ATTACHMENT 2
NORTHEAST-POCONO RELIABILITY PROJECT
NECESSITY STATEMENT

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1.0 INTRODUCTION

PPL Electric is requesting Pennsylvania Public Utility Commission (PUC or the Commission) approval to site and construct transmission lines associated with the proposed West Pocono 230 – 69 kV Substation in Buck Township, Luzerne County and the proposed North Pocono 230 – 69 kV Substation in Covington Township, Lackawanna County (together, the "Northeast-Pocono Reliability Project"). As explained below, the proposed Northeast-Pocono Reliability Project is required to resolve violations of PPL Electric's "Reliability Principles & Practices" (RP&P) guidelines and to reinforce the 69 kV systems in Carbon, Lackawanna, Luzerne, Monroe, Pike, and Wayne Counties by bringing a new 230 kV supply into the area.

PPL Electric is proposing to build a 230 kV network of transmission facilities which will extend into the counties identified above. This network will be created by extending the existing 230 kV system which currently loops around the defined Northeast Pocono area. Extending the 230 kV source(s) into the area which is closer to the growing customer load and tying those 230 kV source(s) into the existing local 69 kV facilities through new regional substations will create a stronger, more reliable power system. PPL Electric's proposed project will significantly reinforce transmission supply to the northeast portion of PPL Electric's service territory.

Currently, the only source of supply to the Northeast Pocono area is provided by 138/69 kV transmission circuits.[1] It has been approximately 30 years since the last major transmission reinforcement was built in this Northeast Pocono area. There has been substantial load growth over time and that load growth is expected to continue. The concern with the transmission facilities in this area is that the 69 kV transmission circuits are long in length and serve a significant number of customers. These customers are vulnerable to long duration outages for loss of the transmission circuit which serves them. The ability to restore service to these customers is limited due to the lack of 230 kV transmission sources in the area. The RP&P violations identified in this report demonstrate that the local transmission system does not measure up to PPL Electric's reliability standards.

A reinforced network of 230 kV transmission facilities in the Northeast Pocono area, along with new transmission substations and 138/69 kV transmission circuit connections, will allow for a

[1] See Appendix 6 for a definition of a 138/69 kV circuit.

system configuration with shorter 138/69 kV transmission circuit lengths and the improved ability to transfer load from one source to another in the event of a facility outage. This system configuration will reduce the number of customers affected by a single facility outage and will also provide an alternate supply of power to customers for the loss of their normal transmission supply circuit, resulting in improved power restoration times.

PPL Electric's transmission system studies of the area that revealed that, starting by the winter of 2014-2015, an outage of any one of the following facilities would result in violations of PPL Electric's RP&P guidelines for load interruption due to a contingency (unplanned outage):

(1) Double-circuit outage of the Blooming Grove – Jackson[2] and Peckville – Jackson 138/69 kV Transmission Line;

(2) Single-circuit outage of the Peckville – Jackson 138/69 kV circuit on the Blooming Grove – Jackson and Peckville – Jackson 138/69 kV Transmission Line;

(3) Single-circuit outage of the Blooming Grove – Jackson 138/69 kV circuit on the Blooming Grove – Jackson and Peckville – Jackson 138/69 kV Transmission Line;

(4) Double-circuit of the East Palmerton – Wagners #1 & #2 138/69 kV Transmission Line; and

(5) Single-circuit outage of the East Palmerton - Wagners #2 138/69 kV circuit on the East Palmerton-Wagners #1 & #2 Transmission Line.

These studies further project that, by the winter of 2015-2016, the normal loading on both the Blooming Grove - Jackson and Peckville-Jackson 138/69 kV circuits will violate PPL Electric's RP&P guidelines. This is a concern because it limits the ability for PPL Electric to restore load from the interruption of a neighboring circuit.

Finally, the transmission system studies identified that, by the winter of 2026-2027, the loss of one of the transformers at the Jackson 138-69 kV Substation could overload the remaining transformer in excess of its one month thermal rating, which also would be a violation of the RP&P guidelines. These violations demonstrate that the 138/69 kV transmission system serving the Northeast Pocono area needs to be reinforced.

[2] Abbreviated names of facilities appear on the figures in Appendix 5.

The Northeast-Pocono Reliability Project is required to resolve the violations of the RP&P guidelines and to reinforce the existing 138/69 kV transmission system serving Carbon, Lackawanna, Luzerne, Monroe, Pike, and Wayne Counties by bringing a new 230 kV supply source closer to the growing load centers. To accomplish this, PPL Electric proposes to locate the new West Pocono and North Pocono 230-69 kV Substations central to the load they will serve. The two new Substations and associated new transmission lines will enable PPL Electric to shorten the length of the existing 138/69 kV transmission circuits, which will reduce the distance between the supply of power and the homes and businesses that use the electricity. This proposed arrangement also will provide an alternate supply of power to the Northeast-Pocono area in the event that the normal supply is interrupted, which will improve power restoration times and provide operating flexibility and improved reliability for customers in the area. The Northeast-Pocono Reliability Project will reduce the number of customers affected by a single facility outage, as well as reduce the duration of the outage.

In this filing, PPL Electric seeks approval from the PUC to site and construct transmission lines associated with two new 230-69 kV transmission substations, the West Pocono 230 – 69 kV Substation and North Pocono 230 – 69 kV Substation.[3] The new Substations will be connected to the existing 230 kV transmission system by building a new 58-mile 230 kV transmission line. The proposed transmission line will be divided into three segments:

(1) Approximately 15 miles of new 230 kV transmission line will be constructed from the existing Jenkins 230-69 kV Substation to the proposed West Pocono 230-69 kV Substation;

(2) Approximately 21 miles of new 230 kV transmission line will be constructed from the proposed West Pocono 230-69 kV Substation to the proposed North Pocono 230-69 kV Substation; and

[3] PPL Electric will file zoning petitions for the West Pocono and North Pocono 230-69 kV Substations, seeking findings that the buildings to shelter control equipment at each of the Substations are reasonably necessary for the convenience or welfare of the public and, therefore, exempt from any local zoning ordinance pursuant to 52 Pa. Code § 5.41 and 53 P.S. § 10619.

(3) Approximately 22 miles of new 230 kV transmission line will be constructed from the proposed North Pocono 230-69 kV Substation to the previously approved Paupack 230-69 kV Substation.[4]

These new 230 kV transmission lines will each be designed for future 230 kV double-circuit capability, but initially only a single 230 kV circuit will be installed until load growth necessitates the addition of the second 230 kV circuit.

PPL Electric also proposes to construct five new 138/69 kV transmission lines to connect the new West Pocono 230 – 69 kV Substation and North Pocono 230 – 69 kV Substation to the existing 69 kV system. Approximately 5.3 miles of new 138/69 kV transmission lines will be constructed to connect the new North Pocono 230-69 kV Substation to the existing 69 kV system. Approximately 6.0 miles of new 138/69 kV transmission line will be constructed to connect the new West Pocono 230-69 kV Substation to the existing 69 kV system. These new 138/69 kV connecting lines will be designed and constructed for future 138 kV operation, but initially will operate at 69 kV until load growth in the area necessitates an increase in the operating voltage.

Collectively, the proposed North Pocono and West Pocono 230-69 kV Substations and associated new 230 kV and 138/69 kV transmission lines make up the proposed Northeast-Pocono Reliability Project.

The estimated cost to site, design, and construct the Northeast-Pocono Reliability Project is approximately $154 million. This cost includes the siting, design, and construction of the proposed new 230 kV and 138/69 kV transmission lines, the West Pocono and North Pocono 230-69 kV Substations, and the acquisition costs for needed rights-of-way. The overhead transmission portion is estimated to cost approximately $100.9 million and the required substation installations are estimated to cost approximately $36 million. Construction of this project is scheduled to begin in Spring 2014 to meet an in-service date of November 2017.

A PPL Electric system map showing existing transmission facilities with a design voltage of 35 kV or greater is included in the **Attachment "2" Map Pocket**. This filing addresses only the

[4] On June 11, 2012, PPL Electric submitted a Zoning Petition, at Docket No. P-2012-2309302, for a finding that will exempt the control equipment building at the proposed Paupack 230-69 kV Substation from the Paupack Township Zoning Ordinance. This Zoning Petition was approved by the Commission on September 27, 2012.

existing and proposed transmission system in Carbon, Lackawanna, Luzerne, Monroe, Pike, and Wayne Counties.

2.0 SYSTEM PLANNING PROCESS AND GUIDELINES

2.1 System Planning

System Planning is the process which assures that transmission systems can supply electricity to all customer loads reliably and economically. This System Planning process assures that the transmission systems:

- Are able to accommodate the forecasted system flows during the summer peak load conditions;
- Are constructed to adequately serve customers' needs with regard to capacity, voltage, and reliability for all load levels throughout the daily load cycle;
- Can sustain probable contingencies and disturbances with no consequential loss of load; and
- Conform to the applicable transmission planning reliability principles, practices, and standards for all normal and emergency operating conditions.

The process of planning the transmission system requires PPL Electric to look into the future to develop a reinforcement plan far enough in advance to be able to complete a project when it is needed. Ideally, transmission facility upgrades are planned such that the in-service date corresponds with the time frame that the facility is required to meet the planning criteria established by the RP&P guidelines. Significant lead times are needed to design and install new line and substation facilities where new sites and/or rights-of-way must be acquired.

2.2 The PPL Electric System Planning Process

The reliable and economical operation of PPL Electric's transmission system requires planning guidelines for system expansion and reinforcement. The principles upon which these planning guidelines are based recognize that:

- The system expansion should be coordinated to achieve an economical balance of construction and operating expenditures;
- The system should maintain a proper balance between the degree of risk, amount and type of load interrupted, and the cost of providing the needed expansion; and
- The system reliability should be maintained to prevent large scale, long term, or frequent service interruptions to avoid adverse effects and hazards to the public.

PPL Electric undertakes an independent analysis of both its bulk electric system (BES) transmission facilities and its non-bulk electric transmission system facilities.[5] The bulk electric system includes transmission facilities operated at voltages of 100 kV or higher. The non-bulk electric system (non-BES) includes transmission facilities operated at voltages less than 100 kV. The PPL Electric planning guidelines are outlined in the RP&P, which was developed to ensure adequate and appropriate levels of electric service to its customers consistent with good utility practice.

The fundamental purpose of the RP&P is to provide PPL Electric planning engineers with a comprehensive set of planning guidelines and criteria that enable them to plan for a reliable transmission and distribution system for PPL Electric's customers. The RP&P is reviewed periodically by PPL Electric engineers and planners. The document is updated as required to reflect current standards and practices. Updates to the document are approved by PPL Electric's senior management. PPL Electric's RP&P is consistent with good utility practices and with the reliability criteria and standards used by similarly situated distribution and transmission utilities.

In accordance with the RP&P guidelines, PPL Electric's transmission system is planned so that it can be operated at all projected load levels and during normal scheduled outages and to withstand specific unscheduled contingencies without exceeding the equipment capability, causing system instability or cascade tripping, or exceeding voltage tolerances. The transmission system is required to have adequate capability so that it can be operated normally and can withstand the following unscheduled contingencies and other system conditions:

[5] See Appendix 6 for the definitions of bulk and non-bulk electrical systems.

- For normal system operations, the system should remain stable, and both thermal and voltage limits should remain within the applicable ratings in order to prevent equipment damage.
- For the loss of any single element (e.g., transmission line, transformer, or generator), following the contingency, the system should remain stable and both thermal and voltage limits should stay within the applicable ratings in order to prevent equipment damage and cascading outages. Typically, the failure of any single element should not result in:
    - Loss of load in excess of the specified limits as defined in the RP&P.
    - Loading of facilities above emergency ratings for each time interval specified in the RP&P.
    - A sustained voltage drop of more than 5% on the non-bulk electric system.

These principles are incorporated in the PPL Electric's RP&P document.

The planning process begins with the development of a computer model of the future system. A specific study year is chosen, and the future system model is developed using the existing system plus any planned modifications to the transmission system scheduled to be completed prior to the study year. Load levels used in the system model are based on the latest forecast prepared annually by PJM Interconnection, L.L.C. (PJM).

Once the system model is complete, comprehensive power flow simulations are performed to determine the ability of the system to comply with the PPL Electric transmission planning and reliability criteria set forth in PPL Electric's RP&P. This is accomplished by simulating the contingency conditions outlined above. All conditions where the system is not in conformance with the RP&P reliability criteria are identified, and system reinforcement alternatives are added to bring the system into compliance. Also identified are estimated costs and lead times to implement the reinforcements under consideration. Computer simulations of the system with the identified reinforcement alternatives are completed to identify the best overall reinforcement that will meet the needs of the area in a reliable and economical manner.

The base case study and assumptions for the power flow simulations for the proposed Northeast-Pocono Reliability Project are provided in Section 6, Appendix 1.

2.3 PJM's Role In The Project

PJM is a Federal Energy Regulatory Commission (FERC) approved Regional Transmission Organization charged with ensuring the reliability of the electric transmission system under its functional control and coordinating the movement of electricity in all or parts of thirteen states and the District of Columbia, including most of Pennsylvania. In order to ensure reliable transmission service, PJM prepares an annual Regional Transmission Expansion Plan (RTEP) to identify system reinforcements that are required to, among other things, meet the North American Electric Reliability Corporation (NERC) Reliability Standards,[6] PJM reliability planning criteria, and transmission owner reliability criteria. The RTEP is a FERC-approved transmission planning process that results from a comprehensive analysis to identify existing and forecasted violations of the NERC Reliability Standards on the transmission systems within PJM's service territory.[7]

PJM's RTEP is an annual process that encompasses a comprehensive series of detailed analyses to ensure power continues to flow reliably to customers under stringent reliability criteria set by NERC. The NERC reliability standards, transmission owner criteria, and PJM reliability planning criteria are used by PJM and the transmission owners to analyze the system and to determine the specific transmission upgrade projects, as part of the overall reliability solution, that are needed to ensure long-term reliable electric service to customers and competitive power markets.

With respect to the BES, PJM conducts RTEP studies in conjunction with its transmission owners and applies NERC or PJM reliability criteria to specific conditions on the transmission system. When the studies show an inability of the transmission system to meet a specific reliability standard under these conditions, solutions such as construction of one or more new

[6] On February 3, 2006, FERC certified the North American Electric Reliability Corporation ("NERC") as the organization required to establish and enforce reliability standards for the bulk electric system. Thereafter, NERC develops and enforces reliability standards, which define the reliability requirements for planning and operating transmission systems in North America. The NERC Reliability Standards apply to all users, owners, and operators of the nation's interconnected transmission grid, including PPL Electric.

[7] PJM's RTEP process is currently set forth in Schedule 6 of PJM's Amended and Restated Operating Agreement ("Schedule 6"). Schedule 6 governs the process by which PJM's members rely on PJM to prepare an annual regional plan for the enhancement and expansion of the transmission facilities to ensure long-term, reliable electric service consistent with established reliability criteria. In addition, Schedule 6 addresses the procedures used to develop the RTEP, the review and approval process for the RTEP, the obligation of transmission owners to build transmission upgrades included in the RTEP, and the process by which interregional transmission upgrades will be developed.

transmission lines or one or more upgrades to existing transmission facilities may be necessary. PPL Electric, an owner of transmission facilities in Pennsylvania, is a member of PJM and actively participates in the PJM transmission planning process.

The proposed Northeast-Pocono Reliability Project will resolve reliability criteria violations of PPL Electric's local planning criteria (RP&P) on the 69 kV transmission system, the non-bulk electrical system. For non-BES system reliability violations, the local transmission operator, in this case PPL Electric, is responsible for identifying the reliability violations and correcting any violations to meet its own local transmission planning criteria. Projects that are necessary to resolve either NERC criteria, PJM reliability criteria, or the transmission owners' own local transmission planning criteria are included as baseline projects in PJM's RTEP.

To meet the spirit of FERC Order 890 for a more open and transparent transmission planning process, PJM has taken a more active role in ensuring that the transmission owners communicate their plans for the development of their lower voltage transmission systems. In order to comply with FERC Order 890, transmission owners began submitting their lower voltage reliability projects to PJM in the 2009 timeframe so that they can be presented before the PJM stakeholders at the Sub-Regional RTEP Committee meetings.

The PJM Sub-Regional RTEP Committee review includes, but is not limited to, the review of the transmission owner criteria, assumptions and models used to identify reliability criteria violations and proposed solutions prior to finalizing the Local Plan. The Committee members are provided an opportunity to review and provide written comments to the transmission owners on the criteria, assumptions, and models used in local planning activities prior to finalizing the Local Plan. Once the Local Plan is finalized, the Committee is provided an opportunity to review and provide written comments to the transmission owners on the Local Plans as integrated into the RTEP. The final draft RTEP, with the transmission owners Local Plans that were reviewed and endorsed by the Committee, is then included in the final version, which is sent to the PJM Board for approval. Once the PJM Board approves the RTEP that includes the transmission owner Local Plans, the transmission owners then move forward to implement the RTEP BES transmission and the non-BES facilities as they are obligated to do under the PJM Tariff and Operating Agreements.

The proposed Northeast-Pocono Reliability Project involves both BES and non-BES facilities. However, the purpose of this Project is to resolve reliability violations that occur on the non-BES (69 kV) system serving portions of the Northeast and Central Regions of PPL Electric. PPL Electric submitted the proposed Northeast-Pocono Reliability Project to PJM for review and inclusion in the RTEP. The Project, as identified in **Table 2-1** below, was presented before stakeholders at the Mid-Atlantic Sub-Regional RTEP meetings, approved by the PJM Board, and included in the 2011 RTEP Report as a series of baseline projects, as follows:

TABLE 2-1: Information Presented at Mid-Atlantic Sub-Regional RTEP

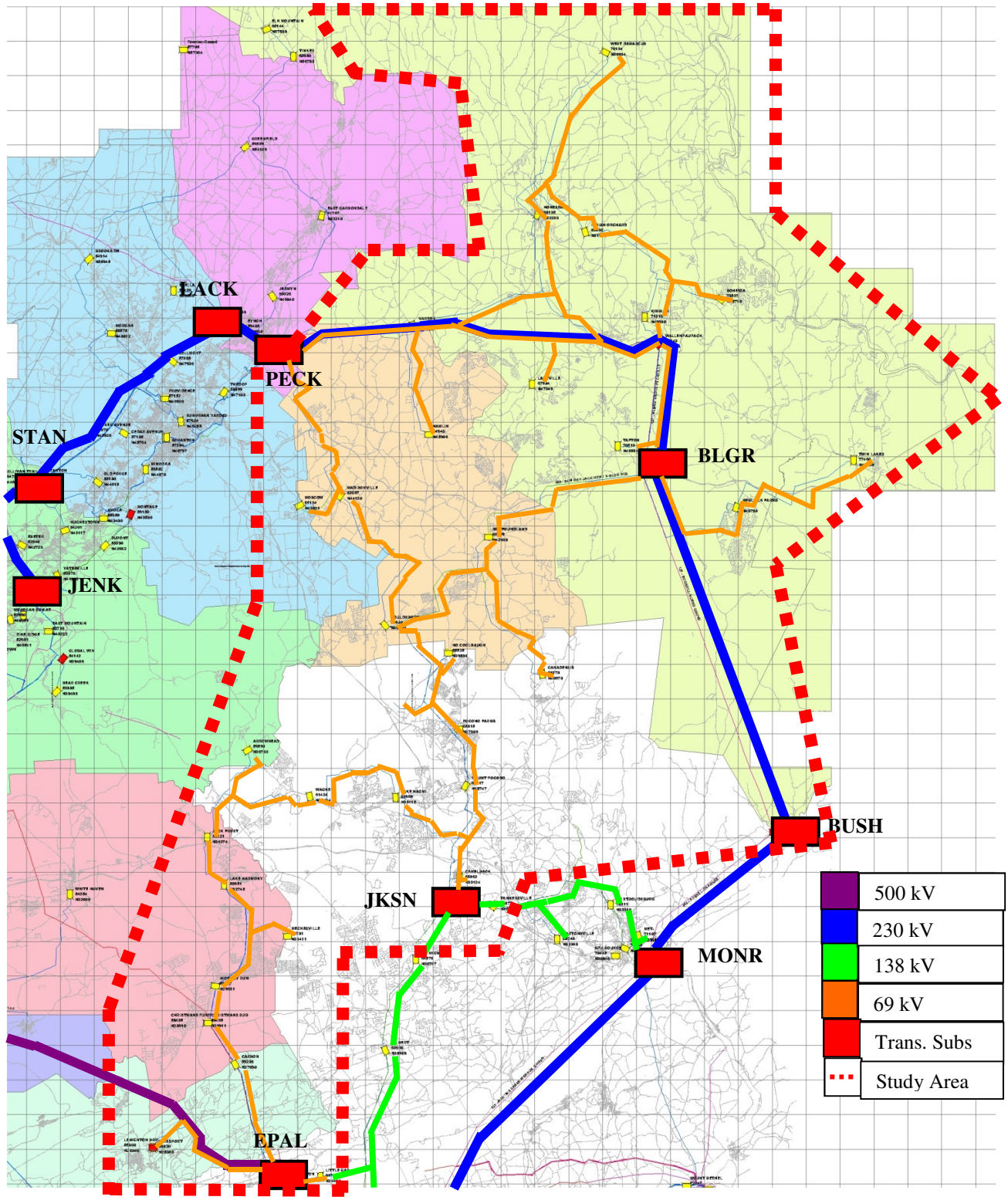
PJM No.	PPL No.	Project Description	Date Presented to Mid-Atlantic Sub-Regional RTEP
b1813.7	**08238**	Jenkins Sub - Install 3E 230 kV CB	3/2/2011
b1890	**08271**	North Pocono; Install 2nd Transformer	3/2/2011
b1813.3	**09058**	West Pocono - North Pocono 230 kV Circuit	3/2/2011
b1813.6	**09063**	Jenkins - West Pocono 230 kV Circuit	3/2/2011
b1813.8	**09068**	Paupack-North Pocono 230 kV Circuit	10/27/2011
b1813.10	**20091**	Re-terminate 69 kV Peckville Lines into Lackawanna	10/27/2011
b1813.2	**30064**	North Pocono 230-69 kV Substation	10/27/2011
b1813.5	**39904**	West Pocono 230-69 kV Substation	10/27/2011

3.0 EXISTING SYSTEM

3.1 Current Configuration of the Northeast Pocono Area

The Northeast Pocono area is loosely bounded on the west by several 230 kV transmission lines; on the north and east by a single 230 kV transmission line; and on the south by a double-circuit 138 kV transmission line. The current configuration of PPL Electric's transmission system in the Northeast Pocono Area consists of long transmission lines between regional substations. **Figure 2-1** below provides an area map of the existing transmission facilities in the Northeast Pocono Area.

FIGURE 2-1 – FUNCTIONAL AREA MAP OF EXISTING FACILITIES IN THE NORTHEAST POCONO AREA



As shown in **Figure 2-1** above, sources of electric power to the Northeast Pocono area currently are provided by four non-BES transmission substations[8] located at the outer boundaries of the area and connected into the 230 kV or 69 kV systems: the Peckville, Blooming Grove, and East Palmerton 230-69 kV Substations and the Jackson 138-69 kV Substation. The Peckville, Blooming Grove, and East Palmerton 230-69 kV Substations receive power from the 230 kV bulk power network and transform that power down to the 69 kV voltage level. The Jackson 138-69 kV Substation receives power from the 230 kV bulk power network through the Monroe and Siegfried 230-138 kV Substations, and transforms that voltage from 138 kV to 69 kV.

Presently, the only sources of electrical power to the northern portion of the Northeast Pocono area are the Peckville-Jackson 138/69 kV and the Blooming Grove-Jackson 138/69 kV circuits. The circuits are constructed for future 138 kV operation, but currently are operated at 69 kV. The Peckville-Jackson 138/69 kV circuit, including the related taps, is 48 miles in length and has one normally open (sectionalizing)[9] point located at the North Coolbaugh 69-12 kV Substation.[10] The Blooming Grove-Jackson 138/69 kV circuit, including related taps, is 67 miles in length and has one normally open (sectionalizing) point located at the Gouldsboro 69-12 kV Substation.[11] From the Jackson 138-69 kV Substation to the Gouldsboro 69-12 kV Substation, the Blooming Grove-Jackson and Peckville-Jackson 138/69 kV circuits are built on double-circuit 138/69 kV tower structures -- that is, both the Blooming Grove-Jackson 138/69 kV circuit and the Peckville-Jackson 138/69 kV circuit are installed on common structures as a double-circuit transmission line. From the Gouldsboro 69-12 kV Substation, the Blooming Grove-Jackson 138/69 kV circuit proceeds on separate single-circuit 138/69 kV tower structures towards the

[8] A substation is classified as part of the BES or non-BES electrical system based on the voltage of the downstream portion of the substation.

[9] See Appendix 6 for the definition of sectionalizing.

[10] The line lengths and number of customers served by the circuits serving the Northeast Pocono area are provided in Appendices 3 and 4.

[11] The Blooming Grove-Jackson 138/69 kV circuit currently supplies the Lake Naomi 138/69 kV Tap. On May 15, 2012, PPL Electric filed a Full Siting Application at Docket No. A-2012-2304631, which currently is pending before the Commission. Therein, PPL Electric is seeking Commission approval to construct a new double-circuit 138/69 kV transmission line, the Jackson-Wagners #1 & #2 138/69 kV Transmission Line from the Jackson 138-69 kV Substation to the Lake Naomi 138/69 kV Tap, a distance of approximately 4 miles. If this project is approved, the Lake Naomi 138/69 kV Tap will have its own independent power source and will no longer be supplied by the Blooming Grove-Jackson 138/69 kV circuit. The in-service date for this project is November 2013. This project is known as B0708 in the PJM project queue. A one-line diagram of the transmission facilities in the northern portion of the Northeast Pocono area after completion of PJM project B0708 is provided as Figure 2-6 in Appendix 2 in Section 6.

Blooming Grove 230-69 kV Substation. From the Gouldsboro 69-12 kV Substation, the Peckville-Jackson 138/69 kV circuit proceeds on separate single-circuit 138/69 kV tower structures to the Peckville 230-69 kV Substation.[12]

A one-line diagram of the existing transmission facilities in the northern portion of the Northeast Pocono area is provided as **Figure 2-4** in Appendix 2 in Section 6.

Presently, the only sources of electrical power to the western portion of the Northeast Pocono area are the East Palmerton-Wagners #1 & #2 138/69 kV circuits. These circuits are constructed for future 138 kV operation, but currently are operated at 69 kV. The East Palmerton-Wagners #1 138/69 kV circuit, including related taps, is 37 miles in length. The East Palmerton-Wagners #2 138/69 kV circuit, including related taps, is 32 miles in length.[13] From the East Palmerton 230-69 kV Substation to the Lake Harmony 69-12 kV Substation, the East Palmerton-Wagners #1 & #2 138/69 kV circuits, are built on double-circuit 138/69 kV tower structures -- that is, both the #1 and #2 138/69 kV circuits are installed on common structures as a double-circuit line. The East Palmerton-Wagners #2 138/69 kV circuit terminates at the Lake Harmony 69-12 kV Substation. The East Palmerton-Wagners #1 138/69 kV circuit then proceeds on separate single-circuit 138/69 kV tower structures from the Lake Harmony 69-12 kV Substation to the Wagners 69-12 kV Substation and then terminates at the Lake Naomi 138/69 kV Tap pole.[14]

A one-line diagram of the existing transmission facilities in the western portion of the Northeast Pocono area is provided as **Figure 2-5** in Section 6, Appendix 2.

[12] See Appendix 6 for the definitions of a circuit and double-circuit transmission line.

[13] The line lengths and number of customers served by the circuits serving the Northeast Pocono area are provided in Appendices 3 and 4.

[14] PPL Electric plans to rebuild the East Palmerton-Wagners #1 & #2 Transmission Line from the Lake Harmony 69-12 kV Substation to the Lake Naomi 138/69 kV Tap pole for double-circuit operation. The length of circuit to be rebuilt is approximately 24 miles. PPL Electric plans to submit this project for Commission review and approval in mid-2013. This project is known as B1203 in the PJM project queue. A one-line diagram of the transmission facilities in the western portion of the Northeast Pocono area after completion of PJM project B1203 is provided as Figure 2-7 in Appendix 2 in Section 6. This project will improve the reliability of the transmission system by having a double-circuit line all the way through from the East Palmerton Substation to the Jackson Substation. However, even after completion of this project, violations have been identified that require further reinforcements in the area.

3.2 Load Growth in the Northeast Pocono Area

The Northeast-Pocono Reliability Project Study Area includes all or parts of six counties: Carbon, Lackawanna, Luzerne, Monroe, Pike, and Wayne. There currently are approximately 128,000 customers (approximately 635 MW of load) in the Northeast Pocono area.

The U.S. Census Bureau reports that the populations in the six counties that are associated with the Project Study Area have increased between 2000 and 2010, but the population change has not been equal across the region (Refer to **Table 2-2**). Based on the 2010 Census, the population of Lackawanna and Luzerne Counties has been relatively stationary, whereas the populations of Carbon and Wayne Counties have risen by over 10-percent, and the populations of Monroe and Pike Counties have risen by over 20-percent (U.S. Census 2010). Several of the townships located within these growing counties have seen a 20 to 40 percent growth in population between 2000 and 2010, and some townships are expected to double in population by 2020. Based on this growth pattern, proposed development within the Northeast Pocono area is anticipated to increase.

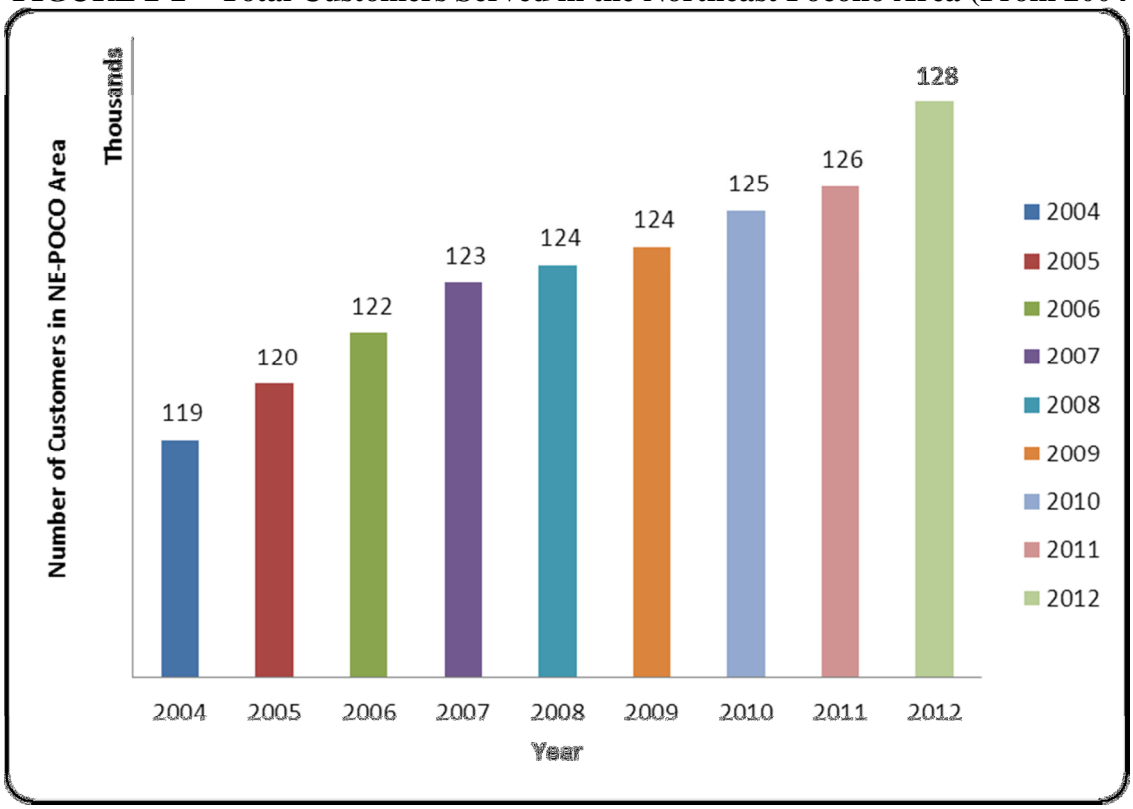
Consistent therewith, PPL Electric has experienced an increase in the peak load in the Northeast Pocono area from 2003 to 2012. During the same time period, the coincident system peak load in the Northeast-Pocono Reliability Project Study Area has grown 12%, from 565 MW to 635 MW. The load in the Northeast Pocono area has increased at a compound annual growth rate of approximately 1.5% per year from 2003 to 2012. PPL Electric also has experienced an increase in the number of customers served in the Northeast Pocono area. Since 2003, the number of electric customers served in the Study Area has grown from approximately 119,000 to 128,000 (refer to **Figure 2-2**).[15] Further, at this time, PJM projects a 1.1% annual future winter growth rate for the overall PPL zone for future years. This growth is consistent with PPL Electric data. Despite the continued and projected load growth in the Northeast Pocono area, there have been no significant improvements to the electric transmission systems serving the area since the early 1980s.

[15] The number of customers refers to billing accounts in the Study Area and does not equal the total population shown in Table 1.

TABLE 2-2: County Population Change (2000-2010)

County	Census 2000	Census 2010	Percent Change
Carbon	58,802	65,249	+11.0%
Lackawanna	213,295	214,437	+0.5%
Luzerne	319,250	320,918	+0.5%
Monroe	138,687	169,842	+22.5%
Pike	46,302	57,369	+23.9%
Wayne	47,722	52,822	+10.7%

FIGURE 2-2 – Total Customers Served in the Northeast Pocono Area (From 2004 to 2012)



4.0 DEFINITION OF THE PROBLEM

4.1 Introduction

Currently, the only source of supply to the Northeast Pocono area is provided by 138/69 kV transmission circuits. There has been substantial load growth in this area since that time, which is expected to continue. However, it has been approximately 30 years since the last major transmission reinforcement was built in the Northeast Pocono area. The concern with the transmission facilities in this area is that the 69 kV transmission circuits are long in length (Refer to Section 6, Appendix 4) and serve a significant number of customers. These customers are vulnerable to long duration outages for loss of the transmission circuit which serves them. The amount of load that can be restored in the Northeast Pocono area after an outage is limited during certain peak winter conditions. This limitation is due to the unacceptable low voltage levels (below 62 kV) that result at particular distribution substations when customer load on the interrupted circuit is transferred to an adjacent circuit through abnormal sectionalizing.

As part of its transmission planning studies, PPL Electric simulates loss of facilities as described in the Planning Process in Section 2.2. The transmission planning studies indicate that the following outages would violate PPL Electric's RP&P guideline for the maximum allowable load that can be interrupted until repairs could be completed:

(1) Double-circuit outage of the Blooming Grove – Jackson and Peckville – Jackson 138/69 kV Transmission Line;

(2) Single-circuit outage of the Peckville – Jackson 138/69 kV circuit on the double-circuit Blooming Grove – Jackson and Peckville – Jackson 138/69 kV Transmission Line;

(3) Single-circuit outage of the Blooming Grove – Jackson 138/69 kV circuit on the double-circuit Blooming Grove – Jackson and Peckville – Jackson 138/69 kV Transmission Line;

(4) Double-circuit outage of the East Palmerton – Wagners #1 & #2 138/69 kV Transmission Line; and

(5) Single-circuit outage of the East Palmerton - Wagners #2 138/69 kV circuit on the double-circuit East Palmerton-Wagners #1 & #2 Transmission Line.

These studies further project that, by the winter of 2015-2016, the normal loading on both the Blooming Grove - Jackson and Peckville-Jackson 138/69 kV circuits will violate PPL Electric's RP&P guidelines for normal line loading. This is a concern because it limits the ability for PPL Electric to restore load from the interruption of a neighboring circuit.

Finally, the transmission system studies identified that, by the winter of 2026-2027, the loss of one of the transformers at the Jackson 138-69 kV Substation could overload the remaining transformer in excess of its one month thermal rating.[16] This would be a violation of the RP&P guidelines.

These violations are evidence that the 138/69 kV transmission system serving the Northeast Pocono area needs to be reinforced. The proposed Northeast-Pocono Reliability Project is required to resolve these violations of the RP&P and to reinforce the existing 138/69 kV transmission system serving the Northeast Pocono area by bringing a new 230 kV supply source closer to the growing load centers, which will reduce the number of customers affected by a single facility outage, as well as the duration of the outage.

The violations PPL Electric has identified are explained more fully below.

4.2 Violations Identified In the Northeast Pocono Area

i. Outage of the Double Circuit Blooming Grove-Jackson and Peckville-Jackson 138/69 kV Transmission Line.

As explained above, the Blooming Grove-Jackson and Peckville-Jackson 138/69 kV circuits are built on double-circuit 138/69 kV tower structures from the Jackson 138-69 kV Substation to the Gouldsboro 69-12 kV Substation. The Blooming Grove-Jackson and Peckville-Jackson 138/69 kV circuits are long and heavily-loaded.[17]

Under peak winter conditions, PPL Electric projects that, by the winter of 2014-15, an outage of the double-circuit Blooming Grove-Jackson and Peckville-Jackson 138/69 kV Transmission Line occurring outside the Jackson 138-69 kV Substation would interrupt approximately 124 MW of customer load served by distribution substations located at Camelback, Sanofi (customer-

[16] See Appendix 6 for a definition of the one month thermal emergency rating.

[17] The line lengths and number of customers served by the circuits serving the Northeast Pocono area are provided in Appendices 3 and 4.

owned),[18] Mount Pocono, and Pocono Farms for an extended period of time until repairs could be made. The amount of load interrupted for this contingency violates the RP&P guideline for maximum allowable load loss for a double-circuit line outage, which only allows 120 MW or less to be interrupted for that period of time until manual sectionalizing can be performed – usually a 2 hour or less duration.

The ability to restore this interrupted load by transferring load between the Blooming Grove and Jackson Substations and between the Peckville and Jackson Substations is limited. This limitation is due to the unacceptable low voltage levels (below 62 kV) that would occur at certain distribution substations located along these abnormally sectionalized circuits.[19] Bus voltages below the lower limit of the values specified in the RP&P is unacceptable. The interruption of customer load in excess of the values specified in the RP&P is a violation of PPL Electric's practices.

Only 56 MW of the 124 MW of the load could be restored from the Blooming Grove and Peckville Substations while maintaining acceptable voltage levels at the local 69 kV distribution substation buses. Therefore, approximately 68 MW would remain interrupted for an extended period of time until repairs can be completed. This amount of interrupted load would violate the RP&P guideline for maximum allowable load loss for a double-circuit line outage, which only allows up to 45 MW to be interrupted until overhead line repairs can be completed in an extended period of time. In general, the amount of time required to repair a damaged overhead transmission line might last for an extended work day or longer.

ii. Outage of the Peckville-Jackson 138/69 kV Circuit on the Double-Circuit Blooming Grove-Jackson and Peckville-Jackson 138/69 kV Transmission Line.

Under peak winter conditions, PPL Electric projects that, by the winter of 2014-2015, an outage of the Peckville-Jackson 138/69 kV circuit on the double-circuit Blooming Grove-Jackson and Peckville-Jackson 138/69 kV Transmission Line, occurring outside of the Jackson 138/69 kV Substation, would interrupt 64 MW of customer load. Given the limitations on the ability to restore interrupted load by transferring load between the Peckville and Jackson Substations, as explained above, only approximately 8 MW of the 64 MW of interrupted load could be restored while maintaining acceptable voltage levels at the local 69 kV distribution substation buses.

[18] The Sanofi customer-owned substation serves a large pharmaceutical company that produces vaccines.
[19] See Appendix 6 for a definition of abnormal sectionalizing..

Therefore, approximately 56 MW of load would remain interrupted for an extended period of time until repairs can be made. Further, Customer load served by distribution substations located at Camelback, Sanofi (customer-owned), Mount Pocono, and Pocono Farms would remain out of service because inadequate voltage would exist if complete load restoration was attempted. The remaining 56 MW of interrupted load would violate the RP&P guideline for maximum allowable load loss for a single transmission circuit outage, which only allows 30 MW or less to be interrupted until overhead line repairs can be completed.

iii. Outage of the Blooming Grove-Jackson 138/69 kV Circuit on the Double-Circuit Blooming Grove-Jackson and Peckville-Jackson 138/69 kV Transmission Line.

Under peak winter conditions, PPL Electric projects that, by the winter of 2021-2022, an outage of the Blooming Grove-Jackson 69 kV circuit on the double-circuit Blooming Grove-Jackson and Peckville-Jackson 138/69 kV Transmission Line, occurring outside of Jackson 138-69 kV Substation, would interrupt 64 MW of customer load. Given the limitations on the ability to restore interrupted load by transferring load between the Blooming Grove and Jackson Substations, as explained above, only 30 MW of interrupted load could be restored while maintaining acceptable voltage levels at the local 69 kV distribution substation buses. Therefore, approximately 34 MW of load would remain interrupted for an extended period of time. Further, customer load served by distribution substations located at Sanofi (customer-owned) and Mount Pocono would remain out of service because inadequate voltage would exist if complete load restoration was attempted. The remaining 34 MW of interrupted load would violate the RP&P guideline for maximum allowable load loss for a single transmission circuit outage, which only allows 30 MW or less to be interrupted until overhead line repairs can be completed.

iv. Outage of the Double-Circuit East Palmerton-Wagners #1 & #2 69 kV Transmission Line.

As explained above, from the East Palmerton 230-69 kV Substation to the Lake Harmony 69-12 kV Substation, the East Palmerton-Wagners #1 & #2 138/69 kV circuits are built on double-circuit 138/69 kV tower structures. Under peak winter conditions, PPL Electric projects that, by the winter of 2024-2025, an outage of the double-circuit East Palmerton-Wagners #1 & #2 138/69 kV Transmission Line occurring outside the East Palmerton 230-69 kV Substation would interrupt approximately 75 MW of load.

Restoring load from the Jackson 138-69 kV Substation, however, results in unacceptable low voltage along the abnormally sectionalized East Palmerton-Wagners #1 & #2 138/69 kV circuits. If load is restored from the Jackson 138-69 kV Substation, customer load served by distribution substations located at Weissport, Lehighton Boro (customer-owned), and Little Gap would need to be interrupted in order to maintain acceptable voltage levels. As a result, only 29 MW of the 75 MW could be restored while maintaining acceptable voltage levels at the local 69 kV distribution substation buses. Therefore, approximately 46 MW would remain interrupted for an extended period of time until repairs can be completed. The remaining 46 MW of interrupted load would violate the RP&P guideline for maximum allowable load loss for a double-circuit line outage, which only allows up to 45 MW to be interrupted until overhead line repairs can be completed.

v. Outage of the East Palmerton-Wagners #2 138/69 kV Circuit on the Double-Circuit East Palmerton-Wagners #1 & #2 Transmission Line.

Under peak winter conditions, PPL Electric projects that, by the winter of 2014-2015, an outage of the East Palmerton-Wagners #2 138/69 kV circuit on the double-circuit East Palmerton-Wagners #1 & #2 138/69 kV Transmission Line occurring outside the East Palmerton 230-69 kV Substation would interrupt 31 MW of customer load. Transferring load between East Palmerton and Jackson Substations is limited due to the resulting unacceptable low voltage that would occur along the abnormally sectionalized East Palmerton-Wagners #2 138/69 kV circuit. If interrupted load is restored from the East Palmerton and Jackson Substations, customer load served by distribution substations located at Weissport, Lehighton Boro (customer), and Little Gap would need to be interrupted in order to maintain acceptable voltage levels. The transmission system currently has no capacity for load restoration using adjacent circuits. Therefore, approximately 31 MW of load would remain interrupted for an extended period of time. This amount of interrupted load would violate the RP&P guideline for maximum allowable load loss for a single transmission circuit outage, which only allows 30 MW or less to be interrupted until overhead line repairs can be completed.

vi. The Normal Line Loading on the Blooming Grove-Jackson 138/69 kV Circuit on the Double-Circuit Blooming Grove-Jackson and Peckville-Jackson 138/69 kV Transmission Line During Peak Winter Conditions.

Under peak winter conditions, PPL Electric projects that, by the winter of 2015-2016, the load on the Blooming Grove-Jackson 138/69 kV circuit on the Double-Circuit Blooming Grove-Jackson

and Peckville Jackson 138/69 kV Transmission Line will be 61 MW. This violates the RP&P guideline, which recommends that the load on a single 138/69 kV transmission circuit not exceed 60 MW. If a circuit is loaded above 60 MW, PPL Electric is restricted in its ability to restore load from the interruption of a neighboring circuit while keeping within the emergency rating of the conductor (approximately 120 MW) and within acceptable voltage limits. Further, when a circuit is long in length and heavily loaded, such as the Blooming Grove-Jackson 138/69 kV circuit, the low voltage condition is exacerbated when trying to restore interrupted load from a neighboring circuit.

vii. The Normal Line Loading on the Peckville-Jackson 138/69 kV Circuit on the Double-Circuit Blooming Grove-Jackson and Peckville-Jackson 138/69 kV Transmission Line During Peak Winter Conditions.

Under peak winter conditions, PPL Electric projects that, by the winter of 2014-2015, the load on the Peckville-Jackson 138/69 kV circuit on the Double-Circuit Blooming Grove-Jackson and Peckville Jackson 138/69 kV Transmission Line will be 64 MW. This violates the RP&P guideline, which recommends that the load on a single 138/69 kV circuit not exceed 60 MW. If a circuit is loaded above 60 MW, PPL Electric is restricted in its ability to restore load from the interruption of a neighboring circuit while keeping within the emergency rating of the conductor (approximately 120 MW) and within acceptable voltage limits. Further, when a circuit is long in length and heavily loaded, such as the Peckville-Jackson 138/69 kV circuit, the low voltage condition is exacerbated when trying to restore interrupted load from a neighboring circuit.

4.3 Other Concerns and Observations

As explained above, the Jackson 138-69 kV Substation receives 230 kV supply from the 230 kV bulk power network through the Monroe and Siegfried 230-138 kV Substations, which transform the voltage down to 138 kV. The Jackson 138-69 kV Substation, in turn, transforms the voltage from 138 kV to 69 kV. The Jackson 138-69 kV Substation currently has two 138/69 kV transformers. Each of the 138/69 kV transformers at the Jackson 138-69 kV Substation has a one month winter emergency rating of 240 MVA.

PPL Electric projects that, by the winter of 2026-2027, the loss of one of the 138/69 kV transformers at Jackson 138-69 kV Substation (failure or maintenance) for an extended period of time could cause the remaining transformer to supply a total minimum load of 243 MVA, which

would exceed the one month winter emergency rating of 240 MVA.[20] PPL Electric's RP&P provides that, for the forced outage of a power transformer, the loading of the remaining transformer(s) should be restricted to the two hour emergency rating[21] and, for succeeding days, the load shall be further reduced to correspond with the applicable one-month and normal ratings. PPL Electric's RP&P guidelines also recommend that a new non-BES substation be added when the minimum normal load at a substation exceeds the one-month emergency rating of the remaining transformer when one transformer is out of service.

Currently, sufficient load can be transferred away from Jackson substation to get below the one month winter emergency rating of the remaining transformer. While PPL Electric does not have a RP&P violation at this time, this contingency demonstrates that the expected future load growth in the area will eventually result in a violation of the RP&P unless PPL Electric reinforces the Northeast Pocono area.

4.4 Summary

The only source of supply to the Northeast Pocono area is provided by 138/69 kV transmission circuits. It has been approximately 30 years since the last major transmission reinforcement was built in the Northeast Pocono area. There has been substantial load growth in this area since that time, which is expected to continue. The existing 138/69 kV transmission circuits serving the Northeast Pocono area are long and serve a significant number of customers who are vulnerable to long duration outages in the event of the loss of single transmission facility.

PPL Electric's system studies indicate that, in the near future, the transmission facilities serving the Northeast Pocono area will exceed the reliability and planning guidelines set forth in PPL Electric's RP&P. PPL Electric projects that each of the seven violations, and the amount of load interrupted as a result therefrom, will increase in magnitude due to the forecasted load growth in the Northeast Pocono area. These violations are evidence that the 138/69 kV transmission system serving the Northeast Pocono area needs to be reinforced.

The Northeast-Pocono Reliability Project is required to resolve the violations of the RP&P guidelines and to reinforce the existing 138/69 kV transmission system serving Carbon,

[20] See Appendix 6 for a definition of the month emergency rating.

[21] The two hour emergency rating is used for the initial loss of one transformer. The remaining transformers must be below the two hour emergency rating after the loss of the first transformer.

Lackawanna, Luzerne, Monroe, Pike, and Wayne Counties by bringing a new 230 kV supply source closer to the growing load centers. To accomplish this, PPL Electric proposes to locate the new West Pocono and North Pocono 230-69 kV Substations central to the load they will serve. The two new Substations and associated new transmission circuits will enable PPL Electric to shorten the length of the existing 69 kV circuits, which will reduce the distance between the supply of power and the homes and businesses that use the electricity. This proposed arrangement also will provide an alternate supply of power to the Northeast Pocono area in the event that the normal supply is interrupted, which will improve power restoration times and provide operating flexibility and improved reliability for customers in the area. The proposed Northeast-Pocono Reliability Project will reduce the number of customers affected by a single facility outage, as well as the duration of the outage.

5.0 ELECTRICAL SOLUTION

PPL Electric's system planning engineers evaluated multiple electrical solutions or functional configurations to identify the best overall long-term solution to the reliability issues in the Northeast Pocono area. PPL Electric selected the preferred electrical solution because it is the best and most economically feasible solution to resolve the reliability issues over the planning horizon. The electric solution or functional configuration presented for the Commission's approval is summarized below.

As a long-term solution to the reliability violations described above, PPL Electric, proposes to construct the following:

- The new West Pocono 230 – 69 kV Substation and North Pocono 230 – 69 kV Substation.
- A new 58 mile 230 kV transmission line that would be designed to current 230 kV standards and operated at 230 kV. A one line diagram of the proposed 230 kV transmission facilities is provided as **Figure 2-8** in Appendix 2. The proposed new transmission line will include three segments:

  (1) The Jenkins-West Pocono 230 kV Transmission Line. Approximately 15 miles of new 230 kV transmission line would be constructed from the existing Jenkins 230-69 kV Substation in Plains Township, Luzerne County to the new West Pocono 230-69 kV Substation in Buck Township, Luzerne County.

(2) The West Pocono-North Pocono 230 kV Transmission Line. Approximately 21 miles of new 230 kV transmission line would be constructed from the new West Pocono 230-69 kV Substation in Buck Township, Luzerne County to the new North Pocono 230-69 kV Substation in Covington Township, Lackawanna County.

(3) The North Pocono-Paupack 230 kV Transmission Line. Approximately 22 miles of new 230 kV transmission line would be constructed from the new North Pocono 230-69 kV Substation in Covington Township, Lackawanna County to the Paupack 230-69 kV Substation in Paupack Township, Wayne County.

- Three new 138/69 kV transmission lines, collectively approximately 5.3 miles long, to connect the new North Pocono 230-69 kV Substation in Covington Township, Lackawanna County to the existing Blooming Grove-Jackson and Peckville-Jackson 138/69 kV circuits. Two of the three transmission lines, each approximately 1.1 miles in length, would be constructed for future double-circuit operation, but initially operated as single-circuits. The third transmission line, approximately 3.1 miles in length, would be constructed for double-circuit operation. These three lines would be designed at current 138 kV standards, but initially operated at 69 kV.

- Two new 138/69 kV transmission lines, each approximately 3.0 miles long, to connect the new West Pocono 230-69 kV Substation in Buck Township, Luzerne County to the existing East Palmerton-Wagners #1 & #2 and Jackson-Wagners #1 & #2 139/69 kV Transmission Lines. These two transmission lines would be constructed for double-circuit operation. The two transmission lines would be designed at current 138 kV standards, but initially operated at 69 kV.

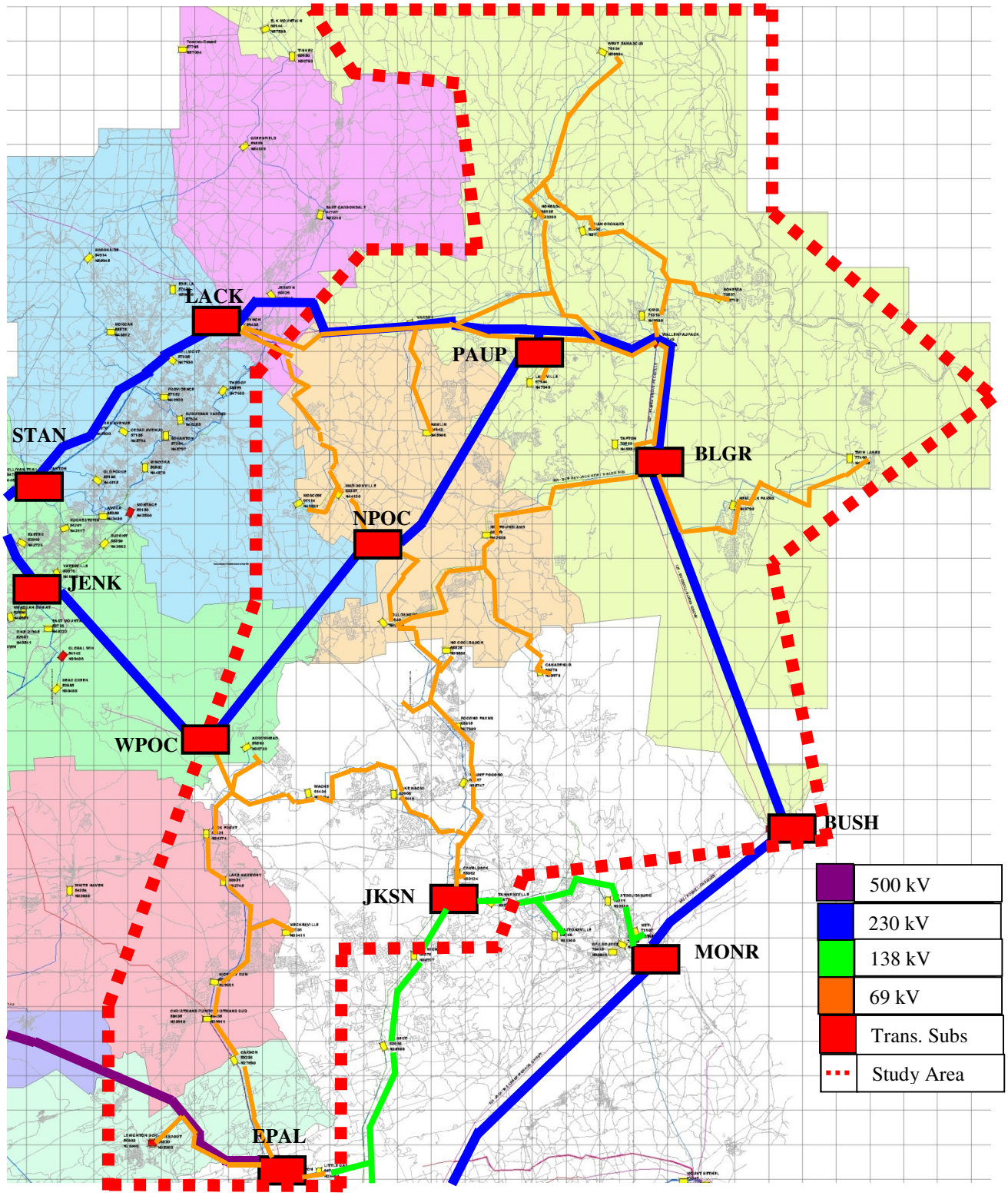
- Install fiber-optic ground wire (OPGW) on the entire length of the new 138/69 kV connecting lines and 230 kV transmission line for protective relay and SCADA use.[22]

Figure 2-3 provides a functional area map of the proposed transmission facilities.[23]

[22] See Appendix 6 for a definition of SCADA.

[23] A detailed explanation of the siting analysis and selection of the preferred routes for the proposed 230 kV and 138/69 kV transmission lines is provided in Attachment 4.

FIGURE 2-3: FUNCTIONAL AREA MAP OF NORTHEAST/POCONO AREA WITH PROPOSED TRANSMISSION FACILITIES



The proposed West Pocono 230-69 kV Substation will be constructed and located between the existing East Palmerton 230-69 kV Substation and the existing Jackson 138-69 kV Substation.[24] The proposed location for the new West Pocono 230-69 kV Substation is central to the load it will serve. The proposed West Pocono 230-69 kV Substation will tie into the existing East Palmerton-Wagners #1 & #2 and Jackson-Wagners #1 & #2 138/69 kV Transmission Lines, which will:

(1) Allow for the reduction in 138/69 kV circuit length through re-sectionalizing the existing transmission facilities (changing the normally open point), and

(2) Allow for a reduction in the number of customers normally served from each 138/69 kV transmission circuit.

The proposed West Pocono 230-69 kV arrangement will create a new double-circuit East Palmerton-West Pocono #1 & #2 138/69 kV Transmission Line and a new double-circuit West Pocono-Jackson #1 & #2 138/69 kV Transmission Line. The West Pocono 230-69 kV Substation also will provide an alternate supply to the existing East Palmerton 230-69 kV and Jackson 138-69 kV Substations using interconnected 69 kV circuits. A one-line diagram of the proposed 138/69 kV transmission facilities from the West Pocono 230-69 kV Substation is provided in Appendix 2, **Figure 2-9**.

The proposed North Pocono 230-69 kV Substation will be constructed and located centrally with respect to the Jackson 138-69 kV, Blooming Grove 230-69 kV, and Lackawanna 230-69 kV Substations.[25] The proposed location for the North Pocono 230-69 kV Substation is central to the load it will serve. The proposed North Pocono 230-69 kV Substation will tie into the Blooming Grove-Jackson and Peckville-Jackson 138/69 kV circuits, which will:

(1) Allow for the reduction in 138/69 kV circuit length through re-sectionalizing the existing transmission facilities (changing the normally open point), and

[24] An explanation of the selection of the site for the new West Pocono 230-69 kV Substation is provided in Section 2.1.1 of Attachment 4.

[25] An explanation of the selection of the site for the new North Pocono 230-69 kV Substation is provided in Section 2.1.1 of Attachment 4.

(2) Allow for a reduction in the number of customers normally served from each 138/69 kV transmission circuit.

The proposed North Pocono 230-69 kV arrangement will create a new single-circuit North Pocono-Jackson #2 138/69 kV Transmission Line, a new double-circuit North Pocono-Blooming Grove and North Pocono-Jackson #1 138/69 kV Transmission Line, and a new single-circuit Lackawanna-North Pocono 138/69 kV Transmission Line. The proposed North Pocono 230-69 kV Substation also will provide an alternate supply to the existing Blooming Grove 230-69 kV, Lackawanna 230-69 kV, and Jackson 138-69 kV Substations using interconnected 69 kV circuits. A one line diagram of the proposed 69 kV transmission facilities from the proposed North Pocono 230-69 kV Substation is provided as **Figure 2-10** in Appendix 2.

The estimated cost to site, design, and construct the proposed Northeast-Pocono Reliability Project is approximately $154 million. This cost includes the siting, design, and construction of the proposed 230 kV and 138/69 kV transmission lines, the proposed West Pocono and North Pocono 230-69 kV Substations, and the acquisition costs for rights-of-way and land for the Substations.

After the Northeast-Pocono Reliability Project is complete, all load initially interrupted after an outage of the double-circuit Blooming Grove-Jackson and Peckville Jackson138/69 kV Transmission Line (future North Pocono-Jackson #1 & #2) occurring near the Jackson 138-69 kV Substation, would be restored in a short period of time after switching is completed.

After the Project is complete, all load initially interrupted after a single-circuit outage of the Peckville-Jackson 138/69 kV circuit (future North Pocono-Jackson #1) occurring near the Jackson 138-69 kV Substation, would be restored in a short period of time after switching is completed.

After the Project is complete, all load initially interrupted after a single-circuit outage of the Blooming Grove-Jackson 138/69 kV circuit (future North Pocono-Jackson #2) occurring near the existing Jackson 138-69 kV Substation, would be restored in a short period of time after switching is completed.

After the Project is complete, all load initially interrupted after an outage of the double-circuit East Palmerton-Wagners #1 & #2 138/69 kV Transmission Line (future East Palmerton-West Pocono #1 & #2) occurring near the existing East Palmerton 230-69 kV Substation, would be restored in a short period of time after switching is completed.

After the Project is complete, all load initially interrupted after a single-circuit outage of the East Palmerton-Wagners #2 138/69 kV circuit (future East Palmerton-West Pocono #2) occurring near the existing East Palmerton 230-69 kV Substation, would be restored in a short period of time after switching is completed.

After the Project is complete, the load of the Peckville-Jackson 138/69 kV circuit will be split between two circuits, the future North Pocono-Jackson #1 and the future Lackawanna- North Pocono 138/69 kV circuits. Those two circuits will be further sectionalized with normally open points between the Lackawanna and North Pocono Substations and between the North Pocono and Jackson Substations. (Refer to **Table 2-9** in Appendix 3 for the projected loading on these new circuits.) As a result, the load on the new North Pocono-Jackson #1 and the Lackawanna-North Pocono 138/69 kV circuits will be within the RP&P guidelines to accommodate load restoration for the interruption of a neighboring circuit.

After the Project is complete, the load of the existing Blooming Grove-Jackson 138/69 kV circuit will be split between two circuits, the future North Pocono-Jackson #2 and the future North Pocono-Blooming Grove 138/69 kV circuits. Those two circuits will be further sectionalized with normally open points between the Blooming Grove and North Pocono Substations and between the North Pocono and Jackson Substations. (Refer to **Table 2-9** in Appendix 3 for the projected loading on these new circuits.) As a result, the load on the new North Pocono-Jackson #2 and the North Pocono-Blooming Grove 138/69 kV circuits will be within the RP&P guidelines to accommodate load restoration for the interruption of a neighboring circuit.

After the Project is complete, the existing East Palmerton – Wagners #1 138/69 kV circuit will become the future East Palmerton – West Pocono #1 138/69 kV circuit. That circuit will be further sectionalized with a normally open point between the East

Palmerton and West Pocono Substations. Refer to **Table 2-9** in Appendix 3 for the projected loading on this new circuit.

After the Project is complete, the existing East Palmerton – Wagners #2 138/69 kV circuit will become the future East Palmerton – West Pocono #2 138/69 kV circuit. That circuit will be further sectionalized with a normally open point between the existing East Palmerton Substation and proposed West Pocono Substation. Refer to **Table 2-9** in Appendix 3 for the projected loading on this new circuit.

After the Project is complete, the Jackson – Wagners #1 138/69 kV circuit will become the future West Pocono – Jackson #1 138/69 kV circuit. That circuit will be further sectionalized with a normally open point between the existing Jackson Substation and proposed West Pocono Substation. Refer to **Table 2-9** in Appendix 3 for the projected loading on this new circuit.

After the Project is complete, the existing Jackson – Wagners #2 138/69 kV circuit will become the future West Pocono – Jackson #2 138/69 kV circuit. That circuit will be further sectionalized with a normally open point between the existing Jackson Substation and proposed West Pocono Substation. Refer to **Table 2-9** in Appendix 3 for the projected loading on this new circuit.

6.0 APPENDICES

APPENDIX 1 – Base Case Study Configuration & Assumptions

A long-range supply study was performed to develop the long term plans for reinforcing the Northeast Pocono area transmission system. The goal of these plans was to identify the required future system facility upgrades, which would have the ability to deliver electric power to current and future PPL Electric customers.

This report examines the load growth in the study area, beginning with the year 2012 and moving ahead in three-year increments through 2027. The study area consists of a section of three PPL Electric regions in the load flow model: the Lehigh, Central, and the Northeast regions.

Both winter and summer peak load models were developed and analyzed; the winter period is when the transmission lines in this area are more heavily loaded.

To develop future summer peak load flow cases, Transmission Planning used a growth rate based on the PJM Load Analysis Subcommittee (LAS) forecast. Using that forecasted summer growth rate, PPL Electric distributed the percent growth among its six regions based upon the actual peak load summer day from 2011 (**Table 2-3**). . The summer peak day of July 22, 2011, was chosen because it was the most recent summer peak that came close to the all-time summer peak for the PPL service territory. The chart below identifies the percent of the total peak load per region based on the July 22, 2011 summer peak day. This percentage split per region is held constant and then applied to the PPL region peak determined by PJM in its Annual Load Forecast.

TABLE 2-3: Regional Percent Peak Load (Summer)

PPL Electric Region	Percentage of 2011 PPL load On summer peak day (%)
Central	13
Harrisburg	19
Lancaster	21
Lehigh	23
Northeast	12
Susquehanna	12

For the future winter peak load flow cases, Transmission Planning used a growth rate based on the PJM Load Analysis Subcommittee (LAS) forecast. PPL Electric distributed

the percent growth among its six regions based upon the actual peak load winter day from 2011 (**Table 2-4**). The winter peak day of January 24, 2011, was chosen because it was the most recent winter peak that came close to the all-time winter peak for the PPL service territory. The peak winter day in 2012, January 4th (6,462 MW), was a much lighter load day than the peak in 2011 (7,432 MW) due to unusually warm seasonal temperatures and, therefore, was not chosen to determine the regional percent distributions. The chart below identifies the percent of the total peak load per region based on the January 24, 2011 winter peak day. This percentage split per region is held constant and then applied to the PPL region peak determined by PJM in its Annual Load Forecast.

TABLE 2-4: Regional Percent Peak Load (Winter)

PPL Electric Region	Percentage of 2011 PPL load On winter peak day (%)
Central	14
Harrisburg	17
Lancaster	19
Lehigh	23
Northeast	14
Susquehanna	13

Transmission Planning modeled PPL Electric's distribution substation loads in the load flow model by using actual metered data values and matched the values to each of the substation buses modeled in the load flow program.

Transmission Planning updated the system topology to reflect planned changes to the transmission system that are expected to be in service by each study year. All local area generation stations and independent power producer (IPP) facilities in the PPL Electric service territory and nearby areas are modeled in the load flow model. The generators are studied as both in-service and out-of-service under different contingencies to determine whether either scenario causes a violation of the RP&P guidelines.

As a result of the assumptions stated earlier, the circuit loadings in the study area during the upcoming 2012-2013 winter are projected to be as noted on **Table 2-5.**

TABLE 2-5: Northeast Pocono Area Line Loading by 11/2012

Related 69 kV Transmission Circuit(s)	2012 Winter Peak Loading (MW)
Peckville-Jackson (PECK Sourced)	49 MW
Peckville-Jackson (JKSN Sourced)	66 MW
Blooming Grove-Jackson (JKSN Sourced)	112 MW
Blooming Grove-Jackson (BLGR Sourced)	35 MW
East Palmerton-Wagners #1	57 MW
East Palmerton-Wagners #2	42 MW

The load flow model study assumes that projects B0708 and B1203 in the PJM Planning queue will be completed and in-service by November 2014.[26] These projects will modify the system topology in the Northeast Pocono area.

Therefore the circuit loadings in the study area during the 2013-2014 winter will change and are projected to be as noted on **Table 2-6**.

TABLE 2-6 - Northeast Pocono Area Line Loading by 11/2014

Related 69 kV Transmission Circuit(s)	2014 Winter Peak Loading (MW)
Peckville-Jackson (PECK Sourced)	49 MW
Peckville-Jackson (JKSN Sourced)	64 MW
Blooming Grove-Jackson (JKSN Sourced)	59 MW
Blooming Grove-Jackson (BLGR Sourced)	35 MW
East Palmerton-Wagners #1	35 MW
East Palmerton-Wagners #2	31 MW
Jackson-Wagners #1	48 MW
Jackson-Wagners #2	41 MW

[26] PJM project B0708 is the construction of a new double-circuit 138/69 kV transmission line, the Jackson-Wagners #1 & #2 138/69 kV Transmission line, from the Jackson 138-69 kV Substation to the Lake Naomi 138/69 kV Tap. A Full Siting Application for this project is currently pending before the Commission at Docket No. A-2012-2304631. The in-service date for this project is November 2013. A one-line diagram of the transmission facilities in the northern portion of the Northeast Pocono area after completion of PJM project B0708 is provided as Figure 2-6 in Appendix 2 in Section 6.

PJM project B1203 is the rebuild of the double circuit Jackson-Wagners #1 & #2 Transmission line from the Lake Harmony 69-12 kV Substation to the Lake Naomi 138/69 kV Tap pole. PPL Electric plans to submit this project for Commission review and approval by mid-2013. A one-line diagram of the transmission facilities in the western portion of the Northeast Pocono area after completion of PJM project B1203 is provided as Figure 2-7 in Appendix 2 in Section 6.

APPENDIX 2 – Related Transmission System One-Line Diagrams

FIGURE 2-4 –EXISTING 138/69 kV TRANSMISSION FACILITIES IN NORTH POCONO AREA (11/2012)

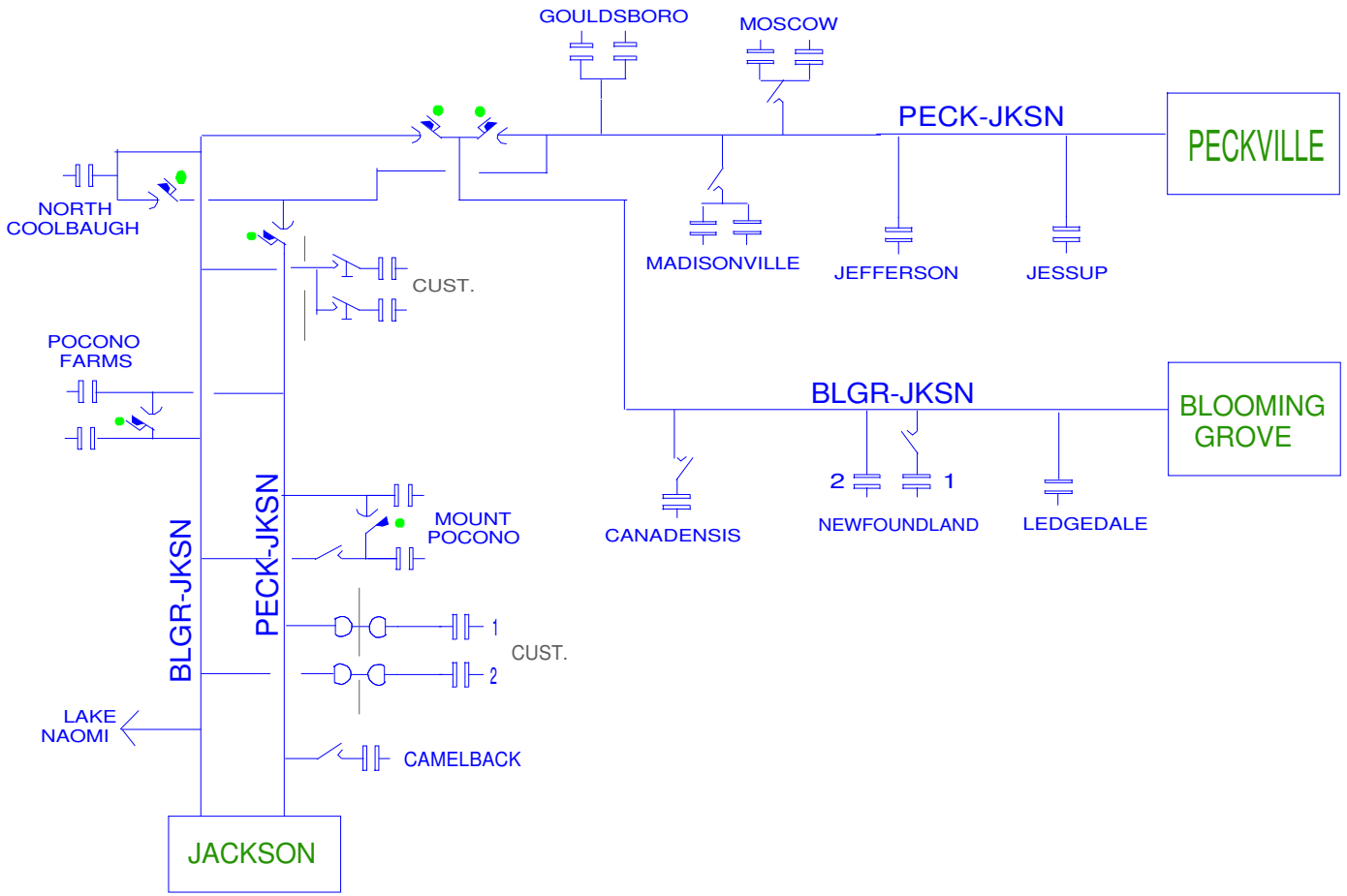


FIGURE 2-5 –EXISTING 138/69 kV TRANSMISSION FACILITIES IN WEST POCONO AREA (11/2012)

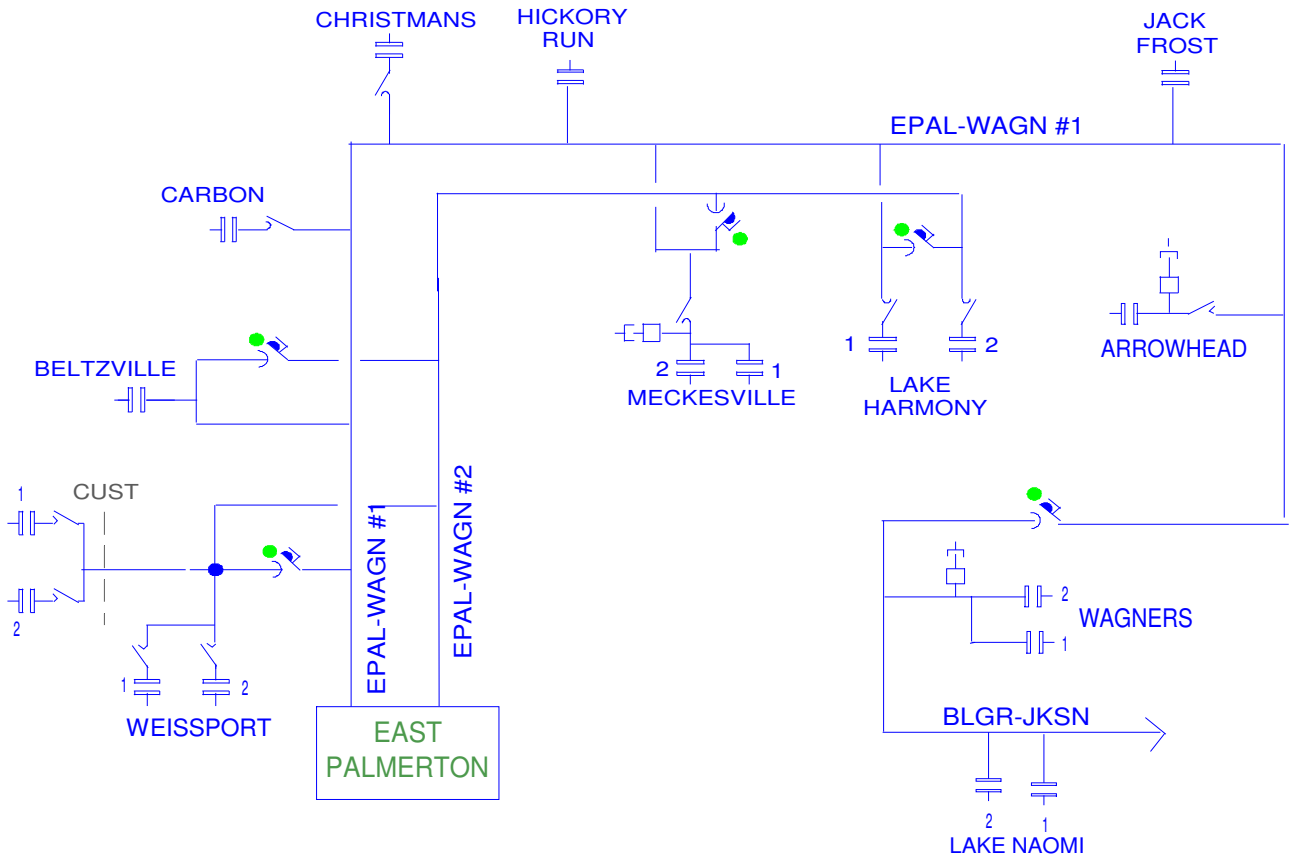


Figure 2-6 – PROPOSED 138/69 kV TRANSMISSION FACILITIES IN NORTH POCONO AREA BY 11/2014

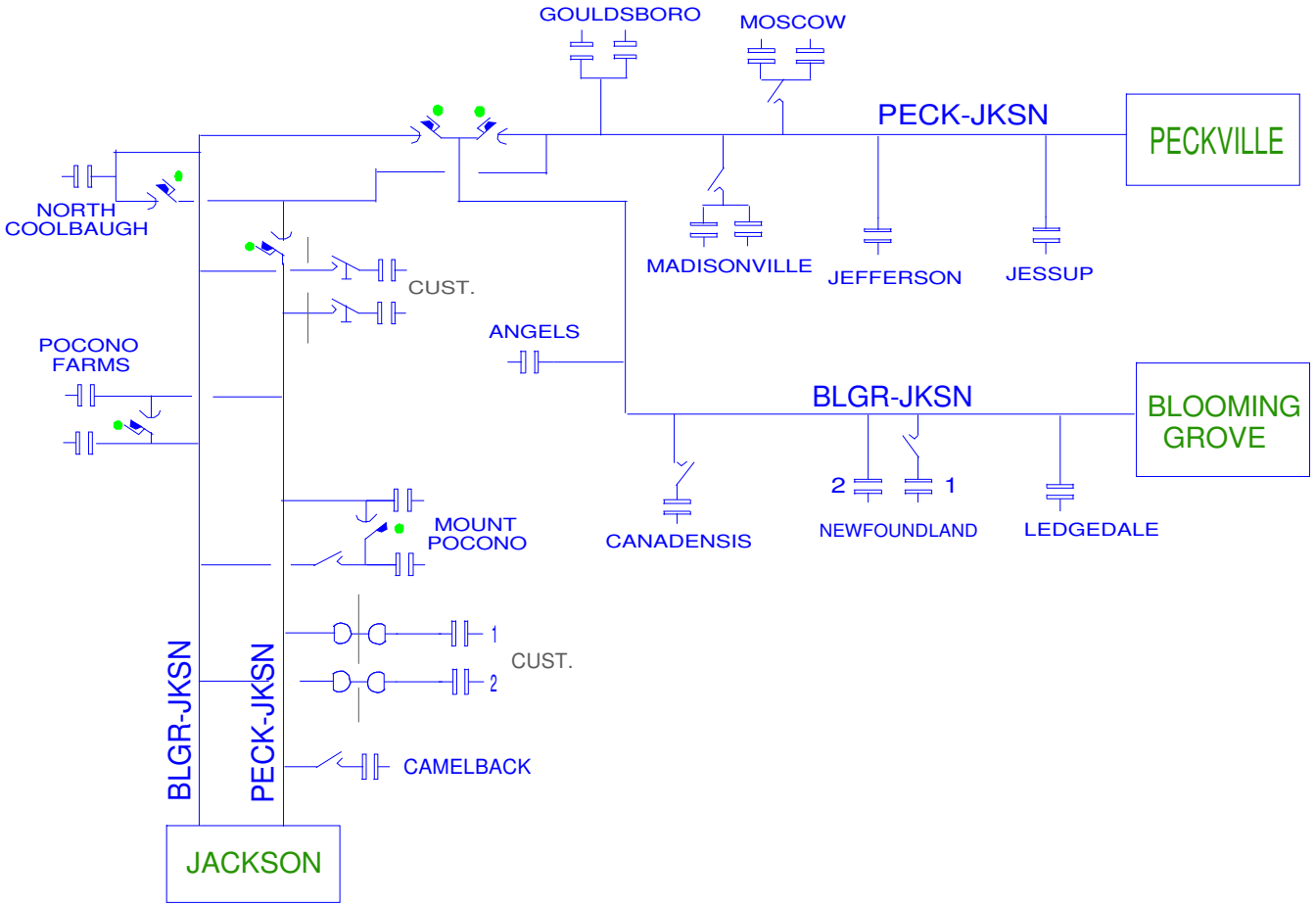


Figure 2-7 – PROPOSED 138/69 kV TRANSMISSION FACILITIES IN WEST POCONO AREA BY 11/2014

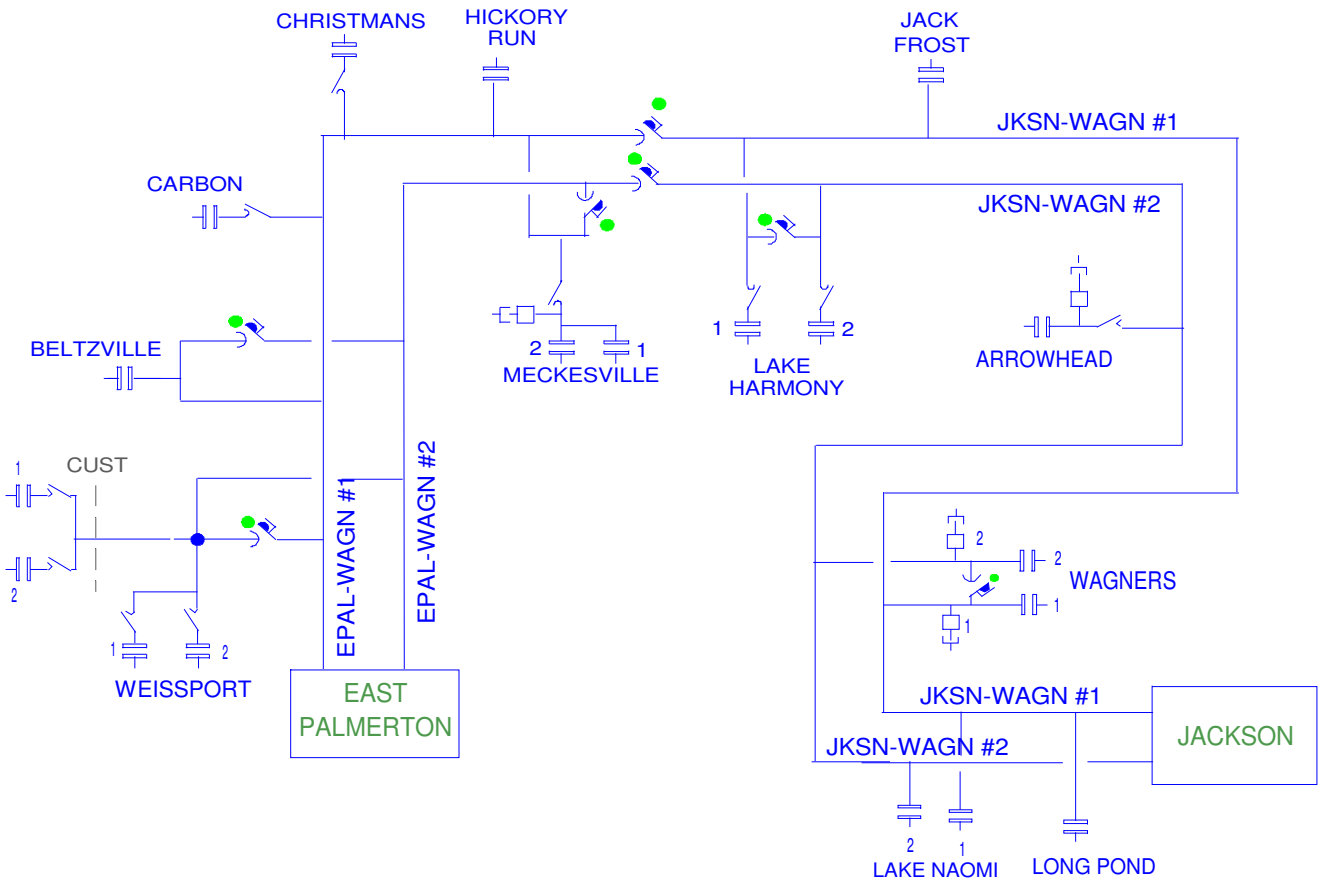


FIGURE 2-8 –PROPOSED 230 KV TRANSMISSION FACILITIES AFTER COMPLETION OF PROJECT

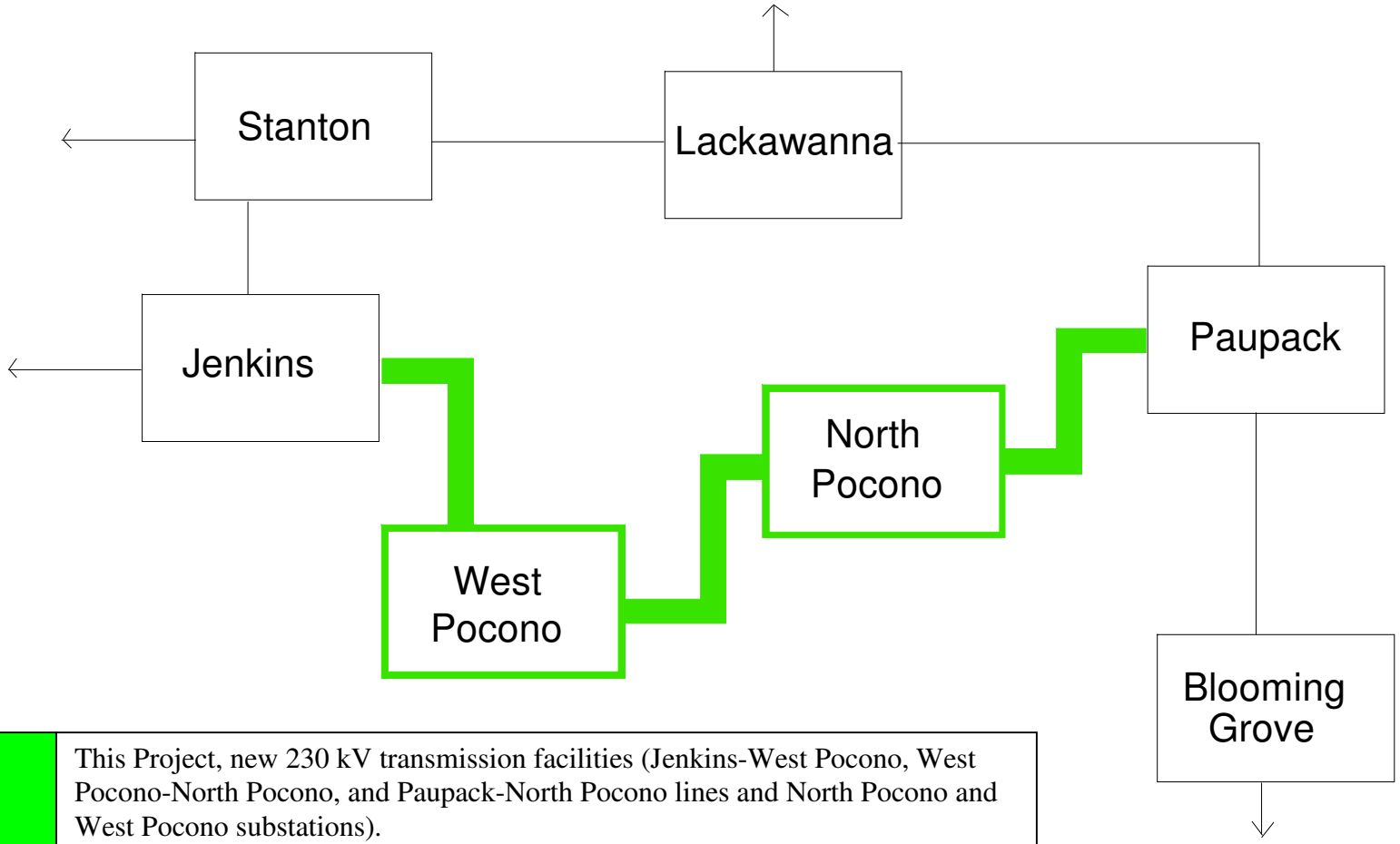


FIGURE 2-9 –PROPOSED 138/69 kV TRANSMISSION FACILITIES (WEST POCONO AREA)
AFTER COMPLETION OF THE PROJECT

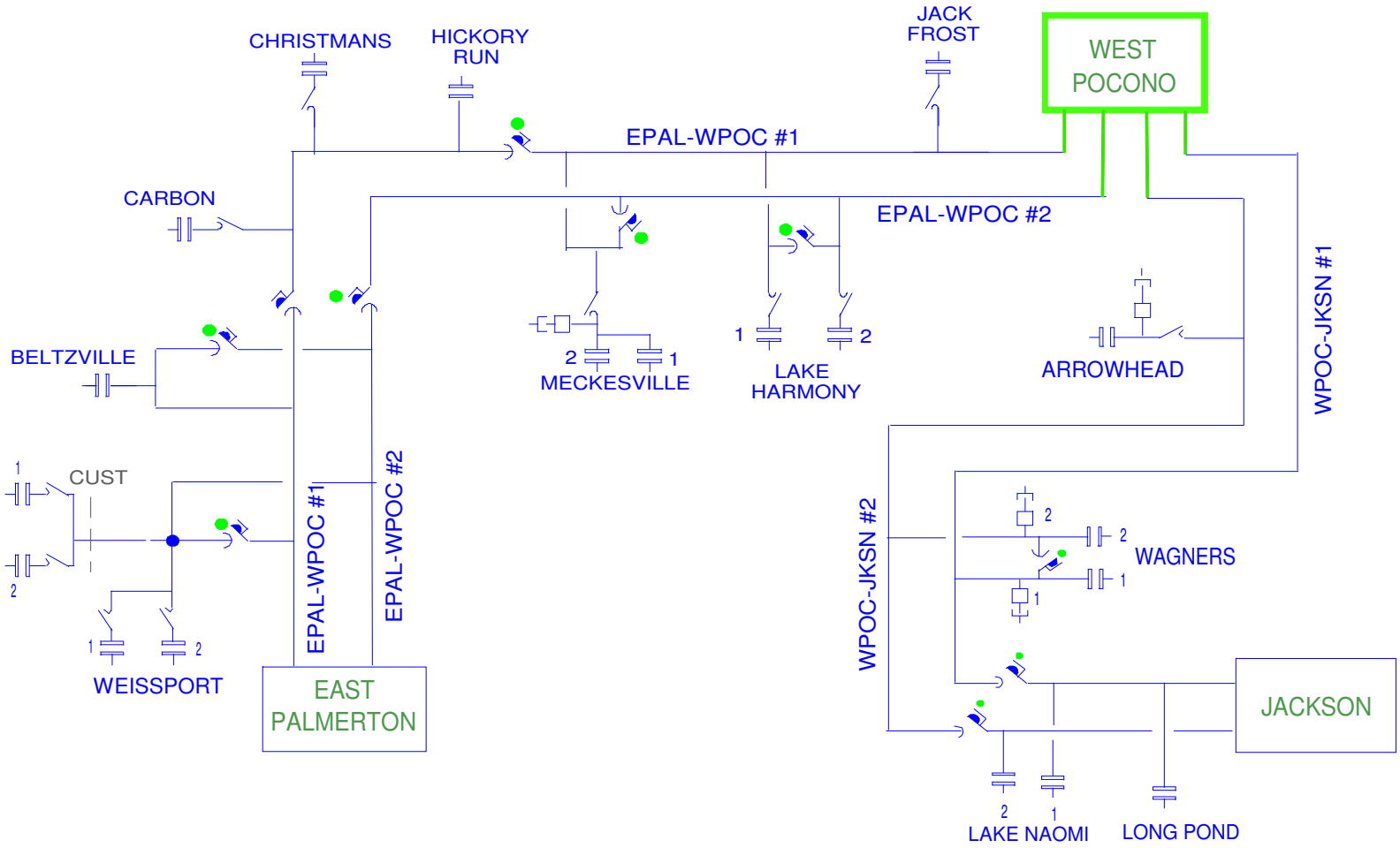
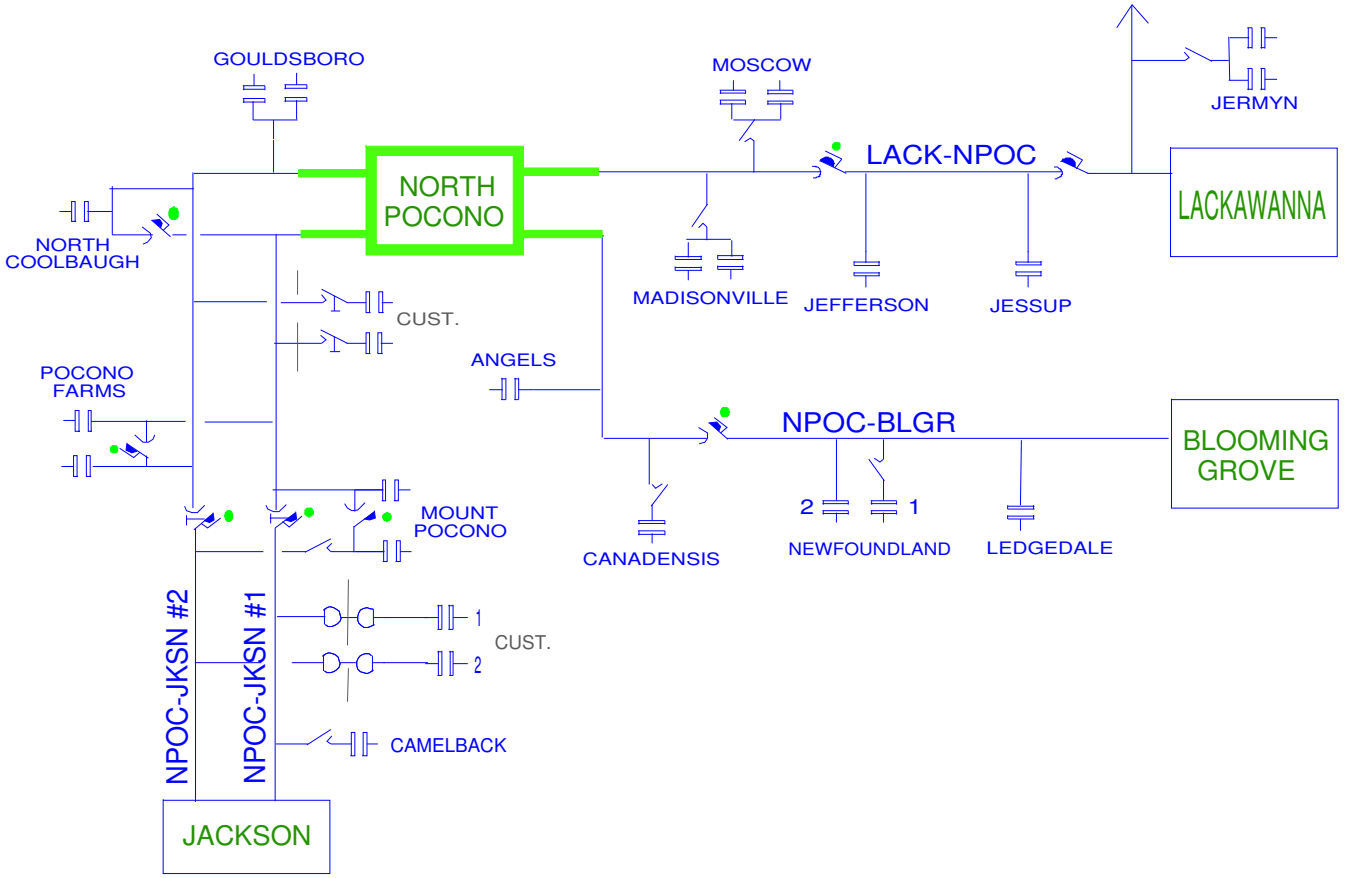


FIGURE 2-10 –PROPOSED 138/69 kV TRANSMISSION FACILITIES (NORTH POCONO AREA)
AFTER COMPLETION OF THE PROJECT



APPENDIX 3 – 69 kV Transmission Circuit Loadings Before and After Completion Of The Project

TABLE 2-7: Current Northeast Pocono Area Transmission Configuration 11/2012				
Circuit Name (Source)	Number of Customers	Length of Main Circuit (miles)*	Total Length of Circuit (miles)	Normal Winter Peak Loading of Circuit (MW)
Blooming Grove-Jackson (Jackson)	16306	19	37	112
Blooming Grove-Jackson (Blooming Grove)	8895	21	30	35
Blooming Grove-Jackson (total)	***25201***	***40***	***67***	***147***
Peckville-Jackson (Jackson)	5914	19	23	66
Peckville-Jackson (Peckville)	11746	22	24	49
Peckville-Jackson (total)	***17660***	***40***	***48***	***115***
East Palmerton-Wagners #1 (East Palmerton)	15017	31	37	57
East Palmerton-Wagners #2 (East Palmerton)	7974	19	32	42

TABLE 2-8: Northeast Pocono Area Transmission Configuration By 11/2014				
Circuit Name (Source)	Number of Customers	Length of Main Circuit (miles)*	Total Length of Circuit (miles)	Normal Winter Peak Loading of Circuit (MW)
Blooming Grove-Jackson (Jackson)	7071	19	25	59
Blooming Grove-Jackson (Blooming Grove)	8895	21	30	35
Peckville-Jackson (Jackson)	5914	19	23	64
Peckville-Jackson (Peckville)	11746	22	24	49
East Palmerton-Wagners #1 (East Palmerton)	9351	16	16	35
East Palmerton-Wagners #2 (East Palmerton)	5075	16	29	31
Jackson-Wagners #1 (Jackson)	7635	31	37	48
Jackson-Wagners #2 (Jackson)	10165	31	34	41

TABLE 2-9: After Northeast Pocono Reliability Project is Completed By 11/2017				
Circuit Name (Source)	Number of Customers	Length of Main Circuit (miles)*	Total Length of Circuit (miles)	Normal Winter Peak Loading of Circuit (MW)
North Pocono-Jackson #2 (Jackson)	3329	7	9	33
North Pocono-Jackson #2 (North Pocono)	7257	14	19	44
Blooming Grove-North Pocono (Blooming Grove)	5630	12	12	19
Blooming Grove-North Pocono (North Pocono)	3265	12	20	17
North Pocono-Jackson #1 (Jackson)	728	7	10	25
North Pocono-Jackson #1 (North Pocono)	5186	14	16	40
Lackawanna-North Pocono (Lackawanna)**	10638	10	20	36
Lackawanna-North Pocono (North Pocono)	6834	13	16	29
East Palmerton-West Pocono #1 (East Palmerton)	7093	12	12	25
East Palmerton-West Pocono #1 (West Pocono)	4455	15	18	22
East Palmerton-West Pocono #2 (East Palmerton)	5075	4	14	32
East Palmerton-West Pocono #2 (West Pocono)	2899	23	26	13
West Pocono-Jackson #1 (West Pocono)	2702	8	8	11
West Pocono-Jackson #1 (Jackson)	2736	16	16	28
West Pocono-Jackson #2 (West Pocono)	4335	15	19	22
West Pocono-Jackson #2 (Jackson)	2931	9	9	7

Notes

Future distribution substations planned are not taken into consideration in the MW values. That is the cause for some unbalanced line loading values.

*Length of line (miles) excludes transmission taps off the main line.

**The Lackawanna-North Pocono 69 kV circuit supplies additional customers not accounted for by 2014. All of Jermyn and the East Palmerton T2 will now be served by this circuit.

APPENDIX 4 – Line Distances in the Northeast Pocono Area (As of 11/2012)

CIRCUIT (OR TAP) NAME	CKT #	VOLTAGE (kV)	MAIN LINE MILES
Peckville-Varden	1	69	16.60
Peckville-Jackson	1	69	40.31
Blooming Grove-Honesdale		69	18.96
Blooming Grove-West Damascus		69	29.79
Blooming Grove-Jackson		69	39.90
East Palmerton-Wagners	1	69	30.68
East Palmerton-Wagners	2	69	18.82
Lake Naomi Tap		69	12.48

CIRCUIT (OR TAP) NAME	CKT #	VOLTAGE (kV)	TOTAL LINE MILES
Peckville-Varden	1	69	23.74
Peckville-Jackson	1	69	47.54
Blooming Grove-Honesdale		69	24.86
Blooming Grove-West Damascus		69	38.42
Blooming Grove-Jackson**		69	54.13
East Palmerton-Wagners	1	69	36.90
East Palmerton-Wagners	2	69	32.47
Lackawanna-Peckville	3	230	2.99
Blooming Grove-Peckville		230	29.45
Bushkill-Blooming Grove		230	21.81

** Excludes Lake Naomi Tap length.

APPENDIX 5 – Transmission Circuit Abbreviations

Before Proposed Project - Transmission Line Names

Full Transmission Line Name	Abbreviation
Blooming Grove-Jackson	BLGR-JKSN
Peckville-Jackson	PECK-JKSN
East Palmerton-Wagners #1	EPAL-WAGN #1
East Palmerton-Wagners #2	EPAL-WAGN #2
Jackson-Wagners #1	JKSN-WAGN #1
Jackson-Wagners #2	JKSN-WAGN #2

After Proposed Project - Transmission Line Names

Full Transmission Line Name	Abbreviation
East Palmerton-West Pocono #1	EPAL-WPOC #1
East Palmerton-West Pocono #2	EPAL-WPOC #2
West Pocono-Jackson #1	WPOC-JKSN #1
West Pocono-Jackson #2	WPOC-JKSN #2
Lackawanna-North Pocono	LACK-NPOC
North Pocono-Jackson #1	NPOC-JKSN #1
North Pocono-Jackson #2	NPOC-JKSN #2
North Pocono-Blooming Grove	NPOC-BLGR
Jenkins-West Pocono	JENK-WPOC
West Pocono-North Pocono	WPOC-NPOC
North Pocono-Paupack	NPOC-PAUP

APPENDIX 6 – References / Definitions

Definitions

"138/69 kV" Transmission Line - In general, the use of the designation "138/69" indicates that the transmission line currently operates at 69 kV but is built to accommodate 138 kV operation at a future date.

Abnormal sectionalizing - The changing of the normally open and normally closed points on a circuit in order to restore load during an outage or to transfer load during maintenance.

Bulk Electric System (BES) - Includes transmission facilities operated at voltages of 100 kV or higher.

Circuit – A single path of electric power flow that originates and terminates at different regional substations, and serves PPL Electric or customer owned substation load when operated at 69 kV or 138 kV. For example, "Blooming Grove-Jackson 138/69 kV circuit" is terminated at both Blooming Grove 230-69 kV Substation and at Jackson 138-69 kV Substation. This circuit serves several distribution substations between Blooming Grove and Jackson regional substations.

Consequential Load Loss – Load that is interrupted as a result of the unplanned outage of a transmission facility. Whereas non-consequential load loss is an intentional interruption of load in order to preserve the integrity of the transmission system.

Double-Circuit Transmission Line – A transmission facility that carries one or more transmission circuits on single tower structures. Commonly two circuits are installed on single tower structures. For example, "double-circuit Blooming Grove-Jackson and Peckville-Jackson 138/69 kV Transmission Line" carries two independent transmission circuits on single tower structures.

Non-Bulk Electrical System - Includes transmission facilities operated at voltages less than 100 kV.

Northeast Pocono Area – The study area that includes portions of the Northeast, Central, and Lehigh regions of PPL Electric's service territory.

One Month Thermal Emergency Rating – The maximum permissible sustained loading capability for a transformer during emergency conditions for a month. The reason one month rating is selected is because it takes approximately one month to install a replacement transformer.

SCADA – An acronym for "Supervisory Control and Data Acquisition".

Sectionalizing - Involves switches on the 69 kV transmission system used to create normally open and normally closed points.