Generation Interconnection
Feasibility Study Report

For

PJM Generation Interconnection Request Queue Position AC2-156

Sandwich

July 2017

Network Impacts

The Queue Project AC2-156 was evaluated as a 20.0 MW (Capacity 7.6 MW) injection at the Sandwich 34.5 kV substation in the ComEd area. Project AC2-156 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AC2-156 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Analysis - 2020

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)

None

Steady-State Voltage Requirements
(Results of the steady-state voltage studies should be inserted here)

To be determined

Short Circuit
(Summary of impacted circuit breakers)

To be determined

Affected System Analysis & Mitigation

MISO Impacts:

There are potential impacts in MISO's area; the impacts will be determined during later study phases.

Delivery of Energy Portion of Interconnection Request

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.
Only the most severely overloaded conditions are listed. 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 will study all overload conditions associated with the overloaded element(s) identified.

1. (CE - CE) The WATERMAN ; B-GLIDDEN ;BT 138 kV line (from bus 272728 to bus 271560 ckt 1) loads from 97.61% to 99.34% (**DC power flow**) of its emergency rating (264 MVA) for the single line contingency outage of '083-L11323__'. This project contributes approximately 4.55 MW to the thermal violation.

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CONTINGENCY '083-L11323__'
 TRIP BRANCH FROM BUS 272730 TO BUS 271558 CKT 1              / WATER;3B 138 GLIDD; B 138
 END
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2. (CE - CE) The WATERMAN ; B-GLIDDEN ;BT 138 kV line (from bus 272728 to bus 271560 ckt 1) loads from 90.9% to 92.5% (**DC power flow**) of its normal rating (208 MVA) for non-contingency condition. This project contributes approximately 3.34 MW to the thermal violation.

3. (CE - AEP) The UNIV PK N;RP-05OLIVE 345 kV line (from bus 274804 to bus 243229 ckt 1) loads from 99.99% to 100.01% (**DC power flow**) of its normal rating (971 MVA) for the single line contingency outage of '765-L11216__-S'. This project contributes approximately 1.61 MW to the thermal violation.

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CONTINGENCY '765-L11216__-S'
 TRIP BRANCH FROM BUS 270644 TO BUS 270607 CKT 1              / WILTO; 765 COLLI; 765
 END
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Light Load Analysis - 2020

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

System Reinforcements

Short Circuit

(Summary form of Cost allocation for breakers will be inserted here if any)

To be determined

Stability and Reactive Power Requirement

(Results of the dynamic studies should be inserted here)

To be determined

Summer Peak Load Flow Analysis Reinforcements

New System Reinforcements

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

None

Contribution to Previously Identified System Reinforcements

(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project. This project may have a % allocation cost responsibility which will be calculated and reported for the Impact Study)
(Summary form of Cost allocation for transmission lines and transformers will be inserted here if any)

None

Secondary Point of Interconnection (POI)

AC2-156, a 50MW solar facility, proposes to interconnect with the ComEd transmission system by connecting to the 138kV bus at Sandwich TSS 146.

Attachment Facilities

The AC2-156 generator lead will interconnect to the 138kV bus at Sandwich TSS 146. This interconnection would require one 138kV circuit breaker, a dead-end structure and revenue metering as shown in the one line diagram.

The cost for the attachment facilities is estimated at $4M. ComEd would take 18-24 months to complete this interconnection from the date ISA and ICSA are executed.

Scope of Work	Cost Estimate
Installation of one 138kV circuit breaker, one dead-end structures and one set of revenue metering (see notes below on cost estimate)	$4,000,000

Direct Connection Network Upgrades

In order to accommodate interconnection of AC2-156, a new 138kV circuit breaker is required at Sandwich TSS 146.

The scope of work includes installation of one 138kV circuit breaker at TSS 146 Sandwich Substation, as shown in the one line diagram below.

The preliminary cost estimate for Direct Connection Network Upgrade is given in the following table.

Scope of Work	Cost Estimate
Installation of a new 138kV circuit breaker at TSS 146 Sandwich Substation together with relay/communication	$3,000,000

ComEd would take approximately 24-months to construct after the ISA / ICSA are signed.

Non-Direct Connection Network Upgrades

The new 138kV circuit breaker at Sandwich TSS 146 will require relay/communications/SCADA upgrades at Waterman TSS 113 and Plano West TDC 527. The ComEd cost at each of these substations is given below:

Scope of Work	Cost Estimate
Relay/communications/SCADA upgrades at Waterman TSS 113 substation	$500,000
Relay/communications/SCADA upgrades at Plano West TDC 527 substation	$500,000
Total Cost Estimate (see notes below on cost estimate)	$1,000,000

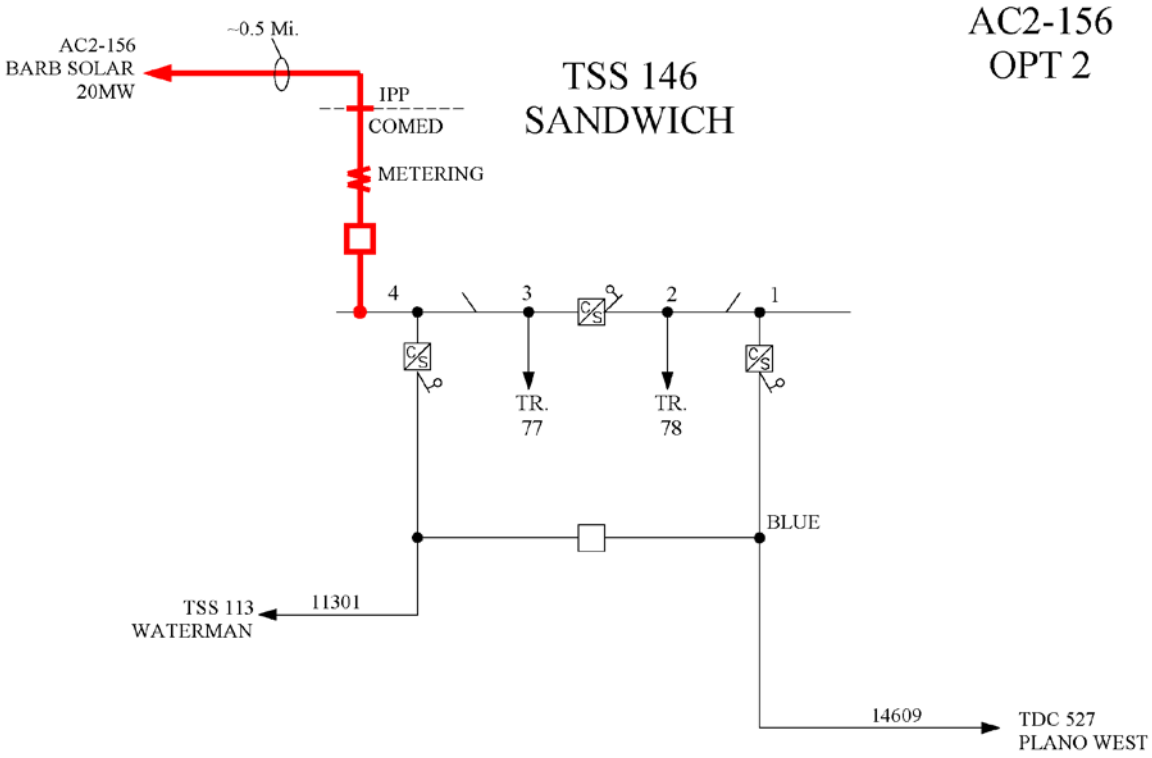
Notes on Cost Estimate:

1) These estimates are Order-of-Magnitude estimates of the costs that ComEd would bill to the customer for this interconnection. These estimates are based on a one-line electrical diagram of the project and the information provided by the Interconnection Customer.

2) There were no site visits performed for these estimates. There may be costs related to specific site related issues that are not identified in these estimates. The site reviews will be performed during the Facilities Study or during detailed engineering.

3) These estimates are not a guarantee of the maximum amount payable by the Interconnection Customer and the actual costs of ComEd's work may differ significantly from these estimates. Per the PJM Tariff, Interconnection Customer will be responsible for paying all actual costs of ComEd's work.

4) The Interconnection Customer is responsible for all engineering, procurement, testing and construction of all equipment on the Interconnection Customer’s side of the Point of Interconnection (POI).



Network Impacts

The Queue Project AC2-156 was evaluated as a 20.0 MW (Capacity 7.6 MW) injection at the Sandwich 138 kV substation in the ComEd area. Project AC2-156 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AC2-156 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Analysis - 2020

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)

None

Steady-State Voltage Requirements
(Results of the steady-state voltage studies should be inserted here)

To be determined

Short Circuit
(Summary of impacted circuit breakers)

To be determined

Affected System Analysis & Mitigation

MISO Impacts:

MISO Impacts to be determined during later study phases (as applicable).

Delivery of Energy Portion of Interconnection Request

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.
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1. (CE - CE) The WATERMAN ; B-GLIDDEN ;BT 138 kV line (from bus 272728 to bus 271560 ckt 1) loads from 97.62% to 99.34% (**DC power flow**) of its emergency rating (264 MVA) for the single line contingency outage of '083-L11323__'. This project contributes approximately 4.54 MW to the thermal violation.

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CONTINGENCY '083-L11323__'
 TRIP BRANCH FROM BUS 272730 TO BUS 271558 CKT 1              / WATER;3B 138 GLIDD; B 138
 END
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2. (CE - CE) The WATERMAN ; B-GLIDDEN ;BT 138 kV line (from bus 272728 to bus 271560 ckt 1) loads from 90.9% to 92.5% (**DC power flow**) of its normal rating (208 MVA) for non-contingency condition. This project contributes approximately 3.34 MW to the thermal violation.

Light Load Analysis - 2020

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System Reinforcements

Short Circuit

(Summary form of Cost allocation for breakers will be inserted here if any)

To be determined

Stability and Reactive Power Requirement

(Results of the dynamic studies should be inserted here)

To be determined

Summer Peak Load Flow Analysis Reinforcements

New System Reinforcements

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

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Contribution to Previously Identified System Reinforcements

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(Summary form of Cost allocation for transmission lines and transformers will be inserted here if any)

None