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For
Interconnection Customer: Source Renewables LLC
Applicant: Source Renewables LLC
4,980 kW Photovoltaic Generator System
2110 Dugan Rd, Olean, NY, 14760

Interconnection to National Grid
NY Western Division
Southwest Region
Olean District
Dugan Substation
13.2 kV Feeder 2256

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1.0 INTRODUCTION

This report presents the analysis results of the National Grid (“National Grid” or the “Company”) interconnection study based on the proposed interconnection and design submittal from the Interconnection Customer in accordance with the Company Electric Service Bulletins (ESB). 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 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 \$126,920.

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 ability to generate is contingent on this facility being served by the interconnecting circuit during normal Utility operating conditions. Therefore, if the interconnecting circuit is out of service, or if abnormal Utility operating conditions of the area EPS are in effect National Grid reserves the right to disengage the facility.

No future increase in generation output beyond that which specified herein for this interconnection has been studied. Any increase in system size and/or design change is subject to a new study and costs associated shall be borne by the Interconnection Customer. An increase in system size may also forfeit the Interconnection Customer’s existing queue position.

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3.0 COMPANY EPS PARAMETERS

Substation	Dugan Rd Station 22	
Transformer Name	TB1	TB2
Transformer Peak Load (kW)	21,653.4	
Contingency Condition Load, N-1 Criteria (kW) (as applicable)	N/A	
Daytime Light Load (kW)	8,655.3	
Generation: Total ¹ , Connected, Queued Ahead (kW)	28,882.5, 5,243.9, 23,902.5	
Contingency Condition Generation: Total ¹ , Connected, Queued Ahead (kW)	N/A	
Supply Voltage (kV)	115	115
Transformer Maximum Nameplate Rating (kVA)	25,000	25,000
Distribution Bus Voltage Regulation	No	No
Transmission GFOV Status	Installed	Installed
Bus Tie	Closed	
Number of Feeders Served from this Bus	3	3

Connecting Feeder/Line	2256
Peak Load on feeder (kW)	3,695.0
Daytime Light Load on Feeder (kW)	2,262.5
Feeder Primary Voltage at POI (kV)	13.2
Line Phasing at POI	3
Circuit Distance from POI to Substation	1.09 mile(s)
Distance to nearest 3-phase, (if applicable)	n/a
Line Regulation	N
Line/Source Grounding Configuration at POI	Effective
Generation: Total ¹ , Connected, Queued Ahead(kW)	10,080.8, 95.8, 5,100.8

System Fault Characteristics without Interconnection Customer DG at POI	
Interconnection Customer POI Location	Pole 35, 2110 Dugan Rd
I 3-phase (3LLL)	6,038.3 Amps
I Line to Ground (3I0)	4,555.1 Amps
Z1 (100 MVA base)	0.41703 + j1.18414 PU
Z0 (100 MVA base)	0.80376 +j2.34801 PU

¹ The total value referenced here includes the subject generator, connected generation and generation that is queued ahead.

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4.0 INTERCONNECTION CUSTOMER SITE

The Interconnection Customer is proposing a new primary service connection with Account No. 4838126000.

This location is presently served via three phase 13.2 kV effectively grounded overhead main line three phase service on Dugan Rd.

The proposed generating system consists of:

Main Service Equipment:

- One (1) 15 kV 600A Gang-Operated Load Break (GOAB) Disconnect Switch
- One (1) set of 10 kV, 8.4 kV MCOV Surge Arrestors
- Pole mounted 300A Fuse, 15 kV Class
- Pole mounted Utility Revenue Meter
- Pole mounted Customer meter
- Riser pole with Solid Blade Fused Cut-Out (15 kV class, 300A)

Sub-System One:

- One (1) 13,200 GWYE / 600V GWYE pad-mounted 2,500 kVA (2,490 kWAC rated) transformer ($Z = 5.75\%$ and $X/R = 8$)
- Inverter, Solectria XGI 1500-166/166, Max Operating PV Power for each inverter 170 kW, number of inverters in Sub-System one are 15.
- ZNSHINE Solar PV Array Fields 545 W (ZXM7-SPDB144 Series)

Sub-System Two:

- One (1) 13,200 GWYE / 600V GWYE pad-mounted 2,500 kVA (2,490 kWAC rated) transformer ($Z = 5.75\%$ and $X/R = 8$)
- Inverter, Solectria XGI 1500-166/166, Max Operating PV Power for each inverter 170 kW, number of inverters in Sub-System one are 15.
- ZNSHINE Solar PV Array Fields 545 W (ZXM7-SPDB144 Series)

Note: The maximum operating power for each inverter provided is 170 kW. With total of 30 inverters the estimated maximum power is 5,100 kW. A derate letter will be required from the manufacturer to equal total of 4,980 kW.

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5.0 SYSTEM IMPACT ANALYSIS

Category	Criteria	Limit	Result
Voltage	Overvoltage	< 105% (ANSI C84.1)	Pass
With the addition of the subject generator the maximum voltage as modeled on the Feeder is 103.33% of nominal.			
Voltage	Undervoltage	> 95% (ANSI C84.1)	Pass
With the addition of the subject generator the minimum voltage as modeled on the Feeder is greater than nominal.			
Voltage	Substation Regulation for Reverse Power	<100% minimum load criteria	Fail
The total generation on Feeders 2252, 2253, 2254, 2255, 2256, 2257 is 23.41 MW. The total minimum load on these Feeders is 8.65 MW. Therefore, the generation to load ratio is 270.44%. This project will require the installation of bi-directional LTC controllers (3V0). However, it has been determined that these mitigation methods are already installed.			
Voltage	Feeder Regulation for Reverse Power	<100% Minimum load to generation ratio	Pass
There are no voltage regulators upstream from the Point of Interconnection. Therefore, no mitigations are required.			
Voltage	Fluctuation	<3% steady state from proposed generation on feeder, <5% steady state from aggregate DER on substation bus, Regulator tap movement exceeds 1 position. ²	Pass
The greatest voltage fluctuation on the feeder occurs nearby to the proposed DG site. The resulting fluctuation at the feeder location is 1.47% due to the proposed generation.			
Voltage	Flicker	Screen H Flicker	Pass
The Pst for the location with the greatest voltage fluctuation is 0.058 and the emissions limit is 0.35.			
Equipment Ratings	Thermal (continuous current)	< 100% thermal limits	Pass
The subject generator's full output current at the applied size of 4,980 kW is 218 A. The total full output current of all DER on Feeder 2256 is 441 A (10,080.8 kW). The limiting element on this feeder, with load unmasking methods, can thermally support 459 Amps. Therefore, no mitigations are required.			

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Equipment Ratings	Withstand (fault current)	<90% withstand limits	Pass
The additional fault current contribution from the generation does not contribute to interrupting ratings in excess of existing EPS equipment.			
Protection	Unintentional Islanding	Unintentional Islanding Document & Company Guidelines	Fail
The subject generator is a 4,980 kW PV generation system. The subject generation exceeds the Company's criteria for islanding a distribution resource under light load conditions. Therefore, the Project will require a National Grid protection and control package per ESB 756B Section 7.6.12.2.			
Protection	Protective device coordination	Company Guidelines	Fail
<p>The DG Interconnection Customer has proposed a 300 Amp fuse for use as Primary Service Protection (PSP). Preliminary fuse curves/specifications were not provided in the initial submittals to review the protection coordination. The Company will require the Interconnection Customer to use a SMU-40, 125E fuse (or equivalent) to provide adequate coordination with the Company's upstream protective devices, or a utility grade microprocessor relay with an automatic disconnecting device.</p> <p>The Interconnection Customer shall revise the site's over current protection to provide adequate coordination with the Company's upstream protective device listed below in accordance with IEEE 242 Table 15-3.</p> <p>-Station Feeder Overcurrent Relays: GE IAC -OC phase relay settings: PU = 720A, Curve = IAC-77, Time Dial = 1.3, Instantaneous Pickup = 3480A -OC ground relay settings: PU = 480A, Curve = IAC-77, Time Dial = 1.8, Instantaneous Pickup = NA</p> <p>If the Interconnection Customer installs an automated clearing device utilizing a utility grade relay, the 50, 51, 50G, and 51G functions must be enabled as highlighted by ESB 756B to provide appropriate coordination with the interconnected distribution.</p> <p>To maintain system coordination, setting changes will be required by the Company's feeder 2256 OC Ground Relay at Dugan Road Substation.</p>			
Protection	Fault Sensitivity	Rated capabilities of EPS equipment	Pass
<p>Fault studies show that contribution from the subject generator for faults on the Dugan Road feeder 2256 will not have a significant increase in fault current seen by utility equipment. Aggregate source fault contribution from the addition of the proposed system is within the rated capabilities of EPS equipment.</p>			

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Protection	Ground Fault Detection	Reduction of reach > x% (by Utility)	Fail
The Interconnection Customer has proposed one (1) 500 kVA zig-zag grounding transformer is proposed on the high side of interconnection transformer with Z=6% and X/R = 4. To be within Company guidelines, the grounding transformer shall have an impedance of 59.24 ohms/phase. With this grounding transformer in service, the Interconnection Customer will contribute approximately 63A of 3I0 current to remote (station bus) bolted line to ground faults and 191A to faults at the PCC.			
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 ground fault overvoltage protection, commonly known as a 115 kV 3V0 protection scheme, is already installed at Dugan Road Station at both transformers. Therefore, no additional upgrades are required.			
Protection	Overvoltage - Distribution System Fault	< 125 % voltage rise	Pass
With subject generator interconnected the modeled voltage rise on the unfaulted phases of the system is 122.6%.			
Protection	Effective Grounding	R0/X1 < 1 and X0/X1 < 3	Fail
With subject generator interconnected the modeled R0/X1 is 1.1247 PU and the X0/X1 is 2.6454 PU. The R0/X1 ratio is currently failing the Company screen as a pre-existing issue and is improved by the addition of this proposed DG Interconnection.			
SCADA	Required EMS Visibility for Generation Sources	Monitoring & Control Requirements	Fail
The 4,980 kW subject generator triggers the requirement for SCADA reporting to the Utility. This requirement is covered by the National Grid Protection and Control package (e.g., the PCC recloser).			
Other	Environmental Regulatory Obligations	Environmental Requirements	
<p>If the facilities are proposed on an existing site with preexisting environmental conditions and/or environmental regulatory obligations, the Customer should be made aware of the following:</p> <ul style="list-style-type: none"> The Customer is responsible, at its sole cost and expense, for providing an uncontaminated corridor for National Grid's facilities such that intrusive work performed during installation and long-term maintenance would not result in potential contact with any site contamination and would not interfere with institutional or engineering controls, if applicable. The aerial extent, depth, and location of the uncontaminated corridor required for National Grid's facilities will be determined with the Customer. The Customer is responsible for providing any and all information regarding site conditions, the nature and extent of any site contamination, and design information 			

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for any engineering controls (including plans and drawings), if applicable, immediately upon acceptance of this proposal.

- The Customer is responsible for all obligations imposed by governmental authorities, including but not limited to notifications regarding modifications to institutional or engineering controls (if applicable), any required monitoring and/or reporting obligations, disposal of any wastes generated at the site, and the resolution of any violations caused by the work.

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. 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	Option 1 – As Applied 4,980 kW	Failures Addressed
National Grid Protection and Control Package (Recloser, Switches, Poles, & SCADA integration)	\$103,920	Unintentional Islanding
Setting changes are required for Station feeder ground overcurrent relay ¹	\$5,000	Protective device coordination

Note 1: Prior projects in the queue may be responsible for setting changes on station feeder ground over current relay. If the previous projects move forward and complete this upgrade, it would be removed from the scope of this project (403848).

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

Option 1: (As applied)

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

- Setting changes are required for Station feeder ground overcurrent relay

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

- National Grid Protection and Control Package (Recloser, Switches, Poles, & SCADA integration)

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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 New York State Standardized Interconnection Requirements (“SIR”).

Planning Grade Estimate

National Grid Work Segment	Planning Grade Cost Estimate not including Tax Liability				Capital portion for calculating tax liability	Tax Liability Applied to Capital	Customer Cost Total
	Material	Labor	Overheads	Pre-Tax Total \$			
Distribution Modifications					Capital Costs	Rate	Total \$
Distribution System Modifications						14.03%	
National Grid Protection and Control Package (Recloser, Switches, and Poles)	\$ 37,478	\$ 16,566	\$ 37,415	\$ 91,459	\$ 88,816	\$ 12,461	\$ 103,920
Non-System Costs						14.03%	
Customer Documentation Review, Field Verification and Witness Testing	\$ -	\$ 12,000	\$ 6,000	\$ 18,000	\$ -	\$ -	\$ 18,000
Substation Modifications						14.03%	
Setting changes are required for Station feeder overcurrent relay	\$ -	\$ 5,000	\$ -	\$ 5,000	\$ -	\$ -	\$ 5,000
Distribution Summary	\$ 37,478	\$ 28,566	\$ 43,415	\$ 109,459	\$ 88,816	\$ 12,461	\$ 121,920
Station Summary	\$ -	\$ 5,000	\$ -	\$ 5,000	\$ -	\$ -	\$ 5,000
Total	\$ 37,478	\$ 33,566	\$ 43,415	\$ 114,459	\$ 88,816	\$ 12,461	\$ 126,920

Notes:

- 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.
- 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 SIR I.C step 11.
- 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.
- 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.