For

Interconnection Customer: Delaware River Solar,LLC

Applicant: Rosario Giufre

4,988 kW Solar Generator System

2,200 kW Solar Generator System

Barrone Road #1, Mamakating NY 12790

Interconnection to Orange & Rockland Utilities

NY East 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

Section		Page
1.0	INTRODUCTION	3
2.0	EXECUTIVE SUMMARY	3
3.0	COMPANY EPS PARAMETERS	3
4.0	INTERCONNECTION CUSTOMER SITE	5
5.0	SYSTEM IMPACT ANALYSIS	6
6.0	MITIGATIONS FOR SYSTEM IMPACT ANALYSIS FAILURES	10
7.0	CONCEPTUAL COST ESTIMATE	12
8.0	REVISION HISTORY	14

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 & Substation upgrade cost of the work associated with the interconnection of the Interconnection Customer is **$495,479**

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	**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 Ahead (kW)	7599, 411, 7188
Contingency Condition Generation: Total, Connected, Queued Ahead (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)	13.2
Line Phasing at POI	3
Circuit distance from POI to substation	13.11 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 Ahead (kW)	7378, 190, 7188

System Fault Characteristics without Interconnection Customer DG at POI with System Upgrades described in Section 6	
Interconnection Customer POI Location (Pole X/Y)	Pole # 03/08, Barrone Road #1
I 3-phase (3LLL)	5,180 Amps
I Line to Ground (3I0)	1,600 Amps
Z1 (100 MVA base)	0.8263+j 2.6106 [Ohms]
Z0 (100 MVA base)	0.9832+j 3.1030 [Ohms]

Substation	Future Wurstsboro
Transformer Name (list multiple where normally tied to common bus)	Future Bank 29
Transformer Peak Load (kW)	1990
Contingency Condition Load, N-1 Criteria (kW) (as applicable)	n/a
Daytime Light Load (kW)	690
Generation: Total, Connected, Queued Ahead (kW)	7366, 178, 7188
Contingency Condition Generation: Total, Connected, Queued Ahead (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	3.05 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 Ahead (kW)	0, 0, 7188

System Fault Characteristics without Interconnection Customer DG at POI with System Upgrades described in Section 6	
Interconnection Customer POI Location (Pole X/Y)	Pole # 03/08, Barrone Road #1
I 3-phase (3LLL)	1458 Amps
I Line to Ground (3I0)	1262 Amps
Z1 (100 MVA base)	2.2674+j 5.0367 [Ohms]
Z0 (100 MVA base)	2.0256+j 7.6910 [Ohms]

4.0 INTERCONNECTION CUSTOMER SITE

The Interconnection Customer is proposing a new primary service connection at a new customer location. The service voltage at the point of interconnection currently is 34.5kV but will be converted in the future to 13.2 kV. The applicant proposes installing two solar projects with AC rating of 4,988 kW and 2,200 kW. The 4,988 kW solar project is interfaced with four (4) inverters and two (2) medium voltage transformers. The 2,200 kW solar project is interfaced with two (2) inverters and one (1) medium voltage transformers.

The proposed POI is on Feeder 5-3-34 supplied from Transformer Bank_15 at the Cuddebackville substation. The POI is on a three phase line section. In the future this project will be served from an upgraded Wurtsboro substation from future Transformer Bank 29 supplying future feeder 9-2-13.

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

The proposed 4,988 kW solar system consists of:

- 17,280 HANWHA Q.PEAK DUO L-G5.2, solar panels each rated 380 W
- 4 INGETEAM IS 1245TL U B480 Inverters each rated 1,247 kVA at 480 Volts AC.
- 2 Generator Step Up transformers, 2,750 kVA, grounded wye primary and wye secondary winding configuration, 35,000 primary volts, 480 secondary volts.
- 1 neutral grounding reactor (NGR) of at least 25 Ohms.

The proposed 2,200 kW solar system consists of:

- 6,480 HANWHA Q.PEAK DUO L-G5.2, solar panels each rated 380 W
- 2 INGETEAM IS 1245TL U B480 Inverters each rated 1,247 kVA at 480 Volts AC.

- 1 Generator Step Up transformers, 2,500 kVA, grounded wye primary and wye secondary winding configuration, 35,000 primary volts, 480 secondary volts.
- 1 neutral grounding reactor (NGR) of at least 25 Ohms.

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 7,188 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 103.7% 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 83.75% of nominal.			
3	Voltage	Substation Regulation for Reverse Power	<100% minimum load criteria	Pass
	The total generation on Feeders 5-3-34, 5-4-34, and 5-10-34 is 7.60 MW. The total minimum load on these Feeders is 8.19 MW. The generation to load ratio is 92.78%.			
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 point of interconnection (POI). The resulting fluctuation at the POI is 2.67% due to the proposed 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 6.34% 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
	Regulator tap movement exceeds 1 position at the voltage regulators UID: 1170782 and UID: 566370.			
8	Voltage	Flicker	Screen H Flicker	Pass
	The Pst for the location with the greatest voltage fluctuation is 0.20 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 314 A. No upstream equipment are overloaded.			
10	Equipment Ratings	Withstand (fault current)	<90% withstand limits	Pass
	The additional fault current contribution from the subject project is 377 A. The maximum fault contribution at the point of interconnection (POI) is 5.37%. There are no protection equipment upstream of the proposed project that exceed its withstand limits.			
11	Protection	Unintentional Islanding	Unintentional Islanding Document & Company Guidelines	Fail
	The rating of subject solar projects is 7.188 MW. The total generation, including the proposed interconnection of 7.188 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 217% and for a possible substation island is 92.78%. There is a possibility of reactive power match in the potential islands.			
12	Protection	Protective device coordination	Company Guidelines	Fail
	Project will require a recloser that coordinates with the feeder breaker. A detailed protection study is required to evaluate the protection coordination impact due to fault current increase by the proposed project.			
13	Protection	Fault Sensitivity	Rated capabilities of EPS equipment	Pass
	No equipment is affected.			
14	Protection	Ground Fault Detection	Reduction of reach > 10%	Fail
	The proposed system interconnection transformers' winding configuration is Yg (primary) – Y (secondary). The one line diagrams for both the projects show a NGR of 25 Ohms. This will require a grounding transformer and not an NGR. The utility will verify the size of the grounding transformer and evaluate the feeder breaker relay settings for reduction of reach by conducting a detailed protection study. This is in progress and is a separate report from this CESIR document.			

15	Protection	Overvoltage - Transmission System Fault	Company 3V0 criteria	Pass
	The generation to load ratio on the serving distribution system has 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 not required.			
16	Protection	Overvoltage - Distribution System Fault	< 138% voltage rise	Pass
	With subject project interconnected the modeled voltage rise on the unfaulted phases of the system is 108%.			
17	Protection	Effective Grounding	IEEE 142 (0<R0/X1<1; 0<X0/X1<3)	Pass
	With subject project interconnected the modeled R0/X1 is 0.38 PU and the X0/X1 is 1.19 PU			
18	SCADA	Required EMS Visibility for Generation Sources	Monitoring & Control Requirements	Yes
	The 7.188 MW subject projects triggers the requirement for SCADA reporting to the Utility.			
19	Auto-Loop			Fail
	The study feeder 5-3-34 has an auto-loop connection to feeder 109-4-34. The proposed projects fail NYSSIR Screen-G when connected in auto-loop configuration to feeder 109-4-34.			

The analysis was also run at the rated project size in normal system configuration connected to the future feeder 9-2-13. The following table shows the impact study results of 7,188 kW at 1.0 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 project the maximum voltage as modeled on the Feeder is 105.4% 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% of nominal.			
3	Voltage	Substation Regulation for Reverse Power	<100% minimum load criteria	Pass
	The total generation on Feeders 9-1-13 and 9-2-13 is 7.37 MW. The total minimum load on these Feeders is 0.69 MW. The generation to load ratio is 1068%.			
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 point of interconnection (POI). The resulting fluctuation at the POI is 1.58% due to the proposed 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 0.02% 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
	Regulator tap movement does not exceeds 1 position at the future bank 29 Load Tap Changer			
8	Voltage	Flicker	Screen H Flicker	Fail
	The Pst for the location with the greatest voltage fluctuation is 0.59 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 314 A. Cutout fuses ID# 1933109,6925245, 2018140 are overloaded.			
10	Equipment Ratings	Withstand (fault current)	<90% withstand limits	Pass
	The additional fault current contribution from the subject project is 176 A. The maximum fault contribution at the point of interconnection (POI) is 13.95%. There are no protection equipment upstream of the proposed project that exceed its withstand limits.			
11	Protection	Unintentional Islanding	Unintentional Islanding Document & Company Guidelines	Fail
	The rating of subject solar projects is 7.188 MW. The total generation, including the proposed interconnection of 7.188 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 5134% and for a possible substation island is 1068%. There is a possibility of reactive power match in the potential islands.			
12	Protection	Protective device coordination	Company Guidelines	Fail

	Project will require a recloser that coordinates with the feeder breaker. A detailed protection study is required to evaluate the protection coordination impact due to fault current increase by the proposed project.			
13	Protection	Fault Sensitivity	Rated capabilities of EPS equipment	Pass
	No equipment is affected.			
14	Protection	Ground Fault Detection	Reduction of reach > 10%	Fail
	The proposed system interconnection transformers' winding configuration is Yg (primary) – Y (secondary). The one line diagrams for both the projects show a NGR of 25 Ohms. This will require a grounding transformer and not an NGR. The utility will verify the size of the grounding transformer and evaluate the feeder breaker relay settings for reduction of reach by conducting a detailed protection study. This is in progress and is a separate report from this CESIR document.			
15	Protection	Overvoltage - Transmission System Fault	Company 3V0 criteria	Pass
	Primary side of future Bank 29 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	Pass
	With subject project interconnected the modeled voltage rise on the unfaulted phases of the system is 108%.			
17	Protection	Effective Grounding	IEEE 142 (0<R0/X1<1; 0<X0/X1<3)	Pass
	With subject project interconnected the modeled R0/X1 is 0.4 PU and the X0/X1 is 1.53 PU			
18	SCADA	Required EMS Visibility for Generation Sources	Monitoring & Control Requirements	Yes
	The 7.188 MW subject projects triggers the requirement for SCADA reporting to the Utility.			
19	Auto-Loop			Pass
	The study feeder future 9-2-13 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
Operate the proposed solar projects at 0.97 Lagging Power Factor	Voltage fluctuations
Modify the bandwidth settings on 1170782 and 566370 voltage regulators to 5 V	Tap movement violations
Upgrade Cuddebackville station LTC controls	Reverse power flow at substation
Upgrade station metering	Reverse power flow at substation
Perform detailed grounding and protection study	Protection Coordination
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 when connected to the auto-loop feeder 109-4-34	Screen-G
Reduce CDG419 system size to 2948kW or less	Screen H flicker
Upgrade cutouts 6925245; 2018140; 1931309	Thermal overload

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.

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

- Operate the proposed solar projects at 0.97 Lagging Power Factor.
- Modify the bandwidth settings on 1170782 and 566370 voltage regulators to 5 V.
- Upgrade overloaded cutout fuses.
- Install electronic reclosers at the POI.
- A detailed grounding and protection study is required to verify grounding transformer design to evaluate reduction of reach and protection coordination.
- 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.

- Customer is advised to install dual bushing generating step up transformers as well as other switchgear that can operate at both 34.5kV and 13.2kV. This will be less expensive for the customer than the utility installing step down transformers just upstream of the POI.

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

Conductor upgrade	$27,300
Install 2 reclosers	$152,000
Additional poles and sensing transformers at PCC	$63,000
2 Gang Operated Air Break Switches	$50,000
2 Primary Metering Clusters	$13,600
Commissioning	$11,000
Engineering Review and Inspections	$10,000
2 Power Quality Meters	$80,000
Contingency (15%)	$61,035
Total Planning Grade Estimate	**$467,935**

The following table shows the costs for substation upgrades related to interconnection.

Engineering, Design, Drafting, Admin	$5,760
Energy Control Center	$5,200
Substation Operations – Electricians	$2,496
Substation Operations – Relay Techs	$2,512
Bitronics Meters (Reverse Metering Capable)	$6,180

Connectors, Wire, Misc.	$1,803
Contingency (15%)	$3,593
Total Substation Estimate	**$27,544**

The total interconnection cost estimate: $495,479

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,
   - 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
1.0	12/23/2020	Draft document
2.0	01/13/2021	Draft document with updated study results to include the 13.2 kV voltage conversion near the POI
3.0	01/15/2021	Added substation costs
4.0	02/19/2021	Added planning distribution estimate and future Wurtsboro results