

Before the
Pennsylvania Public Utility Commission

**MONROE-JACKSON #2 138 kV
TRANSMISSION LINE**

AND

**STROUDSBURG #1 AND #2 138 kV
TAPS**

EXHIBITS AND APPENDICES IN SUPPORT OF THE
Letter of Notification

Application Docket No. _____

Submitted by: PPL Electric Utilities Corporation

SUMMARY

This Letter of Notification is being submitted by PPL Electric Utilities Corporation (“PPL Electric”) pursuant to the Pennsylvania Public Utility Commission’s (“Commission”) regulations at 52 Pa. Code §§ 57.71 through 57.77 for approval to construct approximately 275 feet of new 138 kV transmission line and reconstruct the Stroudsburg Taps for 138 kV operation. This project is needed to complete the conversion of the Stroudsburg Substation from 69 kV to 138 kV operation. This project is located in the Borough of Stroudsburg, Monroe County. PPL Electric is proposing to have this project in service by November, 2010.

This project is part of PPL Electric’s overall long-term Southern Pocono 138 kV Conversion Plan (“Plan”) for the heavily loaded service area of the Southern Pocono region. The conversion is required to increase reliability by relieving overloading of a nearby transmission line and low voltage issues in the area. The Plan calls for converting the existing 69 kV facilities in the Southern Pocono area to 138 kV operation. Increasing the operating voltage from 69 kV to 138 kV will double the capacity of the existing transmission lines and substations and will enable PPL Electric to continue to provide reliable electric service to its customers without establishing additional major transmission corridors.

The total estimated cost of the proposed transmission line work is \$900,000. In addition, PPL Electric estimates that it will spend \$1.75 million (including the transformer cost) for the substation modifications. Construction is scheduled to begin as soon as possible to support the project’s in-service date of November, 2010.

This document, which describes the need for the project and discusses the engineering and siting analysis for the proposed construction, consists of the following exhibits and appendices:

- Exhibit "A" - Necessity Statement
 - Exhibit "B" - Engineering Description
 - Exhibit "C" - Environmental Assessment
-
- Appendix A - PPL Electric Design Criteria and Safety Practices
 - Appendix B - Magnetic Field Management at PPL Electric
 - Appendix C - List of Involved Governmental Agencies, Municipalities, and Other Public Entities

PPL ELECTRIC UTILITIES SERVICE TERRITORY

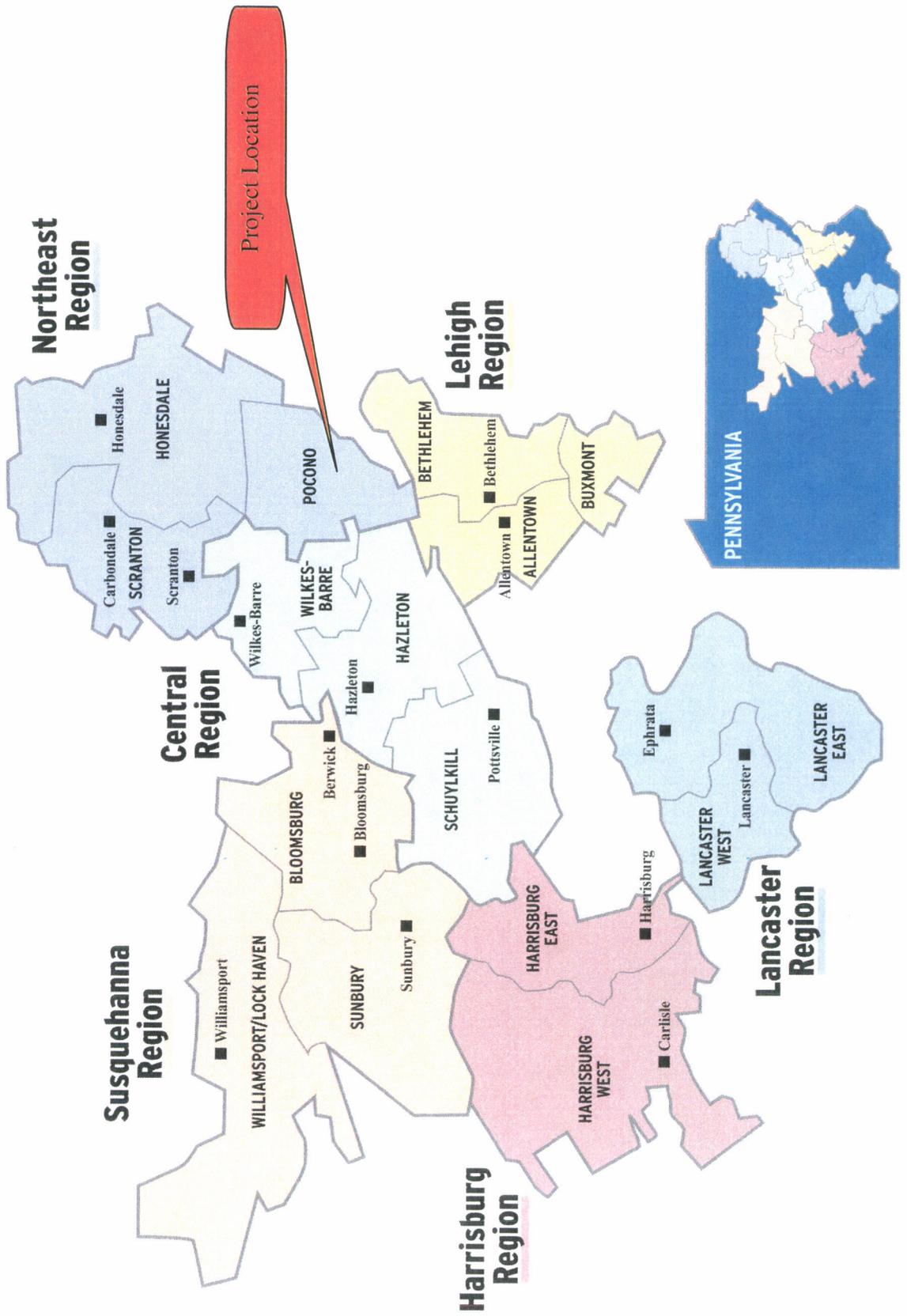


Exhibit A

[Faint handwritten text]

EXHIBIT "A"
MONROE-JACKSON #2 138 kV TRANSMISSION LINE
AND
STROUDSBURG #1 AND #2 138 kV TAPS
NECESSITY STATEMENT

TABLE OF CONTENTS

<u>SECTION</u>	<u>TOPIC</u>	<u>PAGE</u>
A.	INTRODUCTION.....	1
B.	EXISTING SYSTEM.....	2
C.	DEFINITION OF THE PROBLEM.....	2
D.	PROPOSED SOLUTION.....	3
E.	FUNCTIONAL ALTERNATIVES.....	5

LIST OF FIGURES

FIGURE 1	FUNCTIONAL ONE-LINE DIAGRAM EXISTING ARRANGEMENT.....	6
FIGURE 2	FUNCTIONAL ONE-LINE DIAGRAM PROPOSED ARRANGEMENT.....	7

MAP

MAP 1	PPL ELECTRIC SYSTEM MAP.....	EXHIBIT "A" MAP POCKET
-------	------------------------------	---------------------------

EXHIBIT "A"
MONROE-JACKSON #2 138 kV TRANSMISSION LINE
AND
STROUDSBURG #1 AND #2 138 kV TAPS
NECESSITY STATEMENT

A. INTRODUCTION

PPL Electric Utilities Corporation ("PPL Electric") plans to convert the transmission system in the Southern Pocono area from 69 kV to 138 kV by November 2010. This conversion is required to resolve transmission line overloads and low voltage issues. To accomplish the conversion, PPL Electric is requesting Commission approval to tap the Monroe-Jackson #1 & #2 138 kV Lines and reconstruct the Stroudsburg #1 and #2 Taps for 138 kV operation. The Stroudsburg 138 kV Taps are needed to source the two proposed 138-12 kV transformers at the Stroudsburg Substation. Approval is also requested to construct approximately 275 feet of new 138 kV line around the Stroudsburg Substation to complete the new Monroe-Jackson #2 138 kV line.

Construction of the Stroudsburg 138 kV Taps and the new 138 kV spans around Stroudsburg Substation is a necessary part of the Southern Pocono 138 kV Conversion Plan. Completion of this work will allow PPL Electric to remain in compliance with North American Electric Reliability Corporation ("NERC") Transmission Planning Standards ("TPL") and PPL Electric's Reliability Principles and Practices.

The estimated cost to design and construct the Stroudsburg #1 and #2 138 kV Tap Lines and the three new 138 kV spans around the Stroudsburg Substation is approximately \$900,000. This project has a scheduled construction start date of March 2010 to meet a required in-service date of November 2010. The required in-service date is defined as the date that the proposed facility must be placed in service to prevent overloads and low voltage conditions that could potentially damage equipment and result in service interruptions to customers.

A PPL system map showing existing transmission facilities with a design voltage of 35 kV or greater is included in the Exhibit "A" map pocket. This filing addresses the 275 feet of new 138 kV line around the Stroudsburg Substation to complete Monroe-Jackson #2 138 kV Transmission Line and the Stroudsburg #1 and #2 138 kV Taps.

B. EXISTING SYSTEM (see Figure 1)

The Stroudsburg 69-12 kV Substation presently has two 69-12 kV transformers. Transformer #1 is presently supplied from a 69 kV tap off the Martins Creek-Stroudsburg 138/69 kV Line. Transformer #2 is supplied from a 69 kV tap off the Jackson-Stroudsburg 138/69 kV Line (see Figure 1). The Jackson-Stroudsburg 138/69 kV Line is served from the Jackson 138-69 kV Regional Substation. The Jackson Substation has two 138-69 kV transformers which supply a standard 138 kV bus design, currently operated at 69 kV. The Jackson-Stroudsburg 138/69 kV Line is served from one of the terminals at the Jackson Substation.

The Martins Creek-Stroudsburg 138/69 kV line is served from the Martins Creek 230-69 kV Regional Substation. The Martins Creek Substation has one 230/69 kV transformer which feeds a standard 69 kV bus design. The Martins Creek-Stroudsburg 138/69 kV line is served from one of the terminals at the Martins Creek Substation.

C. DEFINITION OF THE PROBLEM

During peak winter load periods, loss of the exiting Monroe-Jackson 138 kV Line¹ or the Monroe 230-138 kV Transformer #2 would result in an overload of the Siegfried-Jackson 138 kV line and low voltage on the 69 kV lines served from Jackson Regional Substation. Under this condition, the Siegfried-Jackson 138 kV line would become overloaded to approximately 105% of its winter emergency rating of 278 Millivolt Ampere ("MVA") by the winter of 2010/2011. Additionally, voltage would drop to a level which is below

PPL Electric's Reliability Principles and Practices ("RP&P") guideline of 62 kV at several distribution substations. Beginning in the winter of 2010/2011 during extended outages, sufficient load could not be transferred away to neighboring facilities to reduce loading on the Siegfried-Jackson 138 kV Line to or below its winter normal rating of 222 MVA without resulting in low 69 kV voltage conditions on neighboring circuits. Overloading a transmission line can cause damage and ultimately lead to conductor failure. These overload conditions would be a violation of the established NERC TPL-002 Reliability Standard and must be rectified.

The problems cited above would interrupt more than 230 MW of load, or approximately 55,000 customers, for extended periods of time until repairs can be made. Such an outage would exceed the maximum acceptable load interruption guideline of 120 MW for loss of a single-circuit 138 kV line according to PPL Electric's RP&P.

Reinforcement of the Southern Pocono Area transmission system is required by the 2010/2011 winter period in order to avoid conductor overload and low voltage conditions which could result in a significant load loss for extended periods.

D. PROPOSED SOLUTION (see Figure 2)

To resolve the problems discussed above, PPL Electric will establish a 138 kV double-circuit network path between the Monroe, Jackson and Siegfried Regional Substations by November 2010. Establishing this double-circuit network path will resolve overload and low voltage concerns for loss of one Monroe-Jackson 138 kV circuit or the Monroe 230-138 kV transformer by reinforcing 138 kV transmission facilities. Creating this double-circuit 138 kV path will require conversion of the Jackson-Stroudsburg 138/69 kV line and a portion of the Martins Creek-Stroudsburg 138/69 kV line from 69 kV to 138 kV operation. The Jackson-Stroudsburg 138/69 kV Line and a portion of the Martins Creek-Stroudsburg 138/69 kV Line use 556 Aluminum Conductor Steel Reinforced ("ACSR")

¹ The existing Monroe-Jackson 138 kV Transmission Line will be renamed the Monroe-Jackson #1 138 kV Transmission Line.

conductor. Raising the operating voltage from 69 kV to 138 kV on one 556 ACSR circuit will double its capacity from a winter normal rating of 111 MVA to a winter normal rating of 222 MVA meeting increased electric demand without the need for additional major transmission line corridors.

To complete the overall Southern Pocono Reinforcement Plan, it will be necessary for PPL Electric to convert the existing 69-12 kV distribution substations served from the Jackson-Stroudsburg 138/69 kV line and the Martins Creek-Stroudsburg 138/69 kV line to 138 kV operation. In 2010, PPL Electric proposes to transfer load from the 69 kV system to the 138 kV system at the Stroudsburg Substation by tapping the new Monroe-Jackson #1 and #2 138 kV Transmission Lines and constructing the Stroudsburg #1 and #2 Taps to feed the Stroudsburg Substation Transformers #1 and #2, respectively. In order to accept load at 138 kV, each of the existing transformers at the Stroudsburg Substation will be replaced with a 138-12 kV, 20/27/34 MVA unit. The Stroudsburg Substation will realize an increase in capacity of approximately 10 MVA for each transformer. Figure 2 shows the proposed transmission line arrangement for the 2010-2011 winter.

Additionally, three new spans (approximately 275 feet in total) of 138 kV line will be constructed to connect the existing Martins Creek-Stroudsburg 138/69 kV Transmission Line to the existing Jackson-Stroudsburg 138/69 kV Transmission Line. These spans will complete the path from Jackson to Monroe for the new Monroe-Jackson #2 138 kV line. Establishing the Monroe-Jackson #1 & #2 138 kV double-circuit network path will provide redundancy which improves reliability and operating flexibility of the system. The Jackson-Stroudsburg 138/69 kV Transmission Line and a portion of the Martins Creek-Stroudsburg 138/69 kV Transmission Line were approved by the Commission for 138 kV operation when they were originally constructed (at Commission Docket No. A 110500F108, and Docket No. A-110500F121, respectively).

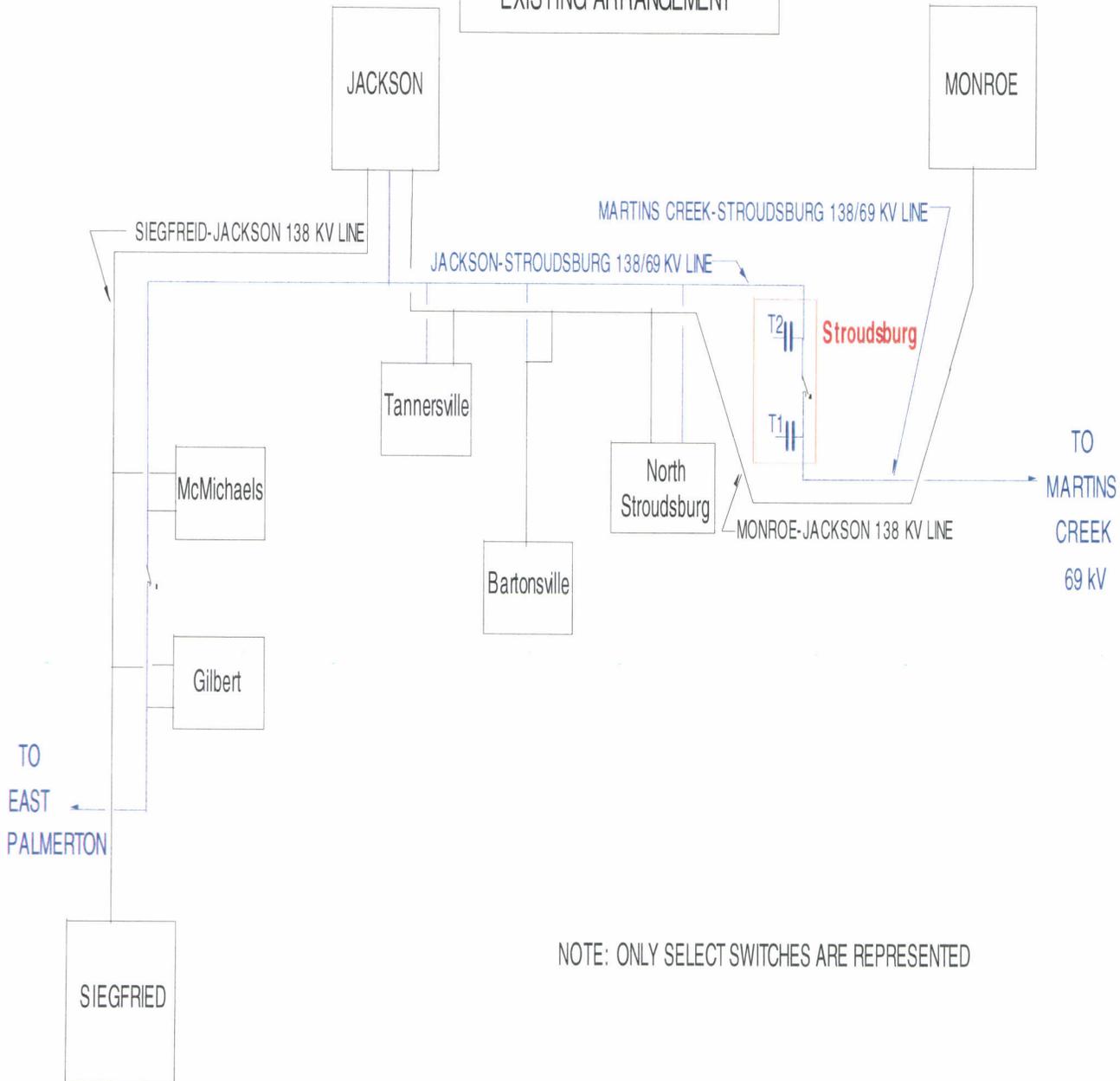
The total estimated cost for the proposed work at the Stroudsburg Substation is approximately \$2.65 million, which includes \$1.75 million for the substation

modifications and \$900,000 for the transmission work. This filing covers only the proposed modifications of transmission facilities, which is the only part of the project that requires prior Commission approval under 52 Pa. Code, Chapter 57, Subchapter G.

E. FUNCTIONAL ALTERNATIVES

No other reasonably economical functional alternatives were identified that would resolve the reliability problems outlined above. Conversion of the transmission system in the Southern Pocono area from 69 kV to 138 kV by November 2010 is required to resolve transmission line overloads and low voltage issues under certain contingency conditions. Construction of the Stroudsburg #1 and #2 138 kV Taps and three new 138 kV spans around the Stroudsburg Substation to complete the Monroe-Jackson #2 138 kV line is an integral part of the overall long range transmission reinforcement plan for the Southern Pocono area. Raising the operating voltage from 69 kV to 138 kV will double the capacity of the existing transmission lines and enable them to meet increased electric demand without the need for additional major transmission corridors. This conversion will expand the existing 138 kV system and improve reliability of service for customers in the Southern Pocono area. It will also provide increased operating flexibility for the electric facilities connecting the Monroe, Jackson and Siegfried Regional Substations.

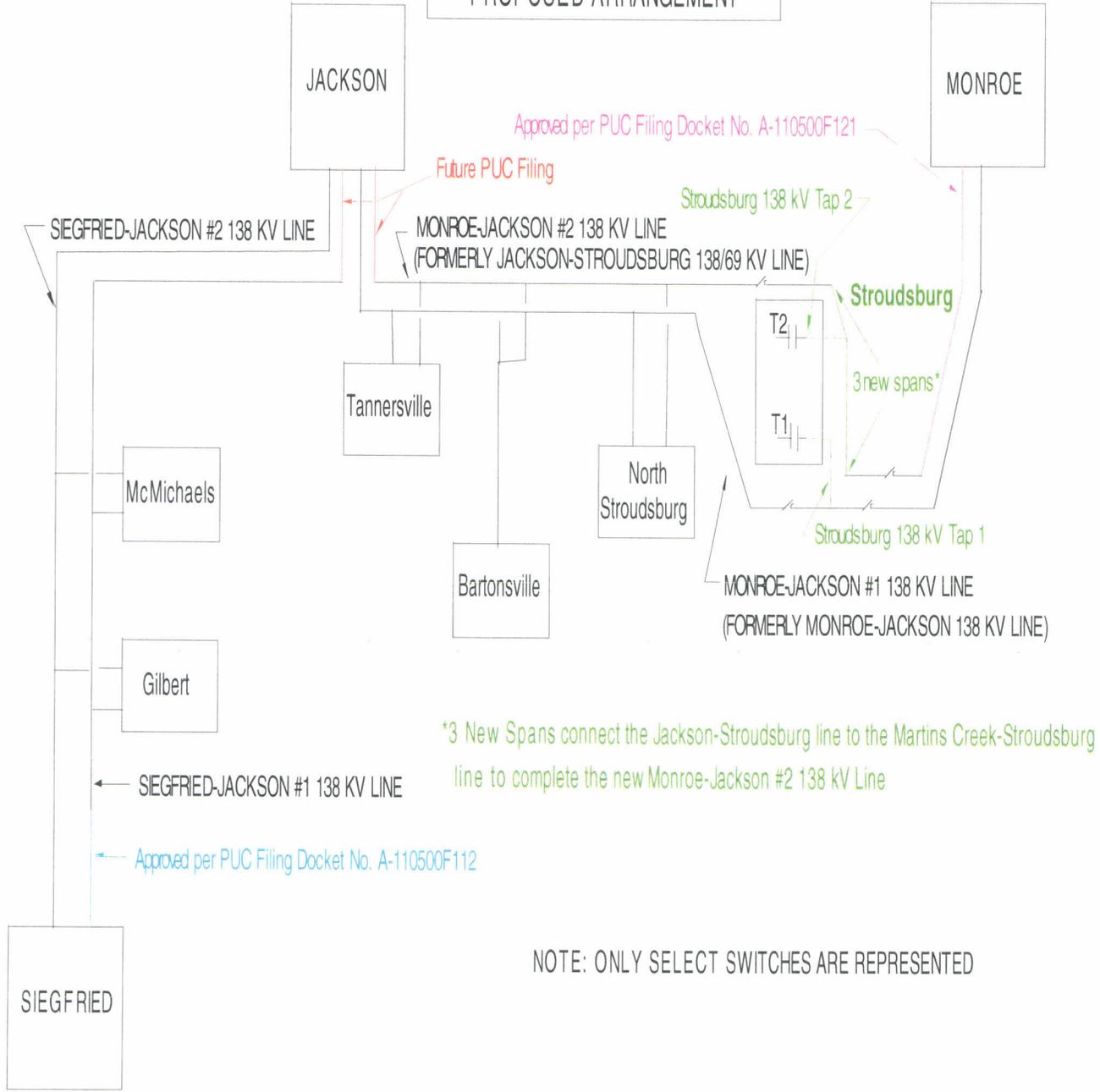
FIGURE 1
FUNCTIONAL ONE-LINE DIAGRAM
EXISTING ARRANGEMENT



NOTE: ONLY SELECT SWITCHES ARE REPRESENTED

Figure 1 - Function One-Line Diagram Existing Arrangement

FIGURE 2
FUNCTIONAL ONE-LINE DIAGRAM
PROPOSED ARRANGEMENT



*3 New Spans connect the Jackson-Stroudsburg line to the Martins Creek-Stroudsburg line to complete the new Monroe-Jackson #2 138 KV Line

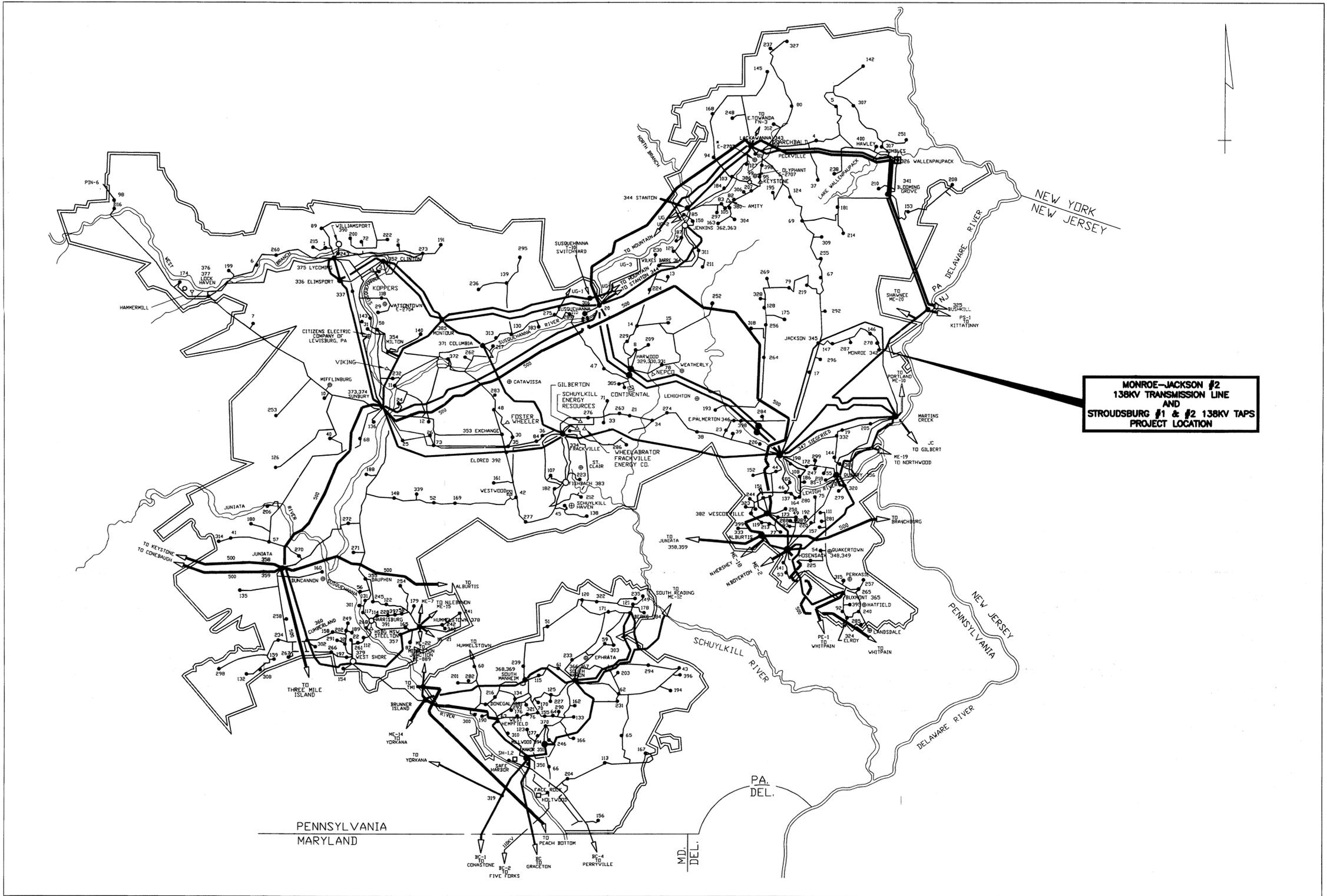
NOTE: ONLY SELECT SWITCHES ARE REPRESENTED

Figure 2 - Functional One-Line Diagram Proposed Arrangement

SUBSTATION LISTING

1 WEST WILLIAMSPORT	151 CRACKERSPORT	301 CENTER CITY
2 FAIRFIELD	152 SCHNECKSVILLE	302 NEW KINGSTOWN
3 MONTGOMERY	153 HEMLOCK	303 REAMSTOWN
4 VARDEN	154 MT. ALLEN	304 DUPONT
5 HONESDALE	155 PRINCE	305 HUMBOLDT
6 JERSEY SHORE	156 COOPERSBURG	306 CEDAR AVE.
7 LUDANTON	157 WERTZVILLE	307 INDIAN ORCHARD
8 VALMONT	158 WEST CARLISLE	308 NOTTINGHAM
9 RIVER	159 BEVENUE	309 NORTH COOLBAUGH
10 LIMESTONE	160 HEGINS	310 LETORT
11 NORTHUMBERLAND	161 LEDLA	311 EAST MOUNTAIN
12 REED	162 YATESVILLE	312 JERMYN
13 ST. JOHNS	163 CENTRAL ALLENTOWN	313 BLOOMSBURG
14 FREELAND	164 OBERLIN	314 MIFFLINTOWN
15 GILBERT	165 STRASBURG	315 RIDGE ROAD
16	166 ATGLEN	316 SUSQUEHANNA
17	167 BROOKSIDE	317 T-10 SW. YD.
18	168 WILLIAMSPORT	318 KIMBLE
19	169 SUSQUEHANNA 230KV	319 CHRISTIANS
20 TAMANEND	170 WERNERSVILLE	320 OILER CREEK
21 WHITE HILL	171 N. BETHLEHEM	321 STEEL CITY
22 PALMERTON	172 W. ALLENTOWN	322 GODSVORNVILLE
23 HAMILTON	173 FLEMINGTON	323 ROBERTSON
24 HUNTER	174 MECKESVILLE	324 S.FOGELSVILLE
25 FAIRVIEW	175 DONERVILLE	325 ELRDY
26	176 MILLERSVILLE	326 BUSHKILL
27	177 SHILLINGTON	327 WALLENPAUPACK
28	178 DUKE	328 ELK MOUNTAIN
29	179 MOUNTAINTOP	329 JACK FROST
30	180 MOUNTAIN TOP	330 HARWOOD 230/69KV
31	181 KELLY	331 HARWOOD 69/12KV
32	182 SPORTING HILL	332 HARWOOD CTG
33	183 MAHANAY CITY	333 HARWOOD 69/12KV
34	184 GREENWOOD	334 KEYSER AVENUE
35	185 MDWRY	335 MICKLEYS
36	186 AL TAMOUNT	336 EAST ALLENTOWN
37	187 HAMLIN	337 PINE RIDGE
38	188 ASHFIELD	338 DALMATIA
39	189 SOUTH SLATINGTON	339 PENNSBORO
40	190 SOUTH MIDDLEBURG	340 PENNSBORO
41	191 WALKER	341 HUGHESVILLE
42	192 FRATLEY	342 SOUTH ALLENTOWN
43	193 FERGANTOWN	343 WEISSBURG
44	194 LEYB	344 HONEYBROOK
45	195 CRESSONA	345 MOSCOW
46	196 SOUTH WHITEHALL	346 ROSSMOYNE
47	197 EAST TOMACKEN	347 NORTHAMPTON
48	198 BEAR GAP	348 WOODRICH
49	199 SALISBURY	349 FAYON
50	200 SOUTH MILTON	350 ELIZABETHTOWN
51	201 HEIDELBERG	351 ENOLA
52	202 LYKENS	352 HILLS HILL
53	203 HANOVER	353 BUCK
54	204 RICHLAND	354 MT. BETHEL
55	205 MACADA	355 RICHFIELD
56	206 ROCKVILLE	356 THOMPSTOWN
57	207 PAXTON	357 TWIN LAKES
58	208 COCALICO	358 EASTON
59	209 EAST ELIZABETHTOWN	359 BEAR CREEK
60	210 EARL	360 DRWIGSBURG
61	211 HEMPFIELD	361 WEST TEXAS
62	212 EAST LANCASTER	362 CANDENSIS
63	213 KINZER	363 LINDEEN
64	214 MT. NEBO	364 JUNIATA 500/230KV
65	215 MT. PINNAC	365 JUNIATA 230/69KV
66	216 WEST BLOOMSBURG	366 CUMBERLAND
67	217 PENNS	367 MINSI TRAIL
68	218 ODUNSBORO	368 JENKINS 230/69KV
69	219 MILLERSVILLE	369 JENKINS CTG
70	220 GIRARD MANDR	370 WILKES-BARRE
71	221 KENMAR	371 BUXMONT
72	222 GWEN CITY	372 SOUTH AKRON 230/138/69KV
73	223	373 SOUTH AKRON 69/12KV
74	224	374 SOUTH MANHEIM 69/12KV
75	225 ELLIOT HEIGHTS	375 SOUTH MANHEIM 230/69KV
76	226 SOUTH AKRON	376 RUTHERFORD
77	227 MACUNGIE	377 WASHINGTON
78	228 EAST HAZLETON	378 PARRISH
79	229 WEST CARBONDALE	379 WEST NEW HOLLAND
80	230 EYNDON	380 LINCOLN
81	231 MINDOKA	381 MIDDLETON
82	232 OLD FORGE	382 STATE HILL
83	233 FOUNTAIN SPRINGS	383 MIVILLE
84	234 SULLIVAN TRAIL	384 TINKER
85	235 SWATARA	385 LAKEVILLE
86	236	386 NORTH MANHEIM
87	237	387 HATFIELD
88	238	388 HERSHEY
89	239	389 S. HERSHEY
90	240	390 S. WILLIAMSPORT
91	241	391 FOGELSVILLE
92	242	392 WINDSOR
93	243	393 WILLOW
94	244	394 WESTGATE
95	245	395 EDLA
96	246	396 SUMMERDALE
97	247	397 DORNEYVILLE
98	248	398 BOHEMIA
99	249	399 WHITE HAVEN
100	250	400 LAURELTON
101	251	401 LINGESTOWN
102	252	402 POCONO FARMS
103	253	403 HICKORY RUN
104	254	404 BLOOMING GLEN
105	255	405 SHERMANSDALE
106	256	406 LARRY'S CREEK
107	257	407 SPANGLER MILLS
108	258	408 E. DANVILLE
109	259	409 DELAND
110	260	410 CARBON
111	261	411 SELLERSVILLE
112	262	412 LITTLE GAP
113	263	413 DRIVILLA
114	264	414 TUSCARORA
115	265	415 BARTONSVILLE
116	266	416 ALTON PARK
117	267	417 SALEM
118	268	418 NORTH BRIDGEPORT
119	269	419 HAMPTON
120	270	420 CAMELBACK
121	271	421 SILVER SPRING
122	272	422 BRECKNOCK
123	273	423 BENTON
124	274	424 GREENFIELD
125	275	425 MCMICHAELS
126	276	426 HUGHESVILLE
127	277	427 NEWVILLE
128	278	428 WYOMING
129	279	429 POINT NORTH
130	280	430 EXETER
131	281	431
132	282	432
133	283	433
134	284	434
135	285	435
136	286	436
137	287	437
138	288	438
139	289	439
140	290	440
141	291	441
142	292	442
143	293	443
144	294	444
145	295	445
146	296	446
147	297	447
148	298	448
149	299	449
150	300	450

* - SUBSTATIONS THAT HAVE BEEN RETIRED.
 ## - SITE OF THE EXISTING 230KV SUBSTATION AND PROPOSED 500KV SUBSTATION



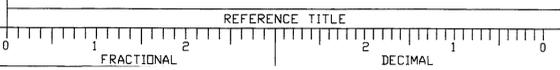
INTERCONNECTIONS

PS PUBLIC SERVICE ELECTRIC AND GAS CO. OF N.J.
 ME METROPOLITAN EDISON CO. (FIRST ENERGY)
 PE PHILADELPHIA ELECTRIC CO. (PECO ENERGY)
 BC BALTIMORE GAS AND ELECTRIC CO.
 SH SAFE HARBOR WATER POWER CORPORATION
 UP THE UNITED GAS IMPROVEMENT CO. - LUZERNE ELECTRIC DIVISION
 PN PENNSYLVANIA ELECTRIC CO. (FIRST ENERGY)
 JC JERSEY CENTRAL POWER AND LIGHT CO. (FIRST ENERGY)

- COMBUSTION TURBINE
- HYDRO ELECTRIC
- COMBINATION
- FIRM SALES
- SUBSTATION / SWITCHING STATION
- STEAM ELECTRIC
- NON-UTILITY GENERATION
- INDEPENDENT POWER PRODUCERS

- 500KV OPERATION
- 230KV OPERATION
- 138KV OPERATION
- 69KV OPERATION

ACCT - 805201	ELECTRICAL SYSTEM MAP	
SCALE - NONE	MONROE-JACKSON #2 138KV TRANSMISSION LINE	
BY - CDW	STROUDSBURG #1 AND #2 138KV TAPS	
REVIEWED	APPROVED	DATE
	G. HAKUN III	7/1/785
	PPL ELECTRIC UTILITIES	
PPL DRAWING NO.	SHEET NO.	REV.
D191830	1	60



NUMBER	REFERENCE TITLE	NUMBER	REFERENCE TITLE
60	8/24/09 161694	ADDED MONROE-JACKSON #2 138KV TRANS. LINE & STROUDSBURG #1 & #2 138KV TAPS.	RRC
59	7/2/09 161667	ADDED ROSEVILLE 138/69KV TAP & NEFFSVILLE #1 & #2 138/69KV TAPS.	RRC
58	5/21/09 161748	ADDED HAWLEY 138/69KV TAP LINE.	RRC
57	4/24/09 169996	HARRISBURG-WALNUT 138/69KV LINE.	RRC

NO.	DATE	ACCT.	#6000	LOCATION CODES	DIAGN. & PROTECT. INFO.	TRANSMISSION MAP INFO.

Exhibit B

EXHIBIT "B"
MONROE-JACKSON #2 138 kV TRANSMISSION LINE
AND
STROUDSBURG #1 AND #2 138 kV TAPS
ENGINEERING DESCRIPTION

TABLE OF CONTENTS

<u>SECTION</u>	<u>TOPIC</u>	<u>PAGE</u>
A.	DESCRIPTION OF PROPOSED LINE	1
B.	MAGNETIC FIELD MANAGEMENT.....	5
C.	RIGHT-OF-WAY STATUS.....	5

LIST OF TABLES

TABLE 1	DESIGN MINIMUM CONDUCTOR CLEARANCES	3
TABLE 2	CONDUCTOR THERMAL RATINGS	4

LIST OF FIGURES

FIGURE 1	PROPOSED 138 kV ANGLE STRUCTURE.....	6
FIGURE 2	PROPOSED 138 kV TAP STRUCTURE.....	7

MAP

MAP 1	AERIAL EXHIBIT – DRAWING.....	EXHIBIT "B" MAP POCKET
-------	-------------------------------	---------------------------

EXHIBIT "B"
MONROE-JACKSON #2 138 kV TRANSMISSION LINE
AND
STROUDSBURG #1 AND #2 138 kV TAPS
ENGINEERING DESCRIPTION

A. DESCRIPTION OF PROPOSED LINE

PPL Electric proposes to construct approximately 275 feet (three spans) of new 138 kV transmission line around the existing Stroudsburg Substation. The new line will connect two existing 138/69 kV transmission lines. PPL Electric also plans to construct two new single-circuit 138 kV tap lines into the existing Stroudsburg Substation to source the proposed 138-12 kV transformers. This project is required to resolve reliability, load, and low voltage issues in the Southern Pocono area. The project is located in Stroudsburg Borough, Monroe County. A plot plan for the transmission line project is provided in the Exhibit "B" map pocket.

A new section of single-circuit 138 kV transmission line, approximately 275 feet in length, will be constructed to connect the existing Martins Creek-Stroudsburg 138/69 kV Transmission Line to the existing Jackson-Stroudsburg 138/69 kV Transmission Line. The new line will be called the Monroe-Jackson #2 138 kV Transmission Line. This construction will require the installation of two foundation and one direct-embedded steel pole structures, which will be approximately 75 feet in height. The new section of transmission line will consist of three 556.5 thousand circular mills (kcmil), 24/7 stranding, aluminum conductor steel reinforced ("ACSR") power conductors. One 3/8 inch steel overhead ground wire will be installed to provide lightning protection for the proposed line.

Two new single-circuit 138 kV transmission tap lines will also be constructed. The new tap lines will be called the Stroudsburg #1 and #2 138 kV Taps. The Stroudsburg #1 138 kV Tap will be approximately 110 feet in length. This tap will require the installation of

one direct-embedded steel pole structure, which will be approximately 65 feet in height. The Stroudsburg #2 138 kV Tap will be approximately 25 feet in length. This tap will share one steel pole structure with the Monroe-Jackson #2 138 kV Transmission Line. Both tap lines will consist of three 556.5 kcmil, 24/7 stranding, ACSR power conductors and one overhead ground wire. The steel overhead ground wires will be installed to provide lightning protection for the proposed tap lines.

The proposed line will be designed to, and generally exceed, minimum National Electrical Safety Code (“NESC”) standards. Design specifications and safety rules practiced by PPL Electric are included in Appendix A. The minimum conductor to ground clearance will be 30 feet on all new line facilities. This minimum clearance occurs at the thermal conductor temperature of 125 degrees Celsius.

The designed minimum conductor clearances and conductor thermal ratings for the line are as follow:

TABLE 1
DESIGN MINIMUM CONDUCTOR CLEARANCES
FOR 556.5 KCMIL 24/7 STRANDING ACSR*

<u>Condition</u>	Stroudsburg #1 Tap Transmission <u>Single-Circuit Design Clearance-to-Ground</u>	Stroudsburg #2 Tap Transmission <u>Single-Circuit Design Clearance-to-Ground</u>	Monroe-Jackson #2 Transmission <u>Single-Circuit Design Clearance-to-Ground</u>
Normal load; average weather (16°C ambient, 60°F temperature)	30.3 feet	30.2 feet	32.7 feet
Predicted extreme thermal load (125°C conductor, 257°F temperature)	30 feet	30 feet	30 feet
Predicted NESC extreme wind load conditions (25 lbs., 16°C, 60°F temperature)	30.3 feet	30.2 feet	31.9 feet
Predicted extreme weather conditions (1-inch ice, 4 lbs. wind, -18°C, 0°F temperature)	30.4 feet	30.3 feet	32.2 feet

* Clearances based on a maximum tension of 500 pounds and a ruling span of 80 feet

* Clearances based on a maximum tension of 500 pounds and a ruling span of 25 feet

* Clearances based on a maximum tension of 4970 pounds and a ruling span of 290 feet with a max span length of 133 feet

TABLE 2
CONDUCTOR THERMAL RATING
556.5 KCMIL 24/7 STRANDING ACSR
(257°F) 125°C MAXIMUM CONDUCTOR TEMPERATURE

Condition	Ambient Temperature °C	Wind Speed Knots	Ampacity Amps
Summer Normal	35	0	815
Winter Normal	10	0	926
Summer Emergency	35	1 1/2	1,041
Winter Emergency	10	1 1/2	1,163

B. MAGNETIC FIELD MANAGEMENT

PPL Electric's Magnetic Field Management Program, summarized in Appendix B, is applied to new and reconstructed transmission line projects. To reduce magnetic field exposures, the program generally prescribes the use of a line design that increases ground clearance by five feet and use of reverse phasing of new double-circuit lines where it is feasible to do so at low or no cost. The implementation of additional modifications will be considered, provided those modifications can be made at low or no cost.

Increased structure height will be utilized on the new line sections to reduce magnetic field exposures. Reverse phasing cannot be utilized because the lines are being constructed as single-circuit lines. Reverse phasing requires a double-circuit line.

C. RIGHT-OF-WAY STATUS

The project is located entirely on property owned in fee by PPL Electric. No additional right-of-way is required.

FIGURE 1
PROPOSED 138 kV ANGLE STRUCTURE
APPROXIMATE HEIGHT – 75'

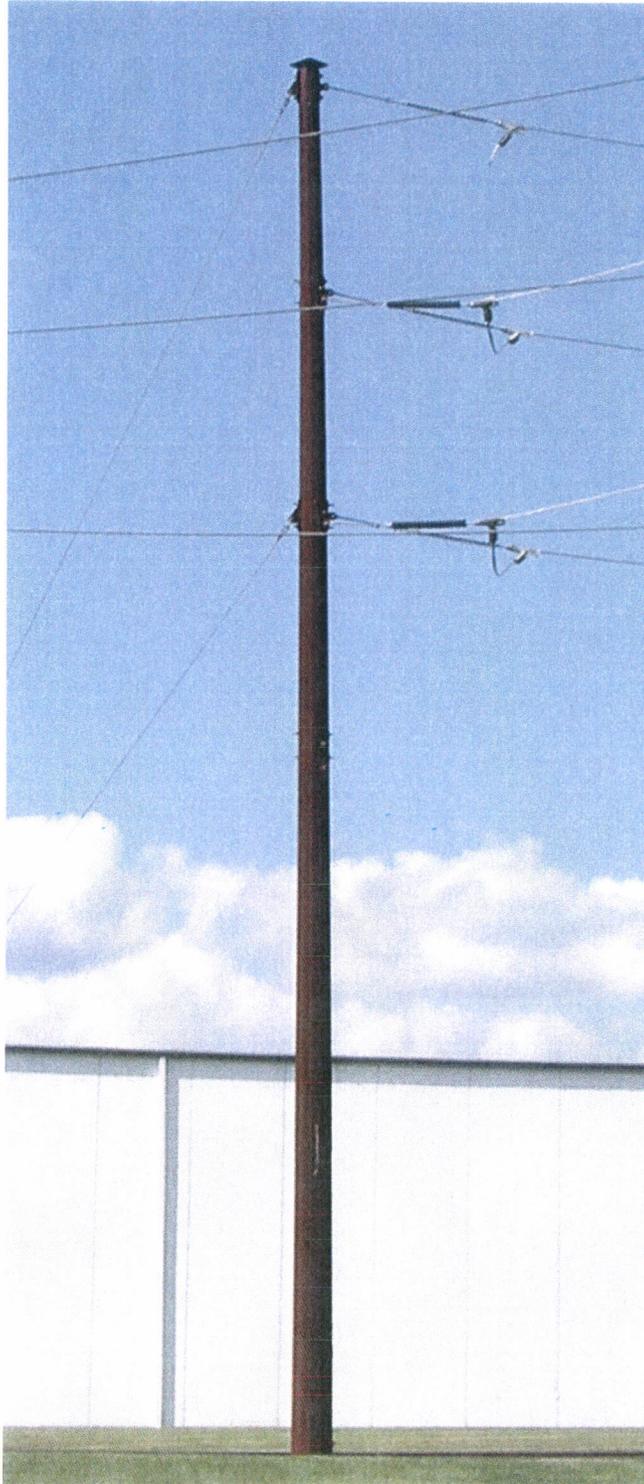
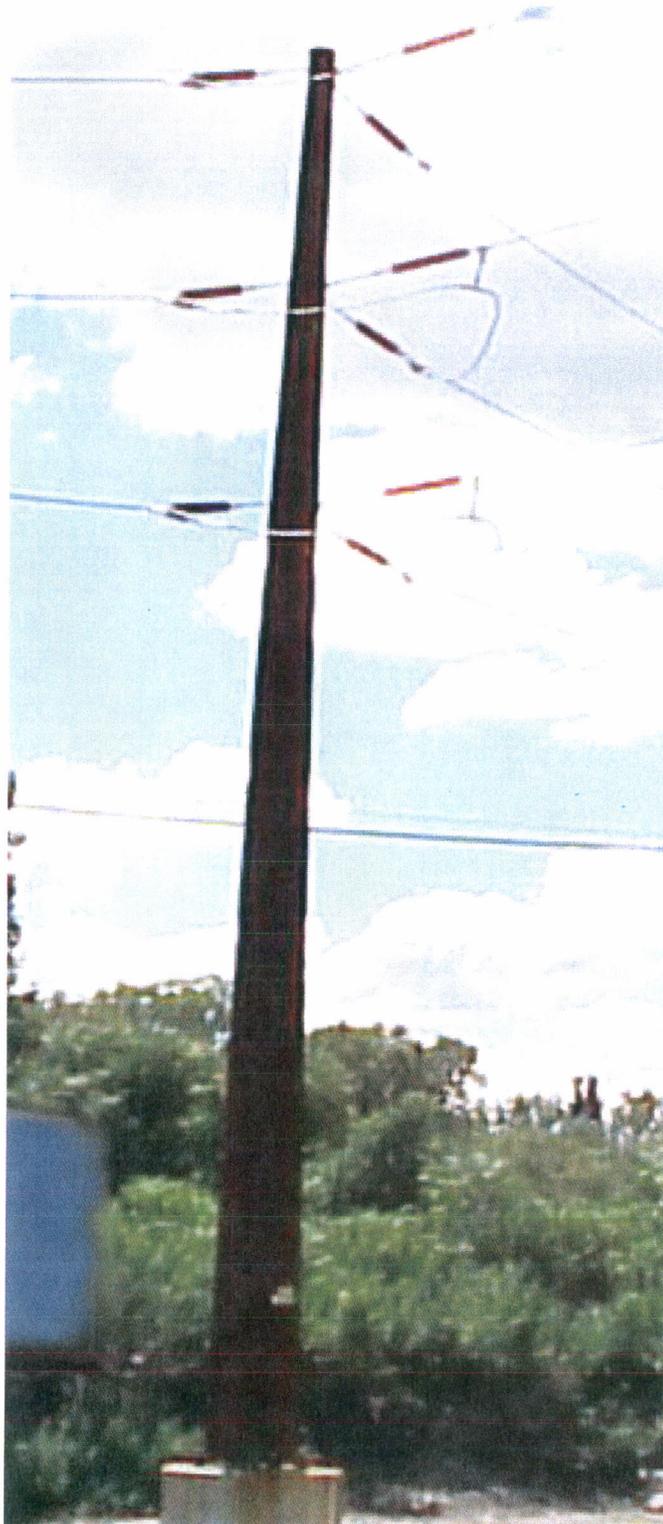
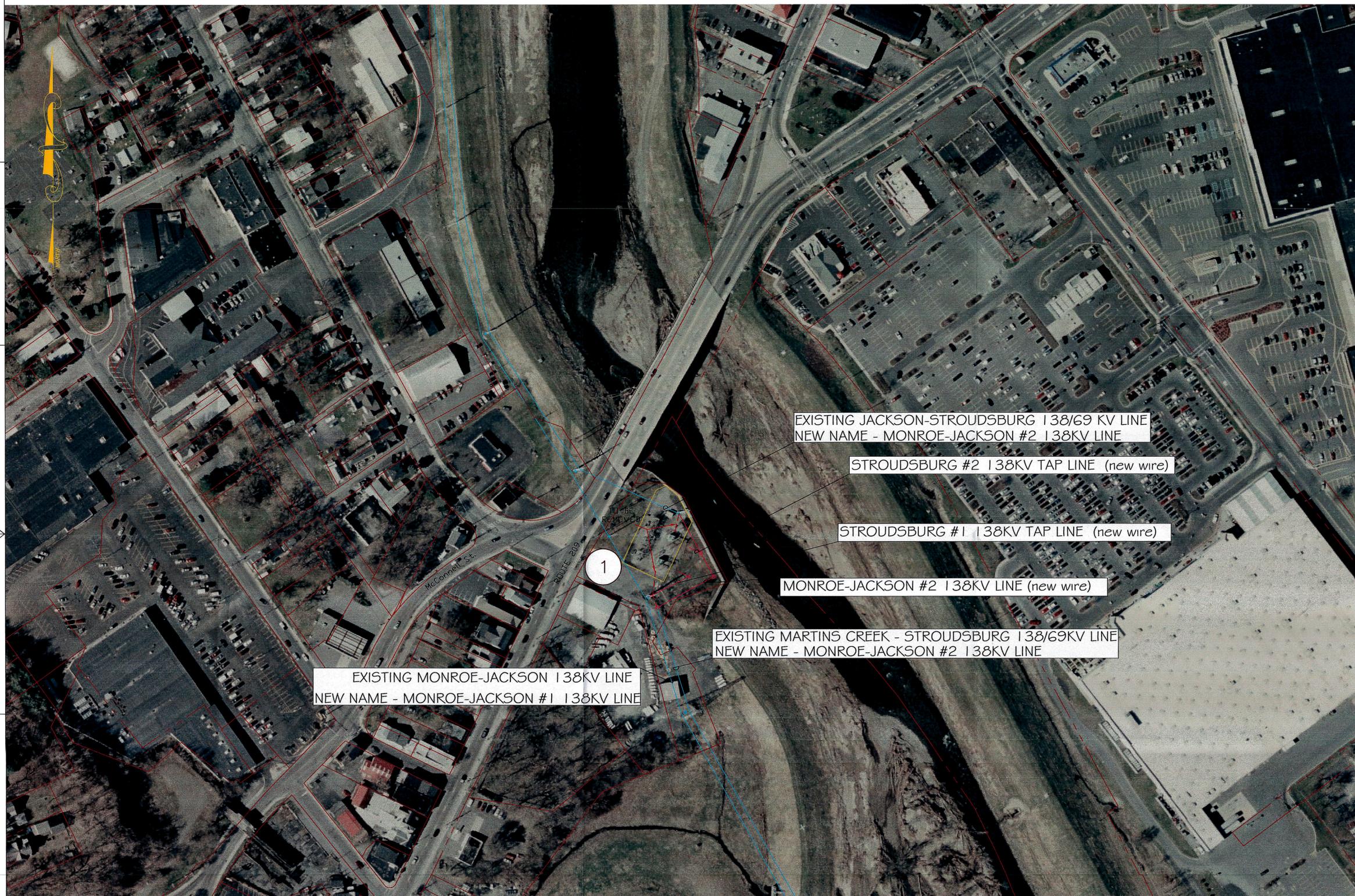


FIGURE 2
PROPOSED 138 kV TAP STRUCTURE
APPROXIMATE HEIGHT – 65'





LEGEND

- EXISTING TRANSMISSION LINE —
- EXISTING TRANSMISSION LINE TO BE REMOVED - - -
- PROPOSED TRANSMISSION LINE —
- PROPERTY LINE - - -
- EXISTING TRANSMISSION POLE ●
- PROPOSED TRANSMISSION STRUCTURE ○

Line Number	Property Owner
1	PF&L INC 2 N. NINTH STREET ALLENTOWN, PA 18101

EXHIBIT B

AERIAL EXHIBIT SHEET 1

**MONROE-JACKSON #2
138KV TRANSMISSION LINE
AND
STROUDSBURG #1 AND #2 138KV TAPS**
MONROE COUNTY, PA.

SCALE: 1" = 100'

PREPARED BY:
 PPL ELECTRIC UTILITIES CORP.
 PPL ELECTRIC UTILITIES

ACCT- 161694		MONROE-JACKSON #2 138KV TRANSMISSION LINE AND STROUDSBURG #1 & #2 138KV TAPS	
SCALE- 1"=100'		STROUDSBURG BOROUGH APPROVED DATE 8/25/09 MONROE COUNTY, PA.	
BY- RRC		APPROVED DATE 8/25/09 PPL ELECTRIC UTILITIES	
PPL DRAWING NO.		SHEET NO. REV. 1 0	
EXHIBIT "B"		EXHIBIT B_5001.DWG/TIF	

REFERENCE TITLE	NUMBER	REFERENCE TITLE	NUMBER	NO.	DATE	ACCT.	REVISION	BY	REVIEWED	APPROVED
<div style="display: flex; justify-content: space-between;"> 0 1 FRACTIONAL 2 2 DECIMAL 1 0 LOCATION CODES C SORTS </div>										

Exhibit C

EXHIBIT "C"
MONROE-JACKSON #2 138 kV TRANSMISSION LINE
AND
STROUDSBURG #1 AND #2 138 kV TAPS
ENVIRONMENTAL ASSESSMENT

TABLE OF CONTENTS

<u>SECTION</u>	<u>TOPIC</u>	<u>PAGE</u>
A.	INTRODUCTION.....	1
B.	LAND USE.....	2
C.	CULTURAL RESOURCES.....	2
D.	NATURAL FEATURES.....	2
E.	THREATENED AND ENDANGERED SPECIES.....	3

EXHIBIT “C”
MONROE-JACKSON #2 138 kV TRANSMISSION LINE
AND
STROUDSBURG #1 AND #2 138 kV TAPS
ENVIRONMENTAL ASSESSMENT

A. INTRODUCTION

PPL Electric plans to convert the Stroudsburg 69-12 kV Substation to 138-12 kV operation. To accomplish this conversion, PPL Electric will construct approximately 275 feet (three spans) of new 138 kV transmission line which will connect the existing Martins Creek-Stroudsburg 138/69 kV Line to the existing Jackson-Stroudsburg 138/69 kV Line. This line will be called the Monroe-Jackson #2 138 kV Transmission Line. Also, associated with this project will be the construction of two new 138 kV taps into the existing Stroudsburg Substation to source the proposed 138 kV transformers. The tap lines will be called the Stroudsburg #1 and #2 138 kV Taps. The new Stroudsburg #1 138 kV Tap will be supplied from the existing Monroe-Jackson 138 kV Transmission Line. The existing Monroe-Jackson 138 kV Transmission Line will be renamed the Monroe-Jackson #1 138 kV Transmission Line. The new Stroudsburg #2 138 kV Tap will be supplied from the newly created Monroe-Jackson #2 138 kV Transmission Line. All of the lines associated with this project will be designed and constructed for single-circuit 138 kV operation.

This project is necessary to increase reliability and resolve load and low voltage issues in this area. Converting the existing 69 kV facilities to 138 kV operation is part of PPL Electric’s long-term plan for the heavily loaded service area of the Southern Pocono region. The 69 kV to 138 kV conversion will provide additional capacity to meet increasing demand for electricity in the area without new transmission corridors.

The proposed project was reviewed with Stroudsburg Borough and Monroe County. Neither the Borough nor the County has any objection. A list of involved governmental agencies, municipalities and other public entities is presented in Appendix C.

B. LAND USE

All construction activities associated with the project will occur on property owned in fee by PPL Electric. The property owned by PPL Electric contains existing electrical facilities. Land use in the area is a mix of commercial and residential sites. Land use impacts are anticipated to be minimal due to the small scope of the project and the fact that the project is located in and along existing PPL Electric facilities.

No nearby communication towers, pipelines or other utilities will be affected by the proposed project. Stroudsburg Pocono Airport is located approximately 3.2 miles northeast of the project location. PPL Electric will file the appropriate documentation with both the Federal Aviation Administration and the PennDOT Bureau of Aviation to ensure that the proposed line section is not a hazard to the airport's flight operations. Existing access roads, where possible, will be used for construction.

C. CULTURAL RESOURCES

This project was reviewed with the Pennsylvania Historical and Museum Commission ("PHMC"). The PHMC has determined that, even though historic buildings, structures, and/or archaeological resources are located in the project area, the project should have no effect on these resources (File No. ER 2009-1950-089-A).

D. NATURAL FEATURES

The proposed project will not affect any unique geological, scenic or natural areas. The Indian Chair, a geologic feature, is located approximately 2.45 miles west of the project location. Also, a section of the Appalachian Trail is located approximately 2.45 miles

southeast of the project location. These features will not be affected due to their distance from the project location, the extensive development between the features and the project location, and the small scale size/scope of the proposed project.

No national natural landmarks, parks, or natural areas are located near the project area. The Delaware Water Gap National Recreation Area is located approximately 2 miles from the project location. This feature will not be affected due to its distance from, and the extensive development between, the feature and the project location.

No tree clearing is required along the new transmission line. The line will not cross any wetlands or other aquatic resources. PPL Electric will acquire and comply with any required soil erosion and sedimentation control permit conditions.

E. THREATENED AND ENDANGERED SPECIES

PPL Electric has coordinated with different state and federal agencies to obtain information regarding endangered and threatened species in close proximity to the project area. A review of the Pennsylvania Natural Diversity Inventory (“PNDI”) records indicates that there are potential impacts under the Pennsylvania Department of Conservation and Natural Resources (“DCNR”), Pennsylvania Fish and Boat Commission and the U.S. Fish and Wildlife Service regulations for species of special concern and resources within, or in close proximity to the project area. PPL Electric retained Mellon Biological Services to respond to the agencies’ requests for additional information regarding the project. Mr. Mellon reviewed the project area and made the determination that no conflicts exist at the project site. Mr. Mellon sent documentation of his findings to the appropriate agencies for review. Correspondence from the agencies indicates that no impacts are anticipated and no further coordination is needed for this project (PNDI Number: 20090720202360).

Appendices

LIST OF APPENDICES

- APPENDIX A - PPL Electric Design Criteria and Safety Practices
- APPENDIX B - Magnetic Field Management at PPL Electric
- APPENDIX C - List of Involved Governmental Agencies, Municipalities, and Other Public Entities

APPENDIX A

PPL ELECTRIC DESIGN CRITERIA AND SAFETY PRACTICES

The National Electrical Safety Code ("NESC") is a set of rules to safeguard people during the installation, operation, and maintenance of electric power lines. The NESC contains the basic provisions considered necessary for the safety of employees and the public. Although it is not intended as a design specification, its provisions establish minimum design requirements. PPL Electric Utilities Corporation ("PPL Electric") has developed design specifications and safety rules which meet or surpass all provisions specified by the NESC.

Engineering Design Criteria and Parameters

The NESC includes loading requirements and clearances for the design, construction, and operation of power lines. The "loads" on conductors and supporting structures are the mechanical forces that develop from the weight of the conductors, the weight of ice on the conductors, plus wind pressure on the conductors and supporting structures. Loading requirements are the loads on the conductors and structures that are anticipated assuming certain ice and wind conditions. Loading requirements always contain "safety factors" to allow for unknown or unanticipated contingencies. The clearances and loading requirements contained in the NESC were developed to ensure public safety and welfare.

PPL Electric transmission line design standards meet or surpass the NESC standards. For example, the relative order of grades of construction for conductors and supporting structures is B, C, and N; Grade B being the highest. According to the NESC standards, construction Grades B, C, or N may be used for transmission lines (except at crossings of railroad tracks and limited access highways where Grade B construction is specified). However, PPL Electric designs all of its transmission lines for Grade B construction. The use of Grade B design and construction specifies such things as larger-minimum crossarm dimensions, larger-minimum conductor size, and increased safety factors.

Another example is the design parameters utilized to account for ice and wind loadings on the overhead ground wire (“OHGW”) and power conductors. The NESC standard ice and wind design magnitudes for the PPL Electric territory are 0.5 inch thickness of radial ice combined with four pounds per square foot horizontal wind pressure (equivalent to 40-mile per hour wind velocity). The conductor sags and tensions used in line designs are the result of various ice and wind combinations, depending on the elevation at the line location and line design voltage. The conductor sags and tensions used in the design of all PPL Electric transmission lines are at least 0.5-inch ice combined with eight pounds wind pressure (equivalent to 57 miles per hour wind velocity). This means that PPL Electric lines are designed to operate safely and reliably during inclement weather even more severe than assumed by the NESC. In addition, PPL Electric transmission lines are designed with more clearance to the ground than required by the NESC. The tables below compare PPL Electric and NESC ground clearances for lines of various voltages.

138 kV

<u>Surface Underneath Conductors</u>	<u>Vertical Clearance to Ground</u>	
	<u>NESC Standard</u>	<u>PPL Electric Design</u>
Roads, streets, alleys	21 Ft.	30 Ft.
Other land traversed by vehicles (such as cultivated field, forest, etc.)	21 Ft.	30 Ft.
Spaces accessible to pedestrians only	17 Ft.	30 Ft.
Railroad tracks	31 Ft.	35 Ft.

230 kV

<u>Surface Underneath Conductors</u>	<u>Vertical Clearance to Ground</u>	
	<u>NESC Standard</u>	<u>PPL Electric Design</u>
Roads, streets, alleys	23 Ft.	32 Ft.
Other land traversed by vehicles (such as cultivated field, forest, etc.)	23 Ft.	32 Ft.
Spaces accessible to pedestrians only	19 Ft.	32 Ft.
Railroad tracks	31 Ft.	36 Ft.

500 kV

<u>Surface Underneath Conductors</u>	<u>Vertical Clearance to Ground</u>	
	<u>NESC Standard</u>	<u>PPL Electric Design</u>
Roads, streets, alleys	28 Ft.	53 Ft.
Other land traversed by vehicles (such as cultivated field, forest, etc.)	28 Ft.	53 Ft.
Spaces accessible to pedestrians only	24 Ft.	53 Ft.
Railroad tracks	38 Ft.	53 Ft.

A relay protection system is used to protect the public safety and welfare as well as equipment and the transmission system. Relay protection is installed for all transmission lines to automatically de-energize the line in the unlikely event that the line or supporting structure fails and the line contacts the ground.

Periodic Maintenance Program on All Transmission Lines

To ensure continued public safety and integrity of service, a periodic maintenance and inspection program is implemented for every transmission line. Where practical, the

program is administered through the use of helicopter patrols, with supplemental foot and structure climbing patrols. Helicopter patrols are performed on all lines annually. The two-man helicopter crew flies parallel, to the left, and above the line so that the observer can look for signs of line damage or deterioration and observe clearances between vegetation and conductors. The observations are included in a report that is forwarded to the appropriate department for corrective action.

Foot and structure climbing patrol programs for a transmission line begin approximately three to five years after the line is energized, unless a helicopter patrol reports a need for earlier action. The frequency of foot patrols varies from once every year to once every several years depending on line type and age.

An assigned foot patroller checks right-of-way conditions, including access roads, bridges, pole washouts, tower footers, vegetation height and clearance to conductors, pole and tower deterioration and, with the use of binoculars, insulators, and condition of hardware. Identified problems are included in a report that is forwarded to the appropriate department for corrective action.

A scheduled line outage is required to perform an overhead patrol because of "hands-on" inspection of hardware. Overhead patrols are conducted on a schedule determined by line age, operating record, and observed general condition. The necessary repairs are also done during the inspection outage.

Personnel Safety Rules

The following are a few of the PPL Electric safety rules that demonstrate the Company's concern for employee safety:

- Work procedures have been developed to allow work to be performed on energized facilities in a safe manner. When lines or apparatus are removed from service to be worked on, the Energy Control Process system is applied. This system provides that a red tag must be physically placed on the control handle of the de-energized equipment. The red tag may be removed only after proper authorization to energize the equipment. Various other tags are used for limited operations and informational purposes.

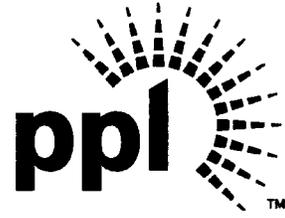
Employees will not apply or remove a tag or change the status of tagged equipment unless authorized.

- Temporary safety grounds are used on de-energized facilities for employee safety during maintenance, construction, or reconstruction work. Safety grounds are wires connecting the de-energized facility to an electrical ground. If the facility should be energized, the safety grounds will divert the current directly to ground and reduce the likelihood of personal injury. The conductor size and attachment clamps of temporary safety grounds must be capable of conducting anticipated fault currents. Rubber gloves, rubber sleeves, and additional rubber protective equipment are used as required when applying or removing temporary safety grounds to or from the lines or apparatus to be grounded. An approved nonconductive working stick of sufficient length to allow workers to maintain the following required minimum clearances is used to test that the line has been de-energized and to apply temporary safety grounds:

<u>Voltage-kV</u>	<u>Minimum Clearance</u>
138	3'-7"
230	5'-3"
500	11'-3"

Before applying grounds, a test is done to confirm that the line is de-energized. The voltage test device is checked before and after use to assure reliability. When ground pins are used to establish proper ground points, they are driven to a depth of not less than four feet as near vertical as possible.

- Poles or structures are inspected and examined for structural integrity before climbing. If there is any reason to believe that a pole is unsafe, it is stabilized before work is performed. Appropriate safety gear in the form of body belts, safety straps, hard hats, gloves, etc., is worn by linemen during line work activity.



**MAGNETIC
FIELD
MANAGEMENT**
**PPL Electric Utilities
Corporation**

APPENDIX B

DECEMBER 2004

TABLE OF CONTENTS

INTRODUCTION	1
DEVELOPMENT OF PPL EU's MAGNETIC FIELD MANAGEMENT PROGRAM.....	6
VARIABLES THAT AFFECT MAGNETIC FIELDS	6
Effect of Phase Current on Magnetic Fields	6
Effect of Conductor Configuration on Magnetic Fields	7
Effect of Distance from the Magnetic Field Source	7
SUMMARY OF PPL EU's MAGNETIC FIELD MANAGEMENT PROGRAM.....	8
MAGNETIC FIELD MANAGEMENT PROGRAM GUIDELINES	9
Overhead Lines	9
New or Rebuilt Transmission Lines	9
Reconductoring or Adding Additional Circuits to Existing Transmission Lines	14
Distribution Lines	14
Underground Transmission Lines.....	15
CHARTS.....	16

INTRODUCTION

At PPL Electric Utilities Corp. (PPL EU), magnetic field management means investigating and implementing methods at low or no cost to reduce magnetic fields in new or rebuilt transmission and distribution lines. This document explains PPL EU's Magnetic Field Management Program, which is part of PPL EU's larger Electric and Magnetic Fields (EMF) policy.

PPL EU's View

Some people are worried that electric and magnetic fields are harming their health. Others think the scientific research does not show a problem at all, and still others believe there's just too much scientific uncertainty to draw any conclusions.

Here's what we do know now. Various panels of scientists that have reviewed the EMF research generally have drawn two main conclusions. First, the large body of evidence does not demonstrate that EMF are harmful. Second, additional research is recommended to explore questions raised in some studies.

Given these conclusions, PPL EU is taking a reasoned approach in responding to the EMF issue. PPL EU's approach to the EMF issue consists of five elements:

- Providing EMF information to customers and employees
- Providing magnetic field measurements
- Establishing and implementing a magnetic field management program to reduce magnetic fields in new or rebuilt facilities when it can be done at no, or low, cost
- Integrating EMF in the public involvement process that PPL EU undertakes in the siting of transmission lines
- Have supported additional research

EMF Are All Around Us

Electric and magnetic fields occur in nature and in all living things. The earth, for instance, has a magnetic field, which makes the needle on a compass point north.

Electric fields and magnetic fields of a different type also surround every wire that carries electricity. In everyday life, these EMF arise from several basic sources, including power lines, electrical appliances, home and building wiring, other utility lines and cables, and currents flowing on water pipes. Though they often occur together, EMF are made up of two separate components:

Electric Fields

Electric fields are produced by the voltage—or electrical pressure—on a wire. The higher the voltage, the higher the electric field. As long as a wire is energized—has voltage present—an electric field is present (see Figure 1). In other words, an appliance, or an electric power line, doesn't actually have to be turned on to create an electric field. It just has to be plugged in. Electric fields diminish with distance and can be blocked or partially shielded by objects such as trees and houses.

Magnetic Fields

Magnetic fields are created by the current or flow of electricity through a wire. Generally speaking, the higher the current, the higher the magnetic field. Because they only occur when current is flowing, magnetic fields are present only when the power is turned on (see Figure 1). Magnetic fields also diminish with distance, but—unlike electric fields—are not blocked by common objects. In recent years, public and scientific interest has turned toward the magnetic field component of EMF because of some scientific studies regarding these fields.

Figure 1

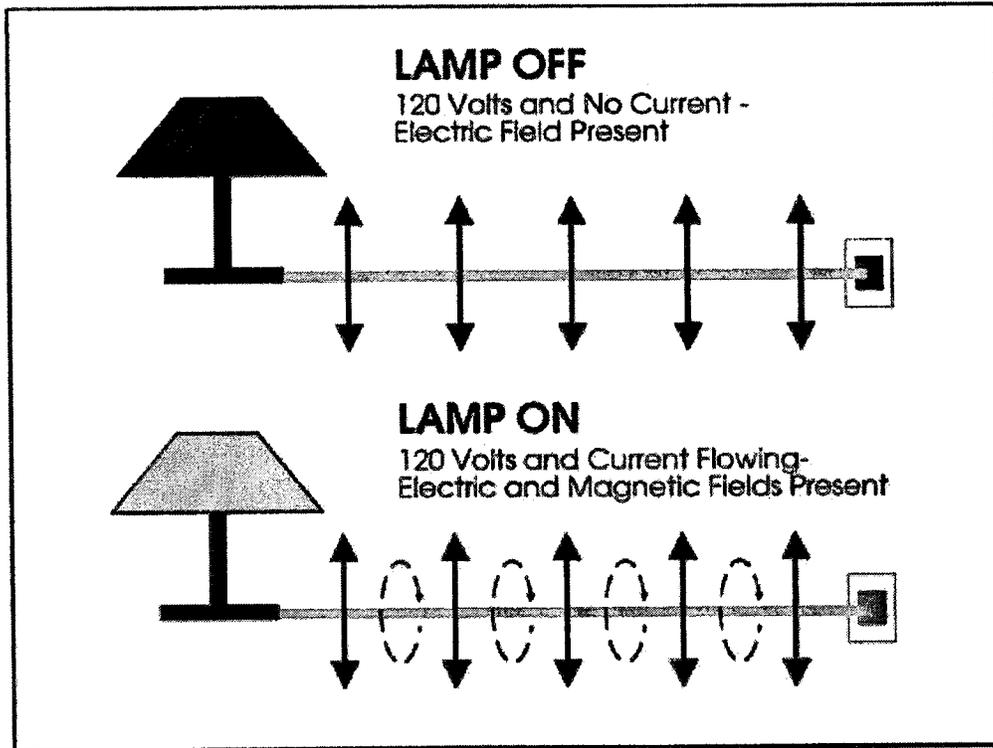


Figure 2

Magnetic field strengths decrease with distance Magnetic fields are measured in milligauss		Source: "EMF in Your Environment", U.S. Environmental Protection Agency 1992		
		At 6 inches	At 1 foot	At 2 feet
Clothes dryer		2 to 10	* to 3	*
Microwave oven		100 to 300	1 to 200	1 to 30
Toaster		5 to 20	* to 7	*
Power drill		100 to 200	20 to 40	3 to 6
Can opener		500 to 1500	40 to 300	3 to 30
Mixer		30 to 600	5 to 100	* to 10
Hair dryer		1 to 700	* to 70	* to 10
Color television		Data not available	* to 20	* to 8

FIGURE 2 * The magnetic field measurement at this distance from the operating appliance could not be distinguished from background measurements taken before the appliance had been turned on.

Measuring Magnetic Fields

Magnetic fields usually are measured in a unit called a milligauss. Magnetic field levels found in the living areas of homes typically range from less than 1 milligauss to about 4 milligauss according to the U.S. Environmental Protection Agency. They can be higher in some cases. The levels next to appliances can exceed 1,000 milligauss (1 gauss). Figures 2 and 3 show how the strength of the field falls off as you move away from the source, just as the heat of a campfire grows weaker as you walk away from it. For overhead power lines, the strength of the magnetic fields is dependent upon a number of factors that will be explained later. Those factors produce a magnetic field that drops off rapidly as you move away from the power line.

Figure 3

Sample Magnetic Field Levels in Milligauss				
Type of Overhead Power Line	Distance from the line			
	Under the line	50 ft.	100 ft.	200 ft.
220 kV and 500 kV	5-400	5-250	1-75	0.5-20
69 kV and 138 kV	3-80	0.5-2.5	0.1-10	0.1-3
12 kV and below	0.4-20	0.1-1	-	-

The magnetic field values provided in this table represent a general range of values associated with the types of overhead power lines listed and are provided for illustration. There will be circumstances in which there will be magnetic field levels above or below the range of values provided due to variations in such factors as height of the wires, current flow and so on.

DEVELOPMENT OF PPL EU's MAGNETIC FIELD MANAGEMENT PROGRAM

One element of our response to EMF concerns expressed by some of our customers is PPL EU's Magnetic Field Management Program. The program was initiated in March 1991 because PPL EU believes it makes good sense, as a matter of policy, to respond to the concerns expressed by some of our customers and to reduce magnetic fields in new and rebuilt facilities where it can be done with either no-cost or low-cost design changes.

This document updates the original program which has been revised several times since 1991. These guidelines were developed by PPL EU's EMF Working Group.

VARIABLES THAT AFFECT MAGNETIC FIELDS

Magnetic fields from transmission and distribution lines are a function of a number of design variables. The following parameters affect the magnetic field levels produced by transmission and distribution lines:

- Current
- Height of conductors above ground
- Configuration of conductors
- Distance from the line

EFFECT OF PHASE CURRENT ON MAGNETIC FIELDS

At power frequencies (i.e., 60 hertz), the magnetic field level is a function of the current or flow of electricity through a wire. Keeping all other parameters the same, the magnetic field is proportional to the current. Hence, if the current increases by 25 percent, the resulting magnetic field level will increase by 25 percent.

The overall load current on any line varies with the demand for power. It's usually highest during daytime hours and lowest at night. There also are weekly, monthly, seasonal and yearly variations.

The difference in the currents between each phase in a multiphase line also can affect the magnetic field. This difference is called phase unbalance. For a constant load, a statistical analysis of this phase unbalance can be made to determine its effect on the magnetic field. Close to the line, there is very little effect. However, the phase unbalance slows the rate at which the magnetic field decreases with distance from the line.

EFFECT OF CONDUCTOR CONFIGURATION ON MAGNETIC FIELDS

In the transmission and distribution of power, utilities like PPL EU presently use both three-phase and single-phase lines. Each phase on a three-phase power line has either a single conductor or a bundle of two or more conductors. In a three-phase system, the ground-level magnetic field is a result of the fields produced by the currents in each of the phases. Placing the three phases as close together as possible (compaction) creates some field cancellation, and the ground-level magnetic field is reduced. However, appropriate phase separation is required for the reliable operation of the line. In addition, the arrangement of the phases can create some; field cancellation and reduction of the ground-level magnetic field.

EFFECT OF DISTANCE FROM THE MAGNETIC FIELD SOURCE

Magnetic field strength diminishes with the vertical and lateral distances from the magnetic field source. Increasing the height of the conductors above ground is useful for magnetic field reduction at ground level, but may result in increased structure costs and increased aesthetic impact of the structures. Another possible method of increasing the distance to the magnetic field source is to increase the right-of-way requirements. By keeping buildings off increased rights of way, thereby requiring the public to live and work further away from lines, exposure to magnetic fields produced by the lines can be reduced. Increases in right of way are not always practical and may increase costs significantly, however.

SUMMARY OF PPL EU's MAGNETIC FIELD MANAGEMENT PROGRAM

Under its Magnetic Field Management Program, PPL EU has changed the way it builds and rebuilds some of its transmission and distribution lines. These design changes reduce magnetic field levels (assuming balanced circuit loadings and phase currents) by up to 69 percent in most of the company's new transmission lines. These guidelines now are being applied to new and reconstructed transmission facilities, based on this program.

The distribution component of the program focuses on 12 kV lines, the company's standard distribution voltage. It concentrates on the three-phase, primary 12 kV lines, since these are the most heavily loaded facilities and often are located in densely populated areas. The guidelines in this program are being applied to these three-phase, primary 12 kV lines.

A maximum 3-5 percent change in estimated cost was used as the limit for the guidelines since this value is consistent with low cost, is within estimating accuracy and is likely to have little impact on overall line costs.

The magnetic field calculations used in this document for the design of PPL EU's overall magnetic field management plan assume balanced load conditions among the phases and a fixed level of current, not necessarily representative of specific transmission or distribution lines. These levels were calculated using the Electric Power Research Institute's ENVIRO computer program. Under actual operating conditions, the magnetic field levels that result may vary due to such things as actual load per circuit, overall current on each phase conductor and the electrical configuration and operation of each line.

MAGNETIC FIELD MANAGEMENT PROGRAM GUIDELINES

The guidelines for magnetic field management are noted below, with discussion points for each.

OVERHEAD LINES

NEW OR REBUILT TRANSMISSION LINES

1. **Balance transmission circuit loads and phase currents as much as possible.**
 - PPL EU should continue to make every effort to balance loadings between the two circuits of a double circuit line when planning new or rebuilt facilities to maximize the effects of reverse phasing.
 - PPL EU should continue the practice of balancing single-phase loads across the three phases of the distribution system. (Unbalanced phase currents on the distribution system are reflected through to the transmission system.)
 - Unbalanced phase currents result in higher magnetic fields that do not drop off as quickly with distance as do the fields resulting from balanced phase currents.
 - For a 5 percent phase current unbalance, the magnetic field 50 feet from the centerline of a single circuit 138 kV line could be more than twice the value than if the same line had balanced phase circuits.
 - Balanced phase currents on each three-phase distribution circuit also reduce magnetic fields from the distribution circuits themselves. In addition, they reduce magnetic fields on the transmission system from which the distribution system circuits are supplied and connected through substations.
 - Apart from magnetic field considerations, balanced phase currents on each three-phase distribution circuit also reduce line losses and improve the system voltage.

2. Continue with the present practice of using long-span construction as the PPL EU 138/69 kV standard

- Structure designs for short-span and long-span construction are illustrated on Charts I and II, respectively.
 - Short-span design does not significantly reduce magnetic fields when compared to long-span design even though it is more compact than long-span design. Comparison of the magnetic field values from Chart III indicates essentially the same values. Therefore, short-span design should not be used solely to reduce magnetic fields.
 - PPL EU will continue to use long-span construction for 138/69 kV double-circuit lines and for single-circuit/future-double-circuit lines.
 - For single-circuit/future-double-circuit lines, PPL EU will continue to install two conductors on the top positions and one in the middle position as shown in Chart IV.
 - This arrangement minimizes magnetic fields as shown in Chart V by placing the three initial conductors higher on the structure, which increases the ground clearances, and by placing the conductors in a triangular configuration.

3. Compact design structures are not a low-cost alternative and should be used for magnetic field reduction only in special applications.

Chart VI illustrates the compact design structure.

- The compact design increases the initial installation costs by 79 percent when compared to the long-span design but reduces the magnetic field from 9 mG to 3 mG (about 67 percent) at the edge of the 100-foot-wide right of way as shown on Chart III.

4. Reverse phase new or rebuilt double-circuit transmission lines for all voltage levels.

- Reverse phasing was adopted by PPL EU in March 1991 for double-circuit 138/69 kV transmission lines and in April 1992 for all other double circuit transmission lines. Reverse phasing is shown in Chart VII. Reverse phasing will reduce the magnetic fields when the current flow on both circuits is in the same

direction. Calculated values contained here are based on balanced and equal phase currents on both circuits.

- Reverse phasing reduces the magnetic field of a double circuit 138 kV single pole transmission line from 29 mG to 9 mG (about 69 percent) at the edge of the 100-foot-wide right of way as shown on Chart III.
- Reverse phasing reduces the magnetic field of a double circuit 230 kV single pole transmission line from 49 mG to 16 mG (about 67 percent) at the edge of the 150-foot-wide right of way as shown on Chart VIII.
- Reverse phasing reduces the magnetic field of a double-circuit 500 kV single pole transmission line from 37 mG to 21 mG (about 43 percent) at the edge of the 200-foot-wide right of way as shown on Chart IX.
- When new or rebuilt double-circuit lines require tapping existing double-circuit lines, PPL EU will review the existing lines to determine if reverse phasing can be provided at low cost.
- Computer modeling is required to develop the optimum phasing and overall conductor arrangements for lines added to, or rebuilt in, multiple-line corridors.
 - Merely adding a reverse-phase double-circuit line to an existing transmission line corridor or reverse phasing a rebuilt line in the multiple-line corridor will not necessarily produce lower magnetic field levels at the edge of the corridor right of way.
 - The corridor must be computer modeled with all the lines, existing phase conductor locations and currents. Then, magnetic field calculations must be made varying the phase arrangements of the new or reconstructed line to determine the appropriate phasing arrangement.
 - Current flow direction on a line also must be considered. For example, a reverse-phased line should have the current flowing in the same direction on both circuits. If the current flow is in the opposite direction for one circuit, reverse phasing will not produce the lowest magnetic field and another phase arrangement that produces lower fields may need to be utilized.

5. Increase the minimum ground clearance for all new transmission lines.

138/69 kV Transmission Lines

- Increasing the minimum line design ground clearance from 25 feet to 30 feet may add up to about 5 percent to the installed cost of a new double-circuit single pole 138/69 kV line. For a given project, such cost may be substantially less, however. In fact, PPL EU frequently uses higher-than-minimum ground clearances due to such features as road crossings, line crossings and site-specific terrain. With long-span reverse-phase design, the magnetic field is reduced from 9 mG to 7 mG (about 22 percent) at the edge of a 100-foot-wide right of way as shown in Chart X.
 - In the actual design of transmission lines to include higher minimum ground clearances, there may be limited segments (such as highway crossings, severe slopes and transmission line crossing locations) where National Electrical Safety Code (NESC) minimum ground clearances may need to be used. The NESC minimum ground clearances are less than the increased ground clearance discussed previously.

230 kV Transmission Lines

- Increasing the minimum line design ground clearances from 27 feet to 32 feet may add up to about 5 percent to the cost of a single-circuit single-pole line (current standard). For a given project, such cost may be substantially less, however. In fact, PPL EU frequently uses higher-than-minimum ground clearances due to such features as road crossings, line crossings and site-specific terrain. By increasing the clearances, the magnetic field is reduced from 30 mG to 28 mG (about 7 percent) at the edge of a 150-foot-wide right of way.
- Increasing clearances from 27 feet to 32 feet could theoretically add up to about 2.8 percent to the cost of a double-circuit single-pole line (current standard) and reduce the magnetic field of a reverse-phase line from 16 mG to 15 mG (about 6 percent) at the edge of a 150-foot-wide right of way. Chart XI is a summary of this data.
- Studies are required for each new 230 kV line to determine optimum structure types, ground clearances, configurations and designs to reduce field levels. Such

studies could include analysis of reduction measures such as additional minimum ground clearances, increasing conductor tensions, using reduced phase spacing (a "Delta" configuration on a single-circuit line), installing the second circuit initially, and/or adding a second set of conductors that are reverse phased and operated in parallel with the first set (bundled/split phase).

500 kV Transmission Lines

- Increasing ground clearances from 33 feet to 53 feet may add up to about 4.5 percent to the cost of a single-circuit "H-frame" line (current standard). For a given project, such cost may be substantially less, however. In fact, PPL EU frequently uses higher-than-minimum ground clearances due to such features as road crossings, line crossings and site-specific terrain. By increasing the clearances, the magnetic field is reduced from 42 mG to 35 mG (about 17 percent) at the edge of a 200-foot-wide right of way.
- Increasing ground clearances from 33 feet to 53 feet could theoretically add up to 2.8 percent to the cost of a double-circuit "H-frame" line (current standard) and reduces the magnetic field of a reverse-phase line from 21 mG to 16 mG (about 24 percent) at the edge of a 200-foot-wide right of way. Chart XII is a summary of this data.
- Studies are required for each new 500 kV line to determine optimum structure types, ground clearances, configurations and designs to reduce field levels. Such studies could include analysis of reduction measures such as additional minimum ground clearances, increasing conductor tensions, using reduced-phase spacing (a "Delta" configuration on a single circuit line), installing the second circuit initially, and/or adding a second set of conductors that are reverse phased and operated in parallel with the first set (bundled/split phase).

RECONDUCTORING OR ADDING ADDITIONAL CIRCUITS TO EXISTING TRANSMISSION LINES

When reconductoring or adding additional circuits to existing transmission lines, PPL EU will evaluate low-cost or no-cost options for magnetic field management on a case-by-case basis.

When reconductoring existing transmission lines or adding additional circuits, low-cost alternatives may not exist; however, the following steps will be taken:

- For a single-circuit line, the use of a Delta arrangement or other modifications on the existing structure, with reduced-phase spacing, will be evaluated.
- For double-circuit lines, application of reverse phasing may reduce the magnetic field under the line and within the right of way and will be evaluated.
- For single- and double-circuit lines, evaluate using higher conductor tensions that can increase the minimum line design ground clearance.

DISTRIBUTION LINES

At the 12 kV distribution level, new main three-phase lines will continue to be constructed with five feet of additional ground clearance.

- Main lines are the most heavily loaded sections of a distribution line and therefore have the highest magnetic fields associated with them.
- Increasing the ground clearance by five feet reduces the magnetic field under the line from 14 mG to 11 mG using the standard eight-foot crossarm design. These values are based on increasing pole heights from 45 feet to 50 feet and a typical operating current of 300 amps per phase.
- Chart XIII is a summary of this data. Increasing ground clearance by five feet could theoretically add about 5 percent to the cost of a typical distribution line.

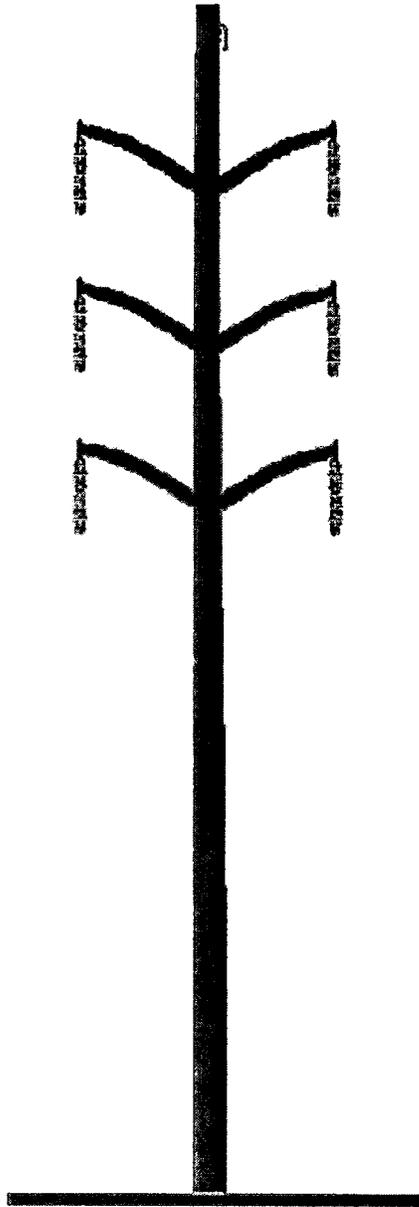


UNDERGROUND TRANSMISSION LINES

Underground transmission lines are required due to environmental or land use factors or restrictions on available clearances, PPL EU will evaluate options for magnetic field management techniques on a case-by-case basis.

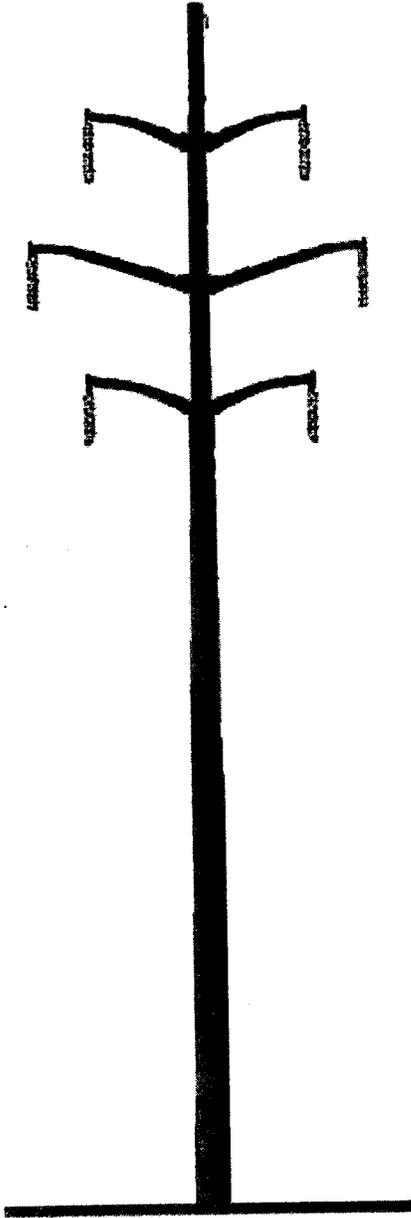
- The phase arrangement that produces the lowest field will be determined.
- The depth of burial of the line will be determined considering the cost of excavation and the location of other buried utilities in the area.
- The use of steel pipe ferromagnetic shielding that reduces magnetic fields will be evaluated.

Short-Span Construction



- More compact design
- Should not be used solely to reduce magnetic fields
- Typical conductor data:
 - 1 3/8" HS steel overhead ground wire - 7.3 feet sag
 - 6-556.5 KCMIL 24/7 ACSR power conductors - (PARAKEET) 10.0 feet sag
 - Average span - 400 feet

Long-Span Construction Remains PPL EU 138 kV Standard



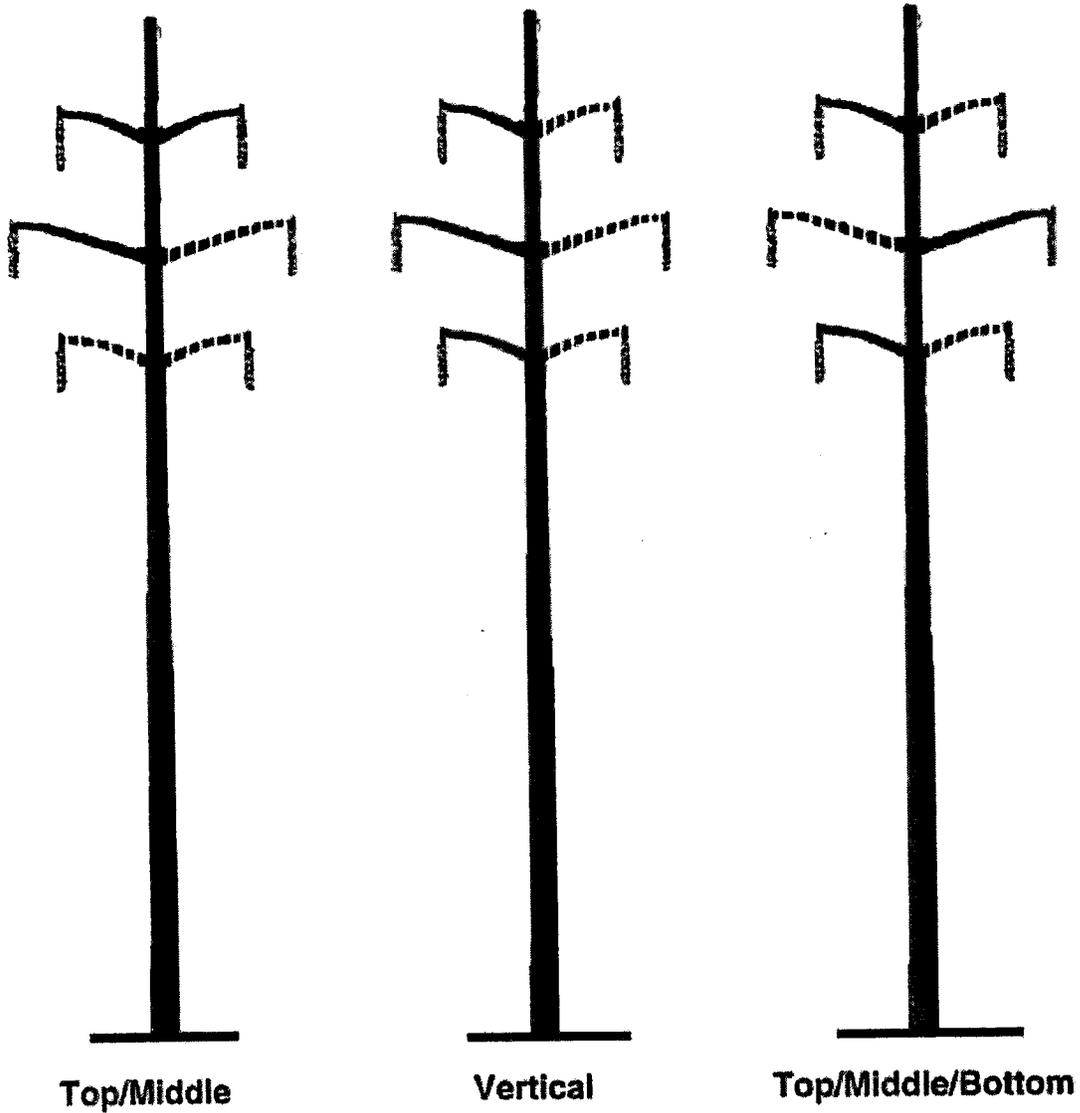
- Lower cost alternative
- Reduces magnetic fields due to higher structures
- Typical conductor data:
 - 1 3/8" HS steel overhead ground wire - 17.3 feet sag
 - 6-556.5 KCMIL 24/7 ACSR power conductors - (PARAKEET) 23.0 feet sag
 - Average span - 600 feet

**138/69 kV REVERSE-PHASE TRANSMISSION LINES
CALCULATED MAGNETIC FIELDS AT 400 AMPERES**

TYPE CONSTRUCTION	MAGNETIC FIELD IN MILLIGAUSS AT THE EDGE OF THE RIGHT OF WAY
SHORT SPAN (CHART I)	30
SHORT SPAN (REVERSE PHASE)	8
LONG SPAN (CHART II)	29
LONG SPAN (REVERSE PHASE)	9
COMPACT (CHART VI)	14
COMPACT (REVERSE PHASE)	3

The edge of right of way is 50 feet from the line centerline.
 The 400 ampere phase current is balanced between phases.
 Calculations are based on a minimum ground clearance of 25 feet.
 LONG SPAN, SHORT SPAN and COMPACT are double-circuit lines.

Typical Single-Circuit Structure Designs



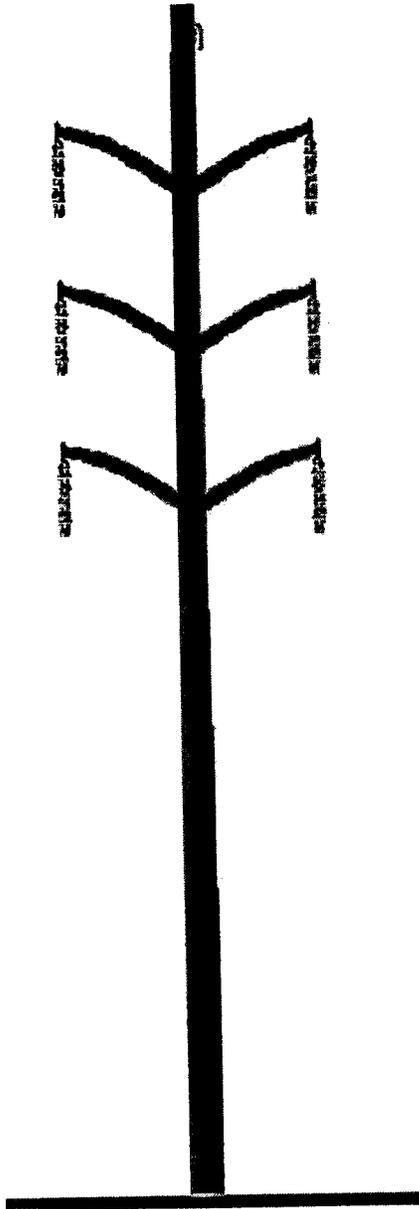
——— initial single circuit
- - - - - future second circuit

**138/69 kV SINGLE CIRCUIT TRANSMISSION LINES
CALCULATED MAGNETIC FIELDS AT 400 AMPERES**

TYPE CONSTRUCTION	MAGNETIC FIELD IN MILLIGAUSS AT THE EDGE OF THE RIGHT OF WAY
TOP/MIDDLE/BOTTOM	20
VERTICAL	17
TOP/MIDDLE	12

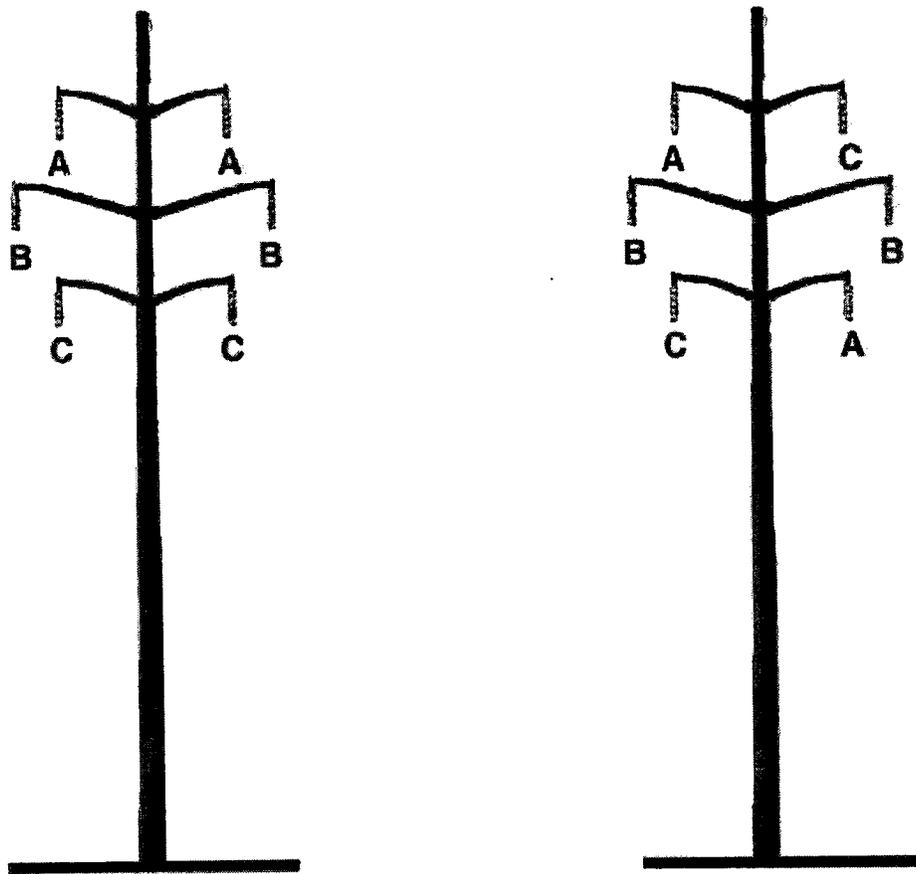
The edge of right of way is 50 feet from the line centerline.
The 400 ampere phase current is balanced between phases.
Calculations are based on a minimum ground clearance of 25 feet.

Compact Design Structure



- **Minimize magnetic fields due to compact design**
- **Not a low-cost alternative**
- **Typical conductor data:**
 - 1 3/8" HS steel overhead ground wire - 9.0 feet sag
 - 6-556.5 KCMIL 24/7 ACSR power conductors - (PARAKEET) 9.0 feet sag
 - Average span - 300 feet

Reverse Phasing of Double-Circuit Transmission Lines



From: $\longrightarrow \longrightarrow \longrightarrow \longrightarrow$ To:

Reverse phasing also can be one of the following phase arrangements:

A	B		B	A		B	C		C	A		C	B
C	C	or	C	C	or	A	A	or	B	B	or	A	A
B	A		A	B		C	B		A	C		B	C

**230 kV REVERSE-PHASE TRANSMISSION LINES
CALCULATED MAGNETIC FIELDS AT 800 AMPERES**

TYPE CONSTRUCTION	MAGNETIC FIELD IN MILLIGAUSS AT THE EDGE OF THE RIGHT OF WAY
DOUBLE CIRCUIT POLE	49
DOUBLE CIRCUIT POLE (REVERSE-PHASE)	16

The edge of right of way is 75 feet from the line centerline.
The 800 ampere phase current is balanced between phases.
Calculations are based on a minimum ground clearance of 27 feet.

**500 kV REVERSE-PHASE TRANSMISSION LINES
CALCULATED MAGNETIC FIELDS AT 1100 AMPERES**

TYPE CONSTRUCTION	MAGNETIC FIELD IN MILLIGAUSS AT THE EDGE OF THE RIGHT OF WAY
DOUBLE CIRCUIT POLE	37
DOUBLE CIRCUIT POLE (REVERSE PHASE)	21

The edge of right of way is 100 feet from the line centerline.
The 1,100 ampere phase current is balanced between phases.
Calculations are based on a minimum ground clearance of 33 feet.

**INCREASED 138/69 kV MINIMUM GROUND CLEARANCE
CALCULATED MAGNETIC FIELDS AT 400 AMPERES**

TYPE CONSTRUCTION	MINIMUM GROUND CLEARANCE FEET	MAGNETIC FIELD IN MILLIGAUSS AT THE EDGE OF THE RIGHT OF WAY
SINGLE CIRCUIT TOP/MIDDLE	25	12
SINGLE CIRCUIT TOP/MIDDLE	30	10
LONG SPAN	25	29
LONG SPAN	30	26
LONG SPAN (REVERSE PHASE)	25	9
LONG SPAN (REVERSE PHASE)	30	7

The edge of right of way is 50 feet from the line centerline.
The 400 ampere phase current is balanced between phases.

**INCREASED 230 kV MINIMUM GROUND CLEARANCE
CALCULATED MAGNETIC FIELDS AT 800 AMPERES**

TYPE CONSTRUCTION	MINIMUM GROUND CLEARANCE FEET	MAGNETIC FIELD IN MILLIGAUSS AT THE EDGE OF THE RIGHT OF WAY
SINGLE CIRCUIT TOP/MIDDLE	27	30
SINGLE CIRCUIT TOP/MIDDLE	32	28
DOUBLE CIRCUIT POLE	27	49
DOUBLE CIRCUIT POLE	32	46
DOUBLE CIRCUIT POLE (REVERSE PHASE)	27	16
DOUBLE CIRCUIT POLE (REVERSE PHASE)	32	15

The edge of right of way is 75 feet from the line centerline.
The 800 ampere phase current is balanced between phases.

**INCREASED 500 kV MINIMUM GROUND CLEARANCE
CALCULATED MAGNETIC FIELDS AT 1,100 AMPERES**

TYPE CONSTRUCTION	MINIMUM GROUND CLEARANCE FEET	MAGNETIC FIELD IN MILLIGAUSS AT THE EDGE OF THE RIGHT OF WAY
SINGLE CIRCUIT "H" STRUCTURE	33	42
SINGLE CIRCUIT "H" STRUCTURE	53	35
DOUBLE CIRCUIT POLE	33	37
DOUBLE CIRCUIT POLE	53	31
DOUBLE CIRCUIT POLE (REVERSE PHASE)	33	21
DOUBLE CIRCUIT POLE (REVERSE PHASE)	53	16

The edge of right of way is 100 feet from the line centerline.
The 1,100 ampere phase current is balanced between phases.

**12 kV DISTRIBUTION LINES
CALCULATED MAGNETIC FIELDS AT 300 AMPERES**

TYPE CONSTRUCTION	POLE HEIGHT FEET	MAGNETIC FIELD IN MILLIGAUSS*	
		AT CENTERLINE	AT 30 FEET FROM CENTERLINE
STANDARD CROSSARM	45	14	7
STANDARD CROSSARM	50	11	6

* Field level under the line at mid-span based on 300 amps, balanced loading, one meter above ground level.

APPENDIX C

LIST OF INVOLVED GOVERNMENTAL AGENCIES, MUNICIPALITIES AND OTHER PUBLIC ENTITIES

1. Pennsylvania Historical and Museum Commission
Bureau for Historic Preservation
Commonwealth Keystone Building, Second Floor
400 North Street
Harrisburg, Pennsylvania 17120-0053
Attn: Mr. Douglas C. McLearen, Chief
2. Pennsylvania Department of Transportation
Commonwealth Keystone Building
400 North Street, 8th Floor
Harrisburg, Pennsylvania 17120
Attn: The Honorable Allen D. Biehler, P.E., Secretary
3. Department of Environmental Protection
P.O. Box 2063
Market Street State Office Building
Harrisburg, Pennsylvania 17105-2063
Attn: Office of Field Operations
4. Monroe County Planning Commission
1 Quaker Plaza, Room 106
Stroudsburg, PA 18360
Attn: John Woodling, Executive Director
5. Monroe County Commissioners
1 Quaker Plaza, Room 201
Stroudsburg, PA 18360
Attn: Suzanne McCool, Chairman
6. Stroudsburg Borough
700 Sarah Street
Stroudsburg, PA 18360
Attn: Charlie Baughman, Mayor
7. Stroudsburg Borough
700 Sarah Street
Stroudsburg, PA 18360
Attn: Barbara K. Quarantello, Borough Manager

8. Stroudsburg Borough Council
700 Sarah Street
Stroudsburg, PA 18360
Attn: Kim M. Diddio, President

9. Stroudsburg Borough Planning Commission
700 Sarah Street
Stroudsburg, PA 18360
Attn: William H. Miller Jr., Chairman