

Before the  
Pennsylvania Public Utility Commission

**RED FRONT 115 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) regulations at 52 Pa. Code §§ 57.71 through 57.77 for PUC approval to site and construct the Red Front 115 kV Transmission Tap Line. The proposed project is located in Lower Windsor Township, York County.

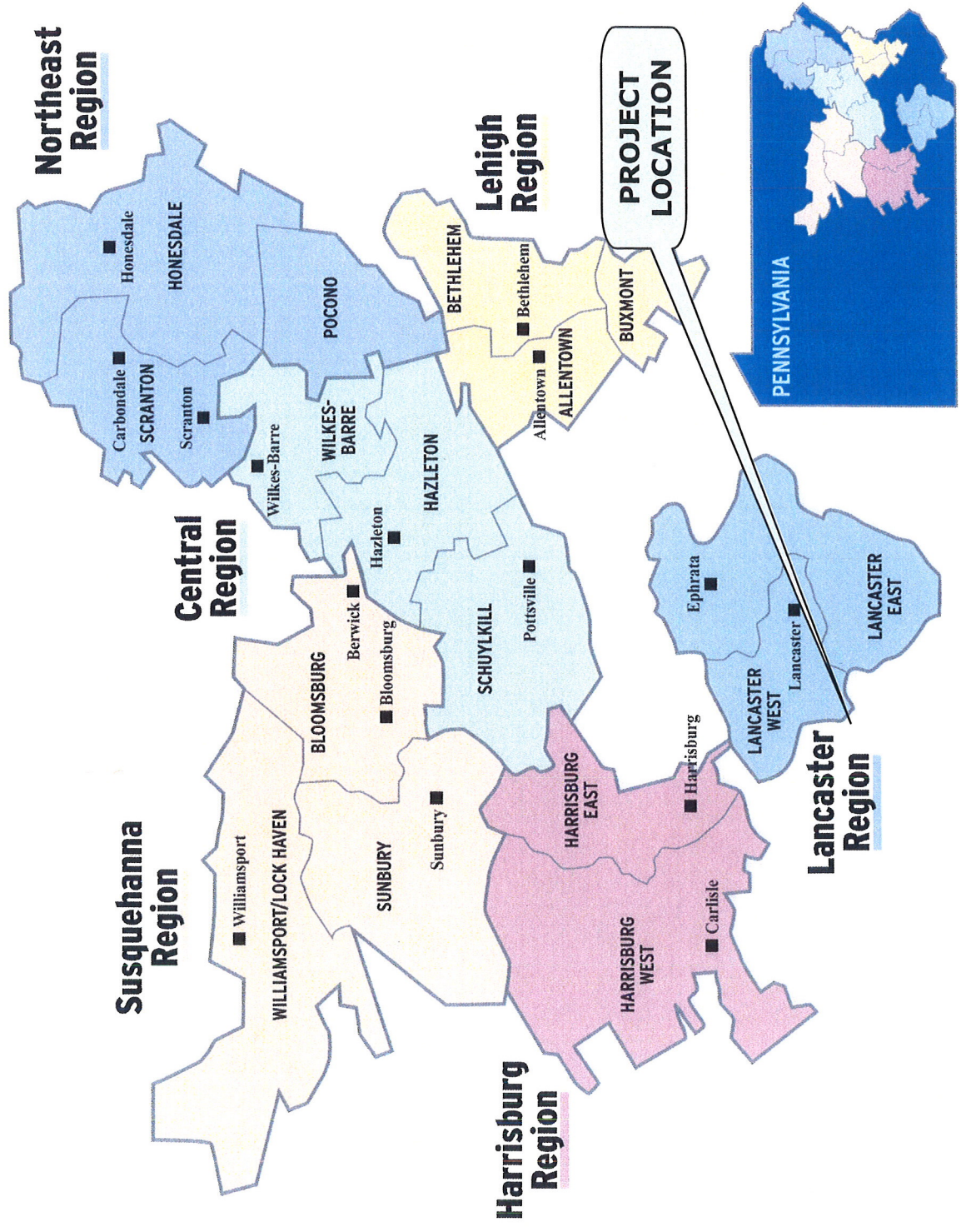
The proposed tap line will provide the source of electrical supply to the new Red Front 115 - 12 kV Substation. The substation and associated 12 kV distribution facilities are required to meet the increasing demand for electricity and improve the reliability of service in central eastern York County.

The estimated cost to design and construct the proposed 115 kV tap line is \$157,000. The project has a scheduled construction start date of June 2010 in order to meet an in-service date of May 2011.

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**  
**RED FRONT 115 kV TAP LINE**  
**NECESSITY STATEMENT**

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**ATTACHMENT 1**  
**RED FRONT 115 kV TAP LINE**  
**NECESSITY STATEMENT**

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**A. INTRODUCTION**

With Pennsylvania Utility Commission approval, PPL Electric plans to install a single circuit 115 kV transmission tap line to supply a new distribution substation to serve PPL Electric's 12 kV connected customers in central eastern York County. The proposed Red Front 115 kV Tap Line will extend approximately 160 feet from Metropolitan Edison's Yorkana – Yoe (988 Line) 115 kV Transmission Line to the new Red Front 115 – 12 kV Substation. The proposed Red Front 115 kV Tap and new Red Front 115 – 12 kV Substation are required to improve customer reliability and meet the increasing demand for electricity in central eastern York County. The Yorkana – Yoe (988 Line) 115 kV Transmission Line is owned and operated by Metropolitan Edison Company (Met Ed), a First Energy Corp. subsidiary and the proposed Red Front 115 kV Tap Line will be owned and operated by PPL Electric Utilities.

The total estimated cost to design and construct the proposed project is \$4.42 million, which includes the estimated \$157,000 cost of the proposed Red Front 115 kV Tap Line. Project construction is scheduled to begin in June 2010 to support the project's required in-service date of May 2011. 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.

A PPL Electric system map showing existing transmission facilities with a design voltage of 35 kV or greater is included in the Attachment 1 map pocket. This filing addresses only the existing and proposed 115 kV regional transmission system in the central eastern York County area.

**B. EXISTING SYSTEM**

The Met Ed-owned Yorkana – Yoe 988 and 989 115 kV Transmission Lines are operated as double circuit facilities and cross the property to be acquired by PPL Electric for the proposed Red Front 115 – 12 kV Substation. These lines occupy right-of-way adjacent to and parallel to the Yorkana – Jackson and Otter Creek - Yorkana 230 kV Transmission Lines and the TMI – Peach Bottom 500 kV Transmission Line. The existing transmission arrangement is shown in Figure 1. These Transmission Lines, specifically the double circuit Yorkana – Yoe 115 kV Transmission Lines, would be a nearby source for any planned new distribution facilities in the Yorkana area.

Presently, PPL Electric serves the 12 kV connected customers located in central eastern York County on the west side of the Susquehanna river from the North Columbia 69 – 12 kV Substation. The North Columbia Substation is located in Lancaster County on the east side of the Susquehanna River. Four 12 kV lines extend from the North Columbia Substation and attach to the Wright’s Ferry Bridge, also known as the Route 30 Bridge. Two of the four lines are dedicated to a large manufacturing customer located in Wrightsville Borough. The other two lines, the 06-03 and the 06-05 lines serve the remainder of customer load in the area (approximately 3,350 customers) and are the only PPL Electric distribution facilities available in the area. The existing distribution arrangement is shown in Figure 2.

**C. DEFINITION OF THE PROBLEM**

PPL Electric’s franchised service territory includes a 13 square mile area located in central eastern York County on the west bank of the Susquehanna River. This territory is isolated from the rest of PPL Electric’s service territory by the Susquehanna River and is further bounded on the south and west by Met Ed’s service territory. As discussed above, the only PPL Electric distribution source

for this area is from PPL Electric's North Columbia 69 – 12 kV Substation, which is located on the east side of the Susquehanna River. This arrangement results in the following problems:

- Long-duration outages on the radial North Columbia 06-03 12 kV circuit. There is no alternate 12 kV source on the west bank of the Susquehanna River near the end of the radial 06-03 line. Furthermore, during periods of peak demand, the 06-05 line cannot be used as an alternate source for the 06-03 line because, the combined load of both lines exceeds the capacity of either line. Therefore, typical line outages interrupt hundreds of customers and extend for many hours due to the radial nature of this line. The new Red Front 12 kV line will provide a tie to the radial North Columbia 06-03 line and allow for customers to be transferred away from the North Columbia 06-03 in case of emergency outages.
- Power quality concerns including low voltage on the 06-03 12 kV line due to both its length (54 miles of OH conductor) and projected amount of load. The North Columbia 06-03 12 kV has been one of the worst performing circuits during the last 5 years. Momentary interruptions have been concerns for PPL Electric customers in the Lower Windsor Township area who are served from this long radial line.
- Projected overloads of the 06-03 line in 2012. The peak load on the North Columbia 06-03 12kV line is projected to exceed the normal planning guideline of the conductor in 2012. With the line being radial, it is not possible to transfer load away from this line to other 12 kV circuits to resolve the overload. The new distribution line from the proposed Red Front Substation will provide additional capacity to supply anticipated load growth from new and existing customers.

- In the unlikely event of a catastrophic bridge failure, all PPL Electric customers on the west side of the Susquehanna River will be out of service until repairs are made. Depending on the nature of the failure, this could be an extended period of time.

#### **D. PROPOSED SOLUTION**

In order to resolve the projected overload, voltage, and reliability issues cited above, PPL Electric plans to construct the new Red Front 115 – 12 kV Substation on the west side of the Susquehanna River, together with new 12 kV distribution facilities to supply the PPL Electric customer load in central eastern York County. The new substation will need to be supplied from an available transmission source in the area.

The proposed substation site is south of Med Ed's Yorkana 230-115 kV Substation and adjacent to an existing transmission corridor containing the Yorkana – Yoe (988 Line and 989 Line) 115 kV Transmission Lines, and other transmission facilities. PPL Electric requested and received a load interconnection study from First Energy to supply a PPL Electric-owned distribution substation tapped from one of the Met Ed-owned 115 kV lines. Based upon the information in First Energy's load interconnection study and PPL Electric's internal cost analysis, the least cost alternative to reliably supply the PPL Electric customers from the proposed Red Front 115 – 12 kV Substation was to tap the Yorkana – Yoe (988 Line) 115 kV Transmission Line. The proposed transmission arrangement is shown in Figure 3.

PPL Electric plans to install a new 12 kV distribution line out of the new Red Front Substation to serve customer load in PPL Electric's service territory on the west side of the Susquehanna River. This new Red Front distribution circuit will have the ability to tie to the North Columbia 06-03 distribution line. It will significantly improve restoration times in the event of an emergency outage by

providing an alternate source for the North Columbia 06-03 line. The new 12 kV line will also alleviate the projected overload of the North Columbia 06-03 line by transferring approximately half of its load to the new line. The proposed system reinforcements will increase service reliability to the 3,350 distribution customers connected to these lines and alleviate the projected future overload. The proposed distribution arrangement is shown in Figure 4.

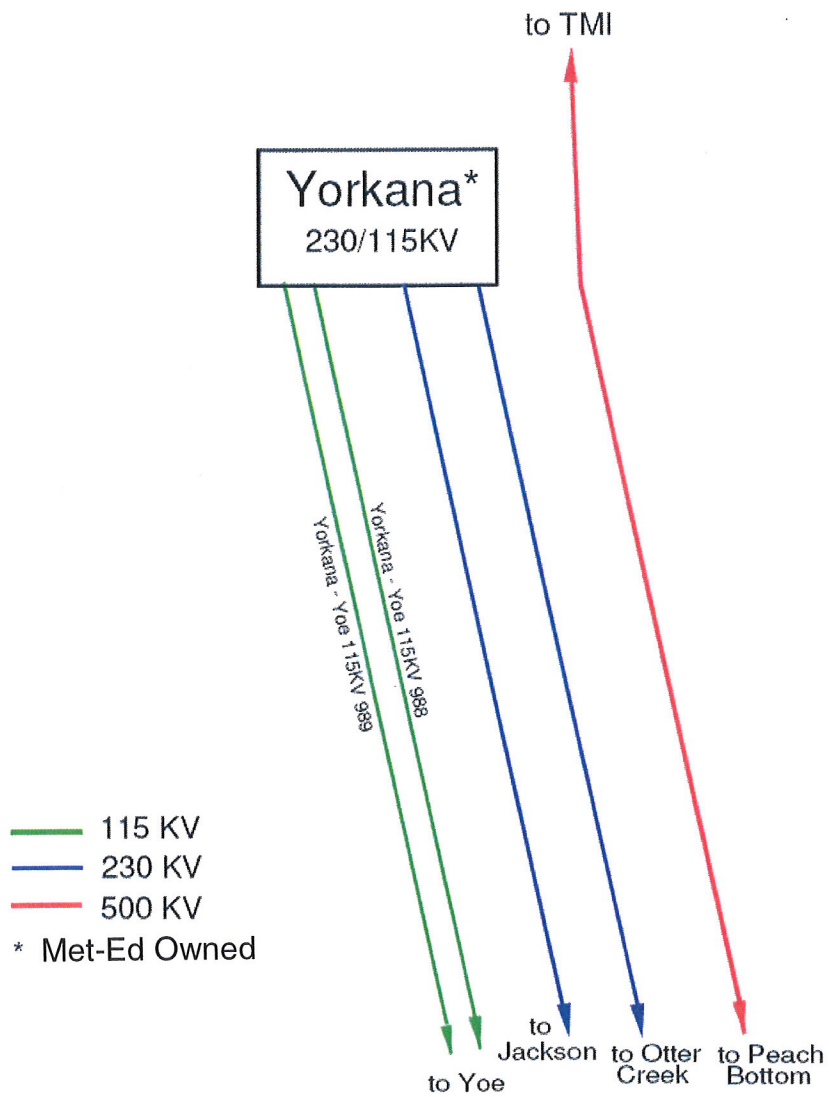
## **E. FUNCTIONAL ALTERNATIVES**

In addition to the preferred alternative above, PPL Electric also considered the following functional alternatives to resolve the thermal loading, voltage, and reliability concerns:

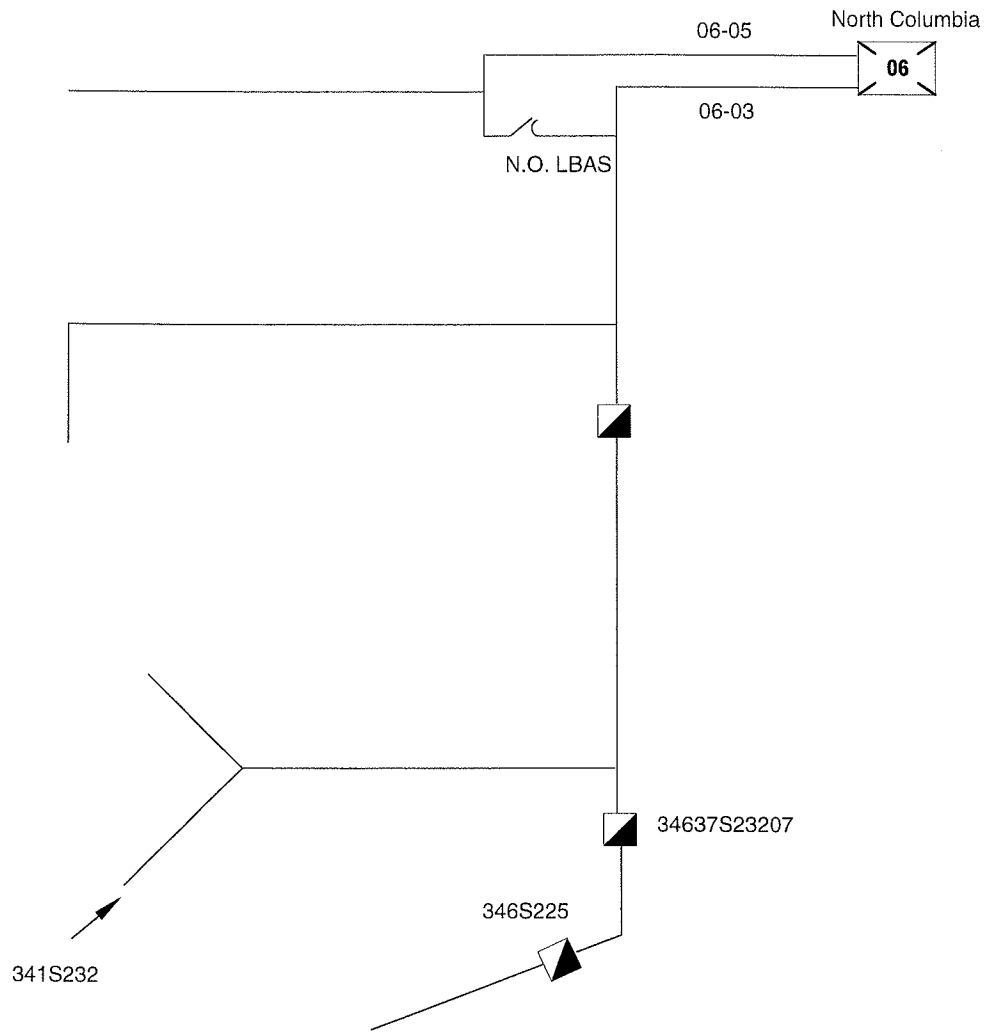
- PPL Electric requested and received a load interconnection study from First Energy to supply the proposed Red Front 115-12kV substation tapped from both the Yorkana – Yoe (988 Line) 115 kV Transmission Line and the Yorkana – Yoe (989 Line) 115 kV Transmission Line. The interconnection tapping of the Yorkana – Yoe (989 Line) 115 kV Transmission Line, rather than the Yorkana - Yoe (988 Line) 115 kV Transmission Line, was determined to be a feasible alternative. However based upon the work scope and cost estimate provided by Met Ed, this alternative would require extensive reconductoring work of Met Ed’s Jackson – Bair 115 kV line. Based on Met Ed’s cost estimate, this alternative would cost approximately \$1,075,000 more than the preferred alternative due to the required reconductoring work.
- PPL Electric considered other transmission alternatives such as tapping the West Hempfield – Manor #2 230 kV Line and the West Hempfield – Manor #1 69 kV line. These potential transmission supply circuits are located on the East side of the Susquehanna River and the proposed Red Front 115-12 kV substation is located on the West side of the

Susquehanna River. Consequently, in order to accommodate this alternative, facilities would be required to cross the Susquehanna River, which is approximately one (1) mile wide at this location. Both of these alternatives would be more costly than the preferred alternative and, further, PPL Electric would not meet the in-service date due to permitting and environmental concerns.

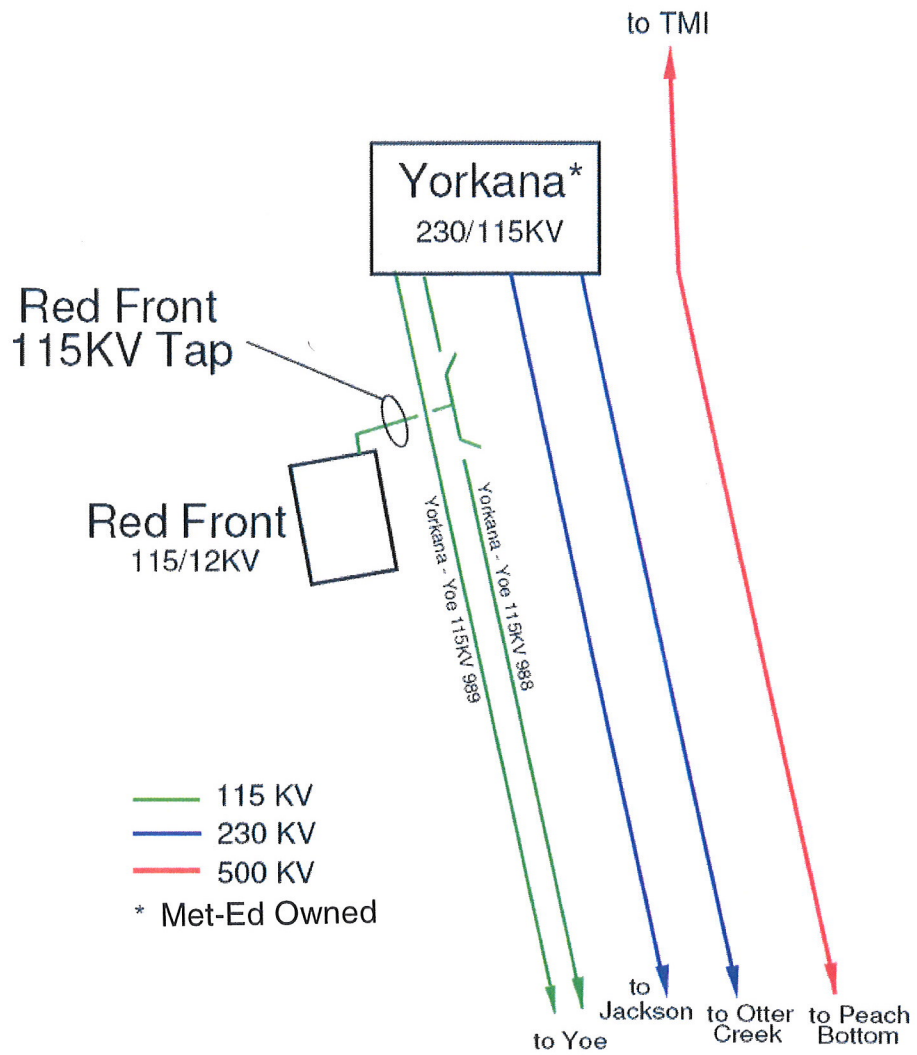
While other functional alternatives were reviewed, the technical and environmental risks along with the associated costs to implement them were significantly higher than the proposals discussed above. As such, these projects were rejected as not reasonable alternatives and removed from consideration. No other reasonably economical functional alternatives were identified that would completely resolve the problems outlined above.



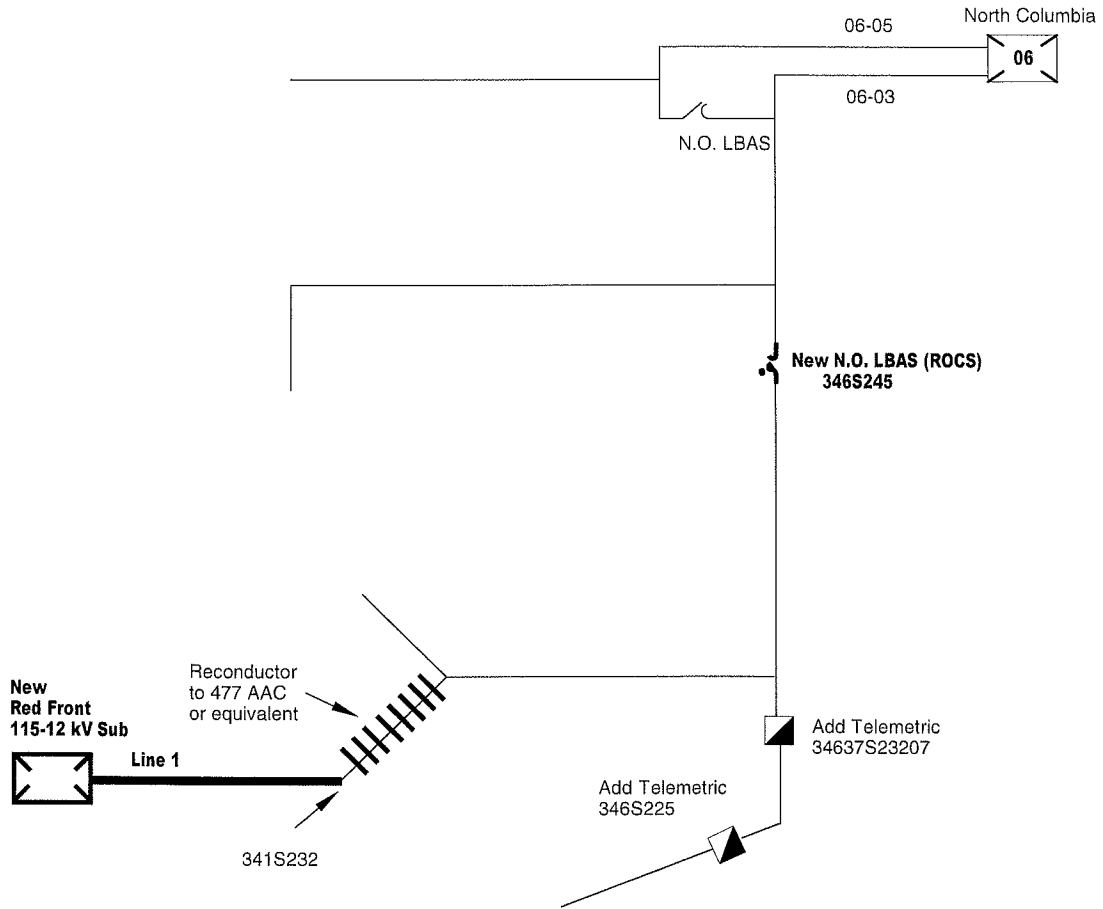
**Figure 1: Existing Transmission Arrangement**



**Figure 2: Existing Distribution Arrangement**



**Figure 3: Proposed Transmission Arrangement**

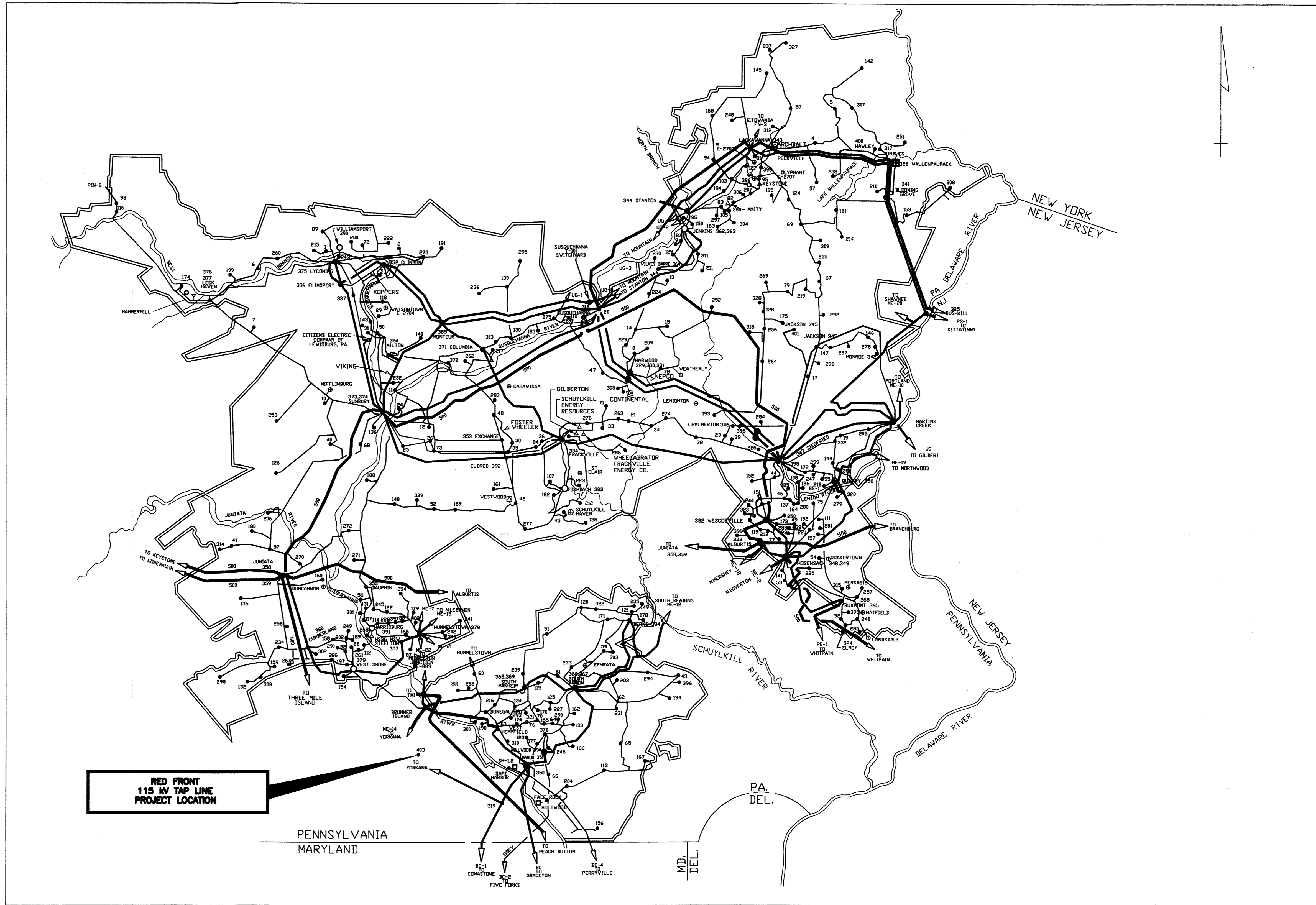


**Figure 4: Proposed Distribution Arrangement**

# SUBSTATION LISTING

1	WEST WILLIAMSPORT	151	CRACKERSPORT	301	CENTER CITY
2	FAIRFIELD	152	SCHNECKSVILLE	302	NEW KINGSTOWN
3	MONTGOMERY	153	HEMLOCK	303	REAMSTOWN
4	YARDEN	154	MT. ALLEN	304	DUPONT
5	HONESDALE	155	PRINCE	305	HUMBOLDT
6	JERSEY SHORE	156	WAKEFIELD	306	CEDAR AVE
7	LOGANTON	157	COOPERSBURG	307	INDIAN OREGARD
8	VALMONT	158	VERTZVILLE	308	NOTTINGHAM
9	RIVER	159	WEST CARLISLE	309	NORTH COOLBAUGH
10	LIMESTONE	160	BENVENUE	310	LETOUR
11	NORTH HUMBURLAND	161	HEGINS	311	EAST MOUNTAIN
12	REED	162	LEOLA	312	JERMYN
13	WRIGHT	163	YATESVILLE	313	BLOOMSBURG
14	ST. JOHNS	164	CENTRAL ALLENTOWN	314	HIFLINTOWN
15	FREELAND	165	DBERLIN	315	RIDGE ROAD
16	GILBERT	166	STRASBURG	316	SUSQUEHANNA
17	CHERRY HILL	167	ATGLEN	317	T-10 SW. YD.
18	SUSQUEHANNA 230KV	168	BROOKSIDE	318	KIMBLES
19	TAMANEND	169	WILLIAMSTOWN	319	CHRISTMAS
20	WHITE HILL	170	E. PETERSBURG	320	OTTIER CREEK
21	PALMERTON	171	VERMERSVILLE	321	STEEL CITY
22	HAMILTON	172	N. BETHLEHEM	322	MCGOVERNVILLE
23	HUNTER	173	V. ALLENTOWN	323	ROBESONIA
24	FAIRVIEW	174	FLEMINGTON	324	S.FOGELSVILLE
25	MONTOUR PUMP	175	NECKSVILLE	325	ELROY
26	MT. CARMEL	176	DONERVILLE	326	BUSHKILL
27	KELLY	177	MILLERSVILLE	327	WALLENPAUPACK
28	SPORTING HILL	178	SHILLINGTON	328	ELK MOUNTAIN
29	MAHANDY CITY	179	DUKE	329	JACK FROST
30	GREENWOOD	180	MCALLISTERVILLE	330	HARWOOD 230/69KV
31	MORVAV	181	NEWFUNDLAND	331	HARWOOD CTG
32	ALTAQUANT	182	MARLIN	332	HARWOOD 69/12KV
33	HAMLIN	183	WEST BERWICK	333	NAZARETH
34	ASHFIELD	184	KEYSER AVENUE	334	ALBURTIS
35	SOUTH SLATINGTON	185	MICKLEYS	335	FRACKVILLE
36	SOUTH MIDDLEBURG	186	EAST ALLENTOWN	336	ELIMSPORT
37	WALKER	187	PINE RIDGE	337	ALLENWOOD
38	FRAILY	188	DALMATIA	338	GRATZ
39	MORGANTOWN	189	PENNSBURG	339	HOCKERSVILLE
40	EGYPT	190	ROSSMOYNE	340	BLOOMING GROVE
41	CRESSONA	191	NORTHAMPTON	341	MONROE
42	SOUTH WHITEHALL	192	WOLRICH	342	LACKAWANNA ##
43	WICKEN	193	FAXTON	343	STANTON
44	BEAR GAP	194	ELIZABETHTOWN	344	JACKSON
45	SALISBURY	195	ENOLA	345	EAST PALMERTON
46	SOUTH MILTON	196	TERRE HILL	346	SIEGFRIED
47	EDDELBERG	197	BUCK	347	HOSENSACK 230/69KV
48	LYKENS	198	MT. BETHEL	348	HOSENSACK 500KV
49	UPPER HANDOVER	199	RICHFIELD	349	CONESTOGA
50	MACADA	200	SCRANTON	350	MANOR
51	ROCKVILLE	201	TWIN LAKES	351	CLINTON
52	THOMPSONTOWN	202	HARLEIGH	352	EXCHANGE
53	PAXTON	203	MILTON	353	HILTON
54	COCALICO	204	BEAR CREEK	354	DAUPHIN
55	EAST ELIZABETHTOWN	205	DRWIGSBURG	355	QUARRY SUB.
56	WARWICK	206	EAST TEXAS	356	STEELTON
57	EARL	207	CANDANIS	357	JUNIATA 500/230KV
58	HEMPFIELD	208	LINDEN	358	JUNIATA 230/69KV
59	EAST LANCASTER	209	MT. JOY	359	LUMBERLAND
60	KINZER	210	BUKTS BLOOMSBURG	360	DONEGAL
61	MT. NEBO	211	MINI TRAIL	361	JENKINS 230/69KV
62	MEANS	212	LAKE NAOMI	362	JENKINS CTG
63	POCONO	213	LANARK	363	WILKES-BARRE
64	GOULDSBORO	214	MONTOURSVILLE	364	BUMONT
65	DILLERVILLE	215	PORT CARBON	365	SOUTH AKRON 230/138/69KV
66	GIRARD MANOR	216	WYTHESBURG	366	SOUTH AKRON 69/12KV
67	KENMAR	217	MILFORD	367	SOUTH AKRON 69/12KV
68	GOVEN CITY	218	TREICHLERS	368	SOUTH MANHEIM 69/12KV
69	LLLIOT HEIGHTS	219	ROSEVILLE	369	SOUTH MANHEIM 230/69KV
70	RDHREESTOWN	220	EAST RUTHERFORD	370	ENGLISIDE
71	MACUNGIE	221	HARTLAND	371	COLUMBIA
72	EAST HAZLETON	222	PARRISH	372	DANVILLE
73	WAGNERS	223	POINT NEW HOLLAND	373	SUNBURY
74	EAST CARBONDALE	224	POINT	374	HUMMELS WHARF
75	EYNDON	225	LINCOLN	375	LYCOMING
76	MINDOKA	226	MIDDLETON	376	LOCK HAVEN CTG
77	OLD FORGE	227	STATE HILL	377	LOCK HAVEN 69/12KV
78	FDUNTAIN SPRINGS	228	MILLVILLE	378	HUMELSTOWN
79	SULLIVAN TRAIL	229	TINKER	379	WEST SHORE
80	SWATARA	230	LAKEVILLE	380	MONTAGE
81	HEPBURN	231	NORTH MANHEIM	381	SOUTH FARMERSVILLE
82	CHAPMAN	232	HATFIELD	382	VECOSVILLE
83	SUBURBAN	233	HERSHEY	383	FISHBACH
84	BOHEMIA	234	S. HERSHEY	384	BERKS
85	PROVIDENCE	235	S. WILLIAMSPORT	385	MONTOUR
86	AVOCA	236	FOGELSVILLE	386	SUBURBAN YARD
87	CASS	237	WINDSOR	387	EDDELA
88	CATASAUQUA	238	V. WILLOW	388	SLUMBERDALE
89	SUSQUEHANNA 500KV	239	WESTGATE	389	DORNEYVILLE
90	SEIDERSVILLE	240	EDDELA	390	WHITE HAVEN
91	ROSEMONT	241	EDDELA	391	LAURELTON
92	QUARRYVILLE	242	EDDELA	392	LINGLESTOWN
93	LAWNTON	243	EDDELA	393	POCONO FARMS
94	LITITZ	244	EDDELA	394	HICKORY RUN
95	RENOVO	245	EDDELA	395	BLOOMING GLEN
96	WALNUT	246	EDDELA	396	SHERMANSDALE
97	WATSON	247	EDDELA	397	LARRYS CREEK
98	TRUXELTOWN	248	EDDELA	398	SPANGLER MILLS
99	LAVINE	249	EDDELA	399	ST. DANVILLE
100	SPRING	250	EDDELA	400	DELANO
101	COLONIAL PARK	251	EDDELA	401	CARBON
102	WEST LANCASTER	252	EDDELA	402	SELLERSVILLE
103	MADISONVILLE	253	EDDELA	403	MECHANISBURG
104	NEFFSVILLE	254	EDDELA	404	CEDAR
105	BEAVER TOWN	255	EDDELA	405	ARROWHEAD
106	BELMONT	256	EDDELA	406	NEWPORT
107	LAKE HARMONY	257	EDDELA	407	HALIFAX
108	GEORGETOWN	258	EDDELA	408	MILLERSBURG
109	SCOTT	259	EDDELA	409	MUNY
110	N. HARRISBURG	260	EDDELA	410	HAUTO
111	MOUNT ROCK	261	EDDELA	411	BERWICK
112	GREENLAND	262	EDDELA	412	SHENANDOAH
113	LANDISVILLE	263	EDDELA	413	PINE GROVE
114	GREEN PARK	264	EDDELA	414	STROUDSBURG
115	SELINSGRÖVE	265	EDDELA	415	FREMANSBURG
116	SUNNER	266	EDDELA	416	ALLENTOWN
117	AUBURN	267	EDDELA	417	BINGEN
118	ROHRSBURG	268	EDDELA	418	RHEIMS
119	DERY	269	EDDELA	419	CLEVELAND
120	EAST GREENVILLE	270	EDDELA	420	LITTLE GAP
121	WEST DAMASCUS	271	EDDELA	421	DRVILLA
122	NEW COLONIA	272	EDDELA	422	TUSCARORA
123	FARMERSVILLE	273	EDDELA	423	BARTONSVILLE
124	GREENFIELD	274	EDDELA	424	ALTON PARK
125	NORTH STROUDSBURG	275	EDDELA	425	SALEN
126	ANNERSVILLE	276	EDDELA	426	NORTH BRIDGEPORT
127	ELIZABETHVILLE	277	EDDELA	427	CAMELBACK
128	VYOMISSING	278	EDDELA	428	PHILADELPHIA SPRING
129	EXETER	279	EDDELA	429	BRECKENCK
130		280	EDDELA	430	BENTON
131		281	EDDELA	431	MCMICHAELS
132		282	EDDELA	432	HUGHESTOWN
133		283	EDDELA	433	NEWVILLE
134		284	EDDELA	434	POINTE NORTH
135		285	EDDELA	435	MARIETTA

\* - 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  
 JN 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 (thick solid line)  
 230KV OPERATION (medium solid line)  
 138KV OPERATION (thin solid line)  
 69KV OPERATION (dashed line)

ACCT - 805201	ELECTRICAL SYSTEM MAP	
SCALE - NONE	RED FRONT 115 KV TAP LINE	
BY - CDW	APPROVED	DATE
	G. HAKUN III	7/17/85
	PPL ELECTRIC UTILITIES	
PPL DRAWING NO.	SHEET NO.	REV.
D191830	1	64

64	1/17/85	38933	ADDED RED FRONT 115 KV TAP LINE.	RRC	JW
63	1/03/85	169983	ADDED COPPERSTONE-HARRISBURG #1 & #2 138/69KV LINES.	RRC	DH
62	1/02/85	163021	ADDED EFFORT MOUNTAIN #1 & #2 138 KV TAPS.	RRC	DH
61	1/01/85	161640	JACKSON SUBSTATION 138 KV CONNECTING LINES	RRC	JW

PPL CO FORM 4877 (7/83)

PPL ELECTRIC UTILITIES

# **Attachment 2**

**ATTACHMENT 2**  
**RED FRONT 115 kV TAP LINE**  
**ENGINEERING DESCRIPTION**

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**MAP**

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**ATTACHMENT 2**  
**RED FRONT 115 kV TAP LINE**  
**ENGINEERING DESCRIPTION**

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**A. DESCRIPTION OF PROPOSED LINE**

PPL Electric proposes to design and construct a single-circuit 115 kV transmission tap line from First Energy's Yorkana – Yoe 115 kV Transmission Line (988) to the proposed Red Front 115 – 12 kV Substation. The proposed tap line will be located in Lower Windsor Township, York County. Refer to the plot plan at the end of Attachment 2 which depicts the location of these facilities.

The proposed tap line will be approximately 160 feet long. One wood pole, approximately 80 feet in height, will be installed and secured with anchor guys. The proposed tap line will consist of three power conductors (single-circuit operation) and one overhead ground wire. The power conductors will be 556.5 KCMIL 26/7 strand ACSR. The 3/8-inch steel overhead ground wire will provide lightning protection for the proposed tap line.

This new 115 kV line will be designed according to, and will generally surpass, National Electrical Safety Code standards. Additional design criteria 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:

**TABLE 1**  
**DESIGN MINIMUM CONDUCTOR CLEARANCES**  
**FOR 556.5 KCMIL 26/7 STRANDING ACSR\***

<u>Condition</u>	<u>Double-Circuit Design Clearance-to-Ground</u>
Normal load, average weather (16°C ambient temperature)	31.0 Feet
Predicted extreme thermal load (125°C conductor temperature)	30.0 Feet
Predicted NESC extreme wind load (16°C ambient temperature)	31.0 Feet
Predicted extreme weather conditions (1-inch ice, 4 lbs. wind, -18°C)	31.0 Feet

\*Clearances based on a maximum tension of 2,500 lbs. at 1 inch ice, 4 lbs. wind, -18°C and a ruling span of 100 feet.

**TABLE 2**  
**CONDUCTOR THERMAL RATING**  
**556.5 KCMIL 26/7 STRANDING ACSR**  
**(257°F) 125°C MAXIMUM CONDUCTOR TEMPERATURE**

<u>Condition</u>	<u>Ambient Temperature °C</u>	<u>Wind Speed Knots</u>	<u>Ampacity Amps</u>
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 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 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.

PPL Electric's Magnetic Field Management Plan cannot be employed on this project because the line is only being constructed for single circuit operation and reverse phasing is not possible. However, some reduction in the magnetic field will be achieved through the use of a taller pole.

C. **RIGHT-OF-WAY STATUS**

The proposed tap line will be contained entirely on the substation property due to its short length. However, PPL Electric has not been successful in acquiring the substation property through negotiations with the property owners. Therefore, PPL Electric will file with the Commission an Application for a finding and determination, pursuant to 15 Pa. C.S. § 1511(c), that the service to be furnished through PPL Electric's proposed exercise of the power of eminent domain to acquire a appropriate property for the Red Front 115 kV Tap Line and Red Front 115-12 kV Substation is necessary or proper for the service, accommodation, convenience, or safety of the public.

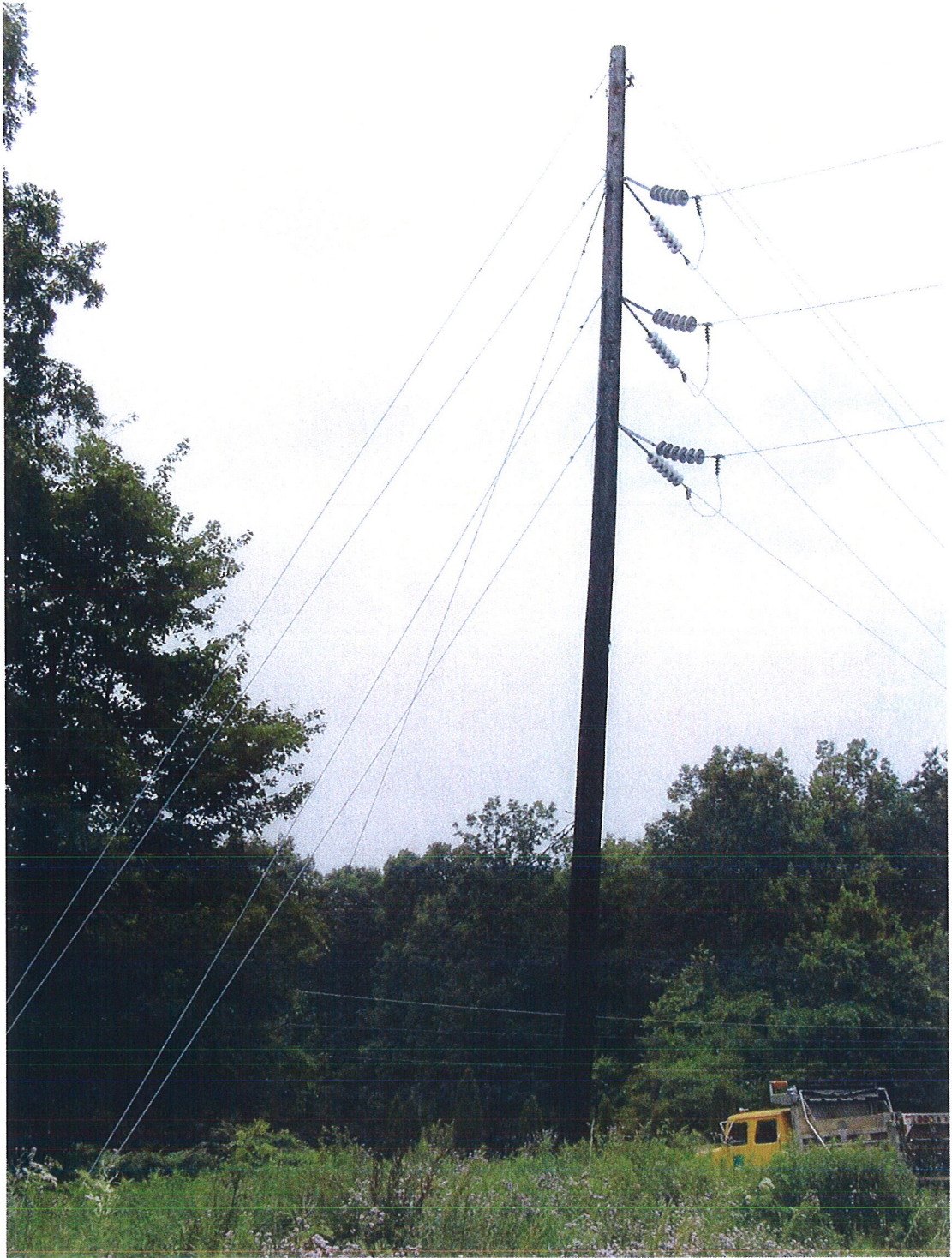
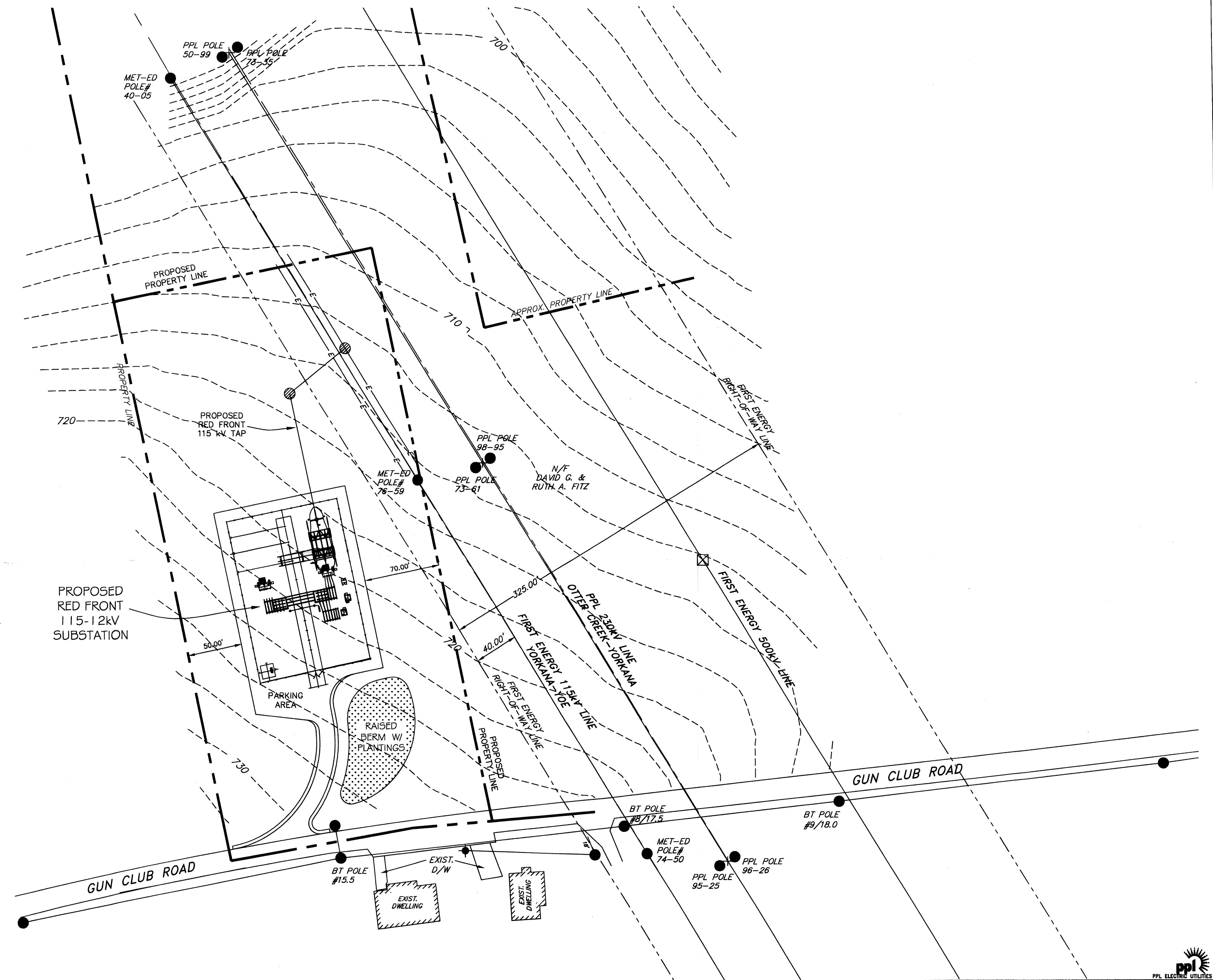
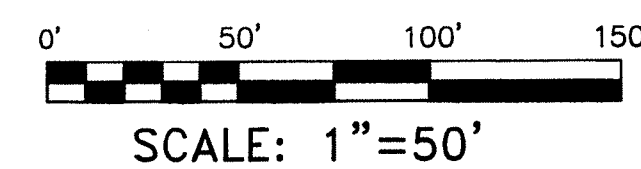


Figure 1 – Proposed 115 kV Angle Structure

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ACCT- 1700091		RED FRONT 115 kV TAP AERIAL EXHIBIT	
SCALE- 1" = 50'			
BY-		LOWER WINDSOR TWP. YORK COUNTY	
REVIEWED		APPROVED	DATE
PPL DRAWING NO.		SHEET NO.	
		REV.	

REFERENCE TITLE	NUMBER	REFERENCE TITLE	NUMBER	NO.	DATE	ACCT.	REVISION	BY	REVIEWED	APPROVED

PC CAD

# **Attachment 3**

**ATTACHMENT 3**  
**RED FRONT 115 kV TAP LINE**  
**ENVIRONMENTAL ASSESSMENT**

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**ATTACHMENT 3**  
**REDFRONT 115 kV TAP LINE**  
**ENVIRONMENTAL ASSESSMENT**

---

**A. INTRODUCTION**

PPL Electric is requesting PUC approval to site and construct a single-circuit 115 kV transmission tap line. The proposed line is approximately 160 feet long and involves the installation of one wood pole. The tap line will provide service to the proposed Red Front 115 – 12 kV Substation.

The proposed project was reviewed with representatives of Lower Windsor Township and York 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**

Both the proposed tap line and substation are located on approximately 3.0 acres of property PPL Electric is in the process of acquiring. The property is located along Gun Club Road approximately 1,500 feet east of Mt. Pisgah Road in Lower Windsor Township. The property is zoned as an industrial zoning district. Presently, the property is being used for agricultural purposes. The source for the proposed Substation is a First Energy owned 115 kV transmission line that crosses the property, resulting in a short 160 foot tap into the substation. Surrounding properties are presently being acquired, ostensibly, for expansion of the “Modern Landfill” on Mt. Pisgah Road.

Two homes are located across Gun Club Road from the site proposed for the tap line and substation. Visual impacts to the homes will be mitigated by landscaping the site after the project is completed.

No communication towers, pipelines, or other utilities will be affected by the proposed project. McGinness Field Airport is approximately 6.9 miles from the project area. 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 airport's flight operations.

**C. CULTURAL RESOURCES**

This project was reviewed with the Pennsylvania Historical and Museum Commission (PHMC). PHMC has determined that, based upon their survey files, no archaeological sites will be affected by the proposed project. Additionally, PHMC notes the location of nearby structures that may be eligible for inclusion on the National Register. However, due to the small scope of the proposed activity, no impact to these structures is expected (File No. ER 2009-1026-077-A).

**D. NATURAL FEATURES**

The proposed tap line will not affect any unique geological, scenic, or natural areas. No National Natural Landmarks, parks, or recreational facilities are located near the project area. No tree clearing is required. The proposed tap line will not cross any wetlands or other aquatic resources. As required, PPL Electric will acquire and adhere to the terms and conditions of any required soil erosion and sedimentation control plans.

**E. THREATENED AND ENDANGERED SPECIES**

PPL Electric has coordinated with certain state and federal agencies to obtain information regarding endangered and threatened plant and animal habitats in close proximity to the project area. These agencies have reported that no threatened or endangered species exist in close proximity to the project.

# **Attachment 4**

## **SUPPORTING ATTACHMENTS**

ATTACHMENT 4 – PPL Electric Design Criteria and Safety Practices

ATTACHMENT 5 – Magnetic Field Management at PPL Electric

ATTACHMENT 6 – List of Property Owners Within the Proposed Right-of-Way

ATTACHMENT 7 – List of Involved Governmental Agencies, Municipalities, and Other  
Public Entities

## ATTACHMENT 4

### PPL 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) 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 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 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 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 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 lines are designed to operate safely and reliably during inclement weather even more severe than assumed by the NESC. In addition, PPL transmission lines are designed with more clearance to the ground than required by the NESC. The tables below compare PPL 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 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 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 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. 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 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.

# **Attachment 5**



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

**ATTACHMENT 5**

**DECEMBER 2004**

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## **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

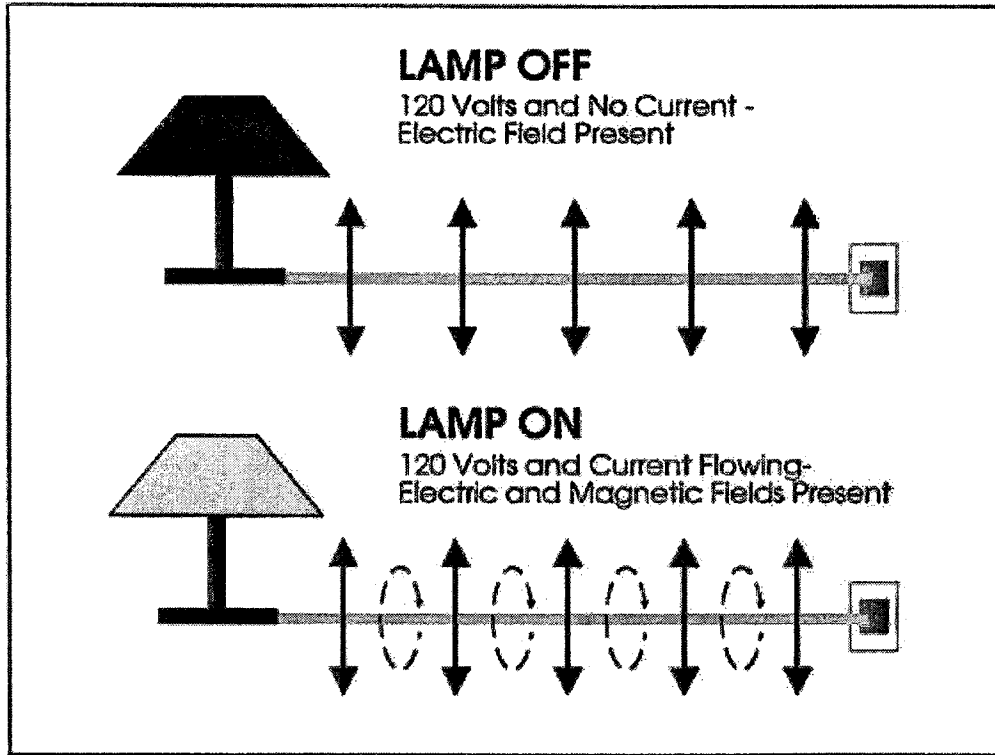


Figure 2









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

<b>Sample Magnetic Field Levels in Milligauss</b>				
<b>Type of Overhead Power Line</b>	<b>Distance from the line</b>			
	<b>Under the line</b>	<b>50 ft.</b>	<b>100 ft.</b>	<b>200 ft.</b>
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.

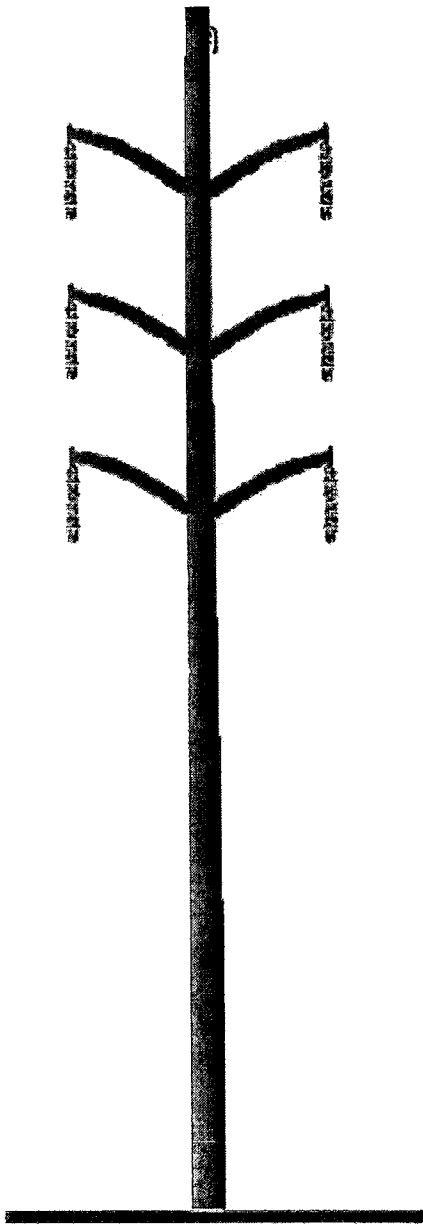
## **UNDERGROUND TRANSMISSION LINES**

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**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.**

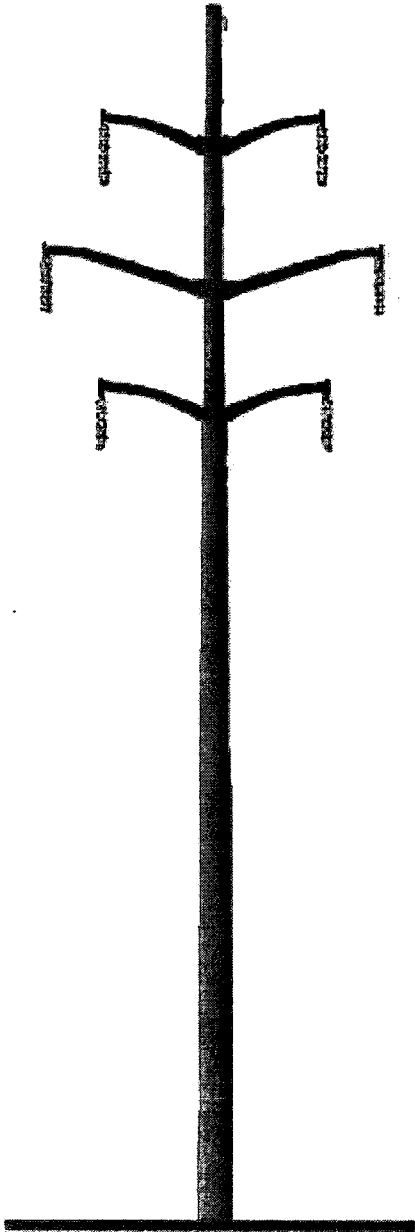
- The phase arrangement that produces the lowest field will be determined.
- The depth of burial of the line will be determined considering the cost of excavation and the location of other buried utilities in the area.
- The use of steel pipe ferromagnetic shielding that reduces magnetic fields will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



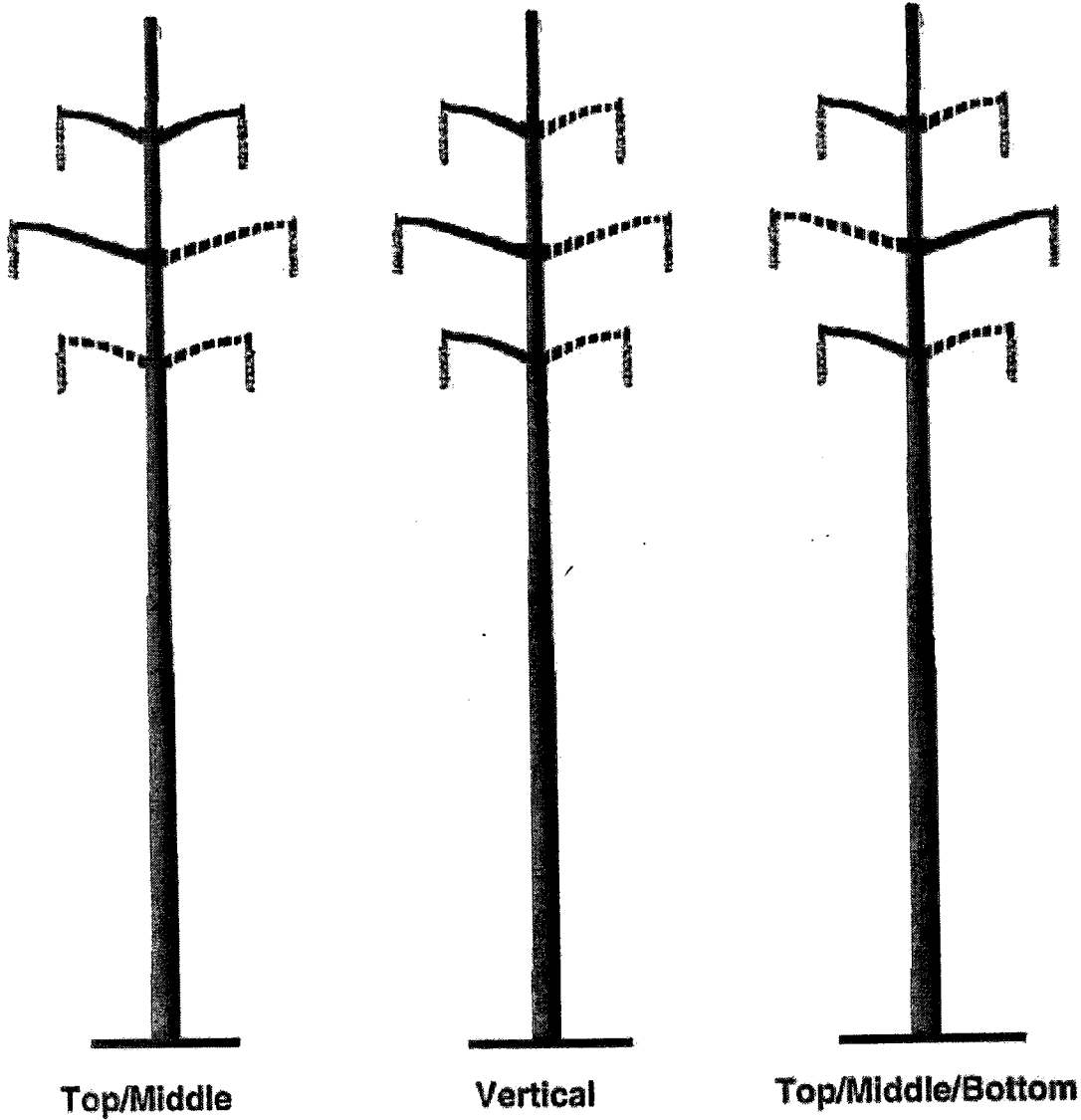
- Lower cost alternative
- Reduces magnetic fields due to higher structures
- Typical conductor data:
  - 1 3/8" HS steel overhead ground wire - 17.3 feet sag
  - 6-556.5 KCMIL 24/7 ACSR power conductors - (PARAKEET) 23.0 feet sag
  - Average span - 600 feet

**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



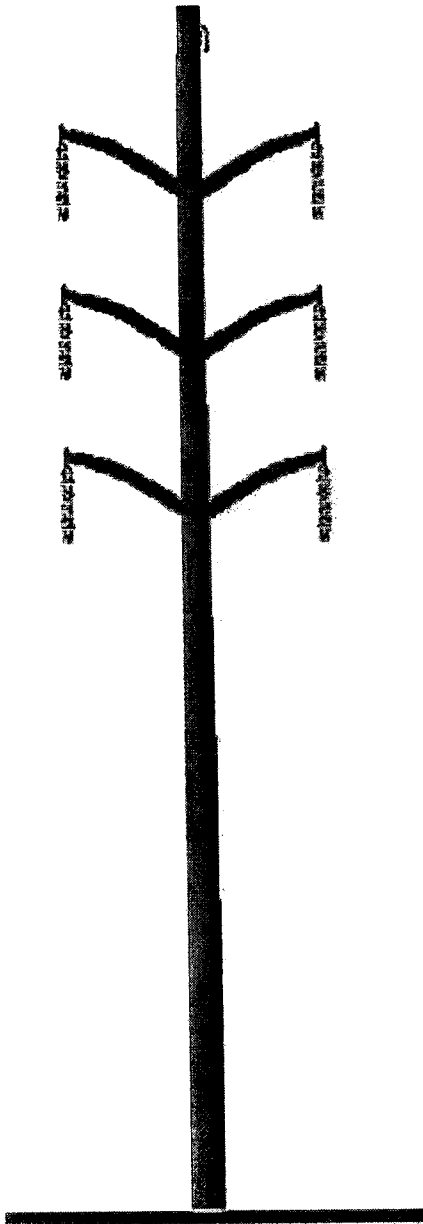
——— initial single circuit  
- - - - - future second circuit

**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

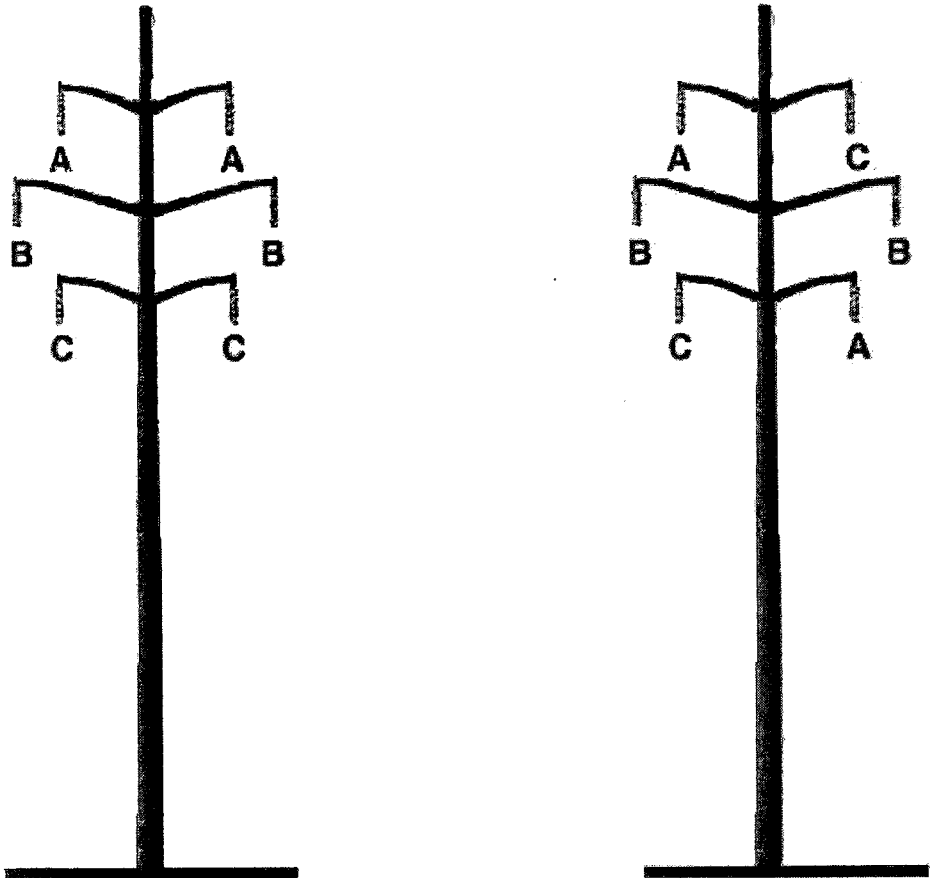
The edge of right of way is 50 feet from the line centerline.  
 The 400 ampere phase current is balanced between phases.  
 Calculations are based on a minimum ground clearance of 25 feet.

# 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: → → → → 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.

# **Attachment 6**

**ATTACHMENT 6**

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

Property Owner/Address

David G. & Ruth A. Fitz  
398 Red Front Road  
York, PA 17406

# **Attachment 7**

## **ATTACHMENT 7**

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

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, 8<sup>th</sup> 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. York County Commissioners  
County Administration Office  
28 East Market Street  
York, Pennsylvania 17401  
Attn: Mr. M. Steve Chronister, President
5. York County Planning Commission  
28 East Market Street, Third Floor  
York, Pennsylvania 17401  
Attn: Ms. Felicia Dell, Director
6. Lower Windsor Township  
2425 Craley Road  
Wrightsville, Pennsylvania 17368  
Attn: Ms. Maureen Hartman, Township Manager
7. Lower Windsor Township Board of Supervisors  
2425 Craley Road  
Wrightsville, Pennsylvania 17368  
Attn: Ms. Kelly Skiptunas, Chair

8. Lower Windsor Township Planning Commission  
2425 Craley Road  
Wrightsville, Pennsylvania 17368  
Attn: Mr. Marlin Mellinger, Chair
  
9. Mr. Donald A. Brennan  
Met-Ed Regional President  
Metropolitan Edison Company  
2800 Pottsville Pike  
P.O. Box 16001  
Reading Pa, 19612-6001