



Distributed Resource Interconnection Guidelines

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GREEN MOUNTAIN POWER INTERCONNECTION GUIDELINES

1. INTRODUCTION

This document is intended as a guideline for individuals requesting to interconnect energy sources to Green Mountain Power's distribution network. Sources are referred to as distributed resources (DR) to encompass energy storage although sometimes the term generators is used since it is the most common subset of DR.

Different and/or additional requirements may need to be met by the owner of the generation project (the "Customer") to ensure the final connection design meets all applicable standards and codes and is safe for the application intended.

1.1. State Programs and Interconnection processes

1.1.1. Rule 5.500, Standard Offers and Direct Power Purchase Agreements

Vermont Public Service Board (PSB) Rule 5.500 establishes the interconnection procedures and application form for "all proposed interconnections of generation resources within the State of Vermont which are not (i) lawfully subject to ISO-NE interconnection rules or successor rules approved by FERC, or (ii) subject to the Board's net metering rule (Rule 5.100) for which the interconnection provisions of those rules will govern." The Rule 5.500 Standard Application form is generally used for all projects above 150kW connecting to distribution. Customers proposing eligible projects should review the 5.500 [application Form](#) and [procedure](#) prior to reading the remainder of GMP's Interconnection Guidelines document

It is also important to consider a revenue source for your project prior to applying for interconnection. For projects applicable to Rule 5.500, there are generally two options, a SPEED Standard Offer feed-in contract or a Direct Purchase Power Agreement with GMP.

PSB Rule 4.300 implements Vermont's Sustainably Priced Energy Enterprise Development (SPEED) program. For more information on the program, please visit the SPEED facilitator website www.vermontspeed.com. The SPEED Facilitator manages Vermont's Standard Offer program which may offer feed-in-tariff contracts to projects rated up to 2,200kW AC.

Green Mountain Power may offer direct power purchase agreements to SPEED resources when GMP considers the interconnection to be mutually beneficial. Please contact distributedresources@greenmountainpower.com for more information.

SPEED Resources rated 150kW or below have a separate application form available [here](#) and generally follow the process and procedures of like sized net meter projects.

1.1.2. Rule 5.100 and Net Meter Projects

Vermont Public Service Board (PSB) Rule 5.100 establishes standards and procedures governing application for, and issuance or revocation of, a certificate of public good for net metering¹ and group net metering systems. Net Metering projects cannot also be SPEED resources.

Rule 5.100 includes aesthetic review criteria and minimum technical requirements for each project. The application form for a Certificate of Public Good is submitted to the Public Service Board and also to the Utility as the interconnection application. Net meter applicants, even for facilities above 150 kW, should review [Rule 5.100](#) and its Appendix A, [technical requirements](#) prior to reading the remainder of GMP's Interconnection Guidelines document.

The tariff outlining GMP's Current Rules and Regulations for Electric Service: Self-Generation and Net Metering, can be found [here](#). The application for projects rated up to and including 150 kW is available [here](#). For photovoltaic (PV) projects rated 15 kW or less, a simplified application form is available [here](#).

Net Metering facilities above 150kW are required to file the Rule 5.500 interconnection application and follow the 5.500 interconnection process.

1.2. Green Mountain Power Distribution System Description

GMP does not operate any spot networks. The majority of GMP's radial distribution feeders are 12.47kV four wire multi-grounded neutral circuits although there are some distribution feeders at differing voltages within the 4 kV, 8 kV, 15 kV, 35kV class circuits. Any stated protection requirements or DR limits are assumed to reference 12.47 kV interconnections unless otherwise stated.

2. EQUIPMENT REQUIREMENTS

2.1. Direct Transfer Trip

Where required by project screening criteria, the Company will install, own, and operate a Customer billable Direct Transfer Trip (DTT) scheme from upstream sectionalizing devices to a Company owned reclosing device near the PCC. The communication requirements for DTT include a latency of less than 35 milliseconds and ability to alarm on loss of a communication path. The Company uses Schweitzer Engineering Laboratories' mirrored bits® communication protocol with either licensed radio paths or fiber optic communication paths however alternatives will be considered if they meet the communication requirements.

DTT is specifically considered for rotating machines that do not pass anti-islanding screens individually, or with aggregate generation on the feeder section. DTT may need to be added to existing facilities due to the increase of other forms of generation in the same feeder sections.

¹ References to net metering throughout this document are also intended to refer to group net metering unless otherwise noted.

When transfer trip is required, DR Customer is responsible to provide the following in the facility design:

- a) A circuit breaker capable of receiving an external trip via a shunt trip or undervoltage release.
- b) Seven feet of unobstructed horizontal wall space in the generator control building to mount a Company owned communications and controls cabinet.
- c) An ungrounded DC source from an uninterruptible power source to the Company owned communications and controls cabinet. The preferred voltage is 24VDC and the power requirements of Company equipment connected to the 24VDC source typically do not exceed 35W but should be verified prior to purchase of the power supply.

2.2. Electronic Recloser

All DR facilities with a rated capacity greater than 500kW AC will require the installation of a Company owned, gang operated, electronic recloser near the PCC. Synchronous and induction generators smaller than 500 kW typically require a recloser, especially when DTT is necessary. After a fault the unit will attempt to reclose when nominal system conditions have been restored. At DR facilities with rotating machines, the recloser may be configured to prevent the generator from restarting for a fixed period of time to limit the visible voltage fluctuations on the area EPS caused by starting inrush current.

2.3. Generator Step Up Transformer

The Company will provide, if requested by the DR Customer, the generator step up (GSU) transformer when the rating is 500kVA or below with a standard secondary distribution voltage.

The only three phase transformer configurations the Company will provide transformers are low voltage grounded wye, high voltage grounded wye and the DR Customer remains responsible to meet all additional functional, equipment, and operating requirements.

For facilities above 500kVA, the DR Customer is responsible to provide the GSU. The following are acceptable configurations based on generator type:

Generator Type	HV Winding	LV Winding
Rotating Machine	(Floating) Wye	Delta
Inverter	Grounded Wye	Grounded Wye

The DR Customer is responsible to ensure there is no backfeed from the GSU or facility when the generator is out of service and is responsible for all consequences resulting from such backfeeds.

Where a transformer rated 500kVA and above is supplied and owned by the NUG it is required to include low side taps.

The Company may permit applications with up to a 20% overload of a customer owned generator step up transformer if the source is variable (ie. Wind/Solar). The DR Customer accepts all associated risk. For new services where transformation is provided by the Company, transformation will be sized to match the planned generation or load.

2.4. Metering

Net Meter:

The Company uses bi-directional smart meters throughout most of its territory. No additional revenue metering or communication is usually required if a net meter facility is installed at an existing service point. If the net metering facility is photovoltaic and eligible for the gross solar adder, an additional gross solar meter will be installed at cost to the DR Customer.

Group Net Meter:

Often group net meter facilities have a new service extension for the sole use of exporting generation. In this case the revenue meter also acts as the gross meter. Self-contained metering is generally used at facilities with 200 amps or less of generation or load. When a self contained meter is used, the Customer is expected to provide and install the socket and GMP will provide the meter. Self-contained metering on three phase 480/277V services requires a Customer provided lockable disconnect discussed in [Vermont Utilities Electric Service Requirements Manual](#) Section 705.D.

For facilities with 400 amps of generation or load the Company will supply the meter, associated instrument transformers, and meter socket. Installation of this equipment will be coordinated with the customer's electrician.

For facilities with between 200 and 400 amps of load or generation, the metering could be either type. At sites of every rated capacity the customer should verify the planned metering type with the distribution designer assigned to the project and confirm installation responsibilities.

Feed-In-Tariff (FIT) & Power Purchase Agreements (PPA):

For FIT and PPA facilities, the DR Customer is responsible to pay for the full cost of a meter and associated equipment for measuring hourly intervals including communication equipment. Generally, the DR Customer is responsible to request, have installed, and maintain a data quality phone line from the local telephone service provider to the metering point for MV90 access.

Data Pulses:

If requested, and for a onetime fee of \$250, the Company will supply KYZ data pulses at the meter location. The DR Customer is responsible for providing any other equipment or software to access and utilize the data pulses. Presently, the Company is unable to supply modbus communication to the meter. For more information on KYZ data pulses, please email distributedresources@greenmountainpower.com to be put in contact with the senior energy consultant for the interconnection location.

General:

If the facility will be secondary metered but the DR Customer's generator uses a non-standard service voltage, the DR Customer may be responsible to provide the metering accuracy rated instrument transformers and stock replacements of each. The DR Customer should verify the Company is able to supply the instrument transformers, particularly when 1000VDC inverters are used.

Secondary metering may be permissible even if the step up transformer is owned by the DR Customer. The Company will determine loss adjustments for the meter based on the facility design. If the DR Customer supplies the generator step up transformer and it is above 500kVA, the DR Customer is responsible to supply a certified transformer test report to the Company for loss compensation.

The Company does not permit shared use of instrument transformers for protection and metering.

For facilities above 1MW, GMP may require primary metering. If the site conditions do not easily accommodate pole mounted primary metering, GMP may consider secondary metering unless multiple step up transformers preclude a single secondary metering point.

The Customer is responsible to ensure their facility metering complies with all maintenance and testing requirements of the programs or incentives for which it is registered and the Customer is responsible for any associated cost. GMP may request verification of the meter at any time but all costs associated with such testing shall be borne by GMP should the metering prove to be accurate within 2%.

2.5. Circuit Breaker

Circuit breaker(s) provided by DR Customers must be capable of interrupting the maximum fault current available at the breaker's location from both the Company's electric system and the DR Customer's generation equipment.

If a facility requires DTT, the circuit breaker must be capable of receiving an external trip via a shunt trip or undervoltage release.

2.6. Relaying

All rotating generators require a relayed circuit breaker although exceptions may be granted if the generator is interfaced with a UL certified inverter. Only utility grade equipment is permitted for protection relaying. Only protection accuracy class instrument transformers are permitted for use with protective relaying. All relay functions can be combined in a single microprocessor based unit.

Where an inverter is used, the settings below refer to the inverters internal protective functions.

2.6.1. Frequency Settings

All DG facilities are to operate at a nominal frequency of 60Hz. All DG Facilities are also responsible to comply with IEEE 1547 and provide two levels of underfrequency protection and one or more levels of overfrequency protection.

Underfrequency set point and clearing times are not permitted above the curve in **Error! Reference source not found.** Figure 1 in order to comply with PRC-006-NPCC-1 Requirement 13 on generator underfrequency settings.

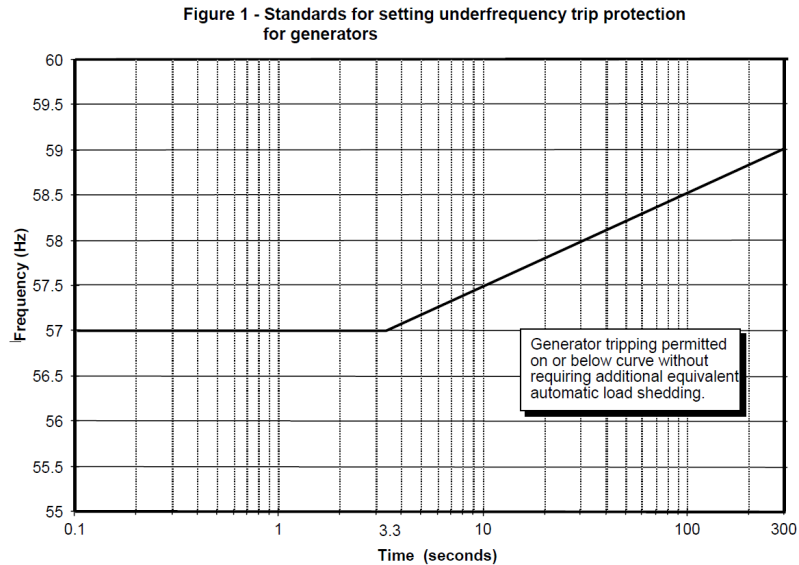


Figure 1 - NPCC Standards for setting underfrequency trip protection for generators

2.7. Manual AC Disconnect Switch

A manual disconnect switch is required for all facilities rated above 150kW AC. A manual disconnect switch is not required for inverter interfaced facilities rated 150kW or less but is still a requirement for rotating generation rated 150kW or less.

Where required, the switch is to be a utility accessible, lockable, load break rated, visible break disconnect switch with safe working clearances as determined by GMP safety standards. The disconnect switch must be located between the area EPS and the DR Unit and capable of interrupting the generator and/or load current.

The manual disconnect switch must be a blade-type switch meeting applicable Underwriters Laboratories (UL), American National Standards Institute (ANSI), IEEE Standards, local/state/federal codes, and the National Electric Code (NEC).

The DR Customer is responsible to affix a weatherproof, permanent label to the switch labeled "GENERATOR DISCONNECT SWITCH". If the disconnect switch is not located within 40 feet line of sight from the Company revenue meter the DR Customer is responsible to post a weatherproof map

at the meter. The map must be a site plan clearly identifying the disconnect switch location. For more information on the disconnect switch, please refer to the [Vermont Utilities Electric Service Requirements Manual](#), Section 805.

2.8. Generation Type Specific

2.8.1. Inverter

The DR facility is responsible to verify compliance with Vermont PSB Rule 5.500 section 5.511(B).

GMP requires all inverters connected to the area EPS to be lab tested by a Nationally Recognized Testing Laboratory (NRTL) and certified to conform with all the tests of IEEE 1547.1. UL1741 is the preferred certification for inverters, however, the Company may accept comparable certifications from other NRTLs. The Company may accept field testing by an NRTL, however, if all test conditions specified by IEEE 1547.1 cannot be completed in the field additional protection requirements may be applied.

2.8.2. Rotating machine

Synchronous Generator

Synchronous Generators are to be designed in accordance with all applicable IEEE, ANSI, and National Electrical Manufacturers Association (NEMA) national standards.

Induction (asynchronous) Generator

DR Customers are responsible to supply their own form of excitation to meet power factor requirements (See Section **Error! Reference source not found.**10.5)

2.9. Single Phase Generation

If multiple single phase generators are installed where three phase service exists, the units are to be connected so that an equal amount of generation is applied to each single phase of the distribution line. The DR Customer's facility design is to include provisions for shutdown of all units when one or more units ceases operation to maintain balanced current and voltage on the area EPS.

A single phase generator at an individual service point cannot exceed 150kW where only single phase service is available. Lower limits may be applied based on area EPS strength at the proposed PCC and for feeders operating below 7.2kV line-to-neutral.

The single phase generator is responsible to comply with all other interconnection requirements, including voltage and current imbalance, voltage flicker, and thermal loading.

Single phase generators at unique services points of the same line section may in aggregate exceed 150kW. The generation is reviewed in aggregate to verify it does not cause negative system impacts. The interconnection request is responsible for all associated study costs. While the absolute limits are stated above, the actual acceptable individual single phase generation limit for

specific feeders may vary. At the Company’s discretion, three phase service may be required for interconnection.

2.10. Telemetry, Monitoring, and Control

Generation facilities rated above 500kW require telemetry. At minimum this is to include:

Net kW (+)	-	To the area EPS
Net kW (-)	-	From the area EPS
Net kVAR (+)	-	To the area EPS
Net kVAR (-)	-	From the area EPS
Net kWh (+)	-	To the area EPS
Net kWh (-)	-	From the area EPS
Voltage (kV)	-	Measured at the recloser at the PCC

Recloser status (control may also be required)

All values are to be delivered in near real time, defined as samples every 5 seconds or less with less than one second delivery delay.

The Company will provide, at cost to the customer, a remote terminal unit (RTU) to interface with the PCC recloser and in most cases the facility inverters or master controller. The implementation of supervisory control and data acquisition (SCADA) to the inverters, including remote power factor adjustment, active power curtailment, ramp rate, and scheduling, will depend upon the site and terms of the generation interconnection agreement.

If necessary, the customer is responsible to provide a suitable environmentally controlled space for telemetry equipment inside a generator building. At locations without a generator building, the customer will be billed for a pole mounted, heated, rack mount cabinet for placement of the RTU and associated network service provider equipment.

The telemetry cabinet requires battery backup and 120V station service. The responsibility to supply and maintain battery backup and station service should be agreed upon between the Company and the customer prior to execution of the generator interconnection agreement and can vary depending upon the facility design.

2.11. Communications

The customer is responsible for all communication costs associated with engineering access, metering data, and telemetry at distributed resource sites. Inverter based facilities 500kW and below generally do not require any communications.

Acceptable forms of communication include:

- a) Business Grade, Private Cellular (Compatible Network)
- b) Business Grade, Private Ethernet LAN
- c) Company Fiber Optic Cable (where available)
- d) Company operated, licensed radios

3. APPLICATION INSTRUCTIONS

Digital copies of applications can be submitted to GMP at distributedresources@greenmountainpower.com. Once the submittal is complete an automated email will supply a confirmation number. The application fee, applicable to 5.500 applications, can be mailed to:

Green Mountain Power
c/o Distributed Resources
2152 Post Road
Rutland, VT 05701

GMP accepts the application forms provided for projects rated 150 kW or below as drafted by the PSB. In some cases the facility design or interconnection location will require GMP to screen the project using the criteria in Section 4 and GMP may request additional information to complete the evaluation.

For projects above 150kW, the Vermont PSB provides instructions effective March 19, 2010 for completion of the Rule 5.500 Application Form, available [here](#) and copied below.

Green Mountain Power has expanded the instructions below to include guidelines specific to applications for interconnection with Green Mountain Power, distinguished from the PSB instructions as underlined text. Section numbers in the box below reference sections of the 5.500 application form.

Vermont Public Service Board Rule 5.500 Standard Application Form Instructions

Instructions to complete the “Standard Application for Interconnection of a Generation Resources in Parallel to the Electric System”.

Section 1. Applicant Information

- A. *Legal Name of Interconnecting Applicant.* Use legal name of the interconnecting corporation or name of individual with mailing address, phone numbers and e-mail address. GMP uses the Interconnecting Applicant mailing address for all billing associated with the application and study process. If the billing address differs, it should be distinguished on the 5.500 application.

If the facility location does not have a 911 address contact the Town Clerk to request an address. Append a copy of the request to the 5.500 application and notify GMP when the address is received.

- B. *Alternative contact information.* Use for engineering firm contact or local contact information for out-of-state applicants. *In general, GMP does not discuss project information with individuals unless their name or company is listed in Section 1 of the application. If the approved project contacts or project ownership changes the Interconnection Applicant is responsible to notify GMP with a revised Section 1.*
- C. *Will Generation Resource be used to supply Internal loads* (other than loads that serves the station itself). For example, if generation is feeding power to industrial loads prior to exportation to the utility, answer “Yes.”
 If Net-Metered or less than 100% of the power output (except what serves the station itself) is going onto the power grid, answer “Yes.”
 If serving retail customers, answer “Yes.” (If generation is supplying other Electric Utility customers’ loads, discuss your plans with your interconnecting utility.)
 If generation is a participant in the Sustainably Priced Energy Enterprise Development (“SPEED”) Standard Offer Program answer “No.” *If the planned facility is not to participate in the SPEED Standard Offer Program, indicate whether the project is planned as Net Meter, Group Net Meter, or Direct PPA with GMP. This helps GMP initiate the correct account for the facility.*
- If group net meter is selected, attach a separate sheet to the application with “Group System Information”:*
- (1) The meters to be included in the group system identified by account number and location;*
 - (2) The procedure for adding and removing meters included in the group system, and direction as to the manner in which the serving utility shall allocate any accrued credits among the meters in the group;*
 - (3) A designated person, including address and telephone number, responsible for all communications from the system to the serving electric utility, except for communications related to billing, payment, and disconnection, and*
 - (4) A binding process for the resolution of any disputes within the group system relating to net metering that does not rely on the serving electric utility, the Public Service Board, or the Department of Public Service.*
- D. *For generators installed at locations with existing electric service.* Answer if generation location already has electric service; *or state if a separate new service is being requested.*
- E. *Additional Information.* Provide utility Line and Pole number of the interconnection point if known; if not known, use other specific location information. *Line and Pole numbers enable GMP to quickly assess the planned interconnection point but can often be confused with pole identifiers used by third party attachments. If the Line and Pole numbers have not been verified with GMP, please include a photo of the pole showing any number tags at eye level. Note, sometimes pole lines installed cross country operated at transmission voltage and are not suitable for distributed resources.* Also provide expected in-service date, the date generation is planned to be on-line.

Section 2. Generator Qualifications

Provide data on prime mover (energy source), generator type and total generation plant nameplate ratings for KW and kVAR. *Note, the nameplate rating of the generator should be stated, not the de-rate anticipated by fuel source or genset*

limitations. GMP expects generators to operate at or near unity power factor unless otherwise agreed upon. The kVA base rating listed in Section 3, not the nameplate kW, could determine whether GMP requests the 5.100 or 5.500 application and applicants should check with GMP if unsure of which application form to use. For rotating machines if the generator specification sheets list multiple models, highlight the ratings applicable to the planned unit. For inverters list the aggregate nameplate kW AC rating. Include any site loads (i.e., include load that serves the station itself here) and provide the maximum expected generation output capacity in KW (for example 2,200 KW). For maximum expected generation output capacity, state the limited or de-rated maximum output expected from the facility. GMP may still use the full generator rating for some screens such as short circuit contribution to a fault.

Section 3. Generator Technical Information

- A. *Information on rotating machines, synchronous and induction generators.* (For inverters or DC systems skip to section 3(C).) This data is available from the generator manufacturer. Some data may not be known until the generator is manufactured, applicant may work with the manufacturer to provide “Typical” or “Average” data. Be sure to note any “Typical” or “Average” data on the application form and prepare to supply actual data when available. Information noted with * may not be applicable for some types of generators. Note, reactance values are to be listed on the application form in per unit (PU). In addition to those listed on the application form, please include Synchronous Reactance (X_d).

The minimum set of protective elements requiring reported set points:

- (2) Undervoltage
 - (2) Overvoltage
 - (1) Voltage restrained time-overcurrent
 - (2) Zero sequence overvoltage or neutral overcurrent
 - (2) Underfrequency
 - (1) Overfrequency
 - (1) Loss of Field
 - (1) Synch Check or Speed Match
- B. *Information on Wind Turbines.* For Wind Turbines answer questions in this section as well as in section 3(A) for induction wind turbines or 3(C) for inverter-based wind turbines as applicable.
- C. *Information for Solar or DC Sources.* For Solar or DC sources answer questions in this section (do not fill out section 3(A) if filling out this section). Provide information on the inverter(s) and for solar provide manufacturer information on the panels.

Does the inverter have an internal isolation transformer? If yes, what are the configurations of the transformer windings?

GSU interfacing winding: _____

PV Array interfacing winding: _____

Section 4. Interconnection Equipment Technical Data (Skip this section if generation is less

than 20 KW.)

- A. Provide information on the interconnection GSU (transformer). Size and impedance information is located on the transformer name plate or available from the transformer manufacturer. See Section Generator Step Up Transformer of this interconnection guidelines document for when GMP may supply the transformation.
- B. Provide the GSU primary and secondary voltages and winding configurations. See Section Generator Step Up Transformer of this interconnection guidelines document for acceptable winding configurations.

Under "Other Transformer Information", indicate the transformer is equipped with taps if rated 500kVA or larger.

- C. Provide data on the interconnecting circuit breaker if applicable. For rotating generators the circuit breaker must be capable of receiving an external trip signal. The applicant must specify whether the circuit breaker is equipped with an undervoltage release or a shunt trip. For all forms of generation the 5.500 application must list the "Generator Disconnect Switch" supplied by the customer and compliant with Vermont Electric Service Requirements 805F.
- D. Provide manufacturer or name plate data for any Current Transformers (CTs) or Potential Transformers (PTs).

Section 5. General Site information

- A. *One-Line Diagrams.* Provide copies of One-Line Diagrams showing the generation facility equipment; this is required for all projects. Projects over 150 KW in size require the One-Line Diagrams to be signed and stamped by a licensed Electrical Engineer (PE). GMP accepts PE licenses issued by the states other than Vermont but not foreign issued licenses. If a one-line is revised after the application is submitted, the applicant is responsible to provide GMP an updated PE stamped copy. One-lines must include wire specifications for customer owned primary including approximate lengths. Customer one-lines should show facilities up to the point of common coupling (PCC) which is typically one of the following:
 - a. Primary riser when transformation is customer owned
 - b. Secondary meter when transformation is GMP owned
- B. *Site Documentation.* Provide detailed information on protection and control schemes. (Not required for Inverter connected generation meeting UL 1741 and IEEE 1547 requirements.)
- C. *Schematics Drawings.* Provide schematics for control circuits, relay current and potential circuits and alarming circuits. (Not required for Inverter connected generation meeting UL 1741 and IEEE 1547 requirements.)
- D. *Site Documentation.* Site location can be provided using USGS maps, hand-drawn maps showing details of the area and generation location, or electronic maps/photographs (e.g., GoogleEarth.com or Mapquest.com). For PV arrays, include the anticipated location of central inverters and GSU Transformer(s). For rotating machines, include floorplans of the generator building. GMP may need seven feet of unobstructed wall space inside generator buildings for a control and communications cabinet.

Although not required on the application site plan, required conduits paths should be detailed prior to the start of construction.

- E. Equipment Datasheets. Provide data sheets for each of the following as applicable to the project:
 - a. Inverter
 - b. Inverter master controller
 - c. Rotating Generator
 - d. Protective Relay(s)
- F. Documentation of Site Control: The rule 5.500 procedure indicates site control may be demonstrated through any of the following:
 - a. Ownership of, a leasehold interest in, or a right to develop a site for the purpose of constructing a Generation Resource;
 - b. An option to purchase or acquire a leasehold site for such purpose; or
 - c. An exclusivity or other business relationship between the Generation Resource and the entity having the right to sell, lease or grant the Generation Resource the right to possess or occupy a site for such purpose.

Section 6. Check List: Required Fee and Enclosures

Check list to confirm that required fee and documents are enclosed.

Section 7. Applicant Signature

Form should be signed and dated by a duly authorized agent of the company or owner if an individual applicant.

Distribution

Send original application form and all attachments to the interconnecting utility.

For SPEED Standard Offer Program participants, a copy of the application form must be sent to:

VEPP Inc. Attn: John Spencer
P. O. Box 1938
Manchester Center, VT 05255

4. SCREENING CRITERIA AND TIERED REVIEW

Rule 5.500 includes a set of fast track screening criteria for Vermont Utilities to evaluate the need for additional studies or system upgrades. The Company has developed the following screening criteria to complement the PSB Rule 5.500 Section 5.505 Fast Track review.

Each generator and circuit has unique characteristics that may cause exceptions to the screening criteria below.

4.1. Circuit and Facility Parameters affecting Fast Track

The Company adopts FERC Order No. 792 Issued November 22, 2013 as the first screen of fast track eligibility. Fast Track eligibility does not guarantee the project will pass the fast track screens. Of the approved distribution wire types used by the Company, only 477 ACSR bare conductor meets the 600 Ampere qualification used in FERC's Fast Track eligibility criteria.

Line Voltage	Fast Track Eligibility Regardless of Location	Fast Track Eligibility on ≥ 600 Ampere Line and ≤ 2.5 Miles from Substation
< 5 kilovolt (kV)	≤ 1 MW	≤ 2 MW
≥ 5 kV and < 15 kV	≤ 2 MW	≤ 3 MW

Table 1: FERC Threshold for Participation in the Fast Track Process

4.2. Governing Bodies and Affected Utilities

The Independent System Operator for New England (ISO-NE) requires notification of any applications for generators rated larger than 1MW. The application and studies completed for projects rated 5MW or larger must be submitted to the ISO-NE Stability and Transmission Task Forces and Reliability Committee. The task forces will determine if an additional transmission study and/or stability model are required. Please refer to ISO-NE Planning Procedure 5-1 for more information.

If the planned generation has the potential to impact a portion of the area electric power system (EPS) not operated by the Company, the Company will notify the affected utility. The affected utility may apply interconnection requirements above and beyond those of the Company which may cause delays to the interconnection process beyond the Company's control.

4.3. Available Service

If the generator size, design, or system impacts require three phase service and three phase service is not available at the PCC the project may require a supplemental review or study. Additional review or study is dependent on the scope of the necessary upgrades.

4.4. Load to Generation Ratio

The Minimum Load to Generation Ratio (MLGR) is evaluated at specific points of interest along the feed to the PCC. It is preferable to evaluate 12 months or more of load data to capture seasonal changes.

Load data may not be available at specific points, particularly protective devices distant from the substation. If load data is not available, it may be approximated using circuit modeling software.

When generation exceeds the minimum load at any of the following circuit points ($MLGR \leq 1$), a supplemental review is required. The supplemental review is to confirm the interconnection will not cause negative system impacts, or such impacts can be resolved with limited and low cost

system upgrades. If the supplemental review is inconclusive, a System Impact Study (SIS) is required.

4.4.1. Distribution Bus

When the minimum bus load is exceeded, distributed resources may cause backfeed onto the transmission system. The transmission service operator (TSO) may not be Green Mountain Power and the TSO may choose to apply additional requirements to the interconnection.

If the minimum load of the distribution bus is exceeded the system area the Company reviews for interconnection impacts increases significantly. The Company will verify there is not a temporary overvoltage damage risk for the arresters and other equipment used on the serving transmission circuit. The DR Customer may be responsible for replacement costs to increase the maximum continuous over voltage (MCOV) rating of the associated arresters or to install an overvoltage protection scheme.

The maximum allowable aggregate generation on a substation transformer is 100% of the top rating. Above this amount requires the substation transformer to be resized. Substation capacity changes require PSB approval and changes to the station's certificate of public good.

4.4.2. Load Tap Changer (LTC) and Bus Regulation

If voltage regulation at the substation is via a Load Tap Changer (LTC), the controls and settings will be evaluated for ability to accept reverse power flow. If the existing controls are not designed for bi-directional power flow, the DR Customer is responsible for replacement costs.

4.4.3. Substation Circuit Regulators and Line Regulators

The hardware controls and software settings will be evaluated for ability to accept reverse power flow. If the existing controls are not designed for bi-directional power flow, the DR Customer is responsible for replacement costs.

4.4.4. Circuit Breaker and Feeder Sectionalizing Devices (anti-islanding screen)

If the aggregate generation exceeds 67% of the minimum load at a circuit breaker or feeder sectionalizing device, the risk of islanding requires evaluation. If rotating generators represent 25% or more of the aggregate generation² an advanced anti-islanding study, or direct transfer trip (DTT) to the rotating generator may be required.

4.5. Integration with Area EPS Grounding

The grounding scheme of distributed resources cannot cause overvoltages that exceed the rating of the equipment connected to the area EPS and cannot disrupt the coordination of the ground fault protection of the area EPS in accordance with the Institute of Electrical and Electronics Engineers (IEEE) Standard 1547-2003 Section 4.1.2. The following screens are intended to evaluate this risk.

² Based on SAND201201365 Suggested Guidelines for Assessment of DG Unintentional Islanding Risk

4.5.1. Effective Grounding

All forms of distributed resources are to be designed to support maintaining the effective grounding of the Company's distribution circuits.

To be considered an effectively grounded source, rotating generators must meet the design criteria of IEEE C62 Section 92.1. Ungrounded rotating generators require two levels of utility controlled zero sequence overvoltage elements (59N) from a microprocessor relay. In general, the Company will install a three phase electronic recloser with voltage sensors at the primary voltage of the interconnection to satisfy this requirement.

Inverter based generators must be UL certified and provide an equivalency to effective grounding. Effective grounding equivalency is defined as providing adequate protection to limit overvoltages to 125% of rated phase to neutral voltage. The Company accepts UL certification as adequate to meet this screening requirement unless specific operating issues have been recorded with the selected inverter.

4.5.2. Ground Fault Current Contribution

If the grounding design of the distributed generator contributes more than 10% percent to a feeder ground fault, the project will not fast track and expensive protection measures are likely.

The Company assumes a maximum fault current contribution of 150% of inverter nameplate rating unless otherwise stated on the inverter data sheet. Fault current contribution of rotating machines and generation step up transformers is derived from modeling the unit characteristics provided in the application.

4.5.3. Short circuit interrupting ratings

The aggregated generation, including the proposed Generation Resource, on a distribution circuit cannot cause any distribution protective devices to exceed 85% of the short circuit interrupting capability³.

4.6. Conductor ampacity, Device ratings & Interrupter phase pick up

The aggregated generation, including the proposed Generating Resource, on a distribution circuit cannot exceed:

1. 80% of the phase pickup of an electronic recloser
2. 90% of the conductor ampacity rating,
3. 100% of a sectionalizing fuse continuous rating
4. 100% of the load tap changer or regulator continuous rating
5. 100% of a hydraulic recloser continuous rating

A supplemental review may permit the project to fast track if the fuse or hydraulic recloser rating can be raised to the next standard size while maintain adequate protection and coordination to

³ Short circuit interrupting capability is not to be confused with the rated load current of fuses or the trip current of reclosers

other existing sectionalizing points. If the supplemental review is inconclusive, a System Impact Study is required.

4.7. Voltage Quality

The DR Customer is responsible to provide voltage elements compliant with IEEE 1547.

The Company reviews voltage impacts of distributed resources using a detailed model of the distribution circuit when available. If the model indicates potential risk a supplemental review or System Impact Study may be required.

4.7.1. Single Phase Generation Voltage Imbalance

Single phase generators are screened to verify they will not cause a voltage unbalance exceeding 3% anywhere on the three phase interconnecting circuit (ANSI C84.1).

4.7.2. Flicker – Generation Disconnection

A distributed resource cannot cause more than a 3% change in the primary voltage at the PCC for a 100% loss of its rated output. If the project fails this screen a System Impact Study is likely required to evaluate strengthening the area EPS.

4.7.3. Flicker – Generator Reconnection

Inverter based facilities have a low likelihood of voltage impact upon reconnection, however, the Company may require staggered restart or inverter ramping if the facility is interconnecting at a comparatively weak location. A PCC is considered comparatively weak when a 100% loss of output can cause a primary voltage change between 2.5% and 3%. DR customers should select inverters with adjustable restart timers or adjustable ramp settings when the screen identifies voltage change within this range.

Rotating generators are screened for voltage fluctuations caused by inrush current during resynchronization. Generator restarts causing greater than a 2% change in output will be restricted. Usually this is accomplished by a programmed time delay between generator breaker closures. If the generator restarting has the capability to cause a voltage fluctuation greater than 3% a System Impact Study is likely required to evaluate strengthening the area EPS.

4.7.4. Flicker – Natural Transients

For photovoltaic facilities, the Company evaluates cloud transients as capable of producing a 70% loss in rated output within a 30 second interval. If a 70% loss in rated output causes greater than a 1.8% voltage dip a System Impact Study is likely required to evaluate strengthening the area EPS.

Wind facilities are evaluated on a case by case basis for the risk of flicker caused by turbulent winds and other factors. In general, if a total loss of output causes greater than a 2.5% change in voltage, a System Impact Study is likely required.

4.7.5. Voltage Rise

DR facilities are not permitted to cause an increase in the nominal voltage at the PCC in excess of 105% during steady state conditions.

4.8. Circuit Ties

If the proposed PCC can be served by another circuit breaker during feeder back-up, all of the screening criteria may need to be evaluated during the feeder back-up scenario.

If the circuit tie is not between breakers with identical settings, a supplemental review becomes likely. If the supplemental review identifies system impacts during feeder back-up, a System Impact Study or operating protocol restriction may be required. Some of GMP's radial circuits employ automatic restoration schemes to operate circuit ties which increases the likelihood of a supplemental review or study.

In the event distributed resources must be curtailed during feeder back-up, the generation typically interconnected to the serving breaker has priority to remain in operation. The Company will provide information, if available, on how frequently feeder backup was used in the past but cannot guarantee its use will not increase in the future.

4.9. Utility funded upgrades

If screening identifies system deficiencies not caused by the generator interconnection, a hold may be placed on the project approval until the issues are corrected. The Company aims to correct deficiencies within 6 months of identification, however, equipment lead time and the scope of corrective action can cause a hold of up to one year or more.

Deficiencies could include but are not limited to:

- a) Load/voltage Imbalance
- b) Reactive Power compensation corrections
- c) Overloaded equipment
- d) Protection Coordination

5. SERVICE EXTENSION GUIDELINES

The [Vermont Utilities Electric Service Requirements Manual](#) is the authority on general service extension requirements in the state. An additional source of information is the tariff governing electric service extensions and relocations. By the end of year 2014 a combined tariff is expected to be approved for the legacy territories of Green Mountain Power and the acquired company Central Vermont Public Service. As of June 1, 2014, the tariffs applicable to each legacy territory are available below:

- a) [Green Mountain Power](#)
- b) [Central Vermont Public Service \(d/b/a GMP\)](#)

6. APPENDICES

6.1. Definitions

Please see the Definitions section of the Rule 5.500 procedure available [here](#) and also applicable to this document.

Note, Rule 5.500 has the following definition for Point of Interconnection: ***The point at which the interconnection between the Interconnecting Utility's system and the Interconnection Requester's equipment interface occurs.***

In practice GMP employees sometimes use point of interconnection to reference where Utility owned interconnection facilities for a specific generator “take-off” from the main line which serves other customers. The demarcation between the Utility owned interconnection facilities and the interconnection Requester’s equipment is more commonly referred to as the Point of Common Coupling, or PCC.

6.2. Initialisms & Abbreviations used in the Interconnection Process

1. CT: Current Transformer
2. CIAC: Contribution In Aid of Construction
3. CPG: Certificate of Public Good
4. DTT: Direct Transfer Trip
5. EPS: Electric Power System
6. GFOV: Ground Fault Overvoltage
7. GIA: Generation Interconnection Agreement
8. GMP: Green Mountain Power
9. GSU: Generator Step Up
10. ISO: Independent System Operator
11. kVA: Kilovolt-amperes
12. LINEEX: Line Extension
13. LTC: Load Tap Changer
14. LROV: Load Rejection Overvoltage
15. MLGR: Minimum Load to Generation Ratio
16. MVA: Mega volt amperes
17. NEMA: National Electrical Manufacturers Association
18. NRTL: Nationally Recognized Testing Laboratory
19. NUG: Non-Utility Generator
20. PCC: The Point of Common Coupling
21. POI: Point of Interconnection
22. PSB: Public Service Board
23. PT: Potential (Voltage) Transformer
24. PV: Photovoltaics
25. ROW: Right of Way
26. SCADA: Supervisory Control and Data Acquisition
27. SPEED: Sustainably Priced Energy Enterprise Development
28. TOV: Temporary Overvoltage
29. UL: Underwriters Laboratory
30. VELCO: Vermont Electric Power Company

6.3.Limitation of Liability and Disclaimer

All interconnections are governed by, and the DR Customer should refer to, applicable laws, rules, regulations, tariffs, regulatory decisions and interconnection agreement governing the interconnection process. These Interconnection Guidelines are not a substitute for said laws, rules, regulations, tariffs, regulatory decisions and the interconnection agreement. The Interconnection Guidelines are available solely to provide customers, contractors, and other parties with additional useful guidance regarding Green Mountain Power’s typical distributed resource interconnection process. In all instances, the content and information provided by Green Mountain Power is superseded by the applicable laws, rules, regulations, tariffs, regulatory decisions and interconnection agreement governing the distributed resource interconnection process. Green Mountain Power must not be held liable under any circumstances for any reliance on these interconnection guidelines or errors, omissions, inaccurate, and/or out-dated content or information provided herein. Green Mountain Power reserves the right to amend any of the requirements at any time. Any person wishing to make a decision based on the content of this document should consult with Green Mountain Power prior to making any such decision.