For

Interconnection Customer: Delaware River Solar

Applicant: Rosario Giufre

5,000 kW Solar Generation System

39,49 Marycrest Road, Blooming Grove, NY 10950

Interconnection to Orange & Rockland Utilities

Central Division

Monroe Substation

13.2 kV Feeder 61-8-13

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1.0 INTRODUCTION

This report presents the analysis results of the Orange and Rockland Utilities ("Orange and Rockland" or the "Company") interconnection study based on the proposed interconnection and design submittal from the Interconnection Customer in accordance with the Company. The intent of this report is to assess this project's feasibility, determine its impact to the existing electric power system (EPS), determine interconnection scope and installation requirements, and determine costs associated with interconnecting the Interconnection Customer's generation to the Company's Electric Power System (EPS). This Coordinated Electric System Impact Review (CESIR) study; according to the New York State Standardized Interconnection Requirements (NYSSIR) Section I.C Step 6; identifies the scope, schedule, and costs specific to this Interconnection Customer's installation requirements.

2.0 EXECUTIVE SUMMARY

The total estimated planning grade cost of the work associated with the interconnection of the Interconnection Customer is **$532,494.**

The interconnection was found to be feasible with modifications to the existing Company EPS and operating conditions, which are described in detail in the body of this Study.

The study was performed between daylight hours of 0800-2000 hours.

3.0 COMPANY EPS PARAMETERS

Substation	Monroe
Transformer Name (list multiple where normally tied to common bus)	Bank #261
Transformer Peak Load (kW)	28,840
Contingency Condition Load, N-1 Criteria (kW) (as applicable)	n/a
Daytime Light Load (kW)	7,160
Generation: Total, Connected, Queued (kW)	11,715; 1,646; 10,069
Contingency Condition Generation: Total, Connected, Queued (kW)	n/a
Supply Voltage (kV)	69
Transformer Maximum Nameplate Rating (kVA)	50,000
Distribution Bus Voltage Regulation	Yes
Transmission GFOV Status	Not installed
Bus Tie	Open
Number of Feeders Served from this Bus	5

Connecting Feeder/Line	61-8-13
Peak Load on feeder (kW)	3,980
Daytime Light Load on Feeder (kW)	640
Feeder Primary Voltage at POI (kV)	13.2
Line Phasing at POI	1
Circuit distance from POI to substation	1.96 miles
Distance from POI to nearest 3-phase, (if applicable)	0.20 miles
Line Regulation	No
Line/Source Grounding Configuration at POI	Effective
Other Generation: Total, Connected, Queued Ahead (kW)	5,599; 556; 5,043

System Fault Characteristics without Interconnection Customer DG at POI with System Upgrades described in Section 6	
Interconnection Customer POI Location (Pole X/Y)	53359/48622
I 3-phase (3LLL)	4639 Amps
I Line to Ground (3I0)	4340 Amps
Z1 (100 MVA base)	0.03888 + j0.96514 [PU]
Z0 (100 MVA base)	0.07792 + j1.12632 [PU]

4.0 INTERCONNECTION CUSTOMER SITE

The Interconnection Customer is proposing a new primary service connection at a new customer location. The service voltage is 13.2 kV. The applicant proposes installing one Solar Generation System with AC power rating of 5,000 kW. The proposed solar project is interfaced with two (2) inverters and two (2) medium voltage transformers.

The proposed point of interconnection (POI) is on Feeder 61-8-13 supplied from Transformer Bank #261 at the Monroe substation. The POI is on a single-phase line section.

The study was performed between the hours of 0800-2000 hours.

The proposed 5,000 kW solar generation system consists of:

- 2 SUNGROW SG 3425 UD-MV Inverters each rated 3425 kVA (limited to 2,500 kVA) at 600 Volts AC.
- 2 Generator Step Up transformer, 3,425 kVA, grounded wye primary and wye secondary winding configuration, 13,200 primary volts, 600 secondary volts.

5.0 SYSTEM IMPACT ANALYSIS

The analysis was run at the rated project size in normal system configuration connected to the feeder 61-8-13. The following table shows the impact study results of 5,000 kW at 1.0 power factor project interconnecting to the distribution system.

#	Category	Criteria	Limit	Result
1	Voltage	Overvoltage	< 105% (ANSI C84.1)	Pass
	With the addition of the subject project the maximum voltage as modeled on the Feeder is 103.6% of nominal.			
2	Voltage	Undervoltage	> 95% (ANSI C84.1)	Pass
	With the addition of the subject project the minimum voltage as modeled on the Feeder is 101.6% of nominal.			
3	Voltage	Substation Regulation for Reverse Power	<100% minimum load criteria	Fail
	The total generation on Bank #261 is 11.71 MW. The minimum load on this substation bank is 8.81 MW. The generation to load ratio is 133.04%.			
4	Voltage	Feeder Regulation for Reverse Power	<100% Minimum load to generation ratio	n/a
	Not applicable (no feeder voltage regulation installed)			
5	Voltage	Fluctuation	<3% steady state from proposed generation on feeder	Pass
	The greatest voltage fluctuation on the feeder occurs at proposed project POI. The resulting fluctuation at the POI is 1.25% due to the proposed project.			
6	Voltage	Fluctuation	<5% steady state from aggregate DER on substation bus	Pass
	The maximum component voltage fluctuation on the system is 2.32% due to all generation output stepping from 0% to 100%.			
7	Voltage	Fluctuation	Regulator tap movement exceeds 1 position, generation change of 75% of nameplate rating does not result in voltage change > ½ the bandwidth of any feeder voltage regulating device.	n/a
	Not applicable (Study feeder has no voltage regulators)			
8	Voltage	Flicker	Screen H Flicker	Pass

#	Category	Criteria	Limit	Result
	The Pst for the location with the greatest voltage fluctuation is 0.04 and the emissions limit is 0.35.			
9	Equipment Ratings	Thermal (continuous current)	< 100% thermal limits assuming no load	Fail
	The subject generator's full output current is 218.69 A. The fuses at cmp 8243991 (size: 40k) and cmp 5297363 (size: 65k) are overloaded with the proposed project online.			
10	Equipment Ratings	Withstand (fault current)	<90% withstand limits	Pass
	CDG-00472 interconnecting to the O&R electric power system with the recommended grounding bank does not cause fault current to exceed the short current interrupting rating of the substation feeder breaker nor of the upstream reclosers.			
11	Protection	Unintentional Islanding	Unintentional Islanding Document & Company Guidelines	Fail
	The rating of subject project is 5.0 MW. The total generation, including the proposed interconnection of 5.0 MW, exceeds the 2/3 of the minimum feeder loading and substation loading. The generation to minimum load ratio for a possible feeder island is 468.20% and for a possible substation island is 133.04%. The power factor is above 99% at the possible islands for extended period of time. Also, no single inverter manufacturer makes up at least 2/3 of the total inverter capacity in the possible islands.			
12	Protection	Protective device coordination	Company Guidelines	Fail
	CDG-00472 will require an ORU owned recloser that coordinates with the 61-8-13 feeder breaker and upstream recloser. The project and O&R owned site recloser will not cause any issues with coordination of upstream distribution protection devices.			
13	Protection	Fault Sensitivity	Rated capabilities of EPS equipment	Fail
	CDG-00472 interconnecting to the O&R electric power system with the recommended grounding bank will not cause adverse issues with fault sensitivity.			
14	Protection	Ground Fault Detection	Reduction of reach > 10% (by Utility)	Fail
	CDG-00472 interconnecting to the O&R electric power system with the recommended grounding bank results in a maximum reduction of reach of 3.9% for 3 phase faults and 5.7% for phase to ground faults. This will have no adverse effects on protection device coordination. Without the grounding bank, the reduction of reach is 70.6% for phase to ground faults which is unacceptable. Grounding bank is mandatory. Refer to mitigations section for Grounding Transformer specifications.			
15	Protection	Overvoltage - Transmission System Fault	Company 3V0 criteria	Fail
	The generation to load ratio on the serving distribution system has not satisfied the Company's planning threshold in which transmission ground fault overvoltage become an electrical hazard due to the distribution source contribution. An evaluation of the existing EPS has been performed and it has been determined that protection mitigation methods are required.			

#	Category	Criteria	Limit	Result
16	Protection	Overvoltage - Distribution System Fault	< 138% voltage rise	Pass
	CDG-00472 interconnecting to the O&R electric power system with the recommended grounding bank results in a Ground Fault Overvoltage (GFOV) of 173% when islanded. A grounding bank is mandatory.			
17	Protection	Effective Grounding	IEEE C62.92.6 Coefficient of Grounding <0.8	Fail
	Based on IEEE C62.92.6 the definition of effective grounding is when the Coefficient of Grounding (CoG) is less than or equal to 0.8. CoG is defined as V L G(fault) /V L L(no fault). CoG without the grounding bank is 1.0 CoG with the recommended grounding bank is 0.58.			
18	SCADA	Required EMS Visibility for Generation Sources	Monitoring & Control Requirements	Yes
	The 5.0 MW subject project triggers the requirement for SCADA reporting to the Utility.			
19	Auto-Loop			Pass
	The study feeder 61-8-13 has no auto-loop connection.			

6.0 MITIGATIONS FOR SYSTEM IMPACT ANALYSIS FAILURES

Detail below is intended to provide sufficient information and clarity to give the Interconnection Customer an understanding to the relationship of costs and scope associated with the DER interconnection and the system modifications due to the DER impact. This includes any required EPS equipment upgrades. Where scope items are identified, associated labor, equipment rentals and indirect project support functions (such as engineering and project management) are intended and implied.

Upgrade Required	Failures Addressed
Convert the single-phase line section from cmp 5299470 to cmp 5900485 (approximately 1100 ft) to three-phase 477 AAC.	Construction to facilitate the interconnection
Upgrade station LTC controls	Reverse power flow at substation
Upgrade station metering	Reverse power flow at substation
Upgrade the fuses at cmp 8243991 and cmp 5297363 with higher size fuses, or replace them with electronic reclosers	Thermal overload
Grounding Bank Specifications	Ground Fault Overvoltage (GFOV)
Install electronic recloser	Monitoring & Control
Install primary metering cluster	Monitoring & Control
Design and Inspections	Monitoring & Control
Commissioning Time Post Installation & Monitoring	Monitoring & Control
Reclose Delay	Risk of islanding
Install 3V0 protection	Overvoltage - Transmission System Fault

Additional details on the scope of mitigations can be found below:

The Substation upgrades required to facilitate the proposed installation include the following:

- Upgrade station LTC controls to work properly with the reverse power flow.
- Upgrade the existing substation meter with a bi-directional meter.
- Install 3V0 protection at substation

The Distribution upgrades required to facilitate the proposed installation include the following:

- Convert the single-phase line section from cmp 5299470 to cmp 5900485 (approximately 1100 ft) to three-phase 477 AAC.
- Upgrade the fuses at cmp 8243991 and cmp 5297363 with higher size fuses, or replace them with electronic reclosers
- Install an electronic recloser at the POI
- Implement reclose delay on upstream protective devices to avoid reclosing into live island

Grounding Transformer Specifications:	
Zig-Zag or Y-Delta	Y-Delta
Delta Load (If Y-Delta configuration)	N/A
Delta Voltage (If Y-Delta configuration)	To be determined by developer
Voltage (Line-to-Line)	13.2 kV
Frequency	60 Hz
Basic Impulse Level (BIL)	To be determined by developer
Rated thermal current (worst case ground fault current through the grounding transformer) This is the transient value through the neutral. Also called Short-time neutral current.	388 Amps
Rated Time (withstand of rated thermal current) Also called short-time neutral current duration	10 seconds, minimum
Rated continuous current (3% of thermal or more conservative value). This is the steady state value through the neutral.	43.7 Amps
Resistor provided at Neutral Terminal	NO
If “Yes” please provide resistor value	NONE
Zero-Sequence Impedance (% or Ohms/Phase)	21.55 Ohms/Phase, +/- 10%
Minimum X0 / R0 Ratio	4
Coil Material	To be determined by developer
Insulation Class	To be determined by developer
Temperature Rise	To be determined by developer
NEMA Rating	To be determined by developer

This study was conducted based upon this facility being served by the interconnecting circuit during normal utility operating conditions. The terms, conditions, notification requirements, and other obligations of both the Company and the facility pertaining to disconnection of the facility are set forth in the applicable section(s) of the NYSSIR and the Interconnection Agreement that will be executed for the project(s) that were studied in this CESIR. Any change in system size and/or design is subject to the requirements of the NYSSIR, as well as supplemental documents developed by the Interconnection Technical Working Group and Interconnection Policy Working Group.

7.0 CONCEPTUAL COST ESTIMATE

The following items are a good faith estimate for the scope and work required to interconnect the project estimated under rates and schedules in effect at the time of this study in accordance with the most recent version of the NYSSIR.

Distribution Planning Grade Estimate

Upgrade Conductor from 3/0 ACSR to 477 ACSR (1-phase 1100ft)	$46,200
Install Conductor 477 ACSR (2-phases 1100ft)	$28,600
Install Recloser (1)	$80,000
Install Smart Cap (1)	$40,700
Install Junction Pole, Fuse Pole	$20,000
Install Primary Metering Cluster	$6,800
Commissioning Time Post Installation	$5,500
Submittal Review, Redbook Inspections	$5,000
SCADA Monitoring/Power Quality Metering	$40,000
Contingency (15%)	$40,920
Total Distribution Estimate	**$313,720**

Substation $3V_0$ installation

Engineering	$12,000
Design/Drafting	$10,500
Construction Administration	$7,840
Safety	$10,000
ECC	$10,400
OH Line	$23,520
Substation Operations - Electricians	$48,620
Substation Operations - Relay Techs	$38,000
Relays and/or Panels	$20,600
Connectors	$258
Control Wire & Misc - Stores	$8,500
Contingency (15%)	$28,536
Total Substation Estimate	**$218,774**

The total interconnection cost estimate: **$532,494.**

Notes:

1. These estimated costs are based upon the results of this study and are subject to change. All costs anticipated to be incurred by the Company are listed.
2. The Company will reconcile actual charges upon project completion and the Interconnection Customer will be responsible for all final charges, which may be higher or lower than estimated according to the NYSSIR I.C step 11.
3. This estimate does not include the following:
   - additional interconnection study costs, or study rework
   - additional application fees,
   - applicable surcharges,
   - property taxes,
   - overall project sales tax,
   - future operation and maintenance costs,
   - adverse field conditions such as weather and Interconnection Customer equipment obstructions,
   - extended construction hours to minimize outage time or Company's public duty to serve,
   - the cost of any temporary construction service, or
   - any required permits.
4. Cost adders estimated for overtime would be based on 1.5 and 2 times labor rates if required for work beyond normal business hours. Per Diems are also extra costs potentially incurred for overtime labor.

8.0 REVISION HISTORY

Revision	Date	Description of Revision
2.0	07/05/2023	Effective Grounding Protection and Coordination Study complete. Recommended Grounding Transformer Specifications provided.
1.0	08/23/2022	Initial document