For

Interconnection Customer: Delaware River Solar

Applicant: Jessina Riano

2253 kW Solar Generator System

18 O'Haire Road, Wallkill NY 10941

Interconnection to Orange & Rockland Utilities

NY Western Division

East Wallkill Substation

13.2 kV Feeder 15-6-13

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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 **$2,587,678.**

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	East Wallkill
Transformer Name (list multiple where normally tied to common bus)	215
Transformer Peak Load (kW)	N/A
Contingency Condition Load, N-1 Criteria (kW) (as applicable)	N/A
Daytime Light Load (kW)	-1008
Generation: Total, Connected, Queue (kW)	13232, 5513, 7719
Contingency Condition Generation: Total, Connected, Queue (kW)	N/A
Supply Voltage (kV)	69
Transformer Maximum Nameplate Rating (kVA)	35000
Distribution Bus Voltage Regulation	LTC
Transmission GFOV Status	Not installed
Bus Tie	Open
Number of Feeders Served from this Bus	3

Connecting Feeder/Line	15-6-13
Peak Load on feeder (kW)	7770
Daytime Light Load on Feeder (kW)	-350
Feeder Primary Voltage at POI (kV)	13.2
Line Phasing at POI	3
Circuit distance from POI to substation	4.07 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)	11109, 3856, 7253

System Fault Characteristics without Interconnection Customer DG at POI with System Upgrades described in Section 6	
Interconnection Customer POI Location (Pole X/Y)	50745/53865
I 3-phase (3LLL)	2358 Amps
I Line to Ground (3I0)	1473 Amps
Z1 (100 MVA base)	0.48136 + j1.85612 PU
Z0 (100 MVA base)	1.10114 + j4.79151 PU

4.0 INTERCONNECTION CUSTOMER SITE

The Interconnection Customer is proposing a new primary service connection at a new customer location. The primary voltage at the POI is currently 4.8kV 3-phase. This will need to be upgraded to 13.2kV 3-phase.

The proposed generating system consists of:

- 5,928 PV modules each rated 535 Watts.
- 1 Inverters derated to 2253 kW at 600 Volts (SUNGROW, SG 3425 UD-MV)
- 1 Generator Step Up transformer, 3425 kVA, YG-Y 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 15-6-13. The following table shows the impact study results of 2253 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 generator the maximum voltage as modeled on the Feeder is 105% 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 102% of nominal.			
3	Voltage	Substation Regulation for Reverse Power	<100% minimum load criteria	Fail
	The total generation on the project Bank #215 is 13.23 MW. The total minimum load on the Bank is -1.01MW. Therefore, the generation to load ratio is -1312.89%.			
4	Voltage	Feeder Regulation for Reverse Power	<100% Minimum load to generation ratio	Fail
	Reverse power observed through voltage regulators UID 1621305, 3P 219A & UID 1628873, 3P 219A 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 1.50% due to this project's generation output stepping from 0% to 100%.			
6	Voltage	Fluctuation	<5% steady state from aggregate DER on substation bus	Pass
	The maximum component voltage fluctuation on the system is 2.178% 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.	Pass
	Not applicable (no voltage regulators on the study feeder).			

#	Category	Criteria	Limit	Result
8	Voltage	Flicker	Screen H Flicker	Pass
	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 98.5 A. Fuse 6091113 & Fuse 6091744 is overloaded when the proposed project is connected to the system.			
10	Equipment Ratings	Withstand (fault current)	<90% withstand limits	Pass
	CDG-00502 with the recommended grounding transformer interconnecting to the O&R electric power system does not cause fault current to exceed the short current interrupting rating of the substation feeder breaker (19.3kA) nor of the upstream reclosers (12.5kA).			
11	Protection	Unintentional Islanding	Unintentional Islanding Document & Company Guidelines	Fail
	The subject generator is a 2.253 MW PV generation system. The study fails Step 1 and Step 4 of the SANDIA Anti-Islanding Screen.			
12	Protection	Protective device coordination	Company Guidelines	Fail
	CDG-00502 with the recommended grounding transformer will require an ORU owned recloser that coordinates with the 15-6-13 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	Pass
	CDG-00502 with the recommended grounding transformer interconnecting to the O&R electric power system will not cause adverse issues with fault sensitivity.			
14	Protection	Ground Fault Detection	Reduction of reach > 10% (by Utility)	Fail
	CDG-00502 with the recommended grounding transformer interconnecting to the O&R electric power system has no adverse effects on reduction of relay reach. For the normal circuit configuration reduction of reach is 4.8% for the substation phase relay and 4.3% for the substation ground relay. For the alternate circuit configuration reduction of reach is 0% for the substation phase relay and 4.72% for the substation ground relay.			
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.			

#	Category	Criteria	Limit	Result
16	Protection	Overvoltage - Distribution System Fault	< 138% voltage rise	Fail
	CDG-00502 with the recommended grounding transformer interconnecting to the O&R electric power system results in a Ground Fault Overvoltage (GFOV) of 137% when islanded in normal configuration. Without the grounding transformer this increases to 173%. A grounding transformer is mandatory.			
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 without supplemental grounding is 1.0 in the alternate circuit configuration. CoG with the grounding bank reduces to 0.796. A grounding transformer is mandatory.			
18	SCADA	Required EMS Visibility for Generation Sources	Monitoring & Control Requirements	Yes
	The 2.253 MW subject generator triggers the requirement for SCADA reporting to the Utility.			
19	Auto-Loop or Other			Pass
	The study feeder 15-6-13 has an alternate configuration causing a loss of load when mid-point recloser 49296/54022 locks out. No adverse effects were identified provided CDG-00502 uses a grounding transformer.			

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; Overvoltage - Transmission System Fault
• Reverse power capability is needed for voltage regulators UID 1621305 & UID 1628873 upstream of the subject project.	Project Feeder Regulation for Reverse Power;
• Upgrade fuse 6091113 & fuse 6091744 to 200A.	Thermal (Continuous current)
• Operate at CDG-00502 at 2253kW and must enable Voltage Reactive Power Control (Volt-Var) in accordance with O&R Smart Inverter Settings	O&R Requirements
• Implement reclose delay on upstream protective devices to avoid reclosing into live island	Risk of Islanding
• Install grounding bank per specifications	Ground fault overvoltage (GFOV), effective grounding
• 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

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:

- Upgrade the POI voltage from 4.8kV to 13.2kV.
  - Shift the Step Transformer (UID: 6053283) from cmp 6092072 to cmp 2321305.
  - Reconductor 13000 feet of 3-ph Conductor to 477 AAC, from cmp 6112231 to cmp 2250497. Install 150 feet of new 3-ph conductor
- Reverse power flow capability needs to be addressed for voltage regulators 1621305 & 1628873.
- Operate at CDG-00502 at 2253kW and must enable Voltage Reactive Power Control (Volt-Var) in accordance with O&R Smart Inverter Settings
- Upgrade fuse 6091113 & fuse 6091744 to 200A.
- Install electronic recloser at the PCC.
- Implement reclose delay 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)	13.2kV
Frequency	60Hz
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.	253 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.	19.7 Amps
Resistor provided at Neutral Terminal	YES
If “Yes” please provide resistor value	5 Ohms
Zero-Sequence Impedance (% or Ohms/Phase)	47.83 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.

Planning Grade Estimate

Description	Cost
Upgrade existing Conductor to 477 (13000ft, 3-phase)	$1,638,000
Install new 477 Conductor (150ft, 3-phase)	$5,850
Install Recloser (2)	$160,000
Junction Pole, 20 Distribution Transformers, Stepdown Transformer, Upgrade voltage regulators to 13.2kV	$190,000
Primary Metering Cluster	$6,800
Commissioning Time Post Installation	$5,500
Submittal Review, Redbook development, Site Inspections	$5,000
SCADA Monitoring/Power Quality Meter	$40,000
Contingency (15%)	$307,673
Total Distribution Estimate	**$2,358,823**

Substation Costs: $3V_0$ installation

Description	Cost
Engineering, Design, Drafting, Admin	$80,020
Labor	$71,680
Material	$47,304
Contingency (15%)	$29,851
Total Substation Estimate	**$228,855**

The total interconnection cost estimate: $2,358,823 + $228,855 = **$2,587,678**

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
1.0	04/20/2023	Initial document
2.0	08/25/2023	Revised EGPC results and Grounding Bank Specifications