

**STATE OF NEW JERSEY
BOARD OF PUBLIC UTILITIES**

IN THE MATTER OF THE PETITION OF	:	
PUBLIC SERVICE ELECTRIC AND GAS	:	
COMPANY FOR A DETERMINATION	:	
PURSUANT TO THE PROVISIONS OF	:	
N.J.S.A. 40:55D-19	:	BPU DOCKET
	:	
(SUSQUEHANNA-ROSELAND)	:	

**TO THE HONORABLE COMMISSIONERS OF THE
NEW JERSEY BOARD OF PUBLIC UTILITIES:**

**SUMMARY OF PRE-FILED DIRECT TESTIMONY
OF ESAM A.F. KHADR ON BEHALF OF PUBLIC SERVICE ELECTRIC
AND GAS COMPANY**

Esam A. F. Khadr, Director – Electric Delivery Planning in the Electric Delivery Department of Public Service Electric and Gas Company (“PSE&G”), submits this testimony on behalf of PSE&G in this proceeding to support the need for the construction of the New Jersey portion of the Susquehanna-Roseland 500 kV transmission line project (“Project”).

Mr. Khadr explains how and why this Project was identified by PJM Interconnection, L.L.C. (“PJM”) as a reliability baseline upgrade in the Regional Transmission Expansion Planning (“RTEP”) process, and why the Project is needed to maintain reliability. Specifically, Mr. Khadr explains that the Project is required to address numerous PJM-identified reliability criteria violations that are anticipated to occur beginning in 2012. Mr. Khadr explains why, from a transmission system reliability perspective, it is critical that this Project be built in a timely manner, as failure to address

the PJM-identified reliability criteria violations could result in lack of adequate voltage support and create thermal overloads on many 230 kV circuits, which would create the potential for system brown-outs and black-outs.

Mr. Khadr also explains why alternative lower voltage transmission projects would be insufficient to address these PJM-identified reliability criteria violations, and why generation and demand response programs do not obviate the need for this Project.

Mr. Khadr further explains that, besides addressing the PJM-identified reliability criteria violations in a timely manner, the Project has numerous additional benefits, including increasing system reliability by providing a new connection to the 500 kV backbone system and the 230 kV system in New Jersey.

Mr. Khadr explains how costs will be allocated for this Project. Specifically, under current federal rules, the costs of this high-voltage transmission Project will be regionalized across all PJM transmission customers; as a result, New Jersey customers will be allocated approximately 14% of the costs of this Project.

Finally, Mr. Khadr explains how he derived estimates of transmission line loadings that he supplied to PSE&G witness Kyle King to support Mr. King's testimony on magnetic field levels across the New Jersey span of the Project.

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1 **PRE-FILED DIRECT TESTIMONY OF ESAM A. F. KHADR**
2 **ON BEHALF OF PUBLIC SERVICE ELECTRIC AND GAS**
3 **COMPANY IN SUPPORT OF SUSQUEHANNA-ROSELAND**
4 **TRANSMISSION LINE PROJECT**
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8 **I. PROFESSIONAL BACKGROUND**

9 **Q. Please state your name, business address, and occupation.**

10 **A.** My name is Esam A. F. Khadr. I am employed by Public Service Electric and
11 Gas Company, 80 Park Plaza, Newark, New Jersey 07102. I currently hold the
12 position of Director – Electric Delivery Planning. I have been employed by
13 PSE&G for a total of 32 years, and have worked for the past 29 years in the
14 transmission and resource planning area.

15 **Q. What are your responsibilities in that position?**

16 **A.** My responsibilities include planning and designing the electric transmission and
17 distribution systems to assure the future reliability of the PSE&G system and
18 related systems to which it is interconnected. My job responsibilities include
19 performing transmission reliability studies to determine compliance with
20 reliability criteria established by the North American Electric Reliability

1 Corporation (“NERC”), as well as with PJM and PSE&G-specific reliability and
2 operational performance criteria. As part of these responsibilities, I coordinate
3 with both PJM and ReliabilityFirst Corporation (“RFC”), the regional arm of
4 NERC covering the PJM region.

5 In addition, my responsibilities include performing analyses of the need
6 for and viability of future economic transmission expansion and acceleration
7 projects in accordance with PJM’s economic cost/benefit metrics. Further, I
8 perform power system simulation studies to determine the feasibility of proposed
9 generation and merchant transmission interconnections and associated network
10 enhancements for such interconnections and analyses of proposed baseline
11 transmission expansion projects impacting the bulk power system.

12 **Q. What is your educational background?**

13 **A.** I earned a Bachelors Degree in Electrical Engineering from the New Jersey
14 Institute of Technology in 1975 and a Masters of Science in Electrical
15 Engineering in 1980 from Manhattan College.

16 **Q. Please summarize your employment experience with PSE&G.**

17 **A.** I have been employed by PSE&G since 1976, and have held various engineering
18 and technical management positions of increasing responsibility. Currently, I am
19 Director – Electric Delivery Planning in PSE&G. I manage the electric
20 transmission and distribution planning organization for PSE&G and participate in
21 the PJM planning process.

22

23

1 **Q. Are you a member of any professional organizations?**

2 **A.** I have chaired the Institute of Electrical and Electronics Engineers (“IEEE”)
3 Power Engineering Society in New York and have served as an industry advisor
4 to several Electric Power Research Institute (“EPRI”) power systems analysis
5 programs. I co-authored “California Energy: The Ingredients for a Crisis,”
6 published in Corporate Real Estate Executive, Vo. 16, No. 3, April 2001.

7 **Q. Have you previously testified before the BPU?**

8 **A.** No, I have not. However, I have testified in two regulatory proceedings before
9 the Federal Energy Regulatory Commission (“FERC”). Specifically, last year, I
10 submitted testimony on behalf of the PJM Transmission Owner Group in Docket
11 No. ER06-456-006, et al., Exhibit PTO-3, Pre-Filed Direct and Answering
12 Testimony of Esam A. F. Khadr on Behalf of PSE&G, JCP&L, Metropolitan
13 Edison Company, Pennsylvania Electric Company, Baltimore Gas and Electric
14 Company and Allegheny Power. In 2006, I submitted testimony on behalf of the
15 Lower Delaware Valley (“LDV”) Owners in Docket No. EL05-50, Exhibit LDV-
16 24, Prepared Answering Testimony of Esam A. F. Khadr on Behalf of Public
17 Service Electric and Gas Company and the LDV Owners in the case of Jersey
18 Central Power & Light Company v. Atlantic City Electric Company, Delmarva
19 Power & Light Company, PECO Energy Company and Public Service Electric
20 and Gas Company.

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1 **II. PURPOSE OF TESTIMONY**

2 **Q. On whose behalf are you submitting your testimony?**

3 **A.** I am submitting this testimony on behalf of PSE&G in this proceeding.

4 **Q. What is the purpose of your testimony?**

5 **A.** The purpose of my testimony is several-fold. First, I will provide a high-level
6 description of the Susquehanna-Roseland 500 kV transmission line project
7 (“Project”). Next, I will describe the nature and objectives of reliability planning,
8 as such planning pertains to the transmission system. I will then describe
9 PSE&G’s involvement in the regional transmission expansion planning (“RTEP”)
10 process performed by PJM that identified the electrical need for this Project.

11 I will explain why the Project is needed, from a transmission planning
12 perspective, to address PJM-identified reliability criteria violations in the region,
13 including in the northern New Jersey area, which includes the northern portions of
14 both the PSE&G system and the system of Jersey Central Power & Light
15 Company (“JCP&L”), and in eastern Pennsylvania. I will also explain why
16 alternatives to this line, including generation, demand response and lower voltage
17 transmission lines, are insufficient to address the identified reliability problems.
18 In this regard, I will explain that lower voltage transmission lines, which have
19 been relied upon in the past to address reliability concerns in this region, cannot
20 effectively be relied upon now to address the breadth and scope of circuit
21 overloads presented.

22 I will discuss how the costs to construct this line will be allocated to New
23 Jersey customers in accordance with existing FERC rules.

1 Finally, I will explain the sources of the line loading estimates that I
2 supplied to PSE&G witness Kyle King to enable him to characterize magnetic
3 field levels across the Project.

4 **Q. Are there any other electrical planning witnesses submitting testimony on**
5 **behalf of PSE&G?**

6 **A.** I am the only PSE&G witness who will be addressing the issue of the electrical
7 need for the Project from a transmission planning perspective. Mr. Steven R.
8 Herling and Mr. Paul F. McGlynn of PJM are also submitting testimony on behalf
9 of PSE&G regarding the issue of the electrical need for the Project.

10 **Q. Are you sponsoring any exhibits?**

11 **A.** Yes, I am sponsoring Exhibits EAK-1 through EAK-7 with my direct testimony:

12

13 **III. BACKGROUND**

14 **Q. Are you personally familiar with the 500 kV Project that is the subject of this**
15 **Petition before the New Jersey Board of Public Utilities?**

16 **A.** Yes, I have been personally familiar with this Project since its inception.

17 **Q. Have you participated in the planning and/or development of other**
18 **transmission line and substation projects during your professional career**
19 **with PSE&G?**

20 **A.** Yes. I have been working in PSE&G's planning department since 1980, and have
21 personally participated in transmission planning activities with respect to
22 numerous transmission line and switching station projects that have been
23 examined, studied and/or constructed throughout PJM.

1 I have also prepared interconnection planning studies for generators and
2 merchant transmission projects interconnecting to the PSE&G system, which
3 projects are either now in-service or are currently in PJM’s interconnection queue.

4 Finally, I am PSE&G’s representative on the PJM Planning Committee
5 and the PJM Transmission Expansion Advisory Committee (“TEAC”), and I am
6 the PSE&G representative on the ongoing Regional Planning Process Working
7 Group (“RPPWG”). I am also PSE&G’s representative on the Reliability
8 Committee of RFC.

9 **Q. Would you briefly describe, in a summary fashion, the electric distribution**
10 **territory served by PSE&G?**

11 **A.** PSE&G currently serves nearly three quarters of New Jersey’s population in a
12 service territory stretching diagonally across the State of New Jersey, covering
13 2,600 square miles, including all of New Jersey’s six largest cities, and running
14 from Bergen County in the northeastern portion of the State down to an area
15 below the city of Camden in the southwest. PSE&G has a customer base of
16 approximately 2.1 million electric customers, and its load requirements are
17 divided among residential, commercial and industrial customers. The PSE&G
18 transmission grid is comprised of approximately 1500 circuit miles, with over 470
19 miles of 500 kV circuits, including jointly-owned lines.

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1 **IV. DESCRIPTION OF THE SUSQUEHANNA-ROSELAND PROJECT**

2 **Q. Please describe the Project from an electrical perspective.**

3 **A.** The Project is a proposed electric reliability transmission enhancement to the PJM
4 transmission system, extending from the Berwick area in Pennsylvania to the
5 Roseland/East Hanover area in northern New Jersey. As part of the Project, PPL
6 Electric Utilities (“PPL Electric”) will construct approximately 100 miles of 500
7 kV circuit as well as a new 500 kV Lackawanna switching station.

8 The New Jersey portion of the Project, running from the Delaware Water
9 Gap east to the Roseland/East Hanover area, spans approximately 45 miles and
10 consists of a new 500 kV transmission circuit and two new 500 kV switching
11 stations - specifically, one at Jefferson and one in Roseland/East Hanover. In
12 Jefferson Township, the existing Branchburg to Ramapo 500 kV circuit will be
13 looped into the new Jefferson switching station. The new 500 kV circuit and the
14 two new switching stations at Jefferson and Roseland/East Hanover comprise a
15 single transmission project, as the switching stations would not be constructed
16 absent construction of the connecting 500 kV circuit.

17 The New Jersey portion of the Project will be located within the
18 transmission zones of PSE&G and JCP&L, as depicted on Exhibit EAK-1, which
19 shows all of the PJM transmission zones based on Attachment J of the PJM Open
20 Access Transmission Tariff on file with the FERC.

21

22

1 **Q. Please explain, in more detail, the integral nature of both the East Hanover**
2 **and Jefferson switching stations to this Project, and how these switching**
3 **stations are related to construction of the 500 kV circuit.**

4 **A.** I will start by explaining the significance of the new Jefferson switching station.
5 At Jefferson, another 500 kV circuit – the Branchburg to Ramapo circuit - passes
6 right outside this area and the Susquehanna-Roseland 500 kV circuit must tie into
7 this existing circuit. This loop-in process will occur at the switching station at
8 Jefferson. Looping in to the existing 500 kV Branchburg-Ramapo circuit is
9 critical from a reliability planning perspective since it ensures redundancy of the
10 500 kV network. Considering the existence of 230 kV and 115 kV circuits in
11 close proximity to the Jefferson switching station, the presence of this new
12 switching station will provide a framework for future reinforcement of ties into
13 the JCP&L 230 kV and 115 kV system, thereby helping to maintain reliability in
14 the future.

15 With respect to the Roseland/East Hanover switching station, this area is
16 one of the most important switching stations in the northern PSE&G zone. As
17 depicted in Exhibit EAK-2, Roseland ties the northern PSE&G zone to the
18 northern JCP&L zone via two 230 kV circuits and also ties the northern PSE&G
19 zone to the central PSE&G zone via one 230 kV circuit and one 138 kV circuit.
20 These ties into Roseland will be overloaded. Specifically, as set forth on Exhibit
21 EAK-3 attached to my testimony, PJM has identified the Branchburg-Readington
22 circuit, the Readington-Roseland circuit, the Whippany-Roseland circuit and the
23 Montville-Roseland circuit as overloaded in the years 2012 and 2014.

1 Construction of the new switching station will furnish a strong 500 kV source of
2 supply into Roseland, thereby relieving this overloading condition and
3 maintaining reliability in the northern PSE&G zone. Moreover, the presence of
4 the switching station will act as a supply source that will back-feed and strengthen
5 the northern JCP&L system.

6

7 **V. RELIABILITY PLANNING**

8 **Q. What happens when a transmission line overloads or exceeds its loading**
9 **capability?**

10 **A.** When a transmission line overloads (the loading on the line exceeds its applicable
11 rating), the conductor, the conductor clamps and the line terminal equipment
12 begin to overheat. Overheating the conductor may cause the line to sag low
13 enough to bring the line into contact with whatever is underneath it. Under these
14 conditions, the metal in the conductor may become brittle, rendering the line
15 useless. In addition, the line may break and fall to the ground, causing a
16 potentially dangerous situation for those near the line as well as the crews
17 required to respond to the event. Overheating of the conductor clamps and line
18 terminal equipment may cause similar results. In short, overloading transmission
19 lines may cause permanent damage to transmission infrastructure, as well as
20 power outages.

21 **Q. What action is required to prevent transmission line overloads?**

22 **A.** There are both short-term and long-term actions that need to be taken to prevent
23 transmission line overloads. In the short-term, to prevent the consequences of a

1 potential transmission line overload, operational actions and directives are
2 implemented by system operators before the line or related equipment fails or is
3 permanently damaged. Such short-term operational actions may include turning
4 specific generating plants off or on, opening or closing specific transmission lines
5 or discontinuing electric service to certain customers or groups of customers in
6 specific areas.

7 However, these are only emergency and temporary “fixes.” They may
8 prevent a specific breakdown on that particular occasion but do not solve the
9 underlying problem. That is the purpose of transmission planning – to design the
10 system and plan for contingencies to resolve the underlying reliability criteria
11 violations and to prevent transmission line overloads from occurring in the first
12 place. On a long-term basis, construction of additional transmission is necessary.

13 **Q. What happens when the voltage drops at a switching station?**

14 **A.** The severity of the consequences depends on the severity of the voltage drop at
15 the switching station. Voltage drops normally occur during heavy load conditions
16 and when critical circuits or large generation facilities trip. Voltage drops of less
17 than 3% are usually not significant. However, when the voltage drop at a
18 switching station exceeds 3%, the consequences can range from dimming of lights
19 in homes and businesses to a voltage collapse.

20 **Q. What happens when there is a voltage collapse on the transmission system?**

21 **A.** A voltage collapse occurs when the voltage on the system drops to a critically low
22 level and the system is unable to support power transfers across the system and
23 customers’ load connected to the system. This condition usually results in a

1 brown-out or a black-out. The area affected could be a single community or an
2 entire region.

3 **Q. How do you as a transmission planner determine if there is a need for a**
4 **planning solution to remedy reliability problems such as line overloads or**
5 **voltage drops?**

6 **A.** NERC has been designated by the FERC as the Electric Reliability Organization
7 (“ERO”) for the United States. Mandatory reliability standards developed by
8 NERC and approved by FERC, which carry with them significant penalties for
9 non-compliance (these penalties can be imposed on PJM and/or transmission
10 owners such as PSE&G), are used by transmission planners to measure the need
11 for additional transmission.

12 These NERC reliability standards define the reliability requirements for
13 planning and operating the North American bulk power system (facilities operated
14 at 100 kV and above). Specifically, the NERC reliability standards require PJM
15 to test events which fall into three (3) categories: A, B and C. NERC Category A
16 criteria, for example, require that, for all facilities in service, ratings and system
17 voltage limits are respected and the system is stable. NERC Category B criteria
18 impose similar requirements but with one facility removed from service (referred
19 to “n minus 1” criteria). Finally, NERC Category C criteria impose such
20 requirements in situations involving second contingencies – i.e. the loss of a
21 second system element (referred to as “n minus 2” criteria). NERC reliability
22 standards were the “criteria” used to determine that the Project was needed to
23 maintain reliability.

1 **Q. How are the NERC reliability standards used to determine when additional**
2 **transmission is needed?**

3 **A.** The NERC reliability standards require PJM to identify the “critical system
4 conditions” that the system must be evaluated against to ensure the system meets
5 the performance criteria specified in these standards. Once these “critical system
6 conditions” are established, PJM, in conjunction with the transmission owners,
7 performs tests to ensure that the system meets the performance criteria in the
8 NERC reliability standards.

9 When these tests show an inability of the existing transmission system to
10 meet a specific reliability standard or standards under these conditions,
11 construction of additional transmission becomes necessary.

12 **Q. What types of tests are used by PJM to determine if transmission system**
13 **upgrades are necessary?**

14 **A.** One type of test or study is a Load Deliverability Study, which examines defined
15 load zones within the PJM region and considers the ability of the transmission
16 system to deliver adequate power to the load zone during a generation capacity
17 deficiency. A generation capacity deficiency occurs when there is high consumer
18 demand on the electric system and insufficient generation capacity within the load
19 zone. A second type of study is a Generation Deliverability Study, which tests the
20 system to assure that capacity resources are not bottled by transmission system
21 constraints and can be delivered to the remainder of the PJM system.

22 Both types of studies are conducted by simulating the transmission system
23 as it is expected to exist during future time periods. The simulation includes

1 expected load growth (for the load deliverability test, this includes the anticipated
2 benefits of demand side management and demand response), the addition of new
3 generating plants and the retirement of existing generation plants, the addition of
4 merchant transmission projects and planned transmission construction projects.
5 Moreover, the simulation is performed within the context of peak periods,
6 modeling the conditions when the transmission system will be most stressed and
7 during which there will be inadequate generation that can be re-dispatched to
8 satisfy the demands of load.

9

10 **VI. THE PJM PLANNING PROCESS**

11 **Q. Could you please describe the process that resulted in the decision to**
12 **construct the Project?**

13 **A.** PJM has in place a FERC-approved Regional Transmission Expansion Planning
14 (“RTEP”) process. This process is memorialized in Schedule 6 of PJM’s
15 Operating Agreement, entitled “Regional Transmission Expansion Planning
16 Protocol.” The purpose of the RTEP is to “enable the transmission needs in the
17 PJM Region to be met on a reliable, economic and environmentally acceptable
18 basis.” Under this process, PJM plans the integrated transmission grid it operates,
19 and identifies potential future reliability criteria violations, utilizing a regional
20 perspective in collaboration with each individual transmission owner.
21 Specifically, PJM evaluates the aggregate of all needs across its system,
22 identifying potential problems on both a local and regional level. By identifying
23 future problems on a regional basis, PJM is able to identify the most effective

1 regional solutions and to minimize the impacts associated with focusing on state
2 and transmission owner boundaries.

3 **Q. Are there other parameters applicable to PJM's planning process?**

4 **A.** Yes. PJM's planning process is collaborative and provides an open and inclusive
5 forum for participation by all classes of market participants and stakeholders. In
6 fact, the FERC requires that PJM's planning process be open, participatory and
7 transparent.

8 **Q. How does the RTEP planning process work?**

9 **A.** The RTEP identifies transmission system upgrades and enhancements needed to
10 maintain the reliability of the transmission system. This identification process
11 keys off of a baseline power case that models expected future system conditions,
12 including existing transmission, generation and demand-side resources, as well as
13 transmission, generation and demand response that is reasonably certain to exist.
14 The result is a single process that integrates many system factors and requires
15 PJM to make initial forecasting assumptions regarding load forecasts, the
16 development or retirement of generation, demand response resources and
17 electricity transfer levels between portions of the grid. These assumptions are
18 then updated annually to reflect, among other things, changes in planned
19 generation or demand response and updated load forecasts.

20 PJM then performs tests on its baseline power case to determine whether
21 there are any potential future violations of NERC reliability standards that need to
22 be addressed through the RTEP.

1 **Q. What happens once PJM identifies potential future reliability criteria**
2 **violations on the system?**

3 **A.** Through its RTEP process, PJM, in collaboration with affected transmission
4 owners, develops specific transmission solutions that are needed to remedy those
5 violations and maintain the reliability of the transmission system. An RTEP
6 project is publicly presented and discussed at PJM's Transmission Expansion
7 Advisory Committee ("TEAC"), at which time stakeholder input and comment
8 regarding the project is obtained. Following this discussion, the project is then
9 submitted to PJM's Board of Managers for review. If approved by the PJM
10 Board of Managers, PJM designates a transmission owner or transmission owners
11 as having construction and ownership responsibility for the project and the project
12 then becomes eligible for cost recovery under FERC rules.

13 **Q. You noted that PJM updates its baseline forecasting assumptions annually.**
14 **Please explain.**

15 **A.** PJM reviews its RTEP baseline assumptions, with respect to generation
16 retirements/additions, load forecasts, demand response forecasts and changes in
17 transmission topology, on an annual basis. As a consequence, PJM also reviews
18 the need for each project identified in the RTEP on an annual basis. As discussed
19 below, this review, or RTEP baseline "retool," has recently occurred using 2008
20 data and has confirmed the need for the Project.

21

22

1 **Q. Please explain the nature of PSE&G’s role in this planning process, and in**
2 **the selection of the Project in particular.**

3 **A.** Under the PJM planning process, PJM is responsible for identifying reliability
4 criteria violations within the PJM region. The affected transmission owner(s)
5 then validates PJM’s analysis using its own planning tools, with a more localized
6 focus. Assuming that PJM and the transmission owner(s) (both of which could be
7 subject to significant monetary penalties imposed by NERC and the FERC in the
8 event of NERC Reliability Standards violations) are in agreement on the nature of
9 the reliability criteria violation or violations at issue, they then work
10 collaboratively in identifying a solution that will remedy the violation(s). The
11 transmission owner is also responsible for developing the construction specifics of
12 a given reliability project, since the transmission owner has greater knowledge of
13 issues such as rights-of-way and local system topology.

14 Prior to developing the Project, PJM identified numerous reliability
15 criteria violations that are projected to occur beginning in 2012 when using a 5-
16 year “look-ahead,” and then identified additional violations when examining
17 Years 6 through 15 as part of PJM’s 15-year planning horizon. PJM and the
18 affected transmission owners then worked together to determine which viable
19 solutions/alternatives existed to address the identified reliability problems. These
20 solutions were then reviewed by the TEAC before the PJM Board reviewed and
21 determined whether the solution should be included in the regional plan.

22

1 **Q. What is the duration of PJM’s planning horizon in identifying reliability**
2 **upgrades?**

3 **A.** PJM performs a 5-year baseline analysis (which includes the current year plus 5
4 years) to assess compliance with all applicable reliability standards and to identify
5 needed transmission upgrades to meet near-term demand growth for customers’
6 electricity needs. This 5-year baseline analysis, however, is only the first step in a
7 more comprehensive 15-year planning process. Under this long-term planning
8 analysis, PJM evaluates the needs of the system for 6 years out to 15 years. The
9 purpose of this planning horizon is to permit the timely consideration of many
10 long lead-time transmission options, ensuring there is sufficient time to address
11 future system reliability needs. This long-term planning analysis also ensures
12 compliance with Section 6.3.4 of the PJM Consolidated Transmission Owners
13 Agreement (“TOA”), a FERC-approved agreement between PJM and the PJM
14 transmission owners, which provides that PJM should conduct its transmission
15 planning based on a planning horizon of at least ten (10) years.

16 **Q. Please explain the impact, if any, of PJM’s implementation of a 15-year**
17 **planning process on the RTEP identification of 500 kV backbone**
18 **transmission projects such as this Project.**

19 **A.** Prior to the implementation of the 15-year planning horizon, PJM and the
20 transmission owners put into place short-term “solutions” to address identified
21 reliability criteria violations, such as the construction of 230 kV circuits and the
22 re-conductoring of existing circuits. The difficulty, however, is that when one
23 looks out across a 5-year planning horizon, one only sees a certain number of

1 violations, and the options to address these violations to maintain reliability are
2 more limited. Use of a 15-year planning horizon enables PJM to more accurately
3 identify reliability criteria violations that will exist in the future and to anticipate
4 and resolve these violations by planning for larger-scale, long-lead time projects
5 that cannot be planned and put into service within a 5-year time frame. In my
6 opinion, the result has been a move away from localized, short-term fixes that
7 simply staunch the bleeding and towards the implementation of an effective and
8 lasting way to deal with multiple reliability criteria violations on a regional, long-
9 term basis.

10 **Q. Once PJM included the Project as part of its RTEP process, and this Project**
11 **was approved by the PJM Board of Managers, was a transmission owner**
12 **member of PJM, in this case PSE&G, then obligated to construct the**
13 **Project?**

14 **A.** Yes, as was PPL Electric for the Pennsylvania portion of the Project, under
15 Section 4.2 of the TOA.

16 **Q. Please explain the nature of PSE&G's construction obligation.**

17 **A.** Once a reliability-based RTEP project is approved by the PJM Board of
18 Managers, PJM then designates a transmission owner(s) as the "appropriate"
19 entity to construct, own and/or finance the project or a portion thereof. That
20 entity can then either build the project itself or contract with another entity to
21 fulfill its obligation to build.

22 In the case of the Project, PSE&G received a notice dated October 9,
23 2007, notifying the company that PSE&G had been designated to build the New

1 Jersey portion of the Project. This letter is attached to my testimony as Exhibit
2 EAK-4. By separate letter, PJM also designated PPL Electric to construct the
3 Pennsylvania portion of the Project. PSE&G accepted the designation of
4 construction responsibility for the New Jersey portion of the Project in a letter to
5 PJM dated November 21, 2007. This letter is attached as Exhibit EAK-5.

6 **Q. If a transmission owner member of PJM receives a construction letter from**
7 **PJM designating it as responsible for constructing a reliability-based RTEP**
8 **project, is that transmission owner required to construct the project or make**
9 **arrangements to have another transmission owner member construct the**
10 **project?**

11 **A.** Yes. While I am not an attorney, Section 4.2.1 of the FERC-approved TOA
12 clearly states that any member that is designated as the “appropriate entity” to
13 construct and own a transmission project identified in the RTEP is required to
14 “construct and own or finance such facilities or enter into appropriate contracts to
15 fulfill such obligations,” subject to the terms of the Agreement.

16

17 **VII. NEED FOR THE SUSQUEHANNA-ROSELAND PROJECT**

18 **Q. What time period was considered in PJM’s load deliverability and**
19 **generation deliverability studies associated with the Project?**

20 **A.** The studies supporting the need for this Project were based on both a 5-year and a
21 6-15-year planning analysis. As the Project was included in PJM’s RTEP that
22 issued in 2007, PJM used 2007 forecasts of load, demand response and generation
23 (both retirements and additions). In November 2008, however, PJM issued its

1 2012 RTEP baseline retool (“retool analysis”). The purpose of this retool
2 analysis, is to incorporate changes in assumptions that have occurred since the
3 2007 RTEP was completed. The retool analysis uses: (i) January 2008 load
4 forecast data; (ii) changes to generation assumptions since the issuance of the
5 2007 RTEP (including announced retirements, decisions to withdraw deactivation
6 requests and new generation in the PJM interconnection queue for which
7 Interconnection Service Agreements have been executed); and (iii) increases in
8 demand response, reflecting the bidding of demand response resources into the
9 several Reliability Pricing Model (“RPM”) capacity auctions that have been held
10 following the 2007 RTEP. Notwithstanding all of these updated assumptions,
11 PJM continues to conclude in the retool analysis that the Project is still required in
12 2012 given the numerous 230 kV overloads that would occur without the Project.

13 **Q. Please describe why PJM has determined that there is currently an electrical**
14 **need for the Project.**

15 **A.** Based on system studies, PJM, in its role as regional transmission planner, has
16 concluded that there are twenty-three (23) 230kV and 500 kV transmission
17 circuits located in the PSE&G, JCP&L, PECO and PPL Electric transmission
18 zones that will be overloaded within PJM’s 15-year planning horizon if the
19 Susquehanna-Roseland line is not constructed and placed into service. In fact,
20 **eight (8) of these circuits will be overloaded by the year 2015 if the line is not**
21 **placed into service.** The existence of these future overloaded circuits will place
22 PJM in violation of NERC Category A and Category B criteria, and applicable

1 NERC planning-related reliability standards, utilizing PJM's load and generation
2 deliverability tests.

3 **Q. Has PSE&G reviewed PJM's studies of the electrical need for the Project to**
4 **validate the results?**

5 **A.** Yes. On behalf of PSE&G, I have reviewed the PJM RTEP studies identifying
6 the reliability criteria violations discussed above, and have worked closely with
7 PJM's planning department in determining the best solutions to address these
8 reliability criteria violations. I have also validated PJM's conclusion that the
9 Project will address all PJM-identified reliability criteria violations in the
10 PSE&G, JCP&L, PECO and PPL Electric transmission zones during the planning
11 horizon.

12 **Q. Based on your reviews and assessments, have you formed an opinion**
13 **regarding the need for the Project?**

14 **A.** Yes, I have. Based on my review of the relevant PJM RTEP studies, it is my
15 opinion that this Project provides the best solution from a reliability and planning
16 perspective to the reliability criteria violations identified in Exhibit EAK-3, which
17 are expected to begin occurring in 2012 if this Project is not constructed. The
18 transmission line overloads projected to occur indicate that construction of a 500
19 kV line is necessary.

20 **Q. The Project has an identified in-service date of 2012. Is it your opinion that**
21 **this Project needs to be placed into service in 2012?**

22 **A.** As set forth in Exhibit EAK-3, and based upon PJM's analysis, there are three (3)
23 circuits that will be overloaded beginning in the year 2012 if the Project is not

1 placed into service, with additional reliability criteria violations occurring on a
2 yearly basis thereafter. Thus, timing is critical with respect to the need for, and
3 construction of, this Project. If the Project is not placed into service in 2012, and
4 there are no material changes in the data underlying PJM's analysis, there will be
5 overloads on critical circuits in the region, and PJM and the transmission owners
6 may need to implement emergency operating procedures, such as reducing
7 transmission system voltages ("brown-outs") or implementing rolling black-outs
8 for network transmission service customers, in order to manage operating
9 conditions. In addition, PJM and the transmission owners, through the
10 transmission planning process, could look to develop and implement "band-aid"
11 projects, such as lower voltage transmission projects, as a means of addressing a
12 small sub-set of these system overloads for a short period of time. However,
13 lower voltage transmission "fixes" will not address all of the identified violations,
14 and thus operational procedures to address the overloads would still be required.
15 It is important to emphasize that unresolved reliability criteria violations place the
16 system at risk and greatly increase the possibility that customer load will need to
17 be curtailed in order to prevent uncontrolled system blackouts.

18 **Q. Please summarize why, in your opinion as a transmission planner, the**
19 **Project is needed.**

20 **A.** It is my opinion that the Project is needed for several reasons. First, the Project
21 will address the PJM-identified regional reliability criteria violations during the
22 planning period, while also providing additional voltage support in the area that
23 will reduce the risk of localized brown-outs and black-outs. In fact, the recent

1 addition of capacitors at Roseland, Whippany and West Orange underscores the
2 need for reactive support in this area, and the Project should help to reduce the
3 need for future capacitor installations. Second, placing the Project in service will
4 serve to increase reliability margins by providing a new connection to the 500 kV
5 backbone system and the 230 kV system. Third, the Project will provide for
6 future connection of the Northern JCP&L 230 kV system to the 500 kV network.
7 Finally, the Project enables future 500 kV network redundancy.

8 **Q. Which types of generation will be delivered over this Project?**

9 **A.** This Project will deliver a mix of generation sources. New Jersey currently
10 imports approximately 25% of its power to serve the needs of its load. *See* page
11 36 of the New Jersey Energy Master Plan, at
12 http://www.nj.gov/emp/docs/pdf/081022_emp.pdf.
13 Wind generation currently makes up approximately 46% of PJM's
14 interconnection queue, with natural gas-fired generation comprising
15 approximately 35% of the interconnection queue. See Exhibit EAK-6, attached to
16 my testimony. Construction of this 500 kV backbone transmission project will
17 afford customers greater access to all types of new generation.

18

19 **Q. In your opinion, will construction of this Project thwart the State's ability to**
20 **address the issue of "leakage" in future regulations?**

21 **A.** No, it will not. While the State has not yet issued any such regulations, these
22 regulations, if adopted, could apply equally to generators that transport power
23 over the Project and to generators that do not. The existence of this Project will

1 not in any respect affect the State’s ability to impose requirements on the sources
2 of generation.

3 **Q. PJM has just included in its RTEP, and the PJM Board has just approved,**
4 **an additional 500 kV project running from Branchburg to Roseland/East**
5 **Hanover to Hudson. Does this mean that the Project is no longer needed?**
6 **Please explain the impact of this new PJM-approved 500 kV RTEP project.**

7 **A.** The need for this new line is additive; it is not a replacement for the Project. The
8 Jefferson-Roseland circuit (the New Jersey portion of the Project) will bring
9 power into northern New Jersey to maintain reliability in the PJM region, while
10 the approved Branchburg to Roseland/East Hanover to Hudson circuit will move
11 the power further east. The two lines will be built to address different sets of
12 PJM-identified reliability criteria violations, with no overlap between the two.
13 Thus, there will remain a critical need for the Project.

14 **Q. Is the Project being constructed to move power out of New Jersey into New**
15 **York?**

16 **A.** No. The Project is being constructed to maintain reliability in PJM, including in
17 Northern New Jersey, as the Project will address numerous reliability criteria
18 violations that will occur in this region absent construction of this Project.

19 It is true that energy does flow in both directions between PJM and New
20 York, as PJM and the New York Independent System Operator, Inc. (“NYISO”)
21 are, and will continue to be, interconnected transmission systems. Just as
22 Interstate 95 does not stop at the entrance to the George Washington Bridge but

1 instead proceeds into New York, the electric grid also does not stop at the New
2 Jersey/New York border.

3 **Q. In your opinion, would lower voltage transmission projects resolve the**
4 **subject PJM-identified reliability criteria violations?**

5 **A.** Lower voltage transmission projects, which have been relied upon in the past,
6 would help to maintain system reliability to a degree. However, they simply will
7 not address all of the PJM-identified overloaded transmission circuits in the
8 region. By contrast, this single Project will address all of the 23 overloaded
9 circuits within the planning horizon time frame, and will fortify the 500 kV
10 backbone system to help ensure future grid reliability in the region.

11 PJM in fact considered, and PSE&G reviewed, a specific low voltage
12 transmission alternative to the Project. As explained in the testimony of PJM
13 witness Paul McGlynn, PJM considered the construction of a new 230 kV line
14 between the Stanton switching station in Pennsylvania and Roseland. Yet, this
15 alternative was ultimately rejected as not being robust enough to address all of the
16 identified reliability criteria violations.

17 **Q. In your opinion, would increasing generation sufficiently address the PJM-**
18 **identified reliability criteria violations?**

19 **A.** As explained by PJM witnesses Herling and McGlynn, PJM models assumptions
20 regarding generation build and generation retirement in its RTEP planning
21 analysis in determining whether transmission solutions need to be built to
22 maintain system reliability. It is important to note that generation build is a
23 market-driven process; PJM cannot mandate that generation be built. Moreover,

1 it is difficult to site and build local generation in densely populated areas such as
2 eastern PJM, due to such factors as strict environmental restrictions and land
3 acquisition costs. Thus, in my opinion, it is very unlikely that additional
4 generation capacity in the vicinity of eastern PJM load centers will materialize in
5 sufficient quantity to eliminate the need for this Project.

6 **Q. Have the PSE&G zone, the State of New Jersey and the PJM region**
7 **experienced significant growth in electrical load and, if so, do you expect this**
8 **growth rate to continue?**

9 **A.** With respect to PSE&G specifically, over the past five (5) years, PSE&G's
10 summer peak load has increased by almost 800 MW from a level of 9855 MW in
11 2003 to a level of 10,654 MW in the summer of 2008 – a 1.6% growth rate. In
12 2006, PSE&G in fact experienced an unrestricted peak load of 11,229 MW during
13 hot weather conditions. If PSE&G were to experience those same weather
14 conditions in the summer of 2012 (the expected in-service date of the Project),
15 coupled with only a 1% growth rate, the 2012 summer peak load would exceed
16 11,900 MW, almost 300 MW above the number contained in PJM's 2008 Load
17 Forecast Report for the PSE&G zone for 2012.

18 PJM's January 2008 Load Forecast Report, attached to my testimony as
19 Exhibit EAK-7, projected the following load growth percentages for the ten-year
20 period 2008-2018: in the PSE&G zone, an increase in load growth of 1.4%
21 annually; in the JCP&L zone, an increase of 2.0% annually; in the Atlantic City
22 Electric Company zone, an increase of 2.6% annually; and in the PJM-wide
23 region, an increase of 1.5% annually.

1 **Q. How will the recent economic downturn impact upon forecasted load growth**
2 **in the State of New Jersey and across the PJM region?**

3 **A.** PJM expects to issue a new load forecast report in early 2009, which may show
4 smaller load growth rates for both New Jersey and for the PJM region due to the
5 recent economic downturn. Examined in isolation, slower load growth could
6 suggest a possibility of an in-service delay for the Project. At the same time,
7 however, there may be off-setting inputs into the planning analysis, such as
8 generation retirements in eastern PJM and/or slowing generation development
9 generally, that could suggest an even more immediate need for the Project. PJM's
10 planning analysis reflects the incorporation of many variables, including but not
11 limited to load growth.

12 In addition, an economic-driven slow-down in energy usage may not
13 produce a corresponding reduction in peak load demand during extreme weather
14 conditions when air-conditioning use is at its maximum.

15 Transmission planning is dynamic; that is why PJM periodically re-
16 examines its forecasts assumptions in its RTEP "re-tools." I believe that, even if
17 load growth slows over the next year or two, the need for this Project will remain
18 given the number and severity of the identified reliability criteria violations at
19 issue. In the event, however, that PJM concludes in the future that the Project is
20 not needed or should be delayed, PSE&G will adhere to PJM's determination.

21

1 **Q. Isn't it true that demand response programs are working in PJM and in New**
2 **Jersey? How will the continuation of these demand response programs**
3 **impact upon future load growth, and the resulting need for this Project?**

4 **A.** In PJM's retool analysis, PJM verified that demand response has increased in
5 PJM in several regions. For the Eastern MAAC region, which includes New
6 Jersey, the Delmarva zone and the PECO zone in Pennsylvania, demand response
7 has increased by a total of 185.9 MW. In the PSE&G zone, demand response has
8 increased by 43 MW, with demand response increasing in the JCP&L zone by 52
9 MW. At the same time, however, based on PJM's January 2008 load forecast
10 report, the load forecast in the Eastern MAAC region has increased for the year
11 2012 by 411 MW over the 2007 load forecast. Thus, while demand response has
12 increased, so have the demands on the system imposed by increased load.

13 At the end of the day, demand response programs, even if they are
14 working, will not negate the need for the construction of the Project. There are
15 several reasons why this is the case. First, unless demand response programs are
16 actually in place, and thus certain, measurable and verifiable, they cannot be
17 relied upon. That is why PJM cannot "model" the New Jersey Energy Master
18 Plan ("EMP") in its planning process – the EMP sets forth goals that may or may
19 not be achieved and does not provide any specifics regarding how demand
20 response programs, to the extent they do materialize, will actually be
21 implemented. In fact, the EMP does not even attempt to make the claim that its
22 goals can or will be achieved in the 2012-2015 time frame, when many of the
23 reliability criteria violations at issue will occur.

1 Second, demand side programs cannot realistically substitute for new
2 transmission capacity to customers in eastern PJM. Demand response does not
3 produce a steady stream of MW output equivalent to generation, as it is typically
4 cycled over a given period of time. Thus, this Project is still very much needed to
5 maintain reliability in the region.

6 **Q. Have you reviewed Mr. Herling's and Mr. McGlynn's direct testimony in**
7 **this proceeding with regard to the electrical need for the Project?**

8 **A.** Yes. I agree with their conclusions regarding the electrical need for the Project.

9

10 **VIII. COST ALLOCATION**

11 **Q. Please explain how costs for the Project will be paid.**

12 **A.** Under current FERC rules set forth in FERC Order No. 494, *PJM*
13 *Interconnection, L.L.C.*, 119 FERC Para. 61,063 (2007), the costs of all regional
14 transmission facilities at a voltage of 500 kV and above are regionalized to all
15 PJM transmission customers on a load ratio share basis. Specifically, costs for
16 these projects are allocated among the PJM transmission zones in proportion to
17 their load ratio share at the time of each zone's annual peak of the previous year
18 ending October 31st. Under this methodology, PSE&G's customers will pay
19 approximately 7.5% of the costs of this Project, and all customers in New Jersey
20 will pay approximately 14% of the costs of the Project.

21

1 **IX. EMF DATA**

2 **Q. Did you perform analyses regarding the expected load that will flow across**
3 **the existing 230 kV line and the proposed 500/230 kV lines as part of the**
4 **Project (i) if the lines were constructed in 2006-08 (most recent period for**
5 **which data is readily available) and (ii) in the year 2013, the first full year**
6 **that the Project will be in service?**

7 **A.** Yes, I did.

8 **Q. What was the purpose of these analyses?**

9 **A.** The purpose was to estimate hourly power flows on transmission circuits along
10 the proposed Susquehanna-Lackawanna-Jefferson-Roseland 500 kV transmission
11 Right-Of-Way (“ROW”) before and after the construction of the Project. PSE&G
12 witness Kyle King used these hourly power flow values to calculate magnetic
13 field levels on all circuits along the route of the Project in New Jersey.

14 **Q. Briefly explain how this analysis was performed.**

15 **A.** Two different methods were used in performing this analysis.

16 Historical Loading

17 Initially, historical data was used to describe the hourly power flow on the
18 existing 230 kV circuits, and to analyze how this would change if the proposed
19 500 kV and the reconfigured 230 kV circuits along the New Jersey portion of the
20 proposed ROW were operating in 2006-08.

21 Production Cost Modeling

22 The second method used a production cost algorithm with a transmission
23 modeling tool to predict the hourly flow, for the year 2013, on the existing 230

1 kV circuits and the proposed 500 and 230 kV circuits along the New Jersey
2 portion of the proposed ROW. The hourly flows estimated by both methods were
3 used by Mr. King to calculate magnetic field levels for conditions with and
4 without the Project at different points along the New Jersey portion of the
5 proposed ROW.

6 **Q. Please further describe these two methodologies.**

7 **A.** PI historian software, developed by OSI SOFT, was used to retrieve hourly
8 historical power flow data for each section of the Roseland-Montville-Newton-
9 Kittatinny 230 kV circuit for the period between August 2006 and August 2008.
10 The anticipated power flows along this ROW post- in-service date of the Project
11 were calculated based on the historical power flow data and the application of
12 distribution factors (“DFAX”). These calculated flows were used to determine
13 magnetic field levels along the ROW after placement of the Project into service.
14 While this method is most closely based on actual data, it has limitations because
15 it does not include the potential impact of all future transmission network
16 changes, load growth, future generation additions and retirements and future
17 market conditions.

18 PROMOD – a production cost modeling software developed by Ventyx –
19 was used to predict hourly power flows on all 500 kV and 230 kV circuits along
20 the Project. PROMOD is a detailed transmission security-constrained unit
21 commitment and dispatch model. PROMOD’s Transmission Analysis Module
22 (“TAM”) provides a line-by-line power flow analysis of an interconnected
23 transmission system and incorporates that information into its hourly evaluation

1 of production costs. The PROMOD study was performed to simulate the
2 transmission system configuration and market forecasts for the year 2013, the first
3 full in-service year of the Project. Ventyx provides a long-range forecast for load,
4 fuel and emissions prices, and these forecasts are updated monthly. The most up-
5 to-date forecast (October 2008) was the source of input to the models. Two
6 simulations, with and without the Project in service, were performed. The hourly
7 power flow results for all circuits along the Susquehanna-Roseland ROW were
8 provided to Mr. King.

9 **Q. Does this conclude your testimony?**

10 **A.** Yes it does.