	–
5	48	EA	CONNECTOR, CP, AL, 2H LUG 1000 KCMIL (TURBINE AND TRANSFORMER)	–
6	66	EA	1/2"-13 X 2-1/2" 316 STAINLESS STEEL HEX CAP SCREW	–
7	128	EA	1/2" 18-8 STAINLESS STEEL SMALL OD EXTRA THICK FLAT WASHER	–
8	48	EA	1/2" 18-8 S/S BELLEVILLE WASHER 4700 LBS	–
9	64	EA	1/2-13 HEAVY HEX NUTS, SILICON BRONZE	–
10a	6	EA	CABLE TO ELBOW SEALING, COLD SHRINK, 35 KV 1250 MCM	–
10b	6	EA	CABLE TO ELBOW SEALING, COLD SHRINK, 35 KV 1000 MCM	–
10c	6	EA	CABLE TO ELBOW SEALING, COLD SHRINK, 35 KV 1/0 – 500 MCM	–
11	.25	EA	CABLE CLEANING KIT, SPECIALIZED PADS CLEAN CABLE INSULATION, COMES W/ 3EA SATURATED PADS/KIT & CASE QTY OF 10	–
12	##	EA	CONNECTOR, CP, CU, 2H LUG TO 7#6 CCS	–
13	##	EA	CONNECTOR,CP, CU GRD. TAP "C",GROUND TAP "C", HYTAP 2/0 TO #1 AWG CU RUN TO TAP #6-#2 STR CU	–
14	##	EA	CONNECTOR,CP, CU GRD. TAP "C", 2/0 AWG-35MM RUN TO 2/0 AWG-35MM TAP. CU WIRE/BAR	–
17	#	EA	CONNECTOR,CP, TIN PLATED "C", HYTAP , 2 AWG – 250 KCMIL RUN TO 2 AWG– 250 KCMIL TAP	–
15	20	FT	8" PVC CONDUIT SCH. 40, 10FT LENGTH, BELL END	–
16	20	FT	2" PVC CONDUIT SCH. 40, 10FT LENGTH, BELL END	–
17	64	EA	1/2" 18-8 STAINLESS STEEL MEDIUM SPLIT LOCK WASHER	–
18	A/R	FT	HEAT SHRINK, 1000V	–

GENERAL NOTES

1. PREVENT CONCRETE FROM ENTERING ALL OPEN CONDUIT ENDS.
2. ALL SPARE CONDUITS SHOULD BE SEALED WITH FLAME RETARDED FOAM AND CAPPED. ALL FLOATING CONDUCTORS IN CONDUIT SHALL BE ENCAPSULATED IN FLAME RETARDED FOAM TO PREVENT RODENT AND MOISTURE DAMAGE. FOAM SHALL BE INSTALLED IN A NEAT AND WORKMAN LIKE MANNER.
3. MARK EACH CIRCUIT WITH DESTINATION.
4. MARK EACH CABLE

PHASE	34.5 kV	SECONDARY
A	RED	BROWN
B	WHITE	ORANGE
C	BLUE	YELLOW

KEY NOTES

1. BOND 4/0 AWG COPPER GROUND BUS (ITEM 6) TO TRANSFORMER GROUNDING PAD. CONNECT TO GROUND GRID WITH 250 KCMIL COPPER.
2. CONNECT GROUNDING CONDUCTORS TO GROUND BUS IN WTG DIST. PANEL
3. TOP OF PEDESTAL AND BOX PADS TO BE AT SAME ELEVATION. CAULK THE JOINT BETWEEN THE BOXPAD AND PEDESTAL.
4. SLACK COIL (FOR ONE EXTRA TERMINATION)
5. SEAL ALL CONDUITS WITH FOAM AFTER CABLE INSTALLATION. SEE SHEET E530 FOR MORE INFORMATION.
6. ALL TURBINE POWER CABLES SHALL BE EQUAL IN LENGTH.
7. EXTEND ELECTRICAL CONDUITS FOR MV CABLE AND GROUNDS INTO NATIVE SOIL BEDDING WITH 45 AND 90 DEG SWEEPS AS REQUIRED.
8. ELBOW TO ELBOW (PIGGYBACK) CONNECTOR KIT REQUIRED.

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Designed: KV
Checked: AMS
Drawn: MC
As-Built Drawing:

Revisions:

#	DATE	DESCRIPTION
A	09/27/17	30% plans

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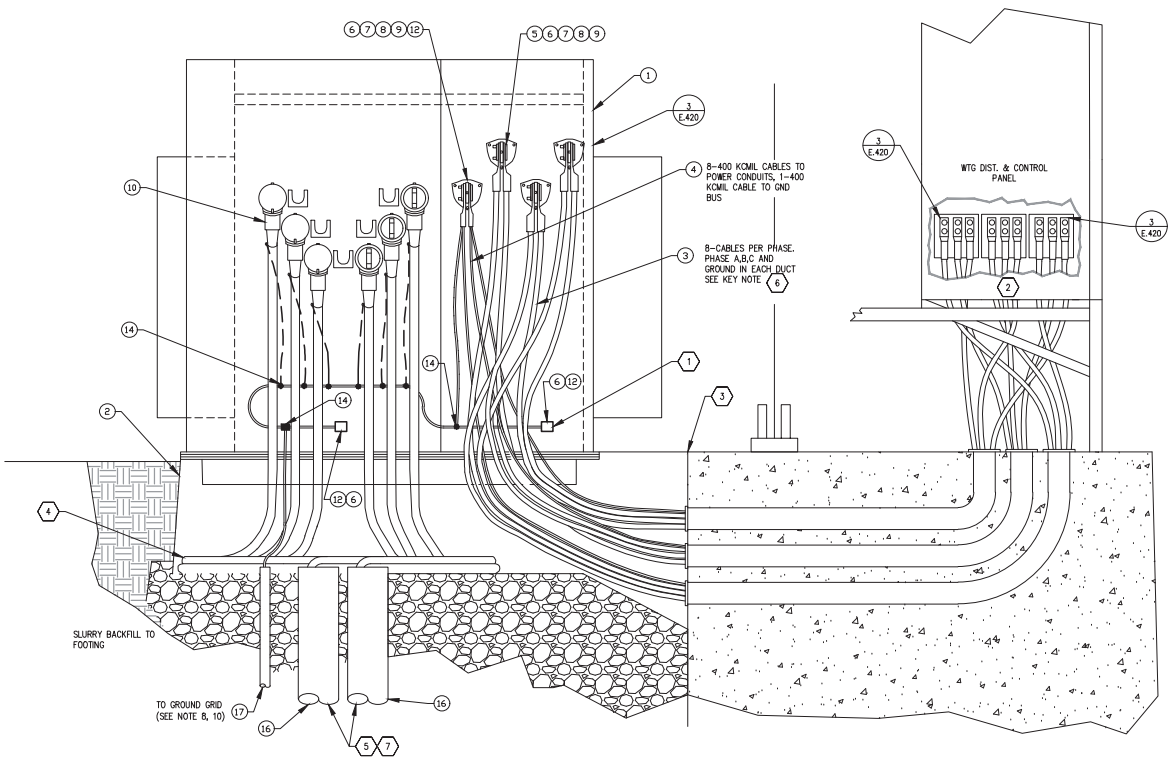
Northwest Ohio Wind Project
Paulding County, Ohio

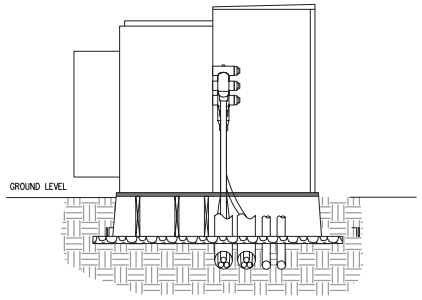
Padmount Transformer Feedthrough

Not For Construction
Array Date: 09/14/2017
Date: 09/27/17
Sheet: E420

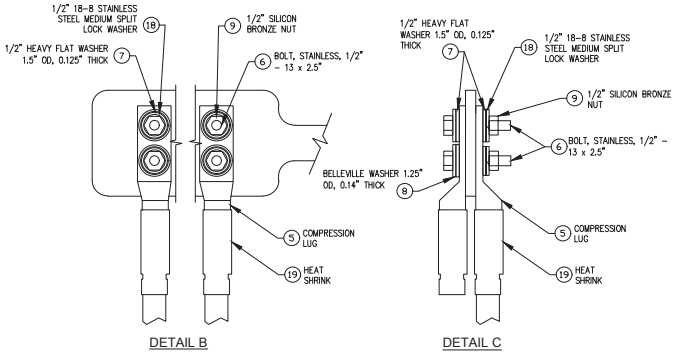
0007186_E400_Padmount Transformer Details.dwg



1 Step-Up Transformer - Front View
NTS



2 Step-Up Transformer - Side View
NTS



3 Termination Detail
NTS

MATERIAL LIST

ITEM	QTY	UNIT	DESCRIPTION	MFG.
1	1	EA	PAD MOUNTED TRANSFORMER	–
2	1	EA	BOX PAD ## INCH X ## INCH X 36 INCH	–
3	###	FT	1000 KCMIL AL STR. CABLE, 2 KV, RHW-2	–
4	###	FT	400 KCMIL BARE CU STR. CABLE, S.D.	–
5	48	EA	CONNECTOR, CP, AL, 2H LUG 1000 KCMIL (TURBINE AND TRANSFORMER)	–
6	66	EA	1/2"-13 X 2-1/2" 316 STAINLESS STEEL HEX CAP SCREW	–
7	128	EA	1/2" 18-8 STAINLESS STEEL SMALL OD EXTRA THICK FLAT WASHER	–
8	48	EA	1/2" 18-8 S/S BELLEVILLE WASHER 4700 LBS	–
9	64	EA	1/2-13 HEAVY HEX NUTS, SILICON BRONZE	–
10a	6	EA	CABLE TO ELBOW SEALING, COLD SHRINK, 35 KV 1250 MCM	–
10b	6	EA	CABLE TO ELBOW SEALING, COLD SHRINK, 35 KV 1000 MCM	–
10c	6	EA	CABLE TO ELBOW SEALING, COLD SHRINK, 35 KV 1/0 – 500 MCM	–
11	.25	EA	CABLE CLEANING KIT, SPECIALIZED PADS CLEAN CABLE INSULATION, COMES W/ 3EA SATURATED PADS/KIT & CASE QTY OF 10	–
12	##	EA	CONNECTOR, CP, CU, 2H LUG TO 7#6 CCS	–
13	##	EA	CONNECTOR,CP, CU GRD. TAP "C",GROUND TAP "C", HYTAP 2/0 TO #1 AWG CU RUN TO TAP #6-#2 STR CU	–
14	##	EA	CONNECTOR,CP, CU GRD. TAP "C", 2/0 AWG–35MM RUN TO 2/0 AWG–35MM TAP. CU WIRE/BAR	–
15	#	EA	CONNECTOR,CP, TIN PLATED "C", HYTAP , 2 AWG – 250 KCMIL RUN TO 2 AWG– 250 KCMIL TAP	–
16	20	FT	8" PVC CONDUIT SCH. 40, 10FT LENGTH, BELL END	–
17	20	FT	2" PVC CONDUIT SCH. 40, 10FT LENGTH, BELL END	–
18	64	EA	1/2" 18-8 STAINLESS STEEL MEDIUM SPLIT LOCK WASHER	–
19	A/R	FT	HEAT SHRINK, 1000V	–

GENERAL NOTES

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2. ALL SPARE CONDUITS SHOULD BE SEALED WITH FLAME RETARDED FOAM AND CAPPED. ALL FLOATING CONDUCTORS IN CONDUIT SHALL BE ENCAPSULATED IN FLAME RETARDED FOAM TO PREVENT RODENT AND MOISTURE DAMAGE. FOAM SHALL BE INSTALLED IN A NEAT AND WORKMAN LIKE MANNER
3. MARK EACH CIRCUIT WITH DESTINATION.
4. MARK EACH CABLE

PHASE	34.5 kV	SECONDARY
A	RED	BROWN
B	WHITE	ORANGE
C	BLUE	YELLOW

KEY NOTES

1. BOND 4/0 AWG COPPER GROUND BUS (ITEM 6) TO TRANSFORMER GROUNDING PAD. CONNECT TO GROUND GRID WITH 250 KCMIL COPPER.
2. CONNECT GROUNDING CONDUCTORS TO GROUND BUS IN WTG DIST. PANEL
3. TOP OF PEDESTAL AND BOX PADS TO BE AT SAME ELEVATION. CAULK THE JOINT BETWEEN THE BOXPAD AND PEDESTAL.
4. SLACK COIL (FOR ONE EXTRA TERMINATION)
5. SEAL ALL CONDUITS WITH FOAM AFTER CABLE INSTALLATION. SEE SHEET E530 FOR MORE INFORMATION.
6. ALL TURBINE POWER CABLES SHALL BE EQUAL IN LENGTH.
7. EXTEND ELECTRICAL CONDUITS FOR MV CABLE AND GROUNDS INTO NATIVE SOIL BEDDING WITH 45 AND 90 DEG SWEEPS AS REQUIRED.
8. ELBOW TO ELBOW (PIGGYBACK) CONNECTOR KIT REQUIRED.

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Designed: KV
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Drawn: MC
As-Built Drawing:

Revisions:

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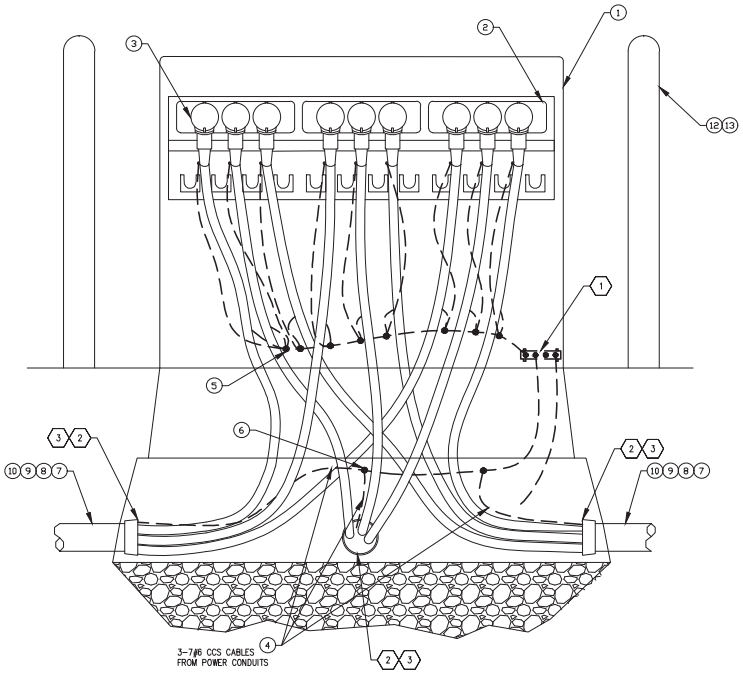
Trishe Wind Ohio, LLC
c/o Starwood Energy Group, LLC
5 Greenwich Office Park, 2nd Floor
Greenwich, CT 06831

Northwest Ohio Wind Project
Paulding County, Ohio

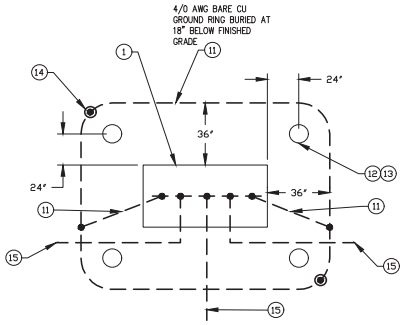
Padmount TransformerTerminal

Not For Construction
Array Date: 09/14/2017
Date: 09/27/17
Sheet: E421

0007186_E400_Padmount Transformer Details.dwg



1 Sectionalizing Cabinet - Front View
NTS



2 Sectionalizing Cabinet - Grounding Detail
NTS

MATERIAL LIST

ITEM	QTY	UNIT	DESCRIPTION	MFG.	
1	1	EA	3-WAY JUNCTION BOX 35KV, WITH GROUNDING		
2	9	EA	JUNCITON, 600A, 35KV, W/MOUNTING HARDWARE		
3	9	EA	DEADBREAK ELBOWS	-	
4	###	FT	7#6 CCS STR. CABLE, S.D.	-	
5	9	EA	CONNECTOR, CONCENTRICS TO JBOX GROUNDING		
6	3	EA	CONNECTOR, TRENCH GROUND TO JBOX GROUNDING		
7	##	FT	8" PVC CONDUIT SCH. 40, 10FT LENGTH, BELL END	-	
8	##	FT	6" PVC CONDUIT SCH. 40, 10FT LENGTH, BELL END	-	
9	##	FT	8" PVC CONDUIT SCH. 40	-	
10	##	FT	6" PVC CONDUIT SCH. 40	-	
11	###	FT	4/0 AWG BARE CU STR. CABLE, S.D.	WTEC	
12	4	EA	4" SCHEDULE 40, 8' LONG, FILLED WITH CONCRETE	CARLON	
13	4	EA	YELLOW PLASTIC BOLLARD COVER	IDEAL SHIELD	
14	2	EA	GROUND ROD, COPPER CLAD STEEL 3/4" x 10' IRREVERSIBLY CRIMP TO GROUND RING	-	
15	##	FT	TRENCH GROUND	-	

GENERAL NOTES

1. PREVENT CONCRETE FROM ENTERING ALL OPEN CONDUIT ENDS.
2. ALL SPARE CONDUITS SHOULD BE SEALED WITH FLAME RETARDED FOAM AND CAPPED. ALL FLOATING CONDUCTORS IN CONDUIT SHALL BE ENCAPSULATED IN FLAME RETARDED FOAM TO PREVENT RODENT AND MOISTURE DAMAGE. FOAM SHALL BE INSTALLED IN A NEAT AND WORKMAN LIKE MANNER.
3. MARK EACH CIRCUIT WITH DESTINATION.
4. MARK EACH CABLE

PHASE	34.5 kV	SECONDARY
A	RED	BROWN
B	WHITE	ORANGE
C	BLUE	YELLOW

5. BOND MV CABLE CONCENTRIC NEUTRALS TO SECTIONALIZING CABINET GROUND.

KEY NOTES

1. BOND 4/0 AWG COPPER GROUND BUS (ITEM 6) TO TRANSFORMER GROUNDING PAD. CONNECT TO GROUND GRID WITH 400 KCMIL COPPER.
2. SEAL ALL CONDUITS WITH FOAM AFTER CABLE INSTALLATION. SEE SHEET E530 FOR MORE INFORMATION.
3. EXTEND ELECTRICAL CONDUITS FOR MV CABLE AND GROUNDS INTO NATIVE SOIL BEDDING WITH 45 AND 90 DEG SWEEPS AS REQUIRED.

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Northwest Ohio Wind Project
Paulding County, Ohio

Sectionalizing Cabinet

Not For Construction
Array Date: 09/14/2017
Date: 09/27/17
Sheet: E422

0007186_E400_Padmount Transformer Details.dwg

MVAC WIRING SCHEDULE

CONDUCTOR LOCATION CODE	ORIGINATING EQUIPMENT	TERMINATING EQUIPMENT	Rated Vac (kV)	Iac (A)	# OF TUBRINES	LENGTH (FT)	CONDUCTOR SIZE	CONDUCTOR MATERIAL	# OF PARALLEL CONDUCTORS	GROUND CONDUCTOR SIZE	GROUND CONDUCTOR MATERIAL	DRAWING REFERENCE	CONDUCTOR SPECIFICS
MV1.SUB-T25	SUB	T25	34.5	460.21	10	4,616	3#1250 KCMIL	AL	1	7#6	Copper Clad Steel	E.200	35kV, (3) 1/C, 100% Insulation, 1/6 Cu CN, Type MV-90
MV1.T25-10	T25	T10	34.5	368.17	8	10,172	3#1000 KCMIL	AL	1	7#6	Copper Clad Steel	E.200	35kV, (3) 1/C, 100% Insulation, 1/6 Cu CN, Type MV-90
MV1.10-09	T10	T09	34.5	322.14	7	2,161	3#750 KCMIL	AL	1	7#6	Copper Clad Steel	E.200	35kV, (3) 1/C, 100% Insulation, 1/6 Cu CN, Type MV-90
MV1.09-08	T09	T08	34.5	276.12	6	3,297	3#500 KCMIL	AL	1	7#6	Copper Clad Steel	E.200	35kV, (3) 1/C, 100% Insulation, 1/3 Cu CN, Type MV-90
MV1.08-05	T08	T05	34.5	230.10	5	2,679	3#500 KCMIL	AL	1	7#6	Copper Clad Steel	E.200	35kV, (3) 1/C, 100% Insulation, 1/3 Cu CN, Type MV-90
MV1.05-04	T05	T04	34.5	184.08	4	1,991	3#4/0 AWG	AL	1	7#6	Copper Clad Steel	E.200	35kV, (3) 1/C, 100% Insulation, 1/2 Cu CN, Type MV-90
MV1.04-03	T04	T03	34.5	138.06	3	1,777	3#4/0 AWG	AL	1	7#6	Copper Clad Steel	E.200	35kV, (3) 1/C, 100% Insulation, 1/2 Cu CN, Type MV-90
MV1.03-02	T03	T02	34.5	92.04	2	1,878	3#1/0 AWG	AL	1	7#6	Copper Clad Steel	E.200	35kV, (3) 1/C, 100% Insulation, 2/3 Cu CN, Type MV-90
MV1.02-01	T02	T01	34.5	46.02	1	2,213	3#1/0 AWG	AL	1	7#6	Copper Clad Steel	E.200	35kV, (3) 1/C, 100% Insulation, 2/3 Cu CN, Type MV-90
MV1.T25-24	T25	T24	34.5	46.02	1	1,633	3#4/0 AWG	AL	1	7#6	Copper Clad Steel	E.200	35kV, (3) 1/C, 100% Insulation, 1/2 Cu CN, Type MV-90
MV2.SUB-JB2/1	SUB	JB2/1	34.5	506.23	11	8,109	3#1250 KCMIL	AL	1	7#6	Copper Clad Steel	E.200	35kV, (3) 1/C, 100% Insulation, 1/6 Cu CN, Type MV-90
MV2.JB2/1-22	JB2/1	T22	34.5	92.04	2	2,964	3#4/0 AWG	AL	1	7#6	Copper Clad Steel	E.200	35kV, (3) 1/C, 100% Insulation, 1/2 Cu CN, Type MV-90
MV2.T22-29	T22	T29	34.5	46.02	1	4,171	3#1/0 AWG	AL	1	7#6	Copper Clad Steel	E.200	35kV, (3) 1/C, 100% Insulation, 2/3 Cu CN, Type MV-90
MV2.22-21	T22	T21	34.5	92.04	2	1,417	3#1/0 AWG	AL	1	7#6	Copper Clad Steel	E.200	35kV, (3), (3) 1/C, 100% Insulation, 2/3 Cu CN, Type MV-90
MV2.21-20	T21	T20	34.5	46.02	1	3,551	3#1/0 AWG	AL	1	7#6	Copper Clad Steel	E.200	35kV, (3), (3) 1/C, 100% Insulation, 2/3 Cu CN, Type MV-90
MV2.JB2/1-17	JB2/1	T17	34.5	184.08	4	2,718	3#750 KCMIL	AL	1	7#6	Copper Clad Steel	E.200	35kV, (3) 1/C, 100% Insulation, 1/6 Cu CN, Type MV-90
MV2.17-15	T17	T15	34.5	138.06	3	4,579	3#500 KCMIL	AL	1	7#6	Copper Clad Steel	E.200	35kV, (3) 1/C, 100% Insulation, 1/3 Cu CN, Type MV-90
MV2.15-14	T15	T14	34.5	92.04	2	3,770	3#1/0 AWG	AL	1	7#6	Copper Clad Steel	E.200	35kV, (3) 1/C, 100% Insulation, 2/3 Cu CN, Type MV-90
MV2.14-13	T14	T13	34.5	46.02	1	1,517	3#1/0 AWG	AL	1	7#6	Copper Clad Steel	E.200	35kV, (3) 1/C, 100% Insulation, 2/3 Cu CN, Type MV-90
MV2.15-07	T15	T07	34.5	92.04	2	2,790	3#4/0 AWG	AL	1	7#6	Copper Clad Steel	E.200	35kV, (3) 1/C, 100% Insulation, 1/2 Cu CN, Type MV-90
MV2.07-06	T07	T06	34.5	46.02	1	1,388	3#1/0 AWG	AL	1	7#6	Copper Clad Steel	E.200	35kV, (3) 1/C, 100% Insulation, 2/3 Cu CN, Type MV-90
MV2.07-16	T07	T16	34.5	46.02	1	3,068	3#1/0 AWG	AL	1	7#6	Copper Clad Steel	E.200	35kV, (3) 1/C, 100% Insulation, 2/3 Cu CN, Type MV-90
MV3.SUB-T23	SUB	T23	34.5	506.23	11	12,285	3#1250 KCMIL	AL	1	7#6	Copper Clad Steel	E.201	35kV, (3) 1/C, 100% Insulation, 1/6 Cu CN, Type MV-90
MV3.T23-28	T23	T28	34.5	138.06	3	2,947	3#1250 KCMIL	AL	1	7#6	Copper Clad Steel	E.201	35kV, (3) 1/C, 100% Insulation, 1/6 Cu CN, Type MV-90
MV3.T28-27	T28	T27	34.5	92.04	2	1,703	3#1/0 AWG	AL	1	7#6	Copper Clad Steel	E.201	35kV, (3) 1/C, 100% Insulation, 2/3 Cu CN, Type MV-90
MV3.T27-26	T27	T26	34.5	46.02	1	1,780	3#1/0 AWG	AL	1	7#6	Copper Clad Steel	E.201	35kV, (3) 1/C, 100% Insulation, 2/3 Cu CN, Type MV-90
MV3.T28-33	T28	T33	34.5	138.06	3	5,853	3#750 KCMIL	AL	1	7#6	Copper Clad Steel	E.201	35kV, (3) 1/C, 100% Insulation, 1/6 Cu CN, Type MV-90
MV3.T33-32	T33	T32	34.5	92.04	2	1,314	3#1/0 AWG	AL	1	7#6	Copper Clad Steel	E.201	35kV, (3) 1/C, 100% Insulation, 2/3 Cu CN, Type MV-90
MV3.T32-31	T32	T31	34.5	46.02	1	5,205	3#1/0 AWG	AL	1	7#6	Copper Clad Steel	E.201	35kV, (3) 1/C, 100% Insulation, 2/3 Cu CN, Type MV-90
MV3.T33-34	T33	T34	34.5	138.06	3	1,674	3#4/0 AWG	AL	1	7#6	Copper Clad Steel	E.201	35kV, (3) 1/C, 100% Insulation, 1/2 Cu CN, Type MV-90
MV3.T34-36	T34	T36	34.5	92.04	2	3,312	3#1/0 AWG	AL	1	7#6	Copper Clad Steel	E.201	35kV, (3) 1/C, 100% Insulation, 2/3 Cu CN, Type MV-90
MV3.T36-37	T36	T37	34.5	46.02	1	1,301	3#1/0 AWG	AL	1	7#6	Copper Clad Steel	E.201	35kV, (3) 1/C, 100% Insulation, 2/3 Cu CN, Type MV-90
MV3.T34-39	T34	T39	34.5	46.02	1	5,680	3#1/0 AWG	AL	1	7#6	Copper Clad Steel	E.201	35kV, (3) 1/C, 100% Insulation, 2/3 Cu CN, Type MV-90
MV4.SUB-T40	SUB	T40	34.5	460.21	10	29,905	3#1250 KCMIL	AL	1	7#6	Copper Clad Steel	E.201	35kV, (3) 1/C, 100% Insulation, 1/6 Cu CN, Type MV-90
MV4.T40-T46	T40	T46	34.5	276.12	6	2,581	3#1000 KCMIL	AL	1	7#6	Copper Clad Steel	E.201	35kV, (3) 1/C, 100% Insulation, 1/6 Cu CN, Type MV-90
MV4.T46-45	T46	T45	34.5	230.10	5	3,997	3#1000 KCMIL	AL	1	7#6	Copper Clad Steel	E.201	35kV, (3) 1/C, 100% Insulation, 1/6 Cu CN, Type MV-90
MV4.45-44	T45	T44	34.5	184.08	4	2,881	3#750 KCMIL	AL	1	7#6	Copper Clad Steel	E.201	35kV, (3) 1/C, 100% Insulation, 1/6 Cu CN, Type MV-90
MV4.44-JB4/1	T44	JB4/1	34.5	138.06	3	3,486	3#500 KCMIL	AL	1	7#6	Copper Clad Steel	E.201	35kV, (3) 1/C, 100% Insulation, 1/3 Cu CN, Type MV-90
MV4.JB4/1-42	JB4/1	T42	34.5	138.06	3	30	3#4/0 AWG	AL	1	7#6	Copper Clad Steel	E.201	35kV, (3) 1/C, 100% Insulation, 1/2 Cu CN, Type MV-90
MV4.42-49	T42	T49	34.5	92.04	2	6,471	3#4/0 AWG	AL	1	7#6	Copper Clad Steel	E.201	35kV, (3) 1/C, 100% Insulation, 1/2 Cu CN, Type MV-90
MV4.49-48	T49	T48	34.5	46.02	1	1,717	3#1/0 AWG	AL	1	7#6	Copper Clad Steel	E.201	35kV, (3) 1/C, 100% Insulation, 2/3 Cu CN, Type MV-90
MV4.49-50	T49	T50	34.5	46.02	1	1,661	3#1/0 AWG	AL	1	7#6	Copper Clad Steel	E.201	35kV, (3) 1/C, 100% Insulation, 2/3 Cu CN, Type MV-90
MV4.JB4/1-43	JB4/1	T43	34.5	46.02	1	1,349	3#1/0 AWG	AL	1	7#6	Copper Clad Steel	E.201	35kV, (3) 1/C, 100% Insulation, 2/3 Cu CN, Type MV-90
MV4.JB4/1-41	JB4/1	T41	34.5	46.02	1	1,386	3#1/0 AWG	AL	1	7#6	Copper Clad Steel	E.201	35kV, (3) 1/C, 100% Insulation, 2/3 Cu CN, Type MV-90

NOTES

1. DISTANCES SHOWN ARE POINT TO POINT DISTANCES MEASURED IN CAD. THEY DO NOT ACCOUNT FOR VERTICAL LENGTHS. ALL LENGTHS TO BE FIELD VERIFIED.
2. REFER TO MVAC SITE PLANS FOR CONDUIT AND WIRING ROUTING.

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As-Built Drawing:

Revisions
#	DATE	DESCRIPTION
A	09/27/17	30% plans

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Northwest Ohio Wind Project
Paulding County, Ohio

MVAC Wiring Schedule

Not For Construction
Array Date: 09/14/2017
Date: 10/27/17
Sheet:

0007186_E800 Schedules.dwg

SHORT CIRCUIT STUDY

Northwest Ohio Wind Project

Paulding, Ohio
September 25, 2017

Prepared for:

WHITE
an MEA company

Prepared by:

Westwood

Westwood

Project Name: NW OH Wind Project	
Title	**J.O. or W.O. Number**
Short Circuit Study	0007186.00

Approvals		**Revision Number**	**Date**	**Description**
Preparer(s) Name	**Reviewer(s) Name**			
Josh Venden	Drew Szabo	0	09/25/2017	Original Release

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INTRODUCTION

NW OH Wind Project is a 100 MW wind generation installation in Paulding, OH consisting 42 of GE 2.5 MW wind turbines. The turbines are grouped into four medium voltage (MV) feeders with 10 turbines on Feeders 1 and 4 and 11 turbines on Feeders 2 and 3. The feeders are connected to a main power transformer that steps the voltage up to 138kV where it interconnects with the AEP transmission system via a short overhead line segment.

OBJECTIVE

The objective of this report is to determine the fault currents at the medium and low voltage buses within the NW OH wind generation plant. The fault current information is used to determine minimum conductor and concentric neutral sizes required to withstand the short circuit current for a set time.

INPUTS & ASSSUMPTIONS

- Short circuit analysis performed with ETAP v16.0.0C power system simulation software.
- Medium voltage AC collector electrical layout is per the Westwood Professional Services Electrical Drawings, MVAC Collection One-Line Diagrams E.200 & E.210.
- ETAP model parameters for equipment such as turbines (WTG), step-up transformers (GSU) and main power transformer (MPT) based on manufacturer data when available or typical ETAP values when information is not available.
- ETAP model parameters for MV cables based on thermal analysis using CYME Cymcap Underground Cable Thermal Analysis software.
- ETAP model parameters for overhead transmission line data based on ETAP library of standard overhead conductors.
- ETAP model parameters for utility equivalent impedance information provided by AEP.
- The short circuit contribution of the wind turbines, as provided by GE, is a maximum of five times the rated current for up to 5 cycles (~12kA).
- The grounded wye connection of the main power transformer secondary is connected to ground reactor of 0.6 ohms.
- Per the Ulteig Relay Settings Philosophy, the maximum clearing times are assumed to be 8.5 cycles for phase faults and 3.5 cycles for ground faults; it is also assumed for CN sizing that 100% of ground fault current flows in the concentric neutral.
- An operating temperature (T_{OP}) of 90°C is assumed for phase conductors and 80°C for concentric neutrals.
- The maximum, or short circuit temperature (T_{SC}), is assumed to be 250°C for phase conductors and 200°C for the concentric neutrals.
- A parallel ground conductor is included in all of the MV cable trenches and is assumed to be 7#8 copper-clad steel.
- Appendix C shows the various ETAP inputs used.

METHODOLOGY

- This analysis utilizes the Short Circuit module of ETAP to calculate bus fault currents at all medium and low voltage buses in the NW OH wind generation facility.
- For each bus the maximum 3-phase (3PH), line-to-ground (SLG), line-to-line (L2L) and double-line-to-ground (LLG) fault currents are shown with the wind farm in and out of service.
- The maximum phase fault current is used to verify conductor sizing; maximum ground fault current is used to determine minimum CN sizing and trench ground conductor withstand time.
- Conductor and concentric neutral (CN) sizing worksheet based on the following ICEA cable temperature rise equation:

$$A = \frac{I * \sqrt{t}}{\sqrt{\mathrm{K} * \log_{10}\left[\frac{T_{SC} + \lambda}{T_{OP} + \lambda}\right]}}$$

Where:

A = cross-sectional area (Circular mils);
I = short circuit current (A);
t = fault clearing time (s);
K = time/temp coefficient (0.0125 Al; 0.0297 Cu);
T_{SC} = short circuit temperature;
T_{OP} = operating temperature;
λ = base temperature (228°C Al; 234°C Cu)

- Appendix A shows the fault currents for each MV and LV bus in the wind farm.

CONCLUSION

- The maximum phase fault current for each cable size is determined from the ETAP analysis. This current corresponds to the minimum required cross-sectional area of phase conductor necessary to withstand the respective fault current for up to 8.5 cycles.
- The table below confirms the cross-sectional area of the phase conductors is larger than the required minimum for every cable size. Cable ampacities are also shown.

Table 1: Phase Conductor Summary

Cable	Material	Maximum 3PH Fault Current	Min. Required Area	Phase Conductor Area	Ampacity & Configuration	
1/0	Al	10486	83908	105600	142.3	Trefoil
4/0	Al	13367	106961	211600	212.9	Trefoil
500	Al	6848	54797	500000	334.7	Trefoil
750	Al	11533	92286	750000	408.6	Trefoil
1000	Al	10238	81923	1000000	477.1	Trefoil
1250	Al	12754	102056	1250000	540.5	Trefoil
1250*	Al	12754	102056	1250000	570.5	Trefoil

** Increased ampacity based on 90% soil compaction in trenches with 11 turbines on the ckt*

- The maximum ground fault current for each cable size is determined from the ETAP analysis. This current is used to determine a minimum required total cross-sectional area of concentric neutral conductors necessary to withstand the respective fault current for up to 3.5 cycles. The cross-sectional area is a combined area of several smaller gauge conductors concentrically wrapped around the phase conductor.

- The following table summarizes the fault current, cross-sectional area and concentric neutral sizes for the cables used at the NW OH wind generation facility. A list of stock cables was provided by White Construction and the cross-sectional area of all CN sizes as indicated below exceed the required minimums.

Table 2: Concentric Neutral Summary

Cable	CN Material	Maximum SLG Fault Current	Fault Location	CN Min. Required Area	Conc Neut SC Withstand Min. Size	
1/0	Cu	7303	T-21	27299	2/3	18x16AWG
4/0	Cu	9801	T-24	36637	1/2	17x14AWG
500	Cu	5922	T-15	22137	1/3	16x12AWG
750	Cu	8634	T-17	32275	1/6	19x14AWG
1000	Cu	7634	T-10	28537	1/6	25x14AWG
1250	Cu	10692	T-25	39968	1/6	20x12AWG

- Future utility system data was also provided based on 2022 projected power flow models. The model was adjusted to reflect the future utility equivalent data and the resulting bus fault currents within the collector system were analyzed to ensure CN sizing was adequate for near term projected increases in fault current. The following table shows the increase in fault current does not result in the need for larger concentric neutrals.

Table 3: Projected Fault Current and CN Sizing

Cable	CN Material	Projected SLG Fault Current	Fault Location	Min. Required cmils neutral	Conc Neut SC Withstand Min. Size	
1/0	Cu	7362	T-21	27520	2/3	18x16AWG
4/0	Cu	9920	T-24	37082	1/2	17x14AWG
500	Cu	7142	T-15	22242	1/3	16x12AWG
750	Cu	8535	T-17	32600	1/6	19x14AWG
1000	Cu	7699	T-10	28780	1/6	25x14AWG
1250	Cu	10834	T-25	40498	1/6	20x12AWG

- The trench ground and low voltage conductors' short circuit withstand time is based on a simplified version of the ICEA equation shown above. Taking Equation (42) from the IEEE 80-2000 standard and solving for time (t) results in the following equation. K_f is the material constant based on Table 2 in IEEE 80-2000.

$$t = \left(\frac{Area_{kCMIL}}{K_f * I_{kA}}\right)^2$$

- K_f is equal to 10.45 for copper-clad steel wire with a conductivity of 40%. The short circuit withstand for the parallel trench ground is approximately 0.725 seconds or 43.5 cycles. This is adequate to withstand maximum ground fault current until protective devices can interrupt the fault.

$$t = \left(\frac{115.570}{10.45 * 12.975}\right)^2 = 0.727\ sec$$

- K_f is equal to 7.00 for soft-drawn copper wire. The connections between the turbine and transformer are 9x1000kCMIL cables. The short circuit withstand for the low voltage cables is over 10 minutes. This is adequate to withstand maximum ground fault current until protective devices can interrupt the fault.

$$t = \left(\frac{9000}{7.00 * 49.876}\right)^2 = 664.5\ sec$$

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APPENDIX A: SHORT CIRCUIT SUMMARY REPORTS

Short-Circuit Summary Report

1/2 Cycle - 3-Phase, LG, LL, & LLG Fault Currents

Prefault Voltage = 100 % of the Bus Nominal Voltage

Bus		3-Phase Fault			Line-to-Ground Fault			Line-to-Line Fault			*Line-to-Line-to-Ground		
ID	kV	Real	Imag.	Mag.	Real	Imag.	Mag.	Real	Imag.	Mag.	Real	Imag.	Mag.
89F1A	34.500	0.682	-8.285	8.313	0.529	-8.434	8.451	7.175	0.591	7.200	6.993	4.881	8.528
89F2A	34.500	0.682	-8.285	8.313	0.529	-8.434	8.451	7.175	0.591	7.200	6.993	4.881	8.528
89F3A	34.500	0.682	-8.285	8.313	0.529	-8.434	8.451	7.175	0.591	7.200	6.993	4.881	8.528
89F4A	34.500	0.682	-8.285	8.313	0.529	-8.434	8.451	7.175	0.591	7.200	6.993	4.881	8.528
89T1A	138.000	1.600	-7.007	7.187	1.491	-7.268	7.419	6.068	1.386	6.224	5.388	5.156	7.457
89T1B	34.500	0.682	-8.285	8.313	0.529	-8.434	8.451	7.175	0.591	7.200	6.993	4.881	8.528
HV BUS MPT	138.000	1.600	-7.007	7.187	1.491	-7.268	7.419	6.068	1.386	6.224	5.388	5.156	7.457
JB-2/1	34.500	0.964	-7.347	7.410	1.975	-6.522	6.814	6.362	0.835	6.417	-7.651	1.973	7.901
JB-4/1	34.500	2.346	-3.482	4.199	2.145	-2.057	2.972	3.016	2.032	3.636	-3.914	-1.349	4.140
MV BUS T-01	34.500	2.638	-2.019	3.322	2.418	-1.720	2.968	1.749	2.284	2.877	-2.862	-1.539	3.250
MV BUS T-02	34.500	2.773	-2.302	3.603	2.555	-1.976	3.230	1.993	2.401	3.121	-3.174	-1.540	3.528
MV BUS T-03	34.500	2.884	-2.591	3.877	2.670	-2.241	3.485	2.244	2.498	3.357	-3.482	-1.514	3.797
MV BUS T-04	34.500	2.963	-2.734	4.032	2.761	-2.414	3.667	2.368	2.566	3.492	-3.657	-1.489	3.949
MV BUS T-05	34.500	3.054	-2.912	4.220	2.865	-2.635	3.892	2.522	2.645	3.655	-3.869	-1.443	4.130
MV BUS T-06	34.500	3.150	-3.100	4.419	2.971	-2.781	4.070	2.684	2.728	3.827	-4.088	-1.470	4.344
MV BUS T-07	34.500	3.217	-3.434	4.705	3.044	-3.109	4.351	2.974	2.786	4.075	-4.416	-1.368	4.623
MV BUS T-08	34.500	2.951	-4.308	5.222	2.922	-3.517	4.573	3.731	2.556	4.522	-5.131	-1.097	5.247
MV BUS T-09	34.500	1.282	-6.356	6.484	2.454	-4.999	5.569	5.504	1.110	5.615	-6.904	0.766	6.946
MV BUS T-10	34.500	1.207	-6.582	6.692	2.392	-5.324	5.837	5.700	1.045	5.795	-7.109	1.010	7.180
MV BUS T-13	34.500	3.040	-2.582	3.988	2.874	-2.344	3.709	2.236	2.633	3.454	-3.597	-1.561	3.921
MV BUS T-14	34.500	3.144	-2.867	4.255	2.981	-2.630	3.976	2.483	2.723	3.685	-3.899	-1.509	4.181
MV BUS T-15	34.500	3.337	-3.807	5.062	3.172	-3.593	4.793	3.297	2.890	4.384	-4.808	-1.189	4.953
MV BUS T-16	34.500	3.050	-2.754	4.109	2.865	-2.446	3.767	2.385	2.641	3.559	-3.732	-1.544	4.039
MV BUS T-17	34.500	1.110	-7.014	7.101	2.202	-6.012	6.402	6.074	0.962	6.150	-7.448	1.519	7.602
MV BUS T-20	34.500	2.850	-4.822	5.601	3.030	-3.683	4.769	4.176	2.468	4.851	-5.645	-1.045	5.741
MV BUS T-21	34.500	2.137	-6.184	6.543	2.799	-4.985	5.717	5.356	1.850	5.666	-6.853	0.132	6.855
MV BUS T-22	34.500	1.603	-6.721	6.910	2.508	-5.599	6.135	5.821	1.389	5.984	-7.265	0.883	7.319
MV BUS T-23	34.500	1.061	-6.916	6.997	2.272	-5.648	6.087	5.990	0.919	6.060	-7.356	1.295	7.469
MV BUS T-24	34.500	1.289	-7.385	7.496	2.021	-6.807	7.100	6.395	1.117	6.492	-7.667	1.965	7.915
MV BUS T-25	34.500	0.857	-7.744	7.791	1.511	-7.356	7.509	6.706	0.742	6.747	-7.727	2.706	8.188
MV BUS T-26	34.500	2.279	-5.481	5.936	2.779	-3.900	4.789	4.746	1.974	5.141	-6.100	-0.568	6.127
MV BUS T-27	34.500	1.786	-6.103	6.359	2.644	-4.492	5.213	5.285	1.547	5.507	-6.655	0.089	6.655
MV BUS T-28	34.500	1.113	-6.640	6.732	2.372	-5.120	5.643	5.750	0.964	5.830	-7.098	0.933	7.159
MV BUS T-29	34.500	2.750	-5.120	5.812	3.021	-3.947	4.970	4.434	2.382	5.033	-5.922	-0.850	5.983
MV BUS T-31	34.500	2.571	-4.113	4.851	2.610	-2.687	3.746	3.562	2.227	4.201	-4.732	-1.300	4.907

1/2 Cycle - 3-Phase, LG, LL, & LLG Fault Currents

Prefault Voltage = 100 % of the Bus Nominal Voltage

Bus		3-Phase Fault			Line-to-Ground Fault			Line-to-Line Fault			*Line-to-Line-to-Ground		
ID	kV	Real	Imag.	Mag.	Real	Imag.	Mag.	Real	Imag.	Mag.	Real	Imag.	Mag.
MV BUS T-32	34.500	1.734	-5.671	5.930	2.579	-3.942	4.710	4.911	1.501	5.135	-6.197	-0.139	6.199
MV BUS T-33	34.500	1.310	-6.052	6.192	2.462	-4.348	4.996	5.241	1.134	5.362	-6.538	0.381	6.549
MV BUS T-34	34.500	1.541	-5.769	5.972	2.517	-4.012	4.736	4.997	1.334	5.172	-6.269	0.041	6.269
MV BUS T-36	34.500	2.282	-4.779	5.296	2.622	-3.141	4.091	4.139	1.976	4.586	-5.349	-0.906	5.426
MV BUS T-37	34.500	2.440	-4.401	5.032	2.605	-2.860	3.869	3.811	2.113	4.358	-4.990	-1.138	5.118
MV BUS T-39	34.500	2.528	-4.108	4.824	2.577	-2.653	3.699	3.558	2.189	4.177	-4.708	-1.283	4.880
MV BUS T-40	34.500	1.244	-5.513	5.652	2.309	-3.336	4.057	4.775	1.078	4.895	-5.848	-0.044	5.848
MV BUS T-41	34.500	2.379	-3.204	3.990	2.102	-1.899	2.833	2.774	2.060	3.456	-3.648	-1.425	3.917
MV BUS T-42	34.500	2.346	-3.475	4.192	2.143	-2.051	2.967	3.009	2.031	3.631	-3.906	-1.350	4.133
MV BUS T-43	34.500	2.378	-3.219	4.002	2.105	-1.908	2.841	2.787	2.059	3.465	-3.663	-1.422	3.929
MV BUS T-44	34.500	1.329	-4.890	5.068	2.161	-2.714	3.469	4.235	1.151	4.389	-5.182	-0.349	5.193
MV BUS T-45	34.500	1.293	-5.082	5.243	2.205	-2.879	3.626	4.401	1.120	4.541	-5.380	-0.260	5.387
MV BUS T-46	34.500	1.267	-5.336	5.485	2.270	-3.143	3.877	4.621	1.097	4.750	-5.657	-0.138	5.659
MV BUS T-48	34.500	2.277	-2.629	3.478	1.908	-1.529	2.445	2.277	1.972	3.012	-3.055	-1.463	3.387
MV BUS T-49	34.500	2.286	-2.889	3.683	1.964	-1.666	2.575	2.502	1.979	3.190	-3.306	-1.430	3.602
MV BUS T-50	34.500	2.277	-2.637	3.484	1.910	-1.533	2.449	2.284	1.972	3.017	-3.063	-1.462	3.394
POI	138.000	1.607	-7.030	7.211	1.499	-7.298	7.451	6.088	1.392	6.245	5.403	5.181	7.486

All fault currents are symmetrical (1/2 Cycle network) values in rms kA.
* LLG fault current is the larger of the two faulted line currents.

Sequence Impedance Summary Report

Bus		Positive Seq. Imp. (ohm)			Negative Seq. Imp. (ohm)			Zero Seq. Imp. (ohm)			Fault Zf (ohm)		
ID	kV	Resistance	Reactance	Impedance	Resistance	Reactance	Impedance	Resistance	Reactance	Impedance	Resistance	Reactance	Impeda
89F1A	34.500	0.19663	2.38789	2.39597	0.19663	2.38789	2.39597	0.04950	2.28159	2.28213	0.00000	0.00000	0.00
89F2A	34.500	0.19663	2.38789	2.39597	0.19663	2.38789	2.39597	0.04950	2.28159	2.28213	0.00000	0.00000	0.00
89F3A	34.500	0.19663	2.38789	2.39597	0.19663	2.38789	2.39597	0.04950	2.28159	2.28213	0.00000	0.00000	0.00
89F4A	34.500	0.19663	2.38789	2.39597	0.19663	2.38789	2.39597	0.04950	2.28159	2.28213	0.00000	0.00000	0.00
89T1A	138.000	2.46787	10.80704	11.08523	2.46787	10.80704	11.08523	1.53784	9.94717	10.06534	0.00000	0.00000	0.00
89T1B	34.500	0.19663	2.38789	2.39597	0.19663	2.38789	2.39597	0.04950	2.28159	2.28213	0.00000	0.00000	0.00
HV BUS MPT	138.000	2.46787	10.80704	11.08523	2.46787	10.80704	11.08523	1.53784	9.94717	10.06534	0.00000	0.00000	0.00
JB-2/1	34.500	0.34972	2.66537	2.68822	0.34972	2.66537	2.68822	1.84180	3.06233	3.57352	0.00000	0.00000	0.00
JB-4/1	34.500	2.65038	3.93435	4.74379	2.65038	3.93435	4.74379	9.21412	6.04556	11.02038	0.00000	0.00000	0.00
MV BUS T-01	34.500	4.76115	3.64527	5.99637	4.76115	3.64527	5.99637	6.88580	4.38042	8.16102	0.00000	0.00000	0.00
MV BUS T-02	34.500	4.25324	3.53059	5.52767	4.25324	3.53059	5.52767	6.12909	4.25911	7.46363	0.00000	0.00000	0.00
MV BUS T-03	34.500	3.82221	3.43327	5.13777	3.82221	3.43327	5.13777	5.48693	4.15616	6.88331	0.00000	0.00000	0.00
MV BUS T-04	34.500	3.63083	3.35013	4.94027	3.63083	3.35013	4.94027	5.00579	4.02514	6.42337	0.00000	0.00000	0.00
MV BUS T-05	34.500	3.41640	3.25697	4.72013	3.41640	3.25697	4.72013	4.46670	3.87834	5.91549	0.00000	0.00000	0.00
MV BUS T-06	34.500	3.21252	3.16132	4.50713	3.21252	3.16132	4.50713	4.29441	3.71037	5.67528	0.00000	0.00000	0.00
MV BUS T-07	34.500	2.89396	3.08939	4.23312	2.89396	3.08939	4.23312	3.81980	3.63428	5.27246	0.00000	0.00000	0.00
MV BUS T-08	34.500	2.15564	3.14673	3.81427	2.15564	3.14673	3.81427	4.03898	3.75811	5.51695	0.00000	0.00000	0.00
MV BUS T-09	34.500	0.60733	3.01134	3.07198	0.60733	3.01134	3.07198	3.51370	3.61045	5.03800	0.00000	0.00000	0.00
MV BUS T-10	34.500	0.53670	2.92782	2.97661	0.53670	2.92782	2.97661	3.12293	3.48265	4.67777	0.00000	0.00000	0.00
MV BUS T-13	34.500	3.80690	3.23282	4.99436	3.80690	3.23282	4.99436	4.87220	3.71841	6.12902	0.00000	0.00000	0.00
MV BUS T-14	34.500	3.45873	3.15421	4.68101	3.45873	3.15421	4.68101	4.35348	3.63525	5.67167	0.00000	0.00000	0.00
MV BUS T-15	34.500	2.59347	2.95885	3.93457	2.59347	2.95885	3.93457	3.06438	3.42858	4.59843	0.00000	0.00000	0.00
MV BUS T-16	34.500	3.59810	3.24837	4.84750	3.59810	3.24837	4.84750	4.86886	3.80247	6.17775	0.00000	0.00000	0.00
MV BUS T-17	34.500	0.43855	2.77042	2.80492	0.43855	2.77042	2.80492	2.33330	3.22307	3.97900	0.00000	0.00000	0.00
MV BUS T-20	34.500	1.80916	3.06150	3.55609	1.80916	3.06150	3.55609	4.34308	3.55321	5.61139	0.00000	0.00000	0.00
MV BUS T-21	34.500	0.99416	2.87748	3.04438	0.99416	2.87748	3.04438	3.12886	3.35854	4.59016	0.00000	0.00000	0.00
MV BUS T-22	34.500	0.66894	2.80406	2.88274	0.66894	2.80406	2.88274	2.64433	3.28086	4.21385	0.00000	0.00000	0.00
MV BUS T-23	34.500	0.43158	2.81375	2.84665	0.43158	2.81375	2.84665	2.80021	3.47981	4.46657	0.00000	0.00000	0.00
MV BUS T-24	34.500	0.45702	2.61749	2.65709	0.45702	2.61749	2.65709	1.48113	2.83302	3.19683	0.00000	0.00000	0.00
MV BUS T-25	34.500	0.28115	2.54108	2.55659	0.28115	2.54108	2.55659	1.03898	2.71261	2.90478	0.00000	0.00000	0.00
MV BUS T-26	34.500	1.28848	3.09847	3.35570	1.28848	3.09847	3.35570	4.66446	3.96404	6.12134	0.00000	0.00000	0.00
MV BUS T-27	34.500	0.87995	3.00623	3.13237	0.87995	3.00623	3.13237	4.05581	3.86646	5.60349	0.00000	0.00000	0.00
MV BUS T-28	34.500	0.48909	2.91798	2.95869	0.48909	2.91798	2.95869	3.47349	3.77310	5.12849	0.00000	0.00000	0.00
MV BUS T-29	34.500	1.62165	3.01916	3.42711	1.62165	3.01916	3.42711	4.06372	3.50842	5.36869	0.00000	0.00000	0.00
MV BUS T-31	34.500	2.17657	3.48202	4.10632	2.17657	3.48202	4.10632	6.76098	4.47662	8.10870	0.00000	0.00000	0.00
MV BUS T-32	34.500	0.98196	3.21229	3.35903	0.98196	3.21229	3.35903	4.98120	4.19128	6.50993	0.00000	0.00000	0.00
MV BUS T-33	34.500	0.68038	3.14420	3.21697	0.68038	3.14420	3.21697	4.53189	4.11925	6.12423	0.00000	0.00000	0.00
MV BUS T-34	34.500	0.86067	3.22253	3.33548	0.86067	3.22253	3.33548	4.98514	4.24267	6.54614	0.00000	0.00000	0.00
MV BUS T-36	34.500	1.62081	3.39416	3.76129	1.62081	3.39416	3.76129	6.11764	4.42423	7.54979	0.00000	0.00000	0.00
MV BUS T-37	34.500	1.91941	3.46157	3.95811	1.91941	3.46157	3.95811	6.56250	4.49555	7.95465	0.00000	0.00000	0.00
MV BUS T-39	34.500	2.16430	3.51687	4.12947	2.16430	3.51687	4.12947	6.92735	4.55405	8.29021	0.00000	0.00000	0.00
MV BUS T-40	34.500	0.77589	3.43782	3.52428	0.77589	3.43782	3.52428	6.83122	5.23575	8.60689	0.00000	0.00000	0.00
MV BUS T-41	34.500	2.97605	4.00788	4.99199	2.97605	4.00788	4.99199	9.69933	6.12335	11.47050	0.00000	0.00000	0.00
MV BUS T-42	34.500	2.65845	3.93786	4.75122	2.65845	3.93786	4.75122	9.23443	6.05109	11.04039	0.00000	0.00000	0.00
MV BUS T-43	34.500	2.95769	4.00373	4.97773	2.95769	4.00373	4.97773	9.67198	6.11896	11.44503	0.00000	0.00000	0.00
MV BUS T-44	34.500	1.03101	3.79275	3.93038	1.03101	3.79275	3.93038	8.66473	5.89112	10.47774	0.00000	0.00000	0.00
MV BUS T-45	34.500	0.93685	3.68140	3.79873	0.93685	3.68140	3.79873	8.14376	5.72074	9.95227	0.00000	0.00000	0.00
MV BUS T-46	34.500	0.83905	3.53339	3.63164	0.83905	3.53339	3.63164	7.34622	5.42604	9.13284	0.00000	0.00000	0.00
MV BUS T-48	34.500	3.74945	4.32961	5.72747	3.74945	4.32961	5.72747	11.57362	6.62232	13.33431	0.00000	0.00000	0.00

Bus		Positive Seq. Imp. (ohm)			Negative Seq. Imp. (ohm)			Zero Seq. Imp. (ohm)			Fault Zf (ohm)		
ID	kV	Resistance	Reactance	Impedance	Resistance	Reactance	Impedance	Resistance	Reactance	Impedance	Resistance	Reactance	Impeda
MV BUS T-49	34.500	3.35538	4.24063	5.40755	3.35538	4.24063	5.40755	10.98652	6.52819	12.77971	0.00000	0.00000	0.00
MV BUS T-50	34.500	3.73660	4.32671	5.71687	3.73660	4.32671	5.71687	11.55448	6.61925	13.31617	0.00000	0.00000	0.00
POI	138.000	2.46184	10.77056	11.04833	2.46184	10.77056	11.04833	1.53107	9.88268	10.00058	0.00000	0.00000	0.00

Short-Circuit Summary Report

1½ Cycle - / -Phase, L3 , LL, & LL3 Fault Currents

Prefault Voltage G 100 = of the Bus Nominal Voltage

Bus		3-Phase Fault			Line-to-Ground Fault			Line-to-Line Fault			*Line-to-Line-to-Ground		
ID	%V	Real	Imag.	k ag.	Real	Imag.	k ag.	Real	Imag.	k ag.	Real	Imag.	k ag.
59F1A	/ 4.800	2.117	-18.99/	16.1/ 2	0.996	-12.866	12.608	1/ .570	1.548	1/ .99/	1/ .6/ 7	6.959	18./ 2/
59F2A	/ 4.800	2.117	-18.99/	16.1/ 2	0.996	-12.866	12.608	1/ .570	1.548	1/ .99/	1/ .6/ 7	6.959	18./ 2/
59F/ A	/ 4.800	2.117	-18.99/	16.1/ 2	0.996	-12.866	12.608	1/ .570	1.548	1/ .99/	1/ .6/ 7	6.959	18./ 2/
59F4A	/ 4.800	2.117	-18.99/	16.1/ 2	0.996	-12.866	12.608	1/ .570	1.548	1/ .99/	1/ .6/ 7	6.959	18./ 2/
59T1A	1/ 5.000	1.741	-5.17/	5./ 86	1.88/	-5.060	5.205	7.050	1.805	7.2/ 9	6./ 92	8.475	5.415
59T1B	/ 4.800	2.117	-18.99/	16.1/ 2	0.996	-12.866	12.608	1/ .570	1.548	1/ .99/	1/ .6/ 7	6.959	18./ 2/
HV BUS k PT	1/ 5.000	1.741	-5.17/	5./ 86	1.88/	-5.060	5.205	7.050	1.805	7.2/ 9	6./ 92	8.475	5.415
JB-2M	/ 4.800	2.897	-1/ .824	1/ .771	/ .82/	-5.70/	9./ 59	11.728	2.289	11.940	-1/ ./ 49	0.547	1/ ./ 76
JB-4M	/ 4.800	/ .5/ 9	-8.211	6.472	2.655	-2./ 00	/ .8/ 7	4.844	/ ./ / 1	8.6/ 4	-8.810	-2.6/ 8	6.105
LV BUS T-01	0.690	82.578	-8/ .662	78./ / 8	85.717	-89.705	5/ .742	46.465	48.796	68.242	1/ .47/	79.446	50.851
LV BUS T-02	0.690	8/ .577	-88.929	77.685	89.8/ 9	-61.860	58.641	45.4/ 1	46.668	67.284	-51.655	-12.4/ 0	52.625
LV BUS T-0/	0.690	84.508	-87.521	79.667	60.298	-6/ .079	57.261	80.070	47.465	65.994	-5/ .86/	-12.767	54.8/ /
LV BUS T-04	0.690	88.4/ 2	-85.850	50.680	60.500	-6/ .650	55.044	80.727	45.012	69.548	-54./ 76	-1/ .129	58./ 91
LV BUS T-08	0.690	86.165	-89./ 78	51.7/ /	61./ 59	-64./ 04	55.902	81.418	45.680	70.754	-58.244	-1/ .850	56./ 19
LV BUS T-06	0.690	86.9/ 8	-89.8/ /	52./ 78	61.99/	-64.42/	59.406	81.881	49./ 14	71./ 40	-58.861	-14.210	56.7/ /
LV BUS T-07	0.690	87.60/	-61.278	54.100	62.827	-68.779	90.788	8/ .060	49.59/	72.5/ 4	-57.2/ 2	-14./ 55	55.411
LV BUS T-05	0.690	85.817	-68.042	57.492	6/ .250	-65.689	9/ ./ 7/	86./ 2/	80.656	78.772	-90.7/ 0	-14./ 45	91.587
LV BUS T-09	0.690	60.162	-7/ .479	94.967	64.74/	-74.568	95.977	6/ .6/ 2	82.114	52.249	-95.819	-14.060	99.817
LV BUS T-10	0.690	60.647	-7/ .921	98.618	68.110	-78.164	99.444	64.014	82.8/ 4	52.511	-99.008	-14.408	100.047
LV BUS T-1/	0.690	88.599	-86.825	79.499	61.165	-62.041	57.128	45.949	45.416	65.549	18.194	52.798	54.175
LV BUS T-14	0.690	86.687	-85.266	51.271	61.771	-6/ .426	55.8/ 8	80.488	49.07/	70./ 54	-54./ 96	-14.269	58.894
LV BUS T-18	0.690	85.685	-62.721	58.576	6/ ./ 88	-66.556	92.127	84./ 1/	80.507	74./ 72	-55.7/ 0	-14.952	59.956
LV BUS T-16	0.690	86.11/	-87.842	50./ 7/	61./ / 5	-62.581	57.522	49.525	45.602	69.606	-5/ .6/ 5	-1/ .971	54.797
LV BUS T-17	0.690	61.689	-74.601	96.754	68.562	-78.614	100.276	64.60/	8/ .411	5/ .52/	-99.50/	-18.172	100.980
LV BUS T-20	0.690	89.286	-68.125	55.081	6/ .542	-65.71/	9/ .794	86./ 95	81./ 27	76.285	-90.968	-14.975	92.190
LV BUS T-21	0.690	60.796	-70.62/	9/ .157	68.109	-72.766	97.642	61.185	82.66/	50.707	-96.116	-18.157	97./ 05
LV BUS T-22	0.690	61./ 82	-72.946	98./ 16	68.854	-74.4/ 6	99.207	6/ .170	8/ .148	52.882	-95.275	-18.220	99.480
LV BUS T-2/	0.690	61.478	-74.750	96.508	68.7/ 5	-78.749	100.296	64.785	8/ .281	5/ .541	-99.927	-14.974	101.04/
LV BUS T-24	0.690	62.407	-74.151	96.940	66./ 52	-78.255	100./ 74	64.2/ 9	84.089	5/ .989	-99.87/	-18.918	100.5/ 7
LV BUS T-28	0.690	62.957	-78.60/	95.40/	66.544	-76.279	101.42/	68.471	84.862	58.226	-100.942	-16.189	102.227
LV BUS T-26	0.690	89.6/ 4	-65.726	90.991	64.201	-71.400	96.019	89.818	81.688	75.508	-94.206	-14.849	98./ 2/
LV BUS T-27	0.690	60./ 17	-71.617	9/ .6/ /	64.759	-7/ .807	97.954	62.019	82.247	51.09/	-96.599	-14.868	97.957
LV BUS T-25	0.690	60.90/	-74.46/	96.195	68./ 16	-78.844	99.568	64.454	82.786	5/ ./ 18	-99.8/ 6	-14.825	100.891
LV BUS T-29	0.690	89.6/ 0	-66.248	59.1/ 0	64.14/	-69.845	94.611	87./ 66	81.682	77.19/	-92.024	-18.066	9/ .249
LV BUS T-/ 1	0.690	87.145	-6/ .4/ 5	58./ 5/	62.208	-67.485	91.761	84.9/ 8	49.800	7/ .947	-59.020	-1/ .802	90.0/ 5

1½ Cycle - / -Phase, L3 , LL, & LL3 Fault Currents

Prefault Voltage G 100 = of the Bus Nominal Voltage

Bus		3-Phase Fault			Line-to-Ground Fault			Line-to-Line Fault			*Line-to-Line-to-Ground		
ID	%V	Real	Imag.	k ag.	Real	Imag.	k ag.	Real	Imag.	k ag.	Real	Imag.	k ag.
LV BUS T-/ 2	0.690	89.145	-71.194	92.889	6/ .919	-7/ .2/ 7	97.207	61.68/	81.2/ 8	50.16/	-96.290	-1/ .614	97.247
LV BUS T-/ /	0.690	89.870	-7/ ./ 12	94.46/	64./ 05	-74.767	95.619	6/ .457	81.601	51.512	-95.284	-1/ .867	99.157
LV BUS T-/ 4	0.690	89.054	-72.1/ 9	9/ .246	6/ .907	-7/ .9/ 2	97.724	62.471	81.179	50.785	-97.118	-1/ ./ 67	95.0/ 0
LV BUS T-/ 6	0.690	87.595	-67.168	55.678	62.560	-70.250	94.290	85.16/	80.180	76.799	-92.468	-1/ ./ 48	9/ .42/
LV BUS T-/ 7	0.690	87./ 94	-68.25/	56.924	62.4/ 1	-65.566	92.982	86.8/ /	49.71/	78.252	-90.696	-1/ ./ 09	91.667
LV BUS T-/ 9	0.690	86.951	-6/ .859	58./ 54	62.079	-67.875	91.764	88.066	49./ 86	7/ .945	-59.118	-1/ ./ 22	90.106
LV BUS T-40	0.690	85.208	-72.792	9/ .201	6/ ./ 20	-74.48/	97.7/ 5	6/ .045	80.481	50.745	-97.814	-12.479	95./ 10
LV BUS T-41	0.690	84.45/	-62.166	52.662	60.148	-66.897	59.7/ 6	8/ .914	47.2/ 0	71.678	-57./ 28	-11.808	55.079
LV BUS T-42	0.690	84.968	-6/ .968	54./ / 6	60.601	-69./ 16	92.072	86./ 76	47.675	7/ .5/ 4	-59.86/	-11.256	90.271
LV BUS T-4/	0.690	84.812	-62.267	52.787	60.205	-67.995	90.52/	84.904	47.256	72.489	-57.985	-11.259	55.650
LV BUS T-44	0.690	86.806	-71.806	91.1/ 7	62.022	-7/ .890	96.240	61.94/	45.992	75.976	-96.02/	-11.2/ 8	96.675
LV BUS T-48	0.690	87.046	-71.991	91.58/	62.440	-7/ .921	96.76/	62./ 89	49.488	79.890	-96.866	-11.614	97.262
LV BUS T-46	0.690	87.788	-72.454	92.650	62.979	-74.249	97./ 62	62.75/	80.064	50./ 00	-97.149	-12.142	97.908
LV BUS T-45	0.690	82.414	-85.500	75.769	85.427	-6/ .960	56.6/ 0	80.955	48.4/ 7	65.298	-5/ .587	-10.456	54.810
LV BUS T-49	0.690	8/ .021	-60.791	50.668	85.985	-68.842	55.185	82.716	48.96/	69.940	-58.762	-10.8/ 5	56.407
LV BUS T-80	0.690	82.4/ 4	-85.56/	75.5/ 0	85.448	-64.011	56.679	81.04/	48.484	65./ 45	-5/ .915	-10.455	54.871
k V BUS T-01	/ 4.800	/ .474	-2.845	4./ 05	2.5/ 2	-1.944	/ .4/ 8	2.206	/ .009	/ .7/ 1	-/ ./ 99	-2.228	4.062
k V BUS T-02	/ 4.800	/ .742	-2.975	4.75/	/ .0/ /	-2.268	/ .756	2.875	/ .242	4.142	-/ .581	-2./ / 0	4.801
k V BUS T-0/	/ 4.800	/ .999	-/ .40/	8.281	/ .215	-2.891	4.1/ 2	2.946	/ .468	4.845	-4.290	-2.420	4.928
k V BUS T-04	/ 4.800	4.174	-/ .892	8.807	/ ./ 62	-2.501	4./ 76	/ .109	/ .617	4.769	-4.818	-2.465	8.146
k V BUS T-08	/ 4.800	4./ 9/	-/ .508	8.512	/ .8/ 6	-/ .068	4.650	/ .29/	/ .507	8.0/ 4	1.518	8.090	8.404
k V BUS T-06	/ 4.800	4.627	-/ .5/ 7	6.011	/ .711	-/ .1/ 8	4.585	/ ./ 21	4.009	8.206	1.774	8./ / 4	8.621
k V BUS T-07	/ 4.800	4.574	-4.40/	6.865	/ .570	-/ .879	8.271	/ .511	4.224	8.659	2.209	8.7/ 2	6.14/
k V BUS T-05	/ 4.800	8.101	-8.96/	7.547	/ .922	-4.067	8.681	8.16/	4.422	6.795	-6.74/	-2.556	7./ / 8
k V BUS T-09	/ 4.800	/ .080	-10.576	11.298	/ .569	-6.068	7.194	9.428	2.649	9.791	-11.07/	-0.657	11.094
k V BUS T-10	/ 4.800	2.989	-11.427	11.504	/ .572	-6.879	7.6/ 4	9.904	2.871	10.2/ 2	-11.854	-0.401	11.890
k V BUS T-1/	/ 4.800	4.2/ 2	-/ .047	8.218	/ .491	-2.879	4./ 41	2.6/ 7	/ .666	4.816	1.18/	4.754	4.921
k V BUS T-14	/ 4.800	4.808	-/ .47/	8.655	/ .654	-2.94/	4.718	/ .006	/ .90/	4.926	1.480	8.179	8./ 75
k V BUS T-18	/ 4.800	8.278	-4.987	7.2/ 9	4.18/	-4.222	8.922	4.291	4.872	6.270	2.855	6.404	6.907
k V BUS T-16	/ 4.800	4./ 29	-/ .296	8.441	/ .807	-2.701	4.427	2.58/	/ .780	4.712	1./ 50	4.598	8.056
k V BUS T-17	/ 4.800	2.576	-12.890	12.914	/ .769	-7.765	5.6/ 4	10.914	2.800	11.196	-12.608	0.190	12.606
k V BUS T-20	/ 4.800	8.444	-6.065	5.182	4.181	-/ .921	8.710	8.284	4.720	7.06/	-6.909	-/ .256	7.681
k V BUS T-21	/ 4.800	8.044	-9.622	10.564	4./ 1/	-8.59/	7./ 0/	5./ / 6	4./ 75	9.418	-10.102	-2./ 02	10./ 60
k V BUS T-22	/ 4.800	4.086	-11.428	12.12/	4.098	-6.969	5.05/	9.901	/ .82/	10.809	-11.648	-1.098	11.696
k V BUS T-2/	/ 4.800	2.627	-12.806	12.779	/ .775	-7.16/	5.095	10.541	2.254	11.079	-12.490	0.058	12.490
k V BUS T-24	/ 4.800	/ .679	-1/ .060	1/ .865	/ .662	-9.091	9.501	11./ 21	/ .197	11.764	-12.981	0.247	12.98/
k V BUS T-28	/ 4.800	2.489	-14.467	14.674	2.560	-10./ 02	10.692	12.844	2.140	12.728	-1/ .557	1.516	14.008

1½ Cycle - / -Phase, L3 , LL, & LL3 Fault Currents

Prefault Voltage G 100 = of the Bus Nominal Voltage

Bus		3-Phase Fault			Line-to-Ground Fault			Line-to-Line Fault			*Line-to-Line-to-Ground		
ID	%V	Real	Imag.	k ag.	Real	Imag.	k ag.	Real	Imag.	k ag.	Real	Imag.	k ag.
k V BUS T-26	/ 4.800	8.022	-5.081	9.459	/ .986	-4./ 21	8.589	6.974	4./ 86	5.222	-5.807	-2.925	5.996
k V BUS T-27	/ 4.800	4.262	-9.996	10.567	/ .975	-8.2/ 5	6.877	5.661	/ .700	9.415	-10.242	-2.010	10.4/ 7
k V BUS T-25	/ 4.800	2.645	-11.57/	12.168	/ .755	-6./ 01	7./ 82	10.291	2./ 01	10.846	-11.552	-0./ 06	11.556
k V BUS T-29	/ 4.800	8.820	-6.679	5.668	4.2/ 9	-4.272	6.015	8.75/	4.756	7.807	-7.478	-/ .2/ 4	5.148
k V BUS T-/ 1	/ 4.800	4.680	-8.159	6.967	/ ./ 60	-2.77/	4./ 87	4.49/	4.0/ 0	6.0/ 6	-8.770	-/ .112	6.888
k V BUS T-/ 2	/ 4.800	/ .547	-9.196	9.965	/ .725	-4.499	8.54/	7.967	/ ./ / 5	5.6/ 5	-9.428	-1.947	9.624
k V BUS T-/ /	/ 4.800	2.597	-10.418	10.510	/ .696	-8.1/ /	6./ 28	9.028	2.816	9./ 69	-10.814	-0.984	10.887
k V BUS T-/ 4	/ 4.800	/ ./ 84	-9.614	10.15/	/ .668	-4.6/ /	8.905	5./ / 1	2.911	5.528	-9.774	-1.804	9.559
k V BUS T-/ 6	/ 4.800	4.810	-6.549	5.200	/ .822	-/ ./ 97	4.59/	8.9/ 1	/ .911	7.108	-7.271	-2.5/ 6	7.504
k V BUS T-/ 7	/ 4.800	4.858	-8.945	7.810	/ .412	-/ .026	4.861	8.181	/ .978	6.806	-6.444	-/ .000	7.105
k V BUS T-/ 9	/ 4.800	4.877	-8.2/ 6	6.984	/ ./ 12	-2.744	4./ 01	4.8/ /	/ .967	6.024	-8.755	-/ .065	6.881
k V BUS T-40	/ 4.800	2.680	-9.428	9.791	/ .2/ 7	-/ .7/ 0	4.9/ 5	5.159	2./ 07	5.807	-9./ 74	-1.266	9.489
k V BUS T-41	/ 4.800	/ .525	-4.895	8.952	2.601	-2.096	/ ./ 40	4.007	/ ./ 24	8.207	-4.944	-2.679	8.62/
k V BUS T-42	/ 4.800	/ .5/ 8	-8.197	6.485	2.654	-2.294	/ .8/ 1	4.8/ 2	/ ./ 25	8.622	-8.496	-2.6/ 4	6.098
k V BUS T-4/	/ 4.800	/ .5/ 0	-4.629	6.009	2.606	-2.107	/ ./ 81	4.0/ 5	/ ./ 28	8.2/ 1	-4.976	-2.677	8.680
k V BUS T-44	/ 4.800	2.6/ /	-5.195	5.610	2.906	-2.968	4.182	7.125	2.292	7.457	-5.187	-1.490	5.292
k V BUS T-48	/ 4.800	2.618	-5.856	5.976	2.999	-/ .16/	4./ 85	7.464	2.277	7.50/	-5.8/ /	-1.417	5.649
k V BUS T-46	/ 4.800	2.640	-9.056	9.462	/ .14/	-/ .455	4.698	7.598	2.295	5.22/	-9.0/ /	-1./ / 8	9.1/ 1
k V BUS T-45	/ 4.800	/ .416	-/ .6/ 1	4.958	2.290	-1.672	2.5/ 6	/ .161	2.965	4./ / 8	-/ .957	-2.480	4.650
k V BUS T-49	/ 4.800	/ .497	-4.1/ 5	8.415	2./ 54	-1.541	/ .012	/ .604	/ .0/ 7	4.71/	-4.461	-2.477	8.102
k V BUS T-80	/ 4.800	/ .419	-/ .646	4.999	2.29/	-1.677	2.541	/ .174	2.970	4./ 47	-4.001	-2.482	4.69/
POI	1/ 5.000	1.747	-5.198	5./ 50	1.862	-5.092	5.242	7.099	1.814	7.289	6.406	8.808	5.446

All fault currents are symmetrical (1½ Cycle networ%) values in rms %A.
* LL3 fault current is the larger of the two faulted line currents.

Sequence Impedance Summary Report

Bus		Positive Seq. Imp. (ohm)			Negative Seq. Imp. (ohm)			Zero Seq. Imp. (ohm)			Fault Zf (ohm)		
ID	%V	Resistance	Reactance	Impedance	Resistance	Reactance	Impedance	Resistance	Reactance	Impedance	Resistance	Reactance	Impeda
59F1A	/ 4.800	0.16201	1.22402	1.2/ 470	0.16/ 01	1.22008	1.2/ 059	0.04980	2.25189	2.2521/	0.00000	0.00000	0.00
59F2A	/ 4.800	0.16201	1.22402	1.2/ 470	0.16/ 01	1.22008	1.2/ 059	0.04980	2.25189	2.2521/	0.00000	0.00000	0.00
59F/ A	/ 4.800	0.16201	1.22402	1.2/ 470	0.16/ 01	1.22008	1.2/ 059	0.04980	2.25189	2.2521/	0.00000	0.00000	0.00
59F4A	/ 4.800	0.16201	1.22402	1.2/ 470	0.16/ 01	1.22008	1.2/ 059	0.04980	2.25189	2.2521/	0.00000	0.00000	0.00
59T1A	1/ 5.000	1.95605	9./ 2868	9.8/ 479	1.95857	9./ 2017	9.829/ 9	1.8/ 754	9.94717	10.068/ 4	0.00000	0.00000	0.00
59T1B	/ 4.800	0.16201	1.22402	1.2/ 470	0.16/ 01	1.22008	1.2/ 059	0.04980	2.25189	2.2521/	0.00000	0.00000	0.00
HV BUS k PT	1/ 5.000	1.95605	9./ 2868	9.8/ 479	1.95857	9./ 2017	9.829/ 9	1.8/ 754	9.94717	10.068/ 4	0.00000	0.00000	0.00
JB-2M	/ 4.800	0.27275	1.42044	1.446/ 9	0.27/ 50	1.4167/	1.44298	1.54150	/ .062/ /	/ .87/ 82	0.00000	0.00000	0.00
JB-4M	/ 4.800	1.528/ 1	2.47759	/ .07762	1.79490	2.46040	/ .0488/	9.21412	6.04886	11.020/ 5	0.00000	0.00000	0.00
LV BUS T-01	0.690	0.00/ 71	0.00/ 77	0.00829	0.00/ 71	0.00/ 77	0.00829	0.00285	0.00264	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-02	0.690	0.00/ 86	0.00/ 69	0.0081/	0.00/ 86	0.00/ 69	0.0081/	0.00285	0.00264	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-0/	0.690	0.00/ 44	0.00/ 6/	0.00800	0.00/ 44	0.00/ 6/	0.00800	0.00285	0.00264	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-04	0.690	0.00/ 40	0.00/ 89	0.00494	0.00/ 40	0.00/ 89	0.00494	0.00285	0.00264	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-08	0.690	0.00/ / 8	0.00/ 84	0.00457	0.00/ / 8	0.00/ 84	0.00457	0.00285	0.00264	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-06	0.690	0.00/ / 4	0.00/ 80	0.00454	0.00/ / 4	0.00/ 49	0.00454	0.00285	0.00264	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-07	0.690	0.00/ 24	0.00/ 48	0.00474	0.00/ 28	0.00/ 48	0.00474	0.00285	0.00264	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-05	0.690	0.00/ 08	0.00/ / 5	0.00488	0.00/ 08	0.00/ / 5	0.00488	0.00285	0.00264	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-09	0.690	0.00266	0.00/ 28	0.00419	0.00266	0.00/ 24	0.00419	0.00285	0.00264	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-10	0.690	0.00264	0.00/ 22	0.00417	0.00264	0.00/ 22	0.00417	0.00285	0.00264	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-1/	0.690	0.00/ 82	0.00/ 86	0.00801	0.00/ 82	0.00/ 86	0.00801	0.00285	0.00264	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-14	0.690	0.00/ 42	0.00/ 81	0.00490	0.00/ 42	0.00/ 81	0.00490	0.00285	0.00264	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-18	0.690	0.00/ 17	0.00/ / 9	0.00464	0.00/ 17	0.00/ / 9	0.00464	0.00285	0.00264	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-16	0.690	0.00/ 46	0.00/ 88	0.00496	0.00/ 46	0.00/ 88	0.00496	0.00285	0.00264	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-17	0.690	0.00262	0.00/ 17	0.00412	0.00262	0.00/ 17	0.00412	0.00285	0.00264	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-20	0.690	0.00/ 04	0.00/ / 8	0.00482	0.00/ 08	0.00/ / 8	0.00482	0.00285	0.00264	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-21	0.690	0.00279	0.00/ 24	0.00427	0.00279	0.00/ 24	0.00427	0.00285	0.00264	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-22	0.690	0.00269	0.00/ 20	0.00415	0.00269	0.00/ 20	0.00415	0.00285	0.00264	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-2/	0.690	0.00261	0.00/ 15	0.00412	0.00261	0.00/ 15	0.00411	0.00285	0.00264	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-24	0.690	0.00268	0.00/ 14	0.00411	0.00268	0.00/ 14	0.00411	0.00285	0.00264	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-28	0.690	0.00289	0.00/ 11	0.00408	0.00289	0.00/ 11	0.00408	0.00285	0.00264	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-26	0.690	0.00257	0.00/ / 1	0.004/ 5	0.00257	0.00/ / 1	0.004/ 5	0.00285	0.00264	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-27	0.690	0.00274	0.00/ 28	0.00428	0.00274	0.00/ 28	0.00428	0.00285	0.00264	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-25	0.690	0.00262	0.00/ 21	0.00414	0.00262	0.00/ 20	0.00414	0.00285	0.00264	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-29	0.690	0.00299	0.00/ / 2	0.00447	0.00299	0.00/ / 2	0.00447	0.00285	0.00264	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-/ 1	0.690	0.00/ 12	0.00/ 47	0.00467	0.00/ 12	0.00/ 47	0.00467	0.00285	0.00264	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-/ 2	0.690	0.00278	0.00/ / 1	0.004/ 0	0.00278	0.00/ / 1	0.004/ 0	0.00285	0.00264	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-/ /	0.690	0.00266	0.00/ 27	0.00422	0.00266	0.00/ 27	0.00422	0.00285	0.00264	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-/ 4	0.690	0.00271	0.00/ / 1	0.00427	0.00271	0.00/ / 0	0.00427	0.00285	0.00264	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-/ 6	0.690	0.0029/	0.00/ 40	0.00449	0.0029/	0.00/ 40	0.00449	0.00285	0.00264	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-/ 7	0.690	0.00/ 0/	0.00/ 44	0.00485	0.00/ 0/	0.00/ 44	0.00485	0.00285	0.00264	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-/ 9	0.690	0.00/ 11	0.00/ 47	0.00467	0.00/ 11	0.00/ 47	0.00467	0.00285	0.00264	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-40	0.690	0.00267	0.00/ / 4	0.00427	0.00267	0.00/ / /	0.00427	0.00285	0.00264	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-41	0.690	0.00/ 15	0.00/ 62	0.00452	0.00/ 17	0.00/ 62	0.00451	0.00285	0.00264	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-42	0.690	0.00/ 05	0.00/ 85	0.00472	0.00296	0.00/ 88	0.00462	0.00281	0.00264	0.00/ 64	0.00000	0.00000	0.00
LV BUS T-4/	0.690	0.00/ 17	0.00/ 62	0.00451	0.00/ 04	0.00/ 89	0.00471	0.00281	0.00264	0.00/ 64	0.00000	0.00000	0.00
LV BUS T-44	0.690	0.00271	0.00/ 4/	0.004/ 7	0.00271	0.00/ 42	0.004/ 7	0.00285	0.00264	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-48	0.690	0.00269	0.00/ 40	0.004/ 4	0.00269	0.00/ / 9	0.004/ /	0.00285	0.00264	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-46	0.690	0.00265	0.00/ / 6	0.004/ 0	0.00265	0.00/ / 6	0.00429	0.00285	0.00264	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-45	0.690	0.00/ / 7	0.00/ 75	0.00806	0.00/ / 6	0.00/ 77	0.00808	0.00285	0.00264	0.00/ 70	0.00000	0.00000	0.00

Bus		Positive Seq. Imp. (ohm)			Negative Seq. Imp. (ohm)			Zero Seq. Imp. (ohm)			Fault Zf (ohm)		
ID	%V	Resistance	Reactance	Impedance	Resistance	Reactance	Impedance	Resistance	Reactance	Impedance	Resistance	Reactance	Impeda
LV BUS T-49	0.690	0.00/ 28	0.00/ 72	0.00494	0.00/ 24	0.00/ 71	0.0049/	0.00285	0.00264	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-80	0.690	0.00/ / 6	0.00/ 77	0.00808	0.00/ / 8	0.00/ 77	0.00804	0.00285	0.00264	0.00/ 70	0.00000	0.00000	0.00
k V BUS T-01	/ 4.800	/ .7277/	2.7/ 468	4.62/ 2/	/ .72971	2.7/ 202	4.62/ 27	6.55850	4./ 5042	5.16102	0.00000	0.00000	0.00
k V BUS T-02	/ 4.800	/ .28585	2.89/ 60	4.16478	/ .26084	2.89098	4.1646/	6.12909	4.28911	7.46/ 6/	0.00000	0.00000	0.00
k V BUS T-0/	/ 4.800	2.55568	2.48528	/ .79/ 08	2.59087	2.48888	/ .79277	8.4569/	4.18616	6.55/ / 1	0.00000	0.00000	0.00
k V BUS T-04	/ 4.800	2.74154	2./ 8904	/ .61701	2.74/ 78	2./ 86/ 0	/ .61667	8.00879	4.02814	6.42/ / 7	0.00000	0.00000	0.00
k V BUS T-08	/ 4.800	2.89074	2.24/ 64	/ .42722	2.89262	2.24054	/ .42651	4.46670	/ .575/ 4	8.91849	0.00000	0.00000	0.00
k V BUS T-06	/ 4.800	2.88065	2.1184/	/ ./ 1/ 76	2.88281	2.11246	/ ./ 1/ 25	4.29441	/ .710/ 7	8.67825	0.00000	0.00000	0.00
k V BUS T-07	/ 4.800	2.280/ 7	2.0/ 26/	/ .0/ 248	2.28215	2.02964	/ .0/ 179	/ .51950	/ .6/ 425	8.27246	0.00000	0.00000	0.00
k V BUS T-05	/ 4.800	1.68007	1.9257/	2.8/ 526	1.6816/	1.9286/	2.8/ 692	4.0/ 595	/ .78511	8.81698	0.00000	0.00000	0.00
k V BUS T-09	/ 4.800	0.4762/	1.69759	1.76/ 42	0.47727	1.694/ 9	1.760/ 2	/ .81/ 70	/ .61048	8.0/ 500	0.00000	0.00000	0.00
k V BUS T-10	/ 4.800	0.42/ 0/	1.6/ / 89	1.65747	0.42406	1.6/ 00/	1.65429	/ .1229/	/ .45268	4.67777	0.00000	0.00000	0.00
k V BUS T-1/	/ 4.800	/ .09967	2.2/ 204	/ .51965	/ .10188	2.22911	/ .51949	4.57220	/ .71541	6.12902	0.00000	0.00000	0.00
k V BUS T-14	/ 4.800	2.77/ 46	2.1/ 505	/ .80192	2.778/ 1	2.1/ 81/	/ .80189	4./ 8/ 45	/ .6/ 828	8.67167	0.00000	0.00000	0.00
k V BUS T-18	/ 4.800	2.00815	1.55428	2.78187	2.00696	1.55120	2.78075	/ .064/ 5	/ .42585	4.8954/	0.00000	0.00000	0.00
k V BUS T-16	/ 4.800	2.91260	2.21756	/ .66059	2.91444	2.21491	/ .66085	4.56556	/ .50247	6.17778	0.00000	0.00000	0.00
k V BUS T-17	/ 4.800	0./ 4/ 45	1.80/ 62	1.842/ 8	0./ 4481	1.49999	1.8/ 908	2./ / / / 0	/ .22/ 07	/ .97900	0.00000	0.00000	0.00
k V BUS T-20	/ 4.800	1.6/ 164	1.51566	2.44/ / 2	1.6/ 25/	1.51811	2.44146	4./ 4/ 05	/ .88/ 21	8.611/ 9	0.00000	0.00000	0.00
k V BUS T-21	/ 4.800	0.581/ 2	1.62/ 58	1.5/ / 47	0.58248	1.62028	1.5/ 052	/ .12556	/ ./ 8584	4.89016	0.00000	0.00000	0.00
k V BUS T-22	/ 4.800	0.84966	1.845/ 0	1.64295	0.88078	1.84465	1.6/ 99/	2.644/ /	/ .25056	4.21/ 58	0.00000	0.00000	0.00
k V BUS T-2/	/ 4.800	0./ 2042	1.828/ 5	1.88567	0./ 2146	1.82151	1.888/ 9	2.50021	/ .47951	4.46687	0.00000	0.00000	0.00
k V BUS T-24	/ 4.800	0./ 9508	1.41/ 08	1.46504	0./ 9906	1.40922	1.46464	1.4511/	2.5/ / 02	/ .1965/	0.00000	0.00000	0.00
k V BUS T-28	/ 4.800	0.22749	1./ / 520	1./ 8740	0.22580	1./ / 4/ 6	1./ 8/ 79	1.0/ 595	2.71261	2.90475	0.00000	0.00000	0.00
k V BUS T-26	/ 4.800	1.11059	1.75105	2.09912	1.11201	1.77768	2.09651	4.66446	/ .96404	6.121/ 4	0.00000	0.00000	0.00
k V BUS T-27	/ 4.800	0.71596	1.65609	1.5/ 297	0.72008	1.65264	1.5/ 024	4.08851	/ .56646	8.60/ 49	0.00000	0.00000	0.00
k V BUS T-25	/ 4.800	0./ 8644	1.89505	1.6/ 7/ 8	0./ 8749	1.89460	1.6/ 415	/ .47/ 49	/ .77/ 10	8.12549	0.00000	0.00000	0.00
k V BUS T-29	/ 4.800	1.46480	1.77196	2.2955/	1.46868	1.765/ 9	2.29650	4.06/ 72	/ .80542	8./ 6569	0.00000	0.00000	0.00
k V BUS T-/ 1	/ 4.800	1.90756	2.12917	2.58590	1.90906	2.12892	2.58727	6.76095	4.47662	5.10570	0.00000	0.00000	0.00
k V BUS T-/ 2	/ 4.800	0.77112	1.54/ 47	1.99528	0.77224	1.54017	1.99864	4.95120	4.19125	6.8099/	0.00000	0.00000	0.00
k V BUS T-/ /	/ 4.800	0.49/ 77	1.77815	1.54285	0.49456	1.77158	1.5/ 966	4.8/ 159	4.11928	6.1242/	0.00000	0.00000	0.00
k V BUS T-/ 4	/ 4.800	0.644/ 4	1.54694	1.98611	0.64847	1.54/ 68	1.98/ / 5	4.95814	4.24267	6.84614	0.00000	0.00000	0.00
k V BUS T-/ 6	/ 4.800	1./ / 890	2.02589	2.42598	1./ / 712	2.028/ 7	2.4269/	6.11764	4.4242/	7.84979	0.00000	0.00000	0.00
k V BUS T-/ 7	/ 4.800	1.61925	2.10072	2.682/ 7	1.62081	2.09781	2.68085	6.86280	4.49888	7.98468	0.00000	0.00000	0.00
k V BUS T-/ 9	/ 4.800	1.55809	2.18661	2.564/ 6	1.556/ 0	2.18/ / 5	2.56272	6.927/ 8	4.88408	5.29021	0.00000	0.00000	0.00
k V BUS T-40	/ 4.800	0.88062	1.98547	2.0/ 440	0.84914	1.94451	2.02058	6.5/ 122	8.2/ 878	5.60659	0.00000	0.00000	0.00
k V BUS T-41	/ 4.800	2.1/ 0/ 6	2.8855/	/ ./ 2985	2.10012	2.84119	/ .29669	9.699/ /	6.12/ / 8	11.47080	0.00000	0.00000	0.00
k V BUS T-42	/ 4.800	1.5/ 120	2.45168	/ .0541/	1.50070	2.46418	/ .08197	9.2/ 44/	6.08109	11.040/ 9	0.00000	0.00000	0.00
k V BUS T-4/	/ 4.800	2.11/ 20	2.8842/	/ ./ 1807	2.079/ 1	2.8/ 7/ 9	/ .2508/	9.67195	6.11596	11.4480/	0.00000	0.00000	0.00
k V BUS T-44	/ 4.800	0.707/ 8	2.20286	2./ 1/ / 8	0.70/ 41	2.15407	2.29488	5.6647/	8.59112	10.47774	0.00000	0.00000	0.00
k V BUS T-48	/ 4.800	0.64662	2.12251	2.21910	0.64/ 72	2.10896	2.20218	5.14/ 76	8.72074	9.98227	0.00000	0.00000	0.00
k V BUS T-46	/ 4.800	0.857/ /	2.02185	2.10817	0.858/ 4	2.0067/	2.090/ 8	7./ 4622	8.42604	9.1/ 254	0.00000	0.00000	0.00
k V BUS T-45	/ 4.800	2.7/ 791	2.90959	/ .99848	2.70904	2.59142	/ .9622/	11.87/ 62	6.622/ 2	1/ ./ / 4/ 1	0.00000	0.00000	0.00
k V BUS T-49	/ 4.800	2./ 7299	2.505/ 1	/ .67664	2./ 4/ 90	2.79002	/ .64/ 91	10.95682	6.82519	12.77971	0.00000	0.00000	0.00
k V BUS T-80	/ 4.800	2.72604	2.90684	/ .95455	2.69716	2.55505	/ .98167	11.88445	6.61928	1/ ./ 1617	0.00000	0.00000	0.00
POI	1/ 5.000	1.95266	9.29921	9.80522	1.95248	9.29/ 77	9.80256	1.8/ 107	9.55265	10.00085	0.00000	0.00000	0.00

Short-Circuit Summary Report

1½ Cycle - / -Phase, L3 , LL, & LL3 Fault Currents

Prefault Voltage G 100 = of the Bus Nominal Voltage

Bus		3-Phase Fault			Line-to-Ground Fault			Line-to-Line Fault			*Line-to-Line-to-Ground		
ID	%V	Real	Imag.	k ag.	Real	Imag.	k ag.	Real	Imag.	k ag.	Real	Imag.	k ag.
89F1A	/ 5.400	2.082	-16.590	16.621	0.961	-12.767	12.805	15./ 01	1.814	15.516	15.074	6.994	14.718
89F2A	/ 5.400	2.082	-16.590	16.621	0.961	-12.767	12.805	15./ 01	1.814	15.516	15.074	6.994	14.718
89F/ A	/ 5.400	2.082	-16.590	16.621	0.961	-12.767	12.805	15./ 01	1.814	15.516	15.074	6.994	14.718
89F5A	/ 5.400	2.082	-16.590	16.621	0.961	-12.767	12.805	15./ 01	1.814	15.516	15.074	6.994	14.718
89T1A	1/ 8.000	2.1/ 0	-9.879	10.104	1.776	-9.215	9./ 8/	8.447	1.854	8.745	7.810	6.146	9.954
89T1B	/ 5.400	2.082	-16.590	16.621	0.961	-12.767	12.805	15./ 01	1.814	15.516	15.074	6.994	14.718
HV BUS k PT	1/ 8.000	2.1/ 0	-9.879	10.104	1.776	-9.215	9./ 8/	8.447	1.854	8.745	7.810	6.146	9.954
JB-2M	/ 5.400	2.621	-1/ .862	15.107	/ .471	-8.797	9.595	12.017	2.280	12.2/ 1	-1/ .641	0.8/ 8	1/ .677
JB-5M	/ 5.400	/ .892	-4.2/ 0	6.419	2.699	-2.299	/ .454	5.460	/ ./ 78	4.674	-4.428	-2.682	6.155
LV BUS T-01	0.690	4/ .018	-4/ .6/ 2	74.515	48.8/ 4	-49.68/	8/ .807	56.552	54.919	64./ 10	1/ .509	79.462	80.685
LV BUS T-02	0.690	45.0/ 1	-44.901	77.754	49.662	-61.4/ 7	84.711	58.507	56.797	67./ 29	-81.70/	-12.469	82.665
LV BUS T-0/	0.690	45.968	-47.798	79.762	60.524	-6/ .049	87./ / 6	40.059	57.609	69.077	-8/ .48/	-12.915	85.475
LV BUS T-05	0.690	44.600	-48.448	80.759	60.9/ /	-6/ .661	88.12/	40.708	58.147	69.9/ 1	-85./ 97	-1/ .281	84.5/ 6
LV BUS T-04	0.690	46./ 55	-49./ 44	81.8/ 9	61.427	-65.287	88.984	41./ 98	58.801	70.874	-84.268	-1/ .7/ 7	86./ 67
LV BUS T-06	0.690	47.119	-49.417	82.591	62.1/ 8	-65.510	89.597	41.4/ 8	59.57/	71.550	-84.490	-15./ 75	86.789
LV BUS T-07	0.690	47.796	-61.26/	85.22/	62.676	-64.768	90.840	4/ .040	40.060	72.950	-87.266	-15.449	88.572
LV BUS T-08	0.690	48.724	-64.044	87.650	6/ .5/ 7	-68.664	9/ .585	46./ / 5	40.866	74.900	-90.786	-15.427	91.951
LV BUS T-09	0.690	60.507	-7/ .46/	94.187	65.92/	-75.916	99.1/ /	6/ .704	42./ 24	82.5/ 9	-98.652	-15.260	99.667
LV BUS T-10	0.690	60.898	-75.008	94.852	64.295	-74.218	99.605	65.090	42.741	8/ .007	-99.1/ 1	-15.610	100.202
LV BUS T-1/	0.690	46.070	-46.405	79.602	61./ 04	-62.02/	87.207	58.929	58.465	68.9/ 8	14.1/ 2	82.9/ 7	85./ 06
LV BUS T-15	0.690	46.8/ 7	-48.256	81./ 82	61.912	-6/ .509	88.622	40.5/ 7	59.228	70.579	-85.521	-15.529	84.656
LV BUS T-14	0.690	48.862	-62.71/	86.009	6/ .410	-66.877	92.229	45./ 06	40.98/	75.587	-88.769	-14.161	90.045
LV BUS T-16	0.690	46.288	-47.422	80.580	61.577	-62.8/ 6	87.908	59.810	58.74/	69.699	14.962	8/ ./ 75	85.888
LV BUS T-17	0.690	61.921	-75.692	97.021	66.042	-74.669	100.55/	65.682	4/ .6/ 7	85.028	-99.9/ 5	-14./ 86	101.111
LV BUS T-20	0.690	49.579	-64.172	88.2/ 5	65.011	-68.752	9/ .9/ 1	46.5/ 6	41.420	76.516	-91.042	-14.165	92./ 06
LV BUS T-21	0.690	61.055	-70.690	9/ ./ 99	64.291	-72.808	97.796	61.216	42.876	80.891	-96.224	-14./ 92	97.558
LV BUS T-22	0.690	61.610	-7/ .026	94.45/	64.772	-75.586	99./ 68	6/ .2/ 9	4/ ./ 67	82.758	-98./ 99	-14.5/ 1	99.602
LV BUS T-2/	0.690	61.7/ /	-75.869	97.0/ 8	64.924	-74.80/	100.560	65.8/ 4	4/ .575	85.052	-100.044	-14.186	101.201
LV BUS T-25	0.690	62.682	-75.276	97.190	66.482	-74./ 57	100.440	65./ 22	45.297	85.174	-99.710	-16.150	101.008
LV BUS T-24	0.690	6/ .270	-74.704	98.66/	67.057	-76./ 51	101.60/	64.460	45.807	84.541	-101.084	-16./ 91	102.506
LV BUS T-26	0.690	49.861	-68.782	91.18/	65./ 70	-71.5/ 6	96.149	49.465	41.841	78.970	-95./ 0/	-15.7/ 7	94.558
LV BUS T-27	0.690	60.444	-71.686	9/ .850	65.965	-7/ .459	98.1/ 2	62.079	42.54/	81.272	-97.008	-15.762	98.125
LV BUS T-28	0.690	61.14/	-75.458	96.521	64.598	-74.494	100.02/	65.447	42.972	8/ .408	-99.660	-15.7/ /	100.75/
LV BUS T-29	0.690	49.849	-66.294	89./ 20	65./ 14	-69.481	95.742	47.509	41.859	77./ 47	-92.116	-14.246	9/ ./ 71
LV BUS T-/ 1	0.690	47./ 5/	-6/ .572	84.4/ 9	62./ 44	-67.581	91.880	45.965	59.669	75.082	-89.095	-1/ .664	90.1/ 6

1Ø Cycle - / -Phase, L3 , LL, & LL3 Fault Currents

Prefault Voltage G 100 = of the Bus Nominal Voltage

Bus		3-Phase Fault			Line-to-Ground Fault			Line-to-Line Fault			*Line-to-Line-to-Ground		
ID	%V	Real	Imag.	k ag.	Real	Imag.	k ag.	Real	Imag.	k ag.	Real	Imag.	k ag.
LV BUS T-/ 2	0.690	49./ 75	-71.248	92.74/	65.086	-7/ .276	97./ 57	61.708	41.5/ 0	80./ / 0	-96./ 92	-1/ .801	97./ 74
LV BUS T-/ /	0.690	49.805	-7/ ./ 87	95.669	65.580	-75.812	98.764	6/ .442	41.802	81.990	-98./ 67	-1/ .749	99./ 24
LV BUS T-/ 5	0.690	49./ 11	-72.206	9/ .55/	65.074	-7/ .972	97.864	62.429	41./ 74	80.928	-97.220	-1/ .444	98.161
LV BUS T-/ 6	0.690	48.104	-67.209	88.855	6/ .017	-70./ 07	95.516	48.201	40./ / 0	76.954	-92.458	-1/ .419	9/ .4/ 0
LV BUS T-/ 7	0.690	47.495	-64./ 20	87.085	62.485	-68.890	9/ .07/	46.464	59.886	74.520	-90.77/	-1/ .576	91.767
LV BUS T-/ 9	0.690	47.176	-6/ .62/	84.4/ 9	62.229	-67.600	91.882	44.094	59.425	75.082	-89.189	-1/ .585	90.20/
LV BUS T-50	0.690	48.519	-72.865	9/ ./ 91	6/ .578	-75.597	97.87/	6/ .110	40.6/ 4	80.912	-97.622	-12.645	98.5/ 9
LV BUS T-51	0.690	45.651	-62.167	82.767	60.268	-66.495	89.816	4/ .914	57./ 66	71.766	-87./ 6/	-11.65/	88.1/ 6
LV BUS T-52	0.690	44.1/ 0	-6/ .971	85.559	60.729	-69./ 16	92.146	46./ 81	57.820	7/ .9/ 0	-89.607	-11.5/ 0	90./ / /
LV BUS T-5/	0.690	45.671	-62.269	82.86/	60./ / 2	-67.996	90.90/	45.904	57.52/	72.440	-87.998	-11.528	88.7/ 7
LV BUS T-55	0.690	46.699	-71.468	91./ 06	62.167	-7/ .627	96./ 62	61.996	59.148	79.120	-96.118	-11./ 95	96.791
LV BUS T-54	0.690	47.254	-72.046	92.028	62.488	-7/ .960	96.889	62.516	59.627	79.750	-96.664	-11.777	97./ 80
LV BUS T-56	0.690	47.962	-72.44/	92.865	6/ .1/ /	-75.291	97.59/	62.85/	40.25/	80.548	-97.24/	-12./ 1/	98.0/ 0
LV BUS T-58	0.690	42.445	-48.79/	78.848	48.4/ 9	-6/ .942	86.699	40.981	54.447	68./ 71	-8/ .886	-10.610	85.445
LV BUS T-59	0.690	4/ .169	-60.788	80.760	49.075	-64.4/ 6	88.2/ 1	42.715	56.090	70.022	-84.794	-10.668	86.546
LV BUS T-40	0.690	42.475	-48.846	78.919	48.447	-65.002	86.758	41.0/ 6	54.474	68.525	-8/ .957	-10.61/	85.614
k V BUS T-01	/ 5.400	/ .400	-2.4/ 8	5./ 2/	2.852	-1.9/ 9	/ .551	2.197	/ .0/ 1	/ .755	-/ ./ 92	-2.259	5.069
k V BUS T-02	/ 5.400	/ .774	-2.968	5.802	/ .057	-2.260	/ .795	2.470	/ .270	5.149	-/ .854	-2./ 49	5.411
k V BUS T-0/	/ 5.400	5.050	-/ ./ 94	4.277	/ .2/ 4	-2.486	5.152	2.9/ 8	/ .400	5.470	-5.284	-2.546	5.9/ 9
k V BUS T-05	/ 5.400	5.220	-/ .48/	4.4/ 6	/ ./ 82	-2.797	5./ 88	/ .101	/ .646	5.795	-5.411	-2.408	4.161
k V BUS T-04	/ 5.400	5.554	-/ .796	4.854	/ .449	-/ .061	5.695	/ .286	/ .841	4.062	1.80/	4.1/ 5	4.551
k V BUS T-06	/ 5.400	5.68/	-/ .827	6.058	/ .7/ 6	-/ .1/ 1	5.874	/ ./ 1/	5.048	4.2/ 8	1.761	4./ 82	4.66/
k V BUS T-07	/ 5.400	5.95/	-5./ 97	6.616	/ .900	-/ .478	4.29/	/ .806	5.28/	4.7/ 0	2.198	4.791	6.195
k V BUS T-08	/ 5.400	4.196	-4.988	7.928	/ .946	-5.072	4.678	4.185	5.405	6.867	-6.770	-2.968	7./ 92
k V BUS T-09	/ 5.400	/ .107	-11.085	11.411	/ .915	-6.105	7.241	9.606	2.698	9.978	-11.261	-0.7/ 2	11.284
k V BUS T-10	/ 5.400	/ .010	-11.661	12.05/	/ .919	-6.627	7.699	10.106	2.614	10.5/ 9	-11.795	-0.550	11.802
k V BUS T-1/	/ 5.400	5.27/	-/ .0/ /	4.250	/ .411	-2.47/	5./ 4/	2.624	/ .701	5.4/ 8	1.1/ 7	5.818	5.941
k V BUS T-15	/ 5.400	5.444	-/ .560	4.720	/ .708	-2.9/ 8	5.7/ 1	2.995	/ .956	5.945	1.5/ 5	4.221	4.515
k V BUS T-14	/ 5.400	4./ 60	-5.944	7.299	5.191	-5.225	4.940	5.289	5.654	6./ 22	2.478	6.578	6.972
k V BUS T-16	/ 5.400	5./ 75	-/ .285	4.570	/ .428	-2.694	5.550	2.852	/ .790	5.7/ 7	1./ 66	5.9/ /	4.118
k V BUS T-17	/ 5.400	2.920	-12.879	1/ .206	/ .820	-7.850	8.721	11.165	2.4/ 8	11.558	-12.864	0.161	12.866
k V BUS T-20	/ 5.400	4.441	-6.108	8.245	5.188	-/ .928	4.752	4.288	5.81/	7.140	-6.940	-/ ./ 78	7.727
k V BUS T-21	/ 5.400	4.177	-9.779	11.064	5./ 66	-4.927	7./ 62	8.571	5.59/	9.489	-10.256	-2.51/	10.426
k V BUS T-22	/ 5.400	5.147	-11.662	12./ 81	5.159	-7.025	8.148	10.106	/ .610	10.7/ 2	-11.849	-1.176	11.917
k V BUS T-2/	/ 5.400	2.662	-12.786	1/ .060	/ .826	-7.222	8.17/	11.08/	2./ 15	11./ 22	-12.750	0.061	12.750
k V BUS T-25	/ 5.400	/ .748	-1/ ./ 90	1/ .907	/ .714	-9.198	9.920	11.606	/ .266	12.047	-1/ .257	0.194	1/ .259
k V BUS T-24	/ 5.400	2.566	-15.864	14.068	2.892	-10.551	10.8/ 5	12.888	2.156	1/ .066	-15.250	1.8/ 2	15./ 47

1½ Cycle - / -Phase, L3 , LL, & LL3 Fault Currents

Prefault Voltage G 100 = of the Bus Nominal Voltage

Bus		3-Phase Fault			Line-to-Ground Fault			Line-to-Line Fault			*Line-to-Line-to-Ground		
ID	%V	Real	Imag.	k ag.	Real	Imag.	k ag.	Real	Imag.	k ag.	Real	Imag.	k ag.
k V BUS T-26	/ 5.400	4.1/ 6	-8.158	9.6/ 2	/ .99/	-5./ / 5	4.89/	7.047	5.545	8./ 56	-8.496	-/ .024	9.11/
k V BUS T-27	/ 5.400	5./ 64	-10.164	11.062	5.020	-4.26/	6.622	8.807	/ .788	9.487	-10./ 95	-2.097	10.60/
k V BUS T-28	/ 5.400	2.688	-12.119	12.515	/ .8/ 2	-6./ 55	7.512	10.405	2./ / 4	10.761	-12.102	-0./ / 6	12.106
k V BUS T-29	/ 5.400	4.6/ 7	-6.7/ 4	8.78/	5.280	-5.28/	6.044	4.8/ 2	5.888	7.609	-7.4/ 0	-/ ./ / 5	8.2/ 4
k V BUS T-/ 1	/ 5.400	5.72/	-4.21/	7.0/ 5	/ ./ 80	-2.775	5./ 7/	5.415	5.09/	6.095	-4.795	-/ .174	6.607
k V BUS T-/ 2	/ 5.400	/ .9/ 0	-9./ / 2	10.126	/ .762	-5.414	4.877	8.084	/ .511	8.774	-9.458	-2.019	9.749
k V BUS T-/ /	/ 5.400	2.941	-10.497	11.000	/ .7/ /	-4.147	6./ 66	9.182	2.462	9.4/ /	-10.676	-0.998	10.72/
k V BUS T-/ 5	/ 5.400	/ .525	-9.766	10./ 59	/ .699	-5.641	4.952	8.561	2.972	8.968	-9.910	-1.46/	10.0/ 2
k V BUS T-/ 6	/ 5.400	5.497	-6.910	8./ 00	/ .457	-/ .501	5.915	4.985	/ .986	7.190	-7./ 28	-2.911	7.884
k V BUS T-/ 7	/ 5.400	5.664	-4.987	7.490	/ .5/ 5	-/ .028	5.479	4.184	5.055	6.474	-6.581	-/ .070	7.171
k V BUS T-/ 9	/ 5.400	5.659	-4.262	7.021	/ ./ / 2	-2.755	5./ 17	5.446	5.029	6.082	-4.81/	-/ .1/ 0	6.60/
k V BUS T-50	/ 5.400	2.692	-9.466	9.9/ 7	/ .260	-/ .7/ 9	5.961	8./ 10	2./ 55	8.6/ 5	-9.598	-1./ 02	9.487
k V BUS T-51	/ 5.400	/ .874	-5.608	6.020	2.611	-2.095	/ ./ 57	5.016	/ ./ 64	4.2/ 9	-5.945	-2.720	4.641
k V BUS T-52	/ 5.400	/ .888	-4.214	6.404	2.694	-2.292	/ .4/ 8	5.458	/ ./ 75	4.66/	-4.415	-2.681	6.1/ 1
k V BUS T-5/	/ 5.400	/ .878	-5.650	6.057	2.616	-2.104	/ ./ 48	5.057	/ ./ 66	4.265	-5.986	-2.719	4.679
k V BUS T-55	/ 5.400	2.67/	-8.296	8.716	2.92/	-2.969	5.166	7.212	2./ 28	7.479	-8.25/	-1.426	8./ 8/
k V BUS T-54	/ 5.400	2.646	-8.697	9.09/	/ .017	-/ .168	5./ 75	7.449	2./ 1/	7.904	-8.6/ 0	-1.542	8.741
k V BUS T-56	/ 5.400	2.682	-9.21/	9.496	/ .165	-/ .596	5.714	8.006	2./ / 4	8./ / 9	-9.156	-1./ 71	9.258
k V BUS T-58	/ 5.400	/ .559	-/ .6/ 2	4.009	2.297	-1.670	2.850	/ .162	2.996	5./ 46	-/ .989	-2.579	5.697
k V BUS T-59	/ 5.400	/ .4/ 4	-5.155	4.557	2./ 92	-1.8/ 9	/ .017	/ .609	/ .070	5.7/ 8	-5.567	-2.410	4.125
k V BUS T-40	/ 5.400	/ .542	-/ .658	4.022	2./ 00	-1.674	2.854	/ .174	2.999	5./ 67	-5.005	-2.581	5.710
POI	1/ 8.000	2.150	-9.915	10.152	1.788	-9.248	9.529	8.487	1.845	8.784	7.8/ 4	6.190	9.984

All fault currents are symmetrical (1½ Cycle networ%) values in rms %A.
* LL3 fault current is the larger of the two faulted line currents.

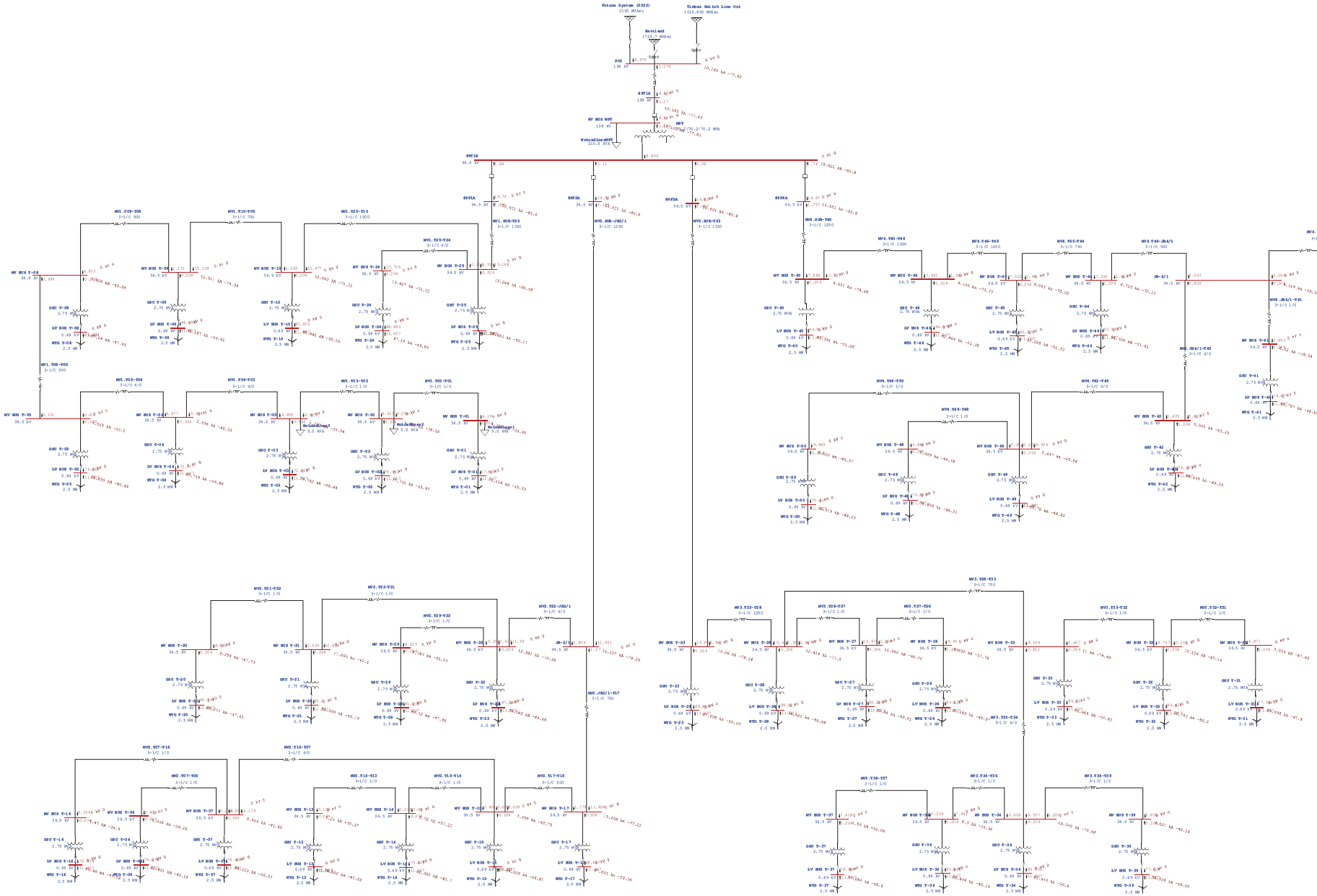
Sequence Impedance Summary Report

Bus		Positive Seq. Imp. (ohm)			Negative Seq. Imp. (ohm)			Zero Seq. Imp. (ohm)			Fault Zf (ohm)		
ID	%V	Resistance	Reactance	Impedance	Resistance	Reactance	Impedance	Resistance	Reactance	Impedance	Resistance	Reactance	Impeda
89F1A	/ 5.400	0.14014	1.18895	1.198/ 9	0.1411/	1.18422	1.19581	0.05918	2.27981	2.280/ 5	0.00000	0.00000	0.00
89F2A	/ 5.400	0.14014	1.18895	1.198/ 9	0.1411/	1.18422	1.19581	0.05918	2.27981	2.280/ 5	0.00000	0.00000	0.00
89F/ A	/ 5.400	0.14014	1.18895	1.198/ 9	0.1411/	1.18422	1.19581	0.05918	2.27981	2.280/ 5	0.00000	0.00000	0.00
89F5A	/ 5.400	0.14014	1.18895	1.198/ 9	0.1411/	1.18422	1.19581	0.05918	2.27981	2.280/ 5	0.00000	0.00000	0.00
89T1A	1/ 8.000	1.6614/	7.70721	7.88527	1.661/ 6	7.70/ 57	7.88048	1.59876	9.60199	9.71826	0.00000	0.00000	0.00
89T1B	/ 5.400	0.14014	1.18895	1.198/ 9	0.1411/	1.18422	1.19581	0.05918	2.27981	2.280/ 5	0.00000	0.00000	0.00
HV BUS k PT	1/ 8.000	1.6614/	7.70721	7.88527	1.661/ 6	7.70/ 57	7.88048	1.59876	9.60199	9.71826	0.00000	0.00000	0.00
JB-2M	/ 5.400	0.262/ 6	1./ 87/ /	1.51192	0.26/ / 6	1./ 8/ 84	1.50869	1.85158	/ .06045	/ .4718/	0.00000	0.00000	0.00
JB-5M	/ 5.400	1.825/ 0	2.54107	/ .04456	1.79514	2.5/ 51/	/ .02/ 90	9.21/ 80	6.05/ 77	11.0191/	0.00000	0.00000	0.00
LV BUS T-01	0.690	0.00/ 71	0.00/ 76	0.00428	0.00/ 71	0.00/ 76	0.00428	0.00248	0.00265	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-02	0.690	0.00/ 46	0.00/ 68	0.00412	0.00/ 46	0.00/ 68	0.00412	0.00248	0.00265	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-0/	0.690	0.00/ 55	0.00/ 62	0.00599	0.00/ 55	0.00/ 62	0.00599	0.00248	0.00265	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-05	0.690	0.00/ 50	0.00/ 48	0.0059/	0.00/ 50	0.00/ 48	0.0059/	0.00248	0.00265	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-04	0.690	0.00/ / 4	0.00/ 4/	0.00587	0.00/ / 4	0.00/ 4/	0.00587	0.00248	0.00265	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-06	0.690	0.00/ / 5	0.00/ 58	0.0058/	0.00/ / 5	0.00/ 58	0.0058/	0.00248	0.00265	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-07	0.690	0.00/ 24	0.00/ 55	0.0057/	0.00/ 24	0.00/ 55	0.0057/	0.00248	0.00265	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-08	0.690	0.00/ 04	0.00/ / 7	0.00544	0.00/ 04	0.00/ / 7	0.00544	0.00248	0.00265	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-09	0.690	0.00266	0.00/ 2/	0.00519	0.00266	0.00/ 2/	0.00518	0.00248	0.00265	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-10	0.690	0.00265	0.00/ 21	0.00516	0.00265	0.00/ 21	0.00516	0.00248	0.00265	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-1/	0.690	0.00/ 4/	0.00/ 44	0.00400	0.00/ 4/	0.00/ 44	0.00400	0.00248	0.00265	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-15	0.690	0.00/ 52	0.00/ 40	0.00590	0.00/ 52	0.00/ 40	0.00590	0.00248	0.00265	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-14	0.690	0.00/ 17	0.00/ / 8	0.0056/	0.00/ 17	0.00/ / 8	0.0056/	0.00248	0.00265	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-16	0.690	0.00/ 56	0.00/ 45	0.00594	0.00/ 56	0.00/ 45	0.00594	0.00248	0.00265	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-17	0.690	0.00262	0.00/ 16	0.00511	0.00262	0.00/ 16	0.00511	0.00248	0.00265	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-20	0.690	0.00/ 05	0.00/ / /	0.00541	0.00/ 05	0.00/ / /	0.00541	0.00248	0.00265	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-21	0.690	0.00279	0.00/ 2/	0.00527	0.00279	0.00/ 2/	0.00526	0.00248	0.00265	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-22	0.690	0.00269	0.00/ 19	0.00517	0.00269	0.00/ 19	0.00517	0.00248	0.00265	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-2/	0.690	0.00261	0.00/ 17	0.00511	0.00261	0.00/ 17	0.00510	0.00248	0.00265	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-25	0.690	0.00265	0.00/ 1/	0.00510	0.00265	0.00/ 1/	0.00510	0.00248	0.00265	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-24	0.690	0.00249	0.00/ 10	0.00505	0.00249	0.00/ 10	0.00505	0.00248	0.00265	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-26	0.690	0.00287	0.00/ / 0	0.005/ 7	0.00287	0.00/ 29	0.005/ 7	0.00248	0.00265	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-27	0.690	0.00275	0.00/ 25	0.00524	0.00275	0.00/ 25	0.00525	0.00248	0.00265	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-28	0.690	0.00262	0.00/ 19	0.0051/	0.00262	0.00/ 19	0.0051/	0.00248	0.00265	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-29	0.690	0.00299	0.00/ / 1	0.00556	0.00299	0.00/ / 1	0.00556	0.00248	0.00265	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-/ 1	0.690	0.00/ 12	0.00/ 56	0.00566	0.00/ 12	0.00/ 54	0.00566	0.00248	0.00265	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-/ 2	0.690	0.00274	0.00/ / 0	0.00529	0.00274	0.00/ / 0	0.00529	0.00248	0.00265	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-/ /	0.690	0.00266	0.00/ 26	0.00521	0.00266	0.00/ 26	0.00521	0.00248	0.00265	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-/ 5	0.690	0.00271	0.00/ 29	0.00526	0.00271	0.00/ 29	0.00526	0.00248	0.00265	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-/ 6	0.690	0.0029/	0.00/ / 9	0.00558	0.0029/	0.00/ / 9	0.00558	0.00248	0.00265	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-/ 7	0.690	0.00/ 0/	0.00/ 5/	0.00547	0.00/ 0/	0.00/ 5/	0.00547	0.00248	0.00265	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-/ 9	0.690	0.00/ 11	0.00/ 56	0.00566	0.00/ 11	0.00/ 56	0.00566	0.00248	0.00265	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-50	0.690	0.00267	0.00/ / /	0.00527	0.00267	0.00/ / 2	0.00526	0.00248	0.00265	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-51	0.690	0.00/ 18	0.00/ 62	0.00581	0.00/ 17	0.00/ 61	0.00580	0.00248	0.00265	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-52	0.690	0.00/ 08	0.00/ 47	0.00572	0.00296	0.00/ 45	0.00562	0.00241	0.00265	0.00/ 65	0.00000	0.00000	0.00
LV BUS T-5/	0.690	0.00/ 17	0.00/ 61	0.00581	0.00/ 05	0.00/ 48	0.00570	0.00241	0.00265	0.00/ 65	0.00000	0.00000	0.00
LV BUS T-55	0.690	0.00271	0.00/ 52	0.005/ 6	0.00271	0.00/ 51	0.005/ 6	0.00248	0.00265	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-54	0.690	0.00269	0.00/ / 9	0.005/ /	0.00269	0.00/ / 8	0.005/ 2	0.00248	0.00265	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-56	0.690	0.00268	0.00/ / 4	0.00529	0.00268	0.00/ / 4	0.00529	0.00248	0.00265	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-58	0.690	0.00/ / 7	0.00/ 77	0.00404	0.00/ / 6	0.00/ 76	0.00405	0.00248	0.00265	0.00/ 70	0.00000	0.00000	0.00

Bus		Positive Seq. Imp. (ohm)			Negative Seq. Imp. (ohm)			Zero Seq. Imp. (ohm)			Fault Zf (ohm)		
ID	%V	Resistance	Reactance	Impedance	Resistance	Reactance	Impedance	Resistance	Reactance	Impedance	Resistance	Reactance	Impeda
LV BUS T-59	0.690	0.00/ 24	0.00/ 71	0.0059/	0.00/ 25	0.00/ 71	0.00592	0.00248	0.00265	0.00/ 70	0.00000	0.00000	0.00
LV BUS T-40	0.690	0.00/ / 6	0.00/ 76	0.00404	0.00/ / 4	0.00/ 76	0.00405	0.00248	0.00265	0.00/ 70	0.00000	0.00000	0.00
k V BUS T-01	/ 5.400	/ .72990	2.70401	5.60742	/ .7/ 179	2.70246	5.60762	6.88457	5./ 7865	8.14979	0.00000	0.00000	0.00
k V BUS T-02	/ 5.400	/ .26056	2.46/ 85	5.15776	/ .262/ 5	2.461/ 6	5.15770	6.12877	5.247/ 2	7.562/ 5	0.00000	0.00000	0.00
k V BUS T-0/	/ 5.400	2.89002	2.52829	/ .77576	2.89186	2.52477	/ .77544	4.58661	5.145/ 7	6.88198	0.00000	0.00000	0.00
k V BUS T-05	/ 5.400	2.75289	2./ 2888	/ .49822	2.75572	2./ 26/ 2	/ .49794	4.00456	5.02/ / 4	6.52200	0.00000	0.00000	0.00
k V BUS T-04	/ 5.400	2.491/ 0	2.21/ 18	/ .50778	2.49/ 10	2.21046	/ .50754	5.566/ 8	/ .87644	4.91507	0.00000	0.00000	0.00
k V BUS T-06	/ 5.400	2.44005	2.08/ 90	/ .29/ 2/	2.44180	2.08112	/ .2928/	5.29508	/ .70849	4.67/ 87	0.00000	0.00000	0.00
k V BUS T-07	/ 5.400	2.2594/	2.00105	/ .01075	2.24127	1.99824	/ .01018	/ .81957	/ .6/ 240	4.27100	0.00000	0.00000	0.00
k V BUS T-08	/ 5.400	1.65675	1.89745	2.41254	1.65824	1.89565	2.41124	5.0/ 864	/ .746/ 2	4.41459	0.00000	0.00000	0.00
k V BUS T-09	/ 5.400	0.56696	1.66612	1.7/ 0/ 2	0.56798	1.6628/	1.7275/	/ .41/ / 8	/ .60867	4.0/ 640	0.00000	0.00000	0.00
k V BUS T-10	/ 5.400	0.51/ 52	1.60154	1.64/ 96	0.5155/	1.49811	1.64097	/ .12260	/ .58086	5.67622	0.00000	0.00000	0.00
k V BUS T-1/	/ 5.400	/ .09948	2.20047	/ .801/ 0	/ .101/ 8	2.1978/	/ .80118	5.87188	/ .71662	6.12768	0.00000	0.00000	0.00
k V BUS T-15	/ 5.400	2.77/ 15	2.10645	/ .58241	2.7759/	2.10/ 78	/ .58226	5./ 4/ 16	/ .6/ / 56	4.67028	0.00000	0.00000	0.00
k V BUS T-14	/ 5.400	2.00/ 77	1.842/ 6	2.72880	2.00458	1.85941	2.72812	/ .06504	/ .52679	5.49688	0.00000	0.00000	0.00
k V BUS T-16	/ 5.400	2.91220	2.18651	/ .65161	2.91/ 97	2.18/ 66	/ .651/ 7	5.86845	/ .80068	6.17650	0.00000	0.00000	0.00
k V BUS T-17	/ 5.400	0./ / / 4/	1.57098	1.408/ 1	0./ / 545	1.56747	1.40422	2./ / 297	/ .22128	/ .977/ 7	0.00000	0.00000	0.00
k V BUS T-20	/ 5.400	1.62/ 22	1.78485	2.51/ / 1	1.625/ 8	1.78240	2.51162	5./ 5276	/ .44152	4.61000	0.00000	0.00000	0.00
k V BUS T-21	/ 5.400	0.852/ 1	1.49098	1.80020	0.85/ 52	1.48761	1.79775	/ .12845	/ ./ 4676	5.4886/	0.00000	0.00000	0.00
k V BUS T-22	/ 5.400	0.45019	1.41452	1.60882	0.45126	1.41202	1.60498	2.65501	/ .27908	5.21226	0.00000	0.00000	0.00
k V BUS T-2/	/ 5.400	0./ 1088	1.59/ 16	1.42418	0./ 1190	1.58981	1.42211	2.79988	/ .5780/	5.56598	0.00000	0.00000	0.00
k V BUS T-25	/ 5.400	0./ 870/	1./ 7899	1.5/ 227	0./ 880/	1./ 7450	1.52909	1.58081	2.8/ 12/	/ .19410	0.00000	0.00000	0.00
k V BUS T-24	/ 5.400	0.216/ 5	1./ 0511	1./ 219/	0.217/ /	1./ 0041	1./ 1845	1.0/ 866	2.7108/	2.90/ 00	0.00000	0.00000	0.00
k V BUS T-26	/ 5.400	1.10264	1.7594/	2.06802	1.10/ 74	1.756/ 1	2.06488	5.6651/	/ .96224	6.1199/	0.00000	0.00000	0.00
k V BUS T-27	/ 5.400	0.71055	1.64542	1.80060	0.71142	1.64129	1.79806	5.04458	/ .86567	4.60202	0.00000	0.00000	0.00
k V BUS T-28	/ 5.400	0./ 57/ 9	1.46658	1.60545	0./ 5852	1.46/ 22	1.60148	/ .57/ 16	/ .771/ 1	4.12696	0.00000	0.00000	0.00
k V BUS T-29	/ 5.400	1.54471	1.7/ 911	2.26794	1.5468/	1.7/ 476	2.26610	5.06/ / 9	/ .40665	4./ 6728	0.00000	0.00000	0.00
k V BUS T-/ 1	/ 5.400	1.90102	2.09847	2.8/ 148	1.90218	2.09442	2.8/ 010	6.76066	5.5758/	8.10755	0.00000	0.00000	0.00
k V BUS T-/ 2	/ 5.400	0.76/ 59	1.81280	1.96702	0.76549	1.80970	1.96548	5.98087	5.18959	6.4084/	0.00000	0.00000	0.00
k V BUS T-/ /	/ 5.400	0.58475	1.75558	1.81085	0.58681	1.751/ 4	1.80812	5.4/ 147	5.11756	6.12279	0.00000	0.00000	0.00
k V BUS T-/ 5	/ 5.400	0.6/ 680	1.816/ 7	1.92577	0.6/ 790	1.81/ 28	1.92222	5.98582	5.25088	6.4557/	0.00000	0.00000	0.00
k V BUS T-/ 6	/ 5.400	1./ 29/ 4	1.99812	2./ 999/	1./ / 045	1.99410	2./ 9807	6.117/ 2	5.52254	7.45859	0.00000	0.00000	0.00
k V BUS T-/ 7	/ 5.400	1.61292	2.07027	2.62552	1.61512	2.06727	2.62278	6.46218	5.59/ 77	7.94/ / 7	0.00000	0.00000	0.00
k V BUS T-/ 9	/ 5.400	1.87851	2.1261/	2.8/ 704	1.87948	2.12/ 10	2.8/ 444	6.9270/	5.44226	8.28896	0.00000	0.00000	0.00
k V BUS T-50	/ 5.400	0.45/ 00	1.92940	2.00554	0.45146	1.91625	1.991/ 0	6.8/ 089	4.2/ / 96	8.60444	0.00000	0.00000	0.00
k V BUS T-51	/ 5.400	2.12942	2.4/ 207	/ ./ 0841	2.09944	2.41596	/ .27614	9.69901	6.12146	11.56927	0.00000	0.00000	0.00
k V BUS T-52	/ 5.400	1.8/ 020	2.54585	/ .06200	1.79997	2.5/ 788	/ .0/ 0/ 7	9.2/ 510	6.059/ 0	11.0/ 915	0.00000	0.00000	0.00
k V BUS T-5/	/ 5.400	2.112/ 4	2.42754	/ .29/ 95	2.07874	2.41118	/ .24995	9.67164	6.11717	11.55/ 80	0.00000	0.00000	0.00
k V BUS T-55	/ 5.400	0.70098	2.17415	2.284/ 0	0.69709	2.14711	2.26694	8.66551	4.889/ 5	10.57656	0.00000	0.00000	0.00
k V BUS T-54	/ 5.400	0.6/ 984	2.09596	2.19040	0.6/ 701	2.07846	2.17/ 98	8.15/ 55	4.71896	9.94098	0.00000	0.00000	0.00
k V BUS T-56	/ 5.400	0.48008	1.99/ 09	2.07479	0.4781/	1.97865	2.061/ 8	7./ 5489	4.52526	9.1/ 142	0.00000	0.00000	0.00
k V BUS T-58	/ 5.400	2.7/ 820	2.88/ 75	/ .97664	2.70946	2.86482	/ .95/ 95	11.47/ / 0	6.6204/	1/ ./ / / 15	0.00000	0.00000	0.00
k V BUS T-59	/ 5.400	2./ 7/ 07	2.78210	/ .64671	2./ 5522	2.765/ 4	/ .62540	10.98619	6.42651	12.77841	0.00000	0.00000	0.00
k V BUS T-40	/ 5.400	2.726/ 2	2.880/ 9	/ .96605	2.69768	2.86257	/ .9/ / / 5	11.44514	6.61756	1/ ./ 1400	0.00000	0.00000	0.00
POI	1/ 8.000	1.64768	7.6790/	7.84491	1.64741	7.674/ 2	7.84224	1.59129	9.4/ 4/ 5	9.64124	0.00000	0.00000	0.00

APPENDIX B: ETAP SINGLE LINE DIAGRAM

One-Line Diagram - NW_OH (Short-Circuit Analysis)



APPENDIX C: ETAP MODEL INPUTS

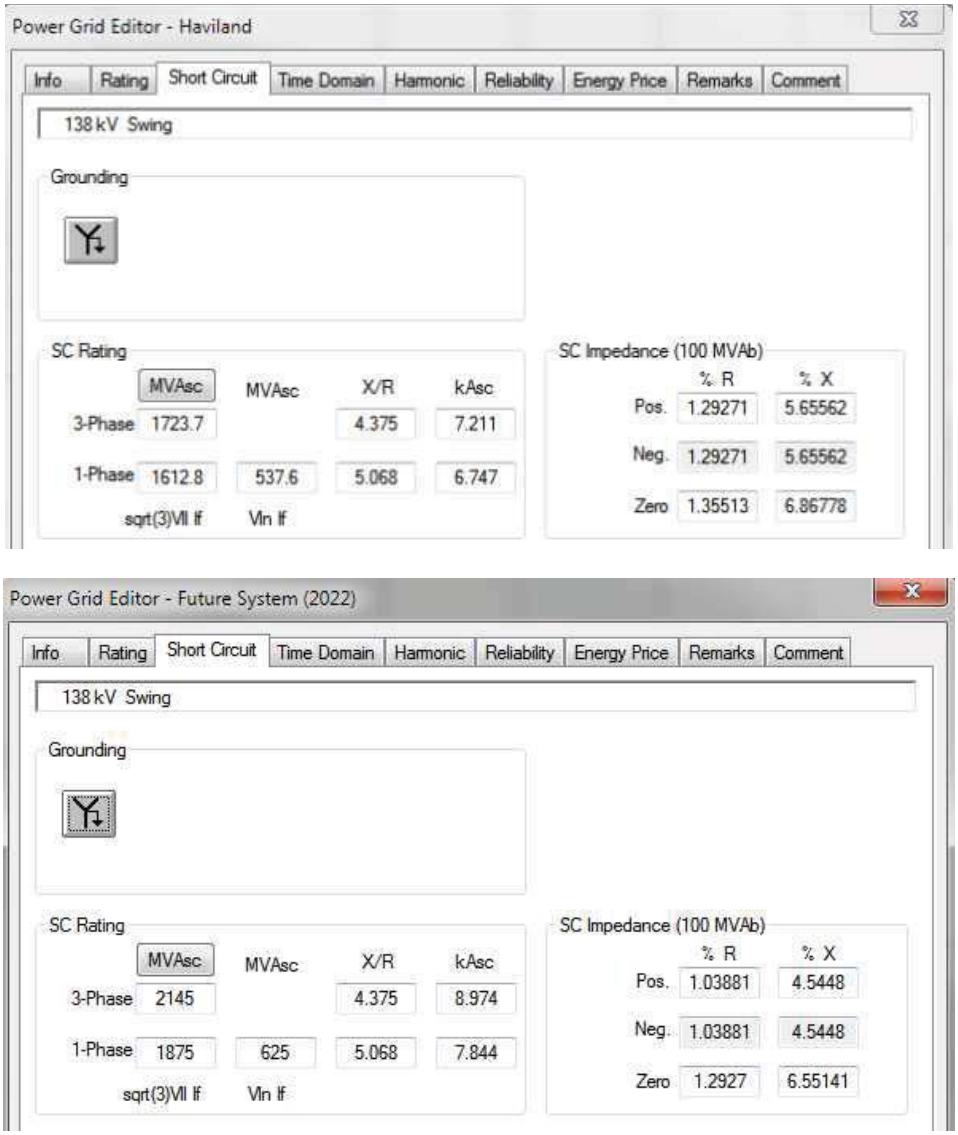


Figure 1: Utility Equivalent Data

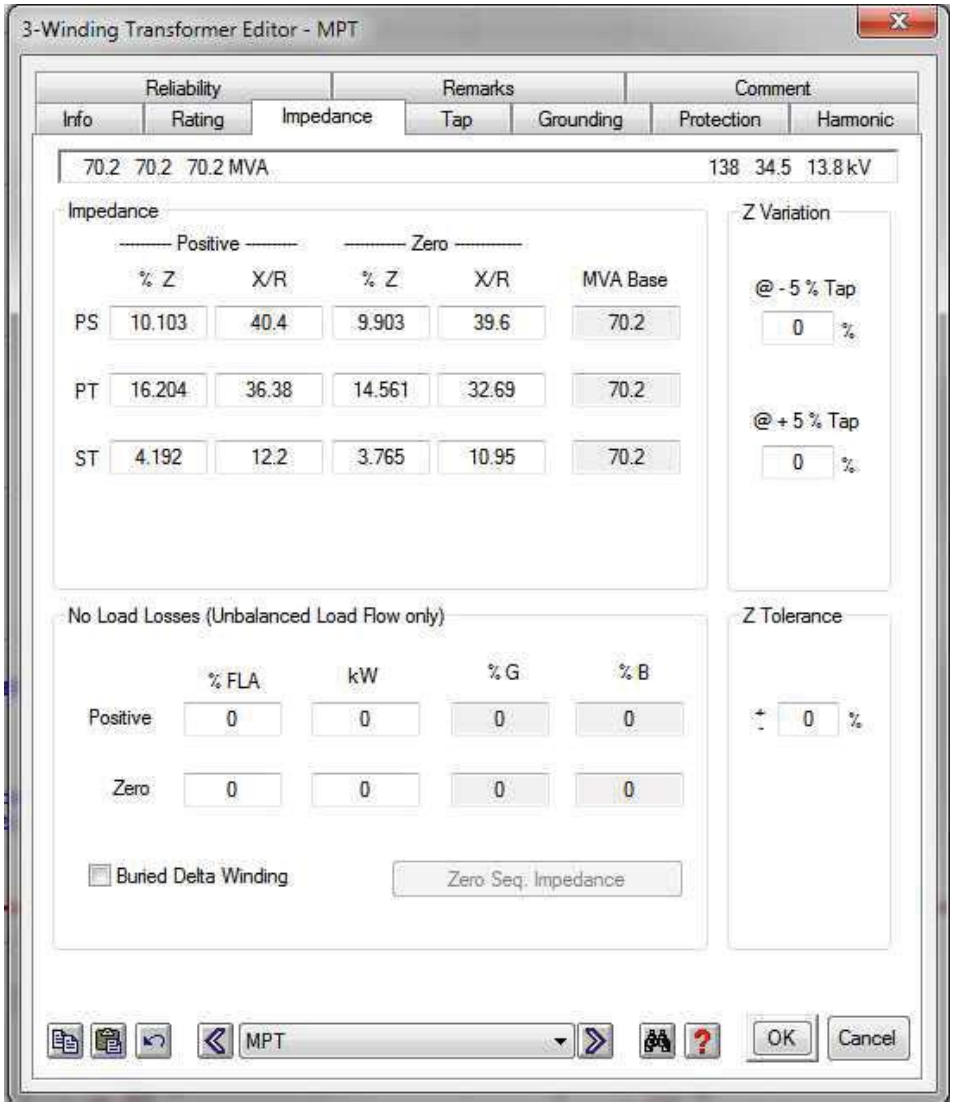


Figure 2: Main Power Transformer Impedance

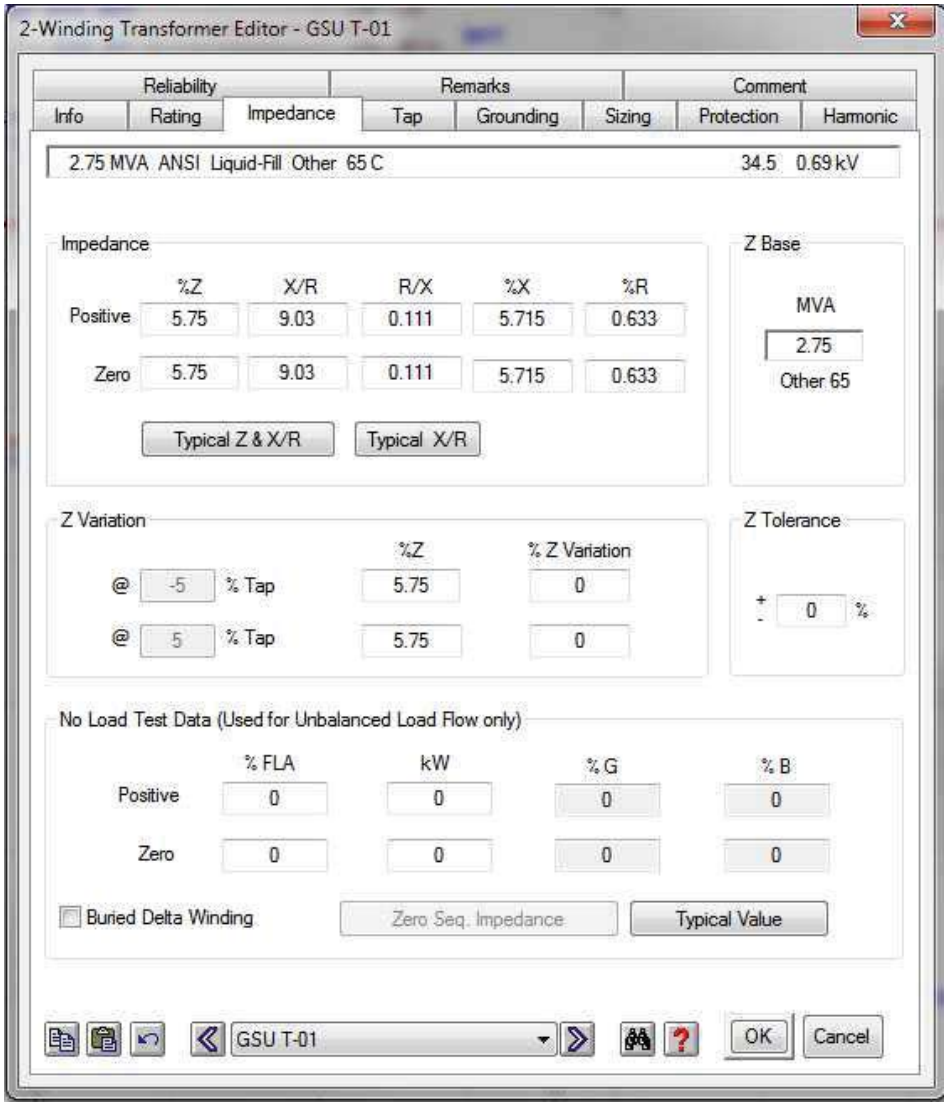


Figure 3: Step-Up Transformer Impedance Data

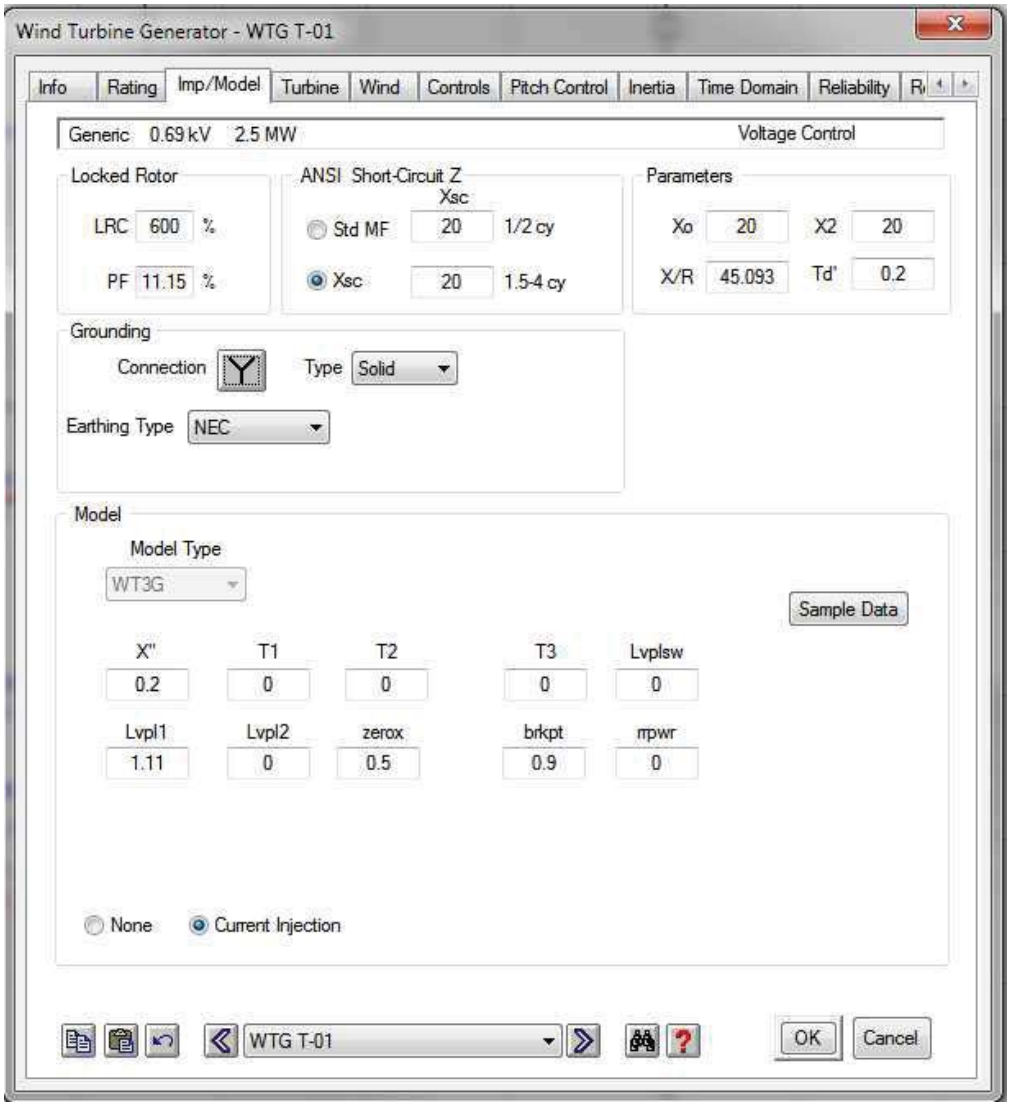


Figure 4: Turbine Impedance/Short Circuit Data

NW_OH 1/C AL XLPE 35 kV 100 % Non-Mag. 60 Hz Ohms/1000ft RHO 200°C.cm/W

Ampacity | Impedance | Physical | Cable Pulling

		Phase		Ground/Neutral		R	X	L	Y	Ro	Xo	Lo	Yo	Rdc
	Avail.	Code	Size	#	Size	90°C	60 Hz	60 Hz	60 Hz	90°C	60 Hz	60 Hz	60 Hz	25°C
1	Yes	1/0 - 2/3 CN	1/0	18	16	0.24087	0.05182	0.00014	1.77E-05	0.35886	0.05482	0.00015	1.77E-05	0.18596
2	Yes	4/0 - 1/2 CN	4/0	17	14	0.11303	0.04679	0.00012	2.2E-05	0.28416	0.07373	0.0002	2.2E-05	0.08673
3	Yes	500 - 1/3 CN	500	16	12	0.4939	0.04115	0.00011	3.05E-05	0.16756	0.04488	0.00012	3.05E-05	0.0361
4	Yes	750 - 1/6 CN	750	19	14	0.0343	0.03865	0.0001	3.56E-05	0.18978	0.05914	0.00016	3.56E-05	0.0248
5	Yes	1000 - 1/6 CN	1000	25	14	0.02568	0.03703	0.0001	3.98E-05	0.20941	0.07373	0.0002	3.98E-05	0.01814
6	Yes	1250 - 1/6 CN	1250	20	12	0.02048	0.03537	9E-05	4.36E-05	0.23977	0.09952	0.00026	4.36E-05	0.01422

Figure 5: Cable Impedance Data

AC CABLE SIZING STUDY

Northwest Ohio Wind Project

Paulding, Ohio
September 27, 2017

Prepared for:

WHITE
an IEA company

Prepared by:

Westwood

Westwood

Project Name: NW OH Wind Project	
Title	**J.O. or W.O. Number**
AC Cable Sizing Study	0007186.00

Approvals		**Revision Number**	**Date**	**Description**
Preparer(s) Name	**Reviewer(s) Name**			
Josh Venden	Drew Szabo	0	09/27/2017	Original Release

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INTRODUCTION

NW OH Wind Project is a 100 MW wind generation installation in Paulding, OH consisting 42 of GE 2.5 MW wind turbines. The turbines are grouped into four medium voltage (MV) feeders with 10 turbines on Feeders 1 and 4 and 11 turbines on Feeders 2 and 3. The feeders are connected to a main power transformer that steps the voltage up to 138kV where it interconnects with the AEP transmission system via a short overhead line segment.

OBJECTIVE

The objective of this report is to provide the design basis for determining the ampacity ratings of the medium and low voltage AC cables between the turbines, transformers, and junction boxes.

INPUTS & ASSSUMPTIONS

- The native soil thermal resistivity is 150°C-cm/W as per the assessment of Westwood Professional Services based on the Geotechnical Engineering Report for Northwest Ohio Wind Project; completed by BARR, December 2014.
- Thermal resistivity of the disturbed soil in the cable trench is based on considerations of residual moisture, such that it indicates a worst case rho value of 200°C-cm/W at the specified 85% compaction.
- Thermal resistivity of the concrete ductbank is assumed to be 55 C-cm/W per NEC.
- Appendix D, has the excerpts for the dry out curves of the soil at various test points.
- Soil ambient temperature at various depths is shown in the following table.

Depth [ft]	Depth [m]	T_{max} [C]
3	0.91	22
4	1.22	21
5	1.52	20
6	1.83	19
7	2.13	18
8	2.44	18
9	2.74	17
10	3.05	17

- Cables are analyzed at their maximum allowable continuous operating temperature of 90° C.
- Load factor assumed conservatively at 100% for determining the cable ampacities.
- Direct buried medium voltage AC Cables are evaluated with minimum 48" soil cover.
- Medium voltage AC collector electrical layout is per the Westwood Professional Services Electrical Drawings, MVAC Collection One-Line Diagrams E.200 & E.210 and Trench Details E.600.
- The standard installation is based on a trefoil arrangement of cables, aluminum conductors with copper concentric neutral wires bonded at both ends.
- The nameplate rating of the turbines is 2.5MW with reactive power capability of 0.9 lead/lag. Maximum cable amp loadings are based on maximum total turbine MVA output; approximately 49A at 34.5 kV.

METHODOLOGY

- Thermal analysis of underground cables is conducted with CYME Cymcap software, which uses the Neher-McGrath methodology to determine reduced cable ratings based on project specific thermal constraints.
- CYMCAP analysis is conducted for single and multiple circuit trenches for all of the MV cable sizes and configurations used in the underground collection design.
- CYMCAP analysis is also performed to verify the ampacity of the low voltage cables passing through the turbine foundation.

THERMAL ANALYSIS RESULTS AND CONCLUSION

SINGLE CIRCUIT AMPACITY

- Table 1 shows a summary of the single circuit cable ampacities and maximum number of turbines that can be connected to each cable size without violating its respective ampacity rating.

Cable	Material	Maximum 3PH Fault Current	Phase Conductor SC Withstand	Ampacity & Configuration	
1/0	Al	7814	PASS	142.3	Trefoil
4/0	Al	12637	PASS	212.9	Trefoil
500	Al	8304	PASS	334.7	Trefoil
750	Al	10974	PASS	408.6	Trefoil
1000	Al	9865	PASS	477.1	Trefoil
1250	Al	12101	PASS	540.5	Trefoil
1250*	Al	12101	PASS	570.5	Trefoil

** Increased ampacity based on 90% soil compaction in trenches with 11 turbines on the ckt*

Table 1: Cable Ampacity Summary

- As the final two rows of the above table indicate, for 1250 kCMIL cable with an ampacity rating large enough to accommodate 11 turbines, a soil compaction of at least 90% must be achieved in the trenches, which reduces the soil thermal resistivity closer to the native soil value of 150°C-cm/W. Feeders 2 and 3 require this compaction level for the MV cable trenches from the substation to the first wind turbine on each feeder.

MULTIPLE CIRCUIT TRENCHES

- In several locations, multiple MV circuits will run parallel to one another in the same right of way (ROW). Further thermal analysis was performed on these areas to determine the minimum spacing between circuits required to maintain acceptable operating temperatures.
- The following table summarizes the locations where multiple circuits will occupy the same parallel trench paths. The table indicates the number of turbines and corresponding loading on each cable segment.
- The worst case from a thermal standpoint occurs in the ROW from Turbine 25 to the Substation where all four fully loaded feeders run parallel to one another. To achieve adequate thermal performance from the

cables, a concrete duct bank installation must be used for the four homerun circuits from T-25 to the Sub. The ductbank must be a minimum of 18" thick and 10' long with the cable ducts spaced 2.5' apart.

Table 2: Multiple Circuit Trench Summary

TRENCH SEGMENT		FEEDERS IN TRENCH			Cable	Ckt Spacing
FROM	TO	FDR	TURBINES	AMPS	Sizes	(center-to-center)
SUB	T-25	1	10	516.51	1250	1.5' x 10' duct bank rho <= 0.55 C-m/W 2.5' duct spacing
		2	11	568.16	1250	
		3	11	568.16	1250	
		4	10	516.51	1250	
T-25	T-24	1	10	516.51	1250	four 12" trenches; 25' ROW backfill rho <= 1.00 C-m/W 7' FDR1-FDR2, 11' FDR2-FDR3, 3' FDR3-FDR4
		2	11	568.16	1250	
		3	11	568.16	1250	
		4	1	51.65	4/0	
T-24	JB-2/1	1	10	516.51	1250	triple 12" trenches; 50' ROW 23.5' FDR1-FDR2 & 23.5' FDR2-FDR3
		2	11	568.16	1250	
		3	11	568.16	1250	
JB-2/1	T-22	1	10	516.51	1250	triple 12" trenches; 35' ROW w/ 4/0 conductor in center trench; 9.5' FDR1-FDR3 & 21' FDR3-FDR2
		2	11	568.16	1250	
		3	4	206.60	4/0	
T-22	T-23	1	10	516.51	1250	triple 12" trenches; 12' ROW w/ 1/0 conductor in center trench; 4.5' between all circuits
		2	11	568.16	1250	
		3	1	51.65	1/0	
T-23	T-28	1	10	516.51	1250	double 12" trenches; 18' ROW 7.5' FDR1-FDR2
		2	10	516.51	1250	
T-28	T-33	1	10	516.51	1250	double 12" trenches; 15' ROW 6' FDR1-FDR2
		2	7	361.55	750	
T-33	T-34	1	10	516.51	1250	double 12" trenches; 20' ROW 9' FDR1-FD2
		2	4	206.60	4/0	
T-34	T-39	1	10	516.51	1250	single 18" trench; 3' ROW 1' FDR1-FDR2
		2	1	51.65	1/0	

WETLANDS, ROAD AND PIPELINE CROSSINGS

- There are several designated wetland areas, road and gas pipeline crossings throughout the site that require directional drill boring installation. The depth of the borings vary by crossing but are assumed a minimum of 10' depth at the time of this study.

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APPENDIX A: **SINGLE CIRCUIT CYMCAP REPORTS**

Study Summary

CYMCAP Version	7.2 Revision 3
Study:	UG Collector Circuits
Execution:	Single Ckt 1_0 - 2_3 CN AL XLPE
Date:	9/18/2017 2:00:06 PM

General Simulation Data

Steady State Option	Equally Loaded
Consider Electrical interaction between circuits	No
Induced currents in metallic layers as a fraction of conductor current (applied to all single phase circuits) :	0.0
Conductor Resistances Computation Option:	IEC-228

Installation Type:Multiple Ductbanks/Backfills

Ambient Soil Temperature at Installation Depth	[°C]	21.0
Native Soil Thermal Resistivity	[K.m/W]	1.5
Consider Non-Isothermal Earth Surface		No

Layer Name	X [ft]	Y [ft]	Width [ft]	Height [ft]	Thermal Resistivity [K.m/W]
Backfill	0.0	2.25	1.5	4.5	2.0

Results Summary

Cable No.	Cable ID	Circuit No.	Feeder ID	Cable Phase	Cable Frequency	Daily Load Factor	X coordinate [ft]	Y coordinate [ft]	Conductor temperature [°C]	Ampacity [A]
1	1_0 AL - 2_3 CN	1	1_0 - 2_3	A	60.0	1.0	-0.06	4.28	89.7	142.3
2	1_0 AL - 2_3 CN	1	1_0 - 2_3	B	60.0	1.0	0.06	4.28	89.6	142.3
3	1_0 AL - 2_3 CN	1	1_0 - 2_3	C	60.0	1.0	0.0	4.18	90.0	142.3

Study Summary

CYMCAP Version	7.2 Revision 3
Study:	UG Collector Circuits
Execution:	Single Ckt 4_0 - 1_2CN AL XLPE
Date:	9/18/2017 12:57:47 PM

General Simulation Data

Steady State Option	Equally Loaded
Consider Electrical interaction between circuits	No
Induced currents in metallic layers as a fraction of conductor current (applied to all single phase circuits) :	0.0
Conductor Resistances Computation Option:	IEC-228

Installation Type:Multiple Ductbanks/Backfills

Ambient Soil Temperature at Installation Depth	[°C]	21.0
Native Soil Thermal Resistivity	[K.m/W]	1.5
Consider Non-Isothermal Earth Surface		No

Layer Name	X [ft]	Y [ft]	Width [ft]	Height [ft]	Thermal Resistivity [K.m/W]
Backfill	0.0	2.25	1.5	4.5	2.0

Results Summary

Cable No.	Cable ID	Circuit No.	Feeder ID	Cable Phase	Cable Frequency	Daily Load Factor	X coordinate [ft]	Y coordinate [ft]	Conductor temperature [°C]	Ampacity [A]
1	4_0 AL - 1_2 CN	1	4_0 - 1_2	A	60.0	1.0	-0.07	4.29	89.4	212.9
2	4_0 AL - 1_2 CN	1	4_0 - 1_2	B	60.0	1.0	0.07	4.29	89.6	212.9
3	4_0 AL - 1_2 CN	1	4_0 - 1_2	C	60.0	1.0	0.0	4.17	90.0	212.9

Study Summary

CYMCAP Version	7.2 Revision 3
Study:	UG Collector Circuits
Execution:	Single Ckt 500 - 1_3CN AL XLPE
Date:	9/18/2017 2:06:09 PM

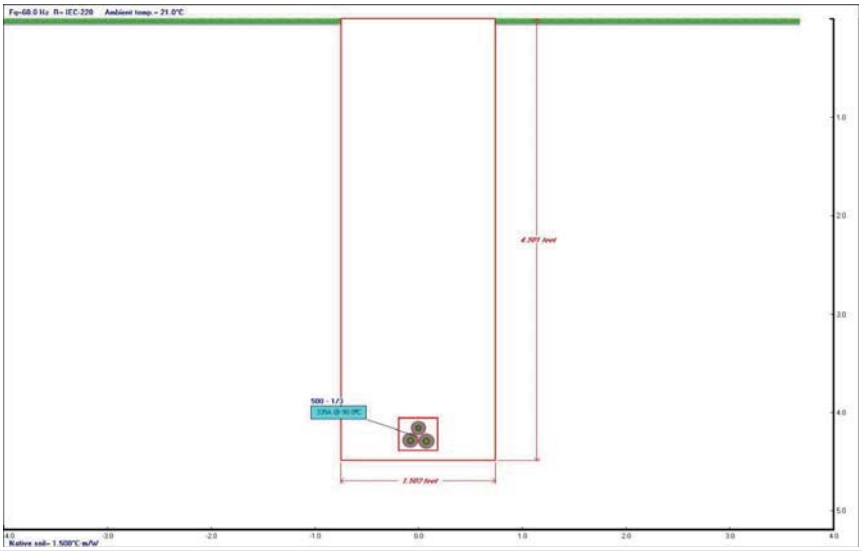
General Simulation Data

Steady State Option	Equally Loaded
Consider Electrical interaction between circuits	No
Induced currents in metallic layers as a fraction of conductor current (applied to all single phase circuits) :	0.0
Conductor Resistances Computation Option:	IEC-228

Installation Type:Multiple Ductbanks/Backfills

Ambient Soil Temperature at Installation Depth	[°C]	21.0
Native Soil Thermal Resistivity	[K.m/W]	1.5
Consider Non-Isothermal Earth Surface		No

Layer Name	X [ft]	Y [ft]	Width [ft]	Height [ft]	Thermal Resistivity [K.m/W]
Backfill	0.0	2.25	1.5	4.5	2.0



Results Summary

Cable No.	Cable ID	Circuit No.	Feeder ID	Cable Phase	Cable Frequency	Daily Load Factor	X coordinate [ft]	Y coordinate [ft]	Conductor temperature [°C]	Ampacity [A]
1	500 AL - 1_3 CN	1	500 - 1_3	A	60.0	1.0	-0.08	4.3	89.6	334.7
2	500 AL - 1_3 CN	1	500 - 1_3	B	60.0	1.0	0.08	4.3	89.6	334.7
3	500 AL - 1_3 CN	1	500 - 1_3	C	60.0	1.0	0.0	4.16	90.0	334.7

Study Summary

CYMCAP Version	7.2 Revision 3
Study:	UG Collector Circuits
Execution:	Single Ckt 750 - 1_6CN AL XLPE
Date:	9/18/2017 2:11:08 PM

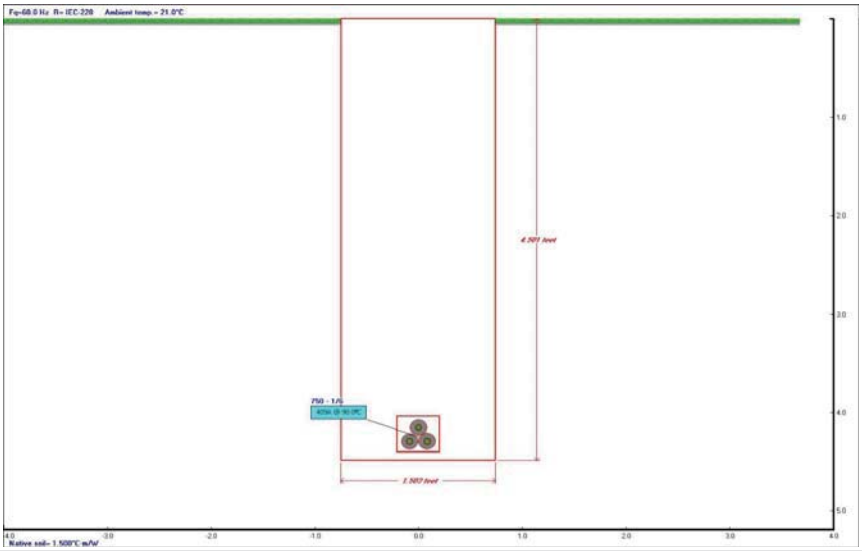
General Simulation Data

Steady State Option	Equally Loaded
Consider Electrical interaction between circuits	No
Induced currents in metallic layers as a fraction of conductor current (applied to all single phase circuits) :	0.0
Conductor Resistances Computation Option:	IEC-228

Installation Type:Multiple Ductbanks/Backfills

Ambient Soil Temperature at Installation Depth	[°C]	21.0
Native Soil Thermal Resistivity	[K.m/W]	1.5
Consider Non-Isothermal Earth Surface		No

Layer Name	X [ft]	Y [ft]	Width [ft]	Height [ft]	Thermal Resistivity [K.m/W]
Backfill	0.0	2.25	1.5	4.5	2.0



Results Summary

Cable No.	Cable ID	Circuit No.	Feeder ID	Cable Phase	Cable Frequency	Daily Load Factor	X coordinate [ft]	Y coordinate [ft]	Conductor temperature [°C]	Ampacity [A]
1	750 AL - 1_6 CN	1	750 - 1_6	A	60.0	1.0	-0.09	4.3	89.7	408.6
2	750 AL - 1_6 CN	1	750 - 1_6	B	60.0	1.0	0.09	4.3	89.6	408.6
3	750 AL - 1_6 CN	1	750 - 1_6	C	60.0	1.0	0.0	4.15	90.0	408.6

Study Summary

CYMCAP Version	7.2 Revision 3
Study:	UG Collector Circuits
Execution:	Single Ckt 1000 - 1_6CN AL XLPE
Date:	9/18/2017 1:55:04 PM

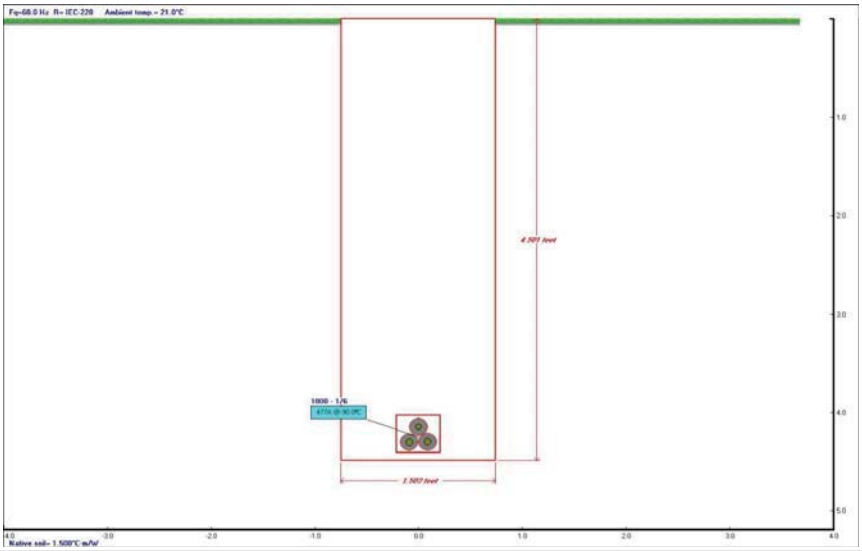
General Simulation Data

Steady State Option	Equally Loaded
Consider Electrical interaction between circuits	No
Induced currents in metallic layers as a fraction of conductor current (applied to all single phase circuits) :	0.0
Conductor Resistances Computation Option:	IEC-228

Installation Type:Multiple Ductbanks/Backfills

Ambient Soil Temperature at Installation Depth	[°C]	21.0
Native Soil Thermal Resistivity	[K.m/W]	1.5
Consider Non-Isothermal Earth Surface		No

Layer Name	X [ft]	Y [ft]	Width [ft]	Height [ft]	Thermal Resistivity [K.m/W]
Backfill	0.0	2.25	1.5	4.5	2.0



Results Summary

Cable No.	Cable ID	Circuit No.	Feeder ID	Cable Phase	Cable Frequency	Daily Load Factor	X coordinate [ft]	Y coordinate [ft]	Conductor temperature [°C]	Ampacity [A]
1	000 AL - 1_6 CN	1	1000 - 1_6	A	60.0	1.0	-0.09	4.3	89.7	477.1
2	000 AL - 1_6 CN	1	1000 - 1_6	B	60.0	1.0	0.09	4.3	89.7	477.1
3	000 AL - 1_6 CN	1	1000 - 1_6	C	60.0	1.0	0.0	4.14	90.0	477.1

Study Summary

CYMCAP Version	7.2 Revision 3
Study:	UG Collector Circuits
Execution:	Single Ckt 1250 - 1_6CN AL XLPE
Date:	9/18/2017 1:52:28 PM

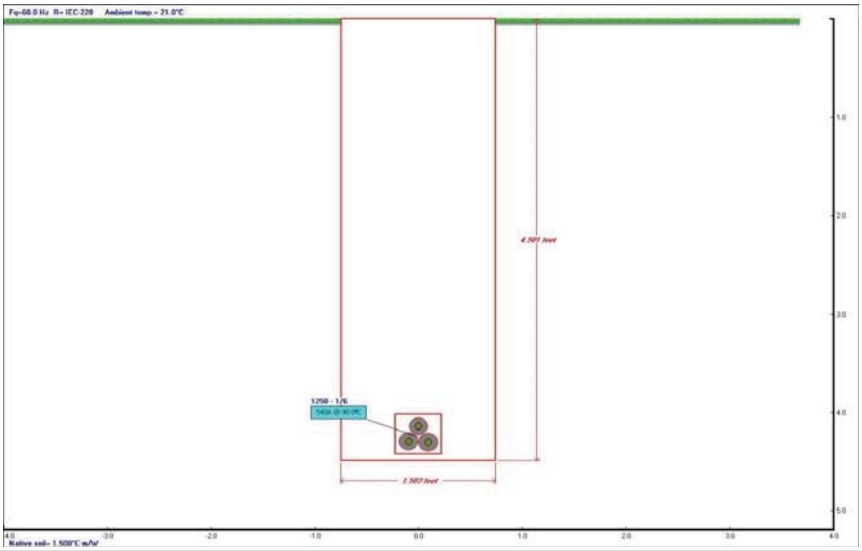
General Simulation Data

Steady State Option	Equally Loaded
Consider Electrical interaction between circuits	No
Induced currents in metallic layers as a fraction of conductor current (applied to all single phase circuits) :	0.0
Conductor Resistances Computation Option:	IEC-228

Installation Type:Multiple Ductbanks/Backfills

Ambient Soil Temperature at Installation Depth	[°C]	21.0
Native Soil Thermal Resistivity	[K.m/W]	1.5
Consider Non-Isothermal Earth Surface		No

Layer Name	X [ft]	Y [ft]	Width [ft]	Height [ft]	Thermal Resistivity [K.m/W]
Backfill	0.0	2.25	1.5	4.5	2.0



Results Summary

Cable No.	Cable ID	Circuit No.	Feeder ID	Cable Phase	Cable Frequency	Daily Load Factor	X coordinate [ft]	Y coordinate [ft]	Conductor temperature [°C]	Ampacity [A]
1	250 AL - 1_6 CN	1	1250 - 1_6	A	60.0	1.0	-0.1	4.31	89.7	540.5
2	250 AL - 1_6 CN	1	1250 - 1_6	B	60.0	1.0	0.1	4.31	89.7	540.5
3	250 AL - 1_6 CN	1	1250 - 1_6	C	60.0	1.0	0.0	4.14	90.0	540.5

Study Summary

CYMCAP Version	7.2 Revision 3
Study:	UG Collector Circuits
Execution:	Single Ckt 1250 - 1_6CN AL XLPE 150rho
Date:	9/18/2017 2:24:58 PM

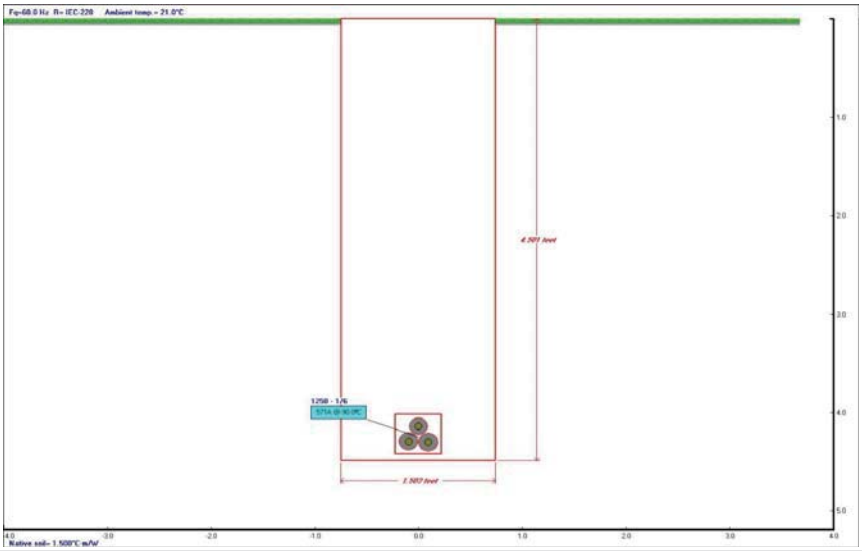
General Simulation Data

Steady State Option	Equally Loaded
Consider Electrical interaction between circuits	No
Induced currents in metallic layers as a fraction of conductor current (applied to all single phase circuits) :	0.0
Conductor Resistances Computation Option:	IEC-228

Installation Type:Multiple Ductbanks/Backfills

Ambient Soil Temperature at Installation Depth	[°C]	21.0
Native Soil Thermal Resistivity	[K.m/W]	1.5
Consider Non-Isothermal Earth Surface		No

Layer Name	X [ft]	Y [ft]	Width [ft]	Height [ft]	Thermal Resistivity [K.m/W]
Backfill	0.0	2.25	1.5	4.5	1.5



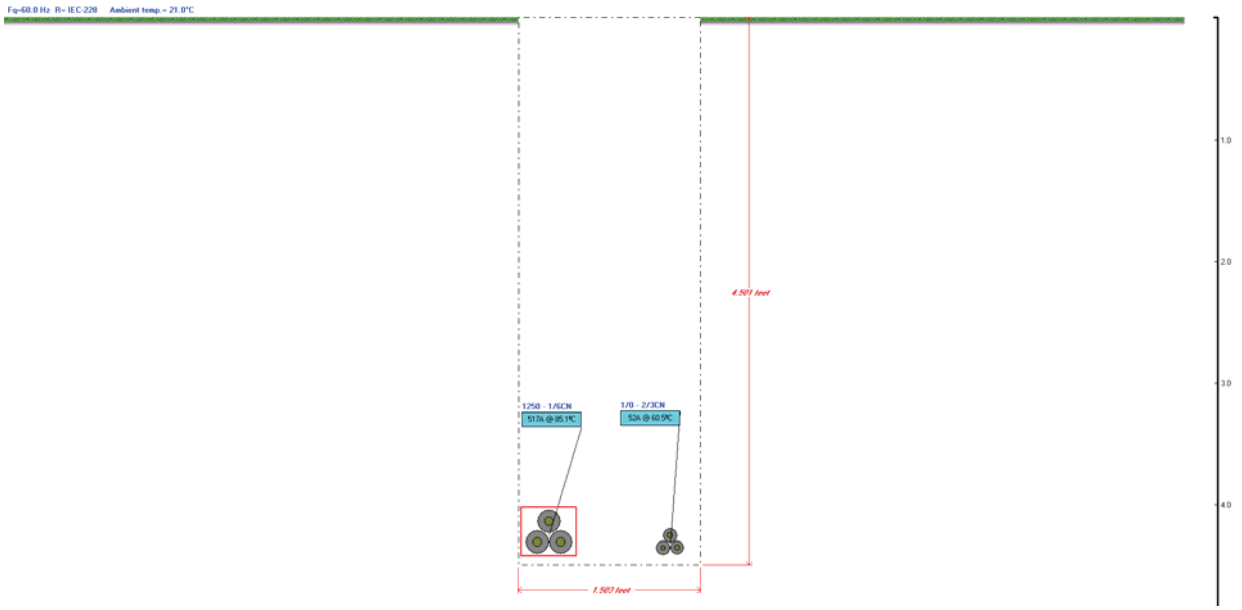
Results Summary

Cable No.	Cable ID	Circuit No.	Feeder ID	Cable Phase	Cable Frequency	Daily Load Factor	X coordinate [ft]	Y coordinate [ft]	Conductor temperature [°C]	Ampacity [A]
1	250 AL - 1_6 CN	1	1250 - 1_6	A	60.0	1.0	-0.1	4.31	90.0	570.5
2	250 AL - 1_6 CN	1	1250 - 1_6	B	60.0	1.0	0.1	4.31	90.0	570.5
3	250 AL - 1_6 CN	1	1250 - 1_6	C	60.0	1.0	0.0	4.14	90.0	570.5

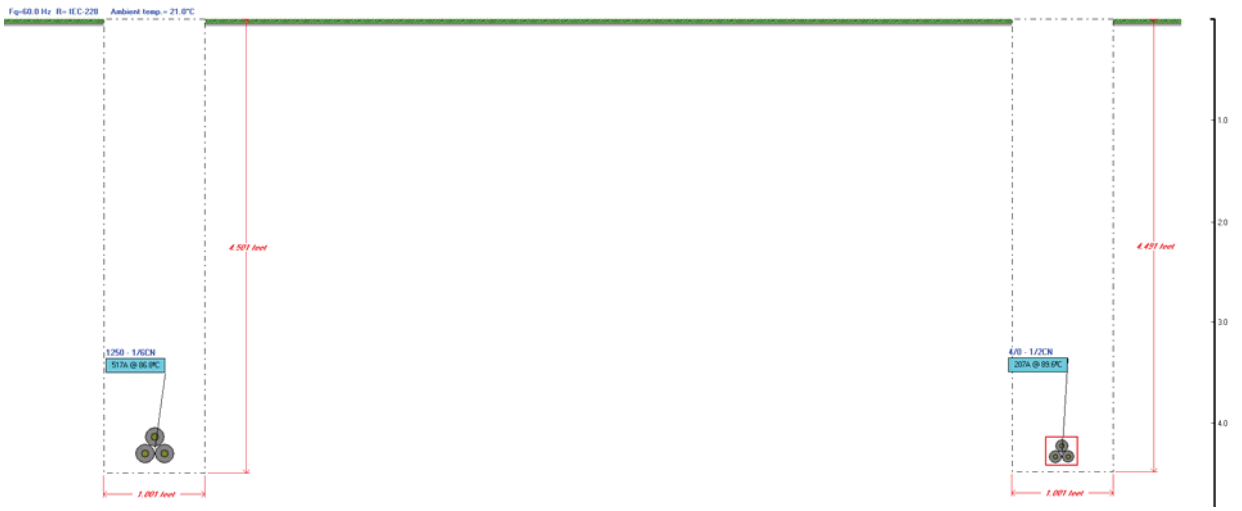
Westwood

APPENDIX B: PARALLEL CIRCUIT CYMCAP REPORTS

ROW: T-34 to T39



ROW: T-33 to T-34



ROW: T-28 to T-33

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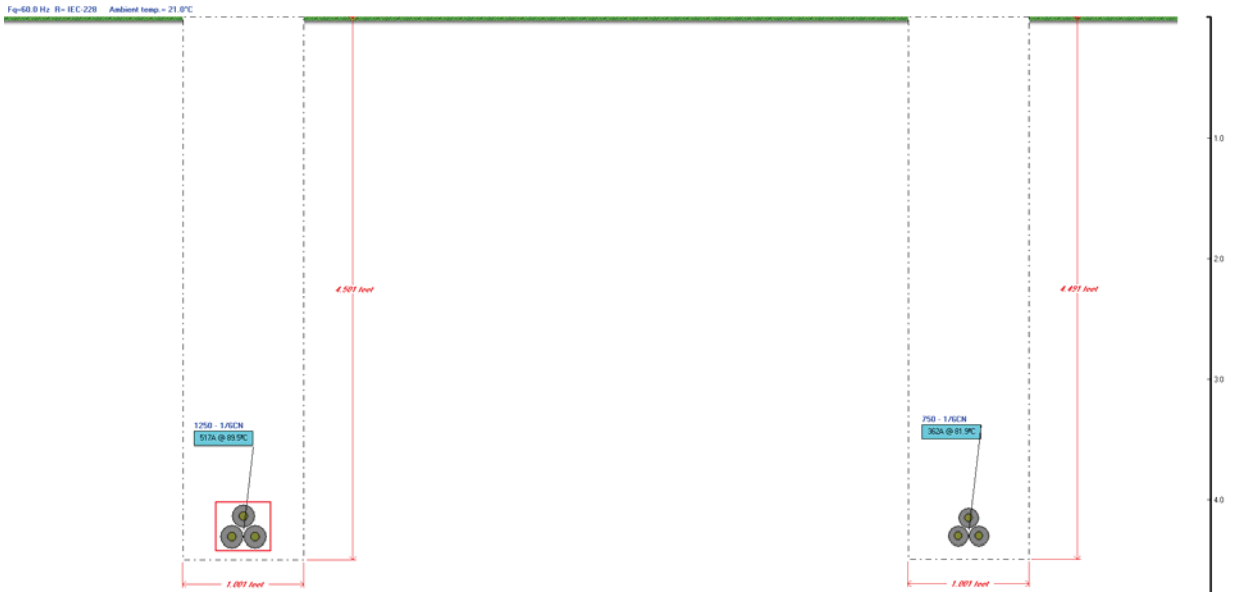
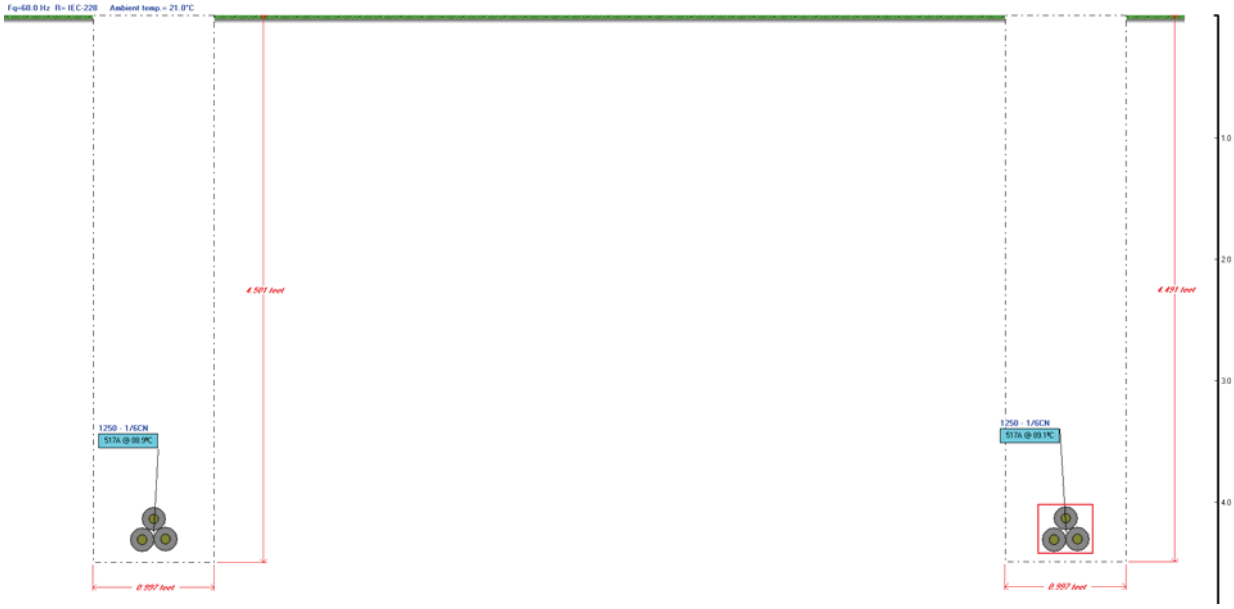
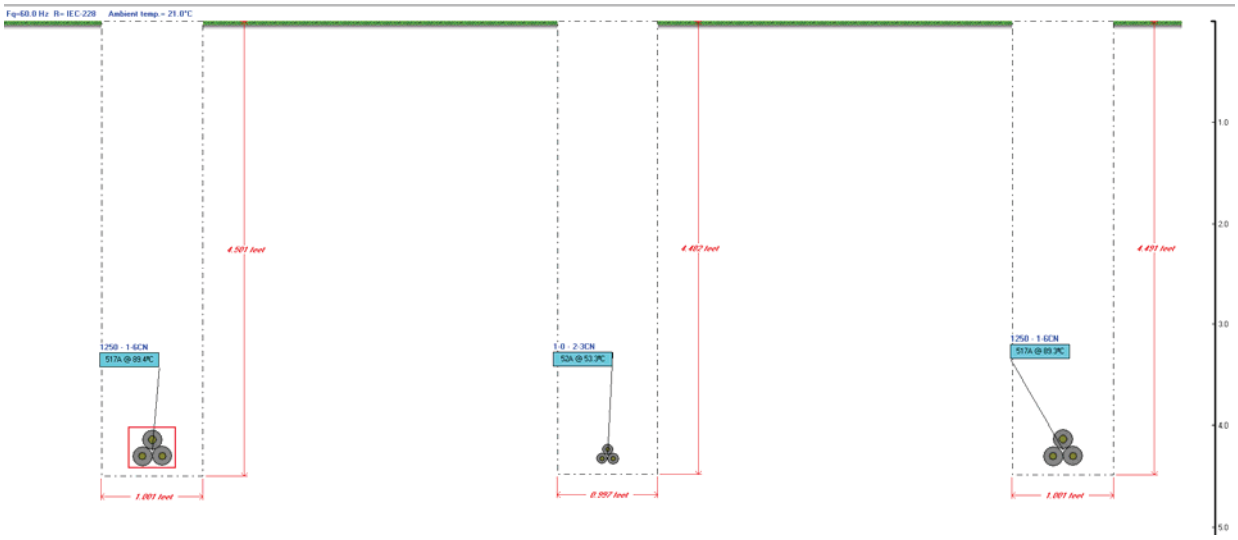


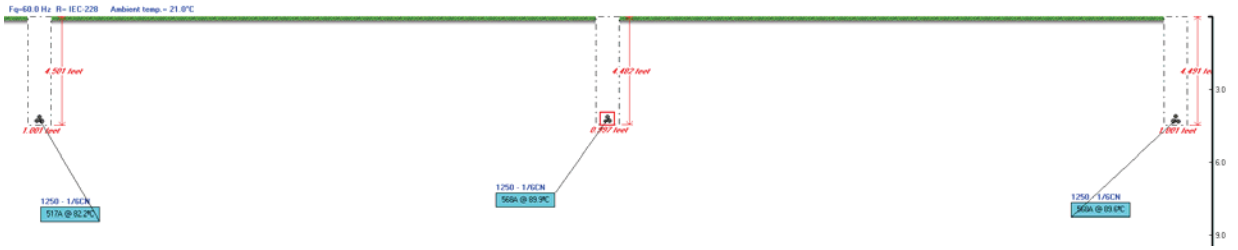
ROW: T-23 to T-28



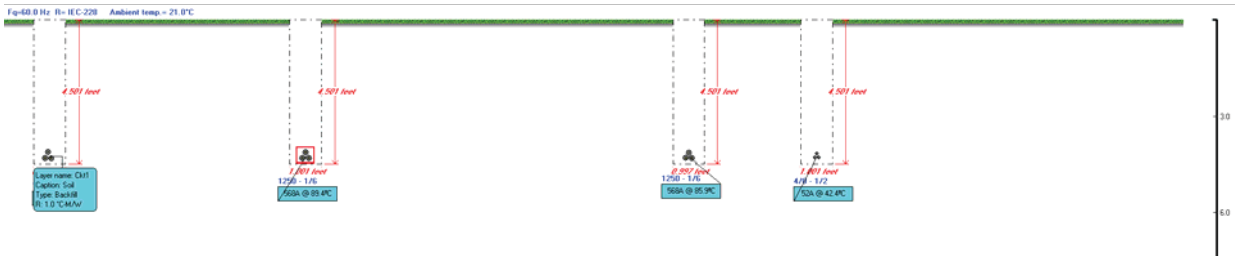
ROW: T-22 to T-23



ROW: JB-2/1 – T-22

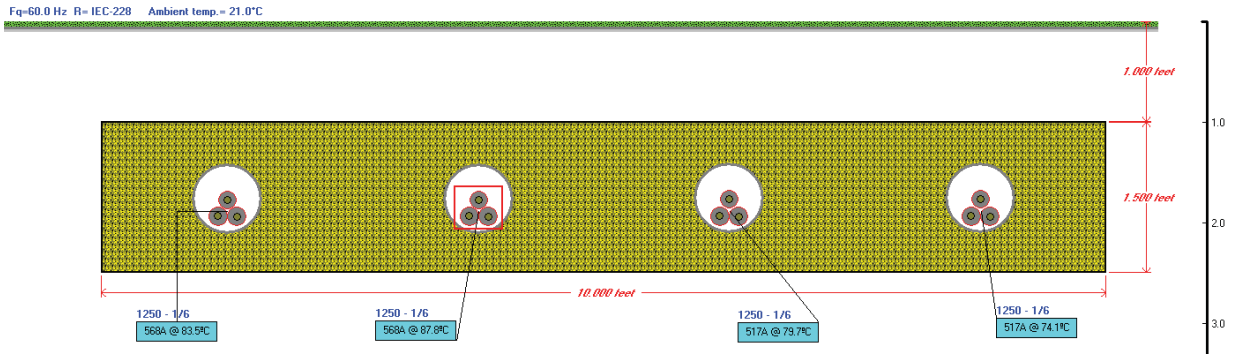


ROW: T-25 to T-25



ROW: T-25 to SUB

Westwood


Fq=60.0 Hz R= IEC-228 Ambient temp.= 21.0°C
1.000 feet
1.500 feet
10.000 feet
1.0
2.0
3.0
1250 - 1/6
568A @ 83.5°C
1250 - 1/6
568A @ 87.6°C
1250 - 1/6
517A @ 79.7°C
1250 - 1/6
517A @ 74.1°C

Summary: Notification of Update to September 1 Notification of Compliance with Condition 6--Final Project Design (Part 2 of 2) electronically filed by Mr. William V Vorys on behalf of Trishe Wind Ohio, LLC