

***Generation Interconnection  
Feasibility Study Report***

***For***

***PJM Generation Interconnection Request Queue  
Position AD2-022***

***East Danville (AEP) – Roxborough (DEP) 230 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.

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 #AD2-022, a 96.0 MW (60.0 MW Capacity) solar facility in Pittsylvania County, Virginia (see Figure 2). The primary point of interconnection will be to the East Danville (AEP) – Roxborough (DEP) 230 kV circuit in the AEP area (see Figure 1). The secondary point of interconnection will be to the East Danville (AEP) - Yanceyville Tap (DEP) 230 kV section of the East Danville (AEP) – Concord (DEP) 230 kV circuit in the AEP area (see Figure 3).

The requested in service date is June 1, 2020.

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 (East Danville - Roxborough 230 kV)

To accommodate the interconnection on the East Danville - Roxborough 230 kV circuit, a new three (3) circuit breaker 230 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, 230 kV line risers, SCADA, and 230 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 230 kV switching station physically configured in a breaker and half bus arrangement but operated as a ring-bus (See Figure 1). Installation of associated protection and control equipment, 230 kV line risers and SCADA will also be required.
- **Estimated Station Cost: \$7,000,000**

## Direct Connection Cost Estimate

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

For AEP building Direct Connection cost estimates:

Description	Estimated Cost
East Danville - Roxborough 230 kV T-Line Cut In	\$1,000,000
<b>Total</b>	<b>\$1,000,000</b>

**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
230 kV Revenue Metering	\$300,000
Upgrade line protection and controls at the East Danville 230 kV substation.	\$300,000
Upgrade line protection and controls at the Roxborough 230 kV substation	To be provided by DEP
<b>Total</b>	<b>\$600,000</b>

**Table 2**

## **Secondary Point of Interconnection (East Danville – Yanceyville Tap 230 kV)**

To accommodate the interconnection on the East Danville – Yanceyville Tap 230 kV section of the East Danville – Concord 230 circuit, a new three (3) circuit breaker 230 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, 230 kV line risers, SCADA, and 230 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 costs above are reimbursable to AEP. The cost of the IC's generating plant and the costs for the line connecting the generating plant to the East Danville - Roxborough 230 kV line 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 the 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 – Option 1**

The Queue Project AD2-022 was evaluated as a 96.0 MW (Capacity 60.0 MW) injection tapping the East Danville to Roxborough 230 kV line in the AEP area. Project AD2-022 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AD2-022 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_P4_#7589_05J.FERR 765'	OPEN BRANCH FROM BUS 242514 TO BUS 242520 CKT 1 500 1 OPEN BRANCH FROM BUS 242514 TO BUS 242684 CKT 2 138 2 OPEN BRANCH FROM BUS 242520 TO BUS 306719 CKT 1 500 1 END	/ 242514 05J.FERR 765 242520 05J.FERR / 242514 05J.FERR 765 242684 05J.FERR / 242520 05J.FERR 500 306719 8ANTIOCH
'AEP_P1-2_#1377'	OPEN BRANCH FROM BUS 242514 TO BUS 242520 CKT 1 1 OPEN BRANCH FROM BUS 242520 TO BUS 306719 CKT 1 500 1 END	/ 242514 05J.FERR 765 242520 05J.FERR 500 / 242520 05J.FERR 500 306719 8ANTIOCH
'AEP_P7-1_#10808_1'	OPEN BRANCH FROM BUS 242575 TO BUS 242737 CKT 1 05OPOSSUMCK1 138 1 OPEN BRANCH FROM BUS 242575 TO BUS 242781 CKT 1 05RUSTBR 138 1 OPEN BRANCH FROM BUS 242575 TO BUS 926520 CKT 1 TAP 138 1 OPEN BRANCH FROM BUS 242701 TO BUS 314667 CKT 1 138 1 END	/ 242575 05CAMDLM 138 242737 / 242575 05CAMDLM 138 242781 / 242575 05CAMDLM 138 926520 AC1-123 / 242701 05LEESVI 138 314667 4ALTVSTA
'AEP_P7-1_#10817'	OPEN BRANCH FROM BUS 926520 TO BUS 247499 CKT 1 05SMITHMTN2 138 1 OPEN BRANCH FROM BUS 242701 TO BUS 314667 CKT 1 138 1 END	/ 926520 AC1-123 TAP 138 247499 / 242701 05LEESVI 138 314667 4ALTVSTA

**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)*

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)*

AD2-022 Contribution to Previously Identified Overloads – Option 1														
#	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	LFFB	'AEP_P4_#7589_05J.FERR 765'	AEP - AEP	05EDAN 1-05DANVL2 138 kV	242631	242620	1	DC	127.5	131.65	ER	415	17.23	
2	N-1	'AEP_P1-2_#1377'	AEP - AEP	05EDAN 1-05DANVL2 138 kV	242631	242620	1	DC	107.25	109.85	ER	415	10.77	
3	DCTL	'AEP_P7-1_#10808_1'	AEP - AEP	05SMITHMTN2-05ROCKCA 138 kV	247499	242775	1	DC	134.45	135.24	ER	277	4.8	
4	DCTL	'AEP_P7-1_#10817'	AEP – AEP	05SMITHMTN2-05ROCKCA 138 kV	247499	242775	1	DC	123.21	124.0	ER	277	4.8	

**Table 4**

### **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.

AD2-022 Delivery of Energy Portion of Interconnection Request – Option 1														
#	Type	Contingency	Affected Area	Facility Description	Bus		Cir.	PF	Loading		Rating		MW Con.	FG App.
		Name			From	To			Initial	Final	Type	MVA		
1	N-1	'AEP_P1-2_#1377'	AEP - AEP	05EDAN 1-05DANVL2 138 kV	242631	242620	1	DC	127.47	131.63	ER	415	17.23	
2	-	None	AEP - AEP	05EDAN 1-05DANVL2 138 kV	242631	242620	1	DC	100.75	106.51	NR	275	15.85	

**Table 5**

### **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
-------------	---------------------	---------------------	----------	----------------

Violation #	Overloaded Facility	Upgrade Description	Schedule	Estimated Cost
1	05EDAN 1-05DANVL2 138 kV line	<p>1) Replace bus 1.5" AL Tubular at Danville  2) Replace two 1200 Switches at Danville  3) Replace Five Sub cond 1590 AAC 61 str</p> <p><b>Note:</b> Project B2697.2 will mitigate the constraints identified above (#1, #2 &amp; #3). The in service date for Project B2697.2 is June 1, 2019.</p> <p>4) 2.78 miles of ACSR ~ 336/556 Six Wire conductor will need to be rebuilt/reconductored.  5) An Engineering study will need to be conducted to determine if the Relay Thermal Limit at East Danville can be adjusted to mitigate the overload.  6) An Engineering study will need to be conducted to determine if the Relay Thermal Limit at Danville can be adjusted to mitigate the overload.  7) An Engineering study will need to be conducted to determine if the Relay Compliance Trip Limit at East Danville can be adjusted to mitigate the overload.  8) An Engineering study will need to be conducted to determine if the Relay Compliance Trip Limit at Danville can be adjusted to mitigate the overload.  9) 0.03 miles of ACSR ~ 1351.5 ~ 45/7 ~ DIPPER - Conductor Section 3 will need to be rebuilt/reconductored.  10) 0.03 miles of ACSR ~ 1351.5 ~ 45/7 ~ DIPPER - Conductor Section 1 will need to be rebuilt/reconductored.  11) Replace 2000A Non-Oil Breaker.  12) Replace five jumpers at East Danville.  13) Replace two risers at Danville.  14) An Engineering study will need to be conducted to determine if the CT Thermal Limit settings at Danville can be adjusted to mitigate the overload.  15) An Engineering study will need to be conducted to determine if the CT Thermal Limit settings at East Danville can be adjusted to mitigate the overload.</p>	An approximate construction time would be 24 to 36 months after signing an interconnection agreement.	\$9,475,000
2	05SMITHMTN2-05ROCKCA 138 kV	S/N and S/E ratings is 409 MVA. No mitigation required based on percent overload.		
			<b>Total Network Upgrades</b>	<b>\$9,475,000</b>

**Table 6**

## 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 96.0 MW (60.0 MW Capacity) solar generating facility of The IC LLC (PJM Project #AD2-022) 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 The IC generating facility.

<b>Cost Breakdown for Primary Point of Interconnection (East Danville – Roxborough 230 kV)</b>		
<b>Attachment Cost</b>	New 230 kV Switching Station and installation of associated protection and controls equipment	\$7,000,000
<b>Direct Connection Cost Estimate</b>	East Danville - Roxborough 230 kV T-Line Cut In	\$1,000,000
<b>Non-Direct Connection Cost Estimate</b>	230 kV Revenue Metering	\$300,000
	Upgrade line protection and controls at the East Danville 230 kV substation	\$300,000
	Upgrade line protection and controls at the Roxborough 230 kV substation	To be provided by DEP
	<b><u>Contribution to Previously Identified System Reinforcements</u></b> <i>(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)</i> <i>(Summary form of Cost allocation for transmission lines and transformers will be inserted here if any)</i>	<b>\$9,475,000</b>
	<b>Total Estimated Cost for Project AD2-022</b>	<b>\$18,075,000</b>

**Table 7**

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.

## **Network Impacts – Option 2**

The Queue Project AD2-022 was evaluated as a 96.0 MW (Capacity 60.0 MW) injection tapping the East Danville to Yanceyville Tap 230kV line in the AEP area. Project AD2-022 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AD2-022 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_P4_#7589_05J.FERR 765	OPEN BRANCH FROM BUS 242514 TO BUS 242520 CKT 1	/ 242514 05J.FERR 765 242520 05J.FERR
	500 1	
	OPEN BRANCH FROM BUS 242514 TO BUS 242684 CKT 2	/ 242514 05J.FERR 765 242684 05J.FERR
	138 2	
AEP_P1-2_#1377'	OPEN BRANCH FROM BUS 242520 TO BUS 306719 CKT 1	/ 242520 05J.FERR 500 306719 8ANTIOCH
	500 1	
	END	
'247499 05SMITHMTN2 242802 05SMITHMTN1 Z1 138/138'	OPEN BRANCH FROM BUS 242514 TO BUS 242520 CKT 1	/ 242514 05J.FERR 765 242520 05J.FERR 500
	1	
	OPEN BRANCH FROM BUS 242520 TO BUS 306719 CKT 1	/ 242520 05J.FERR 500 306719 8ANTIOCH
	500 1	
	END	

**Table 8**

### **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)*

AD2-022 Contribution to Previously Identified Overloads – Option 2														
#	Type	Contingency Name	Affected Area	Facility Description	Bus				Loading		Rating		MW	FG
					From	To	Cir.	PF	Initial	Final	Type	MVA	Con.	App.
1	LFFB	'AEP_P4_#7589_05J.FERR 765'	AEP - AEP	05EDAN 1- 05DANVL2 138 kV	242631	242620	1	DC	127.5	131.59	ER	415	16.99	
2	N-1	'AEP_P1-2_#1377'	AEP - AEP	05EDAN 1- 05DANVL2 138 kV	242631	242620	1	DC	107.25	109.81	ER	415	10.62	

**Table 9**

## **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.

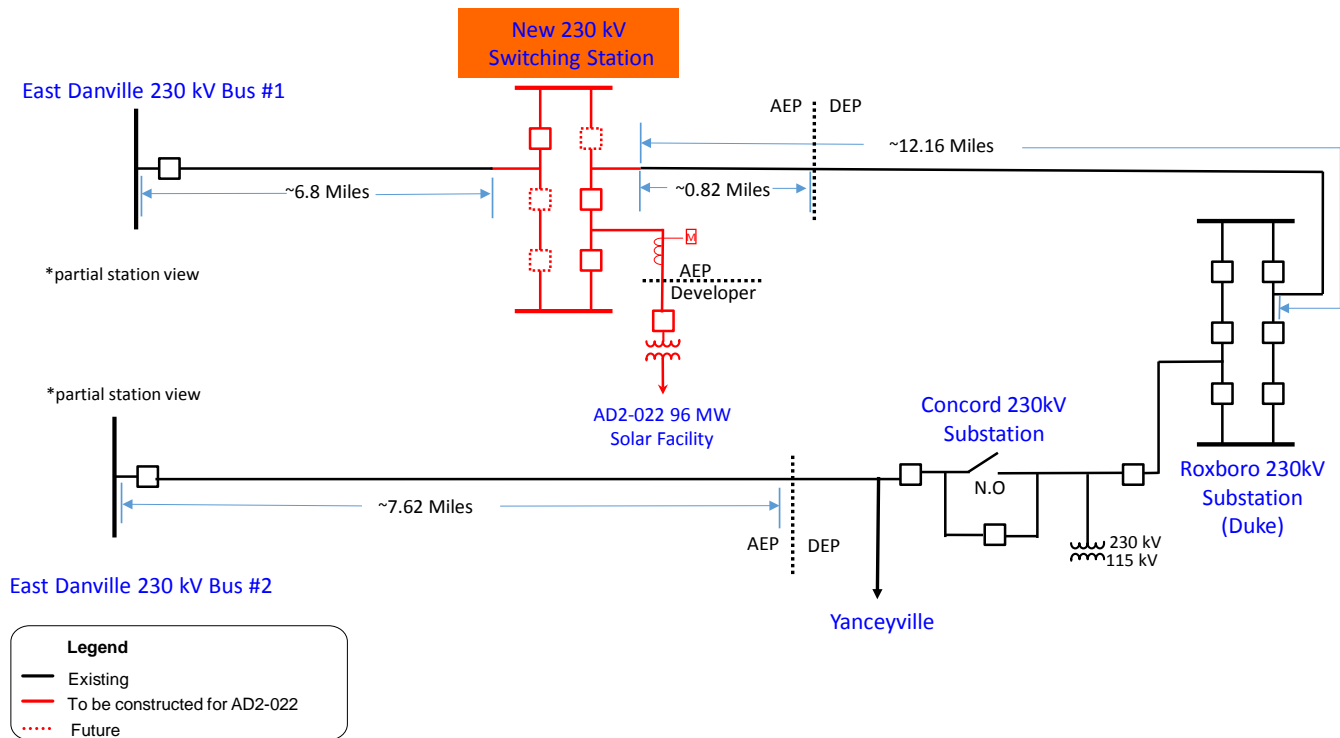
Only the most severely overloaded conditions are listed. There is no guarantee of full delivery of energy for this project by fixing only the conditions listed in this section. With a Transmission Interconnection Request, a subsequent analysis will be performed, which will study all overload conditions associated with the overloaded element(s) identified.

AD2-022 Delivery of Energy Portion of Interconnection Request – Option 2														
#	Type	Contingency Name	Affected Area	Facility Description	Bus		Cir.	PF	Loading		Rating		MW Con.	FG App.
					From	To			Initial	Final	Type	MVA		
1	N-1	'AEP_P1-2_#1377'	AEP - AEP	05EDAN 1-05DANVL2 138 kV	242631	242620	1	DC	127.47	131.57	ER	415	16.99	
2	None	None	AEP - AEP	05EDAN 1-05DANVL2 138 kV	242631	242620	1	DC	100.75	106.42	NR	275	15.6	
3	N-1	'247499 05SMITHMTN2 242802 05SMITHMTN1 Z1 138/138	AEP-AEP	05EDAN 2-05EDAN 1 138 kV	242632	242631	Z1	DC	92.16	100.84	ER	296	25.68	

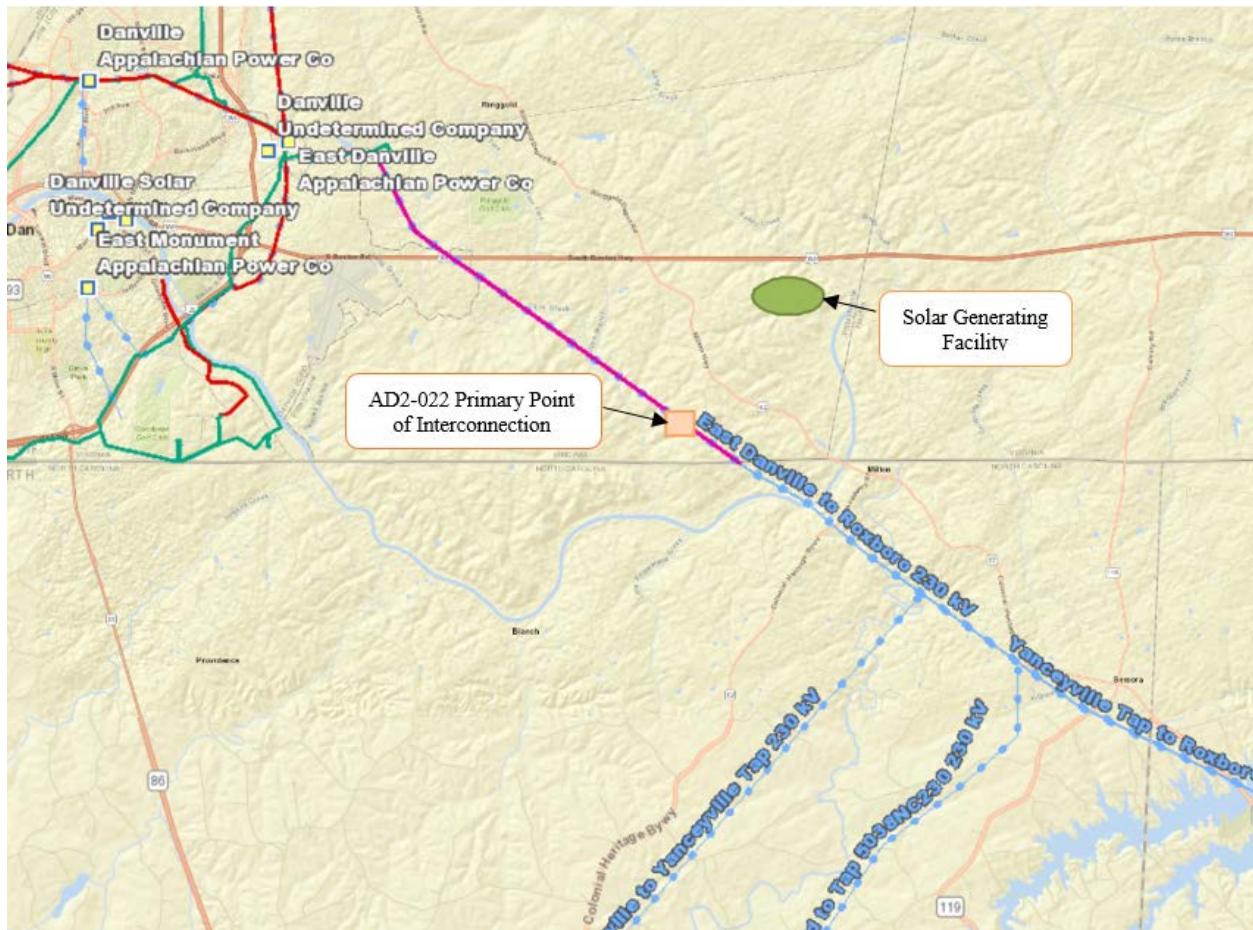
**Table 10**

**Figure 1: Primary Point of Interconnection (East Danville-Roxborough 230 kV)**  
**Single-Line Diagram**

**AD2-022 Primary Point of Interconnection  
(East Danville – Roxboro 230KV)**



**Figure 2: Primary Point of Interconnection (East Danville - Roxborough 230 kV)**

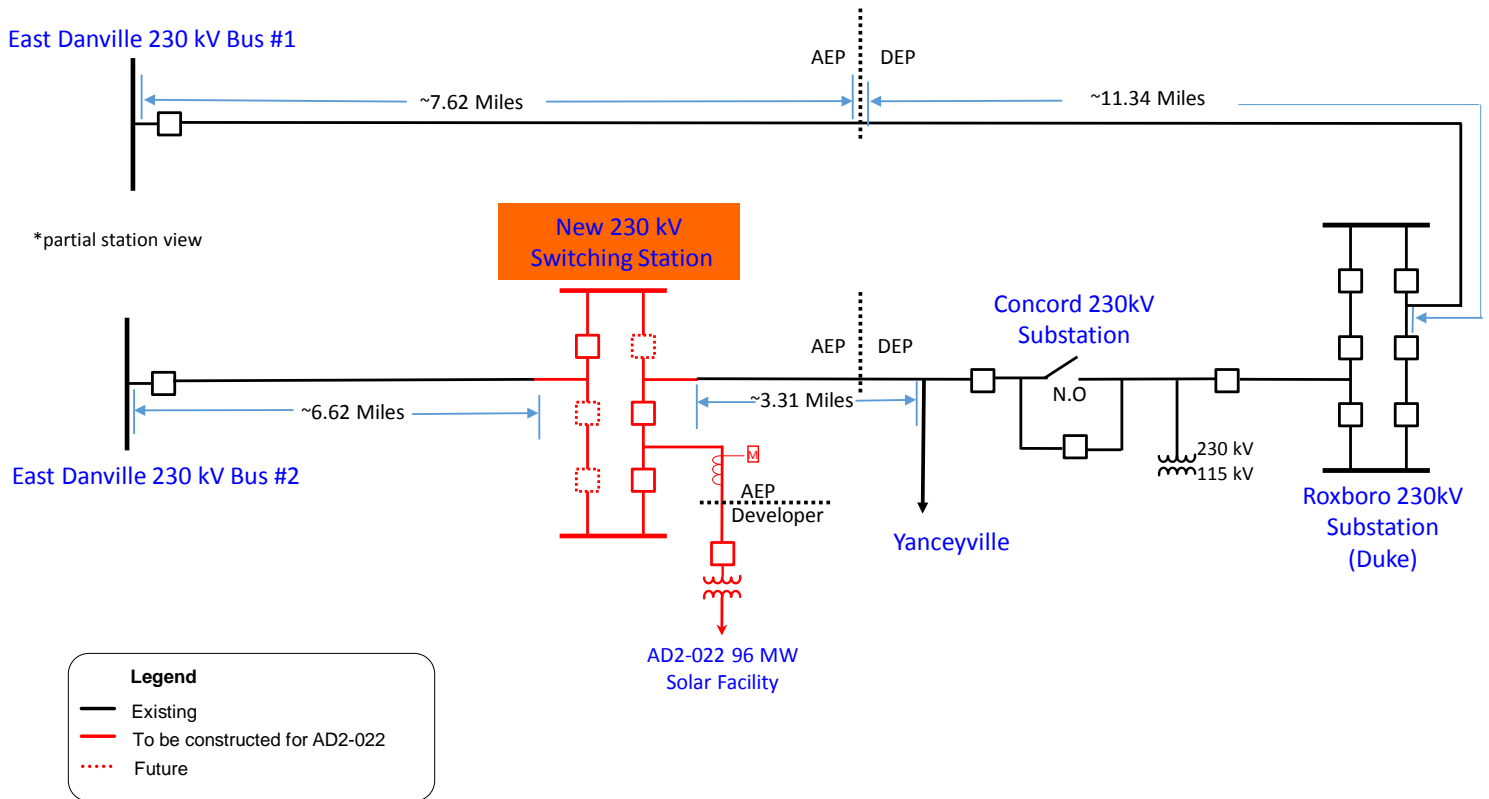




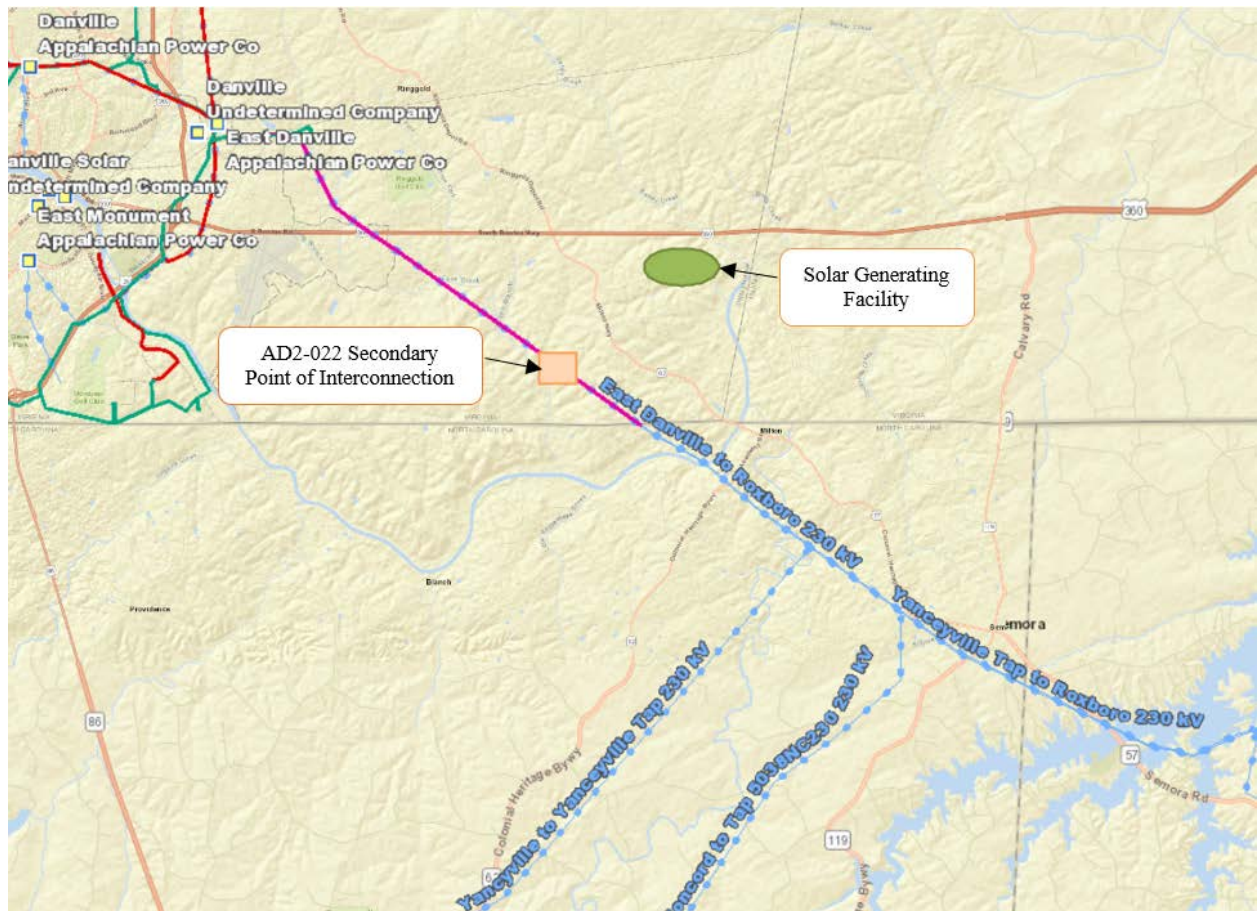
**Figure 3: Secondary Point of Interconnection (East Danville - Yanceyville Tap 230 kV)**

**Single-Line Diagram**

**AD2-022 Secondary Point of Interconnection  
(East Danville – Yanceyville Tap 230KV)**



**Figure 4: Secondary Point of Interconnection (East Danville – Yanceyville Tap 230 kV)**



## **Appendices for Primary 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 05EDAN 1-05DANVL2 138 kV line (from bus 242631 to bus 242620 ckt 1) loads from 127.5% to 131.65% (**DC power flow**) of its emergency rating (415 MVA) for the line fault with failed breaker contingency outage of 'AEP\_P4\_#7589\_05J.FERR 765'. This project contributes approximately 17.23 MW to the thermal violation.

CONTINGENCY 'AEP\_P4\_#7589\_05J.FERR 765'

OPEN BRANCH FROM BUS 242514 TO BUS 242520 CKT 1 / 242514 05J.FERR  
765 242520 05J.FERR 500 1

OPEN BRANCH FROM BUS 242514 TO BUS 242684 CKT 2 / 242514 05J.FERR  
765 242684 05J.FERR 138 2

OPEN BRANCH FROM BUS 242520 TO BUS 306719 CKT 1 / 242520 05J.FERR  
500 306719 8ANTIOCH 500 1

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
244012	05PINNACLE	-2.08
315131	1EDGECEMA	4.25
315132	1EDGECEMB	4.25
314557	3BETHEL C	0.35
314554	3BTLEBRO	0.37
314572	3EMPORIA	0.14
314578	3HORNRTN	1.21
314582	3KELFORD	0.3
314603	3SCOT NK	1.24
314617	3TUNIS	0.28
314620	6CASHIE	0.27
314574	6EVERETS	0.98
314594	6PLYMOTH	0.26
932631	AC2-084 C	3.42
932632	AC2-084 E	1.68
932701	AC2-093 C	24.41
932702	AC2-093 E	13.96
932761	AC2-100 C	3.66
932762	AC2-100 E	1.79
932821	AC2-107 C	3.48
932822	AC2-107 E	1.63
933941	AD1-017 C	0.84
933942	AD1-017 E	1.36
933991	AD1-023 C	4.1
933992	AD1-023 E	2.23
934201	AD1-047 C	2.75

934202	AD1-047 E	1.83
934231	AD1-050 C	2.01
934232	AD1-050 E	1.1
934311	AD1-055 C	1.07
934312	AD1-055 E	0.28
934331	AD1-057 C O1	4.1
934332	AD1-057 E O1	2.19
934341	AD1-058 C	3.99
934342	AD1-058 E	1.01
934521	AD1-076 C O1	16.71
934522	AD1-076 E O1	8.51
934611	AD1-087 C O1	3.38
934612	AD1-087 E O1	1.59
934621	AD1-088 C	4.
934622	AD1-088 E	1.88
LTF	AD1-120	7.55
LTF	AD1-121	7.6
934911	AD1-123 C	0.47
934912	AD1-123 E	0.24
934991	AD1-131 C	1.31
934992	AD1-131 E	0.87
935171	AD1-152 C O1	3.36
935172	AD1-152 E O1	2.24
935221	AD1-157 C	0.46
935222	AD1-157 E	0.31
935231	AD1-160 C	0.34
935232	AD1-160 E	0.47
936161	AD2-022 C O1	10.77
936162	AD2-022 E O1	6.46
936171	AD2-023 C O1	6.2
936172	AD2-023 E O1	3.36
936261	AD2-033 C	4.75
936262	AD2-033 E	3.17
936331	AD2-043 C	2.
936332	AD2-043 E	2.36
936361	AD2-046 C O1	3.83
936362	AD2-046 E O1	1.76
936401	AD2-051 C O1	2.96
936402	AD2-051 E O1	1.27
936481	AD2-063 C O1	5.54
936482	AD2-063 E O1	3.69
936531	AD2-068 C	2.28
936532	AD2-068 E	1.17
936641	AD2-081 C	2.55

936642	AD2-081 E	1.15
936651	AD2-082 C	0.52
936652	AD2-082 E	0.25
936701	AD2-089 C	3.17
936702	AD2-089 E	2.11
936711	AD2-090 C O1	2.12
936712	AD2-090 E O1	1.42
LTF	AD2-099	4.98
937441	AD2-195 C	3.14
937442	AD2-195 E	1.35
937461	AD2-200 C	0.5
937462	AD2-200 E	0.24
937481	AD2-202 C O1	0.93
937482	AD2-202 E O1	0.47
LTF	AMIL	0.17
LTF	BLUEG	2.07
LTF	CANNELTON	0.27
LTF	CARR	0.07
LTF	CBM-S1	1.13
LTF	CBM-S2	16.92
LTF	CBM-W2	3.07
LTF	CLIFTY	10.77
LTF	CPL	5.57
LTF	DEARBORN	0.98
LTF	EDWARDS	0.45
LTF	ELMERSMITH	0.71
LTF	FARMERCITY	0.12
LTF	G-007A	0.79
LTF	GIBSON	0.59
LTF	NEWTON	0.97
LTF	O-066A	0.36
LTF	PRAIRIE	0.86
LTF	RENSSELAER	0.05
LTF	ROSETON	0.38
LTF	SMITHLAND	< 0.01
LTF	TATANKA	0.34
LTF	TILTON	0.61
LTF	TRIMBLE	0.41
900672	V4-068 E	0.1
LTF	VFT	2.1
917332	Z2-043 E	0.36
917342	Z2-044 E	0.25
917512	Z2-088 E OPI	1.66
918492	AA1-063AE OP	1.37

918512	AA1-065 E OP	1.46
918532	AA1-067 E	0.29
918562	AA1-072 E	0.06
919692	AA2-053 E	1.33
919702	AA2-057 E	1.51
LTF	AA2-074	3.79
920042	AA2-088 E	3.27
920592	AA2-165 E	0.2
920672	AA2-174 E	0.15
930401	AB1-081 C	4.09
930402	AB1-081 E	1.75
930861	AB1-132 C	4.93
930862	AB1-132 E	2.11
931231	AB1-173 C	0.77
931232	AB1-173 E	0.36
931241	AB1-173AC	0.77
931242	AB1-173AE	0.36
923911	AB2-031 C OI	0.77
923912	AB2-031 E OI	0.38
923941	AB2-035 C	0.15
923942	AB2-035 E	0.06
923991	AB2-040 C OI	2.52
923992	AB2-040 E OI	2.06
924021	AB2-043 C OI	1.21
924022	AB2-043 E OI	1.99
924151	AB2-059 C OI	4.82
924152	AB2-059 E OI	2.49
924161	AB2-060 C OI	3.48
924162	AB2-060 E OI	1.64
924301	AB2-077 C OI	0.78
924302	AB2-077 E OI	0.52
924311	AB2-078 C OI	0.78
924312	AB2-078 E OI	0.52
924321	AB2-079 C OI	0.78
924322	AB2-079 E OI	0.52
924391	AB2-088 C	0.19
924392	AB2-088 E	0.09
924401	AB2-089 C	0.91
924402	AB2-089 E	0.47
924411	AB2-090 C	1.53
924412	AB2-090 E	0.78
924491	AB2-098 C	0.23
924492	AB2-098 E	0.1
924501	AB2-099 C	0.2

924502	AB2-099 E	0.08
924511	AB2-100 C	3.5
924512	AB2-100 E	1.72
925121	AB2-169 C	2.26
925122	AB2-169 E	2.03
925171	AB2-174 C O1	2.38
925172	AB2-174 E O1	2.15
925221	AB2-176 C	0.63
925222	AB2-176 E	0.27
925591	AC1-034 C	3.12
925592	AC1-034 E	2.36
925611	AC1-036 C	0.33
925612	AC1-036 E	0.54
925781	AC1-054 C	3.03
925782	AC1-054 E	1.4
925991	AC1-075 C	1.96
925992	AC1-075 E	1.11
926021	AC1-080 C	0.65
926022	AC1-080 E	0.37
926051	AC1-083 C	4.18
926052	AC1-083 E	6.82
926071	AC1-086 C	7.26
926072	AC1-086 E	3.31
926201	AC1-098 C	2.4
926202	AC1-098 E	1.43
926211	AC1-099 C	0.8
926212	AC1-099 E	0.47
926271	AC1-105 C	2.39
926272	AC1-105 E	1.19
926771	AC1-163 C	0.65
926772	AC1-163 E	0.3
927021	AC1-189 C	3.63
927022	AC1-189 E	1.81
927141	AC1-208 C	3.54
927142	AC1-208 E	1.57
927251	AC1-221 C	1.59
927252	AC1-221 E	1.59
927261	AC1-222 C	1.54
927262	AC1-222 E	1.46



## **Appendices for Alternate 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 05EDAN 1-05DANVL2 138 kV line (from bus 242631 to bus 242620 ckt 1) loads from 127.5% to 131.59% (**DC power flow**) of its emergency rating (415 MVA) for the line fault with failed breaker contingency outage of 'AEP\_P4\_#7589\_05J.FERR 765'. This project contributes approximately 16.99 MW to the thermal violation.

CONTINGENCY 'AEP\_P4\_#7589\_05J.FERR 765'

OPEN BRANCH FROM BUS 242514 TO BUS 242520 CKT 1 / 242514 05J.FERR  
765 242520 05J.FERR 500 1

OPEN BRANCH FROM BUS 242514 TO BUS 242684 CKT 2 / 242514 05J.FERR  
765 242684 05J.FERR 138 2

OPEN BRANCH FROM BUS 242520 TO BUS 306719 CKT 1 / 242520 05J.FERR  
500 306719 8ANTIOCH 500 1

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
244012	05PINNACLE	-2.08
315131	1EDGECEMA	4.25
315132	1EDGECEMB	4.25
314557	3BETHEL C	0.35
314554	3BTLEBRO	0.37
314572	3EMPORIA	0.14
314578	3HORNRTN	1.21
314582	3KELFORD	0.3
314603	3SCOT NK	1.24
314617	3TUNIS	0.28
314620	6CASHIE	0.27
314574	6EVERETS	0.98
314594	6PLYMOTH	0.26
932631	AC2-084 C	3.42
932632	AC2-084 E	1.68
932701	AC2-093 C	24.41
932702	AC2-093 E	13.96
932761	AC2-100 C	3.66
932762	AC2-100 E	1.79
932821	AC2-107 C	3.48
932822	AC2-107 E	1.63
933941	AD1-017 C	0.84
933942	AD1-017 E	1.36
933991	AD1-023 C	4.1
933992	AD1-023 E	2.23
934201	AD1-047 C	2.75

934202	AD1-047 E	1.83
934231	AD1-050 C	2.01
934232	AD1-050 E	1.1
934311	AD1-055 C	1.07
934312	AD1-055 E	0.28
934331	AD1-057 C O1	4.1
934332	AD1-057 E O1	2.19
934341	AD1-058 C	3.99
934342	AD1-058 E	1.01
934521	AD1-076 C O1	16.71
934522	AD1-076 E O1	8.51
934611	AD1-087 C O1	3.38
934612	AD1-087 E O1	1.59
934621	AD1-088 C	4.
934622	AD1-088 E	1.88
LTF	AD1-120	7.55
LTF	AD1-121	7.6
934911	AD1-123 C	0.47
934912	AD1-123 E	0.24
934991	AD1-131 C	1.31
934992	AD1-131 E	0.87
935171	AD1-152 C O1	3.36
935172	AD1-152 E O1	2.24
935221	AD1-157 C	0.46
935222	AD1-157 E	0.31
935231	AD1-160 C	0.34
935232	AD1-160 E	0.47
936161	AD2-022 C O2	10.62
936162	AD2-022 E O2	6.37
936171	AD2-023 C O2	6.28
936172	AD2-023 E O2	3.41
936261	AD2-033 C	4.75
936262	AD2-033 E	3.17
936331	AD2-043 C	2.
936332	AD2-043 E	2.36
936361	AD2-046 C O2	3.8
936362	AD2-046 E O2	1.75
936401	AD2-051 C O2	2.92
936402	AD2-051 E O2	1.25
936481	AD2-063 C O2	4.78
936482	AD2-063 E O2	3.19
936531	AD2-068 C	2.28
936532	AD2-068 E	1.17
936641	AD2-081 C	2.55

936642	AD2-081 E	1.15
936651	AD2-082 C	0.52
936652	AD2-082 E	0.25
936701	AD2-089 C	3.17
936702	AD2-089 E	2.11
936711	AD2-090 C O2	2.14
936712	AD2-090 E O2	1.43
LTF	AD2-099	4.98
937441	AD2-195 C	3.14
937442	AD2-195 E	1.35
937461	AD2-200 C	0.5
937462	AD2-200 E	0.24
937481	AD2-202 C O2	0.9
937482	AD2-202 E O2	0.45
LTF	AMIL	0.17
LTF	BLUEG	2.07
LTF	CANNELTON	0.27
LTF	CARR	0.07
LTF	CBM-S1	1.13
LTF	CBM-S2	16.92
LTF	CBM-W2	3.07
LTF	CLIFTY	10.77
LTF	CPL	5.57
LTF	DEARBORN	0.98
LTF	EDWARDS	0.45
LTF	ELMERSMITH	0.71
LTF	FARMERCITY	0.12
LTF	G-007A	0.79
LTF	GIBSON	0.59
LTF	NEWTON	0.97
LTF	O-066A	0.36
LTF	PRAIRIE	0.86
LTF	RENSSELAER	0.05
LTF	ROSETON	0.38
LTF	SMITHLAND	< 0.01
LTF	TATANKA	0.34
LTF	TILTON	0.61
LTF	TRIMBLE	0.41
900672	V4-068 E	0.1
LTF	VFT	2.1
917332	Z2-043 E	0.36
917342	Z2-044 E	0.25
917512	Z2-088 E OP1	1.66
918492	AA1-063AE OP	1.37

918512	AA1-065 E OP	1.46
918532	AA1-067 E	0.29
918562	AA1-072 E	0.06
919692	AA2-053 E	1.33
919702	AA2-057 E	1.51
LTF	AA2-074	3.79
920042	AA2-088 E	3.27
920592	AA2-165 E	0.2
920672	AA2-174 E	0.15
930401	AB1-081 C	4.09
930402	AB1-081 E	1.75
930861	AB1-132 C	4.93
930862	AB1-132 E	2.11
931231	AB1-173 C	0.77
931232	AB1-173 E	0.36
931241	AB1-173AC	0.77
931242	AB1-173AE	0.36
923911	AB2-031 C OI	0.77
923912	AB2-031 E OI	0.38
923941	AB2-035 C	0.15
923942	AB2-035 E	0.06
923991	AB2-040 C OI	2.52
923992	AB2-040 E OI	2.06
924021	AB2-043 C OI	1.21
924022	AB2-043 E OI	1.99
924151	AB2-059 C OI	4.82
924152	AB2-059 E OI	2.49
924161	AB2-060 C OI	3.48
924162	AB2-060 E OI	1.64
924301	AB2-077 C OI	0.78
924302	AB2-077 E OI	0.52
924311	AB2-078 C OI	0.78
924312	AB2-078 E OI	0.52
924321	AB2-079 C OI	0.78
924322	AB2-079 E OI	0.52
924391	AB2-088 C	0.19
924392	AB2-088 E	0.09
924401	AB2-089 C	0.91
924402	AB2-089 E	0.47
924411	AB2-090 C	1.53
924412	AB2-090 E	0.78
924491	AB2-098 C	0.23
924492	AB2-098 E	0.1
924501	AB2-099 C	0.2

924502	AB2-099 E	0.08
924511	AB2-100 C	3.5
924512	AB2-100 E	1.72
925121	AB2-169 C	2.26
925122	AB2-169 E	2.03
925171	AB2-174 C O1	2.38
925172	AB2-174 E O1	2.15
925221	AB2-176 C	0.63
925222	AB2-176 E	0.27
925591	AC1-034 C	3.12
925592	AC1-034 E	2.36
925611	AC1-036 C	0.33
925612	AC1-036 E	0.54
925781	AC1-054 C	3.03
925782	AC1-054 E	1.4
925991	AC1-075 C	1.96
925992	AC1-075 E	1.11
926021	AC1-080 C	0.65
926022	AC1-080 E	0.37
926051	AC1-083 C	4.18
926052	AC1-083 E	6.82
926071	AC1-086 C	7.26
926072	AC1-086 E	3.31
926201	AC1-098 C	2.4
926202	AC1-098 E	1.43
926211	AC1-099 C	0.8
926212	AC1-099 E	0.47
926271	AC1-105 C	2.39
926272	AC1-105 E	1.19
926771	AC1-163 C	0.65
926772	AC1-163 E	0.3
927021	AC1-189 C	3.63
927022	AC1-189 E	1.81
927141	AC1-208 C	3.54
927142	AC1-208 E	1.57
927251	AC1-221 C	1.59
927252	AC1-221 E	1.59
927261	AC1-222 C	1.54
927262	AC1-222 E	1.46