PJM Generator Interconnection Request
Queue AB2-141
George Washington 138 kV
Feasibility Study Report

December 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

Interconnection Customer (IC) proposes to install PJM Project #AB2-141, a 394 MW (388.6 MW Capacity) natural gas generating facility (Two Combustion Turbines (CTs)) to the American Electric Power (AEP) transmission system. The point of interconnection requested is a direct connection to the newly configured George Washington 138 kV GIS substation via two (2) 138 kV circuit breaker. The location of the natural gas generating facility is in Interconnection Customer , WV.

The requested Backfeed date is March 1, 2018.

The requested in-service date is April 1, 2019.

The objective of this Feasibility Study is to determine budgetary cost estimates and approximate construction timelines for identified transmission facilities required to connect the proposed generating facilities 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

Direct Connection into the newly configured George Washington 138 kV GIS Substation:

To accommodate direct connection to the newly configured George Washington 138 kV GIS substation, an additional 138 kV circuit breaker will be required. Installation of associated protection and control equipment, SCADA, and 138 kV revenue metering will also be required.

Direct Connection to the newly configured George Washington 138 kV GIS substation Work and Cost:

- Install one new 138 kV circuit breaker. Installation of associated protection and control equipment, SCADA, and 138 kV revenue metering will also be required.
- **Estimated Station Cost: $2,500,000**

Protection and Relay Work and Cost:

- Install line protection and controls at the newly configured George Washington 138 kV GIS substation.
- **Estimated Cost: $250,000**

It is understood that Interconnection Customer Power is responsible for all costs associated with this interconnection. The costs above are reimbursable to AEP. The cost of Interconnection Customer Power's generating plant and the costs for the line

connecting the generating plant to Interconnection Customer Power's switching station are not included in this report; these are assumed to be Interconnection Customer Power's responsibility.

The Generation Interconnection Agreement does not in or by itself establish a requirement for American Electric Power to provide power for consumption at the developer's facilities. A separate agreement may be reached with the local utility that provides service in the area to ensure that infrastructure is in place to meet this demand and proper metering equipment is installed. It is the responsibility of the developer to contact the local service provider to determine if a local service agreement is required.

Local and 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 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. The Queue Project AB2-141 was evaluated as a 394.0 MW (Capacity 388.6 MW) injection at the George Washington 138kV substation in the AEP area. Project AB2-141 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AB2-141 was studied with a commercial probability of 53%.

1 https://www.aep.com/about/codeofconduct/OASIS/TransmissionStudies/GuideLines/AEP_East_FERC_715_2016_Final_Part_4.pdf

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

Network Impacts

The Queue Project AB2-141 was evaluated as a 394.0 MW (Capacity 388.6 MW) injection at the George Washington 138kV substation in the AEP area. Project AB2-141 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AB2-141 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Analysis - 2020

Generator Deliverability

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

AB2-141 Generator Deliverability

#	Contingency Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Cir.	PF	Loading Initial	Loading Final	Rating Type	Rating MVA	MW Con.	FG App.
1	N-1	GWASHINGTON-DILLES_138KV_CKT2	AEP - AEP	05DILESBTMZ1-05HOLLOW 138 kV line	247840	247131	1	DC	94.35	121.74	ER	456	124.89	1
2	N-1	DILLESZ2_HOLLOWAY_138KV	AEP - AEP	05DILESBTMZ1-05HOLLOW 138 kV line	247840	247131	1	DC	94.31	121.69	ER	456	124.89	

Multiple Facility Contingency

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

None

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

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)

None

Affected System Analysis & Mitigation

LGEE Impacts:

LGEE Impacts to be determined during later study phases (as applicable).

MISO Impacts:

MISO Impacts to be determined during later study phases (as applicable).

Duke, Progress & TVA Impacts:

Duke Carolina, Progress, & TVA Impacts to be determined during later study phases (as applicable).

OVEC Impacts:

OVEC Impacts to be determined during later study phases (as applicable).

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.

AB2-141 Delivery of Energy Portion of Interconnection Request															
		Contingency	Affected		Bus				Loading		Rating		MW	FG
#	Type	Name	Area	Facility Description	From	To	Cir.	PF	Initial	Final	Type	MVA	Con.	App.
1	N-1	GWASHINGTON-DILLES_138KV_CKT2	AEP - AEP	05DILESBTMZ1-05HOLLOW 138 kV line	247840	247131	1	DC	91.86	119.63	ER	456	126.62	

Light Load Analysis - 2020

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)

Generator Deliverability

1. (AEP - AEP) The 05DILESBTMZ1-05HOLLOW 138 kV line (from bus 247840 to bus 247131 ckt 1) loads from 94.35% to 121.74% (**DC power flow**) of its emergency rating (456 MVA) for the single line contingency outage of 'GWASHINGTON-DILLES_138KV_CKT2'. This project contributes approximately 124.89 MW to the thermal violation.

AEP
2.5 miles of the First Energy portion of 138 kV line is limiting this line. No upgrades required.

First Energy

Description	Total with Tax	Tax	Total Cost
Convert the Burger-Harmon No2 and Burger-Cloverdale No. 1 138kV circuits to a single circuit by 6-wiring the two circuits for 2.4 miles and extend the new circuit into Holloway Sub (0.25 miles).	$2,061,100.00	$233,800.00	$1,827,300.00
Convert the former Burger Loop 138kV circuits to a single circuit by 6-wiring the two circuits for 2.4 miles and extend the new circuit into Holloway Sub (0.25 miles).	$2,000,700.00	$226,600.00	$1,774,100.00
Totals	**$4,061,800**	**$460,400**	**$3,601,400**

2. (AEP - AEP) The 05DILESBTMZ1-05HOLLOW 138 kV line (from bus 247840 to bus 247131 ckt 1) loads from 94.31% to 121.69% (**DC power flow**) of its emergency rating (456 MVA) for the single line contingency outage of 'DILLESZ2_HOLLOWAY_138KV'. This project contributes approximately 124.89 MW to the thermal violation.

Same as New System Reinforcement #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)

None

Light Load 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)

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

Conclusion

Based upon the results of this Feasibility Study, the construction of the 394.0 MW (388.6 MW Capacity) Interconnection Customer's natural gas generating facility (PJM Project #AB2-141) will require the following additional interconnection charges. This plan of service will interconnect the proposed generating facility in a manner that will provide operational reliability and flexibility to both the AEP system and the Interconnection Customer's generating facility.

Cost Breakdown for the Direct Connection at the newly configured George Washington 138 kV GIS Substation:

Estimated Attachment Cost: $2,500,000

Estimated Affected System Cost: $4,000,000

Estimated Protection and Relay Cost: $250,000

Total Estimated Cost for Project AB2-141: $6,750,000

The estimates are preliminary in nature, as they were determined without the benefit of detailed engineering studies. Final estimates will require an on-site review and coordination to determine final construction requirements.

Additional Information for the Feasibility Report:

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.

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 05DILESBTMZ1-05HOLLOW 138 kV line (from bus 247840 to bus 247131 ckt 1) loads from 94.35% to 121.74% (**DC power flow**) of its emergency rating (456 MVA) for the single line contingency outage of 'GWASHINGTON-DILLES_138KV_CKT2'. This project contributes approximately 124.89 MW to the thermal violation.

CONTINGENCY 'GWASHINGTON-DILLES_138KV_CKT2'
OPEN BRANCH FROM BUS 243012 TO BUS 247852 CKT 1 / 243012 05G WASH 138 247839 05DILLES BTM 138 2
END

Bus Number	*Bus Name*	*Full Contribution*
235344	*01HANNIB*	*0.51*
243189	*05MLG2*	*11.33*
247632	*Y3-068 OP1*	*175.15*
921992	*AA2-098*	*6.43*
923312	*AB1-140*	*3.21*
923342	*AB1-143*	*3.21*
923422	*AB1-157*	*3.21*
924441	*AB2-093*	*64.22*
924521	*AB2-101*	*9.96*
924871	*AB2-141 C*	*124.89*