For

Interconnection Customer: Delaware River Solar, LLC

Applicant: Rosario Giufre

3,000 kW Solar Generation System

50 Barone Road Farm, Wurtsboro NY 12790

Interconnection to Orange & Rockland Utilities

NY Western Division

Cuddebackville Substation

34.5 kV Feeder 5-3-34

and

Future Wurtsboro Substation

Future 13.2 kV Feeder 9-2-13

TABLE OF CONTENTS

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 **$285,086.50**

Remainder Due = **$0**

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

3.1 Current System Configuration

Substation	Cuddebackville
Transformer Name (list multiple where normally tied to common bus)	Bank 15
Transformer Peak Load (kW)	20,250
Contingency Condition Load, N-1 Criteria (kW) (as applicable)	n/a
Daytime Light Load (kW)	8,190
Generation: Total, Connected, Queued (kW)	14,720; 2,855; 11,867
Contingency Condition Generation: Total, Connected, Queued (kW)	n/a
Supply Voltage (kV)	69
Transformer Maximum Nameplate Rating (kVA)	35,000
Distribution Bus Voltage Regulation	Yes
Transmission GFOV Status	Not installed
Bus Tie	Closed
Number of Feeders Served from this Bus	3

Connecting Feeder/Line	5-3-34
Peak Load on feeder (kW)	9,820
Daytime Light Load on Feeder (kW)	3,400
Feeder Primary Voltage at POI (kV)	34.5
Line Phasing at POI	3
Circuit distance from POI to substation	12.45 miles
Distance from POI to nearest 3-phase, (if applicable)	n/a
Line Regulation	No
Line/Source Grounding Configuration at POI	Effective
Other Generation: Total, Connected, Queued (kW)	3,354; 291; 3,063

System Fault Characteristics without Interconnection Customer DG at POI with System Upgrades described in Section 6	
Interconnection Customer POI Location (Pole X/Y)	50 Barone Road Farm, Wurtsboro, NY 12790 Pole: 46337/58180
I 3-phase (3LLL)	1,566 Amps
I Line to Ground (3I0)	1,529 Amps
Z1 (100 MVA base)	0.3399 + j1.0898 [p.u.]
Z0 (100 MVA base)	0.4003 + j1.0776 [p.u.]

3.2 Future System Configuration

Substation	Future Wurtsboro
Transformer Name (list multiple where normally tied to common bus)	Future Bank 29
Transformer Peak Load (kW)	1,990
Contingency Condition Load, N-1 Criteria (kW) (as applicable)	n/a
Daytime Light Load (kW)	690
Generation: Total, Connected, Queued (kW)	3,178; 178; 3,000
Contingency Condition Generation: Total, Connected, Queued (kW)	n/a
Supply Voltage (kV)	34.5
Transformer Maximum Nameplate Rating (kVA)	20,000
Distribution Bus Voltage Regulation	Yes
Transmission GFOV Status	Not installed
Bus Tie	Closed
Number of Feeders Served from this Bus	2

Connecting Feeder/Line	Future 9-2-13
Peak Load on feeder (kW)	390
Daytime Light Load on Feeder (kW)	140
Feeder Primary Voltage at POI (kV)	13.2
Line Phasing at POI	3
Circuit distance from POI to substation	2.38 miles
Distance from POI to nearest 3-phase, (if applicable)	n/a
Line Regulation	No
Line/Source Grounding Configuration at POI	Effective
Other Generation: Total, Connected, Queued (kW)	3,000; 0; 3,000

System Fault Characteristics without Interconnection Customer DG at POI with System Upgrades described in Section 6	
Interconnection Customer POI Location (Pole X/Y)	50 Barone Road Farm, Wurtsboro, NY 12790 Pole: 46337/58180
I 3-phase (3LLL)	1,521 Amps
I Line to Ground (3I0)	1,403 Amps
Z1 (100 MVA base)	1.2333 + j2.7665 [p.u.]
Z0 (100 MVA base)	0.9215 + j3.6565 [p.u.]

4.0 INTERCONNECTION CUSTOMER SITE

The Interconnection Customer is proposing a new primary service connection at a new customer location. The service voltage is 34.5 kV. The applicant proposes installing one Solar Generation System with AC power rating of 3,000 kW. The proposed solar project is interfaced with one (1) inverter and one (1) medium voltage transformer.

The proposed point of interconnection (POI) is on Feeder 5-3-34 supplied from Transformer Bank #15 at the Cuddebackville substation in the current configuration. The proposed project will be connected to Feeder 9-2-13 supplied from Transformer Future Bank #29 at the Future Wurtsboro substation in the future configuration. The POI is on a three-phase line section in both the system configurations.

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

The proposed 3,000 kW solar generation system consists of:

- One (1) SUNGROW SG 3425 UD-MV Inverter (limited to 3,000 kW) at 600 Volts AC.
- One Generator Step Up transformer, 3,425 kVA, grounded wye primary and wye secondary winding configuration, 34,500 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 5-3-34. The following table shows the impact study results of 3,000 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 103.5% of nominal.			
2	Voltage	Undervoltage	> 95% (ANSI C84.1)	Fail
	With the addition of the subject project the minimum voltage as modeled on the Feeder is 85.1% of nominal. These low voltage violations are pre-existing.			
3	Voltage	Substation Regulation for Reverse Power	<100% minimum load criteria	Fail
	The total generation on Bank #15 is 14.72 MW. The minimum load on this substation bank is 8.19 MW. The generation to load ratio is 179.74%.			
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 0.83% due to the proposed project.			
6	Voltage	Fluctuation	<5% steady state from aggregate DER on substation bus	Fail
	The maximum component voltage fluctuation on the system is 8.80% 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
	There are two voltage regulators on the study feeder. The maximum voltage fluctuation is 3.09 V which is greater than the 1/2 BW limit of 2 V of the respective voltage regulator.			
8	Voltage	Flicker	Screen H Flicker	Pass
	The Pst for the location with the greatest voltage fluctuation is 0.032 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 50.20 A. There will be no thermal overload on the upstream devices.			
10	Equipment Ratings	Withstand (fault current)	<90% withstand limits	Pass
	CDG-00419 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.			
11	Protection	Unintentional Islanding	Unintentional Islanding Document & Company Guidelines	Fail
	The rating of subject project is 3 MW. The total generation, including the proposed interconnection of 3 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 98.64% and a possible substation island is 179.74%. Also, no single inverter manufacturer makes up at least 2/3 of the total inverter capacity in the possible substation island.			
12	Protection	Protective device coordination	Company Guidelines	Fail
	CDG-00419 will require an ORU owned recloser that coordinates with the feeder breaker 3-5-2. 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-00419 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)	Pass
	CDG-00419 interconnecting to the O&R electric power system with the recommended grounding transformer results in a maximum reduction of reach of 0.4% for 3 phase faults and 0.8% for phase to ground faults. This will have no adverse effects on protection device coordination. For future feeder 9-2-13, there will be a maximum reduction of reach of 0.8% for 3 phase faults and 3.7% for phase to ground faults. This will have no adverse effects on future protection device coordination.			
15	Protection	Overvoltage - Transmission System Fault	Company 3V0 criteria	Pass
	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. Primary side of Bank #15 is Yg and will not require 3V0 protection. An evaluation of the existing EPS has been performed and it has been determined that protection mitigation methods are not required.			
16	Protection	Overvoltage - Distribution System Fault	< 138% voltage rise	Fail
	CDG-00419 interconnecting to the O&R electric power system **without** the recommended grounding transformer results in a Ground Fault Overvoltage (GFOV) of 173% when islanded. The recommended grounding transformer 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 transformer is 1.00. CoG with the recommended grounding transformer is 0.54. Refer to mitigations section for grounding transformer specifications.			
18	SCADA	Required EMS Visibility for Generation Sources	Monitoring & Control Requirements	Yes
	The 3 MW subject project triggers the requirement for SCADA reporting to the Utility.			
19	Auto-Loop	Alternate Circuit Configuration		Fail
	The study feeder 5-3-34 has an auto-loop connection to feeder 109-4-34. The proposed project CDG-00419 is not permitted to generate while fed from Washington Heights 109-4-34 due to failure of the 3V0 screen.			

The analysis was run at the rated project size in future system configuration connected to the feeder 9-2-13 fed from Bank #29 (Future Wurtsboro Substation). The following table shows the impact study results of 3,000 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 104.9% 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 103.5% of nominal.			
3	Voltage	Substation Regulation for Reverse Power	<100% minimum load criteria	Fail
	The total generation on Bank #29 is 3.18 MW. The minimum load on this substation bank is 0.69 MW. The generation to load ratio is 460.58%.			
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 0.33% 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 0.88% 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
	There are two voltage regulators on the study feeder. The maximum voltage fluctuation is 0.14 V which is lower than the 1/2 BW limit of 1 V of the respective voltage regulator.			
8	Voltage	Flicker	Screen H Flicker	Pass
	The Pst for the location with the greatest voltage fluctuation is 0.116 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 131.21 A. There will be no thermal overload on the upstream devices.			
10	Equipment Ratings	Withstand (fault current)	<90% withstand limits	Pass
	CDG-00419 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.			
11	Protection	Unintentional Islanding	Unintentional Islanding Document & Company Guidelines	Fail
	The rating of subject project is 3 MW. The total generation, including the proposed interconnection of 3 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 127.14% and a possible substation island is 460.58%. No single inverter manufacturer makes up at least 2/3 of the total inverter capacity in the possible substation island. The power factor in the potential feeder island is above 0.99 power factor for extended period.			
12	Protection	Protective device coordination	Company Guidelines	Fail
	CDG-00419 will require an ORU owned recloser that coordinates with the feeder breaker on the future feeder 9-2-13. 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-00419 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)	Pass
	CDG-00419 interconnecting to the O&R electric power system with the recommended grounding transformer results in a maximum reduction of reach of 0.4% for 3 phase faults and 0.8% for phase to ground faults. This will have no adverse effects on protection device coordination. For future feeder 9-2-13, there will be a maximum reduction of reach of 0.8% for 3 phase faults and 3.7% for phase to ground faults. This will have no adverse effects on future protection device coordination.			
15	Protection	Overvoltage - Transmission System Fault	Company 3V0 criteria	Fail
	An evaluation of the existing EPS has been performed and it has been determined that protection mitigation methods are required. Future Bank #29 will require 3V0 protection as part of its installation.			
16	Protection	Overvoltage - Distribution System Fault	< 138% voltage rise	Fail
	CDG-00419 interconnecting to the O&R electric power system **without** the recommended grounding transformer results in a Ground Fault Overvoltage (GFOV) of 173% when islanded. The recommended grounding transformer 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 transformer is 1.00. CoG with the recommended grounding transformer is 0.54. Refer to mitigations section for grounding transformer specifications.			
18	SCADA	Required EMS Visibility for Generation Sources	Monitoring & Control Requirements	Yes
	The 3 MW subject project triggers the requirement for SCADA reporting to the Utility.			
19	Auto-Loop	Alternate Circuit Configuration		Pass
	The study feeder 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
Enable Voltage Reactive Power Control (Volt-Var) in accordance with O&R Smart Inverter Settings	Voltage Fluctuation, Regulator tap movement
Upgrade station LTC controls (Bank #15 and Future Bank #29)	Reverse power flow at substation
Upgrade station metering (Bank #15 and Future Bank #29)	Reverse power flow at substation
Upgrade fuse cutout sizes at cmp 6925245 and cmp 1931309 on feeder 9-2-13 or replace them with solid blades	Equipment thermal rating
Grounding Transformer, Specifications below	Effective Grounding
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
Disconnect the proposed projects while operating in auto-loop configuration connected to feeder 109-4-34	Alternate Circuit Configuration

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 (Bank #15 and Future Bank #29) LTC controls to work properly with the reverse power flow.
- Upgrade the existing substation (Bank #15 and Future Bank #29) meter with a bi-directional meter.

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

- Enable Voltage Reactive Power Control (Volt-Var) in accordance with O&R Smart Inverter Settings
- Install an electronic recloser at the POI.
- Upgrade fuse cutout sizes at cmp 6925245 and cmp 1931309 on feeder 9-2-13 or replace them with solid blades.
- Implement reclose delay on upstream protective devices to avoid reclosing into live island.

- Disconnect the proposed projects while operating in auto-loop configuration connected to feeder 109-4-34.
- Install Zig-Zag Grounding transformer on high side of Yg/Y Generator Step Up transformer as studied in EGPC results.

Grounding Transformer Specifications:	
Zig-Zag or Y-Delta	Zig-Zag
Delta Load (If Y-Delta configuration)	N/A
Delta Voltage (If Y-Delta configuration)	To be determined by developer
Voltage (Line-to-Line)	34.5 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.	72 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.	10.04 Amps
Resistor provided at Neutral Terminal	NO
If “Yes” please provide resistor value	NONE
Zero-Sequence Impedance (% or Ohms/Phase)	245.40 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

- Customer is advised to install a dual voltage generating step-up transformer as well as other switchgear that can operate at both 34.5 kV and 13.2 kV or the project will not be allowed to operate after voltage conversion. The customer may choose to interconnect with their proposed transformer and change it out at the customer’s expense in the future prior to voltage conversion to remain interconnected.

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

Install 477 ACSR (3-phases, 350 feet)	$13,650
Install Recloser (x1)	$85,000
Install Switch (x1)	$25,000
Install Junction Pole (x3)	$10,000
Install Riser	$10,000
Sensing Transformers (x4) on 2 Poles	$23,000
Install Primary Metering Cluster	$6,800
Commissioning Time Post Installation	$5,500
SCADA Monitoring/Power Quality Metering	$40,000
Contingency (15%)	$33,592.50
Total Distribution Estimate	**$257,542.50**

Substation Upgrade Estimate

Engineering	$2,400
Design/Drafting	$3,360
ECC	$5,200
Substation Operations - Electricians	$2,496
Substation Operations - Relay Techs	$2,512
Bitronics Meters	$6,180
Connectors	$103
Control Wire & Misc - Stores	$1,700
Contingency (15%)	$3,593
Total Substation Estimate	**$27,544**

Total Interconnection Cost Estimate: $257,542.50 + $27,544 = **$285,086.50**

Remainder Due = **$0**

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	06/07/2023	Effective Grounding Protection and Coordination Study complete. Recommended Grounding Transformer Specifications provided.
1.0	03/06/2023	Initial document for CESIR restudy of CDG-00419