Before the
Pennsylvania Public Utility Commission

DAPPERS 138/69 kV TAP LINE

ATTACHMENTS IN SUPPORT OF THE
Letter of Notification

Application Docket No.___________

Submitted by: PPL Electric Utilities Corporation

SUMMARY

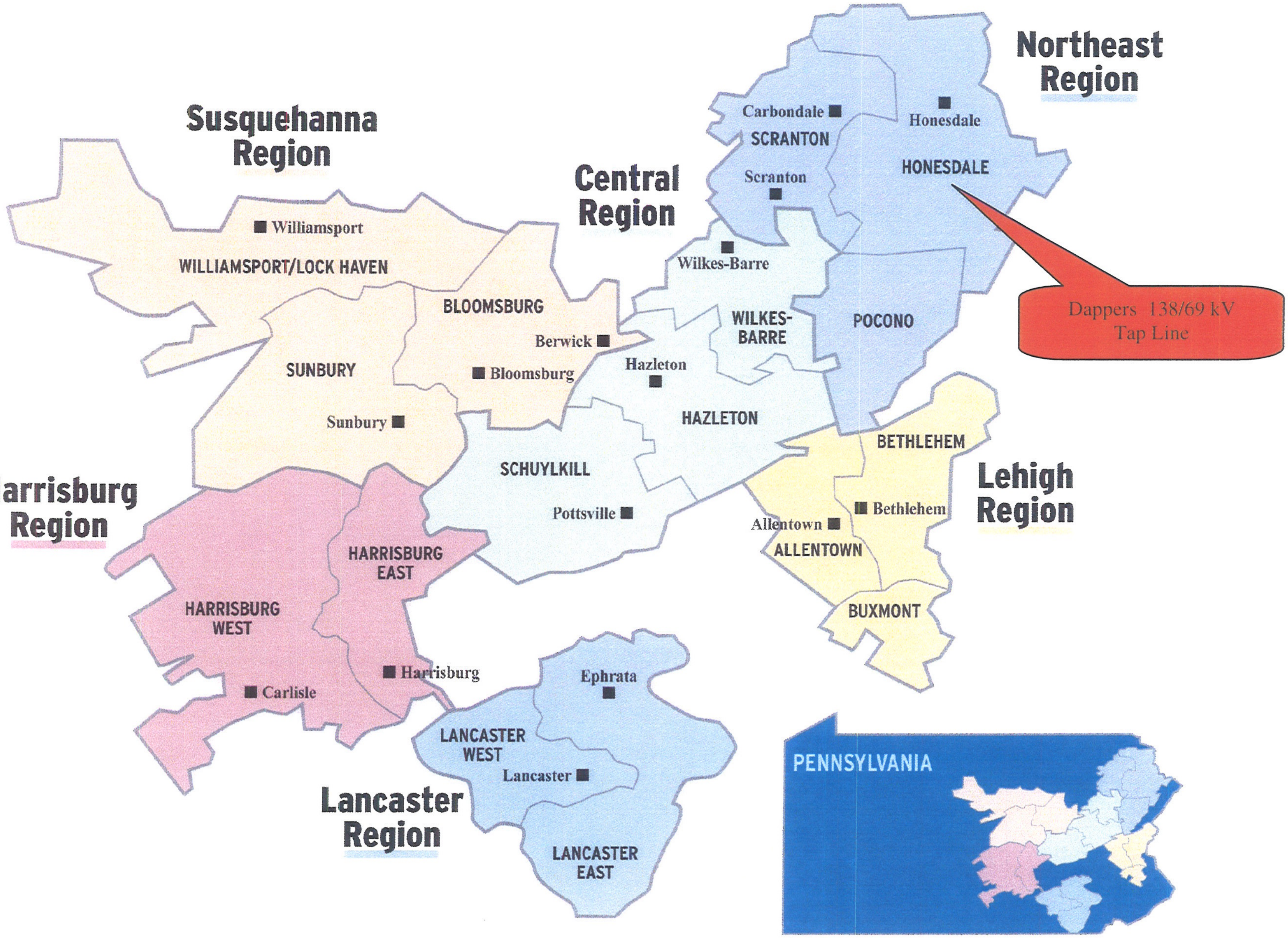
A Letter of Notification is being submitted by PPL Electric Utilities Corporation (PPL Electric) pursuant to the Pennsylvania Public Utility Commission's (PUC or the Commission) regulations at 52 Pa. Code §§ 57.71 through 57.77 for approval to site and construct the single-circuit Dappers 138/69 kV Tap Line to serve the planned Dappers 69-12 kV Substation. Together, the tap line and substation are required to improve reliability of service in the Varden and Honesdale areas of Wayne County. This project is located in Cherry Ridge Township, Wayne County. The proposed tap line will be designed and constructed for 138 kV operation, although the tap line initially will be operated at 69 kV.

The total estimated cost of the proposed transmission work is approximately $200,000. In addition, PPL Electric estimates that it will spend approximately $1.08 million (including the transformer cost) for the substation and distribution work associated with this project. This project has a scheduled construction start date of February 2012, in order to meet an in-service date of November 2012.

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

Attachment "1"	Necessity Statement
Attachment "2"	Engineering Description
Attachment "3"	Environmental Assessment
Attachment "4"	PPL Electric Design Criteria and Safety Practices
Attachment "5"	PPL Electric Magnetic Field Management Program
Attachment "6"	List of Involved Governmental Agencies, Municipalities

PPL ELECTRIC UTILITIES SERVICE TERRITORY



Attachment 1

ATTACHMENT "1"

DAPPERS 138/69 kV TAP LINE

NECESSITY STATEMENT

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ATTACHMENT "1"
DAPPERS 138/69 kV TAP LINE
NECESSITY STATEMENT

A. INTRODUCTION

PPL Electric is requesting PUC approval to site and construct a single-circuit 138/69 kV transmission tap line. The proposed Dappers 138/69 kV Tap will extend approximately 312 feet from the existing Blooming Grove-Honesdale 138/69 kV Transmission Line to the new Dappers 69-12 kV Substation. The proposed tap will be designed and constructed for single-circuit 138/69 kV operation. The tap line initially will be operated at 69kV and will be converted to operate at 138 kV when future load growth makes it appropriate to do so. The tap line and new substation are required to improve reliability

The estimated cost to design and construct the tap is approximately $200,000. Construction is scheduled to begin in February 2012 to support the project's proposed in-service date of November 2012. The required in service date is defined as the date that the facility needs to be placed in service to address reliability issues on the existing system that could cause service interruptions 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 138/69 kV regional transmission system in the Honesdale area.

B. EXISTING SYSTEM

Presently, the Honesdale and Varden areas are served from the Varden 69-12 kV Substation and the Honesdale 69-12 kV Substation via each substation's associated 12 kV distribution lines: the Varden 46-03 and the Honesdale 34-02 12 kV distribution lines. Presently, the Varden 46-03 distribution line serves approximately 1,520 customers in the Varden area, and the Honesdale

34-02 distribution line serves approximately 1,380 customer in the Honesdale area. See Figure 1 on page 5 of this Attachment for the existing transmission system configuration and Figure 3 on page 7 of this Attachment for the existing distribution system configuration.

C. DEFINITION OF THE PROBLEM

The existing Varden 46-03 and Honesdale 34-02 distribution lines currently exceed PPL Electric's Reliability Principles & Practices (RP&P) guideline for customer count per feeder. The RP&P guideline limits the number of customers served from a 12kV circuit to 1,300 customers. Currently, customer counts on the Varden 46-03 and Honesdale 34-02 distribution lines are 1,520 and 1,380 customers, respectively.

The existing Varden 46-03 distribution line also exceeds PPL Electric's RP&P guideline for circuit exposure. The RP&P guideline is that a 12kV circuit and its associated branches should not exceed 50 miles of circuit exposure. Presently the Varden 46-03 line has 114 miles of exposure. A large portion of the circuit is exposed to possible tree related outages. The long length of the circuit and the resulting increase in exposure to damage increases the number of outages a customer experiences. Decreasing the length of a circuit limits circuit exposure, thereby reducing the number of customers affected by an outage. Also, the existing system configuration has limited transfer capability with the adjoining substations for maintaining service during maintenance and other planned and unplanned outages of equipment. The rural nature of the area, the length of the Varden 46-03 circuit, and the high number of customers on the circuit result in a large number of customers experiencing multiple outages per year. The combination of these factors has led to the Varden 46-03 distribution line being among the worst performing circuits on PPL Electric's system.

D. PROPOSED SOLUTION

In order to improve the integrity of the system and address the reliability concerns in this area, PPL Electric plans to construct the new Dappers 69-12 kV Substation to improve the reliability of the Varden 46-03 and Honesdale 34-02 distributions line. The new Dappers 69-12 kV Substation will be supplied from the existing Blooming Grove-Honesdale 138/69 kV

Transmission Line. The proposed Dappers 138/69 kV Tap will extend approximately 312 feet from the existing Blooming Grove-Honesdale 138/69 kV Transmission Line to the new Dappers 69-12 kV Substation.

The location of the new Dappers 69-12kV Substation will provide a source central to the load it will serve. Locating the substation central to its load will increase reliability and operating flexibility; it will also reduce the number of customers affected by a line outage and result in shorter restoration times. Additionally, the 12 kV circuits from the proposed Dappers Substation will reduce the length of line per existing circuit, thereby reducing the amount of exposure for the existing lines.

The distribution lines supplied by the new Dappers 69-12 kV Substation will transfer load away from the Varden 46-03 and Honesdale 34-02, which reduce the number of customers served by these lines. Once the project is completed, the two new distribution lines supplied by the Dappers 69-12 kV Substation will serve a total of approximately 1,150 customers. In turn, the number of customers served by Varden 46-3 distribution line will be reduced from approximately 1,520 to 1,100, which is below the PPL Electric RP&P guideline of 1300 customers per line. The number of customers served by the Honesdale 34-02 distribution line will be reduced from approximately 1,380 to 900 customers.

The total estimated cost of this solution is approximately $1.08 million, which includes an estimated $746,000 for the new substation, $200,000 for the transmission line, $134,000 for the distribution lines. Figure 2 (page 6) for the proposed transmission system configuration and Figure 4 (page 8) for the proposed distribution system configuration in this area.

E. **FUNCTIONAL ALTERNATIVE**

An alternative to building the new substation and transmission line would be to decrease the number of customers per 12 kV circuit by installing two new 12 kV circuits; one originating from the existing Honesdale Substation and the other originating from the existing Varden substation. This alternative would require a new 12kV distribution line to follow the same line route as the Honesdale 34-2 for about 3 miles. This alternative would do less to improve reliability due to the fact that two distribution circuits installed on the same poles are susceptible to outages on both lines from the same causes. Further, this alternative would require costly upgrades to both the Honesdale and Varden substations to accommodate the additional lines and terminals. In addition, minor distribution work on the Varden 46-03 distribution line would be required. This alternative would provide no cost savings because it would cost approximately $1.11 million.

PPL Electric rejected this alternative because the preferred alternative provides additional reliability and operating flexibility, allows for a better long-term plan for the entire area, and is slightly less expensive.

FUNCTIONAL ONE-LINE DIAGRAM
EXISTING TRANSMISSION SYSTEM

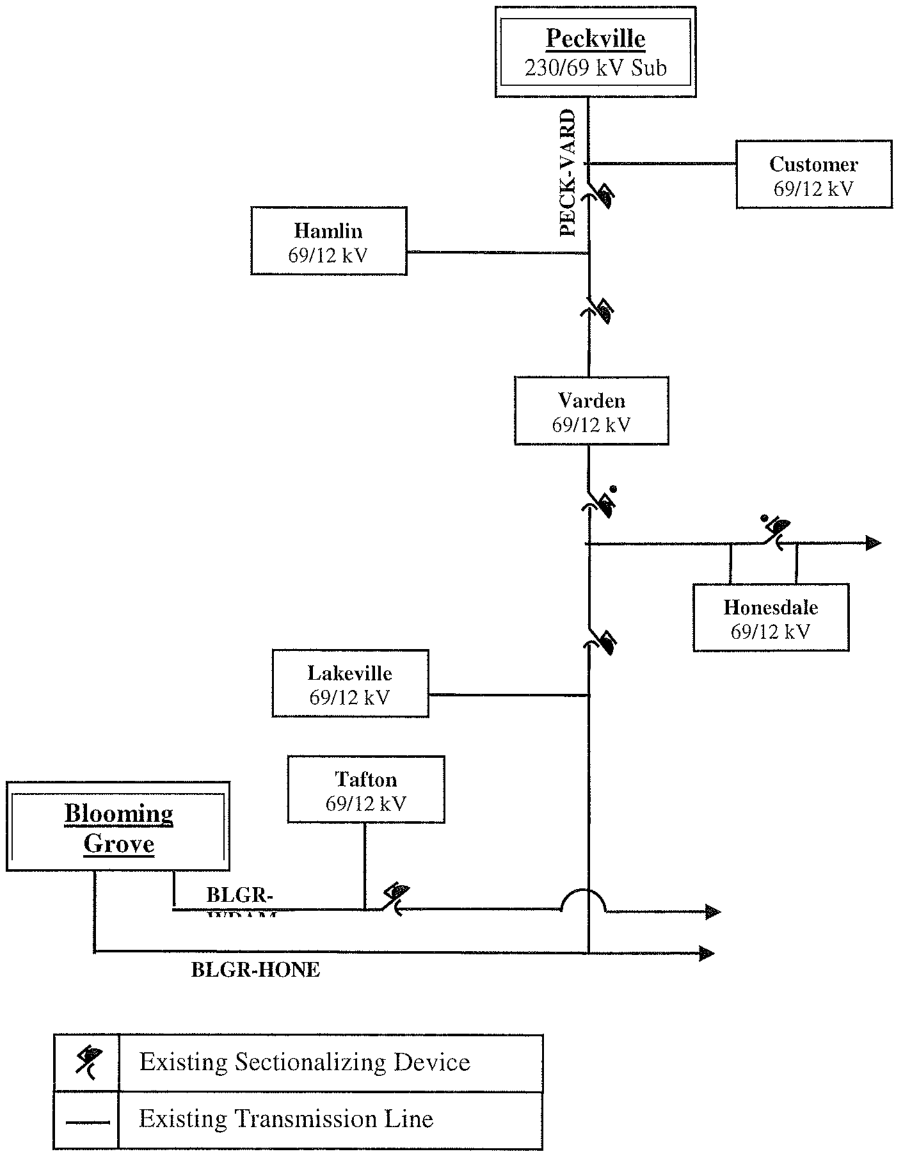


FIGURE 1

FUNCTIONAL ONE-LINE DIAGRAM
PROPOSED TRANSMISSION SYSTEM

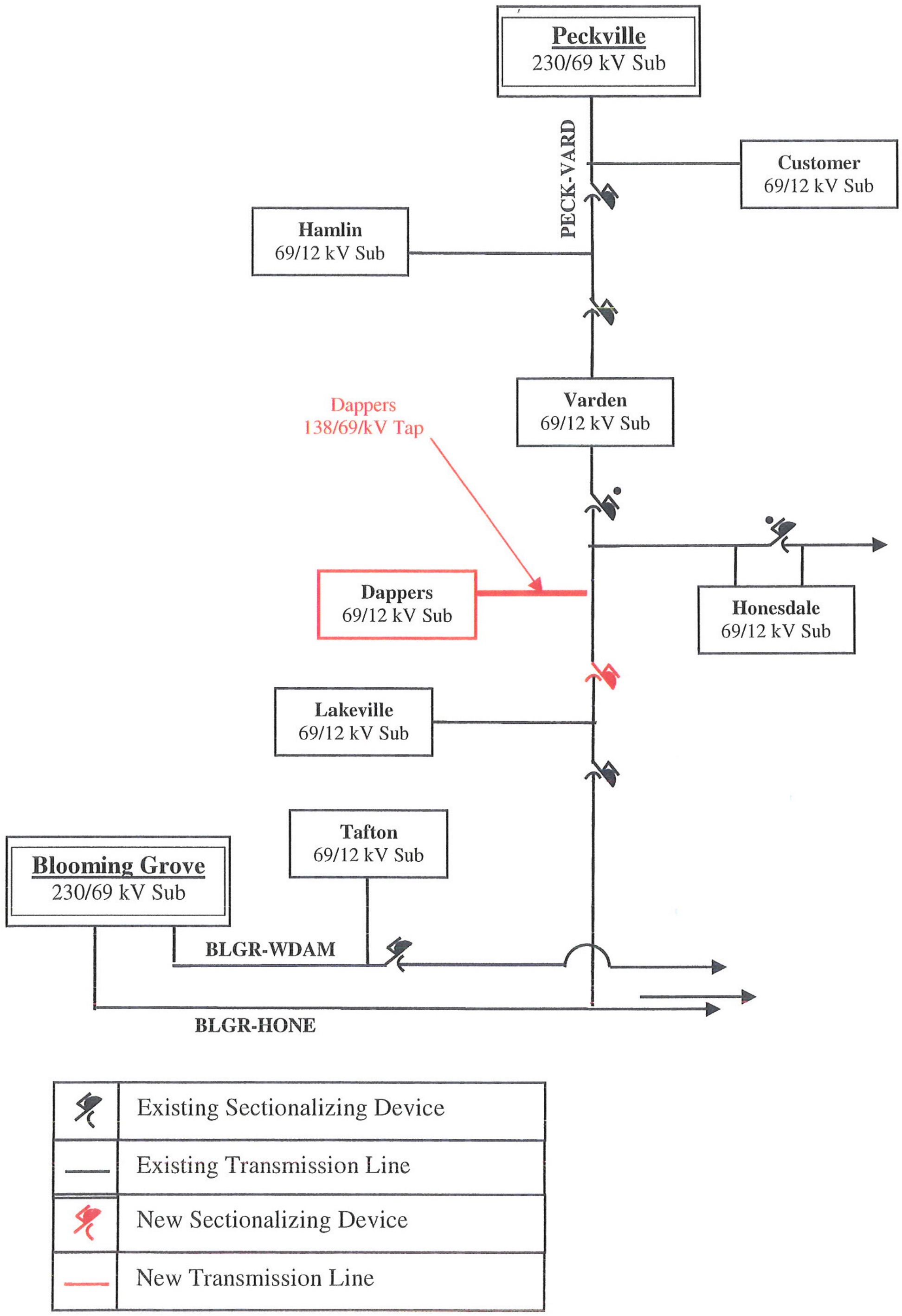


FIGURE 2

CHERRY RIDGE TOWNSHIP AREA
FUNCTIONAL ONE-LINE DIAGRAM
EXISTING 12 kV DISTRIBUTION SYSTEM

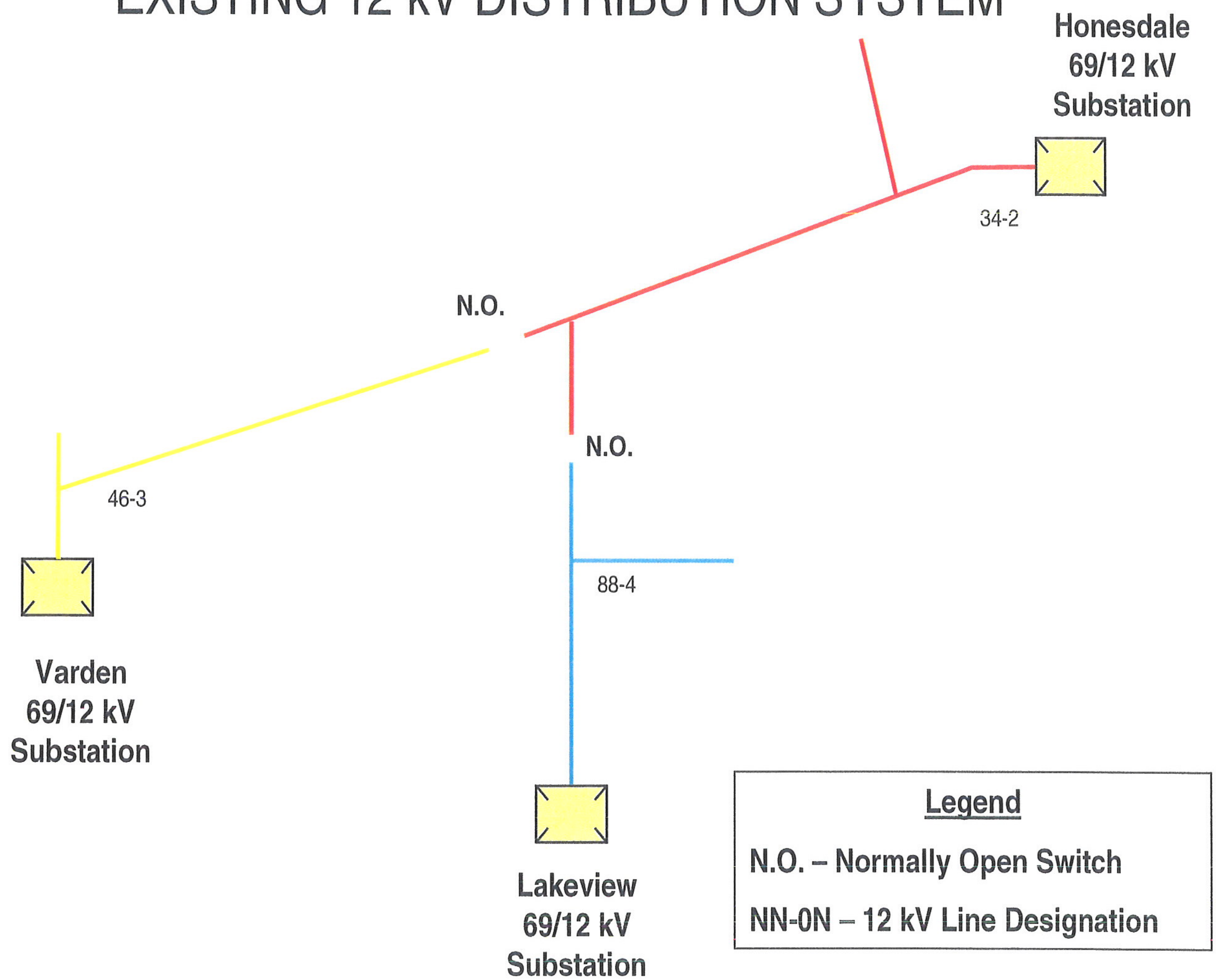


FIGURE 3

CHERRY RIDGE TOWNSHIP AREA
FUNCTIONAL ONE-LINE DIAGRAM
PROPOSED 12 kV DISTRIBUTION SYSTEM

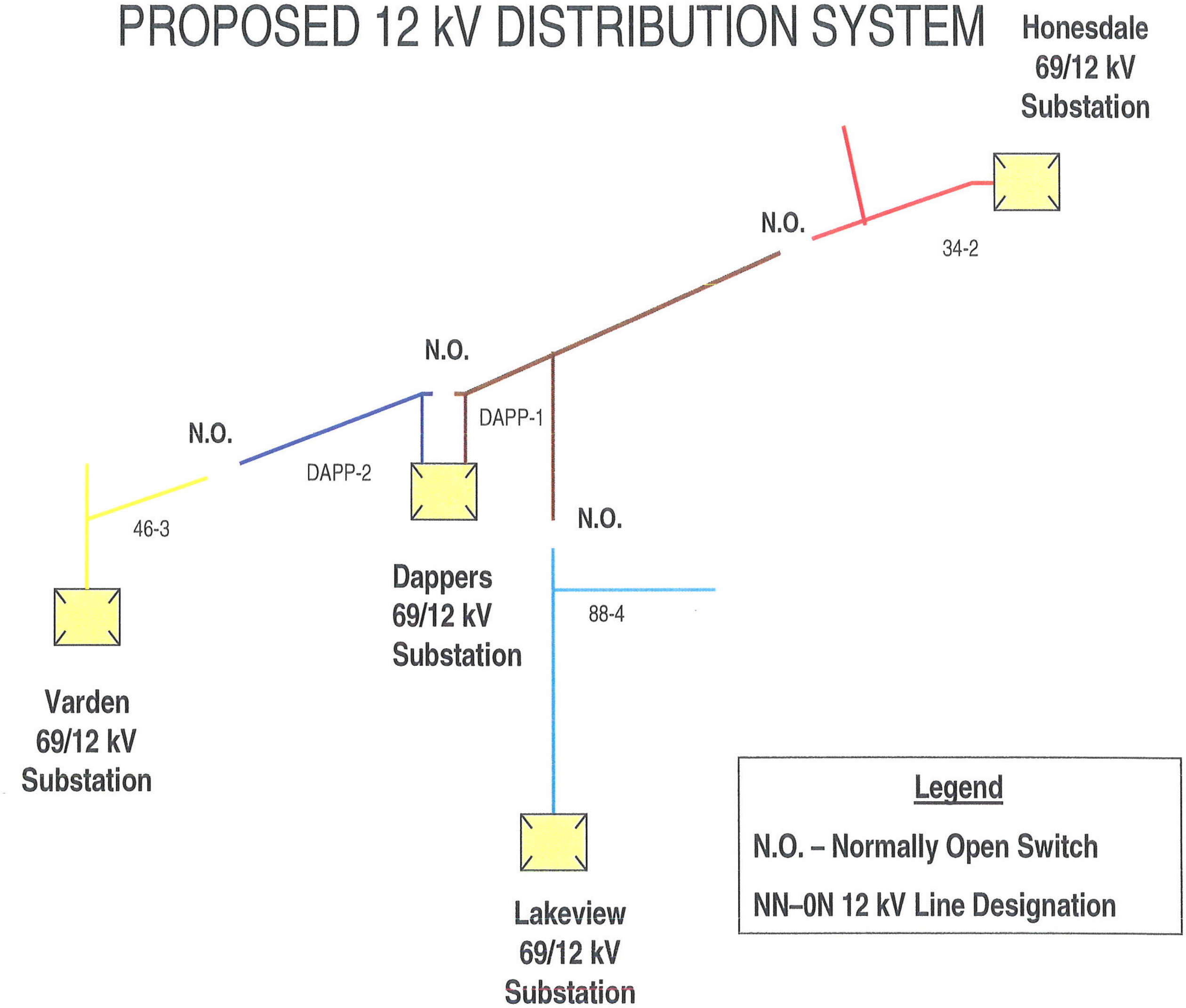
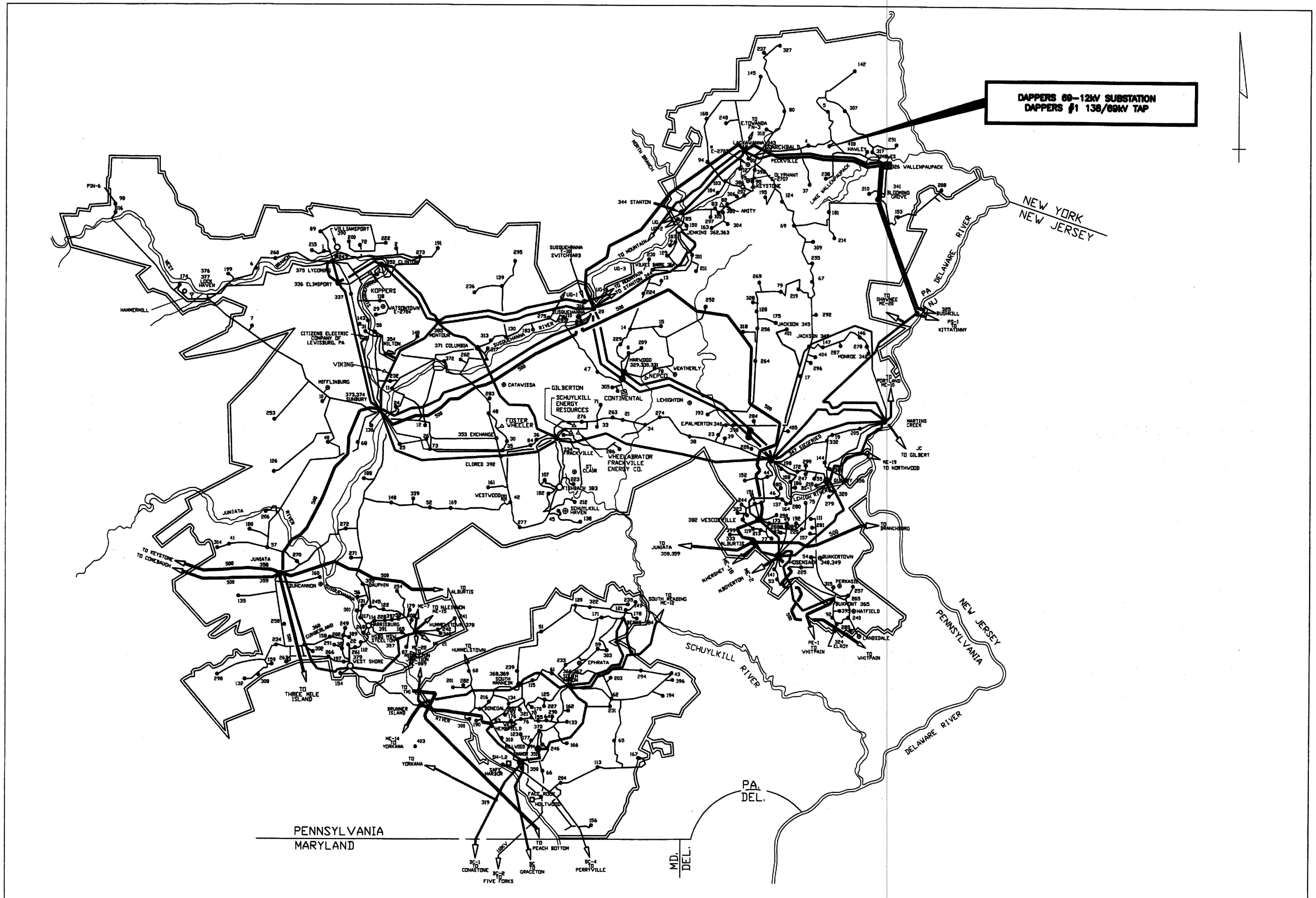


FIGURE 4

SUBSTATION LISTING

1	WEST WILLIAMSPORT	151	CRACKERSPORT	301	CENTER CITY
2	FAIRFIELD	152	SCHNECKSVILLE	302	NEW KINGSTOWN
3	MONTGOMERY	153	HEMLOCK	303	REAMSTOWN
4	VARDEN	154	MT. ALLEN	304	DUPONT
5	HONESDALE	155	PRINCE	305	HUMBOLDT
6	JERSEY SHORE	156	WAKEFIELD	306	CEDAR AVE.
7	LOGANTON	157	COOPERSBURG	307	INDIAN ORCHARD
8	VALMONT	158	WERTZVILLE	308	NOTTINGHAM
9	RIVER	159	WEST CARLISLE	309	NORTH COOLBAUGH
10	LIMESTONE	160	BENVENUE	310	LETORT
11	NORTHUMBERLAND	161	HEGINS	311	EAST MOUNTAIN
12	REED	162	LEOLA	312	JERMYN
13	WRIGHT	163	YATESVILLE	313	BLOOMSBURG
14	ST.JOHNS	164	CENTRAL ALLENTOWN	314	MIFFLINTOWN
15	FREELAND	165	OBERLIN	315	RIDGE ROAD
16	*	166	STRASBURG	316	SUSQUEHANNA T-10 SW. YD.
17	GILBERT	167	ATGLEN	317	KIMBLES
18	*	168	BROOKSIDE	318	CHRISTMANS
19	CHERRY HILL	169	WILLIAMSTOWN	319	OTTER CREEK
20	SUSQUEHANNA 230KV	170	E. PETERSBURG	320	STEEL CITY
21	TAMANEND	171	WERNERSVILLE	321	McGOVERNVILLE
22	WHITE HILL	172	N. BETHLEHEM	322	ROBESONIA
23	PALMERTON	173	W. ALLENTOWN	323	S.FOGELSVILLE
24	HAMILTON	174	FLEMINGTON	324	ELROY
25	HUNTER	175	MECKESVILLE	325	BUSHKILL
26	FAIRVIEW	176	DONERVILLE	326	WALLENPAUPACK
27	*	177	MILLERSVILLE	327	ELK MOUNTAIN
28	*	178	SHILLINGTON	328	JACK FROST
29	MONTOUR PUMP	179	DUKE	329	HARWOOD 230/69KV
30	MT. CARMEL	180	MCALLISTERVILLE	330	HARWOOD CTG
31	KELLY	181	NEWFOUNDLAND	331	HARWOOD 69/12KV
32	SPORTING HILL	182	MARLIN	332	NAZARETH
33	MAHANOY CITY	183	WEST BERWICK	333	ALBURTIS
34	GREENWOOD	184	KEYSER AVENUE	334	FRACKVILLE
35	MOWRY	185	MICKLEYS	335	*
36	ALTAMOUNT	186	EAST ALLENTOWN	336	ELIMSPORT
37	HAMLIN	187	PINE RIDGE	337	ALLENWOOD
38	ASHFIELD	188	DALMATIA	338	*
39	SOUTH SLATINGTON	189	PENNSBORO	339	GRATZ
40	SOUTH MIDDLEBURG	190	NORTH COLUMBIA	340	HOCKERSVILLE
41	WALKER	191	HUGHESVILLE	341	BLOOMING GROVE
42	FRAILEY	192	SOUTH ALLENTOWN	342	MONROE
43	MORGANTOWN	193	WEISSPORT	343	LACKAWANNA ##
44	EGYPT	194	HONEYBROOK	344	STANTON
45	CRESSONA	195	MOSCOW	345	JACKSON
46	SOUTH WHITEHALL	196	*	346	EAST PALMERTON
47	EAST TOMHICKEN	197	ROSSMOYNE	347	SIEGFRIED
48	BEAR GAP	198	NORTHAMPTON	348	HOSENSACK 230/69KV
49	SALISBURY	199	WOOLRICH	349	HOSENSACK 500KV
50	SOUTH MILTON	200	FAXON	350	CONESTOGA
51	HEIDELBERG	201	ELIZABETHTOWN	351	MANOR
52	LYKENS	202	ENOLA	352	CLINTON
53	UPPER HANOVER	203	TERRE HILL	353	EXCHANGE
54	RICHLAND	204	BUCK	354	MILTON
55	MACADA	205	MT. BETHEL	355	DAUPHIN
56	ROCKVILLE	206	RICHFIELD	356	QUARRY SUB.
57	THOMPSONTOWN	207	SCRANTON	357	STEELTON
58	PAXTON	208	TWIN LAKES	358	JUNIATA 500/230KV
59	COCALICO	209	HARLEIGH	359	JUNIATA 230/69KV
60	EAST ELIZABETHTOWN	210	TAFTON	360	CUMBERLAND
61	WARWICK	211	BEAR CREEK	361	DONEGAL
62	EARL	212	ORWIGSBURG	362	JENKINS 230/69KV
63	HEMPFIELD	213	EAST TEXAS	363	JENKINS CTG
64	EAST LANCASTER	214	CANDENSIS	364	WILKES-BARRE
65	KINZER	215	LINDEN	365	BUXMONT
66	MT. NEBO	216	MT. JOY	366	SOUTH AKRON 230/138/69KV
67	MT. POCONO	217	WEST BLOOMSBURG	367	SOUTH AKRON 69/12KV
68	PENNS	218	MINSI TRAIL	368	SOUTH MANHEIM 69/12KV
69	GOULDSBORO	219	LAKE NAOMI	369	SOUTH MANHEIM 230/69KV
70	DILLERVILLE	220	LANARK	370	ENGLESIDE
71	GIRARD MANOR	221	*	371	COLUMBIA
72	KENMAR	222	MONTOURSVILLE	372	DANVILLE
73	GOWEN CITY	223	PORT CARBON	373	SUNBURY
74	*	224	BLYTHEBURN	374	HUMMELS WHARF
75	ELLIOT HEIGHTS	225	MILFORD	375	LYCOMING
76	ROHRERSTOWN	226	TREICHLERS	376	LOCK HAVEN CTG
77	MACUNGIE	227	ROSEVILLE	377	LOCK HAVEN 69/12KV
78	EAST HAZLETON	228	RUTHERFORD	378	HUMMELSTOWN
79	WAGNERS	229	HARTLAND	379	WEST SHORE
80	EAST CARBONDALE	230	PARRISH	380	MONTAGE
81	EYNON	231	WEST NEW HOLLAND	381	SOUTH FARMERSVILLE
82	MINOOKA	232	POINT	382	WESCOSVILLE
83	OLD FORGE	233	LINCOLN	383	FISHBACH
84	FOUNTAIN SPRINGS	234	MIDDLETON	384	BERKS
85	SULLIVAN TRAIL	235	STATE HILL	385	MONTOUR
86	*	236	MILLVILLE	386	SUBURBAN YARD
87	SWATARA	237	TINKER	387	*
88	*	238	LAKEVILLE	388	*
89	HEPBURN	239	NORTH MANHEIM	389	MACK
90	*	240	HATFIELD	390	WILLIAMSPORT
91	*	241	HERSHEY	391	HARRISBURG
92	FRANCONIA	242	S. HERSHEY	392	ELDRED
93	EMMAUS	243	S. WILLIAMSPORT	393	*
94	MORGAN	244	FOGELSVILLE	394	MILLWOOD
95	THROOP	245	WINDSOR	395	TELFORD
96	*	246	W. WILLOW	396	TWIN VALLEY
97	*	247	WESTGATE	397	DEVONSHIRE
98	CHAPMAN	248	EDELA	397	JESSUP
99	SUBURBAN	249	SUMMERDALE	398	BELTZVILLE
100	*	250	DORNEYVILLE	399	SCHOENECK
101	*	251	BOHEMIA	400	HAWLEY
102	*	252	WHITE HAVEN	401	EFFORT MOUNTAIN
103	PROVIDENCE	253	LAURELTON	402	COPPERSTONE
104	*	254	LINGLESTOWN	403	RED FRONT
105	AVOCA	255	POCONO FARMS	404	APPENZELL
106	*	256	HICKORY RUN	405	BLUE MOUNTAIN
107	CASS	257	BLOOMING GLEN	406	DAPPERS 69-12kV
108	CATASAQUA	258	SHERMANDSDALE		
109	*	259	*		
110	SUSQUEHANNA 500KV	260	LARRYS CREEK		
111	SEIDERSVILLE	261	SPANGLER MILLS		
112	ROSEMONT	262	E. DANVILLE		
113	QUARRYVILLE	263	DELANO		
114	LAWNTON	264	CARBON		
115	LITITZ	265	SELLERSVILLE		
116	RENOVO	266	MECHANICSBURG		
117	WALNUT	267	CARLISLE		
118	WATSON	268	CEDAR		
119	TREXLERTOWN	269	ARROWHEAD		
120	LAVINO	270	NEWPORT		
121	SPRING	271	HALIFAX		
122	COLONIAL PARK	272	MILLERSUBRG		
123	WEST LANCASTER	273	MUNCY		
124	MADISONVILLE	274	HAUTO		
125	NEFFSVILLE	275	BERWICK		
126	BEAVERTOWN	276	SHENANDOAH		
127	BELMONT	277	PINE GROVE		
128	LAKE HARMONY	278	STROUDSBURG		
129	GEORGETOWN	279	FREEMANSBURG		
130	SCOTT	280	ALLENTOWN		
131	N. HARRISBURG	281	BINGEN		
132	MOUNT ROCK	282	RHEEMS		
133	GREENLAND	283	CLEVELAND		
134	LANDISVILLE	284	LITTLE GAP		
135	GREEN PARK	285	ORVILLA		
136	SELINSGROVE	286	TUSCARORA		
137	SUMNER	287	BARTONSVILLE		
138	AUBURN	288	ALTON PARK		
139	ROHRSBURG	289	SALEM		
140	DERRY	290	NORTH BRIDGEPORT		
141	EAST GREENVILLE	291	HAMPDEN		
142	WEST DAMASCUS	292	CAMELBACK		
143	NEW COLUMBIA	293	SILVER SPRING		
144	FARMERSVILLE	294	BRECKNOCK		
145	GREENFIELD	295	BENTON		
146	NORTH STROUDSBURG	296	MCMICHAELS		
147	TANNERSVILLE	297	HUGHESTOWN		
148	ELIZABETHVILLE	298	NEWVILLE		
149	WYOMISSING	299	POINTE NORTH		
150	EXETER	300	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
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
68	7/9/10	165202	INDICATE WEST HEMPFIELD-PRINCE #1 & #2 RECONSTRUCTION	RRC	RWM	KBK
71	8/31/10	389371	ADDED DAPPERS 69-12kV SUBSTATION.	RRC		DG
70	3/10/10	169008	ADDED BLUE MOUNTAIN #1 & #2 138kV TAP	RWM	RWM	KBK
69	7/9/10	165202	INDICATE WEST HEMPFIELD- PRINCE #1 & #2 RECONSTRUCTION	JLL	RWM	KBK

REFERENCE TITLE | NUMBER | REFERENCE TITLE | NUMBER

FRACTIONAL | DECIMAL

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

ACCT- 805201
SCALE- NONE
BY- CDW
REVIEWED

ELECTRICAL SYSTEM MAP
DAPPERS 69-12kV SUBSTATION
DAPPERS #1 138/69kV TAP

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

PPL DRAWING NO. D191830 | SHEET NO. 1 | REV. 71

PC CAD

D191830_S001.DWG

Attachment 2

ATTACHMENT "2"

DAPPERS 138/69 kV TAP LINE

ENGINEERING DESCRIPTION

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ATTACHMENT "2"
DAPPERS 138/69 kV TAP LINE
ENGINEERING DESCRIPTION

A. DESCRIPTION OF PROPOSED LINE

PPL Electric proposes to design and construct the Dappers 138/69 kV Tap to serve the proposed Dappers 69-12 kV Substation. The Dappers 138/69 kV Tap will extend from the existing Blooming Grove-Honesdale 138/69 kV Transmission Line to the proposed Dappers 69-12 kV Substation. The tap will be designed and constructed for single-circuit 138 kV operation, although it initially will be operated at 69 kV. The circuit will be operated at 138 kV when future load increases make it appropriate to maintain service reliability. This project is located in Cherry Ridge Township, Wayne County. The location of these proposed facilities is shown on the Aerial Attachment at the end of Attachment "2."

The tap line will be approximately 312 feet in length and be supported by two steel mono-poles that will be direct embedded and guyed. The first pole, the tap structure, will be approximately 70 feet in height (see Figure 1). The second pole, the angle structure, will be located on the south side of the new tap line and pole will be approximately 65 feet in height (see Figure 2). The circuit will consist of three power conductors and one overhead ground wire. The power conductors will be 556.5 kcmil,[1] 24/7 strand ACSR.[2] A 3/8 inch steel overhead ground wire will provide lightning protection for the proposed tap line. In addition, one LSAB (load sectionalizing air brake) switch pole will be installed in the existing Blooming Grove-Honesdale 138/69 kV Transmission Line (see Figure 3).

The new 138/69 kV tap will be designed according to, and will generally surpass, National Electrical Safety Code ("NESC") minimum standards. Additional design criteria and safety rules practiced by PPL Electric are explained in Attachment 4. The minimum conductor-to-

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[1] A kcmil is a thousand circular mils. A circular mil is the cross-sectional area of a wire one mil in diameter, where 1 kcmil = 0.5067 mm².

[2] Aluminum conductor steel reinforced.

ground clearance will be 32.4 feet for the new tap. This minimum clearance occurs at a maximum thermal 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 24/7 STRAND ACSR[3]

Condition	Single-circuit Design Clearance-to-Ground
Normal load, average weather (16°C ambient, 60°F temperature)	34.3 feet
Predicted extreme thermal load (125°C conductor, 257°F temperature)	32.4 feet
Predicted NESC extreme wind load conditions (25 lbs., 16°C, 60°F temperature)	34.1 feet
Predicted extreme weather conditions, 0°F (1-inch ice, 4 lbs. wind, -18°C)	34.4 feet

TABLE 2
CONDUCTOR THERMAL RATING
556.5 KCMIL 24/7 ACSR
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

[3] Clearances based on a maximum tension of 3,000 pounds and a ruling span of 75 feet.

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 a line design that provides 5 feet higher ground clearances than required under the NESC 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 and will not interfere with the operation of the line.

Increased structure height will be utilized in the design of the new line to reduce magnetic field exposures. Reverse phasing cannot be utilized because only one circuit will be installed. Reverse phasing requires a double-circuit line.

C. RIGHT-OF-WAY STATUS

The Dappers Substation and Dappers Tap will be constructed on a 10.23-acre parcel owned by PPL Electric. No additional right-of-way is required for the construction of the tap line or substation.

FIGURE 1
PROPOSED 138/69 kV TAP STRUCTURE
APPROXIMATE HEIGHT - 70'

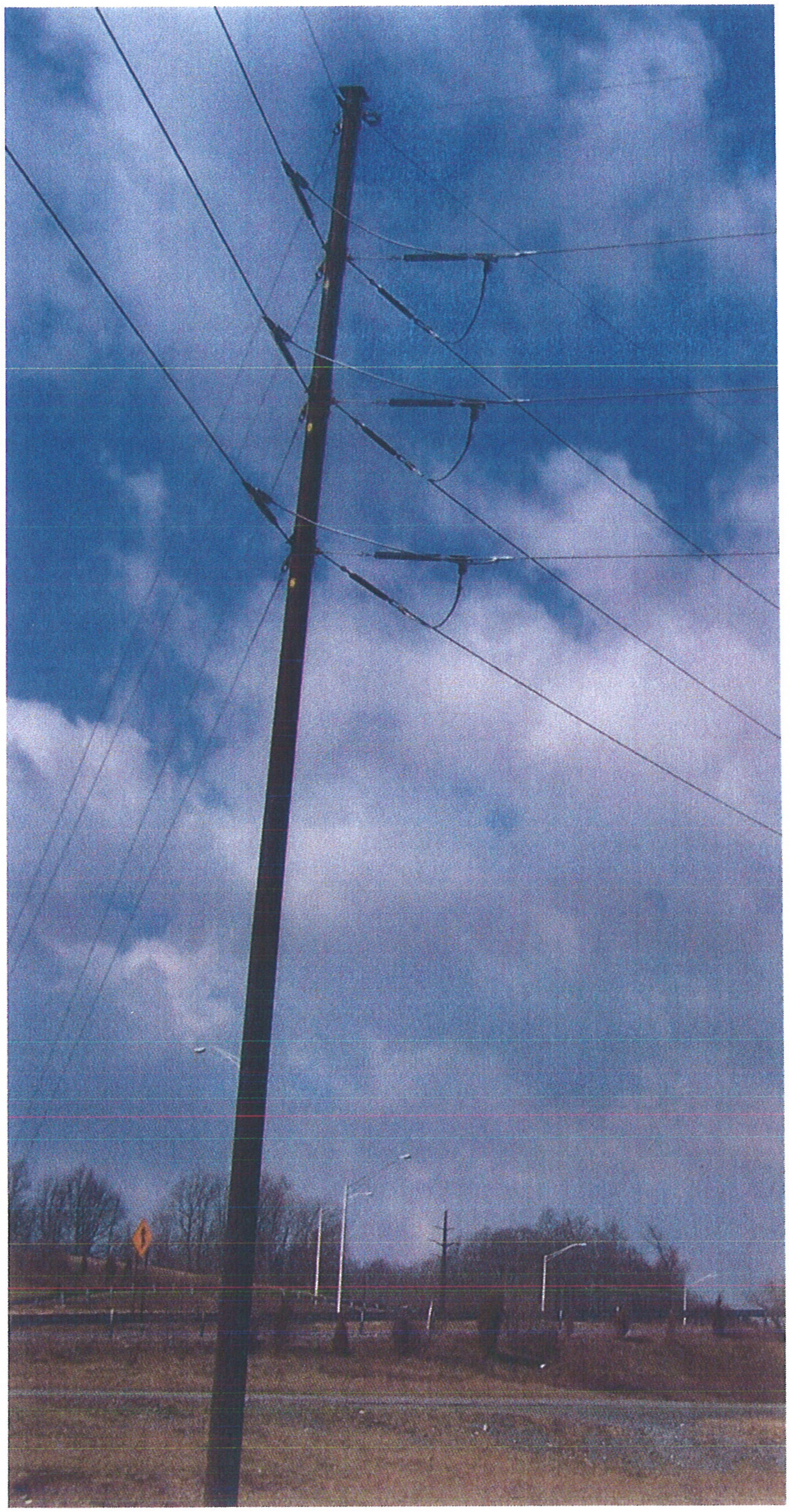


FIGURE 2
PROPOSED 138/69 kV ANGLE STRUCTURE
APPROXIMATE HEIGHT – 65’

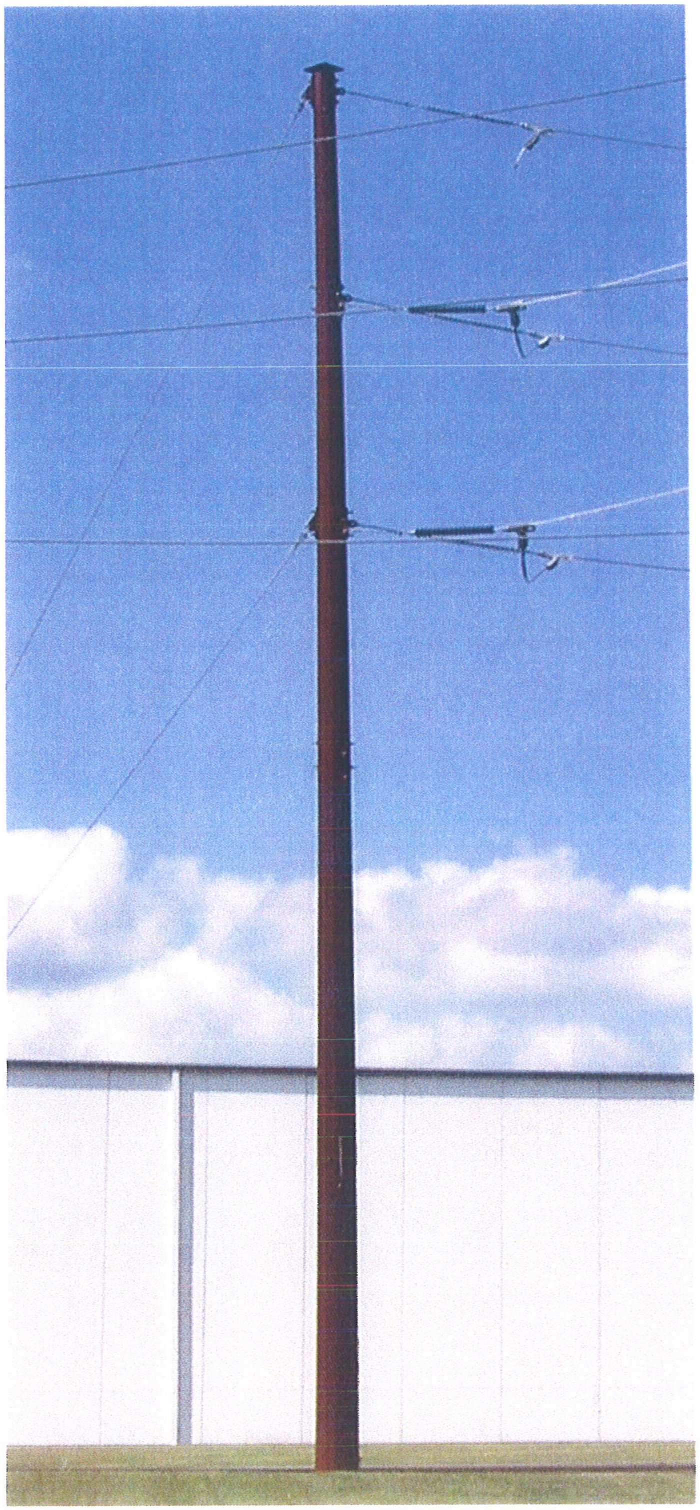


FIGURE 3
PROPOSED 138/69 kV SWITCH STRUCTURE
APPROXIMATE HEIGHT – 65'

LEGEND

- EXISTING TRANSMISSION LINE
- PROPOSED TRANSMISSION LINE
- EXISTING PROPERTY LINE
- PPL ELECTRIC PROPERTY LINE
- EXISTING TRANSMISSION POLE
- PROPOSED TRANSMISSION STRUCTURE
- EXISTING TRANSMISSION TOWER
- PROPERTY ID NUMBER (1)

Property ID Number	Property Owner
1	PPL UTILITIES TWO NORTH NINTH STREET ALLENTOWN, PA 18101

ATTACHMENT 2

AERIAL ATTACHMENT
SHEET 1

DAPPERS 138/69KV TAP LINE
CHERRY RIDGE TOWNSHIP
WAYNE COUNTY, PA.

SCALE: 1" = 100'

100' 0 50' 100' 200'

PPL ELECTRIC UTILITIES

PREPARED BY:
PPL ELECTRIC UTILITIES CORP.

Attachment 3

ATTACHMENT "3"

DAPPERS 138/69 kV TAP LINE

ENVIRONMENTAL ASSESSMENT

TABLE OF CONTENTS

ATTACHMENT "3"
DAPPERS 138/69 kV TAP LINE
ENVIRONMENTAL ASSESSMENT

A. INTRODUCTION

To meet the increasing demand for electricity and improve reliability, PPL Electric is proposing to construct the Dappers 138/69 kV Tap to supply the proposed Dappers 69-12 kV Substation. The project involves the installation of approximately 312 feet of new transmission line on 2 transmission poles and one LSAB (load sectionalizing air brake) pole. The short tap will be designed for single-circuit 138 kV operation, although it initially will be operated at 69 kV. The tap and substation will be constructed on property owned by PPL Electric.

PPL Electric provided information describing the project to Cherry Ridge Township and Wayne County, and neither the Township nor the County objected to the project. A list of involved governmental agencies, municipalities, and other public entities is presented in Attachment 6.

B. LAND USE

The proposed tap line and substation are located on a 10.23-acre parcel in Cherry Ridge Township, Wayne County owned by PPL Electric. The property is a wooded parcel that is zoned for Rural Development use and traversed by the existing Blooming Grove-Honesdale 138/69 kV Transmission Line along the eastern edge of the property. The property is bordered by wooded parcels on the north, south, and west sides of the substation site. To the east, the property is bordered by the Owego Turnpike. Residential properties are located on the opposite side of the Owego Turnpike. Due to the transmission facilities in the area, the incremental visual impacts of the project will be minimal.

The proposed line will tap the existing Blooming Grove-Honesdale 138/69 kV Transmission Line, which traverses the site proposed for the project, and extends to the new Dappers 69-12 kV Substation.

No nearby communication towers, pipelines, or other utilities will be affected by the proposed project. The Cherry Ridge Airport is located approximately 0.20 miles to the east of the project site and the Port Florence Airport is located approximately 3.65 miles to the east of the project site. Impacts to these airports are not expected due to the location of the project in relation to the orientation of the runways, and the fact that the property currently contains structures that are taller than the proposed structures. Nonetheless, the appropriate notifications were filed with the Federal Aviation Administration and PennDOT Bureau of Aviation to confirm that the proposed tap line will not be a hazard to the airports' flight operations. These entities have not responded with any objection to the project being a hazard to air navigation.

C. CULTURAL RESOURCES

The project was reviewed by the Pennsylvania Historical and Museum Commission (PHMC). The PHMC has determined that there are no National Register eligible or listed historic or archaeological properties in the area (File No. ER 2010-0783-127-A). Therefore, no impacts to such resources are anticipated and no further investigations are required.

D. NATURAL FEATURES

The project will not affect any unique geological, scenic, or natural areas. The recreational areas located closest to the project site are: the Pennsylvania State Game Lands Number 183, which is located approximately 6 miles southeast of the project site; the Prompton State Park, which is located approximately 6.2 miles northwest of the project site; the Varden Conservation Area, which is located approximately 6.8 miles west of the project site; and the Delaware State Forest, which is located approximately

7.9 miles southeast of the project site. There are no anticipated impacts to these features due to the distance from the project area, development between the project area and the features, and the small project size.

Approximately 2.25 acres of tree clearing is required for this project. PPL Electric will apply its "Specifications for Initial Clearing and Control of Vegetation on or Adjacent to Electric Right-of-Way Through Use of Herbicides, Mechanical, and Hand Clearing Techniques" to mitigate impacts.

The transmission tap line will not cross any wetlands or areas designated as "Waters of the U.S." or "Waters of the Commonwealth." PPL Electric will acquire and comply with any required soil erosion and sedimentation control permit conditions. Additionally, any required permits will be obtained from the Pennsylvania Department of Environmental Protection and the United States Army Corps of Engineers prior to construction, and PPL Electric will comply with all conditions placed on the permits.

E. THREATENED AND ENDANGERED SPECIES

PPL Electric has coordinated with different state and federal agencies to obtain information regarding threatened and endangered species in close proximity to the project area. A review of the Pennsylvania Natural Diversity Inventory (PNDI) records indicates that there are no anticipated impacts to threatened and endangered species and/or special concern species and resources (PNDI Search ID: 20100119224886).

LIST OF SUPPLEMENTAL ATTACHMENTS

ATTACHMENT "4"	PPL Design Criteria and Safety Practices
ATTACHMENT "5"	PPL Magnetic Field Management Program
ATTACHMENT "6"	List of Involved Governmental Agencies, Municipalities and Other Public Entities

Attachment 4

ATTACHMENT “4”

DAPPERS 138/69 kV TAP LINE

PPL ELECTRIC DESIGN CRITERIA AND SAFETY PRACICES

The National Electrical Safety Code (NESC) is a set of rules to safeguard people during the installation, operation, or 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 has developed design specifications and safety rules which meet or surpass all provisions specified by the NESC.

Engineering Design Criteria and Parameters

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

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

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

138 kV

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. Numerous 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.

<u>Personnel Safety Rules</u>

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

ATTACHMENT 5

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

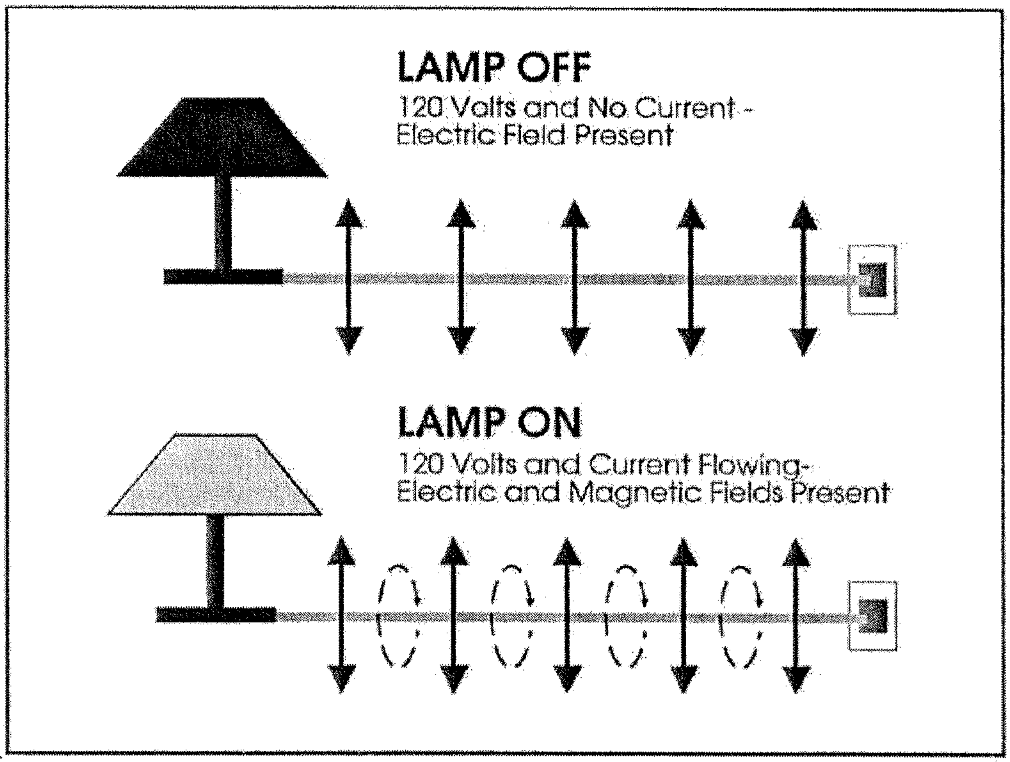

LAMP OFF
120 Volts and No Current -
Electric Field Present
LAMP ON
120 Volts and Current Flowing-
Electric and Magnetic Fields Present

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.

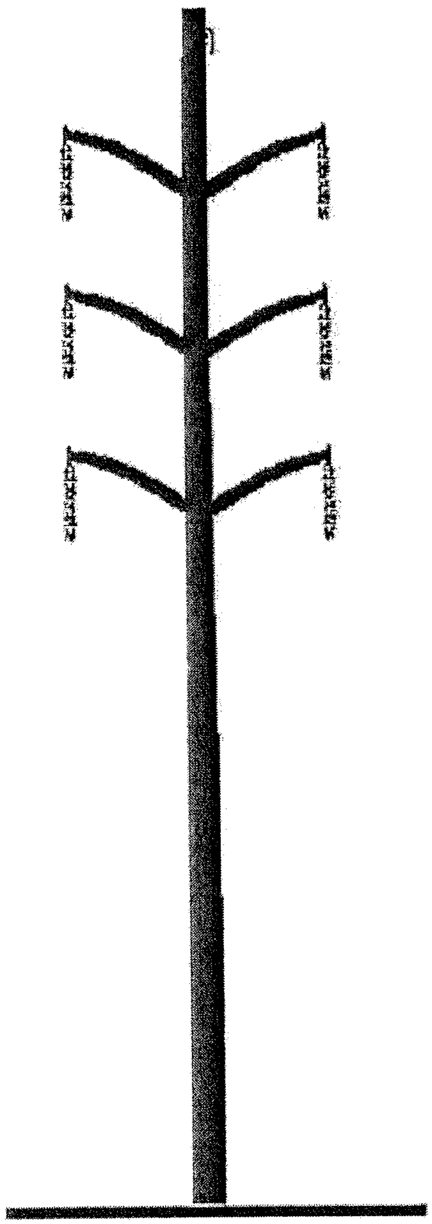
- Main lines are the most heavily loaded sections of a distribution line and therefore have the highest magnetic fields associated with them.
- Increasing the ground clearance by five feet reduces the magnetic field under the line from 14 mG to 11 mG using the standard eight-foot crossarm design. These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

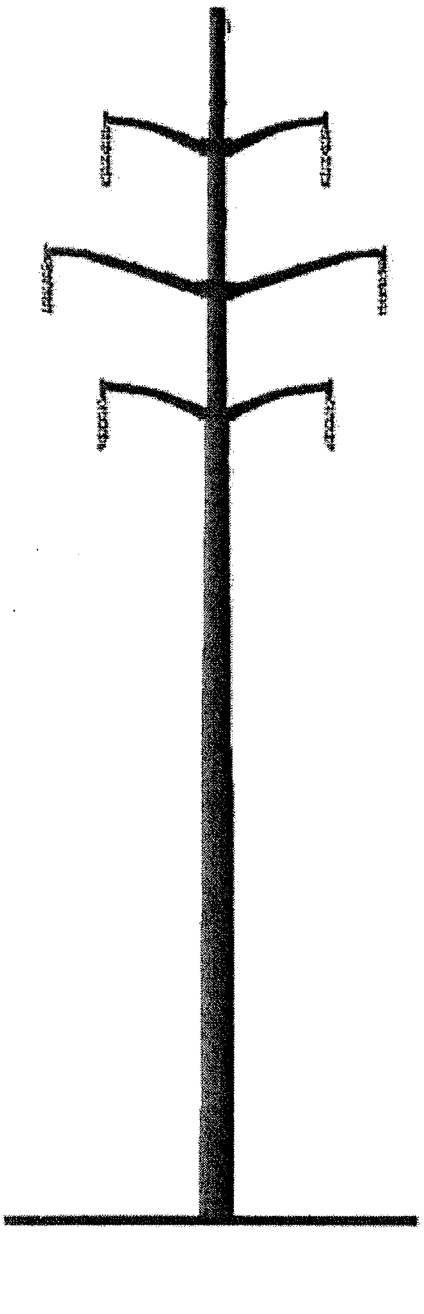
Short-Span Construction



- **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:**

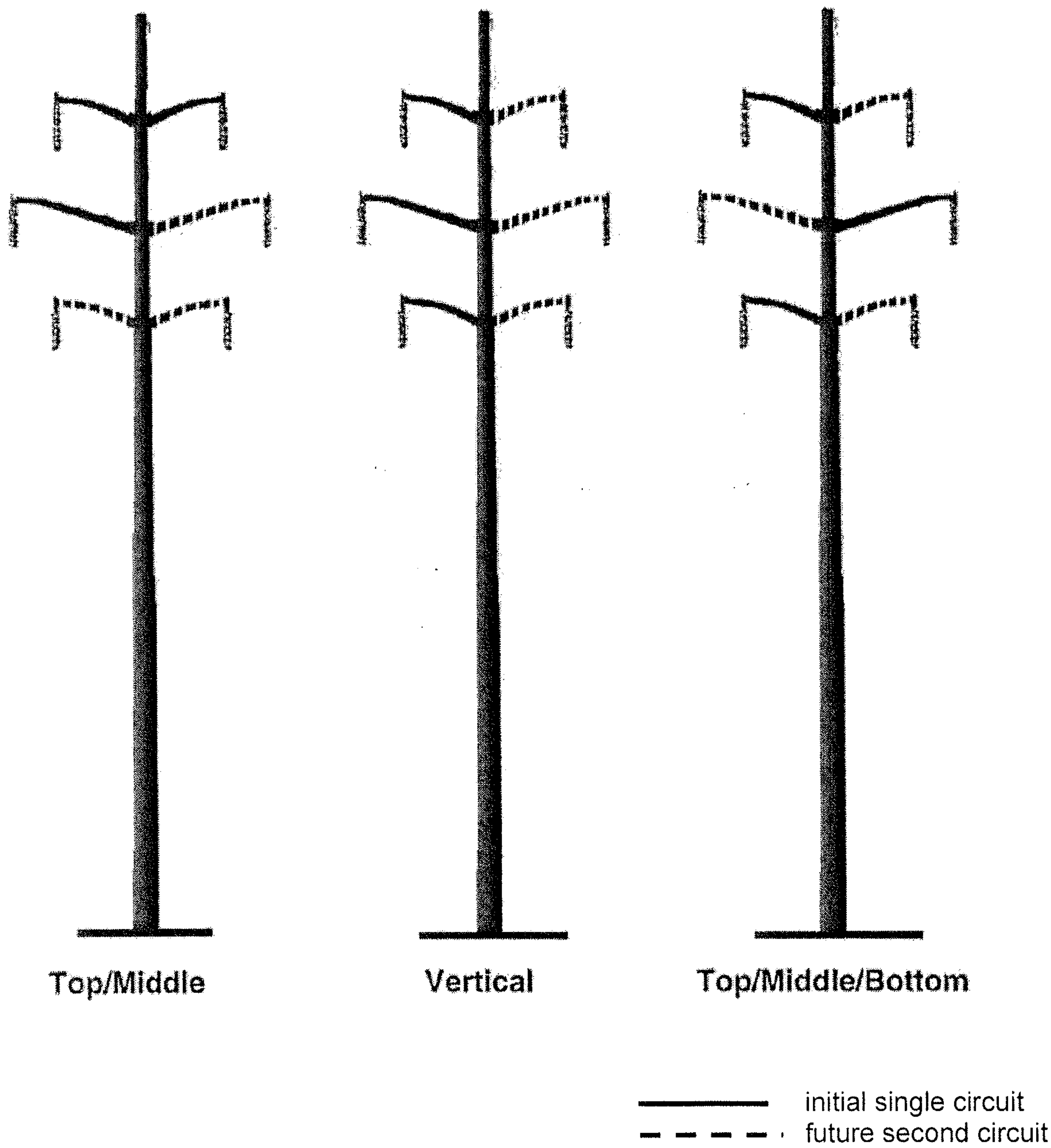
1 3/8" HS steel overhead ground wire - 17.3 feet sag
6-556.5 KCMIL 24/7 ACSR power conductors - (PARAKEET) 23.0 feet sag
Average span - 600 feet

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

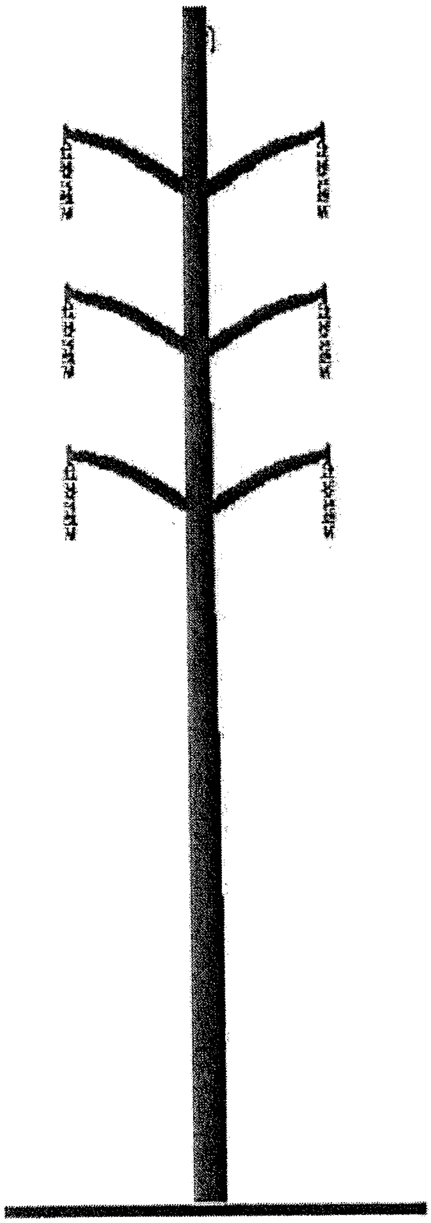


138/69 kV SINGLE CIRCUIT TRANSMISSION LINES CALCULATED MAGNETIC FIELDS AT 400 AMPERES

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

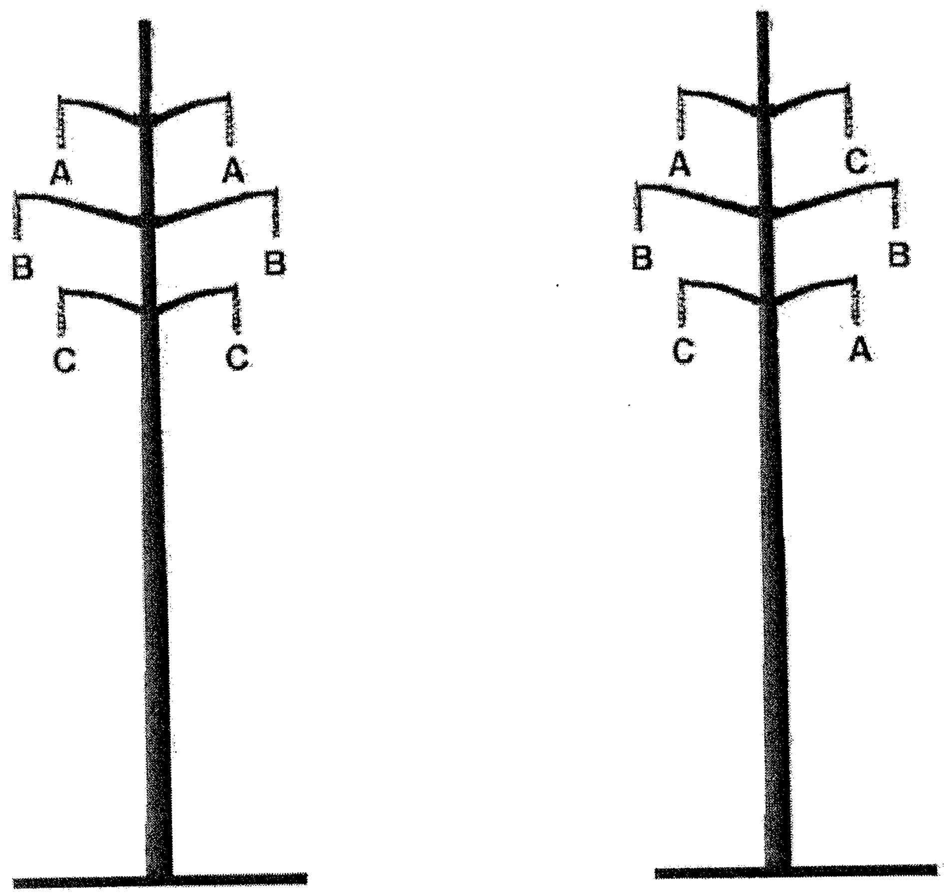


- **Minimize magnetic fields due to compact design**
- **Not a low-cost alternative**
- **Typical conductor data:**

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

CHART VII

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"

DAPPERS 138/69 kV TAP LINE

LIST OF INVOLVED GOVERNMENTAL AGENCIES, MUNICIPALITIES AND OTHER PUBLIC ENTITIES

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

Pennsylvania Department of Transportation
Commonwealth Keystone Building
400 North Street, 8th Floor
Harrisburg, Pennsylvania 17120
Attn: The Honorable Allen D. Beihler, P.E., Secretary

Department of Environmental Protection
P. O. Box 2063
Market Street Office Building
Harrisburg, Pennsylvania 17105-2063
Attn: Office of Field Operations

Wayne County Commissioners
925 Court Street
Honesdale, PA 18431
Attn: Brian W. Smith, Chairperson

Wayne County Planning Commission
925 Court Street
Honesdale, PA 18431
Attn: Edward J. Coar, Director

Cherry Ridge Township Board of Supervisors
269 Spinner Rd
Honesdale, PA 18431
Attn: John W. Rickard, Jr., Chairperson

Cherry Ridge Township Planning Board
269 Spinner Rd
Honesdale, PA 18431
Attn: Lois Powderly, Secretary