For

Interconnection Customer: Albany County Radar Solar Site

Applicant: Siemens

1,500 kW PV DG Generator System

897 Watervliet-Shaker Road, Albany, NY 12205

Interconnection to National Grid

NY East

Capital Region

Albany District

Sand Creek Substation

13.2 kV Feeder 45252

TABLE OF CONTENTS

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 NYS DPS SIR and ESB 750 series. 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 $121,813.

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.

3.0 COMPANY EPS PARAMETERS

Substation	Sand Creek
Transformer Name	TB1
Transformer Peak Load (kW)	13,090
Contingency Condition Load, N-1 Criteria (kW) (as applicable)	6,730
[Daytime, 24 hour] Light Load (kW)	8,400
Generation: Total[1], Connected, Queued Ahead (kW)	2,510; 1,500; 1,010
Contingency Condition Generation: Total[1], Connected, Queued Ahead (kW)	2,260; 1,880; 380
Supply Voltage (kV)	115
Transformer Maximum Nameplate Rating (kVA)	29,760
Distribution Bus Voltage Regulation	Yes
Transmission GFOV Status	Not installed
Bus Tie	None
Number of Feeders Served from this Bus	3

Connecting Feeder/Line	45252
Peak Load on feeder (kW)	3,428
[Daytime, 24 hour] Light Load on Feeder (kW)	2,390
Feeder Primary Voltage at POI (kV)	13.2
Line Phasing at POI	3
Circuit Distance from POI to Substation	0.843 Miles
Distance to nearest 3-phase, (if applicable)	NA
Line Regulation	YES
Line/Source Grounding Configuration at POI	Effective
Generation: Total[1], Connected, Queued Ahead(kW)	1,631; 131; 1,500

System Fault Characteristics without Interconnection Customer DG at POI	
Interconnection Customer POI Location	New pole between pole 1-1/2 and 1 on branch off of Watervliet Shaker Rd
I 3-phase (3LLL)	5,245 Amps
I Line to Ground (3I0)	4,482 Amps
Z1 (100 MVA base)	0.17636 + j0.83808 pu

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

Z0 (100 MVA base)	0.46322 + j1.21794 pu

4.0 INTERCONNECTION CUSTOMER SITE

The Interconnection Customer is proposing a new primary service connection to existing service at Account No. 4152728011.

The proposed generating system consists of:

- One (1) 3 phase 4 wire gang operated air-break fused pad mounted disconnect, 15 kV, 900A, 65kAIC, 110kV BIL
- One (1) pad mounted switch 15kV rated, 110kV BIL with lightning arrestors with 65T fuses
- Pad-mounted utility revenue metering
- One (1) 1,600 kVA, 13.2 kV – 600V wye grounded – wye grounded, pad-mount transformers with Z = 5.75% and X/R = 8
- One (1) 125 kVA, wye grounded zig-zag grounding bank with Z=4.2% and X/R=4.5
- One (1) 600V, 2500A, 3PH, 4W, MCB with 2500A rated main Breakers
- 1,500 kW of inverter-based PV System consisting of Hanwha Qcells and 14 Kaco Blueplanet 110 TL3-US inverters, 600VAC UL 1741SA and IEEE 1547 approved.

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 103.5% 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 95.4% of nominal.			
Voltage	Substation Regulation for Reverse Power	<100% minimum load criteria	Pass
The total generation on Feeders 45251, 45252, 45253 is 2.51 MW. The total minimum load on these Feeders is 8.4 MW. Therefore, the generation to load ratio is 30%.			
Voltage	Feeder Regulation for Reverse Power	<67% Minimum load to generation ratio	Pass
There is no voltage regulation between Sand Creek substation and the POI.			
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 at POI and substation bus occurs at substation. The resulting fluctuation at the feeder location is 1.01% due to the proposed generation and 4.7% on the substation bus due to the aggregate generation.			
Voltage	Flicker	Screen H Flicker	Pass
The Pst for the location with the greatest voltage fluctuation is 0.017 and the emissions limit is 0.35.			
Equipment Ratings	Thermal (continuous current)	< 100% thermal limits	Pass
The subject generator's full output current is 65.6A. The PCC is off of new three-phase built for new Boces Training Center. The total full output current of all DER downstream of OH is 71.3A. Sand Creek 45252 336AL OH Cable is rated at 404A.			

Equipment Ratings	Withstand (fault current)	<90% withstand limits	Pass
The additional fault 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 1.5 MW generation system. The subject generation exceeds the Company's criteria for islanding a distributed resource under light load conditions. Therefore, the project will require a National Grid Protection and Control Package.			
Protection	Protective device coordination	Company Guidelines	Fail
There are no protective devices between the interconnecting generator and the upstream substation feeder breaker. The DG Interconnection Customer has proposed a 65T fuse for use as Primary Service Protection (PSP). This protective device is shown in the proper location on the submitted line diagrams. Preliminary fuse curves/specifications were not provided in the initial submittals. For the study a S&C 65T Speed Fuse was assumed the fuse studied did provide adequate coordination with the substation feeder breaker on the Company's EPS. The customer shall submit formal fuse curves/specifications for review and approval by National Grid to ensure proper coordination if the project moves forward. Customers PSP must provide adequate coordination with the Company's upstream protective device listed below in accordance with IEEE 242 Table 15-2. <u>45252 Feeder Breaker GEIAC77 CT Ratio: 600/5</u> - GEIAC77 phase relay settings (50/51): PU = 6, TD = 1.5, Instantaneous = 3,480 Amps - GEIAC77 ground relay settings (50/51N): PU = 4, TD = 3, Instantaneous = 3,480 Amps			
Protection	Fault Sensitivity	Rated capabilities of EPS equipment	Pass
Fault studies show that contribution from the subject generator for faults on the feeder will not have a significant increase in fault current seen by utility equipment. Aggregate source fault contribution with the addition of the subject generator is within the rated capabilities of EPS equipment.			
Protection	Ground Fault Detection	Reduction of reach > x% (by Utility)	Pass
The Customer is proposing one 1,600kVA 13.2kV Wye-Grounded Primary to 0.6kV Wye-Grounded Secondary step-up transformer, with an impedance of 5.75% and an X:R ratio equal to 8. To achieve effective grounding the customer is proposing one (1) 125 kVA, 15kV rated primary connected Zig-Zag grounding bank with an impedance of 4.2% and X:R ratio of 4.5. The grounding bank proposed has a single-phase impedance of 75.6 Ohms on a 13.2 kV 125 KVA base, this was found to be adequate for interconnection. With this grounding bank in service, the interconnection Customer will contribute approximately 90 Amps of 3I0 current to remote bolted line to ground faults and 133 Amps to line to ground faults at the PCC.			

Protection	Overvoltage - Transmission System Fault	Company 3V0 criteria	Pass
The generation to load ratio on the serving distribution system has passed 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.			
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 121.3%.			
Protection	Effective Grounding	R0/X1<1; X0/X1<3	Pass
With the subject generator interconnected the modeled R0/X1 is 1.0286 PU and the X0/X1 is 1.53848 PU. This is already failing as a preexisting issue that the Company will strive to correct.			
SCADA	Required EMS Visibility for Generation Sources	Monitoring & Control Requirements	Fail
The 1.5MW subject generator triggers the requirement for SCADA reporting to the Utility.			
Other			Fail
Customer will be required to work with National Grid for FAA permitting for new poles in an area where FAA permits are required.			

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 – (1500 kW)	Failures Addressed
National Grid Protection and Control Package	$103,813	Unintentional Islanding
Station 3V0 single bank	$0	3V0

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

Option 1:

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

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

- The PCC was updated to connect to a new section of OH 336AL OH with fuse already moved under previous WR.
- National Grid protection and control package (recloser, switches, poles, and SCADA integration).

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

CESIR Estimate to Developer							
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
Distribution Modifications	Material	Labor	Overheads	Pre-Tax Total $	Capital Costs	Rate	Total $
Distribution System Modifications						13.91%	
National Grid Protection and Control Package(Recloser, Switches,Poles, & SCADA integration)	$ 37,478	$ 16,566	$ 37,415	$ 91,459	$ 88,816	$ 12,354	$ 103,813
Customer Documentation Review, Field Verification and Witness Testing	$ -	$ 12,000	$ 6,000	$ 18,000	$ -	$ -	$ 18,000
Distribution Summary	**$ 37,478**	**$ 28,566**	**$ 43,415**	**$ 109,459**	**$ 88,816**	**$ 12,354**	**$ 121,813**
Total	**$ 37,478**	**$ 28,566**	**$ 43,415**	**$ 109,459**	**$ 88,816**	**$ 12,354**	**$ 121,813**

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 SIR 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.