W4-021A Howard (Black Fork) 138kV

Generation Interconnection

Local Network Impacts

The impact of the proposed generating facility on the AEP System was assessed for adherence with applicable reliability criteria. AEP planning criteria require that the transmission system meet single contingency performance criteria in accordance with the AEP FERC Form 715. Therefore, this criterion was used to assess the impact of the proposed facility on the AEP System. Queue project W4-021A was studied as a (n) 200 MW (26 MW Capacity) injection into AEP's system at the Howard 138 kV station. Project W4-021A was evaluated for compliance with reliability criteria for summer peak conditions in 2014. Potential network impacts were as follows:

Potential network impacts were as follows for the primary point of interconnection:

Normal System (2014 Summer Conditions Full/Capacity Output)

- No problems identified

Normal System (2014 Summer Conditions Full Output)

- No problems identified.

Single Contingency (2014 Summer Conditions Full/Capacity Output)

- No problems identified

Single Contingency (2014 Summer Conditions Full Output)

- Greely 69 kV – Tiffin Center 69 kV line flow increases from 87.8% to 117.8% of its emergency rating (39 MVA) with an impact of 29.99% for outage of Greenlawn 138 kV – Tiffin 138 kV line.

- Chatfield138 kV – Howard 138 kV line flow increases from 90.3% to 118.1% of its emergency rating (167 MVA) with an impact of 27.84% for contingency 5121_B2_TOR6.

- Chatfield 138 kV – South Tiffin 138 kV line flow increases from 78.5% to 106.1% of its emergency rating (167 MVA) with an impact of 27.62% for contingency 5121_B2_TOR6.

- Howard 138 kV – North Lexington line flow increases from 86.3% to 111% of its emergency rating (179 MVA) with an impact of 24.65% for contingency 5121_B2_TOR6.

- Fostoria 138 kV – Melmore 138 kV line flow increases from 81.3% to 101.7% of its emergency rating (167 MVA) with an impact of 20.42% for contingency 7161_B2_TOR7.

- Howard 138 kV – North Bellville 138 kV line flow increases from 90.3% to 110.6% of its emergency rating (133 MVA) with an impact of 20.29% for contingency 5121_B2_TOR6.

- Tiffin Center 69 kV – Maule Road 69 kV line flow increases from 96.4% to 106.1% of its emergency rating (73 MVA) with an impact of 9.67% for contingency 5251_B2_TOR1.

Multiple Contingency (2014 Summer Conditions Full/Capacity Output)

- No problems identified.

Multiple Contingency (2014 Summer Conditions Full Output)

1. Fremont Center 138 kV – Tiffin 138 kV line flow increases from 96.9% to 106.3% of its emergency rating (205 MVA) with an impact of 9.34% for contingency 513 (Category C5).

2. Greenlawn 138 kV – Tiffin 138 kV line flow increases from 96.8% to 117.7% of its emergency rating (143 MVA) with an impact of 14.86 for contingency 517 (Category C5).

3. Muskingum 138 kV – Wolf Creek 138 kV line flow increases from 99.8% to 101.5% of its emergency rating (205 MVA) with an impact of 1.64 for contingency 467 (Category C5).

4. Corner – Layman 138 kV line flow increases from 99.5% to 101.1% of its emergency rating (205 MVA) with an impact of 1.63% for contingency 519 (Category C5).

5. S73 138 kV – T131 138 kV line flow increases from 99.5% to 100.5% of its emergency rating (167 MVA) with an impact of 1.05% for contingency 42 (Category C5).

Contribution to Previously Identified Overloads (2015 Summer Conditions Full/Capacity Output)

- No problems identified.

Contribution to Previously Identified Overloads (2014 Summer Conditions Full Output)

- Nevada (NORTH CENTRAL CO-OP) 69 – Upper Sandusky 69 loads from 158.4% to 204.8 of its emergency rating (31 MVA) for contingency 5121_B2.

- Broken Sword 69 - Nevada (NORTH CENTRAL CO-OP) 69 loads from 163.9% to 210.2% of its emergency rating (31 MVA) for contingency 5121_B2.

- Howard – Brookside 138 kV line loads from 311.6% to 354.3% of its normal rating (133 MVA) for the base case.

- Bucyrus Center – Broken Sword 69 kV line loads from 106.8% to 133.3% of its emergency ratting (54 MVA) for contingency 5121_B2.

- Greenlawn – Melmore 138 kV line loads from 105.7% to 127.2% of its emergency rating (143 MVA) for contingency 7104_B2.

- Maple Grove – Riverview 69 kV line loads from 150.4% to 164.8% of its emergency rating (31 MVA) for contingency 5150_B2.

- Holran – Maple Grove 69 kV line loads from 128.2% to 142.6% of its emergency rating (31 MVA) for contingency 5150_B2.

- Fremont Center – Holran 69 kV line loads from 118.1% to 132.2% of its emergency rating (31 MVA) for contingency 5150_B2.

- Greenlawn – Tiffin 138 kV line loads from 100.3% to 113.4% of its emergency rating (143 MVA) for contingency 7162_B1.

- Fremont Center – Tiffin 138 kV line loads from 119.8% to 132.8% of its emergency rating (205 MVA) for contingency 7104_B2.

- General Electric Tiffin – Tiffin Tapoff 69 kV line loads 140.1% to 153% of its emergency rating (73 MVA) for contingency 5150_B2.

- General Electric Tiffin – Maule Road 69 kV line loads from 141% to 153.9% of its emergency rating (73 MVA) for contingency 5150_B2.

- Tiffin Center – Maule Road 69 kV line loads from 155.2% to 168.1% of its emergency rating (73 MVA) for contingency 5150_B2.

- Riverview – Tiffin Tapoff 69 kV line loads from 121.7% to 134.6% of its emergency rating (73 MVA) for contingency 5150_B2.

- East Fremont – Fremont Center 69 kV line loads from 119.3% to 128.2% of its emergency rating (36 MVA) for contingency 5250_B2.

- Bridgeville – Chandlersville 138 kV line loads from 156% to 161.6% of its emergency rating (185 MVA) for contingency 5121_B2.

- Bethel Church – West Dover 138 kV line loads from 145% to 150.6% of its emergency rating (185 MVA) for contingency 5121_B2.

- General Electric Dover – West New Philadelphia 69 kV line loads from 120.4% to 125.6% of its emergency rating (48 MVA) for contingency (open line from bus Strasburg 138 kV to bus West Dover 138 kV).

- Bridgeville – Chandlersville 138 kV line loads from 144.8% to 149.8% of its emergency rating (185 MVA) for contingency 7114_C5. Overloads in Project W3-014.

- Chandlersville – Philadelphia 138 kV line loads from 140% to 144.3% of its normal rating (191 MVA) for the base case. Overloads in Project W3-005.

- Fremont Center – Tiffin 138 kV line loads from 120.8% to 136.3% of its emergency rating (205 MVA) for contingency 7114_C5. Overloads in Project W3-012.

- Greenlawn – Melmore 138 kV line loads from 116.1% to 143.7% of its emergency rating (143 MVA) for contingency 7114_C5. Overloads in Project W3-012.

- Holran – Maple Grove 69 kV line loads from 116.5% to 123.3% of its emergency rating (31 MVA) for contingency 517_C5. Overloads in Project W3-011.

- Maple Grove – Riverview 69 kV line loads from 140% to 147.3% of its emergency rating (31 MVA) for contingency 517_C5. Overloads in Project W3-011.

- Tiffin Center – Maule Road 69 kV line loads from 107.9% to 123.2% of its emergency rating (73 MVA) for contingency 7114_C5. Unable to locate which project caused the line to overload for the first time.

Short Circuit Analysis

- No problems identified.

Local/Network Upgrades

- The 556.5 ACSR 138 kV conductor is the limiting element for the Fremont Center – Tiffin 138 kV line. A sag check will be required to determine if the line section can be operated above their emergency rating of 205 MVA. The results of the sag study could prove that no additional upgrades are necessary, that some upgrades on the circuit are

necessary, or that the entire 12.6 mile section of line would need to be rebuilt. Estimated Cost (2011 Dollars) for the sag study: **$50,400**.

- The Greenlawn relay thermal limit is the limiting element for the Greenlawn - Tiffin 138 kV line. The cost to perform an engineering study to determine if the thermal limits can be adjusted is **$10,000** (2011 dollars).

- The 556.5 ACSR 138 kV conductor section 2 is the limiting element for the Muskingum – Wolf Creek 138 kV line. A sag check will be required to determine if the line section can be operated above their emergency rating of 205 MVA. The results of the sag study could prove that no additional upgrades are necessary, that some upgrades on the circuit are necessary, or that the entire 4.4 mile section of line would need to be rebuilt. Estimated Cost (2011 Dollars) for the sag study: $**17,600**.

- The conductor section 1 is the limiting element for the Corner – Layman 138 kV line. A sag check will be required to determine if the line section can be operated above their emergency rating of 205 MVA. The results of the sag study could prove that no additional upgrades are necessary, that some upgrades on the circuit are necessary, or that the entire 7.1 mile section of line would need to be rebuilt. Estimated Cost (2011 Dollars) for the sag study: **$28,400**.

- The 397.5 ACSR conductor section 1 is the limiting element for the S73 138 kV – T131 138 kV line. A sag check will be required to determine if the line section can be operated above their emergency rating of 167 MVA. The results of the sag study could prove that no additional upgrades are necessary, that some upgrades on the circuit are necessary, or that the entire 7.5 mile section of line would need to be rebuilt. Estimated Cost (2011 Dollars) for the sag study: **$30,000**.

- Howard – Brookside 138 kV line. AEP and First Energy are working on a collaborate project to resolve this overload.

Contribution to Previously Identified System Reinforcements

- The ACSR 336.4 conductor section 1 is the limiting element for the Tiffin Center – Maule Road 69 kV line. A sag check will be required to determine if the line section can be operated above their emergency rating of 73 MVA. The results of the sag study could prove that no additional upgrades are necessary, that some upgrades on the circuit are necessary, or that the entire 1.8 mile section of line would need to be rebuilt. Estimated Cost (2011 Dollars) for the sag study: **$7,200**.

Network Impacts

Queue project W4-021A was studied as a(n) 200.0 MW (26.0 MW of which was Capacity) injection into AEP's system at the Howard 138.0 kV substation. Project W4-021A was evaluated for compliance with reliability criteria for summer peak conditions in 2014.

Potential transmission network impacts are as follows:

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)

Analysis showed a significant fault contribution (i.e. above 3%) to **4** breakers, which were previously identified as over-dutied. The breakers are listed below:

BUS_NO	BUS	BREAKER	Rating Type	Duty Percent With w4-021A_AEP	Duty Percent Without w4-021A_AEP	Duty Percent Difference	Note
0	05HOWARD 138.kV	C	T	145.70%	125.20%	20.50%	Over 100%, > 3% contribution
0	05HOWARD 138.kV	I	T	145.70%	125.20%	20.50%	Over 100%, > 3% contribution
0	05HOWARD 138.kV	D	T	145.30%	125.20%	20.10%	Over 100%, > 3% contribution
0	05HOWARD 138.kV	H	T	145.30%	125.20%	20.10%	Over 100%, > 3% contribution

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.)

- No problems identified.

System Reinforcements

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.)

1. The overdutied condition on the "C" 138kV circuit breaker at Howard can be alleviated by replacing the breaker at an estimated cost of **$300,000**.

2. The overdutied condition on the "D" 138kV circuit breaker at Howard can be alleviated by replacing the breaker at an estimated cost of **$300,000**.

3. The overdutied condition on the "I" 138kV circuit breaker at Howard can be alleviated by replacing the breaker at an estimated cost of **$300,000**.

4. The overdutied condition on the "H" 138kV circuit breaker at Howard can be alleviated by replacing the breaker at an estimated cost of **$300,000**.