W1-035 Baker 500kV

Generation Interconnection

AEP 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 contingency performance criteria in accordance with the AEP FERC Form 715. Therefore, this set of criteria was used to assess the impact of the proposed facility on the AEP System. The additional 750 MW generation was studied as 750 MW net energy injections consistent with the interconnection application. The results are summarized below.

Normal System (2013 Winter Conditions)

- No problems identified

Single Contingency (2013 Winter Conditions)

- Outage of *Baker – Tri-State 345 kV line*

Monitored Facility	Equipment	Percent Overload
Baker 765/345 kV	Transformer	103%

Multiple Contingency (2013 Winter Conditions)

- Double contingency: For a contingency involving *Baker – Tri-State 345kV line* and Baker 765*/345 kV transformer*, the following thermal overloads are expected:

Monitored Facility	Equipment	Percent Overload
Baker - 345/138 kV	Transformer	136%
Tri-State - Hubbardstown 138kV	Transmission line	110%
Hubbardstown - Big Sandy 138kV	Transmission line	123%
Big Sandy-Baker 138kV	Transmission line	135%

Short Circuit Analysis

- Baker 345kV circuit breaker J1 is over-dutied from 93.3% to 102.2% of its interrupting capability.

Stability Analysis

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

Network Impacts

Queue project W1-035 was studied as a(n) 750.0MW (750.0MW of which was Capacity) injection into AEP's system at the Zelda 345kV substation. Project W1-035 was evaluated for compliance with reliability criteria for summer peak conditions in 2014. Potential network impacts were as follows:

Generator Deliverability

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

1. The Baker 765/345 kV transformer (from bus 242523 to bus 242510 ckt 1) loads from 69.7% to 100.45% (DC power flow) of its normal rating (1587 MVA) for non-contingency condition. This project contributes approximately 487.86 MW to cause the thermal violation.

2. The Baker-Big Sandy 138 kV line (from bus 243670 to bus 243669 ckt 1) loads from 72.72% to 100.33% (DC power flow) of its emergency rating (888 MVA) for the single line contingency ('317_B3'). This project contributes approximately 245.18 MW to cause the thermal violation.

3. The Baker 345/138 kV transformer (from bus 242523 to bus 243670 ckt 1) loads from 72.75% to 100.36% (DC power flow) of its emergency rating (888 MVA) for the single line contingency ('317_B3'). This project contributes approximately 245.18 MW to cause the thermal violation.

4. The North Haverhill-Plymouth G 69 kV line (from bus 243176 to bus 243178 ckt 1) loads from 99.53% to 102.82% (DC power flow) of its emergency rating (59 MVA) for the single line contingency ('317_B3'). This project contributes approximately 12.03 MW to cause the thermal violation.

5. The Baker 765/345 kV transformer (from bus 242523 to bus 242510 ckt 1) loads from 72.46% to 106.43% (DC power flow) of its emergency rating (1752 MVA) for the single line contingency ('1384_B2'). This project contributes approximately 595.17 MW to cause the thermal violation.

6. The Tri State-Kenova 138 kV line (from bus 242835 to bus 242691 ckt 1) loads from 95.27% to 121.19% (DC power flow) of its emergency rating (474 MVA) for the single line contingency ('317_B3'). This project contributes approximately 122.89 MW to cause the thermal violation.

7. The Zelda-Baker 345 kV line (from bus 270001 to bus 242523 ckt 1) loads from 56.26% to 139.72% (DC power flow) of its normal rating (896 MVA) for non-contingency condition. This project contributes approximately 747.85 MW to cause the thermal violation.

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)

PJM has completed the short circuit analysis of the W1-035 queue project Baker 345 kV. In this project, one steam turbine was added to the Zelda 345 kV substation and two steam turbines were added to the Foothill 345 kV substation. Our analysis found 1 new breaker, to be over-dutied in the AEP transmission area. The new over-duty breaker is listed below:

BUS_NO	BUS	BREAKER	Rating Type	Duty Percent With w1-035_AEP	Duty Percent Without w1-035_AEP	Duty Percent Difference	Note
0	05BAKER 345.kV	J1	T	109.80%	95.80%	14.00%	New Over-duty

Contribution to Previously Identified Overloads

(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project. This project may have % allocation of cost responsibility which will be calculated and reported for the Impact Study.)

8. The Tri State-West Hunt 138 kV line (from bus 242835 to bus 242842 ckt 1) loads from 102.91% to 125.61% (DC power flow) of its emergency rating (250 MVA) for the single line contingency ('317_B3'). This project contributes approximately 56.76 MW to cause the thermal violation.

9. The Kenova-South Point 138 kV line (from bus 242691 to bus 243088 ckt 1) loads from 101.04% to 135.99% (DC power flow) of its emergency rating (367 MVA) for the single line contingency ('317_B3'). This project contributes approximately 128.25 MW to cause the thermal violation.

10. The Tri State-Darrah 1 138 kV line (from bus 242835 to bus 242621 ckt 1) loads from 162.11% to 218.72% (DC power flow) of its emergency rating (151 MVA) for the single line contingency ('317_B3'). This project contributes approximately 85.49 MW to cause the thermal violation.

System Reinforcements

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

1. In order to mitigate the overload on the Baker 345/765kV transformer the work listed below needs to be done. The work will take **30 months** to complete. **This upgrade also mitigates Network Impact #2, 3, 4, 5, 6, 8, 9, and 10**.

- Install two (2) 2250 MVA 765/345 kV transformers at Baker Station
  Estimated Cost = **$60,000,000**

- Add three (3) 765 kV breakers and associated equipment at Baker Station: Estimated Cost = **$12,000,000**

- Add three (3) 345 kV breakers and associated equipment at Baker Station Estimated cost = **$3,600,000**

The above listed upgrades also mitigate Network Impact #2, 3, 4, 5, 6, 8, 9, and 10.

The reason for addition of two 765/345 kV transformers instead of one is to mitigate overload concerns arising from a Category C3 (double) contingency event involving the existing 765/345 kV bank and one of the additional 765/345 kV banks.

- Double contingency: For a contingency involving Baker 765/345 kV Transformer T100 + Baker 765/345kV Transformer T400.

Monitored Facility	Equipment	Percent Overload
Baker - 345/138 kV	Transformer	136%
Tri-State - Hubbardstown138kV	Transmission line	111%
Hubbardstown-Big Sandy138kV	Transmission line	122%
Big Sandy-Baker 138kV	Transmission line	136%

- Replace existing Baker 345 kV breaker J1: Estimated Cost = **$2,000,000**

7. The Zelda – Baker 345kV line is an attachment line owned by the developer. It will become overloaded by W1-035, and needs to be upgraded to accommodate the additional output.

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.