Generation Interconnection Feasibility Study Report

For

PJM Generation Interconnection Request Queue Position AD1-090

Muskingum River 345 kV

April 2018

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 #AD1-090, a 1260.0 MW (1180.0 MW Capacity) natural gas generating facility in Washington County, OH (see Figure 2). The Primary point of interconnection will be a direct connection to AEP's Muskingum River 345 kV substation (see Figure 1). The Secondary Point of interconnection is to AEP's Muskingum River – West Millersport 345 kV circuit #2 (See Figure 3).

The requested in backfeed date is October 1, 2021.

The requested in service date is January 1, 2022.

Attachment Facilities

Primary Point of Interconnection (Muskingum River 345 kV Substation)

To accommodate the interconnection at the Muskingum River 345 kV substation, the substation will have to be expanded requiring the installation of one 345 kV circuit breaker (see Figure 1). Installation of associated protection and control equipment, 345 kV line risers, SCADA, and 345 kV revenue metering will also be required.

Direct Connection Work and Cost:

- Expand the Muskingum River 345 kV substation; Install one new 345 kV circuit breaker (see Figure 1). Installation of associated protection and control equipment, 345 kV line risers, SCADA, and 345 kV revenue metering will also be required.
    - **Estimated Station Cost: $2,500,000**

Non-Direct Connection Cost Estimate

The total preliminary cost estimate for Non-Direct Connection work is given in the following tables below:

For AEP building Direct Connection cost estimates:

Description	Estimated Cost
345 kV Revenue Metering	**$350,000**
Upgrade line protection and control settings at the Muskingum 345 kV substation	**$600,000**
Total	**$950,000**

Table 1

Secondary Point of Interconnection (Muskingum River – W.Millersport #2 138kV substation)

To accommodate the interconnection on the Muskingum River – W.Millersport 345 kV circuit #2, a new three (3) circuit breaker 138 kV switching station physically configured in a breaker and half bus arrangement but operated as a ring-bus will be constructed (see Figure 3). Installation of associated protection and control equipment, 345kV line risers, SCADA, and 345 kV revenue metering will also be required. AEP reserves the right to specify the final acceptable configuration considering design practices, future expansion, and compliance requirements.

Interconnection Customer Requirements

It is understood that the IC is responsible for all costs associated with this interconnection. The cost of the IC's generating plant and the costs for the line connecting the generating plant to the Muskingum River 345 kV substation are not included in this report; these are assumed to be the IC'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.

Requirement from the PJM Open Access Transmission Tariff:

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.

Revenue Metering and SCADA Requirements

PJM Requirements

The Interconnection Customer will be required to install equipment necessary to provide Revenue Metering (KWH, KVARH) and real time data (KW, KVAR) for IC's generating Resource. See PJM Manuals M-01 and M-14D, and PJM Tariff Sections 24.1 and 24.2.

AEP Requirements

The Interconnection Customer will be required to comply with all AEP Revenue Metering Requirements for Generation Interconnection Customers. The Revenue Metering Requirements may be found within the "Requirements for Connection of New Facilities or Changes to Existing Facilities Connected to the AEP Transmission System" document located at the following link:

http://www.pjm.com/~/media/planning/plan-standards/private-aep/aep-interconnection-requirements.ashx

Option 1

Network Impacts

The Queue Project AD1-090 was evaluated as a 1260.0 MW (Capacity 1180.0 MW) injection at the Muskingum River 345kV substation in the AEP area. Project AD1-090 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AD1-090 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Base Case Used

Summer Peak Analysis – 2021 Case

Contingency Descriptions

The following contingencies resulted in overloads:

Option 1	
Contingency Name	**Description**
AEP_P1-2_#8971	CONTINGENCY 'AEP_P1-2_#8971' OPEN BRANCH FROM BUS 242932 TO BUS 247797 CKT 1 / 242932 05CANTNC 345 247797 05STEMPLE 345 1 END
DLCO-P12_301	CONTINGENCY 'DLCO-P12_301' OPEN BRANCH FROM BUS 242946 TO BUS 253965 CKT 1 / 242946 05TIDD 345 253965 15COLLIE 345 1 END

Table 2

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)

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)

Note: Please see Appendices for projects providing impacts to flow gate violations. The values in the Reference column correspond to the proper table in the Appendix.

AD1-090 Contribution to Previously Identified Overloads															
	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	DLCO-P12_301	AEP - AP	AA2-121 TAP-01WYLIE R 345 kV line	920250	235707	1	DC	113.97	121.29	NR	1409	101.8	1
2	N-1	AEP_P1-2_#8971	AEP - AP	AA2-121 TAP-01WYLIE R 345 kV line	920250	235707	1	DC	108.73	114.75	NR	1409	83.38	

Table 3

Steady-State Voltage Requirements

None

Short Circuit

(Summary of impacted circuit breakers)

New circuit breakers found to be over-duty:

Bus Name	BREAKER	Breaker Capacity (Amps)	Duty Percent With AD1-090	Duty Percent Without AD1-090
05MUSKNG 345.kV	SH	50000	112.33%	86.82%
05MUSKNG 345.kV	SI	50000	112.33%	86.82%
05MUSKNG 345.kV	SG	50000	112.22%	86.56%
05MUSKNG 138.kV	HE	63000	110.58%	97.64%
05MUSKNG 138.kV	HF	63000	110.47%	97.54%

Bus Name	BREAKER	Breaker Capacity (Amps)	Duty Percent With AD1-090	Duty Percent Without AD1-090
05MUSKNG 138.kV	HD	63000	109.32%	96.06%
05MUSKNG 138.kV	HT	63000	109.24%	98.35%
05MUSKNG 138.kV	HU	63000	109.24%	98.35%
05MUSKNG 345.kV	SA	50000	109.04%	82.07%
05MUSKNG 345.kV	SB	50000	109.04%	82.07%
05MUSKNG 345.kV	SP	50000	108.07%	82.21%
05MUSKNG 345.kV	SQ	50000	108.07%	84.97%
05MUSKNG 345.kV	SJ	50000	107.94%	82.11%
05MUSKNG 345.kV	SK	50000	107.94%	82.11%
05MUSKNG 138.kV	HB	63000	106.56%	93.70%
05MUSKNG 345.kV	SR	50000	104.30%	84.97%
05MUSKNG 345.kV	SU	50000	104.30%	84.97%
05MUSKNG 345.kV	SW	50000	104.30%	84.97%
05MUSKNG 138.kV	HP	63000	101.69%	90.19%
05MUSKNG 138.kV	HK	63000	100.44%	88.25%
05KARL 138.kV	105	16700	100.01%	99.89%

Table 4

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.

Note: Only the most severely overloaded conditions are listed below. 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 shall study all overload conditions associated with the overloaded element(s) identified.

AD1-090 Delivery of Energy Portion of Interconnection Request															
	Contingency		Affected	Facility	Bus				Loading		Rating		MW	FG
#	Type	Name	Area	Description	From	To	Cir.	PF	Initial	Final	Type	MVA	Con.	App.
3	N-1	DLCO-P12_301	AEP - AP	AA2-121 TAP-01WYLIE R 345 kV line	920250	235707	1	DC	107.86	111.64	NR	1409	108.7	

Table 5

New System Reinforcements

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

#	Contingency	Overloaded Facility	Upgrade Description	Schedule	Estimated Cost
#1	Short Circuit Study	Muskingum River 345kV Circuit Breakers SH, SI, SG, SP, SQ, SA, SB, SJ, SK, SR, SU, SW	Replace the Muskingum River 345kV Circuit Breakers SH, SI, SG, SP, SQ, SA, SB, SJ, SK, SR, SU, SW	An approximate construction time would be 24 months after signing an interconnection agreement.	$30,000,000
#2	Short Circuit Study	Muskingum River 138kV Circuit Breakers HE, HF, HD, HT, HU, HB, HP, HK	Replace the Muskingum River 138kV Circuit Breakers HE, HF, HD, HT, HU, HB, HP, HK	An approximate construction time would be 24 months after signing an interconnection agreement.	$8,000,000
#3	Short Circuit Study	Karl Road 138kV Circuit Breaker 105	Circuit Breaker 105 is schedule to be replaced with a 63kA	Scheduled to be replaced in 2020	N/A
				Total New Network Upgrades	**$38,000,000**

Table 6

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)

1. (AEP - AP) The AA2-121 TAP-01WYLIE R 345 kV line (from bus 920250 to bus 235707 ckt 1) loads from 113.97% to 121.29% (**DC power flow**) of its normal rating (1409 MVA) for the single line contingency outage of 'DLCO-P12_301'. This project contributes approximately 101.8 MW to the thermal violation.

AEP:
Not owned by AEP

APS:
Limiting SN rating (1409 MVA) is an AEP rating at the TIDD substation. The AA2-121 tap (Abby Lane Substation) will sectionalize the line between TIDD and WYLIE RIDGE. The FE limiting rating of the AA2-121 Tap-Wylie Ridge 345 kV line is 1542 MVA (SN) / 1878 MVA (STE). However, overload still exists; install 954 ACSS transmission line on open arm positions and replace line risers with 954 45/7 ACSS double circuit for minimum rating 1743 MVA (SN) / 1900 MVA (STE). Cost estimate and timeframe listed below:

Description	Total with Tax	Tax	Total Cost
Install 10.4 miles of bundled 954 ACSS conductor on the open arms of the Wylie Ridge-Tidd 345 kV line from Wylie Ridge to the proposed Abby Lane Substation @ **Abby Lane-Wylie Ridge 345 kV Install New Conductor on Open Arms**	$11,234,500	$1,345,000	$9,889,500
Replace 2-954 ACSR line terminal conductor @ AA2-121 Interconnection SS	$41,000	$5,000	$36,000
Replace 2-954 ACSR line terminal conductor on the present Tidd (AEP) @ Wylie Ridge SS	$41,000	$5,000	$36,000
Totals	**$11,316,500**	**$1,355,000**	**$9,961,500**

Table 7

Schedule - Approximately 12 Months to Complete

2. (AEP - AP) The AA2-121 TAP-01WYLIE R 345 kV line (from bus 920250 to bus 235707 ckt 1) loads from 108.73% to 114.75% (**DC power flow**) of its normal rating (1409 MVA) for the single line contingency outage of 'AEP_P1-2_#8971'. This project contributes approximately 83.38 MW to the thermal violation.

Same as Contribution to Previously Identified #1

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.

Note: The time provided between anticipated normal completion of System Impact, Facilities Studies, subsequent execution of ISA and ICSA documents, and the proposed Backfeed Date is shorter than usual and may be difficult to achieve.

Conclusion

Based upon the results of this Feasibility Study, the construction of the IC's 1260.0MW (1180.0 MW Capacity) natural gas generating facility (PJM Project #AD1-090) 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 IC's generating facility.

Cost Breakdown for Point of Interconnection (Muskingum River 345 kV Substation)		
Attachment Cost	Expand Muskingum River 345 kV Substation	$2,500,000
Non-Direct Connection Cost Estimate	345 kV Revenue Metering	$350,000
	Upgrade line protection and control settings at the Muskingum River 345 kV substation	$600,000
New system Reinforcements	*(Upgrades required to mitigate reliability criteria violations , i.e. Network impacts, identified for earlier generation or transmission interconnection projects in the PJM Queue)*	$49,316,500
	Total Estimated Cost for Project AD1-090	**$52,766,500**

Table 8

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.

Option 2

Network Impacts

The Queue Project AD1-051 was evaluated as a 1260.0 MW (Capacity 1180.0MW) injection Muskingum River – West Millersport 345kV line in the AEP area. Project AD1-090 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AD1- 090 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Base Case Used

Summer Peak Analysis – 2021 Case

Contingency Descriptions

The following contingencies resulted in overloads:

Option 2	
Contingency Name	**Description**
AEP_P1-2_#730-A	CONTINGENCY 'AEP_P1-2_#730-A' OPEN BRANCH FROM BUS 242940 TO BUS 934630 CKT 2 / 242940 05MUSKNG 345 934630 AD1-090 TAP 345 2 END
AEP_P1-2_#730-B	CONTINGENCY 'AEP_P1-2_#730-B' OPEN BRANCH FROM BUS 934630 TO BUS 242949 CKT 2 / 934630 AD1-090 TAP 345 242949 05WMILLP 345 2 END
AEP_P1-2_#8971	CONTINGENCY 'AEP_P1-2_#8971' OPEN BRANCH FROM BUS 242932 TO BUS 247797 CKT 1 / 242932 05CANTNC 345 247797 05STEMPLE 345 1 END
DLCO-P12_301	CONTINGENCY 'DLCO-P12_301' OPEN BRANCH FROM BUS 242946 TO BUS 253965 CKT 1 / 242946 05TIDD 345 253965 15COLLIE 345 1 END

Table 9

Generator Deliverability

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

	Contingency				Bus				Loading		Rating			
#	Type	Name	Affected Area	Facility Description	From	To	Cir.	PF	Initial	Final	Type	MVA	MW Con.	FG App.

1	N-1	'AEP_P1-2_#730-B'	AEP - AEP	AD1-090 TAP-05MUSKNG	934630	242940	1	DC	0.01	129.66	NR	910	1180	
2	N-1	'AEP_P1-2_#730-A'	AEP - AEP	AD1-090 TAP-05WMILLP	934630	2429498	1	DC	.01	129.66	NR	910	1180	

Table 10

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)

AD1-090 Contribution to Previously Identified Overloads - Option 2															
	Contingency		Affected	Facility	Bus				Loading		Rating		MW	FG
#	Type	Name	Area	Description	From	To	Cir.	PF	Initial	Final	Type	MVA	Con.	App.
3	N-1	DLCO-P12_301	AEP - AP	AA2-121 TAP-01WYLIE R 345 kV line	920250	235707	1	DC	113.97	121.25	NR	1409	101.2	3
4	N-1	AEP_P1-2_#8971	AEP - AP	AA2-121 TAP-01WYLIE R 345 kV line	920250	235707	1	DC	108.73	114.71	NR	1409	82.86	

Table 11

Steady-State Voltage Requirements

None

Short Circuit

(Summary of impacted circuit breakers)

New circuit breakers found to be over-duty:

Bus Name	BREAKER	Breaker Capacity (Amps)	Duty Percent With AD1-090	Duty Percent Without AD1-090_op2
05MUSKNG 345.kV	SH	50000	108.49%	86.82%
05MUSKNG 345.kV	SI	50000	108.49%	86.82%

Bus Name	BREAKER	Breaker Capacity (Amps)	Duty Percent With AD1-090	Duty Percent Without AD1-090_op2
05MUSKNG 138.kV	HT	63000	108.23%	98.35%
05MUSKNG 138.kV	HU	63000	108.23%	98.35%
05MUSKNG 138.kV	HE	63000	107.47%	97.64%
05MUSKNG 138.kV	HF	63000	107.37%	97.54%
05MUSKNG 138.kV	HD	63000	106.07%	96.06%
05MUSKNG 345.kV	SP	50000	103.80%	82.21%
05MUSKNG 345.kV	SQ	50000	103.80%	84.97%
05MUSKNG 345.kV	SA	50000	103.75%	82.07%
05MUSKNG 345.kV	SB	50000	103.75%	82.07%
05MUSKNG 345.kV	SJ	50000	103.74%	82.11%
05MUSKNG 345.kV	SK	50000	103.74%	82.11%
05MUSKNG 138.kV	HB	63000	103.33%	93.70%
05MUSKNG 345.kV	SR	50000	101.84%	84.97%
05MUSKNG 345.kV	SU	50000	101.84%	84.97%
05MUSKNG 345.kV	SW	50000	101.84%	84.97%
05MUSKNG 138.kV	HP	63000	100.06%	90.19%
05KARL 138.kV	105	16700	100.02%	99.89%

Table 12

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.

Note: Only the most severely overloaded conditions are listed below. 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 shall study all overload conditions associated with the overloaded element(s) identified.

AD1-090 Delivery of Energy Portion of Interconnection Request - Option 2													
	Contingency		Affected	Facility	Bus				Loading		Rating		MW
#	Type	Name	Area	Description	From	To	Cir.	PF	Initial	Final	Type	MVA	Con.
5	N-1	DLCO-P12_301	AEP - AP	AA2-121 TAP-01WYLIE R 345 kV line	920250	235707	1	DC	107.86	111.62	NR	1409	108.1
6	N-1	AEP_P1-2_#730-B	AEP - AEP	AD1-090 TAP-05MUSKNG 345 kV line	934630	242940	2	DC	0.01	138.45	NR	910	1260
7	N-1	AEP_P1-2_#730-A	AEP - AEP	AD1-090 TAP-05WMILLP 345 kV line	934630	242949	2	DC	0.01	138.45	NR	910	1260

Table 13

Figure 1: Primary Point of Interconnection (Muskingum River 345 kV Substation)

Single-Line Diagram

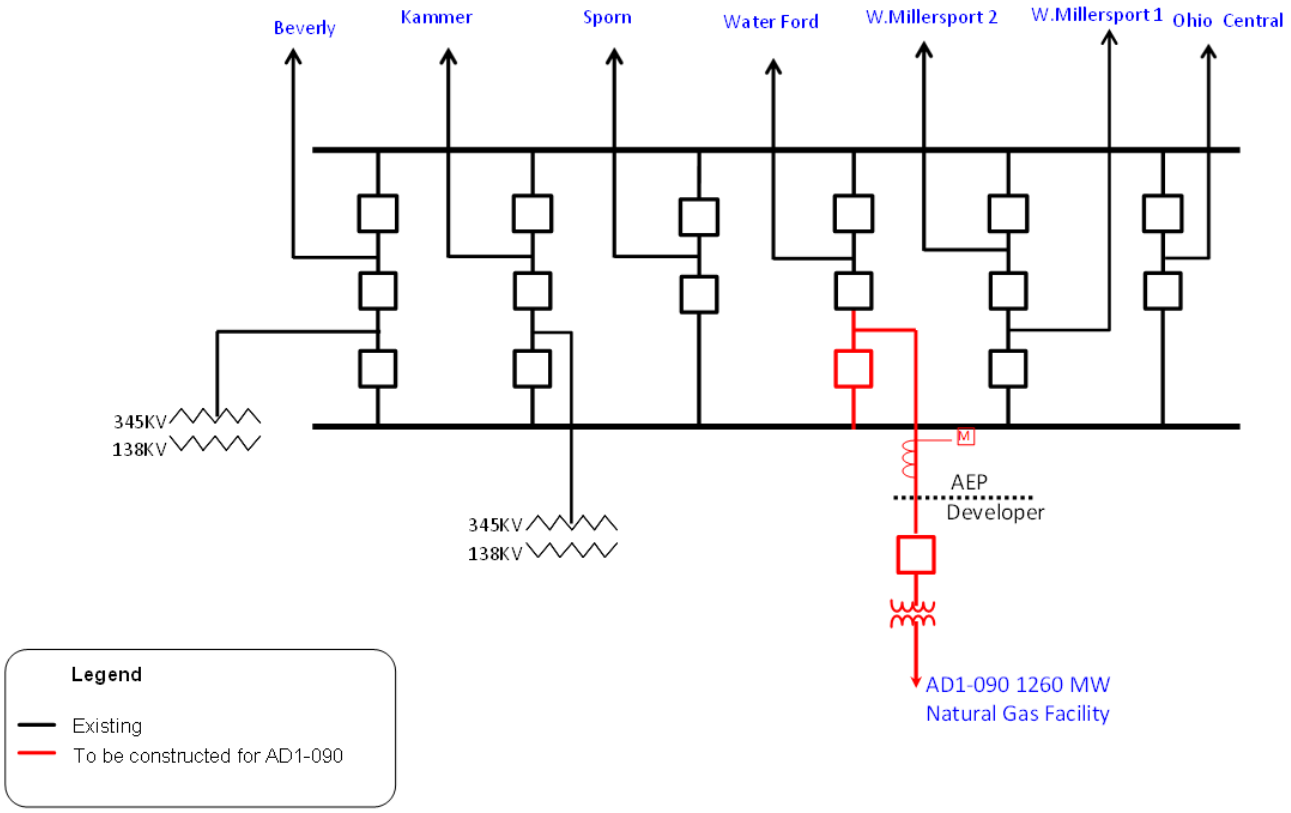
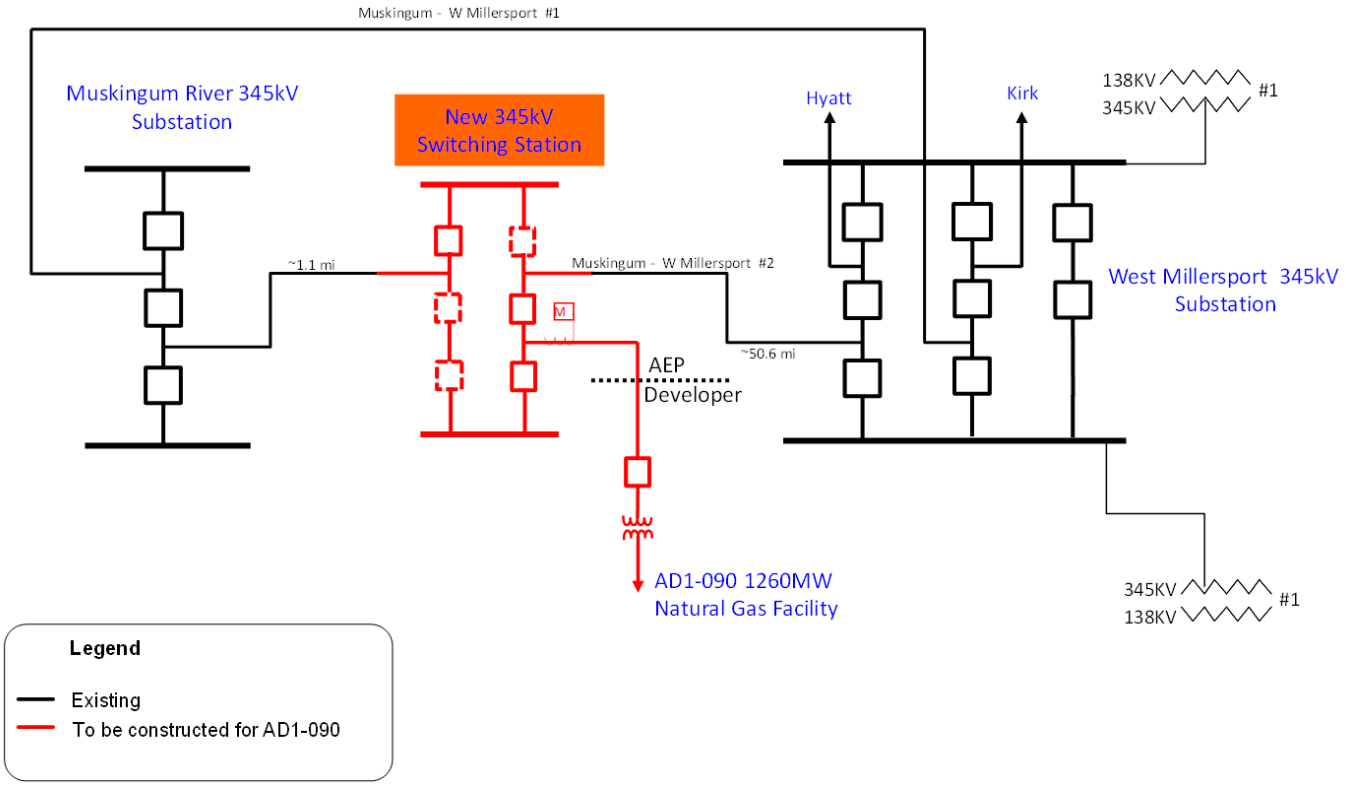


Figure 3: Secondary Point of Interconnection (Muskingum River – W. Millersport #2 345 kV)

Single-Line Diagram



Appendices – Option 1

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 – Option 1

(AEP - AP) The AA2-121 TAP-01WYLIE R 345 kV line (from bus 920250 to bus 235707 ckt 1) loads from 113.97% to 121.29% (**DC power flow**) of its normal rating (1409 MVA) for the single line contingency outage of 'DLCO-P12_301'. This project contributes approximately 101.8 MW to the thermal violation.

CONTINGENCY 'DLCO-P12_301'
OPEN BRANCH FROM BUS 242946 TO BUS 253965 CKT 1 / 242946 05TIDD 345 253965 15COLLIE 345 1
END

Bus Number	*Bus Name*	*Full Contribution*
235344	*01HANNIB*	*0.41*
247798	*05CARROLCNTY*	*20.11*
243190	*05CDG1*	*14.46*
243191	*05CDG2*	*40.7*
243185	*05CDG3*	*43.16*
243622	*05CVG4*	*9.21*
243624	*05CVG6*	*4.78*
243189	*05MLG2*	*20.05*
247838	*05MOUNDS PWR*	*15.87*
247202	*05WSHG1A*	*3.23*
247203	*05WSHG1B*	*3.23*
247204	*05WSHG1S*	*4.6*
247237	*05WTRG1A*	*2.76*
247238	*05WTRG1B*	*2.76*
247239	*05WTRG1C*	*2.76*
247240	*05WTRG1S*	*6.46*
932061	*AC2-016*	*3.05*
932291	*AC2-043 C*	*1.24*

934631	*AD1-090 C O1*	*101.8*
247581	*W3-111 C*	*0.67*
247582	*W3-112 C*	*0.5*
247583	*W3-113 C*	*0.5*
918031	*AA1-014*	*0.09*
920251	*AA2-121*	*420.47*
920431	*AA2-141*	*0.8*
924441	*AB2-093*	*65.58*
924551	*AB2-104*	*39.9*
924871	*AB2-141 C*	*57.64*
925351	*AC1-003*	*49.11*
926251	*AC1-103*	*119.89*

Appendices – Option 2

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 AD1-090 TAP-05MUSKNG 345 kV line (from bus 934630 to bus 242940 ckt 2) loads from .01% to 129.66% (**DC power flow**) of its normal rating (910 MVA) for the single line contingency outage of 'AEP_P1-2_#730-B'. This project contributes approximately 1180.0 MW to the thermal violation.

CONTINGENCY 'AEP_P1-2_#730-B'
OPEN BRANCH FROM BUS 934630 TO BUS 242949 CKT 2 / 934630 AD1-090 TAP 345 242949 05WMILLP 345 2
END

Bus Number	*Bus Name*	*Full Contribution*
934631	*AD1-090 C O2*	*1180.*

Appendix 2

(AEP - AEP) The AD1-090 TAP-05WMILLP 345 kV line (from bus 934630 to bus 242949 ckt 2) loads from .01% to 129.66% (**DC power flow**) of its normal rating (910 MVA) for the single line contingency outage of 'AEP_P1-2_#730-A'. This project contributes approximately 1180.0 MW to the thermal violation.

CONTINGENCY 'AEP_P1-2_#730-A'
OPEN BRANCH FROM BUS 242940 TO BUS 934630 CKT 2 / 242940 05MUSKNG 345 934630 AD1-090 TAP 345 2
END

Bus Number	*Bus Name*	*Full Contribution*
934631	*AD1-090 C O2*	*1180.*

Appendix 3

(AEP - AP) The AA2-121 TAP-01WYLIE R 345 kV line (from bus 920250 to bus 235707 ckt 1) loads from 113.97% to 121.25% (**DC power flow**) of its normal rating (1409 MVA) for the single line contingency outage of 'DLCO-P12_301'. This project contributes approximately 101.24 MW to the thermal violation.

CONTINGENCY 'DLCO-P12_301'
OPEN BRANCH FROM BUS 242946 TO BUS 253965 CKT 1 / 242946 05TIDD 345 253965 15COLLIE 345 1
END

Bus Number	*Bus Name*	*Full Contribution*
235344	*01HANNIB*	*0.41*
247798	*05CARROLCNTY*	*20.11*
243190	*05CDG1*	*14.46*
243191	*05CDG2*	*40.7*
243185	*05CDG3*	*43.16*
243622	*05CVG4*	*9.21*
243624	*05CVG6*	*4.78*
243189	*05MLG2*	*20.05*
247838	*05MOUNDS PWR*	*15.87*
247202	*05WSHG1A*	*3.23*
247203	*05WSHG1B*	*3.23*
247204	*05WSHG1S*	*4.6*
247237	*05WTRG1A*	*2.76*
247238	*05WTRG1B*	*2.76*
247239	*05WTRG1C*	*2.76*
247240	*05WTRG1S*	*6.46*
932061	*AC2-016*	*3.05*
932291	*AC2-043 C*	*1.24*

934631	*AD1-090 C O2*	*101.24*
LTF	*AD1-092*	*4.46*
LTF	*AD1-093*	*7.65*
LTF	*AD1-094*	*1.45*
LTF	*CARR*	*1.62*
LTF	*CBM-S1*	*11.42*
LTF	*CBM-S2*	*6.33*
LTF	*CBM-W1*	*44.76*
LTF	*CBM-W2*	*70.3*
LTF	*CIN*	*10.8*
LTF	*CPLE*	*1.23*
LTF	*IPL*	*6.96*
LTF	*LGEE*	*2.3*
LTF	*MEC*	*19.09*
LTF	*MECS*	*12.*
LTF	*RENSSELAER*	*1.28*
LTF	*ROSETON*	*9.26*
247581	*W3-111 C*	*0.67*
247582	*W3-112 C*	*0.5*
247583	*W3-113 C*	*0.5*
LTF	*WEC*	*2.83*
LTF	*Y3-032*	*7.83*
LTF	*Z1-043*	*11.07*
918031	*AA1-014*	*0.09*
920251	*AA2-121*	*420.47*
920431	*AA2-141*	*0.8*

LTF	*AB2-013*	*6.37*
924441	*AB2-093*	*65.58*
924551	*AB2-104*	*39.9*
924871	*AB2-141 C*	*57.64*
925351	*AC1-003*	*49.11*
926251	*AC1-103*	*119.89*