Before the
Pennsylvania Public Utility Commission

TRUMBAUERSVILLE #1 & #2 138/69 kV TAP LINE

Attachments in Support of the Letter of Notification

Application Docket No. ______________

Submitted by: PPL Electric Utilities Corp.

SUMMARY

This filing is submitted by PPL Electric Utilities Corporation (PPL Electric) pursuant to the Pennsylvania Public Utility Commission's (PUC, or the Commission) regulations at 52 Pa. Code §§ 57.71 through 57.77 for PUC approval to site and construct the Trumbauersville #1 & #2 138/69 kV Transmission Tap Line. The proposed project will be approximately 275 feet long. It will be located in part on a section of existing PPL Electric right-of-way, and in part on property that is under a contract providing PPL Electric the option to purchase.

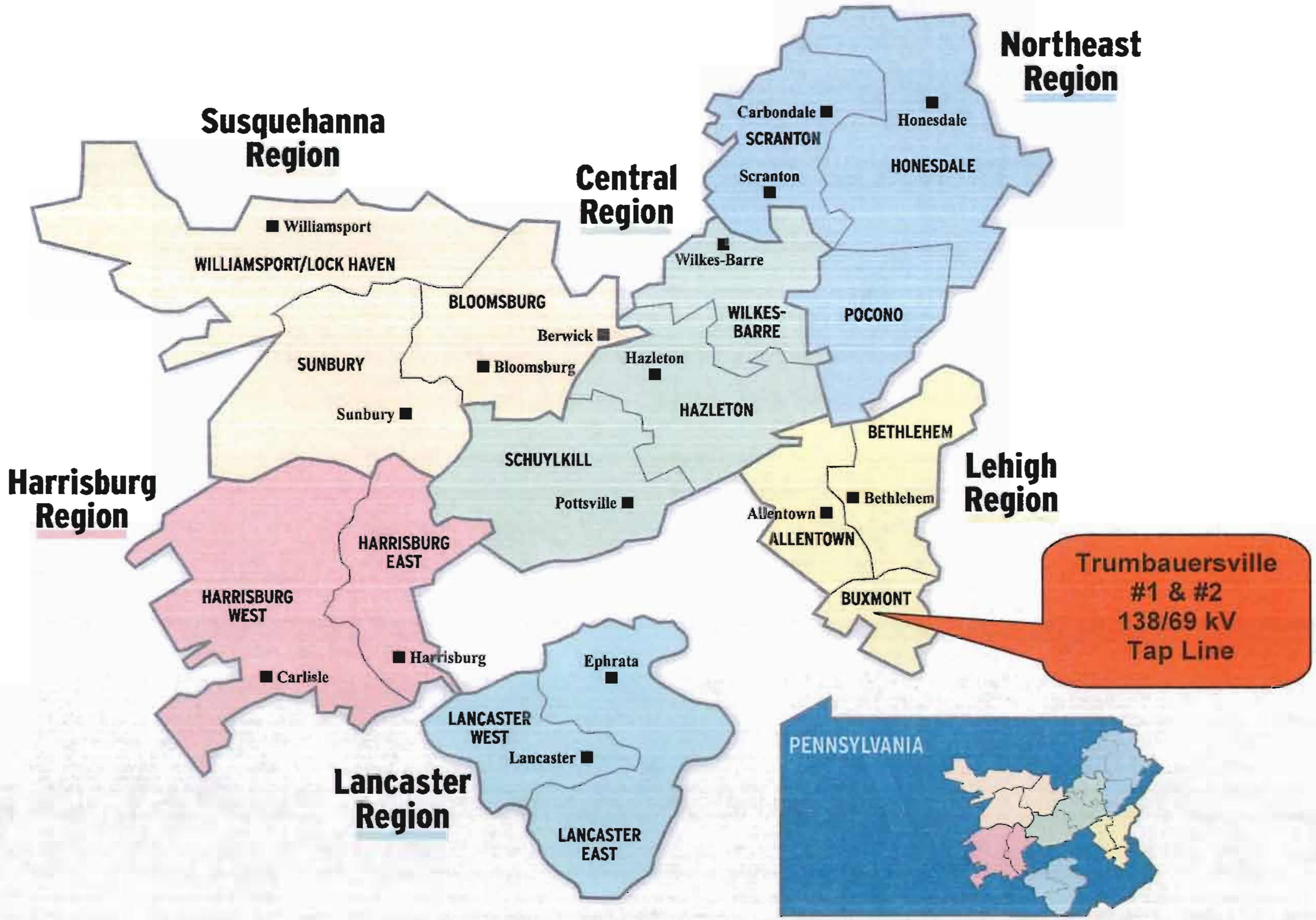
The proposed tap line will provide the source of electrical supply to the new Trumbauersville 69 - 12 kV Substation. The substation and associated 12 kV distribution facilities are required to meet the increasing demand for electricity and improve the reliability of service in Richland Township, Bucks County and the nearby vicinity.

The estimated cost to design and construct the proposed 138 kV tap line is $644,000. Due to difficulties in locating a suitable site for the substation, the required in-service date of May 2012 is not achievable. Project construction will begin as soon as possible after Commission approval to minimize the potential exposure of an unplanned interruption of service. As such, PPL Electric respectfully requests an expedited review of this application.

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

Attachment 1 -	Necessity Statement
Attachment 2 -	Engineering Description
Attachment 3 -	Environmental Assessment
Attachment 4 -	PPL Design Criteria and Safety Practices
Attachment 5 -	PPL Electric Magnetic Field Management Program
Attachment 6 -	List of Property Owners Within the Proposed Right-of-Way
Attachment 7-	List of Involved Governmental Agencies, Municipalities and Other Public Entities

PPL ELECTRIC UTILITIES SERVICE TERRITORY



Attachment
1

ATTACHMENT 1

TRUMBAUERSVILLE #1 & #2 138/69 kV TAP LINE

NECESSITY STATEMENT

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ATTACHMENT 1

TRUMBAUERSVILLE #1 & #2 138/69 kV TAP LINE

NECESSITY STATEMENT

A. INTRODUCTION

PPL Electric is requesting PUC approval to site and construct a double-circuit 138/69 kV transmission tap line. The proposed facilities are required to meet the load growth demands in the Richland/Milford area. Both the Buxmont – Quakertown #1 & #2 138/69 kV Transmission Lines will be tapped through two Load Sectionalizing Air Break (LSAB) switches to a common point. From this point, a single circuit will be extended to the proposed new Trumbauersville 69 – 12 kV Substation. The proposed tap will be constructed using two LSAB switches in order to provide better reliability in the event of an outage on either the Buxmont – Quakertown #1 or #2 138/69 kV Transmission Line. The tap will be built for future 138 kV operations, but will initially operate at 69 kV. The second circuit will be extended into the substation and the tap will be upgraded to 138 kV operation when future demand for electricity warrants this construction.

The estimated cost to design and construct the proposed tap line is approximately $644,000. The required in-service date for this project is May 2012. The required in-service date is defined as the date the proposed facility needs to be placed in service to prevent equipment overloads that have the potential to damage existing facilities and, thereby, cause the interruption of service to customers. Due to difficulties in locating a suitable site for the substation, which caused a delay in the engineering and construction of this Project, the required in-service date will not be met. Project construction will begin as soon as practical after Commission approval to minimize the potential exposure to an unplanned interruption of electrical service. Therefore, PPL Electric respectfully requests an expedited review of this application.

A PPL Electric system map showing existing transmission facilities with a design voltage of 35 kV or greater is included in the map pocket at the end of Attachment 1. This filing addresses only the existing and proposed 138/69 kV system in the Richland/Milford area.

B. EXISTING SYSTEM

Presently the Richland and Milford 69 – 12 kV Substations provide service to the area of concern. The Richland 69 – 12 kV Substation has two 69 – 12 kV transformers that are energized from the Buxmont – Quakertown #1 and #2 138/69 kV Lines, which are two separate 69 kV transmission lines. The Richland Substation currently supplies six 12 kV distribution lines, including the Richland 36-2 and 36-5 12 kV distribution lines, which serve a total of nearly 3,600 customers. The Milford 69 – 12 kV Substation has two 69 – 12 kV transformers that are energized from one 69 kV transmission line, the Hosensack – Coopersburg 138/69 kV Line. The Milford 69 – 12 kV Substation currently supplies three 12 kV distribution lines, including the Milford 24-2 and 24-3 lines, which in total serve about 2,700 customers. Additionally, the Ridge Road 70-2 12 kV Distribution Line serves about 1,300 customers in the area.

C. DEFINITION OF THE PROBLEM

PPL Electric plans its system in accordance with its Reliability Principles and Practices (RP&P) guidelines, so that PPL Electric can sustain probable contingencies and disturbances with minimal customer service interruptions and it can adequately serve each customer's needs with regard to capacity, voltage and reliability for all load levels throughout the daily load cycle. System Planning is the process which assures that PPL Electric's regional system can supply electricity to all customer load in a manner that is reliable and economic. In addition, the system is planned so that system reliability can be maintained to prevent large scale, long term, or frequent service interruptions in order to avoid adverse effects and hazards to the public.

The planning process begins with the development of a computer model of the future system. A specific study year is chosen. The future system model is then developed using the existing system plus any planned modifications to the transmission system scheduled to be in service prior to the study year. Load levels used in the system model are based on the latest forecast prepared annually by PPL Electric, which is based on recent summer peak load forecasts that take into account ambient temperatures and humidity indices.

Once the system model is complete, comprehensive power flow simulations are performed to determine the ability of the system to comply with the PPL Electric transmission planning reliability criteria. All conditions where the system is not in conformance with the reliability criteria are identified, and system reinforcements are added to bring the system into conformance. Also identified are estimated costs and lead-times to implement the required reinforcements. Computer simulations of the system with the identified reinforcement alternatives are completed to identify the best overall reinforcement that will meet the needs of the region in a reliable and economic manner.

Due to the increasing demand for electricity, the Richland 69 – 12 kV Substation served a peak load of approximately 43.2 MVA in the summer of 2011 and is expected to serve a peak load of 45.7 MVA by 2012, which exceeds its 2-hour rating of 39.7 MVA. Also, both the Richland 36-2 and 36-5 12 kV Distribution Lines peaked over the normal planning guideline of 10 MVA in the summer of 2011 and are again expected to exceed their ratings in the summer of 2012. Additionally, the 36-2 line currently serves approximately 1,700 customers and the 36-5 line serves 1,860 customers, exceeding the recommended customer count per feeder of 1,300 as outlined in PPL Electric's RP&P.

In addition to the concerns with the Richland Substation, the Milford 69 – 12 kV Substation served a peak load of 21 MVA in the summer of 2011, and is expected to serve a peak load of 21.6 MVA in the summer of 2012. This load exceeds the Milford Substation's summer emergency rating of 20.5 MVA. Additionally, the Milford 24-2 12 kV Distribution Line served a peak load of 8.2 MVA in the summer of 2011 and is expected to peak at 8.4 MVA in the summer of 2012. This peak load exceeds the normal planning guidelines for this type of conductor, which is 8 MVA. The Milford 24-2 and the Ridge Road 70-2 12 kV distribution line have experienced significant outages due to the large number of customers they serve and the lack of sectionalizing devices and tie lines that would allow quicker restoration of electric service.

D. PROPOSED SOLUTION

To resolve the projected conductor and substation overload and reliability issues discussed in Section C, PPL Electric proposes construction of the new Trumbauersville 69 – 12 kV Substation, which will be supplied by the Trumbauersville #1 & #2 138/69 kV Tap Line which is proposed in this Letter of Notification. PPL Electric will own, operate and maintain the new Trumbauersville 69 – 12 kV Substation and the Trumbauersville 138/69 kV Tap Line. Three new 12 kV circuits will initially be installed. The new Trumbauersville 69 – 12 kV Substation and the new 12 kV distribution circuits will allow transfer of load to relieve the overloading on the Richland Substation and the Richland 36-2 and 36-5 12 kV Lines, as well as the Milford Substation and the Milford 24-2 12 kV Line.

The Trumbauersville Substation and new 12 kV distribution lines will reduce peak loading on the Richland 36-2 12 kV Distribution Line by approximately 7.3 MVA and the Richland 36-5 Line by 8.7 MVA, which is a total reduction of 16 MVA at the Richland Substation. The Milford 24-2 Line will see a reduction of

5.4 MVA and the Milford 24-3 Line will be reduced by 4.4 MVA, for a total reduction of nearly 10 MVA at the Milford Substation.

Upon completion of the proposed project, the customer counts for the distribution lines in question will be as follow:

- 36-2 12 kV line: from 1700 to 409,
- 36-5 12 kV line: from 1860 to 231,
- 24-2 12 kV line: from 1400 to 509.

While the customer count on the 70-2 12 kV line did not exceed the RP&P its customer count will decrease to 1000. The 24-3 12 kV line will see a modest increase to 657 customers.

The total estimated cost of this solution is approximately $4,531,000, which includes $1,341,000 for the new substation, $644,000 for the transmission work, and $2,546,000 for distribution work.

E. FUNCTIONAL ALTERNATIVE

An alternative to building the new substation and tap line would be to upgrade the transformers at both Richland and Milford Substations from 25 MVA and 10 MVA, to 35 MVA and 28 MVA, respectively. With the added capacity at the Richland Substation, a new 12 kV distribution line could then be constructed. The new line would be run as a double circuit along the 36-05 line. The new line would tap into the existing 36-05, taking a large portion of its customer load.

At the Milford Substation, the additional capacity would allow a new 12 kV distribution line, as well. This new line would run as a double circuit with the 24-03. The new line would tap into the 24-03 and take a large portion of its existing load. In order to improve the performance and reliability of the Milford 24-02 and the Ridge Road 70-02, the 24-02 line would be extended and tied to the 70-02 via a normally open LBAS. These additions would allow for transfer of load in the event of an outage on either of these lines, and would solve the loading issues at Milford Substation.

This alternative is estimated to cost approximately $3 million. While this alternative is less expensive than the preferred alternative, PPL Electric has rejected this alternative because it does not address loading issues on the 36-2 line and the preferred alternative described above in Section D, provides much greater capacity in a region that is experiencing large load growth, as well as much greater flexibility in sectionalizing and load transfer to restore customers in the event of an outage. Further, because the rejected alternative involves construction of double circuit lines, the reliability of service could be less than under the proposed alternative, because a single event could cause an interruption of service on both circuits.

FIGURE 1
FUNCTIONAL ONE-LINE DIAGRAM OF EXISTING TRANSMISSION FACILITIES

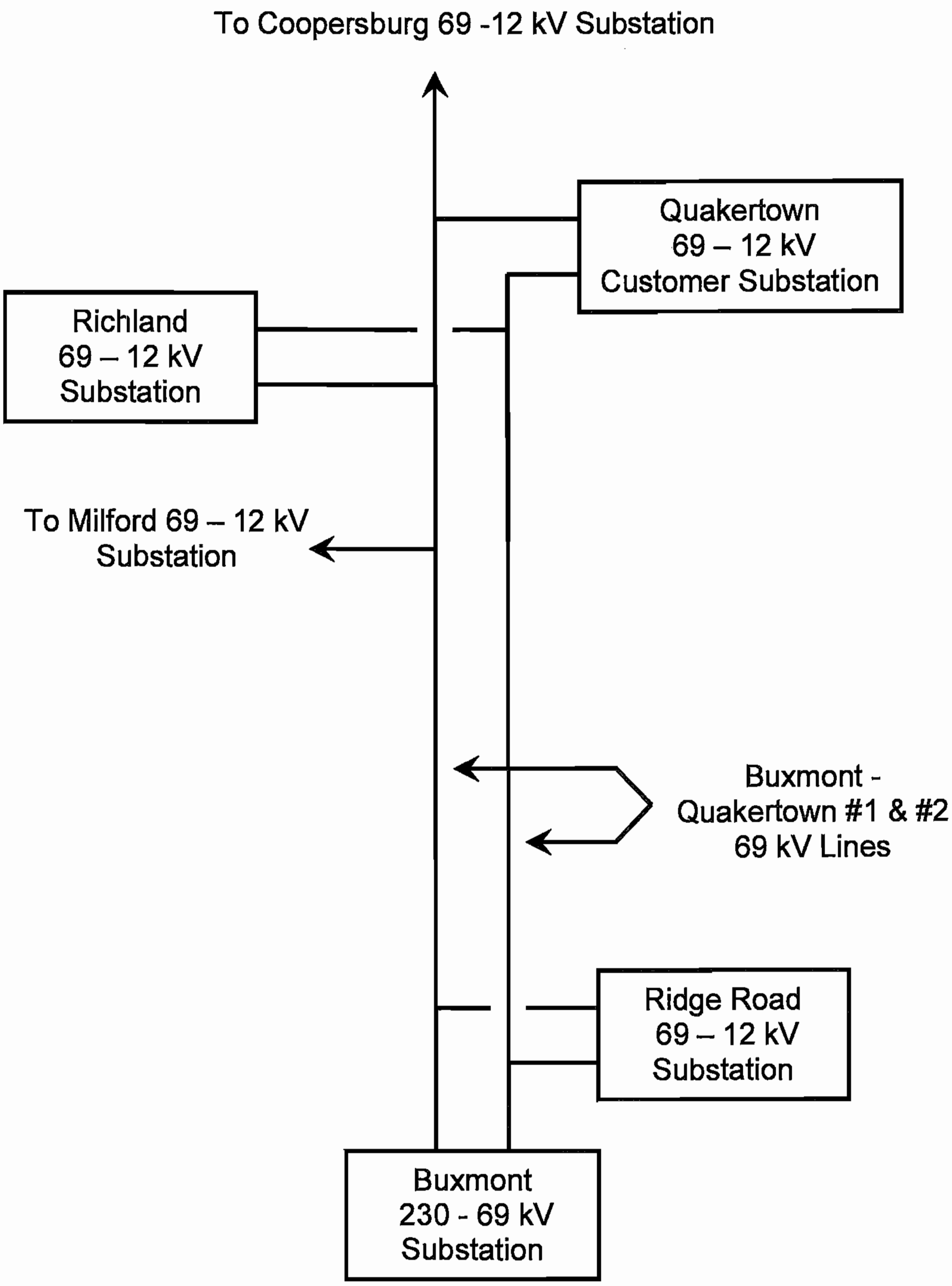


FIGURE 2
FUNCTIONAL ONE-LINE DIAGRAM OF PROPOSED TRANSMISSION FACILITIES

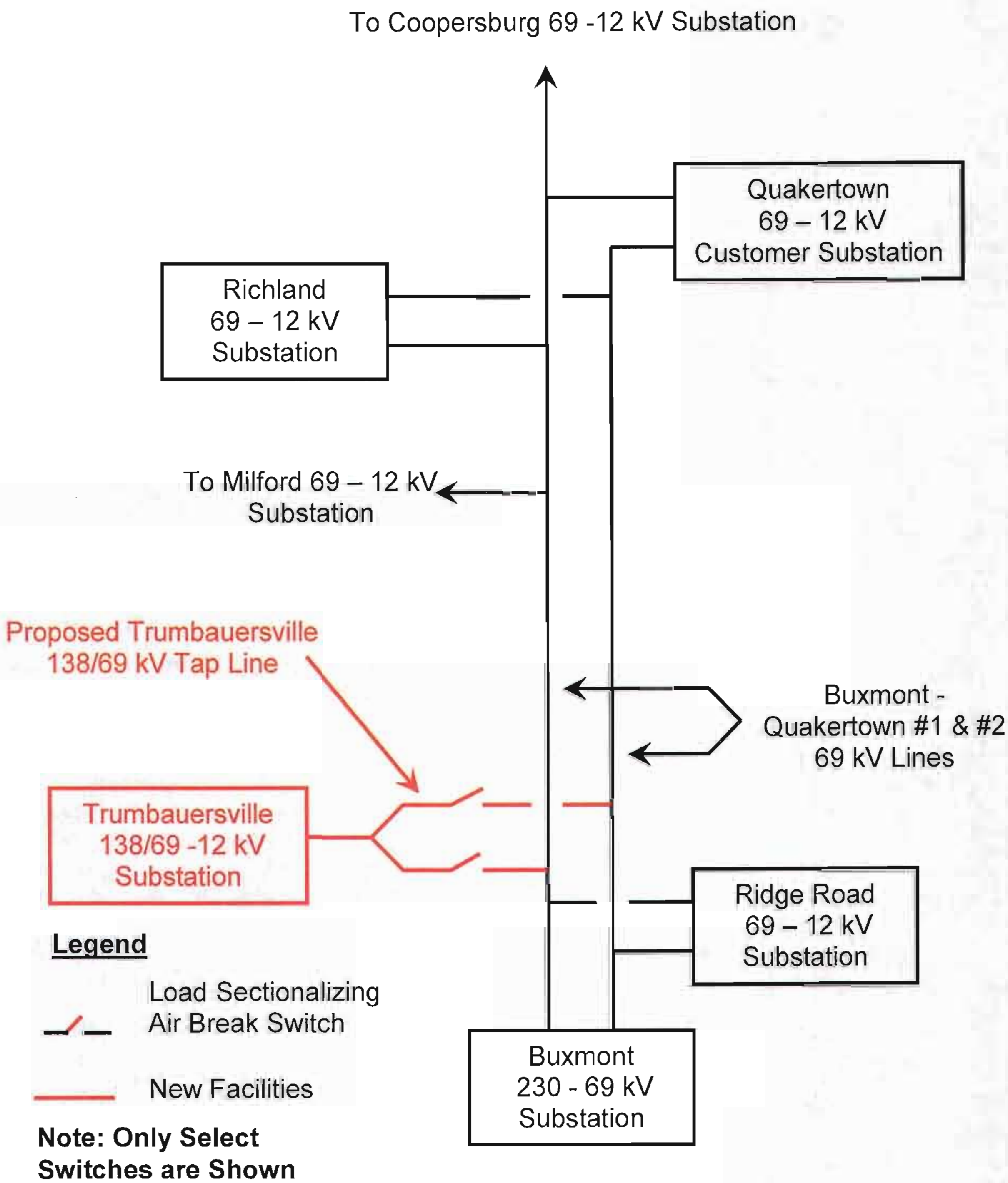
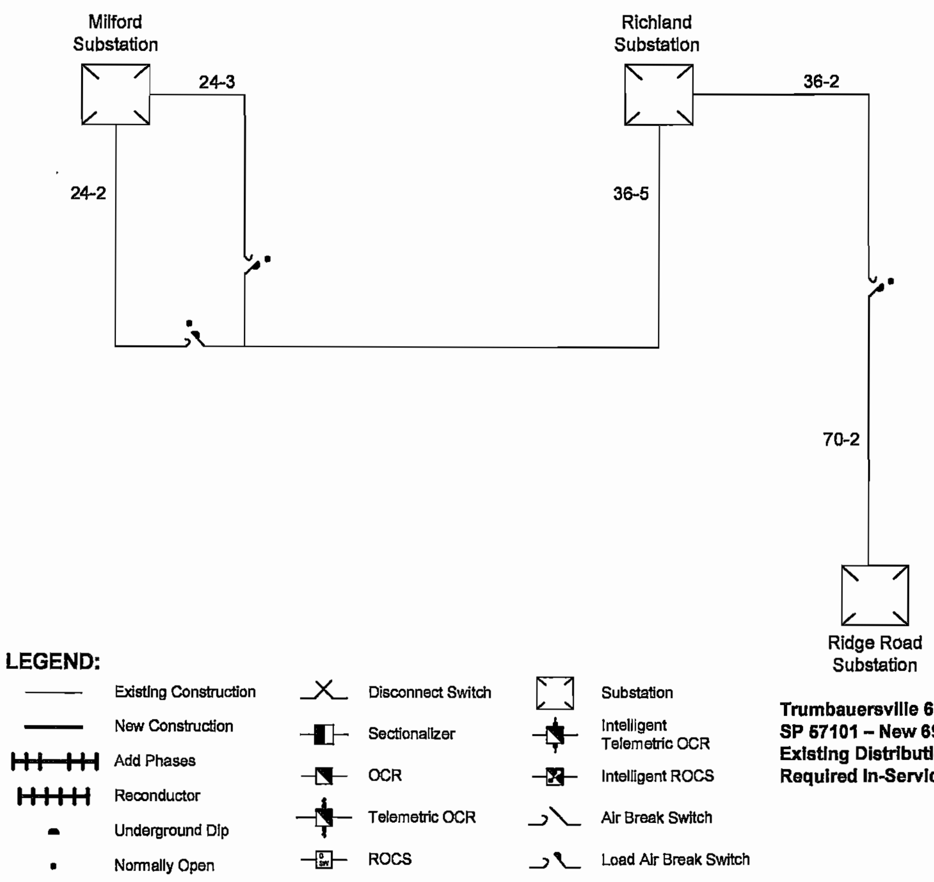


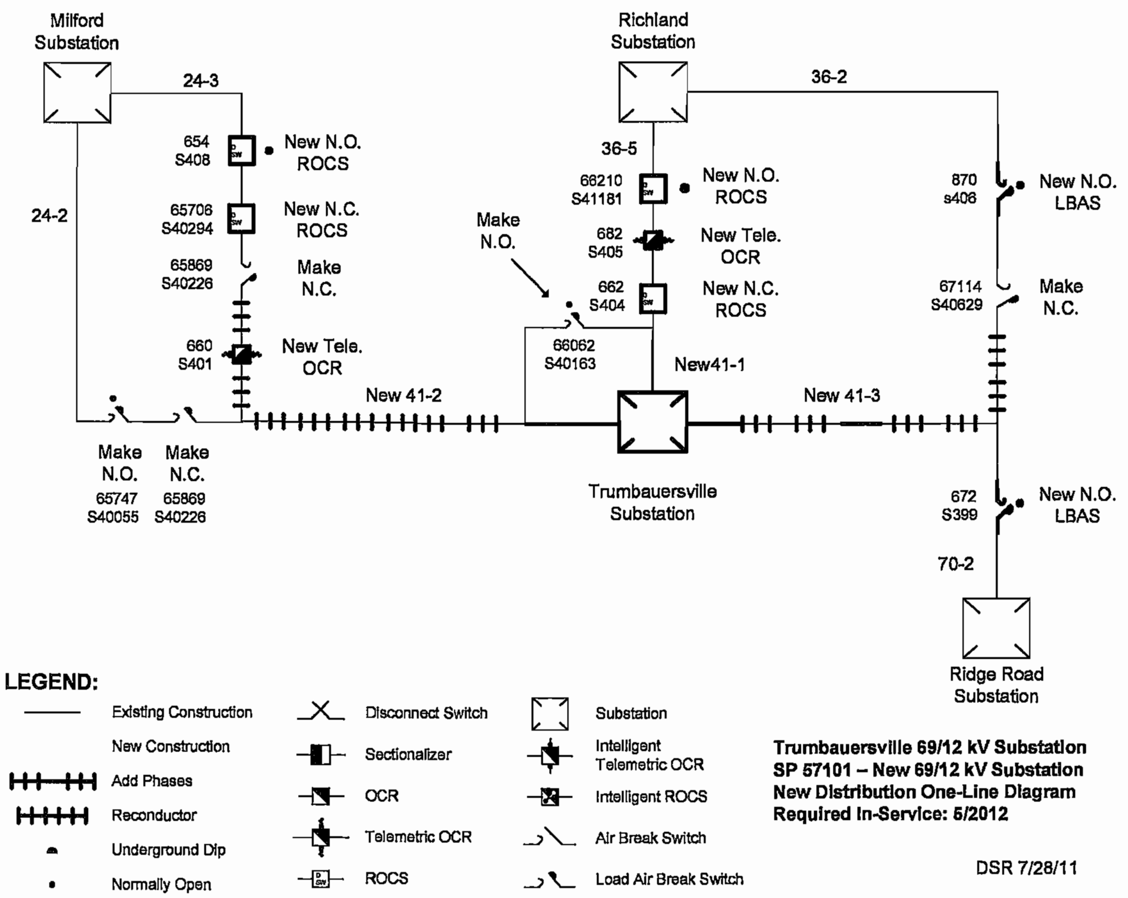
FIGURE 3
FUNCTIONAL ONE-LINE DIAGRAM OF EXISTING DISTRIBUTION FACILITIES



Trumbauersville 69/12 kV Substation
SP 67101 – New 69/12 kV Substation
Existing Distribution One-Line Diagram
Required In-Service: 6/2012

DSR 6/23/11

FIGURE 4
FUNCTIONAL ONE-LINE DIAGRAM OF PROPOSED DISTRIBUTION FACILITIES

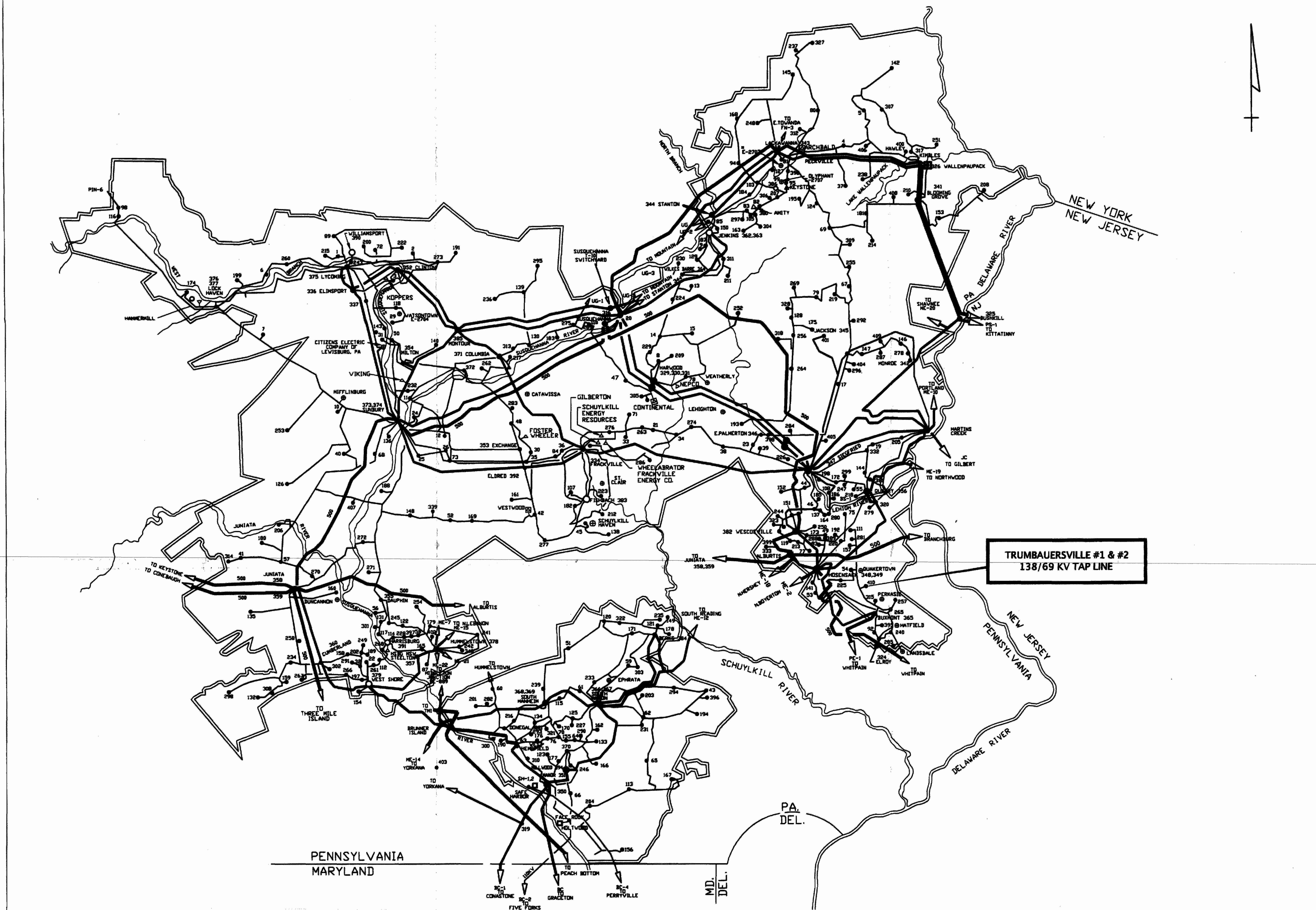


SUBSTATION LISTING

1. WEST WILLIAMSPORT
2. FAIRFIELD
3. MONTGOMERY
4. VARDEN
5. HONESDALE
6. JERSEY SHORE
7. LOGANTON
8. VALMONT
9. RIVER
10. LIMESTONE
11. NORTHUMBERLAND
12. REED
13. WRIGHT
14. ST. JOHNS
15. FREELAND
16. *
17. GILBERT
18. *
19. CHERRY HILL
20. SUSQUEHANNA 230kV
21. TAMAMEND
22. WHITE HILL
23. PALMERTON
24. HAMILTON
25. HUNTER
26. FAIRVIEW
27. *
28. *
29. MONTOUR PUMP
30. MT. CARMEL
31. KELLY
32. SPORTING HILL
33. MAHANOY CITY
34. GREENWOOD
35. MOWERY
36. ALTAMOUNT
37. HAMLIN
38. ASHFIELD
39. SOUTH SLATINGTON
40. SOUTH MIDDLEBURG
41. WALKER
42. FRAILEY
43. MORGANTOWN
44. EGYPT
45. CRESSONA
46. SOUTH WHITEHALL
47. EAST TOMHICKEN
48. BEAR GAP
49. SALISBURY
50. SOUTH MILTON
51. HEIDELBERG
52. LYKENS
53. UPPER HANOVER
54. RICHLAND
55. MACADA
56. ROCKVILLE
57. THOMPSONTOWN
58. PAXTON
59. COCALICO
60. EAST ELIZABETHTOWN
61. WARWICK
62. EARL
63. HEMPFIELD
64. EAST LANCASTER
65. KINZER
66. MT. NEBO
67. MT. POCONO
68. PENNS
69. GOULDSBORO
70. DILLERVILLE
71. GIRARD MANOR
72. KENMAR
73. GOWEN CITY
74. *
75. ELLIOT HEIGHTS
76. ROHRERSTOWN
77. MACUNGIE
78. EAST HAZLETON
79. WAGNERS
80. EAST CARBONDALE
81. EYNON
82. MINOOKA
83. OLD FORGE
84. FOUNTAIN SPRINGS
85. SULLIVAN TRAIL
86. *
87. SWATARA
88. *
89. HEPBURN
90. *
91. *
92. FRANCONIA
93. EMMAUS
94. MORGAN
95. THROOP
96. *
97. *
98. CHAPMAN
99. SUBURBAN
100. *
101. *
102. *
103. PROVIDENCE
104. *
105. AVOCA
106. *
107. CASS
108. CATASAQUA
109. *
110. SUSQUEHANNA 500kV
111. SEIDERSVILLE
112. ROSEMONT
113. QUARRYVILLE
114. LAWNTON
115. LITITZ
116. RENOVO
117. WALNUT
118. WATSON
119. TREXLERTOWN
120. LAVINO
121. SPRING
122. COLONIAL PARK
123. WEST LANCASTER
124. MADISONVILLE
125. NEFFSVILLE
126. BEAVERTOWN
127. BELMONT
128. LAKE HARMONY
129. GEORGETOWN
130. SCOTT
131. NORTH HARRISBURG
132. MOUNT ROCK
133. GREENLAND
134. LANDISVILLE
135. GREEN PARK
136. SELINSGROVE
137. SUMNER
138. AUBURN
139. ROHRSBURG
140. DERRY
141. EAST GREENVILLE
142. WEST DAMASCUS
143. NEW COLUMBIA
144. FARMERSVILLE
145. GREENVILLE
146. NORTH STROUDSBURG
147. TANNERSVILLE
148. ELIZABETHVILLE
149. WYOMISSING
150. EXETER
151. CRACKERSPORT
152. SCHNECKSVILLE
153. HEMLOCK
154. MT. ALLEN
155. PRINCE
156. WAKEFIELD
157. COOPERSBURG
158. WERTZVILLE
159. WEST CARLISLE
160. BENVENUE
161. HEGINS
162. LEOLA
163. YATESVILLE
164. CENTRAL ALLENTOWN
165. OBERLIN
166. STRASBURG
167. ATGLEN
168. BROOKSIDE
169. WILLIAMSTOWN
170. EAST PETERSBURG
171. WERNERSVILLE
172. NORTH BETHLEHEM
173. WEST ALLENTOWN
174. FLEMINGTON
175. MECKESVILLE
176. DONERVILLE
177. MILLERSVILLE
178. SHILLINGTON
179. DUKE
180. MCALLISTERVILLE
181. NEWFOUNDLAND
182. MARLIN
183. WEST BERWICK
184. KEYSER AVENUE
185. MICKLEYS
186. EAST ALLENTOWN
187. PINE RIDGE
188. DALMATIA
189. PENNSBORO
190. NORTH COLUMBIA
191. HUGHSVILLE
192. SOUTH ALLENTOWN
193. WEISSPORT
194. HONEYBROOK
195. MOSCOW
196. *
197. ROSSMOYNE
198. NORTHAMPTON
199. WOOLRICH
200. FAXON
201. ELIZABETHTOWN
202. ENOLA
203. TERRE HILL
204. BUCK
205. MT. BETHEL
206. RICHFIELD
207. SCRANTON
208. TWIN LAKES
209. HARLEIGH
210. TAFTON
211. BEAR CREEK
212. ORWIGSBURG
213. EAST TEXAS
214. CANDENSIS
215. LINDEN
216. MT. JOY
217. WEST BLOOMSBURG
218. MINSI TRAIL
219. LAKE NAOMI
220. LANARK
221. *
222. MONTOURSVILLE
223. PORT CARBON
224. BLYTHEBURN
225. MILFORD
226. TREICHLERS
227. ROSEVILLE
228. RUTHERFORD
229. HARTLAND
230. PARRISH
231. WEST NEW HOLLAND
232. POINT
233. LINCOLN
234. MIDDLETON
235. STATE HILL
236. MILLVILLE
237. TINKER
238. LAKEVILLE
239. NORTH MANHEIM
240. HATFIELD
241. HERSHEY
242. SOUTH HERSHEY
243. SOUTH WILLIAMSPORT
244. FOGELSVILLE
245. WINDSOR
246. WEST WILLOW
247. WESTGATE
248. EDELA
249. SUMMERDALE
250. DORNEYVILLE
251. BOHEMIA
252. WHITE HAVEN
253. LAURELTON
254. LINGLESTOWN
255. POCONO FARMS
256. HICKORY RUN
257. BLOOMING GLEN
258. SHERMANDSDALE
259. *
260. LARRYS CREEK
261. SPANGLER MILLS
262. EAST DANVILLE
263. DELANO
264. CARBON
265. SELLERSVILLE
266. MECHANICSBURG
267. CARLISLE
268. CEDAR
269. ARROWHEAD
270. NEWPORT
271. HALIFAX
272. MILLERSBURG
273. MUNCY
274. HAUTO
275. BERWICK
276. SHENANDOAH
277. PINE GROVE
278. STROUDSBURG
279. FREEMANSBURG
280. ALLENTOWN
281. BINGEN
282. RHEEMS
283. CLEVELAND
284. LITTLE GAP
285. ORVILLA
286. TUSCARORA
287. BARTONSVILLE
288. ALTON PARK
289. SALEM
290. NORTH BRIDGEPORT
291. HAMPDEN
292. CAMELBACK
293. SILVER SPRING
294. BRECKNOCK
295. BENTON
296. McMICHAELS
297. HUGHSTOWN
298. NEWVILLE
299. POINTE NORTH
300. MARIETTA
301. CENTER CITY
302. NEW KINGSTOWN
303. REAMSTOWN
304. DUPONT
305. HUMBOLT
306. CEDAR AVE.
307. INDIAN ORCHARD
308. NOTTINGHAM
309. NORTH COOLBAUGH
310. LETORT
311. EAST MOUNTAIN
312. JERMYN
313. BLOOMSBURG
314. MIFFLINTOWN
315. RIDGE ROAD
316. SUSQUEHANNA T-10 SW. YARD
317. KIMBLES
318. CHRISTMANS
319. OTTER CREEK
320. STEEL CITY
321. McGOVERNVILLE
322. ROBESONIA
323. SOUTH FOGELSVILLE
324. ELROY
325. BUSHKILL
326. WALLENPAUPACK
327. ELK MOUNTAIN
328. JACK FROST
329. HARWOOD 230/69kV
330. HARWOOD CTG
331. HARWOOD 69/12kV
332. NAZARETH
333. ALBURTIS
334. FRACKVILLE
335. *
336. ELIMSPORT
337. ALLENWOOD
338. *
339. GRATZ
340. HOCKERSVILLE
341. BLOOMING GROVE
342. MONROE
343. LACKAWANNA ##
344. STANTON
345. JACKSON
346. EAST PALMERTON
347. SIEGFRIED
348. HOSENSACK 230/69kV
349. HOSENSACK 500kV
350. CONESTOGA
351. MANOR
352. CLINTON
353. EXCHANGE
354. MILTON
355. DAUPHIN
356. QUARRY SUB.
357. STEELTON
358. JUNIATA 500/230kV
359. JUNIATA 230/69kV
360. CUMBERLAND
361. DONEGAL
362. JENKINS 230/69kV
363. JENKINS CTG
364. WILKES-BARRE
365. BUXMONT
366. SOUTH AKRON 230/138/69kV
367. SOUTH AKRON 69/12kV
368. SOUTH MANHEIM 69/12kV
369. SOUTH MANHEIM 230/69kV
370. ENGLESIDE
371. COLUMBIA
372. DANVILLE
373. SUNBURY
374. HUMMELS WHARF
375. LYCOMING
376. LOCK HAVEN CTG
377. LOCK HAVEN 69/12kV
378. HUMMELSTOWN
379. WEST SHORE
380. MONTAGE
381. SOUTH FARMERSVILLE
382. WESCOSVILLE
383. FISHBACH
384. BERKS
385. MONTOUR
386. SUBURBAN YARD
387. *
388. *
389. MACK
390. WILLIAMSPORT
391. HARRISBURG
392. ELDRED
393. *
394. MILLWOOD
395. TELFORD
396. TWIN VALLEY
397. DEVONSHIRE
397. JESSUP
398. BELTZVILLE
399. SCHOENECK
400. HAWLEY
401. EFFORT MOUNTAIN
402. COPPERSTONE
403. RED FRONT
404. APPENZELL
405. BLUE MOUNTAIN
406. DAPPERS 69/12kV
407. MEISERVILLE
408. LEDGEDALE
409. EAST TANNERSVILLE
410. TRUMBAUERSVILLE

* - SUBSTATIONS THAT HAVE BEEN RETIRED.

\## - SITE OF THE EXISTING 230kV SUBSTATION AND PROPOSED 500kV SYBSTATION.



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

NO.	DATE	ACCT.		BY	REVIEWED	APPROVED
92	7/13/11	161670	ADDED EAST TANNERSVILLE SUB and 138KV TAP	MG		DJG
95	9/9/11	169017	ADDED TRUMBAUERSVILLE #1 & #2 138/69 KV TAP LINE	mg		KBK
94	8/19/11	161723	ADDED EAST PETERSBURG #1 & #2 138KV TAP & PARK CITY #1 & #2 138KV TAP	mg		JBW
93	7/22/11	10014283	DEPICT LOCATION OF MARTINS CREEK - SIEGFRIED #2 230KV LINE REBUILD	mg		DJG

REFERENCE TITLE | NUMBER | REFERENCE TITLE | NUMBER

PPL ELECTRIC UTILITIES

ACCT- 805201
SCALE- NONE
BY- CDW
REVIEWED

ELECTRICAL SYSTEM MAP
TRUMBAUERSVILLE #1 & #2 138/69 KV TAP LINE

APPROVED G. HAKUN III | DATE 7/17/85 | PPL ELECTRIC UTILITIES

PPL DRAWING NO. D191830 | SHEET NO. 1 | REV. 95

PC CAD

#6000 | LOCATION CODES | PLAN & PROFILE NO. | TRANSMISSION MAP NO. | C | SORTS

D19'830_S001.DWG

PPL EU FORM 4877 (7/03)

Attachment
2

ATTACHMENT "2"

TRUMBAUERSVILLE #1 & #2 138/69 kV TAP LINE

ENGINEERING DESCRIPTION

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ATTACHMENT "2"

TRUMBAUERSVILLE #1 & #2 138/69 kV TAP LINE

ENGINEERING DESCRIPTION

A. DESCRIPTION OF THE PROPOSED LINE

PPL Electric proposes to install a double-circuit 138/69 kV transmission tap line from its existing Buxmont – Quakertown #1 & #2 138/69 kV Transmission Line to the proposed Trumbauersville 69 – 12 kV Substation. The proposed tap line will be located in Richland Township, Bucks County. Refer to the Aerial Exhibit at the end of Attachment 2 which depicts the location of these facilities.

The proposed tap line will be approximately 275 feet long. The tap to the new substation will be a double tap, single circuit arrangement. Both the Buxmont – Quakertown #1 and #2 Circuits will be tapped, via two LSAB switches, to a common point. From this point, the tap line will initially be constructed with one circuit connecting to the proposed Trumbauersville Substation. A second circuit will be added, and the operating voltage will be increased to 138 kV, when load growth in the area makes it appropriate to do so.

The proposed Trumbauersville #1 & #2 138/69 kV Tap will be connected to the Buxmont – Quakertown #1 & #2 138/69 kV Line by installing a "high-low" tap system. This arrangement uses a high-height tap pole on the circuit closest to the substation and a low-height pole on the other circuit. This arrangement allows the high pole circuit enough vertical clearance to cross above the low pole's circuit. Both poles in this arrangement will be single-shaft steel monopoles. The high pole will be approximately 120 feet tall and the low pole will be approximately 80 feet tall. Both poles will be direct-embedded and guyed. See photograph on page 5 of this Attachment.

Two LSAB switches will be installed. Each switch will be installed on a direct-embedded, single shaft steel monopole that will be approximately 85 feet tall. The LSAB switch poles will be connected by an X-brace for structural integrity. See photograph on page 6 of this Attachment. The remaining two steel monopoles will average 60 feet in height. These poles will be direct-embedded and guyed. See photograph on page 7 of this Attachment. Lastly, the insulators on the existing monopoles on either side of the proposed tap will be switched from suspension insulators to tension insulators.

The proposed tap line will consist of six power conductors for the double-circuit section and three power conductors for the single-circuit section. The power conductors will be 556.5 kcmil[1], 24/7 stranding, ACSR[2] conductors. A 3/8-inch steel overhead ground wire will provide lightning protection for the proposed tap line.

The proposed line will be designed to, and will generally exceed, National Electrical Safety Code (NESC) minimum standards. Design specifications and safety rules practiced by PPL Electric are included in Attachment 4. The minimum conductor to ground clearance will be 30 feet, which occurs at a maximum conductor temperature of 125° C. The design minimum conductor ground clearances and conductor thermal ratings are as follow:

[1] Kcmil stands for "thousand circular mils." A circular mil is the cross-sectional areas of a wire one mil in diameter, where 1 kcmil = 0.5067 mm².
[2] Aluminum Conductor Steel Reinforced

TABLE 1

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

Condition	Double-Circuit Design Clearance to Ground
Normal load, average weather (16°C ambient temperature)	30.95 feet
Predicted extreme thermal load (125°C conductor temperature)	30.00 feet
Predicted NESC extreme wind load (16°C ambient temperature)	30.81 feet
Predicted extreme weather conditions (1-inch ice, 4 lbs. wind, -10°C)	31.08 feet

*Clearances based on a maximum tension of 2500 lbs. at 1 inch ice, 4 lbs. wind, -10°C and a ruling span of 85 feet.

TABLE 2

CONDUCTOR THERMAL RATING 556.5 KCMIL 24/7 STRANDING ASCR (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	1.5	1041
Winter Emergency	10	1.5	1163

B. MAGNETIC FIELD MANAGEMENT

PPL Electric's Magnetic Field Management Program is summarized in Attachment 5 and is applied to reconstruction and new line projects. In order to lower magnetic field exposures, the program generally prescribes the use of line design that provides 5 feet higher ground clearances and 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.

For this project, reverse phasing cannot be utilized to reduce magnetic field levels at this time because, initially, the line will be constructed for single circuit operation. PPL Electric will evaluate reverse phasing when the second circuit is added in the future. However, some reduction of the magnetic field will be achieved by utilizing structures that will increase the ground clearance by five additional feet.

C. RIGHT-OF-WAY STATUS

An approximate 50 foot section of the proposed Tap Line will occupy existing PPL Electric right-of-way. The balance of the Tap Line is located on the substation property, which is presently under a contract which provides PPL Electric with the option to purchase the property.

PROPOSED HIGH – LOW TAP

High Pole -- 120 Feet Tall

Low Pole – 80 Feet Tall

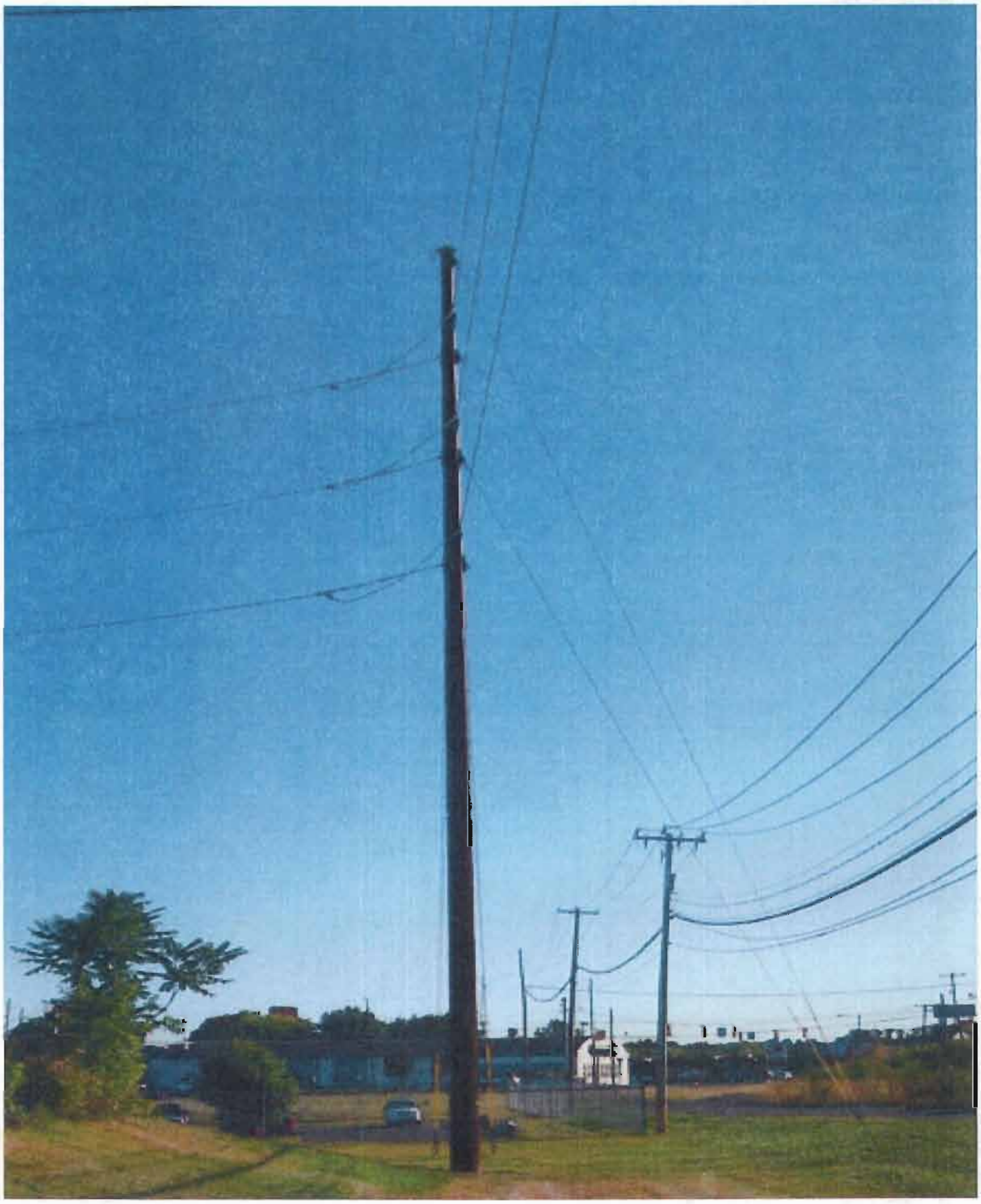
FIGURE 1

PROPOSED LOAD-SECTIONALIZING AIR BREAK SWITCHES
(LSAB)

Height – 85 Feet

FIGURE 2

PROPOSED GUYED ANGLE STRUCTURE



Pole Height – 60 feet (Average)

FIGURE 3

PROPERTY LABEL	Property Owner
1	ADELE M. STEWART
2	MILFORD ACQUISITIONS, INC.

LEGEND

- EXISTING TRANSMISSION LINE
- EXISTING RIGHT-OF-WAY
- EXISTING PROPERTY LINE
- PROPOSED PROPERTY LINE
- PROPOSED TRANSMISSION LINE

ATTACHMENT 2

AERIAL PLOT PLAN

TRUMBAUERSVILLE 138/69 kV TAP LINE
RICHLAND TWP., BUCKS COUNTY, PA.

SCALE: 1"=100'

PREPARED BY:
PPL ELECTRIC UTILITIES CORP.
PPL ELECTRIC UTILITIES

Attachment 3

ATTACHMENT 3

TRUMBAUERSVILLE #1 & #2 138/69 kV TAP LINE

ENVIRONMENTAL ASSESSMENT

TABLE OF CONTENTS

ATTACHMENT 3

TRUMBAUERSVILLE #1 & #2 138/69 kV TAP LINE

ENVIRONMENTAL ASSESSMENT

A. INTRODUCTION

PPL Electric is requesting PUC approval to site and construct a double circuit transmission tap line. The proposed tap line will be designed and constructed to support double circuit operation in the future. Initially, the new substation will be served by only one of the circuits. The second circuit will be constructed when increased demand for electricity makes it appropriate in order to maintain reliable service to customers. The proposed tap line will be approximately 275 feet long and will provide service to the proposed Trumbauersville 69 – 12 kV Substation.

The proposed project was reviewed with representatives of Richland Township and Bucks County, and neither the Township nor the County has any objection. A list of involved governmental agencies, municipalities, and other public entities is presented in Attachment 7.

B. LAND USE

The proposed substation and all but fifty feet of the proposed tap line will be located on approximately 2.05 acres of land presently under a contract which provides to PPL Electric the option to purchase the property. The property is situated along Yankee Road in a Rural/Agricultural Zoning District. The site of the proposed substation is located on a portion of the Tollgate Crossing subdivision. Visual impacts to existing and future homes in the area will be minimal because the site and the surrounding area are wooded.

No communication towers, pipelines, or other utilities will be affected by the proposed project. Two airports are located within four miles of the proposed project location. Quakertown Airport is approximately 2.15 miles to the northwest and Pennridge Airport is approximately 3.5 miles southeast 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 the proposed tap line will not be a hazard to the airports' flight operations.

C. CULTURAL RESOURCES

PPL Electric reviewed multiple potential locations with the Pennsylvania Historical and Museum Commission (PHMC) for this Project. For the selected site, PHMC determined that there is a high probability of significant archaeological sites in the area. PHMC required a Phase 1 archaeological survey of the site to locate any significant archaeological resources. PPL Electric contracted with Dr. Frank Vento, Professor of Geology at Clarion State University, to perform the Phase 1 survey. Dr. Vento did not find any artifacts in his Phase 1 Survey, and the appropriate documentation was submitted to PHMC. PPL Electric will comply with any further requests for investigations or surveys from the PHMC. Additionally, PHMC notes that no evaluation of historic structures will be necessary for this project.[3]

D. NATURAL FEATURES

The project will not affect any recreational areas or natural landmarks. The recreation area closest to the proposed project is Lake Nockamixon State Park located approximately 4.8 miles to the east of the Project area. The nearest natural area is Elmont Swamp, which is located approximately 2.8 miles south of the proposed site. Due to the small scale of the proposed tap line and the distance and terrain between these areas, no impacts are expected.

[3] File No. ER 2011-0287-017-B.

The project will not affect any unique geological, scenic or natural areas. The line will not cross any wetlands or other aquatic resources. PPL Electric will acquire all required environmental permits and adhere to all of their terms and conditions. Some minimal tree clearing may be required, and PPL Electric will apply its "Specification for Initial Clearing and Control of Vegetation On or Adjacent to Electric Line Right-of-Way Through Use of Herbicides, Mechanical and Hand Clearing Techniques" to mitigate any impacts. PPL Electric will employ its "Specification for Soil Erosion and Sedimentation Control on Transmission Line Rights-of-Way" as appropriate. PPL Electric will acquire any required soil erosion and sedimentation control permits, and PPL Electric will comply with any conditions placed on those permits.

E. THREATENED AND ENDANGERED SPECIES

PPL Electric has coordinated with the relevant state and federal agencies to obtain information regarding endangered and threatened species that could occur in the vicinity of the proposed project. All agencies report that, except for occasional transient species of wildlife, no threatened or endangered plant or animal life is found in the project area.[4]

[4] Pennsylvania Natural Diversity Inventory (PNDI) Search ID: 20110726308529.

Attachment 4

ATTACHMENT "4"

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 Corp. (PPL Electric) has developed design specifications and safety rules which meet or surpass all requirements 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 enhancements such 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

Surface Underneath Conductors	Vertical Clearance to Ground: NESC Standard	Vertical Clearance to Ground: PPL Electric Design
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

Surface Underneath Conductors	Vertical Clearance to Ground NESC Standard	Vertical Clearance to Ground PPL Electric Design
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

Surface Underneath Conductors	Vertical Clearance to Ground NESC Standard	Vertical Clearance to Ground PPL Electric Design
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. The program is administered through the use of helicopter patrols, with supplemental foot and structure climbing patrols. A number of 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:

Voltage-kV	Minimum Clearance
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.

Attachment
5

MAGNETIC FIELD MANAGEMENT

PPL Electric Utilities Corporation

DECEMBER 2004

TABLE OF CONTENTS

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

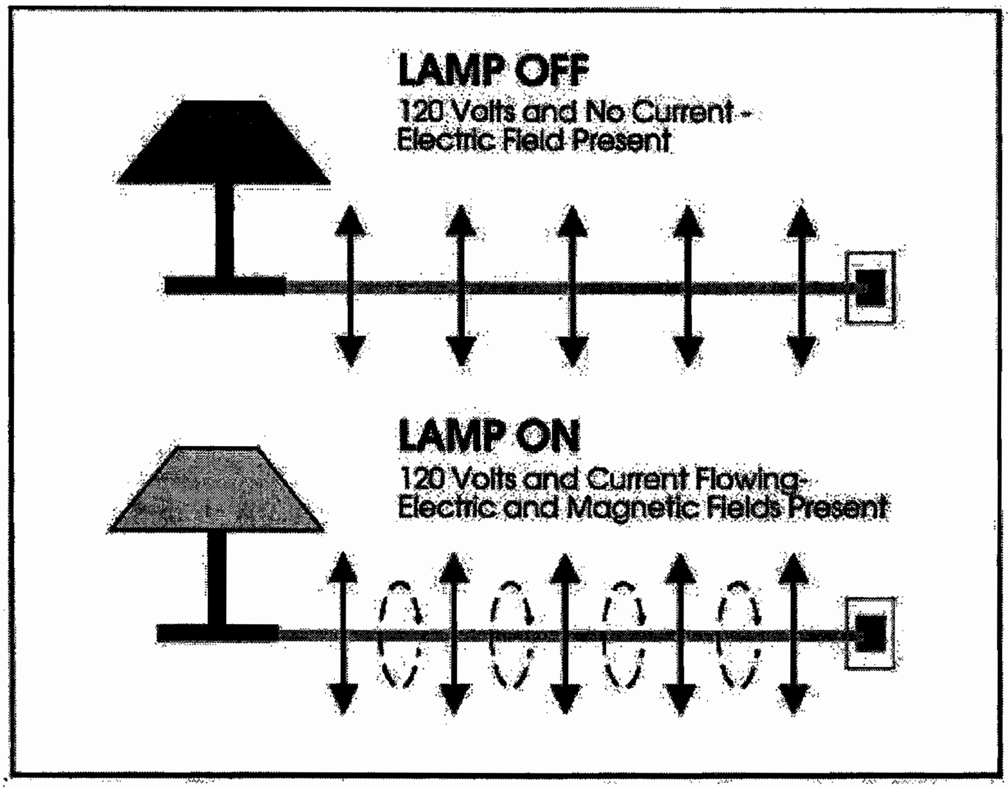

LAMP OFF
120 Volts and No Current -
Electric Field Present
LAMP ON
120 Volts and Current Flowing-
Electric and Magnetic Fields Present

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.

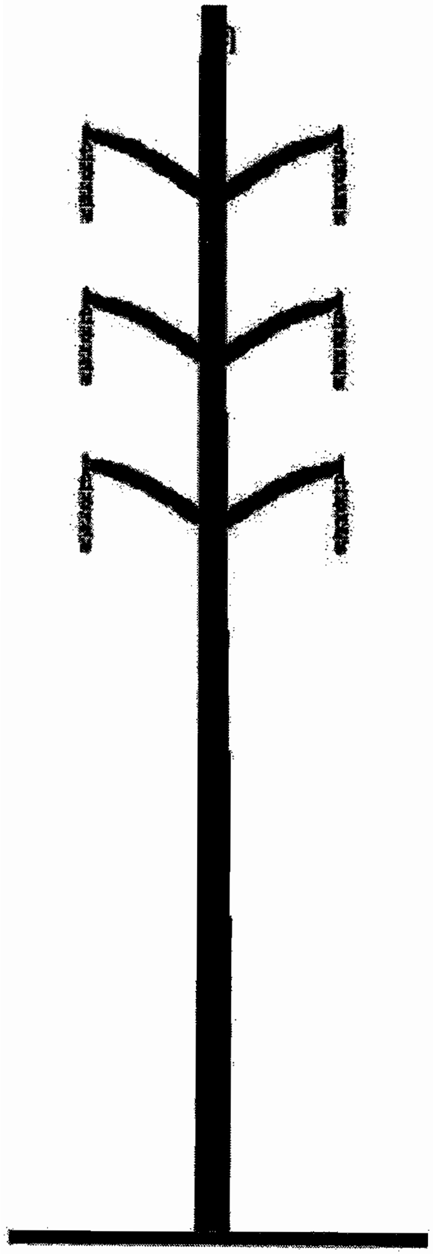
- Main lines are the most heavily loaded sections of a distribution line and therefore have the highest magnetic fields associated with them.
- Increasing the ground clearance by five feet reduces the magnetic field under the line from 14 mG to 11 mG using the standard eight-foot crossarm design. These 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.

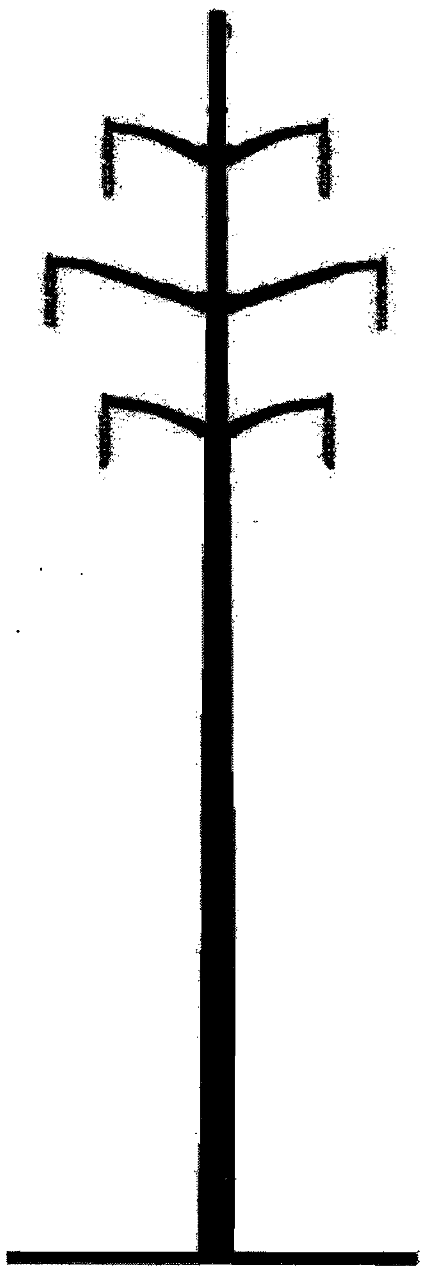
Short-Span Construction



- **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:**

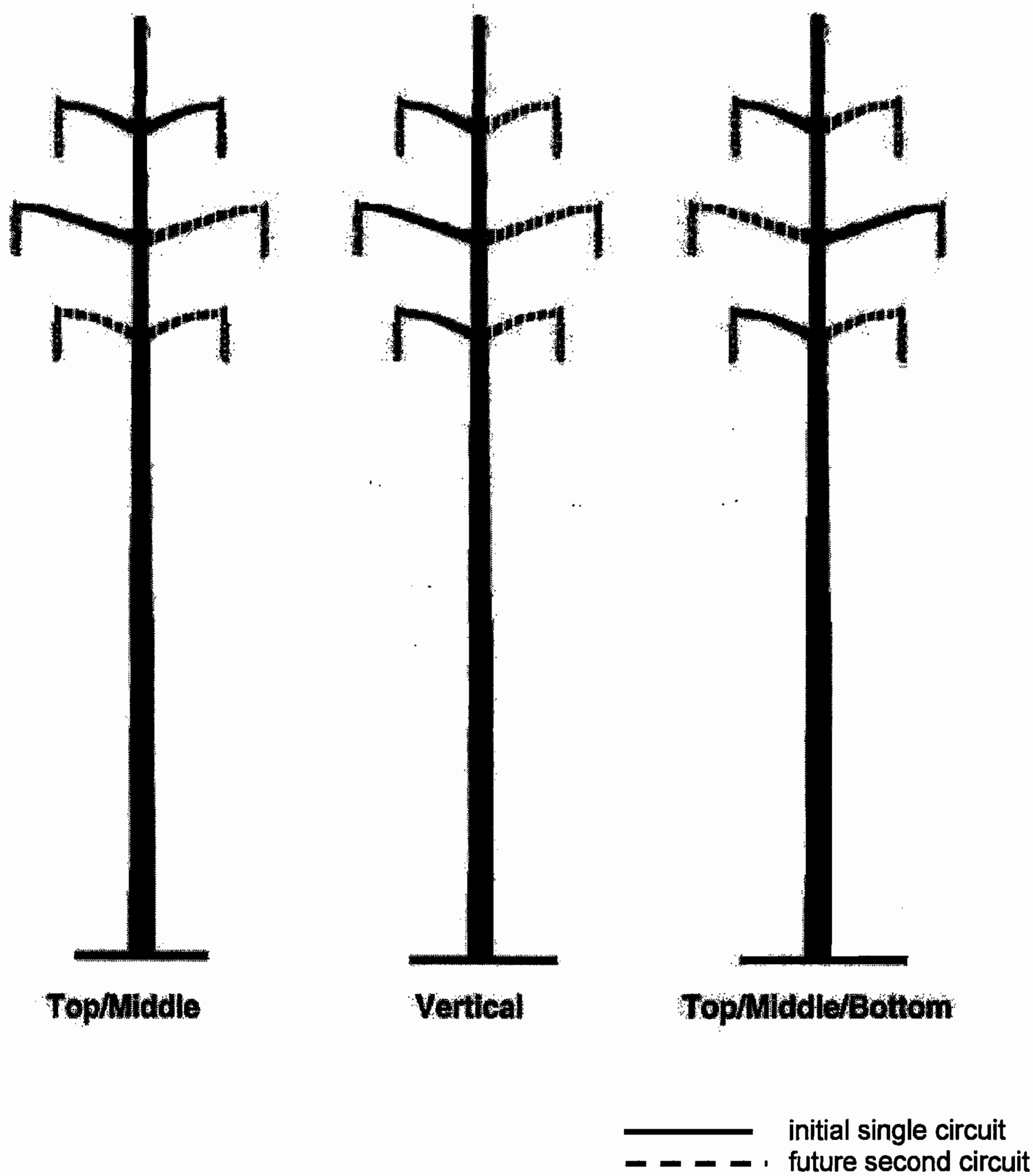
1 3/8" HS steel overhead ground wire - 17.3 feet sag
6-556.5 KCMIL 24/7 ACSR power conductors - (PARAKEET) 23.0 feet sag
Average span - 600 feet

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

TYPE CONSTRUCTION	MAGNETIC FIELD IN MILLLIGAUSS 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

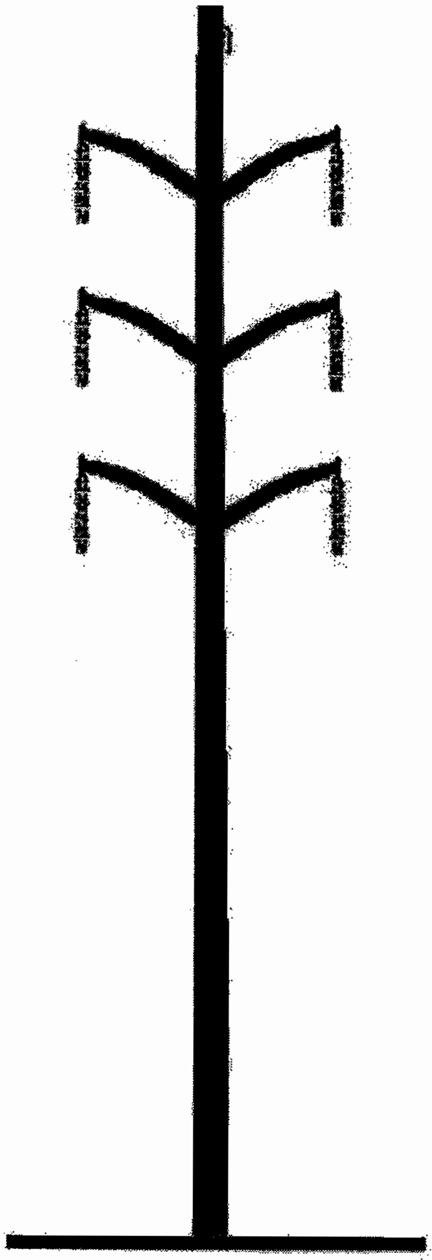


138/69 kV SINGLE CIRCUIT TRANSMISSION LINES
CALCULATED MAGNETIC FIELDS AT 400 AMPERES

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.

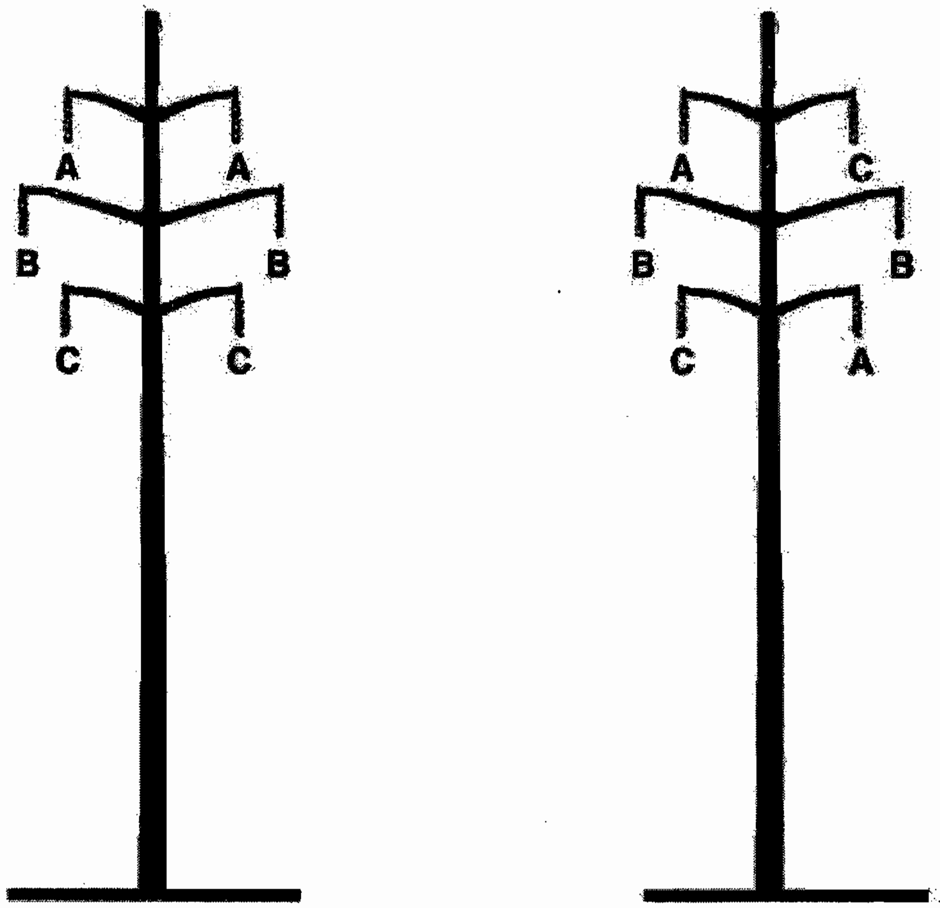
Compact Design Structure



- **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: ⟶ ⟶ ⟶ ⟶ 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

CHART VIII

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.

CHART IX

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.

Attachment 6

ATTACHMENT "6"

TRUMBAUERSVILLE #1 & #2 138/69 kV TAP LINE

LIST OF PROPERTY OWNERS WITHIN THE PROPOSED RIGHT-OF-WAY

Property Owner/Address	Parcel Number
Adele M. Stewart 117 Yankee Rd. Quakertown, PA 18951 Attn: Shawn Ventrola	1
Milford Acquisitions, Inc[1] 1590 Canary Rd. Quakertown, PA 18951	2

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[1] This property is under a contract which provides PPL Electric the option to purchase.

Attachment
7

ATTACHMENT "7"

TRUMBAUERSVILLE #1 & #2 138/69 kV TAP LINE

LIST OF INVOLVED GOVERNMENTAL AGENCIES, MUNICIPALITIES AND OTHER PUBLIC ENTITIES RECEIVING APPLICATIONS

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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. Bucks County Commissioners
   55 East Court Street
   Doylestown, PA 18901
   Attn: The Honorable Charles Martin, Chairman

5. Bucks County Planning Commission
   The Almshouse Neshaminy Manor Center
   1260 Almshouse Road
   Doylestown, PA 18901
   Attn: Ms. Lynn T. Bush, Executive Director

6. Richland Township
   1328 California Road
   Quakertown, PA 18951
   Attn: Mr. Stephen Sechriest, Manager

7. Richland Township Planning Commission
   1328 California Road
   Quakertown, PA 18951
   Attn: Mr. Timothy Ritter, Chairman