Generation Interconnection

Feasibility Study Report

for

Queue Project AG1-477

GRUNDY COUNTY 34.5 KV

15.9 MW Capacity / 19.9 MW Energy

January 2021

Table of Contents

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.

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/Storage generating facility located in Grundy County, Illinois. The installed facilities will have a total capability of 19.9 MW with 15.9 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is December 29, 2023. This study does not imply a TO commitment to this in-service date.

Queue Number	AG1-477
Project Name	GRUNDY COUNTY 34.5 KV
State	Illinois
County	Grundy
Transmission Owner	ComEd
MFO	19.9
MWE	19.9
MWC	15.9
Fuel	Solar/Storage
Basecase Study Year	2024

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

4 Point of Interconnection

AG1-477 will interconnect with the ComEd distribution system at the TSS 77 Mazon 138/34.5 kV substation.

5 Cost Summary

The costs associated with interconnecting the AG1-477 project to the ComEd distribution system will be documented in the two-party Interconnection Agreement between the IC and ITO.

The AG1-477 project will be responsible for the following costs:

Description	Total Cost
Total Physical Interconnection Costs	$ To be provided in the two party IA
Total System Network Upgrade Costs	$ 6,950,000
Total Costs	**$ 6,950,000**

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 2016-36, 2016-25 I.R.B. (6/20/2016). If at a future date it is determined that the Federal Income Tax Gross charge is required, the Transmission Owner shall be reimbursed by the Interconnection Customer for such taxes.

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

6 Transmission Owner Scope of Work

The interconnection for this project is within the jurisdiction of a state tariff and the PJM process is solely for the access to the wholesale energy and ancillary markets.

The substation identified is Mazon 138/34.5 kV substation.

7 Schedule

See Section 11.5.

8 Transmission Owner Analysis

See Section 11.5.

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 Meteorological Data Reporting Requirements

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

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

10.3 Interconnected Transmission Owner Requirements

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

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

11 Summer Peak - Load Flow Analysis

The Queue Project AG1-477 was evaluated as a 19.9 MW (Capacity 15.9 MW) injection at the Mazon 34.5 kV substation in the ComEd area. Project AG1-477 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AG1-477 was studied with a commercial probability of 53%. 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
16304211 4	271987	MAZON ; R	138.0	CE	271187	CHANNAHON; R	138.0	CE	1	COMED_P7-1_138-L6101___-S_+_138-L7413__R-S-B	tower	230.0	132.82	135.79	DC	6.81
16304211 5	271987	MAZON ; R	138.0	CE	271187	CHANNAHON; R	138.0	CE	1	COMED_P7-1_138-L6101___-S_+_138-L7413__R-S-A	tower	230.0	118.82	121.75	DC	6.74
16304213 9	272125	ESSJ339 ; R	138.0	CE	271337	DRESDEN ; R	138.0	CE	1	COMED_P7-1_138-L6101___-S_+_138-L7413__R-S-B	tower	280.0	123.3	125.73	DC	6.8

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
163042140	272125	ESS J339 ; R	138.0	CE	271337	DRESDEN ; R	138.0	CE	1	COMED_P7-1_138-L6101___-S_+_138-L7413__R-S-A	tower	280.0	111.85	114.26	DC	6.73

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
162692876	271987	MAZON ; R	138.0	CE	271187	CHANNAHON; R	138.0	CE	1	Base Case	operation	173.0	130.2	134.05	DC	6.66
162692877	271987	MAZON ; R	138.0	CE	271187	CHANNAHON; R	138.0	CE	1	EXT_P12:138:AMIL::MCCLEANCOUNTY:OGLESBY:1382	operation	223.0	120.2	123.25	DC	6.8
162692901	272125	ESS J339 ; R	138.0	CE	271337	DRESDEN ; R	138.0	CE	1	Base Case	operation	210.0	126.31	129.49	DC	6.65
162692902	272125	ESS J339 ; R	138.0	CE	271337	DRESDEN ; R	138.0	CE	1	EXT_P12:138:AMIL::MCCLEANCOUNTY:OGLESBY:1382	operation	268.0	115.04	117.57	DC	6.79

11.5 System Reinforcements - Summer Peak Load Flow - Primary POI

ID	Idx	Facility	Upgrade Description	Cost
163042115,163042114	1	MAZON ; R 138.0 kV - CHANNAHON; R 138.0 kV Ckt 1	ComEd CE_NUN_L7719 (572) : 138kV line conductor upgrades, replace station conductor at both terminals and upgrade 1-138kV circuit breaker. A preliminary estimate is $4.5M with a construction timeline of 30 months. Upon completion the limit rating swill be 292/321/367/433 MVA (SN/SLTE/SSTE/SLD). Project Type : FAC Cost : $5,200,000 Time Estimate : 30.0 Months	$5,200,000
163042139,163042140	2	ESS J339 ; R 138.0 kV - DRESDEN ; R 138.0 kV Ckt 1	ComEd CE_NUN_L1206 (536) : Reconductor 138kV L1206 from Dresden Station to ESS J339. Upon completion of work the ratings will be 312/312/318/334/384 MVA (SN/SLTE/SSTE/SLD/ALDR). Project Type : FAC Cost : $1,750,000 Time Estimate : 24.0 Months	$1,750,000
			TOTAL COST	$6,950,000

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
163042114	271987	MAZON ; R	CE	271187	CHANNAHON; R	CE	1	COMED_P7-1_138-L6101___-S_+_138-L7413__R-S-B	tower	230.0	132.82	135.79	DC	6.81

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
274849	CRESCENT ;1U	0.3178	50/50	0.3178
274851	PROVIDENC;RU	0.3273	50/50	0.3273
293771	O-035 E	11.9235	50/50	11.9235
916211	Z1-072 E	9.0232	50/50	9.0232
926821	AC1-168 C O1	1.3234	50/50	1.3234
926822	AC1-168 E O1	8.8814	50/50	8.8814
927201	AC1-214 C O1	0.6038	50/50	0.6038
927202	AC1-214 E O1	12.1652	50/50	12.1652
936511	AD2-066 C O1	39.6003	50/50	39.6003
936512	AD2-066 E O1	26.4002	50/50	26.4002
946541	AF1-318 C O1	10.6329	50/50	10.6329
946542	AF1-318 E O1	49.7810	50/50	49.7810
953201	J715 C	3.1216	PJM External (MISO)	3.1216
953202	J715 E	16.8884	PJM External (MISO)	16.8884
957751	AF2-069 C	0.4431	50/50	0.4431
957752	AF2-069 E	1.4300	50/50	1.4300
957761	AF2-070 C	0.6244	50/50	0.6244
957762	AF2-070 E	3.0312	50/50	3.0312
958341	AF2-128 C O1	2.8180	50/50	2.8180
958342	AF2-128 E O1	13.1933	50/50	13.1933
961651	AG1-005 C O1	30.2100	50/50	30.2100
961652	AG1-005 E O1	20.1400	50/50	20.1400
962721	AG1-121 C O1	7.4150	50/50	7.4150
962722	AG1-121 E O1	34.6888	50/50	34.6888
965671	AG1-435 C O1	5.0290	50/50	5.0290
965672	AG1-435 E O1	23.5450	50/50	23.5450
966081	AG1-477 C	5.4416	50/50	5.4416
966082	AG1-477 E	1.3690	50/50	1.3690
966101	**AG1-479 C (Withdrawn : 12/03/2020)**	**5.4416**	**50/50**	**5.4416**
966102	**AG1-479 E (Withdrawn : 12/03/2020)**	**1.3690**	**50/50**	**1.3690**
LGEE	LGEE	0.0509	Confirmed LTF	0.0509
CPLE	CPLE	0.0471	Confirmed LTF	0.0471
G-007A	G-007A	0.0575	Confirmed LTF	0.0575
VFT	VFT	0.1548	Confirmed LTF	0.1548
CBM-W2	CBM-W2	2.1594	Confirmed LTF	2.1594
TVA	TVA	0.2324	Confirmed LTF	0.2324
SIGE	SIGE	0.0117	Confirmed LTF	0.0117

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
CBM-S2	CBM-S2	0.8665	Confirmed LTF	0.8665
CBM-S1	CBM-S1	0.0574	Confirmed LTF	0.0574
CBM-N	CBM-N	0.0288	Confirmed LTF	0.0288
MEC	MEC	0.5434	Confirmed LTF	0.5434
LAGN	LAGN	0.3570	Confirmed LTF	0.3570
CBM-W1	CBM-W1	0.7711	Confirmed LTF	0.7711

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
163042139	272125	ESS J339 ; R	CE	271337	DRESDEN ; R	CE	1	COMED_P7-1_138-L6101___-S_+_138-L7413__R-S-B	tower	280.0	123.3	125.73	DC	6.8

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
274836	EQUISTAR ; R	15.6407	50/50	15.6407
274849	CRESCENT ;1U	0.3168	50/50	0.3168
274851	PROVIDENC;RU	0.3263	50/50	0.3263
293771	O-035 E	11.8874	50/50	11.8874
916211	Z1-072 E	8.9958	50/50	8.9958
926821	AC1-168 C O1	1.3172	50/50	1.3172
926822	AC1-168 E O1	8.8396	50/50	8.8396
927201	AC1-214 C O1	0.6020	50/50	0.6020
927202	AC1-214 E O1	12.1283	50/50	12.1283
936511	AD2-066 C O1	39.5586	50/50	39.5586
936512	AD2-066 E O1	26.3724	50/50	26.3724
946541	AF1-318 C O1	10.6012	50/50	10.6012
946542	AF1-318 E O1	49.6327	50/50	49.6327
953201	J715 C	3.1216	PJM External (MISO)	3.1216
953202	J715 E	16.8884	PJM External (MISO)	16.8884
957751	AF2-069 C	0.4418	50/50	0.4418
957752	AF2-069 E	1.4257	50/50	1.4257
957761	AF2-070 C	0.6225	50/50	0.6225
957762	AF2-070 E	3.0220	50/50	3.0220
958341	AF2-128 C O1	2.8095	50/50	2.8095
958342	AF2-128 E O1	13.1534	50/50	13.1534
961651	AG1-005 C O1	30.1200	50/50	30.1200
961652	AG1-005 E O1	20.0800	50/50	20.0800
962721	AG1-121 C O1	7.3833	50/50	7.3833
962722	AG1-121 E O1	34.5407	50/50	34.5407
965671	AG1-435 C O1	5.0076	50/50	5.0076
965672	AG1-435 E O1	23.4444	50/50	23.4444
966081	AG1-477 C	5.4319	50/50	5.4319
966082	AG1-477 E	1.3665	50/50	1.3665
966101	**AG1-479 C (Withdrawn : 12/03/2020)**	**5.4319**	**50/50**	**5.4319**
966102	**AG1-479 E (Withdrawn : 12/03/2020)**	**1.3665**	**50/50**	**1.3665**
LGEE	LGEE	0.0126	Confirmed LTF	0.0126
CPLE	CPLE	0.0055	Confirmed LTF	0.0055
CBM-W2	CBM-W2	1.6128	Confirmed LTF	1.6128
NY	NY	0.0216	Confirmed LTF	0.0216
TVA	TVA	0.1470	Confirmed LTF	0.1470
O-066	O-066	0.2490	Confirmed LTF	0.2490

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
SIGE	SIGE	0.0117	Confirmed LTF	0.0117
CBM-S2	CBM-S2	0.2297	Confirmed LTF	0.2297
CBM-S1	CBM-S1	0.0342	Confirmed LTF	0.0342
G-007	G-007	0.0388	Confirmed LTF	0.0388
MEC	MEC	0.4465	Confirmed LTF	0.4465
LAGN	LAGN	0.2502	Confirmed LTF	0.2502

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
AC1-168	Kewanee-Streator	Active
AC1-214	Crescent Ridge	In Service
AD2-066	Mazon-Crescent Ridge	Active
AF1-318	Crescent Ridge-Corbin	Active
AF2-069	Crescent Ridge 138 kV	Active
AF2-070	Crescent Ridge 138 kV	Active
AF2-128	Crescent Ridge-Corbin 138 kV	Active
AG1-005	Corbin-Crescent Ridge 138 kV	Active
AG1-121	Crescent Ridge 138 kV	Active
AG1-435	Kewanee-Hennepin 138 kV	Active
AG1-477	Grundy County 34.5 kV	Active
AG1-479	Grundy County 34.5 kV II	Withdrawn
Z1-072	Crescent Ridge	In Service
J715	MISO	MISO

11.8 Contingency Descriptions

Contingency Name	Contingency Definition
Base Case	
EXT_P12:138:AMIL::MCCLEANCOUNTY:OGLESBY:1382	CONTINGENCY 'EXT_P12:138:AMIL::MCCLEANCOUNTY:OGLESBY:1382' / 10351 OPEN BRANCH FROM BUS 272017 TO BUS 348881 CKT 1 / 272017 MINONK ; 138 348881 4MINONK TAP 138 1 OPEN BRANCH FROM BUS 348880 TO BUS 348881 CKT 1 / 348880 4EL PASO 138 348881 4MINONK TAP 138 1 OPEN BRANCH FROM BUS 348881 TO BUS 348935 CKT 1 / 348881 4MINONK TAP 138 348935 4CORBIN 138 1 OPEN BRANCH FROM BUS 348854 TO BUS 348880 CKT 1 / 348854 4MCLEAN CO 138 348880 4EL PASO 138 1 OPEN BRANCH FROM BUS 349373 TO BUS 348880 CKT 1 / 349373 1EL PASO 34.5 348880 4EL PASO 138 1 OPEN BRANCH FROM BUS 349380 TO BUS 348880 CKT 1 / 349380 2EL PASO 69.0 348880 4EL PASO 138 1 END
COMED_P7-1_138-L6101___-S_+_138-L7413__R-S-A	CONTINGENCY 'COMED_P7-1_138-L6101___-S_+_138-L7413__R-S-A' / CONTINGENCY # 207 TRIP BRANCH FROM BUS 272521 TO BUS 926820 CKT 1 / STREATOR ; 138 AC1-168 TAP 138 TRIP BRANCH FROM BUS 271836 TO BUS 271241 CKT 1 / KEWANEE ;11 138 CRESCENT ; R 138 END
COMED_P7-1_138-L6101___-S_+_138-L7413__R-S-B	CONTINGENCY 'COMED_P7-1_138-L6101___-S_+_138-L7413__R-S-B' / CONTINGENCY # 207 TRIP BRANCH FROM BUS 965670 TO BUS 271835 CKT 1 / AG1-435 TAP 138 KEWANEE ;23 138 TRIP BRANCH FROM BUS 271836 TO BUS 271241 CKT 1 / KEWANEE ;11 138 CRESCENT ; R 138 END

12 Short Circuit Analysis

No breakers were identified as overdutied.

13 Affected Systems

13.1 MISO

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