



Generation Interconnection

Feasibility Study Report

for

Queue Project AG1-059

ROBBINS 138 KV

69.6 MW Capacity / 116 MW Energy

January 2021

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1 Introduction

This Feasibility Study has been prepared in accordance with the PJM Open Access Transmission Tariff, 36.2, as well as the Feasibility Study Agreement between the Interconnection Customer (IC), and PJM Interconnection, LLC (PJM), Transmission Provider (TP). The Interconnected Transmission Owner (ITO) is APS.

2 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. Cost allocation rules for network upgrades can be found in PJM Manual 14A, Attachment B. The possibility of sharing the reinforcement costs with other projects may be identified in the feasibility study, but the actual allocation will be deferred until the impact study is performed.

The Interconnection Customer seeking to interconnect a wind or solar generation facility shall maintain meteorological data facilities as well as provide that meteorological data which is required per Schedule H to the Interconnection Service Agreement and Section 8 of Manual 14D.

An Interconnection Customer 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.

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.

3 General

The Interconnection Customer (IC), has proposed a Solar generating facility located in Westmoreland County, Pennsylvania. The installed facilities will have a total capability of 116 MW with 69.6 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is January 01, 2023. This study does not imply a TO commitment to this in-service date.

Queue Number	AG1-059
Project Name	ROBBINS 138 KV
State	Pennsylvania
County	Westmoreland
Transmission Owner	APS
MFO	116
MWE	116
MWC	69.6
Fuel	Solar
Basecase Study Year	2024

Any new service customers who can feasibly be commercially operable prior to June 1st of the basecase study year are required to request interim deliverability analysis.

4 Point of Interconnection

4.1 Primary POI

AG1-059 will interconnect with the FirstEnergy, West Penn Power system. The interconnection of the project at the Primary POI will be accomplished by constructing a new direct connection to the Robbins 138 kV Substation in the APS area. The IC will be responsible for acquiring all easements, properties, and permits that may be required for construction.

Attachment 1 shows a one-line diagram of the proposed primary direct connection facilities for the AG1-059 generation project to connect to the FirstEnergy (“FE”) transmission system. IC will be responsible for constructing all of the facilities on its side of the POI, including the Attachment facilities which connect the generator to the FE transmission system.

4.2 Secondary POI

The interconnection of the project at a Secondary POI can be accomplished by tapping the Wycoff–Springdale 138 kV line in the APS area. A full scope of work or estimated cost is not provided for the proposed Secondary POI.

This report does not provide costs for the interconnection of the Secondary POI. The Secondary POI was analyzed for network impacts by PJM. Network impact results for the transmission system are shown in the Summer Peak - Load Flow Analysis – Secondary Point of Interconnection section of this report. If the customer selects the Secondary POI, then FirstEnergy will evaluate any impacts to their below 100 kV system for that interconnection in the System Impact Study phase.

5 Cost Summary

The AG1-059 project will be responsible for the following costs:

Description	Total Cost
Total Physical Interconnection Costs	\$2,232,000
Total System Network Upgrade Costs	\$38,815,245 ¹
Total Costs	\$41,047,245

This cost excludes a Federal Income Tax Gross Up charges. This tax may or may not be charged based on whether this project meets the eligibility requirements of IRS Notice 2016-36, 2016-25 I.R.B. (6/20/2016). If at

¹ This project currently causes and/or contributes to overloads of the Transmission System (see Summer Peak Load Flow Analysis section below) and therefore has potential to have cost allocation for the system reinforcements listed in the report. This will be re-evaluated in the System Impact phase. The results may vary with queue customers withdrawing from the queue and other generators deactivating over time. If a customer is the first to cause the need for a project (causes loading to exceed 100% of rating), then the customer is responsible. If a customer contributes to a facility that is already overloaded by a prior queue, then they may receive cost allocation.

a future date it is determined that the Federal Income Tax Gross charge is required, the Transmission Owner shall be reimbursed by the Interconnection Customer for such taxes.

Cost allocations for any System Upgrades will be provided in the System Impact Study Report.

6 Transmission Owner Scope of Work

AG1-059 will interconnect with the FirstEnergy (APS) system. The interconnection of the project will be accomplished by constructing a new direct connection to the Robbins 138 kV Substation. The IC will be responsible for acquiring all easements, properties, and permits that may be required for construction.

The total physical interconnection costs is given in the table below:

Description	Total Cost
At Robbins Substation, extend the #2 138 kV bus.	\$140,000
Install a 138 kV breaker with SCADA control and disconnect switch.	\$1,310,000
Upgrade relaying at Robbins Substation.	\$782,000
Total Physical Interconnection Costs	\$2,232,000

7 Schedule

Based on the scope of work for the interconnection facilities, it is expected to take a minimum of **24 months** after the signing of an Interconnection Construction Service Agreement and construction kickoff call to complete the installation. This assumes that there will be no environmental issues with any of the new properties associated with this project, that there will be no delays in acquiring the necessary permits for implementing the defined Direct Connection and network upgrades, and that all transmission system outages will be allowed when requested.

If the customer is ultimately responsible for network upgrades, then the schedule for those upgrades will be refined in future study phases. The customer would need to wait for those upgrades to be completed prior to commercial operation unless determined deliverable by an interim deliverability study. The elapsed time to complete any network upgrades is provided in the System Reinforcements table of this report¹.

8 Transmission Owner Analysis

FE performed an analysis of its underlying transmission <100 kV system. The AG1-059 project did not contribute to any overloads on the FE transmission <100 kV system.

9 Interconnection Customer Requirements

9.1 System Protection

The IC must design its Customer Facilities in accordance with all applicable standards, including the standards in FE's "Requirements for Transmission Connected Facilities" document located at:

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

Preliminary Protection requirements will be provided as part of the Facilities Study. Detailed Protection Requirements will be provided once the project enters the construction phase.

The IC has requested a non-standard GSU transformer winding configuration. This transformer is in violation of section 14.2.6 of FE's "Requirement for Transmission Connected Facilities" document and will not be accepted. The GSU transformer must have a grounded wye connection on the high (utility) side and delta connected on the low side.

9.2 Compliance Issues and Interconnection Customer Requirements

The proposed Customer Facilities must be designed in accordance with FE's "Requirements for Transmission Connected Facilities" document located at: <http://www.pjm.com/planning/design-engineering/to-tech-standards/private-firstenergy.aspx>. In particular, the IC is responsible for the following:

1. The purchase and installation of a fully rated 138 kV circuit breaker to protect the AG1-059 generator lead line. A single circuit breaker must be used to protect this line; if the project has

several GSU transformers, the individual GSU transformer breakers cannot be used to protect this line.

2. 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.
3. 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.
4. Compliance with the FE and PJM generator power factor and voltage control requirements.
5. The execution of a back-up service agreement to serve the customer load supplied from the AG1-059 generation project metering point when the units are out-of-service. This assumes the intent of the IC is to net the generation with the load.

The IC will also be required to meet all PJM, ReliabilityFirst, and NERC reliability criteria and operating procedures for standards compliance. For example, the IC will need to properly locate and report the over and under voltage and over and under frequency system protection elements for its units as well as the submission of the generator model and protection data required to satisfy the PJM and ReliabilityFirst audits. Failure to comply with these requirements may result in a disconnection of service if the violation is found to compromise the reliability of the FE Transmission System.

9.3 Power Factor Requirements

The IC shall design its non-synchronous Customer Facility with the ability to maintain a power factor of at least 0.95 leading (absorbing VARs) to 0.95 lagging (supplying VARs) measured at the high-side of the facility substation transformer(s) connected to the FE Transmission System.

10 Revenue Metering and SCADA Requirements

10.1 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 Section 8 of Attachment O.

10.2 Meteorological Data Reporting Requirements

The solar generation facility shall provide the Transmission Provider with site-specific meteorological data including:

- Back Panel temperature (Fahrenheit) - (Required for plants with Maximum Facility Output of 3 MW or higher)

- Irradiance (Watts/meter²) - (Required for plants with Maximum Facility Output of 3 MW or higher)
- Ambient air temperature (Fahrenheit) - (Accepted, not required)
- Wind speed (meters/second) - (Accepted, not required)
- Wind direction (decimal degrees from true north) - (Accepted, not required)

10.3 Interconnected Transmission Owner Requirements

The IC will be required to comply with all Interconnected Transmission Owner's revenue metering requirements for generation interconnection customers located at the following link:

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

11 Summer Peak - Load Flow Analysis - Primary POI

The Queue Project AG1-059 was evaluated as a 116.0 MW (Capacity 69.6 MW) injection at the Robbins 138 kV substation in the APS area. Project AG1-059 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AG1-059 was studied with a commercial probability of 53.0 %. Potential network impacts were as follows:

11.1 Generation Deliverability

(Single or N-1 contingencies for the Capacity portion only of the interconnection)

None

11.2 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	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC DC	MW IMPACT
16549111 2	23523 8	01ROBBIN	138.0	AP	23519 5	01HUNTD N	138.0	AP	1	AP-P7-1-WPP-138-113-01	tower	287.0	87.93	112.85	DC	71.54
16726785 2	23523 8	01ROBBIN	138.0	AP	23519 5	01HUNTD N	138.0	AP	1	AP-P2-3-WP-138-AA2-161-B5	breaker	287.0	87.93	112.85	DC	71.54
16549111 1	92058 0	AA2-161 TAP	138.0	AP	23528 3	01WYCOFJ	138.0	AP	1	AP-P7-1-WPP-138-113-01	tower	332.0	99.5	112.89	DC	44.46
16703888 7	92058 0	AA2-161 TAP	138.0	AP	23528 3	01WYCOFJ	138.0	AP	1	AP-P2-3-WP-138-AA2-161-B5	breaker	332.0	99.5	112.89	DC	44.46

11.3 Contribution to Previously Identified Overloads

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

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC DC	MW IMPACT
169543250	920570	AA2-161 TAP	138.0	AP	235277	01YUKON	138.0	AP	1	AP-P1-2-WP-138-049	single	384.0	117.41	127.69	DC	39.5
169543243	920580	AA2-161 TAP	138.0	AP	235277	01YUKON	138.0	AP	1	AP-P1-2-WP-138-048	single	384.0	118.55	128.69	DC	38.94

11.4 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	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CK T ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC DC	MW IMPACT
169543249	920570	AA2-161 TAP	138.0	AP	235277	01YUKON	138.0	AP	1	AP-P1-2-WP-138-049	operation	384.0	118.81	135.96	DC	65.84
169543242	920580	AA2-161 TAP	138.0	AP	235277	01YUKON	138.0	AP	1	AP-P1-2-WP-138-048	operation	384.0	119.97	136.87	DC	64.9

11.5 System Reinforcements - Summer Peak Load Flow - Primary POI

ID	Idx	Facility	Upgrade Description	Cost
165491112,167 267852	1	01ROBBIN 138.0 kV - 01HUNTDN 138.0 kV Ckt 1	<u>APS</u> WP-AG1-F-0022 (872) : Replace RT (KD-4 & KD-41) at Huntingdon substation. Project Type : FAC Cost : \$781,515 Time Estimate : 12.0 Months	\$781,515
169543243	4	AA2-161 TAP 138.0 kV - 01YUKON 138.0 kV Ckt 1	<u>APS</u> WP-AG1-F-0025A (879) : Reconductor 5.1 miles of 1024.5 ACAR 24/13 from Yukon Substation to the new AA2-161 substation on the Yukon - Wycoff Jct 138 kV line. This line shares a common structure with the Yukon - AA2-161 - Robbins 138 kV line. Project Type : FAC Cost : \$13,285,755 Time Estimate : 42.0 Months WP-AG1-F-0025B (880) : Replace 954 ACSR 45/7 Line Risers at Yukon substation. Project Type : FAC Cost : \$130,252 Time Estimate : 12.0 Months WP-AG1-F-0025C (881) : Replace Relays (ZR, OR, AUX CT GEN, & KC-4) at Yukon substation. Project Type : FAC Cost : \$781,515 Time Estimate : 12.0 Months	\$14,197,522
165491111,167 038887	2	AA2-161 TAP 138.0 kV - 01ROUTE51 138.0 kV Ckt 1	<u>APS</u> WP-AG1-F-0026 (882) : Reconductor 3.6 miles of 1024.5 ACAR 24/13 from the new AA2-161 substation to Wycoff Jct on the Yukon - Wycoff Jct 138 kV line. This line shares a common structure with the Yukon - AA2-161 - Robbins 138 kV line. Project Type : FAC Cost : \$9,378,180 Time Estimate : 36.0 Months	\$9,378,180

ID	Idx	Facility	Upgrade Description	Cost
169543250	3	AA2-161 TAP 138.0 kV - 01YUKON 138.0 kV Ckt 1	<p><u>APS</u> WP-AG1-F-0024A (875) : Reconductor 5.1 miles of 1024.5 ACAR 24/13 from Yukon Substation to the new AA2-161 substation on the Yukon - Robbins 138 kV line. This line shares a common structure with the Yukon - AA2-161 - Wycoff 138 kV line. Project Type : FAC Cost : \$13,285,755 Time Estimate : 42.0 Months</p> <p>WP-AG1-F-0024B (876) : Replace 954 ACSR 45/7 Line Risers at Yukon substation. Project Type : FAC Cost : \$130,252 Time Estimate : 12.0 Months</p> <p>WP-AG1-F-0024C (877) : Replace 1200 A disconnect switch at Yukon substation. Project Type : FAC Cost : \$260,505 Time Estimate : 12.0 Months</p> <p>WP-AG1-F-0024D (878) : Replace Relay Terminals (Aux CT GEN, KD-4, & KC-4) at Yukon substation. Project Type : FAC Cost : \$781,515 Time Estimate : 12.0 Months</p>	\$14,458,028
TOTAL COST				\$38,815,245

11.6 Flow Gate Details - Primary POI

The following indices contain additional information about each facility presented in the body of the report. For each index, a description of the flowgate and its contingency was included for convenience. The intent of the indices is to provide more details on which projects/generators have contributions to the flowgate in question. All New Service Queue Requests, through the end of the Queue under study, that are contributors to a flowgate will be listed in the indices. Please note that there may be contributors that are subsequently queued after the queue under study that are not listed in the indices. Although this information is not used "as is" for cost allocation purposes, it can be used to gage the impact of other projects/generators. It should be noted the project/generator MW contributions presented in the body of the report are Full MW Impact contributions which are also noted in the indices column named "Full MW Impact", whereas the loading percentages reported in the body of the report, take into consideration the PJM Generator Deliverability Test rules such as commercial probability of each project as well as the ramping impact of "Adder" contributions. The MW Impact found and used in the analysis is shown in the indices column named "Gendeliv MW Impact".

11.6.1 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
167267852	235238	01ROBBIN	AP	235195	01HUNTDN	AP	1	AP-P2-3-WP-138-AA2-161-B5	breaker	287.0	87.93	112.85	DC	71.54

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
920571	AA2-161 C	225.5917	50/50	225.5917
941401	AE2-137	38.2582	50/50	38.2582
962141	AG1-059 C O1	42.9244	50/50	42.9244
962142	AG1-059 E O1	28.6163	50/50	28.6163
WEC	WEC	0.0104	Confirmed LTF	0.0104
LGEE	LGEE	0.0201	Confirmed LTF	0.0201
CPL	CPL	0.0109	Confirmed LTF	0.0109
CBM-W2	CBM-W2	0.2598	Confirmed LTF	0.2598
NY	NY	0.0293	Confirmed LTF	0.0293
TVA	TVA	0.0378	Confirmed LTF	0.0378
O-066	O-066	0.2827	Confirmed LTF	0.2827
SIGE	SIGE	0.0078	Confirmed LTF	0.0078
CBM-S2	CBM-S2	0.2088	Confirmed LTF	0.2088
CBM-S1	CBM-S1	0.0106	Confirmed LTF	0.0106
G-007	G-007	0.0431	Confirmed LTF	0.0431
MEC	MEC	0.0508	Confirmed LTF	0.0508
LAGN	LAGN	0.0490	Confirmed LTF	0.0490
CBM-W1	CBM-W1	0.4767	Confirmed LTF	0.4767

11.6.2 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
167038887	920580	AA2-161 TAP	AP	235283	01WYCOFJ	AP	1	AP-P2-3-WP-138-AA2-161-B5	breaker	332.0	99.5	112.89	DC	44.46

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
920571	AA2-161 C	287.4082	50/50	287.4082
941401	AE2-137	48.7417	50/50	48.7417
962141	AG1-059 C O1	26.6756	50/50	26.6756
962142	AG1-059 E O1	17.7837	50/50	17.7837
G-007A	G-007A	0.0983	Confirmed LTF	0.0983
VFT	VFT	0.2645	Confirmed LTF	0.2645
CALDERWOOD	CALDERWOOD	0.0129	Confirmed LTF	0.0129
PRAIRIE	PRAIRIE	0.0801	Confirmed LTF	0.0801
CHEOAH	CHEOAH	0.0125	Confirmed LTF	0.0125
CBM-N	CBM-N	0.0504	Confirmed LTF	0.0504
COTTONWOOD	COTTONWOOD	0.0588	Confirmed LTF	0.0588
HAMLET	HAMLET	0.0104	Confirmed LTF	0.0104
GIBSON	GIBSON	0.0175	Confirmed LTF	0.0175
BLUEG	BLUEG	0.0556	Confirmed LTF	0.0556
TRIMBLE	TRIMBLE	0.0178	Confirmed LTF	0.0178
CATAWBA	CATAWBA	0.0070	Confirmed LTF	0.0070

11.6.3 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
169543250	920570	AA2-161 TAP	AP	235277	01YUKON	AP	1	AP-P1-2-WP-138-049	single	384.0	117.41	127.69	DC	39.5

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
235030	01MHNG-T155	0.0802	80/20	0.0802
235134	01AL&D6	0.1489	80/20	0.1489
235610	01SPRGD1	1.5901	80/20	1.5901
235611	01SPRGD2	1.5901	80/20	1.5901
235612	01SPRGD3	5.8121	80/20	5.8121
235613	01SPRGD4	5.7254	80/20	5.7254
235614	01SPRGD5	6.0578	80/20	6.0578
235776	01AL DAM5	0.1280	80/20	0.1280
920571	AA2-161 C	370.4937	80/20	370.4937
936881	AD2-112 C	10.6213	80/20	10.6213
941401	AE2-137	62.8323	80/20	62.8323
945021	AF1-167 C	0.4181	80/20	0.4181
945451	AF1-210 C	0.5582	80/20	0.5582
960231	AF2-314 C	0.7018	80/20	0.7018
960891	AF2-380 C	0.4560	80/20	0.4560
962141	AG1-059 C O1	39.5036	80/20	39.5036
966451	AG1-514 C	0.8399	80/20	0.8399
G-007A	G-007A	0.6833	Confirmed LTF	0.6833
VFT	VFT	1.9028	Confirmed LTF	1.9028
CALDERWOOD	CALDERWOOD	0.1740	Confirmed LTF	0.1740
PRAIRIE	PRAIRIE	0.7930	Confirmed LTF	0.7930
CHEOAH	CHEOAH	0.1757	Confirmed LTF	0.1757
CBM-N	CBM-N	0.3840	Confirmed LTF	0.3840
COTTONWOOD	COTTONWOOD	0.6909	Confirmed LTF	0.6909
HAMLET	HAMLET	0.2212	Confirmed LTF	0.2212
GIBSON	GIBSON	0.1643	Confirmed LTF	0.1643
BLUEG	BLUEG	0.5330	Confirmed LTF	0.5330
TRIMBLE	TRIMBLE	0.1708	Confirmed LTF	0.1708
CATAWBA	CATAWBA	0.1316	Confirmed LTF	0.1316

11.6.4 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
169543243	920580	AA2-161 TAP	AP	235277	01YUKON	AP	1	AP-P1-2-WP-138-048	single	384.0	118.55	128.69	DC	38.94

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
235030	01MHNG-T155	0.0811	80/20	0.0811
235134	01AL&D6	0.1506	80/20	0.1506
235610	01SPRGD1	1.6083	80/20	1.6083
235611	01SPRGD2	1.6083	80/20	1.6083
235612	01SPRGD3	5.8785	80/20	5.8785
235613	01SPRGD4	5.7908	80/20	5.7908
235614	01SPRGD5	6.1271	80/20	6.1271
235776	01AL DAM5	0.1294	80/20	0.1294
920571	AA2-161 C	373.8795	80/20	373.8795
936881	AD2-112 C	10.7428	80/20	10.7428
941401	AE2-137	63.4065	80/20	63.4065
945021	AF1-167 C	0.4228	80/20	0.4228
945451	AF1-210 C	0.5644	80/20	0.5644
960231	AF2-314 C	0.7094	80/20	0.7094
960891	AF2-380 C	0.4612	80/20	0.4612
962141	AG1-059 C O1	38.9391	80/20	38.9391
966451	AG1-514 C	0.8495	80/20	0.8495
G-007A	G-007A	0.6881	Confirmed LTF	0.6881
VFT	VFT	1.9157	Confirmed LTF	1.9157
CALDERWOOD	CALDERWOOD	0.1754	Confirmed LTF	0.1754
PRAIRIE	PRAIRIE	0.8007	Confirmed LTF	0.8007
CHEOAH	CHEOAH	0.1772	Confirmed LTF	0.1772
CBM-N	CBM-N	0.3864	Confirmed LTF	0.3864
COTTONWOOD	COTTONWOOD	0.6972	Confirmed LTF	0.6972
HAMLET	HAMLET	0.2235	Confirmed LTF	0.2235
GIBSON	GIBSON	0.1654	Confirmed LTF	0.1654
BLUEG	BLUEG	0.5364	Confirmed LTF	0.5364
TRIMBLE	TRIMBLE	0.1720	Confirmed LTF	0.1720
CATAWBA	CATAWBA	0.1330	Confirmed LTF	0.1330

11.7 Queue Dependencies

The Queue Projects below are listed in one or more indices for the overloads identified in your report. These projects contribute to the loading of the overloaded facilities identified in your report. The percent overload of a facility and cost allocation you may have towards a particular reinforcement could vary depending on the action of these earlier projects. The status of each project at the time of the analysis is presented in the table. This list may change as earlier projects withdraw or modify their requests.

Queue Number	Project Name	Status
AA2-161	Yukon-Robbins 138kV	Engineering and Procurement
AD2-112	Springdale CC II 138kV	Engineering and Procurement
AE2-137	Yukon-Robbins 138 kV II	Active
AF1-167	West Freedom-C&K Coal 25 kV	Active
AF1-210	Burma 23 kV	Engineering and Procurement
AF2-314	Vandergrift 25 kV	Active
AF2-380	Karns City-Bear Creek 25 kV	Active
AG1-059	Robbins 138 kV	Active
AG1-514	Springdale CT III 138 kV	Active

11.8 Contingency Descriptions - Primary POI

Contingency Name	Contingency Definition
AP-P2-3-WP-138-AA2-161-B5	CONTINGENCY "'AP-P2-3-WP-138-AA2-161-B5'" / 498 OPEN BRANCH FROM BUS 235277 TO BUS 920570 CKT 1 / 235277 01YUKON 138 920570 AA2-161 TAP 138 1 OPEN BRANCH FROM BUS 235277 TO BUS 920580 CKT 1 / 235277 01YUKON 138 920580 AA2-161 TAP 138 1 END
AP-P1-2-WP-138-048	CONTINGENCY 'AP-P1-2-WP-138-048' /* AA2-161 - YUKON 138 KV (ROBBINS) DISCONNECT BRANCH FROM BUS 235277 TO BUS 920570 CKT 1 /* 01YUKON 138 AA2- 161 END
AP-P7-1-WPP-138-113-01	CONTINGENCY 'AP-P7-1-WPP-138-113-01' /* YUKON - AA2-161 LINES DISCONNECT BRANCH FROM BUS 235277 TO BUS 920570 CKT 1 /* 01YUKON 138 AA2- 161 138 DISCONNECT BRANCH FROM BUS 235277 TO BUS 920580 CKT 1 /* 01YUKON 138 AA2- 161 138 END
AP-P1-2-WP-138-049	CONTINGENCY 'AP-P1-2-WP-138-049' /* AA2-161 - YUKON 138 KV (WYCOFF JCT) DISCONNECT BRANCH FROM BUS 235277 TO BUS 920580 CKT 1 /* 01YUKON 138 AA2- 161 138 END

12 Short Circuit Analysis - Primary POI

The following Breakers are overdutied:

None

12.1 System Reinforcements - Short Circuit

None

13 Summer Peak - Load Flow Analysis - Secondary POI

The Queue Project AG1-059 was evaluated as a 116.0 MW (Capacity 69.6 MW) injection tapping the Wycoff to Springdale 138 kV line in the APS area. Project AG1-059 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AG1-059 was studied with a commercial probability of 53.0 %. Potential network impacts were as follows:

13.1 Generation Deliverability

(Single or N-1 contingencies for the Capacity portion only of the interconnection)

None

13.2 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	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC DC	MW IMPACT
171689958	920570	AA2-161 TAP	138.0	AP	235238	01ROBBIN	138.0	AP	1	AP-P7-1-WPP-138-113-01	tower	287.0	94.72	106.28	DC	33.17
173966577	920570	AA2-161 TAP	138.0	AP	235238	01ROBBIN	138.0	AP	1	AP-P2-3-WP-138-AA2-161-B5	breaker	287.0	94.72	106.28	DC	33.17

13.3 Contribution to Previously Identified Overloads

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

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC DC	MW IMPACT
169543250	920570	AA2-161 TAP	138.0	AP	235277	01YUKON	138.0	AP	1	AP-P1-2-WP-138-049	single	384.0	117.41	127.24	DC	37.75
169543243	920580	AA2-161 TAP	138.0	AP	235277	01YUKON	138.0	AP	1	AP-P1-2-WP-138-048	single	384.0	118.55	128.71	DC	39.01

13.4 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	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADIN G %	POST PROJECT LOADIN G %	AC D C	MW IMPAC T
16954324 9	92057 0	AA2- 161 TAP	138. 0	AP	23527 7	01YUKO N	138. 0	AP	1	AP- P1-2- WP- 138- 049	operatio n	384.0	118.81	135.2	DC	62.92
16954324 2	92058 0	AA2- 161 TAP	138. 0	AP	23527 7	01YUKO N	138. 0	AP	1	AP- P1-2- WP- 138- 048	operatio n	384.0	119.97	136.9	DC	65.01

13.5 Flow Gate Details - Secondary POI

The following indices contain additional information about each facility presented in the body of the report. For each index, a description of the flowgate and its contingency was included for convenience. The intent of the indices is to provide more details on which projects/generators have contributions to the flowgate in question. All New Service Queue Requests, through the end of the Queue under study, that are contributors to a flowgate will be listed in the indices. Please note that there may be contributors that are subsequently queued after the queue under study that are not listed in the indices. Although this information is not used "as is" for cost allocation purposes, it can be used to gage the impact of other projects/generators. It should be noted the project/generator MW contributions presented in the body of the report are Full MW Impact contributions which are also noted in the indices column named "Full MW Impact", whereas the loading percentages reported in the body of the report, take into consideration the PJM Generator Deliverability Test rules such as commercial probability of each project as well as the ramping impact of "Adder" contributions. The MW Impact found and used in the analysis is shown in the indices column named "Gendeliv MW Impact".

13.5.1 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
173966577	920570	AA2-161 TAP	AP	235238	01ROBBIN	AP	1	AP-P2-3-WP-138-AA2-161-B5	breaker	287.0	94.72	106.28	DC	33.17

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
920571	AA2-161 C	225.5917	50/50	225.5917
941401	AE2-137	38.2582	50/50	38.2582
962141	AG1-059 C O2	19.9014	50/50	19.9014
962142	AG1-059 E O2	13.2676	50/50	13.2676
WEC	WEC	0.0104	Confirmed LTF	0.0104
LGEE	LGEE	0.0201	Confirmed LTF	0.0201
CPL	CPL	0.0109	Confirmed LTF	0.0109
CBM-W2	CBM-W2	0.2598	Confirmed LTF	0.2598
NY	NY	0.0293	Confirmed LTF	0.0293
TVA	TVA	0.0378	Confirmed LTF	0.0378
O-066	O-066	0.2827	Confirmed LTF	0.2827
SIGE	SIGE	0.0078	Confirmed LTF	0.0078
CBM-S2	CBM-S2	0.2088	Confirmed LTF	0.2088
CBM-S1	CBM-S1	0.0106	Confirmed LTF	0.0106
G-007	G-007	0.0431	Confirmed LTF	0.0431
MEC	MEC	0.0508	Confirmed LTF	0.0508
LAGN	LAGN	0.0490	Confirmed LTF	0.0490
CBM-W1	CBM-W1	0.4767	Confirmed LTF	0.4767

13.5.2 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
169543250	920570	AA2-161 TAP	AP	235277	01YUKON	AP	1	AP-P1-2-WP-138-049	single	384.0	117.41	127.24	DC	37.75

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
235030	01MHNG-T155	0.0802	80/20	0.0802
235134	01AL&D6	0.1489	80/20	0.1489
235610	01SPRGD1	1.5901	80/20	1.5901
235611	01SPRGD2	1.5901	80/20	1.5901
235612	01SPRGD3	5.8121	80/20	5.8121
235613	01SPRGD4	5.7254	80/20	5.7254
235614	01SPRGD5	6.0578	80/20	6.0578
235776	01AL DAM5	0.1280	80/20	0.1280
920571	AA2-161 C	370.4937	80/20	370.4937
936881	AD2-112 C	10.6213	80/20	10.6213
941401	AE2-137	62.8323	80/20	62.8323
945021	AF1-167 C	0.4181	80/20	0.4181
945451	AF1-210 C	0.5582	80/20	0.5582
960231	AF2-314 C	0.7018	80/20	0.7018
960891	AF2-380 C	0.4560	80/20	0.4560
962141	AG1-059 C O2	37.7496	80/20	37.7496
966451	AG1-514 C	0.8399	80/20	0.8399
G-007A	G-007A	0.6833	Confirmed LTF	0.6833
VFT	VFT	1.9028	Confirmed LTF	1.9028
CALDERWOOD	CALDERWOOD	0.1740	Confirmed LTF	0.1740
PRAIRIE	PRAIRIE	0.7930	Confirmed LTF	0.7930
CHEOAH	CHEOAH	0.1757	Confirmed LTF	0.1757
CBM-N	CBM-N	0.3840	Confirmed LTF	0.3840
COTTONWOOD	COTTONWOOD	0.6909	Confirmed LTF	0.6909
HAMLET	HAMLET	0.2212	Confirmed LTF	0.2212
GIBSON	GIBSON	0.1643	Confirmed LTF	0.1643
BLUEG	BLUEG	0.5330	Confirmed LTF	0.5330
TRIMBLE	TRIMBLE	0.1708	Confirmed LTF	0.1708
CATAWBA	CATAWBA	0.1316	Confirmed LTF	0.1316

13.5.3 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
169543243	920580	AA2-161 TAP	AP	235277	01YUKON	AP	1	AP-P1-2-WP-138-048	single	384.0	118.55	128.71	DC	39.01

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
235030	01MHNG-T155	0.0811	80/20	0.0811
235134	01AL&D6	0.1506	80/20	0.1506
235610	01SPRGD1	1.6083	80/20	1.6083
235611	01SPRGD2	1.6083	80/20	1.6083
235612	01SPRGD3	5.8785	80/20	5.8785
235613	01SPRGD4	5.7908	80/20	5.7908
235614	01SPRGD5	6.1271	80/20	6.1271
235776	01AL DAM5	0.1294	80/20	0.1294
920571	AA2-161 C	373.8795	80/20	373.8795
936881	AD2-112 C	10.7428	80/20	10.7428
941401	AE2-137	63.4065	80/20	63.4065
945021	AF1-167 C	0.4228	80/20	0.4228
945451	AF1-210 C	0.5644	80/20	0.5644
960231	AF2-314 C	0.7094	80/20	0.7094
960891	AF2-380 C	0.4612	80/20	0.4612
962141	AG1-059 C O2	39.0073	80/20	39.0073
966451	AG1-514 C	0.8495	80/20	0.8495
G-007A	G-007A	0.6881	Confirmed LTF	0.6881
VFT	VFT	1.9157	Confirmed LTF	1.9157
CALDERWOOD	CALDERWOOD	0.1754	Confirmed LTF	0.1754
PRAIRIE	PRAIRIE	0.8007	Confirmed LTF	0.8007
CHEOAH	CHEOAH	0.1772	Confirmed LTF	0.1772
CBM-N	CBM-N	0.3864	Confirmed LTF	0.3864
COTTONWOOD	COTTONWOOD	0.6972	Confirmed LTF	0.6972
HAMLET	HAMLET	0.2235	Confirmed LTF	0.2235
GIBSON	GIBSON	0.1654	Confirmed LTF	0.1654
BLUEG	BLUEG	0.5364	Confirmed LTF	0.5364
TRIMBLE	TRIMBLE	0.1720	Confirmed LTF	0.1720
CATAWBA	CATAWBA	0.1330	Confirmed LTF	0.1330

13.6 Contingency Descriptions - Secondary POI

Contingency Name	Contingency Definition
AP-P2-3-WP-138-AA2-161-B5	CONTINGENCY 'AP-P2-3-WP-138-AA2-161-B5' / 652 OPEN BRANCH FROM BUS 235277 TO BUS 920570 CKT 1 / 235277 01YUKON 138 920570 AA2-161 TAP 138 1 OPEN BRANCH FROM BUS 235277 TO BUS 920580 CKT 1 / 235277 01YUKON 138 920580 AA2-161 TAP 138 1 END
AP-P1-2-WP-138-048	CONTINGENCY 'AP-P1-2-WP-138-048' / 565 OPEN BRANCH FROM BUS 235277 TO BUS 920570 CKT 1 / 235277 01YUKON 138 920570 AA2-161 TAP 138 1 END
AP-P7-1-WPP-138-113-01	CONTINGENCY 'AP-P7-1-WPP-138-113-01' /* YUKON - AA2-161 LINES DISCONNECT BRANCH FROM BUS 235277 TO BUS 920570 CKT 1 /* 01YUKON 138 AA2- 161 138 DISCONNECT BRANCH FROM BUS 235277 TO BUS 920580 CKT 1 /* 01YUKON 138 AA2- 161 138 END
AP-P1-2-WP-138-049	CONTINGENCY 'AP-P1-2-WP-138-049' / 569 OPEN BRANCH FROM BUS 235277 TO BUS 920580 CKT 1 / 235277 01YUKON 138 920580 AA2-161 TAP 138 1 END

14 Affected Systems

14.1 NYISO

NYISO Impacts to be determined during later study phases (as applicable).

14.2 MISO

MISO Impacts to be determined during later study phases (as applicable).