DRS-TK-5

RLC ENGINEERING

FINAL REPORT

REVISION 0

MARCH 2, 2022

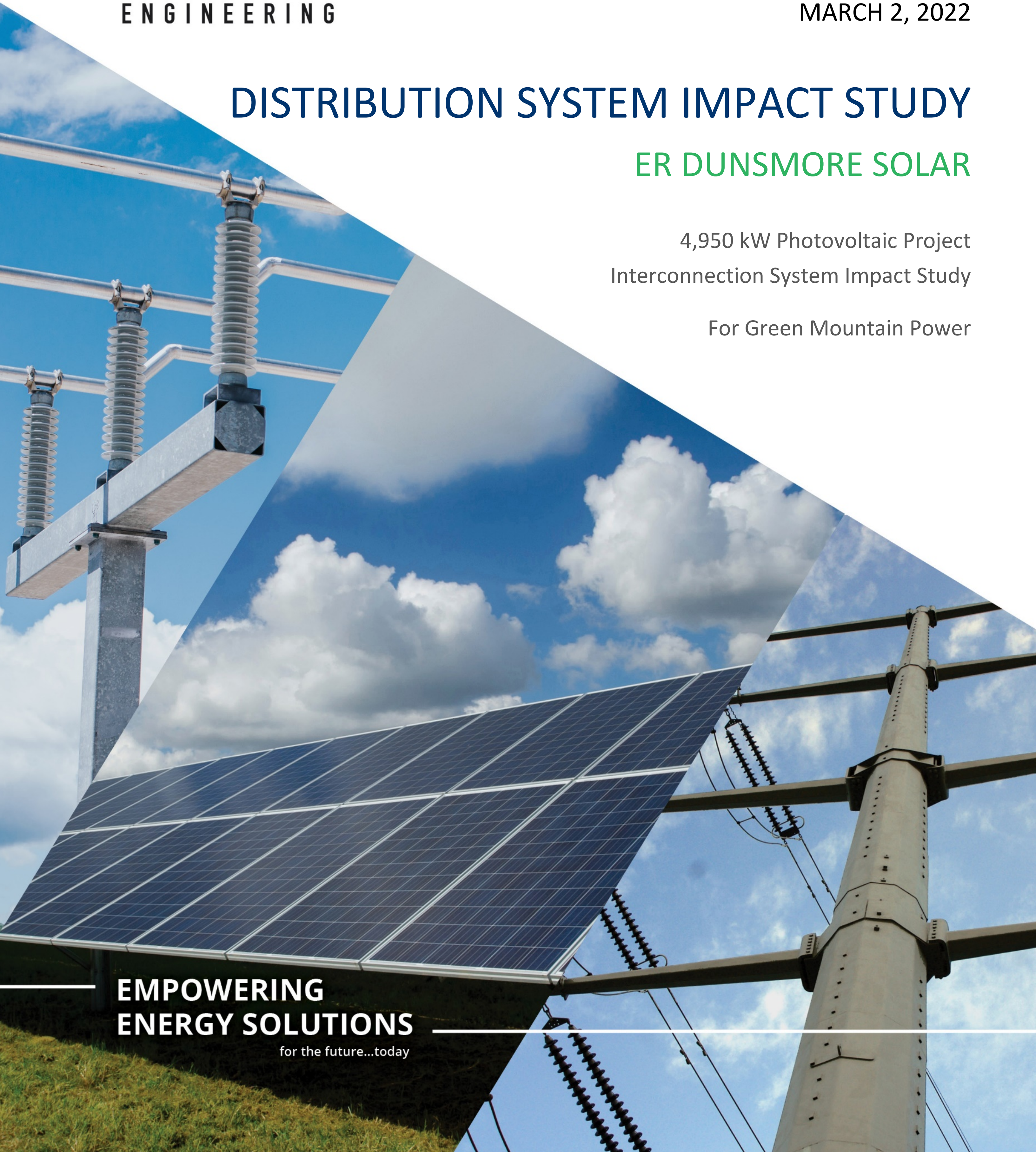
DISTRIBUTION SYSTEM IMPACT STUDY

ER DUNSMORE SOLAR

4,950 kW Photovoltaic Project

Interconnection System Impact Study

For Green Mountain Power



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Revision History

Rev.	Date	Revised By	Reason
A	2/21/2021	JLT	Original Draft Release
B	3/1/2022	JLT	Revised Draft Release
0	3/2/2022	ALS	Final Report Release

LEGAL NOTICE

EXECUTIVE SUMMARY

On behalf of Green Mountain Power (GMP), RLC Engineering, LLC (RLC) conducted a distribution system impact study (Study) of the proposed ER Dunsmore, LLC 4,950 kW photovoltaic project (Project), to be located in Swanton, Vermont, pursuant to the interconnection requirements of Vermont Public Utility Commission (PUC) Rule 5.500. The primary focus of this Study was to:

1. Assess compliance of the proposed Project with the requirements of distributed generation interconnecting to the GMP system according to the Green Mountain Power Interconnection Guidelines for Distributed Energy Resources (https://greenmountainpower.com/wp-content/uploads/2017/01/Final-2021-DER-Guidelines-2-2021-03-19.pdf).
2. Assess the steady state, time-based, and protection impacts of the proposed Project on the distribution systems served from the North Elm Street substation.
3. Identify distribution system and substation upgrades that may be necessary to complete the interconnection of the Project.

The Study includes an evaluation of the following items:

- Steady State Load Flow Analysis
- Time Series Analysis
- Protection Evaluation
- Verification of Compliance with Standards

Note that all modeling and simulations were conducted using Eaton's CYME software.

Project Description

The photovoltaic (PV) Project in Table 0-1 proposes to interconnect to the NE-G16 feeder, which is supplied by GMP's North Elm Street 34.5/12.47 kV substation.

Table 0-1: Project Interconnecting on the 12.47 kV Network

Project	Location	Developer	Maximum Output (kW)
ER Dunsmore Solar	2642 Dunsmore Road, Swanton, VT 05488	ER Dunsmore, LLC	4,950

The Project proposes the inverter and transformer design outlined in Table 0-2.

Table 0-2: Project Generators and Step Up Transformers

Generator(s)	# of Inverters	Step Up Transformer(s)	# of GSU's
CPS-SCH275KTL-DO/US-800	18	Customer-Owned, 3 phase, 12.47 kV Grounded Wye – 800 V Grounded Wye, 2,500 kVA, 5.75%Z	2

The proposed interconnection complies with all applicable standards, provided all recommendations of this Study report are met.

Study Findings

GMP provided RLC with a detailed CYME model including the NE-G16 feeder and the North Elm Street substation. The NE-G17 feeder is also served from the North Elm Street substation; however, it was not included within the provided model. Therefore, an aggregate load and generator were placed at the NE-G17 feeder head to reflect this circuit. The loading scenarios outlined in Table 0-3 were taken into account when applicable.

Table 0-3: Loading Scenarios

Loading Scenario	Native Loading Levels (kW)*		
	NE-G16	NE-G17	Substation
Peak	7,023	2,889	10,212
Minimum Daytime	2,975	1,764	4,786
*Note: The native load levels were measured in the provided CYME model and include system losses.			

A summary of all simulation results and network upgrades necessary to mitigate adverse impacts caused by the Project is presented in Table 0-4 and Table 0-5.

Table 0-4: Study Results Summary – Part 1

Analysis Type	Criteria	Results	Upgrades	Notes
Voltage	Steady State: 95% < V < 105%	High voltages up to 110.46% across feeder under peak & minimum load, peak generation scenarios	Voltage violations were successfully addressed by the reconductoring required to address thermal violations.	The NE-G16 S/S regulators were set to 121 V midpoint, bandwidth = 3 V, Rset = 0, and Xset = 0 The line regulators at taglet 491205 were set to 121 V midpoint, bandwidth = 3 V, Rset = 0, and Xset = 0 The high voltage violations were mitigated with the reconductoring proposed to address thermal violations. GMP shall make final determination on all device and conductor upgrades.
	Reconnection: 95% < V < 105%	Reconnection high voltages up to 106.8% due to the Project were observed prior to voltage regulators adjusting.	The Project reconnection must be staggered relative to the existing recloser-equipped generation on the circuit. The Project shall have an enter service delay of 8 minutes. Additionally, the Project is required to implement a stepwise linear ramp during its enter service period utilizing 20% steps over a 5 minute (300 s) period, i.e. the Project output ramps up 20% every 1 minute (60 s).	The Project reconnection period may result in temporary high voltages if enter service periods of other feeder generation overlap with that of the Project's. Note that reconnection ramp data for existing feeder generation was not available for the study. GMP shall make the final determination on all settings.
	Voltage Imbalance: Imbalance < 3%	No violations	None	
	Flicker: IEEE 1547-2018 Section 7.2.3 Compliance	No violations with a Shape Factor of 0.2	None	Note that a 100% to 0% output change within 1s corresponds to a Shape Factor of 0.2. Any full output ramp longer than 1s would result in even less severe flicker. GMP believes that a 1s ramp rate is sufficiently conservative for solar project flicker analysis.
Thermal	< 90% Conductor Ratings < 100% Fuse Ratings < 100% LTC Ratings < 100% Regulator Ratings < 100% Hydraulic Recloser Ratings	3x 150 A Regulators overloaded up to 172.8% ~18,000 ft of 1/0 6/1 ACSR conductor overloaded up to 144.1% ~220 ft of 1/0 AAAC conductor overloaded up to 113.1% ~820 ft of 336 AAC conductor loaded up to 90.9% S/S Regulators 1212 overloaded up to 104.5%	1. Replace 150 A 7851, 7812, and 7813 regulators with 3x 328 A regulators 2. Reconductor ~18,000 ft of 1/0 6/1 ACSR conductor with 477 18/1 ACSR conductor 3. Reconductor ~220 ft of 1/0 AAAC conductor with 477 18/1 ACSR conductor 4. Reconductor ~1,700 ft of 336 AAC conductor with 477 18/1 ACSR conductor 5. Replace 437 A 1212 S/S regulators with 546 A regulators	GMP shall make final determination on all device and conductor upgrades.

Table 0-5: Study Results Summary – Part 2

Analysis Type	Criteria	Results	Upgrades	Notes
Protection Evaluation	<u>% of Pickup</u> (Device Current ≤ 67% of Pickup at Peak Load, 0% Generation)	No violations	None	Results: BB-7 breaker: 54.87% NE-G16 breaker: 54.27% 640800_640799 recloser: 64.81% 638314_1210006 recloser: 30.36% ER Dunsmore recloser: 0%
	<u>% of Pickup</u> (Device Current ≤ 67% of Pickup at Min Load, 100% Generation)	Failed Criteria: 640800_640799 - 156.94%	Increase minimum phase pickup: 640800_640799 - from 216 A to 510 A	Results: BB-7 breaker: 40% NE-G16 breaker: 60.88% 640800_640799: 66.47% 638314_1210006: 61.94% ER Dunsmore recloser: 65.59%
	<u>Protective Reach</u> Reach ≥ 3	<u>NE-G16 breaker relay reach:</u> Pre-Project (LLL/LG) - 3.97/5.51 Post-Project (LLL/LG) - 4.00/5.52 <u>640800_640799 recloser reach:</u> Pre-Project (LLL/LG) - 4.23/3.49 Post-Project (LLL/LG) - 2.27/3.05 <u>638314_1210006 recloser reach:</u> Post-Project (LLL/LG) - 4.26/4.5	A recloser was added at tag 473021_1290259 to address reach violations. See Table 2-3 for proposed protection settings GMP shall make the final determination on device location and any other upgrades that are necessary to maintain reliability	Resulting reach: <u>640800_640799 recloser reach:</u> Pre-Project (LLL/LG) - 4.23/3.49 Post-Project (LLL/LG) - 3.21/3.07 <u>473021_1290259 recloser reach:</u> Post-Project (LLL/LG) - 3.22/3.09
	<u>Coordination</u> Maintain GMP Margins	Failed criteria	See Table 2-2 and Table 2-3 for proposed protection settings in order to maintain GMP margin criteria	
Ground Fault Overvoltage	<u>Transmission</u> Minimum Load:Gen > 2	Failed criteria	None — the existing DTT protection scheme from both the North St. Albans B-10 and the Nason Street B-3 to the NE-G16 mitigates ground fault over voltage conditions on the transmission system.	GMP requires that the minimum load to generation ratio on transmission systems be greater than 2 (i.e. total generation excluding DTT) for all distributed resources without DTT from the operating devices under study. Transmission Ground Fault Overvoltage has been addressed at the North Elm Street substation, so this is not a concern.
	<u>Distribution</u> Inverter DER > 500 kW	DER Project is > 500 kW	A GMP installed recloser at the PCC is required.	GMP requires a recloser at the PCC for all inverter-based DER greater than 500 kW. GMP also requires inverter settings to be modified from the default settings and meet all applicable standards including the ISO-NE SRD.
Islanding	Inverter DER ≥ 1,000 kW	DER Project is ≥ 1,000 kW	Reclose block is required. GMP shall make final determination on the design and cost of reclose block in a Facilities Study.	GMP requires reclose block for inverter DER greater than or equal to 1,000 kW where the summation of a line segment's DER is greater than ½ of the line segment's minimum load. For this Project, reclose block will be required at the existing upstream fuse (that would be replaced with an electronic line recloser), the existing upstream line recloser, and the NE-G16 substation breaker. The equipment and costs required would be determined in a Facilities Study.

1 LOAD FLOW EVALUATION

1.1 Voltage Levels and Imbalance

Steady state load flow simulations were performed to verify compliance with ANSI C84.1 Range A distribution voltage limits (±5%) and GMP voltage imbalance criteria, which mandates that all three phase lines contain less than 3% imbalance.

Simulations were conducted with all voltage regulating equipment allowed to adjust. A voltage results summary is shown in Table 1-1. Note that small customer violations were ignored for this analysis.

Table 1-1: Steady State Voltage Evaluation Summary – Existing System

Evaluation	Scenario	Voltage Violations	Notes
Peak Loading, Max Generation	Pre-Project	No violations	
	Post-Project	High voltages up to 107.49% upstream of the PCC	
Light Daytime Loading, Max Generation	Pre-Project	No violations	
	Post-Project	Voltages as high as 105.07% were observed	

As shown, the Project causes high voltage conditions under peak loading and light daytime loading with maximum generation. These high voltages were mitigated with the thermal upgrades discussed in Section 1.4.

Table 1-2 summarizes the steady state load flow simulation results including the required system upgrades.

Table 1-2: Steady State Voltage Evaluation Summary – System Upgrades Included

Evaluation	Scenario	Voltage Violations	Notes
Peak Loading, Max Generation	Pre-Project	No violations	
	Post-Project	No violations	
Light Daytime Loading, Max Generation	Pre-Project	No violations	
	Post-Project	No violations	

The required system upgrades mitigate all post-Project high voltages.

1.2 Reconnection Voltages

A voltage evaluation was performed to confirm that the reconnection of generation facilities after an outage would not result in ANSI C84.1 Range A violations. The reconnection simulations and evaluations were performed in four steps:

1. Load flow was run on the system with no generation online and all voltage regulation equipment allowed to adjust.
2. All pre-Project generation that is not interconnected to the distribution system through a recloser was brought online at full output with all voltage regulation equipment held fixed.
3. All voltage regulation equipment was allowed to adjust with only pre-Project generation in service.
4. The existing recloser-connected generation and the Project were interconnected simultaneously with all voltage regulation equipment held fixed.

A reconnection results summary is shown in Table 1-3. Note that pre-Project customer violations were ignored for this analysis.

Table 1-3: Reconnection Voltage Evaluation Summary – Instant Project Reconnection

Evaluation	Scenario	Voltage Violations	Notes
Peak Loading, Max Generation	No Generation, Regulation Adjusting	No violations	
	Non-Recloser Generation Online, Regulation Fixed	Voltage violations as high as 109.97% were seen on the medium voltage system	
	Regulation Adjusting	No violations	
	Recloser Generation Online, Regulation Fixed	Voltage violations as high as 106.8% were seen on the medium voltage system	
Light Daytime Loading, Max Generation	No Generation, Regulation Adjusting	No violations	
	Non-Recloser Generation Online, Regulation Fixed	Voltage violations as high as 106.16% were seen on the medium voltage system	
	Regulation Adjusting	No violations	
	Recloser Generation Online, Regulation Fixed	No violations	

As shown, the Project resulted in high voltage violations when brought online at maximum output during the reconnection evaluation. The following Project reconnection mitigation strategies are required to alleviate the observed violations:

- The Project's reconnection must be staggered relative to the existing large DER facilities: 2,200 kW PV.
- The Project reconnection must start at 8 minutes.

- The Project must implement a stepwise linear ramp during its enter service period utilizing 20% steps over a 5 minute (300 s) period, i.e. the Project ramps up to maximum output by increasing 20% every 1 minute (60 s). This enter service recommendation complies with IEEE 1547-2018 Section 4.10.3.

Note that the Project's enter service period cannot overlap with the existing recloser-equipped generators', as this will result in high voltages prior to regulator adjustments. Table 1-4 summarizes the reconnection results with the proposed mitigation strategy.

Table 1-4: Reconnection Voltage Evaluation Summary – Delayed Project Reconnection

Evaluation	Scenario	Voltage Violations	Notes
Peak Loading, Max Generation	No Generation, Regulation Adjusting	No violations	The ER Dunsmore Solar Project causes high voltages prior to regulators adjusting if brought online at 100%
	Non-Recloser Generation Online, Regulation Fixed	Voltage violations as high as 109.97% were seen on the medium voltage system	
	Regulation Adjusting	No violations	
	2,200 kW PV Online, Regulation Fixed (Start 7 Minutes)	No violations	
	Regulation Adjusting	No violations	
	ER Dunsmore Solar Brought Online in 20% (990 kW) Blocks, Regulation Fixed (Start 8 Minutes)	No violations	
Light Daytime Loading, Max Generation	No Generation, Regulation Adjusting	No violations	
	Non-Recloser Generation Online, Regulation Fixed	Voltage violations as high as 106.16% were seen on the medium voltage system	
	Regulation Adjusting	No violations	
	2,200 kW PV Online, Regulation Fixed (Start 7 Minutes)	No violations	
	Regulation Adjusting	No violations	
	ER Dunsmore Solar Brought Online in 20% (990 kW) Blocks, Regulation Fixed (Start 8 Minutes)	No violations	

1.3 Voltage Flicker

Voltage flicker testing was conducted with CYME's Long Term Dynamics module to evaluate compliance with both IEEE 1547-2018, Section 7.2.3 and IEEE 1453-2015. The following form of this evaluation was performed:

- Single site – used to evaluate the Project's sole contribution to flicker levels

Section 1.3.1 discusses the single site evaluation.

1.3.1 Single Site Evaluation

The single site evaluation ensures that short- and long-term flicker severities (P_{st} and P_{lt}) are within their short- and long-term flicker emission limits (E_{Pst} and E_{Plt}) of 0.35 and 0.25, respectively, as defined by IEEE 1547-2018. Note that short-term simulations were conducted over 600 seconds and long-term simulations were conducted over 2 hours. Therefore, long-term simulations were comprised of 12 short-term simulations in series and short-term emissions were determined based on the most conservative results seen across all 12 short-term simulations.

GMP provided a PV output profile that was used to simulate potential Project output volatility due to rapidly moving clouds. Within this profile, the most volatile 2-hour interval was chosen and used for Long Term Dynamics modeling. This volatile output is shown in Figure 1-1.

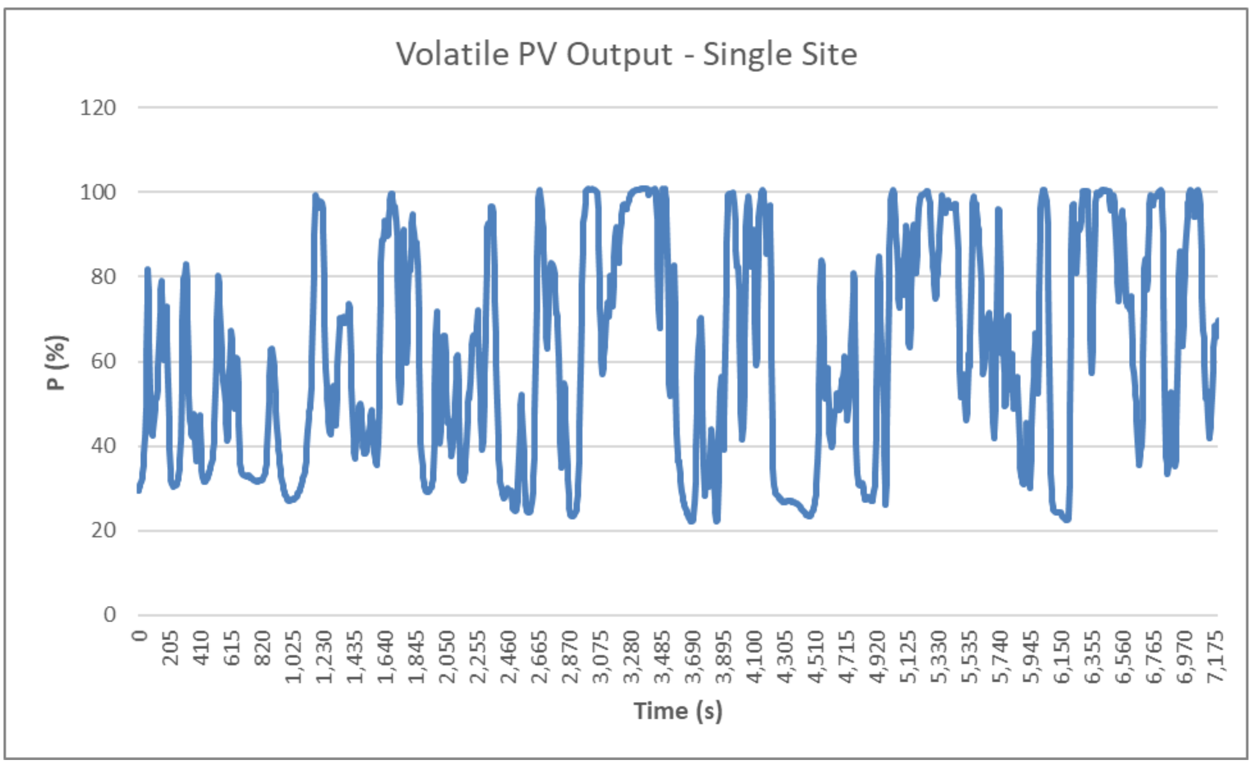


Figure 1-1: 2 Hour Volatile PV Profile – Single Site

This profile was run across the two loading scenarios identified in Table 0-3. Results from these simulations can be seen in Table 1-5.

Table 1-5: IEEE 1547-2018 Voltage Flicker Evaluation Summary – Single Site

Loading	LTD Simulation	Volatile PV Output			
		PCC		Criteria Compliance Determination	
		P_{st}	P_{lt}	Short Term Pass?	Long Term Pass?
Peak Daytime	1	0.0102	0.0080	Yes	Yes
	2	0.0065		Yes	
	3	0.0065		Yes	
	4	0.0083		Yes	
	5	0.0094		Yes	
	6	0.0043		Yes	
	7	0.0111		Yes	
	8	0.0074		Yes	
	9	0.0057		Yes	
	10	0.0081		Yes	
	11	0.0059		Yes	
	12	0.0072		Yes	
Minimum Daytime	1	0.0077	0.0062	Yes	Yes
	2	0.0046		Yes	
	3	0.0051		Yes	
	4	0.0063		Yes	
	5	0.0079		Yes	
	6	0.0036		Yes	
	7	0.0081		Yes	
	8	0.0064		Yes	
	9	0.0049		Yes	
	10	0.0059		Yes	
	11	0.0049		Yes	
	12	0.0059		Yes	

As shown, no criteria violations occurred under any loading scenario for the single site evaluation.

1.4 Thermal

Steady state load flow simulations were performed to examine power flows through feeder and substation devices. GMP thermal criteria dictates that the following ratings not be exceeded:

1. 90% of conductor ampacity ratings
2. 100% of sectionalizing fuse continuous ratings
3. 100% of load tap changer or regulator continuous ratings
4. 100% of hydraulic recloser continuous ratings
5. 100% of regulator continuous ratings, without load bonus

A thermal results summary is shown in Table 1-6. Note that small customer violations were ignored for this analysis.

Table 1-6: Steady State Thermal Evaluation Summary – Existing System

Evaluation	Scenario	Thermal Violations	Notes
Peak Loading, Max Generation	Pre-Project	No violations	
	Post-Project	• 3x 150 A Regulators overloaded up to 152.6% • ~14,000 ft of 1/0 6/1 ACSR conductor overloaded up to 119.1%	
Light Daytime Loading, Max Generation	Pre-Project	No violations	
	Post-Project	• 3x 150 A Regulators overloaded up to 172.8% • ~18,000 ft of 1/0 6/1 ACSR conductor overloaded up to 144.1% • ~220 ft of 1/0 AAAC conductor overloaded up to 113.1% • ~1,700 ft of 336 AAC conductor loaded up to 90.9% • S/S Regulators 1212 overloaded up to 104.5%	
0% Loading, Max Generation	Pre-Project	No violations	
	Post-Project	• 640131_638293_226822 Cutout Solid overloaded up to 103.9% • 3x 150 A Regulators overloaded up to 192.7% • ~16,000 ft of 1/0 6/1 ACSR conductor overloaded up to 163.3% • ~220 ft of 1/0 AAAC conductor overloaded up to 128.9% • ~1,700 ft of 336 AAC conductor loaded up to 116.0% • S/S Regulators 1212 overloaded up to 124.8%	

As shown, the Project overloads the substation regulator, the in-line 150 A voltage regulators, and various sections of conductor. The following upgrades are required to mitigate the peak loading and light daytime loading scenarios' thermal violations:

1. Upgrade ~18,000 ft of 1/0 6/1 ACSR conductor to 477 18/1 ACSR conductor
2. Upgrade ~220 ft of 1/0 AAAC conductor to 477 18/1 ACSR conductor
3. Upgrade ~1,700 ft of 336 AAC with 556 18/1 ACSR conductor
4. Upgrade line regulators to 328 A units
5. Upgrade S/S regulators 1212 to 546 A units

Table 1-7 summarizes the thermal results including the required system upgrades.

Table 1-7: Steady State Thermal Evaluation Summary – System Upgrades Included

Evaluation	Scenario	Thermal Violations	Notes
Peak Loading, Max Generation	Pre-Project	No violations	
	Post-Project	No violations	
Light Daytime Loading, Max Generation	Pre-Project	No violations	
	Post-Project	No violations	
0% Loading, Max Generation	Pre-Project	No violations	
	Post-Project	• 640131_638293_226822 Cutout Solid overloaded up to 114.6% • S/S Regulators 1212 overloaded up to 105.7% • ~1,500 ft of 477 ACSR conductor loaded up to 98%	

As shown, the required system upgrades alleviate all thermal violations for peak and light daytime loading conditions with max generation. GMP shall make final determination regarding the required upgrades and device sizes.

2 PROTECTION EVALUATION

2.1 % of Pickup, Reach, and Coordination

A protection evaluation was conducted to evaluate compliance with the following GMP criteria:

1. % of Pickup – Non-fault currents shall not exceed 67% of the phase pickup of an electronic recloser under peak load conditions
2. % of Pickup – Non-fault currents shall not exceed 67% of the phase pickup of an electronic recloser under the conditions of 0% load and 100% generation
3. Reach – Pickup levels shall not be less than 3.0 for bolted LLL and LG faults
4. Coordination – Margins shall be maintained per GMP's standards between protective devices from the Project to the substation

Simulations were performed for respective evaluations and a protection results summary is shown in Table 2-1.

Table 2-1: Protection Evaluation Summary

Evaluations	Results	Upgrades/Remediations	Notes
% of Pickup (Device Current ≤ 67% of Pickup at Peak Load, 0% Generation)	No violations	None	Results: BB-7 breaker: 54.87% NE-G16 breaker: 54.27% 640800_640799 recloser: 64.81% 638314_1210006 recloser: 30.36% ER Dunsmore recloser: 0%
% of Pickup (Device Current ≤ 67% of Pickup at Min Load, 100% Generation)	Failed Criteria: 640800_640799 - 156.94%	Increase minimum phase pickup: 640800_640799 - from 216 A to 510 A	Results: BB-7 breaker: 40% NE-G16 breaker: 60.88% 640800_640799 recloser: 66.47% 638314_1210006 recloser: 61.94% ER Dunsmore recloser: 65.59%
Protective Reach (Reach ≥ 3)	NE-G16 breaker relay reach: Pre-Project (LLL/LG) - 3.97/5.51 Post-Project (LLL/LG) - 4.00/5.52 640800_640799 recloser reach: Pre-Project (LLL/LG) - 4.23/3.49 Post-Project (LLL/LG) - 2.27/3.05 638314_1210006 recloser reach: Post-Project (LLL/LG) - 4.26/4.5	A recloser was added at tag 473021_1290259 to address reach violations. See Table 2-3 for the proposed protection settings GMP shall make the final determination on device location and any other upgrades that are necessary to maintain reliability	Resulting reach: 640800_640799 recloser reach: Pre-Project (LLL/LG) - 4.23/3.49 Post-Project (LLL/LG) - 3.21/3.07 473021_1290259 recloser reach: Post-Project (LLL/LG) - 3.22/3.09
Coordination (Maintain GMP Margins)	Failed criteria	See Table 2-2 and Table 2-3 for proposed protection settings in order to maintain GMP margin criteria	

Table 2-2 shows the existing and proposed protective devices with their location, types, ratings, and minimum time separation with the proposed settings shown in Table 2-3. The phase/ground TCC plots with these settings can be seen in Figure 2-1 and Figure 2-2, respectively.

Table 2-2: Protective Devices – Part 1

Device	Taglet	Type	Relay	Cont. Rating (A)	Inter. Rating (A)	Minimum Time Separation Between Device (s)	Next Upstream Device
BB-7			SEL-387	1,200	12,500		
NE-G16			SEL-351	1,200	12,500	P: 0.579 G: 6.237	BB-7
640800_640799	640800_640799	GVR	SEL-351R	560	12,000	P: 0.452 G: 0.383	NE-G16
638314_1210006 (New)	638314_1210006_POLE	Viper ST	SEL-651R	800	12,000	P: 0.671 G: 0.794	640800_640799
ER DUNSMORE - GMP RECLOSER (New)	ER DUNSMORE PCC	Viper S	SEL-351R	800	12,000	P: 0.589 G: 0.613	688967_PRIOH (New)
485763_638836	485763_638836	V4H		50	2,000	0.593	611231_PRIOH 80T Fuse (New)
473021_1290259 (New)	473021_1290259_POLE	Viper ST	SEL-651R	800	12,000	P: 1.345 G: 1.599	640800_640799
636871_636870	636871_636870	GVR	SEL-351R	560	12,000	P: 0.807 G: -	541883_PRIOH (New)
636316_636884	636316_636884	V4H		100	2,000	1.034	541883_PRIOH (New)

Table 2-3 shows the existing and proposed protection settings for protective devices used to satisfy % of pickup, protective reach, and GMP coordination margin criteria.

Table 2-3: Protective Devices – Part 2

Device	Existing Phase Pickup (A)	Existing Ground Pickup (A)	Existing Curve	Existing TD	Recommended Phase Pickup (A)	Recommended Ground Pickup (A)	Recommended Curve	Recommended TD
BB-7	343	720	EI (U4)	P: 4.39 G: 5.3				
NE-G16	750	480	EI (U4)	P: 2 G: 4.2				P: 3.5 G: 6.8
640800_640799	216	216	EI (U4)	PS: 3.8 GS: 3.8	510	410		P: 3 G: 4.2
638314_1210006 (New)					360	290	EI (U4)	PS: 4 GS: 5.5
ER DUNSMORE - GMP RECLOSER (New)					340	250	EI (U4)	PS: 3 GS: 4.8
485763_638836	100		F: A S: C					
473021_1290259 (New)					360	290	EI (U4)	PS: 1.8 GS: 1
636871_636870	80	0	EI	PS: 4.1				
636316_636884	200		F: A S: C					

Figure 2-1 shows the phase TCC plot for all devices upstream of the Project PCC using the recommended device settings from Table 2-3.

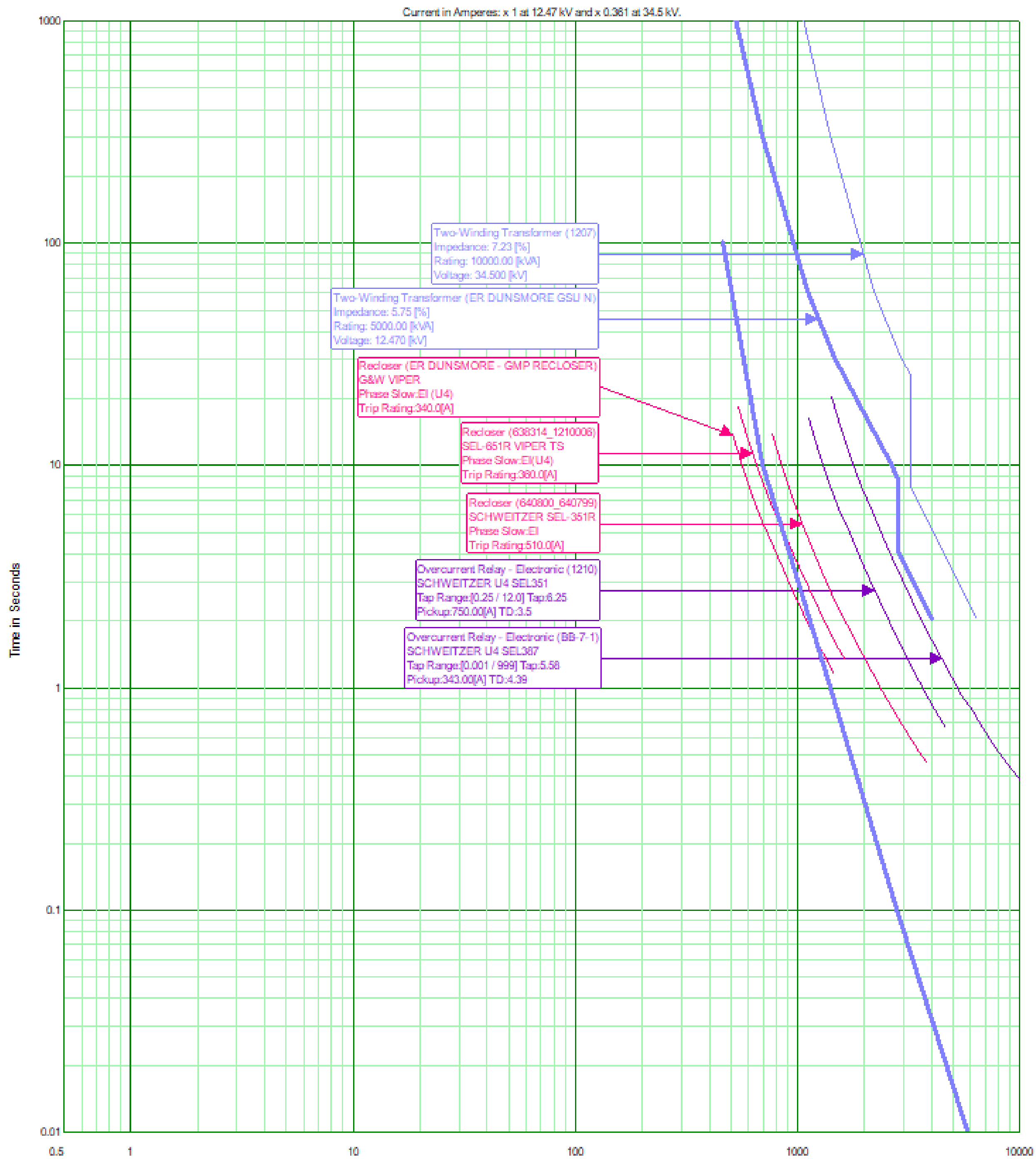


Figure 2-1: Device Phase Coordination TCC Plot with GSU Magnetizing Inrush

Figure 2-2 shows the ground TCC plot for all devices upstream of the Project PCC.

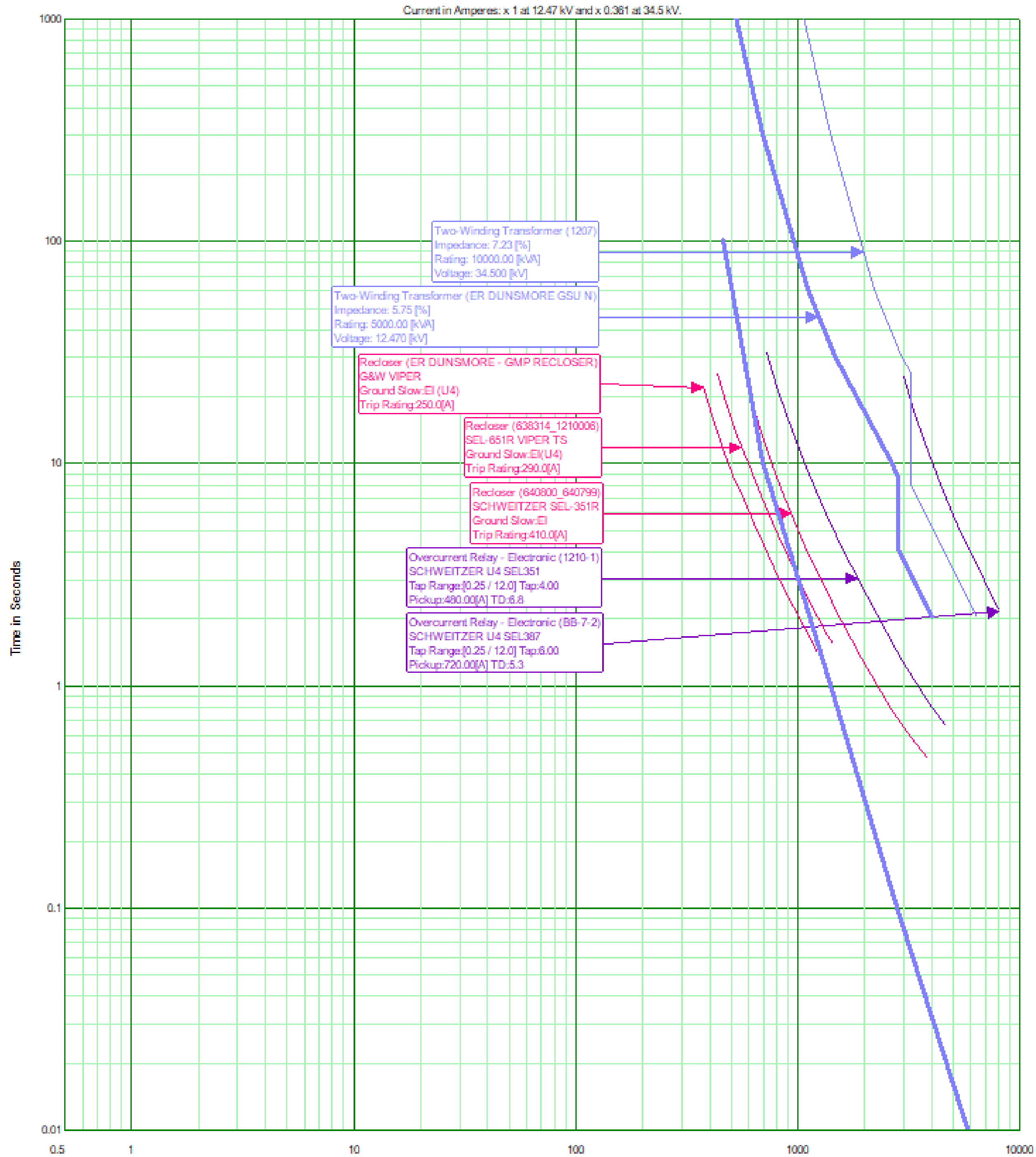


Figure 2-2: Device Ground Coordination TCC Plot with GSU Magnetizing Inrush

GMP shall make final determination on all protective device settings.

2.2 Ground Fault Overvoltages

The possibility of ground fault over voltage on the transmission system (TGFOV) is a concern when there is a reverse flow of power onto the transmission system that cannot be dampened during line-to-ground faults on the transmission. TGFOV can also occur with no reverse flow when the minimum load-to-generation ratio for the section of the transmission system at issue is less than 2.

In this instance, the minimum load-to-generation ratio is less than 2.0. For the Project, this issue will be addressed by an existing direct transfer trip protection scheme from both the North St. Albans B-10 and the Nason Street B-3 to the NE-G16. As such, temporary overvoltage at the subtransmission level need not be studied further.

For a distribution level evaluation, GMP requires a recloser at the PCC for all inverter-based DER greater than 500 kW. The project will be responsible for the monthly recurring cost of communications to GMP from the PCC recloser. GMP also requires inverter settings to be modified from the default settings and meet all applicable standards including the ISO-NE SRD as detailed below in Section 3.2.

2.3 Islanding

For inverter-based DER equal to or greater than 1,000 kW, GMP requires reclose block on upstream three phase protective devices when the summation of line segment DER is greater than one-half of the line segment’s minimum load. For the Project, reclose block will be required at the existing upstream fuse (that would be replaced with an electronic line recloser), the existing upstream line recloser, and the NE-G16 substation breaker.

3 COMPLIANCE WITH STANDARDS

3.1 Vermont PUC Rule 5.500, Section 5.510

The Project is required to comply with Section 5.510 "Codes and Standards" of the PUC Rule 5.500. Note that the Project must comply with the most up to date versions of the standards provided in Table 3-1 within a 6-month grace period.

Table 3-1: Vermont PUC Rule 5.500, Section 5.510 Compliance Summary

Item	Standard/Code	Details
A	IEEE 1547	See Section 3.2
B	UL 1741	See Section 3.3
C	IEEE Standard 929-2000	Standard withdrawn
D	NFPA 70 (2002) National Electric Code	Customer to ensure compliance with latest version
E	IEEE Standard C37.90.1-1989 (R1994)	Customer to ensure compliance with latest version
F	IEEE Standard C37.90.2 (1995)	Customer to ensure compliance with latest version
G	IEEE Standard C37.108-1989 (R2002)	Not applicable to Project
H	IEEE Standard C57.12.44-2000	Customer to ensure compliance with latest version
I	IEEE Standard C62.41.2-2002	Customer to ensure compliance with latest version
J	IEEE Standard C62.45-1992 (R2002)	Customer to ensure compliance with latest version
K	ANSI C84.1-1995	See Sections 1.1
L	IEEE Standard 100-2000	Proper terminology used
M	NEMA MG 1-1998	N/A – Project is inverter-based
N	IEEE Standard 519-1992	Project is IEEE 1547 and UL 1741 Compliant

As shown, the Project complies with all standards applicable to the NE-G16 interconnection. All standards applicable to Project-side low voltages are outside the scope of this Study.

3.2 ISO-NE SRD

The Project is required to comply with ISO New England's (ISO-NE) "Inverter Source Requirement Document" (SRD) (effective February 6, 2018).

The inverter datasheet states compliance with UL 1741 SA and IEEE 1547, which are the applicable ISO-NE SRD standards. However, the Project must also comply with the following ISO-NE SRD tables as applicable:

- Table I: Inverters' Voltage Trip Settings
- Table II: Inverters' Frequency Trip Settings
- Table III: Inverters' Voltage Ride-through Capability and Operational Requirements
- Table IV: Inverters' Frequency Ride-through Capability
- Table V: Grid Support Utility Interactive Inverter Functions Status

Further, GMP requires the Project to enter Momentary Cessation for over voltage conditions while operating in the Permissive Operation mode (Table III: Inverters Voltage Ride-through Capability and Operational Requirements). GMP requires the inverters to enter Permissive Operation with Momentary Cessation with a Maximum Response of 0.1s. If the proposed inverters are not capable of this Maximum Response, a Category III inverter shall be used instead which can comply with this requirement (IEEE 2018 6.4.2 Table 16). Inverter responses to under voltages while operating in the Permissive Operation mode are specified in the ISO-NE SRD at footnotes a and b.

3.3 IEEE and UL Standards

The Project is required to comply with IEEE 1547-2018 and UL 1741 SA (2016). As discussed in Section 3.2, the Project inverters state compliance with UL 1741 SA; however, the inverter datasheet only states compliance with IEEE 1547a-2014. The Project shall confirm inverter compliance with IEEE 1547-2018.

4 CONCLUSIONS and RECOMMENDATIONS

The primary objective of this Study was to assess the impacts of the Project on the GMP system, and to identify system modifications and conditions required for interconnection. Please note that this Study makes no determination regarding tariffs applicable for Project operation.

The following conclusions and conditions are based on the assessments described in Sections 1, 2, and 3:

1. The Project is compliant with the interconnection requirements in PUC Rule 5.500 and the Green Mountain Power Interconnection Guidelines for Distributed Energy Resources on the condition that all requirements in this Study are satisfied.

2. The Project causes high voltages up to 110.46% under peak loading and light daytime loading with maximum generation conditions. These are mitigated by the reconductoring and regulator replacements proposed to address thermal violations.

3. The Project causes reconnection high voltages up to 106.8% prior to regulator adjustments. To address these violations, the Project reconnection must be staggered relative to the existing recloser-equipped generators located on NE-G16, with an enter service delay of 8 minutes. Additionally, the Project is required to implement a stepwise linear ramp during its enter service period, utilizing 20% steps over a 5 minute (300 s) period, i.e. the Project output ramps up 20% (990 kW) every 1 minute (60 s). GMP shall make final determination on all Project reconnection functions.

4. Note that to interconnect the Project, the single B-phase #2 ACSR lateral branch along Dunsmore Rd was reconductored with approximately 2,500 ft of three-phase 477 18/1 ACSR. GMP shall make final determination on all line designs.

5. The Project causes existing conductors in the Project path to be overloaded. To eliminate these violations, approximately 18,000 ft of 1/0 ACSR, 220 ft of 1/0 AAAC, and 1,700 ft of 336 AAC are required to be reconductored to 477 18/1 ACSR conductor. GMP shall make final determination on all line designs.

6. The Project overloads the existing NE-G16 substation 437 A regulators. Therefore, these regulators must be replaced with 546 A regulators. GMP shall make final determination on all device replacements and settings.

7. The NE-G16 substation regulators were modeled with the following settings:
    a. Forward: Midpoint = 121.0 V, Bandwidth = 3 V, Rset and Xset = 0
    b. Reverse: Midpoint = 121.0 V, Bandwidth = 3 V, Rset and Xset = 0

    GMP will make the final determination on settings changes.

8. The Project overloads the existing single-phase 150 A line regulators (Taglets: 491205, 640537, and 637958). Therefore, these regulators must be replaced with 328 A regulators. GMP shall make final determination on all device replacements and settings.

9. The regulators described in 8. above were modeled with the following settings:
    a. Forward: Midpoint = 121.0 V, Bandwidth = 3 V, Rset and Xset = 0
    b. Reverse: Midpoint = 121.0 V, Bandwidth = 3 V, Rset and Xset = 0

    GMP will make the final determination on settings changes.

10. The existing NE-G16 feeder breaker requires the following settings to meet % of pickup, protective reach criteria, achieve adequate coordination, and reduce the risk of tripping due to the Project's GSU magnetizing inrush current:
    a. Minimum phase pickup = 750 A
    b. Phase time multiplier = 3.5
    c. Phase curve = EI (U4)
    d. Minimum ground pickup = 480 A
    e. Ground time multiplier = 6.8
    f. Ground curve = EI (U4)

    GMP shall make the final determination on all protection settings.

11. The existing GVR 351R line recloser (Taglet: 640800_640799) requires the following settings to meet % of pickup, protective reach criteria, achieve adequate coordination, and reduce the risk of tripping due to the Project's GSU magnetizing inrush current:
    a. Minimum phase pickup = 510 A
    b. Phase time multiplier = 3.0
    c. Phase slow curve = EI (U4)
    d. Minimum ground pickup = 410 A
    e. Ground time multiplier = 4.2
    f. Ground slow curve = EI (U4)

    GMP shall make the final determination on all protection settings.

12. A new Viper-ST 651R line recloser is required to replace an existing 80T fuse (Taglet: 638314_1210006). This recloser requires the following settings to meet % of pickup, protective reach criteria, achieve adequate coordination, and reduce the risk of tripping due to the Project's GSU magnetizing inrush current:
    a. Minimum phase pickup = 360 A
    b. Phase time multiplier = 4.0
    c. Phase slow curve = EI (U4)
    d. Minimum ground pickup = 290 A
    e. Ground time multiplier = 5.5
    f. Ground slow curve = EI (U4)

    GMP shall make the final determination on all protection settings.

13. A new Viper-ST 651R line recloser is required (Taglet: 473021_1290259). This recloser requires the following settings to meet % of pickup, protective reach criteria, and achieve adequate coordination:
    a. Minimum phase pickup = 360 A
    b. Phase time multiplier = 1.8
    c. Phase slow curve = EI (U4)
    d. Minimum ground pickup = 290 A
    e. Ground time multiplier = 1.0
    f. Ground slow curve = EI (U4)

    GMP shall make the final determination on all protection settings.

14. A GMP recloser shall be installed at the PCC to address ground fault overvoltage concerns. The Project will be responsible for the monthly recurring cost of communications to GMP from the PCC recloser. This device requires the following settings to meet % of pickup, achieve adequate coordination, and reduce the risk of tripping due to the Project's GSU magnetizing inrush current:
    a. Minimum phase pickup = 340 A
    b. Phase time multiplier = 4.0
    c. Phase slow curve = EI (U4)
    d. Minimum ground pickup = 250 A
    e. Ground time multiplier = 4.8
    f. Ground slow Curve = EI (U4)

    GMP shall make the final determination on all protection settings.

15. A sectionalizer is required to be added at Taglet 488946_1433503 in order to maintain reliability with the addition of the Project. GMP shall make final determination on all new devices and reliability upgrades.

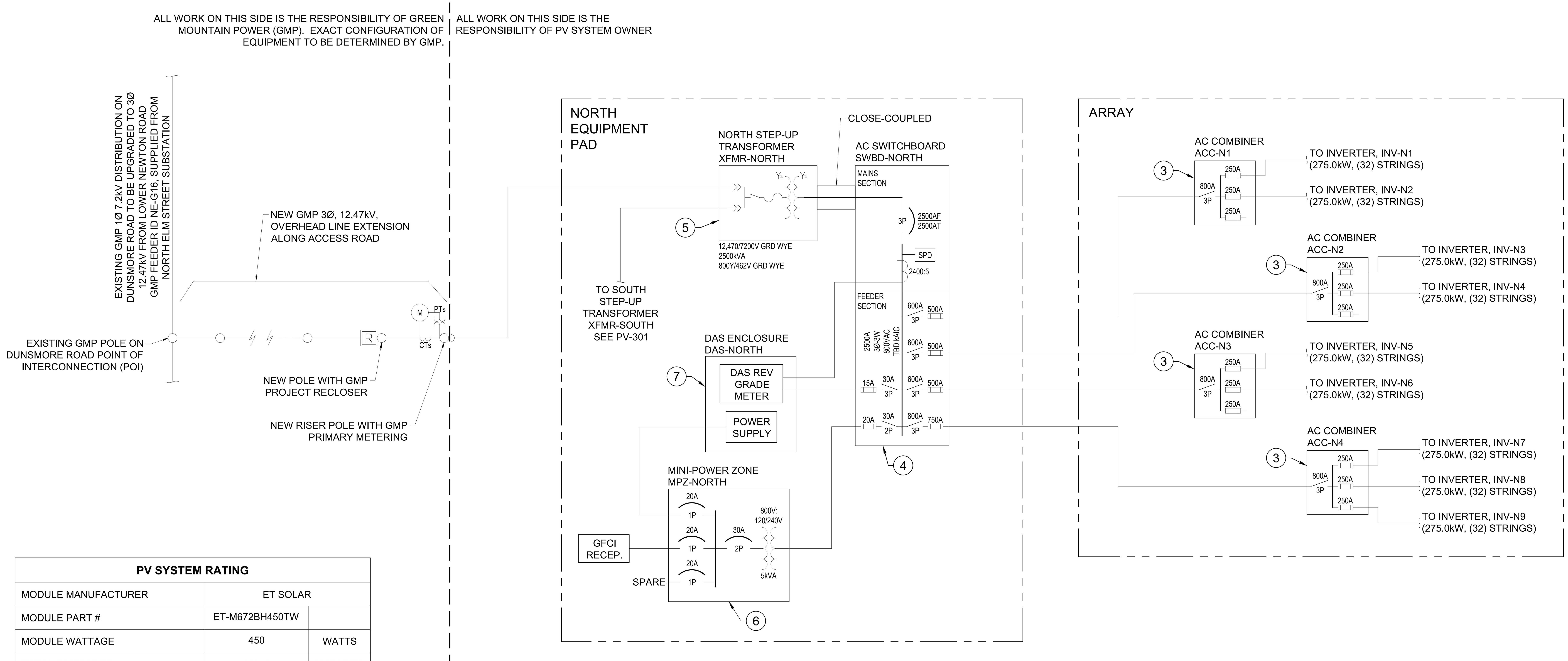
16. A single-phase 80T fuse is required to be added downstream of the Project PCC at Taglet 488947_1444709 in order to maintain reliability with the addition of the Project. GMP shall make final determination on all new devices and reliability upgrades.

17. Reclose block will be required at the existing upstream fuse (that would be replaced with an electronic line recloser), the existing upstream line recloser, and the NE-G16 substation breaker. The equipment and costs required would be determined in a Facilities Study.

18. The Project shall comply with the ISO-NE SRD requirements as detailed in Section 3.2.

19. Because the Project capacity exceeds 1,000 kW, GMP is required to submit a generator notification form to ISO-NE per ISO-NE Planning Procedure 5-1. ISO may determine that a Proposed Plan Application (PPA) is required, which may result in additional study consistent with ISO Study and Performance Requirements in Planning Procedures 5-6 and 5-3. GMP will keep the Project apprised of any updates regarding the ISO-NE review.

Appendix A – Project One-Line Diagram



PV SYSTEM RATING		
MODULE MANUFACTURER	ET SOLAR	
MODULE PART #	ET-M672BH450TW	
MODULE WATTAGE	450	WATTS
TOTAL # MODULES	14976	MODULES
TOTAL STC POWER RATING kW (DC)	6739.20	kWDC
TOTAL SYSTEM RATING kW (AC)	4950	kWAC
PV SERIES STRING RATINGS		
# OF SERIES IN STRING	26	MODULES
MAX Voc @ -28C	1465.30	VOLTS
MAX STRING CURRENT (Isc)	11.58	AMPS
STC POWER RATING (PER STRING)	11,700	WATTS

PV SYSTEM - BILL OF MATERIALS (APPLIES TO PV-300 & PV-301)

ITEM	QTY	DESCRIPTION
1	14976	PV MODULE, 450 WATT, MONOCRYSTALLINE, BIFACIAL, (144) HALF-CELLS, ET SOLAR MODEL ET-M672BH450TW, MODULE SPECS: Vmp = 41.4; Imp = 10.87; Voc = 49.6; Isc = 11.58
2	18	PV INVERTER, 275.0 kW, 500-1500 VDC INPUT, (12) MPPT'S, 900-1300 VDC MPPT, (36) FUSED INPUTS, (3) PER MPPT, 800VAC 3Ø-3W OUTPUT, CHINT POWER SYSTEMS MODEL CPS-SCH275KTL-DO/US-800. INVERTER SHALL COMPLY WITH IEEE STD 1547 SECTION 7.4 (LIMITATION OF OVERVOLTAGE CONTRIBUTION) ALONG WITH ISO-NE SRD REQUIREMENTS.
3	8	AC COMBINER BOX, 800VAC 3Ø-3W, 800A RATED BUS, 800A MAIN DISCONNECT, (3) SETS OF 250A INPUT FUSES, SOLARBOS MODEL ACC-800-3-250-N4 OR EQUAL.
4	2	AC SWITCHBOARD, 800V, 3Ø-3W, 2500A RATED BUS, 2500A MAIN BREAKER, (1) 800A-3P FUSED SWITCH WITH 750A FUSES, (3) 600A-3P FUSED SWITCH WITH 500A FUSES, (1) 15A-3P AND (1) 20A-2P BRANCH FUSED SWITCHES, INTEGRATED SPD SURGE PROTECTION, NEMA 3R ENCLOSURE. SWITCHBOARD TO BE CLOSE COUPLED WITH TRANSFORMER. AIC AS INDICATED ON DRAWINGS.
5	2	TRANSFORMER, 2500kVA, 12,470Y/7,200V GRD WYE PRIMARY, 800Y/462V GRD WYE SECONDARY, LOOP-FEED, 200A RATED BUSHING WELLS, LOAD BREAK SWITCH WITH VIEWING WINDOW, ELBOW MOUNTED 10kV LIGHTNING ARRESTORS ON XFMR-SOUTH, 5.75% IMPEDANCE. TRANSFORMER TO BE CLOSE COUPLED WITH SWITCHBOARD.
6	2	MINI-POWER ZONE, 800V PRIMARY, 120/240V 1Ø-3W SECONDARY, 5kVA, 12-CIRCUIT, NEMA 3R ENCLOSURE
7	2	DATA ACQUISITION SYSTEM (DAS), TO INCLUDE: INVERTER DIRECT MONITORING; POWER METER; WEATHER STATION WITH POA IRRADIANCE, CELL TEMP, AMBIENT TEMP SENSORS.

GENERAL NOTE: EXACT MANUFACTURER, MODEL NUMBER AND SIZE OF THE MODULES AND INVERTERS ARE SUBJECT TO CHANGE DEPENDING ON MARKET AVAILABILITY. THE EXACT EQUIPMENT WILL NOT BE MATERIALLY DIFFERENT FROM WHAT IS SPECIFIED HERE AND TOTAL NAMEPLATE AC CAPACITY OF INVERTERS WILL NOT EXCEED 4950 kW.

NOT FOR CONSTRUCTION

SOLAR POWER ENGINEERING
272 SPRING HOLLOW LANE
MONTPELIER, VT 05602
802.595.5510

encore RENEWABLE ENERGY®

STATE OF VERMONT BRIAN P. BROWNING No. 7013 PROFESSIONAL ENGINEER

ER DUNSMORE LLC
4.95 MWAC PV PROJECT

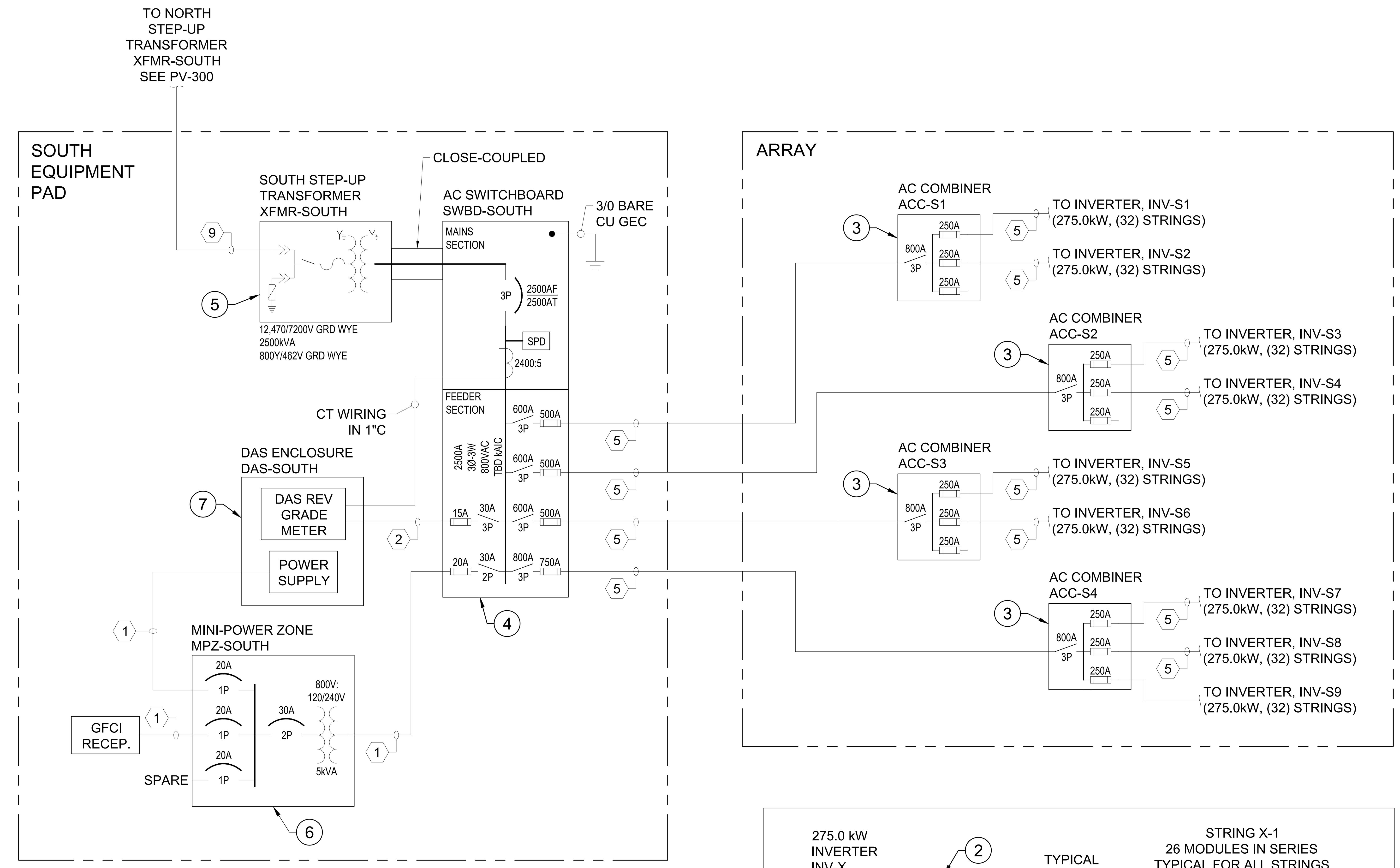
2642 DUNSMORE ROAD
ST ALBANS, VERMONT 05488

DATE:	11/04/2021
PROJ NO.:	ERE_DRS_1121
SCALE:	NONE
DRAWN BY:	BPB

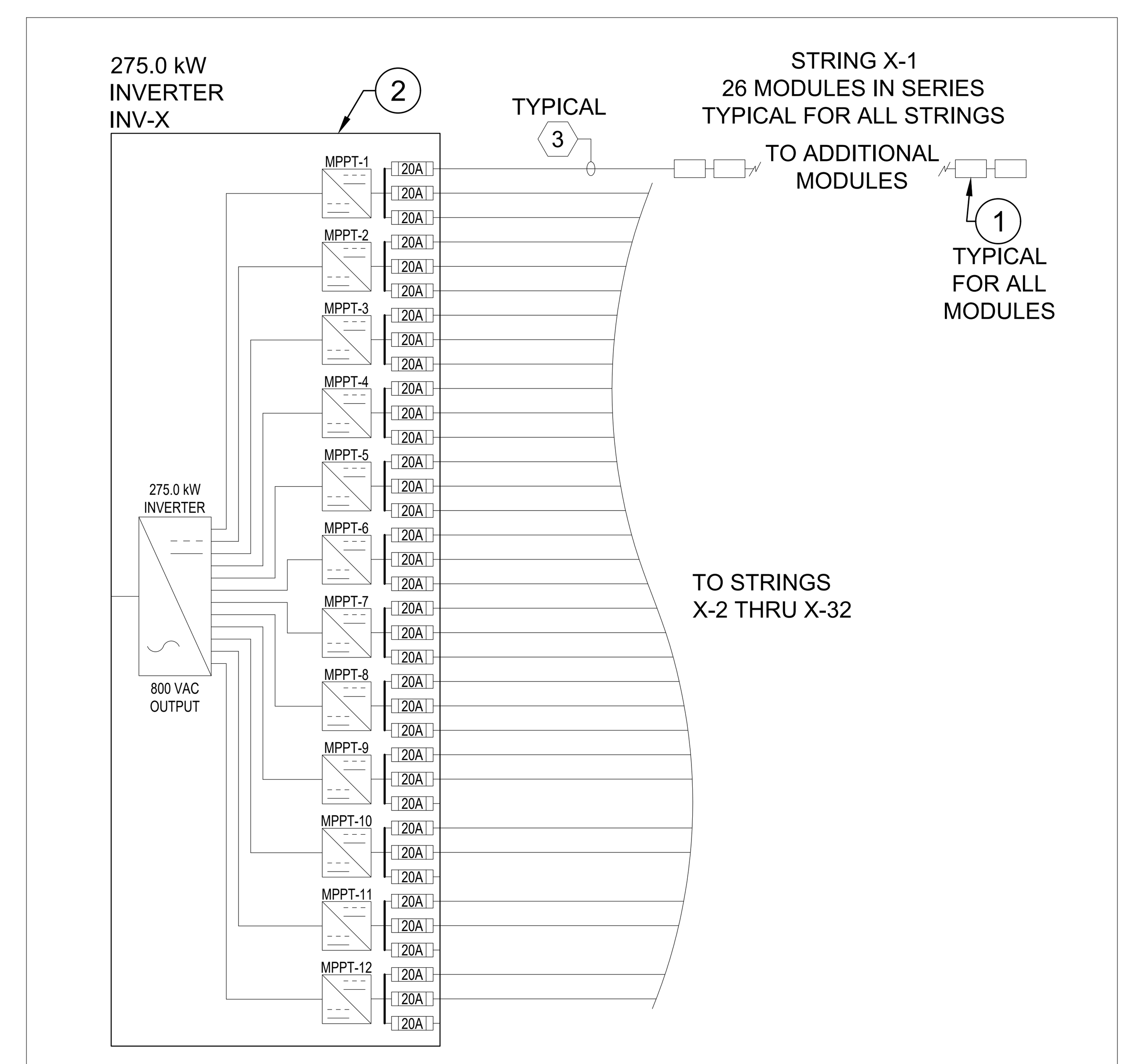
REVISIONS	
ISSUED FOR INTERCONNECT	11/04/2021

ONE-LINE DIAGRAM
INTERCONNECT, NORTH XFMR & SWBD

PV-300



INVERTERS - INPUT & OUTPUT RATINGS			
INVERTER DESIGNATION	INV-N1 THRU INV-N9	INV-S1 THRU INV-S9	
INVERTER SIZE	275	275	kW
MODULE WATTAGE	450	450	WATTS
MODULES PER STRING	26	26	MODULES
QTY OF PARALLEL STRINGS	32	32	STRINGS
DC OPERATING INPUT VOLTAGE	1076.4	1076.4	DC VOLTS
DC OPERATING INPUT CURRENT	347.8	347.8	DC AMPS
MAXIMUM SYSTEM VOLTAGE @-28C	1465.3	1465.3	DC VOLTS
MAXIMUM SHORT CIRCUIT CURRENT	463.2	463.2	DC AMPS
INVERTER OUTPUT VOLTAGE	800	800	AC VOLTS
INVERTER RATED OUTPUT CURRENT	198.5	198.5	AC AMPS



275.0 kW INVERTER WIRING

NOTES
1. WIRING CONFIGURATION SHOWN IS TYPICAL FOR ALL INVERTERS.

NOT FOR CONSTRUCTION

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272 SPRING HOLLOW LANE
MONTPELIER, VT 05602
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encore RENEWABLE ENERGY

STATE OF VERMONT BRIAN P. BROWNING No. 7013 PROFESSIONAL ENGINEER

ER DUNSMORE LLC 4.95 MWAC PV PROJECT

2642 DUNSMORE ROAD
ST ALBANS, VERMONT 05488

DATE: 11/04/2021
PROJ NO.: ERE_DRS_1121
SCALE: NONE
DRAWN BY: BPB

REVISIONS

ISSUED FOR INTERCONNECT	11/04/2021

ONE-LINE DIAGRAM
SOUTH XFMR & SWBD, INVERTER WIRING

PV-301

Appendix B – Interconnection Application

Vermont Public Service Board Attachment 1 to Rule 5.500

STANDARD APPLICATION FOR INTERCONNECTION OF GENERATION RESOURCES IN PARALLEL TO THE ELECTRIC SYSTEM OF: Green Mountain Power
(Name of Utility)

Shaded area to be completed by Interconnecting Utility

Interconnecting Utility: ____________
Interconnecting Utility's Designated Contact Person: ____________
Interconnecting Utility's Address: ____________
Interconnecting Utility's Fax Number: ____________
Interconnecting Utility's E-Mail Address: ____________
Substation ____________ Circuit ____________ ☐ Distribution ☐ Transmission

Preamble and Instructions:
An owner of a generation resource who requests interconnection to a State regulated distribution or transmission facility must submit an application to the Interconnecting Utility. An application is accepted as complete when it provides all applicable information required. There is a **$300.00** Application fee that must be submitted to the Interconnecting Utility along with the Application.

Section 1. Applicant Information
A. Legal Name of Interconnecting Applicant (or, if an Individual, Individual's Name)
Name: ER Dunsmore LLC
Mailing Address: 110 Main Street, Suite 2C
City: Burlington State: Vermont Zip Code: 05401
Facility Location: 2642 Dunsmore Road, Swanton VT 05488
(Facility E-911 address)

Telephone (Daytime): ( ) 802-540-8364 , (Alternate): ( ) - .
Fax Number: ____________ E-Mail Address: jesse@encore.eco

B. Alternative Contact Information (if different from Applicant)
Contact Name: Doug MacDonald
Contact Title: Encore Engineering Manager
Address: 110 Main Street, Suite 2C
Telephone (Daytime): (802) 777 - 0141 (Alternate): (____) ____ - ______
Fax Number: ____________ E-Mail Address: doug@encore.eco

C. Will the Generation Resource be used for any of the following:
To supply power to internal loads (other than the station itself)? ☐ Yes ☑ No
To participate in the SPEED Standard Offer Program? ☐ Yes ☑ No

D. For generators installed at locations with existing electric service:
(Local Electric Service Provider*) ____________
(Existing Account Number*) ____________

E. Additional Information
Requested Point of Interconnection: 1-ph line along Dunsmore Rd. GPS coordinates: (44.848299, -73.146786 .

Section 2. Generator Qualifications
All data applicable only to the generator facility, NOT the necessary interconnection facilities

Energy source:
☑ Solar ☐ Wind ☐ Hydro ☐ Diesel ☐ Natural Gas ☐Fuel Oil ☐Other____
(state type)

Type of Generator:
☐ Synchronous ☐ Induction ☑ Inverter (DC Generator or Solar)

Generator Manufacturer: Chint Power Systems.
Generator Model Name & Number: CPS SCH275KTL - DO/US -800.
Nameplate Rating: 4950 kW.
Generator Nameplate kVAR: 4950.
Applicant or Customer-Site Load: 0.
Typical Reactive Load (if known): 0.
Maximum Physical Export Capability
Requested: 4950 kW.

Section 3. Generator Technical Information

a. *Induction or Synchronous Generators (for rotating machines)*

Rated Power Factor Leading: ______________________
Rated Power Factor Lagging: ______________________
List of Adjustable Set points for the protective equipment or software: ________________
Direct Axis Transient Reactance, X'd: _________________ P.U.
Direct Axis Unsaturated Transient Reactance, X'di: ______________________ P.U. Direct Axis Subtransient Reactance, X"d: ___________________________ P.U. Generator Saturation Constant (1.0): ______________________
Generation Saturation Constant (1.2): _____________________
Negative Sequence Reactance: ___________________________ P.U.
Zero Sequence Reactance: ______________________________ P.U.
kVA Base: ____
RPM Frequency: _____________________________________
*Field Volts ____
*Field Amperes ______________________________________
*Motoring Power (kW) ________________________________
*Neutral Grounding Resistor (If Applicable) ________________
*I22t or K (Heating Time Constant) _______________________
*Rotor Resistance _____________________________________
*Stator Resistance *Stator Reactance ______________________
*Rotor Reactance*Magnetizing Reactance __________________
*Short Circuit Reactance _________________________________
*Exciting Current _____________________________________
*Temperature Rise _____________________________________
*Frame Size *Design Letter ______________________________
*Reactive Power Required In Vars (No Load) _______________
*Reactive Power Required In Vars (Full Load) _______________
*Total Rotating Inertia, H: _____________ Per Unit on kVA Base

b. For Wind Turbines

Total Number of turbines to be interconnected pursuant to this application:_______________

Height to blade tip : _______________ Blade diameter __________

Quantity of Turbines ______________ Size (KW) Each _________

c. For Solar or DC sources

Inverter Manufacturer, Model Name & Number : CPS SCH 275KTL-DO/US-800.

Quantity of Inverters: 18. Size Each: 275 kW.

Panel Manufacturer, Model Name & Number: ET -M672BH450TW.

Quantity of Panels: 14,976 Modules. Size (Watts): 450W.

Inverters are UL1741SA listed ☑ Yes ☐ No

Section 4. Interconnection Equipment Technical Data *(for generation over 20 KW)* Will a transformer (GSU) be used between the generator and the point of interconnection? ☑ Yes ☐ No

Will the transformer be provided by Interconnection Applicant? ☑ Yes ☐ No

Is the Transformer three phase? ☑ Yes ☐ No

Is the Transformer pad mounted or Pole mounted? ☑ Pad ☐ Pole

Transformer Size (Solar): 2 x 2500 kVA Impedance: 5.76 -6 % on 2500 kVA Base

Interconnection Voltage (GSU Data):

Transformer Primary: 12470 Volts ☐ Single Phase ☐ Delta ☐ Wye ☑ Grounded Wye

Transformer Secondary (Solar): 800 Volts ☐ Single Phase ☐ Delta ☐ Wye ☑ Grounded Wye

Transformer Secondary (Battery): N/a Volts ☐ Single Phase ☐ Delta ☐ Wye ☐ Grounded Wye

Interconnecting Circuit Breaker (if applicable):

Manufacturer: _____ Type: ____ Load Rating:___ Interrupting Rating: ______

Trip Speed: ______________________

Current Transformer (CT) Data (if applicable):

Manufacturer: _____________ Type: __________ Accuracy Class: ________ Ratio: 4000:5

Potential Transformer Data (if applicable):

Manufacturer: _____________ Type: __________ Accuracy Class: ________ Ratio: _______

Section 5. General Site Information

a. Enclose copy of site electrical One-Line Diagrams showing the configuration of all generating facility equipment, current and potential circuits, and protection and control schemes.
[Note: This one-line diagram must be signed and stamped by a licensed Professional Engineer if the generating facility is larger than 150 kW.]

b. Enclose copy of any site documentation that describes and details the operation of the protection and control schemes.

c. Enclose copies of schematic drawings for all protection and control circuits, relay current circuits, relay potential circuits, and alarm/monitoring circuits (if applicable).

d. Enclose copy of any site documentation that indicates the precise physical location of the proposed generating facility (e.g. USGS topographic map or other diagram).

Section 6. Check List: Required Fee and Enclosures
Is an application fee enclosed? ☒ Yes
Are One-Line Diagrams enclosed? ☒ Yes
Is site documentation enclosed? ☒ Yes
Are schematic drawings enclosed? ☒ Yes ☐ No
Are site maps enclosed? ☒ Yes

Section 7. Applicant Signature
I hereby certify that, to the best of my knowledge, all the information provided in the Interconnection Application is true and correct.

Signature of Applicant: ____________________ Date: __________

Appendix C – Generation Specifications

275kW/275kVA, 1500Vdc String Inverters for North America

CPS SCH275KTL-DO/US-800

The 275kW high power CPS three phase string inverters are designed for ground mount applications. The units are high performance, advanced and reliable inverters designed specifically for the North American environment and grid. High efficiencies, wide operating voltages, broad temperature ranges and NEMA Type 4X enclosure enable this inverter platform to operate at high performance across many applications. The SCH275KTL inverters include 12 MPPTs and are available with either 36 fused PV string inputs or 24 unfused PV string inputs. The CPS FlexOM solution enables communication, controls and remote product upgrades.

Key Features

- NFPA 70, NEC 2017 compliant
- Touch safe DC Fuse holders adds convenience and safety
- CPS FlexOM Gateway enables remote FW upgrades
- Integrated DC disconnect switch
- Protection Functions for enhanced reliability and safety
- Selectable Max AC Active Power of 250kW or 275kW
- 12 MPPTs with 36 fused inputs or 24 unfused inputs
- Copper and Aluminum compatible AC connections
- NEMA Type 4X outdoor rated, tough tested enclosure
- Full power capacity up to 42°C
- Standard 5 year warranty with extensions to 20 years
- Supported comm protocols (Modbus RTU, TCP/IP, PLC, CAN)

Chint Power Systems America
6800 Koll Center Parkway, Suite 235 Pleasanton, CA 94566
Tel: 855-584-7168 Mail: AmericaSales@chintpower.com Web: www.chintpowersystems.com

Model Name	CPS SCH275KTL-DO/US-800
DC Input	
Max. DC Input Voltage	1500V
Operating DC Input Voltage Range	500-1500Vdc
Start-up DC Input Voltage / Power	600Vdc / 300W
Number of MPP Trackers	12
MPPT Voltage Range @ PF>0.99[1]	900-1300Vdc
Max. PV Short-Circuit Current	600A, 50A per MPPT
Number of DC Inputs	36 Fused Inputs, 3 per MPPT or 24 Non-Fused Inputs, 2 per MPPT (determined by SKU)
DC Disconnection Type	Load-rated DC switches
DC Surge Protection	Type II
AC Output	
Max AC Output Power (Selectable) @ PF>0.99	250kW / 275kW
Max. AC Apparent Power	275kVA
Rated Output Voltage	800Vac
Output Voltage Range[2]	704-880Vac
Grid Connection Type	3-Phase / PE
Max. AC Output Current @800Vac	198.5A
Rated Output Frequency	60Hz
Output Frequency Range[2]	57 - 63Hz
Power Factor	>0.99 (±0.8 adjustable)
Current THD @ Rated Load	<3%
Max. Fault Current Contribution (1 Cycle RMS)	215.2A
Max. OCPD Rating	250A
AC Surge Protection	Type II
System and Performance	
Max. Efficiency	99.0%
CEC Efficiency	98.5%
Stand-by / Night Consumption	5W
Environment	
Enclosure Protection Degree	NEMA Type 4X
Cooling Method	Variable speed cooling fans
Operating Temperature Range[3]	-22°F to +140°F / -30°C to +60°C (derating from +107°F / +42°C)
Operating Humidity	0 to 100%
Operating Altitude	8202ft / 2500m (no derating)
Audible Noise	<80dBA @ 1m and 25°C
Display and Communication	
User Interface and Display	LED indicators, WiFi + APP
Inverter Monitoring	Modbus RS485 / Ethernet TCP/IP / PLC / CAN
Site Level Monitoring	CPS FlexOM (1 per 32 inverters)
Modbus Data Mapping	SunSpec / CPS
Remote Diagnostics / FW Upgrade Functions	Standard / (with FlexOM Gateway)
Mechanical	
Dimensions (HxWxD)	26.8 x 41.3 x 15.7in (680 x 1050 x 400mm)
Weight	Approx. 260lbs / 118kg
Mounting / Installation Angle	Vertical installation
AC Termination	Stud Type Terminal (Wire range: 3/0AWG – 600kcmil AL/CU, Lugs not supplied)
DC Termination	36 Fused Input: Screw Clamp Fuse Holder (Wire range: #14 - #6 AWG CU) 24 Non-Fused Input: Screw Clamp Terminal (Wire range: #14 - #8 and #6 - #4 AWG CU)
Fused String Inputs (3 per MPPT)[4]	20A fuses provided (Fuse values up to 30A acceptable)
Safety	
Certifications and Standards	UL1741SA-2018, CSA-22.2 NO.107.1-01, IEEE1547-2018, FCC PART15
Selectable Grid Standard	IEEE 1547-2018, CA Rule 21, ISO-NE, HECO Rule 14H
Smart-Grid Features	Volt-RideThru, Freq-RideThru, Ramp-Rate, Specified-PF, Volt-Var, Freq-Watt, Volt-Watt
Protection Functions	
Reactive Power at Night	Yes
IV Curve Tracing	Yes
Insulation Resistance Monitoring	Yes
Onboard Fault Oscillography	Yes
PV String Current Monitoring	Yes
Residual Current Monitoring	Yes
Input Reverse Polarity Protection	Yes
Output Overcurrent Protection	Yes
Output Short-Circuit Protection	Yes
Output Overvoltage Protection	Yes
Warranty	
Standard	5 Years
Extended Terms	10, 15 and 20 years

1) See user manual for further information regarding MPPT Voltage Range when operating at non-unity PF
2) The "Output Voltage Range" and "Output Frequency Range" may differ according to the specific grid standard.
3) See user manual for further requirements regarding non-operating conditions.
4) Fused string inputs only applicable to the SCH275KTL 36 input model.

Facilities Report

For the interconnection of

ER Dunsmore, LLC 4,950 kW Solar Project
2642 Dunsmore Road, Swanton, Vermont

Revision October 2023

NOTE: This revision updates the previous estimate with October 2023 prices. Actual costs will be trued up upon completion of construction.

ER Dunsmore, LLC is proposing to interconnect 4,950 kW of photovoltaic generation, to be located at 2642 Dunsmore Road, in Swanton, Vermont (the Project). The Project will interconnect to the GMP NE-G16 circuit in the vicinity of Line 415, Pole 15, tag 488946. In order to interconnect this Project in a safe and reliable manner, the steps listed in this Facilities Report must be completed.

1) **Distribution Line Extension, PCC Recloser, Metering, Line Rebuild, Line Reconductoring, Line Regulators, and Line Reclosers ($1,865,943)**

   a. Material and installation costs for an approximately 1,700' overhead line extension, from tag 488946 to the Project site, using 477 18/1 ACSR conductor. This line extension will include a hook-stick disconnect switch at or near tag 488946, a sectionalizer just downstream of the disconnect switch, and primary metering.
   b. Material and installation costs for a three-phase, pole-mounted, Viper S recloser to be located at the point of common coupling (PCC). A 1 kVA transformer will supply power to the recloser and associated communications equipment.
   c. The costs to install, test, and commission a supervisory control and data acquisition (SCADA) system and to interface this system with the PCC recloser.
   d. Material and installation costs for a three-phase, four-wire, 15 kV-class bi-directional pole-mounted metering package to be located at the PCC. The installation costs include line crew and meter department labor estimates. Per metering agreement, the Project contributes 100% toward the installed cost of the meter, voltage and current transformers, socket, and metering material. GMP retains ownership of these items.
   e. Material and installation costs to rebuild approximately 2,500' of single-phase line, along Dunsmore Road, from tag 639820 to tag 488946, to three-phase using 477 18/1 ACSR.

f. Material and installation costs to reconductor approximately 20,000' of existing three-phase line, from tag 639648 to tag 639820, with 477 18/1 ACSR conductor.
g. Material and installation costs to replace the three existing 150 A line regulators at tags 491205, 640537, and 637958 with 328 A regulators.
h. Material and installation costs for a new Viper ST line recloser, at tag 638314, to replace the existing 80T fuse.
i. Material and installation costs for a new Viper ST line recloser at tag 473021.
j. Material and installation costs for a direct transfer trip scheme from the new line recloser at tag 473021 to an existing downstream synchronous rotating machine generator.
k. Engineering and technician time to establish reclose block and input settings changes at the existing electronic GVR recloser at tag 640799.
l. Material and installation costs for a new cutout and 80T fuse at tag 488947.

2) Substation Regulators and Breaker Settings ($258,122)

a. Material and installation costs to replace the existing NE-G16 substation 437 A regulators with 546 A regulators.
b. Engineering and technician time to input settings changes to the NE-G16 substation breaker.

3) Customer Responsibilities

(Includes costs not specified above)

a. Provide GMP a Certificate of Insurance prior to beginning any construction activities. The certificate can be mailed to *Green Mountain Power, Attn: Ryan Jarvis, 163 Acorn Lane, Colchester, VT 05446*.
b. The Project must provide certified transformer test reports from the manufacturer to GMP. This report is required at least one month before interconnection.
c. The Project must provide copies of the factory inverter test reports at least one month prior to interconnection.
d. The Project is responsible for providing all conduits, associated trenching, and all equipment located beyond the point of common coupling in accordance with the Vermont Electric Service Requirements Manual.
e. The Project is responsible to provide road access to all interconnection equipment, including the PCC recloser and primary metering.
f. The above estimate does not include any necessary tree trimming or removal costs.
g. If ledge is encountered, the additional cost per pole increases by $661 and the additional cost per anchor increases by $265.
h. With payment of the total cost estimate shown below, the Project is responsible to provide a complete contact list of all contractors involved with the project construction.

All costs listed are estimates; payment of the full estimate is required prior to the ordering of materials and scheduling of an interconnection date. The majority of this project appears to be exempt from the Contribution In Aid of Construction (CIAC) tax, however if the IRS determines otherwise the Project will be responsible for the additional tax. The cost estimates contained in this Facilities Study are valid at the time the Study was performed and are subject to change. The Project will be trued up to actual cost after construction is complete. Based on the results of the true up, any excess funds will be refunded to the Project; likewise, any shortage will be billed. This estimate does not include any possible charges from communication providers or others.

4) Summary of Cost Estimates

1) Distribution Line Extension, PCC Recloser, Metering, Line Rebuild, Line Reconductoring, Line Regulators, and Line Reclosers:	$1,865,943
2) Substation Regulators and Breaker Settings:	$258,122
Total:	**$2,124,065**

PLEASE DETACH AND MAIL BACK WITH REMITTANCE

FOR INTERNAL GMP USE AT TIME OF CONSTRUCTION:

Substation Operations $258,122 ____(23222) Project # 192173____

Distribution Upgrades
& Line Extension $1,865,943___(23222) Project # __________

TGFOV Charge $___N/A________ GL ACCT# 01.18241__