Generation Interconnection
Revised Feasibility Study Report

For

PJM Generation Interconnection Request
Queue Position X2-025

Sunbury 230kV

January 2012

Preface

The intent of the feasibility study is to determine a plan, with ballpark cost and construction time estimates, to connect the subject generation to the PJM network at a location specified by the Interconnection Customer. The Interconnection Customer may request the interconnection of generation as a capacity resource or as an energy-only resource. As a requirement for interconnection, the Interconnection Customer may be responsible for the cost of constructing: (1) Direct Connections, which are new facilities and/or facilities upgrades needed to connect the generator to the PJM network, and (2) Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system.

In some instances a generator interconnection may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection, may also contribute to the need for the same network reinforcement. The possibility of sharing the reinforcement costs with other projects may be identified in the feasibility study, but the actual allocation will be deferred until the impact study is performed.

The Feasibility Study estimates do not include the feasibility, cost, or time required to obtain property rights and permits for construction of the required facilities. The project developer is responsible for the right of way, real estate, and construction permit issues. For properties currently owned by Transmission Owners, the costs may be included in the study.

General

The Interconnection Customer (IC), has proposed a natural gas generating facility located in Shamokin Dam, PA. The installed facilities will have a total capability of 416 MW with 416 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is October 31, 2015. **This study does not imply a PPL Electric Utilities (PPL EU) commitment to this in-service date.**

Point of Interconnection

X2-025 will interconnect with the PPL EU transmission system at one of two options. Option 1 is to connect at the Sunbury 230kV substation. Option 2 is to connect at the Sunbury 500kV substation.

Option 1: Overhead Connection to Sunbury 230 kV Bay 7

The X2-025 project can be connected to the Bay 7 position at PPL EU's Sunbury 230 kV Substation via an overhead line along the substation fence. This line would span approximately 2000 feet and be terminated at PPL EU's Bay 7 in a double breaker-double bus arrangement.

Figure 1: X2-025 Overhead Connection to Sunbury 230 kV Yard (One Line Diagram)

Figure 2: X2-025 Overhead Connection to Sunbury 230 kV Yard (Substation Layout)

The total magnitude cost of Direct Connection Facilities needed to connect to a new 230 kV station is **$3,365,943** (excluding any applicable state or federal taxes). The 230 kV connection estimate is based on the assumption that the connection will span approximately 2000 feet.

A further breakdown of the direct connection costs for the new 230 kV substation connection is as follows:

$	1,287,096	Transmission work for the direct connection
$	2,000,681	Substation work at PPL EU Sunbury Substation
$	78,166	Siting and certification

230 kV Transmission Tap Direct Connection Work

$1,287,096 (230 kV Transmission tap)

A new 230kV transmission line spanning approximately 2000 feet will connect the X2-025 project to Bay 7 of the Sunbury 230kV yard. Prior to the interconnection, the Sunbury – Montour line that is currently terminated in Bay 7 must be moved to the vacant Bay 8. This will avoid an undesired 230kV line crossing (the X2-025 transmission tap crossing over the Sunbury – Montour line) that would occur if the new transmission tap were to terminate in Bay 8.

The estimate for the transmission tap includes costs to move the Sunbury – Montour line and to construct the new tap. The costs of associated work for line terminations, new poles & foundations, and optical ground wire for relay and control are part of the estimate.

This transmission extension will be located either just inside or just outside the Sunbury substation fence. A final line route will be selected during a later study. The tap will be owned by PPL EU regardless of its location.

If the tap is built outside the substation fence, a PA PUC Waiver will be required. The estimated cost of this filing is approximately $78,166 and is broken out as a cost separate from the transmission tap work under the total cost for the Direct Connection Facilities. The lead time required from filing preparation to PA PUC approval is approximately 12 months.

If the tap is located inside the substation fence, filing with the PA PUC will not be required, as the tap will transmit electricity within the confines of the substation. The total cost of the project if no siting activities are required will be approximately $3,287,777.

Sunbury 230 kV Substation Expansion – Direct Connection Work

$2,000,681 (Sunbury 230 kV Substation Expansion)

To accommodate the X2-025 project, Bay 7 and the buses at the Sunbury 230kV yard must be upgraded to 3000A capacity. The 230 kV switchyard work also includes installing two new circuit breakers/foundations and four disconnect switches/foundations, as well as control cubicle and device wiring.

Option 2: Overhead Connection to New Sunbury 500 kV Switchyard

The X2-025 project can be connected to an available 500 kV bay at PPL EU's proposed new Sunbury 500 kV Gas Insulated Switchyard (GIS) located adjacent to the existing Sunbury 500 kV GIS. This connection option is contingent on the completion of the new switchyard by PPL EU prior to the developer's requested in-service date.

Figure 3: X2-025 Overhead Connection to Proposed Sunbury 500 kV Yard (One Line Diagram)

Figure 4: X2-025 Overhead Connection to Proposed Sunbury 500 kV Yard (Substation Layout)

The total magnitude cost of Direct Connection Facilities needed to connect to the proposed 500 kV switchyard is **$5,710,898** (excluding any applicable state or federal taxes). The 500 kV connection estimate is based on the assumption that the connection will span approximately 2500 feet.

A further breakdown of the direct connection costs for the new 500 kV switchyard connection is as follows:

$	2,171,837	Transmission work for the direct connection
$	3,461,478	Substation work at PPL EU Sunbury Substation
$	77,584	Siting and certification

500 kV Transmission Tap Direct Connection Work

$2,171,837 (500 kV Transmission tap)

The transmission direct connection cost includes construction of one 2500 foot 500 kV tap between the developer's site and the proposed Sunbury 500 kV yard. The tap will be constructed outside and parallel to the substation fence.

This transmission extension would be traversing to-be-acquired right-of-way and would be owned by PPL EU. A PA PUC Letter of Notification will be required, as the tap does not exceed 2 miles in length. The estimated cost of this filing would be approximately $77,584 and is broken out as a cost separate from the transmission tap work under the total cost for the Direct Connection Facilities. The lead time required from filing preparation to PA PUC approval would be approximately 12 months.

The transmission direct connection cost also includes associated line terminations and transfers to accommodate the connection.

Sunbury 500 kV Substation Direct Connection Work

$3,461,478 (Sunbury 500 kV Substation)

A bay for the X2-025 project must be installed at the new 500 kV GIS in a double breaker-double bus arrangement. The required substation work includes installation of the following GIS equipment: two circuit breakers & foundations, four disconnect switches & foundations, a dead-end structure & foundations, bus support foundations, and bus work. Control cubicle wiring and device wiring must also be completed at the new switchyard.

X2-025 Generator Regulation or Reactive Support Requirements

The PPL EU preliminary load flow studies have indicated that the X2-025 generator will maintain the required voltage regulation on the Sunbury 230 kV bus or the Sunbury 500 kV bus within their required ranges. A voltage schedule will be developed after the Facilities Study stage.

As specified in Part IV, Subpart E at 54.7 of the PJM OATT, the Project X2-025 generator shall design its "Facility" to maintain a composite power factor delivery at continuous rated power output at the generators terminals at a power factor of at least 0.95 leading (absorbing vars) to 0.90 lagging (supplying vars).

X2-025 Generator and GSU Modeling

Per the X2-025 supplied data the following was used in modeling the generators and the GSUs:

X2-025 Generators: Two units, MVA base 225, net injected into PPL EU system 416 MW, pf at the Sunbury 230 kV ring bus .9 lead and .9 lag, saturated sub-transient reactance = 15.36% on 225 MVA base.

GSUs (Generator Step Up Transformers): Two transformers, rating 233.3 MVA each, 230/16.5 kV, Positive Sequence Impedance R = 0.00214 pu and X = 0.09 pu, all at 140 MVA base.

Estimated Schedule

Option 1: Overhead Connection to Sunbury 230 kV Bay 7

- Siting and Right of Way (if required): 12 months
- Engineering: 12 months
- Construction: 10 months

If Option 1 is selected, the total duration of the project will be 37 months (starting in September 2012 and ending in October 2015). This duration will be reduced if siting and right of way activities are not required. The requested in-service date can be met.

Option 2: Overhead Connection to New Sunbury 500 kV Switchyard

- Siting and Right of Way: 12 months
- Engineering: 12 months
- Construction: 13 months

If Option 2 is selected, the total duration of the project will be 41 months (starting in June 2012 and ending in October 2015). The requested in-service date can be met.

The chosen substation work and the transmission tap to X2-025 would depend on the project start date as well as the project start window. PPL EU's outage windows for construction are typically available in the spring and the fall of the year. Missing an outage window will cause at least a delay of 6 months.

Notes:

- PPL EU recommends that an Interim ISA/CSA be completed during the Facilities Study stage or earlier to address the critical path items, such as long lead-time purchases and the compressed project schedule.

- Procurement lead-times for metering equipment may extend to 30 weeks. Meter design, procurement and installation schedules must be implemented accordingly.

- Excepting any operational, governmental and/or environmental regulatory delays, the use of additional resources, such as overtime, premiums for expedited material, and/or contractor labor, may enable PPL EU to decrease this construction period for an additional cost. It is also assumed that all rights-of-way, easements, and permits are secured without impact on anticipated construction start dates.

PaPUC Certification & Environmental Issues

All required land and rights-of-way will be purchased by PPL EU for tap connection. It is assumed here that the 230 kV or 500 kV tap would be owned by PPL EU.

PUC filing is anticipated if Option 1 with an outside-the-fence transmission tap is selected, or if Option 2 is selected. PPL EU will determine environmental impacts and mitigation strategies of the facilities being certified (i.e. - the transmission lines). These costs are not included in this estimate.

To avoid duplication of costs and efforts, PPL EU recommends that the project X2-025 obtain all environmental approvals required for construction of their generating station and share pertinent details with PPL EU prior to PPL EU beginning work.

Metering Equipment Installation at the Point of Interconnection

Installation of revenue grade metering equipment will be required at the X2-025 point of interconnection. PPL EU will design and supply the required metering equipment but all the installation cost would be borne by the developer. All metering equipment must meet applicable PPL EU tariff requirements as well as being compliant with all applicable requirements of the PJM agreements. The equipment must provide bi-directional revenue metering (KWH and KVARH) and real-time data (KW, KVAR, circuit breaker status, and generator bus voltages) for the developer's generating resource.

The developer is also required to provide revenue metering (KWH and KVARH) and real-time telemetry data (KW, KVAR, and KV) to PJM in compliance with the requirements listed in PJM Manuals M-01 and M-14. Any data from the PPL EU revenue meters can be transferred by fiber optic link to the PJM RTU located at the IPP facility.

Estimate Assumptions for Interconnection

- This magnitude estimate has been prepared without extensive research and field review.

- Estimate is based on the assumption that if PPL EU does not already own sufficient land to modify the existing 230 kV yard or expand the 500 kV yard, Sunbury LLC will provide additional land required with no cost to PPL EU.

- It is assumed here that the transmission tap to the X2-025 facility will be owned by PPL EU, regardless of which option is selected. All required right-of-way for the tap would be made available to PPL EU at no cost by the project X2-025 developer.

- No environmental, real estate, or permitting issues were reviewed for the estimate of this project.

Network Impacts

Queue project X2-025 was studied as a(n) 416.0 MW (416.0 MW of which was Capacity) injection into PPL's system. Project X2-025 was evaluated for compliance with reliability criteria for summer peak conditions in 2015.

Option 1: SUNB 230.0 kV substation

Potential transmission network impacts are as follows:

Generator Deliverability

(Single or N-1 contingencies for the Capacity portion only of the interconnection)

1. (PECO) The Nottingham-Nottingham Reactor 230 kV line (from bus 213844 to bus 213846 ckt 1) loads from 96.14% to 96.66% (DC power flow) of its emergency rating (627 MVA) for the single contingency 'PJM17'. This project contributes approximately 22.74 MW to the thermal violation.

```
CONTINGENCY 'PJM17'
  DISCONNECT BRANCH FROM BUS 200004 TO BUS 200013 CKT 1
     /* CNASTONE PEACHBTM 500 500
END
```

2. (PJM) The Conastone-EMORY GR500 500 kV line (from bus 200004 to bus 200101 ckt 1) loads from 99.08% to 100.03% (DC power flow) of its emergency rating (2901 MVA) for the single contingency 'CNSTN__230-4'. This project contributes approximately 89.32 MW to the thermal violation.

```
CONTINGENCY 'CNSTN__230-4'
     /* CONASTONE 230-4 TRANSFORMER
  DISCONNECT BRANCH FROM BUS 220963 TO BUS 200004 CKT 2
     /* CONASTONE 500-4 TRANSFORMER
END
```

3. (PECO) The Nottingham Reactor-Peach Bottom 230 kV line (from bus 213846 to bus 213869 ckt 1) loads from 96.02% to 96.53% (DC power flow) of its emergency rating (627 MVA) for the single contingency 'PJM17'. This project contributes approximately 22.74 MW to the thermal violation.

```
CONTINGENCY 'PJM17'
  DISCONNECT BRANCH FROM BUS 200004 TO BUS 200013 CKT 1
     /* CNASTONE PEACHBTM 500 500
END
```

Multiple Facility Contingency

(Double Circuit Tower Line contingencies only with full energy output. Stuck Breaker and Bus Fault contingencies will be applied during the Impact Study)

No violations identified.

Contribution to Previously Identified Overloads

(This project contributes to the following contingency overloads, i.e. "Network Impacts", identified for earlier generation or transmission interconnection projects in the PJM Queue.)

4. (BG&E) The North West 2311 & 2310-Granite 2311 & 2312 230 kV line (from bus 220962 to bus 220972 ckt 1) loads from 123.18% to 124.21% (DC power flow) of its emergency rating (621 MVA) for the single contingency 'PP1EB'. This project contributes approximately 23.97 MW to the thermal violation.

```
CONTINGENCY 'PP1EB'
     / NO PATH
  OPEN BRANCH FROM BUS 200101 TO BUS 235632 CKT 1
     / 200003 BRIGHTON 500 200004 CNASTONE 500 1
END
```

5. (BG&E) The Conastone-EMORY GRV230 230 kV line (from bus 220963 to bus 220400 ckt 2) loads from 106.24% to 106.66% (DC power flow) of its emergency rating (941 MVA) for the single contingency 'PP1EC'. This project contributes approximately 28.62 MW to the thermal violation.

```
CONTINGENCY 'PP1EC'
     / NO PATH
  OPEN BRANCH FROM BUS 200101 TO BUS 200004 CKT 1
     / 200003 BRIGHTON 500 200004 CNASTONE 500 1
END
```

6. (PECO/BG&E) The Cooper-Graceton 230 kV line (from bus 214089 to bus 220964 ckt 1) loads from 126.33% to 127.0% (DC power flow) of its emergency rating (485 MVA) for the single contingency 'PJM17'. This project contributes approximately 22.74 MW to the thermal violation.

```
CONTINGENCY 'PJM17'
  DISCONNECT BRANCH FROM BUS 200004 TO BUS 200013 CKT 1
     /* CNASTONE PEACHBTM 500 500
END
```

7. (PL/UGI) The Berwick-Koonsville Ab 69 kV line (from bus 212060 to bus 234263 ckt 1) loads from 104.07% to 105.8% (DC power flow) of its emergency rating (51 MVA) for the tower contingency 'UGI - MOUNTAIN - SUSQHNA TOWER_SPS'. This project contributes approximately 5.45 MW to the thermal violation.

```
CONTINGENCY 'UGI - MOUNTAIN - SUSQHNA TOWER_SPS'
     /* WITH SPS 8227 TRIP SCHEME
  OPEN BRANCH FROM BUS 208113 TO BUS 234250 CKT 1
     / 208113 SUSQ 230 234250 MOUN-TAP 230 1
  OPEN BRANCH FROM BUS 208120 TO BUS 234251 CKT 1
     / 208120 SU10 230 234251 MOUNT-H1 230 1
  OPEN BRANCH FROM BUS 234251 TO BUS 234252 CKT 1
     / 234251 MOUNT-H1 230 234252 MOUNTAIN 230 1
  OPEN BRANCH FROM BUS 234251 TO BUS 234254 CKT 1
     / 234251 MOUNT-H1 230 234254 MNTN TR1 69.0 1
  OPEN BRANCH FROM BUS 234257 TO BUS 234254 CKT 1
     / 234257 MOUNT 2 69.0 234254 MNTN TR1 69.0 1
```

```
  OPEN BRANCH FROM BUS 234256 TO BUS 234254 CKT 1
     / 234256 MOUNT 1 69.0 234254 MNTN TR1 69.0 1
  DISCONNECT BUS 207999
     /* BUS 208000 REPLACED WITH BUS 207999 MAR 3, 2010
  DISCONNECT BRANCH FROM BUS 208095 TO BUS 207999 CKT 2
  DISCONNECT BRANCH FROM BUS 207999 TO BUS 208001 CKT 1
END
```

8. (PL/METED) The Brunner Island Bus-Yorkana 230 kV line (from bus 207922 to bus 204515 ckt 1) loads from 137.18% to 138.6% (DC power flow) of its emergency rating (617 MVA) for the single contingency 'PJM17'. This project contributes approximately 21.39 MW to the thermal violation.

```
CONTINGENCY 'PJM17'
  DISCONNECT BRANCH FROM BUS 200004 TO BUS 200013 CKT 1
     /* CNASTONE PEACHBTM 500 500
END
```

9. (PL/BG&E) The Otter Creek Switchyard-Conastone 230 kV line (from bus 208048 to bus 220963 ckt 1) loads from 103.01% to 103.88% (DC power flow) of its emergency rating (531 MVA) for the single contingency 'PJM17'. This project contributes approximately 28.91 MW to the thermal violation.

```
CONTINGENCY 'PJM17'
  DISCONNECT BRANCH FROM BUS 200004 TO BUS 200013 CKT 1
     /* CNASTONE PEACHBTM 500 500
END
```

10. (BG&E) The North West 2326 & 2322-Granite 2326 & 2332 230 kV line (from bus 220961 to bus 220973 ckt 1) loads from 102.14% to 102.98% (DC power flow) of its emergency rating (728 MVA) for the single contingency 'PP1EB'. This project contributes approximately 23.16 MW to the thermal violation.

```
CONTINGENCY 'PP1EB'
     / NO PATH
  OPEN BRANCH FROM BUS 200101 TO BUS 235632 CKT 1
     / 200003 BRIGHTON 500 200004 CNASTONE 500 1
END
```

11. (PJM) The Peach Bottom-Conastone 500 kV line (from bus 200013 to bus 200004 ckt 1) loads from 138.00% to 138.86% (DC power flow) of its emergency rating (2815 MVA) for the single contingency 'PJM67'. This project contributes approximately 103.33 MW to the thermal violation.

```
CONTINGENCY 'PJM67'
  DISCONNECT BRANCH FROM BUS 200026 TO BUS 200004 CKT 1
     /* HUNTERTN CNASTONE 500 500
END
```

12. (PJM) The Peach Bottom-Conastone 500 kV line (from bus 200013 to bus 200004 ckt 1) loads from 139.28% to 140.24% (DC power flow) of its normal rating (2490 MVA) for non contingency condition. This project contributes approximately 104.79 MW to the thermal violation.

13. (BG&E) The EMORY GRV230-North West 2326 & 2322 230 kV line (from bus 220400 to bus 220961 ckt 1) loads from 101.59% to 101.77% (DC power flow) of its emergency rating (1800 MVA) for the single contingency 'BG_CKT2322A'. This project contributes approximately 20.92 MW to the thermal violation.

```
CONTINGENCY 'BG_CKT2322A'
     /*CONASTONE TO NORTHWEST CKT #2322
  DISCONNECT BRANCH FROM BUS 220962 TO BUS 220400 CKT 1
     /* CONASTONE TO NORTHWEST CKT #2322
END
```

14. (PJM) The Conastone-EMORY GR500 500 kV line (from bus 200004 to bus 200101 ckt 1) loads from 112.93% to 114.08% (DC power flow) of its normal rating (2338 MVA) for non contingency condition. This project contributes approximately 87.21 MW to the thermal violation.

15. (BG&E) The Conastone-EMORY GRV230 230 kV line (from bus 220963 to bus 220400 ckt 1) loads from 122.81% to 123.06% (DC power flow) of its emergency rating (819 MVA) for the single contingency 'PP1EC'. This project contributes approximately 28.28 MW to the thermal violation.

```
CONTINGENCY 'PP1EC'
     / NO PATH
  OPEN BRANCH FROM BUS 200101 TO BUS 200004 CKT 1
     / 200003 BRIGHTON 500 200004 CNASTONE 500 1
END
```

16. (PL/BG&E) The Safe Harbor Units 3-4 Tap-Graceton 230 kV line (from bus 208071 to bus 220964 ckt 1) loads from 104.87% to 105.66% (DC power flow) of its emergency rating (485 MVA) for the single contingency 'PJM17'. This project contributes approximately 23.87 MW to the thermal violation.

```
CONTINGENCY 'PJM17'
  DISCONNECT BRANCH FROM BUS 200004 TO BUS 200013 CKT 1
     /* CNASTONE PEACHBTM 500 500
END
```

17. (PECO) The Peach Bottom-Cooper 230 kV line (from bus 213869 to bus 214089 ckt 1) loads from 127.81% to 128.48% (DC power flow) of its emergency rating (485 MVA) for the single contingency 'PJM17'. This project contributes approximately 22.74 MW to the thermal violation.

```
CONTINGENCY 'PJM17'
  DISCONNECT BRANCH FROM BUS 200004 TO BUS 200013 CKT 1
     /* CNASTONE PEACHBTM 500 500
END
```

18. (BG&E) The EMORY GRV230-North West 2311 & 2310 230 kV line (from bus 220400 to bus 220962 ckt 1) loads from 101.63% to 101.81% (DC power flow) of its emergency rating (1800 MVA) for the single contingency 'BG_CKT2310A'. This project contributes approximately 20.99 MW to the thermal violation.

```
CONTINGENCY 'BG_CKT2310A'
     /* CONASTONE TO NORTHWEST CKT #2310
  DISCONNECT BRANCH FROM BUS 220961 TO BUS 220400 CKT 1
     /* CONASTONE TO NORTHWEST CKT#2310
END
```

New System Reinforcements

(Upgrades required to mitigate reliability criteria violations, i.e. "Network Impacts", initially caused by the addition of this project generation.)

1. To mitigate the overload on Nottingham-Nottingham Reactor 230 kV line, PECO has proposed to replace the line 220-08 reactor and bypass circuit switcher at Nottingham substation to achieve a minim summer emergency rating of 741 MVA. The upgrade is estimated to cost **$1,700,000** and take approximately 24 months. This overload has been caused by a later project within the X2 queue. Cost allocations for this upgrade will be determined during the System Impact Study phase.

2. The upgrade described under #14 of the Contributions to Previously Identified System Reinforcements will correct this overload.

3. To mitigate the overload on Nottingham Reactor-Peach Bottom 230 kV line, PECO has proposed to reconductor line 220-08 between Nottingham Reactor and Peach Bottom Tap to achieve a minimum summer emergency rating of 741 MVA. This line is approximately 14 miles long. The upgrade is estimated to cost **$10,000,000** and take approximately 48 months. This overload has been caused by a later project within the X2 queue. The total cost of the upgrade exceeds the cost allocation threshold so this project will not have a cost responsibility for the upgrade.

Contribution to Previously Identified System Reinforcements

(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project. This project may have a % allocation cost responsibility which will be calculated and reported for the Impact Study.)

4. To mitigate the overload on North West 2311 & 2310-Granite 2311 & 2312 230 kV line, BGE has proposed to reconductor the line with 2,167 ACSR which will increase the rating to 1105MVA. There will also be substation terminal cost upgrades associated with the reinforcement. The upgrade is estimated to cost **$23,600,000** and take approximately 6 years. This overload has been caused by a prior project. Cost allocations for this upgrade will be determined during the System Impact Study phase.

5, 13, 15, 18.
To mitigate the overload on Conastone-EMORY GRV230 230 kV line (#5 & 15), EMORY GRV230-North West 2326 & 2322 230 kV line (#13), and EMORY GRV230-North West 2311 & 2310 230 kV line (#18), BGE has proposed to construct a new double circuit 230kV line between Conastone and North West using 1590MCM conductor. The upgrade is estimated to cost **$54,700,000** and take approximately 72-84 months. This overload has been caused by a prior project. Cost allocations for this upgrade will be determined during the System Impact Study phase.

6. To mitigate the overload on Cooper-Graceton 230 kV line, BGE and PECO have proposed the following:

   BGE: A double circuit line will be built with 1033.5kcmil ACSR creating one circuit by connecting the two lines into one. Rating for 2 – 1033.5kcmil 45/7 ACSR (Ortolan) at 125°C = 968/1227MVA SN/SE. BGE ownership is for 1.85 miles and the rebuild of 11 structures. It would be built as a double circuit line with the conductors jumpered across at the terminal ends. The line construction is estimated at $3,000,000. Two breakers ($400,000/breaker) would need to be replaced at Graceton for a cost of $800,000. An additional cost of $200,000 would also be incurred for 4 breaker disconnects and line connections to cover thermal. The project is estimated to take 30 months to complete: 12 months for the CPCN process & design and an additional 18 months for construction. The total cost of the project is estimated at $4,000,000.

   PECO: Reconductor line 220-93 from Cooper to Graceton to achieve a minimum summer emergency rating of 725MVA. The line is approximately 4 miles long. The estimated cost for the PECO portion of the work is $2,800,000, and will require 24 months to complete.

   The total upgrade is estimated to cost **$6,800,000** and take approximately 30 months. This overload has been caused by a prior project. Cost allocations for this upgrade will be determined during the System Impact Study phase.

7. To mitigate the overload on Berwick-Koonsville Ab 69 kV line, PPL has proposed to reconductor 9.73 miles of the 69kV line. The upgrade is estimated to cost **$7,900,000** and take approximately 12 months. This overload has been caused by a prior project. Cost allocations for this upgrade will be determined during the System Impact Study phase.

8. To mitigate the overload on Brunner Island Bus-Yorkana 230 kV line, PPL and METED have proposed the following:

   PPL: PPL EU will rebuild and upgrade approximately 0.6 miles of PPL EU owned Brunner Island – Yorkana 230kV line and the substation line terminal equipment. The existing 1033 kcmil ACSR conductor will be replaced with new 1590 kcmil ACSR conductor or equivalent with and operating temperature of 140deg C to achieve the summer normal and emergency ratings of 712 MVA and 865 MVA respectively. The Yorkana 230kV bay conductors at Brunner Island 230kV switchyard will also be upgraded to conform the higher line ratings.PPL EU will require 24 months to construct this upgrade after the ISA/CSA are signed. The total transmission and substation upgrade cost is $1,300,000.

   METED: Reconductor Met-Ed's 12.5 mile section of the Brunner -Yorkana (1055) 230 kV line with 1590 ACSS conductor. Based on the Feasibility Study review performed, the total cost of this Network Upgrade is $9,270,900 excluding tax. It is estimated that it will take three years to complete the work needed to implement this project.

The total upgrade is estimated to cost $10,570,900 and take approximately 36 months. This overload has been caused by a prior project. Cost allocations for this upgrade will be determined during the System Impact Study phase.

9. To mitigate the overload on Otter Creek Switchyard-Conastone 230 kV line, BGE and PPL have proposed the following:

BGE: Rebuild the Otter Creek-Conastone 230kV line to the PA border. The line is approximately 4.7 miles long. The new rating of the line will be 648MVA (normal) and 802MVA (emergency). The upgrade is estimated to cost $19,000,000 and will take 36-60 months to complete.

PPL: A PPL project to reconductor the Manor-Conastone line with 1590 ACSR is underway. This project will equip the line to handle 653/793 MVA (Summer Normal/ Emergency and is estimated to cost $17,000,000. The upgraded is estimated to be in-service by October 2013.

The total upgrade is estimated to cost **$36,000,000** and take approximately 60 months/years. This overload has been caused by a prior project. Cost allocations for this upgrade will be determined during the System Impact Study phase.

10. To mitigate the overload on North West 2326 & 2322-Granite 2326 & 2332 230 kV line, BGE has proposed to reconductor the line with 2,167 ACSR which will increase the rating to 1105MVA. There will also be substation terminal cost upgrades associated with the reinforcement. The upgrade is estimated to cost **$23,600,000** and take approximately 6 years. This overload has been caused by a prior project. Cost allocations for this upgrade will be determined during the System Impact Study phase.

11, 12. To mitigate the overload on Peach Bottom-Conastone 500 kV line, BGE and PECO have proposed the following:

BGE:

- At Conastone construct a new two breaker 4000A bay (breakers D, F) with two 63 kA breakers. Includes line termination structures, allowance for a second line and the relocation of the 500kV cap bank. 36 months to complete - $14M
- Construct a new 500kV line from Conastone - Peachbotton rated for a minimum of 2939/3733 SN/SE. Build 9.6 miles 500KV line from Conastone to Pennsylvania line. Purchase 150’ R/W. Total for project $46.8 million 5-7 years

PECO:

- Replace existing Peach Bottom-Conastone 500kV Line (5012) terminal equipment at Peach Bottom Substation to match the conductor summer normal and emergency rating of 2920 / 3707 MVA (PECO portion only)- $5 million, 3 years
- Build new second Peach Bottom-Conastone 500kV Line on separate towers from existing 5012 Line with a minimum summer emergency rating of 3510 MVA (PECO portion only)- $20 million, 5 years [Right-of-way costs are not included]

The total upgrade is estimated to cost **$85,800,000** and take approximately 7 years. This overload has been caused by a prior project. Cost allocations for this upgrade will be determined during the System Impact Study phase.

14. To mitigate the overload on Conastone-EMORY GR500 500 kV line, BGE has proposed to upgrade the two breaker bay at Conastone with two 4000A circuit breakers, four 4000A circuit breaker disconnect switches, a one 4000A line switch. The upgrade is estimated to cost **$3,000,000** and take approximately 24-36 months. This overload has been caused by a prior project. Cost allocations for this upgrade will be determined during the System Impact Study phase.

16. To mitigate the overload on Safe Harbor Units 3-4 Tap-Graceton 230 kV line, PPL has proposed to reconductor Manor-Graceton 230 kV with 1590 ACSR. This project will equip the line to handle 653/793 MVA (Summer Normal/Emergency). The upgrade is estimated to cost **$22,700,000**. The upgrade is currently underway and is scheduled to be completed by November 2013. This overload has been caused by a prior project. Cost allocations for this upgrade will be determined during the System Impact Study phase.

17. To mitigate the overload on Peach Bottom-Cooper 230 kV line, PECO has proposed to reconductor Line 220-08 from PB Tap to Cooper Substation to achieve a minimum summer emergency rating of 741 MVA. The line is approximately 1.4 miles long. . The upgrade is estimated to cost **$1,000,000** and take approximately 24 months. This overload has been caused by a prior project. Cost allocations for this upgrade will be determined during the System Impact Study phase.

Short Circuit

(Report over-dutied breakers.)

PJM identified two over-dutied circuit breakers on the transmission system:

Bus #	Bus	Breaker	Rating Type	Duty % w/ X2-025	Duty % w/o X2-025	Duty % Difference
208109	SUNB 230.kV	ELIMSPORT NO	S	114.40%	96.70%	17.70%
208109	SUNB 230.kV	ELDRED NORTH	S	109.80%	92.00%	17.80%

PPL identified two over-dutied circuit breakers on the 69kV system:

Bus	Breaker
Sunbury Yard 1	Danville West 69kV
Sunbury Yard 2	Milton Steel West 69kV
Sunbury Yard 2	Milton West 69kV

PPL will replace all five circuit breakers under the Transmission Modernization Program. The Interconnection Customer will not share any of the cost responsibility. The 230kV circuit

breakers will be replaced by December 2012. The 69kV circuit breakers will be replaced by December 2015.

Energy Portion of Interconnection Request

PJM also studied the delivery of the energy portion of the surrounding generation. Any potential problems identified below are likely to result in operational restrictions to the project under study. The developer can proceed with network upgrades to eliminate the operational restriction at their discretion by submitting a Transmission Interconnection request.

Note: Only the most severely overloaded conditions are listed. There is no guarantee of full delivery of energy for this project by fixing only the conditions listed in this section. With a Transmission Interconnection Request, a subsequent analysis will be performed which analyzes all overload conditions associated with the overloaded element(s) identified. As a result of the aggregate energy resources in the area, the following violations were identified.

No violations identified.

Option 2: SUNBURY 500.0 kV substation

Potential transmission network impacts are as follows:

Generator Deliverability

(Single or N-1 contingencies for the Capacity portion only of the interconnection)

1. (PECO) The Nottingham-Nottingham Reactor 230 kV line (from bus 213844 to bus 213846 ckt 1) loads from 96.15% to 96.62% (DC power flow) of its emergency rating (627 MVA) for the single contingency 'PJM17'. This project contributes approximately 20.89 MW to the thermal violation.

```
CONTINGENCY 'PJM17'
  DISCONNECT BRANCH FROM BUS 200004 TO BUS 200013 CKT 1
     /* CNASTONE PEACHBTM 500 500
END
```

2. (PJM) The Conastone-EMORY GR500 500 kV line (from bus 200004 to bus 200101 ckt 1) loads from 99.08% to 100.0% (DC power flow) of its emergency rating (2901 MVA) for the single contingency 'CNSTN__230-4'. This project contributes approximately 86.77 MW to the thermal violation.

```
CONTINGENCY 'CNSTN__230-4'
     /* CONASTONE 230-4 TRANSFORMER
  DISCONNECT BRANCH FROM BUS 220963 TO BUS 200004 CKT 2
     /* CONASTONE 500-4 TRANSFORMER
END
```

3. (PECO) The Nottingham Reactor-Peach Bottom 230 kV line (from bus 213846 to bus 213869 ckt 1) loads from 96.02% to 96.49% (DC power flow) of its emergency rating (627 MVA) for the single contingency 'PJM17'. This project contributes approximately 20.89 MW to the thermal violation.

```
CONTINGENCY 'PJM17'
  DISCONNECT BRANCH FROM BUS 200004 TO BUS 200013 CKT 1
     /* CNASTONE PEACHBTM 500 500
END
```

Multiple Facility Contingency

(Double Circuit Tower Line contingencies only with full energy output. Stuck Breaker and Bus Fault contingencies will be applied during the Impact Study)

No violations identified.

Contribution to Previously Identified Overloads

(This project contributes to the following contingency overloads, i.e. "Network Impacts", identified for earlier generation or transmission interconnection projects in the PJM Queue.)

4. (BG&E) The North West 2311 & 2310-Granite 2311 & 2312 230 kV line (from bus 220962 to bus 220972 ckt 1) loads from 123.18% to 124.18% (DC power flow) of its emergency rating (621 MVA) for the single contingency 'PP1EB'. This project contributes approximately 23.32 MW to the thermal violation.

```
CONTINGENCY 'PP1EB'
     / NO PATH
  OPEN BRANCH FROM BUS 200101 TO BUS 235632 CKT 1
     / 200003 BRIGHTON 500 200004 CNASTONE 500 1
END
```

5. (BG&E) The Conastone-EMORY GRV230 230 kV line (from bus 220963 to bus 220400 ckt 2) loads from 106.24% to 106.65% (DC power flow) of its emergency rating (941 MVA) for the single contingency 'PP1EC'. This project contributes approximately 27.84 MW to the thermal violation.

```
CONTINGENCY 'PP1EC'
     / NO PATH
  OPEN BRANCH FROM BUS 200101 TO BUS 200004 CKT 1
     / 200003 BRIGHTON 500 200004 CNASTONE 500 1
END
```

6. (PECO/BG&E) The Cooper-Graceton 230 kV line (from bus 214089 to bus 220964 ckt 1) loads from 126.32% to 126.94% (DC power flow) of its emergency rating (485 MVA) for the single contingency 'PJM17'. This project contributes approximately 20.89 MW to the thermal violation.

```
CONTINGENCY 'PJM17'
  DISCONNECT BRANCH FROM BUS 200004 TO BUS 200013 CKT 1
     /* CNASTONE PEACHBTM 500 500
END
```

7. (PL/METED) The Brunner Island Bus-Yorkana 230 kV line (from bus 207922 to bus 204515 ckt 1) loads from 137.19% to 138.58% (DC power flow) of its emergency rating (617 MVA) for the single contingency 'PJM17'. This project contributes approximately 21.18 MW to the thermal violation.

```
CONTINGENCY 'PJM17'
  DISCONNECT BRANCH FROM BUS 200004 TO BUS 200013 CKT 1
     /* CNASTONE PEACHBTM 500 500
END
```

8. (PL/BG&E) The Otter Creek Switchyard-Conastone 230 kV line (from bus 208048 to bus 220963 ckt 1) loads from 103.01% to 103.86% (DC power flow) of its emergency rating (531 MVA) for the single contingency 'PJM17'. This project contributes approximately 28.18 MW to the thermal violation.

```
CONTINGENCY 'PJM17'
  DISCONNECT BRANCH FROM BUS 200004 TO BUS 200013 CKT 1
     /* CNASTONE PEACHBTM 500 500
END
```

9. (BG&E) The North West 2326 & 2322-Granite 2326 & 2332 230 kV line (from bus 220961 to bus 220973 ckt 1) loads from 102.14% to 102.96% (DC power flow) of its emergency rating (728 MVA) for the single contingency 'PP1EB'. This project contributes approximately 22.54 MW to the thermal violation.

```
CONTINGENCY 'PP1EB'
     / NO PATH
  OPEN BRANCH FROM BUS 200101 TO BUS 235632 CKT 1
     / 200003 BRIGHTON 500 200004 CNASTONE 500 1
END
```

10. (PJM) The Peach Bottom-Conastone 500 kV line (from bus 200013 to bus 200004 ckt 1) loads from 138.00% to 138.82% (DC power flow) of its emergency rating (2815 MVA) for the single contingency 'PJM67'. This project contributes approximately 98.85 MW to the thermal violation.

```
CONTINGENCY 'PJM67'
  DISCONNECT BRANCH FROM BUS 200026 TO BUS 200004 CKT 1
     /* HUNTERTN CNASTONE 500 500
END
```

11. (PJM) The Peach Bottom-Conastone 500 kV line (from bus 200013 to bus 200004 ckt 1) loads from 139.47% to 140.37% (DC power flow) of its normal rating (2490 MVA) for non contingency condition. This project contributes approximately 98.97 MW to the thermal violation.

12. (PJM) The Conastone-EMORY GR500 500 kV line (from bus 200004 to bus 200101 ckt 1) loads from 112.93% to 114.04% (DC power flow) of its normal rating (2338 MVA) for non contingency condition. This project contributes approximately 84.73 MW to the thermal violation.

13. (BG&E) The Conastone-EMORY GRV230 230 kV line (from bus 220963 to bus 220400 ckt 1) loads from 122.81% to 123.05% (DC power flow) of its emergency rating (819 MVA) for the single contingency 'PP1EC'. This project contributes approximately 27.51 MW to the thermal violation.

```
CONTINGENCY 'PP1EC'
     / NO PATH
  OPEN BRANCH FROM BUS 200101 TO BUS 200004 CKT 1
     / 200003 BRIGHTON 500 200004 CNASTONE 500 1
END
```

14. (PL/BG&E) The Safe Harbor Units 3-4 Tap-Graceton 230 kV line (from bus 208071 to bus 220964 ckt 1) loads from 104.87% to 105.65% (DC power flow) of its emergency rating (485 MVA) for the single contingency 'PJM17'. This project contributes approximately 23.33 MW to the thermal violation.

```
CONTINGENCY 'PJM17'
  DISCONNECT BRANCH FROM BUS 200004 TO BUS 200013 CKT 1
     /* CNASTONE PEACHBTM 500 500
END
```

15. (PECO) The Peach Bottom-Cooper 230 kV line (from bus 213869 to bus 214089 ckt 1) loads from 127.80% to 128.42% (DC power flow) of its emergency rating (485 MVA) for the single contingency 'PJM17'. This project contributes approximately 20.89 MW to the thermal violation.

```
CONTINGENCY 'PJM17'
  DISCONNECT BRANCH FROM BUS 200004 TO BUS 200013 CKT 1
     /* CNASTONE PEACHBTM 500 500
END
```

New System Reinforcements

(Upgrades required to mitigate reliability criteria violations, i.e. "Network Impacts", initially caused by the addition of this project generation.)

None required.

Contribution to Previously Identified System Reinforcements

(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project. This project may have a % allocation cost responsibility which will be calculated and reported for the Impact Study.)

None required.

Short Circuit

(Report over-dutied breakers.)

None required.

Energy Portion of Interconnection Request

PJM also studied the delivery of the energy portion of the surrounding generation. Any potential problems identified below are likely to result in operational restrictions to the project under study. The developer can proceed with network upgrades to eliminate the operational restriction at their discretion by submitting a Transmission Interconnection request.

Note: Only the most severely overloaded conditions are listed. There is no guarantee of full delivery of energy for this project by fixing only the conditions listed in this section. With a Transmission Interconnection Request, a subsequent analysis will be performed which analyzes all overload conditions associated with the overloaded element(s) identified. As a result of the aggregate energy resources in the area, the following violations were identified.

No violations identified.

Generation Interconnection Feasibility Study Report

For

PJM Generation Interconnection Request Queue Position X2-025

Sunbury 230kV

January 2012

Preface

The intent of the feasibility study is to determine a plan, with ballpark cost and construction time estimates, to connect the subject generation to the PJM network at a location specified by the Interconnection Customer. The Interconnection Customer may request the interconnection of generation as a capacity resource or as an energy-only resource. As a requirement for interconnection, the Interconnection Customer may be responsible for the cost of constructing: (1) Direct Connections, which are new facilities and/or facilities upgrades needed to connect the generator to the PJM network, and (2) Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system.

In some instances a generator interconnection may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection, may also contribute to the need for the same network reinforcement. The possibility of sharing the reinforcement costs with other projects may be identified in the feasibility study, but the actual allocation will be deferred until the impact study is performed.

The Feasibility Study estimates do not include the feasibility, cost, or time required to obtain property rights and permits for construction of the required facilities. The project developer is responsible for the right of way, real estate, and construction permit issues. For properties currently owned by Transmission Owners, the costs may be included in the study.

General

The Interconnection Customer (IC), has proposed a natural gas generating facility located in Shamokin Dam, PA. The installed facilities will have a total capability of 416 MW with 416 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is October 31, 2015. **This study does not imply a PPL Electric Utilities (PPL EU) commitment to this in-service date.**

Point of Interconnection

X2-025 will interconnect with the PPL EU transmission system at one of two options. Option 1 is to connect at the Sunbury 230kV substation. Option 2 is to connect at the Sunbury 500kV substation.

Direct Connection

Option 1: Overhead Outside-the-Fence Connection to Sunbury 230 kV Bay 8

The X2-025 project can be connected to the available Bay 8 position at PPL EU's Sunbury 230 kV Substation via an outside-the-fence overhead line. This line would span approximately 2000 ft. and be terminated at PPL EU's Bay 8 in a double-breaker arrangement.

The total magnitude cost of Direct Connection Facilities needed to connect to a new 230 kV station is $3,769,693 (excluding any applicable state or federal taxes). The 230 kV connection estimate is based on the assumption that the connection will span approximately 2000 ft.

A further breakdown of the direct connection costs for the new 230 kV substation connection is as follows:

$	1,800,000	Transmission work for the direct connection.
$	1,919,693	Substation work at PPL EU Sunbury Substation.
$	50,000	Siting and certification

230 kV Transmission Tap Direct Connection Work

$1,800,000 (230 kV Transmission tap)

The transmission direct connection cost includes construction of one 230 kV transmission line spanning approximately 2000 ft. This estimate includes associated work for line terminations, new poles/foundations, and optical ground wire for relay and control.

This transmission extension would be traversing acquired right-of-way and would be owned by PPL EU. A PA PUC Waiver will be required, as the tap is of very short length. The estimated cost of this filing would be approximately $50,000 and is not included in the above transmission tap cost estimate. The lead time required from filing preparation to PA PUC approval would be approximately 6 to 9 months.

Sunbury 230 kV Substation Expansion – Direct Connection Work

$1,919,693 (Sunbury 230 kV Substation Expansion)

The 230 kV substation work includes installing two circuit breakers/foundations and two disconnect switches/foundations, as well as control cubicle and device wiring.

Option 2: Overhead Connection to new Sunbury 500 kV Switchyard

The X2-025 project can be connected to an available 500 kV bay at PPL EU's proposed new Sunbury 500 kV Switchyard located approximately 1.5 miles from the existing Sunbury Substation. This connection option is contingent on the completion of the new switchyard by PPL EU prior to the developer's requested in-service date, as well as the siting of the required 500 kV line.

The total magnitude cost of Direct Connection Facilities needed to connect to the proposed 500 kV station is **$12,841,509** (excluding any applicable state or federal taxes). The 500 kV connection estimate is based on the assumption that approximately 1.5 miles of transmission line will be required.

A further breakdown of the direct connection costs for the new 500 kV switchyard connection is as follows:

$	7,500,000	Transmission work for the direct connection.
$	5,291,509	Substation work at PPL EU Sunbury Substation.
$	50,000	Siting and certification

500 kV Transmission Tap Direct Connection Work

$7,500,000 (500 kV Transmission tap)

The transmission direct connection cost includes construction of one 1.5 mile 500 kV tap between the developer's site and the proposed Sunbury 500 kV yard east of the Susquehanna River.

This transmission extension would be traversing to-be-acquired right-of-way and would be owned by PPL EU. A PA PUC Letter of Notification will be required, as the tap does not exceed 2 miles in length. The estimated cost of this filing would be approximately $50,000 and is not included in the above transmission tap cost estimate. The lead time required from filing preparation to PA PUC approval would be approximately 6 to 9 months.

The transmission direct connection cost also includes associated line terminations and transfers to accommodate the connection.

Sunbury 500 kV Substation Direct Connection Work

$5,291,509 (Sunbury 500 kV Substation)

The new 500 kV substation work includes installing two circuit breakers/foundations, four disconnect switches/foundations, a dead-end structure/foundations, bus support foundations, bus work, control cubicle wiring, and device wiring. At the existing 500 kV substation, two dead-end structures and foundations must be installed, as well as bus support foundations and bus work.

X2-025 Generator Regulation or Reactive Support Requirements at Sunbury 230 kV Substation

The PPL EU preliminary load flow studies have indicated that the X2-025 generator will maintain the required voltage regulation on the Sunbury 230 kV bus with in its required range. A voltage schedule of 1.05 or higher may be specified on the Sunbury 230 kV bus.

As specified in Part IV, Subpart E at 54.7 of the PJM OATT, the Project X2-025 generator shall design its "Facility" to maintain a composite power factor delivery at continuous rated power output at the generators terminals at a power factor of at least 0.95 leading (absorbing vars) to 0.90 lagging (supplying vars).

X2-025 Generator and GSU modeling for the Sunbury 230kV Connection

Per the X2-025 supplied data the following was used in modeling the generator and the GSU:

X2-025 Generator: Generator MVA base 225, Net injected into PPL EU system 416 MW, pf at the generator terminals .9 lead and .9 lag, saturated sub-transient reactance = 15.36% on 225 MVA base

GSU (Unit Step up Transformer): Rating 1000 MVA, 230/16.5 kV, Positive Sequence Impedance is R = 0.00214 pu and X = 0.06 pu, all at 140 MVA base.

Estimated Schedule

Option 1: Overhead Direct Connection to Sunbury 230 kV Bay 7

The estimated PPL EU elapsed time to complete the Sunbury 230 kV substation expansion is 30 months. The 1000 ft. transmission tap construction lead time is 24 months.

PPL EU engineering activities for this option must start by early January 2013 to accommodate X2-025's connection by 2015.

Option 2: Overhead Connection to New Sunbury 500 kV Switchyard

The estimated PPL EU elapsed time to complete the Sunbury 500 kV substation expansion is 36 months. The 1.5 mile transmission tap construction lead time is 30 months.

PPL EU engineering activities for this option must start by early July 2012 to accommodate X2-025's connection by 2015.

The chosen substation work and the transmission tap to X2-025 would depend on the project start date as well as the project start window. PPL EU's outage windows for construction are typically available in the spring and the fall of the year. Missing an outage window will cause at least a delay of 6 months.

Notes:

- PPL EU recommends that an Interim ISA/CSA be completed during the Facilities Study stage or earlier to address the critical path items, such as long lead-time purchases and the compressed project schedule.

- Procurement lead-times for metering equipment may extend to 30 weeks. Meter design, procurement and installation schedules must be implemented accordingly.

- Excepting any operational, governmental and/or environmental regulatory delays, the use of additional resources, such as overtime, premiums for expedited material, and/or contractor labor, may enable PPL EU to decrease this construction period for an additional cost. It is also assumed that all rights-of-way, easements, and permits are secured without impact on anticipated construction start dates.

PaPUC Certification & Environmental Issues

All required land and rights-of-way will be purchased by PPL EU for tap connection. It is assumed here that the 230 kV or 500 kV tap would be owned by PPL EU.

PUC filing is anticipated if Option 2 is selected. If PPL EU is required to file before the PA PUC for the certification of the transmission work, PPL EU will determine environmental impacts and mitigation strategies of the facilities being certified (i.e. - the transmission lines). These costs are not included in this estimate.

To avoid duplication of costs and efforts, PPL EU recommends that the project X2-025 obtain all environmental approvals required for construction of their generating station and share pertinent details with PPL EU prior to the PPL EU beginning work.

Cost Estimate to Provide Start up Auxiliary Station Service Connection

The following cost estimates are provided for the station service load of approximately 45 MW for the start up of X2-025. It is assumed that this load will be at a power factor of 90%. The following cost estimates for two options are provided:

1. From 230 kV substation bus:
   From the 230 kV South bus, overhead supply to the start-up transformer is not possible due to the two 230 kV line crossings (Sunbury – Eldred & Sunbury – Susquehanna #1) and one 500 kV line crossing (Sunbury – Susquehanna #2). Therefore it is planned that the 230 kV connection would be provided from the 230 kV South bus in the vicinity of Bay 2 or 3, whichever is available, via a 230 kV proper ampacity solid dielectric cable. The cable would be connected to the 230 kV South bus via a 600 amp motor operated disconnect switch to the X2-025 Aux Transformer location; a distance of approximately 1000 feet is assumed.

   The total Magnitude Cost Estimate is approximately **$2.3 million**

2. From 69 kV substation bus:
   From the 69 kV Yard #2 West bus, overhead supply to the start-up transformer is not possible due to the several 230 kV and 69 kV line crossings in addition to one 500 kV line crossing. Therefore it is planned that the 69 kV connection would be provided from the 69 kV Yard #2 East bus in the vicinity of Bay 5 to 8, whichever is accessible, via a 69 kV proper ampacity solid dielectric cable. The cable would be connected to the 69 kV Yard #2 East bus via a 600 amp motor operated disconnect switch to the X2-025 Aux Transformer location; a distance of approximately 3000 feet is assumed.

   The total Magnitude Cost Estimate is approximately **$3.3 million**

Metering Equipment Installation at the Point of Interconnection

Installation of revenue grade metering equipment will be required at the X2-025 point of interconnection. PPL EU will design and supply the required metering equipment but all the installation cost would be borne by the developer. All metering equipment must meet applicable PPL EU tariff requirements as well as being compliant with all applicable requirements of the PJM agreements. The equipment must provide bi-directional revenue metering (KWH and KVARH) and real-time data (KW, KVAR, circuit breaker status, and generator bus voltages) for the developer's generating resource.

The developer is also required to provide revenue metering (KWH and KVARH) and real-time telemetry data (KW, KVAR, and KV) to PJM in compliance with the requirements listed in PJM Manuals M-01 and M-14. Any data from the PPL EU revenue meters can be transferred by fiber optic link to the PJM RTU located at the IPP facility.

Estimate Assumptions for Interconnection

- This magnitude estimate has been prepared without extensive research and field review.
- Estimate is based on the assumption that if PPL EU does not already own sufficient land to modify the existing 230 kV yard or expand the 500 kV yard, Sunbury LLC will provide additional land required with no cost to PPL EU.
- It is assumed here that the transmission tap to the X2-025 facility will be owned by PPL EU, regardless of which option is selected. All required right-of-way for the tap would be made available to PPL EU at no cost by the project X2-025 developer.
- No environmental, real estate, or permitting issues were reviewed for the estimate of this project.

Network Impacts

Queue project X2-025 was studied as a(n) 416.0 MW (416.0 MW of which was Capacity) injection into PPL's system. Project X2-025 was evaluated for compliance with reliability criteria for summer peak conditions in 2015.

Option 1: SUNB 230.0 kV substation

Potential transmission network impacts are as follows:

Generator Deliverability

(Single or N-1 contingencies for the Capacity portion only of the interconnection)

1. (PECO) The Nottingham-Nottingham Reactor 230 kV line (from bus 213844 to bus 213846 ckt 1) loads from 96.14% to 96.66% (DC power flow) of its emergency rating (627 MVA) for the single contingency 'PJM17'. This project contributes approximately 22.74 MW to the thermal violation.

```
CONTINGENCY 'PJM17'
  DISCONNECT BRANCH FROM BUS 200004 TO BUS 200013 CKT 1
     /* CNASTONE PEACHBTM 500 500
END
```

2. (PJM) The Conastone-EMORY GR500 500 kV line (from bus 200004 to bus 200101 ckt 1) loads from 99.08% to 100.03% (DC power flow) of its emergency rating (2901 MVA) for the single contingency 'CNSTN__230-4'. This project contributes approximately 89.32 MW to the thermal violation.

```
CONTINGENCY 'CNSTN__230-4'
     /* CONASTONE 230-4 TRANSFORMER
  DISCONNECT BRANCH FROM BUS 220963 TO BUS 200004 CKT 2
     /* CONASTONE 500-4 TRANSFORMER
END
```

3. (PECO) The Nottingham Reactor-Peach Bottom 230 kV line (from bus 213846 to bus 213869 ckt 1) loads from 96.02% to 96.53% (DC power flow) of its emergency rating (627 MVA) for the single contingency 'PJM17'. This project contributes approximately 22.74 MW to the thermal violation.

```
CONTINGENCY 'PJM17'
  DISCONNECT BRANCH FROM BUS 200004 TO BUS 200013 CKT 1
     /* CNASTONE PEACHBTM 500 500
END
```

Multiple Facility Contingency

(Double Circuit Tower Line contingencies only with full energy output. Stuck Breaker and Bus Fault contingencies will be applied during the Impact Study)

No violations identified.

Contribution to Previously Identified Overloads

(This project contributes to the following contingency overloads, i.e. "Network Impacts", identified for earlier generation or transmission interconnection projects in the PJM Queue.)

4. (BG&E) The North West 2311 & 2310-Granite 2311 & 2312 230 kV line (from bus 220962 to bus 220972 ckt 1) loads from 123.18% to 124.21% (DC power flow) of its emergency rating (621 MVA) for the single contingency 'PP1EB'. This project contributes approximately 23.97 MW to the thermal violation.

```
CONTINGENCY 'PP1EB'
     / NO PATH
  OPEN BRANCH FROM BUS 200101 TO BUS 235632 CKT 1
     / 200003 BRIGHTON 500 200004 CNASTONE 500 1
END
```

5. (BG&E) The Conastone-EMORY GRV230 230 kV line (from bus 220963 to bus 220400 ckt 2) loads from 106.24% to 106.66% (DC power flow) of its emergency rating (941 MVA) for the single contingency 'PP1EC'. This project contributes approximately 28.62 MW to the thermal violation.

```
CONTINGENCY 'PP1EC'
     / NO PATH
  OPEN BRANCH FROM BUS 200101 TO BUS 200004 CKT 1
     / 200003 BRIGHTON 500 200004 CNASTONE 500 1
END
```

6. (PECO/BG&E) The Cooper-Graceton 230 kV line (from bus 214089 to bus 220964 ckt 1) loads from 126.33% to 127.0% (DC power flow) of its emergency rating (485 MVA) for the single contingency 'PJM17'. This project contributes approximately 22.74 MW to the thermal violation.

```
CONTINGENCY 'PJM17'
  DISCONNECT BRANCH FROM BUS 200004 TO BUS 200013 CKT 1
     /* CNASTONE PEACHBTM 500 500
END
```

7. (PL/UGI) The Berwick-Koonsville Ab 69 kV line (from bus 212060 to bus 234263 ckt 1) loads from 104.07% to 105.8% (DC power flow) of its emergency rating (51 MVA) for the tower contingency 'UGI - MOUNTAIN - SUSQHNA TOWER_SPS'. This project contributes approximately 5.45 MW to the thermal violation.

```
CONTINGENCY 'UGI - MOUNTAIN - SUSQHNA TOWER_SPS'
     /* WITH SPS 8227 TRIP SCHEME
  OPEN BRANCH FROM BUS 208113 TO BUS 234250 CKT 1
     / 208113 SUSQ 230 234250 MOUN-TAP 230 1
  OPEN BRANCH FROM BUS 208120 TO BUS 234251 CKT 1
     / 208120 SU10 230 234251 MOUNT-H1 230 1
  OPEN BRANCH FROM BUS 234251 TO BUS 234252 CKT 1
     / 234251 MOUNT-H1 230 234252 MOUNTAIN 230 1
  OPEN BRANCH FROM BUS 234251 TO BUS 234254 CKT 1
     / 234251 MOUNT-H1 230 234254 MNTN TR1 69.0 1
  OPEN BRANCH FROM BUS 234257 TO BUS 234254 CKT 1
     / 234257 MOUNT 2 69.0 234254 MNTN TR1 69.0 1
```

```
  OPEN BRANCH FROM BUS 234256 TO BUS 234254 CKT 1
     / 234256 MOUNT 1 69.0 234254 MNTN TR1 69.0 1
  DISCONNECT BUS 207999
     /* BUS 208000 REPLACED WITH BUS 207999 MAR 3, 2010
  DISCONNECT BRANCH FROM BUS 208095 TO BUS 207999 CKT 2
  DISCONNECT BRANCH FROM BUS 207999 TO BUS 208001 CKT 1
END
```

8. (PL/METED) The Brunner Island Bus-Yorkana 230 kV line (from bus 207922 to bus 204515 ckt 1) loads from 137.18% to 138.6% (DC power flow) of its emergency rating (617 MVA) for the single contingency 'PJM17'. This project contributes approximately 21.39 MW to the thermal violation.

```
CONTINGENCY 'PJM17'
  DISCONNECT BRANCH FROM BUS 200004 TO BUS 200013 CKT 1
     /* CNASTONE PEACHBTM 500 500
END
```

9. (PL/BG&E) The Otter Creek Switchyard-Conastone 230 kV line (from bus 208048 to bus 220963 ckt 1) loads from 103.01% to 103.88% (DC power flow) of its emergency rating (531 MVA) for the single contingency 'PJM17'. This project contributes approximately 28.91 MW to the thermal violation.

```
CONTINGENCY 'PJM17'
  DISCONNECT BRANCH FROM BUS 200004 TO BUS 200013 CKT 1
     /* CNASTONE PEACHBTM 500 500
END
```

10. (BG&E) The North West 2326 & 2322-Granite 2326 & 2332 230 kV line (from bus 220961 to bus 220973 ckt 1) loads from 102.14% to 102.98% (DC power flow) of its emergency rating (728 MVA) for the single contingency 'PP1EB'. This project contributes approximately 23.16 MW to the thermal violation.

```
CONTINGENCY 'PP1EB'
     / NO PATH
  OPEN BRANCH FROM BUS 200101 TO BUS 235632 CKT 1
     / 200003 BRIGHTON 500 200004 CNASTONE 500 1
END
```

11. (PJM) The Peach Bottom-Conastone 500 kV line (from bus 200013 to bus 200004 ckt 1) loads from 138.00% to 138.86% (DC power flow) of its emergency rating (2815 MVA) for the single contingency 'PJM67'. This project contributes approximately 103.33 MW to the thermal violation.

```
CONTINGENCY 'PJM67'
  DISCONNECT BRANCH FROM BUS 200026 TO BUS 200004 CKT 1
     /* HUNTERTN CNASTONE 500 500
END
```

12. (PJM) The Peach Bottom-Conastone 500 kV line (from bus 200013 to bus 200004 ckt 1) loads from 139.28% to 140.24% (DC power flow) of its normal rating (2490 MVA) for non contingency condition. This project contributes approximately 104.79 MW to the thermal violation.

13. (BG&E) The EMORY GRV230-North West 2326 & 2322 230 kV line (from bus 220400 to bus 220961 ckt 1) loads from 101.59% to 101.77% (DC power flow) of its emergency rating (1800 MVA) for the single contingency 'BG_CKT2322A'. This project contributes approximately 20.92 MW to the thermal violation.

```
CONTINGENCY 'BG_CKT2322A'
     /*CONASTONE TO NORTHWEST CKT #2322
  DISCONNECT BRANCH FROM BUS 220962 TO BUS 220400 CKT 1
     /* CONASTONE TO NORTHWEST CKT #2322
END
```

14. (PJM) The Conastone-EMORY GR500 500 kV line (from bus 200004 to bus 200101 ckt 1) loads from 112.93% to 114.08% (DC power flow) of its normal rating (2338 MVA) for non contingency condition. This project contributes approximately 87.21 MW to the thermal violation.

15. (BG&E) The Conastone-EMORY GRV230 230 kV line (from bus 220963 to bus 220400 ckt 1) loads from 122.81% to 123.06% (DC power flow) of its emergency rating (819 MVA) for the single contingency 'PP1EC'. This project contributes approximately 28.28 MW to the thermal violation.

```
CONTINGENCY 'PP1EC'
     / NO PATH
  OPEN BRANCH FROM BUS 200101 TO BUS 200004 CKT 1
     / 200003 BRIGHTON 500 200004 CNASTONE 500 1
END
```

16. (PL/BG&E) The Safe Harbor Units 3-4 Tap-Graceton 230 kV line (from bus 208071 to bus 220964 ckt 1) loads from 104.87% to 105.66% (DC power flow) of its emergency rating (485 MVA) for the single contingency 'PJM17'. This project contributes approximately 23.87 MW to the thermal violation.

```
CONTINGENCY 'PJM17'
  DISCONNECT BRANCH FROM BUS 200004 TO BUS 200013 CKT 1
     /* CNASTONE PEACHBTM 500 500
END
```

17. (PECO) The Peach Bottom-Cooper 230 kV line (from bus 213869 to bus 214089 ckt 1) loads from 127.81% to 128.48% (DC power flow) of its emergency rating (485 MVA) for the single contingency 'PJM17'. This project contributes approximately 22.74 MW to the thermal violation.

```
CONTINGENCY 'PJM17'
  DISCONNECT BRANCH FROM BUS 200004 TO BUS 200013 CKT 1
     /* CNASTONE PEACHBTM 500 500
END
```

18. (BG&E) The EMORY GRV230-North West 2311 & 2310 230 kV line (from bus 220400 to bus 220962 ckt 1) loads from 101.63% to 101.81% (DC power flow) of its emergency rating (1800 MVA) for the single contingency 'BG_CKT2310A'. This project contributes approximately 20.99 MW to the thermal violation.

```
CONTINGENCY 'BG_CKT2310A'
     /* CONASTONE TO NORTHWEST CKT #2310
  DISCONNECT BRANCH FROM BUS 220961 TO BUS 220400 CKT 1
     /* CONASTONE TO NORTHWEST CKT#2310
END
```

New System Reinforcements

(Upgrades required to mitigate reliability criteria violations, i.e. "Network Impacts", initially caused by the addition of this project generation.)

1. To mitigate the overload on Nottingham-Nottingham Reactor 230 kV line, PECO has proposed to replace the line 220-08 reactor and bypass circuit switcher at Nottingham substation to achieve a minim summer emergency rating of 741 MVA. The upgrade is estimated to cost **$1,700,000** and take approximately 24 months. This overload has been caused by a later project within the X2 queue. Cost allocations for this upgrade will be determined during the System Impact Study phase.

2. The upgrade described under #14 of the Contributions to Previously Identified System Reinforcements will correct this overload.

3. To mitigate the overload on Nottingham Reactor-Peach Bottom 230 kV line, PECO has proposed to reconductor line 220-08 between Nottingham Reactor and Peach Bottom Tap to achieve a minimum summer emergency rating of 741 MVA. This line is approximately 14 miles long. The upgrade is estimated to cost **$10,000,000** and take approximately 48 months. This overload has been caused by a later project within the X2 queue. The total cost of the upgrade exceeds the cost allocation threshold so this project will not have a cost responsibility for the upgrade.

Contribution to Previously Identified System Reinforcements

(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project. This project may have a % allocation cost responsibility which will be calculated and reported for the Impact Study.)

4. To mitigate the overload on North West 2311 & 2310-Granite 2311 & 2312 230 kV line, BGE has proposed to reconductor the line with 2,167 ACSR which will increase the rating to 1105MVA. There will also be substation terminal cost upgrades associated with the reinforcement. The upgrade is estimated to cost **$23,600,000** and take approximately 6 years. This overload has been caused by a prior project. Cost allocations for this upgrade will be determined during the System Impact Study phase.

5, 13, 15, 18.
To mitigate the overload on Conastone-EMORY GRV230 230 kV line (#5 & 15), EMORY GRV230-North West 2326 & 2322 230 kV line (#13), and EMORY GRV230-North West 2311 & 2310 230 kV line (#18), BGE has proposed to construct a new double circuit 230kV line between Conastone and North West using 1590MCM conductor. The upgrade is estimated to cost **$54,700,000** and take approximately 72-84 months. This overload has been caused by a prior project. Cost allocations for this upgrade will be determined during the System Impact Study phase.

6. To mitigate the overload on Cooper-Graceton 230 kV line, BGE and PECO have proposed the following:

BGE: A double circuit line will be built with 1033.5kcmil ACSR creating one circuit by connecting the two lines into one. Rating for 2 – 1033.5kcmil 45/7 ACSR (Ortolan) at 125°C = 968/1227MVA SN/SE. BGE ownership is for 1.85 miles and the rebuild of 11 structures. It would be built as a double circuit line with the conductors jumpered across at the terminal ends. The line construction is estimated at $3,000,000. Two breakers ($400,000/breaker) would need to be replaced at Graceton for a cost of $800,000. An additional cost of $200,000 would also be incurred for 4 breaker disconnects and line connections to cover thermal. The project is estimated to take 30 months to complete: 12 months for the CPCN process & design and an additional 18 months for construction. The total cost of the project is estimated at $4,000,000.

PECO: Reconductor line 220-93 from Cooper to Graceton to achieve a minimum summer emergency rating of 725MVA. The line is approximately 4 miles long. The estimated cost for the PECO portion of the work is $2,800,000, and will require 24 months to complete.

The total upgrade is estimated to cost **$6,800,000** and take approximately 30 months. This overload has been caused by a prior project. Cost allocations for this upgrade will be determined during the System Impact Study phase.

7. To mitigate the overload on Berwick-Koonsville Ab 69 kV line, PPL has proposed to reconductor 9.73 miles of the 69kV line. The upgrade is estimated to cost **$7,900,000** and take approximately 12 months. This overload has been caused by a prior project. Cost allocations for this upgrade will be determined during the System Impact Study phase.

8. To mitigate the overload on Brunner Island Bus-Yorkana 230 kV line, PPL and METED have proposed the following:

PPL: PPL EU will rebuild and upgrade approximately 0.6 miles of PPL EU owned Brunner Island – Yorkana 230kV line and the substation line terminal equipment. The existing 1033 kcmil ACSR conductor will be replaced with new 1590 kcmil ACSR conductor or equivalent with and operating temperature of 140deg C to achieve the summer normal and emergency ratings of 712 MVA and 865 MVA respectively. The Yorkana 230kV bay conductors at Brunner Island 230kV switchyard will also be upgraded to conform the higher line ratings.PPL EU will require 24 months to construct this upgrade after the ISA/CSA are signed. The total transmission and substation upgrade cost is $1,300,000.

METED: Reconductor Met-Ed's 12.5 mile section of the Brunner -Yorkana (1055) 230 kV line with 1590 ACSS conductor. Based on the Feasibility Study review performed, the total cost of this Network Upgrade is $9,270,900 excluding tax. It is estimated that it will take three years to complete the work needed to implement this project.

The total upgrade is estimated to cost $10,570,900 and take approximately 36 months. This overload has been caused by a prior project. Cost allocations for this upgrade will be determined during the System Impact Study phase.

9. To mitigate the overload on Otter Creek Switchyard-Conastone 230 kV line, BGE and PPL have proposed the following:

BGE: Rebuild the Otter Creek-Conastone 230kV line to the PA border. The line is approximately 4.7 miles long. The new rating of the line will be 648MVA (normal) and 802MVA (emergency). The upgrade is estimated to cost $19,000,000 and will take 36-60 months to complete.

PPL: A PPL project to reconductor the Manor-Conastone line with 1590 ACSR is underway. This project will equip the line to handle 653/793 MVA (Summer Normal/ Emergency and is estimated to cost $17,000,000. The upgraded is estimated to be in-service by October 2013.

The total upgrade is estimated to cost **$36,000,000** and take approximately 60 months/years. This overload has been caused by a prior project. Cost allocations for this upgrade will be determined during the System Impact Study phase.

10. To mitigate the overload on North West 2326 & 2322-Granite 2326 & 2332 230 kV line, BGE has proposed to reconductor the line with 2,167 ACSR which will increase the rating to 1105MVA. There will also be substation terminal cost upgrades associated with the reinforcement. The upgrade is estimated to cost **$23,600,000** and take approximately 6 years. This overload has been caused by a prior project. Cost allocations for this upgrade will be determined during the System Impact Study phase.

11, 12. To mitigate the overload on Peach Bottom-Conastone 500 kV line, BGE and PECO have proposed the following:

BGE:

- At Conastone construct a new two breaker 4000A bay (breakers D, F) with two 63 kA breakers. Includes line termination structures, allowance for a second line and the relocation of the 500kV cap bank. 36 months to complete - $14M
- Construct a new 500kV line from Conastone - Peachbotton rated for a minimum of 2939/3733 SN/SE. Build 9.6 miles 500KV line from Conastone to Pennsylvania line. Purchase 150' R/W. Total for project $46.8 million 5-7 years

PECO:

- Replace existing Peach Bottom-Conastone 500kV Line (5012) terminal equipment at Peach Bottom Substation to match the conductor summer normal and emergency rating of 2920 / 3707 MVA (PECO portion only)- $5 million, 3 years
- Build new second Peach Bottom-Conastone 500kV Line on separate towers from existing 5012 Line with a minimum summer emergency rating of 3510 MVA (PECO portion only)- $20 million, 5 years [Right-of-way costs are not included]

The total upgrade is estimated to cost **$85,800,000** and take approximately 7 years. This overload has been caused by a prior project. Cost allocations for this upgrade will be determined during the System Impact Study phase.

14. To mitigate the overload on Conastone-EMORY GR500 500 kV line, BGE has proposed to upgrade the two breaker bay at Conastone with two 4000A circuit breakers, four 4000A circuit breaker disconnect switches, a one 4000A line switch. The upgrade is estimated to cost **$3,000,000** and take approximately 24-36 months. This overload has been caused by a prior project. Cost allocations for this upgrade will be determined during the System Impact Study phase.

16. To mitigate the overload on Safe Harbor Units 3-4 Tap-Graceton 230 kV line, PPL has proposed to reconductor Manor-Graceton 230 kV with 1590 ACSR. This project will equip the line to handle 653/793 MVA (Summer Normal/Emergency). The upgrade is estimated to cost **$22,700,000**. The upgrade is currently underway and is scheduled to be completed by November 2013. This overload has been caused by a prior project. Cost allocations for this upgrade will be determined during the System Impact Study phase.

17. To mitigate the overload on Peach Bottom-Cooper 230 kV line, PECO has proposed to reconductor Line 220-08 from PB Tap to Cooper Substation to achieve a minimum summer emergency rating of 741 MVA. The line is approximately 1.4 miles long. . The upgrade is estimated to cost **$1,000,000** and take approximately 24 months. This overload has been caused by a prior project. Cost allocations for this upgrade will be determined during the System Impact Study phase.

Short Circuit

(Report over-dutied breakers.)

PJM identified two over-dutied circuit breakers on the transmission system:

Bus #	Bus	Breaker	Rating Type	Duty % w/ X2-025	Duty % w/o X2-025	Duty % Difference
208109	SUNB 230.kV	ELIMSPORT NO	S	114.40%	96.70%	17.70%
208109	SUNB 230.kV	ELDRED NORTH	S	109.80%	92.00%	17.80%

PPL identified two over-dutied circuit breakers on the 69kV system:

Bus	Breaker
Sunbury Yard 1	Danville West 69kV
Sunbury Yard 2	Milton Steel West 69kV
Sunbury Yard 2	Milton West 69kV

PPL will replace all five circuit breakers under the Transmission Modernization Program. The Interconnection Customer will not share any of the cost responsibility. The 230kV circuit

breakers will be replaced by December 2012. The 69kV circuit breakers will be replaced by December 2015.

Energy Portion of Interconnection Request

PJM also studied the delivery of the energy portion of the surrounding generation. Any potential problems identified below are likely to result in operational restrictions to the project under study. The developer can proceed with network upgrades to eliminate the operational restriction at their discretion by submitting a Transmission Interconnection request.

Note: Only the most severely overloaded conditions are listed. There is no guarantee of full delivery of energy for this project by fixing only the conditions listed in this section. With a Transmission Interconnection Request, a subsequent analysis will be performed which analyzes all overload conditions associated with the overloaded element(s) identified. As a result of the aggregate energy resources in the area, the following violations were identified.

No violations identified.

Option 2: SUNBURY 500.0 kV substation

Potential transmission network impacts are as follows:

Generator Deliverability

(Single or N-1 contingencies for the Capacity portion only of the interconnection)

1. (PECO) The Nottingham-Nottingham Reactor 230 kV line (from bus 213844 to bus 213846 ckt 1) loads from 96.15% to 96.62% (DC power flow) of its emergency rating (627 MVA) for the single contingency 'PJM17'. This project contributes approximately 20.89 MW to the thermal violation.

```
CONTINGENCY 'PJM17'
  DISCONNECT BRANCH FROM BUS 200004 TO BUS 200013 CKT 1
     /* CNASTONE PEACHBTM 500 500
END
```

2. (PJM) The Conastone-EMORY GR500 500 kV line (from bus 200004 to bus 200101 ckt 1) loads from 99.08% to 100.0% (DC power flow) of its emergency rating (2901 MVA) for the single contingency 'CNSTN__230-4'. This project contributes approximately 86.77 MW to the thermal violation.

```
CONTINGENCY 'CNSTN__230-4'
     /* CONASTONE 230-4 TRANSFORMER
  DISCONNECT BRANCH FROM BUS 220963 TO BUS 200004 CKT 2
     /* CONASTONE 500-4 TRANSFORMER
END
```

3. (PECO) The Nottingham Reactor-Peach Bottom 230 kV line (from bus 213846 to bus 213869 ckt 1) loads from 96.02% to 96.49% (DC power flow) of its emergency rating (627 MVA) for the single contingency 'PJM17'. This project contributes approximately 20.89 MW to the thermal violation.

```
CONTINGENCY 'PJM17'
  DISCONNECT BRANCH FROM BUS 200004 TO BUS 200013 CKT 1
     /* CNASTONE PEACHBTM 500 500
END
```

Multiple Facility Contingency

(Double Circuit Tower Line contingencies only with full energy output. Stuck Breaker and Bus Fault contingencies will be applied during the Impact Study)

No violations identified.

Contribution to Previously Identified Overloads

(This project contributes to the following contingency overloads, i.e. "Network Impacts", identified for earlier generation or transmission interconnection projects in the PJM Queue.)

4. (BG&E) The North West 2311 & 2310-Granite 2311 & 2312 230 kV line (from bus 220962 to bus 220972 ckt 1) loads from 123.18% to 124.18% (DC power flow) of its emergency rating (621 MVA) for the single contingency 'PP1EB'. This project contributes approximately 23.32 MW to the thermal violation.

```
CONTINGENCY 'PP1EB'
     / NO PATH
  OPEN BRANCH FROM BUS 200101 TO BUS 235632 CKT 1
     / 200003 BRIGHTON 500 200004 CNASTONE 500 1
END
```

5. (BG&E) The Conastone-EMORY GRV230 230 kV line (from bus 220963 to bus 220400 ckt 2) loads from 106.24% to 106.65% (DC power flow) of its emergency rating (941 MVA) for the single contingency 'PP1EC'. This project contributes approximately 27.84 MW to the thermal violation.

```
CONTINGENCY 'PP1EC'
     / NO PATH
  OPEN BRANCH FROM BUS 200101 TO BUS 200004 CKT 1
     / 200003 BRIGHTON 500 200004 CNASTONE 500 1
END
```

6. (PECO/BG&E) The Cooper-Graceton 230 kV line (from bus 214089 to bus 220964 ckt 1) loads from 126.32% to 126.94% (DC power flow) of its emergency rating (485 MVA) for the single contingency 'PJM17'. This project contributes approximately 20.89 MW to the thermal violation.

```
CONTINGENCY 'PJM17'
  DISCONNECT BRANCH FROM BUS 200004 TO BUS 200013 CKT 1
     /* CNASTONE PEACHBTM 500 500
END
```

7. (PL/METED) The Brunner Island Bus-Yorkana 230 kV line (from bus 207922 to bus 204515 ckt 1) loads from 137.19% to 138.58% (DC power flow) of its emergency rating (617 MVA) for the single contingency 'PJM17'. This project contributes approximately 21.18 MW to the thermal violation.

```
CONTINGENCY 'PJM17'
  DISCONNECT BRANCH FROM BUS 200004 TO BUS 200013 CKT 1
     /* CNASTONE PEACHBTM 500 500
END
```

8. (PL/BG&E) The Otter Creek Switchyard-Conastone 230 kV line (from bus 208048 to bus 220963 ckt 1) loads from 103.01% to 103.86% (DC power flow) of its emergency rating (531 MVA) for the single contingency 'PJM17'. This project contributes approximately 28.18 MW to the thermal violation.

```
CONTINGENCY 'PJM17'
  DISCONNECT BRANCH FROM BUS 200004 TO BUS 200013 CKT 1
     /* CNASTONE PEACHBTM 500 500
END
```

9. (BG&E) The North West 2326 & 2322-Granite 2326 & 2332 230 kV line (from bus 220961 to bus 220973 ckt 1) loads from 102.14% to 102.96% (DC power flow) of its emergency rating (728 MVA) for the single contingency 'PP1EB'. This project contributes approximately 22.54 MW to the thermal violation.

```
CONTINGENCY 'PP1EB'
     / NO PATH
  OPEN BRANCH FROM BUS 200101 TO BUS 235632 CKT 1
     / 200003 BRIGHTON 500 200004 CNASTONE 500 1
END
```

10. (PJM) The Peach Bottom-Conastone 500 kV line (from bus 200013 to bus 200004 ckt 1) loads from 138.00% to 138.82% (DC power flow) of its emergency rating (2815 MVA) for the single contingency 'PJM67'. This project contributes approximately 98.85 MW to the thermal violation.

```
CONTINGENCY 'PJM67'
  DISCONNECT BRANCH FROM BUS 200026 TO BUS 200004 CKT 1
     /* HUNTERTN CNASTONE 500 500
END
```

11. (PJM) The Peach Bottom-Conastone 500 kV line (from bus 200013 to bus 200004 ckt 1) loads from 139.47% to 140.37% (DC power flow) of its normal rating (2490 MVA) for non contingency condition. This project contributes approximately 98.97 MW to the thermal violation.

12. (PJM) The Conastone-EMORY GR500 500 kV line (from bus 200004 to bus 200101 ckt 1) loads from 112.93% to 114.04% (DC power flow) of its normal rating (2338 MVA) for non contingency condition. This project contributes approximately 84.73 MW to the thermal violation.

13. (BG&E) The Conastone-EMORY GRV230 230 kV line (from bus 220963 to bus 220400 ckt 1) loads from 122.81% to 123.05% (DC power flow) of its emergency rating (819 MVA) for the single contingency 'PP1EC'. This project contributes approximately 27.51 MW to the thermal violation.

```
CONTINGENCY 'PP1EC'
     / NO PATH
  OPEN BRANCH FROM BUS 200101 TO BUS 200004 CKT 1
     / 200003 BRIGHTON 500 200004 CNASTONE 500 1
END
```

14. (PL/BG&E) The Safe Harbor Units 3-4 Tap-Graceton 230 kV line (from bus 208071 to bus 220964 ckt 1) loads from 104.87% to 105.65% (DC power flow) of its emergency rating (485 MVA) for the single contingency 'PJM17'. This project contributes approximately 23.33 MW to the thermal violation.

```
CONTINGENCY 'PJM17'
  DISCONNECT BRANCH FROM BUS 200004 TO BUS 200013 CKT 1
     /* CNASTONE PEACHBTM 500 500
END
```

15. (PECO) The Peach Bottom-Cooper 230 kV line (from bus 213869 to bus 214089 ckt 1) loads from 127.80% to 128.42% (DC power flow) of its emergency rating (485 MVA) for the single contingency 'PJM17'. This project contributes approximately 20.89 MW to the thermal violation.

```
CONTINGENCY 'PJM17'
  DISCONNECT BRANCH FROM BUS 200004 TO BUS 200013 CKT 1
     /* CNASTONE PEACHBTM 500 500
END
```

New System Reinforcements

(Upgrades required to mitigate reliability criteria violations, i.e. "Network Impacts", initially caused by the addition of this project generation.)

None required.

Contribution to Previously Identified System Reinforcements

(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project. This project may have a % allocation cost responsibility which will be calculated and reported for the Impact Study.)

None required.

Short Circuit

(Report over-dutied breakers.)

None required.

Energy Portion of Interconnection Request

PJM also studied the delivery of the energy portion of the surrounding generation. Any potential problems identified below are likely to result in operational restrictions to the project under study. The developer can proceed with network upgrades to eliminate the operational restriction at their discretion by submitting a Transmission Interconnection request.

Note: Only the most severely overloaded conditions are listed. There is no guarantee of full delivery of energy for this project by fixing only the conditions listed in this section. With a Transmission Interconnection Request, a subsequent analysis will be performed which analyzes all overload conditions associated with the overloaded element(s) identified. As a result of the aggregate energy resources in the area, the following violations were identified.

No violations identified.

Attachment A

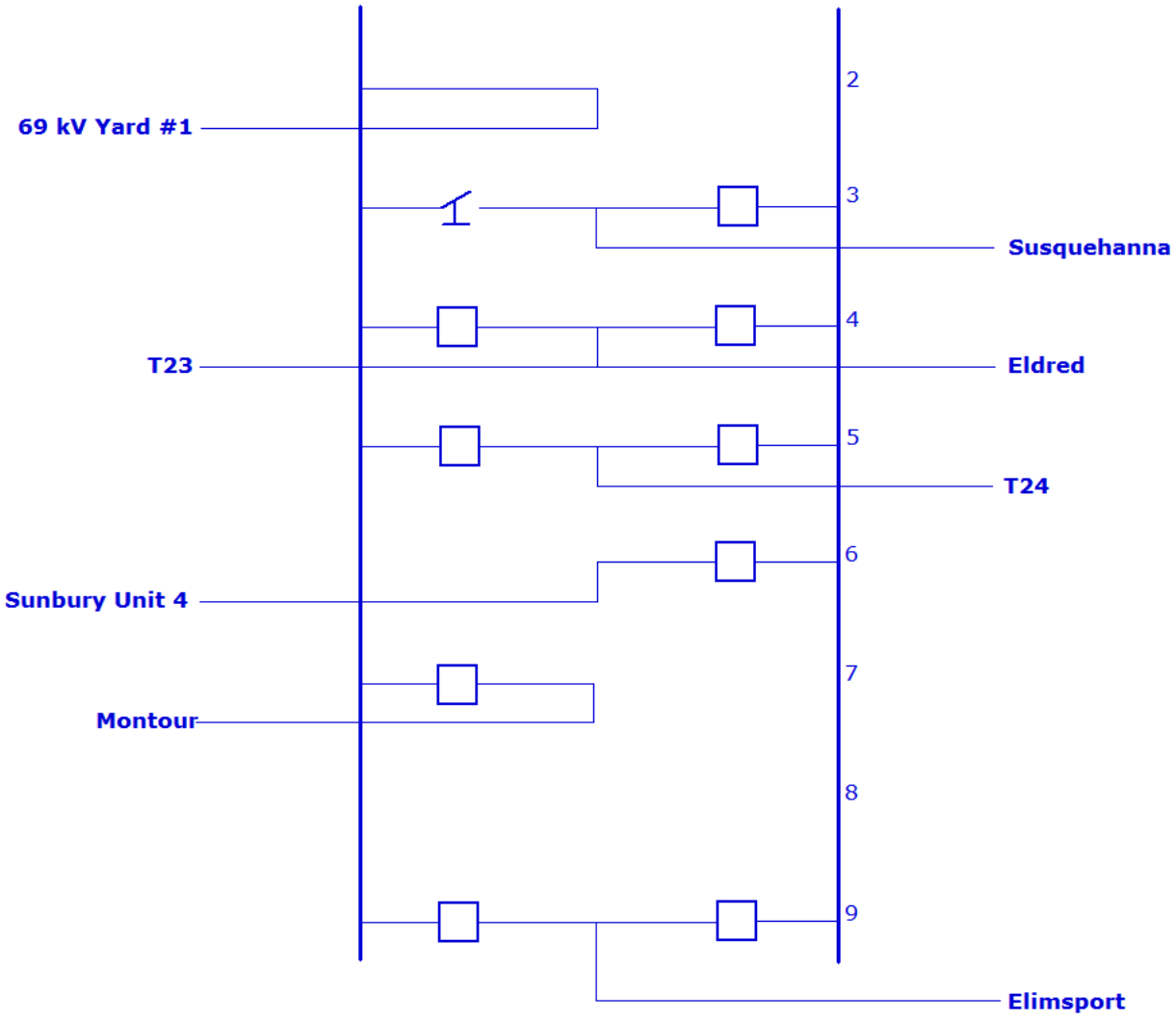

Figure 1. Existing Sunbury 230 kV Yard

IPP connection would approach from the left of this diagram.