

***Generation Interconnection  
Feasibility Study Report***

***For***

***PJM Generation Interconnection Request  
Queue Position AE1-144***

***Goddard-Plumville 138 kV***

**May 2019**

## 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), has proposed a solar / battery storage generating facility located in Flemingsburg, KY. The installed facilities will have a total capability of 120 MW with 80.2 MW of this output being recognized by PJM as capacity. The capacity & energy rights are associated with the solar generating facility only. The proposed in-service date for this project is June 1, 2022. **This study does not imply a EKPC commitment to this in-service date.**

## Point of Interconnection

AE1-144 will interconnect with the EKPC transmission system along one of the following points of interconnection:

1. Along the Goddard - Plumville 138kV line
2. At the Goddard 138kV switchyard

## Cost Summary

The AE1-144 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	\$ 0
Direct Connection Network Upgrades	\$ 5,270,000
Non Direct Connection Network Upgrades	\$ 100,000
<b>Total Costs</b>	<b>\$ 5,370,000</b>

In addition, the AE1-144 project may be responsible for a contribution to the following costs:

<b>Description</b>	<b>Total Cost</b>
System Upgrades	\$ 23,248,000

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.

<b>Description</b>	<b>Total Cost</b>
Build 138kv switching station near Mt. Carmel, KY including associated transmission line work. Preliminary TOL Provided Estimated Time to Construct: 24 months	\$ 5,270,000
<b>Total Direct Connection Facility Costs</b>	<b>\$ 5,270,000</b>

## **Non-Direct Connection Cost Estimate**

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

<b>Description</b>	<b>Total Cost</b>
Adjust remote, relaying, and metering settings at the Goddard 138 kV switchyard	\$ 50,000
Adjust remote, relaying, and metering settings at the Plumville 138 kV switchyard	\$ 50,000
<b>Total Non-Direct Connection Facility Costs</b>	<b>\$ 100,000</b>

## **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.

## **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.

### **EKPC Requirements**

The Interconnection Customer will be required to comply with all EKPC Revenue Metering Requirements for Generation Interconnection Customers. The Revenue Metering Requirements may be found within the "EKPC Facility Connection Requirements" document located at the following link:

<http://www.pjm.com/planning/design-engineering/to-tech-standards/ekpc.aspx>

# Network Impacts

## Option 1

The Queue Project AE1-144 was evaluated as a 120 MW (Capacity 80.2 MW) injection tapping the Goddard to Plumville 138 kV line in the EKPC area. Project AE1-144 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AE1-144 was studied with a commercial probability of 53%. Potential network impacts were as follows:

## Summer Peak Analysis – 2022

### Contingency Descriptions

The following contingencies resulted in overloads:

Contingency Name	Contingency Definition
DEO&K-DAY-EKPC.C5 4541MELDAHLSRPLCKSTUARTSPURLOC KDPLEK	CONTINGENCY 'DEO&K-DAY-EKPC.C5 4541MELDAHLSRPLCKSTUARTSPURLOCKDPLEK' OPEN BRANCH FROM BUS 342838 TO BUS 249581 CKT 1 OPEN BRANCH FROM BUS 253077 TO BUS 342838 CKT 1 END
.345.DEO&K-DAY.C5 4511HILLCRESTSTUARTCLINTONSTUART DPL-A	CONTINGENCY '.345.DEO&K-DAY.C5 4511HILLCRESTSTUARTCLINTONSTUARTDPL-A' OPEN BRANCH FROM BUS 253077 TO BUS 249578 CKT 1 OPEN BRANCH FROM BUS 926060 TO BUS 253077 CKT 1 END
.138.DEO&K.C2 816_SILVERGROVE	CONTINGENCY '.138.DEO&K.C2 816_SILVERGROVE' OPEN BRANCH FROM BUS 249573 TO BUS 250097 CKT 1 OPEN BRANCH FROM BUS 249988 TO BUS 250097 CKT 1 OPEN BRANCH FROM BUS 250042 TO BUS 250097 CKT 1 OPEN BRANCH FROM BUS 250052 TO BUS 250097 CKT 1 OPEN BRANCH FROM BUS 250053 TO BUS 250097 CKT 1 OPEN BRANCH FROM BUS 249571 TO BUS 249573 CKT 1 OPEN BRANCH FROM BUS 249573 TO BUS 249577 CKT 1 END
.345.DEO&K.B2 RED BANK-SG-ZIMMER 4545	CONTINGENCY '.345.DEO&K.B2 RED BANK-SG-ZIMMER 4545' OPEN BRANCH FROM BUS 249573 TO BUS 249577 CKT 1 OPEN BRANCH FROM BUS 249573 TO BUS 250097 CKT 1 OPEN BRANCH FROM BUS 249571 TO BUS 249573 CKT 1 END

Contingency Name	Contingency Definition
<b>DAY_P7_BEATTY-S. CHARLESTON 34542_1</b>	CONTINGENCY 'DAY_P7_BEATTY-S. CHARLESTON 34542_1' OPEN BRANCH FROM BUS 243453 TO BUS 253110 CKT 1 / 243453 05BEATTY 345 253110 09ADKINS 345 1 OPEN BRANCH FROM BUS 243453 TO BUS 253248 CKT 1 / 243453 05BEATTY 345 253248 09SCHARL 345 1 END
<b>EKPC_P1-2_SPUR-STU345</b>	CONTINGENCY 'EKPC_P1-2_SPUR-STU345' /* SPURLOCK - STUART OPEN BRANCH FROM BUS 253077 TO BUS 342838 CKT 1 /* 253077 09STUART 345.00 342838 7SPURLOCK 345.00 END
<b>Base Case</b>	
<b>.345.DEO&amp;K.C2 1493_RED BANK</b>	CONTINGENCY '.345.DEO&K.C2 1493_RED BANK' OPEN BRANCH FROM BUS 249571 TO BUS 249573 CKT 1 OPEN BRANCH FROM BUS 249573 TO BUS 250097 CKT 1 OPEN BRANCH FROM BUS 249573 TO BUS 249577 CKT 1 OPEN BRANCH FROM BUS 249571 TO BUS 250092 CKT 1 END
<b>DAY_P4_STUART_HH</b>	CONTINGENCY 'DAY_P4_STUART_HH' OPEN LINE FROM BUS 253077 TO BUS 342838 CKT 1 / 253077 09STUART 345 342838 7SPURLOCK 345 1 OPEN LINE FROM BUS 253077 TO BUS 253076 CKT 1 / 253077 09STUART 345 253076 09STUART 138 1 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)

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CK T ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADIN G %	POST PROJECT LOADIN G %	AC D C	MW IMPAC T
11823 2	25303 8	09KILLE N	DAY	24293 8	05MARQ UI	AEP	1	.345.DEO&K-DAY.C5 4511HILLCRESTSTUARTCLINTONSTUART DPL-A	towe r	1372. 0	99.03	99.72	DC	20.96
71987 9	25303 8	09KILLE N	DAY	24293 8	05MARQ UI	AEP	1	.345.DEO&K-DAY.C5 4511HILLCRESTSTUARTCLINTONSTUART DPL-A	towe r	1372. 0	99.03	99.72	DC	20.96
11827 3	34255 9	4BOON E CO	EKPC	25005 4	08LONGB R	DEO& K	1	DEO&K-DAY-EKPC.C5 4541MELDAHLSRCLCKSTUARTSPURLOCK DPLEK	towe r	284.0	93.55	98.12	DC	13.0

Note: Please see 0 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)

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CK T ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADIN G %	POST PROJECT LOADIN G %	AC D C	MW IMPAC T
71839 9	24694 6	05WLDC A T	AEP	24301 9	05HILLS B	AEP	1	DAY_P4_STUART_HH	break er	185.0	118.08	120.01	DC	7.95
71963 4	24694 6	05WLDC A T	AEP	24301 9	05HILLS B	AEP	1	DEO&K-DAY-EKPC.C5 4541MELDAHLSRCLCKSTUARTSPURLOCK DPLEK	tower	185.0	144.97	147.81	DC	11.65
11823 1	25303 8	09KILLE N	DAY	24293 8	05MARQ UI	AEP	1	DAY_P7_BEATTY-S. CHARLESTON 34542_1	tower	1372. 0	105.99	106.65	DC	19.93
71987 8	25303 8	09KILLE N	DAY	24293 8	05MARQ UI	AEP	1	DAY_P7_BEATTY-S. CHARLESTON 34542_1	tower	1372. 0	105.99	106.65	DC	19.93
11702 7	34283 8	7SPURLO CK	EKPC	25307 7	09STUAR T	DAY	1	.138.DEO&K.C2 816_SILVERGROVE	break er	1421. 0	110.02	113.5	DC	48.2
11702 8	34283 8	7SPURLO CK	EKPC	25307 7	09STUAR T	DAY	1	.345.DEO&K.C2 1493_RED BANK	break er	1421. 0	109.9	113.38	DC	48.17
11774 7	34283 8	7SPURLO CK	EKPC	25307 7	09STUAR T	DAY	1	.345.DEO&K.B2 RED BANK-SG-ZIMMER 4545	single	1421. 0	109.65	112.0	DC	32.19
11774 8	34283 8	7SPURLO CK	EKPC	25307 7	09STUAR T	DAY	1	Base Case	single	1240. 0	105.18	107.66	DC	29.85

Note: Please see 0 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.

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.

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC DC	MW IMPACT
719221	246946	05WLDCAT	AEP	243019	05HILLSB	AEP	1	EKPC_P1-2_SPUR-STU345	operation	185.0	117.54	119.48	DC	7.96
117746	342838	7SPURLOCK	EKPC	253077	09STUART	DAY	1	.345.DEO&K.B2 RED BANK-SG-ZIMMER 4545	operation	1421.0	109.84	113.32	DC	48.17
117749	342838	7SPURLOCK	EKPC	253077	09STUART	DAY	1	Base Case	operation	1240.0	103.43	107.09	DC	44.66

## System Reinforcements

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

ID	Index	Facility	Upgrade Description	Cost
719634,718399	3	05WLDCAT 138.0 kV - 05HILLSB 138.0 kV Ckt 1	<b>AEP</b> Description : Rebuild / reconductor 10 miles of ACSR ~ 477 ~ 26/7 ~ HAWK- Conductor Section 1. Estimated cost: \$15 million. Time Estimate : 24-36 Months Cost : \$15,000,000	\$15,000,000
118232,719879,719878,118231	1	09KILLEN 345.0 kV - 05MARQUI 345.0 kV Ckt 1	<b>AEP</b> Description : 1) A Sag Study will be required on the 32 miles of ACAR ~ 983.1 ~ 30/7 ~ RAIL5 - Conductor Section 1 to mitigate the overload. Depending on the sag study results, the cost for this upgrade is expected to be between \$128,00 (no remediations required, just sag study) and \$64 million (complete line reconductor/rebuild). New rating after sag study: S/N:1414 S/E: 1764. Time Estimate: a) Sag Study: 6-12 months b) Rebuild: The standard time required for	\$248,000

			<p>construction differs from state to state. An approximate construction time would be 24 to 36 months after signing an interconnection agreement.  Time Estimate : 6-12 Months  Cost : \$128,000</p> <p><b>DAY</b>  Description : Replace the wave trap at Killen station with a 3000A wave trap.  Time Estimate : 9.0 Months  Cost : \$120,000</p>	
118273	2	<b>4BOONE CO 138.0 kV - 08LONGBR 138.0 kV Ckt 1</b>	<p><b>EKPC</b>  Description : No Violation. EKPC emergency rating 284 MVA</p>	\$0
117748,117027,117028,117747	4	<b>7SPURLOCK 345.0 kV - 09STUART 345.0 kV Ckt 1</b>	<p><b>DAY</b>  Description : Dayton will upgrade the conductor on its section of the line with bundled 954 MCM 54x7 ACSS rated at 300F  Time Estimate : 20.0 Months  Cost : \$8,000,000</p> <p><b>EKPC</b>  Description : No Violation. EKPC emergency rating 1792 MVA</p>	\$8,000,000
			<b>TOTAL COST</b>	<b>\$23,248,000</b>

# Network Impacts

## Option 2

The Queue Project AE1-144 was evaluated as a 120 MW (Capacity 80.2 MW) injection at the Goddard 138 kV substation in the EKPC area. Project AE1-144 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AE1-144 was studied with a commercial probability of 53%. Potential network impacts were as follows:

## Summer Peak Analysis – 2022

### Contingency Descriptions

The following contingencies resulted in overloads:

Contingency Name	Contingency Definition
DEO&K-DAY-EKPC.C5 4541MELDAHLSRCLKSTUARTSPURLOCK KDPLEK	CONTINGENCY 'DEO&K-DAY-EKPC.C5 4541MELDAHLSRCLKSTUARTSPURLOCKDPLEK' OPEN BRANCH FROM BUS 342838 TO BUS 249581 CKT 1 OPEN BRANCH FROM BUS 253077 TO BUS 342838 CKT 1 END
.138.DEO&K.C2 816_SILVERGROVE	CONTINGENCY '.138.DEO&K.C2 816_SILVERGROVE' OPEN BRANCH FROM BUS 249573 TO BUS 250097 CKT 1 OPEN BRANCH FROM BUS 249988 TO BUS 250097 CKT 1 OPEN BRANCH FROM BUS 250042 TO BUS 250097 CKT 1 OPEN BRANCH FROM BUS 250052 TO BUS 250097 CKT 1 OPEN BRANCH FROM BUS 250053 TO BUS 250097 CKT 1 OPEN BRANCH FROM BUS 249571 TO BUS 249573 CKT 1 OPEN BRANCH FROM BUS 249573 TO BUS 249577 CKT 1 END
.345.DEO&K.B2 RED BANK-SG-ZIMMER 4545	CONTINGENCY '.345.DEO&K.B2 RED BANK-SG-ZIMMER 4545' OPEN BRANCH FROM BUS 249573 TO BUS 249577 CKT 1 OPEN BRANCH FROM BUS 249573 TO BUS 250097 CKT 1 OPEN BRANCH FROM BUS 249571 TO BUS 249573 CKT 1 END
DAY_P7_BEATTY-S. CHARLESTON 34542_1	CONTINGENCY 'DAY_P7_BEATTY-S. CHARLESTON 34542_1' OPEN BRANCH FROM BUS 243453 TO BUS 253110 CKT 1 / 243453 05BEATTY 345 253110 09ADKINS 345 1 OPEN BRANCH FROM BUS 243453 TO BUS 253248 CKT 1 / 243453 05BEATTY 345 253248 09SCHARL 345 1 END
EKPC_P1-2_SPUR-STU345	CONTINGENCY 'EKPC_P1-2_SPUR-STU345' /* SPURLOCK - STUART OPEN BRANCH FROM BUS 253077 TO BUS 342838 CKT 1 /* 253077 09STUART 345.00 342838 7SPURLOCK 345.00 END
Base Case	

Contingency Name	Contingency Definition
.345.DEO&K.C2 1493_RED BANK	CONTINGENCY '.345.DEO&K.C2 1493_RED BANK' OPEN BRANCH FROM BUS 249571 TO BUS 249573 CKT 1 OPEN BRANCH FROM BUS 249573 TO BUS 250097 CKT 1 OPEN BRANCH FROM BUS 249573 TO BUS 249577 CKT 1 OPEN BRANCH FROM BUS 249571 TO BUS 250092 CKT 1 END
DAY_P4_STUART_HH	CONTINGENCY 'DAY_P4_STUART_HH' OPEN LINE FROM BUS 253077 TO BUS 342838 CKT 1 / 253077 09STUART 345 342838 7SPURLOCK 345 1 OPEN LINE FROM BUS 253077 TO BUS 253076 CKT 1 / 253077 09STUART 345 253076 09STUART 138 1 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)

None

### Contribution to Previously Identified Overloads

(This project contributes to the following contingency overloads, i.e. "Network Impacts", identified for earlier generation or transmission interconnection projects in the PJM Queue)

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJE CT LOADIN G %	POST PROJE CT LOADIN G %	AC D C	MW IMPAC T
70582 1	24694 6	05WLDCA T	AEP	24301 9	05HILLSB	AEP	1	DAY_P4_STUART_HH	break er	185.0	118.08	120.08	DC	8.21
70700 2	24694 6	05WLDCA T	AEP	24301 9	05HILLSB	AEP	1	DEO&K-DAY-EKPC.C5 4541MELDAHLSRCLCKSTUARTSPURLOCK DPLEK	tower	185.0	144.97	147.82	DC	11.68
97150	25303 8	09KILLEN	DAY	24293 8	05MARQ UI	AEP	1	DAY_P7_BEATTY-S. CHARLESTON 34542_1	tower	1372.0	105.99	106.61	DC	18.77
70720 2	25303 8	09KILLEN	DAY	24293 8	05MARQ UI	AEP	1	DAY_P7_BEATTY-S. CHARLESTON 34542_1	tower	1372.0	105.99	106.61	DC	18.77
96153	34283 8	7SPURLO CK	EKPC	25307 7	09STUAR T	DAY	1	.138.DEO&K.C2 816_SILVERGROVE	break er	1421.0	110.02	113.29	DC	45.27
96154	34283 8	7SPURLO CK	EKPC	25307 7	09STUAR T	DAY	1	.345.DEO&K.C2 1493_RED BANK	break er	1421.0	109.91	113.18	DC	45.23
96772	34283 8	7SPURLO CK	EKPC	25307 7	09STUAR T	DAY	1	.345.DEO&K.B2 RED BANK-SG-ZIMMER 4545	single	1421.0	109.65	111.86	DC	30.23
96773	34283 8	7SPURLO CK	EKPC	25307 7	09STUAR T	DAY	1	Base Case	single	1240.0	105.17	107.51	DC	28.04

Note: Please see 0 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.*

*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.*

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC DC	MW IMPACT
706589	246946	05WLDCAT	AEP	243019	05HILLSB	AEP	1	EKPC_P1-2_SPUR-STU345	operation	185.0	117.54	119.54	DC	8.22
96771	342838	7SPURLOCK	EKPC	253077	09STUART	DAY	1	.345.DEO&K.B2 RED BANK-SG-ZIMMER 4545	operation	1421.0	109.84	113.11	DC	45.23
96774	342838	7SPURLOCK	EKPC	253077	09STUART	DAY	1	Base Case	operation	1240.0	103.42	106.87	DC	41.96

## Attachment 2. Flowgate Details – Option 1

### 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 gauge 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.

### Index 1

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC DC	MW IMPACT
719878	253038	09KILLEN	DAY	242938	05MARQUI	AEP	1	DAY_P7_BEATTY-S. CHARLESTON 34542_1	tower	1372.0	105.99	106.65	DC	19.93

Bus #	Bus	MW Impact
253038	09KILLEN	298.68
253077	09STUART	479.37
902531	W2-040 C	0.7
902532	W2-040 E	1.14
904722	V4-073 E	0.15
913222	Y1-054 E	1.78
914372	Y2-111 E	1.13
915582	Y3-080 E	0.75
915662	Y3-099 E	0.16
915672	Y3-100 E	0.16
916182	Z1-065 E	0.54
916272	Z1-080 E	0.47
918802	AA1-099 E	0.31
925242	AB2-178 E	1.57
925921	AC1-068 C	7.93
925922	AC1-068 E	3.71
925931	AC1-069 C	7.93
925932	AC1-069 E	3.71
925981	AC1-074 C O1	7.05
925982	AC1-074 E O1	3.02
926061	AC1-085 C O1	34.63
926062	AC1-085 E O1	56.51
926101	AC1-089 C O1	4.37

<b>Bus #</b>	<b>Bus</b>	<b>MW Impact</b>
926102	AC1-089 E O1	7.12
926691	AC1-152	3.35
926791	AC1-165 C	7.84
926792	AC1-165 E	3.8
926801	AC1-166 C	7.84
926802	AC1-166 E	3.8
926851	AC1-172	3.35
930062	AB1-014 E	13.66
931181	AB1-169	301.91
932462	AC2-066 E	0.44
932481	AC2-068 C	2.36
932482	AC2-068 E	3.87
932551	AC2-075 C	1.68
932552	AC2-075 E	0.84
932661	AC2-088 C O1	7.59
932662	AC2-088 E O1	6.25
932841	AC2-111 C O1	2.05
932842	AC2-111 E O1	3.34
935011	AD1-134	7.7
935031	AD1-136 C	1.07
935032	AD1-136 E	0.91
935041	AD1-140 C O1	7.35
935042	AD1-140 E O1	6.08
936251	AD2-031 C O1	2.31
936252	AD2-031 E O1	3.77
936281	AD2-036 C	5.04
936282	AD2-036 E	2.52
936381	AD2-048 C	5.6
936382	AD2-048 E	2.79
936571	AD2-072 C O1	4.98
936572	AD2-072 E O1	2.44
937111	AD2-147 C O1	4.66
937112	AD2-147 E O1	6.43
937151	AD2-151 C O1	7.56
937152	AD2-151 E O1	10.44
938051	AE1-007 C	0.68
938052	AE1-007 E	1.11
938061	AE1-008 C	0.51
938062	AE1-008 E	0.84
938271	AE1-040 C O1	2.57
938272	AE1-040 E O1	1.29
938921	AE1-120	7.76
939141	AE1-144 C O1	13.32
939142	AE1-144 E O1	6.61
940091	AE1-251 C O1	7.38
940092	AE1-251 E O1	4.92
CARR	CARR	0.46
CATAWBA	CATAWBA	0.06
CBM-S1	CBM-S1	8.57
CBM-W1	CBM-W1	10.21
CBM-W2	CBM-W2	57.11
CIN	CIN	9.11
G-007	G-007	1.34
HAMLET	HAMLET	0.41
IPL	IPL	6.22
LGEE	LGEE	3.97

<b>Bus #</b>	<b>Bus</b>	<b>MW Impact</b>
MEC	MEC	10.03
MECS	MECS	3.88
O-066	O-066	4.51
RENSSELAER	RENSSELAER	0.37
WEC	WEC	1.37

## Index 2

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CK T ID	CONT NAME	Type	Rating MVA	PRE PROJE CT LOADIN G %	POST PROJE CT LOADIN G %	AC D C	MW IMPAC T
118273	342559	4BOON E CO	EKPC	250054	08LONGB R	DEO& K	1	DEO&K-DAY-EKPC.C5 4541MELDAHLSRPLCKSTUARTSPURLOCK DPLEK	tower	284.0	93.55	98.12	DC	13.0

Bus #	Bus	MW Impact
342957	1SPURLK1G	5.65
342960	1SPURLK2G	8.85
342963	1SPURLK3G	4.65
342966	1SPURLK4G	4.65
925981	AC1-074 C O1	9.17
925982	AC1-074 E O1	3.93
932551	AC2-075 C	2.18
932552	AC2-075 E	1.1
935011	AD1-134	5.07
936281	AD2-036 C	6.55
936282	AD2-036 E	3.27
936381	AD2-048 C	5.97
936382	AD2-048 E	2.98
936571	AD2-072 C O1	3.35
936572	AD2-072 E O1	1.64
939141	AE1-144 C O1	8.69
939142	AE1-144 E O1	4.31
940091	AE1-251 C O1	7.91
940092	AE1-251 E O1	5.27
CARR	CARR	0.05
CBM-S1	CBM-S1	4.35
CBM-S2	CBM-S2	0.84
CBM-W1	CBM-W1	0.16
CBM-W2	CBM-W2	15.92
CIN	CIN	1.18
CPLE	CPLE	0.25
DEARBORN	DEARBORN	0.24
G-007	G-007	0.12
IPL	IPL	0.5
LGEE	LGEE	1.78
MEC	MEC	1.41
O-066	O-066	0.4
RENSSELAER	RENSSELAER	0.04
WEC	WEC	0.05

### Index 3

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CK T ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADIN G %	POST PROJECT LOADIN G %	AC D C	MW IMPAC T
719634	246946	05WLDCA T	AEP	243019	05HILLS B	AEP	1	DEO&K-DAY-EKPC.C5 4541MELDAHLSRCLCKSTUARTSPURLOCK DPLEK	tower	185.0	144.97	147.81	DC	11.65

Bus #	Bus	MW Impact
916272	Z1-080 E	0.56
918802	AA1-099 E	0.37
925981	AC1-074 C O1	3.22
925982	AC1-074 E O1	1.38
926101	AC1-089 C O1	38.83
926102	AC1-089 E O1	63.35
932551	AC2-075 C	0.76
932552	AC2-075 E	0.38
936281	AD2-036 C	2.3
936282	AD2-036 E	1.15
936381	AD2-048 C	4.0
936382	AD2-048 E	1.99
939141	AE1-144 C O1	7.78
939142	AE1-144 E O1	3.86
940091	AE1-251 C O1	4.11
940092	AE1-251 E O1	2.74
CARR	CARR	0.06
CBM-S1	CBM-S1	2.91
CBM-S2	CBM-S2	0.5
CBM-W1	CBM-W1	0.9
CBM-W2	CBM-W2	13.2
CIN	CIN	1.29
CPLE	CPLE	0.14
DEARBORN	DEARBORN	0.12
G-007	G-007	0.14
IPL	IPL	0.72
LGEE	LGEE	1.12
MEC	MEC	1.6
O-066	O-066	0.49
RENSSELAER	RENSSELAER	0.04
WEC	WEC	0.14

## Index 4

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC DC	MW IMPACT
117028	342838	7SPURLOCK	EKPC	253077	09STUART	DAY	1	.345.DEO&K.C2 1493_RED BANK	breaker	1421.0	109.9	113.38	DC	48.17

Bus #	Bus	MW Impact
251968	08ZIMRHP	42.07
251969	08ZIMRLP	23.04
251970	08MELDL1	2.13
251971	08MELDL2	2.13
251972	08MELDL3	2.14
342957	1SPURLK1G	22.01
342960	1SPURLK2G	41.69
342963	1SPURLK3G	21.91
342966	1SPURLK4G	21.91
925981	AC1-074 C O1	15.33
925982	AC1-074 E O1	6.57
926101	AC1-089 C O1	4.76
926102	AC1-089 E O1	7.76
926951	AC1-182	1.0
932551	AC2-075 C	3.64
932552	AC2-075 E	1.83
935011	AD1-134	17.51
936281	AD2-036 C	10.95
936282	AD2-036 E	5.48
936381	AD2-048 C	11.99
936382	AD2-048 E	5.98
936571	AD2-072 C O1	9.67
936572	AD2-072 E O1	4.74
936821	AD2-105 C O1	4.67
936822	AD2-105 E O1	6.45
936831	AD2-106 C O1	2.84
936832	AD2-106 E O1	3.93
936841	AD2-107 C O1	2.24
936842	AD2-107 E O1	3.1
939131	AE1-143 C	7.18
939132	AE1-143 E	3.55
939141	AE1-144 C O1	32.19
939142	AE1-144 E O1	15.98
940091	AE1-251 C O1	14.88
940092	AE1-251 E O1	9.92
AE1-042	AE1-042	5.9
CARR	CARR	0.5
CBM-S1	CBM-S1	13.83
CBM-S2	CBM-S2	1.93
CBM-W1	CBM-W1	4.06
CBM-W2	CBM-W2	66.38
CIN	CIN	7.17

<b>Bus #</b>	<b>Bus</b>	<b>MW Impact</b>
CPLE	CPLE	0.42
DEARBORN	DEARBORN	0.91
G-007	G-007	1.34
IPL	IPL	4.34
LGEE	LGEE	5.21
MEC	MEC	8.05
O-066	O-066	4.53
RENSSELAER	RENSSELAER	0.39
WEC	WEC	0.71

## Attachment 3. Flowgate Details – Option 2

### Index 1

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CK T ID	CONT NAME	Type	Rating MVA	PRE PROJE CT LOADIN G %	POST PROJE CT LOADIN G %	AC D C	MW IMPAC T
707002	246946	05WLDCA T	AEP	243019	05HILLS B	AEP	1	DEO&K-DAY-EKPC.C5 4541MELDAHLSRCLCKSTUARTSPURLOCK DPLEK	tower	185.0	144.97	147.82	DC	11.68

Bus #	Bus	MW Impact
916272	Z1-080 E	0.56
918802	AA1-099 E	0.37
925981	AC1-074 C O1	3.22
925982	AC1-074 E O1	1.38
926101	AC1-089 C O1	38.83
926102	AC1-089 E O1	63.35
932551	AC2-075 C	0.76
932552	AC2-075 E	0.38
936281	AD2-036 C	2.3
936282	AD2-036 E	1.15
936381	AD2-048 C	4.0
936382	AD2-048 E	1.99
939141	AE1-144 C O2	7.81
939142	AE1-144 E O2	3.87
CARR	CARR	0.06
CBM-S1	CBM-S1	2.91
CBM-S2	CBM-S2	0.5
CBM-W1	CBM-W1	0.9
CBM-W2	CBM-W2	13.2
CIN	CIN	1.29
CPL	CPL	0.14
DEARBORN	DEARBORN	0.12
G-007	G-007	0.14
IPL	IPL	0.72
LGEE	LGEE	1.12
MEC	MEC	1.6
O-066	O-066	0.49
RENSSELAER	RENSSELAER	0.04
WEC	WEC	0.14

## Index 2

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC DC	MW IMPACT
707202	253038	09KILLEN	DAY	242938	05MARQUI	AEP	1	DAY_P7_BEATTY-S. CHARLESTON 34542_1	tower	1372.0	105.99	106.61	DC	18.77

Bus #	Bus	MW Impact
253038	09KILLEN	298.68
253077	09STUART	479.37
902531	W2-040 C	0.7
902532	W2-040 E	1.14
904722	V4-073 E	0.15
913222	Y1-054 E	1.78
914372	Y2-111 E	1.13
915582	Y3-080 E	0.75
915662	Y3-099 E	0.16
915672	Y3-100 E	0.16
916182	Z1-065 E	0.54
916272	Z1-080 E	0.47
918802	AA1-099 E	0.31
925242	AB2-178 E	1.57
925921	AC1-068 C	7.93
925922	AC1-068 E	3.71
925931	AC1-069 C	7.93
925932	AC1-069 E	3.71
925981	AC1-074 C O1	7.05
925982	AC1-074 E O1	3.02
926061	AC1-085 C O1	34.63
926062	AC1-085 E O1	56.51
926101	AC1-089 C O1	4.37
926102	AC1-089 E O1	7.12
926691	AC1-152	3.35
926791	AC1-165 C	7.84
926792	AC1-165 E	3.8
926801	AC1-166 C	7.84
926802	AC1-166 E	3.8
926851	AC1-172	3.35
930062	AB1-014 E	13.66
931181	AB1-169	301.91
932462	AC2-066 E	0.44
932481	AC2-068 C	2.36
932482	AC2-068 E	3.87
932551	AC2-075 C	1.68
932552	AC2-075 E	0.84
932661	AC2-088 C O1	7.59
932662	AC2-088 E O1	6.25
932841	AC2-111 C O1	2.05
932842	AC2-111 E O1	3.34
935011	AD1-134	7.7

<b>Bus #</b>	<b>Bus</b>	<b>MW Impact</b>
935031	AD1-136 C	1.07
935032	AD1-136 E	0.91
935041	AD1-140 C O1	7.35
935042	AD1-140 E O1	6.08
936251	AD2-031 C O1	2.31
936252	AD2-031 E O1	3.77
936281	AD2-036 C	5.04
936282	AD2-036 E	2.52
936381	AD2-048 C	5.6
936382	AD2-048 E	2.79
936571	AD2-072 C O1	4.98
936572	AD2-072 E O1	2.44
937111	AD2-147 C O1	4.66
937112	AD2-147 E O1	6.43
937151	AD2-151 C O1	7.56
937152	AD2-151 E O1	10.44
938051	AE1-007 C	0.68
938052	AE1-007 E	1.11
938061	AE1-008 C	0.51
938062	AE1-008 E	0.84
938271	AE1-040 C O2	2.68
938272	AE1-040 E O2	1.35
938921	AE1-120	7.76
939141	AE1-144 C O2	12.54
939142	AE1-144 E O2	6.23
940091	AE1-251 C O2	6.16
940092	AE1-251 E O2	4.11
CARR	CARR	0.46
CATAWBA	CATAWBA	0.07
CBM-S1	CBM-S1	8.57
CBM-W1	CBM-W1	10.2
CBM-W2	CBM-W2	57.09
CIN	CIN	9.1
G-007	G-007	1.34
HAMLET	HAMLET	0.41
IPL	IPL	6.22
LGEE	LGEE	3.97
MEC	MEC	10.03
MECS	MECS	3.88
O-066	O-066	4.52
RENSSELAER	RENSSELAER	0.37
WEC	WEC	1.37

## Index 3

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC DC	MW IMPACT
96154	342838	7SPURLOCK	EKPC	253077	09STUART	DAY	1	.345.DEO&K.C2 1493_RED BANK	breaker	1421.0	109.91	113.18	DC	45.23

Bus #	Bus	MW Impact
251968	08ZIMRHP	42.07
251969	08ZIMRLP	23.04
251970	08MELDL1	2.13
251971	08MELDL2	2.13
251972	08MELDL3	2.14
342957	1SPURLK1G	22.01
342960	1SPURLK2G	41.69
342963	1SPURLK3G	21.91
342966	1SPURLK4G	21.91
925981	AC1-074 C O1	15.33
925982	AC1-074 E O1	6.57
926101	AC1-089 C O1	4.76
926102	AC1-089 E O1	7.76
926951	AC1-182	1.0
932551	AC2-075 C	3.64
932552	AC2-075 E	1.83
935011	AD1-134	17.51
936281	AD2-036 C	10.95
936282	AD2-036 E	5.48
936381	AD2-048 C	11.99
936382	AD2-048 E	5.98
936571	AD2-072 C O1	9.67
936572	AD2-072 E O1	4.74
936821	AD2-105 C O1	4.67
936822	AD2-105 E O1	6.45
936831	AD2-106 C O1	2.84
936832	AD2-106 E O1	3.93
936841	AD2-107 C O1	2.24
936842	AD2-107 E O1	3.1
939131	AE1-143 C	7.18
939132	AE1-143 E	3.55
939141	AE1-144 C O2	30.23
939142	AE1-144 E O2	15.0
940091	AE1-251 C O2	11.73
940092	AE1-251 E O2	7.82
AE1-042	AE1-042	5.9
CARR	CARR	0.5
CBM-S1	CBM-S1	13.83
CBM-S2	CBM-S2	1.93
CBM-W1	CBM-W1	4.07
CBM-W2	CBM-W2	66.4
CIN	CIN	7.18

<b>Bus #</b>	<b>Bus</b>	<b>MW Impact</b>
CPLE	CPLE	0.42
DEARBORN	DEARBORN	0.91
G-007	G-007	1.34
IPL	IPL	4.34
LGEE	LGEE	5.22
MEC	MEC	8.06
O-066	O-066	4.53
RENSSELAER	RENSSELAER	0.39
WEC	WEC	0.71