For

Interconnection Customer: Delaware River Solar

Applicant: Rosario Giufre

5000 KW Solar Generator System

129 Old Ridge Road, Warwick NY 10990

Interconnection to Orange & Rockland Utilities

NY Central Division

Wisner 69KV Substation

13.2 kV Feeder 80-1-13

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1. 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. 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 08:00-20:00 hrs.

3. COMPANY EPS PARAMETERS

Substation	**Wisner**
Transformer Name (list multiple where normally tied to common bus)	Bank 280
Transformer Peak Load (kW)	20990
Contingency Condition Load, N-1 Criteria (kW) (as applicable)	N/A
[Daytime, 12 hours] Light Load (kW)	3720
Generation: Total, Connected, Queued Ahead (kW)	18600, 5370, 13230
Contingency Condition Generation: Total, Connected, Queued Ahead (kW)	N/A
Supply Voltage (kV)	69
Transformer Maximum Nameplate Rating (kVA)	25000
Distribution Bus Voltage Regulation	N
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)	4880
[Daytime, 12 hours] Light Load on Feeder (kW)	970
Feeder Primary Voltage at POI (kV)	13.2

Line Phasing at POI	3
Circuit distance from POI to substation	5.46 mile(s)
Distance from POI to nearest 3-phase, (if applicable)	0.0 miles
Line Regulation	N
Line/Source Grounding Configuration at POI	effective
Other Generation: Total, Connected, Queued Ahead (kW)	5956, 956, 5000

System Fault Characteristics without Interconnection Customer DG at POI with System Upgrades described in Section 6	
Interconnection Customer POI Location (Pole X/Y)	Pole# 85/89: 129 Old Ridge Road, Warwick NY 10990
I 3-phase (3LLL)	1894 Amps
I Line to Ground (3I0)	1813 Amps
Z1 (100 MVA base)	1.1637 + j4.4836 PU
Z0 (100 MVA base)	1.4672 + j4.5534 PU

4. 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 80-1-13 supplied from Transformer Bank #280 at the Wisner substation. The POI is on a three-phase line section.

The proposed generating system consists of:

- 10,608 PV modules each rated 535 Watts
- 2 Inverters each rated 2,500 KW at 600 Volts (SUNGROW, SG3425UD-MV)
- 2 Generator Step Up transformer(s), 3420 kVA, YG-Y winding configuration, 13.2 KV primary volts, 600 V secondary volts.

5. 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 5000 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 99% of nominal.			
3	Voltage	Substation Regulation for Reverse Power	<100% minimum load criteria	Fail
	The total generation on Feeders 80-1-13, 80-2-13, 80-3-13 is 18.60 MW. The total minimum load on these Feeders is 3.73 MW. Therefore, the generation to load ratio is 499%.			
4	Voltage	Feeder Regulation for Reverse Power	<100% Minimum load to generation ratio	Pass
	There is no line regulator on the project circuit.			
5	Voltage	Fluctuation	<3% steady state from proposed generation on feeder	Pass
	The greatest voltage fluctuation on the feeder occurs at: The resulting fluctuation at the feeder location is 2.17% 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 0.732% 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
	No voltage fluctuation observed.			
8	Voltage	Flicker	Screen H Flicker	Pass
	The Pst for the location with the greatest voltage fluctuation is 0.09 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 218.7 A. No thermal limits are exceeded			
10	Equipment Ratings	Withstand (fault current)	<90% withstand limits	Pass
	The additional fault current contribution from the generation contributes 7.27% to interrupting ratings in excess of existing EPS equipment.			
11	Protection	Unintentional Islanding	Unintentional Islanding Document & Company Guidelines	Fail
	The subject generator is a 5000 MW PV generation system. Failed at Steps 1 & 2 for midline recloser. • Implement Reclose Delay to avoid the possibility of an Island			
12	Protection	Protective device coordination	Company Guidelines	Fail
	Project will require a recloser that coordinates with the feeder breaker and upstream reclosers. A detailed protection study is required to evaluate the protection coordination impact due to fault current increase by the proposed project. **Update:** Project CDG-00471 will require a recloser that coordinates with the feeder breaker and upstream reclosers. 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
	A detailed protection study is required to determine if fault contribution is above the allowed limit of 10%. **Update:** Project CDG-00471 interconnecting to the O&R electric power system with the recommended grounding transformer will not cause any adverse effects to fault sensitivity of upstream distribution protection devices. The additional fault current contribution from the generation does not contribute to interrupting ratings in excess of existing EPS equipment. The grounding transformer (500KVA, Z=6.18%, X/R =4) must connect to the secondary 480V side of the GSU transformer.			
14	Protection	Ground Fault Detection	Reduction of reach > 10% (by Utility)	Pass
	The Interconnection Customer has proposed a ground resistance (Rg) at least 25 Ohms. The utility will verify the size of the grounding transformers and evaluate the feeder breaker relay settings for reduction of reach by conducting a detailed protection study. **Update:** Project CDG-00471 interconnecting to the O&R electric power system with the recommended grounding transformer will cause a reduction of reach for the 80-1-2k relay of 4.9% for a line to ground fault. This will have no adverse effects on protection device coordination. To be within company guidelines a 500 KVA grounding bank with an impedance of 6.18% and an X/R ratio of 4 shall connect to the DER side of the generating step-up transformer (secondary side).			
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
	With subject generator interconnected the modeled voltage rise on the un-faulted phases of the system is 239%. **Update:** Project CDG-00471 interconnecting to the O&R electric power system with the recommended grounding transformer will cause a maximum ground fault overvoltage (GFOV) of 0.87 per unit			
17	Protection	Effective Grounding	IEEE 142 (0<R0/X1<1; 0<X0/X1<3)	Pass
	With subject generator interconnected the modeled R0/X1 is 0.33 PU and the X0/X1 is 1.02 PU **Update:** Project CDG-00471 interconnecting to the O&R electric power system with the recommended grounding transformer, the modeled R0/X1 is 0.66 PU and the X0/X1 is 3.08 PU. However, based on IEEE C62.92.6 the definition of effective grounding is when the Coefficient of grounding being less than or equal to 0.8. Coefficient Of Grounding (CoG) is defined as V_{L-G}(fault)/V_{L-L}(no fault). CoG for Project CDG-00471 interconnecting to the O&R electric power system with the recommended grounding transformer is 0.67.			
18	SCADA	Required EMS Visibility for Generation Sources	Monitoring & Control Requirements	Yes
	The 5000 MW subject generator triggers the requirement for SCADA reporting to the Utility.			
19	Auto-Loop or Other			Yes
	This project is on an autoloop. If a fault occurs between the Wisner substation and 80-1 SR 49334/47212 this SR will lockout. TR 49391/48306 will close thus feeding CDG471 from Chester 63-8.			

6. 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	Failed Screens After Interconnection to Circuit 80-1-13
Upgrade substation components to handle reverse power flow	Substation Regulation for Reverse Power

Install reclose delay to avoid possibility of the islanding	Protection, Unintentional Islanding
Install 3V0 control for substation components	Protection, Overvoltage - Transmission System Fault (Company 3V0)
Install electronic recloser	Monitoring & Control
Install SCADA monitoring and control for communications and reporting for proposed DG site	SCADA, Required EMS Visibility for Generation Sources
Install primary metering cluster at PCC	Monitoring and Control
500 KVA grounding bank with an impedance of 6.18% and an X/R ratio of 4 shall connect to the DER side of the generating step-up transformer (secondary side).	Fault Sensitivity, Ground Fault Detection, Overvoltage - Distribution System Fault, Effective Grounding

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

Option 1:

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

- Install 3V0 protection to feeder breaker to work with existing 3V0 protection installed at substation
- Upgrade existing substation meter with bi-directional meter
- Upgrade Bank 280 components to support reverse flow

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

- Operate the CDG-00471 project at unity power factor producing maximum output of 5000 KW AC
- Install electronic recloser at PCC
- Install primary metering at PCC
- A detailed grounding and protection study is required to evaluate sensitivity, reduction of reach, protection coordination, and effective grounding
- Install Reclose Delay to avoid the possibility of an Island
- Power Quality Metering

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. 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	Option 1
Installing Conductor 477 (150ft)	$5,850
Installing Recloser	$80,000
Installing Smart Capacitors (4)	$162,800
Installing Junction Pole	$10,000
Installing 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: the following table shows the costs for $3V_0$ installation

Description	Cost
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:

Option 1 is **$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. REVISION HISTORY

Revision	Date	Description of Revision
1.0	08/01/2022	Initial document
2.0	08/03/2022	Corrected autoloop info
3.0	09/09/2022	Updated Screens 12, 13, 14, 16, 17 with EGPC info