# For

# Interconnection Customer: Delaware River Solar, LLC

# Applicant: Rosario Giufre

# 5000 kW Solar Generator System

# 384 kW Solar Generator System

# State Route 42, Thompson NY 12701

# Interconnection to Orange & Rockland Utilities

# NY Western Division

# Mongaup Substation

# 13.2 kV Feeder 2-1-13


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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:

**CDG-00492**: **$1,385,248**

**CDG-00493**: **$35,420, contingent on CDG-00492 upgrades**

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 | Mongaup |
|---|---|
| Transformer Name (list multiple where normally tied to common bus) | Bank #12 |
| Transformer Peak Load (kW) | 2,031 |
| Contingency Condition Load, N-1 Criteria (kW) (as applicable) | N/A |
| Daytime Light Load (kW) | 424 |
| Generation: Total, Connected, Queue (kW) | 5673, 289, 5384 |
| Contingency Condition Generation: Total, Connected, Queue (kW) | N/A |
| Supply Voltage (kV) | 69 |
| Transformer Maximum Nameplate Rating (kVA) | 7,500 |
| Distribution Bus Voltage Regulation | Yes, LTC |
| Transmission GFOV Status | Not installed |
| Bus Tie | N/A |
| Number of Feeders Served from this Bus | 1 |

| Connecting Feeder/Line | 2-1-13 |
|---|---|
| Peak Load on feeder (kW) | 2,031 |
| Daytime Light Load on Feeder (kW) | 424 |
| Feeder Primary Voltage at POI (kV) | 13.2 |
| Line Phasing at POI | 3 |
| Circuit distance from POI to substation | 5.66 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) | 5673, 289, 5384 |

| System Fault Characteristics without Interconnection Customer DG at POI with System Upgrades described in Section 6 | |
|---|---|
| Interconnection Customer POI Location (Pole X/Y) | State Route 42, Thompson NY 12701<br>Pole: 39516/58248 |
| I 3-phase (3LLL) | 4015 A |
| I Line to Ground (3I0) | 1136 A |
| Z1 (100 MVA base) | 0.1457+ j0.4868 [p.u.] |
| Z0 (100 MVA base) | 0.2640 + j0.7585 [p.u.] |

## 4.0 INTERCONNECTION CUSTOMER SITE

The Interconnection Customer is proposing a new primary service connection at new customer locations. The service voltage is 13.2 kV. The applicant proposes installing one PV project with AC power rating of 5,000 kW and one PV project with AC power rating of 384 kW. The proposed 5000 KW project is interfaced with two (2) 2500 KVA inverters and two (2) 3420 KVA step-up transformers. The proposed 384 KW project is interfaced with four (4) 96 KVA inverters and one (1) 500 KVA step-up transformer.

The project location was studied using the O&R system. The projects are in NYSEG territory and NYSEG must approve the Community Solar arrangement. The projects may require NYSEG metering and NYSEG subscribers.

The proposed generating systems consists of:

Project #1 (CDG-00492):

- 10,608 PV panels each rated 535 Watts
- 2 Inverters each derated to 2,500 kW at 600 Volts (SUNGROW, SG 3425 UD-MV)
- 2 Generator Step Up transformers, 3420 kVA, YG-Y winding configuration, 13,200 primary volts, 600 secondary volts.

Project #2 (CDG-00493):

- 9,360 PV panels each rated 535 Watts
- 1 Inverter derated to 384 kW at 600 Volts (SUNGROW, SG 125HV)

- 1 Generator Step Up transformer, 500 kVA, YG-YG 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 2-1-13. The following tables show the impact study results of cluster 5384 KW project interconnecting to the distribution system.

| **Project #1 (**CDG-00492**)** | | | | |
|---|---|---|---|---|
| **#** | **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 108% of nominal. This screen was performed for cluster as well. See results for CDG-00493 below. | | | |
| **2** | Voltage | Undervoltage | > 95% (ANSI C84.1) | Pass |
| | With the addition of the subject generator the minimum voltage as modeled on the Feeder is 84% of nominal in respect to 83% at pre-existing condition. However, pre-existing undervoltage does not get worse after interconnection of the project. This screen was also performed for cluster. See results for CDG-00493 below. | | | |
| **3** | Voltage | Substation Regulation for Reverse Power | <100% minimum load criteria | Fail |
| | The total generation on substation bank is 5.29 MW. The total minimum load on the substation bank is 0.42 MW. Therefore, the generation to load ratio is 1249%. This screen was performed for cluster as well. See results for CDG-00493 below. | | | |
| **4** | Voltage | Feeder Regulation for Reverse Power | <100% Minimum load to generation ratio | Pass |
| | There is no line voltage regulator between POI and substation. | | | |
| **5** | Voltage | Fluctuation | <3% steady state from proposed generation on feeder | Fail |
| | The greatest voltage fluctuation on the feeder occurs at POI with 3.33% due to this project's generation output stepping from 0% to 100%. This screen was performed for cluster as well. See results for CDG-00493 below. | | | |
| **6** | Voltage | Fluctuation | <5% steady state from aggregate DER on substation bus | Fail |
| | The maximum component voltage fluctuation on the system is 9.4% due to all generation output stepping from 0% to 100%. This screen was performed for cluster as well. See results for CDG-00493 below. | | | |

| | | | | |
|---|---|---|---|---|
| **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 |
| | This screen was performed for cluster. See results for CDG-00493 below. | | | |
| **8** | Voltage | Flicker | Screen H Flicker | Pass |
| | This screen was performed for cluster. See results for CDG-00493 below. | | | |
| **9** | Equipment Ratings | Thermal (continuous current) | < 100% thermal limits assuming no load | Fail |
| | The subject generator's full output current is 218.69 A. Following equipment are overloaded when the proposed project is connected to the system,<br>1. 3P fuse of the OH Cutout Switch 1696894.<br>2. 3P fuse of the OH Cutout Switch 903360.<br>3. 3P fuse of the OH Cutout Switch 1568019.<br>This screen was also performed for cluster. See results for CDG-00493 below. | | | |
| **10** | Equipment Ratings | Withstand (fault current) | <90% withstand limits | Pass |
| | This screen was performed for cluster. See results for CDG-00493 below. | | | |
| **11** | Protection | Unintentional Islanding | Unintentional Islanding Document & Company Guidelines | Pass |
| | This screen was performed for cluster. See results for CDG-00493 below. | | | |
| **12** | Protection | Protective device coordination | Company Guidelines | Fail |
| | A detailed protection study is required. | | | |
| **13** | Protection | Fault Sensitivity | Rated capabilities of EPS equipment | Fail |
| | A detailed protection study is required. | | | |
| **14** | Protection | Ground Fault Detection | Reduction of reach > 10% (by Utility) | Fail |
| | A detailed protection study is required. | | | |
| **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 | Fail |
| | CDG-00492 will cause line to ground voltage to exceed 1.38 pu of its nominal during a single line to ground fault without a grounding bank. A detailed protection study is required. | | | |
| **17** | Protection | Effective Grounding | IEEE 142 (0<R0/X1<1; 0<X0/X1<3) | Pass |
| | This screen was performed for cluster. See results for CDG-00493 below. | | | |
| **18** | SCADA | Required EMS Visibility for Generation Sources | Monitoring & Control Requirements | Yes |
| | The 5000-kW subject generator triggers the requirement for SCADA reporting to the Utility. | | | |
| **19** | Auto-Loop or Other | | | N/A |
| | 2-1-13 is not on an Autoloop. | | | |

**Project #2 (**CDG-00493**)**

| # | 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 109% of nominal. This screen was performed for the cluster. | | | |
| **2** | Voltage | Undervoltage | > 95% (ANSI C84.1) | Pass |
| | With the addition of the subject generator the minimum voltage as modeled on the Feeder is 84% of nominal in respect to 83% at pre-existing condition. However, pre-existing undervoltage does not get worse after interconnection of the cluster. | | | |
| **3** | Voltage | Substation Regulation for Reverse Power | <100% minimum load criteria | Fail |
| | The total generation on substation bank is 5.57 MW. The total minimum load on these Feeders is 0.42 MW. Therefore, the generation to load ratio is 1313.97%. 3V0 protection and reverse power capability need to be addressed. | | | |
| **4** | Voltage | Feeder Regulation for Reverse Power | <100% Minimum load to generation ratio | Pass |
| | There is no line voltage regulator between POI and substation. | | | |

| | | | | |
|---|---|---|---|---|
| **5** | Voltage | Fluctuation | <3% steady state from proposed generation on feeder | Fail |
| | This screen was performed for cluster. The greatest voltage fluctuation on the feeder occurs at POI with 3.5% due to this cluster's generation output stepping from 0% to 100%. | | | |
| **6** | Voltage | Fluctuation | <5% steady state from aggregate DER on substation bus | Fail |
| | This screen was performed for cluster. The maximum component voltage fluctuation on the system is 9.27% 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 |
| | Generation change of 75% of nameplate rating results in voltage change > ½ the bandwidth of voltage regulating devices on the feeder with maximum of 1 V and 2 V. The maximum voltage change is 2.21 V and 4.2 V after mitigations applied for Screen #1. | | | |
| **8** | Voltage | Flicker | Screen H Flicker | Pass |
| | This screen was performed for cluster. The Pst for the location with the greatest voltage fluctuation is 0.14 and the emissions limit is 0.35. | | | |
| **9** | Equipment Ratings | Thermal (continuous current) | < 100% thermal limits assuming no load | Fail |
| | The subject cluster's full output current is 235.49 A. Following equipment are overloaded after interconnection of the cluster and need to be upgraded or replaced.<br>1. 3P fuse of the OH 100A Cutout Switch 1696894.<br>2. 3P fuse of the OH 100A Cutout Switch 903360.<br>3. 3P fuse of the OH 100A Cutout Switch 1568019. | | | |
| **10** | Equipment Ratings | Withstand (fault current) | <90% withstand limits | Pass |
| | The additional fault current contribution from the generation contributes 9.4% to interrupting ratings in excess of existing EPS equipment. Since the fault contribution is below the allowed limit of 10%, the protection equipment upstream of the proposed project cannot exceed the withstand limits. | | | |
| **11** | Protection | Unintentional Islanding | Unintentional Islanding Document & Company Guidelines | Pass |
| | The subject generator is a 5384 kW PV cluster generation system. Feeder recloser passes this screen. | | | |

| | | | | |
|---|---|---|---|---|
| **12** | Protection | Protective device coordination | Company Guidelines | Fail |
| | A detailed protection study is required. | | | |
| **13** | Protection | Fault Sensitivity | Rated capabilities of EPS equipment | Fail |
| | A detailed protection study is required. | | | |
| **14** | Protection | Ground Fault Detection | Reduction of reach > 10% (by Utility) | Fail |
| | A detailed protection study is required. | | | |
| **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 | Fail |
| | CDG-00493 will cause line to ground voltage to exceed 1.38 pu of its nominal during a single line to ground fault without a grounding bank. A detailed protection study is required. | | | |
| **17** | Protection | Effective Grounding | IEEE 142 (0<R0/X1<1; 0<X0/X1<3) | Pass |
| | This screen was performed for cluster. With subject generator interconnected the modeled R0/X1 is 0.54 PU and the X0/X1 is 1.56 PU. | | | |
| **18** | SCADA | Required EMS Visibility for Generation Sources | Monitoring & Control Requirements | Yes |
| | The 5.384 MW subject generator triggers the requirement for SCADA reporting to the Utility. | | | |
| **19** | Auto-Loop or Other | | | N/A |
| | 2-1-13 is not on an Autoloop. | | | |

## 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; TGFOV |
| • CDG-00492 and CDG-00493 must operate at a combined 2300 KW at 0.98PF absorbing VARs | Overvoltage Violations; Voltage Fluctuation <3% on Feeder & <5% on Substation |
| • Upgrade or replace 3P fuse of the OH Cutout Switch 1696894<br>• Upgrade or replace 3P fuse of the OH Cutout Switch 903360<br>• Upgrade or replace 3P fuse of the OH Cutout Switch 1568019 | Equipment Ratings, Thermal (Continuous Current) |
| • Perform detailed grounding and protection study | Protective device coordination, Fault sensitivity, Ground fault detection, Effective grounding |
| • Install primary metering at PCC | Monitoring and control |
| • Install electronic recloser at PCC | Monitoring and control |
| • Install GOAB switch | 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
- Upgrade station LTC controls to work properly with the reverse power flow.
- Upgrade existing substation meter with bi-directional meter

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

- CDG-00492 and CDG-00493 must operate at a combined 2300 KW at 0.98PF absorbing VARs
- Upgrade or replace 3P fuse of the OH Cutout Switch 1696894
- Upgrade or replace 3P fuse of the OH Cutout Switch 903360
- Upgrade or replace 3P fuse of the OH Cutout Switch 1568019
- Install electronic recloser at the PCCs

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 projects estimated under rates and schedules in effect at the time of this study in accordance with the most recent version of the NYSSIR.

**CDG-00492: Distribution Planning Grade Estimate**

| Description | Cost |
|---|---|
| Upgrade existing Conductor to 477 (6500ft) | $819,000 |
| Install new 477 Conductor (200ft) | $7,800 |
| Install Recloser (2) | $160,000 |
| Install GOAB switch (1) | $25,000 |
| Junction Pole (3) | $30,000 |
| Install Primary Metering Cluster (1) | $6,800 |
| Commissioning Time Post Installation (1) | $5,500 |
| Submittal Review, Redbook development, Site Inspections | $5,000 |
| Power Quality Meter/SCADA Monitoring | $40,000 |
| Contingency (15%) | $164,865 |
| **Total Distribution Estimate** | **$1,263,965** |

CDG-00493 Distribution Planning Grade Estimate below is contingent on CDG-00492 Distribution Upgrades. The remaining Distribution Upgrade costs specific to CDG-00493 are below.

**CDG-00493: Distribution Planning Grade Estimate**

| Description | Cost |
|---|---|
| Install Primary Metering Cluster (1) | $6,800 |
| Commissioning Time Post Installation (1) | $5,500 |
| Submittal Review, Redbook development, Site Inspections | $5,000 |
| Contingency (15%) | $2,595 |
| **Total Distribution Estimate** | **$19,895** |

**Substation Costs: $3V_0$ installation**

| Description | Cost |
|---|---|
| Engineering | $24,000 |
| Design/Drafting | $15,750 |
| ECC | $10,400 |
| Substation Operations - Electricians | $84,150 |
| Substation Operations - Relay Techs | $66,500 |
| Relay and/or Panels | $41,200 |
| Connectors | $2,225 |
| Control Wire & Misc - Stores | $8,500 |
| Contingency (15%) | $37,909 |
| **Total Substation Estimate** | **$290,634** |

Market-Initiated Cost Sharing 2.0 is applicable to the 3V0 installation. The projects will be responsible for a Pro-Rata Share of the Qualifying Upgrade Cost based on kW Capacity.

CDG-00492 3V0 Cost Share: (3000kW/7189kW Capacity) * $290,634 = $121,283

CDG-00493 3V0 Cost Share: (384kW/7189W Capacity) * $290,634 = $15,525

**CDG-00492** Total Interconnection Cost Estimate: $1,263,965 + $121,283 = **$1,385,248.**

**CDG-00493** Total Interconnection Cost Estimate: $19,895 + $15,525 = **$35,420.**

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.
5. The project location was studied using the O&R system. The projects are in NYSEG territory and NYSEG must approve the Community Solar arrangement. The projects may require NYSEG metering and NYSEG subscribers.

## 8.0 REVISION HISTORY

| Revision | Date | Description of Revision |
|---|---|---|
| 2.0 | 02/06/2023 | Revised for reduced size mitigation to a combined 2300 KW at 0.98PF absorbing VARs |
| 1.0 | 01/03/2023 | Initial document |