EXHIBIT A
SECOND SUPPLEMENTAL PREFILED
TESTIMONY OF D. ROBICHAUD
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 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.

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	$ 1,800,000
Direct Connection Network Upgrades	$ 0
Non Direct Connection Network Upgrades	$ 4,000,000
Allocation for New System Upgrades	$ 35,963,733
Contribution for Previously Identified Upgrades	$ 22,844,831
Total Costs	**$ 64,608,564**

Attachment Facilities

Generation Substation: Install metering and associated protection equipment. The estimated cost is $600,000.

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 $1,200,000.

The estimated total cost of the Attachment Facilities is $1,800,000. 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	$5,200,000	**$5,200,000**
# 2	2	From 53.95% To 115.64%	Rebuild 5.88 miles of the Five Points – Wharton 115 kV line # 189	$7,644,000	**$7,644,000**
# 11	11	From 105.22% To 117.7%	Rebuild Clubhouse-Lakeview 230 kV Line #254	$23,670,000	**$0**
# 3	3	From 59.51% To 107.04%	Replace relays at Everetts substation on the Poplar Chapel – Everetts 115 kV line # 25	$500,000	**$400,671**
# 4	4	From 92.19% To 119.8%	Rebuild 10.28 miles of the Shawboro – Elizabeth City 230 kV line #2021	$15,420,000	**$15,420,000**
# 5	5	From 65.27% To 126.96%	Rebuild 5.14 miles of the AB2-169 Tap – Five Points D.P 115kV line # 189	$6,682,000	**$6,682,000**
# 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 129.15% To 138.93%	Rebuild the 4.3 miles of Dominion 230 kV Line #2058 Rocky Mt. – Hathaway	$13,000,000	**$0**
# 8, 9	8	From 105.1% To 109.65%	Reconductor 0.14 miles of the Chesterfield to Basin 230kV line	$350,000	**$0**
# 10	10	From 107.23% To 123.79%	Rebuild the 20.5 miles of Dominion 230 kV Line #218 Everetts - Greenville	$30,750,000	**$22,844,831**
			Total Estimate Allocated Cost of Network Upgrades		**$ 58,808,564**

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 130-A	CONTINGENCY 'DVP_P1-2: LN 130-A' OPEN BRANCH FROM BUS 314562 TO BUS 314570 CKT 1 /* 3CLUBHSE 115.00 - 3METCATP 115.00 OPEN BRANCH FROM BUS 314570 TO BUS 314572 CKT 1 /* 3METCATP 115.00 - 3EMPORIA 115.00 OPEN BRANCH FROM BUS 314570 TO BUS 314588 CKT 1 /* 3METCATP 115.00 - 3METCALF 115.00 OPEN BRANCH FROM BUS 314572 TO BUS 925170 CKT 1 /* 3EMPORIA 115.00 - AB2-174 TAP 115.00 OPEN BRANCH FROM BUS 314572 TO BUS 314863 CKT 1 /* 3EMPORIA 115.00 - 3EMPOR_1 115.00 OPEN BUS 314570 /* ISLAND OPEN BUS 314572 /* ISLAND OPEN BUS 314588 /* ISLAND END
DVP_P1-2: LN 2020	CONTINGENCY 'DVP_P1-2: LN 2020' OPEN BRANCH FROM BUS 313851 TO BUS 314638 CKT 1 /* 6ECITYDP2 230.00 - 6ELIZ CT 230.00 OPEN BRANCH FROM BUS 313851 TO BUS 314639 CKT 1 /* 6ECITYDP2 230.00 - 6TANGLEW 230.00 OPEN BRANCH FROM BUS 314639 TO BUS 314651 CKT 1 /* 6TANGLEW 230.00 - 6WINFALL 230.00

	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 /* 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_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: 2014T2034	CONTINGENCY 'DVP_P4-2: 2014T2034' /* EARLEYS OPEN BRANCH FROM BUS 314569 TO BUS 314620 CKT 1 /* 2034 OPEN BRANCH FROM BUS 314620 TO BUS 933990 CKT 1 /* 2034 OPEN BRANCH FROM BUS 314569 TO BUS 314574 CKT 1 /* 2014 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 314569 TO BUS 314620 CKT 1 /* 6EARLEYS 230.00 - 6CASHIE 230.00 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

Summer Peak Analysis – 2021

Generator Deliverability

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

Overload		Contingency			Bus				Loading %		Rating			
Number	Type	Name	Affected Area	Facility Description	From	To	Circuit	Power Flow	Initial	Final	Type	MVA	MW Contribution	Flowgate Appendix
1	N-1	DVP_P1-2: LN 2181	DVP - CPLE	6MORNSTR-6ROCKYMT230T 230 kV line	313845	304222	1	AC	95.19	102.64	ER	374	28.43	

Multiple Facility Contingency

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

Overload		Contingency			Bus				Loading %		Rating			
Number	Type	Name	Affected Area	Facility Description	From	To	Circuit	Power Flow	Initial	Final	Type	MVA	MW Contribution	Flowgate Appendix
2	DCTL	DVP_P7-1: LN 25-2034_A	DVP - DVP	3FIVE PT-3WHARTON 115 kV line	314576	314622	1	DC	53.95	115.64	ER	91	56.13	2
3	LFFB	DVP_P4-2: 2014T2034	DVP - DVP	3POPLR C-3EVERETS 115 kV line	314596	314573	1	AC	59.51	107.04	ER	239	118.15	3
4	LFFB	DVP_P4-2: 246T247	DVP - DVP	6ELIZ CT-6SHAWBRO 230 kV line	314638	314647	1	AC	92.19	119.8	ER	699	189.38	4
5	DCTL	DVP_P7-1: LN 25-2034_A	DVP - DVP	AB2-169 TAP-3FIVE PT 115 kV line	925120	314576	1	DC	65.27	126.96	ER	91	56.13	5
6	LFFB	DVP_P4-3: 203422	DVP - DVP	6TRWBRDG 230/115 kV transformer	314616	314613	2	AC	49.31	107.63	ER	200	135.47	10

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		Contingency			Bus				Loading %		Rating			
Number	Type	Name	Affected Area	Facility Description	From	To	Circuit	Power Flow	Initial	Final	Type	MVA	MW Contribution	Flowgate Appendix
7	DCTL	DVP_P7-1: LN 81-2056	DVP - CPLE	6MORNSTR-6ROCKYMT230T 230 kV line	313845	304222	1	AC	129.15	138.93	ER	374	43.04	6
8	LFFB	DVP_P4-2: 562T563	DVP - DVP	6CHESTF B-6BASIN 230 kV line	314287	314276	1	AC	105.1	109.65	ER	549	29.22	7
9	N-1	DVP_P1-2: LN 563	DVP - DVP	6CHESTF B-6BASIN 230 kV line	314287	314276	1	AC	100.4	104.2	ER	449	19.71	
10	DCTL	DVP_P7-1: LN 2058-2181	DVP - CPLE	6EVERETS-6GREENVILE T 230 kV line	314574	304451	1	AC	107.23	123.79	ER	478	82.65	8
11	LFFB	DVP_P4-2: 246T247	DVP - DVP	AB2-100 TAP-6CLUBHSE 230 kV line	924510	314563	1	AC	105.22	117.7	ER	459	68.22	9

New System Reinforcements

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

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost	AD1-074/ AD1-075/ AD1-076 Allocation
#2	3FIVE PT-3WHARTON 115 kV	Description: Rebuild 5.88 miles of the Five Points – Wharton 115 kV line # 189 Rating: 199/199/229 Schedule: 30 – 36 months AD1-074/AD1-075/AD1-076 is the driver for this	n6143	$7,644,000	**$7,644,000**

<table>
<tr><td></td><td></td><td>upgrade.</td><td></td><td></td><td></td></tr>
<tr><td>#3</td><td>3POPLR C-3EVERETS 115kV</td><td>Description: Replace relays at Everetts substation on the Poplar Chapel – Everetts 115 kV line # 25

Rating: 300/300/345

Schedule: 14 – 16 months

<table><tr><th>Queue</th><th>MW</th><th>Cost %</th><th>Cost ($500,000)</th></tr><tr><td>AD1-023</td><td>29.29</td><td>19.86%</td><td>$99,329</td></tr><tr><td>AD1-076</td><td>118.15</td><td>80.14%</td><td>$400,671</td></tr></table></td><td>n6141</td><td>$500,000</td><td>$400,671</td></tr>
<tr><td>#4</td><td>6ELIZ CT-6SHAWBRO 230 kV</td><td>Description: Rebuild 10.28 miles of the Shawboro – Elizabeth City 230 kV line #2021

Ratings: 1047/1047/1204

Schedule: 30 – 36 months

AD1-074/AD1-075/AD1-076 is the driver for this upgrade.</td><td>n6314</td><td>$15,420,000</td><td>$15,420,000</td></tr>
<tr><td>#5</td><td>AB2-169 TAP-3FIVE PT 115 kV line</td><td>Description: Rebuild 5.14 miles of the AB2-169 Tap – Five Points D.P 115kV line # 189

Ratings: 261/261/301

Schedule: 30 – 36 months</td><td>n6142</td><td>$6,682,000</td><td>$6,682,000</td></tr>
</table>

		AD1-074/AD1-075/AD1-076 is the driver for this upgrade.			
#6	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/AD1-075/AD1-076 is the driver for this upgrade.	N6287.1	$617,062	**$617,062**
		Total			**$30,763,733**

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)

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost	AD1-074/ AD1-075/ AD1-076 Allocation
#1, 7	6MORNSTR-6ROCKYMT2 30T 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**
#8, 9	6CHESTF B-6BASIN 230 kV	Description: Reconductor 0.14 miles of the Chesterfield to Basin 230kV line This project is in-service.	b2990	$350,000	**$0**

<table>
<tr>
<td rowspan="2">#10</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</th><th>MW</th><th>Cost %</th><th>Cost $30,750,000</th></tr>
<tr><td>AD1-023</td><td>15.1</td><td>13.57%</td><td>$4,173,708</td></tr>
<tr><td>AD1-057</td><td>13.5</td><td>12.13%</td><td>$3,731,461</td></tr>
<tr><td>AD1-076</td><td>82.65</td><td>74.29%</td><td>$22,844,831</td></tr>
</table>
</td>
<td>n6144</td>
<td>$30,750,000</td>
<td>$22,844,831</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 1: 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.

Note 2: 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</td>
<td>dep003</td>
<td>$10,000,000</td>
<td>-</td>
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#11	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			**$22,844,831**

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 Number	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
14	N-1	DVP_P1-2: LN 2181	DVP - CPLE	6MORNSTR-6ROCKYMT230T 230 kV line	313845	304222	1	AC	128.6	138.39	ER	374	42.9	
15	N-1	DVP_P1-2: LN 2058	DVP - DVP	6MORNSTR-6NASH 230 kV line	313845	314591	1	AC	114	122.28	ER	449	43.76	
16	N-1	DVP_P1-2: LN 563	DVP - DVP	6CHESTF B-6BASIN 230 kV line	314287	314276	1	AC	123.55	129.19	ER	449	29.74	
17	N-1	DVP_P1-2: LN 2131A	DVP - DVP	6CLUBHSE-6SAPONY 230 kV line	314563	314435	1	AC	99.9	112.39	ER	599	75.14	
18	N-1	DVP_P1-2: LN 2131A	DVP - DVP	6EARLEYS-6NUCO TP 230 kV line	314569	314575	1	AC	105.33	134.56	ER	572	170.35	
19	N-1	DVP_P1-2: LN 2131A	DVP - CPLE	6EVERETS-6GREENVILE T 230 kV line	314574	304451	1	AC	87.36	108.29	ER	478	105.29	
20	N-1	DVP_P1-2: LN 2131A	DVP - DVP	6NUCO TP-6SUFFOLK 230 kV line	314575	314537	1	AC	99.12	128.31	ER	572	170.35	
21	N-1	DVP_P1-2: LN 2131A	DVP - DVP	6LAKEVEW-AB2-100 TAP 230 kV line	314583	924510	1	AC	105.39	124.18	ER	375	71.82	
22	N-1	DVP_P1-2: LN 2058	DVP - CPLE	6NASH-6PA-RMOUNT#4 230 kV line	314591	304226	1	AC	104.05	111.96	ER	470	43.76	
23	N-1	DVP_P1-2: LN 2034-B	DVP - DVP	3POPLR C-3EVERETS 115 kV line	314596	314573	1	AC	55.31	109.08	ER	225	124.47	
24	N-1	DVP_P1-2: LN 2034-A	DVP - DVP	6TRWBRDG 230/115 kV transformer	314616	314613	1	AC	52.51	111.18	ER	195	131.04	
25	N-1	DVP_P1-2: LN 2131A	DVP - DVP	6TRWBRDG-AD1-023 TAP 230 kV line	314616	933990	1	AC	54.26	112.59	ER	572	362.61	
26	N-1	DVP_P1-2: LN 2131A	DVP - DVP	6CASHIE-6EARLEYS 230 kV line	314620	314569	1	AC	67.79	127.12	ER	572	362.61	
27	N-1	DVP_P1-2: LN 247	DVP - DVP	6ELIZ CT-6SHAWBRO 230 kV line	314638	314647	1	AC	86.63	115.44	ER	572	163.98	
28	N-1	DVP_P1-2: LN 2020	DVP - DVP	6SUNBURY-6SUFFOLK 230 kV line	314648	314537	1	AC	103.69	137.57	ER	449	153.11	
29	N-1	DVP_P1-2: LN 2020	DVP - DVP	6WINFALL-W1-029 230 kV line	314651	901080	1	AC	66.1	100.14	ER	449	153.21	
30	N-1	DVP_P1-2: LN 246	DVP - DVP	6S HERTFORD-6WINFALL 230 kV line	314662	314651	1	AC	81.72	111.9	ER	733	219.82	
31	N-1	DVP_P1-2: LN 594	DVP - DVP	8CHANCE-8BRISTER 500 kV line	314905	314900	1	AC	98.49	101.42	ER	2442	82.62	
32	N-1	DVP_P1-2: LN 576	DVP - DVP	8ELMONT-8LADYSMITH 500 kV line	314908	314911	1	AC	108.16	113.41	ER	2442	137.49	
33	N-1	DVP_P1-2: LN 574	DVP - DVP	8MDLTHAN-8NO ANNA 500 kV line	314914	314918	1	AC	100.13	104.63	ER	2442	126.51	
34	N-1	DVP_P1-2: LN 575	DVP - DVP	8SPOTSYL-8MORRSVL 500 kV line	314934	314916	1	AC	96.13	98.97	ER	3219	76.47	
35	N-1	DVP_P1-2: LN 2020	DVP - DVP	W1-029-6SUNBURY 230 kV line	901080	314648	1	AC	105.07	138.96	ER	449	153.11	
36	N-1	DVP_P1-2: LN 246	DVP - DVP	Z1-036 TAP-6S HERTFORD 230 kV line	916040	314662	1	AC	83.89	114.08	ER	733	219.82	
37	N-1	DVP_P1-2: LN 130-A	DVP - DVP	AB2-100 TAP-6CLUBHSE 230 kV line	924510	314563	1	AC	126.44	137.02	ER	375	47.15	
38	N-0	Base Case	DVP - DVP	AB2-100 TAP-6CLUBHSE 230 kV line	924510	314563	1	AC	101.7	111.5	NR	375	43.26	
39	N-0	Base Case	DVP - DVP	AB2-100 TAP-6CLUBHSE 230 kV line	924510	314563	1	AC	101.7	111.5	NR	375	43.26	
40	N-1	DVP_P1-2: LN 2131A	DVP - DVP	AD1-023 TAP-6CASHIE 230 kV line	933990	314620	1	AC	69.56	128.81	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
    - 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

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

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: $ 9,200,000 -$4,000,000 = $5,200,000[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	$5,200,000	**$5,200,000**

Steady-State Voltage Requirements

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

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.

[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 $5,200,000.

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 $9,200,000. This upgrade replicates $4,000,000 of non-direct physical interconnection work and therefore has a cost of $5,200,000.

Light Load Analysis in 2021

Not required

Affected System Analysis & Mitigation

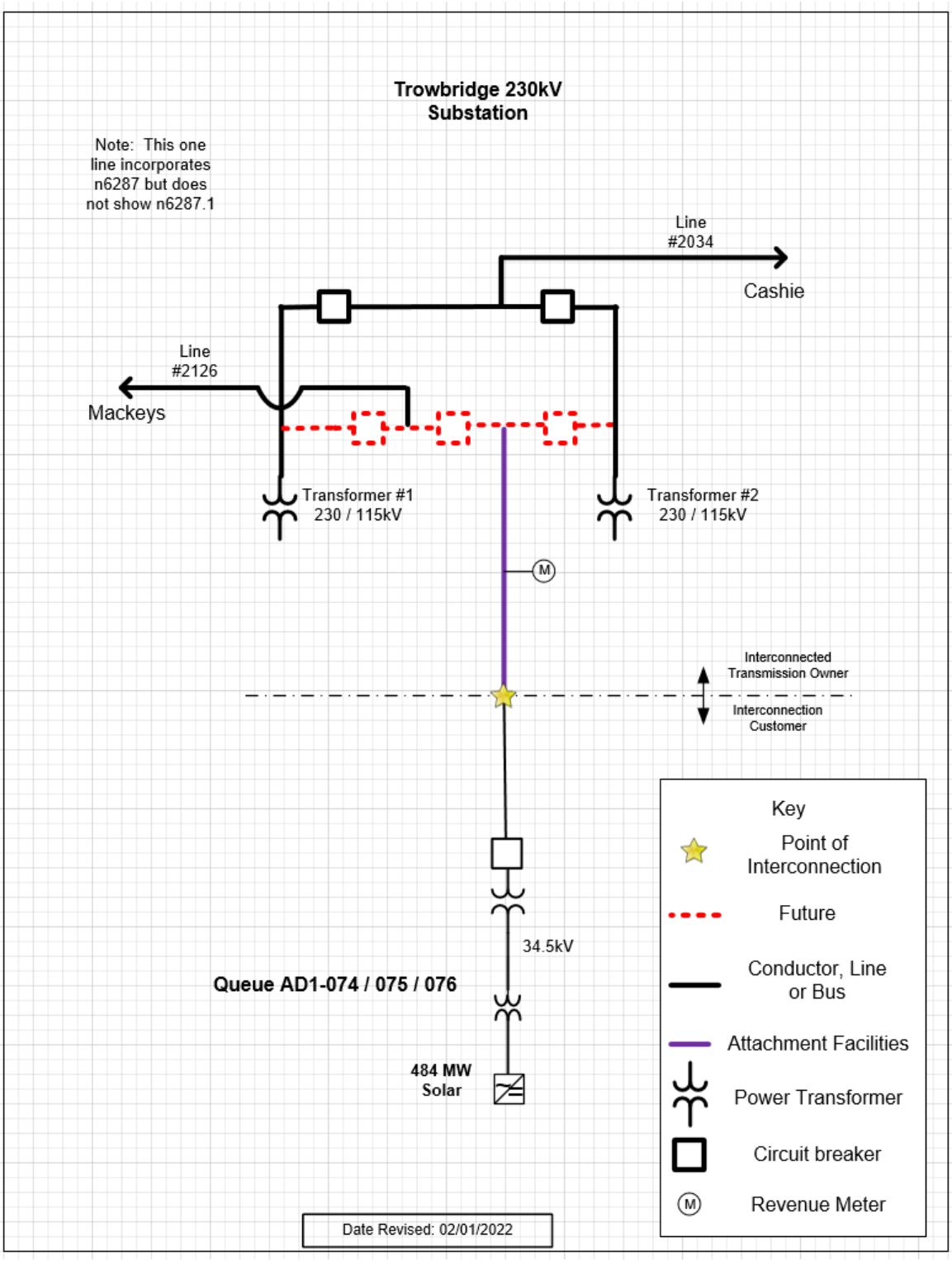
Duke Energy/Progress:

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. Although this information is not used "as is" for cost allocation purposes, it can be used to gage other generators impact.

It should be noted the generator contributions presented in the appendices sections are full contributions, whereas in the body of the report, those contributions take into consideration the commercial probability of each project.

Appendix 2

(DVP - DVP) The 3FIVE PT-3WHARTON 115 kV line (from bus 314576 to bus 314622 ckt 1) loads from 53.95% to 115.64% (**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 314569 TO BUS 314620 CKT 1 /* 6EARLEYS 230.00 - 6CASHIE 230.00
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 3

(DVP - DVP) The 3POPLR C-3EVERETS 115 kV line (from bus 314596 to bus 314573 ckt 1) loads from 59.51% to 107.04% (AC power flow) of its load dump rating (239 MVA) for the line fault with failed breaker contingency outage of 'DVP_P4-2: 2014T2034'. This project contributes approximately 118.15 MW to the thermal violation.

CONTINGENCY 'DVP_P4-2: 2014T2034' /* EARLEYS
OPEN BRANCH FROM BUS 314569 TO BUS 314620 CKT 1 /* 2034
OPEN BRANCH FROM BUS 314620 TO BUS 933990 CKT 1 /* 2034
OPEN BRANCH FROM BUS 314569 TO BUS 314574 CKT 1 /* 2014
END

Bus Number	*Bus Name*	*Full Contribution*
315294	*1DOMTR10*	*4.68*
315292	*1DOMTR78*	*3.16*
315293	*1DOMTR9*	*2.58*
314566	*3CRESWEL*	*2.76*
314594	*6PLYMOTH*	*1.18*
314648	*6SUNBURY*	*0.34*
314651	*6WINFALL*	*1.05*
933991	*AD1-023 C*	*18.97*
933992	*AD1-023 E*	*10.33*
934521	*AD1-076 C O1*	*78.29*
934522	*AD1-076 E O1*	*39.86*
LTF	*AMIL*	*0.17*
LTF	*BLUEG*	*0.88*
LTF	*CALDERWOOD*	*0.53*
LTF	*CANNELTON*	*0.17*
LTF	*CATAWBA*	*0.52*
LTF	*CBM-N*	*< 0.01*

LTF	*CHEOAH*	*0.5*
LTF	*CLIFTY*	*3.21*
LTF	*COTTONWOOD*	*1.8*
LTF	*EDWARDS*	*0.27*
LTF	*ELMERSMITH*	*0.5*
LTF	*FARMERCITY*	*0.22*
LTF	*G-007A*	*0.38*
LTF	*GIBSON*	*0.31*
LTF	*HAMLET*	*1.08*
LTF	*MORGAN*	*1.58*
LTF	*NEWTON*	*0.75*
LTF	*NYISO*	*0.04*
LTF	*O-066A*	*0.17*
LTF	*PRAIRIE*	*1.64*
LTF	*SMITHLAND*	*0.15*
LTF	*TATANKA*	*0.37*
LTF	*TILTON*	*0.32*
LTF	*TRIMBLE*	*0.17*
LTF	*TVA*	*0.66*
LTF	*UNIONPOWER*	*0.89*
LTF	*VFT*	*1.01*
901082	*W1-029E*	*23.47*
913392	*Y1-086 E*	*1.07*
916041	*Z1-036 C*	*5.2*
916042	*Z1-036 E*	*34.83*
917122	*Z2-027 E*	*0.52*

920691	*AA2-178 C*	*2.03*
920692	*AA2-178 E*	*4.74*
923831	*AB2-022 C*	*0.99*
923832	*AB2-022 E*	*0.53*
925121	*AB2-169 C*	*4.79*
925122	*AB2-169 E*	*4.3*

Appendix 4

(DVP - DVP) The 6ELIZ CT-6SHAWBRO 230 kV line (from bus 314638 to bus 314647 ckt 1) loads from 92.19% to 119.8% (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 189.38 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*
314582	*3KELFORD*	*0.78*

314603	*3SCOT NK*	*2.7*
314617	*3TUNIS*	*0.7*
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	*AD1-023 C*	*27.52*
933992	*AD1-023 E*	*14.98*
934331	*AD1-057 C O1*	*6.07*
934332	*AD1-057 E O1*	*3.24*
934521	*AD1-076 C O1*	*125.48*
934522	*AD1-076 E O1*	*63.9*
LTF	*CARR*	*0.07*
LTF	*CBM-S1*	*3.22*
LTF	*CBM-S2*	*6.65*
LTF	*CBM-W1*	*7.05*
LTF	*CBM-W2*	*17.3*
LTF	*CIN*	*1.58*
LTF	*CPLE*	*2.31*
LTF	*G-007*	*0.43*
LTF	*IPL*	*1.01*
LTF	*LGEE*	*0.34*
LTF	*MEC*	*3.58*
LTF	*MECS*	*1.58*

LTF	*O-066*	*2.73*
LTF	*RENSSELAER*	*0.05*
900671	*V4-068 C*	*0.06*
900672	*V4-068 E*	*0.18*
901081	*W1-029C*	*4.69*
901082	*W1-029E*	*171.41*
LTF	*WEC*	*0.43*
913391	*Y1-086 C*	*1.01*
913392	*Y1-086 E*	*8.99*
916041	*Z1-036 C*	*23.54*
916042	*Z1-036 E*	*157.7*
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*	*8.68*
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*	*3.75*
927141	*AC1-208 C*	*5.8*

927142	*AC1-208 E*	*2.58*

Appendix 5

(DVP - DVP) The AB2-169 TAP-3FIVE PT 115 kV line (from bus 925120 to bus 314576 ckt 1) loads from 65.27% to 126.96% (**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 314569 TO BUS 314620 CKT 1        /* 6EARLEYS
230.00 - 6CASHIE 230.00
  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 6

(DVP - CPLE) The 6MORNSTR-6ROCKYMT230T 230 kV line (from bus 313845 to bus 304222 ckt 1) loads from 129.15% to 138.93% (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*
314582	*3KELFORD*	*0.7*
314603	*3SCOT NK*	*3.23*
314617	*3TUNIS*	*0.55*
314539	*3UNCAMP*	*1.04*
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	*AD1-023 C*	*7.25*
933992	*AD1-023 E*	*3.95*
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*	*7.32*
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*	*0.73*
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*	*2.02*
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*
923801	*AB2-015 C O1*	*3.94*
923802	*AB2-015 E O1*	*3.23*
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*	*8.83*
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 7

(DVP - DVP) The 6CHESTF B-6BASIN 230 kV line (from bus 314287 to bus 314276 ckt 1) loads from 105.1% to 109.65% (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 29.22 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*
314582	*3KELFORD*	*0.33*
314314	*3LOCKS*	*0.06*

314315	*3LOCKS E*	*0.83*
314603	*3SCOT NK*	*1.31*
314617	*3TUNIS*	*0.33*
314539	*3UNCAMP*	*0.94*
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*	*2.63*
932632	*AC2-084 E*	*1.3*
933991	*AD1-023 C*	*4.75*
933992	*AD1-023 E*	*2.59*
934011	*AD1-025 C O1*	*9.49*
934012	*AD1-025 E O1*	*5.62*
934331	*AD1-057 C O1*	*4.25*
934332	*AD1-057 E O1*	*2.27*
934521	*AD1-076 C O1*	*19.36*
934522	*AD1-076 E O1*	*9.86*
934571	*AD1-082 C O1*	*4.48*
934572	*AD1-082 E O1*	*2.55*
935161	*AD1-151 C O1*	*9.07*
935162	*AD1-151 E O1*	*6.04*
LTF	*CARR*	*0.23*
LTF	*CBM-S1*	*3.98*
LTF	*CBM-S2*	*8.62*

LTF	*CBM-W1*	*7.44*
LTF	*CBM-W2*	*20.87*
LTF	*CIN*	*1.69*
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*	*6.64*
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*
923801	*AB2-015 C O1*	*3.36*
923802	*AB2-015 E O1*	*2.76*
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*	*1.96*
925062	*AB2-161 E O1*	*3.2*
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*	*0.48*
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 8

(DVP - CPLE) The 6EVERETS-6GREENVILE T 230 kV line (from bus 314574 to bus 304451 ckt 1) loads from 107.23% to 123.79% (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*
314582	*3KELFORD*	*0.72*

314603	*3SCOT NK*	*2.51*
314617	*3TUNIS*	*0.7*
314539	*3UNCAMP*	*1.18*
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	*AD1-023 C*	*13.47*
933992	*AD1-023 E*	*7.33*
934331	*AD1-057 C O1*	*8.81*
934332	*AD1-057 E O1*	*4.7*
934521	*AD1-076 C O1*	*54.76*
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*	*9.04*

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*	*4.57*
LTF	*NEWTON*	*2.15*
LTF	*NYISO*	*0.09*
LTF	*O-066A*	*0.47*
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*	*2.75*
901082	*W1-029E*	*23.39*
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*	*29.13*

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*
923801	*AB2-015 C O1*	*4.4*
923802	*AB2-015 E O1*	*3.61*
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*	*6.64*
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*	*3.29*
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 9

(DVP - DVP) The AB2-100 TAP-6CLUBHSE 230 kV line (from bus 924510 to bus 314563 ckt 1) loads from 105.22% to 117.7% (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*
314582	*3KELFORD*	*0.91*
314603	*3SCOT NK*	*3.54*
314617	*3TUNIS*	*0.81*
314541	*3WATKINS*	*0.32*
314620	*6CASHIE*	*0.83*
314574	*6EVERETS*	*2.42*
314594	*6PLYMOTH*	*0.69*
932631	*AC2-084 C*	*6.99*
932632	*AC2-084 E*	*3.44*
933991	*AD1-023 C*	*11.93*
933992	*AD1-023 E*	*6.49*
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*	*4.48*
LTF	*CBM-S2*	*9.25*
LTF	*CBM-W1*	*9.79*
LTF	*CBM-W2*	*24.07*
LTF	*CIN*	*2.19*
LTF	*CPLE*	*3.18*
LTF	*G-007*	*0.61*

LTF	*IPL*	*1.4*
LTF	*LGEE*	*0.47*
LTF	*MEC*	*4.96*
LTF	*MECS*	*2.19*
LTF	*O-066*	*3.87*
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*	*3.85*
919701	*AA2-057 C*	*7.44*
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*	*8.98*
927022	*AC1-189 E*	*4.48*
927141	*AC1-208 C*	*9.4*
927142	*AC1-208 E*	*4.17*

Appendix 10

(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*