Generation Interconnection

System Impact Study Report

for

Queue Project AG1-198

UNION CITY 34.5 KV

7.2 MW Capacity / 12 MW Energy

August 2021

Table of Contents

© PJM Interconnection 2021. All rights reserved

© PJM Interconnection 2021. All rights reserved

1 Introduction

This System Impact Study has been prepared in accordance with the PJM Open Access Transmission Tariff, 205, as well as the System Impact Study Agreement between the Interconnection Customer (IC), and PJM Interconnection, LLC (PJM), Transmission Provider (TP). The Interconnected Transmission Owner (ITO) is Mid-Atlantic Interstate Transmission, LLC (MAIT) (PENELEC Zone).

2 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.

The Interconnection Customer seeking to interconnect a wind or solar generation facility shall maintain meteorological data facilities as well as provide that meteorological data which is required per Schedule H to the Interconnection Service Agreement and Section 8 of Manual 14D.

© PJM Interconnection 2021. All rights reserved

3 General

The Interconnection Customer (IC), has proposed a Solar generating facility located in Erie County, Pennsylvania. The installed facilities will have a total capability of 12 MW with 7.2 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is January 15, 2023. This study does not imply a TO commitment to this in-service date.

Queue Number	AG1-198
Project Name	UNION CITY 34.5 KV
State	Pennsylvania
County	Erie
Transmission Owner	PENELEC
MFO	12
MWE	12
MWC	7.2
Fuel	Solar
Basecase Study Year	2024

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.

© PJM Interconnection 2021. All rights reserved

4 Point of Interconnection

AG1-198 will interconnect with the PENELEC system via a tap on the 34.5 kV Northeast circuit out of Union City Substation at pole # 4008343. The IC's proposed generating unit site is approximately 3.3 miles north of Union City, PA., near 15000 Smiley Hill Road (Rt. 8).

Attachment 1 shows a one-line diagram of the proposed primary direct connection facilities for the AG1-198 generation project to connect to the Penelec distribution system.

5 Cost Summary

The AG1-198 project will be responsible for the following costs:

Description	Total Cost
Total Physical Interconnection Costs	$441,022
Allocation towards System Network Upgrade Costs (PJM Identified - Summer Peak)*	$0
Allocation towards System Network Upgrade Costs (PJM Identified - Light Load)*	$0
Allocation towards System Network Upgrade Costs (TO Identified)*	$0
Total Costs	$441,022

*As your project progresses through the study process and other projects modify their request or withdraw, then your cost allocation could change.

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

© PJM Interconnection 2021. All rights reserved

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.

© PJM Interconnection 2021. All rights reserved

6 Transmission Owner Scope of Work

The AG1-198 will interconnect with the Penelec distribution system via a tap on the 34.5 kV Northeast circuit out of the Union City Substation at pole # 4008343. The IC will be responsible for acquiring all easements, properties, and permits that may be required to construct the new interconnection station and the associated facilities.

Attachment 1 shows a one-line diagram of the proposed primary direct connection facilities for the AG1-198 generation project to connect to the Penelec distribution system. The IC will be responsible for constructing all of the facilities on its side of the POI, including the attachment facilities which connect the generator to the FE distribution system's direct connection facilities.

The total physical interconnection costs is given in the table below:

Description	Total Cost
Proposed tap point at 4008343 on existing pole or interspersed pole on existing Union City 34.5kV distribution circuit, add new SCADA switch, add new primary metering. The customer is responsible to build their own line from their site to Penelec's existing facilities.	$163,766
Line Terminal Upgrade @ Union City	$232,196
Customer Substation Review	$45,060
Total Physical Interconnection Costs	$441,022

© PJM Interconnection 2021. All rights reserved

7 Schedule

Based on the scope of work for the interconnection facilities, it is expected to take a minimum of **14 months** after the signing of an Interconnection Agreement and construction kickoff call to complete the installation of the physical connection work. This assumes that there will be no environmental issues with any of the new properties associated with this project, that there will be no delays in acquiring the necessary permits for implementing the defined interconnection work, and that all system outages will be allowed when requested.

The schedule for any required Network Impact Reinforcements will be more clearly identified in future study phases. The estimated time to complete each of the required reinforcements is identified in the "System Reinforcements" section of the report.

8 Transmission Owner Analysis

Penelec performed an analysis of its distribution system. The AG1-198 project did not contribute to any overloads on the distribution system.

9 Interconnection Customer Requirements

9.1 System Protection

An analysis was conducted to assess the impact of the Union City 34.5 kV (AG1-198) Project on the system protection requirements in the area. The results of this review show that the following relay additions will be required:

Proposed single line diagrams show Foundation Solar Partners, LLC (Developer) constructing a generation facility they call **"Cass Solar"** tapping Penelec's Union City – 34.5 kV Northeast circuit at pole 4008343.

The 34.5kV interconnection proposal will require Developer to meet applicable "Technical Requirements" as outlined in First Energy's document titled "Technical Interconnection Requirements and Study Criteria for Distributed Energy Resources Interconnected to Distribution Systems ". Anti-islanding system shall meet IEEE 1547 and UL 1741. Therefore, no Direct Transfer Trip (DTT) will be required.

9.2 General Concerns

It is to be understood, for abnormal operation of the Penelec system, which could cause Developer's generation facility to be electrically isolated from the Penelec system synchronous source via the tripping of a interconnecting primary voltage line or device, Developer will, via Penelec's direction, be required to disconnect the generation from Penelec's system and remain disconnected (**units are required to be OFF LINE**), until the Penelec system normal circuitry is restored. These abnormal conditions will be reviewed by Penelec system operators as to the need for the generation facility to be disconnected.

© PJM Interconnection 2021. All rights reserved

9.3 Requirements for Owner's/Developer's generation IPP Facility

The proposed interconnection Owner's/Developer's facilities must be designed in accordance with the document titled *Technical Interconnection Requirements and Study Criteria for Distributed Energy Resources Interconnected to Distribution Systems.*

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

Additionally, Owner/Developer is responsible to provide adequate protection (for their equipment) under any distribution system operating condition' - which includes 'Separation from supply' (i.e. tripping of F.E. circuit breakers) and 'Re-synchronizing the generation after electric restoration of the supply' (i.e. reclosing of F.E. circuit breakers).

Owner's/Developer's protection must be designed to coordinate with the reclosing practices of FirstEnergy line protective devices. The generator must cease to energize the FirstEnergy circuit to which it is connected prior to reclosing of any (FE) automatic reclosing devices.

Owners/Developer's electrical protection and control schematics shall be provided to FE for consideration. FE may request modifications, if required, to meet the technical requirements.

9.4 Compliance Issues

Foundation Solar Partners, LLC will be responsible for meeting a power factor between 0.95 lagging (producing MVARs) to 0.95 leading (absorbing MVARs) and assure that voltage deviation will be less than 1.0 volt as measured at the POI under all Solar Gen operating conditions due to the inherent dynamic reactive power capability of this solar facility.

Generators with no inherent VAR (reactive power) control capability, or those that have a restricted VAR capability less than the defined requirements, must provide dynamic supplementary reactive support located at the generation facility with electrical characteristics equivalent to that provided by a similar sized synchronous generator. A Dynamic Reactive Compensation (either Static VAR Compensator (SVC) or STATCOM) or other method be applied in order to maintain the required specifications at the POI. Foundation Solar Partners, LLC is responsible for the installation of equipment on its side of the POI in order to adhere to the criteria stated above by FirstEnergy.

10 Revenue Metering and SCADA Requirements

10.1 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 Section 8 of Attachment O.

© PJM Interconnection 2021. All rights reserved

10.2 Meteorological Data Reporting Requirements

The solar generation facility shall provide the Transmission Provider with site-specific meteorological data including:

- Back Panel temperature (Fahrenheit) - (Required for plants with Maximum Facility Output of 3 MW or higher)
- Irradiance (Watts/meter^2) - (Required for plants with Maximum Facility Output of 3 MW or higher)
- Ambient air temperature (Fahrenheit) - (Accepted, not required)
- Wind speed (meters/second) - (Accepted, not required)
- Wind direction (decimal degrees from true north) - (Accepted, not required)

10.3 Interconnected Transmission Owner Requirements

The IC will be required to comply with all Interconnected Transmission Owner's revenue metering requirements for generation interconnection customers located at the following link:

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

© PJM Interconnection 2021. All rights reserved

11 Summer Peak Analysis

The Queue Project AG1-198 was evaluated as a 12.0 MW (Capacity 7.20 MW) injection at the Union City 34.5 kV substation in the PENELEC area. Project AG1-198 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AG1-198 was studied with a commercial probability of 100.0 %. Potential network impacts were as follows:

11.1 Generation Deliverability

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

None

11.2 Multiple Facility Contingency

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

None

11.3 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

11.4 Steady-State Voltage Requirements

None

11.5 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.

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
166176532	200585	26TITUSVIL	115.0	PENELEC	946400	AF1-304 TAP	115.0	PENELEC	1	PN-P1-2-PN-115-022-A	operation	245.0	39.22	44.01	AC	12.0

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
166176555	200633	26HAYNIE	115.0	PENELEC	200583	26PINEY	115.0	AP	1	ATSI-P1-2-CEI-345-700T	operation	190.0	90.33	91.31	AC	1.91
166176556	200633	26HAYNIE	115.0	PENELEC	200583	26PINEY	115.0	AP	1	PN-P1-2-PN-345-107T	operation	190.0	90.33	91.31	AC	1.91
166176383	946400	AF1-304 TAP	115.0	PENELEC	200584	26GRANDVW	115.0	PENELEC	1	PN-P1-2-PN-115-022-A	operation	245.0	79.25	83.46	AC	12.0
166176580	957160	AF2-010 TAP	115.0	PENELEC	200585	26TITUSVIL	115.0	PENELEC	1	PN-P1-2-PN-115-022-A	operation	245.0	29.55	34.45	AC	12.0
166176439	966770	AG1-548 TAP	115.0	PENELEC	200567	26ERIE SO.	115.0	PENELEC	1	PN-P1-3-PN-115-070-A	operation	282.0	66.77	70.97	AC	12.0
166176440	966770	AG1-548 TAP	115.0	PENELEC	200567	26ERIE SO.	115.0	PENELEC	1	PN-P1-2-PN-115-020-A-A	operation	282.0	66.76	70.96	AC	12.0
166176441	966770	AG1-548 TAP	115.0	PENELEC	200567	26ERIE SO.	115.0	PENELEC	1	Base Case	operation	232.0	53.01	56.75	AC	8.66

© PJM Interconnection 2021. All rights reserved

11.6 System Reinforcements

None

© PJM Interconnection 2021. All rights reserved

11.7 Flow Gate Details

The following indices contain additional information about each facility presented in the body of the report. For each index, a description of the flowgate and its contingency was included for convenience. The intent of the indices is to provide more details on which projects/generators have contributions to the flowgate in question. All New Service Queue Requests, through the end of the Queue under study, that are contributors to a flowgate will be listed in the indices. Please note that there may be contributors that are subsequently queued after the queue under study that are not listed in the indices. Although this information is not used "as is" for cost allocation purposes, it can be used to gage the impact of other projects/generators. It should be noted the project/generator MW contributions presented in the body of the report are Full MW Impact contributions which are also noted in the indices column named "Full MW Impact", whereas the loading percentages reported in the body of the report, take into consideration the PJM Generator Deliverability Test rules such as commercial probability of each project as well as the ramping impact of "Adder" contributions. The MW Impact found and used in the analysis is shown in the indices column named "Gendeliv MW Impact".

None

© PJM Interconnection 2021. All rights reserved

11.8 Queue Dependencies

None

© PJM Interconnection 2021. All rights reserved

11.9 Contingency Descriptions

Contingency Name	Contingency Definition
ATSI-P1-2-CEI-345-700T	CONTINGENCY 'ATSI-P1-2-CEI-345-700T' /* PN/ATSI ERIE WEST - ASHTABULA - PERRY 345KV DISCONNECT BRANCH FROM BUS 239036 TO BUS 238547 CKT 1 /* 02PERRY 345 02AT 345 DISCONNECT BRANCH FROM BUS 238547 TO BUS 239082 CKT 1 /* 02AT 345 02S8-ATT 345 DISCONNECT BRANCH FROM BUS 239082 TO BUS 238544 CKT 8 /* 02S8-ATT 345 02ASH_3 138 DISCONNECT BRANCH FROM BUS 238547 TO BUS 200599 CKT 1 /* 02AT 345 26ERIE W 345 END
PN-P1-2-PN-345-107T	CONTINGENCY 'PN-P1-2-PN-345-107T' /* ERIE WEST - ASHTABULA - PERRY 345KV DISCONNECT BRANCH FROM BUS 200599 TO BUS 238547 CKT 1 /* 26ERIE W 345 02AT 345 DISCONNECT BRANCH FROM BUS 238547 TO BUS 239082 CKT 1 /* 02AT 345 02S8-ATT 345 DISCONNECT BRANCH FROM BUS 238547 TO BUS 239036 CKT 1 /* 02AT 345 02PERRY 345 DISCONNECT BUS 238547 /* 02AT 345 END
PN-P1-2-PN-115-020-A-A	CONTINGENCY 'PN-P1-2-PN-115-020-A-A' /* GRANDVIEW - TITUSVILLE 115 KV DISCONNECT BRANCH FROM BUS 200584 TO BUS 946400 CKT 1 /* 26GRANDVW 115 AF1-304 TAP 115 END
PN-P1-2-PN-115-022-A	CONTINGENCY 'PN-P1-2-PN-115-022-A' /* ERIE SOUTH - UNION CITY 115KV DISCONNECT BRANCH FROM BUS 200567 TO BUS 966770 CKT 1 /* 26ERIE SO. 115 AG1-548 TAP 115 END
Base Case	
PN-P1-3-PN-115-070-A	CONTINGENCY 'PN-P1-3-PN-115-070-A' /* GRANDVIEW #2 XFMR FAULT DISCONNECT BRANCH FROM BUS 200584 TO BUS 200592 CKT 2 /* 26GRANDVW 115 26GRNDVW#2 35 DISCONNECT BRANCH FROM BUS 200584 TO BUS 946400 CKT 1 /* 26GRANDVW 115 AF1-304 TAP 115 DISCONNECT BRANCH FROM BUS 200584 TO BUS 200587 CKT 1 /* 26GRANDVW 115 26CLRK SUM 115 END

© PJM Interconnection 2021. All rights reserved

12 Light Load Analysis

Light Load Analysis is not required for solar projects.

13 Short Circuit Analysis

The following Breakers are overdutied:

None

© PJM Interconnection 2021. All rights reserved

14 Stability and Reactive Power

Not Required

© PJM Interconnection 2021. All rights reserved

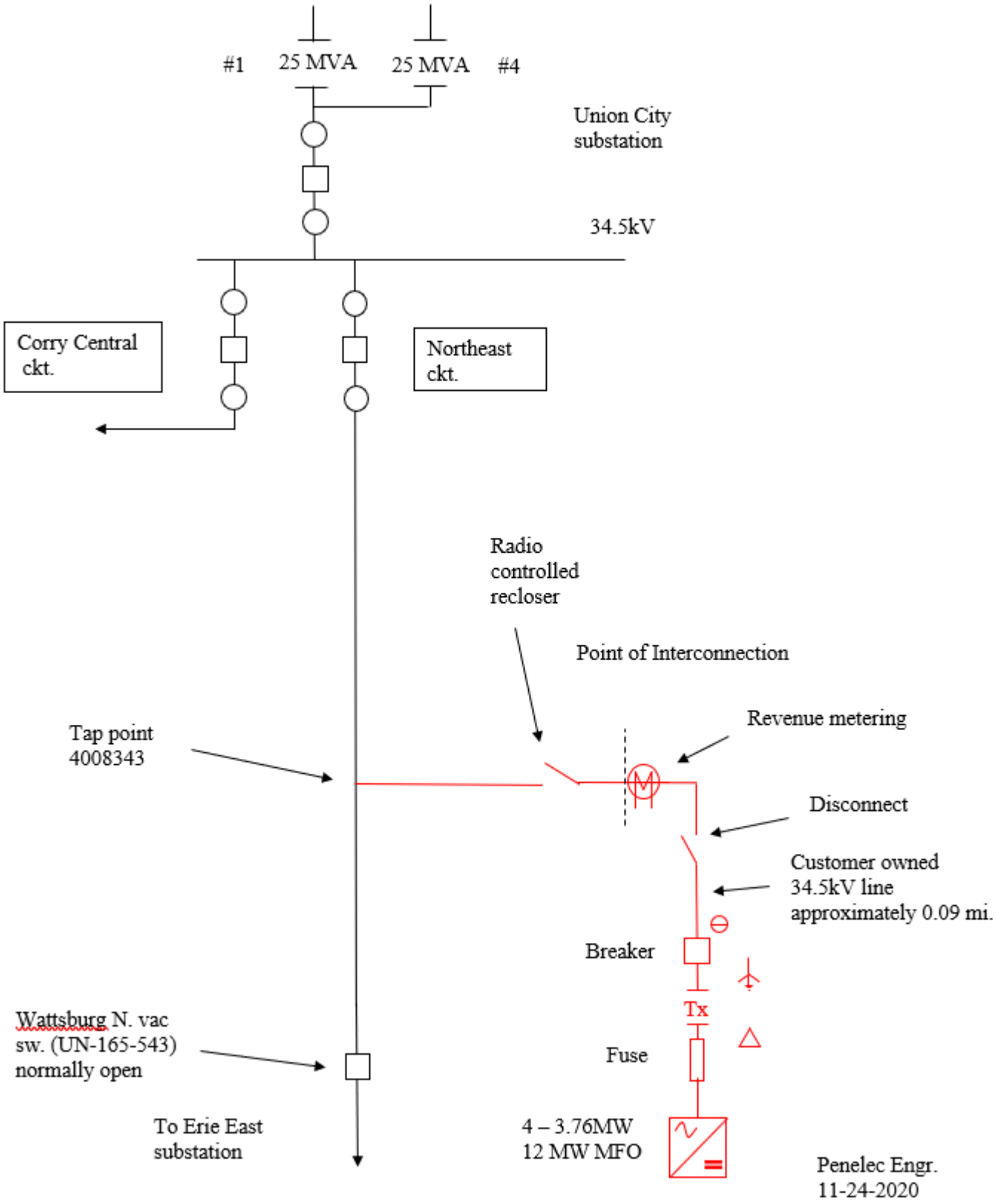
15 Affected Systems

15.1 NYISO

This project has been identified by PJM as having greater than 3% DFAX contribution (or 10% DFAX for over 500kV) to flow gates in the NYISO area. NYISO is evaluating the need for affected system study. Results will be provided in the Facilities phase. (Reference PJM Manual 14A Section 4.2.4 for Affected System Coordination.)

© PJM Interconnection 2021. All rights reserved

16 Attachment 1: One Line Diagram



© PJM Interconnection 2021. All rights reserved