

***Generation Interconnection
Feasibility Study Report***

For

***PJM Generation Interconnection Request
Queue Position AC2-020***

“Greenfield-Buckskin 69kV”

July 2017

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.

Note: PJM utilizes manufacturer models to ensure the performance of inverters is properly captured during the simulations performed for stability verification. Inverter manufacturers provide such models to their customers. The list of manufacturer models PJM has already validated is contained in Attachment G-2 of Manual 14A. Manufacturer models may be updated from time to time, for various reasons such as to reflect changes to the control systems or to more accurately represent the capabilities of inverters and controls which are currently available in the field. Additionally, as new inverter models are developed, inverter manufacturers provide such new models which must be used in the conduct of these studies. PJM needs adequate time to evaluate the new models in order to reduce delays to the System Impact Study process timeline for the Interconnection Customer as well as other Interconnection Customers in the study group. Therefore, **PJM will require that any Interconnection Customer with a new manufacturer model must supply that model to PJM, along with a \$10,000 fully refundable deposit, no later than three (3) months prior to the starting date of the System Impact Study** (See Section 2.2.2. of Manual 14A for starting dates) for the Interconnection Request which shall specify the use of the new model. The Interconnection Customer will be required to submit a completed dynamic model study request form (Attachment G-1 of Manual 14A) in order to document the request for the study.

General

The Interconnection Customer (IC), has proposed a **solar** generating facility located in Ross County, Greenfield, Ohio. The installed facilities will have a total capability of **20.0 MW** with **7.6 MW** of this output being recognized by PJM as capacity. The proposed in-service date for this project is **December 31, 2019**. **This study does not imply a Dayton Power and Light commitment to this in-service date.**

Point of Interconnection

The AC2-020 “Greenfield-Buckskin 69 kV” project requested that PJM study **two** electrical points of interconnection in the Feasibility analysis. The primary option was studied as an injection into a tap off of the Greenfield-Buckskin 69 kV line. The secondary option was studied as an injection into the Buckskin 12 kV bus (modeled at the Buckskin 69 kV bus). Dayton Power and Light is only required to provide Attachment Facilities, Direct Connection, and Non-Direct Connection scope and costs for the primary interconnection option. Therefore, Dayton Power and Light provided interconnection scope and costs for the tap off of the Greenfield-Buckskin 69 kV line. Load flow results are provided for both options in this report.

For the primary Point of Interconnection (POI), AC2-020 “Greenfield-Buckskin 69 kV” will interconnect with the Dayton Power and Light transmission system at a tap location on the **Greenfield-Buckskin 69kV line**. Presently, the Greenfield-Buckskin 69kV line serves as a tie line between Dayton Power and Light and AEP.

Cost Summary

The AC2-020 “Greenfield-Buckskin 69 kV” project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	\$ 64,000
Direct Connection Network Upgrades	\$ 0
Non Direct Connection Network Upgrades	\$ 428,000
Total Costs	\$ 492,000

In addition, the AC1-020 project **may** be responsible for a contribution to the following costs for reinforcements to resolve overloads in the AEP and DEOK zones (see “**Network Impacts**” section below for details):

Description	Total Cost
New System Upgrades	\$ 53,960,000
Previously Identified Upgrades	\$ 197,021,813
Total Costs	\$ 250,981,813

Attachment Facilities

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

Description	Total Cost
Tap the Greenfield-Buckskin 69 kV line and install a three-way phase switch to interconnect the AC2-020 project. (One switch covering the generator lead line is considered an Attachment Facility). (Dayton)	\$ 64,000
Total Attachment Facility Costs	\$ 64,000

The substation Attachment Facility cost estimate for the AC2-020 project is approximately **\$64,000**. Dayton Power and Light plans to tap the Greenfield-Buckskin 69kV line and install a three-way phase over phase switch to interconnect the AC2-020 Greenfield-Buckskin 69kV Project. The three-way switch will be equipped with the necessary communication systems to facilitate remote supervisory control of the switch and status monitoring. One switch of the three-way switch will be considered to be an Attachment Facility (the switch covering the generator lead line). DP&L will install 69kV metering adjacent to the switch.

Direct Connection Cost Estimate

There is no Direct Connection scope of work required for this project.

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.

Description	Total Cost
Tap the Greenfield-Buckskin 69 kV line and install a three-way phase switch to interconnect the AC2-020 project. (Two network switches of the three-way switch are considered Non-Direct Connection Facilities). (Dayton)	\$ 128,000
Protection System changes at Greenfield (Dayton) Substation	\$ 100,000
Protection System changes at Buckskin (AEP) Substation	\$ 200,000
Total Non-Direct Connection Facility Costs	\$ 428,000

The total Non-Direct Connection cost estimate for the AC2-020 project is approximately **\$428,000**.

Of the total, the transmission Non-Direct connection cost estimate for the AC2-020 project is approximately **\$128,000**. Dayton Power and Light plans to tap the Greenfield-Buckskin 69kV line and install a three-way phase over phase switch to interconnect the AC2-020 Greenfield-Buckskin 69kV Project. The three-way switch will be equipped with the necessary communication systems to facilitate remote supervisory control of the switch and status monitoring. Two switches of the three-way switch will be considered to be Non-Direct Connection facilities (the two switches that are in network with the main circuit).

Of the total, the substation Non-Direct connection cost estimate for the AC2-020 project is approximately **\$300,000**. Protection system changes will need to be made at Dayton's Greenfield Substation to facilitate the interconnection of the new generation. AEP will also need to make any required protection system changes at their Buckskin Substation.

Dayton Interconnection Requirements

The Dayton Power and Light Company (DP&L) has prepared this Facilities Connection Requirements document to ensure compliance with North American Electric Reliability Council (NERC) Reliability Standards and applicable Regional Reliability Organization, sub regional, Power Pool, and individual Transmission Owner planning criteria and facility connection requirements in compliance to NERC Standard FAC-001-2. These connection requirements apply to all generation facilities, transmission facilities, and end-users connecting to the DP&L transmission system. Detailed information outlining DP&L interconnection requirements can be reviewed utilizing the following link:

<http://www.pjm.com/~media/planning/plan-standards/private-dayton/dayton-facilities-connection-requirements.ashx>

Dayton Schedule for Attachment Facilities and Non-Direct Connection Work:

Based on the extent of the Dayton primary Non-Direct Connection and Attachment upgrades required to support the AC2-020 generation project, it is expected to take a **minimum of 12 months** from the date of a fully executed Interconnection Construction Service Agreement to complete the installation subject to market conditions and vendor lead times. This includes the requirement for the Interconnection Customer to make a preliminary payment to Dayton which funds the construction of the Non-Direct Connection facilities and the first three months of construction work in earnest for the Attachment Facility upgrades. It assumes that there will be no environmental or permitting issues to implement the Non-Direct Connection upgrades for this project and that all system outages will be allowed when requested.

American Electric Power (AEP) and Duke Energy (DEOK) Schedule for Network Upgrade Work:

See “**Network Impacts**” section below for the estimated time to complete each network upgrade listed for AEP and Duke Energy. Note that some of this work may be able to be performed

coincident with each other. Final project schedule considering outage conflicts would be determined in a Facilities Study.

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.

Dayton Metering Requirements

The Interconnection Customer will be required to comply with all Dayton Revenue Metering Requirements for Generation Interconnection Customers as outlined in the link below. The Revenue Metering Requirements may be found within the Dayton Power & Light Co. "Requirements for the Connection of Facilities to the Dayton Power & Light Co. Transmission System" document located at the following link:

<http://www.pjm.com/~media/planning/plan-standards/private-dayton/dayton-facilities-connection-requirements.ashx>

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

Network Impacts

Option 1

The Queue Project AC2-020 was evaluated as a 20.0 MW (Capacity 7.6 MW) injection tapping the Greenfield – Buckskin 69 kV line in the Dayton area. Project AC2-020 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AC2-020 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Analysis - 2020

Contingency Descriptions

The following contingencies resulted in overloads:

Option 1	
Contingency Name	Description
7981_A	CONTINGENCY '7981_A'
	OPEN BRANCH FROM BUS 243019 TO BUS 931430 CKT 1 / 243019 05HILLSB 138 931430 AC2-061 TAP 138 1
	OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB 138 253111 09MIDDLE 138 1
	OPEN BRANCH FROM BUS 249995 TO BUS 250122 CKT 1 / 249995 08CLINCO 138 250122 08WARRN1 138 1
	OPEN BRANCH FROM BUS 253111 TO BUS 253057 CKT 1 / 253111 09MIDDLE 138 253057 09OHH 138 1
	END
7981_B	CONTINGENCY '7981_B'
	OPEN BRANCH FROM BUS 931430 TO BUS 249995 CKT 1 / 931430 AC2-061 TAP 138 249995 08CLINCO 138 1
	OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB 138 253111 09MIDDLE 138 1
	OPEN BRANCH FROM BUS 249995 TO BUS 250122 CKT 1 / 249995 08CLINCO 138 250122 08WARRN1 138 1

	OPEN BRANCH FROM BUS 253111 TO BUS 253057 CKT 1 / 253111 09MIDDLE 138 253057 09OHH 138 1 END
8108_C2_05HILLSB 138-D_A	CONTINGENCY '8108_C2_05HILLSB 138-D_A' OPEN BRANCH FROM BUS 243019 TO BUS 931430 CKT 1 / 243019 05HILLSB 138 931430 AC2-061 TAP 138 1 OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB 138 253111 09MIDDLE 138 1 OPEN BRANCH FROM BUS 249995 TO BUS 250122 CKT 1 / 249995 08CLINCO 138 250122 08WARRN1 138 1 OPEN BRANCH FROM BUS 253111 TO BUS 253057 CKT 1 / 253111 09MIDDLE 138 253057 09OHH 138 1 END
8109_C2_05HILLSB 138-A_A	CONTINGENCY '8109_C2_05HILLSB 138-A_A' OPEN BRANCH FROM BUS 243019 TO BUS 243102 CKT 1 / 243019 05HILLSB 138 243102 05SINKG8 138 1 OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB 138 253111 09MIDDLE 138 1 OPEN BRANCH FROM BUS 931350 TO BUS 243102 CKT 1 / 931350 AC2-049 TAP 138 243102 05SINKG8 138 1 OPEN BRANCH FROM BUS 253111 TO BUS 253057 CKT 1 / 253111 09MIDDLE 138 253057 09OHH 138 1 END
8110_C2_05HILLSB 138-B_A	CONTINGENCY '8110_C2_05HILLSB 138-B_A' OPEN BRANCH FROM BUS 243019 TO BUS 243102 CKT 1 / 243019 05HILLSB 138 243102 05SINKG8 138 1 OPEN BRANCH FROM BUS 243019 TO BUS 926100 CKT 1 / 243019 05HILLSB 138 926100 AC1-089 TAP 138 1 OPEN BRANCH FROM BUS 931350 TO BUS 243102 CKT 1 / 931350 AC2-049 TAP 138 243102 05SINKG8 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)

#	Contingency		Affected Area	Facility Description	Bus		Circuit	Power Flow	Loading %		Rating		MW Contribution	Ref
	Type	Name			From	To			Initial	Final	Type	MVA		
1	LFFB	8109_C2_0 5HILLSB 138-A_A	AEP - AEP	05ADAMS-05WARERD 138 kV line	243464	246942	1	DC	98.18	98.69	ER	150	1.52	1
2	LFFB	8110_C2_0 5HILLSB 138-B_A	AEP - AEP	05ADAMS-05WARERD 138 kV line	243464	246942	1	DC	69.38	69.92	ER	150	1.59	
3	LFFB	8109_C2_0 5HILLSB 138-A_A	AEP - AEP	05SEAMAN-05ADAMS 138 kV line	243571	243464	1	DC	85.08	85.59	ER	150	1.5	2
4	LFFB	8109_C2_0 5HILLSB 138-A_A	AEP - AEP	05WARERD- 05WAVERL 138 kV line	246942	243585	1	DC	87.98	88.49	ER	150	1.52	3
5	LFFB	8110_C2_0 5HILLSB 138-B_A	AEP - AEP	05WARERD- 05WAVERL 138 kV line	246942	243585	1	DC	59.18	59.72	ER	150	1.59	

Note: Please see Attachment 3 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		Affected Area	Facility Description	Bus		Circuit	Power Flow	Loading %		Rating		MW Contribution	Ref
	Type	Name			From	To			Initial	Final	Type	MVA		
6	DCTL	7981_B	AEP - AEP	05HILLSB-05SINKG8 138 kV line	243019	243102	1	DC	124.56	125.14	ER	185	2.14	4
7	LFFB	8108_C2_0 5HILLSB 138-D_A	AEP - AEP	05HILLSB-05SINKG8 138 kV line	243019	243102	1	DC	124.61	125.2	ER	185	2.14	
8	DCTL	7981_A	AEP - AEP	05HILLSB-05SINKG8 138 kV line	243019	243102	1	DC	124.61	125.2	ER	185	2.14	
9	LFFB	8109_C2_0 5HILLSB 138-A_A	AEP - DEO&K	05HILLSB-AC2-061 TAP 138 kV line	243019	931430	1	DC	145.59	146.18	ER	184	2.13	5
10	DCTL	7981_B	AEP - AEP	05SINKG8-AC2-049 TAP 138 kV line	243102	931350	1	DC	126.78	127.38	ER	179	2.14	6
11	LFFB	8108_C2_0 5HILLSB 138-D_A	AEP - AEP	05SINKG8-AC2-049 TAP 138 kV line	243102	931350	1	DC	126.78	127.38	ER	179	2.14	
12	DCTL	7981_A	AEP - AEP	05SINKG8-AC2-049 TAP 138 kV line	243102	931350	1	DC	126.78	127.38	ER	179	2.14	
13	LFFB	8109_C2_0 5HILLSB 138-A_A	DEO&K - DEO&K	08CLINCO-08WARRN1 138 kV line	249995	250122	1	DC	121.78	122.32	ER	198	2.13	7
14	DCTL	7981_B	AEP - AEP	AC2-049 TAP-05MILLBR 138 kV line	931350	243042	1	DC	126.66	127.27	ER	179	2.14	8

#	Contingency		Affected Area	Facility Description	Bus		Circuit	Power Flow	Loading %		Rating		MW Contribution	Ref
	Type	Name			From	To			Initial	Final	Type	MVA		
15	LFFB	8108_C2_0 5HILLSB 138-D_A	AEP - AEP	AC2-049 TAP-05MILLBR 138 kV line	931350	243042	1	DC	126.66	127.27	ER	179	2.14	
16	DCTL	7981_A	AEP - AEP	AC2-049 TAP-05MILLBR 138 kV line	931350	243042	1	DC	126.66	127.27	ER	179	2.14	
17	LFFB	8109_C2_0 5HILLSB 138-A_A	DEO&K - DEO&K	AC2-061 TAP-08CLINCO 138 kV line	931430	249995	1	DC	145.59	146.18	ER	184	2.13	9

Note: Please see Attachment 3 for projects providing impacts to flowgate violations. The values in the Reference column correspond to the proper table in the Attachment.

Steady-State Voltage Requirements

(Results of the steady-state voltage studies should be inserted here)

To be determined in System Impact Study Phase.

Short Circuit

(Summary of impacted circuit breakers)

New circuit breakers found to be over-duty:

None

Contributions to previously identified 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).

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.

None

Light Load Analysis - 2020

Light Load Studies to be conducted during later study phases (as required by PJM Manual 14B).

Not required for this solar project.

System Reinforcements

Short Circuit

(Summary form of Cost allocation for breakers will be inserted here if any)

None

Stability and Reactive Power Requirement

(Results of the dynamic studies should be inserted here)

To be determined in System Impact Study phase.

Summer Peak Load Flow Analysis Reinforcements

New System Reinforcements

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

Note that this project is not the first to cause these overloads and the mitigation for all overloads exceeds \$5 million. These violations are presented in the Feasibility Report since they are valid and cost allocation is not performed during the Feasibility study phase. These violations will be further evaluated during the System Impact Study phase. If other queue projects withdraw from the queue, the reinforcement scope may change causing the cost to also change. If the reinforcement cost falls below \$5 million, this project may have a cost allocation for the required reinforcement.

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
#1	05ADAMS-05WARERD 138 kV line	(AEP) Rebuild/reconductor 20.52 miles of conductor; estimated cost: \$30.78 M Schedule: Approximate construction time 24-36 months after signing Interconnection Construction Service Agreement.	Pending	\$30,780,000
#2	05ADAMS-05WARERD 138 kV line	Same as #1.	-	-
#3	05SEAMAN-05ADAMS 138 kV line	(AEP) Rebuild/reconductor 8 miles of conductor; estimated cost: \$12 M Schedule: Approximate construction time 24-36 months after execution of Interconnection Construction Service Agreement.	Pending	\$12,000,000
#4	05WARERD-05WAVERL 138 kV line	(AEP) Rebuild/reconductor 3.12 miles of conductor; estimated cost: \$4.68 M (AEP) Rebuild/reconductor 4.37 miles of conductor; estimated cost: \$6.5 M Schedule: Approximate construction time 24-36 months after execution of Interconnection Construction Service Agreement.	Pending	\$11,180,000

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
#5	05WARERD-05WAVERL 138 kV line	Same as #4.	-	-
Total New Network Upgrades				\$53,960,000

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 ¹
#6	05HILLSB-05SINKG8 138 kV line	(AEP) (1) Rebuild/reconductor approximately 4.36 miles of conductor; estimated cost: \$6.54 M (2) Engineering study to determine if the Relay Compliance Trip limits settings can be adjusted to mitigate the overload; estimated cost: \$25,000. New relay packages will be required if the setting cannot be adjusted; estimated cost; \$600,000. (3) Replace jumpers; estimated cost: \$50,000 (4) Replace switch; estimated cost: \$400,000 (5) Rebuild/reconductor approximately 8.93 miles of conductor; estimated cost: \$13.4 M Schedule: Approximate construction time 24-36 months after execution of Interconnection Construction Service Agreement.	Pending	\$20,990,000
#7	05HILLSB-05SINKG8 138 kV line	Same as #6	-	-
#8	05HILLSB-05SINKG8 138 kV line	Same as #6	-	-

¹ Upgrade costs assume that the sag study performed resulted in the need to reconductor/rebuild the overloaded facility.

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost ¹
#9	05HILLSB-AC2-061 TAP 138 kV line	(AEP) (1) Rebuild/reconductor approximately 5 miles of conductor; estimated cost: \$7.5 M (2) Engineering study to determine if the Relay Compliance Trip limits settings can be adjusted to mitigate the overload; estimated cost: \$25,000. New relay packages will be required if the setting cannot be adjusted; estimated cost: \$600,000. Schedule: Approximate construction time 24-36 months after execution of Interconnection Construction Service Agreement.	Pending	\$8,100,000
		(DEOK) (1) At Clinton County replace on line switch, one metering package, one motorized line switch, one lightning arrester and miscellaneous jumpers and connectors. (2) Rebuild 3 miles of feeder with bundled (2) 954ASCR and steel poles. New rating will be 603 MVA with terminal equipment rated at 3000A. Total Estimated Cost: \$4,766,547. Schedule: 30 months to engineer, procure and construct after execution of Interconnection Construction Service Agreement.	Pending	\$4,766,547

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost ¹
#10	05SINKG8-AC2-049 TAP 138 kV line	(AEP) (1) An engineering study will need to be conducted to determine if the Relay Compliance Trip limits settings can be adjusted to mitigate the overload; estimated cost: \$25,000. New relay packages will be required if the settings cannot be adjusted; estimated cost: \$600,000 (2) 20.37 miles of AEP owned conductor will need to be reconducted/rebuilt; estimated cost: \$30.56 million (3) Replace Millbrook Park line riser; estimated cost: \$100,000 (4) Replace Bus and Risers; estimated cost: \$400,000 (5) Replace Trap Riser, estimated cost: \$100,000 (6) Replace switch; estimated cost: \$400,000 (7) A Sag Study will be required on the 20.37 mile section of line to mitigate the overload. Depending on the sag study results, cost for this upgrade is expected to be between \$81,480 (no remediation required, just sag study) and \$30.56 million (complete line re-conductor/rebuild required) (8) A Sag Study will be required on the 9.76 mile section of line to mitigate the overload. Depending on the sag study results, cost for this upgrade is expected to be between \$39,040 (no remediation required, just sag study) and \$14.64 million (complete line re-conductor/rebuild required) (9) An engineering study will need to be conducted to determine if the CT Thermal limits settings can be adjusted to mitigate the overload; estimated cost: \$25,000. New relay packages will be required if the settings cannot be adjusted; estimated cost: \$600,000 Schedule: (1) Sag Study: 6 to 12 months. (2) Rebuild: The standard time required for construction differs from state to state. An approximate construction time would be 24 to 36 months after signing an interconnection agreement. Total elapsed time with sag study and rebuild work: 30-48 months.	Pending	\$77,960,000

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost ¹
#11	05SINKG8-AC2-049 TAP 138 kV line	Same as #10.	-	-
#12	05SINKG8-AC2-049 TAP 138 kV line	Same as #10.	-	-
#13	08CLINCO-08WARRN1 138 kV line	(DEOK) (1) At Warren replace one circuit breaker, two circuit breaker disconnect switches, system protection CTs and one relay, one wave trap, one lightning arrestor and miscellaneous jumpers and connectors. (2) Rebuild 16 miles of feeder with bundled (2) 954ASCR and steel poles. (3) At Clinton County replace one lightning arrestor, one motorized line switch, and miscellaneous jumpers and connectors. New rating will be 603 MVA with terminal equipment rated at 3000A. Total Estimated Cost: \$27,175,266; Schedule: 36 months to engineer, procure and construct after execution of Interconnection Construction Service Agreement.	Pending	\$27,175,266
#14	AC2-049 TAP-05MILLBR 138 kV line	(AEP) (1) Same as #10 plus: (2) 8.52 miles of conductor will need to be rebuilt/reconductored; estimated cost: \$12.78 million (3) 20.37 miles of conductor will need to be rebuilt/reconductored; estimated cost: \$30.56 million (4) 9.76 miles of conductor will need to be rebuilt/reconductored; estimated cost: \$14.64 million (5) Replace the wave trap at Millbrook Park; estimated cost: \$50,000 Schedule: Approximate construction time 24-36 months after execution of Interconnection Construction Service Agreement.	Pending	\$58,030,000

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost ¹
#15	AC2-049 TAP-05MILLBR 138 kV line	Same as #14.	-	-
#16	AC2-049 TAP-05MILLBR 138 kV line	Same as #14.	-	-
#17	AC2-061 TAP-08CLINCO 138 kV line	Same as #9.	-	-
Total New Network Upgrades				\$197,021,813

Light Load Load Flow Analysis Reinforcements

New System Reinforcements

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

Not applicable.

Contribution to Previously Identified System Reinforcements

(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project. This project may have a % allocation cost responsibility which will be calculated and reported for the Impact Study)

(Summary form of Cost allocation for transmission lines and transformers will be inserted here if any)

Not applicable.

Option 2

The Queue Project AC2-020 was evaluated as a 20.0 MW (Capacity 7.6 MW) injection at the Buckskin 12 kV substation (modeled at the Buckskin 69 kV bus) in the AEP area. Project AC2-020 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AC2-020 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Analysis - 2020

Contingency Descriptions

The following contingencies resulted in overloads:

Option 2	
Contingency Name	Description
5913_B2_TOR2982	CONTINGENCY '5913_B2_TOR2982'
	OPEN BRANCH FROM BUS 243019 TO BUS 243102 CKT 1 / 243019 05HILLSB 138 243102 05SINKG8 138 1
	OPEN BRANCH FROM BUS 931350 TO BUS 243102 CKT 1 / 243042 05MILLBR 138 243102 05SINKG8 138 1
	END
7353_B2_TOR12737	CONTINGENCY '7353_B2_TOR12737'
	OPEN BRANCH FROM BUS 931430 TO BUS 249995 CKT 1 / 243019 05HILLSB 138 249995 08CLINCO 138 1
	OPEN BRANCH FROM BUS 249995 TO BUS 250122 CKT 1 / 249995 08CLINCO 138 250122 08WARRN1 138 1
	END
7954_C1_05MILLBR 138-2_A	CONTINGENCY '7954_C1_05MILLBR 138-2_A'
	OPEN BRANCH FROM BUS 243042 TO BUS 243088 CKT 1 / 243042 05MILLBR 138 243088 05S POIN 138 1
	OPEN BRANCH FROM BUS 243042 TO BUS 931350 CKT 1 / 243042 05MILLBR 138 931350 AC2-049 TAP 138 1
	END

7981_A	CONTINGENCY '7981_A' OPEN BRANCH FROM BUS 243019 TO BUS 931430 CKT 1 / 243019 05HILLSB 138 931430 AC2-061 TAP 138 1 OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB 138 253111 09MIDDLE 138 1 OPEN BRANCH FROM BUS 249995 TO BUS 250122 CKT 1 / 249995 08CLINCO 138 250122 08WARRN1 138 1 OPEN BRANCH FROM BUS 253111 TO BUS 253057 CKT 1 / 253111 09MIDDLE 138 253057 09OHH 138 1 END
7981_B	CONTINGENCY '7981_B' OPEN BRANCH FROM BUS 931430 TO BUS 249995 CKT 1 / 931430 AC2-061 TAP 138 249995 08CLINCO 138 1 OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB 138 253111 09MIDDLE 138 1 OPEN BRANCH FROM BUS 249995 TO BUS 250122 CKT 1 / 249995 08CLINCO 138 250122 08WARRN1 138 1 OPEN BRANCH FROM BUS 253111 TO BUS 253057 CKT 1 / 253111 09MIDDLE 138 253057 09OHH 138 1 END
8108_C2_05HILLSB 138-D_A	CONTINGENCY '8108_C2_05HILLSB 138-D_A' OPEN BRANCH FROM BUS 243019 TO BUS 931430 CKT 1 / 243019 05HILLSB 138 931430 AC2-061 TAP 138 1 OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB 138 253111 09MIDDLE 138 1 OPEN BRANCH FROM BUS 249995 TO BUS 250122 CKT 1 / 249995 08CLINCO 138 250122 08WARRN1 138 1 OPEN BRANCH FROM BUS 253111 TO BUS 253057 CKT 1 / 253111 09MIDDLE 138 253057 09OHH 138 1 END
8109_C2_05HILLSB 138-A_A	CONTINGENCY '8109_C2_05HILLSB 138-A_A' OPEN BRANCH FROM BUS 243019 TO BUS 243102 CKT 1 / 243019 05HILLSB 138 243102 05SINKG8 138 1 OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB 138 253111 09MIDDLE 138 1 OPEN BRANCH FROM BUS 931350 TO BUS 243102 CKT 1 / 931350 AC2-049 TAP 138 243102 05SINKG8 138 1

	OPEN BRANCH FROM BUS 253111 TO BUS 253057 CKT 1 / 253111 09MIDDLE 138 253057 09OHH 138 1 END
8110_C2_05HILLSB 138-B_A	CONTINGENCY '8110_C2_05HILLSB 138-B_A' OPEN BRANCH FROM BUS 243019 TO BUS 243102 CKT 1 / 243019 05HILLSB 138 243102 05SINKG8 138 1 OPEN BRANCH FROM BUS 243019 TO BUS 926100 CKT 1 / 243019 05HILLSB 138 926100 AC1-089 TAP 138 1 OPEN BRANCH FROM BUS 931350 TO BUS 243102 CKT 1 / 931350 AC2-049 TAP 138 243102 05SINKG8 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)

#	Contingency		Affected Area	Facility Description	Bus		Circuit	Power Flow	Loading %		Rating		MW Contribution	Ref
	Type	Name			From	To			Initial	Final	Type	MVA		
1	LFFB	8109_C2_0 5HILLSB 138-A_A	AEP - AEP	05ADAMS-05WARERD 138 kV line	243464	246942	1	DC	98.18	98.73	ER	150	1.64	
2	DCTL	7981_B	AEP - AEP	05SEAMAN-05ADAMS 138 kV line	243571	243464	1	DC	88.25	88.79	ER	150	1.58	1
3	LFFB	8109_C2_0 5HILLSB 138-A_A	AEP - AEP	05SEAMAN-05ADAMS 138 kV line	243571	243464	1	DC	85.08	85.63	ER	150	1.62	
4	LFFB	8108_C2_0 5HILLSB 138-D_A	AEP - AEP	05SEAMAN-05ADAMS 138 kV line	243571	243464	1	DC	88.25	88.79	ER	150	1.58	
5	DCTL	7981_A	AEP - AEP	05SEAMAN-05ADAMS 138 kV line	243571	243464	1	DC	88.25	88.79	ER	150	1.58	
6	DCTL	7981_B	AEP - AEP	05WARERD-05WAVERL 138 kV line	246942	243585	1	DC	90.7	91.24	ER	150	1.6	2
7	LFFB	8109_C2_0 5HILLSB 138-A_A	AEP - AEP	05WARERD-05WAVERL 138 kV line	246942	243585	1	DC	87.98	88.53	ER	150	1.64	

#	Contingency		Affected Area	Facility Description	Bus		Circuit	Power Flow	Loading %		Rating		MW Contribution	Ref
	Type	Name			From	To			Initial	Final	Type	MVA		
8	LFFB	8108_C2_0 5HILLSB 138-D_A	AEP - AEP	05WARERD-05WAVERL 138 kV line	246942	243585	1	DC	90.7	91.24	ER	150	1.6	
9	DCTL	7981_A	AEP - AEP	05WARERD-05WAVERL 138 kV line	246942	243585	1	DC	90.7	91.24	ER	150	1.6	
10	LFFB	8110_C2_0 5HILLSB 138-B_A	DEO&K - DEO&K	08CLINCO-08WARRN1 138 kV line	249995	250122	1	DC	75.35	75.98	ER	198	2.46	

Note: Please see Attachment 4 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		Affected Area	Facility Description	Bus		Circuit	Power Flow	Loading %		Rating		MW Contribution	Ref
	Type	Name			From	To			Initial	Final	Type	MVA		
11	DCTL	7981_B	AEP - AEP	05HILLSB-05SINKG8 138 kV line	243019	243102	1	DC	124.56	125.19	ER	185	2.31	3
12	LFFB	8108_C2_0 5HILLSB 138-D_A	AEP - AEP	05HILLSB-05SINKG8 138 kV line	243019	243102	1	DC	124.61	125.25	ER	185	2.31	
13	DCTL	7981_A	AEP - AEP	05HILLSB-05SINKG8 138 kV line	243019	243102	1	DC	124.61	125.25	ER	185	2.31	
14	LFFB	8109_C2_0 5HILLSB 138-A_A	AEP - DEO&K	05HILLSB-AC2-061 TAP 138 kV line	243019	931430	1	DC	145.59	146.23	ER	184	2.32	4

#	Contingency		Affected Area	Facility Description	Bus			Power Flow	Loading %		Rating		MW Contribution	Ref
	Type	Name			From	To	Circuit		Initial	Final	Type	MVA		
15	BUS	7954_C1_0 5MILLBR 138-2_A	AEP - DEO&K	05HILLSB-AC2-061 TAP 138 kV line	243019	931430	1	DC	110.18	110.71	ER	184	1.9	
16	DCTL	7981_B	AEP - AEP	05SINKG8-AC2-049 TAP 138 kV line	243102	931350	1	DC	126.78	127.43	ER	179	2.31	5
17	LFFB	8108_C2_0 5HILLSB 138-D_A	AEP - AEP	05SINKG8-AC2-049 TAP 138 kV line	243102	931350	1	DC	126.78	127.43	ER	179	2.31	
18	DCTL	7981_A	AEP - AEP	05SINKG8-AC2-049 TAP 138 kV line	243102	931350	1	DC	126.78	127.43	ER	179	2.31	
19	DCTL	7981_B	AEP - AEP	05ADAMS-05WARERD 138 kV line	243464	246942	1	DC	100.9	101.44	ER	150	1.6	6
20	LFFB	8108_C2_0 5HILLSB 138-D_A	AEP - AEP	05ADAMS-05WARERD 138 kV line	243464	246942	1	DC	100.9	101.44	ER	150	1.6	
21	DCTL	7981_A	AEP - AEP	05ADAMS-05WARERD 138 kV line	243464	246942	1	DC	100.9	101.44	ER	150	1.6	
22	LFFB	8109_C2_0 5HILLSB 138-A_A	DEO&K - DEO&K	08CLINCO-08WARRN1 138 kV line	249995	250122	1	DC	121.78	122.37	ER	198	2.32	7
23	DCTL	7981_B	AEP - AEP	AC2-049 TAP-05MILLBR 138 kV line	931350	243042	1	DC	126.66	127.32	ER	179	2.31	8
24	LFFB	8108_C2_0 5HILLSB 138-D_A	AEP - AEP	AC2-049 TAP-05MILLBR 138 kV line	931350	243042	1	DC	126.66	127.32	ER	179	2.31	
25	DCTL	7981_A	AEP - AEP	AC2-049 TAP-05MILLBR 138 kV line	931350	243042	1	DC	126.66	127.32	ER	179	2.31	

#	Contingency		Affected Area	Facility Description	Bus		Circuit	Power Flow	Loading %		Rating		MW Contribution	Ref
	Type	Name			From	To			Initial	Final	Type	MVA		
26	LFFB	8109_C2_0 5HILLSB 138-A_A	DEO&K - DEO&K	AC2-061 TAP-08CLINCO 138 kV line	931430	249995	1	DC	145.59	146.23	ER	184	2.32	9
27	BUS	7954_C1_0 5MILLBR 138-2_A	DEO&K - DEO&K	AC2-061 TAP-08CLINCO 138 kV line	931430	249995	1	DC	110.13	110.65	ER	184	1.9	

Note: Please see Attachment 4 for projects providing impacts to flowgate violations. The values in the Reference column correspond to the proper table in the Attachment.

Steady-State Voltage Requirements

(Results of the steady-state voltage studies should be inserted here)

To be determined in System Impact Study Phase.

Short Circuit

(Summary of impacted circuit breakers)

New circuit breakers found to be over-duty:

None

Contributions to previously identified 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.

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.

#	Contingency		Affected Area	Facility Description	Bus		Circuit	Power Flow	Loading %		Rating		MW Contribution	Ref
	Type	Name			From	To			Initial	Final	Type	MVA		
28	N-1	7353_B2_T OR12737	AEP - AEP	05HILLSB-05SINKG8 138 kV line	243019	243102	1	DC	89.88	90.41	ER	185	1.91	
29	N-1	5913_B2_T OR2982	AEP - DEO&K	05HILLSB-AC2-061 TAP 138 kV line	243019	931430	1	DC	110.82	111.34	ER	184	1.9	
30	N-1	7353_B2_T OR12737	AEP - AEP	05SINKG8-AC2-049 TAP 138 kV line	243102	931350	1	DC	90.88	91.43	ER	179	1.91	
31	N-1	7353_B2_T OR12737	AEP - AEP	AC2-049 TAP-05MILLBR 138 kV line	931350	243042	1	DC	90.83	91.37	ER	179	1.91	

Light Load Analysis - 2020

Light Load Studies to be conducted during later study phases (as required by PJM Manual 14B).

Not required for this solar project.

System Reinforcements

Short Circuit

(Summary form of Cost allocation for breakers will be inserted here if any)

None.

Stability and Reactive Power Requirement

(Results of the dynamic studies should be inserted here)

To be determined in System Impact Study phase.

Summer Peak Load Flow Analysis Reinforcements

New System Reinforcements

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

Not provided for Option 2.

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)

Not provided for Option 2.

Light Load Load Flow Analysis Reinforcements

New System Reinforcements

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

Not applicable.

Contribution to Previously Identified System Reinforcements

(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project. This project may have a % allocation cost responsibility which will be calculated and reported for the Impact Study)

(Summary form of Cost allocation for transmission lines and transformers will be inserted here if any)

Not applicable.

Attachment 1. One Line Diagram
AC2-020 “Greenfield-Buckskin 69 kV”

Attachment 2. Site Plan

Attachment 3. Option 1 Flowgate Details

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.

Appendix 1							
Bus Number	Bus Name	Full Contribution	Project Status	Bus Number	Bus Name	Full Contribution	Project Status
931022	AC2-008 E	1.38	W	931441	AC2-062 C OP	3.35	Active
931121	AC2-019 C	0.6	W	931442	AC2-062 E OP	1.5	Active
931122	AC2-019 E	0.98	W	931651	AC2-087 C OP	2.82	Active
931131	AC2-020 C OP	0.42	Active	931652	AC2-087 E OP	2.24	Active
931132	AC2-020 E OP	1.1	Active	247592	W4-036	0.71	Active
931192	AC2-027 E	1.58	W	916272	Z1-080 E	0.6	IS
931221	AC2-031 C	11.53	Active	924371	AB2-085 C OP	27.15	Active
931222	AC2-031 E	5.68	Active	924372	AB2-085 E OP	12.78	Active
931281	AC2-042 C	36.03	Active	924541	AB2-103 C OP	10.99	Active
931282	AC2-042 E	24.02	Active	924542	AB2-103 E OP	5.17	Active
931381	AC2-055 C OP	1.37	Active	926061	AC1-085 C	26.15	Active
931382	AC2-055 E OP	2.23	Active	926062	AC1-085 E	42.67	Active
931421	AC2-060 C	3.81	Active	926101	AC1-089 C	8.84	Active
931422	AC2-060 E	2.14	Active	926102	AC1-089 E	14.42	Active
931431	AC2-061 C	7.91	Active	926631	AC1-144 C	11.58	Active
931432	AC2-061 E	8.02	Active	926632	AC1-144 E	5.63	Active

Appendix 2

Bus Number	Bus Name	Full Contribution	Project Status	Bus Number	Bus Name	Full Contribution	Project Status
931022	AC2-008 E	1.35	W	931432	AC2-061 E	7.82	Active
931121	AC2-019 C	0.59	W	931441	AC2-062 C OP	3.24	Active
931122	AC2-019 E	0.96	W	931442	AC2-062 E OP	1.45	Active
931131	AC2-020 C OP	0.41	Active	931651	AC2-087 C OP	2.78	Active
931132	AC2-020 E OP	1.09	Active	931652	AC2-087 E OP	2.21	Active
931192	AC2-027 E	1.55	W	247592	W4-036	0.7	Active
931221	AC2-031 C	11.26	Active	916272	Z1-080 E	0.58	IS
931222	AC2-031 E	5.55	Active	924541	AB2-103 C OP	10.8	Active
931281	AC2-042 C	35.2	Active	924542	AB2-103 E OP	5.08	Active
931282	AC2-042 E	23.47	Active	926061	AC1-085 C	25.55	Active
931381	AC2-055 C OP	1.35	Active	926062	AC1-085 E	41.69	Active
931382	AC2-055 E OP	2.2	Active	926101	AC1-089 C	8.63	Active
931421	AC2-060 C	3.76	Active	926102	AC1-089 E	14.08	Active
931422	AC2-060 E	2.11	Active	926631	AC1-144 C	11.31	Active
931431	AC2-061 C	7.71	Active	926632	AC1-144 E	5.5	Active

Appendix 3

Bus Number	Bus Name	Full Contribution	Project Status	Bus Number	Bus Name	Full Contribution	Project Status
931022	AC2-008 E	1.38	W	931441	AC2-062 C OP	3.35	Active
931121	AC2-019 C	0.6	W	931442	AC2-062 E OP	1.5	Active
931122	AC2-019 E	0.98	W	931651	AC2-087 C OP	2.82	Active
931131	AC2-020 C OP	0.42	Active	931652	AC2-087 E OP	2.24	Active
931132	AC2-020 E OP	1.1	Active	247592	W4-036	0.71	Active
931192	AC2-027 E	1.58	W	916272	Z1-080 E	0.6	IS
931221	AC2-031 C	11.53	Active	924371	AB2-085 C OP	27.15	Active
931222	AC2-031 E	5.68	Active	924372	AB2-085 E OP	12.78	Active
931281	AC2-042 C	36.03	Active	924541	AB2-103 C OP	10.99	Active
931282	AC2-042 E	24.02	Active	924542	AB2-103 E OP	5.17	Active
931381	AC2-055 C OP	1.37	Active	926061	AC1-085 C	26.15	Active
931382	AC2-055 E OP	2.23	Active	926062	AC1-085 E	42.67	Active
931421	AC2-060 C	3.81	Active	926101	AC1-089 C	8.84	Active
931422	AC2-060 E	2.14	Active	926102	AC1-089 E	14.42	Active
931431	AC2-061 C	7.91	Active	926631	AC1-144 C	11.58	Active
931432	AC2-061 E	8.02	Active	926632	AC1-144 E	5.63	Active

Appendix 4

Bus Number	Bus Name	Full Contribution	Project Status	Bus Number	Bus Name	Full Contribution	Project Status
931022	AC2-008 E	2.78	W	931441	AC2-062 C OP	6.62	Active
931121	AC2-019 C	0.76	W	931442	AC2-062 E OP	2.96	Active
931122	AC2-019 E	1.25	W	931651	AC2-087 C OP	3.97	Active
931131	AC2-020 C OP	0.59	Active	931652	AC2-087 E OP	3.15	Active
931132	AC2-020 E OP	1.55	Active	247592	W4-036	1.01	Active
931192	AC2-027 E	2.01	W	924371	AB2-085 C OP	8.23	Active
931221	AC2-031 C	23.37	Active	924372	AB2-085 E OP	3.87	Active
931222	AC2-031 E	11.51	Active	924541	AB2-103 C OP	5.1	Active
931281	AC2-042 C	73.05	Active	924542	AB2-103 E OP	2.4	Active
931282	AC2-042 E	48.7	Active	926061	AC1-085 C	53.03	Active
931381	AC2-055 C OP	1.86	Active	926062	AC1-085 E	86.52	Active
931382	AC2-055 E OP	3.04	Active	926101	AC1-089 C	17.87	Active
931421	AC2-060 C	5.36	Active	926102	AC1-089 E	29.16	Active
931422	AC2-060 E	3.02	Active	926631	AC1-144 C	23.48	Active
931431	AC2-061 C	20.27	Active	926632	AC1-144 E	11.41	Active
931432	AC2-061 E	20.55	Active				

Appendix 5

Bus Number	Bus Name	Full Contribution	Project Status	Bus Number	Bus Name	Full Contribution	Project Status
931022	AC2-008 E	2.83	W	931442	AC2-062 E OP	2.95	Active
931121	AC2-019 C	0.77	W	931651	AC2-087 C OP	3.98	Active
931122	AC2-019 E	1.26	W	931652	AC2-087 E OP	3.16	Active
931131	AC2-020 C OP	0.59	Active	247592	W4-036	1.01	Active
931132	AC2-020 E OP	1.54	Active	916272	Z1-080 E	2.18	IS
931192	AC2-027 E	2.04	W	924371	AB2-085 C OP	8.72	Active
931221	AC2-031 C	23.89	Active	924372	AB2-085 E OP	4.1	Active
931222	AC2-031 E	11.77	Active	924541	AB2-103 C OP	5.31	Active
931281	AC2-042 C	74.67	Active	924542	AB2-103 E OP	2.5	Active
931282	AC2-042 E	49.78	Active	926061	AC1-085 C	54.2	Active
931381	AC2-055 C OP	1.87	Active	926062	AC1-085 E	88.44	Active
931382	AC2-055 E OP	3.06	Active	926101	AC1-089 C	18.22	Active
931421	AC2-060 C	5.37	Active	926102	AC1-089 E	29.73	Active
931422	AC2-060 E	3.02	Active	926631	AC1-144 C	24	Active
931441	AC2-062 C OP	6.6	Active	926632	AC1-144 E	11.66	Active

Appendix 6

Bus Number	Bus Name	Full Contribution	Project Status	Bus Number	Bus Name	Full Contribution	Project Status
931022	AC2-008 E	2.78	W	931441	AC2-062 C OP	6.62	Active
931121	AC2-019 C	0.76	W	931442	AC2-062 E OP	2.96	Active
931122	AC2-019 E	1.25	W	931651	AC2-087 C OP	3.97	Active
931131	AC2-020 C OP	0.59	Active	931652	AC2-087 E OP	3.15	Active
931132	AC2-020 E OP	1.55	Active	247592	W4-036	1.01	Active
931192	AC2-027 E	2.01	W	924371	AB2-085 C OP	8.23	Active
931221	AC2-031 C	23.37	Active	924372	AB2-085 E OP	3.87	Active
931222	AC2-031 E	11.51	Active	924541	AB2-103 C OP	5.1	Active
931281	AC2-042 C	73.05	Active	924542	AB2-103 E OP	2.4	Active
931282	AC2-042 E	48.7	Active	926061	AC1-085 C	53.03	Active
931381	AC2-055 C OP	1.86	Active	926062	AC1-085 E	86.52	Active
931382	AC2-055 E OP	3.04	Active	926101	AC1-089 C	17.87	Active
931421	AC2-060 C	5.36	Active	926102	AC1-089 E	29.16	Active
931422	AC2-060 E	3.02	Active	926631	AC1-144 C	23.48	Active
931431	AC2-061 C	20.27	Active	926632	AC1-144 E	11.41	Active
931432	AC2-061 E	20.55	Active				

Appendix 7

Bus Number	Bus Name	Full Contribution	Project Status	Bus Number	Bus Name	Full Contribution	Project Status
931022	AC2-008 E	2.83	W	931441	AC2-062 C OP	6.6	Active
931121	AC2-019 C	0.77	W	931442	AC2-062 E OP	2.95	Active
931122	AC2-019 E	1.26	W	931651	AC2-087 C OP	3.98	Active
931131	AC2-020 C OP	0.59	Active	931652	AC2-087 E OP	3.16	Active
931132	AC2-020 E OP	1.54	Active	247592	W4-036	1.01	Active
931192	AC2-027 E	2.04	W	916272	Z1-080 E	3.82	IS
931221	AC2-031 C	23.89	Active	924371	AB2-085 C OP	8.72	Active
931222	AC2-031 E	11.77	Active	924372	AB2-085 E OP	4.1	Active
931281	AC2-042 C	74.67	Active	924541	AB2-103 C OP	5.31	Active
931282	AC2-042 E	49.78	Active	924542	AB2-103 E OP	2.5	Active
931381	AC2-055 C OP	1.87	Active	926061	AC1-085 C	54.2	Active
931382	AC2-055 E OP	3.06	Active	926062	AC1-085 E	88.44	Active
931421	AC2-060 C	5.37	Active	926101	AC1-089 C	18.22	Active
931422	AC2-060 E	3.02	Active	926102	AC1-089 E	29.73	Active
931431	AC2-061 C	28.84	Active	926631	AC1-144 C	24	Active
931432	AC2-061 E	29.24	Active	926632	AC1-144 E	11.66	Active

Appendix 8

Bus Number	Bus Name	Full Contribution	Project Status
931022	AC2-008 E	2.78	W
931121	AC2-019 C	0.76	W
931122	AC2-019 E	1.25	W
931131	AC2-020 C OP	0.59	Active
931132	AC2-020 E OP	1.55	Active
931192	AC2-027 E	2.01	W
931221	AC2-031 C	23.37	Active
931222	AC2-031 E	11.51	Active
931281	AC2-042 C	73.05	Active
931282	AC2-042 E	48.7	Active
931351	AC2-049 C	20.15	Active
931352	AC2-049 E	13.43	Active
931381	AC2-055 C OP	1.86	Active
931382	AC2-055 E OP	3.04	Active
931421	AC2-060 C	5.36	Active
931422	AC2-060 E	3.02	Active
931431	AC2-061 C	20.27	Active
931432	AC2-061 E	20.55	Active

Bus Number	Bus Name	Full Contribution	Project Status
931441	AC2-062 C OP	6.62	Active
931442	AC2-062 E OP	2.96	Active
931451	AC2-064 C	47.29	Active
931452	AC2-064 E	31.53	Active
931651	AC2-087 C OP	3.97	Active
931652	AC2-087 E OP	3.15	Active
247592	W4-036	1.01	Active
924371	AB2-085 C OP	8.23	Active
924372	AB2-085 E OP	3.87	Active
924541	AB2-103 C OP	5.1	Active
924542	AB2-103 E OP	2.4	Active
926061	AC1-085 C	53.03	Active
926062	AC1-085 E	86.52	Active
926101	AC1-089 C	17.87	Active
926102	AC1-089 E	29.16	Active
926631	AC1-144 C	23.48	Active
926632	AC1-144 E	11.41	Active

Appendix 9

Bus Number	Bus Name	Full Contribution	Project Status	Bus Number	Bus Name	Full Contribution	Project Status
931022	AC2-008 E	2.83	W	931441	AC2-062 C OP	6.6	Active
931121	AC2-019 C	0.77	W	931442	AC2-062 E OP	2.95	Active
931122	AC2-019 E	1.26	W	931651	AC2-087 C OP	3.98	Active
931131	AC2-020 C OP	0.59	Active	931652	AC2-087 E OP	3.16	Active
931132	AC2-020 E OP	1.54	Active	247592	W4-036	1.01	Active
931192	AC2-027 E	2.04	W	916272	Z1-080 E	2.18	IS
931221	AC2-031 C	23.89	Active	924371	AB2-085 C OP	8.72	Active
931222	AC2-031 E	11.77	Active	924372	AB2-085 E OP	4.1	Active
931281	AC2-042 C	74.67	Active	924541	AB2-103 C OP	5.31	Active
931282	AC2-042 E	49.78	Active	924542	AB2-103 E OP	2.5	Active
931381	AC2-055 C OP	1.87	Active	926061	AC1-085 C	54.2	Active
931382	AC2-055 E OP	3.06	Active	926062	AC1-085 E	88.44	Active
931421	AC2-060 C	5.37	Active	926101	AC1-089 C	18.22	Active
931422	AC2-060 E	3.02	Active	926102	AC1-089 E	29.73	Active
931431	AC2-061 C	28.84	Active	926631	AC1-144 C	24	Active
931432	AC2-061 E	29.24	Active	926632	AC1-144 E	11.66	Active

Attachment 4. Option 2 Flowgate Details

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							
Bus Number	Bus Name	Full Contribution	Project Status	Bus Number	Bus Name	Full Contribution	Project Status
931022	AC2-008 E	1.31	W	931432	AC2-061 E	9.69	Active
931121	AC2-019 C	0.58	W	931441	AC2-062 C OP	5.12	Active
931122	AC2-019 E	0.95	W	931442	AC2-062 E OP	2.29	Active
931131	AC2-020 C OP	0.44	Active	931451	AC2-064 C	5.1	Active
931132	AC2-020 E OP	1.15	Active	931452	AC2-064 E	3.4	Active
931192	AC2-027 E	1.53	W	931651	AC2-087 C OP	2.69	Active
931221	AC2-031 C	11.02	Active	931652	AC2-087 E OP	2.14	Active
931222	AC2-031 E	5.43	Active	247592	W4-036	0.69	Active
931281	AC2-042 C	34.44	Active	924541	AB2-103 C OP	10.77	Active
931282	AC2-042 E	22.96	Active	924542	AB2-103 E OP	5.07	Active
931351	AC2-049 C	2.17	Active	926061	AC1-085 C	25	Active
931352	AC2-049 E	1.45	Active	926062	AC1-085 E	40.79	Active
931381	AC2-055 C OP	1.04	Active	926101	AC1-089 C	8.43	Active
931382	AC2-055 E OP	1.69	Active	926102	AC1-089 E	13.75	Active
931421	AC2-060 C	3.67	Active	926631	AC1-144 C	11.07	Active
931422	AC2-060 E	2.07	Active	926632	AC1-144 E	5.38	Active
931431	AC2-061 C	9.56	Active				

Appendix 2

Bus Number	Bus Name	Full Contribution	Project Status	Bus Number	Bus Name	Full Contribution	Project Status
931022	AC2-008 E	1.34	W	931441	AC2-062 C OP	14.53	Active
931121	AC2-019 C	0.59	W	931442	AC2-062 E OP	6.5	Active
931122	AC2-019 E	0.96	W	931451	AC2-064 C	5.11	Active
931131	AC2-020 C OP	0.44	Active	931452	AC2-064 E	3.41	Active
931132	AC2-020 E OP	1.16	Active	931651	AC2-087 C OP	2.71	Active
931192	AC2-027 E	1.55	W	931652	AC2-087 E OP	2.15	Active
931221	AC2-031 C	11.2	Active	247592	W4-036	0.69	Active
931222	AC2-031 E	5.51	Active	924371	AB2-085 C OP	27.11	Active
931281	AC2-042 C	34.99	Active	924372	AB2-085 E OP	12.76	Active
931282	AC2-042 E	23.33	Active	924541	AB2-103 C OP	10.95	Active
931351	AC2-049 C	2.18	Active	924542	AB2-103 E OP	5.15	Active
931352	AC2-049 E	1.45	Active	926061	AC1-085 C	25.4	Active
931381	AC2-055 C OP	1.04	Active	926062	AC1-085 E	41.44	Active
931382	AC2-055 E OP	1.7	Active	926101	AC1-089 C	8.57	Active
931421	AC2-060 C	3.7	Active	926102	AC1-089 E	13.99	Active
931422	AC2-060 E	2.08	Active	926631	AC1-144 C	11.25	Active
931431	AC2-061 C	9.71	Active	926632	AC1-144 E	5.46	Active
931432	AC2-061 E	9.84	Active				

Appendix 3

Bus Number	Bus Name	Full Contribution	Project Status
931022	AC2-008 E	2.78	W
931121	AC2-019 C	0.76	W
931122	AC2-019 E	1.25	W
931131	AC2-020 C OP	0.64	Active
931132	AC2-020 E OP	1.68	Active
931192	AC2-027 E	2.01	W
931221	AC2-031 C	23.37	Active
931222	AC2-031 E	11.51	Active
931281	AC2-042 C	73.05	Active
931282	AC2-042 E	48.7	Active
931381	AC2-055 C OP	1.51	Active
931382	AC2-055 E OP	2.47	Active
931421	AC2-060 C	5.36	Active
931422	AC2-060 E	3.02	Active
931431	AC2-061 C	20.27	Active
931432	AC2-061 E	20.55	Active

Bus Number	Bus Name	Full Contribution	Project Status
931441	AC2-062 C OP	6	Active
931442	AC2-062 E OP	2.68	Active
931651	AC2-087 C OP	3.93	Active
931652	AC2-087 E OP	3.12	Active
247592	W4-036	1.01	Active
924371	AB2-085 C OP	8.23	Active
924372	AB2-085 E OP	3.87	Active
924541	AB2-103 C OP	5.1	Active
924542	AB2-103 E OP	2.4	Active
926061	AC1-085 C	53.03	Active
926062	AC1-085 E	86.52	Active
926101	AC1-089 C	17.87	Active
926102	AC1-089 E	29.16	Active
926631	AC1-144 C	23.48	Active
926632	AC1-144 E	11.41	Active

Appendix 4

Bus Number	Bus Name	Full Contribution	Project Status	Bus Number	Bus Name	Full Contribution	Project Status
931022	AC2-008 E	2.83	W	931442	AC2-062 E OP	2.78	Active
931121	AC2-019 C	0.77	W	931651	AC2-087 C OP	3.94	Active
931122	AC2-019 E	1.26	W	931652	AC2-087 E OP	3.12	Active
931131	AC2-020 C OP	0.64	Active	247592	W4-036	1.01	Active
931132	AC2-020 E OP	1.68	Active	916272	Z1-080 E	2.18	IS
931192	AC2-027 E	2.04	W	924371	AB2-085 C OP	8.72	Active
931221	AC2-031 C	23.89	Active	924372	AB2-085 E OP	4.1	Active
931222	AC2-031 E	11.77	Active	924541	AB2-103 C OP	5.31	Active
931281	AC2-042 C	74.67	Active	924542	AB2-103 E OP	2.5	Active
931282	AC2-042 E	49.78	Active	926061	AC1-085 C	54.2	Active
931381	AC2-055 C OP	1.52	Active	926062	AC1-085 E	88.44	Active
931382	AC2-055 E OP	2.47	Active	926101	AC1-089 C	18.22	Active
931421	AC2-060 C	5.37	Active	926102	AC1-089 E	29.73	Active
931422	AC2-060 E	3.02	Active	926631	AC1-144 C	24	Active
931441	AC2-062 C OP	6.21	Active	926632	AC1-144 E	11.66	Active

Appendix 5

Bus Number	Bus Name	Full Contribution	Project Status
931022	AC2-008 E	2.78	W
931121	AC2-019 C	0.76	W
931122	AC2-019 E	1.25	W
931131	AC2-020 C OP	0.64	Active
931132	AC2-020 E OP	1.68	Active
931192	AC2-027 E	2.01	W
931221	AC2-031 C	23.37	Active
931222	AC2-031 E	11.51	Active
931281	AC2-042 C	73.05	Active
931282	AC2-042 E	48.7	Active
931381	AC2-055 C OP	1.51	Active
931382	AC2-055 E OP	2.47	Active
931421	AC2-060 C	5.36	Active
931422	AC2-060 E	3.02	Active
931431	AC2-061 C	20.27	Active
931432	AC2-061 E	20.55	Active

Bus Number	Bus Name	Full Contribution	Project Status
931441	AC2-062 C OP	6	Active
931442	AC2-062 E OP	2.68	Active
931651	AC2-087 C OP	3.93	Active
931652	AC2-087 E OP	3.12	Active
247592	W4-036	1.01	Active
924371	AB2-085 C OP	8.23	Active
924372	AB2-085 E OP	3.87	Active
924541	AB2-103 C OP	5.1	Active
924542	AB2-103 E OP	2.4	Active
926061	AC1-085 C	53.03	Active
926062	AC1-085 E	86.52	Active
926101	AC1-089 C	17.87	Active
926102	AC1-089 E	29.16	Active
926631	AC1-144 C	23.48	Active
926632	AC1-144 E	11.41	Active

Appendix 6

Bus Number	Bus Name	Full Contribution	Project Status
931022	AC2-008 E	1.34	W
931121	AC2-019 C	0.59	W
931122	AC2-019 E	0.96	W
931131	AC2-020 C OP	0.44	Active
931132	AC2-020 E OP	1.16	Active
931192	AC2-027 E	1.55	W
931221	AC2-031 C	11.2	Active
931222	AC2-031 E	5.51	Active
931281	AC2-042 C	34.99	Active
931282	AC2-042 E	23.33	Active
931351	AC2-049 C	2.18	Active
931352	AC2-049 E	1.45	Active
931381	AC2-055 C OP	1.04	Active
931382	AC2-055 E OP	1.7	Active
931421	AC2-060 C	3.7	Active
931422	AC2-060 E	2.08	Active
931431	AC2-061 C	9.71	Active
931432	AC2-061 E	9.84	Active

Bus Number	Bus Name	Full Contribution	Project Status
931441	AC2-062 C OP	14.53	Active
931442	AC2-062 E OP	6.5	Active
931451	AC2-064 C	5.11	Active
931452	AC2-064 E	3.41	Active
931651	AC2-087 C OP	2.71	Active
931652	AC2-087 E OP	2.15	Active
247592	W4-036	0.69	Active
924371	AB2-085 C OP	27.11	Active
924372	AB2-085 E OP	12.76	Active
924541	AB2-103 C OP	10.95	Active
924542	AB2-103 E OP	5.15	Active
926061	AC1-085 C	25.4	Active
926062	AC1-085 E	41.44	Active
926101	AC1-089 C	8.57	Active
926102	AC1-089 E	13.99	Active
926631	AC1-144 C	11.25	Active
926632	AC1-144 E	5.46	Active

Appendix 7

Bus Number	Bus Name	Full Contribution	Project Status	Bus Number	Bus Name	Full Contribution	Project Status
931022	AC2-008 E	2.83	W	931441	AC2-062 C OP	6.21	Active
931121	AC2-019 C	0.77	W	931442	AC2-062 E OP	2.78	Active
931122	AC2-019 E	1.26	W	931651	AC2-087 C OP	3.94	Active
931131	AC2-020 C OP	0.64	Active	931652	AC2-087 E OP	3.12	Active
931132	AC2-020 E OP	1.68	Active	247592	W4-036	1.01	Active
931192	AC2-027 E	2.04	W	916272	Z1-080 E	3.82	IS
931221	AC2-031 C	23.89	Active	924371	AB2-085 C OP	8.72	Active
931222	AC2-031 E	11.77	Active	924372	AB2-085 E OP	4.1	Active
931281	AC2-042 C	74.67	Active	924541	AB2-103 C OP	5.31	Active
931282	AC2-042 E	49.78	Active	924542	AB2-103 E OP	2.5	Active
931381	AC2-055 C OP	1.52	Active	926061	AC1-085 C	54.2	Active
931382	AC2-055 E OP	2.47	Active	926062	AC1-085 E	88.44	Active
931421	AC2-060 C	5.37	Active	926101	AC1-089 C	18.22	Active
931422	AC2-060 E	3.02	Active	926102	AC1-089 E	29.73	Active
931431	AC2-061 C	28.84	Active	926631	AC1-144 C	24	Active
931432	AC2-061 E	29.24	Active	926632	AC1-144 E	11.66	Active

Appendix 8

Bus Number	Bus Name	Full Contribution	Project Status
931022	AC2-008 E	2.78	W
931121	AC2-019 C	0.76	W
931122	AC2-019 E	1.25	W
931131	AC2-020 C OP	0.64	Active
931132	AC2-020 E OP	1.68	Active
931192	AC2-027 E	2.01	W
931221	AC2-031 C	23.37	Active
931222	AC2-031 E	11.51	Active
931281	AC2-042 C	73.05	Active
931282	AC2-042 E	48.7	Active
931351	AC2-049 C	20.15	Active
931352	AC2-049 E	13.43	Active
931381	AC2-055 C OP	1.51	Active
931382	AC2-055 E OP	2.47	Active
931421	AC2-060 C	5.36	Active
931422	AC2-060 E	3.02	Active
931431	AC2-061 C	20.27	Active
931432	AC2-061 E	20.55	Active

Bus Number	Bus Name	Full Contribution	Project Status
931441	AC2-062 C OP	6	Active
931442	AC2-062 E OP	2.68	Active
931451	AC2-064 C	47.29	Active
931452	AC2-064 E	31.53	Active
931651	AC2-087 C OP	3.93	Active
931652	AC2-087 E OP	3.12	Active
247592	W4-036	1.01	Active
924371	AB2-085 C OP	8.23	Active
924372	AB2-085 E OP	3.87	Active
924541	AB2-103 C OP	5.1	Active
924542	AB2-103 E OP	2.4	Active
926061	AC1-085 C	53.03	Active
926062	AC1-085 E	86.52	Active
926101	AC1-089 C	17.87	Active
926102	AC1-089 E	29.16	Active
926631	AC1-144 C	23.48	Active
926632	AC1-144 E	11.41	Active

Appendix 9

Bus Number	Bus Name	Full Contribution	Project Status	Bus Number	Bus Name	Full Contribution	Project Status
931022	AC2-008 E	2.83	W	931441	AC2-062 C OP	6.21	Active
931121	AC2-019 C	0.77	W	931442	AC2-062 E OP	2.78	Active
931122	AC2-019 E	1.26	W	931651	AC2-087 C OP	3.94	Active
931131	AC2-020 C OP	0.64	Active	931652	AC2-087 E OP	3.12	Active
931132	AC2-020 E OP	1.68	Active	247592	W4-036	1.01	Active
931192	AC2-027 E	2.04	W	916272	Z1-080 E	2.18	IS
931221	AC2-031 C	23.89	Active	924371	AB2-085 C OP	8.72	Active
931222	AC2-031 E	11.77	Active	924372	AB2-085 E OP	4.1	Active
931281	AC2-042 C	74.67	Active	924541	AB2-103 C OP	5.31	Active
931282	AC2-042 E	49.78	Active	924542	AB2-103 E OP	2.5	Active
931381	AC2-055 C OP	1.52	Active	926061	AC1-085 C	54.2	Active
931382	AC2-055 E OP	2.47	Active	926062	AC1-085 E	88.44	Active
931421	AC2-060 C	5.37	Active	926101	AC1-089 C	18.22	Active
931422	AC2-060 E	3.02	Active	926102	AC1-089 E	29.73	Active
931431	AC2-061 C	28.84	Active	926631	AC1-144 C	24	Active
931432	AC2-061 E	29.24	Active	926632	AC1-144 E	11.66	Active