



Rule 5.500 Fast Track Analysis for “BDE East Montpelier Lazar Solar, LLC”

Located at 2537 Route 2, East Montpelier, Vermont

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In this document GMP provides the result of its Fast Track Analyses on the proposed project. The document will include Project Description, Notes and Fast Track Scope (Section 1); Rule 5.500 Criteria and Fast Track Review (Section 2); Supplemental Review (Section 3) and Summary (Section 4).

SECTION 1

Project Description, Notes, Fast Track Scope

Project Description

BDE East Montpelier Lazar Solar, LLC. propose to install a 500kW-AC¹ solar project (the “Project”) on 2537 Route 2 in East Montpelier, Vermont. The Project requests to interconnect in the vicinity of Line Tag 47415 Pole 81 (the Point of Interconnection “POI”) on Green Mountain Power’s (“GMP”) 48G1 distribution circuit – a 7.2/12.47 kV grounded-wye configuration fed from GMP’s Plainfield #48 substation. The other distribution circuit off of Plainfield #48 substation is the 48G2. The power transformer at the substation is rated at 3.75/5.25 MVA and it is bus regulated using three (3) voltage regulators, one for each phase on the substation’s 12.47 kV bus.

As of November 11, 2015, prior to the submission of the Project, the 48G1 has a total of 59.9 kW-AC and the 48G2 has a total of 591.45 kW-AC of installed and proposed distributed resources, most are photovoltaic (“PV”) systems except for a 107.2 kW hydro installed on 48G2. The existing installed and proposed projects shall be included in the analysis as part of the total or aggregate distributed resources as necessary. The Project proposes to interconnect using an inverter at the proposed Project site.

Substation, Circuit and Protection Loading

Line and PoleTag	Protection Type	Equipment and Control Type	Phases	Maximum Loading (MVA) ²	Minimum Loading (MVA) ³
Plainfield #48 Substation		Transformer, 12.47 kV Bus	3	2.86	1.0
48G1 Circuit	Circuit Recloser	VWE Form 6	3	0.81	0.283

Relevant studies or information

There are no existing relevant studies or information on the 48G1 circuit.

Modeling Assumptions

The modeling assumption used in this fast track is based on the Electrical One-Line Diagram submitted for the Project.

PF% - Per the Project’s application information is 99%.

Short Circuit Contribution of the Project is 150%.

¹ The total output capacity is rated for 696.8 kW -DC per the module rating. However, the proposed inverters have a combined nominal rated output of 500 kW-AC.

² SCADA data from FY 2013 was used for the circuit level data and line load data was based on a CymDIST load flow using the SCADA data.

³ The minimum daytime loading of the circuit is assumed to be 35% of the peak loading condition due to “load masking” effects of existing distributed resources on each circuit. Further analysis on minimum daytime loading shall be examined during System Impact Study, if required.

Inverter Connection Type – Three phase, no low impedance continuous bond to the GMP neutral, also known as ineffectively grounded, or a three wire connection.

Voltage Flicker - For inverter based PV system, inrush current is not a significant indicator of voltage drop or flicker as it would for rotating machine generators. To measure the sudden change in voltage, GMP's voltage flicker test for inverter based PV systems shall be used to test the impact of the Project and the aggregate generation to the distribution circuit. The voltage flicker test will monitor the voltage readings during the startup of the Project, with or without the aggregate generators, as well as the cloud shading effects on the PV modules. The cloud shading effect will consider the output drop of 70% for the Project with or without the aggregate PV system, from its nameplate rating to 30% of its output before any voltage regulation can react to the change of voltage. The % difference in voltage readings at the Project's POI and at any point in the distribution circuit shall be validated using the GE flicker table and GMP's voltage quality policy.

Fast Track Scope: The Fast Track Analysis is meant to be a coarse screen that allows easily connectible projects to proceed to an Interconnection Agreement without having to do any additional studies. If future studies are required, this analysis can be used to pin point areas of additional study.

Please see the “GMP Distributed Resource Interconnection Guidelines” for further information to be found at <http://www.greenmountainpower.com/customers/distributed-resources/a-guide-to-customer-owned-generation-and-distributed-resource/>.

SECTION 2

Rule 5.500 Criteria and Fast Track Review

Criteria that are not passed will be colored in red.

- 1) The Interconnection Requester’s proposed Generation Resource meets the applicable codes and standards of Section 5.510 or is certified equipment package under Section 5.511.**

The inverters proposed for the Project are SunGrow Power SG-30KU (16 units) and SunGrow Power SG-20KU (1 unit) which complies with UL1741 and IEEE 1547 standards.

- 2) The proposed interconnection point is not at transmission voltage (i.e. not over 23 kV line to line or 13.28 line to neutral).**

The Project proposes to interconnect to GMP’s 48G1 distribution circuit, which has a voltage level of 7.2/12.47 kV and a four-wire, grounded-wye line configuration. The 48G1 distribution circuit is not a transmission line.

- 3) For interconnection to a Radial Feeder, the aggregated generation, including the proposed Generation Resource, on the circuit will not exceed 15% of the line section annual peak load as most recently measured at the substation. A line section is that portion of a distribution system connected to a customer bounded by Automatic Disconnect Devices or the end of the distribution line.**

The 48G1 circuit measured a peak demand of approximately .81 MVA at the substation without active distributed resource⁴. The aggregate distributed generation on the 48G1 circuit, including the Project, is approximately 559.9 kW-AC. The generation types for the aggregate generation on the circuit are all inverter-based photovoltaic (“PV”) systems. The aggregate generation on the circuit will be about 69.12 % of the peak load.

Presently, there is one (1) 65A-K link fuse from the Project to the 48G1 circuit recloser in the substation. The aggregate generation also exceeds the line annual peak load on this fuse bank.

⁴ The peak loading of 48G1 circuit is recorded on January 8, 2015 at 6pm. It is assumed that all PV systems were not active during this time.

There is also a concern of reverse flow back to the sub transmission with the addition of the Project. The total aggregate generation from both on 48G1 and 48G2 including the Project is 1,151.35 kW-AC, while the substation's coincidental peak load is measured at 2,810 kVA. The aggregate substation generation will be about 41% of the substation peak load.

- 4) The aggregated generation, including the proposed Generation Resource, on a distribution circuit will not contribute more than 10% to the distribution circuit's maximum fault current at the point on the high voltage (primary) level nearest the proposed interconnection point.**

The maximum available fault current without any generation contribution taken into account is calculated as 1,016 Amps Line-to-Ground ("LG") and 1,251 Amps three phase Line-to-Line-to-Line ("LLL") at the POI. The proposed generation is assumed to contribute fault current up to 150% of its maximum export power. The addition of the proposed generation will contribute (at worst case scenario) 34.72 Amps per a phase of fault current or 3.42% of the available LG fault current.

- 5) The aggregated generation, including the proposed Generation Resources, on a distribution circuit will not cause any distribution protective devices and equipment (including, but not limited to, substation breakers, fuse cutouts, and line reclosers), or customer equipment on the system to exceed 85% of the short-circuit interrupting capability; nor is the Generation Resource proposed for a circuit that already exceeds 85% of the short-circuit interrupting capability.**

The maximum fault current contribution from the aggregate generation does not go over 85% of the short-circuit interrupting capability of the existing line protective devices and equipment.

- 6) For interconnection of a proposed single-phase or effectively-grounded three-phase Generation Resource where the primary distribution System is three-phase, four-wire, the Generation Resource will be connected line-to-neutral. For interconnection of a proposed single-phase or three-phase Generation Resource where the primary distribution system is three-phase, three-wire, the Generation Resource will be connected line-to-line.**

The 48G1 circuit is a three phase, four wire system, otherwise known as "grounded wye". The proposed project will be connected through a grounded wye-grounded wye transformer. Although the Project connection is considered as ineffectively grounded, GMP believes that the inverter functions per IEEE 1547 and UL 1741 shall not permit overvoltage in excess of 125% per 120V per unit. In an event that overvoltage occurs in excess of 125% once the Project has been connected, remediation steps shall be implemented to maintain the power quality, reliability and safety of GMP's electric distribution system and the Project must pay the costs of system upgrades.

- 7) Voltage drop due to starting the proposed generator is within acceptable limits, meaning that inrush current, due to starting the proposed Generation Resource up to once per hour, is not greater than 3% of the available fault current. Voltage drop due to starting the**

proposed Generation Resource more than once per hour meets a tighter inrush-current tolerance, to be determined by the Interconnecting Utility.

The proposed Project and the aggregate generation in the 48G1 distribution circuit show considerable impact on voltage flicker. The calculated worst case flicker is 0.57%.

8) For any single Generation Resource, the available utility short circuit current at the Point of Interconnection divided by the rated output current of the Generation Resource is no less than:

- a) 50 for Generation Resource of less than 100 kW;
- b) 40 for Generation Resources from 100 kw to less than 500 kW; and
- c) **20 for Generation Resources equal to or greater than 500 kW.**

The line-to-ground fault current at the nearest three-phase from the POI on the primary side is 1,016.

*The per phase amps of the project are $500kW/(3*7.2kV) = 23.15$*

$1016/23.15 = 43.89$

9) Aggregate generation, including the Generation Resource, on a circuit will not exceed 2 MVA in an area where there are known or posted transient stability limitations to generating units located in the general electrical vicinity (e.g. three or four busses from the point of interconnection).

There are no transient stability limitations that GMP is aware of.

10) No System Upgrades, in excess of limited preparation that do not necessitate a Facilities Study, are required to facilitate the interconnection of the Generation Resource.

The Project will require changing the substation regulator settings in Plainfield #48 substation due to potential back feed issue during minimum daytime loading condition. The total aggregate generation from 48G1 and 48G2 distribution circuits could potentially exceed the substation's minimum daytime loading. The new settings will incorporate co-generation settings that are implemented on regulators if any back feeding conditions may occur. Other than the regulator settings, the Project will require line extension from the POI to the Point of Common Coupling (PCC) or the Project Site.

The work mentioned above needed to install the Project are not considered significant system upgrades, hence the Project does not necessitate a Facilities Study.

11) For interconnection of the proposed Generation Resource to the load side of spot network protectors, the proposed Generation Resource utilizes inverter-based equipment and aggregate generation, including proposed Generation Resource, will not exceed the smaller

of 5% of a spot network's maximum load or 50 kW. Synchronous generators cannot be connected to a secondary network.

There are no spot networks on the GMP system.

12) If the Generation Resource is to be connected on a shared, single-phase secondary, aggregate generation capacity on the shared secondary, including the proposed generation, will not exceed 20 kVA.

Not Applicable. This project is three phase.

13) If the Generation Resource is single-phased and is to be interconnected on a center tap neutral of a 240 volts service, its addition will not create an imbalance between the two side of the 240 volt service of more than 20% of the service transformer nameplate.

Not Applicable. This project is three phase.

SECTION 3

Supplemental Review

This section will assess whether the failed criteria in Section 2 can be addressed using known solutions that would not require more in depth analysis. Over recent years, GMP has found consistent means to address various concerns to the point where additional review may not be necessary. This is where for each failed criterion, a written technical justification for why GMP believes that the Project can be interconnected (subject to any conditions) without further study.

This section also covers additional topics or potential issues that are **not** covered in the existing fast track criteria or need additional discussion. This may include islanding, transmission impacts, arc flash and protection. It covers some specific criteria (i.e. voltage stability review, etc.) that may be triggered on specific fast track criteria.

This section will clarify if supplemental review, via System Impact Study, is needed to ensure the safe and reliable interconnection of the Project. As explained above, there may be explanations for failed fast track criteria or other issues that can be provided to mitigate concerns and place a project on the Fast Track despite the project not passing all criteria.

For this Fast Track, the Project failed a criterion and is discussed below.

Criterion 3 – Load vs. generation output and Protective Devices. This criterion is a flag for minimum load to suppress overvoltage and detect reverse flows on the system, specifically on line and substation equipment.

The addition of the Project exceeds the minimum load requirement to suppress overvoltage concerns from generating resources due to faults in the distribution system. However, GMP believes that overvoltage concerns are prohibited by the inverter protective elements per IEEE 1547. In an event that overvoltage occurs in excess of 125% once the Project has been connected, remediation steps shall be implemented to maintain the power quality, reliability and safety of GMP's electric distribution system and the Project must pay the costs of system upgrades.

Also, any potential reverse flow on existing line equipment due to the addition of the Project will be handled accordingly. The substation regulator settings will be equipped with co-generator settings to accept reverse flow conditions back to the subtransmission system. Additionally, the reverse flow back to the sub transmission system will be addressed by GMP with the addition of a 3Vo scheme or equivalent system in order to detect overvoltage conditions on un-faulted phases caused by single phase line to ground faults on the 34.5 kV transmission system.

SECTION 4

Summary

As mentioned in Section 3, System Impact and Facilities studies are not required for the Project. The Project, however, will require changing the #48 Plainfield substation regulator settings to incorporate co-generation settings to address reverse flow back from the circuit to the substation bus. The Project also requires line extension from the POI to the PCC. The line extension must comply with the interconnection requirements (such as metering, transformer configuration, etc.) to interconnect the Project with GMP's distribution system. The line extension and interconnection requirements are per GMP's tariff, service requirements and DR interconnection guidelines, and other applicable standards and guidelines.