

***Generation Interconnection
Feasibility Study Report***

Queue Position AB2-156

W.H. Zimmer 345 kV

August 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 has proposed an uprate to an existing coal generating facility located at W. H. Zimmer Substation, Clermont County, Ohio. This project requests an increase to the install capability (upon Integration with PJM) of 50 MW with 50 MW of this output being recognized by PJM as capacity. The installed facilities will have a total capability of 1350 MW with 50 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is October 1, 2017. **This study does not imply a Duke Energy Ohio and Kentucky (or “DEOK”) commitment to this in-service date.**

Point of Interconnection

AB2-156 will interconnect with the DEOK transmission system through direct injection into W. H. Zimmer Substation. The primary point of interconnection will be direct injection at disconnect #1448. The secondary point of interconnection will be direct injection at disconnect #1442. Refer to the one-line diagram in Appendix 2 for system configuration.

Network Impacts

The Queue Project AB2-156 was evaluated as a 50.0 MW (Capacity 50.0 MW) injection at the Zimmer 345kV substation in the DEOK area. Project AB2-156 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AB2-156 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)

1. (DEO&K - DEO&K) The 08ZIMER-08SGROVE 345 kV line (from bus 249577 to bus 249573 ckt 1) loads from 98.39% to 100.01% (**DC power flow**) of its emergency rating (1664 MVA) for the single line contingency outage of 'P1-#.B2 PORT UNION-ZIMMER 4544'. This project contributes approximately 26.94 MW to the thermal violation.

CONTINGENCY 'P1-#.B2 PORT UNION-ZIMMER 4544'
OPEN BRANCH FROM BUS 249570 TO BUS 249577 CKT 1
END

Please refer to Appendix 3 for a table containing the generators having contribution to this flowgate.

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)

1. (EKPC - DAY) The 7SPURLOCK-09STUART 345 kV line (from bus 342838 to bus 253077 ckt 1) loads from 117.88% to 119.06% (**DC power flow**) of its emergency rating (1374 MVA) for the single line contingency outage of 'P1-#.B2 RED BANK-SG-ZIMMER 4545'. This project contributes approximately 16.72 MW to the thermal violation.

CONTINGENCY 'P1-#.B2 RED BANK-SG-ZIMMER 4545'
OPEN BRANCH FROM BUS 249573 TO BUS 249577 CKT 1
OPEN BRANCH FROM BUS 249573 TO BUS 250097 CKT 1
OPEN BRANCH FROM BUS 249571 TO BUS 249573 CKT 1
END

Please refer to Appendix 4 for a table containing the generators having contribution to this flowgate.

2. (EKPC - DAY) The 7SPURLOCK-09STUART 345 kV line (from bus 342838 to bus 253077 ckt 1) loads from 107.55% to 108.58% (**DC power flow**) of its emergency rating (1374 MVA) for the single line contingency outage of 'P1-#.B2 PORT UNION-ZIMMER 4544'. This project contributes approximately 14.7 MW to the thermal violation.

CONTINGENCY 'P1-#.B2 PORT UNION-ZIMMER 4544'
OPEN BRANCH FROM BUS 249570 TO BUS 249577 CKT 1
END

Steady-State Voltage Requirements

None

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).

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.

Not Applicable

Light Load Analysis - 2020

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

System Reinforcements

Short Circuit

None

Stability and Reactive Power Requirement

To be determined at later study stages.

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. (DEO&K - DEO&K) The 08ZIMER-08SGROVE 345 kV line (from bus 249577 to bus 249573 ckt 1) loads from 98.39% to 100.01% (**DC power flow**) of its emergency rating (1664 MVA) for the single line contingency outage of 'P1-#.B2 PORT UNION-ZIMMER 4544'. This project contributes approximately 26.94 MW to the thermal violation.

Reinforcement: Reconductor Zimmer-Silver Grove 345 kV to 2045 MVA

Cost: \$32,096,408

Time: 4 years

Please refer to Appendix 3 for a table containing the generators having contribution to this flowgate.

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. (EKPC - DAY) The 7SPURLOCK-09STUART 345 kV line (from bus 342838 to bus 253077 ckt 1) loads from 117.88% to 119.06% (**DC power flow**) of its emergency rating (1374 MVA) for the single line contingency outage of 'P1-#.B2 RED BANK-SG-ZIMMER 4545'. This project contributes approximately 16.72 MW to the thermal violation.

EKPC

Reinforcement:

1. Upgrade DPL limiting element (currently at 1374 LTE) (Costs do not include DPL work)

2. Increase MOT on the Spurlock - Stuart 345kV double-954 54x7 ACSR from 212°F to 275°F (LTE of 257°F) (3.81 miles).

Cost: \$800,000

Time: 24 months

Dayton

Reinforcement: Upgrade the thermal capacity of the substation conductor at Stuart 345kV Substation. The limiting Dayton element will have a Summer Normal Rating of 1561MVA and Summer Emergency Rating of 1800MVA.

Cost: \$30,000

Time: 2 weeks

Please refer to Appendix 4 for a table containing the generators having contribution to this flowgate.

2. (EKPC - DAY) The 7SPURLOCK-09STUART 345 kV line (from bus 342838 to bus 253077 ckt 1) loads from 107.55% to 108.58% (**DC power flow**) of its emergency rating (1374 MVA) for the single line contingency outage of 'P1-#.B2 PORT UNION-ZIMMER 4544'. This project contributes approximately 14.7 MW to the thermal violation.

Same as Contribution to Previously Identified Overload #1

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

Appendix 1

[Reserved]

Appendix 2

[Reserved]

Appendix 3

This appendix contains additional information about flowgate in question presented in the body of the report. A description of the flowgate and its contingency is included for convenience. However, the intent of this appendix 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.

(DEO&K - DEO&K) The 08ZIMER-08SGROVE 345 kV line (from bus 249577 to bus 249573 ckt 1) loads from 98.39% to 100.01% (**DC power flow**) of its emergency rating (1664 MVA) for the single line contingency outage of 'P1-#.B2 PORT UNION-ZIMMER 4544'. This project contributes approximately 26.94 MW to the thermal violation.

CONTINGENCY 'P1-#.B2 PORT UNION-ZIMMER 4544'
 OPEN BRANCH FROM BUS 249570 TO BUS 249577 CKT 1
 END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
251970	08MELDL1	3.38
251971	08MELDL2	3.38
251972	08MELDL3	3.39
251968	08ZIMRHP	92.3
251969	08ZIMRLP	50.6
342910	1DALE 3G	4.71
342911	1DALE 4G	5.27
342957	1SPURLK1G	9.69
342960	1SPURLK2G	19.04
342963	1SPURLK3G	10.01
342966	1SPURLK4G	10.01
923522	AB1-169 C OP	209.07
924101	AB2-054	49.56
925001	AB2-156	26.94

Appendix 4

This appendix contains additional information about flowgate in question presented in the body of the report. A description of the flowgate and its contingency is included for convenience. However, the intent of this appendix 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.

(EKPC - DAY) The 7SPURLOCK-09STUART 345 kV line (from bus 342838 to bus 253077 ckt 1) loads from 117.88% to 119.06% (**DC power flow**) of its emergency rating (1374 MVA) for the single line contingency outage of 'P1-#.B2 RED BANK-SG-ZIMMER 4545'. This project contributes approximately 16.72 MW to the thermal violation.

CONTINGENCY 'P1-#.B2 RED BANK-SG-ZIMMER 4545'
 OPEN BRANCH FROM BUS 249573 TO BUS 249577 CKT 1
 OPEN BRANCH FROM BUS 249573 TO BUS 250097 CKT 1
 OPEN BRANCH FROM BUS 249571 TO BUS 249573 CKT 1
 END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
251970	08MELDL1	2.79
251971	08MELDL2	2.79
251972	08MELDL3	2.8
251968	08ZIMRHP	57.29
251969	08ZIMRLP	31.4
342910	1DALE 3G	17.57
342911	1DALE 4G	19.02
342921	1JKCT 2G	5.66
342924	1JKCT 3G	5.66
342939	1JKCT 9G	4.15
342942	1JKCT 10G	4.15
342957	1SPURLK1G	28.49
342960	1SPURLK2G	54.39
342963	1SPURLK3G	28.58
342966	1SPURLK4G	28.58
923522	AB1-169 C OP	597.06
924101	AB2-054	170.8
925001	AB2-156	16.72