Generation Interconnection
Facility Study Report

For

PJM Generation Interconnection Request
Queue Position AC1-165

"Atlanta 69 kV III"
49.9 MW Energy, 33.6 MW Capacity

November 2018

General

Buckeye Plains II Solar Project, LLC, the Interconnection Customer (IC), has proposed a solar generating facility located along SR 207 in New Holland, Pickaway County, Ohio. See Site Plan in **Attachment 2.** The installed facilities will have a total capability of **49.9 MW** with **33.6 MW** of this output being recognized by PJM as capacity. The IC expects to be in commercial operation by **December 31, 2021.**

Point of Interconnection

AC1-165 "Atlanta 69 kV III" will interconnect with the Dayton Power & Light Company (DP&L) transmission system at the Atlanta Substation 69 kV bus. Presently Atlanta Substation consists of two 345 kV line feeds, a 345/69 kV transformer, and a single 69 kV line. – Proposed interconnection queue projects, AC1-068 and AC1-069, will expand the 69 kV portion of the Atlanta Substation to a ring bus. The AC1-165 project would require further extension of that 69 kV ring bus to accommodate an additional 69 kV bay position and 69 kV circuit breaker. The last dead-end structure inside the Atlanta Substation fence on the AC1-165 69 kV generator lead line will be designated as the Point of Interconnection (*see One Line in **Attachment 1***).

Cost Summary

The **AC1-165** project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$ 0
Direct Connection Network Upgrades	$ 0
Non Direct Connection Network Upgrades (Dayton)	$ 785,724
Allocation for New System Upgrades (AEP)[1]	$ 83,028
Contribution for Previously Identified Upgrades (Dayton)	$ 27,458
Total Costs	**$ 896,210**

[1] Note: Stuart Unit 1 deactivated on 9/30/2017 and the remaining Stuart and Killen generating units deactivated on 6/1/2018. These units are contributing to the flows on the Adkins – Beatty 345 kV line in this AC1analysis per the PJM Tariff to retain their capacity rights on the system. The rights for Stuart Unit 1 were terminated as of 9/30/2018. If no other queue positions claim the rights of the remaining Stuart and Killen generating units by 6/1/2019, the rights for these plants will also expire. If this occurs, no constraints, based on the generation dispatch in this study, will exist on the Adkins – Beatty 345 kV line and no upgrades will be required to be built on the Adkins – Beatty 345 kV line. The status of whether anyone claims the rights of the old Stuart and Killen generating units will be monitored and tracked to determine if construction of the network upgrades identified in this Facilities Study are still needed.

A. Transmission Owner Facilities Study Summary

1. Description of Project

Buckeye Plains II Solar Project, LLC, the Interconnection Customer (IC), has proposed a solar generating facility located along SR 207 in New Holland, Pickaway County, Ohio. See Site Plan in **Attachment 2.** The installed facilities will have a total capability of **49.9 MW** with **33.6 MW** of this output being recognized by PJM as capacity. The IC expects to be in commercial operation by **December 31, 2021.**

Point of Interconnection (POI)

AC1-165 "Atlanta 69 kV III" will interconnect with the Dayton Power & Light Company transmission system at the Atlanta Substation 69kV bus. Presently Atlanta Substation consists of two 345 kV line feeds, a 345/69 kV transformer, and a single 69 kV line. Proposed interconnection queue projects, AC1-068 and AC1-069, will expand the 69 kV portion of the Atlanta Substation to a ring bus. The AC1-165 project would require further extension of that 69 kV ring bus to accommodate an additional 69 kV bay position and 69 kV circuit breaker.

The Point of Interconnection (POI) will be the last dead-end structure inside the Atlanta Substation fence on the AC1-165 69 kV generator lead line (*see One Line attached in **Attachment 1***).

2. Amendments to the Original System Impact Study Results

The AC1-165 System Impact Study was revised on October 23, 2018 to incorporate the following changes[2]:

1. Stuart Unit 1 deactivated on 9/30/2017 and their Capacity Interconnection Rights terminated as of 9/30/2018. With their rights terminated, a retool of the System Impact Study was required. Analysis results were updated and AC1-166 is now the first to cause the need for network upgrade n5933. AC1-165 will only be responsible for their cost allocation of $83,945 towards this upgrade.
2. Ownership of the Adkins-Beatty 345 kV line changed in June 2018 to be fully owned by American Electric Power (AEP). With this change, the responsibility for completing network upgrade n5933 is now with AEP. The scope, cost and schedule for n5933 has been updated.

[2] Stuart Unit 1 deactivated on 9/30/2017 and their Capacity Interconnection Rights terminated as of 9/30/2018. With their rights terminated, a retool of the System Impact Study was required.

The original AC1-165 System Impact Study report was revised in November, 2017 to incorporate the following changes:

1. Load flow analysis was retooled considering the removal of the output from queue positions Z1-097 and Z2-029 (uprates to Adkins and Stuart units). The additional MW from Z1-097 and Z2-029 projects were already captured in the existing units in the case and thus were double modeled.
2. Load flow analysis was retooled considering separating the AC1-068 output from AC1-069. The original System Impact Study report from September 2017 combined the AC1-068 and AC1-069 output at the latter queue position for the analysis.
3. Results were updated considering a load flow software error which missed a "Basecase/N-0" overload on the Adkins-Beatty 345 kV line which requires an upgrade to the Dayton end normal rating of this line.

3. Interconnection Customer's Submitted Milestone Schedule

The IC's proposed Commercial Operation Date (COD) for the generation facility is **December 31, 2021.**

- Permits – state level CPCN and county level Final Site Plan approval complete by ---- January 2021
- Plan to break ground --- June 2021
- Substantial site work completed --- November 2021
- Delivery of major electrical equipment --- November 2021
- Back Feed Power --- November 2021
- Commercial Operation --- December 2021

A **24** month schedule has been developed for DP&L to complete all required engineering, construction, and associated activities from the date which is one month after the month in which the Interconnection Construction Service Agreement is effective.

4. Scope of Customer's Work

IC will install a 49.9 MW solar generating facility located in **New Holland, Pickaway County, Ohio**. The IC will construct and own facilities including the solar generator facilities, a 34.5-69 kV generation step up (GSU) transformer, a 69 kV breaker with associated relay/protection/controls, and 69 kV line up to the Point of Interconnection (POI). The POI will be the last dead-end structure inside the Atlanta Substation fence on the AC1-165 69 kV generator lead line, shown on the one-line diagram in **Attachment 1**.

IC shall coordinate with Dayton the establishment of dedicated communication circuits for SCADA monitoring to the Dayton Transmission System Control Center. Additionally, IC will be responsible for paying all expenses to meet the Dayton Protection Requirements due to direct connections and other upgrades required by this project. The DP&L Protection Requirements are outlined in **Attachment 4.**

The proposed attachment of the IC's project to the Atlanta 69kV substation will be made via the 69kV five breaker ring bus where one position will be dedicated to the AC1-165 generator. The IC will construct a 69 kV line extension from its project substation up to the POI which will be last dead-end structure inside the Atlanta Substation fence, as shown in Attachment I. IC will be responsible for acquiring all rights-of-way, easements, properties, vegetation clearing, environmental, state siting approvals, and local permits that may be required to construct all attachment facilities, up to the POI shown in the one-line diagram in **Attachment 1**.

Reference the TO's Generation Connection Requirements in **Attachment 3.**

5. Description of Facilities Included in the Facilities Study

Attachment Facilities –

- The Interconnection Customer will construct the 69 kV attachment line from its generating facility into the proposed Point of Interconnection as depicted on the one line diagram in **Attachment 1**.

Direct Connection Network/Local Upgrades –

None.

Non-Direct Connection Network Upgrades[3] –

Atlanta 345-69 kV Substation:

- Expand the 69 kV ring bus yard to accommodate a new 69 kV breaker bay position (initial four breaker ring bus established under Queue Project AC1-069).
- Procure and install one (1) new 69 kV circuit breaker in the 69 kV ring bus with associated switches, line relaying, and interconnection metering.
- Atlanta Substation will require the addition of the following equipment:
    - 69 kV Disconnect Switches;
    - 69 kV Fiber Line and Transfer Trip Relays;
    - (1) 69 kV Gas Circuit Breaker;
    - 69 kV Revenue Class Metering Equipment;
    - 69 kV Instrument Transformers;
    - 69 kV Bus Bay Structures;
    - 69 kV Insulators;
    - 69 kV Lightning Arrestors;

[3] This scope of work assumes the AC1-068 is required to build a new 69 kV ring bus at Atlanta Substation and AC1-069 is required to expand to accommodate an additional bay. If AC1-068 and AC1-069 withdraw from the interconnection queue, then the AC1-165 project will be responsible for the cost of the three-breaker ring bus scoped in the AC1-068 Facilities Study report.

- SCADA Remote Terminal Unit (RTU) upgrades;
- Physical Site Expansion including Grading; and
- Foundational Work for New Equipment.

(PJM Network Upgrade Number n5894)

Contribution to Previously Identified System Upgrades -

New Holland-Robinson 69 kV Line (Dayton)[4]

Replace the 1200A, 69 kV wave trap on the New Holland 69 kV terminal at Robinson Substation with a new 2000A, 69 kV wave trap.

(PJM Network Upgrade Number n5456)

Adkins-Beatty 345 kV Line (AEP)[5]

Replace 345 kV takeoff structure with a full tension structure and upgrade the conductor to 1351.5 AAC (All Aluminum Conductor) on the Beatty 345 kV line leaving the Adkins Substation.

(PJM Network Upgrade Number n5933)

6. Total Costs of Transmission Owner Facilities included in Facilities Study

The AC1-165 project will be responsible for the following costs:

Description	NUN	Cost (without tax)
Attachment Facilities	N/A	$ 0
Direct Connection Network Upgrades	N/A	$ 0
Non Direct Connection Network Upgrades		
Atlanta substation: Expand 69 kV ring bus to accommodate new AC1-165 generator bay.	n5894	$ 785,724

[4] This project contributes to this an overload of this line and will therefore receive cost allocation for this upgrade. The AC1-069 queue project is the first to cause the need for this reinforcement. Per PJM Cost Allocation Rules, AC1-165 will have cost allocation for the upgrade to alleviate the overload. That project is defined as Network Upgrade Number n5456 above.

[5] This project contributes to an overload of the normal rating of the Adkins-Beatty 345 kV line caused by the AC1-166 queue. Per PJM Cost Allocation Rules, this project will have cost allocation for the upgrade to alleviate the overload. That project is defined as Network Upgrade Number n5933 above.

Description	NUN	Cost (without tax)
New System Reinforcements		
Adkins-Beatty 345 kV Line: Replace full takeoff structure and upgrade conductor on the Beatty terminal leaving Adkins Substation. (AEP)[1]	n5933	$83,028
Contribution for Previously Identified System Upgrades		
New Holland-Robinson 69 kV Line: Replace 1200A wave trap on New Holland 69 kV terminal at Robinson Substation with 2000A wave trap (Dayton)	n5456	$27,458
Total Costs		**$896,210**

The costs given in this report show the estimates without state or federal tax. This tax may or may not be charged based on whether or not this project meets the eligibility requirements of IRS Notice 88-129. The IC will be responsible for the actual cost of all implementing all work identified in the table above.

7. Summary of Milestone Schedules for Completion of Work Included in Facilities Study:

A proposed **twenty four (24)-month** schedule for Dayton's network upgrade and non-direct transmission work is estimated to complete engineering, construction and the associated activities listed above starting one month from the date of a fully executed Interconnection Construction Service Agreement. This schedule assumes that all issues covered by the "Environmental, Real Estate and Permitting Issues" section of this document are resolved, and outages occur as planned.

Construction cannot begin and is predicated upon (a.) all applicable environmental, power siting, and local permits obtained, and (b.) all line and equipment outages secured through Dayton Transmission System Operations and PJM.

Activity Schedule	Start Month	End Month
Preliminary Engineering	1	4
Detailed Engineering	4	12
Equipment Procurement – Delivery	12	15

Above Grade Construction	15	22
Testing & Commissioning	22	24

Back-up Service Agreement

The execution of a back-up retail service agreement with the TO will be necessary to serve the customer load supplied from the AC1-165 interconnection point when the units are out-of-service. This assumes the intent of the IC is to net the generation with the load.

General Assumptions/Qualifiers

The accomplishment of the work on the TO system to support the estimated costs and proposed schedule is dependent on the following:

- Obtaining the necessary transmission line/equipment outages. Transmission outages are typically not granted from June to September and are discouraged during extreme winter conditions. PJM and Dayton TSO requires 6 to 12-month notice for greater than 5-day and 30-day outages respectively.
- IC provides location and orientation of their attachment facilities.
- No extreme weather.
- No force majeure.

B. Transmission Owner Facilities Study Results

1. Transmission Lines – New

None.

2. Transmission Line – Upgrades

New Holland-Robinson 69 kV Line (Dayton)

Replace the 1200A, 69 kV wave trap on the New Holland 69 kV terminal at Robinson Substation with a new 2000A, 69 kV wave trap. After the project is complete, the SN/SE ratings of New Holland-Robinson 69 kV line will be 221 MVA/ 239 MVA.

(PJM Network Upgrade Number n5456)

Adkins-Beatty 345 kV Line (AEP)

Replace 345 kV takeoff structure with a full tension structure and upgrade the conductor to 1351.5 AAC (All Aluminum Conductor) on the Beatty 345 kV line leaving the Adkins Substation.

(PJM Network Upgrade Number n5933)

3. New Substation/Substation Facilities

Atlanta 345-69 kV Substation:

- Expand the 69 kV ring bus yard to accommodate a new 69 kV breaker bay position (initial three breaker ring bus established under Queue Project AC1-068, additional bay added for AC1-069).
- Procure and install one (1) new 69 kV circuit breaker in the 69 kV ring bus with associated switches, line relaying, and interconnection metering.
- Atlanta Substation will require the addition of the following equipment:

    - 69 kV Disconnect Switches;
    - 69 kV Fiber Line and Transfer Trip Relays;
    - (1) 69 kV Gas Circuit Breaker;
    - 69 kV Revenue Class Metering Equipment;
    - 69 kV Instrument Transformers;
    - 69 kV Bus Bay Structures;
    - 69 kV Insulators;
    - 69 kV Lightning Arrestors;
    - SCADA Remote Terminal Unit (RTU) upgrades;
    - Physical Site Expansion including Grading; and
    - Foundational Work for New Equipment.

    (PJM Network Upgrade Number n5894)

4. Upgrades to Substation / Substation Facilities

None.

5. Metering & Communications

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.

IC will be responsible for designing, furnishing and installing Supervisory Control and Data Acquisition (SCADA) RTU equipment in its generation substation, and for obtaining the telecommunication circuits and data transfer from the RTU to the Transmission Owner Data Center.

Transmission Owner (Dayton) Requirements

The Interconnection Customer will be required to comply with all Dayton Revenue Metering Requirements for Generation Interconnection Customers. The Revenue Metering Requirements may be found within the Dayton Power & Light Co. "Requirements for the Connection of Facilities to the Dayton Power & Light Co. Transmission System" document located at the following link:

http://www.pjm.com/~/media/planning/plan-standards/private-dayton/dayton-facilities-connection-requirements.ashx

The metering point for this interconnection will be located at the last dead-end structure inside the Atlanta Substation fence. The meter will be located on the 69 kV line connected to the AC1-165 generator as shown in **Attachment 1**.

6. Environmental, Real Estate and Permitting Issues

IC will be responsible for acquiring all rights-of-way, easements, properties, vegetation clearing, environmental, state siting approvals, and municipal permits that may be required to construct all attachment facilities, up to the POI shown in the one-line diagram in Attachment 1. The IC will be responsible for the costs incurred to obtain the necessary environmental and other permits necessary to construct the non-direct and direct connect facilities.

7. Information Required for Interconnection Service Agreement

The following table summarizes the total estimated costs according to FERC criteria. The estimated costs are in **2018 dollars.** The taxes are a CIAC (Contribution in Aid of Construction) Federal Income Tax Gross Up charge. This tax may or may not be charged based on whether or not this project meets eligibility requirements of IRS Notice 88-129. This tax is not included in the table below.

Description	Direct Labor	Direct Material	Indirect Labor	Indirect Materials
Attachment Facilities	N/A	N/A	N/A	N/A
Direct Connection Network Upgrades	N/A	N/A	N/A	N/A
Non Direct Connection Network Upgrades				

Description	Direct Labor	Direct Material	Indirect Labor	Indirect Materials
Atlanta substation: Expand 69 kV ring bus to accommodate new AC1-165 generator bay. *(PJM Network Upgrade n5894)*	$353,577	$275,003	$78,572	$78,572
Allocation for New System Upgrades				
Adkins-Beatty 345 kV Line: Replace full takeoff structure and upgrade conductor on the Beatty terminal leaving Adkins Substation. (AEP) *(PJM Network Upgrade n5933)*	$37,363	$29,060	$8,303	$8,303
Contribution to Previously Identified System Upgrades				
New Holland-Robinson 69 kV Line: Replace 1200A wave trap on New Holland 69 kV terminal at Robinson Substation with 2000A wave trap (Dayton) *(PJM Network Upgrade n5456)*	$12,355	$9,610	$2,746	$2,746
Total	$403,295	$313,673	$89,621	$89,621

Schedule:

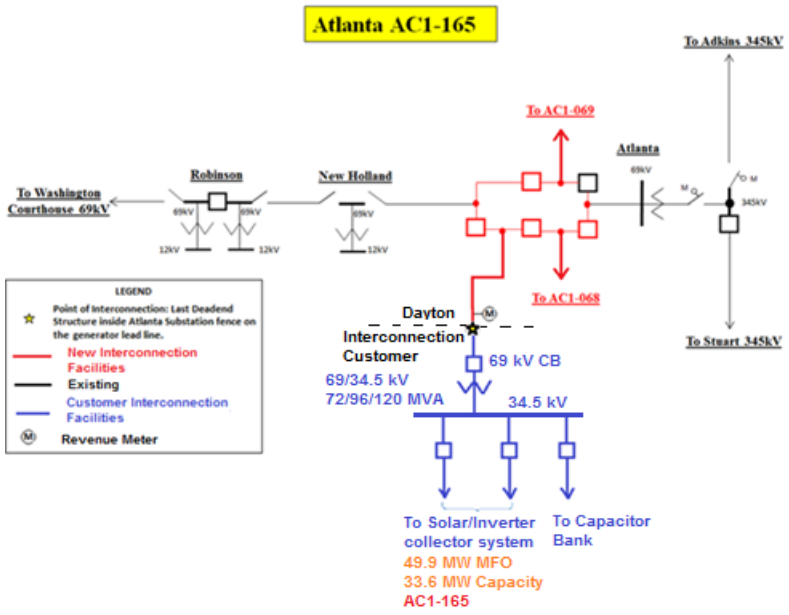
A proposed **twenty four (24)-month** schedule for Dayton's network upgrade and non-direct transmission work is estimated to complete engineering, construction and the associated activities listed above starting one month from the date of a fully executed Interconnection Construction Service Agreement. This schedule assumes that all issues covered by the "Environmental, Real Estate and Permitting Issues" section of this document are resolved, and outages occur as planned.

Construction cannot begin and is predicated upon (a.) all applicable environmental, power siting, and local permits obtained, and (b.) all line and equipment outages secured through Dayton Transmission System Operations and PJM.

Activity Schedule	Start Month	End Month
Preliminary Engineering	1	4
Detailed Engineering	4	12
Equipment Procurement – Delivery	12	15
Above Grade Construction	15	22
Testing & Commissioning	22	24

Attachment 1. PJM Queue #AC1-165

One Line Diagram



Attachment 2. PJM Queue #AC1-165
Site Plan Drawing

AC1-165 site location; Along SR 207 in New Holland, Pickaway County, OH
Northwest of Dayton's Atlanta 69 kV Substation

Attachment 3. PJM Queue #AC1-165

Dayton Generation Connection Requirements

The Dayton Power and Light Company (DP&L) has prepared this Facilities Connection Requirements document to ensure compliance with North American Electric Reliability Council (NERC) Reliability Standards and applicable Regional Reliability Organization, sub regional, Power Pool, and individual Transmission Owner planning criteria and facility connection requirements in compliance to NERC Standard FAC-001-2. These connection requirements apply to all generation facilities, transmission facilities, and end-users connecting to the DP&L transmission system. Detailed information outlining DP&L interconnection requirements can be reviewed utilizing the following link:

http://www.pjm.com/~/media/planning/plan-standards/private-dayton/dayton-facilities-connection-requirements.ashx

Attachment 4. PJM Queue #AC1-165

System Relay and Protection Requirements

The Interconnection Customer will be required to comply with all Dayton System Relay and Protection Requirements. The System Relay and Protection Requirements may be found within the Dayton Power & Light Co. "Requirements for the Connection of Facilities to the Dayton Power & Light Co. Transmission System" document located at the following link:

Specifically reference the "System Relay and Protection Requirements" section which can be found on pages 7-9.

http://www.pjm.com/-/media/planning/plan-standards/private-dayton/dayton-facilities-connection-requirements.ashx?la=en

System Protection and Coordination.

Generation facilities, transmission facilities, and end-user facilities connecting to the DP&L transmission system are responsible for determining that the proper protective equipment meet all applicable standards, is properly installed and coordinates with DP&L relaying. Protective relaying systems and associated communications systems for all facility interconnections shall be planned, designed, constructed, and maintained in accordance with applicable NERC, RF, and PJM standards. Utility grade protective relays and fault clearing systems are to be utilized on the interconnected power system. Utility grade relays are defined as follows:

- Meet ANSI/IEEE Standard C37.90, *Relays and Relay Systems Associated with Electric Power Apparatus*.
- Have relay test facilities to allow testing without unwiring or disassembling the relay.
- Have appropriate test plugs/switches for testing the operation of the relay.
- Have targets to indicate relay operation.

The Applicant must take responsibility for providing adequate system protection to its facilities and to DP&L facilities under any transmission operating condition, whether or not their facilities are in operation. Conditions may include but are not limited to:

Single phasing of supply

System faults.

Equipment failures.

Abnormal voltage or frequency.

Lightning and switching surges.

Excessive harmonic voltages and/or currents.

Excessive negative sequence voltages
Separation from DP&L.
Synchronizing of generation to the DP&L system.

DP&L reserves the right to specify functional specifications and relay settings deemed necessary to avoid safety hazards or to prevent any disturbance, impairment or interference with DP&L's ability to serve other customers. The criteria for these functional specifications and settings will be based on existing DP&L protection practices. DP&L reserves the right to specify the type and manufacturer for these protective relays to ensure compatibility with existing relays. DP&L will make the specific recommendations and requirements for protection based on the individual substation location, voltage and configuration.

For generation facilities, the relay protection system may be part of a self-contained generation control package. Additional relay protection may be required if testing or operational problems are encountered with this self-contained generation control package. DP&L shall review the interface protection and/or the self-contained protection schemes included with the generation before the unit will be permitted to connect to the DP&L system. The following relay functions are required by the Applicant for protection of the DP&L system. Use of the transfer trip receiver is conditional as set forth below.

Relay	**Purpose**
Frequency	To detect under and over frequency operation and separate the customer's parallel generation.
Under/over voltage	To detect under and over voltage operation and cause separation of the customer's parallel generation.
Transfer Trip Receiver	To receive a trip signal from a DP&L transfer trip transmitter and separate the customer's parallel generation.
Ground Detector	To detect a ground fault on the DP&L or customer system and separate the customer's parallel generation.
Directional Power	To detect a reverse power flow condition and separate the customer's parallel generation.

The purpose of these relays is to detect the Generation Owner's energizing of a DP&L circuit that has been isolated from the DP&L system, by circuit breaker or other disconnect device operations or detect

the generation operating at an abnormal voltage or frequency, or to detect a fault or abnormal condition on the DP&L system requiring the Generation Owner to separate their generation from the DP&L system. Output contacts of these relays shall directly energize the trip coil(s) of the generation breaker or an intermediate auxiliary tripping relay that directly energizes the breaker trip coil(s). The relaying system shall have a power source independent from the ac system or immune to ac system loss or disturbances (e.g., dc battery and charger) to assure proper operation of the protection scheme. Loss of this source shall cause removal of the generation from the DP&L system.

DP&L will specify settings for the generation's DP&L-required relays to ensure coordination between the generation protective equipment and the DP&L system relays. It is the Generation Owner's responsibility to determine that their internal protective equipment coordinates with the required DP&L protective equipment and is adequate to meet all applicable standards. DP&L reserves the right to modify relay settings when deemed necessary.

A transfer trip relaying system (or other not specified above) must be installed at the Generation Owner's expense if DP&L determines it is necessary to protect the Transmission System. The transfer trip relaying system shall consist of all transfer trip transmitters located at DP&L facilities, transfer trip receivers at the Generation Facility and the communication channels between the DP&L location(s) and the Generation Facility.

Also, the Interconnection Customer should be familiar with the PJM Protection System Standards which can be found at the link below.

(http://www.pjm.com/-/media/documents/manuals/m07.ashx