Generation Interconnection
Feasibility Study Report
Queue Position AE1-061

The Interconnection Customer (IC), has proposed a 10.0 MW Energy (5.0 MW Capacity) battery storage generating facility to be located at 3039 Vine Rd, Vineland, Atlantic County, New Jersey. PJM studied the AE1-061 project into the Atlantic City Electric Company (ACE) system as an injection into the Minotola 12 kV Substation at the T1 transformer (PSSE bus #228515) and evaluated it for compliance with reliability criteria for summer peak conditions in 2022. AE1-061 was studied with a commercial probability of 53%. The in-service date, as requested by the IC during the project kick-off call, is September 1, 2020. This date may not be attainable due to required PJM studies (System Impact and Facilities) and the Transmission Owner's construction schedule.

Point of Interconnection

The IC requested a distribution level Point of Interconnection. As a result, the AE1-061 project will interconnect with the Atlantic City Electric Company distribution system as follows:

- 10 MWs of generation will connect to a new 138/13 kV transformer at the Minotola Substation via a new express feeder.

Direct Connection Requirements

Criteria Limits for Distributed Energy Resource (DER) Connections to the ACE, DPL and Pepco Distribution Systems (less than 69kV)

1. Single Phase Limit
Any DER with a capacity that exceeds 100kW shall be a balanced 3 phase system.

2. Voltage Limits
DER's are permitted to cause a voltage fluctuation of up to 2% at the Point of Interconnection, ½ the band width of any voltage regulator at its terminals, and ½ the net dead band of a switched capacitor bank at its connection point. When a DER is at maximum output, it shall not raise the feeder voltage above the ANSI C84.1 or state limit, whichever is more conservative.

3. Existing Distribution Circuit Capacity Limits
The aggregate limit of large (250 kW and over) generators running in parallel with a single, existing distribution circuit is 0.5 MWs on the 4kV, 3MWs on the 12 kV, 6 MWs on the 25 kV, and 10 MWs on the 34 kV.

4. Express Circuit Capacity Limits
Distributed generation installations which exceed the criteria limit for an existing circuit require an express circuit.

The maximum generator size for express circuits, depending on transformer capacity, shall be:

- 4 kV 0.5 MW

- 12 – 13.8 kV 10 MW
- 23 – 25 kV 10 MW
- 33.26 – 34.5 kV 15 MW

5. Distribution Power Transformer Limit
The aggregate limit of large (250 kW and over) generator injection to a single distribution transformer of 22.5 MVA nameplate or larger is 10 MW. Transformers with nameplate ratings lower than 22.5 MVA will be given lower ratings on an individual basis. If the transformer rating is significantly greater than 40 MVA it may be possible to consider a greater generation capacity.

Adding a new transformer will be considered if there is no availability on any of the existing transformers and space is available in an existing substation. Any proposed transformers would be ACE's standard distribution transformer.

6. Express Circuit Length Limit
If there is no space for an additional transformer at the closest substation, the next closest substation will be considered. The length of an express circuit is limited to 5 miles, or for the sake of the feasibility study, 3.8 straight line miles to the substation. This simplification is used because the feasibility study phase does not allow for the time and resources to examine routes in detail (including existing pole lines, easements, ROW, and environmental issues etc.)

7. When a New Substation is Required
If a distribution express circuit can't be built from an existing substation for a project, it will be necessary to construct a new distribution substation with a standard ring bus design. It will be supplied by extending existing transmission lines. It is the developer's responsibility to verify eligibility of this configuration for solar renewable energy certificates.

All limits, given above in MWs, are subject to more detailed study to ensure feasibility.

Transmission Owner Scope of Work

Transmission Owner scope of work required to accommodate 10 MW of generation via a new Express Feeder from a new Transformer:

1. Design and construct one new 13 kV feeder with 477 AAC from Minotola Substation the generation site – approximately 0.2 miles.
2. One new 13 kV feeder terminal position will be constructed.
3. Install a utility operated recloser equipped with the proper relaying and communications.
4. Install one new 138/13 kV substation transformer at Minotola Substation.
5. Install utility grade primary metering.
6. Generation telemetry and remote trip capability will be provided to the control center.
7. A detailed, time-based study may be performed during later study phases.
8. Direct transfer trip will be required. Approximately 0.2 miles of 48SM ADSS fiber optic cable was estimated for this report to provide the communication channel from Minotola Substation to the battery storage site (note: *this may require secondary zone tree trimming*). 13 kV potential transformers will need to be installed if none already in-service.

Estimated Costs			
Minotola Substation T#			
New Substation Transformer			$4,600,000
477 AAC Express Feeder	0.2	mi.	$115,000
Fiber Installation	0.2	mi.	$45,000
Feeder Terminal			$575,000
Telecommunications Equipment			$68,080
Recloser & Metering			$92,000
SCADA Integration into EMS			$11,500
Miscellaneous Engineering Costs			$69,000
Approximate Total Cost			$5,575,580

The estimated time to complete this work is **24 - 36 months** after receipt of a fully executed interconnection agreement.

The above estimate and scope of work is contingent on the execution of and payment for the work required for both AE1-045 and AE1-046.

Interconnection Customer Scope of Work

The IC is responsible for all design and construction related to activities on their side of the Point of Interconnection. Site preparation, including grading and an access road, as necessary, is assumed to be by the IC. Route selection, line design, and right-of-way acquisition of the direct connect facilities is not included in this report and is the responsibility of the IC.

Protective relaying and metering design and installation must comply with ACE'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.

The IC will purchase and install all metering instrument transformers as well as construct a metering structure per ACE's specifications. The secondary wiring connections at the instrument transformers will be completed by the IC's contractors and inspected by ACE, while the secondary wiring work at the metering enclosure will be completed by ACE's Meter technicians. The metering control cable and meter cabinets will be supplied by ACE and installed by the IC's contractors. ACE's meter technicians will program and install two solid state multi-function meters (Primary & Backup) for the new metering position. Each meter will be equipped with load profile, telemetry, and form-c pulse outputs. The ownership of metering equipment purchased or installed by the IC shall be transferred to the Transmission Owner at Commercial Operation, unless the IC asserts its right to install, own and operate the metering system.

Power Factor Requirement

The generators used for this project shall be capable of operating at a power factor (or schedule) specified by ACE in the range of 0.95 leading to 0.95 lagging. 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 1.00, not impacting Volt-ampere reactive ("VARs") continuously.

Inverter Requirements (if applicable):

The inverter 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 shall operate in accordance with the latest IEEE 1547 series of standards that have been approved and use default settings except when specified otherwise by ACE. The battery storage owner/operator shall cooperate with ACE to implement these capabilities with settings acceptable to ACE. ACE reserves the right to request setting changes in the future if needed to maintain electrical system integrity.

Security Requirements

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

High Voltage Warning

Typically, voltage received at the 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 transformers with no load taps should be used to adjust secondary voltage to avoid the possibility of inverter trips. Failure to account for this may result in lost energy production.

Additional Operating Requirements

1. ACE will require the capability to remotely disconnect the generator from the grid by communication from its System Operations facility. This will be accomplished with a line recloser.
2. It is the IC's responsibility to send the data that PJM and ACE requires directly to PJM (or in some cases to ACE directly). 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 interval MWH and MVARH.
3. The IC will be required to make provisions for a voice quality phone ("plain old telephone", or "POT") line within approximately 3 feet of each ACE metering position to facilitate remote interrogation and data collection.
4. 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.
5. ACE reserves the right to charge the IC operation and maintenance expenses to maintain the IC attachment facilities, including metering and telecommunications facilities, owned by ACE.

Summer Peak Analysis - 2020

Transmission Network Impacts

Potential transmission network impacts are as follows:

Generator Deliverability

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

None

Multiple Facility Contingency

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

None

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)

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
98651	228503	MNOTLA 2	AE	227901	DOROTHY	AE	1	AE_P1-2 LANDIS-MINO	single	478.0	111.68	112.73	DC	5.0

System Reinforcements

(Upgrades required to mitigate reliability criteria violations, i.e. Network Impacts, initially caused by the addition of this project generation)

ID	Index	Facility	Upgrade Description	Cost
98651	3	**MNOTLA 2 138.0 kV - DOROTHY 138.0 kV Ckt 1**	**AE** Description : To mitigate the (ACE) Dorothy-Lewis#3 138 kV line (from bus 227901 to bus 227949 ckt 1) overload, it will require increasing the emergency rating of the Dorothy to Lewis#3 138 kV line by rebuilding the circuit. The rebuild will include the installation of new poles, foundations, insulators, and conductor. Time Estimate : 36-60 Months Cost : $80,000,000	$80,000,000
			TOTAL COST	**$80,000,000**

Short Circuit

No issues identified.

Stability and Reactive Power Requirement

To be performed during later study phases.

Light Load Analysis - 2022

Light Load Studies to be conducted during later study phases (as required by PJM Manual 14B).

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	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
98233	227901	DOROTHY	AE	227949	LEWIS #3	AE	1	AE_P1-2 LANDIS-MINO	operation	205.0	255.83	260.7	DC	10.0
98237	227901	DOROTHY	AE	227949	LEWIS #3	AE	1	Base Case	operation	154.0	174.16	176.55	DC	3.68

98261	228502	MNOTLA 1	AE	228500	LANDIS	AE	1	AE_P1-2 MINO-DOR	operation	286.0	189.53	193.02	DC	10.0
98265	228502	MNOTLA 1	AE	228500	LANDIS	AE	1	Base Case	operation	230.0	121.67	124.42	DC	6.32
98648	228503	MNOTLA 2	AE	227901	DOROTHY	AE	1	AE_P1-2 LANDIS-MINO	operation	478.0	113.4	115.49	DC	10.0

Flow Gate Details

The following appendices contain additional information about each flowgate presented in the body of the report. For each appendix, a description of the flowgate and its contingency was included for convenience. However, the intent of the appendix section is to provide more information on which projects/generators have contributions to the flowgate in question. Although this information is not used "as is" for cost allocation purposes, it can be used to gage other generators impact.It should be noted the generator contributions presented in the appendices sections are full contributions, whereas in the body of the report, those contributions take into consideration the commercial probability of each project.

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ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
98651	228503	MNOTLA 2	AE	227901	DOROTHY	AE	1	AE_P1-2 LANDIS-MINO	single	478.0	111.68	112.73	DC	5.0

Bus #	Bus	MW Impact
902091	W1-130C	0.65
931191	AB1-169A	549.99
938301	AE1-045 C	2.0
938311	AE1-046 C	2.0
938421	AE1-061 C	5.0
BAYOU	BAYOU	0.0
BIG_CAJUN1	BIG_CAJUN1	0.0
BIG_CAJUN2	BIG_CAJUN2	0.01
BLUEG	BLUEG	0.01
CALDERWOOD	CALDERWOOD	0.0
CANNELTON	CANNELTON	0.0
CARR	CARR	0.0
CATAWBA	CATAWBA	0.0
CHEOAH	CHEOAH	0.0
CHILHOWEE	CHILHOWEE	0.0

Bus #	Bus	MW Impact
CHOCTAW	CHOCTAW	0.0
COFFEEN	COFFEEN	0.0
COTTONWOOD	COTTONWOOD	0.01
DEARBORN	DEARBORN	0.0
DUCKCREEK	DUCKCREEK	0.0
EDWARDS	EDWARDS	0.0
ELMERSMITH	ELMERSMITH	0.0
FARMERCITY	FARMERCITY	0.0
GIBSON	GIBSON	0.0
HAMLET	HAMLET	0.0
NEWTON	NEWTON	0.0
PRAIRIE	PRAIRIE	0.01
RENSSELAER	RENSSELAER	0.0
SANTEETLA	SANTEETLA	0.0
SMITHLAND	SMITHLAND	0.0
TATANKA	TATANKA	0.0
TILTON	TILTON	0.0
TRIMBLE	TRIMBLE	0.0
TVA	TVA	0.0
UNIONPOWER	UNIONPOWER	0.0

Contingency Name	Contingency Definition
Base Case	
AE_P1-2 DOR-LEWIS	CONTINGENCY 'AE_P1-2 DOR-LEWIS' OPEN LINE FROM BUS 227901 TO BUS 227949 CIRCUIT 1 / END
AE_P1-2 MINO-DOR	CONTINGENCY 'AE_P1-2 MINO-DOR' OPEN LINE FROM BUS 228503 TO BUS 227901 CIRCUIT 1 / END
AE_P1-2 LANDIS-MINO	CONTINGENCY 'AE_P1-2 LANDIS-MINO' OPEN LINE FROM BUS 228500 TO BUS 228502 CIRCUIT 1 / END