# *Generation Interconnection Feasibility Study Report*

# *For*

# *PJM Generation Interconnection Request Queue Position AA1-114*

# *East Hazelton-Harwood 69kV*

**February 2015**

# 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.

The conduct of light load analysis as required under the PJM planning process is not performed during the Generation Interconnection Feasibility Study phase of the PJM study process. Additional reinforcement requirements for this Interconnection Request may be defined during the conduct of the light load analysis which shall be performed following execution of the System Impact Study agreement.

# General

The Interconnection Customer (IC), has proposed a wind generating facility located in Carbon County, Pennsylvania. The installed facilities will have a total capability of 68 MW with 8.8 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is December 2017. **This study does not imply a PPL Electric Utilities (PPL EU) commitment to this in-service date.**

## Point of Interconnection

AA1-114 will interconnect with the PPL EU transmission system at one of two options. Option 1 is to connect along the Harwood-East Hazelton #1 69kV line. Option 2 is to connect along the Harwood-East Hazelton #2 69kV line.

## Cost Summary

The AA1-114 project will be responsible for the following costs:

| Description | Total Cost |
|---|---|
| Attachment Facilities | $ 1,780,000 |
| Direct Connection Network Upgrades | $ 0 |
| Non Direct Connection Network Upgrades | $ 12,452,000 |
| **Total Costs** | **$ 14,232,000** |

The 69 kV connection estimate is based on the assumptions stated in the following Transmission Attachment Facilities, Direct Connection, and Substation Non- Direct Connection Work sections. This estimate may vary depending upon the Queue AA1-114 substation location and orientation.

In addition, the AA1-114 project may be responsible for a contribution to the following costs:

| Description | Total Cost |
|---|---|
| New System Upgrades | $ 15,438,000 |
| Previously Identified Upgrades | $ 0 |
| **Total Costs** | **$ 15,438,000** |

Cost allocations for these upgrades will be provided in the System Impact Study Report.

# Overview

The AA1-114 project can be connected to PPL EU's 69 kV transmission system by tapping the Harwood-E. Hazelton #1 69 kV line in the vicinity of 40°54'9.63"N75°58'22.93"W. The Point of Interconnection (POI) will be where the PPL EU transmission line lands on the customer's dead-end structure inside the IC's yard. Please see Attachment 1 for a one-line diagram of the POI.

Note: This POI requires PPL to upgrade an existing 69 kV line. The upgrade scope does not conform with the PPL standard for 69kV transmission line design. Therefore, PPL EU may recommend that the POI be revised in the System Impact Study stage. This change may require a Material Modification evaluation by PJM and PPL.

# Attachment Facilities

## Transmission Line Work

The transmission line work includes tapping the Harwood-E. Hazelton #1 69 kV line in the vicinity of 40°54'9.63"N75°58'22.93"W and building approximately 600' of 69 kV tap line using 556.5 Kcmil ACSR conductors with SFPOC 0.567" dia. 48 fiber OPGW. The tap line will be a 69 kV steel pole design. At the tapping point, two MOLBAB (Motor Operated Load Break Air Break) switches will be installed. The switches would be installed on a custom designed steel pole with concrete foundations. See Attachment 1 for the connection schematic.

## Substation Work for Mini Yard

Outside the IPP customer substation, a mini yard with a motor-operated switch and 69 kV breaker will be installed in the future by PPL. A small control house will contain the circuit breaker relays and communication devices.

## Cost

The total preliminary cost estimate for the Attachment work is given in the table below. These costs do not include CIAC Tax Gross-up.

| Description | Total Cost |
|---|---|
| Transmission line work and mini yard | $ 1,780,000 |
| **Total Attachment Facility Costs** | **$ 1,780,000** |

# Direct Connection Cost Estimate

There are no Direct Connection Facilities to be constructed by the Transmission Owner.

# Non-Direct Connection Cost Estimate

## Rebuild Existing Transmission Line

In order to accommodate the full output of this generator, approximately 4.4 miles of existing 556/795 ACSR conductors on Harwood-E. Hazelton #1 69 kV line will need to be rebuilt using 1590 ACSR conductor with SFPOC 0.567" dia. 48 fiber OPGW.

Note: This upgrade does not conform with PPL standard for 69kV transmission line. Therefore, PPL EU may recommend that the POI be revised in the System Impact Study stage.

## Harwood Substation Work

The protection system at the source end of the 69 kV line will be modified to support this interconnection. To accommodate AA1-114, the following upgrades are required at PPL EU's Harwood 230-69kV Substation:

- Replace all conductor and copper tubing in bay 12 for 1033.5 ACSR KCMIL SIZE , 54/7 conductor at Harwood's 69 kV yard (see picture below)
- Install a fiber patch panel at Harwood's 69 kV control cubicle.
- Install fiber based Direct Transfer Trip (DTT) Cabinet SEL 2440, fuses and test switches at Harwood's 69 kV cubicle in new DTT box (see picture below)
- Install SEL 2830M in DTT box
- Install new control switches for test and blocking in DTT box.
- Run duplex Patch cord fiber optic cable from new SEL 2830 in the new DTT box to new fiber optic patch panel in the 69 kV control cubicle
- Connect contacts of East Hazleton #1 69kV primary and backup line relay to new SEL 2440 relay for trip (located in 69 kV cubicle).
- Run a single mode 24 ADSS tie between patch panel (New) and splice box located in last transmission structure of the Harwood-East Hazleton #1 69 kV line (splice box will be provided by Transmission Dept.)
- Modify SCADA for new alarms (program new alarms in SCADA for IPP)
- Modify Alarm Management system (program new alarms in AMS for IPP)

## Cost

The total preliminary cost estimate for the Non-Direct Connection work is given in the table below. These costs do not include CIAC Tax Gross-up.

| Description | Total Cost |
|---|---|
| Rebuild transmission line | $ 12,038,000 |
| Harwood substation work | $ 414,000 |
| **Total Non-Direct Connection Facility Costs** | **$ 12,452,000** |

# Alternate Outlet

The IC has not requested an alternate outlet for their generation. When the Harwood-E. Hazelton #1 69 kV line needs to come off line for any line maintenance or repair activities, the generator will be required to come off line.

# Preliminary Schedule

The estimated PPL EU elapsed time to complete the 69 kV Attachment Facilities, Direct Connection, and Non-Direct connection substation work is approximately 36 months after the receipt of a fully executed ISA/CSA.

The schedule for the 69 kV substation work to accommodate AA1-114 would depend on the project's start date. The work to accommodate AA1-114 will require substation facility outages. PPL EU's outage windows for construction are typically available in the spring and fall of the year. Missing an outage window could result in project delays.

The transmission and substation work can be completed concurrently. PPL EU will commence siting, engineering design, material purchase and construction of the facilities identified in this study after receiving written authorization by PJM to begin work. This time frame is contingent upon the acquisition of all rights of way in the stated time frame before the start of construction and detailed design.

# Transmission Owner Assumptions in Developing the Cost Estimates

- For the custom-designed steel transmission poles, the lead-time is approximately 32 to 42 weeks. It is estimated that approximately custom designed steel poles will be needed for this project.
- During construction, if extreme weather conditions or other system safety concerns arise, field construction may need to be rescheduled, which could possibly delay the schedule.
- This magnitude estimate has been prepared without extensive research or field review.
- For the new 69 kV tap from AA1-114 to the Harwood-E. Hazelton #1 69 kV line, it is as assumed that a new ROW and siting study would be required and the tap would be owned by PPL EU.
- No environmental, real estate, or permitting issues were reviewed for the estimate of this project.
- This estimate assumes that suitable facility outages can be schedule as required to install the new circuit breaker. Failure to meet a scheduled facility outage may result in project delays.
- 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 but no guarantees can be made. It is also assumed that all rights-of-way and easements are secured by the anticipated construction start dates.
- PPL EU recommends that an Interim ISA be completed during the Facilities Study stage to address critical path items, such as long lead-time purchases and any other compressed project schedule issues.
- The ISA/CSA or an Interim Interconnection Service Agreement (IISA) must be signed by the AA1-114 Interconnection Customer, PJM, and PPL EU before any PPL EU design and construction activities may commence.

# Interconnection Customer Requirements

## AA1-114 Generator, GSU, and Line Modeling

The turbines will be modeled as one unit and will inject 68 MW into PPL EU's system.

Per the AA1-114 supplied data the following was used in modeling the generator and the GSU:

**AA1-114 Generator (Vestas V110):**

- Number of Turbines: 34

- Size: 2 MW per turbine
- MVA Base: 2.08 MVA
- 0.90 lead to 0.90 lag power factor at 69 kV bus

**Transformers:**

- GSU (Generator Step Up Transformer):
- Number of machines per GSU: 34
- MVA Base: 45 MVA
- Voltage Level: 34.5/69 kV
- Impedance: 8.0%
- GSU (Wind Turbine Unit):
- MVA Base: 2.1 MVA
- Voltage Level: 34.5/0.69 kV

**Transmission Line:**

- Voltage Level: 69 kV
- MVA Base: 100 MVA
- Length: 0.2 miles
- Positive sequence impedance: 0.00450+j0.00550
- Zero sequence impedance: 0.0140+j0.04750

## Telephone Circuit Requirements (At the IPP)

PPL EU will require a communication path for SCADA, DTT, and voice circuits. PPL EU anticipates that telephone circuits will be required to establish these paths. The Interconnection Customer will be responsible to procure the following:

- A normal dialup telephone line for voice communication

Phone lines tend to be long lead-time items and must be in place and operational for equipment testing. The Interconnection Customer should investigate with the local phone company the possibility of obtaining this type of service at their facility.

All installation, maintenance, and monthly lease or billing charges for communications facilities are the responsibility of the Interconnection Customer.

## Intertie and PC Protective Relaying Equipment

The Interconnection Customer will need to install suitable protection and control equipment at its facilities based on PPL EU parallel generation requirements. This includes both Intertie Protective Relaying (IPR) and Point of Contact (POC) relaying. Please refer to the PPL EU web site for the IPR and POC requirements. The website addresses are shown below:

IPR Requirements:
https://www.pplelectric.com/at-your-service/electric-rates-and-rules/customer-owned-generation.aspx

POC Requirements:
https://www.pplelectric.com/at-your-service/electric-rates-and-rules/point-of-contact-requirements-for-high-voltage-facilities.aspx

## Isolation Breaker Requirement at the Interconnection Customer's Substation

Per the customer's preliminary sketches, the customer is planning to provide a high side circuit breaker at 69 kV with a manually operated 69 kV disconnect switch on the PPL EU line side of this breaker. Unless otherwise indicated, it is assumed that this be will be the "Isolation Circuit Breaker" and will be operated by the IPR relay and the DTT signal. It is requested that the customer confirm this or provide alternate isolation breaker.

## AA1-114 Generator Harmonic and Flicker Requirements

On the PPL EU 69 kV system, the total harmonic distortion to the fundamental voltage wave from a single customer is limited to 1.5% of nominal. In addition, no individual harmonic component can exceed 1.0% of the fundamental system voltage.

If PPL EU discovers that objectionable harmonics in excess of the stated limits are being injected into the system from AA1-114's equipment, the Queue AA1-114 Interconnection Customer will be responsible for taking corrective measures to mitigate harmonic currents.

Concerning voltage flicker, the Interconnection Customer must limit the severity of their voltage variation to within a level which will not cause objectionable flickers to other customers. A voltage drop greater than 5% at the point of interconnection is generally not acceptable. The frequency and severity of the voltage variation will be considered when determining whether a customer's equipment is violating PPL EU flicker guidelines. PPL EU uses the General Electric flicker-irritation curves as a guideline to determine if the system is operating within acceptable limits. PPL EU will require corrective actions by the Interconnection Customer if their operation causes flickers that exceed PPL EU guidelines. One such correction could be the installation of static var compensators (SVC) to hold a constant voltage.

## AA1-114 Generator Regulation or Reactive Support Requirements

As specified in Part IV, Subpart E at 54.7 of the PJM OATT, the Project AA1-114 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 0.95 lagging (supplying vars).

*"For all new wind-powered and other non-synchronous generation facilities, if determined in the system Feasibility study to be required for the safety or reliability of the Transmission*

*System, the Generation Interconnection Customer shall design its Customer Facility with the ability to maintain a composite power delivery at continuous rated power output at a power factor of at least 0.95 leading to 0.95 lagging."*

The PPL EU preliminary load flow studies have indicated that the AA1-114 generator will maintain the required voltage regulation within the required ranges. A MW/MVAR schedule will be developed at the time of the Facilities Study.

# Revenue Metering and SCADA Requirements

## PJM Requirements

The Interconnection Customer will be required to install equipment necessary to provide Revenue Metering (KWH, KVARH) and real time data (KW, KVAR) for IC's generating Resource. See PJM Manuals M-01 and M-14D, and PJM Tariff Sections 24.1 and 24.2.

## PPL EU Requirements

### SCADA Equipment Requirements

PPL EU will require installation of PPL EU approved SCADA equipment that will connect to its existing SCADA system to provide real time values of KW, KVAR, and kV metering data at the POC. SCADA equipment will also provide capability to trip and the status monitoring of the POC isolating circuit breaker. In addition to that, monitoring of other abnormal conditions at developer's plant will be provided where deemed necessary. This connection will be a 4-wire dedicated FDDA-type phone line. PPL EU will provide detailed specifications and design drawings for this equipment.

### Revenue Metering Equipment Installation at the Point of Interconnection

Installation of revenue grade Bi-directional Metering Equipment will be required at the Queue AA1-114 Point of Interconnection (POI) to measure KWh and KVARh. PPL EU will design and supply the required metering equipment but all the installation cost would be borne by the developer including CT/PTs. 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 equipment should be housed in a control cabinet or similar enclosure and must be accessible to PPL EU metering personnel.

# Other Issues Impacting the Interconnection Customer

## Distribution Service Requirements

The Interconnection Customer must submit a request for electric service through PPL EU's Industrial and Commercial Services (ICS) group if the queue AA1-114 requires back-up electric

service at a voltage less than 69 kV. The ICS Help Desk can be reached at 1-888-220-9991. Cost for distribution electric service is NOT included in the PPL scope of work transmission or substation estimates.

### Future Conversion of line to 138 kV from 69 kV

PPL EU presently has no plans to convert this line to 138 kV in the next 15-20 years. If the transmission system in this area is converted to 138 kV in the future, the Interconnection Customer would be responsible for conversion of its substation to 138 kV at that time.

### PA PUC Certification & Environmental Issues

All required land and right of way will be made available to PPL EU at no cost from the Interconnection Customer developer. It is assumed here that the transmission tap would be owned by PPL EU.

### Intertie 69-34.5 kV Transformer Turns Ratio

PPL EU typically procures the transformers with the following high side (69 kV) taps:

70.6 kV, 68.8 kV, 67.0 kV, 65.2 kV, 63.4 kV with nominal midpoint voltage is 67 kV, this provides a range of 5% above (in two 2.5% steps) and 5% below (in two 2.5% steps) to the mid-point range of 67 kV.

## Maintenance Considerations

The Queue AA1-114 facility will not be able to generate into the PPL EU network during maintenance on the new 69 kV generator supply line. PPL EU on-going annual and long-term planned maintenance of this circuit will require PPL EU to remove the circuit from operation one (1) time every four (4) years, for an outage period of approximately two (2) weeks. The actual duration may be shorter. During maintenance periods, the circuit may or may not be returned to service during the evening hours. That decision depends on the type of work being performed. Unexpected and unplanned maintenance outages are not included in the one-in-four number and duration time. Annual inspections that uncover damaged poles, conductors, or hardware, which require immediate repair, are scheduled as soon as practicable. These types of unplanned outages may last up to 16 hours.

# Network Impacts

## Option 1

The Queue Project AA1-114 was studied as a 68.0 MW (Capacity 8.8 MW) injection as a tap of the Harwood – East Hazelton #1 69 kV line in the PPL area. Project AA1-114 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). A Summer Peak 2018 case was used for the analysis. Project AA1-114 was studied with a commercial probability of 53%. Potential network impacts were as follows:

### Contingency Descriptions

The following contingencies resulted in overloads:

| Contingency Name | Description |
|---|---|
| PJM69 | CONTINGENCY 'PJM69'<br>DISCONNECT BRANCH FROM BUS 200021 TO BUS 200009 CKT 1<br>/* SUNBURY JUNIATA 500 500<br>DISCONNECT BRANCH FROM BUS 200021 TO BUS 200022 CKT 2<br>/* SUNBURY SUSQHANA 500 500 / CKT 1 -> 2<br>DISCONNECT BRANCH FROM BUS 200021 TO BUS 208109 CKT 24<br>/* SUNBURY SUNBURY 500 230<br>END |
| PL100990 | CONTINGENCY 'PL100990'<br>/* COLUMBIA 230KV BF<br>DISCONNECT BUS 207942<br>/* COLU 230 (COLU-FRAC & COLU T1)<br>DISCONNECT BUS 207943<br>/* MONT-COLU & COLU T2<br>DISCONNECT BUS 207974<br>/* FRAC T2<br>END |

**Generator Deliverability**

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

None.

**Multiple Facility Contingency**

*(Double Circuit Tower Line, Fault with a Stuck Breaker, and Bus Fault contingencies for the full energy output)*

| | Contingency | | Affected | | Bus | | | Power | Loading % | | Rating | | MW | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| # | Type | Name | Area | Facility Description | From | To | Circuit | Flow | Initial | Final | Type | MVA | Contribution | Ref |
| 1 | LFFB | PL100990 | PPL | HARW-W1-111 TAP 69 kV line | 211590 | 901900 | 1 | DC | 97.80 | 100.78 | ER | 90 | 5.96 | 1 |

*Note: Please see Attachment 2 for projects providing impacts to flowgate violations. The values in the Reference column correspond to the proper table in the Attachment.*

**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)*

None.

**Short Circuit**

*(Summary of impacted circuit breakers)*

None.

**Potential Congestion due to Local Energy Deliverability**

*PJM also studied the delivery of the energy portion of this interconnection request. Any 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 Merchant Transmission Interconnection request.*

*Note: Only the most severely overloaded conditions are listed below. 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 shall study all overload conditions associated with the overloaded element(s) identified.*

| | Contingency | | Affected | | Bus | | | Power | Loading % | | Rating | | MW | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| # | Type | Name | Area | Facility Description | From | To | Circuit | Flow | Initial | Final | Type | MVA | Contribution | Ref |
| 2 | N-1 | PJM69 | PPL | SUSQHANA 500/230 kV transformer | 208116 | 200022 | 21 | DC | 118.39 | 119.22 | ER | 1165 | 21.60 | |
| 3 | Non | None | PPL | HOBR 1-HARW 69 kV line | 211621 | 211590 | 1 | DC | 36.21 | 103.78 | ER | 97 | 65.55 | |
| 4 | Non | None | PPL | MCCI 1-MCCI TP1 69 kV line | 211705 | 211708 | 1 | DC | 50.68 | 120.76 | ER | 97 | 67.98 | |
| 5 | Non | None | PPL | MCCI TP1-HOBR 1 69 kV line | 211708 | 211621 | 1 | DC | 36.31 | 103.89 | ER | 97 | 65.55 | |
| 6 | Non | None | PPL | AA1-114 TAP-MCCI 1 69 kV line | 918950 | 211705 | 1 | DC | 52.43 | 122.52 | ER | 97 | 67.98 | |

## Transmission Owner Identified Overloads

| # | Case | Contingency | Facility | Loading | | Rating | |
|---|---|---|---|---|---|---|---|
| | | | | Initial | Final | Type | MVA |
| 7 | 2018 Summer Peak | none | AA1-114 – MCCI1 section of HARW-EHAZ 1 69kV line | 58% | 127% | SN | 97 |
| 8 | 2018 Summer Peak | none | MCCI1 – MCCI TP1 section of HARW-EHAZ 1 69kV line | 57% | 125% | SN | 97 |
| 9 | 2018 Summer Peak | none | MCCI TP1-HOBR 1 section of HARW-EHAZ 1 69kV line | 39% | 102% | SN | 97 |
| 10 | 2018 Summer Peak | none | HOBR 1-HARW section of HARW-EHAZ 1 69kV line | 39% | 102% | SN | 97 |

**New System Reinforcements**

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

| Violation # | Overloaded Facility | Upgrade Description | Network Upgrade Number | Upgrade Cost |
|---|---|---|---|---|
| 1 | HARW-W1-111 TAP 69 kV line | Re-conductor 1.5 miles of the Harwood – W1-111 section of the 69 kV line with 556 ACSR. Estimated Cost: $3.4 M; Estimated Time: 18 months | Pending | **$ 3,400,000** |
| 7 | AA1-114 – MCCI1 section of HARW-EHAZ 1 69kV line | In order to accommodate the full output of this generator, approximately 4.4 miles of existing 556/795 ACSR along with existing NEPCO-HARW section of Harwood-E. Hazelton #1 69 kV line will need to be rebuilt using 1590 ACSR conductor. | Pending | **$ 12,038,000** |
| 8 | MCCI1 – MCCI TP1 section of HARW-EHAZ 1 69kV line | | | |
| 9 | MCCI TP1-HOBR 1 section of HARW-EHAZ 1 69kV line | | | |
| 10 | HOBR 1-HARW section of HARW-EHAZ 1 69kV line | | | |
| | | | **Total New Network Upgrades** | **$ 15,438,000** |

**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.

## Option 2

The Queue Project AA1-114 was studied as a 68.0 MW (Capacity 8.8 MW) injection as a tap of the Harwood – East Hazelton #2 69 kV line in the PPL area. Project AA1-114 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). A Summer Peak 2018 case was used for the analysis. Project AA1-114 was studied with a commercial probability of 53%. Potential network impacts were as follows:

### Contingency Descriptions

The following contingencies resulted in overloads:

| Contingency Name | Description |
|---|---|
| PJM69 | CONTINGENCY 'PJM69'<br>DISCONNECT BRANCH FROM BUS 200021 TO BUS 200009 CKT 1<br>/* SUNBURY JUNIATA 500 500<br>DISCONNECT BRANCH FROM BUS 200021 TO BUS 200022 CKT 2<br>/* SUNBURY SUSQHANA 500 500 / CKT 1 -> 2<br>DISCONNECT BRANCH FROM BUS 200021 TO BUS 208109 CKT 24<br>/* SUNBURY SUNBURY 500 230<br>END |
| PL100900 | CONTINGENCY 'PL100990'<br>/* COLUMBIA 230KV BF<br>DISCONNECT BUS 207942<br>/* COLU 230 (COLU-FRAC & COLU T1)<br>DISCONNECT BUS 207943<br>/* MONT-COLU & COLU T2<br>DISCONNECT BUS 207974<br>/* FRAC T2<br>END |

**Generator Deliverability**

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

None.

**Multiple Facility Contingency**

*(Double Circuit Tower Line, Fault with a Stuck Breaker, and Bus Fault contingencies for the full energy output)*

| | Contingency | | Affected | | Bus | | | Power | Loading % | | Rating | | MW | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| # | Type | Name | Area | Facility Description | From | To | Circuit | Flow | Initial | Final | Type | MVA | Contribution | Ref |
| 1 | LFFB | PL100990 | PPL | HARW-W1-111 TAP 69 kV line | 211590 | 901900 | 1 | DC | 97.80 | 100.78 | ER | 90 | 5.96 | 1 |

*Note: Please see Attachment 3 for projects providing impacts to flowgate violations. The values in the Reference column correspond to the proper table in the Attachment.*

**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)*

None.

**Short Circuit**

*(Summary of impacted circuit breakers)*

None.

**Potential Congestion due to Local Energy Deliverability**

*PJM also studied the delivery of the energy portion of this interconnection request. Any 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 Merchant Transmission Interconnection request.*

*Note: Only the most severely overloaded conditions are listed below. 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 shall study all overload conditions associated with the overloaded element(s) identified.*

| | Contingency | | Affected | | Bus | | | Power | Loading % | | Rating | | MW | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| # | Type | Name | Area | Facility Description | From | To | Circuit | Flow | Initial | Final | Type | MVA | Contribution | Ref |
| 2 | N-1 | PJM69 | PPL | SUSQHANA 500/230 kV transformer | 208116 | 200022 | 21 | DC | 118.36 | 119.20 | ER | 1165 | 21.60 | |

# Attachment 1. Single Line Diagram

# Attachment 2. Option 1 Flowgate Details

The following appendices contain additional information about each flowgate presented in the body of the report. For each appendix, a description of the flowgate and its contingency was included for convenience. However, the intent of the appendix section is to provide more information on which projects/generators have contributions to the flowgate in question. Although this information is not used "as is" for cost allocation purposes, it can be used to gage other generators impact.

It should be noted the generator contributions presented in the appendices sections are full contributions, whereas in the body of the report, those contributions take into consideration the commercial probability of each project.

## Appendix 1

(PL - PL) The HARW-W1-111 TAP 69 kV line (from bus 211590 to bus 901900 ckt 1) loads from 97.8% to 100.78% (DC power flow) of its emergency rating (90 MVA) for the line fault with failed breaker contingency outage of 'PL100990'. This project contributes approximately 5.96 MW to the thermal violation.

| Bus Number | Bus Name | Full Contribution |
|---|---|---|
| 918951 | AA1-114 C OP | 0.77 |
| 918952 | AA1-114 E OP | 5.19 |

# Attachment 3. Option 2 Flowgate Details

The following appendices contain additional information about each flowgate presented in the body of the report. For each appendix, a description of the flowgate and its contingency was included for convenience. However, the intent of the appendix section is to provide more information on which projects/generators have contributions to the flowgate in question. Although this information is not used "as is" for cost allocation purposes, it can be used to gage other generators impact.

It should be noted the generator contributions presented in the appendices sections are full contributions, whereas in the body of the report, those contributions take into consideration the commercial probability of each project.

## Appendix 1

(PL - PL) The HARW-W1-111 TAP 69 kV line (from bus 211590 to bus 901900 ckt 1) loads from 97.8% to 100.78% (DC power flow) of its emergency rating (90 MVA) for the line fault with failed breaker contingency outage of 'PL100990'. This project contributes approximately 5.96 MW to the thermal violation.

| Bus Number | Bus Name | Full Contribution |
|---|---|---|
| 918951 | AA1-114 C OP | 0.77 |
| 918952 | AA1-114 E OP | 5.19 |