For

Interconnection Customer: Delaware River Solar

Applicant: Rosario Giufre

4110 kW Solar Generator System
State Highway 17A & 94, Warwick NY 10990

Interconnection to Orange & Rockland Utilities

NY Central Division

Wisner Substation

13.2 kV Feeder 80-1-13

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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 CESIR Study Requirements Rev. 1.6. 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 **$498,926.**

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 hrs.

3.0 COMPANY EPS PARAMETERS

Substation	**Wisner**
Transformer Name (list multiple where normally tied to common bus)	280
Transformer Peak Load (kW)	20975.4
Contingency Condition Load, N-1 Criteria (kW) (as applicable)	N/A
Daytime Light Load (kW)	7882
Generation: Total, Connected, Queue (kW)	22847, 5675, 17172
Contingency Condition Generation: Total, Connected, Queue (kW)	N/A
Supply Voltage (kV)	69
Transformer Maximum Nameplate Rating (kVA)	25000
Distribution Bus Voltage Regulation	Non-LTC
Transmission GFOV Status	Not Installed
Bus Tie	Open
Number of Feeders Served from this Bus	3

Connecting Feeder/Line	**80-1-13**
Peak Load on feeder (kW)	N/A
Daytime Light Load on Feeder (kW)	1572.83
Feeder Primary Voltage at POI (kV)	13.2
Line Phasing at POI	3
Circuit distance from POI to substation	5.82 miles
Distance from POI to nearest 3-phase, (if applicable)	N/A
Line Regulation	N
Line/Source Grounding Configuration at POI	Effective
Other Generation: Total, Connected, Queue (kW)	10188, 1078, 9110

System Fault Characteristics without Interconnection Customer DG at POI with System Upgrades described in Section 6	
Interconnection Customer POI Location (Pole X/Y)	49358/47669
I 3-phase (3LLL)	1859 Amps
I Line to Ground (3I0)	1266 Amps
Z1 (100 MVA base)	0.71994 + j 2.6591 PU
Z0 (100 MVA base)	1.11112 + j4.87321 PU

4.0 INTERCONNECTION CUSTOMER SITE

The Interconnection Customer is proposing a new primary service connection at a new customer location.

The proposed generating system consists of:

- 13,104 PV panels each rated 535 Watts.
- 2 Inverter derated to 2,055 kW at 600 Volts (SUNGROW, SG 3425 UD-MV)
- 2 Generator Step Up transformer, 3,425 kVA, YG-Y winding configuration, 13,200 primary volts, 600 secondary volts.

There is a Transmission Right-of-Way located through the site in which the proposed project is to be installed. The easement rights restricts any building and obstructions within a 50 foot boundary of 25 feet on either side of the line. The PV installation and any associated equipment must not be located within ORU's 50 foot easement. The applicant should review the property deed and any associated public records to determine if any easements are encumbered by the project.

5.0 SYSTEM IMPACT ANALYSIS

The analysis was run at the rated project size in normal system configuration connected to the feeder 80-1-13. The following table shows the impact study results of 4110 kW at unity power factor project interconnecting to the distribution system.

#	Category	Criteria	Limit	Result
1	Voltage	Overvoltage	< 105% (ANSI C84.1)	Fail
	With the addition of the subject generator the maximum voltage as modeled on the Feeder is 106% of nominal.			
2	Voltage	Undervoltage	> 95% (ANSI C84.1)	Pass
	With the addition of the subject generator the minimum voltage as modeled on the Feeder is 101% of nominal.			
3	Voltage	Substation Regulation for Reverse Power	<100% minimum load criteria	Fail
	The total generation on the project Bank 280 is 22.85 MW. The total minimum load on the Bank is 7.88 MW. Therefore, the generation to load ratio is 289.86%.			
4	Voltage	Feeder Regulation for Reverse Power	<100% Minimum load to generation ratio	Pass
	Not applicable (no feeder voltage regulators upstream of the subject project).			
5	Voltage	Fluctuation	<3% steady state from proposed generation on feeder	Pass
	The greatest voltage fluctuation on the feeder occurs at proposed project point of interconnection (POI). The resulting fluctuation at the feeder location is 2.25% due to this project's generation output stepping from 0% to 100%.			
6	Voltage	Fluctuation	<5% steady state from aggregate DER on substation bus	Fail
	The maximum component voltage fluctuation on the system is 5.401% 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.	Fail
	The greatest voltage fluctuation on the feeder occurs at Switchable Cap Bank. The resulting fluctuation at the feeder location is 3.03V due to the proposed generation and the voltage fluctuation limit is 2V.			

8	Voltage	Flicker	Screen H Flicker	Pass
	The Pst for the location with the greatest voltage fluctuation is 0.12 and the emissions limit is 0.35.			
9	Equipment Ratings	Thermal (continuous current)	< 100% thermal limits assuming no load	Pass
	The subject generator's full output current is 179.77 A. No equipment is overloaded when the proposed project is connected to the system.			
10	Equipment Ratings	Withstand (fault current)	<90% withstand limits	Pass
	CDG-00506 interconnecting to the O&R electric power system with the recommended grounding bank with neutral grounding resistor does not cause fault current to exceed the short current interrupting rating of the substation feeder breaker nor of the upstream recloser. This is also true when connected to the 63-8-13 via autoloop.			
11	Protection	Unintentional Islanding	Unintentional Islanding Document & Company Guidelines	Fail
	The subject generator is a 4.11 MW PV generation system. The study fails step 4 of the SANDIA Anti-Islanding Screen.			
12	Protection	Protective device coordination	Company Guidelines	Pass
	CDG-00506 will require an ORU owned recloser that coordinates with the 80-1-13 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. This is also true when connected to the 63-8-13 via autoloop.			
13	Protection	Fault Sensitivity	Rated capabilities of EPS equipment	Pass
	CDG-00506 interconnecting to the O&R electric power system with the recommended grounding bank with neutral grounding resistor will not cause adverse issues with fault sensitivity.			
14	Protection	Ground Fault Detection	Reduction of reach > 10% (by Utility)	Fail
	CDG-00506 interconnecting to the O&R electric power system with the recommended grounding bank with neutral grounding resistor results in a maximum reduction of reach of 2% for 3 phase faults and 8.4% for phase to ground faults. The grounding bank with neutral grounding resistor is mandatory.CDG-00506 interconnecting to the O&R electric power system with the recommended grounding bank with neutral grounding resistor has no effect on the reduction of reach while connected to the alternate circuit 63-8-13. Refer to mitigations section for grounding bank with neutral grounding resistor specifications.			
15	Protection	Overvoltage - Transmission System Fault	Company 3V0 criteria	Fail
	The generation to load ratio on the serving distribution system has failed 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.			

16	Protection	Overvoltage - Distribution System Fault	< 138% voltage rise	Pass
	CDG-00506 interconnecting to the O&R electric power system with the recommended grounding bank with neutral grounding resistor results in a Ground Fault Overvoltage (GFOV) of 132% when islanded. GFOV while islanded on the alternate circuit 63-8-13 is also 132%.			
17	Protection	Effective Grounding	IEEE C62.92.6 Coefficient of Grounding <0.8	Pass
	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 with the recommended grounding bank with neutral grounding resistor is 0.76 on the 80-1-13 and 0.76 when connected to the alternate circuit 63-8-13.			
18	SCADA	Required EMS Visibility for Generation Sources	Monitoring & Control Requirements	Yes
	The 4.110 MW subject generator triggers the requirement for SCADA reporting to the Utility.			
19	Auto-Loop or Other			Fail
	CDG-00506 cannot stay online while feeder 63-8-13 picks up load from 80-1-13. Overvoltage was observed on autoloop feeder upon interconnection of the project. Additionally, fails on Screen 7.			

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
• 3V0 protection and reverse power capability are needed at substation.	Substation Regulation for Reverse Power;
• The 4110 kW generation needs to be reduced to 3850 kW and must enable Voltage Reactive Power Control (Volt-Var) in accordance with O&R Smart Inverter Settings	Overvoltage Violations; Voltage Fluctuation Violations;
• Reclose Delay - Implement reclose delay on upstream protective devices to avoid reclosing into live island	Risk of Islanding
• Install primary metering at PCC	Monitoring and control
• Install electronic recloser at PCC	Monitoring and control
• SCADA communications and reporting for proposed DG site	Monitoring and control
• Grounding Bank Specifications	Reduction of Reach for protective devices, Transient Overvoltage

Additional details on the scope of each option can be found below:

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

- Install 3V0 protection.
- Reverse power flow capability needs to be addressed.
- Upgrade existing substation meter with bi-directional meter.

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

- The 4110 kW generation needs to be reduced to 3850 kW and must enable Voltage Reactive Power Control (Volt-Var) in accordance with O&R Smart Inverter Settings.
- Install electronic recloser at the PCC.
- Install four (4) RTU capacitors.
- Implement reclose blocking on upstream protective devices to avoid reclosing into live island.

Grounding Transformer Specifications:	
Zig-Zag or Y-Delta	To be determined by developer
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.	236 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.	33.7 Amps
Resistor provided at Neutral Terminal	YES
If “Yes” please provide resistor value	10 Ohms
Zero-Sequence Impedance (% or Ohms/Phase)	27.99 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

Refer to Section 4 of this CESIR Report for Transmission Right-of-Way stipulations.

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.

Planning Grade Estimate

Description	Estimate
Install 477 ACSR (3 phase, 150 feet)	$5,850
Install Recloser (1)	$80,000
Install RTU Capacitor (4)	$162,800
Install Junction Pole	$10,000
Install Primary Metering Cluster	$6,800
Commissioning Time Post Installation	$5,500
Design and Inspections	$5,000
SCADA Monitoring/Power Quality Meter	$40,000
Contingency (15%)	$47,393
Total Distribution Estimate	**$363,343**

Substation Costs: $3V_0$ installation

Description	Estimate
Engineering	$12,000
Design/Drafting	$10,500
ECC	$10,400
OH Line	$23,520
Substation Operations - Electricians	$29,920
Substation Operations - Relay Techs	$22,800
Connectors	$258
Control Wire & Misc. - Stores	$8,500
Contingency (15%)	$17,685
Total Substation Estimate	**$135,583**

The total interconnection cost estimate: **$363,343 + $135,583 = $498,926**

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	07/18/2023	Effective Grounding Protection and Coordination Study complete. Recommended Grounding Transformer Specifications provided.
1.0	03/22/2023	Initial document