Generation Interconnection

Facility Study Report

for

Queue Project AE2-278

URBANA 138KV

90.4 MW Capacity / 150.7 MW Energy

July 2021

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1 Preface

The intent of the Facility 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 Facility Study estimates attempt to identify the estimated time required to obtain property rights and permits for construction of the required facilities. The project Interconnection Customer 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.

2 General

The Interconnection Customer (IC), has proposed a Solar generating facility located in Champaign County, Ohio. The installed facilities will have a total capability of 150.7 MW with 90.4 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is October 1, 2021. **This study does not imply a TO commitment to this in-service date.**

Queue Number	AE2-278
Project Name	URBANA 138 KV
State	Ohio
County	Champaign
Transmission Owner	Dayton
MFO	150.7
MWE	150.7
MWC	90.4
Fuel	Solar
Basecase Study Year	2022

Any new service customers who can feasibly be commercially operable prior to June 1st of the basecase study year are required to request interim deliverability analysis.

3 Point of Interconnection

AE2-278 will interconnect with The Dayton Power and Light Company d/b/a AES Ohio transmission system at the Urbana Substation 138 kV bus. The physical Point of Interconnection (POI) will be the last takeoff structure leaving the Urbana 138 kV yard. Dayton will own the takeoff structure and all attachment hardware. The Interconnection Customer will own the conductor terminating onto the structure. Under the AE2-278 project, the IC will construct a single 138 kV line up to the POI in the Urbana 138 kV yard.

Under the AE2-278 project, the IC will construct a single 138 kV line up to the POI in the Urbana 138 kV yard.

See Attachment 1 for a one line of the physical interconnection point.

4 Cost Summary

The AE2-278 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	**$90,000**
Direct Connection Network Upgrades	**$0**
Non-Direct Connection Network Upgrades	**$2,397,803.93**
Total Physical Interconnection Costs	**$2,487,803.93**

In addition, the AE2-278 project may be responsible for a contribution to the following costs

Description	Total Cost
Allocation towards System Network Upgrade Costs	**$0**

This cost excludes a Federal Income Tax Gross Up charges. This tax may or may not be charged based on whether this project meets the eligibility requirements of IRS Notice 88-129. If at a future date it is determined that the Federal Income Tax Gross charge is required, the Transmission Owner shall be reimbursed by the Interconnection Customer for such taxes.

Note 1: PJM Open Access Transmission Tariff (OATT) section 217.3A outline cost allocation rules. The rules are further clarified in PJM Manual 14A Attachment B. The allocation of costs for a network upgrade will start with the first Queue project to cause the need for the upgrade. Later queue projects will receive cost allocation contingent on their contribution to the violation and are allocated to the queues that have not closed less than 5 years following the execution of the first Interconnection Service Agreement which identifies the need for this upgrade.

Note 2: For customers with System Reinforcements listed: If your present cost allocation to a System Reinforcement indicates $0, then please be aware that as changes to the interconnection process occur, such

as prior queued projects withdrawing from the queue, reducing in size, etc, the cost responsibilities can change and a cost allocation may be assigned to your project. In addition, although your present cost allocation to a System Reinforcement is presently $0, your project may need this system reinforcement completed to be deliverable to the PJM system. If your project comes into service prior to completion of the system reinforcement, an interim deliverability study for your project will be required.

5 Transmission Owner Facilities Study Summary

5.1 Description of the Project

Generator Interconnection Request AE2-278 is for a 150.7 MW Maximum Facility Output (MFO) solar generating facility, which consists of 79 Power Electronics FS2000 inverters. The AE2-278 solar generating facility will be located in Champaign County, Ohio.

5.2 Point of Interconnection

AE2-278 will interconnect with The Dayton Power and Light Company d/b/a AES Ohio transmission system at the Urbana Substation 138 kV bus. The physical Point of Interconnection (POI) will be the last takeoff structure leaving the Urbana 138 kV yard. Dayton will own the takeoff structure and all attachment hardware. The Interconnection Customer will own the conductor terminating onto the structure. Under the AE2-278 project, the IC will construct a single 138 kV line up to the POI in the Urbana 138 kV yard.

See **Attachment 1** for a one line of the physical interconnection point.

5.3 Amendments to the Original System Impact Study Results

The original AE2-278 System Impact Study report was issued in February 2020 and there have been no changes since.

5.4 Interconnection Customer's Submitted Milestone Schedule

Note: This Facilities Study Report was prepared based on initial dates from the Interconnection Customer. Since then, the Interconnection Customer provided updated dates and the final schedule for the Transmission Owner work is shown below:

- Plan to break ground: Q3 2022
- Permits – state level CPCN and county level Final Site Plan approval complete by: Q3 2022
- Substantial site work completed: Q4 2022
- Delivery of major electrical equipment: Q1 2023
- Back Feed Power early to: Q1 2023
- Commercial Operation: Q2 2023

A **24-month** schedule has been developed for DP&L d/b/a AES Ohio 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.

5.5 Scope of Customer's Work

The IC will install a total of 150.7 MW of solar generation in Miami County, Ohio as part of the AE2-278 project. The IC will construct and own facilities including the solar generator facilities, inverters, a 34.5-138 kV generation step up (GSU) transformer, a 138 kV breaker with associated relay/protection/controls, and a 138

kV line up to the Point of Interconnection (POI). The last 138kV takeoff structure leaving the Urbana 138kV substation serve as the POI. Dayton Power and Light will own the structure and associated hardware while the IC will own the conductor to the connection point as shown in Attachment 1.

The IC shall coordinate with Dayton on 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 will be made via the addition of two 138 kV breakers in the Urbana 138kV substation. The Urbana Substation is designed for a two bus, four breaker configuration. Thus, to create a reliable connection to the system, this project will require two new breakers. One of the breakers is required to isolate the existing 138/69kV transformer and the other will be for the new generator. The 138 kV generator lead line will be constructed by the developer as noted above and will be terminated onto the 138 kV takeoff structure leaving the Eldean 138kV substation. Dayton will install the line relaying, communications, and interconnection metering to accommodate the interconnection of the AE2- 278 generator.

The 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.

5.6 Description of Facilities Included in the Facilities Study

5.6.1 Attachment Facilities

This report assumes that the Interconnection Customer will construct and own the attachment line from its generating facility into the proposed Point of Interconnection as depicted on the one line diagram in Attachment 1. The IC will also be responsible for the fiber/OPGW that Dayton requires on the generator line for the communication assisted trip scheme. This work is primarily for engineering drawing review. These costs do not include CIAC Tax Gross-up.

Description	Total Cost
138kV Check Metering	**$90,000**
DP&L d/b/a AES Ohio requires the IC to build the lead line up to the POI which is the takeoff structure leaving the AES Ohio owned sub)	**$0**
Total Attachment Cost Estimate	**$90,000**

5.6.2 Direct Connection Network/Local Upgrades

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

Description	Total Cost
None	**$0**
Total Direct Connection Facility Costs	**$0**

There is no direct connection cost estimate for the AE2-278 project.

5.6.3 Non-Direct Connection Network/Local Upgrades

The substation non direct connection work for this project includes the addition of two 138 kV breaker positions to the existing Urbana 138kV substation. The Urbana Substation is designed for a two bus, four breaker configuration. Thus, to create a reliable connection to the system, this project will require two new breakers. One of the breakers is required to isolate the existing 138/69kV transformer and the other will be for the new generator. The 138 kV generator lead line will be constructed by the developer and will be terminated onto the 138 kV takeoff structure leaving the Urbana Substation. There will also be transmission line re-routing costs to accommodate the AE2-278 generator. The new 138kV breakers will be equipped with the necessary communication systems to facilitate remote supervisory control of the breaker and status monitoring. There will also be protection and control changes required at the Urbana 138 kV substation. The 138 kV generator lead line will be constructed by the developer and will be terminated onto the 138 kV takeoff structure leaving the Urbana 138kV switchyard. Dayton will install the line relaying, communications, and interconnection metering to accommodate the interconnection of the AE2- 278 generator.

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

Description	Total Cost
Install two new 138 kV breakers at the Urbana Substation to interconnect the AE2-278 project. This will include the installation of all physical structures, P&C equipment, communications equipment, and associated facilities. PJM Network Upgrade Number n7480.	**$1,210,433**
T-Line Re Routing Costs at the Urbana 138kV Substation. PJM Network Upgrade Number n7481.	**$1,172,370.93**
Review Protection and Control Settings at the Urbana 138kV substation. PJM Network Upgrade Number n7480.	**$15,000**
Total Non-Direct Connection Facility Costs	**$2,397,803.93**

5.7 Total Costs of Transmission Owner Facilities included in Facilities Study

Description	NUN	Total Cost without Tax
Attachment Facilities		
138kV Check Metering		**$90,000**
(DP&L d/b/a AES Ohio requires the IC to build the lead line up to the POI which is the takeoff structure leaving the AES Ohio owned sub)		**$0**
Direct Connection Network Upgrades		
None		**$0**
Non-Direct Connection Network Upgrades		
Install two new 138 kV breakers at the Urbana Substation to interconnect the AE2-278 project. This will include the installation of all physical structures, P&C equipment, communications equipment, metering equipment, and associated facilities. PJM Network Upgrade Number n7480.		**$1,210,433**
T-Line Re-Routing Costs at the Urbana 138kV Substation. PJM Network Upgrade Number n7481.		**$1,172,370.93**
Review Protection and Control Settings at the Urbana 138kV substation. PJM Network Upgrade Number n7480.		**$15,000**
Total Costs		**$2,487,803.93**

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 this project meets the eligibility requirements of IRS Notice 88-129. If applicable, the tax shown in the rightmost column above would be applied. The IC will be responsible for the actual cost of all implementing all work identified in the table above.

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

A proposed eighteen **(18)-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	3
Detailed Engineering	3	6
Equipment Procurement – Delivery	6	12
Above Grade Construction	12	15
Testing & Commissioning	15	18

5.8.1 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 AE2-278 interconnection point when the units are out-of-service. This assumes the intent of the IC is to net the generation with the load.

5.8.2 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 require 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.

6 Transmission Owner Facilities Study Results

6.1 Transmission Lines – New

None

6.2 Transmission Lines – Upgrades

None

6.3 New Substation / Substation Facilities

None

6.4 Upgrades to Substation / Substation Facilities

- Two new 138 kV breakers at the Urbana 138kV substation to interconnect the AE2-278 queue generator.
- T-Line routing costs at the Urbana 138kV substation.
- Review Protection and Control Settings at the Urbana 138kV substation.
- The following equipment will be required to add the AE2-278 queue project:
    - 138 kV Disconnect Switches
    - 138 kV Fiber Line and Transfer Trip Relays
    - (2) 138 kV Gas Circuit Breakers
    - 138 kV Revenue Class Metering Equipment (check meter)
    - 138 kV Instrument Transformers
    - 138 kV Bus Structures
    - 138 kV Insulators
    - 138 kV Lightning Arrestors
    - SCADA Remote Terminal Unit (RTU)
    - Physical Site Expansion including Grading
    - Foundational Work for New Equipment

6.5 Metering and Communications

6.5.1 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.

6.5.2 Transmission Owner (Dayton) Requirements

The Interconnection Customer will be required to comply with all Dayton d/b/a AES Ohio Revenue Metering Requirements for Generation Interconnection Customers as outlined in the link below. 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

http://www.pjm.com/planning/design-engineering/to-tech-standards.aspx

The meter will be located on the 138 kV line connected to the AE2-278 generator as shown in **Attachment 1**.

6.6 Environmental, Real Estate and Permitting Issues

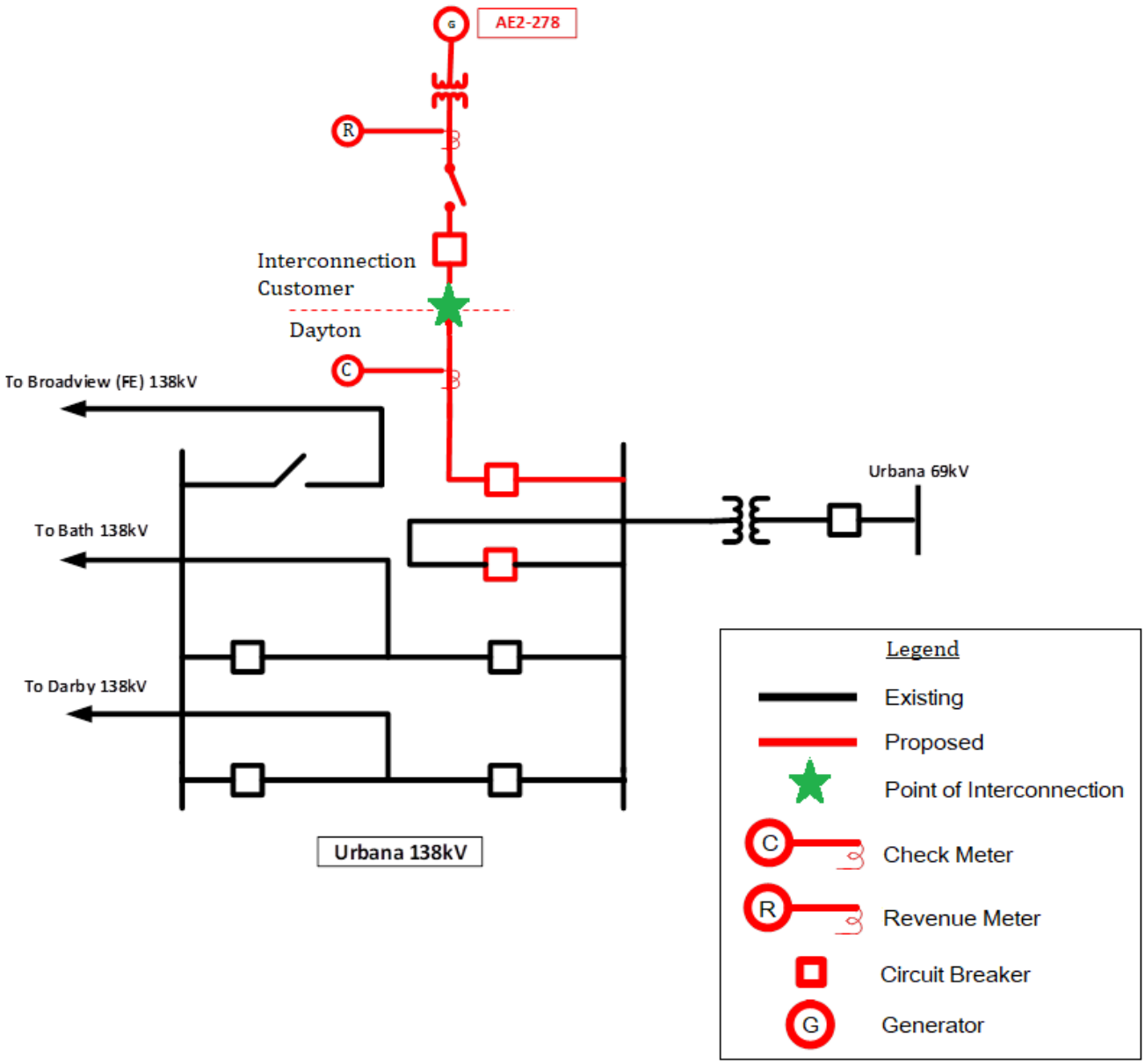
The IC will be responsible for acquiring all rights-of-way, easements, properties, vegetation clearing, environmental, state siting approvals, and municipal permits that may be required to construct all attachment facilities, up to the POI shown in the one-line diagram in Attachment 1. The IC will be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

6.7 Information Required for Interconnection Service Agreement

The following table summarizes the total estimated costs according to FERC criteria. The estimated costs are in **2020 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 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 Material
Attachment Facilities				
138kV Check metering	**$41,210**	**$40,623**	**$6452**	**$1715**
(DP&L d/b/a AES Ohio requires the IC to build the lead line up to the POI which is the takeoff structure leaving the AES Ohio owned sub)				
Direct Connection Network Upgrades				
None	**$0**	**$0**	**$0**	**$0**
Non-Direct Connection Network Upgrades				
Install two new 138 kV breakers at the Urbana Substation to interconnect the AE2-278 project. This will include the installation of all physical structures, P&C equipment, communications equipment, metering equipment, and associated facilities.	**$554,249**	**$549,147**	**$86,771**	**$20,266**
T-Line Re-Routing Costs at the Urbana 138kV Substation.	**$818,570.00**	**$8,422.47**	**$339,763.48**	**$5,614.98**
Review Protection and Control Settings at the Urbana 138kV substation	**$10,000**		**$5,000**	
Total Costs	**$1,424,029**	**$598,192.47**	**$437,986.48**	**$27,595.98**

7 Attachment 1: One Line Diagram



8 Attachment 2 – Project Location

9 Attachment 3

9.1 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:

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

10 Attachment 4

10.1 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 Protection and Coordination" section which can be found on pages 8-10.

https://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