#V3-029 Chatfield 138kV

Generation Interconnection

Local AEP Impacts

Options #1 & #2

Unlike PJM, AEP performs AC analysis for interconnection projects in the feasibility stage. In analyzing the V2-019A Project with all other Wind Interconnection Projects in the AEP's footprint at 13-20% (based on the queue position) of their total capacity, AEP discovered 153 new overloads on the AEP bulk (100 kV and above) system. Furthermore, there were several contingencies that did not converge and the project contributed to several existing overload conditions on the AEP system. A detailed report of the AC Contingency analysis for V2-019A was shared by AEP. PJM, on the other hand, only recognized 3 of the 153 ***new*** overloads on the AEP system. Considering the extensive differences between AEP's and PJM's analyses and methodologies, AEP is unable to verify or confirm PJM's analyses for V2-019A and the subsequent projects, including V3-029.

AEP is providing the requested information for the V3-029 interconnection project without confirming or denying PJM's results to comply with PJM's request on attachment facilities and transmission improvements that address system conditions identified by PJM. Please note that these transmission improvements are based on the information shared by PJM and are therefore preliminary in nature. The extent of improvements needed for the interconnection may vary by type of project and its position in the queue. AEP will work with PJM to resolve the differences in results before these projects enter the Impact Study stage.

Subsequent to this analysis being completed the V2-019A project withdrew from the PJM Interconnection queue.

Network Impacts

The queue V3-029 project was studied as a 150MW injection (19.5MW of which was capacity) into AEP's system. Two separate studies were performed to analyze the project's impact at two different points of interconnection. The primary interconnection point was at the Chatfield 138kV substation, while the secondary interconnection option was a tap of the Howard – Melmor 138kV line. Project V3-029 was evaluated for compliance with reliability criteria for summer peak conditions in 2014. Potential network impacts were as follows:

PJM utilizes a DC analysis to determine thermal overloads in the Feasibility Study stage of a project.

Option #1 – Connection to the Chatfield 138kV station

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

No problems identified

Multiple Facility Contingency
(Double Circuit Tower Line, Line with Failed Breaker and Bus Fault contingencies for the full energy output)

No problems identified

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

1. The addition of the V2-020 project causes the short circuit duty on the Howard “C” 138kV circuit breaker to increase from 113.6% to 117.6% of its rated capability.

2. The addition of the V2-020 project causes the short circuit duty on the Howard “D” 138kV circuit breaker to increase from 113.6% to 117.6% of its rated capability.

3. The addition of the V2-020 project causes the short circuit duty on the Howard “H” 138kV circuit breaker to increase from 113.6% to 117.6% of its rated capability.

4. The addition of the V2-020 project causes the short circuit duty on the Howard “I” 138kV circuit breaker to increase to 113.6% to 117.6% of its rated capability.

The V2-020 initially caused the circuit breaker overdutied condition. Subsequent to this evaluation the V2-020 project has withdrawn from the PJM generation interconnection queue

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

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)

1. The overdutied condition on the Howard "C" 138kV circuit breaker can be alleviated by replacing the circuit breaker with one of higher interrupting rating. The cost of replacement is **$375,000.**

2. The overdutied condition on the Howard "D" 138kV circuit breaker can be alleviated by replacing the circuit breaker with one of higher interrupting rating. The cost of replacement is **$375,000.**

3. The overdutied condition on the Howard "H" 138kV circuit breaker can be alleviated by replacing the circuit breaker with one of higher interrupting rating. The cost of replacement is **$375,000.**

4. The overdutied condition on the Howard "I" 138kV circuit breaker can be alleviated by replacing the circuit breaker with one of higher interrupting rating. The cost of replacement is **$375,000.**

Potential Congestion due to Local Energy Deliverability

(PJM also studied the delivery of the energy portion of the surrounding generation. Any potential 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 Transmission Interconnection Request. Note: Only the most severely overloaded conditions are listed below. There is no guarantee of full deliverability for this project by fixing only the conditions listed in this section. With a Transmission Interconnection Request, a subsequent analysis will be performed which analyzes all overload conditions associated with the identified overloaded element(s). As a result of the aggregate energy resources in the area, the following violations were identified:

1. The Howard-Brookside 138kV line (from bus 243024 to bus 238586 ckt 1) loads from 204.24% to 227.39% (DC power flow) of its normal rating (133MVA) for non-contingency conditions as a result of V3-029. This project contributes approximately 30.8MW to cause this thermal violation.

2. The Howard-Brookside 138kV line (from bus 243024 to bus 238586 ckt 1) loads from 194.21% to 219.55% (DC power flow) of its emergency rating (173MVA) for the operational contingency (5147_B2_TOR707_V1-010A) as a result of V3-029. This project contributes approximately 43.8MW to cause this thermal violation.

3. The Chatfield-South Tiffin 138kV line (from bus 242984 to bus 243110 ckt 1) loads from 140.76% to 173.01% (DC power flow) of its emergency rating (192MVA) for the operational contingency (5147_B2_TOR707_V1-010A) as a result of V3-029. This project contributes approximately 61.9MW to cause this thermal violation.

4. The Chatfield-South Tiffin 138kV line (from bus 242984 to bus 243110 ckt 1) loads from 95.4% to 121.32% (DC power flow) of its normal rating (156MVA) for non-contingency

conditions as a result of V3-029. This project contributes approximately 40.4MW to cause this thermal violation.

5. The V1-010 TAP-Melmore 138kV line (from bus 292059 to bus 243039 ckt 1) loads from 113.51% to 151.71% (DC power flow) of its emergency rating (179MVA) for the operational contingency (5242_B2_TOR4783B_MOAB) as a result of V3-029. This project contributes approximately 68.4MW to cause this thermal violation.

6. The V1-010 TAP-Melmore 138kV line (from bus 292059 to bus 243039 ckt 1) loads from 99.45% to 133.83% (DC power flow) of its normal rating (138MVA) for non-contingency conditions as a result of V3-029. This project contributes approximately 47.4MW to cause this thermal violation.

7. The V1-010 TAP-Howard 138kV line (from bus 292059 to bus 243024 ckt 2) loads from 125.3% to 151.37% (DC power flow) of its emergency rating (179MVA) for the operational contingency (5147_B2_TOR707_V1-010B) as a result of V3-029. This project contributes approximately 52.1MW to cause this thermal violation.

8. The V1-010 TAP-Howard 138kV line (from bus 292059 to bus 243024 ckt 2) loads from 94.09% to 116.73% (DC power flow) of its normal rating (138MVA) for non-contingency conditions as a result of V3-029. This project contributes approximately 31.2MW to cause this thermal violation.

9. The Melmore-Fostoria Central 138kV line (from bus 243039 to bus 243006 ckt 1) loads from 98.54% to 113.44% (DC power flow) of its normal rating (167MVA) for non-contingency conditions as a result of V3-029. This project contributes approximately 24.9MW to cause this thermal violation.

10. The Melmore-Fostoria Central 138kV line (from bus 243039 to bus 243006 ckt 1) loads from 88.46% to 104.41% (DC power flow) of its emergency rating (245MVA) for the operational contingency (5242_B2_TOR4783B_MOAB) as a result of V3-029. This project contributes approximately 39.1MW to cause this thermal violation.

Option #2 – connection to the Howard-West End Fostoria 138kV circuit

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

No problems identified

Multiple Facility Contingency
(Double Circuit Tower Line, Line with Failed Breaker and Bus Fault contingencies for the full energy output)

1. The V3-029 TAP-V1-010 TAP 138kV line (from bus 293403 to bus 292059 ckt 1) loads from 92.22% to 135.53% (DC power flow) of its emergency rating (179MVA) for the tower contingency (520) as a result of V3-029. This project contributes approximately 77.5MW to cause this thermal violation.

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

1 The addition of the V2-020 project causes the short circuit duty on the Howard "C" 138kV circuit breaker to increase from 113.6% to 117.6% of its rated capability.

2. The addition of the V2-020 project causes the short circuit duty on the Howard "D" 138kV circuit breaker to increase from 113.6% to 117.6% of its rated capability.

3. The addition of the V2-020 project causes the short circuit duty on the Howard "H" 138kV circuit breaker to increase from 113.6% to 117.6% of its rated capability.

4. The addition of the V2-020 project causes the short circuit duty on the Howard "I" 138kV circuit breaker to increase to 113.6% to 117.6% of its rated capability.

The V2-020 initially caused the circuit breaker overdutied condition. Subsequent to this evaluation the V2-020 project has withdrawn from the PJM generation interconnection queue

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

New System Reinforcements

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

1. The overload on the V3-029 Tap-V1-010 Tap can be alleviated by reconductoring the approximately 10 mile long section of line. The PJM estimated cost for the reconductoring is **$10,000,000.**

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)

1. The overdutied condition on the Howard "C" 138kV circuit breaker can be alleviated by replacing the circuit breaker with one of higher interrupting rating. The cost of replacement is **$375,000.**

2. The overdutied condition on the Howard "D" 138kV circuit breaker can be alleviated by replacing the circuit breaker with one of higher interrupting rating. The cost of replacement is **$375,000.**

3. The overdutied condition on the Howard "H" 138kV circuit breaker can be alleviated by replacing the circuit breaker with one of higher interrupting rating. The cost of replacement is **$375,000.**

4. The overdutied condition on the Howard "I" 138kV circuit breaker can be alleviated by replacing the circuit breaker with one of higher interrupting rating. The cost of replacement is **$375,000.**

Potential Congestion due to Local Energy Deliverability

(PJM also studied the delivery of the energy portion of the surrounding generation. Any potential 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 Transmission Interconnection Request. Note: Only the most severely overloaded conditions are listed below. There is no guarantee of full deliverability for this project by fixing only the conditions listed in this section. With a Transmission Interconnection Request, a subsequent analysis will be performed which analyzes all overload conditions associated with the identified overloaded element(s). As a result of the aggregate energy resources in the area, the following violations were identified:

1. The Howard-Brookside 138kV line (from bus 243024 to bus 238586 ckt 1) loads from 204.24% to 222.99% (DC power flow) of its normal rating (133MVA) for non-contingency conditions as a result of V3-029. This project contributes approximately 24.9MW to cause this thermal violation.

2. The Howard-Brookside 138kV line (from bus 243024 to bus 238586 ckt 1) loads from 194.17% to 220.12% (DC power flow) of its emergency rating (173MVA) for the operational contingency (5147_B2_TOR707_V1-010A_V3-029OP2_A) as a result of V3-029. This project contributes approximately 44.9MW to cause this thermal violation.

3. The V1-010 TAP-Chatfield 138kV line (from bus 292059 to bus 242984 ckt 1) loads from 170.98% to 204.38% (DC power flow) of its emergency rating (179MVA) for the operational contingency (5147_B2_TOR707_V1-010A_V3-029OP2_A) as a result of V3-029. This project contributes approximately 59.8MW to cause this thermal violation.

4. The V1-010 TAP-Chatfield 138kV line (from bus 292059 to bus 242984 ckt 1) loads from 133.85% to 153.22% (DC power flow) of its normal rating (138MVA) for non-

contingency conditions as a result of V3-029. This project contributes approximately 26.7MW to cause this thermal violation.

5. The Chatfield-South Tiffin 138kV line (from bus 242984 to bus 243110 ckt 1) loads from 140.71% to 171.85% (DC power flow) of its emergency rating (192MVA) for the operational contingency (5147_B2_TOR707_V1-010A_V3-029OP2_A) as a result of V3-029. This project contributes approximately 59.8MW to cause this thermal violation.

6. The Chatfield-South Tiffin 138kV line (from bus 242984 to bus 243110 ckt 1) loads from 95.4% to 112.53% (DC power flow) of its normal rating (156MVA) for non-contingency conditions as a result of V3-029. This project contributes approximately 26.7MW to cause this thermal violation.

7. The V3-029 TAP-05Melmore 138kV line (from bus 293403 to bus 243039 ckt 1) loads from 113.39% to 161.78% (DC power flow) of its emergency rating (179MVA) for the operational contingency (5242_B2_TOR4783B_MOAB) as a result of V3-029. This project contributes approximately 86.6MW to cause this thermal violation.

8. The V3-029 TAP-Melmore 138kV line (from bus 293403 to bus 243039 ckt 1) loads from 99.29% to 152.03% (DC power flow) of its normal rating (138MVA) for non-contingency conditions as a result of V3-029. This project contributes approximately 72.8MW to cause this thermal violation.

9. The V1-010 TAP-Howard 138kV line (from bus 292059 to bus 243024 ckt 2) loads from 125.3% to 145.92% (DC power flow) of its emergency rating (179MVA) for the operational contingency (5147_B2_TOR707_V1-010B) as a result of V3-029. This project contributes approximately 42.3MW to cause this thermal violation.

10. The V1-010 TAP-Howard 138kV line (from bus 292059 to bus 243024 ckt 2) loads from 94.09% to 112.49% (DC power flow) of its normal rating (138MVA) for non-contingency conditions as a result of V3-029. This project contributes approximately 25.4MW to cause this thermal violation.

11. The Melmore-Fostoria Central 138kV line (from bus 243039 to bus 243006 ckt 1) loads from 98.51% to 122.50% (DC power flow) of its normal rating (167MVA) for non-contingency conditions as a result of V3-029. This project contributes approximately 40.1MW to cause this thermal violation.

12. The Melmore-Fostoria Central 138kV line (from bus 243039 to bus 243006 ckt 1) loads from 88.46% to 108.64% (DC power flow) of its emergency rating (245MVA) for the operational contingency (5242_B2_TOR4783B_MOAB) as a result of V3-029. This project contributes approximately 49.5MW to cause this thermal violation.

13. The V1-010 TAP-Howard 138kV line (from bus 292059 to bus 243024 ckt 1) loads from 93.02% to 111.21% (DC power flow) of its normal rating (138MVA) for non-

contingency conditions as a result of V3-029. This project contributes approximately 25.1MW to cause this thermal violation.

MISO IMPACTS

Any impacts on the MISO transmission system will be identified in the Impact Study.