Generation Interconnection Feasibility Study Report

For

PJM Generation Interconnection Request Queue Position AD1-103

Beaver-Davis Besse 345kV

April 2018

Preface

The intent of the feasibility study is to determine a plan, with ballpark cost and construction time estimates, to connect the subject generation to the PJM network at a location specified by the Interconnection Customer. The Interconnection Customer may request the interconnection of generation as a capacity resource or as an energy-only resource. As a requirement for interconnection, the Interconnection Customer may be responsible for the cost of constructing: (1) Direct Connections, which are new facilities and/or facilities upgrades needed to connect the generator to the PJM network, and (2) Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system.

In some instances a generator interconnection may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection, may also contribute to the need for the same network reinforcement. The possibility of sharing the reinforcement costs with other projects may be identified in the feasibility study, but the actual allocation will be deferred until the impact study is performed.

The Feasibility Study estimates do not include the feasibility, cost, or time required to obtain property rights and permits for construction of the required facilities. The project developer is responsible for the right of way, real estate, and construction permit issues. For properties currently owned by Transmission Owners, the costs may be included in the study.

The conduct of light load analysis as required under the PJM planning process is not performed during the Generation Interconnection Feasibility Study phase of the PJM study process. Additional reinforcement requirements for this Interconnection Request may be defined during the conduct of the light load analysis which shall be performed following execution of the System Impact Study agreement.

General

The Interconnection Customer (IC), has proposed a Wind generating facility located in Huron County, Ohio. The installed facilities will have a total capability of 500.4 MW with 65.05 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is December 18, 2020. **This study does not imply a ATSI commitment to this in-service date.**

Point of Interconnection

AD1-103 will interconnect with the ATSI transmission system along one of the following

Primary: Beaver – Davis Besse 345kV line

Secondary: Hayes 345kV substation

Cost Summary

The AD1-103 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$ 0
Direct Connection Network Upgrades	$ 4,440,700
Non Direct Connection Network Upgrades	$ 0
Total Costs	**$ 4,440,700**

In addition, the AD1-103 project may be responsible for a contribution to the following costs:

Description	Total Cost
New System Upgrades	$ 1,160,400
Previously Identified Upgrades	$ 0
Total Costs	**$ 1,160,400**

Cost allocations for these upgrades will be provided in the System Impact Study Report.

Attachment Facilities

No Attachment Facilities are required to support this interconnection request.

Direct Connection Cost Estimate

The total preliminary cost estimate for the Direct Connection work is given in the table below. These costs do not include CIAC Tax Gross-up.

Description	Activity Cost	Tax (if applicable)	Total Cost
The Beaver – Davis Besse 345kV (AD1-103) Project Direct connection and attachment facilities includes: ▪ Expanding the Beaver-Davis Besse (X1-027A) 345kV four circuit breaker ring bus into 345kV five future six circuit breaker ring bus to accommodate one 345kv circuit breaker and a 345kV generation-tie line exit. ▪ Install 345kV line dead-end structure 345kV circuit breaker, DSW's, MOABS, CVT'S and arresters. ▪ Install 345kV line relay & control panel over fiber. ▪ Install standard dual non-pilot 345kV SEL411L line relay & control and SEL501 breaker failure to trip (BFT). ▪ Install and terminate fiber communication at the POI. This does not include the generation-tie line fiber communication which is part of the Firelands Wind, LLC facility. ▪ Prepare foundation, conduit and grounding for 345kV breaker, line dead-end and support structure.	$ 4,440,700	$ 591,600	$ 5,032,300
Total Direct Connection Facility Costs	**$ 4,440,700**	**$ 591,600**	**$ 5,032,300**

Non-Direct Connection Cost Estimate

No Non-Direct Connection Facilities are required to support this interconnection request.

Customer Facilities

The proposed project consists of a wind farm with 139 Wind Turbine Generator Systems (WTGs), 3.6MW each, with a total maximum facility output of 500.4MW. The collector substation will consist of one collector substation at a voltage level of 34.5kV with three transformers to step up the 34.5kV collector substation voltage to the 345kV transmission voltage. The wind farm collection facility site GPS location is (41.1368410, -82.7854040) and the facility is located approximately 19 miles from the designated primary POI. The 345kV generator-tie transmission line will be built by the IC from the wind farm collection facility to the designated primary POI located at the FirstEnergy / ATSI Beaver-Davis Besse 345kV line.

Transmission Owner Scope of Work

The primary point of interconnection is on the Beaver-Davis Bessie 345kV line, approximately 28 miles from Beaver substation and approximately 31 miles from Davis Besse 345kV substation as shown in Attachment 1. Note that this is the same point of interconnection as the previously submitted X1-027A and AC2-103 Gen Queue projects. It has been validated with PJM, and assumed that for this study and report, that the X1-027A and AC2-103 Gen Queue projects will be completed before the requested in-service date of this AD1-103 project.

To interconnect the Beaver-Davis Besse (AD1-103) project to the Beaver-Davis Besse 345kV line, it is required to expand the proposed ATSI owned Beaver-Davis Besse 345kV (X1-027A / AC2-103) four breaker ring bus to a five breaker, future six breaker, ring bus to accommodate the new 345kV line exit for the AD1-103 345kV generation tie-line (Attachment 2). The IC is responsible to design and build the approximate 19 miles 345kV generator-tie line from their collector facility to the primary POI and will be responsible for acquiring all easements, properties and permits that may be required to construct the proposed 345kV generation tie-line and associated generation facilities.

This report contains the connection requirements, direct connection costs and schedule, power flow analysis, short circuit analysis, and a cost and schedule for any associated system reinforcements for the requested primary POI.

The Beaver – Davis Besse 345kV (AD1-103) project direct connection and attachment facilities includes:

- Expanding the Beaver-Davis Besse (X1-027A)/AC2-103) 345kV four circuit breaker ring bus into 345kV five breaker, future six breaker, ring bus to accommodate a 345kV generation-tie line.
- Installing a 345kV line dead-end structure, 345kV circuit breaker, DSW's, MOABS, CVT'S wavetrap and arresters.
- Installing 345kV line relay & control panel.
- Installing standard dual pilot 345kV SEL411L line relay & control and SEL501 breaker failure to trip (BFT).
- Prepare foundation, conduit and grounding for 345kV breaker, line dead-end and support structure.

The proposed direct connection and attachment facilities one-line diagram is shown in Attachment 2.

Project Schedule

Based on the scope of the direct connection and attachment facility required for the Beaver-Davis Besse 345kV (AD1-103) interconnection project, it is expected to take a minimum of nineteen (19) months from the signing of a Connection Service Agreement (CSA) to complete the direct connection and attachment facilities and approximately six (6) months to complete the identified network upgrade. The schedule assumes that there will be no environmental issues with any of the properties associated with this project, that there will be no delays in acquiring the necessary permits for implementing the defined direct connection, attachment facility and network upgrades, and that PJM will allow all transmission system outages when requested. The schedule assumes engineering start date before 06/01/2019 to meet the requested in-service date.

Interconnection Customer Requirements

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.

3. The Interconnection Customer seeking to interconnect a wind generation facility shall maintain meteorological data facilities as well as provide that meteorological data which is required per item 5.iv. of Schedule H to the Interconnection Service Agreement.

4. The IC shall design its wind facility with the ability to maintain a power factor of at least 0.95 leading to 0.95 lagging measured at the high side of the facility substation transformers.

5. The purchase and installation of a fully rated 345kV circuit breaker to permit tripping of the entire plant.

6. The purchase and installation of the minimum required FE generation interconnection relaying and control facilities. This includes over/under voltage protection, over/under frequency protection, and zero sequence voltage protection relays.

7. The purchase and installation of a 345kV interconnection metering instrument transformer. FE will provide the ratio and accuracy specifications based on the customer generation levels.

8. The purchase and installation of a revenue class meter for each unit to measure the power delivered in compliance with the FE standards.

9. The purchase and installation of supervisory control and data acquisition (SCADA) equipment to provide information in a compatible format to the FE Transmission System Control Center.

10. The establishment of dedicated communication circuits for SCADA report to the FE Transmission System Control Center.

11. A compliance with the FE and PJM generator power factor and voltage control requirements.

12. The execution of a back-up retail service agreement with the electric distribution company to serve the customer load supplied from the Beaver-Davis Besse 345kV AD1-103 generation project interconnection point when the units are out-of-service.

13. The IC shall design its wind facility with the ability to maintain a power factor of at least 0.95 leading to 0.95 lagging measured at the high side of the facility substation transformers.

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.

Requirements

The Interconnection Customer will be required to comply with all FE Revenue Metering Requirements for Generation Interconnection Customers. The Revenue Metering Requirements may be found within the "FirstEnergy Requirements for Transmission Connected Facilities" document located at the following links:

http://www.firstenergycorp.com/feconnect
http://www.pjm.com/planning/design-engineering/to-tech-standards.aspx

Network Impacts

Option 1

The Queue Project AD1-103 was evaluated as a 500.4 MW (Capacity 65.1 MW) injection at the Queue Project X1-027A Tap (345kV), which is a tap of the Beaver to Davis Besse 345kV line in the ATSI area. Project AD1-103 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AD1-103 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Analysis - 2021

Contingency Descriptions

The following contingencies resulted in overloads:

Contingency Name	Description
AEP_P4_#517	CONTINGENCY 'AEP_P4_#517' OPEN BRANCH FROM BUS 241901 TO BUS 242936 CKT 1 / 241901 02LALLENDORF 345 242936 05FOSTOR 345 1 OPEN BRANCH FROM BUS 238889 TO BUS 242936 CKT 1 / 238889 02LEMOYN 345 242936 05FOSTOR 345 1 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

Contingency Name	Description
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
ATSI-P7-1-TE-345-024T	CONTINGENCY 'ATSI-P7-1-TE-345-024T' /* Y1-069-FOSTORIA/LEMOYNE-FOSTORIA 345 DISCONNECT BRANCH FROM BUS 241901 TO BUS 242936 CKT 1 /* 02_Y1-069 345 05FOSTOR 345 DISCONNECT BRANCH FROM BUS 238889 TO BUS 242936 CKT 1 /* 02LEMOYN 345 05FOSTOR 345 END

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)

	Contingency		Affected		Bus			Power	Loading %		Rating		MW	
#	Type	Name	Area	Facility Description	From	To	Circuit	Flow	Initial	Final	Type	MVA	Contribution	Ref
1	LFFB	ATSI-P2-3-CEI-345-001	FE - FE	02AD Q-2-02AVON 138 kV line	238524	238552	1	DC	98	104.9	ER	316	48.29	1
2	DCTL	ATSI-P7-1-CEI-345-001	FE - FE	02AD Q-2-02AVON 138 kV line	238524	238552	1	DC	98	104.9	ER	316	48.29	
3	DCTL	ATSI-P7-1-OEC-345-001	FE - FE	02BEAVER-02CARLIL 345 kV line	238569	238607	1	DC	88.72	100.6	ER	1243	147.08	2
4	LFFB	ATSI-P2-3-OEC-345-023	FE - FE	02BEAVER-02LAKEAVE 345 kV line	238569	239725	2	DC	93.2	104.6	ER	1646	186.58	3
5	LFFB	AEP_P4_#517	FE - FE	02LEMOYN-02WOOD+ 138 kV line	238890	239176	1	DC	99.89	104.98	ER	223	25.23	4
6	DCTL	ATSI-P7-1-TE-345-024T	FE - FE	02LEMOYN-02WOOD+ 138 kV line	238890	239176	1	DC	99.89	104.98	ER	223	25.23	
7	LFFB	ATSI-P2-3-CEI-345-001	FE - FE	02LRN Q2-02AD Q-2 138 kV line	238915	238524	1	DC	98.04	104.93	ER	316	48.29	5
8	DCTL	ATSI-P7-1-CEI-345-001	FE - FE	02LRN Q2-02AD Q-2 138 kV line	238915	238524	1	DC	98.04	104.93	ER	316	48.29	
9	LFFB	ATSI-P2-3-CEI-345-001	FE - FE	02USSTEEL-02LRN Q2 138 kV line	239734	238915	1	DC	98.97	104.88	ER	500	65.52	6

#	Contingency Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Circuit	Power Flow	Loading % Initial	Loading % Final	Rating Type	Rating MVA	MW Contribution	Ref
10	DCTL	ATSI-P7-1-CEI-345-001	FE - FE	02USSTEEL-02LRN Q2 138 kV line	239734	238915	1	DC	98.97	104.88	ER	500	65.52	

*Note: Please see **Error! Reference source not found.** for projects providing impacts to flowgate violations. The values in the Reference column correspond to the proper table in the Attachment.*

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)

#	Contingency Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Circuit	Power Flow	Loading % Initial	Loading % Final	Rating Type	Rating MVA	MW Contribution	Ref
11	DCTL	ATSI-P7-1-OEC-345-001	FE - FE	02BEAVER-02BLKRVR 138 kV line	238570	239728	1	DC	108.04	112.68	ER	387	39.74	7
12	LFFB	ATSI-P2-3-CEI-345-001	FE - FE	02BLKRVR-02USSTEEL 138 kV line	239728	239734	1	DC	105.27	111.18	ER	500	65.52	8
13	DCTL	ATSI-P7-1-CEI-345-001	FE - FE	02BLKRVR-02USSTEEL 138 kV line	239728	239734	1	DC	105.27	111.18	ER	500	65.52	

*Note: Please see **Error! Reference source not found.** for projects providing impacts to flowgate violations. The values in the Reference column correspond to the proper table in the Attachment.*

Short Circuit

(Summary of impacted circuit breakers)

None.

Potential Congestion due to Local Energy Deliverability

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.

None.

New System Reinforcements

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

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
#1, 2, 7, 8, 12, 13	02AD Q-2-02AVON 138 kV line	In order to mitigate the overloads of facilities above, the following reinforcements are required: **ATSI:** **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.**		**$ 0**

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
#3	02BEAVER-02CARLIL 345 kV line	In order to mitigate the overloads of facilities above, the following reinforcements are required: **ATSI:** **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 $504,700**		**$ 504,700**
#4	02BEAVER-02LAKEAVE 345 kV line	In order to mitigate the overloads of facilities above, the following reinforcements are required: **ATSI:** **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.** **The estimated cost to reconductor the Beaver 345kV substation and line drop conductor on the Beaver-Lake Ave # 345kV line is $45,000**		**$ 45,000**

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
#5, 6	02LEMOYN-02WOOD+ 138 kV line	In order to mitigate the overloads of facilities above, the following reinforcements are required: **ATSI:** **ATSI concurred with PJM result and will propose to reconductor the limiting element of the line to alleviate the thermal overload as part of the Beaver-Davis Besse 345kV (AD1-103) project. ATSI will propose the existing limiting element a subtransmission line conductor 477Kcmil ACSR 24/7 strand with 477Kcmil ACSR conductor. The line new rating would be 317MVA/SN & 365MVA/SE.** **The estimated cost to reconductor the Lemoyne-Woodville tap 138kV line is $610,700 (without tax).**		**$ 610,700**
#9, 10	02USSTEEL-02LRN Q2 138 kV line	In order to mitigate the overloads of facilities above, the following reinforcements are required: **ATSI:** **There is an existing PJM base line upgrade project (b2896) to reduce the identified overload. After all proposed base line upgrade projects have been completed, the Charleston-Lorain Q2 138kV rating would be 498MVA summer normal and 593MVA summer emergency.** **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.**		**$ 0**
			Total New Network Upgrades	**$ 1,160,400**

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)

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
#11	02BEAVER-02BLKRVR 138 kV line	In order to mitigate the overloads of facilities above, the following reinforcements are required: **ATSI:** **There is an existing PJM base line (b2673, b2898 & bxxx) to upgrade the limiting elements on the Beaver-Black River 138kV line. 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 project is to reconductor/replace the limiting elements, 795ACSR 26/7 & 336Kcmil six wire transmission line conductor, 1600A wave-trap at Black River & a relay thermal GCY51 at Beaver substation. The Proposed PJM base line projects are listed below:** **– PJM b2673-Reconductor Beaver-Brownhelm junction 138kV line with 954Kcmil ACSS,498SN/573SE MVA rating. The scheduled in-service date is 06/1/2021.** **– PJM b2898(TBD)-reconductor Brownhelm junction-Black River 138kV line with 954Kcmil ACSS, 498SN/573SE MVA rating & upgrade the 1600A wavetrap with 2000A,489SN/554SE MVA rating. The scheduled in-service date is 06/1/2021.** **– PJM bxxx(TBD)-replace the GCY51 relay thermal with SEL. The scheduled in-service date is 06/1/2021.** **After all the proposed PJM base line projects have been completed, the Beaver-Black River 138kV line rating would be 540MVA summer normal and emergency. The new limiting element would be the relay ZR 321 primary/back up at Black river.**		**$ 0**
			Total New Network Upgrades	**$ 0**

Option 2

The Queue Project AD1-103 was evaluated as a 500.4 MW (Capacity 65.1 MW) injection at the Hayes 345kV substation in the ATSI area. Project AD1-103 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AD1-103 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Analysis - 2021

Contingency Descriptions

The following contingencies resulted in overloads:

Contingency Name	Description
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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

Contingency Name	Description
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
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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)

	Contingency		Affected		Bus			Power	Loading %		Rating		MW	
#	Type	Name	Area	Facility Description	From	To	Circuit	Flow	Initial	Final	Type	MVA	Contribution	Ref
1	LFFB	ATSI-P2-3-CEI-345-001	FE - FE	02AD Q-2-02AVON 138 kV line	238524	238552	1	DC	98.01	104.96	ER	316	48.72	1
2	DCTL	ATSI-P7-1-CEI-345-001	FE - FE	02AD Q-2-02AVON 138 kV line	238524	238552	1	DC	98.01	104.96	ER	316	48.72	
3	DCTL	ATSI-P7-1-OEC-345-001	FE - FE	02BEAVER-02CARLIL 345 kV line	238569	238607	1	DC	88.66	99.89	ER	1243	138.98	2
4	LFFB	ATSI-P2-3-OEC-345-023	FE - FE	02BEAVER-02LAKEAVE 345 kV line	238569	239725	2	DC	93.14	103.87	ER	1646	175.44	3
5	LFFB	ATSI-P2-3-CEI-345-001	FE - FE	02LRN Q2-02AD Q-2 138 kV line	238915	238524	1	DC	98.01	104.96	ER	316	48.72	4
6	DCTL	ATSI-P7-1-CEI-345-001	FE - FE	02LRN Q2-02AD Q-2 138 kV line	238915	238524	1	DC	98.01	104.96	ER	316	48.72	
7	LFFB	AEP_P4_#517	FE - AEP	02W.FREM-05FRMNT 138 kV line	239154	243009	1	DC	96.05	99.86	ER	361	30.17	5
8	DCTL	ATSI-P7-1-TE-345-024T	FE - AEP	02W.FREM-05FRMNT 138 kV line	239154	243009	1	DC	96.05	99.86	ER	361	30.17	

#	Contingency Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Circuit	Power Flow	Loading % Initial	Loading % Final	Rating Type	Rating MVA	MW Contribution	Ref
9	LFFB	ATSI-P2-3-CEI-345-001	FE - FE	02USSTEEL-02LRN Q2 138 kV line	239734	238915	1	DC	98.97	104.94	ER	500	66.15	6
10	DCTL	ATSI-P7-1-CEI-345-001	FE - FE	02USSTEEL-02LRN Q2 138 kV line	239734	238915	1	DC	98.97	104.94	ER	500	66.15	

*Note: Please see **Error! Reference source not found.** for projects providing impacts to flowgate violations. The values in the Reference column correspond to the proper table in the Attachment.*

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)

#	Contingency Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Circuit	Power Flow	Loading % Initial	Loading % Final	Rating Type	Rating MVA	MW Contribution	Ref
11	DCTL	ATSI-P7-1-OEC-345-001	FE - FE	02BEAVER-02BLKRVR 138 kV line	238570	239728	1	DC	108.02	112.72	ER	387	40.3	7
12	LFFB	ATSI-P2-3-CEI-345-001	FE - FE	02BLKRVR-02USSTEEL 138 kV line	239728	239734	1	DC	105.27	111.24	ER	500	66.15	8
13	DCTL	ATSI-P7-1-CEI-345-001	FE - FE	02BLKRVR-02USSTEEL 138 kV line	239728	239734	1	DC	105.27	111.24	ER	500	66.15	

*Note: Please see **Error! Reference source not found.** for projects providing impacts to flowgate violations. The values in the Reference column correspond to the proper table in the Attachment.*

Short Circuit

(Summary of impacted circuit breakers)

None.

Potential Congestion due to Local Energy Deliverability

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.

None.

Appendices

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 98.0% to 104.9% (**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 48.29 MW to the thermal violation.

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	0.49
934261	AD1-052 C2	0.49
934461	AD1-070 C O1	1.83
934462	AD1-070 E O1	8.6
934761	AD1-103 C O1	6.28

Bus Number	Bus Name	Full Contribution
LTF	CBM-W2	27.32
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
LTF	WEC	1.39
907062	X1-027A E1	10.5
907065	X1-027A E2	10.5

Bus Number	Bus Name	Full Contribution
934762	AD1-103 E O1	42.02
934891	AD1-118	4.4
LTF	CARR	0.9
LTF	CBM-S1	3.89
LTF	CBM-S2	1.64
LTF	CBM-W1	31.43

Bus Number	Bus Name	Full Contribution
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 88.72% to 100.6% (**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 147.08 MW to the thermal violation.

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	1.02
934261	AD1-052 C2	1.02
934461	AD1-070 C O1	4.3
934462	AD1-070 E O1	20.19
LTF	AD1-092	4.68
LTF	AD1-093	8.03
LTF	AD1-094	1.53
934761	AD1-103 C O1	19.12
934762	AD1-103 E O1	127.96
934891	AD1-118	11.43

Bus Number	Bus Name	Full Contribution
LTF	G-007	2.54
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	8.61
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
LTF	WEC	3.04
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

Bus Number	Bus Name	Full Contribution
LTF	CARR	1.36
LTF	CBM-S1	7.57
LTF	CBM-S2	2.41
LTF	CBM-W1	73.95
LTF	CBM-W2	55.95
LTF	CIN	9.17
LTF	CPLE	0.34

Bus Number	Bus Name	Full Contribution
LTF	Z1-043	11.71
931951	AB1-107 1	43.8
931961	AB1-107 2	101.15
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 93.2% to 104.6% (**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 186.58 MW to the thermal violation.

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	1.27
934261	AD1-052 C2	1.27
934461	AD1-070 C O1	5.47
934462	AD1-070 E O1	25.67
LTF	AD1-092	6.31
LTF	AD1-093	10.83

Bus Number	Bus Name	Full Contribution
LTF	CIN	12.56
LTF	CPLE	0.65
LTF	G-007	3.32
LTF	IPL	8.09
LTF	LGEE	2.24
LTF	MEC	25.2
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
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

Bus Number	Bus Name	Full Contribution
LTF	AD1-094	2.06
934761	AD1-103 C O1	24.26
934762	AD1-103 E O1	162.32
934891	AD1-118	14.5
LTF	CARR	2.21
LTF	CBM-S1	10.76
LTF	CBM-S2	4
LTF	CBM-W1	97.09
LTF	CBM-W2	77.7

Bus Number	Bus Name	Full Contribution
LTF	Y3-032	44.43
LTF	Z1-043	15.78
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 02LEMOYN-02WOOD+ 138 kV line (from bus 238890 to bus 239176 ckt 1) loads from 99.89% to 104.98% (**DC power flow**) of its emergency rating (223 MVA) for the line fault with failed breaker contingency outage of 'AEP_P4_#517'. This project contributes approximately 25.23 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
238564	02BAYSG1	11.68
240968	02BG2 GEN	0.88
240969	02BG4 G1	0.21
240970	02BG4 G2&3	0.42
240971	02BG4 G4&5	0.42
240950	02BG5	2.76
240973	02BG6 AMPO	3.87
238979	02NAPMUN	3.79
240975	02PGE GEN	6.12
932791	AC2-103 C	1.95
932792	AC2-103 E	13.06
934761	AD1-103 C O1	3.28
934762	AD1-103 E O1	21.95
934891	AD1-118	7.83
LTF	BAYOU	0.1
LTF	BIG_CAJUN1	0.19
LTF	BIG_CAJUN2	0.37
LTF	BLUEG	0.51
LTF	CALDERWOOD	0.15
LTF	CANNELTON	0.05
LTF	CATAWBA	0.11
LTF	CBM-N	0.03
LTF	CBM-W1	22.37
LTF	CELEVELAND	0.31
LTF	CHEOAH	0.14

Bus Number	Bus Name	Full Contribution
LTF	HAMLET	0.35
940041	J308 C	2.96
940042	J308 E	11.83
940121	J392	11.19
940241	J419	6.31
981121	J444	13.86
970371	J537 C	2
970372	J537 E	8.01
951331	J601 C	1.02
951332	J601 E	4.1
981022	J646 E	0.08
LTF	MEC	1.27
LTF	MECS	19.79
LTF	MORGAN	0.31
LTF	NYISO	0.46
LTF	O-066	0.4
LTF	ROWAN	0.22
LTF	SANTEETLA	0.04
LTF	SMITHLAND	0.01
LTF	TRIMBLE	0.1
LTF	TVA	0.14
LTF	UNIONPOWER	0.17
LTF	WEC	0.31
907062	X1-027A E1	5.49
907065	X1-027A E2	5.49

Bus Number	Bus Name	Full Contribution
LTF	CHILHOWEE	0.05
LTF	CHOCTAW	0.16
LTF	CLIFTY	3.42
LTF	COTTONWOOD	0.37
LTF	ELMERSMITH	0.14
LTF	G-007	0.12
LTF	GIBSON	0.04

Bus Number	Bus Name	Full Contribution
907067	X1-027A E3	5.49
907069	X1-027A E4	5.49
LTF	Y3-032	18.11
931951	AB1-107 1	23.22
931961	AB1-107 2	45.58
926941	AC1-181	0.29

Appendix 5

(FE - FE) The 02LRN Q2-02AD Q-2 138 kV line (from bus 238915 to bus 238524 ckt 1) loads from 98.04% to 104.93% (**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 48.29 MW to the thermal violation.

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	0.49
934261	AD1-052 C2	0.49
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
LTF	CARR	0.9
LTF	CBM-S1	3.89
LTF	CBM-S2	1.64
LTF	CBM-W1	31.43

Bus Number	Bus Name	Full Contribution
LTF	CBM-W2	27.32
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
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 6

(FE - FE) The 02USSTEEL-02LRN Q2 138 kV line (from bus 239734 to bus 238915 ckt 1) loads from 98.97% to 104.88% (**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 65.52 MW to the thermal violation.

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	0.67
934261	AD1-052 C2	0.67
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
LTF	CARR	1.22
LTF	CBM-S1	5.17
LTF	CBM-S2	2.13
LTF	CBM-W1	42.35
LTF	CBM-W2	36.44
LTF	CIN	5.84

Bus Number	Bus Name	Full Contribution
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	5.26
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
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
931951	AB1-107 1	23.8
931961	AB1-107 2	52.22
925751	AC1-051 C	0.5
925752	AC1-051 E	3.32
926941	AC1-181	0.32

Appendix 7

(FE - FE) The 02BEAVER-02BLKRVR 138 kV line (from bus 238570 to bus 239728 ckt 1) loads from 108.04% to 112.68% (**DC power flow**) of its emergency rating (387 MVA) for the tower line contingency outage of 'ATSI-P7-1-OEC-345-001'. This project contributes approximately 39.74 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
238564	02BAYSG1	7.52
238572	02BEAVGB	2.36
240968	02BG2 GEN	0.38
240969	02BG4 G1	0.09
240970	02BG4 G2&3	0.19
240971	02BG4 G4&5	0.19
240950	02BG5	1.15
240973	02BG6 AMPO	1.68
239276	02COLLW 11	-1.55
239297	02CPPW41	-1.94
240975	02PGE GEN	2.6
239175	02WLORG-6	3.75
932791	AC2-103 C	3.07
932792	AC2-103 E	20.57
934251	AD1-052 C1	0.42
934261	AD1-052 C2	0.42
934761	AD1-103 C O1	5.17
934762	AD1-103 E O1	34.58
934891	AD1-118	3.66
LTF	CARR	0.71
LTF	CBM-S1	3.09

Bus Number	Bus Name	Full Contribution
LTF	CBM-S2	1.24
LTF	CBM-W1	25.75
LTF	CBM-W2	21.89
LTF	CIN	3.52
LTF	CPLE	0.21
LTF	G-007	0.94
LTF	IPL	2.27
LTF	LGEE	0.64
LTF	MEC	6.97
LTF	MECS	13.53
LTF	O-066	3.21
LTF	RENSSELAER	0.55
LTF	ROSETON	4
LTF	WEC	1.12
907062	X1-027A E1	8.64
907065	X1-027A E2	8.64
907067	X1-027A E3	8.64
907069	X1-027A E4	8.64
LTF	Y3-032	11.29
931951	AB1-107 1	14.7
931961	AB1-107 2	32.02

Appendix 8

(FE - FE) The 02BLKRVR-02USSTEEL 138 kV line (from bus 239728 to bus 239734 ckt 1) loads from 105.27% to 111.18% (**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 65.52 MW to the thermal violation.

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

Bus Number	Bus Name	Full Contribution
LTF	CPLE	0.37
LTF	G-007	1.55
LTF	IPL	3.76
LTF	LGEE	1.07
LTF	MEC	11.55

Bus Number	Bus Name	Full Contribution
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	0.67
934261	AD1-052 C2	0.67
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
LTF	CARR	1.22
LTF	CBM-S1	5.17
LTF	CBM-S2	2.13
LTF	CBM-W1	42.35
LTF	CBM-W2	36.44
LTF	CIN	5.84

Bus Number	Bus Name	Full Contribution
LTF	MECS	22.11
LTF	O-066	5.26
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
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
931951	AB1-107 1	23.8
931961	AB1-107 2	52.22
925751	AC1-051 C	0.5
925752	AC1-051 E	3.32
926941	AC1-181	0.32

Attachment 1. Flowgate Details – Option 2

Appendices

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 98.01% to 104.96% (**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 48.72 MW to the thermal violation.

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	0.49
934261	AD1-052 C2	0.49
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

Bus Number	Bus Name	Full Contribution
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
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

Bus Number	Bus Name	Full Contribution
LTF	CARR	0.9
LTF	CBM-S1	3.88
LTF	CBM-S2	1.64
LTF	CBM-W1	31.44

Bus Number	Bus Name	Full Contribution
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 88.66% to 99.89% (**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 138.98 MW to the thermal violation.

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	1.02
934261	AD1-052 C2	1.02
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

Bus Number	Bus Name	Full Contribution
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
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

Bus Number	Bus Name	Full Contribution
LTF	CBM-S2	2.4
LTF	CBM-W1	73.96
LTF	CBM-W2	55.9
LTF	CIN	9.16
LTF	CPLE	0.34

Bus Number	Bus Name	Full Contribution
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 93.14% to 103.87% (**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 175.44 MW to the thermal violation.

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	1.27
934261	AD1-052 C2	1.27
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

Bus Number	Bus Name	Full Contribution
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
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

Bus Number	Bus Name	Full Contribution
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

Bus Number	Bus Name	Full Contribution
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 98.01% to 104.96% (**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 48.72 MW to the thermal violation.

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	0.49
934261	AD1-052 C2	0.49
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

Bus Number	Bus Name	Full Contribution
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
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

(FE - AEP) The 02W.FREM-05FRMNT 138 kV line (from bus 239154 to bus 243009 ckt 1) loads from 96.05% to 99.86% (**DC power flow**) of its emergency rating (361 MVA) for the line fault with failed breaker contingency outage of 'AEP_P4_#517'. This project contributes approximately 30.17 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
238564	02BAYSG1	10.61
240968	02BG2 GEN	0.5
240969	02BG4 G1	0.13
240970	02BG4 G2&3	0.26
240971	02BG4 G4&5	0.26
240950	02BG5	1.55
240973	02BG6 AMPO	2.28
238601	02FRMENG 1	7.55
238602	02FRMENG 2	7.55
238603	02FRMENG 3	13.64
238979	02NAPMUN	1.97
240975	02PGE GEN	3.51
932791	AC2-103 C	1.97
932792	AC2-103 E	13.2
934251	AD1-052 C1	1.38
934261	AD1-052 C2	1.38
934761	AD1-103 C O2	3.92
934762	AD1-103 E O2	26.25
934891	AD1-118	4.28
LTF	AMIL	0.12
LTF	BAYOU	0.53
LTF	BIG_CAJUN1	0.83
LTF	BIG_CAJUN2	1.67
LTF	BLUEG	1.27
LTF	CALDERWOOD	0.32
LTF	CANNELTON	0.19
LTF	CATAWBA	0.19
LTF	CBM-N	0.11
LTF	CBM-W1	10.17
LTF	CELEVELAND	0.54
LTF	CHEOAH	0.29
LTF	CHILHOWEE	0.1

Bus Number	Bus Name	Full Contribution
LTF	CHOCTAW	0.57
LTF	CLIFTY	5.98
LTF	COTTONWOOD	2.09
LTF	EDWARDS	0.13
LTF	ELMERSMITH	0.54
LTF	FARMERCITY	0.12
LTF	G-007A	0.06
LTF	GIBSON	0.34
LTF	HAMLET	0.57
LTF	MECS	12.41
LTF	MORGAN	0.95
LTF	NEWTON	0.61
LTF	NYISO	1.6
LTF	O-066A	0.04
LTF	PRAIRIE	1.14
LTF	ROWAN	0.37
LTF	SANTEETLA	0.09
LTF	SMITHLAND	0.11
LTF	TATANKA	0.19
LTF	TILTON	0.25
LTF	TRIMBLE	0.25
LTF	TVA	0.43
LTF	UNIONPOWER	0.41
LTF	VFT	0.19
907062	X1-027A E1	5.54
907065	X1-027A E2	5.54
907067	X1-027A E3	5.54
907069	X1-027A E4	5.54
LTF	X1-078	0.05
LTF	Y3-032	11.89
931951	AB1-107 1	20.61
931961	AB1-107 2	36.88

Appendix 6

(FE - FE) The 02USSTEEL-02LRN Q2 138 kV line (from bus 239734 to bus 238915 ckt 1) loads from 98.97% to 104.94% (**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 66.15 MW to the thermal violation.

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	0.67
934261	AD1-052 C2	0.67
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

Bus Number	Bus Name	Full Contribution
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
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
931951	AB1-107 1	23.8
931961	AB1-107 2	52.22
925751	AC1-051 C	0.5
925752	AC1-051 E	3.32
926941	AC1-181	0.32

Appendix 7

(FE - FE) The 02BEAVER-02BLKRVR 138 kV line (from bus 238570 to bus 239728 ckt 1) loads from 108.02% to 112.72% (**DC power flow**) of its emergency rating (387 MVA) for the tower line contingency outage of 'ATSI-P7-1-OEC-345-001'. This project contributes approximately 40.3 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
238564	02BAYSG1	7.51
238572	02BEAVGB	2.36
240968	02BG2 GEN	0.38
240969	02BG4 G1	0.09
240970	02BG4 G2&3	0.19
240971	02BG4 G4&5	0.19
240950	02BG5	1.15
240973	02BG6 AMPO	1.68
239276	02COLLW 11	-1.55
239297	02CPPW41	-1.94
240975	02PGE GEN	2.6
239175	02WLORG-6	3.75
932791	AC2-103 C	3.07
932792	AC2-103 E	20.57
934251	AD1-052 C1	0.42
934261	AD1-052 C2	0.42
934761	AD1-103 C O2	5.24
934762	AD1-103 E O2	35.06
934891	AD1-118	3.66
LTF	CARR	0.71
LTF	CBM-S1	3.09

Bus Number	Bus Name	Full Contribution
LTF	CBM-S2	1.24
LTF	CBM-W1	25.76
LTF	CBM-W2	21.89
LTF	CIN	3.52
LTF	CPLE	0.21
LTF	G-007	0.94
LTF	IPL	2.27
LTF	LGEE	0.64
LTF	MEC	6.97
LTF	MECS	13.53
LTF	O-066	3.21
LTF	RENSSELAER	0.55
LTF	ROSETON	4
LTF	WEC	1.13
907062	X1-027A E1	8.64
907065	X1-027A E2	8.64
907067	X1-027A E3	8.64
907069	X1-027A E4	8.64
LTF	Y3-032	11.3
931951	AB1-107 1	14.7
931961	AB1-107 2	32.02

Appendix 8

(FE - FE) The 02BLKRVR-02USSTEEL 138 kV line (from bus 239728 to bus 239734 ckt 1) loads from 105.27% to 111.24% (**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 66.15 MW to the thermal violation.

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

Bus Number	Bus Name	Full Contribution
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

Bus Number	Bus Name	Full Contribution
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	0.67
934261	AD1-052 C2	0.67
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

Bus Number	Bus Name	Full Contribution
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
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
931951	AB1-107 1	23.8
931961	AB1-107 2	52.22
925751	AC1-051 C	0.5
925752	AC1-051 E	3.32
926941	AC1-181	0.32