Generation Interconnection Facilities Study Report

for

PJM Generation Interconnection Request Queue Position AB2-049

"Gloucester Township 12 kV"

Revised June 2020

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A. Transmission Owner Facilities Study Summary

1. Description of Project

Syncarpha GEMS, LLC, the Interconnection Customer (IC), has proposed a 3 MW MFO (1.14 MWC) solar generating facility to be located in Gloucester Township, New Jersey. PJM studied AB2-049 as a 3 MW injection into Atlantic City Electric Company's (ACE) system at the Pine Hill 69 kV Substation and evaluated it for compliance with reliability criteria for summer peak conditions in 2020. The planned in-service date is 12-18 months from the date an interconnection agreement is executed between ACE and the IC.

The subject generation will require one (1) new Point of Interconnection (POI) off of ACE's existing Pine Hill Substation 69/12 kV transformer T4. To establish this connection, a tap will be made to ACE's existing feeder NJ1145. An ACE-operated recloser equipped with relaying and communications and utility grade primary metering will be installed at the POI. Since transfer trip of the POI recloser is required, an ADSS fiber optic path must be established from Pine Hill Substation to the POI.

At Pine Hill Substation, the LTC controller for Transformer T4 will be replaced with a new controller capable of handling reverse power flow, and the T4 differential protection scheme will be reconfigured to use a new microprocessor relay.

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 March 2017, has changed. Specifically, an upgrade of T4's LTC controller and differential protection has been determined to be necessary as described in Section 1 above. The estimates herein were also performed in more detail than those provided in the Impact Study.

3. Interconnection Customer's Milestone Schedule

ACE's portion of the project is projected to be completed approximately 12-18 months following receipt of a fully executed interconnection agreement. This schedule assumes standard land use and environmental permitting and approval processes.

Substation Work Complete:	12-18 months prior to new estimated ISD
Commercial Operation:	On or before June 3, 2023

4. Customer's Scope of Work

The IC assumes full responsibility for the design, permitting and construction of all facilities associated with the AB2-049 generating station on their side of the POI. AB2-049 will interconnect with the ACE distribution system via the existing ACE 12 kV Feeder NJ1145. ACE will construct all necessary Feeder upgrades and installations and will perform all necessary work at Pine Hill Substation to accommodate this interconnection.

This proposed interconnection will be required to satisfy the requirements outlined in IEEE 1547, including but not limited to over/under voltage, over/under frequency and anti-islanding requirements. ACE's system protection group will need to receive the proposed settings for review to ensure compliance with this standard.

The proposed interconnection will be required to satisfy the requirements outlined in ACE's "Technical Considerations Covering Parallel Operations of Customer Owned Generation" document for units greater than 1 MW. ACE's system protection group will need to receive the proposed settings and associated schemes for review to ensure compliance with this standard.

Step-up Transformer Requirements

If the IC elects to use a step-up transformer with a delta high side winding, additional measures are required in order to prevent Temporary-Over-Voltage (TOV) during abnormal conditions. Three phase voltage sensing must be installed on the high side (12 kV) of the generator's transformer. Potential Transformers (PT's) cannot be installed on lower voltage bus. This requirement can be avoided by using a grounded-wye/grounded-wye step-up transformer.

Inverter Requirements

The inverters at the DG location shall have the following capabilities:

- Voltage flicker reduction through dynamic VAR or fixed PF response
- Ramp rate control
- SCADA communications
- Curtailment or other mitigation ability if high voltage were to occur
- Disturbance ride through for both voltage and frequency
- Ability to receive and respond to a transfer trip signal
- Ability to adjust PF or VARs based on utility signal
- Ability to adjust real power output based on utility signal
- Ability to operate on a Volt/VAR schedule
- Ability to maintain a voltage schedule

The inverter(s) shall operate in accordance with both the IEEE 1547 and UL 1741 series of standards that have been approved and use default settings except when specified otherwise by ACE. While inverters should be capable of voltage stabilization through dynamic VAR response and capable of low voltage and system disturbance ride through, neither of these capabilities will be implemented until such time that the IEEE 1547 series of standards are revised and approved to include standards for these capabilities. At such time as these revised standards become available, the generation owner/operator shall cooperate with ACE to implement these capabilities with settings acceptable to ACE. Until such time, the inverters shall operate with a fixed power factor value between 0.95 lead and 0.95 lag as specified by ACE. The value is supplied below:

1. Operate inverters at unity (**1.00**) power factor ("PF")

Note: In the future, ACE reserves the right to issue new fixed power factor setting requirements (0.95 lead to 0.95 lag) if necessary.

It is the responsibility of the owner to secure the inverter from any unauthorized access (including physical and remote access) which could alter settings or adversely affect the inverter's ability to operate as required. Security measures should include utilizing secure password settings and/or physical locks on cabinet doors.

ACE will require the capability to remotely disconnect the generator from the grid by communication from its System Operations facility. Such disconnection may be facilitated by a generator breaker, a line recloser, or other method depending upon the specific circumstances and the evaluation of ACE.

A mutually acceptable means of interrupting and disconnecting the generator with a visible break, able to be tagged and locked out, shall be worked out with ACE Distribution Engineering. When the trip command is sent to customer equipment rather than a utility owned recloser, the customer must 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 ACE 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.

As the study was performed with the generator on the transformer that it will be served from during normal conditions, the IC will not be allowed to generate when the feeder either is served by an alternate transformer or is in an alternate configuration.

5. Description of Facilities Included in the Facilities Study (ACE's Scope of Work)

This report describes the electrical interconnection facilities and upgrades to existing ACE facilities necessary to support the IC's generation. The IC's interconnection circuit construction and the IC's generation facilities are not included in this study.

Attachment Facilities – Substation

Scope: At Pine Hill Substation, the existing LTC controller for Transformer T4 will be replaced with a new controller capable of handling reverse power flow should it occur. The new controller will be installed in the transformer's control cabinet and will be interfaced to ACE's control system via a multi-mode fiber optic cable to the substation control house. The Transformer T4 differential relaying will be replaced with microprocessor relays and tied into existing schemes as required.

Major Substation Equipment to be Installed

- Prewired Panel Assembly to be installed in existing Panel #1's rack, consisting of the following main items: Qty. 1
    - Microprocessor Transformer Current Differential Relay
    - Lockout Relay
    - Test Switches1
    - Indicator Light
- Tap Changer Controller w/ Adapter Panel Qty. 1

Substation Assumptions

- A mobile transformer is not required to firm load during the required Pine Hill outage(s).

Attachment Facilities – Distribution

Scope: The tie-in for this generation will be established by creating a 3-phase tap at the IC's POI along Hickstown Road to the existing 12 kV feeder NJ1145. This tap will use one (1) 477 AAC conductor per phase, for a total distance of approximately 0.1 mile. Standard ACE overhead wood pole construction will be used.

Additionally, an ACE-operated three-phase recloser equipped with relaying and fiber optic communications must be installed at the POI location. Three wood poles will be needed at the POI (dead-end pole, recloser pole and metering pole). The three-phase 12 kV revenue metering points will be established on the IC side of the recloser at the POI. See Section B.7 of this report for a detailed scope of work.

Major Distribution Equipment to be Installed (POI-A)

- Three-phase pole-mounted recloser, complete with generator/load side, line side, and recloser bypass switches plus surge arresters and auxiliary transformer — Qty. 1
- Recloser control cabinet with recloser control relay and fiber optic communications — Qty. 1
- Three-phase set of pole-mounted revenue grade metering transformers (VT's & CT's), complete with surge arresters and disconnect switches — Qty. 1
- Revenue quality meters — Qty. 2
- 477 AAC conductor, bare — Qty. 600 ft.
- Neutral Conductor, 1/0 CU, bare — Qty. 200 ft.
- Recloser pole, wood — Qty. 1
- Metering pole, wood — Qty. 1
- Double Dead-End pole, wood — Qty. 1

Distribution Assumptions

- No modifications are required to existing feeder NJ1145.
- Matting will generally not be needed as the entire route is along public roads.
- ACE will supply and install the metering transformers, meters, and wireless modem for the POI location. In the event that a wireless modem is unable to reliably communicate at the POI, the IC will be responsible for providing a POTS (Plain Old Telephone Service) line or equivalent technology approved by ACE. The IC will be responsible for any necessary auxiliary power for the meters as required by ACE.

Attachment Facilities – Telecommunications

Scope: OPGW is already installed on the nearby 0756 Pine Hill – Pitman 69kV line. There is a fiber optic splice case installed on the dead-end transmission structure for the 0756 line where the line intersects Hickstown Road. A 48SM ADSS fiber optic cable can be installed from this transmission structure to the existing feeder on the south side of Hickstown Road (which is underbuilt on the 0756 line). This ADSS cable would then be routed overhead along the existing feeder to reach the POI location. The total distance to run the ADSS cable is approximately 0.60 mile.

A fiber optic splice / break-out box will need to be installed at the IC's location to allow fiber to be routed to the POI's recloser controls.

Major Telecommunications Equipment to be Installed

- 48SM ADSS fiber optic cable Qty. 3,700 ft

Telecommunications Assumptions

- It is assumed that the fiber optic communications with the POI recloser will be implemented using the existing OPGW along the 0756 Pitman line. If new ADSS must be run from Pine Hill Substation to the POI recloser rather than using the OPGW, conduit will be required from the control house to a riser pole outside the substation
- Sufficient fiber optic pairs are available in the existing OPGW from Pine Hill to the splice case at Hickstown Road such that they can be used as the communications path back to Pine Hill for the POI recloser. If this existing OPGW path cannot be used for the POI recloser, significantly more ADSS cable will be required and a new route established.

6. Total Cost of Transmission Owner Facilities Included in the Facilities Study

Item	*Total Cost*
Substation Attachment Facilities	$237,770
Distribution Line Attachment Facilities	$697,271
Total Cost	**$935,041**

7. Summary of the Schedule for Completion of Work for the Facilities Study

The overall estimated timeline for this project, including upgrades, is approximately 12-18 months after receipt of a fully executed interconnection agreement.

Attachment Facility	*Timeframe*
Engineering, Procurement, and Construction	12-18 months

B. Transmission Owner Facilities Study Results

This section describes facilities identified to be installed, replaced, and/or upgraded by ACE to accommodate the project. During detailed design and analysis other components may be identified for installation or replacement due to this interconnection.

1. Transmission Lines – New

Not applicable

2. Transmission Lines – Upgrade

Not applicable

3. Distribution Lines – Upgrade

- Install a 3-phase tap off of the existing NJ1145 feeder, using standard ACE wood pole construction and one (1) 477 AAC Conductor per phase and 1/0 CU neutral.
- Install three (3) wood poles (double dead-end pole, recloser pole and metering pole).
- Install a 3-phase pole-mounted recloser with disconnect and bypass switches, surge arresters, transformer, and control cabinet with relay.
- Install a 3-phase pole-mounted revenue grade metering transformer with disconnect switches and surge arresters.
- Install revenue quality meters.
- Install insulators, connectors, fittings, grounding, guying, etc.

4. New Substation/Switchyard Facilities

Not applicable

5. Substation/Switchyard Facility Upgrades

Pine Hill Substation

- Remove existing Transformer T4 LTC controller and replace with new unit
- Remove existing Transformer T4 differential relays and replace with new microprocessor unit
- Install conduit from control house to Transformer T4
- Install pre-ducted multi-mode fiber optic cable between the SCADA system in the control house and the LTC controller in the Transformer T4 control cabinet. Connect each end using new fiber optic transceivers.
- Test and commission all new relay, control, and communications systems.

6. Telecommunications Facility Upgrades

- The new relay will need to be connected to the station's existing GPS clock and Ethernet switch.
- Install 48SM ADSS cable between the POI and existing fiber optic splice case on the 0756 Pine Hill – Pitman 69kV dead-end structure at Hickstown Rd.

Drawing Review and Relay Test
ACE will review the IPR cabinet drawing prior to the purchase of equipment then test for proper relay operation after installation of the required protection equipment at IC site.

7. Metering & Communications

Metering

The net interchange of electrical energy will be measured by the new revenue meters, owned by ACE, located at the Point of Interconnection, as shown in Exhibit B. This will be the official measurement of megawatt hours ("MWH") and megavar hours ("MVARH") received into and delivered by the Company's Electric System by the net generation and load behind the meter. These revenue meters will be the source for reporting generation output to PJM.

ACE will purchase all metering instrument transformers and related surge arresters and switches and will install them on an ACE-supplied wood pole at each POI location. All secondary metering wiring will be completed by ACE. The metering control cable and meter cabinets will be supplied and installed by ACE. ACE meter technicians will program and install two solid state multi-function meters (Primary & Backup) for each new metering position. The primary meter will be equipped with load profile, telemetry and DNP V3.00 communications protocol via serial ports (RS-485 for IC's use and RS-232 for ACE's use).

Transmission Owner will supply a wireless modem for MV90 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. The IC should submit this request as early as possible since it can take a substantial amount of time for the phone company to install this line.

The location of the metering cabinets will be determined in the construction phase. The IC will provide 120 VAC power to the primary meter location.

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

High Voltage Warning

Typically, voltage received at the IC's meter from the utility can be up to 105% of nominal (without generation on). Normal operating procedures dictate that voltage at the substation be raised to the higher end of an acceptable bandwidth in order to provide adequate supply to distant customers. It is recommended that the IC use step-up transformers with no load taps at the POI to adjust secondary voltage to avoid the possibility of inverter trips. Failure to account for this may result in lost energy production.

8. Environmental, Real Estate and Permitting

Permitting and Real Estate

All work to accommodate the interconnection of AB2-049 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 ACE. Any setbacks in obtaining the necessary real property rights, acquisitions and permits required for this interconnection may delay the construction schedule. Road crossing permits will be required at several locations for the new express feeder.

Environmental

Environmental permits may need to be secured in order to rebuild the existing pole line. In particular, additional tree trimming or clearing may be needed. This estimate assumes that all the applicable permitting will be obtained for the generating facility by the IC.

9. Summary of Results of Study

10. **Description**	**Total Cost (Forecast)**
JOB AB2-049 Pine Hill 12kV Substation Attachments	$237,770.36
Indirects	$54,870.08
Project Coordination & Oversight	$21,021.64
Complete Project Plan	$1,980.44
Project Design	$13,728.56
Procure	$460.00
Project Construction Coordination & Oversight	$40,535.84
Construction Prep	$5,544.56
Material Delivery	$356.92
Field Construction	$97,861.36
Perform Construction Close	$1,410.96
	$237,770.36

Description	Total Cost (Forecast)
JOB AB2-049 Pine Hill 12kV Feeder NJ1145 Revised Scope	$697,271
Indirects	$160,563
Project Coordination & Oversight	$52,522
Complete Project Plan	$14,097
Project Design	$31,520
Permitting & Licensing	$41,874
Procure	$3,290
Project Construction Coordination & Oversight	$78,721
Construction Prep	$16,967
Material Delivery	$2,642
Field Construction	$281,248
Perform Construction Close	$9,827
	$697,271

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. ACE 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.

ACE reserves the right to charge the Interconnection Customer operation and maintenance expenses to maintain the Interconnection Customer attachment facilities, including but not limited to metering facilities, owned by ACE.

11. Schedules and Assumptions

The ACE schedule is based on an 12-18 month lead-time from receipt of a fully executed interconnection agreement, including the assumption that it would not be impacted by storm damage and restoration, 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 work load at ACE 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 projected in-service date.

Attachment #1