Generation Interconnection
Facilities Study Report

PJM Generation Interconnection Request
Queue Position AE1-229 "Churchtown-Upper Pittsgrove 138kV"

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Transmission Owner Facilities Study Summary

1 Description of Project

Pittsgrove Solar I, LLC, the Interconnection Customer (IC), has proposed a 149.3 MW (89.0 MW Capacity) solar generating facility to be located at Latitude: 39.6465420, Longitude: -75.3626530. PJM studied the AE1-229 project as an injection into the Atlantic City Electric Company (ACE) transmission system at a tap of the Churchtown to Upper Pittsgrove 138kV circuit and evaluated it for compliance with reliability criteria for summer peak conditions in 2022. The project was studied at a commercial probability of 100%. The planned in-service date, as requested by the IC, is September 30, 2021. This date may not be attainable due to additional required PJM studies and the Transmission Owner's construction schedule.

The proposed 149.3 MWs of generation will require one (1) new Point of Interconnection (POI). Based on the options evaluated the POI will be at a newly constructed substation which will connect to the existing ACE Churchtown-Upper Pittsgrove 138kV circuit.

The newly constructed 138kV substation will consist of a 3-position ring bus. Two of the positions on the ring bus will be transmission line terminals for the tie-in of existing ACE line 1405. The other position will be a terminal configured for the interconnection of the AE1-229 generation.

Note: Due to Deepwater Substation retirement, 138kV loads have been routed to Churchtown 138kV Substation. PJM was notified of Deepwater substation retirement prior to queue AE1.

2 Amendments to the System Impact Study or System Impact Study Results

The scope of the project as stated in the Impact Study, submitted in August 2019 has not been changed. Also, the estimates herein were performed in more detail than those provided in the Impact Study.

3 Interconnection Customer's Milestone Schedule

Site Work Complete:	32-48 months prior to new estimated ISD
Commercial Operation:	[PJM to fill in new estimated ISD]

4 Interconnection Customer's Scope of Work

The IC assumes full responsibility for the design, permitting and construction of all facilities associated with the AE1-229 generating station on their side of the POI. ACE requires that an IC circuit breaker is located within 500 feet of the ACE substation to facilitate the relay protection scheme between ACE and the IC at POI. The IC shall conform to Transmission Owner's engineering and construction standards and coordinate all work directly with Transmission Owner to ensure minimal interruption to the electric system. The IC also assumes responsibility for the permitting and construction of the service road(s) to the generating site.

Protective relaying and metering design and installation must comply with Transmission Owner's applicable standards. The IC is also required to provide revenue metering and real-time telemetering data

to PJM in conformance with the requirements contained in PJM Manuals M-01 and M-14 and the PJM Tariff. It is critical that the IC also provides 120 VAC power to the primary meter locations installed by Transmission Owner.

Transmission Owner will require the capability to remotely disconnect the generator from the grid by communication from its System Operations facility. Such disconnection will be performed by IC circuit breaker and associated disconnect switches. When the trip command is sent to IC equipment the customer shall have a circuit breaker capable of locking out, a lockout relay, or inverter logic that does not allow the inverters to automatically reconnect. The IC is responsible for calling Transmission Owner System Operations before manually reconnecting with the grid. The phone number to System Operations should be clearly displayed next to the circuit breaker or inverter controls.

Transmission Owner Facilities Study Results

5 New Attachment Facilities: Transmission Owner Scope of Work

This section describes the attachment facilities necessary to support the interconnection to the IC's generating site. This section describes facilities identified to be installed, replaced, and/or upgraded by Transmission Owner to accommodate the project. During detailed design and analysis other components may be identified for installation or replacement due to this interconnection.

The scope of work for the installation of IC's interconnection and generation facilities are not included in this study nor are the responsibility of the Transmission Owner.

5.1 Attachment Facilities – Transmission Line

Install a new short transmission line (no longer than 500 ft) from new bus position at the new switchyard to the IC's POI station. Two (2) new transmission dead-end poles will be required for re-termination of line 1405 into the new switchyard.

Material/Equipment	Quantity
▪ 138kV Dead-end/Take-off Structure	2
▪ 138kV Dead-end/Take-off Structure Foundation (group of piers)	2
▪ 138kV Dead-end Insulators	12
▪ 1590kcmil ACSR Conductor	2,000 ft

Major Labor Activities

- Install dead-end foundations, structures, and insulators.
- Cut 1405 line and install 1590kcmil ACSR conductor from each line end to dead-end structure and into new substation
- Run conductor from new bus position at the new switchyard to the IC's POI station

6 New Direct Connection Facilities: Transmission Owner Scope of Work

This section describes upgrades to existing facilities required to accommodate the interconnection of AE1-229. During detailed design and analysis other components may be identified for installation or replacement due to this interconnection.

6.1 Direct Connection Facilities-Substation

The interconnection of AE1-229 will require a newly constructed 138kV substation with a 3-position ring bus. Two of the positions on the ring bus will be transmission line terminals for the tie-in of existing ACE Line 1405. The other position will be a terminal configured for the interconnection of AE1-229 generation. New protection relaying will be added for the new terminals. Relay settings changes are required at the Churchtown and Upper Pittsgrove terminals. Churchtown & Upper Pittsgrove lines will be protected by SEL-421, as a primary protection, and SEL-311C, as a backup. Each breaker will be controlled by SEL-451 with Reclosing & Breaker Failure functions. Lockout relays will be utilized to directly trip related breakers under fault conditions and send transfer trips to the remote end via Mirror Bits. Additionally, relay outputs will be wired to remotely control IC breaker for operational switching. Bus protection will be provided by two (2) SEL-487B. Time synchronization will be provided by Arbiter GPS Clock. Communication control will be provided by Orion LX and Siemens Ruggedcom RSG2100. Short circuit, arc flash, lighting, direct stroke shielding, and ground grid studies will be required for the new station.

Major Substation Equipment to be Installed

Material/Equipment	Quantity
▪ 138kV Circuit Breaker, 2000A, 40kA, 3 cycle	3
▪ 138kV Line Disconnect Switch, Motor Operated, 2000A	3
▪ 138kV CB Disconnect Switch, 2000A	6
▪ 138kV CT/VT Combination Unit, Single Phase	3
▪ 138kV CCVT	9
▪ 138kV Surge Arresters	9
▪ 138kV Disconnect Switch Stand, High, Steel	9
▪ 138kV CT/VT Stand, Single Phase, High, Steel	9
▪ 138kV Dead-end/Take-off Structure	3
▪ 138kV/240-120V SSVT	2
▪ 138kV Breaker Foundation (slab)	3
▪ 138kV Line Disconnect Switch Stand Foundation (group of piers)	3
▪ 138kV Single Phase CCVT Stand Foundation (group of piers)	9
▪ 138kV Dead-end/Take-off Structure Foundation (group of piers)	3
▪ 138kV Bus Support Structure, 3-phase, Steel	23
▪ 138kV Station Post Insulators	81
▪ 4” SPS AL Bus with 954 ACSR Damper	850 ft
▪ 954 ACSR Bare Conductor	1,000 ft
▪ Fencing	1,000 ft
▪ Control Enclosure, includes AC/DC Panelboards, 125VDC Battery & Charger (47’x16’)	1
▪ Pre-cast Cable Trench (24” x 24”)	300 ft
▪ 4” Sch 40 PVC Conduit	1,500 ft
▪ Ground Conductor, 4/0 Bare Copper	6,500

▪ Bus Differential Relay Panel with two (2) SEL-487B (24" wide)	1
▪ Transmission Line Relay Panel with SEL-421 & SEL-311C (24" wide)	2
▪ 138kV Circuit Breaker Control Panel with two (2) SEL-451/LOR (24" wide)	1
▪ 138kV Circuit Breaker Control Panel with one (1) SEL-451/LOR (24" wide)	1
▪ RTU/Communications Panel with SEL2411, Orion LX, & Ethernet switches (24")	1
▪ Physical Security Panel (24")	1
▪ Fiber Panel	1
▪ MPLS Panel	1
▪ Comm DC Plant Panel	1
▪ Control Cable 4C#10AWG	3,500 ft
▪ Control Cable 4C#12AWG	2,500 ft
▪ Control Cable 12C#12AWG	2,500 ft
▪ Serial/Fiber Optic Transceiver (SEL-2830)	3
▪ Multimode (62.5um) Fiber-Optic Cable	250 ft
▪ Single-Mode (1300nm) Fiber-Optic Patch Cable	500 ft

Major Labor Activities

- Site Development (grading, drainage, final surfacing)
- Install grounding system.
- Install trench/conduit.
- Build up foundations for a new equipment.
- Install 138kV breakers.
- Install Dead-end structures.
- Install 138kV Line & CB Switches.
- Install 138kV CCVTs.
- Install surge arresters.
- Install control house.
- Install fence.
- Install lightning.
- Cut the line and connect it to new structures.
- Install six 4-inch conduits from new breakers to the new trench.
- Install three 4-inch conduit from new CCVT to existing trench.
- Install three 4-inch conduits from existing trench to IC yard.
- Install four 4C#10 cables between POI breaker and control house termination cabinet, and panels.
- Install two 12C#12 cables between POI breaker and control house termination cabinet, and panels.
- Install twelve 4C#10 cables between new 138kV breakers and control house termination cabinet, and panels.
- Install three 4C#12 cables between new PTs and control house termination cabinet, and panels.
- Relay settings for newly installed relays.
- RTU points list and configurations for a new Orion RTU & ethernet switch.
- Testing and commissioning.

7 Metering

A three phase 138 kV revenue metering point will need to be established within the Interconnection Customer Facilities at the Point of Interconnection. The Interconnection Customer will purchase and install all metering instrument transformers as well as construct a metering structure per the Interconnected Transmission Owner's specifications. The secondary wiring connections at the instrument transformers will be completed by the Interconnection Customer. The secondary wiring connection at the metering enclosure will be completed by the Interconnected Transmission Owner. The metering control cable and meter cabinets will be supplied and installed by the Interconnected Transmission Owner. The Interconnection Customer will install conduit for the control cable between the instrument transformers and the metering enclosure. The location of the metering enclosure will be determined during construction. The Interconnection Customer will provide 120V power to the meter cabinet. The Interconnected Transmission Owner will provide both the primary and backup meters. The Interconnected Transmission Owner will program, install, and own the primary & backup solid state multi-function meters for the new metering position.

Each meter will be equipped with load profile, telemetry, and DNP outputs. The Interconnection Customer will be provided with one meter DNP output for each meter. ACE will supply a wireless modem for remote meter interrogation. In the event that a wireless modem is unable to reliably communicate, the IC will be required to make provisions for a POTS (Plain Old Telephone Service) line or equivalent technology approved by ACE within approximately three feet of the ACE metering position to facilitate remote interrogation and data collection. It is the Interconnection Customer's responsibility to send the data that PJM and Interconnected Transmission Owner require directly to PJM. The Interconnection Customer will grant permission for PJM to send Interconnected Transmission Owner the following telemetry that the Interconnection Customer sends to PJM: real time MW, MVAR, volts, amperes, generator status, and interval MWH and MVARH.

The Interconnected Transmission Owner's revenue meters will be the official meters and must be the source for reporting generation output to PJM. The Interconnection Customer is responsible for installing telemetry equipment necessary to obtain the revenue meter data and submitting the data to PJM.

8 Telemetry

It is the IC's responsibility to send the data that PJM and Transmission Owner requires directly to PJM. The IC will grant permission for PJM to send Transmission Owner the following telemetry that the IC sends to PJM: real time MW, MVAR, volts, amperes, generator status, and generator breaker position.

9 Environmental, Real Estate and Permitting

9.1 Permitting and Real Estate

All work to accommodate the interconnection of AE1-229 is dependent upon the IC obtaining all necessary permits. Moreover, the IC shall be responsible for acquiring all necessary real property rights and acquisitions, including but not limited to rights of way, easements, and fee simple, in a form approved by Transmission Owner. Any setbacks in obtaining the necessary real property rights, acquisitions and permits required for this interconnection may delay the construction schedule.

9.2 Environmental

Environmental permits may need to be secured. Additional tree trimming/clearing may be needed. This estimate assumes that all the applicable permitting will be obtained by the IC for the generating facility and the service road(s).

10 Proposed Schedule for Completion of Work

The Transmission Owner project schedule is based on an 36-48-month lead-time from receipt of a fully executed interconnection agreement; this timeline is subject to storm damage and restoration efforts that may impact the resources and/or the geographic area of this project, time of year limitations, permitting issues, outage scheduling, system emergencies, and contractor and equipment availability.

It is important to note that this project will be incorporated into the existing project workload at Transmission Owner at the time of contract execution. If the workload of existing projects is extensive, resource constraints may cause this project to be delayed beyond the planned in-service date.

Attachment/Upgrade Facilities	*Timeframe*
Transmission Attachment Facilities AE1-229 Construction	36-48 months

11 Total Cost of Transmission Owner Facilities

Item	*Total Cost*
Transmission Owner Facilities	**$8,706,302**

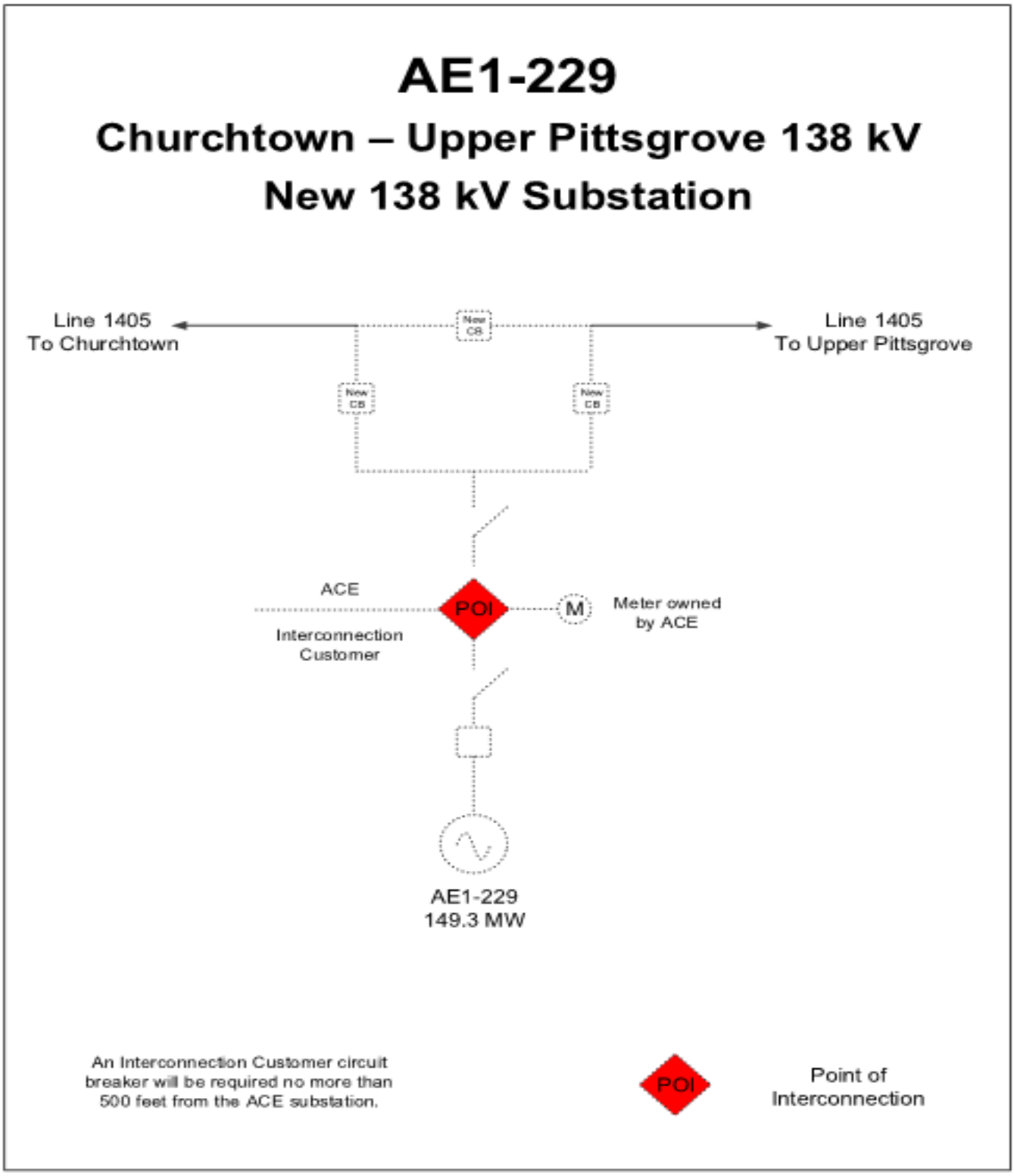
12 Transmission Owner Scope of Work Cost Breakdown

Attachment Facilities for AE1-229	*Costs ($)*		*Total Cost ($)*
	Material/Equip.	Labor	
Planning/Engineering & Design		$119,320	$119,320
Execution/Construction	$245,368	$224,432	$469,800
Total Cost	$245,368	$343,752	**$589,120**

Direct Connection Facilities for AE1-229	*Costs ($)*		*Total Cost ($)*
	Material/Equip.	Labor	
Planning/Engineering & Design		$650,018	$650,018
Execution/Construction	$4,100,767	$3,366,397	$7,467,164
Total Cost	$4,100,767	$4,016,415	**$8,117,182**

Generation projects meeting IRS "Safe Harbor" provisions generally do not incur "CIAC"(Contribution in Aid to Construction), a tax collected by the utility for the state or federal government. Transmission Owner does not expect to collect CIAC for this project. If for any reason "CIAC" would be required for this project, it would be the responsibility of the party owning the generator to pay this cost.

Transmission Owner reserves the right to charge the Interconnection Customer operation and maintenance expenses to maintain the Interconnection Customer attachment facilities, including metering facilities, owned by Transmission Owner.


AE1-229
Churchtown – Upper Pittsgrove 138 kV
New 138 kV Substation
Line 1405
To Churchtown
New CB
Line 1405
To Upper Pittsgrove
New CB
New CB
ACE
POI
M
Meter owned by ACE
Interconnection Customer
AE1-229
149.3 MW
An Interconnection Customer circuit breaker will be required no more than 500 feet from the ACE substation.
POI
Point of Interconnection