Generation Interconnection

Feasibility Study Report

for

Queue Project AF2-112

OAKLAND-GORMAN 69 KV

13.4 MW Capacity / 20 MW Energy

July 2020

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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.

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 Garrett County, Maryland. The installed facilities will have a total capability of 20 MW with 13.4 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is June 01, 2022. This study does not imply a TO commitment to this in-service date.

Queue Number	**AF2-112**
Project Name	OAKLAND-GORMAN 69 KV
State	Maryland
County	Garrett
Transmission Owner	APS
MFO	20
MWE	20
MWC	13.4
Fuel	Solar
Basecase Study Year	2023

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

The interconnection of the project at the Primary POI will be accomplished by tapping the Oakland - Gorman 69 kV line and constructing a one span tap. The transmission line tap will be located approximately 1.3 miles from Gorman Substation. The IC will be responsible for acquiring all easements, properties, and permits that may be required to construct both the new interconnection line tap and the associated Attachment Facilities. The project will also require Non-Direct Connection upgrades at Snowy Creek Substation and William Substation.

Attachment 1 shows a one-line diagram of the proposed primary Direct Connection facilities for the AF2-112 generation project to connect to the FirstEnergy ("FE") Transmission System. The IC will be responsible for constructing the facilities on its side of the POI, including the Attachment Facilities which connect the generator to the FE Transmission System's Direct Connection facilities.

5 Cost Summary

The AF2-112 project will be responsible for the following costs:

Description	Total Cost
Total Physical Interconnection Costs	$1,018,700
Total System Network Upgrade Costs	$20,701,800[1]
Total Costs	$21,720,500

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 88-129. If at 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.

[1] This project currently causes overloads of the Transmission System (see Summer Peak Load Flow Analysis section below) and therefore has potential to have cost allocation for the system reinforcement 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's MW contribution to a facility that is already overloaded by a prior queue is less than 5 MW, then they will not receive cost allocation.

6 Transmission Owner Scope of Work

The interconnection of the project at the Primary POI will be accomplished by tapping the Oakland - Gorman 69 kV line and constructing a one span tap. The transmission line tap will be located approximately 1.3 miles from Gorman Substation. The IC will be responsible for acquiring all easements, properties, and permits that may be required to construct both the new interconnection line tap and the associated Attachment Facilities. The project will also require Non-Direct Connection upgrades at Snowy Creek Substation and William Substation.

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

Description	Total Cost
Construct a new 69 kV tap with 1200 A non-automatic SCADA controlled load-break switches along the Snowy Creek – William 69 kV line	$935,500
Modify line relay settings as needed at Snowy Creek	$31,600
Modify line relay settings as needed at William	$31,600
Review customer drawings, create nameplates and update CD drawing	$20,000
Total Physical Interconnection Costs	$1,018,700

7 Schedule

Based on the scope of work for the interconnection facilities, it is expected to take a minimum of **10 months** to complete the installation after the signing of an Interconnection Construction Service Agreement and holding the construction kick-off call. 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 report. [1]

8 Transmission Owner Analysis

FE performed an analysis of its underlying transmission <100 kV system. The AF2-112 project did not contribute to any overloads on the FE <100 kV Transmission 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.

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 69 kV circuit breaker to protect the AF2-112 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 AF2-112 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)
- Irradiance (Watts/meter2)
- 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:

https://pjm.com/planning/design-engineering/to-tech-standards/private-firstenergy.aspx

11 Summer Peak - Load Flow Analysis - Primary POI

The Queue Project AF2-112 was evaluated as a 20.0 MW (Capacity 13.4 MW) injection tapping the Oakland to Gorman 69 kV line in the APS area. Project AF2-112 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF2-112 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	CONTNAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
100533533	235385	01PARSNS	138.0	AP	235362	01LOUGHL	138.0	AP	1	AP-P2-3-MP-138-160	breaker	179.0	99.86	105.12	DC	9.42
100533556	235427	01WILLIM	138.0	AP	235385	01PARSNS	138.0	AP	1	AP-P2-3-MP-138-153	breaker	192.0	99.14	104.04	DC	9.41
100533557	235427	01WILLIM	138.0	AP	235385	01PARSNS	138.0	AP	1	AP-P2-3-MP-138-160	breaker	192.0	97.84	102.74	DC	9.42

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	CONTNAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
100533314	235385	01PARSNS	138.0	AP	235362	01LOUGHL	138.0	AP	1	AP-P2-2-MP-138-101-A	bus	179.0	104.48	108.77	DC	7.69
100533531	235385	01PARSNS	138.0	AP	235362	01LOUGHL	138.0	AP	1	AP-P2-4-MP-138-200	breaker	179.0	103.99	108.3	DC	7.72

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONTNAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
10053353 2	235385	01PARSNS	138.0	AP	235362	01LOUGHL	138.0	AP	1	AP-P2-3-MP-138-153	breaker	179.0	101.2	106.45	DC	9.41
10053333 0	235427	01WILLIM	138.0	AP	235385	01PARSNS	138.0	AP	1	AP-P2-2-MP-138-101-A	bus	192.0	102.19	106.2	DC	7.69
10053355 5	235427	01WILLIM	138.0	AP	235385	01PARSNS	138.0	AP	1	AP-P2-4-MP-138-200	breaker	192.0	101.74	105.76	DC	7.72

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.

None

11.5 System Reinforcements - Summer Peak Load Flow - Primary POI

ID	Idx	Facility	Upgrade Description	Cost
100533557,100533556,100533555,100533330	2	**01WILLIM 138.0 kV - 01PARSNS 138.0 kV Ckt 1**	**APS** **b3028 (538) : PJM Baseline Upgrade b3028. Upgrade substation disconnect leads at William 138 kV Substation. The baseline project has a projected in-service date of 06/01/2021.** **Project Type : FAC** **Cost : $0** **n4655 (541) : Reconfigure Albright 138 kV SS to breaker-and-a-half layout** **Project Type : CON** **Cost : $20,701,800** **Time Estimate : 30.0 Months**	$20,701,800
100533531,100533314,100533533,100533532	1	**01PARSNS 138.0 kV - 01LOUGHL 138.0 kV Ckt 1**		
			TOTAL COST	**$20,701,800**

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
100533531	235385	01PARSNS	AP	235362	01LOUGHL	AP	1	AP-P2-4-MP-138-200	breaker	179.0	103.99	108.3	DC	7.72

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
235091	U2-061_E	25.0860	50/50	25.0860
235093	W2-057 BAT	3.1513	50/50	3.1513
235625	01BACKB	1.3131	50/50	1.3131
235801	01WM_AA1_062	12.7448	50/50	12.7448
235854	01KL_K28_T16	0.7576	50/50	0.7576
237512	01ROTHROCK	0.6466	50/50	0.6466
292310	K-019 E	24.6823	50/50	24.6823
292401	K-028 E	8.5455	50/50	8.5455
885642	T-016 E	4.0855	50/50	4.0855
918472	**AA1-062 E (Suspended)**	**73.7587**	**50/50**	**73.7587**
920072	**AA2-103 E (Suspended)**	**11.5338**	**50/50**	**11.5338**
934931	AD1-125 C	2.5607	50/50	2.5607
934932	AD1-125 E	14.8593	50/50	14.8593
937191	AD2-157 C O1	2.5690	Adder	3.02
937192	AD2-157 E O1	3.5476	Adder	4.17
937361	AD2-180 C O1	2.2986	50/50	2.2986
937362	AD2-180 E O1	14.4687	50/50	14.4687
938341	AE1-052	5.7669	50/50	5.7669

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
938831	AE1-109 C	0.6829	Adder	0.8
938832	AE1-109 E	0.8869	Adder	1.04
943212	AF1-000 E	34.0247	50/50	34.0247
958181	AF2-112 C O1	5.1751	50/50	5.1751
958182	AF2-112 E O1	2.5489	50/50	2.5489
NEWTON	NEWTON	0.2944	Confirmed LTF	0.2944
FARMERCITY	FARMERCITY	0.0148	Confirmed LTF	0.0148
G-007A	G-007A	0.6114	Confirmed LTF	0.6114
VFT	VFT	1.6318	Confirmed LTF	1.6318
CALDERWOOD	CALDERWOOD	0.1108	Confirmed LTF	0.1108
PRAIRIE	PRAIRIE	0.6819	Confirmed LTF	0.6819
CHEOAH	CHEOAH	0.1106	Confirmed LTF	0.1106
EDWARDS	EDWARDS	0.0959	Confirmed LTF	0.0959
TILTON	TILTON	0.1758	Confirmed LTF	0.1758
MADISON	MADISON	0.0544	Confirmed LTF	0.0544
GIBSON	GIBSON	0.1529	Confirmed LTF	0.1529
BLUEG	BLUEG	0.4965	Confirmed LTF	0.4965
TRIMBLE	TRIMBLE	0.1597	Confirmed LTF	0.1597
CATAWBA	CATAWBA	0.0528	Confirmed LTF	0.0528

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
100533330	235427	01WILLIM	AP	235385	01PARSNS	AP	1	AP-P2-2-MP-138-101-A	bus	192.0	102.19	106.2	DC	7.69

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
235091	U2-061_E	25.0525	50/50	25.0525
235093	W2-057 BAT	3.1313	50/50	3.1313
235625	01BACKB	1.3113	50/50	1.3113
235801	01WM_AA1_062	12.7278	50/50	12.7278
235854	01KL_K28_T16	0.7451	50/50	0.7451
237512	01ROTHROCK	0.6457	50/50	0.6457
292310	K-019 E	24.6494	50/50	24.6494
292401	K-028 E	8.4045	50/50	8.4045
885642	T-016 E	4.0181	50/50	4.0181
918472	**AA1-062 E (Suspended)**	**73.6602**	**50/50**	**73.6602**
920072	**AA2-103 E (Suspended)**	**11.5184**	**50/50**	**11.5184**
934931	AD1-125 C	2.5286	50/50	2.5286
934932	AD1-125 E	14.6730	50/50	14.6730
937191	AD2-157 C O1	2.4936	Adder	2.93
937192	AD2-157 E O1	3.4436	Adder	4.05
937361	AD2-180 C O1	2.2543	50/50	2.2543
937362	AD2-180 E O1	14.1896	50/50	14.1896
938341	AE1-052	5.7592	50/50	5.7592
938831	AE1-109 C	0.6633	Adder	0.78
938832	AE1-109 E	0.8616	Adder	1.01
943212	AF1-000 E	33.9793	50/50	33.9793
958181	AF2-112 C O1	5.1555	50/50	5.1555
958182	AF2-112 E O1	2.5393	50/50	2.5393
NEWTON	NEWTON	0.2783	Confirmed LTF	0.2783
FARMERCITY	FARMERCITY	0.0139	Confirmed LTF	0.0139
G-007A	G-007A	0.5730	Confirmed LTF	0.5730
VFT	VFT	1.5351	Confirmed LTF	1.5351
CALDERWOOD	CALDERWOOD	0.1054	Confirmed LTF	0.1054
PRAIRIE	PRAIRIE	0.6457	Confirmed LTF	0.6457
CHEOAH	CHEOAH	0.1051	Confirmed LTF	0.1051
EDWARDS	EDWARDS	0.0906	Confirmed LTF	0.0906
TILTON	TILTON	0.1657	Confirmed LTF	0.1657
MADISON	MADISON	0.0504	Confirmed LTF	0.0504
GIBSON	GIBSON	0.1441	Confirmed LTF	0.1441
BLUEG	BLUEG	0.4687	Confirmed LTF	0.4687
TRIMBLE	TRIMBLE	0.1508	Confirmed LTF	0.1508
CATAWBA	CATAWBA	0.0504	Confirmed LTF	0.0504

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
AA1-062	Williams 138kV	Suspended
AA2-103	Backbone Mountain 138kV	Suspended
AD1-125	Baker 138 kV	Active
AD2-157	Hampshire-Gore 138kV	Active
AD2-180	Elk Garden-Parr Run 138kV	Active
AE1-052	William 138 kV	Active
AE1-109	Frenchs Mill 34 kV	Active
AF1-000	N/A	N/A
AF2-112	Oakland-Gorman 69 kV	Active
U2-061	Garrett County	In Service
W2-057	Laurel Mountain	In Service

11.8 Contingency Descriptions - Primary POI

Contingency Name	Contingency Definition
AP-P2-4-MP-138-200	CONTINGENCY 'AP-P2-4-MP-138-200' /* ALBRIGHT BREAKER FAILURE - TIE BREAKER DISCONNECT BRANCH FROM BUS 235120 TO BUS 235304 CKT 1 /* 01ALBRIG 138 01BRANDN 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 235305 CKT 1 /* 01ALBRIG 138 01 106 J 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 235320 CKT 1 /* 01ALBRIG 138 01DENVER 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 235356 CKT 1 /* 01ALBRIG 138 01KINGWD 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 235398 CKT 1 /* 01ALBRIG 138 01RUTHBL 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 235402 CKT 1 /* 01ALBRIG 138 01SNOW T 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 934440 CKT 1 /* 01ALBRIG 138 AD1-068 TAP 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 235485 CKT 1 /* 01ALBRIG 138 01METTIK 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 960650 CKT 1 /* 01ALBRIG 138 01MTZION 138 END
AP-P2-3-MP-138-160	CONTINGENCY 'AP-P2-3-MP-138-160' /* ALBRIGHT-SNOWY CREEK STK BKR AT ALBRIGHT DISCONNECT BRANCH FROM BUS 235120 TO BUS 235485 CKT 1 /* 01ALBRIG 138 01METTIK 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 960650 CKT 1 /* 01ALBRIG 138 01MTZION 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 235305 CKT 1 /* 01ALBRIG 138 01 106 J 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 235320 CKT 1 /* 01ALBRIG 138 01DENVER 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 235402 CKT 1 /* 01ALBRIG 138 01SNOW T 138 DISCONNECT BRANCH FROM BUS 235402 TO BUS 235403 CKT 1 /* 01SNOW T 138 01SNWYCK 138 DISCONNECT BRANCH FROM BUS 235402 TO BUS 235497 CKT 1 /* 01SNOW T 138 01OAKPRK 138 DISCONNECT BRANCH FROM BUS 235403 TO BUS 237273 CKT 1 /* 01SNWYCK 138 01SNOW C 66 END

Contingency Name	Contingency Definition
AP-P2-2-MP-138-101-A	CONTINGENCY 'AP-P2-2-MP-138-101-A' /* ALBRIGHT-138-SOUTH DISCONNECT BRANCH FROM BUS 235120 TO BUS 235320 CKT 1 /* 01ALBRIG 138 01DENVER 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 235402 CKT 1 /* 01ALBRIG 138 01SNOW T 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 934440 CKT 1 /* 01ALBRIG 138 AD1-068 TAP 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 235485 CKT 1 /* 01ALBRIG 138 01METTIK 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 235305 CKT 1 /* 01ALBRIG 138 01 106 J 138 END
AP-P2-3-MP-138-153	CONTINGENCY 'AP-P2-3-MP-138-153' /* OAK PARK-KELSO GAP STK BKR AT ALBRIGHT DISCONNECT BRANCH FROM BUS 235120 TO BUS 235485 CKT 1 /* 01ALBRIG 138 01METTIK 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 960650 CKT 1 /* 01ALBRIG 138 01MTZION 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 235305 CKT 1 /* 01ALBRIG 138 01 106 J 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 235320 CKT 1 /* 01ALBRIG 138 01DENVER 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 934440 CKT 1 /* 01ALBRIG 138 AD1-068 TAP 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 235402 CKT 1 /* 01ALBRIG 138 01SNOW T 138 DISCONNECT BRANCH FROM BUS 235402 TO BUS 235403 CKT 1 /* 01SNOW T 138 01SNWYCK 138 DISCONNECT BRANCH FROM BUS 235402 TO BUS 235497 CKT 1 /* 01SNOW T 138 01OAKPRK 138 DISCONNECT BRANCH FROM BUS 235403 TO BUS 237273 CKT 1 /* 01SNWYCK 138 01SNOW C 66 DISCONNECT BRANCH FROM BUS 235497 TO BUS 237313 CKT 1 /* 01OAKPRK 138 01KELSOG 138 END

12 Short Circuit Analysis - Primary POI

Short Circuit Analysis to be performed in the System Impact phase.

13 Summer Peak - Load Flow Analysis - Secondary POI

The Queue Project AF2-112 was evaluated as a 20.0 MW (Capacity 13.4 MW) injection at the Gorman 69 kV substation in the APS area. Project AF2-112 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF2-112 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	CONTNAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
100533533	235385	01PARSNS	138.0	AP	235362	01LOUGHL	138.0	AP	1	AP-P2-3-MP-138-160	breaker	179.0	99.86	105.18	DC	9.53
100533556	235427	01WILLIM	138.0	AP	235385	01PARSNS	138.0	AP	1	AP-P2-3-MP-138-153	breaker	192.0	99.14	104.1	DC	9.52
100533557	235427	01WILLIM	138.0	AP	235385	01PARSNS	138.0	AP	1	AP-P2-3-MP-138-160	breaker	192.0	97.84	102.8	DC	9.53

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	CONTNAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
100533314	235385	01PARSNS	138.0	AP	235362	01LOUGHL	138.0	AP	1	AP-P2-2-MP-138-101-A	bus	179.0	104.48	108.87	DC	7.86

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONTNAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
10053353 1	235385	01PARSNS	138.0	AP	235362	01LOUGHL	138.0	AP	1	AP-P2-4-MP-138-200	breaker	179.0	103.99	108.39	DC	7.89
10053353 2	235385	01PARSNS	138.0	AP	235362	01LOUGHL	138.0	AP	1	AP-P2-3-MP-138-153	breaker	179.0	101.2	106.52	DC	9.52
10053333 0	235427	01WILLIM	138.0	AP	235385	01PARSNS	138.0	AP	1	AP-P2-2-MP-138-101-A	bus	192.0	102.19	106.29	DC	7.86
10053355 5	235427	01WILLIM	138.0	AP	235385	01PARSNS	138.0	AP	1	AP-P2-4-MP-138-200	breaker	192.0	101.74	105.85	DC	7.89

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.

None

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
100533531	235385	01PARSNS	AP	235362	01LOUGHL	AP	1	AP-P2-4-MP-138-200	breaker	179.0	103.99	108.39	DC	7.89

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
235091	U2-061_E	25.0860	50/50	25.0860
235093	W2-057 BAT	3.1513	50/50	3.1513
235625	01BACKB	1.3131	50/50	1.3131
235801	01WM_AA1_062	12.7448	50/50	12.7448
235854	01KL_K28_T16	0.7576	50/50	0.7576
237512	01ROTHROCK	0.6466	50/50	0.6466
292310	K-019 E	24.6823	50/50	24.6823
292401	K-028 E	8.5455	50/50	8.5455
885642	T-016 E	4.0855	50/50	4.0855
918472	**AA1-062 E (Suspended)**	**73.7587**	**50/50**	**73.7587**
920072	**AA2-103 E (Suspended)**	**11.5338**	**50/50**	**11.5338**
934931	AD1-125 C	2.5607	50/50	2.5607
934932	AD1-125 E	14.8593	50/50	14.8593
937191	AD2-157 C O1	2.5690	Adder	3.02
937192	AD2-157 E O1	3.5476	Adder	4.17
937361	AD2-180 C O1	2.2986	50/50	2.2986
937362	AD2-180 E O1	14.4687	50/50	14.4687
938341	AE1-052	5.7669	50/50	5.7669
938831	AE1-109 C	0.6829	Adder	0.8
938832	AE1-109 E	0.8869	Adder	1.04
943212	AF1-000 E	34.0247	50/50	34.0247
958181	AF2-112 C O2	5.2831	50/50	5.2831
958182	AF2-112 E O2	2.6021	50/50	2.6021
NEWTON	NEWTON	0.2944	Confirmed LTF	0.2944
FARMERCITY	FARMERCITY	0.0148	Confirmed LTF	0.0148
G-007A	G-007A	0.6114	Confirmed LTF	0.6114
VFT	VFT	1.6318	Confirmed LTF	1.6318
CALDERWOOD	CALDERWOOD	0.1108	Confirmed LTF	0.1108
PRAIRIE	PRAIRIE	0.6819	Confirmed LTF	0.6819
CHEOAH	CHEOAH	0.1106	Confirmed LTF	0.1106
EDWARDS	EDWARDS	0.0959	Confirmed LTF	0.0959
TILTON	TILTON	0.1758	Confirmed LTF	0.1758
MADISON	MADISON	0.0544	Confirmed LTF	0.0544
GIBSON	GIBSON	0.1529	Confirmed LTF	0.1529
BLUEG	BLUEG	0.4965	Confirmed LTF	0.4965
TRIMBLE	TRIMBLE	0.1597	Confirmed LTF	0.1597
CATAWBA	CATAWBA	0.0528	Confirmed LTF	0.0528

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
100533330	235427	01WILLIM	AP	235385	01PARSNS	AP	1	AP-P2-2-MP-138-101-A	bus	192.0	102.19	106.29	DC	7.86

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
235091	U2-061_E	25.0525	50/50	25.0525
235093	W2-057 BAT	3.1313	50/50	3.1313
235625	01BACKB	1.3113	50/50	1.3113
235801	01WM_AA1_062	12.7278	50/50	12.7278
235854	01KL_K28_T16	0.7451	50/50	0.7451
237512	01ROTHROCK	0.6457	50/50	0.6457
292310	K-019 E	24.6494	50/50	24.6494
292401	K-028 E	8.4045	50/50	8.4045
885642	T-016 E	4.0181	50/50	4.0181
918472	**AA1-062 E (Suspended)**	**73.6602**	**50/50**	**73.6602**
920072	**AA2-103 E (Suspended)**	**11.5184**	**50/50**	**11.5184**
934931	AD1-125 C	2.5286	50/50	2.5286
934932	AD1-125 E	14.6730	50/50	14.6730
937191	AD2-157 C O1	2.4936	Adder	2.93
937192	AD2-157 E O1	3.4436	Adder	4.05
937361	AD2-180 C O1	2.2543	50/50	2.2543
937362	AD2-180 E O1	14.1896	50/50	14.1896
938341	AE1-052	5.7592	50/50	5.7592
938831	AE1-109 C	0.6633	Adder	0.78
938832	AE1-109 E	0.8616	Adder	1.01
943212	AF1-000 E	33.9793	50/50	33.9793
958181	AF2-112 C O2	5.2639	50/50	5.2639
958182	AF2-112 E O2	2.5927	50/50	2.5927
NEWTON	NEWTON	0.2783	Confirmed LTF	0.2783
FARMERCITY	FARMERCITY	0.0139	Confirmed LTF	0.0139
G-007A	G-007A	0.5730	Confirmed LTF	0.5730
VFT	VFT	1.5351	Confirmed LTF	1.5351
CALDERWOOD	CALDERWOOD	0.1054	Confirmed LTF	0.1054
PRAIRIE	PRAIRIE	0.6457	Confirmed LTF	0.6457
CHEOAH	CHEOAH	0.1051	Confirmed LTF	0.1051
EDWARDS	EDWARDS	0.0906	Confirmed LTF	0.0906
TILTON	TILTON	0.1657	Confirmed LTF	0.1657
MADISON	MADISON	0.0504	Confirmed LTF	0.0504
GIBSON	GIBSON	0.1441	Confirmed LTF	0.1441
BLUEG	BLUEG	0.4687	Confirmed LTF	0.4687
TRIMBLE	TRIMBLE	0.1508	Confirmed LTF	0.1508
CATAWBA	CATAWBA	0.0504	Confirmed LTF	0.0504

13.6 Contingency Descriptions - Secondary POI

Contingency Name	Contingency Definition
AP-P2-4-MP-138-200	CONTINGENCY 'AP-P2-4-MP-138-200' /* ALBRIGHT BREAKER FAILURE - TIE BREAKER DISCONNECT BRANCH FROM BUS 235120 TO BUS 235304 CKT 1 /* 01ALBRIG 138 01BRANDN 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 235305 CKT 1 /* 01ALBRIG 138 01 106 J 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 235320 CKT 1 /* 01ALBRIG 138 01DENVER 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 235356 CKT 1 /* 01ALBRIG 138 01KINGWD 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 235398 CKT 1 /* 01ALBRIG 138 01RUTHBL 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 235402 CKT 1 /* 01ALBRIG 138 01SNOW T 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 934440 CKT 1 /* 01ALBRIG 138 AD1-068 TAP 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 235485 CKT 1 /* 01ALBRIG 138 01METTIK 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 960650 CKT 1 /* 01ALBRIG 138 01MTZION 138 END
AP-P2-3-MP-138-160	CONTINGENCY 'AP-P2-3-MP-138-160' /* ALBRIGHT-SNOWY CREEK STK BKR AT ALBRIGHT DISCONNECT BRANCH FROM BUS 235120 TO BUS 235485 CKT 1 /* 01ALBRIG 138 01METTIK 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 960650 CKT 1 /* 01ALBRIG 138 01MTZION 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 235305 CKT 1 /* 01ALBRIG 138 01 106 J 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 235320 CKT 1 /* 01ALBRIG 138 01DENVER 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 235402 CKT 1 /* 01ALBRIG 138 01SNOW T 138 DISCONNECT BRANCH FROM BUS 235402 TO BUS 235403 CKT 1 /* 01SNOW T 138 01SNWYCK 138 DISCONNECT BRANCH FROM BUS 235402 TO BUS 235497 CKT 1 /* 01SNOW T 138 01OAKPRK 138 DISCONNECT BRANCH FROM BUS 235403 TO BUS 237273 CKT 1 /* 01SNWYCK 138 01SNOW C 66 END

Contingency Name	Contingency Definition
AP-P2-2-MP-138-101-A	CONTINGENCY 'AP-P2-2-MP-138-101-A' /* ALBRIGHT-138-SOUTH DISCONNECT BRANCH FROM BUS 235120 TO BUS 235320 CKT 1 /* 01ALBRIG 138 01DENVER 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 235402 CKT 1 /* 01ALBRIG 138 01SNOW T 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 934440 CKT 1 /* 01ALBRIG 138 AD1-068 TAP 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 235485 CKT 1 /* 01ALBRIG 138 01METTIK 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 235305 CKT 1 /* 01ALBRIG 138 01 106 J 138 END
AP-P2-3-MP-138-153	CONTINGENCY 'AP-P2-3-MP-138-153' /* OAK PARK-KELSO GAP STK BKR AT ALBRIGHT DISCONNECT BRANCH FROM BUS 235120 TO BUS 235485 CKT 1 /* 01ALBRIG 138 01METTIK 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 960650 CKT 1 /* 01ALBRIG 138 01MTZION 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 235305 CKT 1 /* 01ALBRIG 138 01 106 J 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 235320 CKT 1 /* 01ALBRIG 138 01DENVER 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 934440 CKT 1 /* 01ALBRIG 138 AD1-068 TAP 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 235402 CKT 1 /* 01ALBRIG 138 01SNOW T 138 DISCONNECT BRANCH FROM BUS 235402 TO BUS 235403 CKT 1 /* 01SNOW T 138 01SNWYCK 138 DISCONNECT BRANCH FROM BUS 235402 TO BUS 235497 CKT 1 /* 01SNOW T 138 01OAKPRK 138 DISCONNECT BRANCH FROM BUS 235403 TO BUS 237273 CKT 1 /* 01SNWYCK 138 01SNOW C 66 DISCONNECT BRANCH FROM BUS 235497 TO BUS 237313 CKT 1 /* 01OAKPRK 138 01KELSOG 138 END

14 Affected Systems

14.1 NYISO

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

15 Attachment 1: One Line Diagram