



Appendix G – National Grid CESIR Study Results



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For
Interconnection Customer: Horizon Solar Power
Project Name: Horizon - NYSOLAR06
3,450 kW* Solar Inverter Generator System

2599 Whitehaven RD, Grand Island, NY 14072

Interconnection to National Grid
NY West
Frontier Region
Niagara Falls (#03) District
Grand Island Station 64 F6454
13.2kV Distribution

*5,000 kW as Applied Application Must Reduce to 3,450 kW

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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 (ESBs). 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 at 3,450 kW 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.

3.0 COMPANY EPS PARAMETERS

Station	Grand Island Station 64	
Transformer Name	TB1	TB2
Transformer Peak Load (kW)	15,087	14,291
Contingency Condition Load; N-1 Criteria (kW) (as applicable)	N/A	
Daytime Light Load (kW)	2,365	2,424
Generation: Total; Connected; Queued (kW)	15,094; 6,058; 4,036	

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Contingency Condition Generation: Total; Connected; Queued (kW)	N/A	
Supply Voltage (kV)	115	115
Transformer Maximum Nameplate Rating (kVA)	22,400	22,400
Distribution Bus Voltage Regulation	Yes	Yes
Transmission GFOV Status	Yes	Yes
Bus Tie	Yes	
Number of Feeders Served from Bus	4	2

Connecting Feeder	F6454
Peak Load on Feeder (kW)	2,933
24/7 Light Load on Sub-T Line (kW)	781
Feeder Primary Voltage at POI (kV)	4.8
Line Phasing at POI	3-phase
Distance to nearest 3-phase, (if applicable)	N/A
Line/Source Grounding Configuration at POI	Ungrounded
Other Generation: Total; Connected; Queued (kW)	14,063; 5,063; 4,000

System Fault Characteristics without Interconnection Customer DG at POI	
Interconnection Customer POI Location	Pole 2,603 on Whitehaven Rd.
I 3-phase (3LLL)	2,771.3 Amps
I Line to Ground (3I0)	1,797.0 Amps
Z1 (100 MVA base)	0.62528 + j1.45222 PU
Z0 (100 MVA base)	1.83427 + j3.72806 PU

4.0 INTERCONNECTION CUSTOMER SITE

The Interconnection Customer is proposing a new primary service connection with Account No. 7827634003.

The requested point of interconnection (POI) location currently 4.8kV, will be served via the 13.2 kV feeder F6454 which will require converting about 2,750 ft. from 4.8kV to 13.2kV.

The proposed generating system consists of:

- Main Service Equipment
 - One (1) 300A Loadbreak Gang-Operated Switch
 - Cooper M-Force
 - Various Surge Arrestors (10.2 kV MCOV)
 - Pole Mounted Customer G&W Viper-S Recloser with SEL 651R2 Relay
 - National Grid Utility Meter
 - Pole mounted Bladed Cutouts (300A Rating)
 - Hubbell CP710133
 - One (1) 500kVA 13.2 kV Grounding Transformer

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- X/R = 5.1
- 10 SEC
- Sub-System (Typical of Two):
 - One (1) 2,500 kVA 13.2 kV Delta / 600 V wye-grounded transformer
 - 5.75% Z
 - X/R = 10
 - One (1) 3,300 kVA / 3,300 kW inverter (Power Electronics HEMK FS3190K)
 - Power will be curtailed to 2,500 kVA / 2,500 kW (unity power factor)
 - Twenty (20) CPS SCH125KTL-DO/US-600 Invertors
 - Rated at 125kW at 600V
 - 19 Strings of 26 CS3U-380W Modules Each

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 sub-transmission network is 104.67% of nominal.			
Voltage	Undervoltage	> 95% (ANSI C84.1)	Pass
With the addition of the subject generator the maximum 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 this distribution system is 15,094 kW (6,05 connected, 4,056 kW in queue, plus this application of 5,000 kW). Comparison of the minimum loading on this station (4,789 kW) to the DER in queue (15,094 kW) is 315% and is above 100%.			
Due to the appropriate reverse power controllers already being installed, reverse power is not a concern.			
Voltage	Feeder Regulation for Reverse Power	<100% Minimum load to generation ratio	Fail
There is one regulator currently being installed located on the line. It is expected that the downstream generation (9,000 kW) is going to backfeed the regulator.			
Proper control settings will be installed when the regulator is installed.			

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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.	Pass
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The greatest voltage fluctuation on the feeder occurs at the point of interconnection, resulting in an 1.7% increase.

Voltage	Flicker	Screen H Flicker	Fail
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The Pst for the location with the greatest voltage fluctuation is 0.448 on the pre-existing three-phase 4.8 kV circuit for the application of this 5,000 kW site and therefore this project fails the emissions limit of 0.35.

The Pst for the location with the greatest voltage fluctuation is 0.157 if converted to a 13.2 kV circuit for the application of this 5,000 kW site and therefore this project passes the emissions limit of 0.35.

Equipment Ratings	Thermal (continuous current)	< 100% thermal limits	Fail
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The subject generator's full output current is 218 A at the 5,000 kW size at 13.2 kV. There is 9,063 kW of other generation sites on F6454, equaling a total of 615 A (14,063 kW) of total generation with the addition of this project.

At 4.8kV, the generator's full output is 601.4 A which is above the rating above the upstream 500 kVA ratio transformer which is rated at 60 A. This will require a conversion from 4.8 kV to 13.2 kV of approximately 2,750 feet.

An upstream regulator has a rating of 252.27 A and it is modeled to have 367 A from the downstream generation feeding through it. This will require the applying generator to downsize to 1,950 kW or have the regulator controls to be set at +/-5% instead of +/-10%.

The feeder's 500 MCM getaway is rated for 359 A and is modeled to have 578 A from the downstream generation pass through it. This will require the replacement the existing getaway with 1000 MCM CU which requires a new conduit as well.

336.4 SAL wire near the station is rated for 514 A and is modeled to have 578 A from the downstream generation pass through it. This will require the applying generator to downsize to 3,450 kW.

Equipment Ratings	Withstand (fault current)	< 90% withstand limits	Pass
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The additional fault current contribution from the generation does not contribute to interrupting ratings in excess of existing EPS equipment.

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Protection	Unintentional Islanding	Unintentional Islanding Document & Company Guidelines	Fail
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The proposed subject generator is a 5,000 kW, but the required size of 3,450 kW PV generation system is evaluated.

The proposed generation system exceeds the Company's criteria for islanding a distributed resource, therefore unintentional islanding is a concern. Therefore the following system upgrades are required:

National Grid Protection and Control Package

Protection	Protective device coordination	Company Guidelines	Pass
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The customer's currently proposed system protection relay for this project is a SEL-651R Recloser. 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.

- Grand Island Feeder 6454 /breaker – Westinghouse CO-11
- OC phase relay settings: CO-11 Curve, PU = 720A, Time Dial = 1.25, Instantaneous Pickup = 3480A
- OC ground relay settings: CO-11 Curve, PU = 480A, Time Dial = 2.1, Instantaneous Pickup = N/A

The 50, 51, 50N, and 51N functions must be enabled as highlighted by ESB 756B to provide appropriate coordination with the interconnected distribution.

Protection	Fault Sensitivity	Rated capabilities of EPS equipment	Pass
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Fault studies show that contribution from the proposed system for faults on the Grand Island 6454 feeder 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.

Protection	Ground Fault Detection	Reduction of reach > 0%	Fail
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The Interconnection Customer has proposed a single 500kVA high side grounded-wye / delta grounding transformer with an impedance of Z = 4.5% and an X/R = 5.1. The Company shall require the Interconnection Customer's high side grounded-wye/ delta grounding bank to have an impedance of 13.34 Ohms to be within Company requirements. The Interconnection Customer will contribute approximately 85A of 310 current to remote bolted line to ground faults and 187A to faults at the PCC.

Protection	Overvoltage - Transmission System Fault	Company 3V0 criteria	Pass
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An evaluation of the existing EPS has been performed and it has been determined that the existing protection scheme at Grand Island Station 64 is already installed to preclude this concern. Therefore, no upgrades are required as mitigation is already in place.

Protection	Overvoltage - Distribution System Fault	< 125 % voltage rise	Pass
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With subject generator interconnected the modeled voltage rise on the unfaulted phases of the system is 125.2%. The voltage rise is currently failing the Company screen as a pre-existing issue. The company will strive to correct this issue independent of the proposed generating system.			
Protection	Effective Grounding	$R0/X1 < 1, X0/X1 < 3$	Pass
With subject generator interconnected the modeled R0/X1 is 1.27987 PU and the X0/X1 is 2.61486 PU. The R0/X1 ratio is currently failing the Company screen as a pre-existing issue. The Company will strive to correct this issue independent of the proposed generating system.			
SCADA	Required EMS Visibility for Generation Sources	Monitoring & Control Requirements	Fail
The 5,000 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			
None noted.			

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 (Reduction to 3,450 kW)	Option 2 (Reduction to 1,950 kW)	Failures Addressed
National Grid Protection and Control Package	██████████	██████████	Unintentional Islanding Protection
~2,750 feet Conversion from 4.8kV to 13.2kV	██████████	██████████	Flicker and Thermal (continuous current)
Regulator Setting Changes	██████████	N/A	Thermal (continuous current)
Upgrade Feeder Getaway Cable (includes new ductbank)	██████████	██████████	Thermal (continuous current)

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

Option 1 (Reduction to 3,450 kW):

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

- National Grid Protection and Control Package (13.2 kV Recloser, external power transformer(s), 13.2 kV disconnect switches, new equipment poles and replacement of adjacent poles to

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support required clearances, and associated hardware). Reference ESB-756B Figure 5 for overview of expected National Grid and customer equipment sequence.

- Convert approximately 2,750 Feet of 4.8kV to 13.2kV (reconductor wires from 5kV class to 15kV class, relocation of 13.2kV/4.8kV ratio transformer, replacement of 4.8kV/120V transformers to 13.2kV/120V transformers)
- Change regulator settings to increase rating. (From +/- 10% to 5%)

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

- Installation of new conduit from the station breaker to the feeder riser pole with a large conductor for the feeder getaway.

Option 2 (Reduction to 1,950 kW):

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

- National Grid Protection and Control Package (13.2 kV Recloser, external power transformer(s), 13.2 kV disconnect switches, new equipment poles and replacement of adjacent poles to support required clearances, and associated hardware). Reference ESB-756B Figure 5 for overview of expected National Grid and customer equipment sequence.
- Convert approximately 2,750 Feet of 4.8kV to 13.2kV (reconductor wires from 5kV class to 15kV class, relocation of 13.2kV/4.8kV ratio transformer, replacement of 4.8kV/120V transformers to 13.2kV/120V transformers)

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

- Installation of new conduit from the station breaker to the feeder riser pole with a large conductor for the feeder getaway.

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 \$	Capital Costs	Rate	Total \$
Distribution Modifications							
Distribution System Modifications							
National Grid Protection and Control Package (Recloser, Switches, and Poles)							
Conversion of Approximately 2,750 ft. from 4.8kV to 13.2 kV							
Regulator Settings Change (Set to +/-5%)							
Non-System Costs							
Customer Documentation Review, Field Verification and Witness Testing							
Substation Modifications							
~400 ft of Feeder Getaway Upgrade and Conduit Installation							
Distribution Summary							
Station Summary							
Total							

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.