STATE OF VERMONT
PUBLIC UTILITY COMMISSION

Case No. _____

Petition of Green Mountain Power for a Certificate of Public Good pursuant to 30 V.S.A. § 248 authorizing the rebuild of the Lowell Substation and the upgrade of 18.1 miles of the B20 line from Johnson to Lowell, and Joint Petition of GMP, the Village of Morrisville Water and Light Department, and the Village of Johnson Water and Light Department for a CPG pursuant to 30 V.S.A. § 248 to authorize the upgrade of 1.5 miles of the B22 line, in the Towns of Lowell, Eden, Johnson, and Morristown, Vermont	

DIRECT TESTIMONY OF WITNESS
KIM L. JONES, P.E.
ON BEHALF OF GREEN MOUNTAIN POWER

November 4, 2019

In this testimony, GMP witness Jones provides evidence in support of the issuance of a Certificate of Public Good authorizing the rebuild of the Lowell Substation and the upgrade of 18.1 miles of the B20 line from Johnson to Lowell and 1.5 miles of the B22 line in the Towns of Lowell, Eden, Johnson, and Morristown, Vermont. Her testimony addresses issues associated with system stability and reliability, need, least-cost planning, consistency with Vermont's Electric Energy Plan, economic benefit, and impacts on existing or planned transmission facilities. Witness Jones also sponsors the project cost estimate.

DIRECT TESTIMONY OF KIM L. JONES, P.E.

1. Q. Please state your name, business address and occupation.

A. My name is Kim L. Jones. I am employed by Green Mountain Power Corporation ("GMP" or the "Company") in the position of Principal Electrical Engineer. My business address is 2152 Post Road, Rutland, Vermont, 05701. I am a licensed professional engineer in the State of Vermont with over thirty years of experience in the field of power system planning. My primary duties include the performance and/or oversight of large, integrated utility planning studies involving transmission and distribution system reliability, operability, loss mitigation, cost-justification, and environmental and aesthetic impact. These studies typically assess options for electrical system improvement, ranging from traditional T&D solutions, to alternative solutions such as Demand Side Management ("DSM") and Distributed Energy Resources ("DERs"). I am involved in Feasibility and System Impact Studies for interconnection of distributed energy resources on the T&D system. I also have considerable experience in the disciplines of Integrated Resource Planning ("IRP") and Distributed Utility Planning ("DUP").

2. Q. Have you provided testimony to the Vermont Public Utility Commission (the "Commission") previously?

A. Yes. I have provided direct, supplemental, and oral testimony before the Commission in numerous cases on behalf of GMP, most recently for the following:

- Case No. 18-0269-PET for the Welden Street to East St. Albans (Line 135) 34.5 kV line reconductoring project.

- Case No. 17-4777-PET for the Bethel to East Barnard (Line 107) 46 kV line reconductoring project.
- Case No. 17-2675-PET for the upgrade of the existing Cambridge substation located in Cambridge, Vermont. This was a joint filing with Vermont Electric Cooperative, Inc. ("VEC").
- Docket No. 8727 for the upgrades to the East Barnard substation and the rebuild of the Sharon substation in Barnard and Sharon, Vermont.
- Case No. 18-2910-PET for the construction of the new GMP Airport Substation in South Burlington, Vermont.
- Case No. 18-4121-PET for the upgrade of the Websterville Substation in Barre, Vermont.

3. Q. What is the purpose of your testimony?

A. The purpose of my testimony is to provide evidence in support of the issuance of a Certificate of Public Good ("CPG") authorizing the rebuild of the Lowell Substation and the reconductoring of 18.1 miles of the B20 line from Johnson to Lowell and 1.5 miles of the B22 line in the Towns of Lowell, Eden, Johnson, and Morristown, Vermont (the "Project"). I conclude that the Project:

- will not adversely affect system stability and reliability;
- is required to meet the need for present and future demand for service which could not otherwise be provided in a more cost-effective manner through energy conservation programs and measures, energy-efficiency and load management measures or the introduction of distributed generation;

- is consistent with the principles for resource selection expressed in the Company's last approved least-cost integrated plan;
- is in compliance with the relevant requirements of the 2016 Vermont Electric Plan;
- will result in an economic benefit to the State and its residents; and
- can be served economically by existing or planned transmission facilities without undue adverse effect on Vermont utilities or customers.

4. Q. Please describe the proposed Project.

A. The proposed Project consists of three components:

1. Rebuild of the GMP Lowell 46/34.5 kV Substation;
2. Reconductoring upgrade of the 34.5 kV line between the GMP Lowell Substation and the GMP Johnson Substation ("B20 Line"); and
3. Reconductoring upgrade of a portion of the 34.5 kV line between the GMP Johnson Substation and the Morrisville #3 Substation ("B22 Line").

5. Q. Please describe the Lowell Substation portion of the proposed Project.

A. GMP proposes to rebuild its Lowell Substation adjacent to the existing substation. The proposed design of the Project includes:

- construction of a new substation yard with all new components including a yard fence, steel structures and foundations, oil containment system, ground grid, conduit system, cable trench system, yard stone, fence lighting, and security system;
- one 30/40/50//56 MVA, 46 kV to 34.5 kV auto transformer;
- one 38 kV vacuum circuit breaker and associated disconnect switches;
- control building for the DC battery system, relay and control equipment, and supervisory control and data acquisition ("SCADA"); and
- two 15 kVA station service transformers and one AC distribution panel.

Further detail of the proposed Lowell Substation work is described in the direct testimony of GMP witness John R. Fiske.

6. Q. Please describe the two subtransmission line portions of the proposed Project.

A. GMP proposes to upgrade and reconductor the 34.5 kV overhead B20 Line. This line is owned by GMP, is 18.1 miles in length and the existing 4/0 ACSR conductor will be replaced with 795 ACSR conductor. This Project will include the replacement of a line that consists of mainly1950 vintage poles as part of the GMP systematic replacement program to address the aging poles on the GMP transmission system.

In addition, GMP, in collaboration with the Village of Morrisville Water and Light Department ("MWL") proposes to reconfigure, upgrade, and reconductor 1.5 miles of the 34.5 kV overhead B22 Line. The B22 line is 6.8 miles in total and is owned by the MWL and the Village of Johnson Water and Light Department. The B22 project work area to be upgraded is 1.5 miles in length and is double circuit with the B22 in top position and 3319 below. The B22 has existing 336 ACSR conductor and the 3319 has 3/0 ACSR. The upgrade will place taller poles such that the B22 will be replaced with 477 ACSR conductor and the 3319 will utilize the 336 ACSR that was previously the B22. The smallest conductor 3/0 ACSR will be retired.

These line upgrades are in the Towns of Lowell, Eden, Johnson, and Morristown, Vermont. Further detail of these two line upgrade components of the proposed Project is described in the direct testimony of GMP witness John R. Fiske.

7. Q. Why is the proposed Project needed at this time?

A. The proposed Project is needed at this time to address asset management concerns for grid reliability improvements and to help mitigate some of the congestion of the Sheffield-Highgate Export Interface ("SHEI") capacity. This Project was identified as a priority T&D capital project given the overlapping benefits it provides for customers. Below, I explain this more relative to each Project component.

8. Q. Please describe the SHEI configuration and the issues created by this constraint.

A. GMP witness Douglas C. Smith describes the SHEI configuration and issues in detail. The information here is a summary. SHEI is a region in northern Vermont, bounded by the 115-kV loop spanning from the Sheffield to Lyndonville line ("K39 line") to the Highgate to St. Albans line ("K42 line"). The 34.5 kV B20 line is a critical subtransmission asset within the interface because it creates a parallel path back to the 115kV system, creating a closed loop system.

Power generated in northern Vermont exceeds local demand. Excess power is then transmitted to points south in the State. Under certain contingencies, this north to south transfer puts a tremendous strain on the existing aging electrical infrastructure, which could lead to voltage collapse or overloading of the transmission system. To handle these contingencies, ISO-New England ("ISO-NE") created the SHEI to control power flow in the region by calculating a set of power export limits for different system configurations. When the system is in a specific configuration, ISO-NE institutes a limit of power that can be transferred across the interface. In many cases this results in the issuance of do-not-exceed ("DNE") orders to

generators in the region to mitigate contingencies before they happen. Specifically, this means that certain generation resources inside this interface are limited in real time to ensure that system capacity is not exceeded in the event of a potential future transmission outage. This curtailment can impact the economics of these projects for customers, including loss of market value from the project's energy output, renewable energy certificates, and Production Tax Credits. As discussed in detail by Douglas C. Smith, among other benefits, this Project will cost-effectively increase the SHEI capacity, thereby reducing the frequency and magnitude of interface congestion.

9. Q. Please describe why the Lowell Substation rebuild is needed at this time.

A. The rebuild of the Lowell Substation is needed to address asset management concerns, increase reliability in the area, and will help mitigate the SHEI constraint. Presently, the Lowell Substation contains aging and obsolete equipment, including one 1973 vintage (46 years old) 15/20 MVA 46kV to 34.5 kV transformer and a 1973 vintage 34.5 kV breaker. The protection and control technologies are obsolete, utilizing electromechanical relaying. While the existing transformer is 46 years old, given GMP has an available spare this transformer would not be replaced for asset maintenance reasons. However, GMP is proposing to replace the existing transformer with a larger 30/40/50//56 MVA transformer, given the added benefit of mitigation to increase the SHEI limit, which Douglas C. Smith will discuss in more detail.

The Lowell Substation is an important component of the State's grid because it permits integration of the area's 46 kV and 34.5 kV networks, providing greater connectivity and strength. GMP, VEC, the Villages of Johnson, Morrisville, and Hyde Park, and the Towns of Stowe and Hardwick all have customers fed directly or off of other lines dependent on this

network. To maintain reliability of this network, the existing substation will remain in service until the new substation work is completed.

10. Q. Please describe why the B20 line reconductoring is needed at this time.

A. The reconductoring of the B20 line will also address asset management and increase reliability, and will help to increase the capacity of the SHEI limit. Below I discuss the asset maintenance needed for the B20 reconductoring. Douglas C. Smith discusses the SHEI-related benefits for all aspects of the Project. The asset condition component of this Project is based on GMP's strategy for addressing aging infrastructure. Accordingly, I start with some background on how GMP plans its transmission upgrade projects.

GMP applies a comprehensive and multi-faceted process to determine which transmission line projects are in need of maintenance and when to complete them including: (1) review and evaluation of the asset maintenance pole inventory data of the entire GMP transmission system; (2) assessing projects for replacement to consider overall size of the project effort and other benefits associated with this Project; and (3) prioritization of the projects based on a number of factors.

First, GMP evaluates the need to address asset management for transmission line projects through its review and evaluation of available data. This data includes the number of poles on the transmission system by decade (1940's, 1950's, etc…) and then assessing individual lines by taking a weighted average of pole age to produce the average age of the line. Based on this information, GMP evaluates the near term-replacement projects to identify project scope and additional system benefits and then determines a schedule to space out the upgrade projects.

GMP has approximately 17,700 wood poles making up its transmission line

infrastructure. Of these, we currently have 2,641 poles that are 1959 or older (over 60 years old). GMP must apply a systematic approach to pole replacement to assure that reliability will not begin to degrade, prevent higher reactive maintenance costs and to also prevent higher future replacement costs due to increased quantities of older assets requiring replacement. For example, if GMP deferred replacement of the 2,641 poles for ten years, we would then be looking at the need to replace at one time over 7,000 poles, all of which would be over 60 years old. Such a concentrated effort to replace aging poles would increase costs, threaten safety and reliability, and be hard to implement all at once. Accordingly, GMP develops a plan to systematically upgrade transmission lines in a manner that maintains safety and reliability and spreads out reconstruction of identified projects for replacement within a realistic timeframe for GMP to manage the construction.

Third, prioritization of these projects is based on a variety of factors including input from field personnel, specific operational needs, T&D efficiency and reliability analysis, customer requests, safety considerations, cost-to-benefit ratios, capacity constraints, regulatory and tariff obligations, as well as resource availability, timing issues and unforeseen events. Prioritization is accomplished by discussing the benefits of a given project, assessing the consequences of not doing a project, and the risk to the Company and customers of deferring the project in order to complete other projects. Representatives from Engineering, Operations and Operations Technology attend planning sessions to discuss project details and decide whether deferring certain projects is justified due to the positive benefits or higher immediacy associated with other projects. Projects that have overlapping benefits for customers are usually given higher priority over other projects. GMP has many identified T&D capital projects to address reliability and safety and these are vetted through GMP's Capital Management Team as part of the budgeting

process.

The structure plant on the B20 line consists mostly of 1957 vintage poles and associated hardware. Of the total 348 poles on this line, 292 poles are 1950's vintage. Aside from already budgeted projects or areas under study, the B20 line is the second oldest line identified on the basis of weighted line age for replacement, with an average pole age of 1960. Accordingly, the work that we are performing as part of this Project would need to be performed even if the B20 was not part of a set of solution steps to mitigate adverse SHEI impacts.

Since the Project captures the economic benefits associated with increasing the capacity of SHEI, we assessed whether we could feasibly address the asset condition needs at this time. Since the oldest line on the basis of average pole age was the Riverside Tap ("Line 96"), is only ten poles, and the oldest transmission line project based on the number of poles 1959 or older, Websterville to McIndoes ("Line 3311") is located in the Ryegate Area where a transmission planning study is currently being analyzed, we determined that addressing the B20 at this time would be consistent with our long-term planning objectives. Since this Project also secures additional benefits for customers by reducing SHEI congestion, we determined that it should be a higher priority than other aging transmission projects.

The existing 4/0 ACSR conductor is in need of replacement and will be replaced with 795 ACSR conductor as part of this Project. The 795 ACSR load carrying capacity is equivalent with the 30/40/50//56 MVA transformer being placed at the Lowell Substation. We chose the 795 ACSR conductor because it experiences very low loss under normal loads, can carry the post-contingency thermal loadings of this system, and be supported with single pole vertical construction without the expense of excessively robust structures or short spans.

11. Q. Please describe why the B22 line reconductoring is needed at this time.

A. The reconductoring of the B22 line will also address asset management and increase reliability, and will help to increase the capacity of the SHEI limit. Craig Myotte from MWL describes the asset condition concerns with respect to the B22 line, and Douglas C. Smith discusses the SHEI benefit from this reconductoring.

12. Q. Are there any anticipated new loads in the area?

A. No. GMP is not aware of any new loads in this area. Discussions with VEC also indicate no anticipated new loads in the area of the proposed upgrades. Growth for both utilities has been flat and in some locations declining. As discussed in more detail by Mr. Smith, VEC has also indicated that substantially increasing load in the area is not a feasible strategy for addressing SHEI congestion.

13. Q. Is this Project being completed for growth in load or growth in DER interconnections?

A. No. This Project is being completed to address the aging infrastructure and asset management issues discussed above, as well as to reduce curtailment of existing generation. It is not being completed for growth in either load or DER interconnections.

14. Q. Please describe any loss benefits associated with the proposed Project.

A. The new transformer will be purchased utilizing a transformer purchase formula to maximize efficiency. Load flow analysis using a peak summer case indicated that the State would see a peak loss reduction of 1 MW due to the reconductoring. Over twenty years, the

value of this loss reduction would be over $1.5 million.

15. Q. Please describe what alternatives to this Project were considered.

A. Alternatives for an aging transmission line that requires an upgrade to address asset condition and reliability issues includes: (1) potential delay of the pole replacement; (2) a relocation of the transmission line; or (3) construction of a new transmission corridor for redundant supply of, in this case, the B20 line. These alternatives were not feasible in this case for several reasons. First, delay of the pole replacement presents safety and reliability risks as the failure of aging pole infrastructure poses a risk to line workers and the public. Moreover, the transmission lines in this case are off-road, with difficult access. This factor increases the risk associated with aging infrastructure as this tends to increase the length of outages caused by structure failure. Other alternatives to address the aging pole infrastructure of the B20, such as relocation and/or construction of a new transmission corridor, were not pursued here because they are not cost-competitive with this Project.

In addition to the above alternatives to addressing the asset condition needs of the B20, GMP also considered alternative ways to mitigate SHEI congestion. As discussed by Mr. Smith, GMP has been involved in a robust discussion about potential solution steps that could mitigate the adverse impact of current SHEI congestion. In consultation with other Vermont utilities and Vermont Electric Power Co., Inc. ("VELCO"), GMP determined that this Project was part of a least-cost package of solution steps, the efficacy of which were studied by VELCO and its consultant, Energy Initiatives Group ("EIG"), as part of the Northern Vermont Export Study. That study work involved power flow simulation studies on the northern Vermont transmission system that assess the ability to reduce curtailment of wind generation by increasing the ability to

transfer power across the SHEI for all lines in conditions and facility-out conditions. Power flow simulation analysis was performed for the existing system and for 45 alternative combinations containing one or more of the following upgrade elements: reactive support, 115 kV transmission, 34.5 kV and 46 kV subtransmission, and battery storage.[1]

16. Q. Please explain why GMP selected this Project and not the other alternatives to this Project.

A. As discussed by Mr. Smith, a SHEI Working Group, with representatives from all the Vermont Distribution Utilities ("VDU") and VELCO, was formed in early 2018 to consider a number of alternatives identified in the Northern Vermont Export Study. The goal of the Working Group was to find the best alternative to cost-effectively address the current level of SHEI congestion, with a focus on benefits to Vermont customers. The group determined that existing congestion could largely be addressed with a combination of solution steps that include this Project, the Sheldon Springs Automatic Voltage Regulation ("AVR"), and the Sheffield AVR. This set of solution steps increases the SHEI voltage and thermal limits, and when combined with the reliability and asset management benefits, represents a unique opportunity to meaningfully reduce SHEI congestion with only modest incremental costs above those that would need to be incurred in upgrading the B20 in the near term. Moreover, as discussed by Mr. Smith in more detail, the B20 and B22 upgrades are a key component of many potential SHEI solution steps and are therefore an important part of the future transmission backbone in northern Vermont.

[1] See Northern Vermont Export Study, available at: https://www.vermontspc.com/library/document/download/5995/VELCO_SHEI_Study_FinalReport.pdf.

17. Q. Can the introduction of DSM or Distributed Generation ("DG") alleviate the need for the Project?

A. No. The application of DSM measures or DG cannot address the aging assets or the SHEI constraints. The reduction of load in this area could actually exacerbate the problem. A battery solution for SHEI was studied as an alternative, however, it was determined that this alternative was not cost competitive. Quarterly information updates regarding the SHEI have been provided to the Vermont System Planning Committee ("VSPC") since October 2017. This Project was also presented to the VSPC's Geotargeting Committee in May 2019. The Project cannot be deferred or avoided with the introduction of conservation, efficiency measures or distributed resources.

18. Q. Is the proposed Project required to meet the need for present and future demand for service which could not otherwise be provided in a more cost-effective manner through energy conservation programs and measures energy-efficiency and load management measures or distributed generation, including but not limited to those developed pursuant to the provisions of 30 V.S.A. §§ 209(d), 218c, and 218(b) (30 V.S.A. § 248(b)(2))?

A. The proposed Project is the most cost-effective option to meet present and projected future demand for service that GMP was able to identify within the affected area. As discussed above, the application of DSM and DG cannot address the asset management concerns, nor the SHEI constraints. Mr. Smith elaborates on why this Project is the least cost approach to mitigating SHEI constraints and the associated adverse impact on Vermont electricity customers.

19. Q. Will the Project adversely affect system stability and reliability (30 V.S.A. § 248(b)(3))?

A. No. The Project will not adversely affect system stability or reliability. As explained above, the proposed Project will actually improve system reliability by addressing aging infrastructure. The new technologies will allow for identification of fault location, enhancing response time for outages on the approximately 18.5 mile line between Lowell and Johnson. The addition of the 46 kV B-30 breaker will provide high-speed transformer protection. As discussed above and in some detail by Mr. Smith, the SHEI export limitations are imposed by ISO-NE in order to ensure system stability and reliability under a variety of conditions. The Project is expected to enable ISO-NE to increase the export limits on the SHEI, resulting in economic benefits associated with increased output of existing renewable resources, without adversely effecting system stability and reliability.

20. Q. Will the Project result in an economic benefit to the State and its residents (30 V.S.A. § 248(b)(4))?

A. Yes. The asset management issues addressed by the Project will prevent equipment failure and will ensure that the 34.5 kV network stays intact to serve GMP customers as well as other utilities. The Project's ability to help GMP lower the risk of loss of load due to equipment failure will provide an economic benefit to the State and its residents. The performance of the Project work will also result in construction work and additional municipal tax payments.

In addition to the economic benefits of this Project that are typical for any asset maintenance project that involves substantial construction and municipal tax payment, this

Project also benefits Vermont electricity customers by mitigating adverse impacts created by the existing SHEI constraints. As discussed by Mr. Smith, these economic benefits are conservatively valued at approximately $14.7 million.

21. Q. Is the proposed Project consistent with the principles for resource selection expressed in the Company's most recently approved least cost IRP (30 V.S.A.§ 248(b)(6))?

A. Yes. GMP seeks to serve projected customer loads in a reliable and efficient manner as outlined in its approved 2018 IRP. The Project will enable the Company to satisfy its obligation to serve and to meet the needs of its customers in a reliable and efficient manner consistent with the resource selection criteria outlined in that plan and with the orders issued by the Commission relating to transmission and distribution planning.

GMP's 2018 IRP, approved by the Commission in Case No. 18-4166-PET, provides specific transmission reliability recommendations, including "Quicken our pace for replacing aged poles." Addressing the aging poles on the B20 line is consistent with that recommendation. In addition, GMP's 2018 IRP included an overview of the SHEI constraint and efforts to resolve this constraint as quickly as possible.

22. Q. Is this Project consistent with the 2016 Vermont Comprehensive Energy Plan which incorporates the Vermont Electric Plan (30 V.S.A. § 248(b)(7))?

A. Yes. The Vermont Comprehensive Energy Plan (the "Plan") identifies the basic objectives that must be satisfied in serving the public interest. Utilities are required to serve their customers at the lowest life-cycle costs, including environmental and economic costs. These objectives call for the provision of electric service that is the most efficient and cost-effective.

The Project supports these objectives by improving the reliability of the power delivery system in the affected area at least cost. Additionally, as discussed in more detail by Mr. Smith, addressing the SHEI constraint is consistent with the Plan by increasing the productivity and value of existing renewable generators in the SHEI.

23. Q. Can the Project be served economically by existing or planned transmission facilities without undue adverse effect on Vermont utilities or customers (30 V.S.A. § 248(b)(10))?

A. Yes. The Project can be served economically by existing or planned transmission facilities. The Project will not have an adverse effect on other Vermont utilities or customers. As noted above, the Project will improve the reliability of the Lowell Substation, which benefits all the utilities that have customers fed off the 34.5 kV network that originates from this Substation. This includes VEC, the Villages of Johnson, Morrisville and Hyde Park, and the Towns of Stowe and Hardwick. In addition, the increased capacity of the SHEI will increase the economic benefits that Vermont electric customers receive from renewable generation in northern Vermont, positively impacting Vermont utility customers generally.

24. Q. Will the Project require any temporary or portable equipment to be installed during construction?

A. No. The project will not require that a portable substation be installed. As stated above, the existing substation will remain in service until the new substation work is completed.

25. Q. Please provide and explain in detail the cost of the Project.

A. GMP estimates that the total Project will cost approximately $15,455,719, which includes a 20% contingency. A copy of the Project's cost estimate is appended to my testimony as **Exhibit GMP KLJ-1**. The total Project costs can be broken down as follows:

Materials	$ 3,903,371
Labor	$ 478,093
Contractor	$ 5,752,679
Indirect adders	$ 2,526,624
AFUDC	$ 218,999
Contingency	$ 2,575,953
Total	$15,455,719

26. Q. Does this conclude your testimony?

A. Yes, it does.