

nationalgrid	Coordinated Electric System Interconnect Review	Doc. #SP.NY-229123 Page 1 of 9
	Distributed Energy Resources - NYSSIR	Version 1.0 – 10/25/2019

**For
Nexamp
3,500 kW Photovoltaic Generator System
36 Stillwater Bridge Road, Schaghticoke, NY 12154**

**Interconnection to National Grid
NY Eastern Division
Capital Region
Troy Operating District
Hemstreet Substation
13.2 kV Feeder 32851**

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nationalgrid	Coordinated Electric System Interconnect Review	Doc. #SP.NY-229123 Page 2 of 9
	Distributed Energy Resources - NYSSIR	Version 1.0 – 10/25/2019

TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
1.0 INTRODUCTION	3
2.0 EXECUTIVE SUMMARY	3
3.0 COMPANY EPS PARAMETERS	4
4.0 INTERCONNECTION CUSTOMER SITE	5
5.0 SYSTEM IMPACT ANALYSIS	5
6.0 MITIGATIONS FOR SYSTEM IMPACT ANALYSIS FAILURES	8
7.0 CONCEPTUAL COST ESTIMATE	9

nationalgrid	Coordinated Electric System Interconnect Review	Doc. #SP.NY-229123 Page 3 of 9
	Distributed Energy Resources - NYSSIR	Version 1.0 – 10/25/2019

1.0 INTRODUCTION

This report presents the analysis results of the Niagara Mohawk Power Corporation d/b/a 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 National Grid electric System Bulletin No. 75, Appendix B ‘Distributed Generation Connected To National Grid Distribution Facilities Per The New York State Standardized Interconnection Requirements’. 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 [REDACTED].

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.

nationalgrid	Coordinated Electric System Interconnect Review	Doc. #SP.NY-229123 Page 4 of 9
	Distributed Energy Resources - NYSSIR	Version 1.0 – 10/25/2019

3.0 COMPANY EPS PARAMETERS

Substation	Hemstreet
Transformer Name	TB#1
Transformer Peak Load (kW)	6784
Contingency Condition Load, N-1 Criteria (kW) (as applicable)	5619
Daytime Light Load (kW)	1863
Generation: Total, Connected, Queued (kW)	6968, 3440, 3528
Contingency Condition Generation: Total, Connected, Queued (kW)	6722, 3194, 3528
Supply Voltage (kV)	115
Transformer Maximum Nameplate Rating (kVA)	12500
Distribution Bus Voltage Regulation	Yes
Transmission GFOV Status	Installed
Bus Tie	None
Number of Feeders Served from this Bus	2

Connecting Feeder/Line	32851
Peak Load on feeder (kW)	5619
Daytime Light Load on Feeder (kW)	1649
Feeder Primary Voltage at POI (kV)	13.2
Line Phasing at POI	3
Distance to nearest 3-phase, (if applicable)	N/A
Line/Source Grounding Configuration at POI	Effective
Other Generation: Total, Connected, Queued (kW)	3222, 3194, 28

System Fault Characteristics without Interconnection Customer DG at POI	
Interconnection Customer POI Location	P4 Stillwater Bridge Rd
I 3-phase (3LLL)	2,344 Amps
I Line to Ground (3I0)	1,694 Amps
Z1 (100 MVA base)	0.4534 + j1.8868PU
Z0 (100 MVA base)	1.1279 + j4.0207PU

nationalgrid	Coordinated Electric System Interconnect Review	Doc. #SP.NY-229123 Page 5 of 9
	Distributed Energy Resources - NYSSIR	Version 1.0 – 10/25/2019

4.0 INTERCONNECTION CUSTOMER SITE

The Interconnection Customer is proposing a new primary service connection with Account No. 3656239005.

This location is presently served via the Company's 13.2kV radial distribution feeder 32851 from the Hemstreet Substation.

The proposed generating system consists of:

- PV DC system consisting of eleven thousand eight hundred fifty-three (11,853) Hyundai Solar HiS-S370HI 370W modules.
- Two (2) SMA Sunny Central 2500-EV-US Inverters with 550 VAC output, 2,500kW, 3-phase, each curtailed to 1,750kW for a total of 3.5MW connected to
- Two (2) 2500kVA, 13.2kV – 550V, wye-grounded primary / delta secondary stepdown transformers, each with a 40Ω Neutral Grounding Reactor with
- Customer owned pole with customer owned 14.4kV, 300A solid blade cutout and customer owned meter
- Customer owned pole with utility owned primary meter
- Customer pole with customer owned 27kV, 630A, 12.5kAIC Tavrida Recloser with SEL-651R-2 Recloser Controller
- Customer pole with customer owned 15kV, 900A, 25kAIC gang operated, lockable load break disconnect switch
- Utility pole with utility owned recloser
- Transition pole with solid blade disconnects

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 104.9% 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 not negatively impacted.			
Voltage	Substation Regulation for Reverse Power	<XX% minimum load criteria	Pass
The total generation on Feeders 32851 and 32852 is 6.967 MW. The total minimum load on these Feeders is 1.863 MW. Therefore, the generation to load ratio is 374%. An evaluation of the existing EPS has been performed and it has been determined that existing substation LTC controller is sufficient for Reverse Power due to co-generation.			

nationalgrid	Coordinated Electric System Interconnect Review	Doc. #SP.NY-229123 Page 6 of 9
	Distributed Energy Resources - NYSSIR	Version 1.0 – 10/25/2019

Category	Criteria	Limit	Result
Voltage	Feeder Regulation for Reverse Power	<XX% Minimum load to generation ratio	Pass
There are no voltage regulators between the substation and the Point of Interconnection.			
Voltage	Fluctuation	<3% steady state from proposed generation on feeder, <5% steady state from aggregate DER on substation bus	Pass
The greatest voltage fluctuation on the feeder occurs at pole 22 on Masters Street. The resulting fluctuation at the feeder location is 0.9% due to the proposed generation and 0.2% on the substation bus due to the aggregate generation.			
Voltage	Flicker	Screen H Flicker	Pass
The Pst for the location with the greatest voltage flicker is 0.105 and the emissions limit is 0.35.			
Equipment Ratings	Thermal (continuous current)	< XX% thermal limits	Pass
The subject generator's full output current is 153 A. The total full output current of all DER downstream of the substation getaway cable is 294 A. The substation getaway cable's thermal capabilities are 484A.			
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 3.5 MW PV generation system. The subject generator exceeds the Company's criteria for islanding a distributed resource under light load conditions and will require a National Grid protection and control package.			

nationalgrid	Coordinated Electric System Interconnect Review	Doc. #SP.NY-229123 Page 7 of 9
	Distributed Energy Resources - NYSSIR	Version 1.0 – 10/25/2019

Category	Criteria	Limit	Result
Protection	Protective device coordination	Company Guidelines	Fail
<p>There are no protective devices between the subject generator's POI and the substation. The proposed customer owned recloser for site overcurrent protection can provide adequate coordination with upstream devices on the Company's EPS, however the submitted settings are not acceptable. The Interconnection Customer shall revise the site's recloser settings to provide adequate coordination with the Company's upstream protective device listed below. Adequate coordination shall be determined in accordance with IEEE 242 Table 15-3.</p> <p><u>Station Breaker R510 – SEL-251</u> - OC phase relay settings: #4 Curve, PU=642A, Time Multiplier=1.25, Instantaneous=3,480A - OC ground relay settings: #4 Curve, PU=420A, Time Multiplier=3.0, Instantaneous=3,480A</p>			
Protection	Fault Sensitivity	Rated capabilities of EPS equipment	Pass
<p>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.</p>			
Protection	Ground Fault Detection	Reduction of reach > 0%	Fail
<p>The Interconnection Customer has proposed two 2500kVA grounded wye primary - delta secondary interconnecting transformers each with an impedance of 5.75% and X/R ratio of 6.8 and equipped with a 40 ohm neutral connected grounding reactor. To be within Company guidelines, both of the neutral reactors shall have an impedance of 17 ohms. With these neutral grounding reactors in service, the Interconnection Customer will contribute approximately 116A of 310 current to remote bolted line to ground faults (64A with one interconnecting transformer out of service) and 405A to faults at the PCC (212A with one interconnecting transformer out of service).</p>			
Protection	Overvoltage - Transmission System Fault	Company 3V0 criteria	Pass
<p>The addition of this generator to the distribution EPS causes the generation to load ratio on the distribution system to exceed the Company's planning threshold for overvoltage on the transmission system as a result of a ground fault. An evaluation of the existing EPS has been performed and it has been determined that existing substation protection mitigation methods are adequate.</p>			
Protection	Overvoltage - Distribution System Fault	< 125 % voltage rise	Pass
<p>With subject generator interconnected the modeled voltage rise on the unfaulted phases of the system is 123%.</p>			
Protection	Effective Grounding	R0/X1 < 1 and X0/X1 < 3	Pass
<p>With subject generator interconnected the modeled R0/X1 is 0.7051 PU and the X0/X1 is 2.2827 PU.</p>			

Category	Criteria	Limit	Result
SCADA	Required EMS Visibility for Generation Sources	Monitoring & Control Requirements	Fail
The 3.5 MW subject generator triggers the requirement for SCADA reporting to the Utility.			
Other	Crossing of Company's Right of Way	Existing Easement in the location of proposed new facilities.	Fail
The Interconnection Customer has proposed crossing the Company's 34.5kV sub-transmission line. This will require the customer to follow the Property Transaction Review (PTR) process for reviewing requests to cross Company facilities.			

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	Option 2	Failures Addressed
National Grid Protection and Control Package (Recloser, Switches, and Poles)	██████████	N/A	Unintentional Islanding
SCADA Integration (equipment integrated into PCC Recloser)	\$██████████	N/A	Required EMS Visibility for Generation Sources

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

Option 1:

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

- N/A

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

- National Grid Protection and Control Package (Recloser, Switches, and Poles)
- SCADA Integration (equipment integrated into the PCC recloser)

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					Capital portion for calculating tax liability	Tax Liability Applied to Capital	Customer Cost Total
	Material	Labor	Overheads	Pre-Tax Total \$	Capital Costs	14.14%	Total \$
Distribution Modifications							
National Grid Protection and Control Package (<i>Recloser, Switches, and Poles</i>)	\$						
SCADA Integration (equipment integrated into PCC Recloser)	\$						
Substation Modifications							
Non-System Costs							
Customer Documentation Review, Field Verification and Witness Testing	\$						
Total Project Costs:	\$						

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.