Feasibility Study Report

For

PJM Generation Interconnection Request Queue Position AD1-067

Mendota Hills

June 1, 2018

Preface

The intent of the feasibility study is to determine a plan, with ballpark cost and construction time estimates, to connect the subject generation to the PJM network at a location specified by the Interconnection Customer. The Interconnection Customer may request the interconnection of generation as a capacity resource or as an energy-only resource. As a requirement for interconnection, the Interconnection Customer may be responsible for the cost of constructing: (1) Direct Connections, which are new facilities and/or facilities upgrades needed to connect the generator to the PJM network, and (2) Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system.

In some instances a generator interconnection may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection, may also contribute to the need for the same network reinforcement.

For Local and Network Upgrades which are required due to overloads associated with the System Impact Studies of an individual New Services Queue, and have a cost less than $5,000,000, the cost of the Local and Network Upgrades will be shared by all proposed projects which have been assigned a Queue Position in the New Services Queue in which the need for the Local and Network Upgrades was identified. The Load Flow Cost Allocation methods discussed in this manual, including cutoffs, still apply to the individual projects. •

For Local and Network Upgrades which are required due to the overloads associated with the System Impact Studies of an individual New Services Queue, and have a cost of $5,000,000 or greater, the cost of the Local and Network Upgrades will be allocated according to the order of the New Service Requests in the New Services Queue and the MW contribution of each individual Interconnection Request for those projects which cause or contribute to the need for the Local or Network Upgrades. The Load Flow Cost Allocation methods discussed in this manual, including cutoffs, still apply to the individual projects.

Cost allocation rules can be found in PJM Manual 14A, Attachment B. The possibility of sharing the reinforcement costs with other projects may be identified in the feasibility study, but the actual allocation will be deferred until the impact study is performed.

The Interconnection Customer seeking to interconnect a wind generation facility shall maintain meteorological data facilities as well as provide that meteorological data which is required per item 5.iv. of Schedule H to the Interconnection Service Agreement.

An Interconnection Customer entering the New Services Queue on or after October 1, 2012 with a proposed new Customer Facility that has a Maximum Facility Output equal to or greater than 100 MW shall install and maintain, at its expense, phasor measurement units (PMUs). See Section 8.5.3 of Appendix 2 to the Interconnection Service Agreement as well as section 4.3 of PJM Manual 14D for additional information.

PJM utilizes manufacturer models to ensure the performance of turbines is properly captured during the simulations performed for stability verification. Turbine manufacturers provide such models to their customers. The list of manufacturer models PJM has already validated is contained in Attachment G-2 of Manual 14A. Manufacturer models may be updated from time to time, for various reasons such as to reflect changes to the control systems or to more accurately

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represent the capabilities turbines and controls which are currently available in the field. Additionally, as new turbine models are developed, turbine manufacturers provide such new models which must be used in the conduct of these studies. PJM needs adequate time to evaluate the new models in order to reduce delays to the System Impact Study process timeline for the Interconnection Customer as well as other Interconnection Customers in the study group. Therefore, PJM will require that any Interconnection Customer with a new manufacturer model must supply that model to PJM, along with a $10,000 fully refundable deposit, no later than three (3) months prior to the starting date of the System Impact Study (See Section 2.2.2. of Manual 14A for starting dates) for the Interconnection Request which shall specify the use of the new model. The Interconnection Customer will be required to submit a completed dynamic model study request form (Attachment G-1 of Manual 14A) in order to document the request for the study.

The Feasibility Study estimates do not include the feasibility, cost, or time required to obtain property rights and permits for construction of the required facilities. The project developer is responsible for the right of way, real estate, and construction permit issues. For properties currently owned by Transmission Owners, the costs may be included in the study.

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General

Queue AD1-067 Mendota Hills project is a proposal for 5.725 Energy (1.1 MW Capacity) injection located in Lee County, IL. The IC has proposed a service date for this project of November 30, 2018.

Impacts on the MISO member transmission systems are not included in this analysis, but will be included in the Impact Study Phase.

This Generation Interconnection Feasibility Study provides analysis results to aid the IC in assessing the practicality and cost of incorporating the facility into the PJM system. This study was limited to load flow analyses of probable contingencies. If the IC elects to pursue a System Impact Study, a more comprehensive analysis will be performed.

Point of Interconnection

The Interconnection Customer (IC) AD1-067 proposes 5.725MW uprate to another PJM queue position AB2-191 that is installing 70.4MW wind generation. The combined output of this facility would become 76.125 MW.

The in-service date of AD1-067 is 4Q 2018. The AB2-191 wind farm is to be interconnected to an existing TSS979 Mendota Hill Wind Farm.

Attachment Facilities

Included in the scope of AB2-191

Direct Connection Network Upgrades

Included in the scope of AB2-191

Non-Direct Connection Network Upgrades

Included in the scope of AB2-191

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Network Impacts

The Queue Project AD1-067 was evaluated as a 5.7 MW (Capacity 1.1 MW) injection at the Mendota Hill; Red 138kV substation in the ComEd area. Project AD1-067 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AD1-067 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Analysis - 2021

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)

None

Affected System Analysis & Mitigation

MISO Impacts:

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

Delivery of Energy Portion of Interconnection Request

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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 WALTO; B-ELECT JCT; B 345 kV line (from bus 270932 to bus 270730 ckt 1) loads from 99.99% to 100.0% (**DC power flow**) of its emergency rating (1528 MVA) for the single line contingency outage of 'COMED_P1-2_345-L15501_B-R'. This project contributes approximately 0.56 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_345-L15501_B-R'
 TRIP BRANCH FROM BUS 270828 TO BUS 274768 CKT 1            / NELSO; B 345 LEECO;BP 345
 END
```

2. (CE - CE) The HAUMESSER; B-W DEKALB ;3T 138 kV line (from bus 271680 to bus 272756 ckt 1) loads from 112.41% to 113.67% (**DC power flow**) of its emergency rating (452 MVA) for the single line contingency outage of 'COMED_P1-2_138-L10714_R-R-A'. This project contributes approximately 5.72 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_138-L10714_R-R-A'
 TRIP BRANCH FROM BUS 271333 TO BUS 934700 CKT 1            / DIXON; R 138 AD1-098 TAP 138
 END
```

3. (CE - CE) The MCGIRR RD;-AD1-098 TAP 138 kV line (from bus 272002 to bus 934700 ckt 1) loads from 113.49% to 114.76% (**DC power flow**) of its emergency rating (449 MVA) for the single line contingency outage of 'COMED_P2-1_094-L11323__'. This project contributes approximately 5.72 MW to the thermal violation.

```
CONTINGENCY 'COMED_P2-1_094-L11323__'
 TRIP BRANCH FROM BUS 271680 TO BUS 272756 CKT 1            / HAUME; B 138 W DEK;3T 138
 END
```

4. (CE - CE) The ESS H445 ;3B-STEWARD ; B 138 kV line (from bus 272362 to bus 272516 ckt 1) loads from 106.71% to 107.88% (**DC power flow**) of its emergency rating (197 MVA) for the single line contingency outage of 'COMED_P2-1_186-L16914__'. This project contributes approximately 2.3 MW to the thermal violation.

```
CONTINGENCY 'COMED_P2-1_186-L16914__'
 TRIP BRANCH FROM BUS 272365 TO BUS 272516 CKT 1            / H440 ;RT 138 STEWA; B 138
 END
```

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5. (CE - CE) The ESS H440 ; R-ESS H440N ;R 138 kV line (from bus 272363 to bus 272364 ckt 1) loads from 87.88% to 88.9% (**DC power flow**) of its emergency rating (226 MVA) for the single line contingency outage of 'COMED_P2-1_186-L16914__'. This project contributes approximately 2.31 MW to the thermal violation.

```
CONTINGENCY 'COMED_P2-1_186-L16914__'
 TRIP BRANCH FROM BUS 272365 TO BUS 272516 CKT 1             / H440 ;RT 138 STEWA; B 138
 END
```

6. (CE - CE) The ESS H440N ;R-ESS H445 ;3B 138 kV line (from bus 272364 to bus 272362 ckt 1) loads from 87.8% to 88.83% (**DC power flow**) of its emergency rating (226 MVA) for the single line contingency outage of 'COMED_P2-1_186-L16914__'. This project contributes approximately 2.3 MW to the thermal violation.

```
CONTINGENCY 'COMED_P2-1_186-L16914__'
 TRIP BRANCH FROM BUS 272365 TO BUS 272516 CKT 1             / H440 ;RT 138 STEWA; B 138
 END
```

7. (CE - CE) The ESS H440 ;RT-ESS H440 ; R 138 kV line (from bus 272365 to bus 272363 ckt 1) loads from 111.05% to 112.22% (**DC power flow**) of its emergency rating (197 MVA) for the single line contingency outage of 'COMED_P2-1_186-L16914__'. This project contributes approximately 2.31 MW to the thermal violation.

```
CONTINGENCY 'COMED_P2-1_186-L16914__'
 TRIP BRANCH FROM BUS 272365 TO BUS 272516 CKT 1             / H440 ;RT 138 STEWA; B 138
 END
```

8. (CE - CE) The W DEKALB ;3T-WATERMAN ;3B 138 kV line (from bus 272756 to bus 272730 ckt 1) loads from 104.44% to 105.71% (**DC power flow**) of its emergency rating (452 MVA) for the single line contingency outage of 'COMED_P1-2_138-L10714_R-R-A'. This project contributes approximately 5.72 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_138-L10714_R-R-A'
  TRIP BRANCH FROM BUS 271333 TO BUS 934700 CKT 1                / DIXON; R 138
AD1-098 TAP 138
  END
```

9. (CE - CE) The AD1-098 TAP-DIXON ; R 138 kV line (from bus 934700 to bus 271333 ckt 1) loads from 113.16% to 114.43% (**DC power flow**) of its emergency rating (449 MVA) for the single line contingency outage of 'COMED_P2-1_094-L11323__'. This project contributes approximately 5.72 MW to the thermal violation.

```
CONTINGENCY 'COMED_P2-1_094-L11323__'
 TRIP BRANCH FROM BUS 271680 TO BUS 272756 CKT 1             / HAUME; B 138 W DEK;3T 138
 END
```

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Light Load Analysis - 2021

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)

None.

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

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

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