#V1-012 Haviland 138kV

Generation Interconnection

Network Impacts

The Queue Project #V1-012 was studied as a(n) 150.0MW(Capactiy19.5MW) injection at Haviland_138kV substation in the AEP area. Project #V1-011 was evaluated for compliance with reliability criteria for summer peak conditions in 2013. Potential network impacts were as follows:

Generator Deliverability

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

No problems were identified.

Multiple Facility Contingency

(Double Circuit Tower Line contingencies only for the full energy output. Stuck breaker and bus fault contingencies will be performed for the Impact Study)

1. The East Lima – Haviland 138 kV line is overloaded to 125% of its 205 MVA emergency rating for a tower outage impacting both the Tillman – S73 138 kV line and the Lincoln – S73 138 kV line. This project contributes approximately 71 MVA to cause the thermal violation. A 5.5 mile portion of this line will need to be sag checked to determine if the line section can be operated above its normal rating. Depending on the results of the sag study, this additional section of conductor may also need to be replaced as part of this project.

2. The Tillman – Milan 138 kV line is overloaded to 106% of its 184 MVA emergency rating for a tower outage impacting both the Haviland – East Lima 138 kV line and the T131 – North Delphos line. This project contributes approximately 35 MVA to cause the thermal violation. A sag check will need to be completed to determine if this line can be operated above its normal rating. Depending on the results of the sag study, the conductor may also need to be replaced as part of this project.

3. The Milan – Harper 138 kV line is overloaded to 125% of its 143 MVA emergency rating for a tower outage impacting both the Haviland – East Lima 138 kV line and the T131 – North Delphos line. This project contributes approximately 37 MVA to cause the thermal violation. A sag check will need to be completed to determine if this line can be operated above its normal rating. Depending on the results of the sage study, the conductor may also need to be replaced as part of this project.

4. The Tillman – S73 138 kV line needs to be sag checked to determine if this line can be operated above its normal rating. Depending on the results of the sag study, the conductor may need to be replaced as part of this project.

Short Circuit

1. The Haviland "I" 138kV circuit breaker is at 103.1% of its short circuit interrupting rating.

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)

1. The North Delphos 138/69 kV transformer is overloaded to 118% of its 120 MVA emergency rating for a tower outage impacting both the Haviland – East Lima 138 kV line and the East Side – Sterling 138 kV line. This project contributes approximately 7 MVA to the thermal violation.

2. The East Side – North Delphos 138 kV line is overloaded to 143% of its 140 MVA emergency rating for a tower outage impacting both Tillman – S73 138 kV line and the Lincoln – S73 138 kV line. This project contributes approximately 33 MVA to cause the thermal violation.

3. The East Side – Sterling 138 kV line is overloaded to 128% of its 140 MVA emergency rating for a tower outage impacting both Tillman – S73 138 kV line and the Lincoln – S73 138 kV line. This project contributes approximately 33 MVA to cause the thermal violation.

4. The Lincoln – S73 138 kV line is overloaded to 178% of its 192 MVA emergency rating for a tower outage impacting both the Haviland – East Lima 138 kV line and the T131 – North Delphos 138 KV line. This project contributes approximately 69 MVA to cause the thermal violation.

5. The North Delphos – T131 138 kV line is overloaded to 178% of its 192 MVA emergency rating for a tower outage impacting both Tillman – S73 138 kV line and the Lincoln – S73 138 kV line. This project contributes approximately 68 MVA to cause the thermal violation.

69kV Problems at Full Capacity

6. Numerous 69 kV lines in the area are overloaded. Nearly 28 miles of 69 kV conductor would need to replaced along with other miscellaneous equipment. Rather than requiring the V1-012 project to fix these overloads, they could curtail. However, the 69 kV facilities do not currently have SCADA to provide monitoring capability. There is no way to know in real time if the lines in question would be overloaded. We suggest adding SCADA to a few key stations in the area to provide monitoring capability. Also, PJM would need to add these stations to their list of monitored facilities. PJM Operations will need to be consulted to determine if monitoring is an acceptable

solution. Further analysis would be needed to determine which stations would be ideal. The alternative is $12,000,000 of upgrades.

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 East-Lima-Haviland 138kV circuit may be alleviated by completing a sag study on a 5.5 mile section of the line to determine if its rating can be increased. PJM's estimated cost of the study is **$110,000.** If the rating cannot be raised, the 5.5 mile section of the line will need to be reconductored, the wave trap and risers replaced at Haviland and East Lima. PJM's estimated cost of the reconductoring and other work is **$5,700,000.**

2. The overload on the Milan-Tillman 138kV circuit may be alleviated by completing a sag study on the 6.5 mile to determine if its rating can be increased. PJM's estimated cost of the study is **$130,000.** The 138kV switch and and risers at Milan will need to be replaced. Estimated cost is **$50,000.** If the rating cannot be raised, the 6.5 mile line will need to be reconductored and the 138kV switch and risers replaced at Milan. PJM's estimated cost of the reconductoring and other work is **$6,550,000.**

3. The overload on the Milan-Harper 138kV circuit can be alleviated by completing a sag study on the 3.2 mile line to determine if its rating can be increased. PJM's estimated cost of the study is **$64,000.** The 138kV risers at Milan will need to be replaced. Estimated cost is **$20,000.** If the rating cannot be raised, the 3.2 mile line will need to be reconductored and the risers replaced at Milan. PJM's estimated cost of the reconductoring and other work is **$3,220,000.**

4. The overload on the Tillman-S73 138kV line can be alleviated by completing a sag study on a 6 mile line to determine if its rating can be increased. PJM's estimated cost of the study is **$120,000.** If the rating cannot be raised, the 6 mile line will need to be reconductored. PJM's estimated cost of the reconductoring and other work is **$3,220,000.**

5. The overdutied condition of the Haviland "I" circuit breaker can be alleviated by replacing the circuit breaker. Estimated cost of the repalcement is **$200,000.**

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)

1. The overload on the North Delphos transformer can be alleviated by replacing the transformer and associated equipment with that of a higher rating. The estimated cost in 2009 dollars is **$2 million.**

2. The overload on the East Side-North Delphos line can be alleviated by rebuilding and reconductoring the 20.3 mile line. The PJM estimated cost is **$20,300,000.**

3. The overload on the East Side-Sterling 138kV line can be alleviated by rebuilding and reconductoring the 3.3 mile line. The PJM estimated cost is **$3,300,000.**

4. The overload on the Lincoln-S73 138kV line can be alleviated by replacing the 138kV risers at Lincoln and rebuilding approximately 17 miles (depending on the location of S73) of 138 kV line between Lincoln and S73. Reconductor the line and replace the existing tower structures. (Network Upgrade #n1504)

   Estimated Cost (2009 Dollars): **$25,663,000**

5. The overload on the T131-North Delphos line can be alleviated by rebuilding approximately 25 miles (depending upon the location of the T131 interconnection) of 138kV line between T131 and North Delphos. The rebuild requires new line conductor and replacement of 16 miles of existing tower structures. The estimated cost in 2009 dollars is **$33 million**.** The 138kV risers also need to be replaced at the North Delphos station. The estimated cost in 2009 dollars is **$10,000.**

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. The Milan-Harper 138 kV line (from bus 23487 to bus 23457 ckt 1) loads from 157.24% to 181.85% (DC power flow) of its rating (143 MVA) for the single line contingency ('5209_B2_TOR770C_MOAB'). This project contributes approximately 35.19 MW to cause the thermal violation.

2. The Milan-Harper 138 kV line (from bus 23487 to bus 23457 ckt 1) loads from 138.25% to 158.73% (DC power flow) of its normal rating (111 MVA) for non-contingency condition. This project contributes approximately 22.73 MW to cause the thermal violation.

3. The S73A -Lincoln 138 kV line (from bus 90794 to bus 23476 ckt 1) loads from 133.94% to 156.39% (DC power flow) of its normal rating (192 MVA) for the single line contingency ('5529_B2_TOR1740B_MOAB'). This project contributes approximately 43.1 MW to cause the thermal violation.

4. The S73A–Lincoln 138 kV line (from bus 90794 to bus 23476 ckt 1) loads from 118.9% to 139.64% (DC power flow) of its normal rating (156 MVA) for non-contingency condition. This project contributes approximately 32.36 MW to cause the thermal violation.

5. The Tillman-Milan 138 kV line (from bus 23519 to bus 23487 ckt 1) loads from 131.78% to 150.91% (DC power flow) of its normal rating (184 MVA) for the single line contingency ('5206_B2_TOR770_WOMOAB_S73B'). This project contributes approximately 35.19 MW to cause the thermal violation.

6. The Tillman-Milan 138 kV line (from bus 23519 to bus 23487 ckt 1) loads from 109.67% to 124.24% (DC power flow) of its normal rating (156 MVA) for non-contingency condition. This project contributes approximately 22.73 MW to cause the thermal violation.

7. The Haviland-S73B 138 kV line (from bus 23152 to bus 90795 ckt 1) loads from 70.52% to 106.4% (DC power flow) of its normal rating (201 MVA) for the tower line contingency ('D|05ALLEN-05SORENS-05CONVOY-05ROB P-345'). This project contributes approximately 72.11 MW to cause the thermal violation.

8. The Haviland-S73B 138 kV line (from bus 23152 to bus 90795 ckt 1) loads from 60.24% to 103.72% (DC power flow) of its normal rating (167 MVA) for non-contingency condition. This project contributes approximately 72.6 MW to cause the thermal violation.

9. The S73B –Tillman 138 kV line (from bus 90795 to bus 23519 ckt 1) loads from 87.69% to 105.2% (DC power flow) of its normal rating (201 MVA) for the single line contingency ('5209_B2_TOR770C_MOAB'). This project contributes approximately 35.19 MW to cause the thermal violation.