PJM Generator Interconnection Request
Queue AB1-080
Dumont-Olive 345kV
Feasibility Study Report

February 2016
Revised March 18, 2016

Preface

The intent of the feasibility study is to determine a plan, with ballpark cost and construction time estimates, to connect the subject generation to the PJM network at a location specified by the Interconnection Customer. The Interconnection Customer may request the interconnection of generation as a capacity resource or as an energy-only resource. As a requirement for interconnection, the Interconnection Customer may be responsible for the cost of constructing: (1) Direct Connections, which are new facilities and/or facilities upgrades needed to connect the generator to the PJM network, and (2) Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system.

In some instances a generator interconnection may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection, may also contribute to the need for the same network reinforcement. The possibility of sharing the reinforcement costs with other projects may be identified in the feasibility study, but the actual allocation will be deferred until the impact study is performed.

The Feasibility Study estimates do not include the feasibility, cost, or time required to obtain property rights and permits for construction of the required facilities. The project developer is responsible for the right of way, real estate, and construction permit issues. For properties currently owned by Transmission Owners, the costs may be included in the study.

General

The Interconnection Customer (IC) proposes to install PJM Project #AB1-080, a 40MW (40 MW Capacity) injection capacity uprate to the existing 675 MW project X2-052. The increase in output is due to higher than expected efficiency in the turbines. This is a Natural Gas facility connecting to American Electric Power's (AEP) Dumont - Olive 345 kV line. The proposed location of the X2-052 interconnection switching station is approximately 1 mile from the Olive 345 kV substation and approximately 14 miles from the Dumont 345 kV substation.

The requested in-service date is 06/01/2018.

The objective of this Feasibility Study is to determine budgetary cost estimates and approximate construction timelines for identified transmission facilities required to increase the proposed generating capacity to the AEP Transmission System. These reinforcements include the Attachment Facilities, Local Upgrades, and Network Upgrades required to maintain the reliability of the AEP Transmission System. Stability analysis is not included as part of this study.

Attachment Facilities

PJM project X2-052 will pay for the necessary direct connection worked required. No additional attachment facilities are required to accommodate the additional output associated with the AB1-080 request.

Local and Network Impacts

The impact of the proposed natural gas fired generating facility on the AEP System was assessed for adherence with applicable reliability criteria. AEP planning criteria require that the transmission system meet performance parameters prescribed in the AEP FERC Form 715[1] and Connection Requirements for AEP Transmission System[2]. Therefore, these criteria were used to assess the impact of the proposed facility on the AEP System. PJM project AB1 - 080 was studied as a 40 MW (40 MW capacity) injection uprate to the X2-052 project in the AEP system consistent with the interconnection application. The proposed Project AB1 - 080 was evaluated for compliance with applicable reliability planning criteria for 2019 summer peak conditions. Project AB1-080 was studied with a commercial probability of 53%. Potential network impacts were as follows:

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Primary Point of Interconnection Potential network impacts were as follows:

Normal System (2019 Summer Conditions Capacity Output)
- No problems identified

Single Contingency (2019 Summer Conditions Capacity Output)
- No problems identified

Multiple Contingency (2019 Summer Conditions Capacity Output)
- No problems identified

Contribution to Previously Identified Overloads (2019 Summer Conditions Capacity Output)

- No problems identified

Normal System (2019 Summer Conditions Full Output)
- No problems identified

Single Contingency (2019 Summer Conditions Full Output)
- No problems identified

Multiple Contingency (2019 Summer Conditions Full Output)
- No problems identified

Contribution to Previously Identified Overloads (2019 Summer Conditions Energy Output)

#	Contingency Name	Contingency Description	Overloaded Facility Description	Limiting element	Mitigation
1	'2978_C2_05 DUMONT 765-B_A'	OPEN BRANCH FROM BUS 243206 TO BUS 907040 CKT 1 / 243206 05DUMONT 765 907040 X1-020 TAP 765 1 OPEN BRANCH FROM BUS 243206 TO BUS 270644 CKT 1 / 243206 05DUMONT 765 270644 WILTON ; 765 1 END	(AEP - AEP) The X2-052 TAP-05DUMONT 345 kV line (from bus 909144 to bus 243219 ckt 2) loads from 107.13% to 108.73% (DC power flow) of its emergency rating (1409 MVA) for the line fault with failed breaker contingency outage of '2978_C2_05DUMONT 765-B_A'. This project contributes approximately 22.53 MW to the thermal violation.	ACSR ~ 954 ~ 45/7 ~ RAIL Conductor Section 1	A sag check will be required for the ACSR ~ 954 ~ 45/7 ~ RAIL Conductor Section 1 to determine if the line section can be operated above its emergency rating of 1409 MVA. The result could prove that no additional upgrades are necessary, that some upgrades on the circuit are necessary, or that the entire 14 mile section of line would need to be rebuilt. Estimated Cost for the Sag Study: $56,000. If deemed necessary to rebuild section of line, Estimated Cost: $28,000,000.

Short Circuit Analysis

- No problems identified

Stability Analysis

- To be determined during System Impact Study.

Voltage Variations

- No problems identified

Additional Limitations of Concern

- None

Local/Network Upgrades

X2-052 TAP – Dumont 345 kV Line Overload

- A sag check will be required for the ACSR ~ 954 ~ 45/7 ~ RAIL Conductor Section 1 to determine if the line section can be operated above its emergency rating of 1409 MVA. The result could prove that no additional upgrades are necessary, that some upgrades on the circuit are necessary, or that the entire 14 mile section of line would need to be rebuilt. In some instances it may be possible to modify the system topology to mitigate the contingency exposure at a lower cost than the line rebuild.

- Estimated Cost for the Sag Study: ~~$56,000.~~

Description	Estimated Cost
X2-052 Tap - Dumont 345 kV line remediation work will include the replacement of tower 20 with a custom steel pole and the removal of swing angle brackets on 2 structures.	$1,077,451

Schedule

It is anticipated that the line remediation work identified above can be coordinated with the cut-in/backfeed date for the X2-052 project and be completed before the June 1, 2018 in service date for the AB1-080 upgrade request.

Conclusion

Based upon the results of this Feasibility Study, a 40MW (40 MW Capacity) injection capacity uprate to the existing 675 MW project X2-052 will require additional interconnection charges. PJM project X2-052 will pay for the necessary direct connection work required.

Estimated Direct Connection Cost: None
Estimated Local/Network Upgrade Cost: $1,077,451

Total Estimated Cost for Project AB1-080: $1,077,451

The estimates are preliminary in nature, as they were determined without the benefit of detailed engineering studies. The cost of remediation for sag limited conductors is not included in this estimate. Final estimates will require an on-site review and coordination to determine final construction requirements.

PJM - AnalysisNetwork Impacts

The Queue Project AB1-080 was evaluated as a 40.0 MW (Capacity 40.0 MW) injection as an uprate to the X2-052 project in the AEP area. Project AB1-080 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AB1-080 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Analysis - 2019

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

None

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

1. (AEP - AEP) The X2-052 TAP-05DUMONT 345 kV line (from bus 909144 to bus 243219 ckt 2) loads from 98.23% to 99.9% (**DC power flow**) of its emergency rating (1409 MVA) for the line fault with failed breaker contingency outage of '112-65-BT4-5__'. This project contributes approximately 23.56 MW to the thermal violation.

CONTINGENCY '112-65-BT4-5__'
TRIP BRANCH FROM BUS 270644 TO BUS 243206 CKT 1 / WILTO; 765
05DUMONT 765
TRIP BRANCH FROM BUS 275233 TO BUS 270644 CKT 1 / WILTO;4M
345 WILTO; 765
TRIP BRANCH FROM BUS 275233 TO BUS 270927 CKT 1 / WILTO;4M
345 WILTO; R 345
TRIP BRANCH FROM BUS 275233 TO BUS 275333 CKT 1 / WILTO;4M
345 WILTO;4C 33
END

2. (AEP - AEP) The X2-052 TAP-05DUMONT 345 kV line (from bus 909144 to bus 243219 ckt 2) loads from 98.22% to 99.89% (**DC power flow**) of its emergency rating (1409 MVA) for the line fault with failed breaker contingency outage of '112-65-BT3-4__'. This project contributes approximately 23.56 MW to the thermal violation.

CONTINGENCY '112-65-BT3-4__'
TRIP BRANCH FROM BUS 270644 TO BUS 243206 CKT 1 / WILTO; 765
05DUMONT 765

TRIP BRANCH FROM BUS 275232 TO BUS 270644 CKT 1 / WILTO;3M 345 WILTO; 765
TRIP BRANCH FROM BUS 275232 TO BUS 270926 CKT 1 / WILTO;3M 345 WILTO; B 345
TRIP BRANCH FROM BUS 275232 TO BUS 275332 CKT 1 / WILTO;3M 345 WILTO;3C 33
END

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. (AEP - AEP) The X2-052 TAP-05DUMONT 345 kV line (from bus 909144 to bus 243219 ckt 2) loads from 107.13% to 108.73% (**DC power flow**) of its emergency rating (1409 MVA) for the line fault with failed breaker contingency outage of '2978_C2_05DUMONT 765-B_A'. This project contributes approximately 22.53 MW to the thermal violation.

CONTINGENCY '2978_C2_05DUMONT 765-B_A'
OPEN BRANCH FROM BUS 243206 TO BUS 907040 CKT 1 / 243206 05DUMONT 765 907040 X1-020 TAP 765 1
OPEN BRANCH FROM BUS 243206 TO BUS 270644 CKT 1 / 243206 05DUMONT 765 270644 WILTON ; 765 1
END

Please refer to Appendix 1 for a table containing the generators having contribution to this flowgate.

Steady-State Voltage Requirements
(Results of the steady-state voltage studies should be inserted here)

To be determined

Short Circuit
(Summary of impacted circuit breakers)

Not required

Affected System Analysis & Mitigation

To be determined

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.

Not Applicable

Light Load Analysis - 2019

Light Load Studies to be conducted during later study phases (as required by PJM Manual 14B).

System Reinforcements

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

To be determined

Stability and Reactive Power Requirement
(Results of the dynamic studies should be inserted here)

To be determined

Summer Peak Load Flow Analysis Reinforcements

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

Multiple Facility Contingency

1. (AEP - AEP) The X2-052 TAP-05DUMONT 345 kV line:
   Reinforcement: A sag check will be required for the ACSR ~ 954 ~ 45/7 ~ RAIL Conductor Section 1 to determine if the line section can be operated above its emergency rating of 1409 MVA. The result could prove that no additional upgrades are necessary, that some upgrades on the circuit are necessary, or that the entire 14 mile section of line would need to be rebuilt..
   Cost:$56,000 for sag study. $28M to rebuild section of the line

Time: 24-36 months after signing an interconnection agreement

2. (AEP - AEP) The X2-052 TAP-05DUMONT 345 kV line:
   Same as Multiple Facility Contingency #1

Contribution to Previously Identified Overloads

1. (AEP - AEP) The X2-052 TAP-05DUMONT 345 kV line:
   Same as Multiple Facility Contingency #1

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)
(Summary form of Cost allocation for transmission lines and transformers will be inserted here if any)

Additional Interconnection Customer Responsibilities:

1. An Interconnection Customer entering the New Services Queue on or after October 1, 2012 with a proposed new Customer Facility that has a Maximum Facility Output equal to or greater than 100 MW shall install and maintain, at its expense, phasor measurement units (PMUs). See Section 8.5.3 of Appendix 2 to the Interconnection Service Agreement as well as section 4.3 of PJM Manual 14D for additional information.

2. The Interconnection Customer may be required to install and/or pay for metering as necessary to properly track real time output of the facility as well as installing metering which shall be used for billing purposes. See Section 8 of Appendix 2 to the Interconnection Service Agreement as well as Section 4 of PJM Manual 14D for additional information.

Appendices

The following appendices contain additional information about each flowgate presented in the body of the report. For each appendix, a description of the flowgate and its contingency was included for convenience. However, the intent of the appendix section is to provide more information on which projects/generators have contributions to the flowgate in question. Although this information is not used "as is" for cost allocation purposes, it can be used to gage other generators impact.

It should be noted the generator contributions presented in the appendices sections are full contributions, whereas in the body of the report, those contributions take into consideration the commercial probability of each project.

Appendix 1

(AEP - AEP) The X2-052 TAP-05DUMONT 345 kV line (from bus 909144 to bus 243219 ckt 2) loads from 107.13% to 108.73% (**DC power flow**) of its emergency rating (1409 MVA) for the line fault with failed breaker contingency outage of '2978_C2_05DUMONT 765-B_A'. This project contributes approximately 22.53 MW to the thermal violation.

CONTINGENCY '2978_C2_05DUMONT 765-B_A'
OPEN BRANCH FROM BUS 243206 TO BUS 907040 CKT 1 / 243206 05DUMONT 765 907040 X1-020 TAP 765 1
OPEN BRANCH FROM BUS 243206 TO BUS 270644 CKT 1 / 243206 05DUMONT 765 270644 WILTON ; 765 1
END

Bus Number	*Bus Name*	*Full Contribution*
247900	*05FR-11G E*	*7.67*
247901	*05FR-12G E*	*7.55*
247902	*05FR-21G E*	*8.07*
247903	*05FR-22G E*	*7.72*
247904	*05FR-3G E*	*15.64*
247905	*05FR-4G E*	*11.76*
247906	*05MDL-1G E*	*17.78*
247907	*05MDL-2G E*	*8.82*
247912	*05MDL-3G E*	*9.22*
247913	*05MDL-4G E*	*8.8*
275146	*BOONE HTG;1E*	*6.06*
274883	*BOONE HTG;1U*	*1.52*
275145	*BOONE HTG;2E*	*6.06*
274884	*BOONE HTG;2U*	*1.52*
274849	*CRESCENT ;1U*	*3.95*
274859	*EASYR;U1 E*	*7.09*
274860	*EASYR;U2 E*	*7.09*
290051	*GSG-6; E*	*6.65*
275149	*KEMPTON ;1E*	*11.35*
274881	*KEMPTON ;1U*	*2.84*
290108	*LEEDK;1U E*	*15.35*
274850	*MENDOTA H;RU*	*3.82*
275148	*MILKS GRV;1E*	*11.35*
274880	*MILKS GRV;1U*	*2.84*
293061	*N-015 E*	*9.77*
293516	*O-009 E1*	*5.98*
293517	*O-009 E2*	*3.04*
293518	*O-009 E3*	*3.34*
293644	*O-022 E1*	*6.38*

293645	*O-022 E2*	*12.39*
293715	*O-029 E*	*6.39*
293716	*O-029 E*	*3.5*
293717	*O-029 E*	*3.22*
293771	*O-035 E*	*4.29*
290021	*O-050 E*	*12.36*
294392	*P-010 E*	*12.4*
294763	*P-046 E*	*5.99*
274830	*PWR VTREC;1U*	*3.85*
274831	*PWR VTREC;2U*	*3.85*
274722	*S-055 E*	*7.03*
884780	*S-058 C*	*27.49*
884782	*S-058 C1*	*27.49*
884781	*S-058 E*	*90.65*
884783	*S-058 E1*	*90.65*
295111	*SUBLETTE E*	*1.73*
886211	*T-143 C1*	*1.83*
886221	*T-143 C2*	*1.83*
886212	*T-143 E1*	*7.33*
886222	*T-143 E2*	*7.33*
890570	*U3-026 C1*	*19.32*
890571	*U3-026 C2*	*19.32*
274814	*UNIV PK N;0U*	*0.42*
274805	*UNIV PK N;1U*	*0.42*
274806	*UNIV PK N;2U*	*0.42*
274807	*UNIV PK N;3U*	*0.42*
274808	*UNIV PK N;4U*	*0.42*
274809	*UNIV PK N;5U*	*0.42*
274810	*UNIV PK N;6U*	*0.42*
274811	*UNIV PK N;7U*	*0.42*
274812	*UNIV PK N;8U*	*0.42*
274813	*UNIV PK N;9U*	*0.42*
274815	*UNIV PK N;XU*	*0.42*
274816	*UNIV PK N;YU*	*0.42*
900371	*V4-046*	*1.51*
900381	*V4-047*	*1.51*
900391	*V4-048*	*1.71*
900401	*V4-049*	*1.71*
903432	*W3-046*	*4.06*
903434	*W3-046*	*3.76*
903435	*W3-046*	*4.06*
903436	*W3-046*	*3.76*
905254	*W4-033 E1*	*0.37*
905262	*W4-033 E2*	*0.13*

274873	*WALNR;1U*	*1.55*
294500	*WALNR;1U E*	*6.18*
274874	*WALNR;2U*	*1.55*
294502	*WALNR;2U E*	*6.18*
295109	*WESTBROOK E*	*3.56*
909145	*X2-052*	*380.26*
910542	*X3-005 E*	*0.41*
914321	*Y2-103*	*28.11*
915011	*Y3-013 1*	*2.34*
915021	*Y3-013 2*	*2.34*
915031	*Y3-013 3*	*2.34*
915601	*Y3-088*	*1.61*
915611	*Y3-089*	*1.61*
915621	*Y3-090*	*1.61*
915631	*Y3-091*	*1.61*
LTF	*Z1-043*	*19.06*
LTF	*Z1-070*	*64.65*
916211	*Z1-072*	*0.73*
916221	*Z1-073*	*0.46*
916502	*Z1-106 E1*	*0.79*
916504	*Z1-106 E2*	*0.79*
916512	*Z1-107 E*	*1.63*
916522	*Z1-108 E*	*1.56*
LTF	*Z1-112*	*6.71*
916651	*Z1-127 1*	*1.04*
916652	*Z1-127 2*	*0.61*
917451	*Z2-081*	*1.04*
917531	*Z2-090 C*	*0.03*
917532	*Z2-090 E*	*0.35*
917711	*Z2-114 C*	*0.4*
917712	*Z2-114 E*	*0.4*
918051	*AA1-018 C OP*	*1.58*
918052	*AA1-018 E OP*	*10.57*
918251	*AA1-040 1*	*0.8*
918261	*AA1-040 2*	*0.8*
LTF	*AA1-071*	*4.47*
918611	*AA1-078*	*2.38*
918972	*AA1-116 E*	*1.62*
918982	*AA1-117 E*	*1.62*
919071	*AA1-129*	*2.14*
919221	*AA1-146*	*11.45*
919581	*AA2-030 C*	*11.45*
919582	*AA2-030 E*	*2.41*
919591	*AA2-035 C OP*	*80.07*

919592	*AA2-035 E OP*	*6.21*
LTF	*AA2-038*	*22.91*
919811	*AA2-067 OP*	*0.76*
920112	*AA2-107 E*	*1.54*
920272	*AA2-123 E*	*1.54*
930041	*AB1-006 C*	*2.89*
930042	*AB1-006 E*	*19.37*
930381	*AB1-079*	*0.88*
930391	*AB1-080*	*22.53*
930442	*AB1-085 E*	*1.58*
930481	*AB1-089 C*	*42.28*
930482	*AB1-089 E*	*1.92*
930491	*AB1-090 C*	*42.28*
930492	*AB1-090 E*	*1.92*
930501	*AB1-091 C OP*	*44.35*
930502	*AB1-091 E OP*	*2.02*

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General

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The requested in-service date is 06/01/2018.

The objective of this Feasibility Study is to determine budgetary cost estimates and approximate construction timelines for identified transmission facilities required to increase the proposed generating capacity to the AEP Transmission System. These reinforcements include the Attachment Facilities, Local Upgrades, and Network Upgrades required to maintain the reliability of the AEP Transmission System. Stability analysis is not included as part of this study.

Attachment Facilities

No additional attachment facilities are required to accommodate the additional output associated with the AB1-080 request.

Local and Network Impacts

The impact of the proposed natural gas fired generating facility on the AEP System was assessed for adherence with applicable reliability criteria. AEP planning criteria require that the transmission system meet performance parameters prescribed in the AEP FERC Form 715[1] and Connection Requirements for AEP Transmission System[2]. Therefore, these criteria were used to assess the impact of the proposed facility on the AEP System. PJM project AB1 - 080 was studied as a 40 MW (40 MW capacity) injection uprate to the an existing generator project in the AEP system consistent with the interconnection application. The proposed Project AB1 - 080 was evaluated for compliance with applicable reliability planning criteria for 2019 summer peak conditions. Project AB1-080 was studied with a commercial probability of 53%. Potential network impacts were as follows:

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222 https://www.aep.com/about/codeofconduct/OASIS/TransmissionStudies/Requirements/AEP_Interconnection_Requirements_rev1.pdf

Primary Point of Interconnection Potential network impacts were as follows:

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- No problems identified

Single Contingency (2019 Summer Conditions Capacity Output)
- No problems identified

Multiple Contingency (2019 Summer Conditions Capacity Output)
- No problems identified

Contribution to Previously Identified Overloads (2019 Summer Conditions Capacity Output)

- No problems identified

Normal System (2019 Summer Conditions Full Output)
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Contribution to Previously Identified Overloads (2019 Summer Conditions Energy Output)

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Short Circuit Analysis

- No problems identified

Stability Analysis

- To be determined during System Impact Study.

Voltage Variations

- No problems identified

Additional Limitations of Concern

- None

Local/Network Upgrades

X2-052 TAP – Dumont 345 kV Line Overload

- A sag check will be required for the ACSR ~ 954 ~ 45/7 ~ RAIL Conductor Section 1 to determine if the line section can be operated above its emergency rating of 1409 MVA. The result could prove that no additional upgrades are necessary, that some upgrades on the circuit are necessary, or that the entire 14 mile section of line would need to be rebuilt. In some instances it may be possible to modify the system topology to mitigate the contingency exposure at a lower cost than the line rebuild.

- Estimated Cost for the Sag Study: $56,000.

Schedule

It is anticipated that the time between receipt of executed agreements and Commercial Operation may range from 12 to 18 months if no line work is required. If line work is required, construction time would be between 24 to 36 months after signing an interconnection agreement.

Conclusion

Based upon the results of this Feasibility Study, a 40MW (40 MW Capacity) injection capacity uprate to the existing 675 MW generator will require additional interconnection charges.

Estimated Direct Connection Cost: None
Estimated Local/Network Upgrade Cost: $56,000

Total Estimated Cost for Project AB1-080: $56,000

The estimates are preliminary in nature, as they were determined without the benefit of detailed engineering studies. The cost of remediation for sag limited conductors is not included in this estimate. Final estimates will require an on-site review and coordination to determine final construction requirements.