#V1-010 Howard-Fostoria Central 138kV
Generation Interconnection

Local Network Impacts

Option #1

Normal System (2012 Summer Conditions) (at full capacity)

On the Howard-Brookside (FE) 138 kV circuit, the following facilities are overloaded:

1. The Howard 300 MCM Cu 138 kV riser overloads to 128% of the summer normal rating of 138 MVA.
2. The Howard 138 kV 600 A switch overloads to 120% of the normal rating of 148 MVA.
3. The Howard 138 kV 0.75 inch Cu tubular line riser overloads to 107% of the summer normal rating of 166 MVA
4. The Howard – Brookside 138 kV 397.5 ACSR 30/7 conductor overloads to 106% of the summer normal rating of 167 MVA.

Normal System (2012 Summer Conditions) (at 13% capacity)

- No problems identified.

Single Contingency (2012 Summer Conditions) (at full capacity)

Howard-Brookside (FE) 138 kV circuit overloads to 113 % of the summer emergency rating of 173 MVA with an outage of the Kammer – South Canton 765 kV, results in the following overloads:

1. The Howard 300 MCM Cu 138 kV riser overloads to 109% of the summer emergency rating of 179 MVA.
2. The Howard 138 kV 600 A switch overloads to 102% of the summer emergency rating of 192 MVA.
3. The Howard – Brookside 138 kV 397.5 ACSR 30/7 conductor overloads to 117% of the summer emergency rating of 167 MVA.

Single Contingency (2012 Summer Conditions) (at 13% capacity)

- No problems identified.

Multiple Contingency (2012 Summer Conditions) (at full capacity)

- Howard – Brookside 138 kV circuit overloads to 127% of the summer emergency rating of 173 MVA with the tower outage:

- Chatfield – V1-010 138 kV and Melmore – V1-010 138 kV (simultaneously)
  - The following facilities are overloaded:
    1. The Howard 300 MCM Cu 138 kV riser overloads to 123% of the summer emergency rating of 179 MVA.
    2. The Howard 138 kV 600 A switch overloads to 114% of the summer emergency rating of 192 MVA.
    3. The Howard 138 kV 800 A wavetrap overloads to 107% of the summer emergency rating of 205 MVA
    4. The Howard 138 kV 0.75 inch Cu tubular line riser overloads to 100% of the summer emergency rating of 219 MVA
    5. The Howard – Brookside 138 kV 397.5 ACSR 30/7 conductor overloads to 131% of the summer emergency rating of 167 MVA.
    6. The Howard metering CT overloads to 102% of the summer emergency rating of 215 MVA.

- Howard – Brookside 138 kV circuit overloads to 126% of the summer emergency rating of 173 MVA with the tower outage:
  - Chatfield – South Tiffin 138 kV and Melmore – Fostoria 138 kV (simultaneously)
  - The following facilities are overloaded:
    1. The Howard 138 kV 600 A switch overloads to 114% of the summer emergency rating of 192 MVA.
    2. The Howard 138 kV 800 A wavetrap overloads to 106% of the summer emergency rating of 205 MVA
    3. The Howard metering CT overloads to 101% of the summer emergency rating of 215 MVA.
    4. The Howard 300 MCM Cu 138 kV riser overloads to 122% of the summer emergency rating of 179 MVA.
    5. The 138 kV 397.5 ACSR 30/7 conductor gets overloaded to 131% of the summer emergency rating of 167 MVA

Contributions (2012 Summer Conditions) (at full capacity)

V1-010 contributes to the overload of the Lincoln – Sterling 138 kV circuit, increasing the loading from 102% (170.7 MVA) to 111% (185.4 MVA) of the summer emergency conductor rating of 167 MVA.

Short Circuit Analysis

- No problems identified.

Stability Analysis

- Stability analysis was not performed as part of this Feasibility Study. The stability assessments are part of the System Impact Study. Based upon the results of this future

System Impact Study, the extent of system upgrades could change and the associated costs could be significantly different.

Local Network Upgrades

* Normal System (2012 Summer Conditions) (at full capacity)

- None required.

* Normal System (2012 Summer Conditions) (at 13% capacity)

- None required.

Single Contingency (2012 Summer Conditions) (at full capacity)

- None required.

Single Contingency (2012 Summer Conditions) (at 13%l capacity)

- None required.

* Multiple Contingency (2012 Summer Conditions) (at full capacity)

Upgrades to the Howard-Brookside (FE) 138kV circuit.

- Replace the Howard 300MCM Cu 138kV riser:
  Estimated Cost (2009 Dollars): **$50,000**

- Replace the Howard 600 A switch:
  Estimated Cost (2009 Dollars): **$100,000**

- Replace the Howard 800 A wavetrap:
  Estimated Cost (2009 Dollars): **$50,000**

- Reconductor and rebuild the Howard – Brookside 138 kV circuit (8 miles):
  Estimated Cost (2009 Dollars): **$ 12,000,000**
  - This estimate only includes the reconductoring and rebuild of the AEP 8 mile section of the circuit, it does not include First Energy's 13.74 miles.

- Reconductor and rebuild the Howard – Brookside 138 kV circuit (13.74 miles):
  PJM Estimated Cost of FirstEnergy Work (2009 Dollars): **$ 20,000,000**

- Replace the Howard 138kV 0.75 inch Cu tubular line riser:
  Estimated Cost (2009 Dollars): **$50,000**

- Replace Howard metering CT:
  Estimated Cost (2009 Dollars): **$100,000**

Total estimated cost to upgrade the Howard-Brookside 138kV circuit is **$32,350,000**

Network Upgrades and fixes (Upgrades required due to normal and single contingency at 13% capacity.)

- None required.

Option #2

Normal System (2012 Summer Conditions) (at full capacity)

On the Howard-Brookside (FE) 138kV circuit the following facilities are overloaded.

1. The Howard 300 MCM Cu 138 kV riser overloads to 184% of the summer normal rating of 138 MVA.
2. The Howard 138 kV 600 A switch overloads to 171% of the normal rating of 148 MVA.
3. The Howard 138 kV 800 A wavetrap overloads to 130% of the summer normal rating of 195 MVA
4. The Howard 138 kV 0.75 inch Cu tubular line riser overloads to 153% of the summer normal rating of 166 MVA
5. The Howard 138 kV 795 ACSR 26/7 bus overloads to 113% of the summer normal rating of 224 MVA.
6. The Howard – Brookside 138 kV 397.5 ACSR 30/7 conductor overloads to 152% of the summer normal rating of 167 MVA.
7. The Howard metering CT overloads to 118% of the summer normal rating of 215 MVA.

Normal System (2012 Summer Conditions) (at 13% capacity)

On the Howard-Brookside (FE) 138kV circuit the following facilities are overloaded.

1. The Howard 300 MCM Cu 138 kV riser overloads to 125% of the summer normal rating of 138 MVA.
2. The Howard 138 kV 600 A switch overloads to 117% of the normal rating of 148 MVA.
3. The Howard 138 kV 0.75 inch Cu tubular line riser overloads to 104% of the summer normal rating of 166 MVA
4. The Howard – Brookside 138 kV 397.5 ACSR 30/7 conductor overloads to 103% of the summer normal rating of 167 MVA.

Single Contingency (2012 Summer Conditions) (at full capacity)

Howard-Brookside (FE) 138 kV circuit overloads to170 % of the summer emergency rating of 167 MVA with an outage of the 02 Beaver – 02 DAV-BE 345 kV, results in the following overloads:

1. The Howard 300 MCM Cu 138 kV riser overloads to 159% of the summer emergency rating of 179 MVA.
2. The Howard 138 kV 600 A switch overloads to 148% of the summer emergency rating of 192 MVA.
3. The Howard 138 kV 800 A wavetrap overloads to 128% of the summer emergency rating of 223 MVA
4. The Howard 138 kV 0.75 inch Cu tubular line riser overloads to 130% of the summer emergency rating of 219 MVA
5. The Howard 138 kV 795 ACSR 26/7 bus overloads to 101% of the summer emergency rating of 282 MVA.
6. The Howard – Brookside 138 kV 397.5 ACSR 30/7 conductor overloads to 170% of the summer emergency rating of 167 MVA.
7. The Howard metering CT overloads to 132% of the summer emergency rating of 215 MVA.
8. The Howard 795 MCM ACSR 138 kV riser overloads to 100% of the summer emergency rating of 282 MVA.

Single Contingency (2012 Summer Conditions) (at 13% capacity)

1. The Howard 300 MCM Cu 138 kV riser overloads to 114% of the summer emergency rating of 179 MVA.
2. The Howard 138 kV 600 A switch overloads to 106% of the summer emergency rating of 192 MVA.
3. The Howard – Brookside 138 kV 397.5 ACSR 30/7 conductor overloads to 122% of the summer emergency rating of 167 MVA.

Contributions (2012 Summer Conditions) (at full capacity)

- V1-010 contributes to the overload of the East Lima – South Kenton 138 kV circuit, 189% (295 MVA) to 194% (303 MVA) of the summer normal conductor rating of 185 MVA.
- V1-010 contributes to the overload of the Ohio Central – South Coshocton 138 kV circuit 102.6 % (190 MVA) to 107.7% (199 MVA) of the summer normal conductor rating of 185 MVA.
- V1-010 contributes to the overload of the Lincoln – Sterling 138 kV circuit 102% (170.7 MVA) to 112% (187.6 MVA) of the summer normal conductor rating of 167 MVA.

Multiple Contingency (2012 Summer Conditions) (at full capacity)

- No problems identified

Short Circuit Analysis

The following Howard 138 kV circuit breakers are overdutied to more than 100 % for the addition of the new generating facility and would need to be replaced.

- Howard 138 kV circuit breaker C overdutied to 109.3%
- Howard 138 kV circuit breaker D overdutied to 109.3%
- Howard 138 kV circuit breaker H overdutied to 109.3%
- Howard 138 kV circuit breaker I overdutied to 109.3%

Stability Analysis

- Stability analysis was not performed as part of this Feasibility Study. The stability assessments are part of the System Impact Study. Based upon the results of this future System Impact Study, the extent of system upgrades could change and the associated costs could be significantly different.

Local Upgrades (at full capacity)

Upgrades to the Howard-Brookside (FE) 138kV circuit.

- Replace the Howard 800 A. wavetrap:
  Estimated Cost (2009 Dollars): **$50,000**

- Replace the Howard 795 ACSR 26/7 bus:
  Estimated Cost (2009 Dollars): **$50,000**

- Replace the Howard metering CT:
  Estimated Cost (2009 Dollars): **$100,000**

- Replace the Howard 795 MCM ACSR 138 kV riser:
  Estimated Cost (2009 Dollars): **$50,000**

Network Upgrades and fixes (Upgrades required due to normal and single contingency at 13% capacity.)

- Replace the Howard 300 MCM Cu 138 kV riser:
  Estimated Cost (2009 Dollars): **$50,000**

- Replace Howard 600 A. switch:
  Estimated Cost (2009 Dollars): **$100,000**

- Replace Howard 138kV 0.75 inch Cu tubular line riser:
  Estimated Cost (2009 Dollars): **$50,000**

- Reconductor and rebuild the Howard – Brookside 138 kV circuit (8 miles):
  Estimated Cost (2009 Dollars): **$ 12,000,000**
  - This estimate only includes the reconductoring and rebuild of the AEP 8 mile section of the circuit, it does not include First Energy's 13.74 miles.

- Reconductor and rebuild the Howard – Brookside 138 kV circuit (13.74 miles):
  PJM Estimated Cost of FirstEnergy Work (2009 Dollars): **$ 20,000,000**

Total estimated cost to upgrade the Howard-Brookside 138kV circuit is **$32,450,000**

Network Upgrades and fixes (Upgrades required due to short circuit)

PJM estimates the cost to replace each of the four overdutied circuit breaers at $300,000 for a total estimated cost of **$1,200,000**.

Network Impacts

Option #1

The #V1-010 project was studied as a(n) 300 MW (Capacity 39 MW) injection at a double tap of the Chatfield-Howard and Howard-Melmore 138kV circuits in the AEP area. Project #V1-010 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)

No problems were identified.

Short Circuit
No problems identified.

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)

None

Option #2

The #V1-010 project was studied as a(n) 300 MW (Capacity 39 MW) injection into the Howard 138kV station in the AEP area. Project #V1-010 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)

No problems were identified.

Short Circuit

No problems identified.

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)

None