Generation Interconnection

Feasibility Study Report

for

Queue Project AF2-346

“ELECTRIC JUNCTION-NELSON 345 KV”

July 2020

1 Introduction

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

2 Preface

The intent of the Feasibility Study is to determine a plan, with ballpark cost and construction time estimates, to connect the subject generation to the PJM network at a location specified by the Interconnection Customer. The Interconnection Customer may request the interconnection of generation as a capacity resource or as an energy-only resource. As a requirement for interconnection, the Interconnection Customer may be responsible for the cost of constructing: (1) Direct Connections, which are new facilities and/or facilities upgrades needed to connect the generator to the PJM network, and (2) Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system.

In some instances a generator interconnection may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection, may also contribute to the need for the same network reinforcement. Cost allocation rules for network upgrades can be found in PJM Manual 14A, Attachment B. The possibility of sharing the reinforcement costs with other projects may be identified in the feasibility study, but the actual allocation will be deferred until the impact study is performed.

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

An Interconnection Customer with a proposed new Customer Facility that has a Maximum Facility Output equal to or greater than 100 MW shall install and maintain, at its expense, phasor measurement units (PMUs). See Section 8.5.3 of Appendix 2 to the Interconnection Service Agreement as well as section 4.3 of PJM Manual 14D for additional information.

The Feasibility Study estimates do not include the feasibility, cost, or time required to obtain property rights and permits for construction of the required facilities. The project developer is responsible for the right of way, real estate, and construction permit issues. For properties currently owned by Transmission Owners, the costs may be included in the study.

3 General

The Interconnection Customer (IC) has proposed a solar uprate to a planned/existing solar and storage generating facility located in Lee County, Illinois. This project is an increase to the Interconnection Customer's AF1-012 and AF1-317 projects and will share the same Point of Interconnection. The AF2-346 queue position is a 75 MW uprate (45 MW Capacity uprate) to the previous AF1-012 and AF1-317 project. The total installed facilities will have a capability of 250 MWs Energy with 170 MWs of this output being recognized by PJM as Capacity. The proposed in-service date for this uprate project is December 31, 2023. This study does not imply a TO commitment to this in-service date.

Queue Number	AF2-346
Project Name	ELECTRIC JUNCTION-NELSON 345 KV
State	Illinois
County	Lee
Transmission Owner	ComEd
MFO	250
MWE	75
MWC	45
Fuel	Solar
Basecase Study Year	2023

A new service customer with a generating facility that could be commercially operable prior to June 1st of the basecase study year is required to request an interim deliverability analysis from PJM.

4 Point of Interconnection

AF2-346 will interconnect with the ComEd transmission system as an uprate to AF1-012 and AF1-317 which taps the Electric Junction to Nelson 345 kV line.

5 Cost Summary

The AF2-346 project will be responsible for the following costs:

Description	Total Cost
Total Physical Interconnection Costs	$200,000
Total System Network Upgrade Costs	$54,300,000
Total Costs	$54,500,000

This cost excludes a Federal Income Tax Gross Up charges. This tax may or may not be charged based on whether this project meets the eligibility requirements of IRS Notice 88-129. If at a future date it is determined

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

6 Transmission Owner Scope of Work

Attachment Facilities

To accommodate interconnection of AF2-346; the relaying, SCADA, communication, and metering between the solar facility and ComEd Interconnection Substation would be reviewed and upgraded if needed.

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

Description	Total Cost
The relaying, SCADA, communication, and metering between the solar facility and ComEd Interconnection Substation would be reviewed and upgraded if needed.	$200,000
Total Physical Interconnection Costs	$200,000

7 Schedule

ComEd would take approximately 18-months to review and possibly upgrade the relaying, SCADA, Communication and metering after the ISA / ICSA are signed.

8 Transmission Owner Analysis

See Section 6.

9 Interconnection Customer Requirements

The Interconnection Customer is responsible for all design and construction related activities on the Interconnection Customer's side of the Point of Interconnection.

10 Revenue Metering and SCADA Requirements

10.1 PJM Requirements

The Interconnection Customer will be required to install equipment necessary to provide Revenue Metering (KWH, KVARH) and real time data (KW, KVAR) for IC's generating Resource. See PJM Manuals M-01 and M-14D, and PJM Tariff Section 8 of Attachment O.

10.2 Interconnected Transmission Owner Requirements

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

ComEd interconnection requirements can be found at https://www.pjm.com/planning/design-engineering/to-tech-standards/private-comed.aspx

To the extent that these Applicable Technical Requirements and Standards may conflict with the terms and conditions of the Tariff, the Tariff shall control.

11 Summer Peak - Load Flow Analysis

The Queue Project AF2-346 was evaluated as a 75.0 MW (Capacity 45.0 MW) injection as an uprate to AF1-012 and AF1-317 which taps the Electric Junction to Nelson 345 kV line in the ComEd area. Project AF2-346 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF2-346 was studied with a commercial probability of 53.0 %. Potential network impacts were as follows:

11.1 Generation Deliverability

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

None

11.2 Multiple Facility Contingency

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

None

11.3 Contribution to Previously Identified Overloads

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

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
96628611	274768	LEE CO EC;BP	345.0	CE	270678	BYRON ; B	345.0	CE	1	COMED_P1-2_345-L15502_B-R-B	single	1726.0	108.97	109.99	DC	17.5
96627956	943410	AF1-012 TAP	345.0	CE	957470	AF2-041 TAP	345.0	CE	1	COMED_P4_155-45-BT6-7__	breaker	1656.0	127.52	128.75	DC	32.54
96627933	957470	AF2-041 TAP	345.0	CE	270730	ELECT JCT; B	345.0	CE	1	COMED_P4_006-45-BT3-4__	breaker	1656.0	134.53	136.47	DC	32.14
96628433	957470	AF2-041 TAP	345.0	CE	270730	ELECT JCT; B	345.0	CE	1	COMED_P1-2_345-L0627__B-R	single	1656.0	108.16	109.26	DC	19.28
96628434	957470	AF2-041 TAP	345.0	CE	270730	ELECT JCT; B	345.0	CE	1	Base Case	single	1334.0	105.86	106.83	DC	15.55

11.4 Potential Congestion due to Local Energy Deliverability

PJM also studied the delivery of the energy portion of this interconnection request. Any problems identified below are likely to result in operational restrictions to the project under study. The developer can proceed with network upgrades to eliminate the operational restriction at their discretion by submitting a Merchant Transmission Interconnection request.

Note: Only the most severely overloaded conditions are listed below. There is no guarantee of full delivery of energy for this project by fixing only the conditions listed in this section. With a Transmission Interconnection Request, a subsequent analysis will be performed which shall study all overload conditions associated with the overloaded element(s) identified.

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
9662862 8	270828	NELSON ; B	345.0	CE	946160	AF1-281 TAP	345.0	CE	1	COMED_P1-2_345-L15502_B-R-B	operation	1479.0	104.37	106.26	DC	29.45
9662861 0	274768	LEE COEC;BP	345.0	CE	270678	BYRON ; B	345.0	CE	1	COMED_P1-2_345-L15502_B-R-B	operation	1726.0	112.36	113.13	DC	29.17
9662848 2	943410	AF1-012 TAP	345.0	CE	957470	AF2-041 TAP	345.0	CE	1	COMED_P1-2_345-L15501_B-R-A	operation	1656.0	126.87	127.65	DC	32.24
9662848 5	943410	AF1-012 TAP	345.0	CE	957470	AF2-041 TAP	345.0	CE	1	Base Case	operation	1334.0	111.16	113.07	DC	25.92
9662855 2	946160	AF1-281 TAP	345.0	CE	274768	LEE COEC;BP	345.0	CE	1	COMED_P1-2_345-L15502_B-R-B	operation	1479.0	113.19	114.81	DC	29.45
9662842 8	957470	AF2-041 TAP	345.0	CE	270730	ELECT JCT; B	345.0	CE	1	Base Case	operation	1334.0	134.6	136.53	DC	25.92
9662842 9	957470	AF2-041 TAP	345.0	CE	270730	ELECT JCT; B	345.0	CE	1	COMED_P1-2_345-L0627__B-R	operation	1656.0	133.93	135.87	DC	32.14

11.5 System Reinforcements - Summer Peak Load Flow - Primary POI

ID	Idx	Facility	Upgrade Description	Cost
96628611	1	LEE CO EC;BP 345.0 kV - BYRON ; B 345.0 kV Ckt 1	CE_NUN_L0627 (902) : ComEd 345kV L0627 SSTE rating is 1837 MVA. The upgrade will be to re-conductor the line and upgrade station conductor at Byron Station. A preliminary estimate for the upgrades is $17.2M. The preliminary construction timeline is 24-30 months contingency upon outage coordination with Byron Nuclear Station. Note that the preliminary cost estimate does not include the potential for new transmission towers. This unknown will add to this estimate if required. Upon completion of the upgrades the new ratings will be 1679/1904/1944/2088 MVA (SN/SLTE/SSTE/SLD). Project Type : FAC Cost : $17,200,000 Time Estimate : 24-30 Months	$17,200,000
96628434,96628433,96627933	3	AF2-041 TAP 345.0 kV - ELECT JCT; B 345.0 kV Ckt 1	CE_NUN_L15502_1 (892) : Replace station conductor at TSS111 Electric Junction. A preliminary estimate for the upgrade is $1.2M with a estimated construction timeline of 24 months. Upon completion of the upgrade the new ratings 1461/1656/1909/1912 MVA (SN/SLTE/SSTE/SLD). Project Type : FAC Cost : $1,200,000 Time Estimate : 24.0 Months CE_NUN_L15502_4 (898) : ComEd 345kV L15502 SSTE rating is 1837 MVA. The upgrade is to perform sag mitigation on a portion of the line section along with re-conductoring on a different section, upgrade station conductor at both line terminals, replace both line motor operated disconnect witches and line current transformers, upgrade line relay schemes at both terminals as well. A preliminary estimate for the upgrade is $10.5M with an estimated construction timeline of 36 months. Upon completion of the upgrades the ratings will be 1683/2068/2367/2564 MVA (SN/SLTE/SSTE/SLD). Project Type : FAC Cost : $10,500,000 Time Estimate : 36.0 Months	$11,700,000
96627956	2	AF1-012 TAP 345.0 kV - AF2-041 TAP 345.0 kV Ckt 1	CE_NUN_15502 (856) : ComEd 345kV L15502 SSTE rating is 1837 MVA. The upgrade will be to re-conductor a portion of the line, 1-345kV circuit breaker and associated switches and upgrade of station conductor. A preliminary estimate for the upgrade is $25.4M with an estimated construction timeline of 30 months. Upon completion of the upgrade the ratings will be 2293/2293/2293/2436 MVA (SN/SLTE/SSTE/SLD). Project Type : FAC Cost : $25,400,000 Time Estimate : 30.0 Months	$25,400,000
			Total System Network Upgrade Costs	**$54,300,000**

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

11.6 Flow Gate Details

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

11.6.1 Index 1

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
96628611	274768	LEE CO EC;BP	CE	270678	BYRON ; B	CE	1	COMED_P1-2_345-L15502_B-R-B	single	1726.0	108.97	109.99	DC	17.5

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
274662	QUAD CITI;1U	43.2174	80/20	43.2174
274663	QUAD CITI;2U	43.3023	80/20	43.3023
274699	CORDOVA ;1C	7.6046	80/20	7.6046
274700	CORDOVA ;2C	7.6046	80/20	7.6046
274701	CORDOVA ;1S	8.5552	80/20	8.5552
274715	NELSON EC;1C	11.2932	80/20	11.2932
274716	NELSON EC;1S	8.2401	80/20	8.2401
274717	NELSON EC;2C	11.3805	80/20	11.3805
274718	NELSON EC;2S	8.3139	80/20	8.3139
274760	LEE CO EC;1U	7.2036	80/20	7.2036
274761	LEE CO EC;2U	7.2036	80/20	7.2036
274762	LEE CO EC;3U	7.1032	80/20	7.1032
274763	LEE CO EC;4U	7.1306	80/20	7.1306
274764	LEE CO EC;5U	7.2219	80/20	7.2219
274765	LEE CO EC;6U	7.2219	80/20	7.2219
274766	LEE CO EC;7U	7.1123	80/20	7.1123
274767	LEE CO EC;8U	7.1123	80/20	7.1123
274848	CAMPGROVE;RU	0.6178	80/20	0.6178
274849	CRESCENT ;1U	0.1851	80/20	0.1851
274850	MENDOTA H;RU	0.0460	80/20	0.0460
274851	PROVIDENC;RU	0.2824	80/20	0.2824
274855	GSG-6 ;RU	0.1939	80/20	0.1939
274857	BIG SKY ;U1	2.1912	80/20	2.1912
274858	BIG SKY ;U2	2.1912	80/20	2.1912
274877	BISHOP HL;1U	0.4581	80/20	0.4581
274878	BISHOP HL;2U	0.4581	80/20	0.4581
276156	O-029 C	0.5200	80/20	0.5200
276157	O-029 C	0.5621	80/20	0.5621
276158	O-029 C	1.0259	80/20	1.0259
276160	W4-084	0.1503	80/20	0.1503
293513	O-009 C1	0.9603	80/20	0.9603
293514	O-009 C2	0.4872	80/20	0.4872
293515	O-009 C3	0.5387	80/20	0.5387
919221	AA1-146	10.5350	80/20	10.5350
919581	AA2-030	61.0746	80/20	61.0746
925581	AC1-033 C	1.7399	80/20	1.7399
926821	AC1-168 C O1	0.6720	80/20	0.6720
926841	AC1-171 C O1	0.7114	80/20	0.7114
927201	AC1-214 C O1	2.1018	80/20	2.1018
927531	AC1-185 1	0.5478	80/20	0.5478
927541	AC1-185 2	0.5478	80/20	0.5478

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
927551	AC1-185 3	0.5478	80/20	0.5478
927561	AC1-185 4	0.5478	80/20	0.5478
927571	AC1-185 5	0.5478	80/20	0.5478
927581	AC1-185 6	0.5478	80/20	0.5478
927591	AC1-185 7	0.5478	80/20	0.5478
927601	AC1-185 8	0.5478	80/20	0.5478
934051	AD1-031 C O1	3.5341	80/20	3.5341
934431	AD1-067 C	0.0565	80/20	0.0565
934701	AD1-098 C O1	3.5512	80/20	3.5512
937001	AD2-134 C	1.1752	80/20	1.1752
937531	AD2-214 C	11.7443	80/20	11.7443
938861	AE1-114 C O1	2.6330	80/20	2.6330
939051	AE1-134 1	4.7459	80/20	4.7459
939061	AE1-134 2	4.7459	80/20	4.7459
943381	AF1-009 C	0.3072	80/20	0.3072
943401	AF1-011 C	3.0417	80/20	3.0417
943411	AF1-012 C	40.8418	80/20	40.8418
946151	AF1-280 C O1	66.7039	80/20	66.7039
946161	AF1-281 C	1.4607	80/20	1.4607
946321	AF1-296 C O1	9.8913	80/20	9.8913
946531	AF1-317 C O1	7.7794	80/20	7.7794
946541	AF1-318 C O1	4.1957	80/20	4.1957
951381	J504	6.4395	PJM External (MISO)	6.4395
951421	J514	3.9054	PJM External (MISO)	3.9054
951511	J530 C	6.4260	PJM External (MISO)	6.4260
954901	J963	1.6344	PJM External (MISO)	1.6344
955051	J981 C	4.5702	PJM External (MISO)	4.5702
955971	J1084	37.1040	PJM External (MISO)	37.1040
956411	J1131	19.9460	PJM External (MISO)	19.9460
957471	AF2-041 C	70.0002	80/20	70.0002
957751	AF2-069 C	0.2434	80/20	0.2434
957761	AF2-070 C	0.3429	80/20	0.3429
958341	AF2-128 C O1	1.0223	80/20	1.0223
958911	AF2-182	87.6402	80/20	87.6402
958921	AF2-183 C	15.5805	80/20	15.5805
959081	AF2-199 C	23.3334	80/20	23.3334
959091	AF2-200 C	46.6668	80/20	46.6668
960551	AF2-346 C	17.5036	80/20	17.5036
961011	AF2-392 C O1	10.2478	80/20	10.2478
961021	AF2-393 O1	17.4678	80/20	17.4678
961031	AF2-394 O1	11.6452	80/20	11.6452
LGEE	LGEE	0.1940	Confirmed LTF	0.1940
CPLE	CPLE	0.4214	Confirmed LTF	0.4214
CBM-W2	CBM-W2	23.0139	Confirmed LTF	23.0139
NY	NY	0.0182	Confirmed LTF	0.0182
CBM-W1	CBM-W1	21.5797	Confirmed LTF	21.5797
TVA	TVA	2.8084	Confirmed LTF	2.8084
CBM-S2	CBM-S2	4.8263	Confirmed LTF	4.8263
CBM-S1	CBM-S1	14.4499	Confirmed LTF	14.4499
MADISON	MADISON	9.9228	Confirmed LTF	9.9228
MEC	MEC	17.6109	Confirmed LTF	17.6109

11.6.2 Index 2

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
96627956	943410	AF1-012 TAP	CE	957470	AF2-041 TAP	CE	1	COMED_P4_155-45-BT6-7__	breaker	1656.0	127.52	128.75	DC	32.54

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
274662	QUAD CITI;1U	39.5685	50/50	39.5685
274663	QUAD CITI;2U	39.6435	50/50	39.6435
274699	CORDOVA ;1C	6.9583	50/50	6.9583
274700	CORDOVA ;2C	6.9583	50/50	6.9583
274701	CORDOVA ;1S	7.8280	50/50	7.8280
274715	NELSON EC;1C	10.1204	50/50	10.1204
274716	NELSON EC;1S	7.3843	50/50	7.3843
274717	NELSON EC;2C	10.1986	50/50	10.1986
274718	NELSON EC;2S	7.4505	50/50	7.4505
276156	O-029 C	0.4620	50/50	0.4620
276157	O-029 C	0.4994	50/50	0.4994
276158	O-029 C	0.9114	50/50	0.9114
290051	GSG-6; E	5.4542	Adder	6.42
293513	O-009 C1	0.8532	50/50	0.8532
293514	O-009 C2	0.4328	50/50	0.4328
293515	O-009 C3	0.4786	50/50	0.4786
293516	O-009 E1	19.7938	50/50	19.7938
293517	O-009 E2	10.0537	50/50	10.0537
293518	O-009 E3	11.0719	50/50	11.0719
293715	O-029 E	21.1618	50/50	21.1618
293716	O-029 E	11.6027	50/50	11.6027
293717	O-029 E	10.6641	50/50	10.6641
293771	O-035 E	4.8987	Adder	5.76
294401	BSHIL;1U E	8.0063	Adder	9.42
294410	BSHIL;2U E	8.0063	Adder	9.42
294763	P-046 E	4.7763	Adder	5.62
919221	AA1-146	9.4409	50/50	9.4409
919581	AA2-030	54.7318	50/50	54.7318
925581	AC1-033 C	1.3114	Adder	1.54
925582	AC1-033 E	8.7792	Adder	10.33
927201	AC1-214 C O1	1.5722	Adder	1.85
927202	AC1-214 E O1	4.9979	Adder	5.88
934051	AD1-031 C O1	2.6635	Adder	3.13
934052	AD1-031 E O1	4.3456	Adder	5.11
934431	AD1-067 C	0.0685	Adder	0.08
934432	AD1-067 E	0.2880	Adder	0.34
934651	AD1-096 C	0.5466	Adder	0.64
934652	AD1-096 E	0.8919	Adder	1.05
934701	AD1-098 C O1	4.0061	Adder	4.71
934702	AD1-098 E O1	2.9248	Adder	3.44
937001	AD2-134 C	1.4258	Adder	1.68

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
937002	AD2-134 E	5.8900	Adder	6.93
937311	AD2-172 C	1.2538	Adder	1.48
937312	AD2-172 E	1.7314	Adder	2.04
937531	AD2-214 C	10.3069	50/50	10.3069
937532	AD2-214 E	6.8713	50/50	6.8713
938861	AE1-114 C O1	3.9885	Adder	4.69
938862	AE1-114 E O1	13.6078	Adder	16.01
939051	AE1-134 1	4.2530	50/50	4.2530
939061	AE1-134 2	4.2530	50/50	4.2530
940501	AE2-035 C	1.2538	Adder	1.48
940502	AE2-035 E	1.7314	Adder	2.04
943381	AF1-009 C	0.3465	Adder	0.41
943382	AF1-009 E	1.3862	Adder	1.63
943401	AF1-011 C	2.2969	Adder	2.7
943402	AF1-011 E	4.5359	50/50	4.5359
943411	AF1-012 C	45.5605	50/50	45.5605
943412	AF1-012 E	30.3737	50/50	30.3737
943921	AF1-060	0.6173	Adder	0.73
946321	AF1-296 C O1	7.5519	Adder	8.88
946322	AF1-296 E O1	35.3560	Adder	41.6
946501	AF1-314 C	2.2277	Adder	2.62
946502	AF1-314 E	10.4296	Adder	12.27
946531	AF1-317 C O1	8.6782	50/50	8.6782
946541	AF1-318 C O1	3.0831	Adder	3.63
946542	AF1-318 E O1	14.4362	Adder	16.98
950181	J407 C	3.0540	PJM External (MISO)	3.0540
950182	J407 E	12.2160	PJM External (MISO)	12.2160
950401	J041 C	1.6591	PJM External (MISO)	1.6591
950402	J041 E	6.6362	PJM External (MISO)	6.6362
950471	J438 C	3.3990	PJM External (MISO)	3.3990
950472	J438 E	13.5959	PJM External (MISO)	13.5959
950501	J449 C	3.2789	PJM External (MISO)	3.2789
950502	J449 E	13.1155	PJM External (MISO)	13.1155
950522	J455 E	21.7650	PJM External (MISO)	21.7650
951031	J344 C	3.0711	PJM External (MISO)	3.0711
951032	J344 E	9.2132	PJM External (MISO)	9.2132
951221	J475 C	3.7552	PJM External (MISO)	3.7552
951222	J475 E	15.0208	PJM External (MISO)	15.0208
951301	J495 C	3.5205	PJM External (MISO)	3.5205
951302	J495 E	10.5615	PJM External (MISO)	10.5615
951381	J504	5.8315	PJM External (MISO)	5.8315
951421	J514	3.4866	PJM External (MISO)	3.4866
951441	J523 C	2.2326	PJM External (MISO)	2.2326
951442	J523 E	1.4884	PJM External (MISO)	1.4884
951451	J524 C	4.5432	PJM External (MISO)	4.5432
951452	J524 E	3.0288	PJM External (MISO)	3.0288
951511	J530 C	5.5515	PJM External (MISO)	5.5515
951512	J530 E	22.2060	PJM External (MISO)	22.2060
951541	J534 C	3.5945	PJM External (MISO)	3.5945
951542	J534 E	14.3780	PJM External (MISO)	14.3780
951551	J535 C	3.0538	PJM External (MISO)	3.0538
951552	J535 E	12.2153	PJM External (MISO)	12.2153

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
951821	J541 C	4.4784	PJM External (MISO)	4.4784
951822	J541 E	24.2296	PJM External (MISO)	24.2296
951841	J555 C	2.0503	PJM External (MISO)	2.0503
951842	J555 E	11.0929	PJM External (MISO)	11.0929
952021	J614 C	0.7591	PJM External (MISO)	0.7591
952022	J614 E	4.1071	PJM External (MISO)	4.1071
952211	J590 C	1.0186	PJM External (MISO)	1.0186
952212	J590 E	5.5109	PJM External (MISO)	5.5109
952231	J598 C (MISO Withdrawn : 1/16/2020)	3.3588	PJM External (MISO)	3.3588
952232	J598 E (MISO Withdrawn : 1/16/2020)	18.1722	PJM External (MISO)	18.1722
953011	J885 C	0.7623	PJM External (MISO)	0.7623
953012	J885 E	4.1241	PJM External (MISO)	4.1241
953082	J836 E	14.4980	PJM External (MISO)	14.4980
953231	J447 C (MISO Withdrawn : 10/24/2019)	1.9707	PJM External (MISO)	1.9707
953232	J447 E (MISO Withdrawn : 10/24/2019)	10.6623	PJM External (MISO)	10.6623
954091	J873 C	3.3287	PJM External (MISO)	3.3287
954092	J873 E	18.0093	PJM External (MISO)	18.0093
954131	J877	18.1375	PJM External (MISO)	18.1375
954301	J898 C	1.1383	PJM External (MISO)	1.1383
954302	J898 E	6.1587	PJM External (MISO)	6.1587
954521	J927 C	1.1322	PJM External (MISO)	1.1322
954522	J927 E	6.1258	PJM External (MISO)	6.1258
954702	J844 E	14.1855	PJM External (MISO)	14.1855
954792	J952 E	6.8510	PJM External (MISO)	6.8510
954861	J959 C	2.3136	PJM External (MISO)	2.3136
954862	J959 E	12.5169	PJM External (MISO)	12.5169
954901	J963	1.4162	PJM External (MISO)	1.4162
954931	J967 C	1.8343	PJM External (MISO)	1.8343
954932	J967 E	9.9242	PJM External (MISO)	9.9242
955051	J981 C	3.8975	PJM External (MISO)	3.8975
955052	J981 E	21.0865	PJM External (MISO)	21.0865
955061	J982 C	0.3020	PJM External (MISO)	0.3020
955062	J982 E	1.6339	PJM External (MISO)	1.6339
955221	J1000	4.0255	PJM External (MISO)	4.0255
955661	J1050 C	2.7961	PJM External (MISO)	2.7961
955662	J1050 E	15.1274	PJM External (MISO)	15.1274
955871	J1072	11.7585	PJM External (MISO)	11.7585
955971	J1084	31.8495	PJM External (MISO)	31.8495
956231	J1110	7.3510	PJM External (MISO)	7.3510
956381	J1128	11.1660	PJM External (MISO)	11.1660
956411	J1131	17.0520	PJM External (MISO)	17.0520
956431	J1135	4.1005	PJM External (MISO)	4.1005
956761	J1174	23.2980	PJM External (MISO)	23.2980
956771	J1175 C	3.6345	PJM External (MISO)	3.6345
956772	J1175 E	19.6635	PJM External (MISO)	19.6635
956781	J1176 C (MISO Withdrawn : 8/15/2019)	1.8415	PJM External (MISO)	1.8415
956782	J1176 E (MISO Withdrawn : 8/15/2019)	9.9630	PJM External (MISO)	9.9630

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
956831	J1181 C	3.0292	PJM External (MISO)	3.0292
956832	J1181 E	16.3888	PJM External (MISO)	16.3888
957751	AF2-069 C	0.0965	Adder	0.21
957752	AF2-069 E	0.3114	Adder	0.69
957761	AF2-070 C	0.1360	Adder	0.3
957762	AF2-070 E	0.6600	Adder	1.47
959101	AF2-201 C O1	1.6265	Adder	3.61
959102	AF2-201 E O1	4.6705	Adder	10.37
959761	AF2-267 C O1	1.1774	Adder	2.61
959762	AF2-267 E O1	5.5122	Adder	12.24
960551	AF2-346 C	19.5260	50/50	19.5260
960552	AF2-346 E	13.0173	50/50	13.0173
961011	AF2-392 C O1	9.0383	50/50	9.0383
961012	AF2-392 E O1	42.3157	50/50	42.3157
961021	AF2-393 O1	15.4062	50/50	15.4062
961031	AF2-394 O1	10.2708	50/50	10.2708
990901	L-005 E	10.7936	Adder	12.7
LGEE	LGEE	0.1198	Confirmed LTF	0.1198
CPLE	CPLE	0.3539	Confirmed LTF	0.3539
CBM-W2	CBM-W2	22.6044	Confirmed LTF	22.6044
NY	NY	0.0896	Confirmed LTF	0.0896
CBM-W1	CBM-W1	47.4254	Confirmed LTF	47.4254
TVA	TVA	2.7342	Confirmed LTF	2.7342
O-066	O-066	0.9139	Confirmed LTF	0.9139
CBM-S2	CBM-S2	4.2830	Confirmed LTF	4.2830
CBM-S1	CBM-S1	13.8791	Confirmed LTF	13.8791
G-007	G-007	0.1404	Confirmed LTF	0.1404
MADISON	MADISON	14.5999	Confirmed LTF	14.5999
MEC	MEC	18.4340	Confirmed LTF	18.4340

11.6.3 Index 3

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
96627933	957470	AF2-041 TAP	CE	270730	ELECT JCT; B	CE	1	COMED_P4_006-45-BT3-4__	breaker	1656.0	134.53	136.47	DC	32.14

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
274715	NELSON EC;1C	9.9439	50/50	9.9439
274716	NELSON EC;1S	7.2555	50/50	7.2555
274717	NELSON EC;2C	10.0207	50/50	10.0207
274718	NELSON EC;2S	7.3205	50/50	7.3205
274761	LEE CO EC;2U	4.6601	50/50	4.6601
274764	LEE CO EC;5U	4.6719	50/50	4.6719
274765	LEE CO EC;6U	4.6719	50/50	4.6719
274859	EASYR;U1 E	27.9407	Adder	32.87
274860	EASYR;U2 E	27.9407	Adder	32.87
293516	O-009 E1	17.3066	Adder	20.36
293517	O-009 E2	8.7904	Adder	10.34
293518	O-009 E3	9.6806	Adder	11.39
293715	O-029 E	18.5027	Adder	21.77
293716	O-029 E	10.1447	Adder	11.93
293717	O-029 E	9.3241	Adder	10.97
293771	O-035 E	4.9500	Adder	5.82
294401	BSHIL;1U E	8.1063	Adder	9.54
294410	BSHIL;2U E	8.1063	Adder	9.54
919221	AA1-146	9.2762	50/50	9.2762
919581	AA2-030	53.7772	50/50	53.7772
925581	AC1-033 C	1.3277	Adder	1.56
925582	AC1-033 E	8.8887	Adder	10.46
927201	AC1-214 C O1	1.5887	Adder	1.87
927202	AC1-214 E O1	5.0503	Adder	5.94
934051	AD1-031 C O1	2.6967	Adder	3.17
934052	AD1-031 E O1	4.3999	Adder	5.18
937531	AD2-214 C	9.0986	Adder	10.7
937532	AD2-214 E	6.0658	Adder	7.14
938861	AE1-114 C O1	4.1945	Adder	4.93
938862	AE1-114 E O1	14.3108	Adder	16.84
939051	AE1-134 1	4.1789	50/50	4.1789
939061	AE1-134 2	4.1789	50/50	4.1789
943401	AF1-011 C	2.3627	Adder	2.78
943402	AF1-011 E	3.9659	Adder	4.67
943411	AF1-012 C	44.9977	50/50	44.9977
943412	AF1-012 E	29.9985	50/50	29.9985
946151	AF1-280 C O1	46.9156	50/50	46.9156
946152	AF1-280 E O1	21.5743	50/50	21.5743
946161	AF1-281 C	1.0273	50/50	1.0273
946162	AF1-281 E	5.8216	50/50	5.8216
946321	AF1-296 C O1	7.6962	Adder	9.05

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
946322	AF1-296 E O1	36.0319	Adder	42.39
946531	AF1-317 C O1	8.5710	50/50	8.5710
950471	J438 C	3.3717	PJM External (MISO)	3.3717
950472	J438 E	13.4869	PJM External (MISO)	13.4869
951381	J504	5.7865	PJM External (MISO)	5.7865
951421	J514	3.4599	PJM External (MISO)	3.4599
951511	J530 C	5.5045	PJM External (MISO)	5.5045
951512	J530 E	22.0180	PJM External (MISO)	22.0180
954091	J873 C	3.3038	PJM External (MISO)	3.3038
954092	J873 E	17.8742	PJM External (MISO)	17.8742
954702	J844 E	14.1620	PJM External (MISO)	14.1620
954792	J952 E	6.7954	PJM External (MISO)	6.7954
954861	J959 C	2.2974	PJM External (MISO)	2.2974
954862	J959 E	12.4296	PJM External (MISO)	12.4296
954901	J963	1.4067	PJM External (MISO)	1.4067
955051	J981 C	3.8638	PJM External (MISO)	3.8638
955052	J981 E	20.9042	PJM External (MISO)	20.9042
955971	J1084	31.5210	PJM External (MISO)	31.5210
956411	J1131	16.9080	PJM External (MISO)	16.9080
956831	J1181 C	3.0077	PJM External (MISO)	3.0077
956832	J1181 E	16.2723	PJM External (MISO)	16.2723
957471	AF2-041 C	107.0010	50/50	107.0010
957472	AF2-041 E	71.3340	50/50	71.3340
957751	AF2-069 C	0.0975	Adder	0.22
957752	AF2-069 E	0.3146	Adder	0.7
957761	AF2-070 C	0.1374	Adder	0.3
957762	AF2-070 E	0.6670	Adder	1.48
958911	AF2-182	61.6410	50/50	61.6410
958921	AF2-183 C	10.9584	50/50	10.9584
958922	AF2-183 E	16.4376	50/50	16.4376
959081	AF2-199 C	35.6670	50/50	35.6670
959082	AF2-199 E	23.7780	50/50	23.7780
959091	AF2-200 C	71.3340	50/50	71.3340
959092	AF2-200 E	47.5560	50/50	47.5560
960551	AF2-346 C	19.2848	50/50	19.2848
960552	AF2-346 E	12.8565	50/50	12.8565
961011	AF2-392 C O1	4.3215	Adder	9.59
961012	AF2-392 E O1	20.2325	Adder	44.91
961021	AF2-393 O1	7.3662	Adder	16.35
961031	AF2-394 O1	4.9108	Adder	10.9
990901	L-005 E	10.9007	Adder	12.82
LGEE	LGEE	0.0434	Confirmed LTF	0.0434
CPLE	CPLE	0.2633	Confirmed LTF	0.2633
CBM-W2	CBM-W2	21.4005	Confirmed LTF	21.4005
NY	NY	0.1637	Confirmed LTF	0.1637
CBM-W1	CBM-W1	45.5989	Confirmed LTF	45.5989
TVA	TVA	2.5326	Confirmed LTF	2.5326
O-066	O-066	1.8077	Confirmed LTF	1.8077
CBM-S2	CBM-S2	3.4911	Confirmed LTF	3.4911
CBM-S1	CBM-S1	12.6692	Confirmed LTF	12.6692
G-007	G-007	0.2787	Confirmed LTF	0.2787
MADISON	MADISON	14.5414	Confirmed LTF	14.5414

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
MEC	MEC	18.1019	Confirmed LTF	18.1019
TRIMBLE	TRIMBLE	0.0134	Confirmed LTF	0.0134

11.7 Queue Dependencies

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

Queue Number	Project Name	Status
AA1-146	Nelson	Active
AA2-030	Nelson	Active
AC1-033	Kewanee	Active
AC1-168	Kewanee-Streator	Active
AC1-171	Powerton	Active
AC1-185	Lee County	Partially in Service - Under Construction
AC1-214	Crescent Ridge	Engineering and Procurement
AD1-031	Kewanee 138 kV	Active
AD1-067	Mendota Hills	Active
AD1-096	Stillman Valley 34 kV	Active
AD1-098	Dixon-McGirr	Active
AD2-134	Shady Oaks	Active
AD2-172	Lena 138kV	Active
AD2-214	Rock Falls-Garden Plains	Active
AE1-114	Maryland-Lancaster 138 kV	Active
AE1-134	Nelson 345 kV	Active
AE2-035	Lena 138 kV	Active
AF1-009	Dixon-McGirr	Active
AF1-011	Schauff Road	Active
AF1-012	Electric Junc-Nelson	Active
AF1-060	Lena 138 kV	Active
AF1-280	Nelson-Lee County	Active
AF1-281	Nelson-Lee County	Active
AF1-296	Garden Plain 138 kV	Active
AF1-314	Lena 138 kV	Active
AF1-317	Electric Jct-Nelson	Active
AF1-318	Crescent Ridge-Corbin	Active
AF2-041	Nelson-Electric Junction 345 kV	Active
AF2-069	Crescent Ridge 138 kV	Active
AF2-070	Crescent Ridge 138 kV	Active
AF2-128	Crescent Ridge-Corbin 138 kV	Active
AF2-182	Nelson-Lee County 345 kV II	Active
AF2-183	Nelson-Lee County 345 kV	Active
AF2-199	Nelson-Electric Junction 345 kV	Active
AF2-200	Nelson-Electric Junction 345 kV	Active
AF2-201	Lena-Ecogrove 138 kV	Active
AF2-267	Lancaster 138 kV	Active
AF2-346	Electric Junction-Nelson 345 kV	Active
AF2-392	Nelson-Dixon 138 kV	Active

Queue Number	Project Name	Status
AF2-393	Nelson-Dixon 138 kV	Active
AF2-394	Nelson-Dixon 138 kV	Active
W4-084	Dixon 12kV	Deactivated
J041	MISO	MISO
J1000	MISO	MISO
J1050	MISO	MISO
J1072	MISO	MISO
J1084	MISO	MISO
J1110	MISO	MISO
J1128	MISO	MISO
J1131	MISO	MISO
J1135	MISO	MISO
J1174	MISO	MISO
J1175	MISO	MISO
J1176	MISO	MISO
J1181	MISO	MISO
J344	MISO	MISO
J407	MISO	MISO
J438	MISO	MISO
J447	MISO	MISO
J449	MISO	MISO
J455	MISO	MISO
J475	MISO	MISO
J495	MISO	MISO
J504	MISO	MISO
J514	MISO	MISO
J523	MISO	MISO
J524	MISO	MISO
J530	MISO	MISO
J534	MISO	MISO
J535	MISO	MISO
J541	MISO	MISO
J555	MISO	MISO
J590	MISO	MISO
J598	MISO	MISO
J614	MISO	MISO
J836	MISO	MISO
J844	MISO	MISO
J873	MISO	MISO
J877	MISO	MISO
J885	MISO	MISO
J898	MISO	MISO
J927	MISO	MISO
J952	MISO	MISO
J959	MISO	MISO
J963	MISO	MISO
J967	MISO	MISO
J981	MISO	MISO
J982	MISO	MISO

11.8 Contingency Descriptions

Contingency Name	Contingency Definition
COMED_P1-2_345-L15502_B-R-B	CONTINGENCY 'COMED_P1-2_345-L15502_B-R-B' TRIP BRANCH FROM BUS 957470 TO BUS 270730 CKT 1 / AF1-012 TAP 345 ELEC JUNC; B 345 END
COMED_P4_155-45-BT6-7__	CONTINGENCY 'COMED_P4_155-45-BT6-7__' TRIP BRANCH FROM BUS 275204 TO BUS 270828 CKT 1 / NELSO;4M 138 NELSO; B 345 TRIP BRANCH FROM BUS 275204 TO BUS 272094 CKT 1 / NELSO;4M 138 NELSO; B 138 TRIP BRANCH FROM BUS 275204 TO BUS 275304 CKT 1 / NELSO;4M 138 NELSO;4C 34.5 TRIP BRANCH FROM BUS 270828 TO BUS 946160 CKT 1 / NELSO; B 345 AF1-281 TAP 345 END
COMED_P4_006-45-BT3-4__	CONTINGENCY 'COMED_P4_006-45-BT3-4__' TRIP BRANCH FROM BUS 274768 TO BUS 270678 CKT 1 / LEECO;BP 345 BYRON; B 345 REMOVE UNIT 1 FROM BUS 274656 / BYRON;1U 25 END
COMED_P1-2_345-L0627__B-R	CONTINGENCY 'COMED_P1-2_345-L0627__B-R' TRIP BRANCH FROM BUS 274768 TO BUS 270678 CKT 1 / LEECO;BP 345 BYRON; B 345 END
COMED_P1-2_345-L15501_B-R-A	CONTINGENCY 'COMED_P1-2_345-L15501_B-R-A' TRIP BRANCH FROM BUS 270828 TO BUS 946160 CKT 1 / NELSO; B 345 AF1-281 TAP 345 END
Base Case	

12 Short Circuit Analysis

The following breakers are overdutied:

None

12.1 System Reinforcements - Short Circuit

None

13 Affected Systems

13.1 MISO

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