#U1-088 Dequine 345kV

Generation Interconnection

This analysis was completed to assess the reliability impact for the new generation interconnecting to the PJM system as a capacity resource.

Local & Network AEP 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. The project was studied as a 100 MW net energy injection (26 MW capacity) consistent with the interconnection application. This project was studied with PJM projects #Q01, Q03, S06, T126, T127, T183, T184, U1-024 and U1-087 already in service at 100% output in the vicinity of U1-088.The results are summarized below.

Normal System (2011 Summer Conditions)

- AEP Dequine – Reynolds[1] 345 kV line[2] is overloaded to 110% (1025 MVA) of its normal rating under system normal conditions. Without the addition of U1-088 Project, the same facilities are loaded to 107% (997 MVA) of normal rating.

- AEP Olive – S06[1] 345 kV line is overloaded to 115% (975 MVA) of its normal rating under system normal conditions. Without the addition of U1-088 Project, the same facilities are loaded to 112% (950 MVA) of normal rating.

*** It was observed that the NIPSCO owned Reynolds transformer was overloaded. PJM should address this potential issue with NIPSCO or MISO as needed.

Single Contingency (2011 Summer Conditions)

- AEP Olive – Reynolds 345 kV line[3] gets overloaded to 113% (1086 MVA) of its normal rating for an outage of the AEP Olive – S06 345 kV line. Without the addition of U1-088 Project, the same facilities are loaded to 110% (1057 MVA) of normal rating under the same contingency.

Multiple Contingency (2011 Summer Conditions)

- AEP Olive – Reynolds[4] 345 kV line[3] gets overloaded to 124% (1192 MVA) of its emergency rating for an outage of AEP Dumont – Greentown 765 kV line and AEP Olive – S06 345 kV line. Without the addition of U1-088 Project, the same facilities are loaded to 121% (1163 MVA) of emergency rating under the same contingency.

[1] Please note that because these lines are overloaded under normal conditions, the same overload issues may appear for several contingencies in the following sections but may not be discussed hereafter.
[2] A section of AEP Dequine – Olive 345 kV line
[3] A section of AEP Dequine – Olive 345 kV line
[4] The affected line may appear in multiple contingencies that are not mentioned.

- AEP Dequine – Reynolds[4] 345 kV line[3] gets overloaded to 162% (1510 MVA) of its emergency rating for an outage of AEP Greentown – Jefferson 765 kV line and AEP Olive – S06 345 kV line. Without the addition of U1-088 Project, the same facilities are loaded to 158% (1473 MVA) of emergency rating under the same contingency.

- AEP Dequine – S06[4] 345 kV line gets overloaded to 135% (1144 MVA) of its emergency rating for an outage of AEP Dequine – Reynolds – Olive 345 kV line and AEP Olive – S06 345 kV line. Without the addition of U1-088 Project, the same facilities are loaded to 131% (1111 MVA) of emergency rating under the same contingency.

- AEP Olive 345/138 kV Transformer #2 gets overloaded to 107% (886 MVA) of its emergency rating for an outage of AEP Cook – Olive 345 kV line and AEP Dumont – Olive 345 kV line. Without the addition of U1-088 Project, the same facilities are loaded to 106% (875 MVA) of emergency rating under the same contingency.

- Assuming that the generators at bus U1-088 are operating at unity power factor, a voltage collapse could occur at AEP Dequine 345 kV bus for an outage of AEP Olive – S06 345 kV line and AEP Eugene – U1-024 345 kV line. The voltage violation and upgrades required to address these violations will be discussed in the stability analysis, which is part of the impact study.

*** Please note that other voltage issues and collapses were observed within the Dequine area when certain contingencies were taken. These issues were not addressed in the above sections and will be studied in detail as part of the stability analysis.

Short Circuit Analysis

- No problems identified.

Stability Analysis

- Stability studies were not performed as part of this Feasibility Study and are not normally performed as part of a Facility Study effort. 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

The 932 MVA SN/SE rating for the Dequine – Reynolds 345 kV circuit is not correct. It is based on a relay limitation that has been eliminated. The present rating should be based on the conductor rating. However, the conductor for this circuit was installed following extensive ice storm damage and is not the original conductor. The original conductor was 1414 MCM ACSR

(paper expanded), and this is what the transmission towers were designed for. However, the replacement conductor was 2303 MCM ACAR. Although similar in size, this conductor has different sag characteristics than the original conductor. Therefore, a sag study is required for the Dequine – Reynolds 345 kV circuit to determine the maximum conductor operating temperature(s), and the associated rating(s).

To address the Olive – S06 345 kV circuit overload and Dequine – S06 345 kV circuit overload, structure and sag analyses will be required to determine if the circuit can be reconductored with a higher capacity conductor. If these analyses eliminate this alternative, then Olive – S06 345 kV and Dequine – S06 345 kV circuits will need to be rebuilt. The cost of rebuilding this double circuit line will be approximately **$1,700,000 per mile**. The cost of reconductoring will be less than rebuilding. However, the cost for reconductoring cannot be provided before the structure and sag studies are completed (some structures may still need to be replaced).

The structure and sag studies required for the Olive – S06 345 kV, Dequine – S06 345 kV and Dequine – Reynolds 345 kV overloads can be performed in the Facility Study and is estimated to cost approximately **$350,000**. It will require approximately 20 weeks from initiation. Most of the conductor lengths for the two circuits involved are located on the same towers. Therefore, a single study should be required to address both overload issues.

AEP Olive 345/138 kV transformer gets overloaded under a double contingency involving AEP Cook – Olive 345 kV line and AEP Dumont – Olive 345 kV line. The overload condition exists even in the absence of U1-087 Project. The plans for improvement to relieve the overload condition for this facility as well as the cost estimate can be provided as part of the System Impact Study. This condition first appeared in feasibility study of PJM Project #U1-024.

Reactive Requirements

PJM requires a power factor correction to 95% lead/lag at the point of interconnection for wind generating facilities. It is expected that Great Lakes will adhere to this standard.

Network Impacts

The Queue Project #U1-87 was studied as a(n) 150MW (Capacity=19.5MW) injection at the Dequine 345 kV substation in the AEP area. Project #U1-87 was evaluated for compliance with reliability criteria for summer peak conditions in 2012. Potential network impacts were as follows:

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

None

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

None

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

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)

1. The Dequine-Westwood 345kV line loads from 112.94% to 115.33% (DC power flow) of its emergency rating (809MVA) for the tower line outage (AEP_TOWER33_WITH_S06B_S31B). This project contributes approximately 29.0MW to the thermal violation.

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)

1. The overload on the Dequine-Westwood 345kV circuit can be alleviated by reconductoring the circuit. Actual cost will be detailed in the Impact Study report after collabaration with MISO.

MISO Impacts

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

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.
As a result of the aggregate energy resources in the area, the following violations were identified:

2. The S06C-Olive 345kV line loads from 142.9% to 145.9% (DC power flow) of its emergency rating (848MVA) for the single line contingency outage (AEP70). This project contributes approximately 39.2MW to the thermal congestion.

3. The Dequine-Reynolds 345kV line loads from 124.2% to 126.7% (DC power flow) of its emergency rating (932MVA) for the single line contingency outage (AEP24). This project contributes approximately 35.0MW to the thermal congestion.
.