Generation Interconnection System Impact Study Report

For

PJM Generation Interconnection Request Queue Position AA2-017

East Palmerton-Acahela 69kV

March 2016

Preface

The intent of the System Impact Study is to determine a plan, with approximate cost and construction time estimates, to connect the subject generation interconnection project to the PJM network at a location specified by the Interconnection Customer. As a requirement for interconnection, the Interconnection Customer may be responsible for the cost of constructing: Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system. All facilities required for interconnection of a generation interconnection project must be designed to meet the technical specifications (on PJM web site) for the appropriate transmission owner.

In some instances an Interconnection Customer may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection or merchant transmission upgrade, 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 System Impact Study is performed.

The System Impact 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

Atlantic Wind, LLC, the Interconnection Customer (IC), has proposed a wind generating facility located in Carbon County, PA. The installed facilities will have a total capability of 98 MW with 12.7 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is December 2018. **This study does not imply a PPL Electric Utilities Corporation (PPL EU) commitment to this in-service date.**

Point of Interconnection

AA2-017 will interconnect with the PPL EU transmission system into both the East Palmerton-Acahela #1 & #2 69kV lines. AA2-017 will have a total capability of 98 MW that must be split across the East Palmerton-Acahela #1 and #2 69kV lines so that a maximum of 50 MW would be generated on either 69kV line.

Cost Summary

The AA2-017 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$ 2,749,000
Direct Connection Network Upgrades	$ 0
Non Direct Connection Network Upgrades	$ 141,000
Allocation for New System Upgrades	$ 0
Contribution for Previously Identified Upgrades	$ 0
Total Costs	**$ 2,890,000**

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Overview

The AA2-017 project can be connected to PPL EU's 69 kV transmission system by tapping both the East Palmerton-Acahela #1 & #2 69 kV lines between Carbon and Hickory Run substations (approximate grid 58607N28657) and extending approximately 0.5 miles of double circuit 138/69 kV transmission line to the Interconnection Customer's Substation. The Point of Interconnections (POIs) will be where the PPL EU transmission lines land on the customers dead-ends inside the IC's yard.

Attachment Facilities

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 (n4944)	$ 2,749,000
Total Attachment Facilities	**$ 2,749,000**

Transmission Line Work

This Project will require siting to identify a suitable route for the 100'-wide right of way needed to construct the approximately 0.5 miles of 138/69 kV double circuit transmission line using 556 Kcmil ACSR conductors with optical ground wire (2-OPGW) from the East Palmerton- Acahela #1 & #2 69 kV double circuit lines to the dead end structures inside the customer's substation (POI). The tap line will be a 138 kV double circuit steel pole design, initially operated at double circuit 69 kV.

The transmission attachment facilities work includes installation of two Motor Operated Load Break Air Break (MOLBAB) switches on the PPL EU East Palmerton-Acahela #1 & #2 69 kV lines on the Acahela side of the tap point. The switches would be installed on a custom designed steel pole with concrete foundations. Also two customer point of contact devices will be installed on the taps that go to the customer's substation. A fiber tap to the Interconnection Customer substation will be required. See Attachment 1 for the connection schematic.

PA PUC Certification of the proposed 69 kV transmission line route will be required as it will be designed for future 138 kV operation. The certification would be through the abbreviated "Letter of Notification" (LON) process since the tap is expected to be less than 2 miles long. The lead time required to prepare, file and obtain PA PUC approval and obtain property rights will be approximately 12-15 months and assumes that no litigation or condemnation is required.

It is assumed that the developer will purchase the property needed for PPL EU's facilities and transfer the rights to PPL EU.

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Direct Connection Cost Estimate

No Direct Connection facilities are required to support this interconnection.

Non-Direct Connection Cost Estimate

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
Substation work (n4945)	$ 141,000
Total Non-Direct Connection Facilities	**$ 141,000**

Substation Work

To accommodate AA2-017, the following upgrades are required at PPL EU's East Palmerton 230-69kV Substation:

- Install fiber-based Direct Transfer Trip (DTT) Cabinet at East Palmerton.
- Install new fiber-based line protection equipment at East Palmerton.
- Modify the Acahela 69kV #1 circuit breaker protection and control scheme at East Palmerton.
- Modify the Acahela 69kV #2 circuit breaker protection and control scheme at East Palmerton.
- Install a DTT transfer switch at East Palmerton to transfer DTT on the Acahela #1 69kV line to the Bus Tie 69kV circuit breaker.
- Install a DTT transfer switch at East Palmerton to transfer DTT on the Acahela #2 69kV line to the Bus Tie 69kV circuit breaker.
- Modify SCADA for new alarms
- Modify AMS (Alarm Management System)
- Install new cables and modify control wiring for the above
- Perform system checks and test equipment before placing in service
- Fiber-based DTT (Direct Transfer Trip) equipment will be used to communicate circuit breaker tripping and status monitoring between the Interconnection Customer facility and the PPL EU East Palmerton 230-69 kV Substations

The following assumptions were used to propose the above upgrades:

- EPAL-WAGN #1 and #2 69 kV lines' relays upgraded to microprocessor based at East Palmerton as part of PPL's existing 2015-2016 relay upgrade initiative.

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Schedule

The estimated PPL EU elapsed time to complete the 69 kV Attachment Facilities and Non-Direct Connection substation work is approximately 18 months after the receipt of a fully executed ISA/CSA.

The schedule for the 69 kV substation work to accommodate AA2-017 would depend on the project's start date. The work to accommodate AA2-017 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.

Milestone	Date
Receive Customer Down Payment/Notification to Proceed	May 1, 2017
Engineering Start	September 1, 2017
Construction Start	January 1, 2018
IC Requested In-Service Date	December 31, 2018
Estimated Scheduled In-Service Date	November 30, 2018

Transmission Owner Assumptions in Developing the Cost Estimates

- For custom-designed steel transmission poles, the lead-time is approximately 32 to 42 weeks. It is estimated that 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 double circuit tap from AA2-017 to the East Palmerton-Acahela #1 & #2 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.
- It is assumed that the developer will purchase the property needed for PPL EU's facilities and transfer the rights to PPL EU.
- No environmental, real estate, or permitting issues were reviewed for the estimate of this project.
- This schedule assumes that suitable line/equipment outages can be scheduled as required. 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.

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- 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 AA2-017 Interconnection Customer, PJM, and PPL EU before any PPL EU design and construction activities may commence.

Interconnection Customer Requirements

1. An Interconnection Customer entering the New Services Queue on or after October 1, 2012 with a proposed new Customer Facility that has a Maximum Facility Output equal to or greater than 100 MW shall install and maintain, at its expense, phasor measurement units (PMUs). See Section 8.5.3 of Appendix 2 to the Interconnection Service Agreement as well as section 4.3 of PJM Manual 14D for additional information.
2. The Interconnection Customer may be required to install and/or pay for metering as necessary to properly track real time output of the facility as well as installing metering which shall be used for billing purposes. See Section 8 of Appendix 2 to the Interconnection Service Agreement as well as Section 4 of PJM Manual 14D for additional information.
3. The Interconnection Customer seeking to interconnect a wind generation facility shall maintain meteorological data facilities as well as provide that meteorological data which is required per item 5.iv. of Schedule H to the Interconnection Service Agreement.

AA2-017 Generator, GSU, and Line Modeling

The turbines will be modeled as two separate units and each will inject 49.5MW into each PPL EU 69kV transmission line. The total generation will be 99 MW. The East Palmerton-Acahela #1 and #2 69kV lines may not be paralleled together at any time through the generator's equipment.

Per the AA2-017 supplied data the following was used in modeling the generator and the GSU:

AA2-017 Generator (Vestas V117):

- Number of Turbines: 49
- Size: 2 MW per turbine
- MVA Base: 2.105 MVA
- Terminal Voltage: 0.69 kV
- 0.95 lead to 0.95 lag power factor

Transformers:

- GSU (Generator Step Up Transformer):
    - Number of machines per GSU: 25
    - MVA Base: 36 MVA
    - Voltage Level: 69/34.5/13.8 MVA
    - Impedance: 9.0%

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- GSU (Wind Turbine Unit):
    - MVA Base: 2.35 kV
    - Voltage Level: 34.5/0.69 kV
    - Impedance: 0.0102+j0.1155 PU (on MVA base)

Transmission Line:

- Voltage Level: 69 kV
- Length: 0.5 mile

Telephone / Communication Circuit Requirements (At the IPP)

PPL EU will require a communication path for SCADA and voice circuits. If not, then the IC's new substation will need its own independent RTU, SCADA circuit, and voice circuit. In this case, PPL EU anticipates that either telephone circuits or IP will be required to establish these paths. The Interconnection Customer would be responsible to procure the following:

- SCADA – either a 4-wire dedicated FDDA-type phone line or DNP over IP. It is at PPL's discretion as to which SCADA (4 wire or DNP/IP) is required to be provided.
- 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 POC 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

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Fiber Connectivity for Direct Transfer Trip (DTT) Protection Scheme

It's anticipated that PPL will install fiber on the East Palmerton-Acahela #1 and #2 69kV lines and will be available for use in 2016. If available at the time, PPL EU will reserve two fiber strands between East Palmerton 230-69kV substations and the IPP for the fiber optic based DTT scheme once the IC signs the ISA/ICSA.

Isolation Breaker Requirement at the Interconnection Customer's Substation

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

AA2-017 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 AA2-017's equipment, the Queue AA2-017 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.

AA2-017 Generator Regulation or Reactive Support Requirements

As specified in Part IV, Subpart E at 54.7 of the PJM OATT, the Project AA2-017 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

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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 AA2-017 generator will maintain the required voltage regulation within the required ranges. A MW/MVAR 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 (POI) Point of Interconnection

Installation of revenue grade Bi-directional Metering Equipment will be required at the Queue AA2-017 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 AA2-017 requires back-up electric service at a voltage less than 69 kV. The ICS Help Desk can be reached at 1-888-220-

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9991. Cost for distribution electric service is NOT included in the PPL scope of work transmission or substation estimates.

Maintenance Considerations:

The Queue AA2-017 facility will not be able to generate into the PPL EU network during maintenance on the new 69 kV generator supply line or the East Palmerton-Acahela #1 & #2 69 kV lines. PPL EU on-going annual and long-term planned maintenance of these circuits will require PPL EU to remove each 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.

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.

PPL EU phase rotation at 69 kV

PPL EU 69kV phase rotation in this region is CBA and will require connection of POC transformer high side bushings in a certain way. Please refer to the below mentioned POC document for phase rotation and transformer connection requirements.

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

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. It is also assumed that the developer will purchase the property needed for PPL EU's facilities and transfer the rights to PPL EU.

PA PUC certification will be required as the tap will be designed for future 138 kV but will initially operate at 69 kV.

Intertie 69-34.5 kV Transformer Turns Ratio

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

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70.6 kV, 68.8 kV, 67.0 kV, 65.2 kV, 63.4 kV with nominal mid-point 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.

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Network Impacts

The Queue Project AA2-017 was studied as a 98 MW (capacity) injection as a tap of the East Palmerton-Acahela #1 & #2 69kV lines in the PPL area. Project AA2-017 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). A Summer Peak 2019 case was used for the analysis. Project AA2-017 was studied with a commercial probability of 13%. Potential network impacts were as follows:

Generator Deliverability

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

None.

Light Load Analysis

Light Load Studies to be conducted during later study phases (applicable to wind, coal, nuclear, and pumped storage projects).

None.

Multiple Facility Contingency

(Double Circuit Tower Line contingencies were studied for the full energy output. The contingencies of Line with Failed Breaker and Bus Fault will be performed for the Impact Study.)

None.

Short Circuit

(Summary of impacted circuit breakers)

None.

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.

Steady-State Voltage Requirements

(Summary of the VAR requirements based upon the results of the steady-state voltage studies)

None.

Stability and Reactive Power Requirement for Low Voltage Ride Through

(Summary of the VAR requirements based upon the results of the dynamic studies)

None.

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New System Reinforcements

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

None.

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.

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

None.

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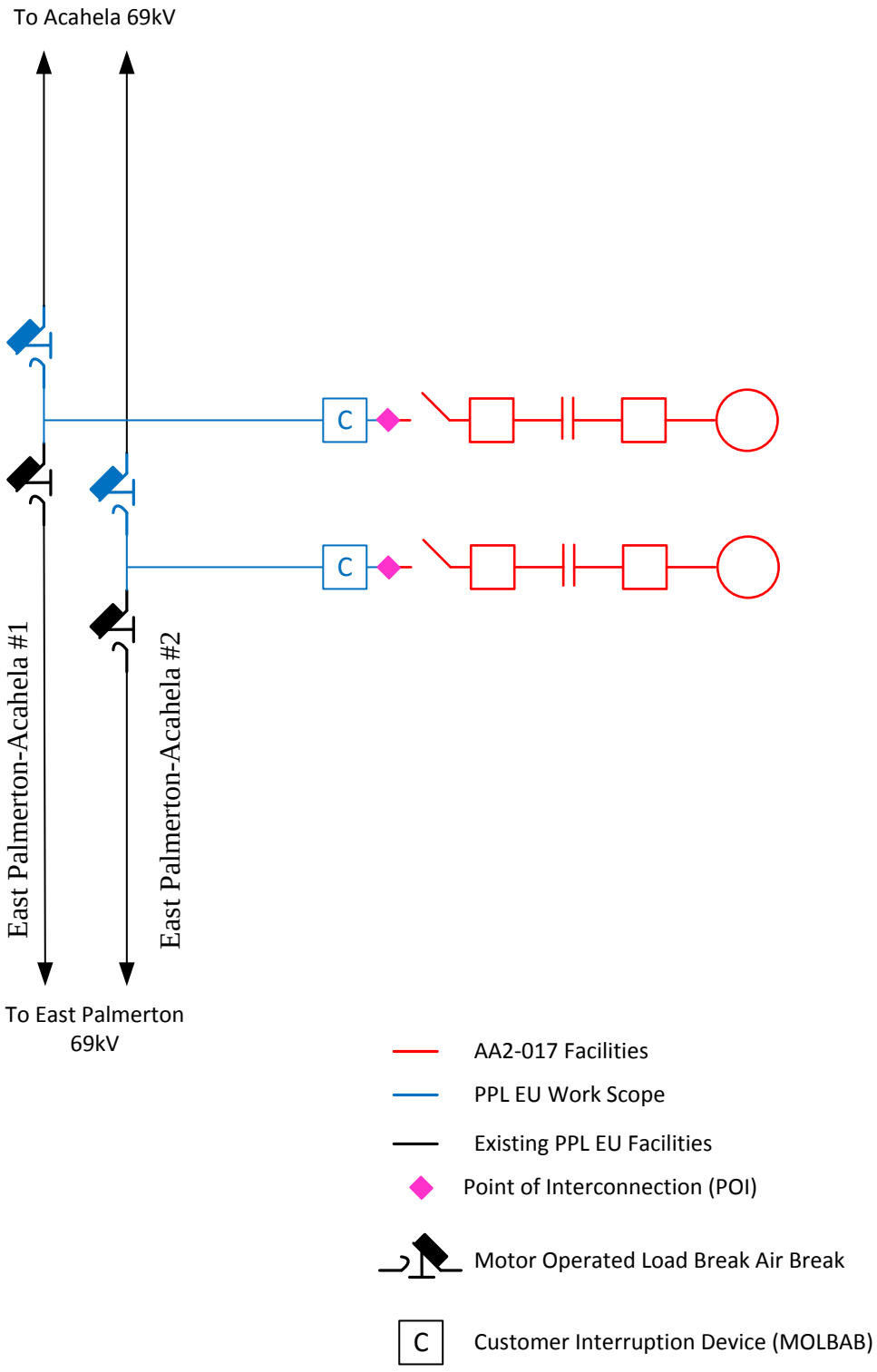
Attachment 1. Single Line Diagram



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Attachment 2

AA2-017 Stability Study Report
East Palmerton 69 kV circuit
EPAL-ACAH1 and EPAL-ACAH2 69 kV Feeders

March 23, 2016

Revision #2

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Executive Summary

PJM Queue project AA2-017 is a request for 98.0 MW Maximum Facility Output (MFO) wind farm. The project comprises of two clusters of (24x2 and 25x2) 2.0 MW Gamesa wind turbines. The Point of Interconnection for the two clusters is on EPAL-ACAH1 and EPAL-ACAH2 69 kV feeders from 69 kV East Palmerton station in PPL system.

This study is based on the RTEP 2019 Summer Peak Case 2019_BaseCases_AA2_Phase2 and modified to include applicable queue projects. The case was also modified to incorporate voltage profile provided by TO. PJM queue project AA2-017 was dispatched at a Maximum Facility Output (MFO) of (48+50) 98.0 MW and POI voltage of 67.9 kV, consistent with the default generator reference voltage specified in PJM Manual 03 *Transmission Operations* Section 3.3.3 for generator connections to the PJM 69.0 kV system.

AA2-017 was tested for compliance with NERC, PJM and other applicable criteria. 49 contingencies were studied, each with a 15 second simulation time period.

Based on the contingencies tested, AA2-017 meets criteria for all contingencies tested.

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Description

This study evaluates the stability, low voltage ride-through (LVRT) and dynamics for PJM queue project AA2-017 which is 98.0 MW MFO wind turbine facility. The project comprises of two clusters of (24x2 and 25x2) 2.0 MW Gamesa wind turbines. The Point of Interconnection for the two clusters is on EPAL-ACAH1 and EPAL-ACAH2 69 kV feeders from 69 kV East Palmerton station in PPL system.

For this stability study, the AA2-017 project was studied for a total net injection of 96.7 MW into the 69.0 kV Transmission System.

Criteria

The stability study for AA2-017 was performed on a 2019 Summer Peak Case 2019_BaseCases_AA2_Phase2 for normal operating conditions, and modified to include applicable queue projects. The case was also modified for the area voltage profile provided by TO. The range of contingencies evaluated was limited to those necessary to assess compliance with NERC, PJM and other applicable criteria. Simulation time was 15 seconds for all faults.

Simulated NERC Standard TPL-001faults include:

1. Three-phase (3ph) fault with normal clearing (Category P1)
2. Single-line-to-ground at bus (slg) withnormal clearing (Category P2)
3. Single-line-to-ground (slg) with delayed clearing as a result of breaker failure (Category P4)
4. Single-line-to-ground (slg) with delayed clearing as a result of protection failure (Category P5)
5. Single-line-to-ground (slg) with normal clearing for common structure (Category P7)

Note: For generator interconnection studies, Category P2, P3 and P6 faults will be studied on an as needed basis.

Other applicable criteria tested include:

1. TO specific criteria
2. Other criteria

The system was tested for an all lines in service condition and the faults listed above. Specific fault descriptions and breaker clearing times used for this study are provided in Appendix A.

All generators were monitored to assess transient stability and satisfactory post-contingency conditions.

Case Setup

Generators within 5 buses from the generator(s) under study are dispatched at their maximum power output and set at unity power factor at the high side of the generator step up transformer. Alternatively, generators can be adjusted to hold scheduled voltages.

Specific dispatch conditions at the generator terminals for the AA2-017 generator, as obtained in

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the power flow solution, are illustrated below:

	40 Gamesa 2.0 MW Turbines	
	GEN 1	**GEN 2**
Gross power output (MW)	50.0	48.0
Reactive power output (MVARS)	-0.1	2.1
Auxiliary Load (MW/MVARS)		
Net real power injection (MW)	49.5	47.6
Voltage at the POI (P.U.)	1.0	1.0

Results

Simulation Initialization
Thecase was initialized successfully. No errors were reported.

20 second no fault test (Steady State evaluation)
The system successfully met the 20 second run test without any significant deviations in system states.

Simulation Results
Dynamics and stability was tested using Siemens/PTI PSS/E Version 32.0, the 2019 case with a Summer Peak Load condition and the data supplied by the developer.

Transient Stability: For all contingencies studied, transient stability is maintained, with all oscillations stabilized in less than 15 seconds. Also, the voltage levels returned to acceptable levels for all contingencies following the fault clearance.
For contingency 30 and 35, G1 tripped OS and for contingency 32, G2 tripped OS when standard clearing times were used. These contingencies were rerun using actual clearing times provided by TO and are stable for the actual clearing times.

LVRT: For the cases studied, the queue project rides through the faults shown in Appendix A thus meeting the LVRT test specified in FERC order 661 and 661A.

Small Signal (if applicable):

SPS:

Maintenance outage: No maintenance outage conditions were evaluated.

Conclusion

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Transient stability is maintained for all contingencies tested.

Mitigations:

None

Recommendations:

1) **Installation of out-of-step protection is recommended**: This study was made using a certain set of operating conditions. There may be other operating conditions, although less probable, that can create stability problems. It is the Customer's responsibility to protect their own equipment from damage due to disturbances on the transmission system by installing out-of-step protection on their generators.

Note: While the stability analysis has been performed at extreme system conditions, there is a potential that evaluation at a different level of generator MW and/or MVAR output at different system load levels and operating conditions may disclose unforeseen stability problems. The regional reliability analysis routinely performed to test all system changes will include one such evaluation. Any problems uncovered in that or other operating or planning studies will need to be resolved.

Moreover, when the proposed generating station is designed and plant specific dynamic data for the plant and its controls are available, it must be forwarded to PJM. If it is different than the data provided for this study, a transient stability analysis at a variety of expected operating conditions using the more accurate data shall be performed to verify impact on the dynamic performance of the system. Note that any and all changes to the generation equipment's dynamic data, including the GSU data, must be submitted to PJM for evaluation.

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Appendix A: Fault Table

No.	Contingency ID	Type of Fault	Clearing time (cycles)		Results
			Normal	Delayed	
Criteria = TPL 001-4_P1					
01	AA2-017-EPAL-P1-01	3 ph fault on EPAL-WAGN 1 69 kV – **G2 tripped by contingency**	7.5	NA	Stable
02	AA2-017-EPAL-P1-02	3 ph fault on EPAL-WAGN 2 69 kV – **G1 tripped by contingency**	7.5	NA	Stable
03	AA2-017-EPAL-P1-03	3 ph fault on EPAL – SIEG 1 69 kV	7.5	NA	Stable
04	AA2-017-EPAL-P1-04	3 ph fault on EPAL – SIEG 2 69 kV	7.5	NA	Stable
05	AA2-017-EPAL-P1-05 (Refer to the SLD)	3 ph fault on EPAL – LIGA 69 kV	7.5	NA	Stable
06	AA2-017-EPAL-P1-06	3 ph fault on East Palmerton 69/230 kV TF1 + East Palmerton - Siegfried 230 kV (SIEG-EPAL 3)	7.5	NA	Stable
07	AA2-017-EPAL-P1-07	3 ph fault on East Palmerton 69/230 kV TF2 + East Palmerton – Harwood 230 kV (HARW-EPAL) + Harwood 230/69 kV TF6	7.5	NA	Stable
08	AA2-017-EPAL-P1-08	3 ph fault on East Palmerton – Harwood 230 kV (HARW-EPAL) + Harwood 230/69 kV TF6 + East Palmerton 230/69 kV TF2	5.0	NA	Stable
09	AA2-017-EPAL-P1-09	3 ph fault on East Palmerton 230/69 kV TF1 + East Palmerton - Siegfried 230 kV (SIEG-EPAL 3)	5.0	NA	Stable
10	AA2-017-HARW-P1-01	3 ph fault on Harwood – East Palmerton 230 kV (HARW-EPAL) + Harwood 230/69 kV TF6 + East Palmerton 230/69 kV TF2	5.0	NA	Stable
11	AA2-017-HARW-P1-02	3 ph fault on Harwood – Susquehanna 230 kV (SUSQ-HARW1) + Harwood 230/69 kV TF5	5.0	NA	Stable
12	AA2-017-HARW-P1-03	3 ph fault on Harwood – Susquehanna 230 kV (SUSQ-HARW2)	5.0	NA	Stable
13	AA2-017-HARW-P1-04	3 ph fault on Harwood 230/69 kV TF4, Loss Harwood Capacitor + Harwood – Susquehanna 230 kV (SUSQ-HARW2)	5.0	NA	Stable
14	AA2-017-HARW-P1-05	3 ph fault on Harwood – Siegfried 230 kV (SIEG-HARW) AA1-103 Tap	5.0	NA	Stable
15	AA2-017-SIEG-P1-01	3 ph fault on Siegfried - East Palmerton 230 kV (SIEG-EPAL 3) + East Palmerton 230/69 kV TF1+ TF3 at Siegfried	5.0	NA	Stable
16	AA2-017-SIEG-P1-02	3 ph fault on Siegfried – Martin Creek 230 kV (MACR-SIEG1) + Siegfried 230/69 kV TF1	5.0	NA	Stable
17	AA2-017-SIEG-P1-03	3 ph fault on Siegfried – Martin Creek 230 kV (MACR-SIEG2) + Siegfried 230/69 kV TF2	5.0	NA	Stable
18	AA2-017-SIEG-P1-04	3 ph fault on Siegfried 230/138 kV TF4	5.0	NA	Stable
19	AA2-017-SIEG-P1-05	3 ph fault on Siegfried 230/138 kV TF5	5.0	NA	Stable
20	AA2-017-SIEG-P1-06	3 ph fault on Siegfried – Frackville 230 kV (SIEG-FRAC)	5.0	NA	Stable
21	AA2-017-SIEG-P1-07	3 ph fault on Siegfried – Harwood 230 kV (SIEG-HARW)	5.0	NA	Stable
Criteria = TPL 001-4_P2					
22	AA2-017-EPAL-P2-01	SLG fault on East Palmerton 69 kV Bus 1, Loss of EPAL-WAGN 1 69 kV + EPAL – LIGA 69 kV + East Palmerton 69/230 kV TF1 + East Palmerton - Siegfried 230 kV (SIEG-EPAL 3) + TF3 at Siegfried + EPAL – SIEG 2 69 kV – **G2 dropped by contingency**	7.5	NA	Stable
23	AA2-017-EPAL-P2-02	SLG fault on East Palmerton 69 kV Bus 3, Loss of EPAL-WAGN 2 69 kV + (EPAL – SIEG 1 69kV) + East Palmerton 69/230 kV TF2 + East Palmerton – Harwood 230 kV (HARW-EPAL) + Harwood 230/69 kV TF6 – **G1 dropped by contingency**	7.5	NA	Stable

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No.	Contingency ID	Type of Fault	Clearing time (cycles)		Results
			Normal	Delayed	
24	AA2-017-EPAL-P2-03	SLG fault on East Palmerton 230 kV, Loss of East Palmerton – Harwood 230 kV (HARW-EPAL) + Harwood 230/69 kV TF6 + East Palmerton 230/69 kV TF2 primary + Additional loss East Palmerton - Siegfried 230 kV (SIEG-EPAL 3) + East Palmerton 230/69 kV TF1 + TF3 at Siegfried – **G1 and G2 dropped by contingency**	5.0	NA	Stable
25	AA2-017-HARW-P2-01	SLG fault on Harwood 230 kV S Bus, Loss of Harwood 230/69 kV TF4 + Harwood Capacitor + Harwood – Susquehanna 230 kV (SUSQ-HARW2)	5.0	NA	Stable
26	AA2-017-HARW-P2-02	SLG fault on Harwood 230 kV N Bus, Loss of Harwood – Susquehanna 230 kV (SUSQ-HARW1) + Harwood 230/69 kV TF5	5.0	NA	Stable
27	AA2-017-SIEG-P2-01	SLG fault on Siegfried 230 kV 230 kV W Bus, Loss of Siegfried 230/138 kV TF5	5.0	NA	Stable
28	AA2-017-SIEG-P2-02	SLG fault on Siegfried 230 kV E Bus, Loss of Siegfried 230/138 kV TF4	5.0	NA	Stable
Criteria = TPL 001-4_P4					
29	AA2-017-EPAL-P4-01	SLG fault @ East Palmerton 69/230 kV TF1 + East Palmerton - Siegfried 230 kV (SIEG-EPAL 3) + TF3 at Siegfried, SB @ East Palmerton 69 kV, Loss of EPAL-WAGN 1 69 kV + EPAL – LIGA 69 kV + EPAL – SIEG 2 69 kV – **G2 tripped by contingency**	7.5	38.0	Stable
30	AA2-017-EPAL-P4-02	SLG fault @ EPAL – SIEG 2 69 kV), SB @ East Palmerton 69 kV, Loss of East Palmerton 69/230 kV TF1 + East Palmerton - Siegfried 230 kV (SIEG-EPAL 3) + Loss of EPAL-WAGN 1 69 kV + Loss of EPAL – LIGA 69kV **– G2 tripped by contingency**	7.5	30.0	Stable
31	AA2-017-EPAL-P4-03	SLG fault @ East Palmerton 69/230 kV TF2 + East Palmerton – Harwood 230 kV (HARW-EPAL) + Harwood 230/69 kV TF6, SB @ East Palmerton 69 kV, Loss of EPAL-WAGN 2 69 kV + EPAL – SIEG 1 69 kV**– G1 tripped by contingency**	7.5	38.0	Stable
32	AA2-017-EPAL-P4-04	SLG fault @ EPAL – SIEG 1 69 kV, SB @ East Palmerton 69 kV, Loss of East Palmerton 69/230 kV TF2 + East Palmerton – Harwood 230 kV (HARW-EPAL) + Harwood 230/69 kV TF6 + EPAL-WAGN 1 69 kV – **G1 tripped by contingency**	5.0	30.0	Stable
33	AA2-017-EPAL-P4-05	SLG fault @ Palmerton – Harwood 230 kV (HARW-EPAL) + Harwood 230/69 kV TF6 + East Palmerton 230/69 kV TF2, SB @ East Palmerton 230 kV, Loss of Siegfried - East Palmerton 230 kV (SIEG-EPAL 3) + East Palmerton 230/69 kV TF1 + TF 3 at Siegfried – **G1 and G2 dropped by contingency**	5.0	17.0	Stable
34	AA2-017-EPAL-P4-06	SLG fault @ Siegfried - East Palmerton 230 kV (SIEG-EPAL 3) + East Palmerton 230/69 kV TF1 + TF 3 at Siegfried, SB @ East Palmerton 230 kV, Loss of Palmerton – Harwood 230 kV (HARW-EPAL) + Harwood 230/69 kV TF6 + East Palmerton 230/69 kV TF2 **– G1 and G2 dropped by contingency**	5.0	17.0	Stable
35	AA2-017-EPAL-P4-07	SLG fault @ EPAL-LIGA 69 kV, SB @ East Palmerton 69 kV, Loss of EPAL – SIEG 2 69 kV + Loss of EPAL – WAGN 1 69 kV + Loss of East Palmerton 69/230 kV TF1 + East Palmerton - Siegfried 230 kV (SIEG-EPAL 3) + TF3 at Siegfried -- **G2 dropped by contingency**	5.0	30.0	Stable
36	AA2-017-HARW-P4-01	SLG fault @ Harwood – Susquehanna 230 kV (SUSQ-HARW1) + Harwood 230/69 kV TF5, SB @ Harwood 230 kV, Loss of Harwood – Siegfried 230 kV (SIEG-HARW)	5.0	17.0	Stable
37	AA2-017-HARW-P4-02	SLG fault @ Harwood – Siegfried 230 kV (SIEG-HARW), SB @ Harwood 230 kV, Loss of Harwood – Susquehanna 230 kV (SUSQ-HARW1) + Harwood 230/69 kV TF5	5.0	17.0	Stable
38	AA2-017-HARW-P4-03	SLG fault @ Harwood – East Palmerton 230 kV (HARW-EPAL) + Harwood 230/69 kV TF6 + East Palmerton 230/69 kV TF2, SB @ Harwood 230 kV, Loss of Harwood – Susquehanna 230 kV (SUSQ-HARW1) + Harwood 230/69 kV TF5	5.0	17.0	Stable
39	AA2-017-HARW-P4-04	SLG fault @ Harwood – Susquehanna 230 kV (SUSQ-HARW1) + Harwood 230/69 kV TF5, SB @ Harwood 230 kV, Loss of	5.0	17.0	Stable

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No.	Contingency ID	Type of Fault	Clearing time (cycles)		Results
			Normal	Delayed	
		Harwood – East Palmerton 230 kV (HARW-EPAL) + Harwood 230/69 kV TF6 + East Palmerton 230/69 kV TF2			
40	AA2-017-HARW-P4-05	SLG @ Harwood 230/69 kV TF4, SB @ Harwood 230 kV, Loss of Harwood – Susquehanna 230 kV (SUSQ-HARW2) + Harwood 230 Capacitor Bank	5.0	17.0	Stable
41	AA2-017-HARW-P4-06	SLG fault on Harwood – Susquehanna 230 kV (SUSQ-HARW2), SB @ Harwood 230 kV S Bus, Loss of Harwood 230 capacitor Bank + Harwood 230/69 kV TF4	5.0	17.0	Stable
42	AA2-017-SIEG-P4-01	SLG fault on Siegfried - East Palmerton 230 kV (SIEG-EPAL 3) + East Palmerton 230/69 kV TF1 + TF3 at Siegfried, SB @ Siegfried 230 kV E Bus, Loss of Siegfried – Harwood 230 kV (SIEG-HARW)/AA1-103 tap + Siegfried 230/138 kV TF4	5.0	17.0	Stable
43	AA2-017-SIEG-P4-02	SLG fault on Siegfried 230/138 kV TF4, SB @ Siegfried 230 kV E Bus, Loss of Siegfried - East Palmerton 230 kV (SIEG-EPAL 3) + East Palmerton 230/69 kV TF1 + TF3 at Siegfried + Siegfried – Harwood 230 kV (SIEG-HARW)/AA1-103 tap	5.0	17.0	Stable
44	AA2-017-SIEG-P4-03	SLG fault @ Siegfried – Martin Creek 230 kV (MACR-SIEG2) + Siegfried 230/69 kV TF2, SB @ Siegfried 230 E Bus, Loss of Siegfried 230/138 kV TF4 + Siegfried – Harwood 230 kV (SIEG-HARW)/AA1-103 tap	5.0	17.0	Stable
45	AA2-017-SIEG-P4-04	SLG fault @ Siegfried 230/138 kV TF4 + Siegfried – Harwood 230 kV (SIEG-HARW)/AA1-103 tap , SB @ Siegfried 230 kV E Bus, Loss of Siegfried – Martin Creek 230 kV (MACR-SIEG2) + Siegfried 230/69 kV TF2	5.0	17.0	Stable
46	AA2-017-SIEG-P4-05	SLG fault @ Siegfried – Frackville 230 kV (SIEG-FRAC), SB @ Siegfried 230 kV E Bus, Loss of Siegfried – Harwood 230 kV (SIEG-HARW)/AA1-103 tap + Siegfried 230/138 kV TF4	5.0	17.0	Stable
47	AA2-017-SIEG-P4-06	SLG fault @ Siegfried 230/138 kV TF4 + Siegfried – Harwood 230 kV (SIEG-HARW)/AA1-103 tap , SB @ Siegfried 230 kV E Bus, Loss of Siegfried – Frackville 230 kV (SIEG-FRAC)	5.0	17.0	Stable
Criteria = TPL 001-4_P5					
48	AA2-017-EPAL-P5-01	SLG fault 80% on East Palmerton – Harwood 230 kV (HARW-EPAL)	5.0	35.0	Stable
49	AA2-017- EPAL -P5-02	SLG fault 80% on East Palmerton - Siegfried 230 kV (SIEG-EPAL 3)	5.0	35.0	Stable
Criteria = TPL 001-4_P7					
		None			

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Appendix B: Project Model

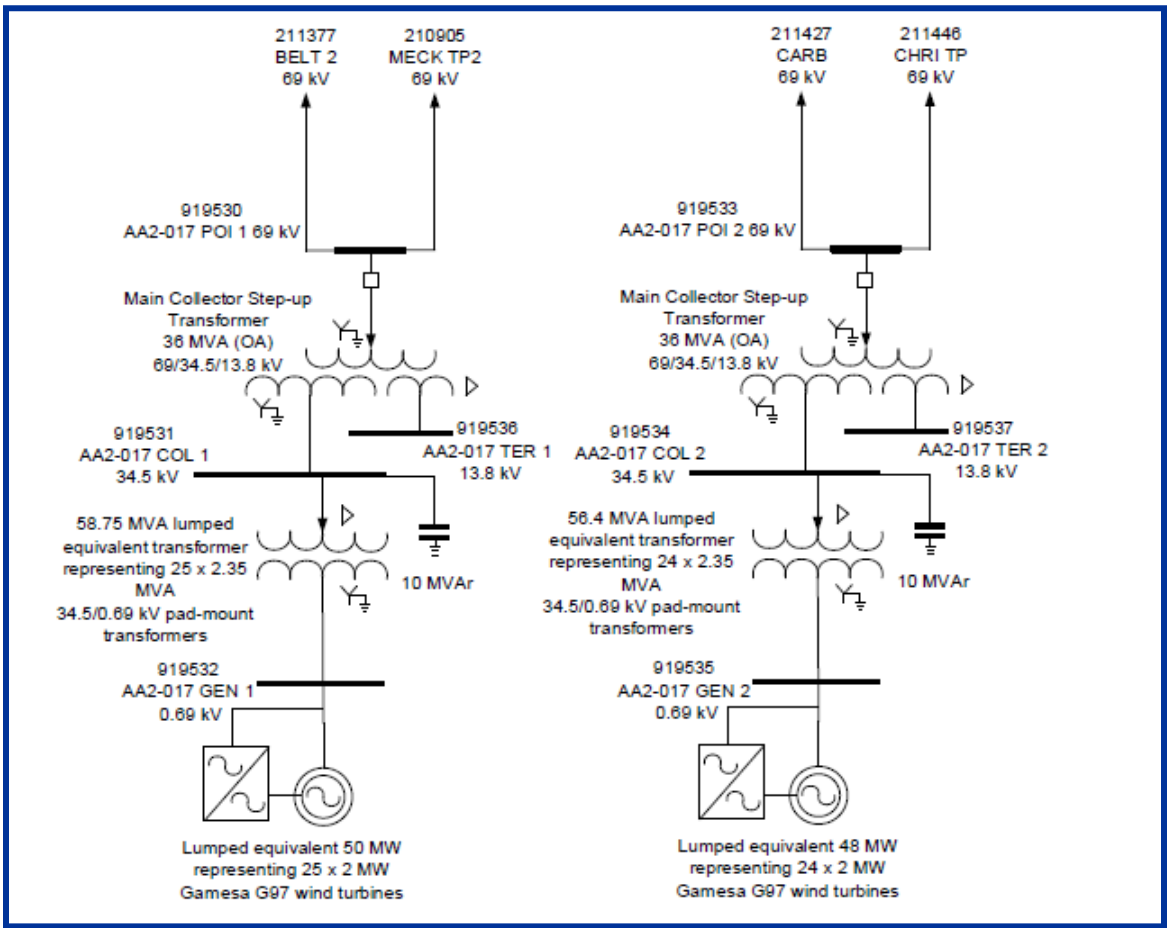

Figure B-1: PJM AA2-017 modeling details

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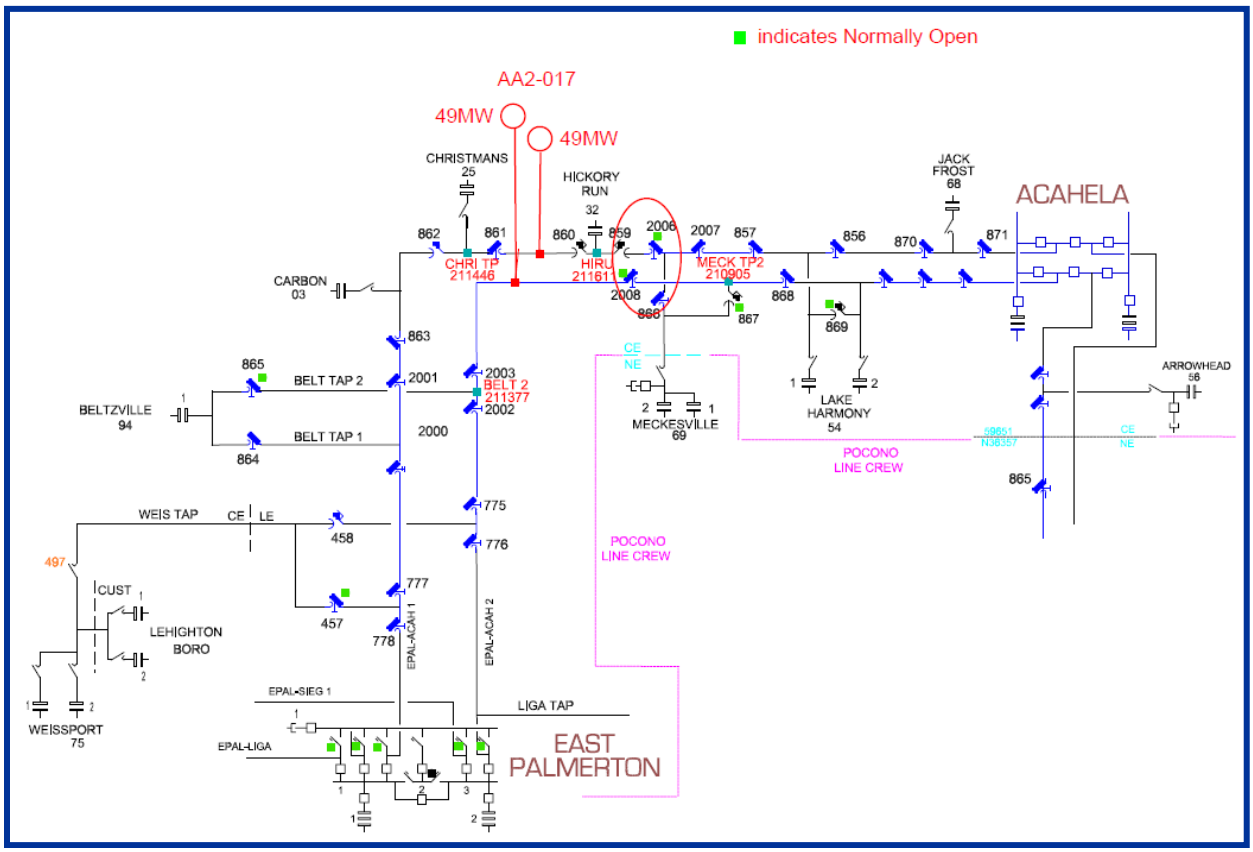
PPL Switching Diagram



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Appendix C: Power Flow and Dynamic Models

C.1) Power Flow Model Data

```
BAT_LTAP,210905,211377,'2', 0.5,919530,'AA2-017POI1', 69.0

BAT_LTAP,211427,211446,'1', 0.5,919533,'AA2-017POI2', 69.0

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RDCH

1

919530,'AA2-017POI1 ',  69.0000,1, 229, 239,   2,1.00608, -31.3476

919531,'AA2-017COL1 ',  34.5000,1, 229, 239,   2,1.00700, -24.0510

919532,'AA2-017GEN1 ',   0.6900,2, 229, 239,   2,1.04215, -18.8328

919533,'AA2-017POI2 ',  69.0000,1, 229, 239,   2,1.00325, -31.9707

919534,'AA2-017COL2 ',  34.5000,1, 229, 239,   2,1.00355, -24.9249

919535,'AA2-017GEN2 ',   0.6900,2, 229, 239,   2,1.03881, -19.6720

919536,'AA2-017TER1 ',  13.8000,1, 229, 239,   2,0.97200, -29.0541

919537,'AA2-017TER2 ',  13.8000,1, 229, 239,   2,0.96918, -29.7573

0 / END OF BUS DATA, BEGIN LOAD DATA

0 / END OF LOAD DATA, BEGIN FIXED SHUNT DATA

919531,'1 ',1,     0.000,    10.000

919534,'1 ',1,     0.000,    10.000

0 / END OF FIXED SHUNT DATA, BEGIN GENERATOR DATA

919532,'1 ',    50.000,    16.430,    16.430,   -16.430,1.01450,919530,    50, 6.30100E-3,
1.50724E-1, 0.00000E+0, 0.00000E+0,1.00000,1,  100.0,    50.000,     7.500,   2,1.0000

919535,'1 ',    48.000,    15.780,    15.780,   -15.780,1.01450,919533,    48, 6.30100E-3,
1.50724E-1, 0.00000E+0, 0.00000E+0,1.00000,1,  100.0,    48.000,     7.200,   2,1.0000

0 / END OF GENERATOR DATA, BEGIN BRANCH DATA

210905,919530,'2 ', 2.38650E-2, 9.41000E-2,   0.00167,   96.30,  126.00,    0.00,  0.00000,
0.00000,  0.00000,  0.00000,1,1,   6.03,   2,1.0000

211377,919530,'2 ', 2.38650E-2, 9.41000E-2,   0.00167,   96.30,  126.00,    0.00,  0.00000,
0.00000,  0.00000,  0.00000,1,2,   6.03,   2,1.0000

211427,919533,'1 ', 5.40500E-3, 2.10650E-2,   0.00038,   97.00,  124.00,    0.00,  0.00000,
0.00000,  0.00000,  0.00000,1,1,   1.37,   2,1.0000

211446,919533,'1 ', 5.40500E-3, 2.10650E-2,   0.00038,   97.00,  124.00,    0.00,  0.00000,
0.00000,  0.00000,  0.00000,1,2,   1.37,   2,1.0000

0 / END OF BRANCH DATA, BEGIN TRANSFORMER DATA

919530,919531,919536,'1 ',1,2,1, 0.00000E+0, 0.00000E+0,2,'            ',1,   2,1.0000

 2.25000E-3, 9.00000E-2,    36.00, 0.00000E+0, 8.00000E-2,    36.00, 0.00000E+0, 4.50000E-2,
36.00,0.97200, -29.0541
```

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C.2) Dynamic Data

```
/*****************************************
/*** AA2-017
/*** PSSE Version 32
/*** LIB FILE: GXX049_v32.lib
/*****************************************
919532 'USRMDL' 1 'GXX049' 1  1  8  45  0  94
  46  1  25  0  8  1  1  1
  0.00 0.00 15.00
  0.00 0.90 0.90 0.90 0.90 0.90 0.90
  0.150 1.750 1.750 1.750 1.750 1.750 16.000
  1.10 1.10 1.20 1.20 2.00
  16.000 15.000 1.500 0.017 0.017
  0.950 0.950 0.950 0.950 0.950
  0.500 0.500 0.500 0.500
  1.050 1.050 1.050 1.050 1.050
```

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C.3) PSS/E Single Line Diagram

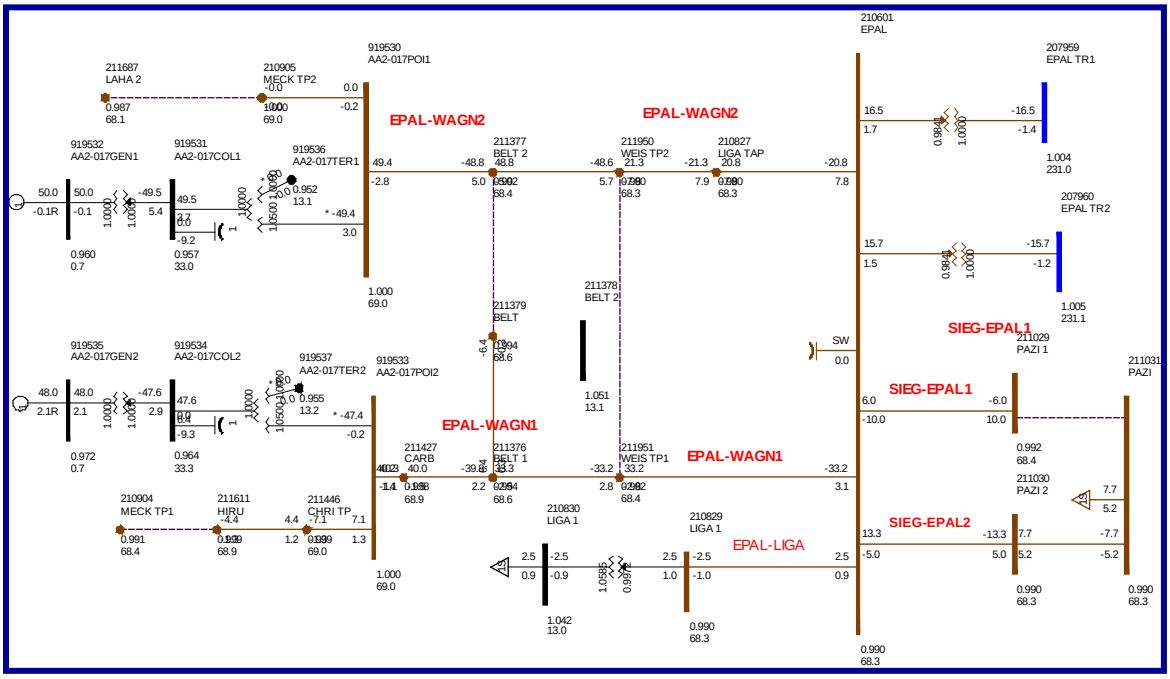

Figure C-1: Single-line diagram for AA2-017 2019-SP case (Breaker information not shown)

C.4) Area Generation

Bus Number	Bus Name	Id	Code	VSched (pu)	Remote Bus Number	In Service	Pgen (MW)	Pmax (MW)	Pmin (MW)	Qgen (Mvar)	Qmax (Mvar)	Qmin (Mvar)
200038	SUSQ 2 24.000	1	2	1.07	200022	1	1260	1260	1096	249.43	488.7	-258
208909	MACR G3 24.000	3	-2	1.026	208025	1	850	850	250	50	50	0
208910	MACR G4 24.000	4	-2	1.026	208025	1	850	850	250	50	50	0
208911	MONT G1 24.000	1	2	1.026	208040	1	736.8	758.5	403	21.606	228	0
208912	MONT G2 24.000	1	2	1.026	208040	1	735.3	756.9	403	43.212	208	0
208912	MONT G2 24.000	2	2	1.026	208040	0	11.07	11.4	0	0	0	0
208918	SUSQ 1 24.000	1	-2	1.0304	208113	1	1340	1340	1096	190	190	0
208942	HARR CT 12.470	1	-2	0.975	0	1	54.4	56	48.72	0	0	0
208943	HARW CT 12.470	1	-2	0.975	0	1	27.2	28	24.36	0	0	0
208944	JENK CT 12.470	1	-2	0.984	0	1	27.2	28	24.36	0	0	0
208946	MACR CT 12.470	CT	-2	1.026	0	1	69.94	72	62.64	4	4	-8
209018	SUNBIPCT 12.470	1	-2	0.986	0	1	34.97	36	31.32	0	0	0
209023	WIENIPP1 13.800	1	-2	0.975	0	1	58.09	59.8	0	0	0	0
209025	WIENIPP3 13.800	2	-2	0.975	0	1	28.27	29.1	0	0	0	0
209025	WIENIPP3 13.800	3	-2	0.975	0	1	30.11	31	0	0	0	0
209026	WIENIPP4 13.800	4	-2	0.975	0	1	28.75	29.6	0	0	0	0
212449	SUNB CT 69.000	1	-2	0.986	0	1	5.828	6	0	0	0	0
234305	HUN GEN4 13.800	4	-2	0.975	234260	1	43.42	44.7	0	16.5	16.5	-30
889013	U2_015_GEN 0.6900	1	-2	1.022	292934	1	98.9	98.9	0	0	0	0
914032	Y2-015-STG 13.800	1	2	1.022	914031	1	125	125	60	0.8979	91	-57
914033	Y2-015-CTG 18.000	1	2	1.022	914031	1	235	235	150	0.8979	120	-95
918844	AA1-103_GEN10.6900	1	2	1.022	918840	1	97.5	97.5	0	25.993	32.06	-32.06
918845	AA1-103_GEN20.6900	1	2	1.022	918840	1	115	115	0	25.993	50	-50
918952	AA1-114_GEN 0.6900	1	2	0.975	918950	1	60	60	0	9.4974	12.18	-17.52
919510	AA2-008 G1 23.000	1	2	1.0304	212397	1	462	462	92	55.627	245	-200
919511	AA2-008 G2 23.000	1	2	1.0304	212397	1	462	462	92	55.627	245	-200
919532	AA2-017GEN1 0.6900	1	2	1	919530	1	50	50	7.5	-0.081	16.43	-16.43
919535	AA2-017GEN2 0.6900	1	2	1	919533	1	48	48	7.2	2.0765	15.78	-15.78

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Area Plants

Bus Number	Bus Name	Code	PGen	QGen	QMax	QMin	VSched (pu)	Remote Bus Number	Remote Bus Name	Voltage (pu)	RMPCT
200038	SUSQ 2 24.000	2	1260	249.4	488.7	-258	1.07	200022	SUSQHANA 500.00	1.07	100
208909	MACR G3 24.000	-2	850	50	50	0	1.026	208025	MACR 230.00	1.0022	50
208910	MACR G4 24.000	-2	850	50	50	0	1.026	208025	MACR 230.00	1.0022	50
208911	MONT G1 24.000	2	736.8	21.6	228	0	1.026	208040	MONT 230.00	1.026	50
208912	MONT G2 24.000	2	735.3	43.2	208	0	1.026	208040	MONT 230.00	1.026	100
208918	SUSQ 1 24.000	-2	1340	190	190	0	1.0304	208113	SUSQ 230.00	1.029	100
208942	HARR CT 12.470	-2	54.4	0	0	0	0.975	0		0.9588	100
208943	HARW CT 12.470	-2	27.2	0	0	0	0.975	0		0.9986	100
208944	JENK CT 12.470	-2	27.2	0	0	0	0.984	0		1.0167	100
208946	MACR CT 12.470	-2	69.9	4	4	-8	1.026	0		0.9799	100
209018	SUNBIPCT 12.470	-2	35	0	0	0	0.986	0		0.9984	100
209023	WIENIPP1 13.800	-2	58.1	0	0	0	0.975	0		0.9773	100
209025	WIENIPP3 13.800	-2	58.4	0	0	0	0.975	0		0.9773	50
209026	WIENIPP4 13.800	-2	28.8	0	0	0	0.975	0		0.9767	100
212449	SUNB CT 69.000	-2	5.8	0	0	0	0.986	0		0.9907	100
234305	HUN GEN4 13.800	-2	43.4	16.5	16.5	-30	0.975	234260	HUNLOCK 69.000	0.9608	50
889013	U2_015_GEN 0.6900	-2	98.9	0	0	0	1.022	292934	U2-015 230.00	1.0259	100
914032	Y2-015-STG 13.800	2	125	0.9	91	-57	1.022	914031	Y2-015 230.00	1.022	100
914033	Y2-015-CTG 18.000	2	235	0.9	120	-95	1.022	914031	Y2-015 230.00	1.022	100
918844	AA1-103_GEN10.6900	2	97.5	26	32.1	-32.1	1.022	918840	AA1-103_TAP 230.00	1.022	100
918845	AA1-103_GEN20.6900	2	115	26	50	-50	1.022	918840	AA1-103_TAP 230.00	1.022	100
918952	AA1-114_GEN 0.6900	2	60	9.5	12.2	-17.5	0.975	918950	AA1-114_TAP 69.000	0.975	100
919510	AA2-008 G1 23.000	2	462	55.6	245	-200	1.0304	212397	SAEG 230.00	1.0304	8
919511	AA2-008 G2 23.000	2	462	55.6	245	-200	1.0304	212397	SAEG 230.00	1.0304	8
919532	AA2-017GEN1 0.6900	2	50	-0.1	16.4	-16.4	1.0	919530	AA2-017POI1 69.000	1	100
919535	AA2-017GEN2 0.6900	2	48	2.1	15.8	-15.8	1.0	919533	AA2-017POI2 69.000	1	100

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