Generation Interconnection Feasibility Study Report

For

PJM Generation Interconnection Request Queue Position AD2-071

Pipe Creek – Strawton 138 kV

December 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.

For Local and Network Upgrades which are required due to overloads associated with the System Impact Studies of an individual New Services Queue, and have a cost less than $5,000,000, the cost of the Local and Network Upgrades will be shared by all proposed projects which have been assigned a Queue Position in the New Services Queue in which the need for the Local and Network Upgrades was identified. The Load Flow Cost Allocation methods discussed in this manual, including cutoffs, still apply to the individual projects.

For Local and Network Upgrades which are required due to the overloads associated with the System Impact Studies of an individual New Services Queue, and have a cost of $5,000,000 or greater, the cost of the Local and Network Upgrades will be allocated according to the order of the New Service Requests in the New Services Queue and the MW contribution of each individual Interconnection Request for those projects which cause or contribute to the need for the Local or Network Upgrades. The Load Flow Cost Allocation methods discussed in this manual, including cutoffs, still apply to the individual projects.

Cost allocation rules can be found in PJM Manual 14A, Attachment B. 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.

PJM utilizes manufacturer models to ensure the performance of turbines is properly captured during the simulations performed for stability verification. Turbine manufacturers provide such models to their customers. The list of manufacturer models PJM has already validated is contained in Attachment G-2 of Manual 14A. Manufacturer models may be updated from time to time, for various reasons such as to reflect changes to the control systems or to more accurately represent the capabilities turbines and controls which are currently available in the field. Additionally, as new turbine models are developed, turbine manufacturers provide such new models which must be used in the conduct of these studies. PJM needs adequate time to evaluate the new models in order to reduce delays to the System Impact Study process timeline for the Interconnection Customer as well as other Interconnection Customers in the study group. Therefore, PJM will require that any Interconnection Customer with a new manufacturer model must supply that model to PJM, along with a $10,000 fully refundable deposit, no later than three (3) months prior to the starting date of the System Impact Study (See Section 2.2.2. of Manual

14A for starting dates) for the Interconnection Request which shall specify the use of the new model. The Interconnection Customer will be required to submit a completed dynamic model study request form (Attachment G-1 of Manual 14A) in order to document the request for the study.

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 #AD2-071, a 100.0 MW (67.0 MW Capacity) solar generating facility in Madison County, Indiana (see Figure 2). The point of interconnection is to AEP's Pipe Creek – Strawton 138 kV section of the Deer Creek – Fisher Body – Strawton 138 kV circuit (see Figure 1).

The requested in service date is December 1, 2021.

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 for maintaining the reliability of the AEP transmission system. Stability analysis is not included as part of this study.

Attachment Facilities

Primary Point of Interconnection (Pipe Creek – Strawton 138 kV)

To accommodate the interconnection on the Pipe Creek – Strawton 138 kV section of the Deer Creek – Fisher Body – Strawton circuit, 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 1). Installation of associated protection and control equipment, 138 kV line risers, SCADA, and 138 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.

New Switching Station Work and Cost:

- Construct 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. Installation of associated protection and control equipment, 138 kV line risers and SCADA will also be required (see Figure 1).
    - **Estimated Station Cost: $6,000,000**

Direct Connection Cost Estimate

The total preliminary cost estimate for Direct Connection work is given in the following table below.

For AEP building Direct Connection cost estimates:

Description	Total Cost
Pipe Creek – Strawton 138 kV T-Line Cut In	$1,000,000
Total	**$1,000,000**

Table 1

Non-Direct Connection Cost Estimate

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

For AEP building Non-Direct Connection cost estimates:

Description	Estimated Cost
138 kV Revenue Metering	$250,000
Upgrade line protection and controls at the Pipe Creek 138 kV station.	$250,000
Upgrade line protection and controls at the Strawton 138 kV substation.	$250,000
Total	**$750,000**

Table 2

Interconnection Customer Requirements

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

Network Impacts

The Queue Project AD2-071 was evaluated as a 100.0 MW (Capacity 67.0 MW) injection tapping the Pipe Creek – Strawton 138kV line in the AEP area. Project AD2-071 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AD2-071 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:

Contingency Name	Description
AEP_P4_#8775_05STRWTN 138	CONTINGENCY 'AEP_P4_#8775_05STRWTN 138' OPEN BRANCH FROM BUS 247116 TO BUS 246988 CKT 1 / 247116 05ALEXAN 138 246988 05STRWTN 138 1 OPEN BRANCH FROM BUS 246771 TO BUS 246988 CKT 1 / 246771 05SELWDZ 138 246988 05STRWTN 138 1 END
AEP_P7-1_#3206_B	CONTINGENCY 'AEP_P7-1_#3206_B' OPEN BRANCH FROM BUS 243218 TO BUS 923880 CKT 1 / 243218 05DESOTO 345 923880 AB2-028 TAP C 345 1 OPEN BRANCH FROM BUS 243222 TO BUS 254535 CKT 1 / 243222 05FALL C 345 254535 16SUNNYS 345 1 END **Note:** This contingency is incorrect. These lines are not double circuited.
AEP_P4_#2965_05DESOTO 345	CONTINGENCY 'AEP_P4_#2965_05DESOTO 345' OPEN BRANCH FROM BUS 243218 TO BUS 923880 CKT 1 / 243218 05DESOTO 345 923880 AB2-028 TAP 345 1 OPEN BRANCH FROM BUS 243218 TO BUS 243278 CKT 1 / 243218 05DESOTO 345 243278 05DESOTO 138 1 END
AEP_P1-2_#8702	CONTINGENCY 'AEP_P1-2_#8702' OPEN BRANCH FROM BUS 243218 TO BUS 243232 CKT 2 / 243218 05DESOTO 345 243232 05SORENS 345 2 END
AEP_P1-2_#673-A	CONTINGENCY 'AEP_P1-2_#673-A' OPEN BRANCH FROM BUS 243218 TO BUS 923880 CKT 1 / 243218 05DESOTO 345 923880 AB2-028 TAP 345 1 END
844_B3_05HOGAN 138-1_WOMOAB	CONTINGENCY '844_B3_05HOGAN 138-1_WOMOAB' OPEN BRANCH FROM BUS 247420 TO BUS 243311 CKT 1 / 247420 05CROSS ST Z 138 243311 05HOGAN 138 1 OPEN BRANCH FROM BUS 243275 TO BUS 243311 CKT 1 / 243275 05DELAWR 138 243311 05HOGAN 138 1 OPEN BRANCH FROM BUS 243311 TO BUS 246913 CKT 1 / 243311 05HOGAN 138 246913 05JONES 138 1 OPEN BRANCH FROM BUS 243311 TO BUS 246046 CKT 1 / 243311 05HOGAN 138 246046 05HOGAN 34.5 1 OPEN BRANCH FROM BUS 243311 TO BUS 246047 CKT 1 / 243311 05HOGAN 138 246047 05HOGAN L 12.0 1 END
AEP_P1-2_#6964-A	CONTINGENCY 'AEP_P1-2_#6964-A' OPEN BRANCH FROM BUS 246763 TO BUS 936560 CKT 1 / 246763 05PIPECK 138 936560 AD2-071 TAP 138 1 END

Table 3

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)

AD2-071 Multiple Facility Contingency														
		Contingency	Affected	Facility	Bus				Loading		Rating		MW	FG
#	Type	Name	Area	Description	From	To	Cir.	PF	Initial	Final	Type	MVA	Con.	App.
1	LFFB	AEP_P4_#8775_05STRWTN 138	AEP - AEP	05PIPECK-05GRNTTA 138 kV line	246763	243303	1	DC	87.89	132.49	ER	205	91.43	
2	LFFB	AEP_P4_#8775_05STRWTN 138	AEP - AEP	AD2-071 TAP-05PIPECK 138 kV line	936560	246763	1	DC	89.99	134.59	ER	205	91.43	

Table 4

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)

AD2-071 Contribution to Previously Identified Overloads														
		Contingency	Affected	Facility	Bus				Loading		Rating		MW	FG
#	Type	Name	Area	Description	From	To	Cir.	PF	Initial	Final	Type	MVA	Con.	App.
1	DCTL	AEP_P7-1_#3206_B	AEP - AEP	05HOGAN-05DELAWR 138 kV line	243311	243275	1	DC	114.86	123.39	ER	231	19.7	
2	LFFB	AEP_P4_#2965_05DESOTO 345	AEP - AEP	05HOGAN-05DELAWR 138 kV line	243311	243275	1	DC	115.29	123.39	ER	231	18.71	

Table 5

Steady-State Voltage Requirements

None

Short Circuit

(Summary of impacted circuit breakers)

New circuit breakers found to be over-duty:

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.

AD2-071 Delivery of Energy Portion of Interconnection Request

#	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	AEP_P1-2_#8702	AEP - AEP	05KEYSTN-05SORENS 345 kV line	243225	243232	1	DC	107.82	108.3	NR	897	9.71	
2	N-1	'AEP_P1-2_#673-A	AEP - AEP	05HOGAN-05DELAWR 138 kV line	243311	243275	1	DC	114.18	122.49	ER	231	19.19	
3	Non	Non	AEP - AEP	05HOGAN-05DELAWR 138 kV line	243311	243275	1	DC	102.78	114.06	NR	167	18.85	
4	N-1	'844_B3_05HOGAN 138-1_WOMOAB	AEP - AEP	05PIPECK-05GRNTTA 138 kV line	246763	243303	1	DC	90.8	118.53	ER	205	59.46	
5	N-1	AEP_P1-2_#6964-A	AEP - AEP	05STRWTN-05ALEXAN 138 kV line	246988	247116	1	DC	119.91	152.85	ER	150	49.4	
6	Non	Non	AEP - AEP	05STRWTN-05ALEXAN 138 kV line	246988	247116	1	DC	86.59	104.32	NR	150	49.4	

AD2-071 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.
7	N-1	AEP_P1-2_#6964-A	AEP - AEP	05ALEXAN-05JONES 138 kV line	247116	246913	1	DC	107.65	140.58	ER	150	49.4	
8	N-1	844_B3_05HOGAN 138-1_WOMOAB	AEP - AEP	AD2-071 TAP-05PIPECK 138 kV line	936560	246763	1	DC	92.9	120.63	ER	205	59.46	

Table 6

Note:

- The correct Summer Emergency rating for Hogan - Delaware 138kV line after the S1498 project (Delaware – Madison line rebuild) will be 286 MVA and will be limited by a CT Thermal Limit.
- The correct Summer Normal rating for Hogan - Delaware 138kV line after the S1498 project will be 261MVA and will be limited by the Hogan bus.
- The correct Summer Emergency rating for Strawton – Alexandria (Aladdin) 138kV line is 360 MVA.
- The correct Summer Normal rating for Strawton – Alexandria (Aladdin) is 257 MVA.
- The correct Summer Emergency rating for Alexandria (Aladdin) – Jones Creek 138kV line is 360 MVA.

New System Reinforcements

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

#	Overloaded Facility	Upgrade Description	Schedule	Estimated Cost
#1	05PIPECK-05GRNTTA 138 kV line	A Sag Study will be required on the 1.9 miles of ACSR ~ 556.5 ~ 26/7 ~ DOVE - Conductor Section 1 to determine any mitigations required for the overload.	An approximate time for the sag study is 6 to 12 months after signing an interconnection agreement	$20,000
#2	AD2-071 TAP-05PIPECK 138 kV line	A Sag Study will be required on the 8.2 miles of ACSR ~ 556.5 ~ 26/7 ~ DOVE - Conductor Section 1 to mitigate the overload. to determine any mitigations required for the overload.	An approximate time for the sag study is 6 to 12 months after signing an interconnection agreement	$32,800
			Total Network Upgrades	**$52,800**

Table 7

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)

Violation #	Overloaded Facility	Upgrade Description	Schedule	Estimated Cost
#1	05HOGAN-05DELAWR 138 kV line	An Engineering study will need to be conducted for the Delaware CT Thermal Limit (996 Amps) to determine if the CT Thermal Limit settings can be adjusted to mitigate the overload. Replace the Delaware bus – Sub cond 500 MCM CU 37 Str. Rebuild/reconductor 5.19 miles of the ACSR~397.5~30/7~LARK conductor section 1. Replace Delaware Line risers -Sub cond 795 AAC 37 Str. **Note:** The supplemental project S1498 will mitigate all of the above constraints for the Hogan - Delaware 138kV line except the CT Thermal Limit. The new Emergency Rating will be 286 MVA after the upgrades are completed.	An approximate time for the Engineering study to determine if the CT Thermal Limit can be adjusted is 6 to 12 months. The in service date for supplemental project S1498 is 12/31/2021.	$25,000 (Engineering Study)
			Total New Network Upgrades	**$25,000**

Table 8

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, the construction of the IC's 100.0 MW (67.0 MW Capacity) solar generating facility (PJM Project #AD2-071) will require the following additional interconnection charges. This plan of service will interconnect the proposed solar 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 (Pipe Creek – Strawton 138 kV)		
Attachment Cost	New 138 kV Switching Station and associated protection and controls.	$6,000,000
Direct Connection Cost Estimate	Pipe Creek – Strawton 138 kV T-Line Cut In	$1,000,000
Non-Direct Connection Cost Estimate	138 kV Revenue Metering	$250,000
	Upgrade line protection and controls at the Pipe Creek 138 kV substation	$250,000
	Upgrade line protection and controls at the Strawton 138 kV substation.	$250,000
	New System Reinforcements *Upgrades required to mitigate reliability criteria violations, i.e. Network Impacts, initially caused by the addition of this project generation)*	$52,800
	Contribution to Previously Identified 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)*	$25,000
	Total Estimated Cost for Project AD2-071	**$7,827,800**

Table 9

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.

Figure 1: Point of Interconnection (Pipe Creek – Strawton 138 kV)

Single-Line Diagram

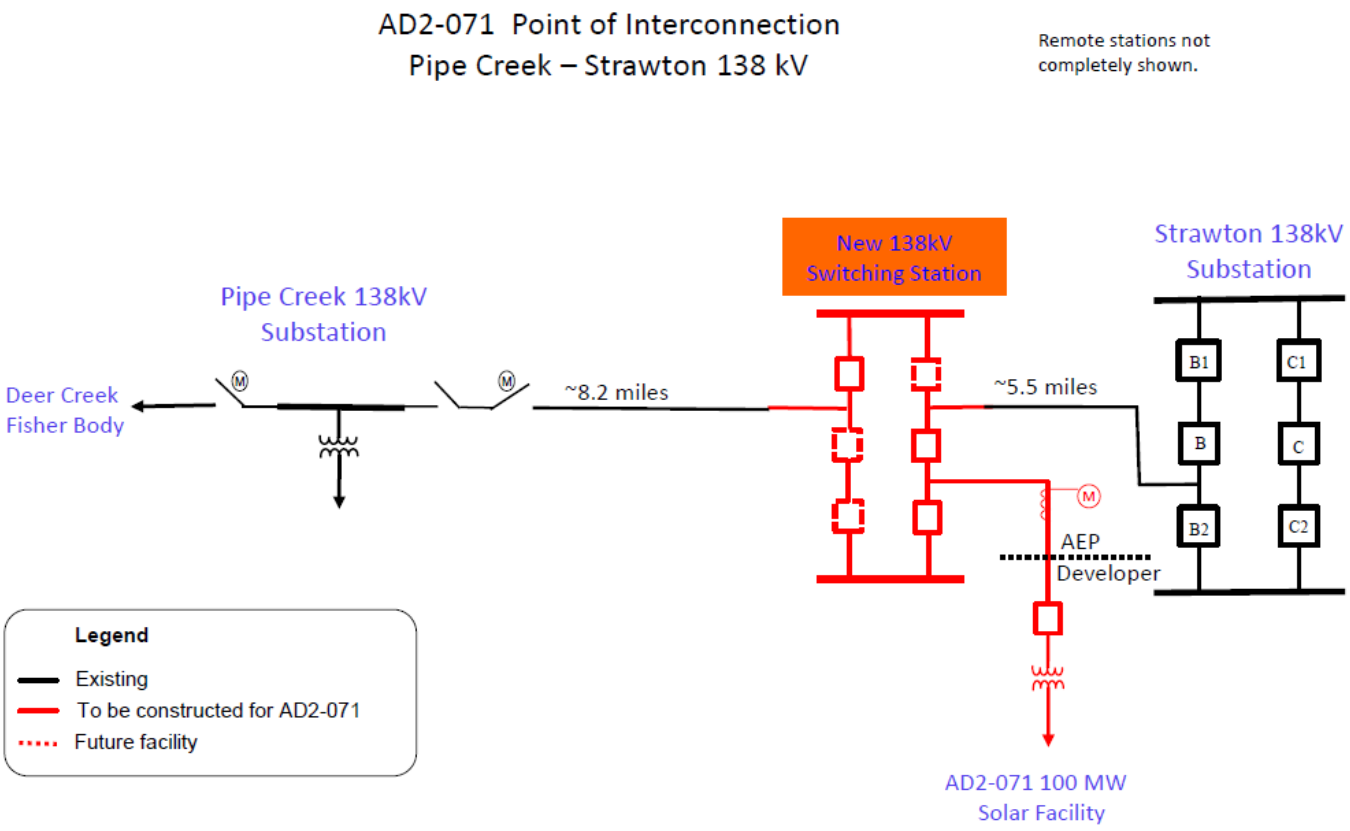
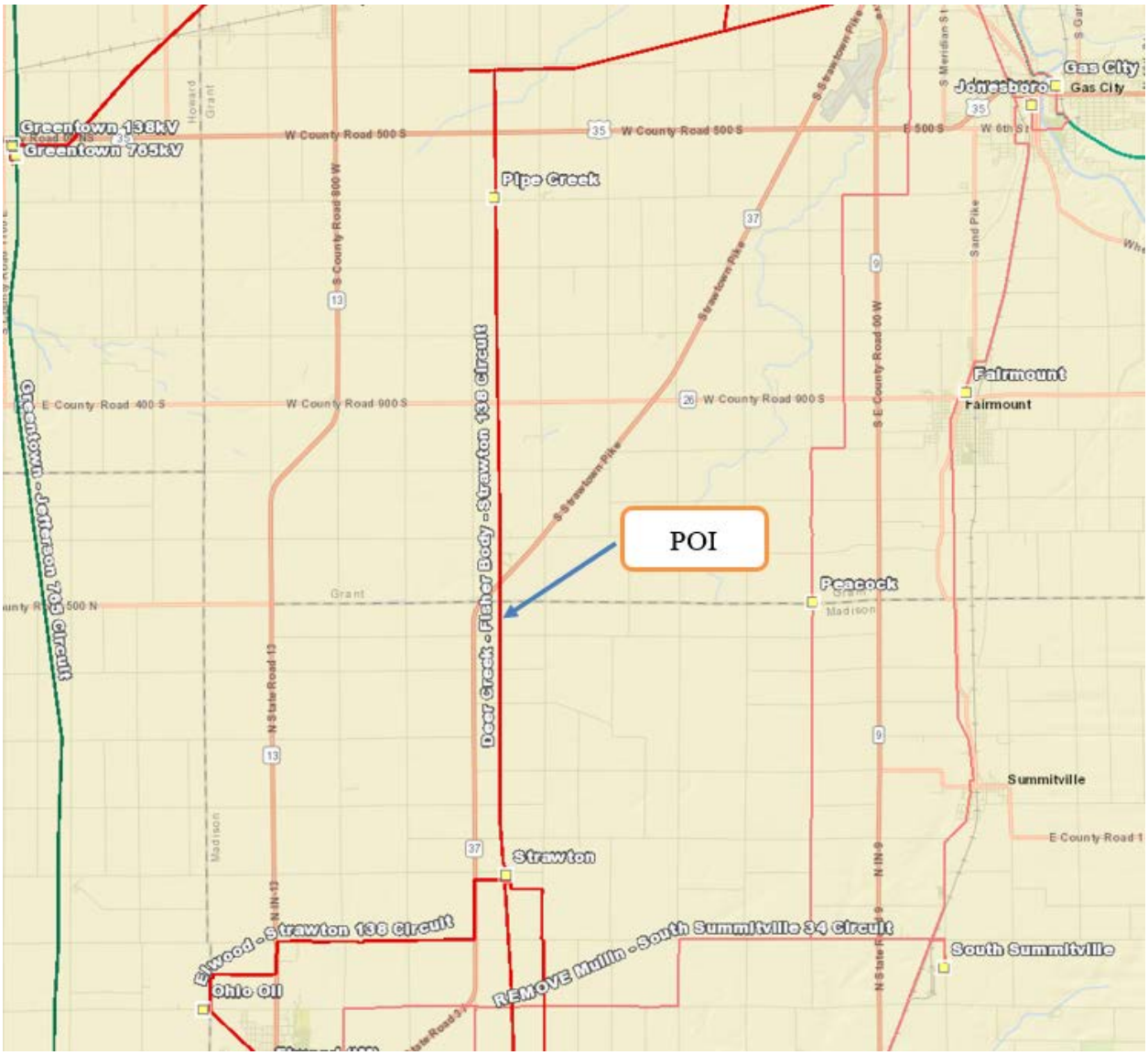


Figure 2: Point of Interconnection (Pipe Creek – Strawton 138 kV)



Appendices for POI

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. All New Service Queue Requests, through the end of the Queue under study, that are contributors to a flowgate will be listed in the Appendices. Please note that there may be contributors that are subsequently queued after the queue under study that are not listed in the Appendices. Although this information is not used "as is" for cost allocation purposes, it can be used to gage the impact of other projects/generators.

It should be noted the project/generator MW contributions presented in the body of the report and appendices sections are full contributions, whereas the loading percentages reported in the body of the report, take into consideration the commercial probability of each project as well as the ramping impact of "Adder" contributions.

Appendix 1

(AEP - AEP) The 05PIPECK-05GRNTTA 138 kV line (from bus 246763 to bus 243303 ckt 1) loads from 87.89% to 132.49% (**DC power flow**) of its emergency rating (205 MVA) for the line fault with failed breaker contingency outage of 'AEP_P4_#8775_05STRWTN 138'. This project contributes approximately 91.43 MW to the thermal violation.

CONTINGENCY 'AEP_P4_#8775_05STRWTN 138'
OPEN BRANCH FROM BUS 247116 TO BUS 246988 CKT 1 / 247116 05ALEXAN 138 246988 05STRWTN 138 1
OPEN BRANCH FROM BUS 246771 TO BUS 246988 CKT 1 / 246771 05SELWDZ 138 246988 05STRWTN 138 1
END

Bus Number	Bus Name	Full Contribution
246991	05WLD G1 C	2.11
247914	05WLD G1 E	75.88
247255	05WLD G2 C	2.21
247958	05WLD G2 E	79.62
936561	AD2-071 C	61.26
936562	AD2-071 E	30.17
LTF	AMIL	< 0.01
LTF	BAYOU	< 0.01
LTF	BIG_CAJUN1	< 0.01
LTF	BIG_CAJUN2	< 0.01
LTF	CARR	< 0.01
LTF	CATAWBA	< 0.01
LTF	CBM-S1	0.03
LTF	CBM-W2	0.13
LTF	CELEVELAND	< 0.01
LTF	CHOCTAW	< 0.01
LTF	CIN	0.15
LTF	COTTONWOOD	0.02
LTF	DEARBORN	0.03
LTF	EDWARDS	0.03
LTF	FARMERCITY	0.01
LTF	G-007	< 0.01
LTF	HAMLET	< 0.01
LTF	IPL	0.18
LTF	LGEE	0.02
LTF	O-066	0.05
LTF	PRAIRIE	0.02
LTF	RENSSELAER	< 0.01

LTF	ROSETON	0.02
LTF	ROWAN	< 0.01
LTF	TATANKA	0.02
LTF	TILTON	< 0.01
LTF	UNIONPOWER	< 0.01
926091	AC1-088	17.87

Appendix 2

(AEP - AEP) The AD2-071 TAP-05PIPECK 138 kV line (from bus 936560 to bus 246763 ckt 1) loads from 89.99% to 134.59% (**DC power flow**) of its emergency rating (205 MVA) for the line fault with failed breaker contingency outage of 'AEP_P4_#8775_05STRWTN 138'. This project contributes approximately 91.43 MW to the thermal violation.

CONTINGENCY 'AEP_P4_#8775_05STRWTN 138'
OPEN BRANCH FROM BUS 247116 TO BUS 246988 CKT 1 / 247116 05ALEXAN 138 246988 05STRWTN 138 1
OPEN BRANCH FROM BUS 246771 TO BUS 246988 CKT 1 / 246771 05SELWDZ 138 246988 05STRWTN 138 1
END

Bus Number	Bus Name	Full Contribution
246991	05WLD G1 C	2.11
247914	05WLD G1 E	75.88
247255	05WLD G2 C	2.21
247958	05WLD G2 E	79.62
936561	AD2-071 C	61.26
936562	AD2-071 E	30.17
LTF	AMIL	< 0.01
LTF	BAYOU	< 0.01
LTF	BIG_CAJUN1	< 0.01
LTF	BIG_CAJUN2	< 0.01
LTF	CARR	< 0.01
LTF	CATAWBA	< 0.01
LTF	CBM-S1	0.03
LTF	CBM-W2	0.13
LTF	CELEVELAND	< 0.01
LTF	CHOCTAW	< 0.01
LTF	CIN	0.15
LTF	COTTONWOOD	0.02
LTF	DEARBORN	0.03
LTF	EDWARDS	0.03
LTF	FARMERCITY	0.01
LTF	G-007	< 0.01
LTF	HAMLET	< 0.01
LTF	IPL	0.18
LTF	LGEE	0.02
LTF	O-066	0.05
LTF	PRAIRIE	0.02
LTF	RENSSELAER	< 0.01

LTF	ROSETON	0.02
LTF	ROWAN	< 0.01
LTF	TATANKA	0.02
LTF	TILTON	< 0.01
LTF	UNIONPOWER	< 0.01
926091	AC1-088	17.87

Appendix 3

(AEP - AEP) The 05HOGAN-05DELAWR 138 kV line (from bus 243311 to bus 243275 ckt 1) loads from 114.86% to 123.39% (**DC power flow**) of its emergency rating (231 MVA) for the tower line contingency outage of 'AEP_P7-1_#3206_B'. This project contributes approximately 19.7 MW to the thermal violation.

CONTINGENCY 'AEP_P7-1_#3206_B'
OPEN BRANCH FROM BUS 243218 TO BUS 923880 CKT 1 / 243218 05DESOTO 345 923880 AB2-028 TAP C 345 1
OPEN BRANCH FROM BUS 243222 TO BUS 254535 CKT 1 / 243222 05FALL C 345 254535 16SUNNYS 345 1
END

Bus Number	Bus Name	Full Contribution
246991	05WLD G1 C	0.57
247914	05WLD G1 E	20.35
247255	05WLD G2 C	0.59
247958	05WLD G2 E	21.35
934161	AD1-043 C O1	10.14
934162	AD1-043 E O1	16.54
936561	AD2-071 C	13.2
936562	AD2-071 E	6.5
LTF	CARR	0.04
LTF	CBM-S1	1.64
LTF	CBM-S2	0.53
LTF	CBM-W1	3.
LTF	CBM-W2	16.01
LTF	CIN	4.6
LTF	CPLE	0.1
LTF	DEARBORN	0.23
LTF	G-007	0.08
LTF	IPL	3.65
938741	J802 C	2.92
938742	J802 E	11.66
939781	J851 C	0.89
939782	J851 E	3.55
LTF	LGEE	0.32
LTF	MEC	2.68
LTF	O-066	0.5
LTF	RENSSELAER	0.03
LTF	ROSETON	0.23
247588	W4-004 C	1.34

247946	W4-004 E	8.94
247589	W4-008 C	1.34
247953	W4-008 E	8.94
LTF	WEC	0.27
917722	Z2-115 E	0.09
920501	AA2-148 C	2.6
920502	AA2-148 E	17.39
923881	AB2-028 C	2.28
923882	AB2-028 E	15.28
926091	AC1-088	4.79