Fox Rothschild LLP
ATTORNEYS AT LAW

Tel (919) 755-8700
Fax (919) 755-8800
www.foxrothschild.com

BENJAMIN L. SNOWDEN
Direct No: 919.719-1257
Email: BSnowden@foxrothschild.com

July 13, 2022

Ms. A. Shonta Dunston
Chief Clerk
North Carolina Utilities Commission
430 N. Salisbury Street, Room 5063
Raleigh, NC 27603

RE: In the matter of the Applications of Macadamia Solar, LLC in Consolidated Dockets EMP-119 Subs 0 and 1 SECOND SUPPLEMENTAL PRE-FILED REPLY TESTIMONY OF DONNA ROBICHAUD

Dear Ms. Dunston:

On behalf of Macadamia Solar, LLC, in the above referenced matter and consolidated dockets, I herewith electronically file the Second Supplemental Prefiled Reply Testimony of Donna Robichaud and Exhibit A thereto. Exhibit B to the Testimony is confidential in nature and will be filed under separate cover.

Seventeen additional paper copies of this filing will be hand delivered to the Clerk's Office within 24 hours of the electronic submission.

Thank you for your assistance with this application. Should you have any questions concerning this filing, please do not hesitate to contact me.

Sincerely,

/s/ Benjamin L. Snowden

Benjamin L. Snowden

pbb

Fox Rothschild LLP
ATTORNEYS AT LAW

Copy to: Parties of Record
Counsel of Record
NC Public Staff

SECOND SUPPLEMENTAL PREFILED REPLY TESTIMONY OF DONNA ROBICHAUD ON BEHALF OF MACADAMIA SOLAR LLC

NCUC DOCKET NO. EMP-119, SUB 0
NCUC DOCKET NO. EMP-119, SUB 1
(CONSOLIDATED DOCKETS)

INTRODUCTION

Q. PLEASE STATE YOUR NAME, TITLE, AND BUSINESS ADDRESS.

A. My name is Donna Robichaud. I am senior vice president of development strategy for Geenex Solar LLC ("Geenex Solar") based in Charlotte, North Carolina. The company's address is 1000 NC Music Factory Blvd, Suite – C3, Charlotte, NC 28206.

Q. ARE YOU THE SAME DONNA ROBICHAUD THAT PROVIDED DIRECT TESTIMONY IN THESE CONSOLIDATED DOCKETS ON AUGUST 31, 2021; SUPPLEMENTAL TESTIMONY ON OCTOBER 20, 2021; REBUTTAL TESTIMONY ON DECEMBER 10, 2021; AND SECOND SUPPLEMENTAL DIRECT TESTIMONY ON MAY 25, 2022?

A. I am.

Q. WHAT IS THE PURPOSE OF YOUR SECOND SUPPLEMENTAL REPLY TESTIMONY?

A. The purpose of my testimony is to (1) respond to the Second Supplemental Testimony of Jay B. Lucas on behalf of the Public Staff, filed in these consolidated dockets on June 29, 2022; (2) inform the Commission of a revised System Impact Study received from PJM in June 2022 ("June 2022 SIS Report"); and (3) provide updated LCOT calculation for the facility based on the June 2022 SIS Report and on a revised Affected

System Study Report for PJM Cluster AD1 that was issued on June 8, 2022, and included as an attachment to Mr. Lucas's June 29 testimony ("June 2022 Affected System Study").

Q. HAVE YOU RECEIVED ANY UPDATED INTERCONNECTION STUDIES FOR THE PROJECT SINCE YOU FILED YOUR SECOND SUPPLEMENTAL DIRECT TESTIMONY IN MAY 2022?

A. Yes. Macadamia Solar received a Generation Interconnection System Impact Study Report for PJM Generation Interconnection Request Queue Position AD1-074/75/76 (Revision 4) (June 2022) (**Exhibit A**) on June 10, 2022. The June 2022 SIS Report supersedes all previous SIS Reports received for the Macadamia facility. PJM issued the revised report because it identified a lower cost solution for an overload driven by one of the contingencies identified in the report. The June 2022 SIS Report reduced the total cost of PJM Upgrades assigned to the project by about $26.3 million, to $71.5 million.

As discussed, DEP also issued a revised Affected System Study for PJM Cluster AD1 on June 8. The June 2022 Affected System Study, which was attached to Mr. Lucas's June 29, testimony, revised the total cost of the upgrade required to DEP's system to $350,000.

Q. HAVE YOU PREPARED UPDATED LCOT CALCULATIONS BASED ON THE JUNE 2022 AFFECTED SYSTEM STUDY?

A. I have. With respect to PJM Network Upgrades, based on the revised cost estimates in the June 2022 SIS Report I have calculated a revised LCOT of $2.75/MWh.

With respect to affected system upgrade costs, based on the June 2022 Affected System Study, I have calculated revised LCOT values of $0.010/MWh if all projects in the AD1 cluster benefitting from the proposed DEP Upgrader are considered, $0.013/MWh if

only Macadamia is considered. These LCOT figures are extremely favorable compared to the benchmark LCOT figures cited by the Public Staff and relied on by the Commission in prior proceedings.

My revised LCOT calculations are included in Confidential **Exhibit B.**

Q. WHAT RECOMMENDATION DOES MR. LUCAS MAKE WITH RESPECT TO THE CPCN APPLICATION?

A. Mr. Lucas recommends that the Commission approve Macadamia's application for a CPCN, subject to certain conditions.

Q. DOES THE APPLICANT ACCEPT THE PUBLIC STAFF'S PROPOSED CONDITIONS?

A. Yes, with one clarification. Mr. Lucas's fourth proposed condition is that Macadamia "shall file a copy of any executed Affected System Operating Agreement with the Commission at the same time such filing is made at the Federal Energy Regulatory Commission[.]" In the event that Macadamia Solar enters into an ASOA, the Applicant will file that ASOA prior its being filed with FERC. However, if another entity (such as Sumac Solar) enters into an ASOA for the affected system upgrades required for the AD1 cluster, Macadamia Solar would not be a party to that ASOA and would not necessarily be able to file it with this Commission prior to its being filed with FERC. In that case, the ASOA would be filed with this Commission by DEP in docket number E-100 Sub 170, and in all likelihood would also be filed by the counter party to the ASOA. Macadamia would have no objection to the Commission taking judicial notice of such a filing in these consolidated dockets.

Q. DOES THIS CONCLUDE YOUR TESTIMONY?

A. Yes.

CERTIFICATE OF SERVICE

This is to certify that the undersigned has this day served the foregoing **SECOND SUPPLEMENTAL PREFILED TESTIMONY OF DONNA ROBICHAUD** upon the following by electronic mail as follows:

Christopher Ayers, Esq.
Executive Director - NC Public Staff
Chris.Ayers@psncuc.nc.gov

Nadia Luhr
NC Public Staff - Legal Division
nadia.luhr@psncuc.nc.gov

William E.H. Creech
NC Public Staff - Legal Division
zeke.creech@psncuc.nc.gov

Robert Josey
NC Public Staff - Legal Division
robert.josey@psncuc.nc.gov

NC Public Staff - Legal Division
4326 Mail Service Center
Raleigh, NC 27599

This the 13th day of July 2022.

/s/ *Benjamin L. Snowden*
Benjamin L. Snowden

NCUC DOCKET NO. EMP-119, SUB 0
NCUC DOCKET NO. EMP-119, SUB 1

SECOND SUPPLEMENTAL PRE-FILED TESTIMONY OF DONNA ROBICHAUD ON BEHALF OF MACADAMIA SOLAR LLC

EXHIBITS

A	Generation Interconnection System Impact Study Report for PJM Generation Interconnection Request Queue Position AD1-074/75/76 (Revision 4) (June 2022)
B	LCOT Analysis for Network Upgrades potentially required for Macadamia Solar Project and for Potential DEP Affected System Upgrades ****CONFIDENTIAL****

NCUC DOCKET NO. EMP-119, SUB 0
NCUC DOCKET NO. EMP-119, SUB 1

SECOND SUPPLEMENTAL PRE-FILED TESTIMONY OF DONNA ROBICHAUD ON BEHALF OF MACADAMIA SOLAR LLC

EXHIBIT A

EXHIBIT A TO SECOND SUPPLEMENTAL
PREFILED REPLY TESTIMONY OF
DONNA ROBICHAUD
MACADAMIA SOLAR, LLC
EMP-119, SUBS 0 AND 1

Generation Interconnection System Impact Study Report

For

PJM Generation Interconnection Request Queue Position AD1-074/075/076

Trowbridge 230kV
320.7 MW Capacity / 484.0 MW Energy

Revision 4: June 2022

Revision 2/3: May 2022

Revision 1: February 2022

Revision 0: December 2019

Introduction

This System Impact Study (SIS) has been prepared in accordance with the PJM Open Access Transmission Tariff, Section 205, as well as the System Impact Study Agreement between Macadamia Solar LLC, the Interconnection Customer (IC) and PJM Interconnection, LLC (PJM), Transmission Provider (TP). The Interconnected Transmission Owner (ITO) is Virginia Electric and Power Company (VEPCO).

Preface

The intent of the System Impact Study is to determine a plan, with approximate cost and construction time estimates, to connect the subject generation interconnection project to the PJM network at a location specified by the IC. As a requirement for interconnection, the IC may be responsible for the cost of constructing Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system. All facilities required for interconnection of a generation interconnection project must be designed to meet the technical specifications (on PJM web site) for the appropriate transmission owner.

In some instances an IC may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection or merchant transmission upgrade, 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 System Impact Study is performed.

The System Impact Study estimates do not include the feasibility, cost, or time required to obtain property rights and permits for construction of the required facilities. The IC 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.

Revision 1 Summary – January 2022

This revision is being issued to incorporate the results of a re-tool and completed stability analysis.

Revision 2/3 Summary – May 2022

The revision is being issued due to a re-tool necessitated by the withdrawal of AD1-023 and to update costs based on the completed facilities study.

Revision 4 Summary – June 2022

This revision is being issued because a lower cost upgrade was found to fix overloads driven by the "DVP_P7-1: LN 25-2034-A" contingency.

General

The IC has proposed a solar generating facility located in Washington County, North Carolina. The installed AD1-074/075/076 facilities will have a total capability of 484 MW with 320.7 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is June 1, 2020. This study does not imply an ITO commitment to this in-service date.

Point of Interconnection

AD1-074/075/076 will interconnect with the ITO transmission system via a direct connection into the Trowbridge 230kV substation.

Cost Summary

The AD1-074/075/076 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$ 3,817,005
Direct Connection Network Upgrades	$ 0
Non Direct Connection Network Upgrades	$ 4,000,000
Allocation for New System Upgrades	$36,284,917
Contribution for Previously Identified Upgrades	$35,198,738
Total Costs	**$79,300,660**

Attachment Facilities

Generation Substation: Install metering and associated protection equipment. The estimated cost is $649,241.

Transmission: Construct approximately one span of 230kV Attachment line between the generation substation and the Trowbridge 230kV Substation. The estimated cost for this work is $3,167,764.

The estimated total cost of the Attachment Facilities is $3,817,005. It is estimated to take 18-24 months to complete this work upon execution of an Interconnection Construction Service Agreement (ICSA). These preliminary cost estimates are based on typical engineering costs. A more detailed engineering cost estimates are normally done when the IC provides an exact site plan location for the generation substation during the Facility Study phase.

Direct Connection Cost Estimate

None.

Non-Direct Network Upgrades:

Substation: Add two breakers in the Trowbridge 230 kV Substation and rearrange the 230 kV bus. See Attachment 1 for One-Line Diagram. The estimated cost of this work scope is $4,000,000. It is estimated to take 24-36 months to complete this work upon execution of an Interconnection Construction Service Agreement. Note attachment 1 shows a third 230 kV breaker due to n6287. See stability analysis portion of this report for details.

Remote Terminal Work: During the Facilities Study, ITO's System Protection Engineering Department will review transmission line protection as well as anti-islanding required to accommodate the new generation and interconnection substation. System Protection Engineering will determine the minimal acceptable protection requirements to reliably interconnect the proposed generating facility with the transmission system. The review is based on maintaining system reliability by reviewing ITO's protection requirements with the known transmission system configuration which includes generating facilities in the area. This review may determine that transmission line protection and communication upgrades are required at remote substations.

Violation #	Ruling Violation #	Loading	Upgrade Description	Upgrade Cost	Allocated Cost
Stability P4.08, P4.09	NA	NA	Reconfigure the Trowbridge substation to move the Mackeys – Trowbridge 230kV line	$8,101,800	**$8,101,800**
# 3, 5	3	From 53.6% To 115.31%	The Contingency driving this upgrade/overload is DVP_P7-1: LN 25-2034-A which is the tower failure of the Dominion 115 kV Line#25 Trowbridge-Everett and 230 kV Line#2034 who share a common tower. Dominion new proposal is to resolve the overload by splitting line #25 off of line#2034, which eliminate the tower contingency.	$1,875,000	$1,875,000
# 4	4	From 80.59% To 108.11%	Rebuild 10.28 miles of the Shawboro – Elizabeth City 230 kV line #2021	$25,691,055	**$25,691,055**
# 6	6	From 49.31% To 107.63%	Add additional 230kV breaker at Trowbridge to prevent loss of TX#1 upon fault on 230kV line 2034 in stuck breaker scenario	$617,062	**$617,062**
# 1, 7	7	From 125.73% To 135.5%	Rebuild the 4.3 miles of Dominion 230 kV Line #2058 Rocky Mt. – Hathaway	$13,000,000	**$0**
# 2, 8	8	From 103.56% To 108.11%	Reconductor 0.14 miles of the Chesterfield to Basin 230kV line	$350,000	**$0**
# 9	9	From 102.22% To 118.77%	Rebuild the 20.5 miles of Dominion 230 kV Line #218 Everetts - Greenville	$39,925,973	**$35,198,738**
# 10	10	From 103.55% To 116.05%	Rebuild Clubhouse-Lakeview 230 kV Line #254	$23,670,000	**$0**
			Total Estimate Allocated Cost of Network Upgrades	**$ 71,483,655**	

Interconnection Customer Requirements

ITO's Facility Interconnection Requirements as posted on PJM's website
http://www.pjm.com/~/media/planning/plan-standards/private-dominion/facility-connection-requirements1.ashx

Voltage Ride Through Requirements - The Customer Facility shall be designed to remain in service (not trip) for voltages and times as specified for the Eastern Interconnection in Attachment 1 of NERC Reliability Standard PRC-024-1, and successor Reliability Standards, for both high and low voltage conditions, irrespective of generator size, subject to the permissive trip exceptions established in PRC-024-1 (and successor Reliability Standards).

Frequency Ride Through Requirements - The Customer Facility shall be designed to remain in service (not trip) for frequencies and times as specified in Attachment 2 of NERC Reliability Standard PRC-024-1, and successor Reliability Standards, for both high and low frequency condition, irrespective of generator size, subject to the permissive trip exceptions established in PRC-024-1 (and successor Reliability Standards).

Reactive Power - The Generation Interconnection Customer shall design its non-synchronous Customer Facility with the ability to maintain a power factor of at least 0.95 leading to 0.95 lagging measured at the generator's terminals.

Meteorological Data Reporting Requirement - The solar generation facility shall, at a minimum, be required to provide the Transmission Provider with site-specific meteorological data including:

- Temperature (degrees Fahrenheit)
- Atmospheric pressure (hectopascals)
- Irradiance
- Forced outage data

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.

Interconnected Transmission Owner Requirements

Metering and SCADA/Communication equipment must meet the requirements outlined in section 3.1.6 Metering and Telecommunications of ITO's Facility Connection Requirement NERC Standard FAC-001 which is publically available at www.dom.com.

Network Impacts

The Queue Project AD1-074/075/076 was evaluated as a 484.0 MW (Capacity 320.7 MW) injection at Trowbridge 230 kV substation in the Dominion area. Project AD1-074/075/076 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AD1-074/075/076 was studied with a commercial probability of 100%. Potential network impacts were as follows:

Contingency Descriptions

The following contingencies resulted in overloads:

Contingency Name	Description
DVP_P1-2: LN 2020	CONTINGENCY 'DVP_P1-2: LN 2020' OPEN BRANCH FROM BUS 313851 TO BUS 314638 CKT 1 230.00 - 6ELIZ CT 230.00 /* 6ECITYDP2 OPEN BRANCH FROM BUS 313851 TO BUS 314639 CKT 1 230.00 - 6TANGLEW 230.00 /* 6ECITYDP2 OPEN BRANCH FROM BUS 314639 TO BUS 314651 CKT 1 230.00 - 6WINFALL 230.00 /* 6TANGLEW OPEN BUS 313851 /* ISLAND OPEN BUS 314639 /* ISLAND OPEN BUS 913391 /* ISLAND OPEN BUS 913392 /* ISLAND END
DVP_P1-2: LN 2034-A	CONTINGENCY 'DVP_P1-2: LN 2034-A' OPEN BRANCH FROM BUS 314614 TO BUS 314616 CKT 1 115.00 - 6TRWBRDG 230.00 /* 3TROWBR2 OPEN BRANCH FROM BUS 314616 TO BUS 933990 CKT 1 230.00 - AD1-023 TAP 230.00 /* 6TRWBRDG END

DVP_P1-2: LN 2034-B	CONTINGENCY 'DVP_P1-2: LN 2034-B' OPEN BRANCH FROM BUS 314569 TO BUS 314620 CKT 1 /* 6EARLEYS 230.00 - 6CASHIE 230.00 OPEN BRANCH FROM BUS 933990 TO BUS 314620 CKT 1 /* AD1-023 TAP 230.00 - 6CASHIE 230.00 OPEN BUS 314620 /* ISLAND END
DVP_P1-2: LN 2058	CONTINGENCY 'DVP_P1-2: LN 2058' OPEN BRANCH FROM BUS 304222 TO BUS 313845 CKT 1 /* 6ROCKYMT230T230.00 - 6MORNSTR 230.00 END
DVP_P1-2: LN 2131A	CONTINGENCY 'DVP_P1-2: LN 2131A' OPEN BRANCH FROM BUS 314662 TO BUS 916040 CKT 1 /* 6S HERTFORD 230.00 - Z1-036 TAP 230.00 OPEN BRANCH FROM BUS 314651 TO BUS 314662 CKT 1 /* 6WINFALL 230.00 - 6S HERTFORD 230.00 OPEN BUS 314662 /* ISLAND END
DVP_P1-2: LN 2181	CONTINGENCY 'DVP_P1-2: LN 2181' OPEN BUS 304226 /* ISLAND: 6PA-RMOUNT#4115.00 OPEN BRANCH FROM BUS 304226 TO BUS 314591 CKT 1 /* 6PA-RMOUNT#4230.00 - 6NASH 230.00 OPEN BRANCH FROM BUS 313845 TO BUS 314591 CKT 1 /* 6HATHAWAY 230.00 - 6NASH 230.00 OPEN BUS 314591 /* ISLAND: 6NASH 230.00 END
DVP_P1-2: LN 246	CONTINGENCY 'DVP_P1-2: LN 246' OPEN BRANCH FROM BUS 314537 TO BUS 314575 CKT 1 /* 6SUFFOLK 230.00 - 6NUCO TP 230.00 OPEN BRANCH FROM BUS 314569 TO BUS 314575 CKT 1 /* 6EARLEYS 230.00 - 6NUCO TP 230.00 OPEN BRANCH FROM BUS 314575 TO BUS 314590 CKT 1 /* 6NUCO TP 230.00

	- 6NUCOR 230.00 OPEN BUS 314575 /* ISLAND OPEN BUS 314590 /* ISLAND END
DVP_P1-2: LN 247	CONTINGENCY 'DVP_P1-2: LN 247' OPEN BRANCH FROM BUS 314537 TO BUS 314648 CKT 1 /* 6SUFFOLK 230.00 - 6SUNBURY 230.00 OPEN BRANCH FROM BUS 314648 TO BUS 901080 CKT 1 /* 6SUNBURY 230.00 - W1-029 230.00 OPEN BUS 314648 /* ISLAND END
DVP_P1-2: LN 563	CONTINGENCY 'DVP_P1-2: LN 563' OPEN BRANCH FROM BUS 314902 TO BUS 314914 CKT 1 /* 8CARSON 500.00 - 8MDLTHAN 500.00 END
DVP_P1-2: LN 574	CONTINGENCY 'DVP_P1-2: LN 574' OPEN BRANCH FROM BUS 314908 TO BUS 314911 CKT 1 /* 8ELMONT 500.00 - 8LDYSMTH 500.00 END
DVP_P1-2: LN 575	CONTINGENCY 'DVP_P1-2: LN 575' OPEN BRANCH FROM BUS 314911 TO BUS 314918 CKT 1 /* 8LDYSMTH 500.00 - 8NO ANNA 500.00 END
DVP_P1-2: LN 576	CONTINGENCY 'DVP_P1-2: LN 576' OPEN BRANCH FROM BUS 314914 TO BUS 314918 CKT 1 /* 8MDLTHAN 500.00 - 8NO ANNA 500.00 END
DVP_P1-2: LN 594	CONTINGENCY 'DVP_P1-2: LN 594' OPEN BRANCH FROM BUS 314916 TO BUS 314934 CKT 1 /* 8MORRSVL 500.00 - 8SPOTSYL 500.00

	END
DVP_P4-2: 246T247	CONTINGENCY 'DVP_P4-2: 246T247' /* SUFFOLK 230 KV OPEN BRANCH FROM BUS 314537 TO BUS 314575 CKT 1 /* 6SUFFOLK 230.00 - 6NUCO TP 230.00 OPEN BRANCH FROM BUS 314569 TO BUS 314575 CKT 1 /* 6EARLEYS 230.00 - 6NUCO TP 230.00 OPEN BRANCH FROM BUS 314575 TO BUS 314590 CKT 1 /* 6NUCO TP 230.00 - 6NUCOR 230.00 OPEN BUS 314575 /* ISLAND: 6NUCO TP 230.00 OPEN BUS 314590 /* ISLAND: 6NUCOR 230.00 OPEN BRANCH FROM BUS 314537 TO BUS 314648 CKT 1 /* 6SUFFOLK 230.00 - 6SUNBURY 230.00 OPEN BRANCH FROM BUS 314648 TO BUS 901080 CKT 1 /* 6SUNBURY 230.00 - W1-029 230.00 OPEN BUS 314648 /* ISLAND: 6SUNBURY 230.00 END
DVP_P4-2: 562T563	CONTINGENCY 'DVP_P4-2: 562T563' /*CARSON OPEN BRANCH FROM BUS 314902 TO BUS 314923 CKT 1 /*CARSON TO MIDLOTHIAN OPEN BRANCH FROM BUS 314914 TO BUS 314902 CKT 1 /*CARSON 500.00 - 8SEPTA 500.00 END
DVP_P4-3: 203422	CONTINGENCY 'DVP_P4-3: 203422' /* TROWBRIDGE OPEN BRANCH FROM BUS 314616 TO BUS 933990 CKT 1 /* LINE 2034 OPEN BRANCH FROM BUS 314616 TO BUS 314613 CKT 1 /* TROWBRIDGE TX.*1 END
DVP_P7-1: LN 2058-2181	CONTINGENCY 'DVP_P7-1: LN 2058-2181' OPEN BRANCH FROM BUS 304222 TO BUS 313845 CKT 1 /* 6ROCKYMT230T230.00 - 6HATHAWAY 230.00

	OPEN BUS 304226 /* ISLAND: 6PA-RMOUNT#4115.00 OPEN BRANCH FROM BUS 304226 TO BUS 314591 CKT 1 /* 6PA-RMOUNT#4230.00 - 6NASH 230.00 OPEN BRANCH FROM BUS 313845 TO BUS 314591 CKT 1 /* 6HATHAWAY 230.00 - 6NASH 230.00 OPEN BUS 314591 /* ISLAND: 6NASH 230.00 END
DVP_P7-1: LN 25-2034_A	CONTINGENCY 'DVP_P7-1: LN 25-2034_A' /*REPLACED ON 4/19/2016 OPEN BRANCH FROM BUS 314573 TO BUS 314596 CKT 1 /* 3EVERETS 115.00 - 3POPLR C 115.00 OPEN BRANCH FROM BUS 314596 TO BUS 314614 CKT 1 /* 3POPLR C 115.00 - 3TROWBR2 115.00 OPEN BUS 314596 /* ISLAND OPEN BRANCH FROM BUS 314614 TO BUS 314616 CKT 1 /* 3TROWBR2 115.00 - 6TRWBRDG 230.00 OPEN BRANCH FROM BUS 314616 TO BUS 933990 CKT 1 /* 6TRWBRDG 230.00 - AD1-023 TAP 230.00 END
DVP_P7-1: LN 81-2056	CONTINGENCY 'DVP_P7-1: LN 81-2056' OPEN BRANCH FROM BUS 314559 TO BUS 314578 CKT 1 /* 3CAROLNA 115.00 - 3HORNRTN 115.00 OPEN BRANCH FROM BUS 314578 TO BUS 314598 CKT 1 /* 3HORNRTN 115.00 - 3ROAN DP 115.00 OPEN BRANCH FROM BUS 314598 TO BUS 314628 CKT 1 /* 3ROAN DP 115.00 - 3DARLINGT DP115.00 OPEN BUS 314578 /* ISLAND: 3HORNRTN 115.00 OPEN BUS 314598 /* ISLAND: 3ROAN DP 115.00 OPEN BRANCH FROM BUS 304226 TO BUS 314591 CKT 1 /* 6PA-RMOUNT#4230.00 - 6NASH 230.00 OPEN BRANCH FROM BUS 313845 TO BUS 314591 CKT 1 /* 6MORNSTR 230.00 - 6NASH 230.00 OPEN BRANCH FROM BUS 304226 TO BUS 304222 CKT 1 /* 6PA-

	RMOUNT#4230.00 - 6ROCKYMT230T	
	OPEN BUS 304226	/* ISLAND
	OPEN BUS 314591	/* ISLAND: 6NASH 230.00
	END	

EXHIBIT A TO SECOND SUPPLEMENTAL
PREFILED REPLY TESTIMONY OF
DONNA ROBICHAUD
MACADAMIA SOLAR, LLC
EMP-119, SUBS 0 AND 1

Summer Peak Analysis – 2021

Generator Deliverability

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

Overload Number	Contingency Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Circuit	Power Flow	Loading % Initial	Loading % Final	Rating Type	Rating MVA	MW Contribution	Flowgate Appendix
1	N-1	DVP_P1-2: LN 2181	DVP - CPLE	6MORNSTR-6ROCKYMT230T 230 kV line	313845	304222	1	AC	93.08	100.56	ER	374	28.43	
2	N-1	DVP_P1-2: LN 563	DVP - DVP	6CHESTF B-6BASIN 230 kV line	314287	314276	1	AC	99.34	103.13	ER	449	19.71	

Multiple Facility Contingency

(Double Circuit Tower Line, Fault with a Stuck Breaker, and Bus Fault contingencies for the full energy output).

Overload Number	Contingency Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Circuit	Power Flow	Loading % Initial	Loading % Final	Rating Type	Rating MVA	MW Contribution	Flowgate Appendix
3	DCTL	DVP_P7-1: LN 25-2034_A	DVP - DVP	3FIVE PT-3WHARTON 115 kV line	314576	314622	1	DC	53.62	115.31		91	56.13	1
4	LFFB	DVP_P4-2: 246T247	DVP - DVP	6ELIZ CT-6SHAWBRO 230 kV line	314638	314647	1	AC	80.59	108.11		699	189.39	2
5	DCTL	DVP_P7-1: LN 25-2034_A	DVP - DVP	AB2-169 TAP-3FIVE PT 115 kV line	925120	314576	1	DC	64.94	126.63		91	56.13	3
6	LFFB	DVP_P4-3: 203422	DVP - DVP	6TRWBRDG 230/115 kV transformer	314616	314613	2	AC	49.31	107.63		200	135.47	4

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

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)

Overload Number	Contingency Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Circuit	Power Flow	Loading % Initial	Loading % Final	Rating Type	Rating MVA	MW Contribution	Flowgate Appendix
7	DCTL	DVP_P7-1: LN 81-2056	DVP - CPLE	6MORNSTR-6ROCKYMT230T 230 kV line	313845	304222	1	AC	125.73	135.5	ER	374	43.04	5
8	LFFB	DVP_P4-2: 562T563	DVP - DVP	6CHESTF B-6BASIN 230 kV line	314287	314276	1	AC	103.56	108.11		549	29.23	6
9	DCTL	DVP_P7-1: LN 2058-2181	DVP - CPLE	6EVERETS-6GREENVILE T 230 kV line	314574	304451	1	AC	102.22	118.77	ER	478	82.65	7
10	LFFB	DVP_P4-2: 246T247	DVP - DVP	AB2-100 TAP-6CLUBHSE 230 kV line	924510	314563	1	AC	103.55	116.05		459	68.22	8

New System Reinforcements

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

Appendix #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost	AD1-074/ AD1-075/ AD1-076 Allocation
#1	3FIVE PT-3WHARTON 115 kV	**DVP:** **Project Id:** n8113 **Project Description:** The Contingency driving this upgrade/overload is DVP_P7-1: LN 25-2034-A which is the tower failure of the Dominion 115 kV Line#25	n8113	$1,875,000	$1,875,000

#3	AB2-169 TAP-3FIVE PT 115 kV line	Trowbridge-Everett and 230 kV Line#2034 who share a common tower. Dominion new proposal is to resolve the overload by splitting line #25 off of line#2034, which eliminate the tower contingency. **Project Type:** CON **Cost:** $1,875,000 **Time Estimate:** **Note: AD1-074/075/076 is the driver for this overload/upgrade.**			
#2	6ELIZ CT-6SHAWBRO 230 kV	Description: Rebuild 10.28 miles of the Shawboro – Elizabeth City 230 kV line #2021 Ratings: 1047/1047/1204 Schedule: 30 – 36 months AD1-074/075/076 is the driver for this upgrade.	n6314	$25,691,055	**$25,691,055**
#4	6TRWBRDG 230/115 kV transformer #2	Description: Add additional 230kV breaker at Trowbridge to prevent loss of TX#1 upon fault on 230kV line 2034 in stuck breaker scenario **Note: This violation occurs as a result of testing the stability reinforcement n6287 Trowbridge reconfiguration in the summer peak load flow analysis.** Type: CON AD1-074/075/076 is the driver for this upgrade.	n6287.1	$617,062	$617,062
Total Cost($)				**$28,183,117**	**$28,183,117**

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 is calculated and reported for in the Impact Study)

Appendix #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost	AD1-074/075/076 Allocation
#5	6MORNSTR-6ROCKYMT230 T 230 kV line	**Dominion Portion:** Description: Rebuild 4.3 miles of Dominion 230 kV Line #2058 Rocky Mt. – Hathaway Rating: 1047/1047/1204 Schedule: 12/31/2024 in-service date Note: Although Queue Project AD1-074/AD1-075/AD1-076 may not have cost responsibility for this upgrade, it may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AD1-074/AD1-075/AD1-076 comes into service prior to completion of the upgrade, it will need an interim study.	b3122	$13,000,000	**$0**
#6	6CHESTF B-6BASIN 230 kV	Chesterfield to Basin 230 kV line - Replace 0.14 miles of 1109 ACAR with a conductor which will increase the line rating to approximately 706 MVA. Note: Project is in-service as of 4/27/2018	b2990	$350,000	**$0**

<table>
<tr>
<td rowspan="2">#7</td>
<td rowspan="2">6EVERETS-6GREENVILE T 230 kV line</td>
<td>Dominion Portion: Description: Rebuild the 20.5 miles of Dominion 230 kV Line #218 Everetts - Greenville

Rating: 1047/1047/1204

Schedule: 30-36 months

<table>
<tr><th>Queue Project</th><th>MW Impact</th><th>Cost (%)</th><th>Cost($)</th></tr>
<tr><td>AD1-057</td><td>11.1</td><td>11.84%</td><td>$ 4,727,235</td></tr>
<tr><td>AD1-076</td><td>82.65</td><td>88.16%</td><td>$35,198,738</td></tr>
</table>
</td>
<td>n6144</td>
<td>$39,925,973</td>
<td>$35,198,738</td>
</tr>
<tr>
<td>Duke Energy/Progress Portion:
Reconductor 2 miles with double 795 ACSS-TW per phase, upgrade disconnect switches and CT ratios

New Rating: 1195/1195/1195

Time Estimate: 30-36 months

Note: The Duke/Progress Energy portion of this line is studied under Duke's FERC tariff process. Reference the applicable affected system study for the AD1 cluster.</td>
<td>dep0003</td>
<td>$10,000,000</td>
<td>-</td>
</tr>
</table>

#8	AB2-100 TAP-6CLUBHSE 230 kV line	Rebuild Clubhouse-Lakeview 230 kV Line #254 with single-circuit wood pole equivalent structures at the current 230 kV standard with a minimum rating of 1047 MVA. Schedule: 10/15/23 Note: Although Queue Project AD1-074/075/076 may not have cost responsibility for this upgrade, Queue Project AD1-074/075/076 may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AD1-074/075/076 comes into service prior to completion of the upgrade, Queue Project AD1-074/075/076 will need an interim study	b3121	$23,670,000	**$0**
Total Cost ($)				**$86,945,973**	**$35,198,738**

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 IC 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 interconnection request by addressing 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.

Overload	Contingency		Affected Area	Facility Description	Bus		Circuit	Power Flow	Loading %		Rating		MW Contribution	Flowgate Appendix
Number	Type	Name			From	To			Initial	Final	Type	MVA		
11	N-1	DVP_P1-2: LN 2181	DVP - CPLE	6MORNSTR-6ROCKYMT230T 230 kV line	313845	304222	1	AC	125.13	134.92	ER	374	42.91	
12	N-1	DVP_P1-2: LN 2058	DVP - DVP	6MORNSTR-6NASH 230 kV line	313845	314591	1	AC	111.06	119.34	ER	449	43.77	
13	N-1	DVP_P1-2: LN 563	DVP - DVP	6CHESTF B-6BASIN 230 kV line	314287	314276	1	AC	120.67	126.31	ER	449	29.74	
14	N-1	DVP_P1-2: LN 2131A	DVP - DVP	6CLUBHSE-6SAPONY 230 kV line	314563	314435	1	AC	97.11	109.62	ER	599	75.14	
15	N-1	DVP_P1-2: LN 2131A	DVP - DVP	6EARLEYS-6NUCO TP 230 kV line	314569	314575	1	AC	102.74	131.88	ER	572	170.35	
16	N-1	DVP_P1-2: LN 2131A	DVP - CPLE	6EVERETS-6GREENVILE T 230 kV line	314574	304451	1	AC	83.92	104.83	ER	478	105.3	
17	N-1	DVP_P1-2: LN 2131A	DVP - DVP	6NUCO TP-6SUFFOLK 230 kV line	314575	314537	1	AC	96.53	125.65	ER	572	170.35	
18	N-1	DVP_P1-2: LN 2131A	DVP - DVP	6LAKEVEW-AB2-100 TAP 230 kV line	314583	924510	1	AC	102.13	120.89	ER	375	71.82	
19	N-1	DVP_P1-2: LN 2058	DVP - CPLE	6NASH-6PA-RMOUNT#4 230 kV line	314591	304226	1	AC	101.24	109.15	ER	470	43.77	
20	N-1	DVP_P1-2: LN 2034-B	DVP - DVP	3POPLR C-3EVERETS 115 kV line	314596	314573	1	AC	47.6	101.3	ER	225	124.48	
21	N-1	DVP_P1-2: LN 2034-A	DVP - DVP	6TRWBRDG 230/115 kV transformer	314616	314613	1	AC	48.79	107.2	ER	195	131.05	

22	N-1	DVP_P1-2: LN 2131A	DVP - DVP	6TRWBRDG-AD1-023 TAP 230 kV line	314616	933990	1	AC	54.3	112.63	ER	572	362.61	
23	N-1	DVP_P1-2: LN 2131A	DVP - DVP	6CASHIE-6EARLEYS 230 kV line	314620	314569	1	AC	62.62	121.7	ER	572	362.61	
24	N-1	DVP_P1-2: LN 247	DVP - DVP	6ELIZ CT-6SHAWBRO 230 kV line	314638	314647	1	AC	74.02	102.54	ER	572	164	
25	N-1	DVP_P1-2: LN 2020	DVP - DVP	6SUNBURY-6SUFFOLK 230 kV line	314648	314537	1	AC	86.34	120.55	ER	449	153.13	
26	N-1	DVP_P1-2: LN 246	DVP - DVP	6S HERTFORD-6WINFALL 230 kV line	314662	314651	1	AC	79.61	109.76	ER	733	219.81	
27	N-1	DVP_P1-2: LN 594	DVP - DVP	8CHANCE-8BRISTER 500 kV line	314905	314900	1	AC	96.94	99.87	ER	2442	82.63	
28	N-1	DVP_P1-2: LN 576	DVP - DVP	8ELMONT-8LADYSMITH 500 kV line	314908	314911	1	AC	105.6	110.86	ER	2442	137.51	
29	N-1	DVP_P1-2: LN 574	DVP - DVP	8MDLTHAN-8NO ANNA 500 kV line	314914	314918	1	AC	97.79	102.28	ER	2442	126.53	
30	N-1	DVP_P1-2: LN 575	DVP - DVP	8SPOTSYL-8MORRSVL 500 kV line	314934	314916	1	AC	95.01	97.86	ER	3219	76.48	
31	N-1	DVP_P1-2: LN 2020	DVP - DVP	W1-029-6SUNBURY 230 kV line	901080	314648	1	AC	87.72	121.93	ER	449	153.13	
32	N-1	DVP_P1-2: LN 246	DVP - DVP	Z1-036 TAP-6S HERTFORD 230 kV line	916040	314662	1	AC	81.77	111.94	ER	733	219.81	
33	N-1	DVP_P1-2: LN 246	DVP - DVP	AB2-100 TAP-6CLUBHSE 230 kV line	924510	314563	1	AC	120.36	133.89	ER	375	60.27	
34	Non	Non	DVP - DVP	AB2-100 TAP-6CLUBHSE 230 kV line	924510	314563	1	AC	100.51	110.3	NR	375	43.26	
35	Non	Non	DVP - DVP	AB2-100 TAP-6CLUBHSE 230 kV line	924510	314563	1	AC	100.51	110.3	NR	375	43.26	
36	N-1	DVP_P1-2: LN 2131A	DVP - DVP	AD1-023 TAP-6CASHIE 230 kV line	933990	314620	1	AC	64.39	123.41	ER	572	362.61	

Stability Study Executive Summary

This system impact study will be performed for generation interconnection request AD1-074, AD1-075, and AD1-076.

Generator Interconnection Request AD1-074 is for a 300 MW Maximum Facility Output (MFO) solar generating facility. AD1-074 consists of 141 x 2.167 MW SMA Sunny Central MVB 2500-US solar inverters. Generator Interconnection Request AD1-075 is for a 75 MW Maximum Facility Output (MFO) solar generating facility. AD1-075 consists of 36 x 2.119 MW SMA Sunny Central MVB 2500-US solar inverters. Generator Interconnection Request AD1-076 is for a 109 MW Maximum Facility Output (MFO) solar generating facility. AD1-076 consists of 52 x 2.133 MW SMA Sunny Central MVB 2500-US solar inverters. Generation interconnection requests AD1-074, AD1-075, and AD1-076 have a Point of Interconnection (POI) directly at the Trowbridge 230 kV substation in Washington County, North Carolina, in the Dominion Energy transmission system.

The power flow scenario for the analysis was based on the RTEP 2021 summer peak load case, modified to include applicable queue projects. AD1-074, AD1-075, and AD1-076, has been dispatched online at maximum facility output, with approximately unity power factor at the high side of the station transformer.

AD1-074, AD1-075, and AD1-076 was tested for compliance with NERC, PJM, Transmission Owner and other applicable criteria. For this study, 92 contingencies were simulated, each with a 20 second simulation time period. Studied faults included:

- Steady-state operation (20 second simulation)
- Three-phase faults with normal clearing time
- Single-phase faults with a stuck breaker
- Single-phase faults placed at 80% of the line with delayed (Zone 2) clearing at remote line end because of primary communications/relaying failure
- Single-phase fault with loss of multiple circuits caused by a common tower contingency

The 92 fault contingencies with the proposed mitigation simulated on the 2021 summer peak load case met the recovery criteria:

- The AD1-074, AD1-075, and AD1-076 generators were able to ride through the faults except for faults where protective actions trip one or more generator(s).
- All generators maintained synchronism and any post-contingency oscillations are positively damped with a damping margin of at least 3%.
- All bus voltages recover to 0.7 p.u. within 2.5 seconds and the final voltages are within the steady-state voltage ranges below per DVP's transmission planning criteria.
    - P1 Category Contingencies:

    - 0.93 to 1.05 p.u. for 230, 115, 69 kV facilities
    - 0.93 to 1.03 p.u. for 138 kV facilities due to legacy switches
    - 1.01 to 1.096 p.u. for 500 kV facilities
  - P2, P4, P5, and P7 Category Contingencies:
    - 0.90 to 1.05 p.u. for 230, 115, 69 kV facilities
    - 0.90 to 1.03 p.u. for 138 kV facilities due to legacy switches
    - 1.00 to 1.096 p.u. for 500 kV facilities
- No transmission element trips, other than those either directly connected or designated to trip as a consequence of the fault.

The following mitigation was identified for the interconnection of the AD1-074, AD1-075, and AD1-076 queue projects:

- An additional 58.87 Mvar of reactive support was identified as mitigation to interconnect the AD1-074, AD1-075, and AD1-076 generators because the plant did not meet the 0.95 lagging power factor requirement. This needs to be addressed by the Interconnection Customer.
- The Trowbridge 230 kV substation was reconfigured to prevent instability of the AD1-074, AD1-075, and AD1-076 queue projects. If the AD1-074, AD1-075, and AD1-076 generator tie line connection is moved between new circuit breakers 2 and 3 and the Trowbridge to Mackeys 230 kV transmission line is moved between new circuit breakers 1 and 2 the AD1-074, AD1-075, and AD1-076 queue projects can remain connected to a 230 kV line at Trowbridge for all P4 contingencies at Trowbridge 230 kV. To accommodate the 230 kV reconfiguration DVP is updating the Trowbridge 115 kV substation to a ring bus therefore the case was updated to have one 115 kV Trowbridge bus.
- Network upgrade number n6287 has been created for the reconfiguration of Trowbridge substation with the following preliminary scope of work and preliminary cost estimate:

  Preliminary Scope:
  230kV Yard
  - Expand 230kV yard to accommodate additional rung of 230kV breakers. This will require relocation of existing 115kV equipment.
  - Relocate Transformer #1 to accommodate new rung of 230kV breakers
  - Install 3 new 230kV breakers[1], and 2 new 230kV backbones
  - Reterminate Line 2126 on new rung, will require T Line reconfiguration outside of station

[1] Two of these breakers are included in the scope of the non-direct physical interconnection at a cost of $4,000,000.

- Terminate new AD1-074/75/76 line on new rung. Will require T Line reconfiguration outside of the station to utilize existing 115kV Line 25 station entrance infrastructure

115kV Yard

- Expand station to the north and rebuild entire 115kV yard (8 breakers, 4 backbones)
- Reterminate all (4) existing 115kV lines
  - Line 1020 and line 25 will require significant T-Line reconfigurations outside of the station

Preliminary Cost Estimate: $ 12,101,800 -$4,000,000 = $8,101,800[2]

New System Reinforcements

Violation #	Upgrade Description	Network Upgrade Number	Upgrade Cost	AD1-074/ AD1-075/ AD1-076 Allocation
P4.08, P4.09	**Dominion Portion:** Description: Reconfiguration of Trowbridge 230 kV and 115 kV substation	n6287	$8,101,800	**$8,101,800**

Steady-State Voltage Requirements

(Summary of the VAR requirements based upon the results of the steady-state voltage studies)

[2] This preliminary estimate includes $4,000,000 in non-direct physical interconnection costs. The additional cost of the work driven by the stability analysis is $8,101,800.

The AD1-074, AD1-075, and AD1-076 projects did not meet the 0.95 lagging power factor requirement. An additional 58.87 Mvar would be required for the plant to meet the 0.95 lagging power factor requirement. The plant did meet the 0.95 leading power factor requirement.

Generator	MFO (MW)	Required Power Factor Range		Maximum Lagging (Mvar)	Minimum Leading (Mvar)
		Lagging	Leading		
AD1-074, AD1-075, and AD1-076	484.00	0.95	0.95		
Total Reactive Power Required				159.08	-159.08
Reactive Power from Generator				**Qmax**	**Qmin**
				178.75	-178.75
Customer Planned Compensation				0	0
Reactive Power Losses				-78.54	-78.54
Total Available Reactive Power at High Side of Main Transformer				100.21	-257.29
Deficiency in Reactive Power				-58.87	Meet

Stability and Reactive Power Requirement for Low Voltage Ride Through

(Summary of the VAR requirements based upon the results of the dynamic studies)

The AD1-074, AD1-075, and AD1-076 generators were observed to be unstable for the contingencies listed in the table below. These P4 contingencies were caused by breaker 2034T2126 failing to open resulting in both 230 kV lines connected to Trowbridge 230 kV tripping. The AD1-074, AD1-075, and AD1-076 queue projects lost sychronism once the two 230 kV line tripped and the generators were connected to the system through the two Trowbridge 230/115 kV transformers.

Fault ID	Fault Description	Clearing Time Normal/Delayed (Cycles)	AD1-074, AD1-075, and AD1-076
P4.08	Fault at Trowbridge 230 kV on AD1-022 TAP circuit 2034. Breaker 2034T2126 is stuck. Fault is cleared with loss of Trowbridge 230/115 kV Transformer 1 and Trowbridge to Mackeys 230 kV circuit 2126.	5.5/26	Unstable
P4.09	Fault at Trowbridge 230 kV on Mackeys circuit 2126. Breaker 2034T2126 is stuck. Fault is cleared with loss of Trowbridge 230/115 kV Transformer 1 and Trowbridge to AD1-022 Tap 230 kV circuit 2034.	5.5/26	Unstable

The Trowbridge 230 kV substation was reconfigured to prevent instability of the AD1-074, AD1-075, and AD1-076 queue projects. If the AD1-074, AD1-075, and AD1-076 generator tie line connection is moved

between new circuit breakers 2 and 3 and the Trowbridge to Mackeys 230 kV transmission line is moved between new circuit breakers 1 and 2 the AD1-074, AD1-075, and AD1-076 queue projects can remain connected to a 230 kV line at Trowbridge for all P4 contingencies at Trowbridge 230 kV. To accommodate the 230 kV reconfiguration DVP proposed updating the Trowbridge 115 kV substation to a ring bus therefore the case was updated to have one 115 kV Trowbridge bus. AD1-074, AD1-075, and AD1-076 remained stable for all P4 contingencies with the Trowbridge 230 and 115 kV substation reconfigured.

The reconfiguration moving the Mackeys – Trowbridge 230kV line is captured under Network Upgrade n6287 with an estimated cost of $12,101,800. This upgrade replicates $4,000,000 of non-direct physical interconnection work and therefore has a cost of $8,101,800.

Light Load Analysis in 2021

Not required

Affected System Analysis & Mitigation

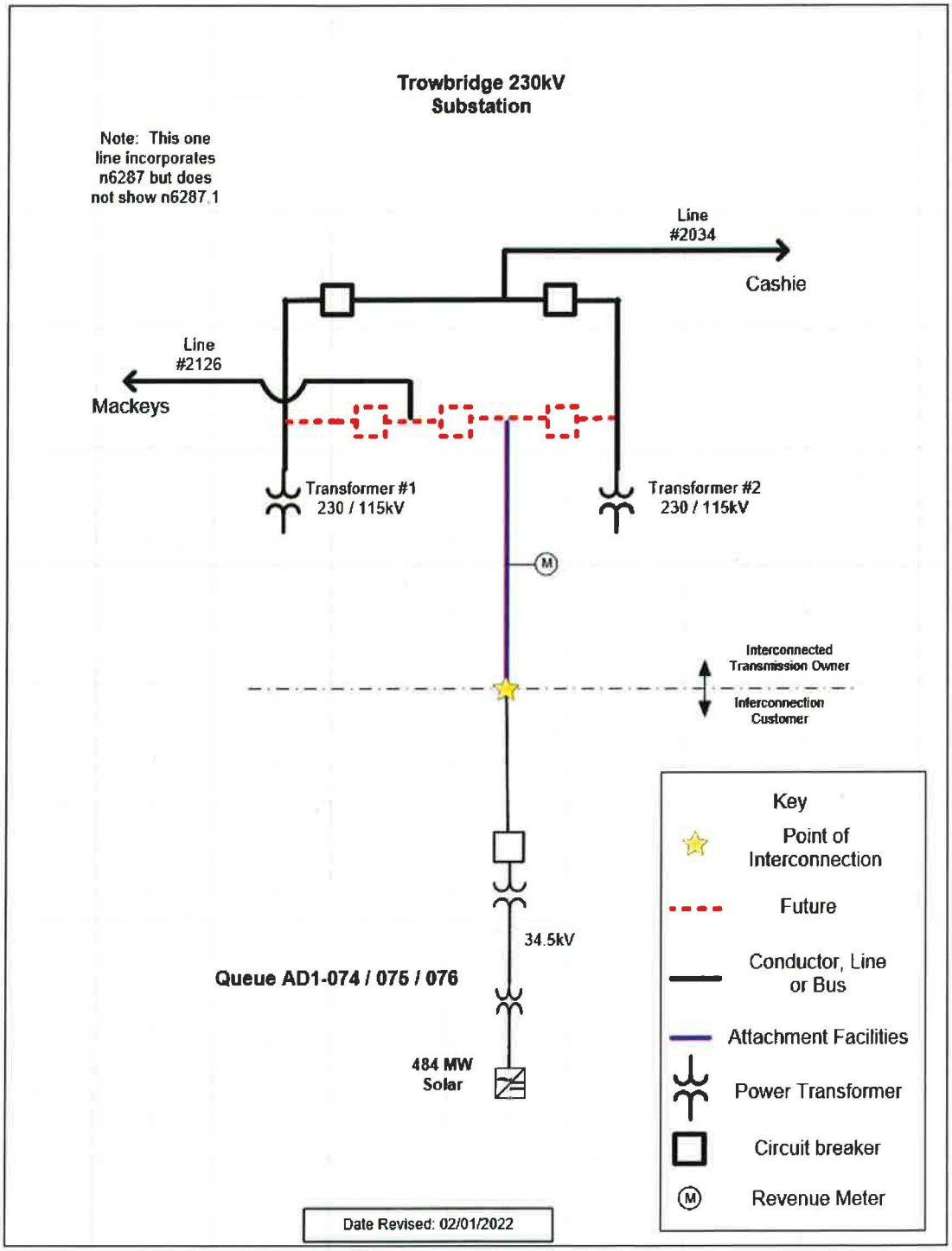
Duke Energy/Progress:

Potential constraints were identified by PJM on the following Dominion – Duke Energy/Progress (DEP) tie lines. Duke/Progress Energy portion of this line will need to be studied under Duke's FERC tariff process. The following facilities were identified in this report:

- Everetts - Greenville 230 kV line

Attachment 1.

System Configuration



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. All New Service Queue Requests, through the end of the Queue under study, that are contributors to a flowgate will be listed in the Appendices. Please note that there may be contributors that are subsequently queued after the queue under study that are not listed in the Appendices. 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 and appendices sections are full contributions, whereas the loading percentages reported in the body of the report, take into consideration the commercial probability of each project as well as the ramping impact of "Adder" contributions.

Appendix 1

(DVP - DVP) The 3FIVE PT-3WHARTON 115 kV line (from bus 314576 to bus 314622 ckt 1) loads from 53.62% to 115.31% (**DC power flow**) of its load dump rating (91 MVA) for the tower line contingency outage of 'DVP_P7-1: LN 25-2034_A'. This project contributes approximately 56.13 MW to the thermal violation.

CONTINGENCY 'DVP_P7-1: LN 25-2034_A' /*REPLACED ON 4/19/2016
OPEN BRANCH FROM BUS 314573 TO BUS 314596 CKT 1 /* 3EVERETS 115.00 - 3POPLR C 115.00
OPEN BRANCH FROM BUS 314596 TO BUS 314614 CKT 1 /* 3POPLR C 115.00 - 3TROWBR2 115.00
OPEN BUS 314596 /* ISLAND
OPEN BRANCH FROM BUS 314614 TO BUS 314616 CKT 1 /* 3TROWBR2 115.00 - 6TRWBRDG 230.00
OPEN BRANCH FROM BUS 314616 TO BUS 933990 CKT 1 /* 6TRWBRDG 230.00 - AD1-023 TAP 230.00
END

Bus Number	*Bus Name*	*Full Contribution*
315294	*1DOMTR10*	*2.96*
315292	*1DOMTR78*	*2.*
315293	*1DOMTR9*	*1.63*
314566	*3CRESWEL*	*1.3*
314594	*6PLYMOTH*	*0.56*
934521	*AD1-076 C O1*	*37.19*
934522	*AD1-076 E O1*	*18.94*
LTF	*AMIL*	*0.06*
LTF	*BLUEG*	*0.31*
LTF	*CALDERWOOD*	*0.18*
LTF	*CANNELTON*	*0.06*
LTF	*CARR*	*< 0.01*
LTF	*CATAWBA*	*0.17*
LTF	*CHEOAH*	*0.17*
LTF	*CLIFTY*	*1.12*
LTF	*COTTONWOOD*	*0.61*

LTF	*EDWARDS*	*0.09*
LTF	*ELMERSMITH*	*0.17*
LTF	*FARMERCITY*	*0.07*
LTF	*G-007A*	*0.11*
LTF	*GIBSON*	*0.11*
LTF	*HAMLET*	*0.36*
LTF	*MORGAN*	*0.53*
LTF	*NEWTON*	*0.26*
LTF	*O-066A*	*0.05*
LTF	*PRAIRIE*	*0.56*
LTF	*RENSSELAER*	*< 0.01*
LTF	*SMITHLAND*	*0.05*
LTF	*TATANKA*	*0.13*
LTF	*TILTON*	*0.11*
LTF	*TRIMBLE*	*0.06*
LTF	*TVA*	*0.22*
LTF	*UNIONPOWER*	*0.3*
LTF	*VFT*	*0.29*
916041	*Z1-036 C*	*2.41*
916042	*Z1-036 E*	*16.14*
920692	*AA2-178 E*	*2.23*
925121	*AB2-169 C*	*19.*
925122	*AB2-169 E*	*17.05*

Appendix 2

(DVP - DVP) The 6ELIZ CT-6SHAWBRO 230 kV line (from bus 314638 to bus 314647 ckt 1) loads from 80.59% to 108.11% (AC power flow) of its load dump rating (699 MVA) for the line fault with failed breaker contingency outage of 'DVP_P4-2: 246T247'. This project contributes approximately 189.39 MW to the thermal violation.

CONTINGENCY 'DVP_P4-2: 246T247' /* SUFFOLK 230 KV
OPEN BRANCH FROM BUS 314537 TO BUS 314575 CKT 1 /* 6SUFFOLK 230.00 - 6NUCO TP 230.00
OPEN BRANCH FROM BUS 314569 TO BUS 314575 CKT 1 /* 6EARLEYS 230.00 - 6NUCO TP 230.00
OPEN BRANCH FROM BUS 314575 TO BUS 314590 CKT 1 /* 6NUCO TP 230.00 - 6NUCOR 230.00
OPEN BUS 314575 /* ISLAND: 6NUCO TP 230.00
OPEN BUS 314590 /* ISLAND: 6NUCOR 230.00
OPEN BRANCH FROM BUS 314537 TO BUS 314648 CKT 1 /* 6SUFFOLK 230.00 - 6SUNBURY 230.00
OPEN BRANCH FROM BUS 314648 TO BUS 901080 CKT 1 /* 6SUNBURY 230.00 - W1-029 230.00
OPEN BUS 314648 /* ISLAND: 6SUNBURY 230.00
END

Bus Number	*Bus Name*	*Full Contribution*
315294	*1DOMTR10*	*4.59*
315292	*1DOMTR78*	*3.1*
315293	*1DOMTR9*	*2.53*
315139	*1GASTONA*	*2.08*
315141	*1GASTONB*	*2.08*
315136	*1ROSEMG1*	*1.48*
315138	*1ROSEMG2*	*0.69*
315137	*1ROSEMS1*	*0.92*
314557	*3BETHELC*	*0.6*
314566	*3CRESWEL*	*6.73*
314603	*3SCOT NK*	*2.7*
314620	*6CASHIE*	*1.59*
314574	*6EVERETS*	*2.49*
314594	*6PLYMOTH*	*2.03*

314651	6WINFALL	6.57
932631	AC2-084 C	4.9
932632	AC2-084 E	2.41
933991	AD1-022 C	18.35
933992	AD1-022 E	9.99
934331	AD1-057 C O1	6.07
934332	AD1-057 E O1	3.24
934521	AD1-076 C O1	125.49
934522	AD1-076 E O1	63.9
LTF	CARR	0.06
LTF	CBM-S1	3.23
LTF	CBM-S2	6.66
LTF	CBM-W1	7.1
LTF	CBM-W2	17.37
LTF	CIN	1.59
LTF	CPLE	2.31
LTF	G-007	0.43
LTF	IPL	1.01
LTF	LGEE	0.34
LTF	MEC	3.59
LTF	MECS	1.6
LTF	O-066	2.71
LTF	RENSSELAER	0.05
900671	V4-068 C	0.06
900672	V4-068 E	0.18
901081	W1-029C	3.23
901082	W1-029E	118.88
LTF	WEC	0.44
913391	Y1-086 C	1.01

913392	*Y1-086 E*	*8.99*
916041	*Z1-036 C*	*23.54*
916042	*Z1-036 E*	*157.71*
917121	*Z2-027 C*	*1.86*
917122	*Z2-027 E*	*4.35*
917331	*Z2-043 C*	*0.4*
917332	*Z2-043 E*	*0.94*
917511	*Z2-088 C OP1*	*0.72*
917512	*Z2-088 E OP1*	*3.1*
918411	*AA1-050*	*0.61*
918511	*AA1-065 C OP*	*2.08*
918512	*AA1-065 E OP*	*5.58*
918531	*AA1-067 C*	*0.32*
918532	*AA1-067 E*	*0.75*
918561	*AA1-072 C*	*0.06*
918562	*AA1-072 E*	*0.16*
919691	*AA2-053 C*	*1.08*
919692	*AA2-053 E*	*2.52*
919701	*AA2-057 C*	*4.52*
919702	*AA2-057 E*	*2.26*
LTF	*AA2-074*	*1.57*
920591	*AA2-165 C*	*0.11*
920592	*AA2-165 E*	*0.3*
920671	*AA2-174 C*	*0.05*
920672	*AA2-174 E*	*0.29*
920691	*AA2-178 C*	*4.94*
920692	*AA2-178 E*	*11.54*
930861	*AB1-132 C*	*8.69*
930862	*AB1-132 E*	*3.72*

923831	*AB2-022 C*	*9.92*
923832	*AB2-022 E*	*5.34*
924501	*AB2-099 C*	*0.56*
924502	*AB2-099 E*	*0.24*
925121	*AB2-169 C*	*11.25*
925122	*AB2-169 E*	*10.1*
926071	*AC1-086 C*	*12.79*
926072	*AC1-086 E*	*5.82*
926201	*AC1-098 C*	*4.58*
926202	*AC1-098 E*	*2.73*
926211	*AC1-099 C*	*1.54*
926212	*AC1-099 E*	*0.9*
927021	*AC1-189 C*	*7.54*
927022	*AC1-189 E*	*3.76*
927141	*AC1-208 C*	*5.8*
927142	*AC1-208 E*	*2.58*

Appendix 3

(DVP - DVP) The AB2-169 TAP-3FIVE PT 115 kV line (from bus 925120 to bus 314576 ckt 1) loads from 64.94% to 126.63% (**DC power flow**) of its load dump rating (91 MVA) for the tower line contingency outage of 'DVP_P7-1: LN 25-2034_A'. This project contributes approximately 56.13 MW to the thermal violation.

CONTINGENCY 'DVP_P7-1: LN 25-2034_A' /*REPLACED ON 4/19/2016
OPEN BRANCH FROM BUS 314573 TO BUS 314596 CKT 1 /* 3EVERETS 115.00 - 3POPLR C 115.00
OPEN BRANCH FROM BUS 314596 TO BUS 314614 CKT 1 /* 3POPLR C 115.00 - 3TROWBR2 115.00
OPEN BUS 314596 /* ISLAND
OPEN BRANCH FROM BUS 314614 TO BUS 314616 CKT 1 /* 3TROWBR2 115.00 - 6TRWBRDG 230.00
OPEN BRANCH FROM BUS 314616 TO BUS 933990 CKT 1 /* 6TRWBRDG 230.00 - AD1-023 TAP 230.00
END

Bus Number	*Bus Name*	*Full Contribution*
315294	*1DOMTR10*	*2.96*
315292	*1DOMTR78*	*2.*
315293	*1DOMTR9*	*1.63*
314566	*3CRESWEL*	*1.3*
314594	*6PLYMOTH*	*0.56*
934521	*AD1-076 C O1*	*37.19*
934522	*AD1-076 E O1*	*18.94*
LTF	*AMIL*	*0.06*
LTF	*BLUEG*	*0.31*
LTF	*CALDERWOOD*	*0.18*
LTF	*CANNELTON*	*0.06*
LTF	*CARR*	*< 0.01*
LTF	*CATAWBA*	*0.17*
LTF	*CHEOAH*	*0.17*
LTF	*CLIFTY*	*1.12*
LTF	*COTTONWOOD*	*0.61*

LTF	*EDWARDS*	*0.09*
LTF	*ELMERSMITH*	*0.17*
LTF	*FARMERCITY*	*0.07*
LTF	*G-007A*	*0.11*
LTF	*GIBSON*	*0.11*
LTF	*HAMLET*	*0.36*
LTF	*MORGAN*	*0.53*
LTF	*NEWTON*	*0.26*
LTF	*O-066A*	*0.05*
LTF	*PRAIRIE*	*0.56*
LTF	*RENSSELAER*	*< 0.01*
LTF	*SMITHLAND*	*0.05*
LTF	*TATANKA*	*0.13*
LTF	*TILTON*	*0.11*
LTF	*TRIMBLE*	*0.06*
LTF	*TVA*	*0.22*
LTF	*UNIONPOWER*	*0.3*
LTF	*VFT*	*0.29*
916041	*Z1-036 C*	*2.41*
916042	*Z1-036 E*	*16.14*
920692	*AA2-178 E*	*2.23*
925121	*AB2-169 C*	*19.*
925122	*AB2-169 E*	*17.05*

Appendix 4

(DVP - DVP) The 6TRWBRDG 230/115 kV transformer (from bus 314616 to bus 314613 ckt 2) loads from 49.31% to 107.63% (AC power flow) of its load dump rating (200 MVA) for the line fault with failed breaker contingency outage of 'DVP_P4-3: 203422'. This project contributes approximately 135.47 MW to the thermal violation.

Note: This violation occurs as a result of testing the stability reinforcement n6287 Trowbridge reconfiguration in the summer peak load flow analysis.

```
CONTINGENCY 'DVP_P4-3: 203422'                    /* TROWBRIDGE
  OPEN BRANCH FROM BUS 314616 TO BUS 933990 CKT 1      /* LINE 2034
  OPEN BRANCH FROM BUS 314616 TO BUS 314613 CKT 1      /* TROWBRIDGE TX.*1
  END
```

Bus Number	*Bus Name*	*Full Contribution*
314566	*3CRESWEL*	*3.15*
314594	*6PLYMOTH*	*1.36*
314648	*6SUNBURY*	*0.36*
314651	*6WINFALL*	*1.17*
934521	*AD1-076 C O1*	*89.76*
934522	*AD1-076 E O1*	*45.71*
LTF	*AMIL*	*0.12*
LTF	*BLUEG*	*0.58*
LTF	*CALDERWOOD*	*0.39*
LTF	*CANNELTON*	*0.11*
LTF	*CATAWBA*	*0.39*
LTF	*CBM-N*	*0.02*
LTF	*CHEOAH*	*0.36*
LTF	*CLIFTY*	*2.07*
LTF	*COTTONWOOD*	*1.28*
LTF	*EDWARDS*	*0.18*

LTF	*ELMERSMITH*	*0.34*
LTF	*FARMERCITY*	*0.15*
LTF	*G-007A*	*0.47*
LTF	*GIBSON*	*0.21*
LTF	*HAMLET*	*0.81*
LTF	*MORGAN*	*1.13*
LTF	*NEWTON*	*0.51*
LTF	*NYISO*	*0.26*
LTF	*O-066A*	*0.22*
LTF	*PRAIRIE*	*1.12*
LTF	*SMITHLAND*	*0.1*
LTF	*TATANKA*	*0.25*
LTF	*TILTON*	*0.21*
LTF	*TRIMBLE*	*0.11*
LTF	*TVA*	*0.47*
LTF	*UNIONPOWER*	*0.65*
LTF	*VFT*	*1.26*
901082	*W1-029E*	*17.76*
913392	*Y1-086 E*	*1.17*
916041	*Z1-036 C*	*5.83*
916042	*Z1-036 E*	*39.05*
917122	*Z2-027 E*	*0.57*
920691	*AA2-178 C*	*2.31*
920692	*AA2-178 E*	*5.4*
923831	*AB2-022 C*	*1.07*
923832	*AB2-022 E*	*0.58*
925121	*AB2-169 C*	*-14.62*

Appendix 5

(DVP - CPLE) The 6MORNSTR-6ROCKYMT230T 230 kV line (from bus 313845 to bus 304222 ckt 1) loads from 125.73% to 135.5% (AC power flow) of its emergency rating (374 MVA) for the tower line contingency outage of 'DVP_P7-1: LN 81-2056'. This project contributes approximately 43.04 MW to the thermal violation.

CONTINGENCY 'DVP_P7-1: LN 81-2056'
OPEN BRANCH FROM BUS 314559 TO BUS 314578 CKT 1 /* 3CAROLNA 115.00 - 3HORNRTN 115.00
OPEN BRANCH FROM BUS 314578 TO BUS 314598 CKT 1 /* 3HORNRTN 115.00 - 3ROAN DP 115.00
OPEN BRANCH FROM BUS 314598 TO BUS 314628 CKT 1 /* 3ROAN DP 115.00 - 3DARLINGT DP115.00
OPEN BUS 314578 /* ISLAND: 3HORNRTN 115.00
OPEN BUS 314598 /* ISLAND: 3ROAN DP 115.00
OPEN BRANCH FROM BUS 304226 TO BUS 314591 CKT 1 /* 6PA-RMOUNT#4230.00 - 6NASH 230.00
OPEN BRANCH FROM BUS 313845 TO BUS 314591 CKT 1 /* 6MORNSTR 230.00 - 6NASH 230.00
OPEN BRANCH FROM BUS 304226 TO BUS 304222 CKT 1 /* 6PA-RMOUNT#4230.00 - 6ROCKYMT230T
OPEN BUS 304226 /* ISLAND
OPEN BUS 314591 /* ISLAND: 6NASH 230.00
END

Bus Number	*Bus Name*	*Full Contribution*
315131	*1EDGECMA*	*21.38*
315132	*1EDGECMB*	*21.38*
315139	*1GASTONA*	*3.75*
315141	*1GASTONB*	*3.75*
315126	*1ROARAP2*	*1.14*
315128	*1ROARAP4*	*1.1*
315136	*1ROSEMG1*	*3.14*
315138	*1ROSEMG2*	*1.47*
315137	*1ROSEMS1*	*1.95*
314557	*3BETHELC*	*1.61*
314554	*3BTLEBRO*	*1.08*

314566	3CRESWEL	1.09
314572	3EMPORIA	0.27
314603	3SCOT NK	3.23
314541	3WATKINS	0.33
314620	6CASHIE	0.49
314574	6EVERETS	1.81
314594	6PLYMOTH	0.44
932631	AC2-084 C	7.04
932632	AC2-084 E	3.47
933991	AD1-022 C	4.84
933992	AD1-022 E	2.63
934331	AD1-057 C O1	19.79
934332	AD1-057 E O1	10.56
934521	AD1-076 C O1	28.52
934522	AD1-076 E O1	14.52
LTF	AMIL	0.38
LTF	BLUEG	1.99
LTF	CALDERWOOD	1.17
LTF	CANNELTON	0.38
LTF	CARR	< 0.01
LTF	CATAWBA	1.14
LTF	CELEVELAND /* 35% REVERSE 4479079 4642907	< 0.01
LTF	CHEOAH	1.09
LTF	CLIFTY	7.31
LTF	COTTONWOOD	3.91
LTF	EDWARDS	0.61
LTF	ELMERSMITH	1.11
LTF	FARMERCITY	0.48

LTF	*G-007A*	*0.76*
LTF	*GIBSON*	*0.69*
LTF	*HAMLET*	*2.25*
LTF	*MORGAN*	*3.43*
LTF	*NEWTON*	*1.68*
LTF	*O-066A*	*0.35*
LTF	*PRAIRIE*	*3.62*
LTF	*SMITHLAND*	*0.32*
LTF	*TATANKA*	*0.82*
LTF	*TILTON*	*0.72*
LTF	*TRIMBLE*	*0.38*
LTF	*TVA*	*1.45*
LTF	*UNIONPOWER*	*1.94*
900671	*V4-068 C*	*0.06*
900672	*V4-068 E*	*0.18*
LTF	*VFT*	*2.03*
907092	*X1-038 E*	*2.6*
LTF	*Y3-032*	*< 0.01*
917331	*Z2-043 C*	*0.36*
917332	*Z2-043 E*	*0.84*
917341	*Z2-044 C*	*0.32*
917342	*Z2-044 E*	*0.75*
917511	*Z2-088 C OP1*	*1.56*
917512	*Z2-088 E OP1*	*6.74*
918411	*AA1-050*	*1.32*
918491	*AA1-063AC OP*	*1.07*
918492	*AA1-063AE OP*	*2.74*
918511	*AA1-065 C OP*	*1.09*
918512	*AA1-065 E OP*	*2.92*

918531	AA1-067 C	0.23
918532	AA1-067 E	0.54
918561	AA1-072 C	0.05
918562	AA1-072 E	0.14
919691	AA2-053 C	1.19
919692	AA2-053 E	2.79
919701	AA2-057 C	8.78
919702	AA2-057 E	4.39
920042	AA2-088 E	5.93
920591	AA2-165 C	0.22
920592	AA2-165 E	0.58
920671	AA2-174 C	0.05
920672	AA2-174 E	0.32
920692	AA2-178 E	1.86
930401	AB1-081 C	2.67
930402	AB1-081 E	6.24
930861	AB1-132 C	15.62
930862	AB1-132 E	6.7
931231	AB1-173 C	1.56
931232	AB1-173 E	0.73
931241	AB1-173AC	1.56
931242	AB1-173AE	0.73
923852	AB2-025 E	0.45
923911	AB2-031 C O1	1.55
923912	AB2-031 E O1	0.76
923991	AB2-040 C O1	5.07
923992	AB2-040 E O1	4.15
924151	AB2-059 C O1	17.15
924152	AB2-059 E O1	8.84

924501	*AB2-099 C*	*0.4*
924502	*AB2-099 E*	*0.17*
924511	*AB2-100 C*	*8.3*
924512	*AB2-100 E*	*4.09*
925121	*AB2-169 C*	*4.03*
925122	*AB2-169 E*	*3.62*
925171	*AB2-174 C O1*	*4.75*
925172	*AB2-174 E O1*	*4.3*
925591	*AC1-034 C*	*11.11*
925592	*AC1-034 E*	*8.38*
926071	*AC1-086 C*	*23.01*
926072	*AC1-086 E*	*10.47*
926201	*AC1-098 C*	*6.58*
926202	*AC1-098 E*	*3.92*
926211	*AC1-099 C*	*2.21*
926212	*AC1-099 E*	*1.3*
927021	*AC1-189 C*	*12.21*
927022	*AC1-189 E*	*6.08*
927141	*AC1-208 C*	*10.44*
927142	*AC1-208 E*	*4.64*

Appendix 6

(DVP - DVP) The 6CHESTF B-6BASIN 230 kV line (from bus 314287 to bus 314276 ckt 1) loads from 103.56% to 108.11% (AC power flow) of its load dump rating (549 MVA) for the line fault with failed breaker contingency outage of 'DVP_P4-2: 562T563'. This project contributes approximately 29.23 MW to the thermal violation.

CONTINGENCY 'DVP_P4-2: 562T563' /*CARSON
OPEN BRANCH FROM BUS 314902 TO BUS 314923 CKT 1 /*CARSON TO MIDLOTHIAN
OPEN BRANCH FROM BUS 314914 TO BUS 314902 CKT 1 /*CARSON 500.00 - 8SEPTA 500.00
END

Bus Number	*Bus Name*	*Full Contribution*
315065	*1CHESTF6*	*32.84*
315131	*1EDGECMA*	*3.05*
315132	*1EDGECMB*	*3.05*
315074	*1HOPCGN1*	*5.89*
315075	*1HOPCGN2*	*5.81*
315077	*1HOPHCF1*	*1.74*
315078	*1HOPHCF2*	*1.74*
315079	*1HOPHCF3*	*1.74*
315080	*1HOPHCF4*	*2.64*
315076	*1HOPPOLC*	*1.24*
315073	*1STONECA*	*4.88*
314557	*3BETHELC*	*0.3*
314554	*3BTLEBRO*	*0.3*
314572	*3EMPORIA*	*0.22*
314578	*3HORNRTN*	*1.43*
314314	*3LOCKS*	*0.06*
314315	*3LOCKS E*	*0.83*
314603	*3SCOT NK*	*1.31*
314541	*3WATKINS*	*0.27*

314620	*6CASHIE*	*0.31*
314594	*6PLYMOTH*	*0.3*
932591	*AC2-079 C*	*2.7*
932592	*AC2-079 E*	*4.41*
932631	*AC2-084 C*	*2.64*
932632	*AC2-084 E*	*1.3*
933991	*AD1-022 C*	*3.17*
933992	*AD1-022 E*	*1.72*
934011	*AD1-025 C O1*	*9.49*
934012	*AD1-025 E O1*	*5.62*
934331	*AD1-057 C O1*	*4.26*
934332	*AD1-057 E O1*	*2.27*
934521	*AD1-076 C O1*	*19.37*
934522	*AD1-076 E O1*	*9.86*
934571	*AD1-082 C O1*	*5.2*
934572	*AD1-082 E O1*	*2.97*
935161	*AD1-151 C O1*	*9.07*
935162	*AD1-151 E O1*	*6.05*
LTF	*CARR*	*0.23*
LTF	*CBM-S1*	*3.99*
LTF	*CBM-S2*	*8.63*
LTF	*CBM-W1*	*7.45*
LTF	*CBM-W2*	*20.89*
LTF	*CIN*	*1.7*
LTF	*CPLE*	*2.76*
LTF	*G-007*	*1.04*
LTF	*IPL*	*1.08*
LTF	*LGEE*	*0.37*
LTF	*MEC*	*4.07*

LTF	*MECS*	*1.38*
LTF	*O-066*	*6.63*
LTF	*RENSSELAER*	*0.18*
292791	*U1-032 E*	*2.54*
900672	*V4-068 E*	*0.12*
LTF	*WEC*	*0.47*
907092	*X1-038 E*	*2.34*
914231	*Y2-077*	*0.7*
916302	*Z1-086 E*	*3.71*
917332	*Z2-043 E*	*0.39*
917342	*Z2-044 E*	*0.22*
917512	*Z2-088 E OP1*	*1.45*
918492	*AA1-063AE OP*	*1.7*
918512	*AA1-065 E OP*	*1.69*
918562	*AA1-072 E*	*0.07*
919692	*AA2-053 E*	*1.6*
919701	*AA2-057 C*	*2.8*
919702	*AA2-057 E*	*1.4*
LTF	*AA2-074*	*1.88*
920042	*AA2-088 E*	*4.24*
920592	*AA2-165 E*	*0.18*
920672	*AA2-174 E*	*0.18*
930402	*AB1-081 E*	*1.46*
930861	*AB1-132 C*	*6.74*
930862	*AB1-132 E*	*2.89*
931231	*AB1-173 C*	*1.1*
931232	*AB1-173 E*	*0.52*
931241	*AB1-173AC*	*1.1*
931242	*AB1-173AE*	*0.52*

923851	*AB2-025 C*	*0.32*
923852	*AB2-025 E*	*0.78*
923911	*AB2-031 C O1*	*1.1*
923912	*AB2-031 E O1*	*0.54*
923991	*AB2-040 C O1*	*3.6*
923992	*AB2-040 E O1*	*2.94*
924151	*AB2-059 C O1*	*4.01*
924152	*AB2-059 E O1*	*2.06*
924501	*AB2-099 C*	*0.23*
924502	*AB2-099 E*	*0.1*
924511	*AB2-100 C*	*6.79*
924512	*AB2-100 E*	*3.35*
924811	*AB2-134 C O1*	*7.23*
924812	*AB2-134 E O1*	*7.11*
925051	*AB2-160 C O1*	*3.59*
925052	*AB2-160 E O1*	*5.86*
925061	*AB2-161 C O1*	*2.28*
925062	*AB2-161 E O1*	*3.72*
925171	*AB2-174 C O1*	*3.52*
925172	*AB2-174 E O1*	*3.18*
925331	*AB2-190 C*	*11.28*
925332	*AB2-190 E*	*4.84*
925591	*AC1-034 C*	*2.6*
925592	*AC1-034 E*	*1.96*
925821	*AC1-061*	*< 0.01*
926071	*AC1-086 C*	*9.93*
926072	*AC1-086 E*	*4.52*
926201	*AC1-098 C*	*2.46*
926202	*AC1-098 E*	*1.47*

926211	*AC1-099 C*	*0.83*
926212	*AC1-099 E*	*0.49*
927141	*AC1-208 C*	*3.74*
927142	*AC1-208 E*	*1.66*
927221	*AC1-216 C O1*	*5.52*
927222	*AC1-216 E O1*	*4.34*

Appendix 7

(DVP - CPLE) The 6EVERETS-6GREENVILE T 230 kV line (from bus 314574 to bus 304451 ckt 1) loads from 102.22% to 118.77% (AC power flow) of its emergency rating (478 MVA) for the tower line contingency outage of 'DVP_P7-1: LN 2058-2181'. This project contributes approximately 82.65 MW to the thermal violation.

CONTINGENCY 'DVP_P7-1: LN 2058-2181'
OPEN BRANCH FROM BUS 304222 TO BUS 313845 CKT 1 /* 6ROCKYMT230T230.00 - 6HATHAWAY 230.00
OPEN BUS 304226 /* ISLAND: 6PA-RMOUNT#4115.00
OPEN BRANCH FROM BUS 304226 TO BUS 314591 CKT 1 /* 6PA-RMOUNT#4230.00 - 6NASH 230.00
OPEN BRANCH FROM BUS 313845 TO BUS 314591 CKT 1 /* 6HATHAWAY 230.00 - 6NASH 230.00
OPEN BUS 314591 /* ISLAND: 6NASH 230.00
END

Bus Number	*Bus Name*	*Full Contribution*
315294	*1DOMTR10*	*2.92*
315292	*1DOMTR78*	*1.97*
315293	*1DOMTR9*	*1.61*
315131	*1EDGECMA*	*8.*
315132	*1EDGECMB*	*8.*
315136	*1ROSEMG1*	*1.85*
315138	*1ROSEMG2*	*0.87*
315137	*1ROSEMS1*	*1.15*
314557	*3BETHELC*	*1.15*
314554	*3BTLEBRO*	*0.43*
314566	*3CRESWEL*	*2.04*
314572	*3EMPORIA*	*0.21*
314578	*3HORNRTN*	*2.04*
314603	*3SCOT NK*	*2.51*
314541	*3WATKINS*	*0.36*
314620	*6CASHIE*	*0.88*

314574	6EVERETS	5.39
314594	6PLYMOTH	0.83
314648	6SUNBURY	0.4
314651	6WINFALL	0.97
932631	AC2-084 C	4.63
932632	AC2-084 E	2.28
933991	AD1-022 C	8.98
933992	AD1-022 E	4.89
934331	AD1-057 C O1	8.81
934332	AD1-057 E O1	4.7
934521	AD1-076 C O1	54.77
934522	AD1-076 E O1	27.89
LTF	AMIL	0.48
LTF	BLUEG	2.5
LTF	CALDERWOOD	1.54
LTF	CANNELTON	0.48
LTF	CATAWBA	1.5
LTF	CBM-N	< 0.01
LTF	CELEVELAND /* 35% REVERSE 4479079 4642907	< 0.01
LTF	CHEOAH	1.44
LTF	CLIFTY	9.03
LTF	COTTONWOOD	5.2
LTF	EDWARDS	0.78
LTF	ELMERSMITH	1.41
LTF	FARMERCITY	0.62
LTF	G-007A	1.04
LTF	GIBSON	0.88
LTF	HAMLET	3.22

LTF	*MORGAN*	*4.56*
LTF	*NEWTON*	*2.15*
LTF	*NYISO*	*0.09*
LTF	*O-066A*	*0.48*
LTF	*PRAIRIE*	*4.68*
LTF	*SMITHLAND*	*0.42*
LTF	*TATANKA*	*1.05*
LTF	*TILTON*	*0.92*
LTF	*TRIMBLE*	*0.47*
LTF	*TVA*	*1.91*
LTF	*UNIONPOWER*	*2.56*
900672	*V4-068 E*	*0.21*
LTF	*VFT*	*2.76*
901082	*W1-029E*	*16.22*
907092	*X1-038 E*	*2.96*
913392	*Y1-086 E*	*1.05*
LTF	*Y3-032*	*< 0.01*
916041	*Z1-036 C*	*4.35*
916042	*Z1-036 E*	*29.14*
917122	*Z2-027 E*	*0.51*
917331	*Z2-043 C*	*0.37*
917332	*Z2-043 E*	*0.86*
917342	*Z2-044 E*	*0.33*
917511	*Z2-088 C OP1*	*1.42*
917512	*Z2-088 E OP1*	*6.13*
918411	*AA1-050*	*1.2*
918492	*AA1-063AE OP*	*2.44*
918511	*AA1-065 C OP*	*1.8*
918512	*AA1-065 E OP*	*4.84*

918531	AA1-067 C	0.69
918532	AA1-067 E	1.62
918561	AA1-072 C	0.06
918562	AA1-072 E	0.14
919692	AA2-053 E	2.58
919701	AA2-057 C	4.25
919702	AA2-057 E	2.12
920042	AA2-088 E	6.25
920592	AA2-165 E	0.28
920672	AA2-174 E	0.3
920691	AA2-178 C	1.5
920692	AA2-178 E	3.5
930402	AB1-081 E	2.42
930861	AB1-132 C	10.36
930862	AB1-132 E	4.44
931231	AB1-173 C	1.21
931232	AB1-173 E	0.56
931241	AB1-173AC	1.21
931242	AB1-173AE	0.56
923831	AB2-022 C	1.02
923832	AB2-022 E	0.55
923911	AB2-031 C O1	1.2
923912	AB2-031 E O1	0.59
923991	AB2-040 C O1	3.93
923992	AB2-040 E O1	3.22
924151	AB2-059 C O1	6.65
924152	AB2-059 E O1	3.42
924501	AB2-099 C	0.53
924502	AB2-099 E	0.23

924511	*AB2-100 C*	*5.86*
924512	*AB2-100 E*	*2.88*
925121	*AB2-169 C*	*10.02*
925122	*AB2-169 E*	*8.99*
925171	*AB2-174 C O1*	*3.64*
925172	*AB2-174 E O1*	*3.3*
925591	*AC1-034 C*	*4.3*
925592	*AC1-034 E*	*3.25*
926071	*AC1-086 C*	*15.26*
926072	*AC1-086 E*	*6.95*
926201	*AC1-098 C*	*4.33*
926202	*AC1-098 E*	*2.58*
926211	*AC1-099 C*	*1.45*
926212	*AC1-099 E*	*0.85*
LTF	*AC1-131*	*5.64*
927021	*AC1-189 C*	*15.46*
927022	*AC1-189 E*	*7.7*
927141	*AC1-208 C*	*5.75*
927142	*AC1-208 E*	*2.55*

Appendix 8

(DVP - DVP) The AB2-100 TAP-6CLUBHSE 230 kV line (from bus 924510 to bus 314563 ckt 1) loads from 103.55% to 116.05% (AC power flow) of its load dump rating (459 MVA) for the line fault with failed breaker contingency outage of 'DVP_P4-2: 246T247'. This project contributes approximately 68.22 MW to the thermal violation.

```
CONTINGENCY 'DVP_P4-2: 246T247'                    /* SUFFOLK 230 KV
 OPEN BRANCH FROM BUS 314537 TO BUS 314575 CKT 1   /* 6SUFFOLK 230.00 -
6NUCO TP 230.00
 OPEN BRANCH FROM BUS 314569 TO BUS 314575 CKT 1   /* 6EARLEYS 230.00 -
6NUCO TP 230.00
 OPEN BRANCH FROM BUS 314575 TO BUS 314590 CKT 1   /* 6NUCO TP 230.00 -
6NUCOR 230.00
 OPEN BUS 314575                                   /* ISLAND: 6NUCO TP 230.00
 OPEN BUS 314590                                   /* ISLAND: 6NUCOR 230.00
 OPEN BRANCH FROM BUS 314537 TO BUS 314648 CKT 1   /* 6SUFFOLK 230.00 -
6SUNBURY 230.00
 OPEN BRANCH FROM BUS 314648 TO BUS 901080 CKT 1   /* 6SUNBURY 230.00 - W1-
029 230.00
 OPEN BUS 314648                                   /* ISLAND: 6SUNBURY 230.00
 END
```

Bus Number	*Bus Name*	*Full Contribution*
315294	*1DOMTR10*	*1.98*
315131	*1EDGECMA*	*9.02*
315132	*1EDGECMB*	*9.02*
315139	*1GASTONA*	*7.4*
315141	*1GASTONB*	*7.4*
315126	*1ROARAP2*	*1.52*
315128	*1ROARAP4*	*1.46*
315136	*1ROSEMG1*	*4.97*
315138	*1ROSEMG2*	*2.33*
315137	*1ROSEMS1*	*3.08*
314557	*3BETHELC*	*0.87*
314554	*3BTLEBRO*	*0.84*
314566	*3CRESWEL*	*1.63*
314578	*3HORNRTN*	*3.35*

314603	*3SCOT NK*	*3.54*
314541	*3WATKINS*	*0.32*
314620	*6CASHIE*	*0.83*
314574	*6EVERETS*	*2.43*
314594	*6PLYMOTH*	*0.69*
932631	*AC2-084 C*	*6.99*
932632	*AC2-084 E*	*3.44*
933991	*AD1-022 C*	*7.95*
933992	*AD1-022 E*	*4.33*
934331	*AD1-057 C O1*	*16.06*
934332	*AD1-057 E O1*	*8.57*
934521	*AD1-076 C O1*	*45.21*
934522	*AD1-076 E O1*	*23.02*
LTF	*CARR*	*0.09*
LTF	*CBM-S1*	*4.49*
LTF	*CBM-S2*	*9.26*
LTF	*CBM-W1*	*9.8*
LTF	*CBM-W2*	*24.09*
LTF	*CIN*	*2.19*
LTF	*CPLE*	*3.18*
LTF	*G-007*	*0.61*
LTF	*IPL*	*1.4*
LTF	*LGEE*	*0.47*
LTF	*MEC*	*4.97*
LTF	*MECS*	*2.19*
LTF	*O-066*	*3.86*
LTF	*RENSSELAER*	*0.08*
900672	*V4-068 E*	*0.24*
LTF	*WEC*	*0.6*

916041	*Z1-036 C*	*3.25*
916042	*Z1-036 E*	*21.75*
917331	*Z2-043 C*	*0.47*
917332	*Z2-043 E*	*1.09*
917341	*Z2-044 C*	*0.26*
917342	*Z2-044 E*	*0.61*
917511	*Z2-088 C OP1*	*0.95*
917512	*Z2-088 E OP1*	*4.11*
918411	*AA1-050*	*0.8*
918491	*AA1-063AC OP*	*1.36*
918492	*AA1-063AE OP*	*3.51*
918511	*AA1-065 C OP*	*1.98*
918512	*AA1-065 E OP*	*5.33*
918531	*AA1-067 C*	*0.31*
918532	*AA1-067 E*	*0.73*
918561	*AA1-072 C*	*0.07*
918562	*AA1-072 E*	*0.18*
919691	*AA2-053 C*	*1.64*
919692	*AA2-053 E*	*3.86*
919701	*AA2-057 C*	*7.45*
919702	*AA2-057 E*	*3.72*
LTF	*AA2-074*	*2.16*
920042	*AA2-088 E*	*6.93*
920591	*AA2-165 C*	*0.19*
920592	*AA2-165 E*	*0.49*
920671	*AA2-174 C*	*0.08*
920672	*AA2-174 E*	*0.45*
920692	*AA2-178 E*	*2.8*
930401	*AB1-081 C*	*1.74*

930402	*AB1-081 E*	*4.08*
930861	*AB1-132 C*	*30.87*
930862	*AB1-132 E*	*13.23*
924151	*AB2-059 C O1*	*11.21*
924152	*AB2-059 E O1*	*5.78*
924501	*AB2-099 C*	*0.61*
924502	*AB2-099 E*	*0.26*
924511	*AB2-100 C*	*42.66*
924512	*AB2-100 E*	*21.01*
925121	*AB2-169 C*	*5.87*
925122	*AB2-169 E*	*5.26*
925591	*AC1-034 C*	*7.26*
925592	*AC1-034 E*	*5.48*
925781	*AC1-054 C*	*3.7*
925782	*AC1-054 E*	*1.7*
926071	*AC1-086 C*	*45.46*
926072	*AC1-086 E*	*20.69*
926201	*AC1-098 C*	*6.54*
926202	*AC1-098 E*	*3.89*
926211	*AC1-099 C*	*2.19*
926212	*AC1-099 E*	*1.29*
927021	*AC1-189 C*	*8.99*
927022	*AC1-189 E*	*4.48*
927141	*AC1-208 C*	*9.4*
927142	*AC1-208 E*	*4.17*

NCUC DOCKET NO. EMP-119, SUB 0
NCUC DOCKET NO. EMP-119, SUB 1

SECOND SUPPLEMENTAL PRE-FILED TESTIMONY OF DONNA ROBICHAUD ON BEHALF OF MACADAMIA SOLAR LLC

EXHIBIT B

**** CONFIDENTIAL ****

REVISED LCOT CALCULATIONS