



Before the
Pennsylvania Public Utility Commission

**MONTOUR–SAEGERS #1 & #2, SAEGERS–CLINTON,
SAEGERS–ELIMSPORT**

230 KV TRANSMISSION LINE TERMINATIONS

**ATTACHMENTS IN SUPPORT OF THE
LETTER OF NOTIFICATION**

Application Docket No. _____

Submitted by: PPL Electric Utilities Corp.

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ATTACHMENT 1
MONTOUR–SAEGERS #1 & #2, SAEGERS–CLINTON, SAEGERS–ELIMSPORT
230 KV TRANSMISSION LINES
NECESSITY STATEMENT

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ATTACHMENT 1
MONTOUR–SAEGERS #1 & #2, SAEGERS–CLINTON, SAEGERS–ELIMSPORT
230 KV TRANSMISSION LINES
NECESSITY STATEMENT

A. INTRODUCTION

PPL Electric Utilities Corporation (PPL Electric) seeks approval from the Pennsylvania Public Utility Commission (“Commission” or “PUC”) to construct two new double-circuit 230 kV transmission lines to interconnect the proposed Panda Patriot Power Generation Plant (“Panda Plant”) to be constructed by Panda Patriot LLC, an independent power producer. Upon Commission approval, the Panda Plant will be interconnected to the PPL Electric transmission system by constructing two new double-circuit 230 kV transmission lines that will extend approximately 500 feet between the between the existing double-circuit Montour–ElimSPORT & Montour–Clinton 230 kV Transmission Line and a new Saegers 230 kV Switchyard (hereinafter, the “Project”). The Panda Plant will be interconnected with the Saegers 230 kV Switchyard via a 0.5 mile, single-circuit 230 kV transmission line to be constructed, owned, and operated by Panda Patriot LLC.

The proposed Panda Plant is a natural gas-fired, combined cycle plant that will produce 765 MW of generation. In order to get the power produced from domestic natural gas production to the electric market, the Panda Plant must be interconnected with the electric grid. As explained below, through the PJM Interconnection LLC (“PJM”) generation interconnection process, PJM and PPL Electric determined that the proposed Project is necessary to connect the Panda Plant to the electric grid.

The estimated cost to design and construct the Project is approximately \$12.4 million.¹ This cost estimate includes \$3 million for the transmission line portion and \$9.4 million for the

¹ The estimated cost for the proposed Project is an order-of-magnitude estimate developed using averages of recent costs for similar projects and without an in-depth analysis of filed investigation. The estimated cost is subject to change as the constructability of the Project, sequence of construction, and other factors that may affect cost are identified and analyzed as the Project progresses.

switchyard work. The entire cost of the Project is the responsibility of Panda Patriot LLC, which will own the Panda Plant. Subject to the Commission's approval, construction is scheduled to begin in November of 2014 to support the mid-2015 in-service date of the Panda Plant.

B. EXISTING SYSTEM

The existing double-circuit Montour–Elimsport & Montour–Clinton 230 kV Transmission Line currently serves load in Lycoming County. The Montour–Elimsport & Montour–Clinton 230 kV Transmission Line is installed on double-circuit monopole towers. The Montour-Elimsport 230 kV circuit extends approximately 22.4 miles from the Montour 230 kV Switchyard to the Elimsport 230 kV Switchyard. The Montour-Clinton 230 kV circuit extends approximately 10.5 miles from the Montour 230 kV Switchyard to the Clinton 230 kV Switchyard. A diagram of the existing transmission system is provided as **Figure 1** below.

The existing Montour-Elimsport & Montour-Clinton 230 kV Transmission Line currently operates in a networked configuration between the Montour 230 kV Switchyard and Clinton 230-69 kV Substation, as well as between the Montour 230 kV Switchyard and Elimsport 230 kV Switchyard. In a “networked” configuration, the transmission line has a voltage source and power supply available at each end of the line. Power can flow from either end of the line to serve the customer load. Electrical power on the double-circuit Montour–Elimsport & Montour–Clinton 230 kV Transmission Line normally flows from the Montour 230 kV Switchyard to both the Clinton 230-69 kV Substation and the Elimsport 230 kV Switchyard.

C. NEED FOR THE PROJECT

1. Overview of PJM's Role

Transmission Owners, such as PPL Electric, are required by federal law to provide open access to their transmission systems. In 1996, the Federal Energy Regulatory Commission (“FERC”) issued Order No. 888 which required Transmission Owners to offer access to their transmission systems to third-parties on a non-discriminatory basis. FERC's Order No. 890 required open and transparent transmission planning. Both orders focused on creating a level playing field to

make the transmission system accessible to all market participants at fair prices. FERC Order No. 1000, which was issued in the summer of 2011, requires local transmission planners to participate in regional planning processes. It also directs regional authorities to allow cost recovery for transmission that is necessary to achieve public policy goals, which may include bringing clean and renewable power to market. Finally, FERC Order No. 1000 provides procedures for non-incumbent developers (non-Transmission Owners) to construct, operate and maintain new transmission facilities necessary to interconnect with the electric grid.

As a FERC-approved Regional Transmission Organization (RTO), PJM administers the process for the interconnection of all new generation facilities to the PJM Transmission Grid, pursuant to the PJM Open Access Transmission Tariff – Part VI (Interconnections with the Transmission System), Subpart A – Generation Interconnection Procedures. PJM’s queue-based interconnection process offers developers the flexibility to explore their respective generation interconnection business opportunities.

Under these procedures, new generation applicants may request interconnection service by submitting an Interconnection Request. As part of the Interconnection Request, the generator requesting interconnection is required to identify points of interconnection with the PJM transmission grid. Upon receipt of the completed Interconnection Request, the project is placed in a PJM interconnection queue.

PJM staff, in coordination with any affected Transmission Owner(s), undertakes a Generation Interconnection Feasibility Study and System Impact Study. The Generation Interconnection Feasibility Study assesses the practicality and cost of interconnecting the generating unit into the PJM system. The System Impact Study is a comprehensive regional analysis of the impact of adding the new generation facility to the system and an evaluation of the impact on deliverability to PJM load in the particular PJM region where the generation facility is located.

Upon completion of the Generation Interconnection Feasibility Study and System Impact Study, a Generation Interconnection Facilities Study is performed by PJM, in coordination with any affected Transmission Owner(s). The Generation Interconnection Facilities Study documents the engineering design work necessary to begin construction of any transmission

facilities required to interconnect the new generation with the electric grid. The Generation Interconnection Facilities Study also provides the cost estimate for the facilities and network upgrades necessary to accommodate the project, as well as an estimate of the time required to complete detailed design and construction of the facilities and upgrades.

If the results of the Generation Interconnection Facilities Study are acceptable to the new interconnection applicant and the affected Transmission Owner(s), an Interconnection Construction Service Agreement is executed. The construction of any interconnection facilities required to interconnect a generator project with the PJM transmission grid is performed in accordance with the terms and conditions specified in the Interconnection Construction Service Agreement. In addition, the new interconnection applicant for transmission service has the right, but not the obligation, to design and install all or any portion of the facilities necessary to interconnect with the Transmission Owner(s) system (“Option to Build”).²

2. The Panda Plant

Panda Energy LLC, through its wholly-owned subsidiary Panda Patriot LLC, is proposing to build a new natural gas, combined-cycle power plant in Clinton Township, Lycoming County, Pennsylvania to take advantage of the abundant natural gas resources in the area. Combined-cycle power plants operate at higher efficiencies than traditional fossil fuel plants by capturing much of the energy contained in the hot exhaust from the natural gas combustion turbines to generate additional electricity. Using that energy, which otherwise would be wasted as hot air,

² In addition to the other terms and conditions applicable to the construction of facilities under the Option to Build, the applicant seeking transmission service must also: (a) obtain all necessary permits and authorizations; (b) obtain all necessary land rights; (c) accept the exclusive right and obligation of the Interconnected Transmission Owner to perform line tie-in work and to calibrate remote terminal units and relay settings; (d) follow accepted procedures to have those facilities that it builds successfully inspected, tested and energized; (e) arrange for all work to be performed by contractors, and using equipment manufacturers or vendors, that are listed on the Interconnected Transmission Owner’s List of Approved Contractors; (f) allow the Interconnected Transmission Owner full site control and reasonable access to its property at all times; (g) allow the Interconnected Transmission Owner to have a reasonable number of appropriate representatives present for all work done on its property/facilities and the right to stop work or order corrective measures for any work with an adverse effect on reliability, safety or security of persons or of property; (h) comply with the Interconnected Transmission Owner’s safety, security and work rules, environmental guidelines and training requirements applicable to the area(s) where construction activity is occurring; and (i) submit to the Interconnected Transmission Owner and PJM initial drawings, certified by a registered professional engineer, of the Transmission Owner Interconnection Facilities that the Interconnection Customer/Developer arranges to build under the Option to Build.

is a major benefit of the combined-cycle design. The electric power produced at the Panda Plant, 765 MW, will be enough to supply approximately 750,000 homes with clean power generated using domestic fuel.

In order to deliver the power into the electric grid, the Panda Plant must interconnect with the existing transmission system. Through the PJM interconnection process described above, PJM and PPL Electric determined that the interconnection of the Panda Plant with PPL Electric's transmission system will require a new 230 kV switchyard that will tie into the existing double-circuit Montour-Elimsport and Montour-Clinton 230 kV Transmission Line. The point of interconnection will occur at the new 230 kV switchyard, which will be owned and operated by PPL Electric. Under the Interconnection Construction Service Agreement, however, Panda Patriot LLC requested the "Option to Build" the required new 230 kV switchyard. PPL Electric is responsible to construct all direct connection facilities from the point of interconnection, *i.e.*, from the 230 kV switchyard, to the existing double-circuit Montour-Elimsport and Montour-Clinton 230 kV Transmission Line.

The Panda Plant interconnection request and approval are available on the PJM website at: <http://www.pjm.com/planning/generation-interconnection/generation-queue-active.aspx>. The Panda Plant is referred in the PJM Generation Interconnection Queue as "X2-012" which indicates its queue position in the PJM interconnection process.

D. PROPOSED SYSTEM

The Panda Plant will be located in Clinton Township, Lycoming County, Pennsylvania on approximately 80 acres of land zoned as Heavy Industrial (I-2). This location was selected due to its proximity to the high voltage transmission line system and the existing heavy industrial zoning. The Panda Plant is located approximately 0.5 miles south of the existing double-circuit Montour-Elimsport & Montour-Clinton 230 kV Transmission Line near Saegers Station Road in Clinton Township, Lycoming County, Pennsylvania.

Pursuant to the PJM approved interconnection process described above, in order to interconnect the Panda Plant, PPL Electric proposes to interconnect the existing double-circuit Montour-

Elimsport & Montour-Clinton 230 kV Transmission Line with a new Saegers 230 kV Switchyard. The new Saegers 230 kV Switchyard will be located adjacent to the existing double-circuit Montour-Elimsport & Montour-Clinton 230 kV Transmission Line.

Under the PJM-approved Interconnection Construction Service Agreement, the required new Saegers 230 kV Switchyard will be constructed by Panda Patriot LLC, but will be owned and operated by PPL Electric. The Panda Plant developer, Panda Patriot LLC, will then build one single-circuit 230 kV transmission line that will extend approximately 0.5 miles between the Saegers 230 kV Switchyard and the Panda Plant.

In order to interconnect the double-circuit Montour-Elimsport & Montour-Clinton 230 kV Transmission Line with the Saegers 230 kV Switchyard, PPL Electric will need to build, upon PUC approval, two new double-circuit 230 kV transmission lines that will extend approximately 500 feet between the Saegers 230 kV Switchyard and the existing Montour-Elimsport & Montour-Clinton 230 kV Transmission Line. The new lines will be designed, constructed, and operated at 230 kV. PPL Electric will own and operate these new lines.

Once the Montour-Elimsport 230 kV circuit is terminated into the Saegers 230 kV Switchyard, the line will be split in two sections at the Switchyard and will be renamed as follows: (1) the section between the Montour and Saegers Switchyards will be named the Montour-Saegers #1 230 kV Line; and (2) the section between the Saegers and Elimsport Switchyards will be named the Saegers-Elimsport 230 kV Transmission Line.

Once the Montour-Clinton 230 kV circuit is terminated into the Saegers 230 kV switchyard, this line will also be split into two sections at the Switchyard and will be renamed as follows: (1) the section between the Montour and Saegers Switchyard will be named the Montour-Saegers #2 230 kV Line; and (2) the section between the Saegers Switchyard and Clinton Substation will be named the Saegers-Clinton 230 kV Transmission Line.

The new line from the new Saegers 230 kV Switchyard to the Panda Plant will be named the Saegers-Panda Patriot 230 kV Line. PPL Electric is not asking for Commission approval to build this particular transmission line because it will be constructed and owned by the Panda

Patriot LLC. There are no plans for PPL Electric to own or operate the Saegers-Panda Patriot 230 kV Line.

The proposed transmission system configuration is provided in **Figure 2**. The total estimated cost of the Project is \$12.4 million, which includes \$3 million for the transmission line work and \$9.4 million for the switchyard work. The entire cost of the Project will be paid for by Panda Patriot LLC.

Figure 1
Functional One-Line Diagram of Existing Transmission System

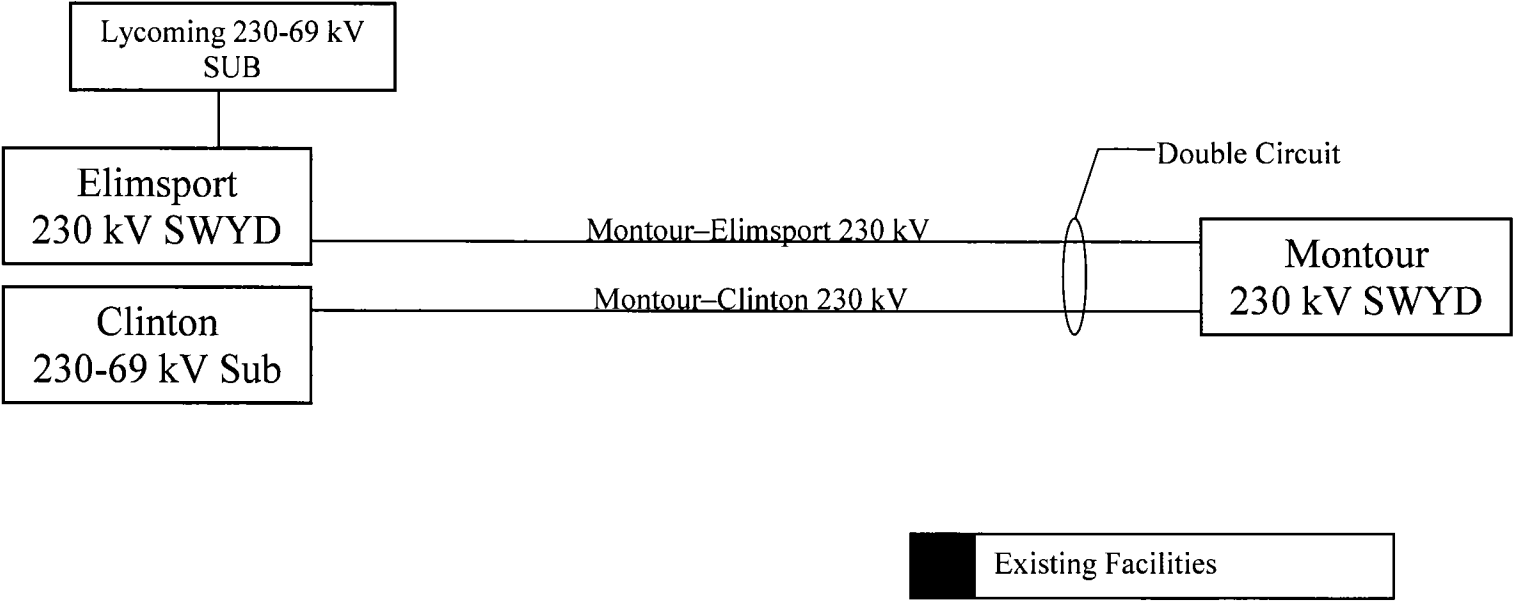
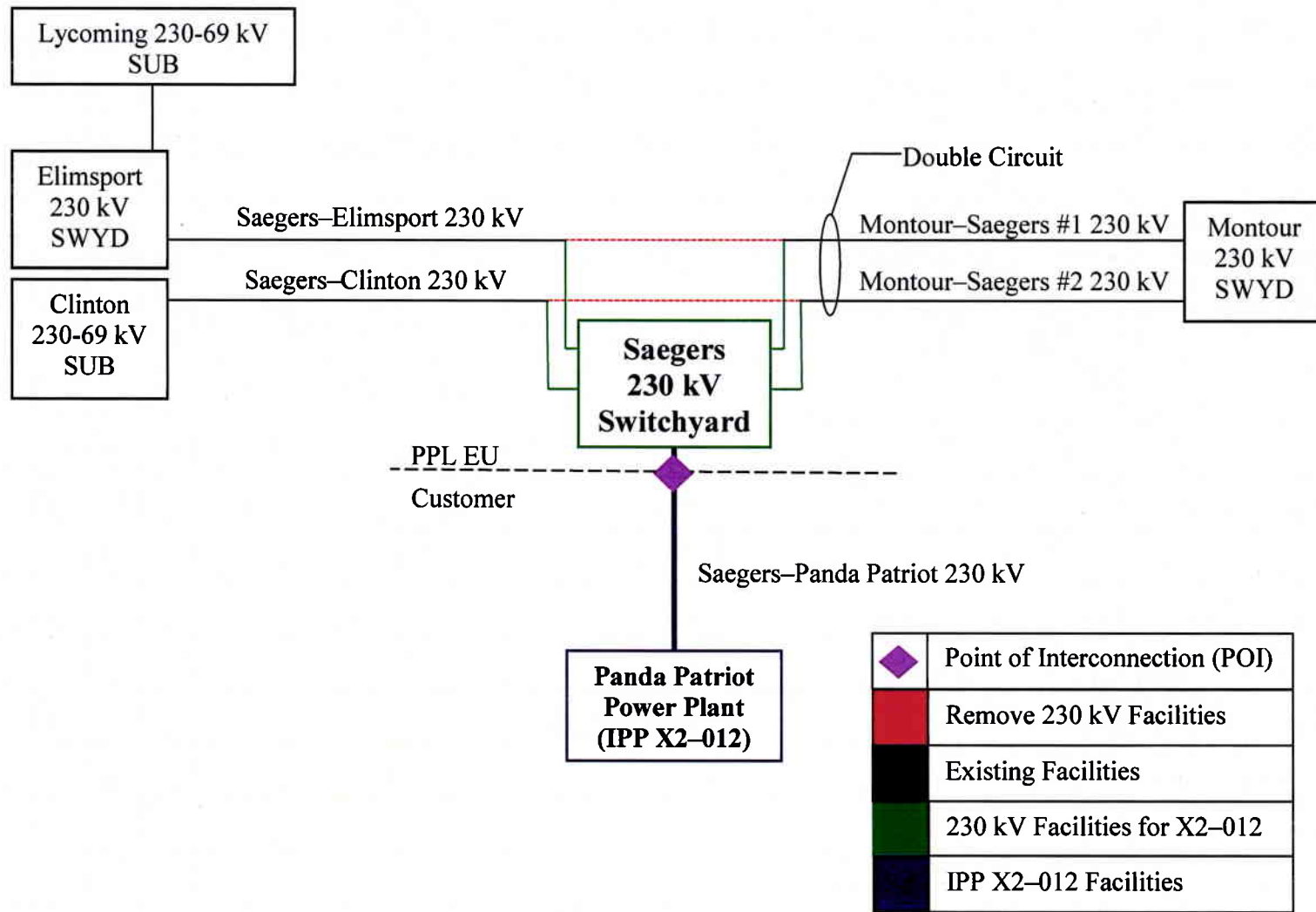


Figure 2
Functional One-Line Diagram of Proposed Transmission System



Attachment

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ATTACHMENT 2
MONTOUR–SAEGERS #1 & #2, SAEGERS–CLINTON, SAEGERS–ELIMSPORT
230 KV TRANSMISSION LINES
ENGINEERING DESCRIPTION

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ATTACHMENT “2”
MONTOUR–SAEGERS #1 & #2, SAEGERS–CLINTON, SAEGERS–ELIMSPORT
230 KV TRANSMISSION LINES
ENGINEERING DESCRIPTION

A. DESCRIPTION OF THE PROPOSED LINE

PPL Electric Utilities Corporation (PPL Electric) seeks approval from the Pennsylvania Public Utility Commission (“Commission” or “PUC”) to construct two new double-circuit 230 kV transmission lines to interconnect the proposed Panda Patriot Power Generation Plant (“Panda Plant”) to be constructed by Panda Patriot LLC, an independent power producer.

Pursuant to the PJM approved interconnection process described in Attachment 1, PPL Electric proposes, upon Commission approval, to construct two new double-circuit 230 kV transmission lines that will extend approximately 500 feet between the existing double-circuit Montour–ElimSPORT & Montour–Clinton 230 kV Transmission Line and the new Saegers 230 kV Switchyard near Saegers Station Road in Clinton Township, Lycoming County, Pennsylvania (hereinafter, the “Project”). The new Saegers 230 kV Switchyard will be located adjacent to the existing double-circuit Montour-ElimSPORT & Montour-Clinton 230 kV Transmission Line. The Panda Plant developer, Panda Patriot LLC, will then build one 230 kV transmission line that will extend approximately 0.5 miles between the Saegers 230 kV Switchyard and the Panda Plant.¹

The new lines will be designed, constructed, and operated at 230 kV. Each double-circuit transmission line will span approximately 500 feet between the Saegers 230 kV Switchyard and the existing Montour-ElimSPORT & Montour-Clinton 230 kV

¹ The new line from the new Saegers 230 kV Switchyard to the Panda Plant will be named the Saegers-Panda Patriot 230 kV Line. PPL Electric is not asking for Commission approval to build this particular transmission line because it will be constructed and owned by the Panda Patriot LLC. There are no plans for PPL Electric to own or operate the Saegers-Panda Patriot 230 kV Line.

Transmission Line. The existing 230 kV transmission lines are currently supported on existing double-circuit monopole structures, which will be removed and replaced with two double-circuit, weathering steel monopoles equipped with pole-mounted glass 230 kV insulator assemblies, 3-1590 thousand circular mills (kcmil),² 45/7 stranding, aluminum conductor steel reinforced (ACSR) conductors per pole, one 0.702-inch diameter Optical Ground Wire (OPGW), and one 0.640-inch all-dielectric self-supporting fiber optic cable (ADSS).

All new poles for this segment of the Project will be self-supported on concrete caisson foundations, with an average height of 130 feet above ground level. A depiction of the type of monopoles used for this Project is provided at the end of this Attachment.

The proposed new 230 kV lines will be designed to comply with, and generally exceed, National Electrical Safety Code (NESC) standards. Design specifications and safety rules practiced by PPL Electric are included in Attachment 4. The minimum conductor to ground clearance will be 35 feet, which occurs at a maximum thermal conductor temperature of 125 degrees Celsius.

The estimated cost to design and construct the Project is approximately \$12.4 million. This includes \$3 million for the transmission line portion and \$9.4 million for the switchyard work. The entire cost of the Project will be paid by Panda Patriot LLC, which will own the Panda Plant. Subject to the Commission's approval, construction is scheduled to begin in November of 2014 to support the mid-2015 in-service date of the Panda Plant.

B. MAGNETIC FIELD MANAGEMENT

PPL Electric's Magnetic Field Management Program is applied to new and reconstructed transmission line projects. The company does not believe that the current scientific

² KCMIL wire size is the equivalent cross sectional area in thousands of circular mils. A circular mil is the area of a circle with a diameter of one thousandth (0.001) of an inch.

evidence demonstrates that magnetic fields cause any adverse health effects or pose a health or safety danger to the public. Nevertheless, PPL Electric has determined, as a matter of policy, to design its new and rebuilt transmission lines to reduce magnetic fields when that can be done at low or no cost and consistent with functional requirements. PPL Electric's Magnetic Field Management Program has been developed to implement that policy decision. To reduce magnetic field exposures, the program generally prescribes the use of a line design that provides five feet higher ground clearance than NESC standards and reverse phasing of new double-circuit lines where it is feasible to do so at low or no cost.

Consistent with its Magnetic Field Management Program, PPL Electric will construct the two new double-circuit 230 kV transmission lines for ground clearances that are a minimum of five feet higher than the required NESC minimum ground clearance for 230 kV lines. Because the existing double circuit line is already reverse phased, the proposed lines also will be reversed phased.

TYPICAL 230 kV STRUCTURE



Attachment

3

ATTACHMENT 3
MONTOUR–SAEGERS #1 & #2, SAEGERS–CLINTON, SAEGERS–ELIMSPORT
230 KV TRANSMISSION LINES
DESCRIPTION OF THE RIGHT OF WAY

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A. INTRODUCTION

PPL Electric Utilities Corporation (PPL Electric) seeks approval from the Pennsylvania Public Utility Commission (“Commission” or “PUC”) to construct two new double-circuit 230 kV transmission lines to interconnect the proposed Panda Patriot Power Generation Plant (“Panda Plant”) to be constructed by Panda Patriot LLC, an independent power producer. The combined cycle natural gas fired power Panda Plant will produce 765 MW of generation. Through the PJM Independent Power Producer (“IPP”) interconnection process,¹ PJM and PPL Electric determined that, subject to PUC approval, the Panda Patriot Power Plant will be interconnected to the PPL Electric transmission system through a new Saegers 230 kV switchyard supplied by the existing Montour–Elimsport & Montour–Clinton 230 kV double-circuit Line.

The Panda Plant will be interconnected with PPL Electric’s transmission system by constructing two new double-circuit 230 kV transmission lines that will extend approximately 500 feet between the between the existing double-circuit Montour–Elimsport & Montour–Clinton 230 kV Transmission Line and a Saegers 230 kV Switchyard and the new Saegers 230 kV Switchyard near Saegers Station Road in Clinton Township, Lycoming County, Pennsylvania (hereinafter, the “Project”). The Panda Plant developer, Panda Patriot LLC, will then build one 230 kV transmission line that will extend approximately 0.5 miles between the Saegers 230 kV Switchyard and the Panda Plant.

The proposed construction activities that PPL Electric seeks PUC approval for will occur within the Clinton Township, Lycoming County. PPL Electric has discussed the proposed Project with representatives from the Borough and County, which have no objection to the Project.

¹ The new generation may also be referred to as IPP X2–012 which indicates its queue position in the PJM IPP interconnection process.

B. THE RIGHT-OF-WAY DESCRIPTION

The Panda Plant will be located in Clinton Township, Lycoming County, Pennsylvania on approximately 80 acres of land zoned as Heavy Industrial (I-2). This location was selected due to its proximity to the high voltage transmission line system and the existing heavy industrial zoning. The Panda Plant is located approximately 0.5 miles south of the existing double-circuit Montour–Elimsport & Montour–Clinton 230 kV Transmission Line near Saegers Station Road in Clinton Township, Lycoming County, Pennsylvania.

The two new 500-foot double-circuit 230 kV transmission lines that PPL Electric seeks PUC approval to construct will be located within the existing right-of-way for the Montour–Elimsport & Montour–Clinton 230 kV Transmission Line and the site proposed for the new Saegers 230 kV Switchyard to be owned and operated by PPL Electric. Both the existing right-of-way and site for the Saegers 230 kV Switchyard are located in areas that contain existing electrical facilities and industrial buildings within Clinton Township, Lycoming County. No additional property rights are required to complete this Project.

The new 0.5 mile 230 kV line from the new Saegers 230 kV Switchyard to the Panda Plant will be named the Saegers-Panda Patriot 230 kV Line. The Saegers-Panda Patriot 230 kV Line will be constructed on land and/or rights-of-way to be independently obtained, owned, and maintained by Panda Patriot LLC. PPL Electric is not asking for Commission approval to build this particular transmission line because it will be constructed and owned by the Panda Patriot LLC. There are no plans in the foreseeable future for PPL Electric to own or operate the Saegers-Panda Patriot 230 kV Line.

An aerial plot plan is provided at the end of Attachment 3.

C. **LAND USE AND ENVIRONMENTAL ASSESSMENT**

Impacts to land use are anticipated to be minimal because the Project will be constructed adjacent to the existing 230 kV transmission line, existing manufacturing facilities, and a railroad. Interference with existing land uses will be further minimized because, where possible, PPL Electric will use previously established access roads for construction.

No nearby communication towers, pipelines, or other utilities will be affected by the proposed Project. The closest airport is the Williamsport Regional Airport, a privately owned facility, which is located approximately 5.7 miles northwest of the Project area. PPL Electric does not anticipate any interference with airport operations because of the distance from the Project area, the presence of existing electrical facilities in the Project area, and the similar height of the new facilities and the existing facilities. However, PPL Electric will file any required documentation with both the Federal Aviation Administration and the Pennsylvania Department of Transportation Bureau of Aviation.

Panda Patriot LLC submitted a letter to the Pennsylvania Historical and Museum Commission (PHMC) in 2011, for the construction of the new 230 kV switchyard and the proposed transmission lines (both the lines to be constructed by PPL Electric and those to be constructed by Panda Patriot LLC), to request information on any additional archaeological or historic architectural resources located within the Panda Project area. By letters dated February 21, 2013 and March 18, 2013 under File No. 2011-2474-081-E and File No. 2011-2474-081-F, no further archaeological work is necessary for this project.

The proposed Project will not affect any unique geological, scenic or natural areas. Further, there are no state lands, national parks, state parks, local parks, recreational areas or natural landmarks located within the Project area.

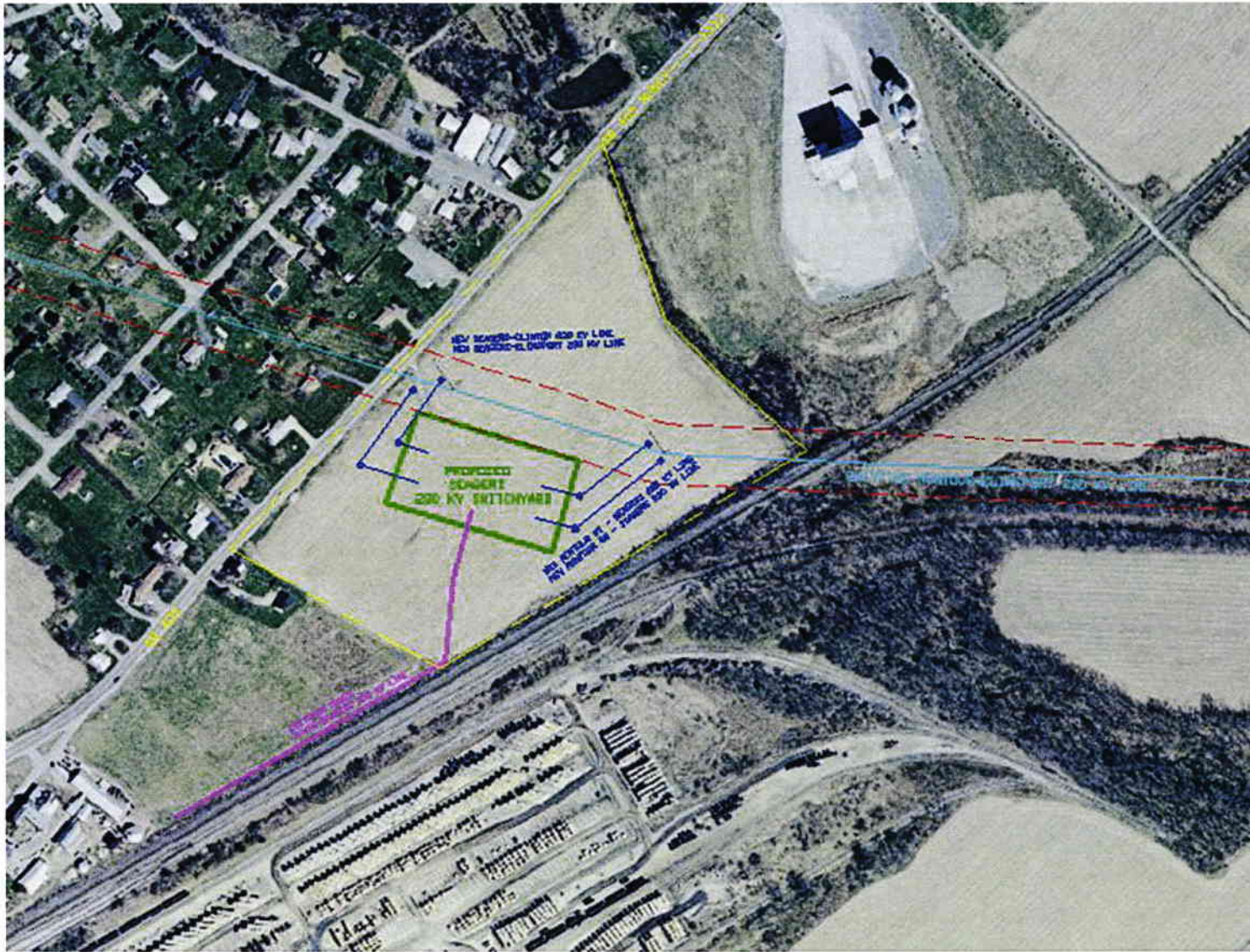
The proposed Project will cross no streams or wetlands. PPL Electric will obtain or join on existing and already approved permits acquired by Panda Patriot LLC from the County Conservation District, Pennsylvania Department of Environmental Protection and the

United States Army Corps of Engineers, and will comply with all of the terms and conditions placed on those permits. PPL Electric also will comply with soil erosion and sedimentation control permits already approved and will comply with any conditions placed on those permits.

Both Panda Patriot LLC and PPL Electric have coordinated with state and federal agencies to obtain information regarding threatened and endangered species in close proximity to the Project area. Panda Patriot LLC conducted an online Pennsylvania Natural Diversity Inventory (PNDI) database review on October 2, 2012 and PPL Electric updated this review on November 13, 2013. Based on this review, the Pennsylvania Game Commission (PGC), Pennsylvania Fish and Boat Commission (PFBC), the Pennsylvania Department of Conservation and Natural Resources (DCNR), and the U.S. Fish and Wildlife Service (USFWS) reported that the Project will not impact any threatened and endangered species and/or special concern species and resources located within the Project area.

D. VEGETATION MANAGEMENT

The Project is being completed in an area that has already been cleared of vegetation for the existing electrical facilities. The existing right-of-way for the Montour-Elimsport & Montour-Clinton 230 kV Transmission Line and the proposed site for the new Seager 230 kV Switchyard are both currently cleared of vegetation. No additional tree clearing is anticipated for the construction of the proposed Project. In areas where vegetation management is required to complete the project, PPL Electric will apply its “Specifications for Initial Clearing and Control of Vegetation On or Adjacent to Electric Line Right-of-Way Through Use of Herbicides, Mechanical and Hand Clearing Techniques” to mitigate any impacts.



Attachment

4

PPL DESIGN CRITERIA AND SAFETY PRACTICES

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

Engineering Design Criteria and Parameters

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

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

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

138 kV

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

230 kV

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

500 kV

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

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

Periodic Maintenance Program on All Transmission Lines

To ensure continued public safety and integrity of service, a periodic maintenance and inspection program is implemented for every transmission line. The program is administered through the use of helicopter patrols, with supplemental foot and structure

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

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

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

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

Personnel Safety Rules

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

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

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

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

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

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

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