Generation Interconnection Feasibility Study Report

For

PJM Generation Interconnection Request Queue Position AD1-070

Fostoria Central 138kV

January 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 #AD1-070, a 205.0 MW (36.0 MW Capacity) wind facility in Hancock County, Ohio (see Figure 2). The point of interconnection will be a direct connection AEP's Fostoria Central138kV substation (see Figure 1). The Secondary point of interconnection is to AEP's Fostoria Central – Melmore 138kV circuit (See figure 3).

The requested in backfeed date is July 1, 2020.

The requested in service date is September 30, 2020.

Attachment Facilities

Primary Point of Interconnection (Fostoria Central 138kV Substation)

To accommodate the interconnection at the Fostoria Central 138 kV substation, the installation of a new 138 kV circuit breaker will be required, associated protection and control equipment, SCADA, and 138 kV revenue metering.

Direct Connection to the Fostoria Central 138 kV Substation Work and Cost:

- Install one (1) new 138 kV circuit breaker (see Figure 1). Installation of associated protection and control equipment, SCADA, and 138 kV revenue metering will also be required.

- **Estimated Station Cost: $1,000,000**

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 Fostoria Central 138 kV substation.	$250,000
Total	**$500,000**

Table 1

Secondary Point of Interconnection (Fostoria Central – Melmore 138 kV)

To accommodate the interconnection on the Fostoria Central – Melmore 138 kV 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 3). Installation of associated protection and control equipment, 138kV 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.

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 Fostoria Central 138 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 AD1-070 was evaluated as a 205.0 MW (Capacity 36.0 MW) injection at the Fostoria Central 138 kV substation in the AEP area. Project AD1-070 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AD1-070 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**
ATSI-P2-3-CEI-345-001	CONTINGENCY 'ATSI-P2-3-CEI-345-001' /* BREAKER FAILURE ON S145 BREAKER AT AVON 345KV DISCONNECT BRANCH FROM BUS 239725 TO BUS 238551 CKT 1 /* 02LAKEAVE 345 02AVON 345 DISCONNECT BRANCH FROM BUS 239725 TO BUS 238551 CKT 2 /* 02LAKEAVE 345 02AVON 345 END
ATSI-P2-3-OEC-345-023	CONTINGENCY 'ATSI-P2-3-OEC-345-023' /* BEAVER 345KV BRK B-121 DISCONNECT BRANCH FROM BUS 238569 TO BUS 239725 CKT 1 /* 02BEAVER 345 02LAKEAVE 345 DISCONNECT BRANCH FROM BUS 238569 TO BUS 238607 CKT 1 /* 02BEAVER 345 02CARLIL 345 END
ATSI-P2-3-OEC-345-031	CONTINGENCY 'ATSI-P2-3-OEC-345-031' /* HAYES 345KV BRK B-3_6_ 12 DISCONNECT BRANCH FROM BUS 239289 TO BUS 238654 CKT 1 /* 02HAYES 345 02DAV-BE 345 DISCONNECT BRANCH FROM BUS 239289 TO BUS 238569 CKT 1 /* 02HAYES 345 02BEAVER 345 DISCONNECT BRANCH FROM BUS 239289 TO BUS 239290 CKT 1 /* 02HAYES 345 02HAYES 138 END
ATSI-P7-1-CEI-345-001	CONTINGENCY 'ATSI-P7-1-CEI-345-001' /* AVON-BEAVER #1 AND #2 345KV LINE OUTAGES DISCONNECT BRANCH FROM BUS 238551 TO BUS 239725 CKT 1 /* 02AVON 345 02LAKEAVE 345 DISCONNECT BRANCH FROM BUS 238551 TO BUS 239725 CKT 2 /* 02AVON 345 02LAKEAVE 345 END

Option 1	
Contingency Name	**Description**
ATSI-P7-1-OEC-345-001	CONTINGENCY 'ATSI-P7-1-OEC-345-001' /* BEAVER-LAKAVE 345 CK 1 & 2 DISCONNECT BRANCH FROM BUS 238569 TO BUS 239725 CKT 1 /* 02BEAVER 345 02LAKEAVE 345 DISCONNECT BRANCH FROM BUS 238569 TO BUS 239725 CKT 2 /* 02BEAVER 345 02LAKEAVE 345 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)

AD1-070 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	ATSI-P2-3-CEI-345-001	FE - FE	02AD Q-2-02AVON 138 kV line	238524	238552	1	DC	97.49	98.98	ER	316	10.43	1
2	DCTL	ATSI-P7-1-CEI-345-001	FE - FE	02AD Q-2-02AVON 138 kV line	238524	238552	1	DC	97.49	98.98	ER	316	10.43	
3	DCTL	ATSI-P7-1-OEC-345-001	FE - FE	02BEAVER-02CARLIL 345 kV line	238569	238607	1	DC	87.39	88.29	ER	1243	24.49	2
4	LFFB	ATSI-P2-3-OEC-345-023	FE - FE	02BEAVER-02LAKEAVE 345 kV line	238569	239725	2	DC	91.9	92.76	ER	1646	31.13	3
5	LFFB	ATSI-P2-3-CEI-345-001	FE - FE	02LRN Q2-02AD Q-2 138 kV line	238915	238524	1	DC	97.52	99.02	ER	316	10.43	4
6	DCTL	ATSI-P7-1-CEI-345-001	FE - FE	02LRN Q2-02AD Q-2 138 kV line	238915	238524	1	DC	97.52	99.02	ER	316	10.43	
7	LFFB	ATSI-P2-3-OEC-345-031	FE - FE	X1-027A TAP-02BEAVER 345 kV line	907060	238569	1	DC	82.48	83.17	ER	1742	26.41	5

Table 3

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)

AD1-070 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	LFFB	ATSI-P2-3-CEI-345-001	FE - FE	02BLKRVR-02USSTEEL 138 kV line	239728	239734	1	DC	117.71	118.99	ER	500	14.13	6
2	DCTL	ATSI-P7-1-CEI-345-001	FE - FE	02BLKRVR-02USSTEEL 138 kV line	239728	239734	1	DC	117.71	118.99	ER	500	14.13	
3	LFFB	ATSI-P2-3-CEI-345-001	FE - FE	02USSTEEL-02LRN Q2 138 kV line	239734	238915	1	DC	111.41	112.69	ER	500	14.13	7
4	DCTL	ATSI-P7-1-CEI-345-001	FE - FE	02USSTEEL-02LRN Q2 138 kV line	239734	238915	1	DC	111.41	112.69	ER	500	14.13	

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.

None

New System Reinforcements

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

AD1-070 Multiple Facility Contingency					
#	Contingency Type	Contingency Name	Affected Area	Facility Description	
1	LFFB	ATSI-P2-3-CEI-345-001	FE - FE	02AD Q-2-02AVON 138 kV line	There is an existing PJM base line (b2897) project to reconductor the Avon-Admiral Q2 line 795Kcmil ACSR conductor to 795kcmil ACSS 45/7 strand with rating of 435MVA summer normal & 500MVA summer emergency. The base line projects are proposed to alleviate the thermal overload identified for the 2021 PJM Winter generation deliverability study. After the proposed PJM base line project has been completed the Admiral-Avon Q2 138kV line new rating would be 435MVA summer normal and 500MVA summer emergency, the limiting element would be the newly reconductor Admiral-Avon Q2 138kv transmission line, and the new expected Admiral-Avon Q2 138kV line overload would be from 62.56% to 66.93% of its 500MVA summer emergency rating, for the same contingency. See notes. Note 1: The line rating 316MVA summer emergency rating on the model is not correct. The Admiral-Avon Q2 138kV line actual rating is 273MVA summer normal and 332MVA summer emergency rating, higher than the model rating. The limiting element is a transmission line conductor 795Kcmil ACSR 36/1 strand. The line loading based on the actual line rating for the same contingency would be from 94.13% to 100.8% (DC power flow) of its emergency rating (332MVA). Note 2: (PJM b2897). The scheduled in-service date is 06/1/2021.
2	DCTL	ATSI-P7-1-CEI-345-001	FE - FE	02AD Q-2-02AVON 138 kV line	
3	DCTL	ATSI-P7-1-OEC-345-001	FE - FE	02BEAVER-02CARLIL 345 kV line	PJM identified a thermal overload on the Beaver-Carlisle 345Kv line for PJM Queue AC2-103 project. The PJM identified thermal overload was confirmed by FE. The limiting elements for the identified thermal overloads are GCY51 ZR3 relay at Beaver and relay thermal (RT) CEYB, impedance relay (ZR) GCY and relay thermal blinder (RT BDD) at Carlisle 345kV substation. ATSI proposed installing a new Dual SEL 345kV relay with UPLC at Beaver and Carlisle substation and adjusting the setting of the Carlisle 345/138kV transformer #1 over current differential relay (BDD). After the proposed projects have been completed, the new Beaver-Carlisle 345kV line rating would be 1228MVA summer normal and 1424MVA summer emergency rating, the new limiting element would be a wave-trap at Carlisle 345kV substation, and the expected line loading would be from 78.08% to 88.54% of its 1424MVA summer emergency rating for the same contingency. The estimated cost to upgrade the Beaver-Carlisle 345kv line relay is $504,700 (without tax).

AD1-070 Multiple Facility Contingency					
#	Contingency Type	Contingency Name	Affected Area	Facility Description	
4	LFFB	ATSI-P2-3-OEC-345-023	FE - FE	02BEAVER-02LAKEAVE 345 kV line	PJM identified a thermal overload on the Beaver-Lake Ave 345Kv line for PJM Queue AC2-103 project. The identified thermal overload was confirmed by FE. The limiting elements for the identified overloads are the existing (2) 954Kcmil ACSR substation conductor (SCCIR) at Beaver 345kV substation and the Beaver-Lake Ave 345kV ckt 2 (2) 954Kcmil ACSR 45/7 strand conductor line drop. ATSI proposed to reconductor the existing (2) 954Kcmil ACSR substation conductor (SCCIR) at Beaver 345kV substation with (2) 954kcmil ACSS 48/7 strand conductor, 2156MVA summer normal & 2295MVA summer emergency rating and the Beaver-Lake Ave 345kV ckt 2 (2) 954Kcmil ACSR 45/7 strand conductor line drop at Beaver with (2) 954Kcmil 54/7 ACSS conductor, 2184MVA summer normal rating and 2326MVA summer emergency rating. After the proposed conductor work has been completed, the Beaver-Lake Ave 345kV ckt2 new line rating would be 1555MVA summer normal and 1892MVA summer emergency, the limiting element would be a substation conductor (SCCIR) 3500 SAC 127 conductor at Beaver substation and the new expected line overload would be from 81.73% to 92.17% of its 1892MVA summer emergency rating, for the same contingency. See note The estimated cost to reconductor the Beaver 345kV substation and line drop conductor on the Beaver-Lake Ave # 345kV line is $45,000 (without tax).
5	LFFB	ATSI-P2-3-CEI-345-001	FE - FE	02LRN Q2-02AD Q-2 138 kV line	There is a proposed PJM base line project (b2897) to upgrade the Admiral-Lorain Q2 138kV line. The limiting elements on the Admiral-Lorain Q2 138kV line are a substation conductor SCCIR (line drop) 795Kcmil ACSR 26/7 strand and a transmission line conductor 795Kcmil ACSR 36/1 strand. The base line projects are proposed to alleviate the thermal overload identified for the 2021 PJM Winter generation deliverability study. The proposed PJM base line projects are to reconductor the existing 795Kcmil ACSR substation conductor (line drop) and 795Kcmil ACSR 26/7 strand transmission line conductor to 795kcmil ACSS with a rating of 435MVA summer normal & 500MVA summer emergency. In-service date Fall of 2020. After all the proposed PJM base line projects have been completed, the Lorain-Admiral Q2 138kV line expected overload would be from 62.58% to 66.95% of its 500MVA summer emergency rating, for the same contingency. Note 1: (PJM b2897). The scheduled in-service date is 06/1/2021.
6	DCTL	ATSI-P7-1-CEI-345-001	FE - FE	02LRN Q2-02AD Q-2 138 kV line	
7	LFFB	ATSI-P2-3-OEC-345-031	FE - FE	X1-027A TAP-02BEAVER 345 kV line	PJM identified a thermal overload on the Beaver-Lake Ave 345Kv line for PJM Queue AC2-103 project. The identified thermal overload was confirmed by FE. The limiting elements for the identified overload are the Beaver substation conductor (SCCIR) 954Kcmil ACSR 45/7 strand (the limiting element). ATSI proposed to reconductor the exiting Beaver substation conductor (SCCIR) 954Kcmil ACSR 45/7 strand (limiting element) with bundle 954kcmil ACSS 48/7 strand conductor, 2184MVA summer normal & 2326MVA summer emergency rating. After the proposed reconductoring projects have been completed, the X1-027A-Beaver 345kV new line rating would be 1486MVA summer normal and 1878MVA summer emergency and the new limiting element would be the transmission line 954Kcmil ACSR 45/7 strand conductor, and the expected line loading would be from 78.1% to 92.29% of its 1878MVA summer emergency rating, for the same contingency. See note. The estimated cost to reconductor the Beaver substation conductor on Beaver-X1-027(Davis Bessie) 345kV line is $41,800 (without tax).

Previous 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)

AD1-070 Contribution to Previously Identified Overloads					
	Contingency		Affected	Facility	
#	Type	Name	Area	Description	Proposed Mitigation
1	LFFB	ATSI-P2-3-CEI-345-001	FE - FE	02BLKRVR-02USSTEEL 138 kV line	There is an existing proposed PJM base line upgrade project (b2896) to alleviate the overload. After the proposed PJM base line upgrade have been completed, the Black River-US Steel 138kV line rating would be 552MVA summer normal and 659MVA summer emergency. After all the proposed PJM base line projects have been completed, the Black River-Charleston (US Steel) 138kV line expected overload would be from 92.88% to 95.56% of its 659MVA summer emergency rating, for the same contingency. See note. The PJM base line projects are listed below: – PJM (b2896)-reconductor the Black River-Charleston 138kV line existing 795Kcmil ACSS conductor with bundle 795Kcmil ACSS conductor with a rating of 897MVA summer normal and 1031MVA summer emergency rating. The scheduled in-service date is 06/1/2021. – PJM (b2896)-upgrade the 2000A wave-traps at Black River and Charleston substation with 3000A wave-trap with rating of 733MVA summer normal and 831MVA summer emergency rating. The scheduled in-service date is 06/1/2021.
2	DCTL	ATSI-P7-1-CEI-345-001	FE - FE	02BLKRVR-02USSTEEL 138 kV line	
3	LFFB	ATSI-P2-3-CEI-345-001	FE - FE	02USSTEEL-02LRN Q2 138 kV line	There is an existing PJM base line upgrade project (b2896) to reduce the identified overload. After PJM base line b2896 have been completed, PJM identified additional thermal overload on the Charleston (US Steel)-Lorain Q2 138Kv line for PJM Queue AC2-103 project. The identified PJM Queue AC2-103 project thermal overload was confirmed by FE. ATSI proposed additional PJM Queue AC2-103 project mitigation to alleviate the remaining overload. After all proposed base line upgrade projects have been completed, the Charleston-Lorain Q2 138kV rating would be 548MVA summer normal and 688MVA summer emergency and the Charleston-Lorain Q2 138kV line expected overload would be 81.90% to 86.21% of its 688MVA summer emergency rating, for the same contingency. Existing PJM base line project: – PJM b2896 - reconductor the existing Charleston-Lorain Q2 138kV line 795Kcmil ACSS conductor to a bundle 795Kcmil ACSS conductor with a rating of 897MVA summer normal and 1031MVA summer emergency rating. The scheduled in-service date is 06/1/2021. – PJM b2896 - upgrade the 2000A wave-traps at Charleston and Lorain substation to 3000A wave-trap with a rating of 733MVA summer normal and 831MVA summer emergency rating. The scheduled in-service date is 06/1/2021. New Proposed mitigation: – Reconductor the existing Lorain substation (2) 795Kcmil ACSR conductor to (2) 795Kcmil ACSS 30/19 strand conductor with a rating of 796MVA summer normal and 848MVA summer emergency rating. The scheduled in-service date is 06/1/2021. The estimated cost to reconductor the existing Lorain 138kV substation conductor (SCCIR) on the Lorain - US Steel Q2 138kV line with (2) 795Kcmil ACSS 30/19 stand conductor is $86,500 (without tax).
4	DCTL	ATSI-P7-1-CEI-345-001	FE - FE	02USSTEEL-02LRN Q2 138 kV line	

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 205.0 MW (36.0 MW Capacity) wind generating facility (PJM Project #AD1-070) will require the following additional interconnection charges. This plan of service will interconnect the proposed wind generating facility in a manner that will provide operational reliability and flexibility to both the AEP system and the IC's generating facility.

Please note that several of the First Energy upgrades are relying on PJM Baseline projects that are not scheduled to be in service until June 2021 which affects the requested in service date.

Cost Breakdown for Point of Interconnection (Fostoria Central 138kV Substation)			
Type	**Company**	**Description**	**Est. Cost**
Attachment Cost	AEP	Install one (1) 138 kV Circuit Breaker at the Fostoria Central 138 kV Substation	$1,000,000
Non-Direct Connection Cost Estimate	AEP	Install 138 kV Revenue Metering	$250,000
	AEP	Upgrade line protection and controls at the Fostoria Central kV substation	$250,000
	FE	Upgrade the Beaver-Carlisle 345kv line relay	$504,700
	FE	Reconductor the Beaver 345kV substation and line drop conductor on the Beaver-Lake Ave # 345kV line	$45,000
	FE	Reconductor the Beaver substation conductor on Beaver-X1-027(Davis Bessie) 345kV line	$41,800
	FE	The estimated cost to reconductor the existing Lorain 138kV substation conductor (SCCIR) on the Lorain - US Steel Q2 138kV line with (2) 795Kcmil ACSS 30/19 stand conductor	$86,500
		Total Estimated Cost for Project AD1-070	**$2,178,000**

Table 5

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.

Option 2

Network Impacts

The Queue Project AD1-070 was evaluated as a 205.0 MW (Capacity 36.0 MW) injection tapping Fostoria to Melmore 138kV line in the AEP area. Project AD1-070 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AD1-070 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**
712_B3_05TIFFIN 138-1_WOMOAB	CONTINGENCY '712_B3_05TIFFIN 138-1_WOMOAB' OPEN BRANCH FROM BUS 243008 TO BUS 243009 CKT 1 / 243008 05FREMCT 138 243009 05FRMNT 138 1 OPEN BRANCH FROM BUS 243008 TO BUS 243130 CKT 1 / 243008 05FREMCT 138 243130 05TIFFIN 138 1 OPEN BRANCH FROM BUS 243015 TO BUS 243130 CKT 1 / 243015 05GREENL 138 243130 05TIFFIN 138 1 OPEN BRANCH FROM BUS 243008 TO BUS 245614 CKT 1 / 243008 05FREMCT 138 245614 05FREMNT C 69.0 1 OPEN BRANCH FROM BUS 243130 TO BUS 245637 CKT 1 / 243130 05TIFFIN 138 245637 05TIFFIN C 69.0 1 OPEN BRANCH FROM BUS 247481 TO BUS 245637 CKT 1 / 247481 05HOLME STSS69.0 245637 05TIFFIN C 69.0 1 OPEN BRANCH FROM BUS 245648 TO BUS 245637 CKT 1 / 245648 05MAULE RD 69.0 245637 05TIFFIN C 69.0 1 END
AEP_P7-1_#7731-A	CONTINGENCY 'AEP_P7-1_#7731-A' OPEN BRANCH FROM BUS 243006 TO BUS 934460 CKT 1 / 243006 05FOSTOR 138 934460 AD1-070 TAP 138 1 OPEN BRANCH FROM BUS 243039 TO BUS 243110 CKT 1 / 243039 05MELMOR 138 243110 05STIFFI 138 1 END
AEP_P7-1_#7732-A	CONTINGENCY 'AEP_P7-1_#7732-A' OPEN BRANCH FROM BUS 242953 TO BUS 243110 CKT 1 / 242953 05AIRCO8 138 243110 05STIFFI 138 1 OPEN BRANCH FROM BUS 242953 TO BUS 243137 CKT 1 / 242953 05AIRCO8 138 243137 05W.END 138 1 OPEN BRANCH FROM BUS 243006 TO BUS 934460 CKT 1 / 243006 05FOSTOR 138 934460 AD1-070 TAP 138 1

Option 2	
Contingency Name	**Description**
	END
ATSI-P2-3-CEI-345-001	CONTINGENCY 'ATSI-P2-3-CEI-345-001' /* BREAKER FAILURE ON S145 BREAKER AT AVON 345KV DISCONNECT BRANCH FROM BUS 239725 TO BUS 238551 CKT 1 /* 02LAKEAVE 345 02AVON 345 DISCONNECT BRANCH FROM BUS 239725 TO BUS 238551 CKT 2 /* 02LAKEAVE 345 02AVON 345 END
ATSI-P2-3-OEC-345-023	CONTINGENCY 'ATSI-P2-3-OEC-345-023' /* BEAVER 345KV BRK B-121 DISCONNECT BRANCH FROM BUS 238569 TO BUS 239725 CKT 1 /* 02BEAVER 345 02LAKEAVE 345 DISCONNECT BRANCH FROM BUS 238569 TO BUS 238607 CKT 1 /* 02BEAVER 345 02CARLIL 345 END
ATSI-P7-1-CEI-345-001	CONTINGENCY 'ATSI-P7-1-CEI-345-001' /* AVON-BEAVER #1 AND #2 345KV LINE OUTAGES DISCONNECT BRANCH FROM BUS 238551 TO BUS 239725 CKT 1 /* 02AVON 345 02LAKEAVE 345 DISCONNECT BRANCH FROM BUS 238551 TO BUS 239725 CKT 2 /* 02AVON 345 02LAKEAVE 345 END
ATSI-P7-1-OEC-345-001	CONTINGENCY 'ATSI-P7-1-OEC-345-001' /* BEAVER-LAKAVE 345 CK 1 & 2 DISCONNECT BRANCH FROM BUS 238569 TO BUS 239725 CKT 1 /* 02BEAVER 345 02LAKEAVE 345 DISCONNECT BRANCH FROM BUS 238569 TO BUS 239725 CKT 2 /* 02BEAVER 345 02LAKEAVE 345 END

Table 6

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)

AD1-070 Multiple Facility Contingency - Option 2															
	Contingency		Affected	Facility	Bus				Loading		Rating		MW	FG
#	Type	Name	Area	Description	From	To	Cir.	PF	Initial	Final	Type	MVA	Con.	App.
1	LFFB	ATSI-P2-3-CEI-345-001	FE - FE	02AD Q-2-02AVON 138 kV line	238524	238552	1	DC	97.45	98.99	ER	316	10.78	1
2	DCTL	ATSI-P7-1-CEI-345-001	FE - FE	02AD Q-2-02AVON 138 kV line	238524	238552	1	DC	97.45	98.99	ER	316	10.78	
3	DCTL	ATSI-P7-1-OEC-345-001	FE - FE	02BEAVER-02CARLIL 345 kV line	238569	238607	1	DC	87.35	88.23	ER	1243	23.96	2
4	LFFB	ATSI-P2-3-OEC-345-023	FE - FE	02BEAVER-02LAKEAVE	238569	239725	2	DC	91.86	92.71	ER	1646	30.32	3

AD1-070 Multiple Facility Contingency - Option 2															
	Contingency		Affected	Facility	Bus				Loading		Rating		MW	FG
#	Type	Name	Area	Description	From	To	Cir.	PF	Initial	Final	Type	MVA	Con.	App.
				345 kV line										
5	LFFB	ATSI-P2-3-CEI-345-001	FE - FE	02LRN Q2-02AD Q-2 138 kV line	238915	238524	1	DC	97.45	98.99	ER	316	10.78	4
6	DCTL	ATSI-P7-1-CEI-345-001	FE - FE	02LRN Q2-02AD Q-2 138 kV line	238915	238524	1	DC	97.45	98.99	ER	316	10.78	
7	DCTL	AEP_P7-1_#7731-A	AEP - FE	05HOWARD-02BRKSID 138 kV line	243024	238586	1	DC	83.8	99.45	ER	245	38.36	5
8	DCTL	AEP_P7-1_#7731-A	AEP - AEP	AC2-015 TAP-05HOWARD 138 kV line	932050	243024	1	DC	84.17	106.94	ER	167	38.03	6
9	DCTL	AEP_P7-1_#7732-A	AEP - AEP	AC2-015 TAP-05HOWARD 138 kV line	932050	243024	1	DC	81	102.25	ER	167	35.48	

Table 7

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)

AD1-070 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.
10	LFFB	ATSI-P2-3-CEI-345-001	FE - FE	02BLKRVR-02USSTEEL 138 kV line	239728	239734	1	DC	117.67	118.99	ER	500	14.6	7
11	DCTL	ATSI-P7-1-CEI-345-001	FE - FE	02BLKRVR-02USSTEEL 138 kV line	239728	239734	1	DC	117.67	118.99	ER	500	14.6	
12	LFFB	ATSI-P2-3-CEI-345-001	FE - FE	02USSTEEL-02LRN Q2 138 kV line	239734	238915	1	DC	111.37	112.69	ER	500	14.6	8
13	DCTL	ATSI-P7-1-CEI-345-001	FE - FE	02USSTEEL-02LRN Q2 138 kV line	239734	238915	1	DC	111.37	112.69	ER	500	14.6	

Table 8

Steady-State Voltage Requirements

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.

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.

AD1-070 Delivery of Energy Portion of Interconnection Request - Option 2															
		Contingency	Affected	Facility	Bus				Loading		Rating		MW	FG
#	Type	Name	Area	Description	From	To	Cir.	PF	Initial	Final	Type	MVA	Con.	App.
1	Non	Non	AEP - FE	05HOWARD-02BRKSID 138 kV line	243024	238586	1	DC	103.93	108.44	NR	167	16.69	
2	Non	Non	AEP - AEP	AD1-070 TAP-05FOSTOR 138 kV line	934460	243006	1	DC	79.96	149.75	NR	167	116.55	
3	N-1	712_B3_05TIFFIN 138-1_WOMOAB	AEP - AEP	AD1-070 TAP-05FOSTOR 138 kV line	934460	243006	1	DC	83.54	137.37	ER	245	131.88	

Table 9

Figure 1: Primary Point of Interconnection (Fostoria Central 138kV Substation)

Single-Line Diagram

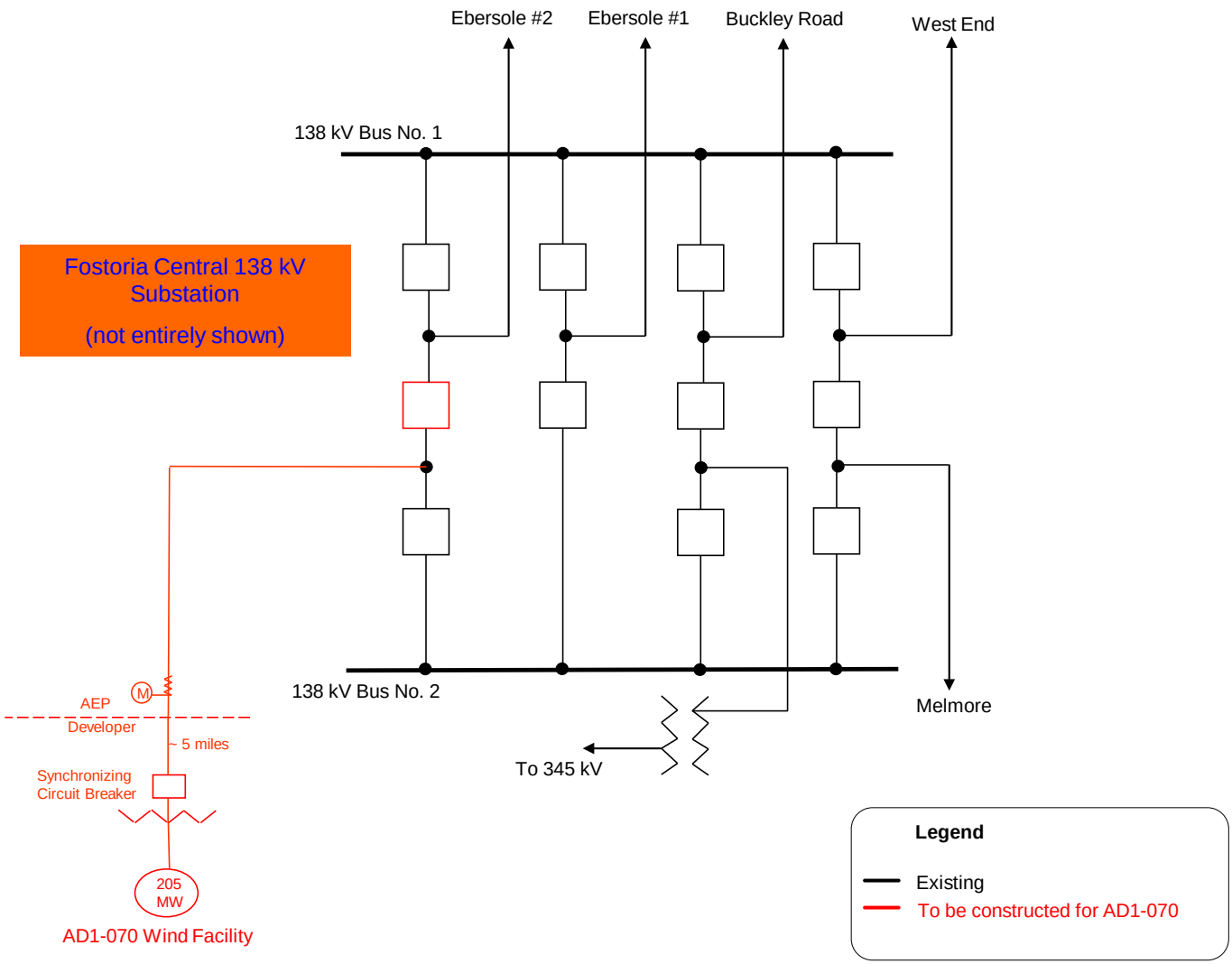

Figure 2: Primary Point of Interconnection (Fostoria Central 138 kV Substation)

Figure 3: Secondary Point of Interconnection (Fostoria Central - Melmore 138kV)

Single-Line Diagram

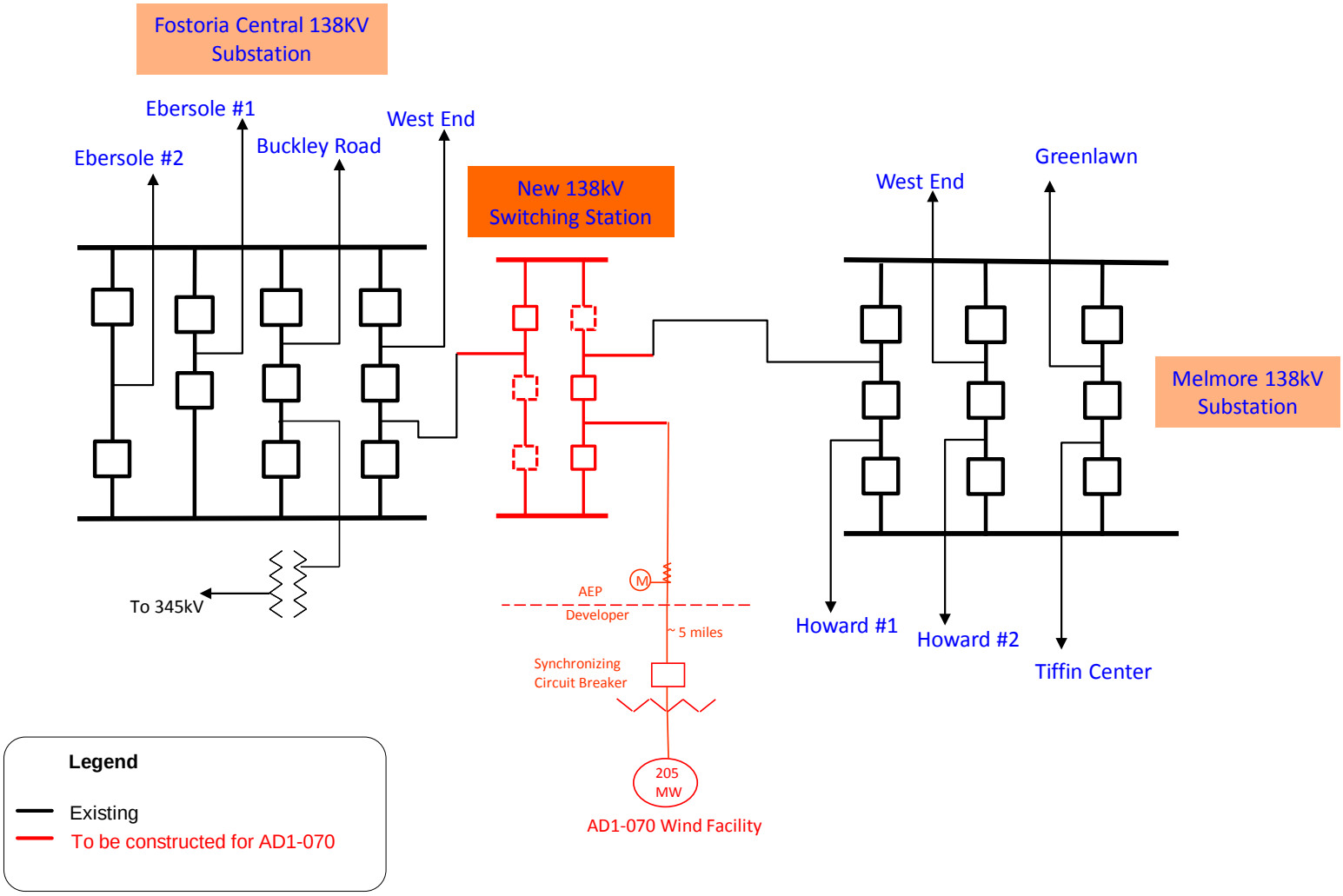

Figure 4: Secondary Point of Interconnection (Fostoria Central - Melmore 138kV)

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

(FE - FE) The 02AD Q-2-02AVON 138 kV line (from bus 238524 to bus 238552 ckt 1) loads from 97.49% to 98.98% (**DC power flow**) of its emergency rating (316 MVA) for the line fault with failed breaker contingency outage of 'ATSI-P2-3-CEI-345-001'. This project contributes approximately 10.43 MW to the thermal violation.

CONTINGENCY 'ATSI-P2-3-CEI-345-001' /* BREAKER FAILURE ON S145 BREAKER AT AVON 345KV
DISCONNECT BRANCH FROM BUS 239725 TO BUS 238551 CKT 1 /* 02LAKEAVE 345 02AVON 345
DISCONNECT BRANCH FROM BUS 239725 TO BUS 238551 CKT 2 /* 02LAKEAVE 345 02AVON 345
END

Bus Number	*Bus Name*	*Full Contribution*
238564	*02BAYSG1*	*8.97*
238572	*02BEAVGB*	*1.6*
240968	*02BG2 GEN*	*0.45*
240969	*02BG4 G1*	*0.11*
240970	*02BG4 G2&3*	*0.23*
240971	*02BG4 G4&5*	*0.23*
240950	*02BG5*	*1.38*
240973	*02BG6 AMPO*	*2.01*
239276	*02COLLW 11*	*-2.18*
239297	*02CPPW41*	*-2.81*
238979	*02NAPMUN*	*2.12*
240975	*02PGE GEN*	*3.11*
239175	*02WLORG-6*	*2.53*
932791	*AC2-103 C*	*3.73*
932792	*AC2-103 E*	*24.99*
934251	*AD1-052 C1*	*0.99*
934261	*AD1-052 C2*	*0.99*
934252	*AD1-052 E1*	*0.44*
934262	*AD1-052 E2*	*0.44*
934461	*AD1-070 C O1*	*1.83*
934462	*AD1-070 E O1*	*8.6*
934761	*AD1-103 C O1*	*6.28*
934762	*AD1-103 E O1*	*42.02*
934891	*AD1-118*	*4.4*
247551	*U4-028 C*	*0.71*
247940	*U4-028 E*	*4.72*
247552	*U4-029 C*	*0.71*
247941	*U4-029 E*	*4.72*
247548	*V4-010 C*	*1.52*
247947	*V4-010 E*	*10.19*

901803	*W1-072A*	*2.52*
907062	*X1-027A E1*	*10.5*
907065	*X1-027A E2*	*10.5*
907067	*X1-027A E3*	*10.5*
907069	*X1-027A E4*	*10.5*
931951	*AB1-107 1*	*17.55*
931961	*AB1-107 2*	*38.52*

Appendix 2

(FE - FE) The 02BEAVER-02CARLIL 345 kV line (from bus 238569 to bus 238607 ckt 1) loads from 87.39% to 88.29% (**DC power flow**) of its emergency rating (1243 MVA) for the tower line contingency outage of 'ATSI-P7-1-OEC-345-001'. This project contributes approximately 24.49 MW to the thermal violation.

CONTINGENCY 'ATSI-P7-1-OEC-345-001' /* BEAVER-LAKAVE 345 CK 1 & 2
DISCONNECT BRANCH FROM BUS 238569 TO BUS 239725 CKT 1 /* 02BEAVER 345 02LAKEAVE 345
DISCONNECT BRANCH FROM BUS 238569 TO BUS 239725 CKT 2 /* 02BEAVER 345 02LAKEAVE 345
END

Bus Number	*Bus Name*	*Full Contribution*
238564	*02BAYSG1*	*22.36*
240968	*02BG2 GEN*	*1.12*
240969	*02BG4 G1*	*0.28*
240970	*02BG4 G2&3*	*0.56*
240971	*02BG4 G4&5*	*0.56*
240950	*02BG5*	*3.41*
240973	*02BG6 AMPO*	*4.97*
238670	*02DVBSG1*	*38.31*
238979	*02NAPMUN*	*5.32*
240975	*02PGE GEN*	*7.7*
239171	*02WLORG-2*	*6.1*
239172	*02WLORG-3*	*6.27*
239173	*02WLORG-4*	*6.26*
239174	*02WLORG-5*	*6.28*
932051	*AC2-015 C*	*4.94*
932052	*AC2-015 E*	*5.77*
932791	*AC2-103 C*	*11.37*
932792	*AC2-103 E*	*76.12*
934251	*AD1-052 C1*	*2.07*
934261	*AD1-052 C2*	*2.07*
934252	*AD1-052 E1*	*0.92*
934262	*AD1-052 E2*	*0.92*
934461	*AD1-070 C O1*	*4.3*
934462	*AD1-070 E O1*	*20.19*
934761	*AD1-103 C O1*	*19.12*
934762	*AD1-103 E O1*	*127.96*
934891	*AD1-118*	*11.43*
940241	*J419*	*8.29*
981121	*J444*	*19.57*
247551	*U4-028 C*	*1.49*

247940	*U4-028 E*	*9.94*
247552	*U4-029 C*	*1.49*
247941	*U4-029 E*	*9.94*
247567	*V2-006 C*	*1.77*
247961	*V2-006 E*	*11.85*
247548	*V4-010 C*	*3.21*
247947	*V4-010 E*	*21.47*
901803	*W1-072A*	*6.53*
907061	*X1-027A C1*	*0.94*
907064	*X1-027A C2*	*0.94*
907066	*X1-027A C3*	*0.94*
907068	*X1-027A C4*	*0.94*
907062	*X1-027A E1*	*31.98*
907065	*X1-027A E2*	*31.98*
907067	*X1-027A E3*	*31.98*
907069	*X1-027A E4*	*31.98*
931951	*AB1-107 1*	*43.8*
931961	*AB1-107 2*	*101.15*
925751	*AC1-051 C*	*0.7*
925752	*AC1-051 E*	*4.7*
926941	*AC1-181*	*0.58*

Appendix 3

(FE - FE) The 02BEAVER-02LAKEAVE 345 kV line (from bus 238569 to bus 239725 ckt 2) loads from 91.9% to 92.76% (**DC power flow**) of its emergency rating (1646 MVA) for the line fault with failed breaker contingency outage of 'ATSI-P2-3-OEC-345-023'. This project contributes approximately 31.13 MW to the thermal violation.

CONTINGENCY 'ATSI-P2-3-OEC-345-023' /* BEAVER 345KV BRK B-121
DISCONNECT BRANCH FROM BUS 238569 TO BUS 239725 CKT 1 /* 02BEAVER 345 02LAKEAVE 345
DISCONNECT BRANCH FROM BUS 238569 TO BUS 238607 CKT 1 /* 02BEAVER 345 02CARLIL 345
END

Bus Number	*Bus Name*	*Full Contribution*
241902	*02_Y1-069 GE*	*33.94*
238564	*02BAYSG1*	*28.22*
240968	*02BG2 GEN*	*1.41*
240969	*02BG4 G1*	*0.35*
240970	*02BG4 G2&3*	*0.71*
240971	*02BG4 G4&5*	*0.71*
240950	*02BG5*	*4.31*
240973	*02BG6 AMPO*	*6.29*
239276	*02COLLW 11*	*-4.18*
239297	*02CPPW41*	*-5.13*
238670	*02DVBSG1*	*48.53*
238979	*02NAPMUN*	*6.76*
240975	*02PGE GEN*	*9.73*
239171	*02WLORG-2*	*7.75*
239172	*02WLORG-3*	*7.96*
239173	*02WLORG-4*	*7.94*
239174	*02WLORG-5*	*7.97*
932051	*AC2-015 C*	*6.25*
932052	*AC2-015 E*	*7.3*
932791	*AC2-103 C*	*14.43*
932792	*AC2-103 E*	*96.56*
934251	*AD1-052 C1*	*2.56*
934261	*AD1-052 C2*	*2.56*
934252	*AD1-052 E1*	*1.14*
934262	*AD1-052 E2*	*1.14*
934461	*AD1-070 C O1*	*5.47*
934462	*AD1-070 E O1*	*25.67*
934761	*AD1-103 C O1*	*24.26*
934762	*AD1-103 E O1*	*162.32*
934891	*AD1-118*	*14.5*

247551	*U4-028 C*	*1.87*
247940	*U4-028 E*	*12.52*
247552	*U4-029 C*	*1.87*
247941	*U4-029 E*	*12.52*
247567	*V2-006 C*	*2.29*
247961	*V2-006 E*	*15.29*
247548	*V4-010 C*	*4.02*
247947	*V4-010 E*	*26.91*
901803	*W1-072A*	*8.29*
907061	*X1-027A C1*	*1.19*
907064	*X1-027A C2*	*1.19*
907066	*X1-027A C3*	*1.19*
907068	*X1-027A C4*	*1.19*
907062	*X1-027A E1*	*40.57*
907065	*X1-027A E2*	*40.57*
907067	*X1-027A E3*	*40.57*
907069	*X1-027A E4*	*40.57*
918401	*AA1-056*	*1.95*
931951	*AB1-107 1*	*55.28*
931961	*AB1-107 2*	*128.22*
925751	*AC1-051 C*	*0.89*
925752	*AC1-051 E*	*5.95*
926941	*AC1-181*	*0.74*

Appendix 4

(FE - FE) The 02LRN Q2-02AD Q-2 138 kV line (from bus 238915 to bus 238524 ckt 1) loads from 97.52% to 99.02% (**DC power flow**) of its emergency rating (316 MVA) for the line fault with failed breaker contingency outage of 'ATSI-P2-3-CEI-345-001'. This project contributes approximately 10.43 MW to the thermal violation.

CONTINGENCY 'ATSI-P2-3-CEI-345-001' /* BREAKER FAILURE ON S145 BREAKER AT AVON 345KV
DISCONNECT BRANCH FROM BUS 239725 TO BUS 238551 CKT 1 /* 02LAKEAVE 345 02AVON 345
DISCONNECT BRANCH FROM BUS 239725 TO BUS 238551 CKT 2 /* 02LAKEAVE 345 02AVON 345
END

Bus Number	*Bus Name*	*Full Contribution*
238564	*02BAYSG1*	*8.97*
238572	*02BEAVGB*	*1.6*
240968	*02BG2 GEN*	*0.45*
240969	*02BG4 G1*	*0.11*
240970	*02BG4 G2&3*	*0.23*
240971	*02BG4 G4&5*	*0.23*
240950	*02BG5*	*1.38*
240973	*02BG6 AMPO*	*2.01*
239276	*02COLLW 11*	*-2.18*
239297	*02CPPW41*	*-2.81*
238979	*02NAPMUN*	*2.12*
240975	*02PGE GEN*	*3.11*
239175	*02WLORG-6*	*2.53*
932791	*AC2-103 C*	*3.73*
932792	*AC2-103 E*	*24.99*
934251	*AD1-052 C1*	*0.99*
934261	*AD1-052 C2*	*0.99*
934252	*AD1-052 E1*	*0.44*
934262	*AD1-052 E2*	*0.44*
934461	*AD1-070 C O1*	*1.83*
934462	*AD1-070 E O1*	*8.6*
934761	*AD1-103 C O1*	*6.28*
934762	*AD1-103 E O1*	*42.02*
934891	*AD1-118*	*4.4*
247551	*U4-028 C*	*0.71*
247940	*U4-028 E*	*4.72*
247552	*U4-029 C*	*0.71*
247941	*U4-029 E*	*4.72*
247548	*V4-010 C*	*1.52*
247947	*V4-010 E*	*10.19*

901803	*W1-072A*	*2.52*
907062	*X1-027A E1*	*10.5*
907065	*X1-027A E2*	*10.5*
907067	*X1-027A E3*	*10.5*
907069	*X1-027A E4*	*10.5*
931951	*AB1-107 1*	*17.55*
931961	*AB1-107 2*	*38.52*

Appendix 5

(FE - FE) The X1-027A TAP-02BEAVER 345 kV line (from bus 907060 to bus 238569 ckt 1) loads from 82.48% to 83.17% (**DC power flow**) of its emergency rating (1742 MVA) for the line fault with failed breaker contingency outage of 'ATSI-P2-3-OEC-345-031'. This project contributes approximately 26.41 MW to the thermal violation.

CONTINGENCY 'ATSI-P2-3-OEC-345-031' /* HAYES 345KV BRK B-3_6_ 12
DISCONNECT BRANCH FROM BUS 239289 TO BUS 238654 CKT 1 /* 02HAYES 345 02DAV-BE 345
DISCONNECT BRANCH FROM BUS 239289 TO BUS 238569 CKT 1 /* 02HAYES 345 02BEAVER 345
DISCONNECT BRANCH FROM BUS 239289 TO BUS 239290 CKT 1 /* 02HAYES 345 02HAYES 138
END

Bus Number	*Bus Name*	*Full Contribution*
241902	*02_Y1-069 GE*	*33.44*
238564	*02BAYSG1*	*25.03*
240968	*02BG2 GEN*	*1.25*
240969	*02BG4 G1*	*0.31*
240970	*02BG4 G2&3*	*0.62*
240971	*02BG4 G4&5*	*0.62*
240950	*02BG5*	*3.83*
240973	*02BG6 AMPO*	*5.56*
239276	*02COLLW 11*	*-3.19*
239297	*02CPPW41*	*-3.91*
238670	*02DVBSG1*	*51.66*
238885	*02LEMOG1*	*6.33*
238886	*02LEMOG2*	*6.33*
238887	*02LEMOG3*	*6.33*
238888	*02LEMOG4*	*6.33*
238979	*02NAPMUN*	*6.24*
240975	*02PGE GEN*	*8.62*
932791	*AC2-103 C*	*20.36*
932792	*AC2-103 E*	*136.25*
934461	*AD1-070 C O1*	*4.64*
934462	*AD1-070 E O1*	*21.77*
934761	*AD1-103 C O1*	*34.22*
934762	*AD1-103 E O1*	*229.04*
934891	*AD1-118*	*14.1*
247567	*V2-006 C*	*2.07*
247961	*V2-006 E*	*13.88*
901803	*W1-072A*	*8.06*
907061	*X1-027A C1*	*1.68*

907064	*X1-027A C2*	*1.68*
907066	*X1-027A C3*	*1.68*
907068	*X1-027A C4*	*1.68*
907062	*X1-027A E1*	*57.24*
907065	*X1-027A E2*	*57.24*
907067	*X1-027A E3*	*57.24*
907069	*X1-027A E4*	*57.24*
918401	*AA1-056*	*1.93*
931951	*AB1-107 1*	*49.16*
931961	*AB1-107 2*	*126.33*
926941	*AC1-181*	*0.68*

Appendix 6

(FE - FE) The 02BLKRVR-02USSTEEL 138 kV line (from bus 239728 to bus 239734 ckt 1) loads from 117.71% to 118.99% (**DC power flow**) of its emergency rating (500 MVA) for the line fault with failed breaker contingency outage of 'ATSI-P2-3-CEI-345-001'. This project contributes approximately 14.13 MW to the thermal violation.

CONTINGENCY 'ATSI-P2-3-CEI-345-001' /* BREAKER FAILURE ON S145 BREAKER AT AVON 345KV
DISCONNECT BRANCH FROM BUS 239725 TO BUS 238551 CKT 1 /* 02LAKEAVE 345 02AVON 345
DISCONNECT BRANCH FROM BUS 239725 TO BUS 238551 CKT 2 /* 02LAKEAVE 345 02AVON 345
END

Bus Number	*Bus Name*	*Full Contribution*
238564	*02BAYSG1*	*12.16*
238572	*02BEAVGB*	*2.15*
240968	*02BG2 GEN*	*0.61*
240969	*02BG4 G1*	*0.15*
240970	*02BG4 G2&3*	*0.31*
240971	*02BG4 G4&5*	*0.31*
240950	*02BG5*	*1.87*
240973	*02BG6 AMPO*	*2.72*
239276	*02COLLW 11*	*-2.84*
239297	*02CPPW41*	*-3.58*
238979	*02NAPMUN*	*2.87*
240975	*02PGE GEN*	*4.21*
239175	*02WLORG-6*	*3.41*
932051	*AC2-015 C*	*3.48*
932052	*AC2-015 E*	*4.06*
932791	*AC2-103 C*	*5.07*
932792	*AC2-103 E*	*33.91*
934251	*AD1-052 C1*	*1.35*
934261	*AD1-052 C2*	*1.35*
934252	*AD1-052 E1*	*0.6*
934262	*AD1-052 E2*	*0.6*
934461	*AD1-070 C O1*	*2.48*
934462	*AD1-070 E O1*	*11.65*
934761	*AD1-103 C O1*	*8.52*
934762	*AD1-103 E O1*	*57.*
934891	*AD1-118*	*5.97*
247542	*U4-001 C*	*1.52*
247934	*U4-001 E*	*10.14*
247551	*U4-028 C*	*0.96*
247940	*U4-028 E*	*6.4*

247552	*U4-029 C*	*0.96*
247941	*U4-029 E*	*6.4*
247567	*V2-006 C*	*1.01*
247961	*V2-006 E*	*6.74*
247548	*V4-010 C*	*2.07*
247947	*V4-010 E*	*13.83*
901803	*W1-072A*	*3.41*
907062	*X1-027A E1*	*14.25*
907065	*X1-027A E2*	*14.25*
907067	*X1-027A E3*	*14.25*
907069	*X1-027A E4*	*14.25*
915952	*Y3-092 FTWR*	*31.39*
915953	*Y3-092 NFTWR*	*31.39*
931951	*AB1-107 1*	*23.8*
931961	*AB1-107 2*	*52.22*
923821	*AB2-019*	*1.76*
925751	*AC1-051 C*	*0.5*
925752	*AC1-051 E*	*3.32*
926941	*AC1-181*	*0.32*

Appendix 7

(FE - FE) The 02USSTEEL-02LRN Q2 138 kV line (from bus 239734 to bus 238915 ckt 1) loads from 111.41% to 112.69% (**DC power flow**) of its emergency rating (500 MVA) for the line fault with failed breaker contingency outage of 'ATSI-P2-3-CEI-345-001'. This project contributes approximately 14.13 MW to the thermal violation.

CONTINGENCY 'ATSI-P2-3-CEI-345-001' /* BREAKER FAILURE ON S145 BREAKER AT AVON 345KV
DISCONNECT BRANCH FROM BUS 239725 TO BUS 238551 CKT 1 /* 02LAKEAVE 345 02AVON 345
DISCONNECT BRANCH FROM BUS 239725 TO BUS 238551 CKT 2 /* 02LAKEAVE 345 02AVON 345
END

Bus Number	*Bus Name*	*Full Contribution*
238564	*02BAYSG1*	*12.16*
238572	*02BEAVGB*	*2.15*
240968	*02BG2 GEN*	*0.61*
240969	*02BG4 G1*	*0.15*
240970	*02BG4 G2&3*	*0.31*
240971	*02BG4 G4&5*	*0.31*
240950	*02BG5*	*1.87*
240973	*02BG6 AMPO*	*2.72*
239276	*02COLLW 11*	*-2.84*
239297	*02CPPW41*	*-3.58*
238979	*02NAPMUN*	*2.87*
240975	*02PGE GEN*	*4.21*
239175	*02WLORG-6*	*3.41*
932051	*AC2-015 C*	*3.48*
932052	*AC2-015 E*	*4.06*
932791	*AC2-103 C*	*5.07*
932792	*AC2-103 E*	*33.91*
934251	*AD1-052 C1*	*1.35*
934261	*AD1-052 C2*	*1.35*
934252	*AD1-052 E1*	*0.6*
934262	*AD1-052 E2*	*0.6*
934461	*AD1-070 C O1*	*2.48*
934462	*AD1-070 E O1*	*11.65*
934761	*AD1-103 C O1*	*8.52*
934762	*AD1-103 E O1*	*57.*
934891	*AD1-118*	*5.97*
247542	*U4-001 C*	*1.52*
247934	*U4-001 E*	*10.14*
247551	*U4-028 C*	*0.96*
247940	*U4-028 E*	*6.4*

247552	*U4-029 C*	*0.96*
247941	*U4-029 E*	*6.4*
247567	*V2-006 C*	*1.01*
247961	*V2-006 E*	*6.74*
247548	*V4-010 C*	*2.07*
247947	*V4-010 E*	*13.83*
901803	*W1-072A*	*3.41*
907062	*X1-027A E1*	*14.25*
907065	*X1-027A E2*	*14.25*
907067	*X1-027A E3*	*14.25*
907069	*X1-027A E4*	*14.25*
915952	*Y3-092 FTWR*	*31.39*
915953	*Y3-092 NFTWR*	*31.39*
931951	*AB1-107 1*	*23.8*
931961	*AB1-107 2*	*52.22*
923821	*AB2-019*	*1.76*
925751	*AC1-051 C*	*0.5*
925752	*AC1-051 E*	*3.32*
926941	*AC1-181*	*0.32*

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

(FE - FE) The 02AD Q-2-02AVON 138 kV line (from bus 238524 to bus 238552 ckt 1) loads from 97.45% to 98.99% (**DC power flow**) of its emergency rating (316 MVA) for the line fault with failed breaker contingency outage of 'ATSI-P2-3-CEI-345-001'. This project contributes approximately 10.78 MW to the thermal violation.

CONTINGENCY 'ATSI-P2-3-CEI-345-001' /* BREAKER FAILURE ON S145 BREAKER AT AVON 345KV
DISCONNECT BRANCH FROM BUS 239725 TO BUS 238551 CKT 1 /* 02LAKEAVE 345 02AVON 345
DISCONNECT BRANCH FROM BUS 239725 TO BUS 238551 CKT 2 /* 02LAKEAVE 345 02AVON 345
END

Bus Number	*Bus Name*	*Full Contribution*
238564	*02BAYSG1*	*8.97*
238572	*02BEAVGB*	*1.6*
240968	*02BG2 GEN*	*0.45*
240969	*02BG4 G1*	*0.11*
240970	*02BG4 G2&3*	*0.23*
240971	*02BG4 G4&5*	*0.23*
240950	*02BG5*	*1.38*
240973	*02BG6 AMPO*	*2.01*
239276	*02COLLW 11*	*-2.18*
239297	*02CPPW41*	*-2.81*
238979	*02NAPMUN*	*2.12*
240975	*02PGE GEN*	*3.11*
239175	*02WLORG-6*	*2.53*
932791	*AC2-103 C*	*3.73*
932792	*AC2-103 E*	*24.99*
934251	*AD1-052 C1*	*0.99*
934261	*AD1-052 C2*	*0.99*
934252	*AD1-052 E1*	*0.44*
934262	*AD1-052 E2*	*0.44*
934461	*AD1-070 C O2*	*1.89*
934462	*AD1-070 E O2*	*8.89*
934761	*AD1-103 C O2*	*6.33*
934762	*AD1-103 E O2*	*42.39*
934891	*AD1-118*	*4.4*
LTF	*CARR*	*0.9*
LTF	*CBM-S1*	*3.88*
LTF	*CBM-S2*	*1.64*
LTF	*CBM-W1*	*31.44*
LTF	*CBM-W2*	*27.29*
LTF	*CIN*	*4.37*

LTF	*CPLE*	*0.29*
LTF	*G-007*	*1.12*
LTF	*IPL*	*2.81*
LTF	*LGEE*	*0.8*
LTF	*MEC*	*8.63*
LTF	*MECS*	*16.34*
LTF	*O-066*	*3.81*
LTF	*RENSSELAER*	*0.7*
LTF	*ROSETON*	*5.06*
247551	*U4-028 C*	*0.71*
247940	*U4-028 E*	*4.72*
247552	*U4-029 C*	*0.71*
247941	*U4-029 E*	*4.72*
247548	*V4-010 C*	*1.52*
247947	*V4-010 E*	*10.19*
901803	*W1-072A*	*2.52*
LTF	*WEC*	*1.39*
907062	*X1-027A E1*	*10.5*
907065	*X1-027A E2*	*10.5*
907067	*X1-027A E3*	*10.5*
907069	*X1-027A E4*	*10.5*
LTF	*Y3-032*	*13.61*
931951	*AB1-107 1*	*17.55*
931961	*AB1-107 2*	*38.52*

Appendix 2

(FE - FE) The 02BEAVER-02CARLIL 345 kV line (from bus 238569 to bus 238607 ckt 1) loads from 87.35% to 88.23% (**DC power flow**) of its emergency rating (1243 MVA) for the tower line contingency outage of 'ATSI-P7-1-OEC-345-001'. This project contributes approximately 23.96 MW to the thermal violation.

CONTINGENCY 'ATSI-P7-1-OEC-345-001' /* BEAVER-LAKAVE 345 CK 1 & 2
DISCONNECT BRANCH FROM BUS 238569 TO BUS 239725 CKT 1 /* 02BEAVER 345 02LAKEAVE 345
DISCONNECT BRANCH FROM BUS 238569 TO BUS 239725 CKT 2 /* 02BEAVER 345 02LAKEAVE 345
END

Bus Number	*Bus Name*	*Full Contribution*
238564	*02BAYSG1*	*22.36*
240968	*02BG2 GEN*	*1.12*
240969	*02BG4 G1*	*0.28*
240970	*02BG4 G2&3*	*0.56*
240971	*02BG4 G4&5*	*0.56*
240950	*02BG5*	*3.41*
240973	*02BG6 AMPO*	*4.97*
238670	*02DVBSG1*	*38.31*
238979	*02NAPMUN*	*5.32*
240975	*02PGE GEN*	*7.7*
239171	*02WLORG-2*	*6.1*
239172	*02WLORG-3*	*6.27*
239173	*02WLORG-4*	*6.26*
239174	*02WLORG-5*	*6.28*
932051	*AC2-015 C*	*4.94*
932052	*AC2-015 E*	*5.77*
932791	*AC2-103 C*	*11.37*
932792	*AC2-103 E*	*76.11*
934251	*AD1-052 C1*	*2.07*
934261	*AD1-052 C2*	*2.07*
934252	*AD1-052 E1*	*0.92*
934262	*AD1-052 E2*	*0.92*
934461	*AD1-070 C O2*	*4.21*
934462	*AD1-070 E O2*	*19.75*
LTF	*AD1-092*	*4.68*
LTF	*AD1-093*	*8.03*
LTF	*AD1-094*	*1.53*
934761	*AD1-103 C O2*	*18.07*
934762	*AD1-103 E O2*	*120.91*
934891	*AD1-118*	*11.43*

LTF	*CARR*	*1.36*
LTF	*CBM-S1*	*7.56*
LTF	*CBM-S2*	*2.4*
LTF	*CBM-W1*	*73.96*
LTF	*CBM-W2*	*55.9*
LTF	*CIN*	*9.16*
LTF	*CPLE*	*0.34*
LTF	*G-007*	*2.55*
LTF	*IPL*	*5.9*
940241	*J419*	*8.29*
981121	*J444*	*19.57*
LTF	*LGEE*	*1.6*
LTF	*MEC*	*18.54*
LTF	*MECS*	*41.25*
LTF	*O-066*	*8.62*
LTF	*RENSSELAER*	*1.07*
LTF	*ROSETON*	*7.74*
247551	*U4-028 C*	*1.49*
247940	*U4-028 E*	*9.94*
247552	*U4-029 C*	*1.49*
247941	*U4-029 E*	*9.94*
247567	*V2-006 C*	*1.77*
247961	*V2-006 E*	*11.85*
247548	*V4-010 C*	*3.21*
247947	*V4-010 E*	*21.47*
901803	*W1-072A*	*6.53*
LTF	*WEC*	*3.05*
907061	*X1-027A C1*	*0.94*
907064	*X1-027A C2*	*0.94*
907066	*X1-027A C3*	*0.94*
907068	*X1-027A C4*	*0.94*
907062	*X1-027A E1*	*31.98*
907065	*X1-027A E2*	*31.98*
907067	*X1-027A E3*	*31.98*
907069	*X1-027A E4*	*31.98*
LTF	*Y3-032*	*34.89*
LTF	*Z1-043*	*11.71*
931951	*AB1-107 1*	*43.8*
931961	*AB1-107 2*	*101.14*
LTF	*AB2-013*	*6.69*
925751	*AC1-051 C*	*0.7*
925752	*AC1-051 E*	*4.7*
926941	*AC1-181*	*0.58*

Appendix 3

(FE - FE) The 02BEAVER-02LAKEAVE 345 kV line (from bus 238569 to bus 239725 ckt 2) loads from 91.86% to 92.71% (**DC power flow**) of its emergency rating (1646 MVA) for the line fault with failed breaker contingency outage of 'ATSI-P2-3-OEC-345-023'. This project contributes approximately 30.32 MW to the thermal violation.

CONTINGENCY 'ATSI-P2-3-OEC-345-023' /* BEAVER 345KV BRK B-121
DISCONNECT BRANCH FROM BUS 238569 TO BUS 239725 CKT 1 /* 02BEAVER 345 02LAKEAVE 345
DISCONNECT BRANCH FROM BUS 238569 TO BUS 238607 CKT 1 /* 02BEAVER 345 02CARLIL 345
END

Bus Number	*Bus Name*	*Full Contribution*
241902	*02_Y1-069 GE*	*33.94*
238564	*02BAYSG1*	*28.22*
240968	*02BG2 GEN*	*1.41*
240969	*02BG4 G1*	*0.35*
240970	*02BG4 G2&3*	*0.71*
240971	*02BG4 G4&5*	*0.71*
240950	*02BG5*	*4.31*
240973	*02BG6 AMPO*	*6.29*
239276	*02COLLW 11*	*-4.18*
239297	*02CPPW41*	*-5.13*
238670	*02DVBSG1*	*48.52*
238979	*02NAPMUN*	*6.75*
240975	*02PGE GEN*	*9.73*
239171	*02WLORG-2*	*7.75*
239172	*02WLORG-3*	*7.96*
239173	*02WLORG-4*	*7.94*
239174	*02WLORG-5*	*7.97*
932051	*AC2-015 C*	*6.25*
932052	*AC2-015 E*	*7.3*
932791	*AC2-103 C*	*14.43*
932792	*AC2-103 E*	*96.56*
934251	*AD1-052 C1*	*2.56*
934261	*AD1-052 C2*	*2.56*
934252	*AD1-052 E1*	*1.14*
934262	*AD1-052 E2*	*1.14*
934461	*AD1-070 C O2*	*5.32*
934462	*AD1-070 E O2*	*25.*
LTF	*AD1-092*	*6.31*
LTF	*AD1-093*	*10.84*
LTF	*AD1-094*	*2.07*

934761	AD1-103 C O2	22.81
934762	AD1-103 E O2	152.63
934891	AD1-118	14.5
LTF	CARR	2.21
LTF	CBM-S1	10.75
LTF	CBM-S2	3.99
LTF	CBM-W1	97.12
LTF	CBM-W2	77.65
LTF	CIN	12.56
LTF	CPLE	0.65
LTF	G-007	3.32
LTF	IPL	8.09
LTF	LGEE	2.24
LTF	MEC	25.21
LTF	MECS	52.8
LTF	O-066	11.27
LTF	RENSSELAER	1.73
LTF	ROSETON	12.51
247551	U4-028 C	1.87
247940	U4-028 E	12.52
247552	U4-029 C	1.87
247941	U4-029 E	12.52
247567	V2-006 C	2.29
247961	V2-006 E	15.29
247548	V4-010 C	4.02
247947	V4-010 E	26.91
901803	W1-072A	8.29
LTF	WEC	4.1
907061	X1-027A C1	1.19
907064	X1-027A C2	1.19
907066	X1-027A C3	1.19
907068	X1-027A C4	1.19
907062	X1-027A E1	40.57
907065	X1-027A E2	40.57
907067	X1-027A E3	40.57
907069	X1-027A E4	40.57
LTF	Y3-032	44.43
LTF	Z1-043	15.79
918401	AA1-056	1.95
931951	AB1-107 1	55.28
931961	AB1-107 2	128.22
LTF	AB2-013	9.03
925751	AC1-051 C	0.89
925752	AC1-051 E	5.95
926941	AC1-181	0.74

Appendix 4

(FE - FE) The 02LRN Q2-02AD Q-2 138 kV line (from bus 238915 to bus 238524 ckt 1) loads from 97.45% to 98.99% (**DC power flow**) of its emergency rating (316 MVA) for the line fault with failed breaker contingency outage of 'ATSI-P2-3-CEI-345-001'. This project contributes approximately 10.78 MW to the thermal violation.

CONTINGENCY 'ATSI-P2-3-CEI-345-001' /* BREAKER FAILURE ON S145 BREAKER AT AVON 345KV
DISCONNECT BRANCH FROM BUS 239725 TO BUS 238551 CKT 1 /* 02LAKEAVE 345 02AVON 345
DISCONNECT BRANCH FROM BUS 239725 TO BUS 238551 CKT 2 /* 02LAKEAVE 345 02AVON 345
END

Bus Number	*Bus Name*	*Full Contribution*
238564	*02BAYSG1*	*8.97*
238572	*02BEAVGB*	*1.6*
240968	*02BG2 GEN*	*0.45*
240969	*02BG4 G1*	*0.11*
240970	*02BG4 G2&3*	*0.23*
240971	*02BG4 G4&5*	*0.23*
240950	*02BG5*	*1.38*
240973	*02BG6 AMPO*	*2.01*
239276	*02COLLW 11*	*-2.18*
239297	*02CPPW41*	*-2.81*
238979	*02NAPMUN*	*2.12*
240975	*02PGE GEN*	*3.11*
239175	*02WLORG-6*	*2.53*
932791	*AC2-103 C*	*3.73*
932792	*AC2-103 E*	*24.99*
934251	*AD1-052 C1*	*0.99*
934261	*AD1-052 C2*	*0.99*
934252	*AD1-052 E1*	*0.44*
934262	*AD1-052 E2*	*0.44*
934461	*AD1-070 C O2*	*1.89*
934462	*AD1-070 E O2*	*8.89*
934761	*AD1-103 C O2*	*6.33*
934762	*AD1-103 E O2*	*42.39*
934891	*AD1-118*	*4.4*
LTF	*CARR*	*0.9*
LTF	*CBM-S1*	*3.88*
LTF	*CBM-S2*	*1.64*
LTF	*CBM-W1*	*31.44*
LTF	*CBM-W2*	*27.29*
LTF	*CIN*	*4.37*

LTF	*CPLE*	*0.29*
LTF	*G-007*	*1.12*
LTF	*IPL*	*2.81*
LTF	*LGEE*	*0.8*
LTF	*MEC*	*8.63*
LTF	*MECS*	*16.34*
LTF	*O-066*	*3.81*
LTF	*RENSSELAER*	*0.7*
LTF	*ROSETON*	*5.06*
247551	*U4-028 C*	*0.71*
247940	*U4-028 E*	*4.72*
247552	*U4-029 C*	*0.71*
247941	*U4-029 E*	*4.72*
247548	*V4-010 C*	*1.52*
247947	*V4-010 E*	*10.19*
901803	*W1-072A*	*2.52*
LTF	*WEC*	*1.39*
907062	*X1-027A E1*	*10.5*
907065	*X1-027A E2*	*10.5*
907067	*X1-027A E3*	*10.5*
907069	*X1-027A E4*	*10.5*
LTF	*Y3-032*	*13.61*
931951	*AB1-107 1*	*17.55*
931961	*AB1-107 2*	*38.52*

Appendix 5

(AEP - FE) The 05HOWARD-02BRKSID 138 kV line (from bus 243024 to bus 238586 ckt 1) loads from 83.8% to 99.45% (**DC power flow**) of its emergency rating (245 MVA) for the tower line contingency outage of 'AEP_P7-1_#7731-A'. This project contributes approximately 38.36 MW to the thermal violation.

CONTINGENCY 'AEP_P7-1_#7731-A'
OPEN BRANCH FROM BUS 243006 TO BUS 934460 CKT 1 / 243006 05FOSTOR 138 934460 AD1-070 TAP 138 1
OPEN BRANCH FROM BUS 243039 TO BUS 243110 CKT 1 / 243039 05MELMOR 138 243110 05STIFFI 138 1
END

Bus Number	*Bus Name*	*Full Contribution*
932051	*AC2-015 C*	*14.23*
932052	*AC2-015 E*	*16.6*
934461	*AD1-070 C O2*	*6.74*
934462	*AD1-070 E O2*	*31.63*
934791	*AD1-106 C O2*	*1.51*
934792	*AD1-106 E O2*	*2.47*
LTF	*CARR*	*0.14*
LTF	*CBM-S1*	*0.97*
LTF	*CBM-S2*	*0.39*
LTF	*CBM-W1*	*6.38*
LTF	*CBM-W2*	*6.61*
LTF	*CIN*	*1.08*
LTF	*CPLE*	*0.07*
LTF	*G-007*	*0.28*
LTF	*IPL*	*0.7*
LTF	*LGEE*	*0.21*
LTF	*MEC*	*2.02*
LTF	*MECS*	*2.85*
LTF	*O-066*	*0.93*
LTF	*RENSSELAER*	*0.11*
LTF	*ROSETON*	*0.82*
247926	*U1-059 E*	*2.36*
247542	*U4-001 C*	*8.26*
247934	*U4-001 E*	*55.28*
247551	*U4-028 C*	*2.43*
247940	*U4-028 E*	*16.28*
247552	*U4-029 C*	*2.43*
247941	*U4-029 E*	*16.28*
247548	*V4-010 C*	*3.93*
247947	*V4-010 E*	*26.28*
247942	*W1-056 E*	*0.87*

LTF	*WEC*	*0.32*
925751	*AC1-051 C*	*2.*
925752	*AC1-051 E*	*13.38*

Appendix 6

(AEP - AEP) The AC2-015 TAP-05HOWARD 138 kV line (from bus 932050 to bus 243024 ckt 1) loads from 84.17% to 106.94% (**DC power flow**) of its emergency rating (167 MVA) for the tower line contingency outage of 'AEP_P7-1_#7731-A'. This project contributes approximately 38.03 MW to the thermal violation.

CONTINGENCY 'AEP_P7-1_#7731-A'
OPEN BRANCH FROM BUS 243006 TO BUS 934460 CKT 1 / 243006 05FOSTOR 138 934460 AD1-070 TAP 138 1
OPEN BRANCH FROM BUS 243039 TO BUS 243110 CKT 1 / 243039 05MELMOR 138 243110 05STIFFI 138 1
END

Bus Number	*Bus Name*	*Full Contribution*
932051	*AC2-015 C*	*30.03*
932052	*AC2-015 E*	*35.04*
934461	*AD1-070 C O2*	*6.68*
934462	*AD1-070 E O2*	*31.35*
LTF	*CALDERWOOD*	*0.02*
LTF	*CARR*	*< 0.01*
LTF	*CATAWBA*	*0.02*
LTF	*CBM-W1*	*4.07*
LTF	*CBM-W2*	*0.84*
LTF	*CELEVELAND*	*0.06*
LTF	*CHEOAH*	*0.02*
LTF	*CHILHOWEE*	*< 0.01*
LTF	*CIN*	*0.17*
LTF	*CLIFTY*	*0.46*
LTF	*G-007*	*0.08*
LTF	*HAMLET*	*0.08*
LTF	*IPL*	*0.11*
LTF	*LGEE*	*< 0.01*
LTF	*MEC*	*0.54*
LTF	*MECS*	*3.07*
LTF	*MORGAN*	*< 0.01*
LTF	*O-066*	*0.25*
LTF	*RENSSELAER*	*< 0.01*
LTF	*ROSETON*	*0.03*
LTF	*ROWAN*	*0.05*
LTF	*SANTEETLA*	*< 0.01*
LTF	*TVA*	*< 0.01*
247551	*U4-028 C*	*2.41*
247940	*U4-028 E*	*16.14*
247552	*U4-029 C*	*2.41*
247941	*U4-029 E*	*16.14*

LTF	*UNIONPOWER*	*0.02*
247548	*V4-010 C*	*3.91*
247947	*V4-010 E*	*26.19*
LTF	*WEC*	*0.11*
925751	*AC1-051 C*	*0.64*
925752	*AC1-051 E*	*4.3*

Appendix 7

(FE - FE) The 02BLKRVR-02USSTEEL 138 kV line (from bus 239728 to bus 239734 ckt 1) loads from 117.67% to 118.99% (**DC power flow**) of its emergency rating (500 MVA) for the line fault with failed breaker contingency outage of 'ATSI-P2-3-CEI-345-001'. This project contributes approximately 14.6 MW to the thermal violation.

CONTINGENCY 'ATSI-P2-3-CEI-345-001' /* BREAKER FAILURE ON S145 BREAKER AT AVON 345KV
DISCONNECT BRANCH FROM BUS 239725 TO BUS 238551 CKT 1 /* 02LAKEAVE 345 02AVON 345
DISCONNECT BRANCH FROM BUS 239725 TO BUS 238551 CKT 2 /* 02LAKEAVE 345 02AVON 345
END

Bus Number	*Bus Name*	*Full Contribution*
238564	*02BAYSG1*	*12.16*
238572	*02BEAVGB*	*2.15*
240968	*02BG2 GEN*	*0.61*
240969	*02BG4 G1*	*0.15*
240970	*02BG4 G2&3*	*0.31*
240971	*02BG4 G4&5*	*0.31*
240950	*02BG5*	*1.87*
240973	*02BG6 AMPO*	*2.72*
239276	*02COLLW 11*	*-2.84*
239297	*02CPPW41*	*-3.58*
238979	*02NAPMUN*	*2.87*
240975	*02PGE GEN*	*4.21*
239175	*02WLORG-6*	*3.41*
932051	*AC2-015 C*	*3.48*
932052	*AC2-015 E*	*4.06*
932791	*AC2-103 C*	*5.07*
932792	*AC2-103 E*	*33.91*
934251	*AD1-052 C1*	*1.35*
934261	*AD1-052 C2*	*1.35*
934252	*AD1-052 E1*	*0.6*
934262	*AD1-052 E2*	*0.6*
934461	*AD1-070 C O2*	*2.56*
934462	*AD1-070 E O2*	*12.04*
934761	*AD1-103 C O2*	*8.6*
934762	*AD1-103 E O2*	*57.55*
934891	*AD1-118*	*5.97*
LTF	*CARR*	*1.22*
LTF	*CBM-S1*	*5.16*
LTF	*CBM-S2*	*2.13*
LTF	*CBM-W1*	*42.36*

LTF	*CBM-W2*	*36.42*
LTF	*CIN*	*5.84*
LTF	*CPLE*	*0.37*
LTF	*G-007*	*1.55*
LTF	*IPL*	*3.76*
LTF	*LGEE*	*1.07*
LTF	*MEC*	*11.55*
LTF	*MECS*	*22.11*
LTF	*O-066*	*5.27*
LTF	*RENSSELAER*	*0.95*
LTF	*ROSETON*	*6.88*
247542	*U4-001 C*	*1.52*
247934	*U4-001 E*	*10.14*
247551	*U4-028 C*	*0.96*
247940	*U4-028 E*	*6.4*
247552	*U4-029 C*	*0.96*
247941	*U4-029 E*	*6.4*
247567	*V2-006 C*	*1.01*
247961	*V2-006 E*	*6.74*
247548	*V4-010 C*	*2.07*
247947	*V4-010 E*	*13.83*
901803	*W1-072A*	*3.41*
LTF	*WEC*	*1.86*
907062	*X1-027A E1*	*14.25*
907065	*X1-027A E2*	*14.25*
907067	*X1-027A E3*	*14.25*
907069	*X1-027A E4*	*14.25*
LTF	*Y3-032*	*18.43*
915952	*Y3-092 FTWR*	*31.39*
915953	*Y3-092 NFTWR*	*31.39*
931951	*AB1-107 1*	*23.8*
931961	*AB1-107 2*	*52.22*
923821	*AB2-019*	*1.76*
925751	*AC1-051 C*	*0.5*
925752	*AC1-051 E*	*3.32*
926941	*AC1-181*	*0.32*

Appendix 8

(FE - FE) The 02USSTEEL-02LRN Q2 138 kV line (from bus 239734 to bus 238915 ckt 1) loads from 111.37% to 112.69% (**DC power flow**) of its emergency rating (500 MVA) for the line fault with failed breaker contingency outage of 'ATSI-P2-3-CEI-345-001'. This project contributes approximately 14.6 MW to the thermal violation.

CONTINGENCY 'ATSI-P2-3-CEI-345-001' /* BREAKER FAILURE ON S145 BREAKER AT AVON 345KV
DISCONNECT BRANCH FROM BUS 239725 TO BUS 238551 CKT 1 /* 02LAKEAVE 345 02AVON 345
DISCONNECT BRANCH FROM BUS 239725 TO BUS 238551 CKT 2 /* 02LAKEAVE 345 02AVON 345
END

Bus Number	*Bus Name*	*Full Contribution*
238564	*02BAYSG1*	*12.16*
238572	*02BEAVGB*	*2.15*
240968	*02BG2 GEN*	*0.61*
240969	*02BG4 G1*	*0.15*
240970	*02BG4 G2&3*	*0.31*
240971	*02BG4 G4&5*	*0.31*
240950	*02BG5*	*1.87*
240973	*02BG6 AMPO*	*2.72*
239276	*02COLLW 11*	*-2.84*
239297	*02CPPW41*	*-3.58*
238979	*02NAPMUN*	*2.87*
240975	*02PGE GEN*	*4.21*
239175	*02WLORG-6*	*3.41*
932051	*AC2-015 C*	*3.48*
932052	*AC2-015 E*	*4.06*
932791	*AC2-103 C*	*5.07*
932792	*AC2-103 E*	*33.91*
934251	*AD1-052 C1*	*1.35*
934261	*AD1-052 C2*	*1.35*
934252	*AD1-052 E1*	*0.6*
934262	*AD1-052 E2*	*0.6*
934461	*AD1-070 C O2*	*2.56*
934462	*AD1-070 E O2*	*12.04*
934761	*AD1-103 C O2*	*8.6*
934762	*AD1-103 E O2*	*57.55*
934891	*AD1-118*	*5.97*
LTF	*CARR*	*1.22*
LTF	*CBM-S1*	*5.16*
LTF	*CBM-S2*	*2.13*
LTF	*CBM-W1*	*42.36*

LTF	*CBM-W2*	*36.42*
LTF	*CIN*	*5.84*
LTF	*CPLE*	*0.37*
LTF	*G-007*	*1.55*
LTF	*IPL*	*3.76*
LTF	*LGEE*	*1.07*
LTF	*MEC*	*11.55*
LTF	*MECS*	*22.11*
LTF	*O-066*	*5.27*
LTF	*RENSSELAER*	*0.95*
LTF	*ROSETON*	*6.88*
247542	*U4-001 C*	*1.52*
247934	*U4-001 E*	*10.14*
247551	*U4-028 C*	*0.96*
247940	*U4-028 E*	*6.4*
247552	*U4-029 C*	*0.96*
247941	*U4-029 E*	*6.4*
247567	*V2-006 C*	*1.01*
247961	*V2-006 E*	*6.74*
247548	*V4-010 C*	*2.07*
247947	*V4-010 E*	*13.83*
901803	*W1-072A*	*3.41*
LTF	*WEC*	*1.86*
907062	*X1-027A E1*	*14.25*
907065	*X1-027A E2*	*14.25*
907067	*X1-027A E3*	*14.25*
907069	*X1-027A E4*	*14.25*
LTF	*Y3-032*	*18.43*
915952	*Y3-092 FTWR*	*31.39*
915953	*Y3-092 NFTWR*	*31.39*
931951	*AB1-107 1*	*23.8*
931961	*AB1-107 2*	*52.22*
923821	*AB2-019*	*1.76*
925751	*AC1-051 C*	*0.5*
925752	*AC1-051 E*	*3.32*
926941	*AC1-181*	*0.32*