*Revised Generation Interconnection*
*Facilities Study Report*

---

# *PJM Generation Interconnection Request Queue Position AD2-135 "Williamstown 12 kV"*

February 2021
Revised: July 2021

**Table of Contents**

## *Transmission Owner Facilities Study Summary*

### 1 Description of Project

The Township of Monroe, Gloucester County, New Jersey, the Interconnection Customer (IC), has proposed a 1.62 MW (0.60 MWC) solar generating facility on Sicklerville Road, Monroe Township, Gloucester County, NJ at approximately Latitude 39°42'7.91"N, Longitude 74°59'2.38"W. PJM studied AD2-135 as a 1.62 MW injection into the Atlantic City Electric Company's (Transmission Owner) system at the Sickler 69/12 kV substation and evaluated it for compliance with reliability criteria for summer peak conditions in 2021. The planned in-service date, as requested by the IC is August 1, 2019; this shall be modified pursuant the execution of an interconnection agreement (ISA/WMPA/CSA) and in consideration of the Transmission Owner's construction timeline.

The proposed 1.62 MWs of generation will require one (1) new Point of Interconnection (POI) off Transmission Owner's existing NJ1733 feeder which is fed from Sickler Substation's 69/12 kV T4 transformer. To accommodate this interconnection, a Transmission Owner-operated recloser equipped with relaying and communications will be installed at the POI location. Utility grade primary metering, generation telemetry and remote trip capability will also be required as part of this interconnection. The POI will be located on the Interconnection Customer's side of the aerial metering cluster disconnect switch. (At the POI, feeder NJ1733 is collocated with Transmission Owner's 0754 Monroe-Tansboro 69kV transmission line, thus the initial tap off to the POI will be on a transmission level structure.)

### 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 February 2019 has changed; the Transmission Owner has identified a need for direct transfer trip and thus, substation upgrades will be required for the interconnection of AD2-135. These upgrades are detailed further within this report.

Moreover, the responsibilities for purchase and installation of metering equipment and connections have been modified within this report to note the Transmission Owner as the responsible entity instead of the IC. 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: | 3-6 months prior to ISD |
| Commercial Operation: | 5/1/2023 |

### 4 Interconnection Customer's Scope of Work

#### *4.1 IC's General Scope*

The IC assumes full responsibility for the design, permitting and construction of all facilities associated with the AD2-135 generating station on their side of the Point of Interconnection (POI). AD2-135 will interconnect with the Transmission Owner distribution system via the existing

Transmission Owner 12 kV Feeder NJ1733. Transmission Owner will construct all necessary upgrades to feeder NJ1733. The IC also assumes responsibility for the permitting and construction of any planned access roads to the generating site. The IC will grant the necessary access and right-of-way required for the Transmission Owner to build and maintain the planned feeder work on the utility side of the POI.

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 location installed by Transmission Owner.

This proposed interconnection will be required to satisfy the requirements outlined in the latest IEEE 1547 series of standards, including but not limited to over/under voltage, over/under frequency and anti-islanding requirements and the requirements outlined in Transmission Owner's "Technical Considerations Covering Parallel Operations of Customer Owned Generation" document for units greater than 1 MW. The Transmission Owner's System Protection group will need to receive the proposed settings and associated schemes for review to ensure compliance with these standards.

### *4.2 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.

### *4.3 Inverter Requirements and Capabilities*

The inverters at the distributed generation (DG/PV site) 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 shall operate in accordance with the IEEE 1547 series of standards that have been approved and use default settings except when specified otherwise by Transmission Owner. The

IC owner/operator shall cooperate with Transmission Owner to implement these capabilities with settings acceptable to the Transmission Owner. The Transmission Owner reserves the right to request setting changes in the future if needed to maintain electrical system integrity.

It is the responsibility of the IC 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.

### *4.4 Power Factor Requirements*

The generators used for this project shall be capable of operating at a power factor (or schedule) specified by Transmission Owner in the range of 0.95 lead to 0.95 lag. It is the responsibility of the developer/customer to obtain equipment that can operate with these requirements while also meeting all applicable requirements of IEEE and UL standards such as but not limited to IEEE 1547 and UL 1741.

For this project, operate inverters at a unity power factor ("PF") of (1.0) not impacting Volt-ampere reactive ("VARs") continuously. In the future, Transmission Owner reserves the right to issue new fixed power factor setting requirements if necessary.

### *4.5 Operating Requirements*

Transmission Owner will require the capability to remotely disconnect the generator from the grid by communication from its System Operations facility. Such disconnection is planned to be facilitated via a line recloser. 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 Transmission Owner's Distribution Engineering group. 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 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.

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.

### *4.6 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.

## 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 Lines*

No new transmission facilities are necessary for the planned interconnection of AD2-135 given the current interconnection size and system configuration.

### *5.2 Attachment Facilities – Substation*

No new substation facilities are necessary for the planned interconnection of AD2-135 given the current interconnection size and system configuration.

### *5.3 Attachment Facilities – Distribution*

The interconnection of AD2-135 will require the installation of a tap off of the existing line in the vicinity of the existing grid location (pole) 64479/41707 on NJ1733. At the POI, Transmission Owner will be installing a three-phase 12 kV metering cluster pole and a utility-operated recloser equipped with relaying and wireless communications on a separate pole. Transmission Owner overhead wood pole construction standards will be used for this installation. In addition, fiber-optic cable, ADSS, will be required to provide means for communications for transfer trip and recloser telemetry. The fiber will be installed from Sickler substation to the POI; the fiber run will most likely run along feeder NJ1733, but specific route will be determined during detailed design. The major material/equipment components and associated labor activities are detailed below.

*Major Distribution/Metering Equipment to be Installed*

| Material/Equipment | Quantity |
|---|---|
| ▪ Conductor, 477 AAC | 900 ft |
| ▪ Neutral, 477 AAC | 300 ft |
| ▪ Fiber-Optic Cable, ADSS, 1300 nm Single-Mode, 48 fibers | 3 miles |
| ▪ ADSS connectors, fittings /pole (approximation based on 200' spans) | 80 |
| ▪ Wood pole (for metering cluster) | 1 |
| ▪ Wood pole (for recloser) | 1 |
| ▪ Insulators, connectors, fittings, grounding, etc. | 1 lot |
| ▪ 3-phase pole-mounted recloser with disconnect and bypass switches, surge arresters, and transformer | 1 set |
| ▪ Recloser control cabinet with SEL-651R-2 relay | 1 |
| ▪ SEL-3622 security gateway (at recloser control cabinet) | 1 |
| ▪ Serial/Fiber Optic Transceiver (SEL-2830) | 1 |
| ▪ Radio Unit, Ebridge, Silver Spring | 1 |
| ▪ Antenna, 824-960MHz | 1 |
| ▪ Battery backup, 13AH | 1 |
| ▪ 3-phase pole-mounted revenue grade metering transformers with disconnect switches and surge arresters | 1 set |
| ▪ High-end primary (1) and backup (1) revenue quality meters | 2 |

*Major Labor Activities*

- Install wood poles at POI location (recloser pole and metering pole)
- Reconfigure existing pole 64479/41707 at the distribution level to tap-off from the main line along Sicklerville Rd.
- Install insulators, connectors, fittings, grounding, etc. associated with the listed installations
- Install 3-phase pole-mounted recloser with disconnect and bypass switches, surge arresters
- Install 3-phase pole-mounted revenue grade metering transformers with disconnect switches and surge arresters at POI location
- Install revenue quality meters (primary/backup) at POI location inclusive of secondary wiring connections
- Install 3-miles of ADSS on existing poles from substation to POI.
- Program and install revenue quality meters (primary/backup) at POI location inclusive of secondary wiring connections
- Install the metering control cable and meter cabinets located on the metering cluster pole.

*Assumptions*

- Minimal traffic control will be required for the work required to make the tap off the existing feeder along Sicklerville Rd. However, the installation of ADSS along the proposed route may require traffic control measures.
- SEL-2830 will be installed with an attenuator due to the distance between the substation and recloser site.

### *5.4 Attachment Facilities – Telecommunications*

The recloser control at the POI will communicate with Transmission Owner System Operations using radio/wireless communications as described in Section 5.3. This work will involve the installation of (1) radio/wireless communications package for recloser controls at the POI location.

Transmission Owner 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.

## 6 Upgrade Facilities: Transmission Owner Scope of Work

This section describes upgrades to existing facilities required to accommodate the interconnection of AD2-135. During detailed design and analysis other components may be identified for installation or replacement due to this interconnection.

### *6.1 Upgrade Facilities-Transmission Lines*

No upgrades to transmission facilities are necessary for the planned interconnection of AD2-135 given the current interconnection size and system configuration.

### *6.2 Upgrade Facilities-Substations*

The interconnection of AD2-135 will require modifications to the protection and control of Sickler 69kV/12kV Transformer #4. Existing 12kV Feeder NJ1733 is currently being upgraded under another scope of work and those SEL451 relays will be used for direct transfer trip of the generation facilities. More specifically, an output from the existing transformer relay (CB M-SEL451) will be wired to an input on the feeder relay (1733P-SEL451) initiating direct transfer trip of the IC facilities under abnormal/fault conditions. Transfer trip signals will utilize single-mode fiber between Sickler Substation and the new distribution recloser pole installed as part of this project. The addition of this generation facility is based on normal operations of Transformer #4. A status contact (52b) from Sickler feeder breaker "J" will be wired to an input of the CB M-SEL451 relay; relay logic will utilize this status to prevent IC facilities from connecting to the system while feeder NJ1733 is in an alternate configuration. The T4 tapchanger controls require updating to handle reverse power flow that the generator will cause.

*Major Substation Equipment to be Installed*

| **Material/Equipment** | **Quantity** |
|---|---|
| ▪ Control Cable 4C#10AWG | 1,000 ft |
| ▪ Serial/Fiber Optic Transceiver (SEL-2830) | 1 |
| ▪ Multimode (62.5um) Fiber-Optic Cable | 200 ft |
| ▪ Single-Mode (1300nm) Fiber-Optic Patch Cable | 100 ft |
| ▪ Conduit, 4-inch, sch 40 PVC | 200 ft |
| ▪ Innerduct for Fiber-Optic cables, 1-inch | 500 ft |
| ▪ Beckwith M-2001C & M-2067B Tapchanger Controller | 1 |
| ▪ Beckwith M-0329B Backup Tapchanger Controller | 1 |
| ▪ Modem/communication package for telemetry | 1 |
| ▪ Radio Unit, Ebridge, Silver Spring | 1 |
| ▪ Antenna, 824-960MHz | 1 |

*Major Labor Activities*

- Install two 4C#10 cables between panels inside the control house
- Install one 4C#10 cable between control house panel and termination cabinet
- Install one 4C#10 cable between control house termination cabinet and CB M.
- Install one 4C#10 cable between control house termination cabinet and T4.
- Install one Multimode Fiber optic cable between T4 and the RTU panel.
- Install one Single-Mode Fiber-Optic Patch cables between panels inside the control house.
- Install one SEL-2830 transceiver on existing 1733P-SEL451 relay.
- Install M-2001C/M-2067B & M-0329B tapchanger controls in existing T4 cabinet.
    - Existing M-0338 & M-0329A tapchanger controls to be removed.
- Install wireless modem/communication package for telemetry including copper ethernet connection to existing ethernet switch.
- Relay settings for CB M-SEL451 & 1733P-SEL451.
- RTU points list updates and configurations for existing Orion RTU & ethernet switch.
- Install 4-inch conduit from first distribution pole outside the yard to the control house for feeder NJ1733.
- Testing and commissioning.

*Assumptions*

- SEL-2830 will be installed with an attenuator due to the distance between the substation and recloser site.
- Existing conduits/trench to CB and transformer are sufficient for newly installed cables.
- NJ1733 feeder protection is upgraded under a different project prior to this queue commencing.

### *6.3 Upgrade Facilities-Distribution*

No upgrades to other distribution facilities beside those noted in Section 5 & 6.2 are necessary for the planned interconnection of AD2-135 given the current interconnection size and system configuration.

### *6.4 Upgrade Facilities-Telecommunications*

No upgrades to other communication systems beside those noted in Section 5 are necessary for the planned interconnection of AD2-135.

## 7 Metering

The net interchange of electrical energy will be measured by the new revenue meter, owned by Transmission Owner, located at the POI, as shown in Attachment 1. This will be the official measurement of megawatt hours ("MWH") and megavar hours ("MVARH") received into and delivered by the Transmission Owner given the net generation and load behind the meter. These revenue meters (primary and backup) will be the source for reporting generation output to PJM.

Transmission Owner will purchase all metering instrument transformers and related surge arresters and switches and will install them on a Transmission Owner-supplied wood pole (metering cluster pole) at the POI location. All secondary wiring at the instrument transformers will be completed by the Transmission Owner. The metering control cable and meter cabinets will be supplied and installed by Transmission Owner and located on the metering cluster pole. Transmission Owner's meter technicians will program and install two solid state multi-function meters (Primary & Backup) for the 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 Transmission Owner's use. The IC shall install their connection to Transmission Owner's meter cabinet accordingly. 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.

It is critical that the IC provides 120 VAC power to the primary meter location. The exact location of the metering cabinets will be determined in the detailed design and construction phase.

## 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 AD2-135 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 in order to install the tap off NJ1733 feeder. This estimate assumes that all the applicable permitting will be obtained for the generating facility by the IC, including the permits for the work to install the service road and thus, allowing the colocation of the feeder alongside it.

## 10 Proposed Schedule for Completion of Work

The Transmission Owner project schedule is based on an 12-18 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* |
|---|---|
| Distribution Attachment Facilities | 12-18 months |
| Permitting and Real Estate | 12-18 months |

## 11 Total Cost of Transmission Owner Facilities

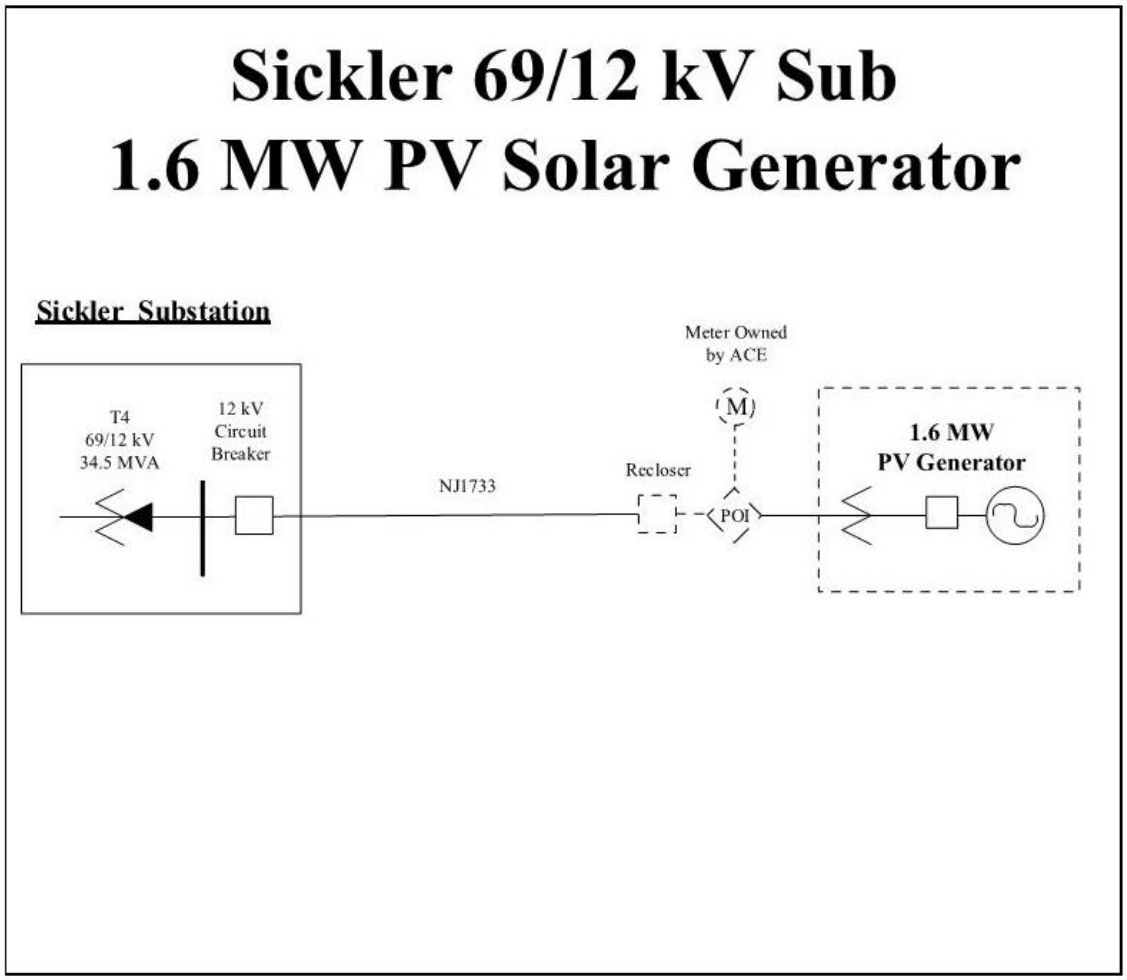
| *Item* | *Total Cost* |
|---|---|
| Distribution Attachment Facilities | $1,390,326.93 |

## 12 Transmission Owner Scope of Work Cost Breakdown

| Description | Total Cost (Forecast) |
|---|---|
| JOB | $1,390,326.93 |
| Indirects | $320,844.68 |
| Project Coordination & Oversight | $105,330.06 |
| Perform Property Analysis | $1,579.84 |
| Complete Project Plan | $28,132.64 |
| Project Design | $80,884.68 |
| Permitting & Licensing | $789.92 |
| Procure | $7,445.68 |
| Project Construction Coordination & Oversight | $205,014.20 |
| Construction Prep | $27,511.20 |
| Material Delivery | $7,547.84 |
| Field Construction | $582,294.83 |
| Perform Construction Close | $22,951.36 |
| | **$1,390,326.93** |

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.




POI Point of Interconnection