STATE OF NEW HAMPSHIRE

BEFORE THE

NEW HAMPSHIRE PUBLIC UTILITIES COMMISSION

DOCKET NO. DE 19-057

REQUEST FOR PERMANENT RATES

DIRECT TESTIMONY OF

CHARLOTTE B. ANCEL and JENNIFER A. SCHILLING

Grid Transformation and Enablement Program:

Clean Innovation Projects

On behalf of Public Service Company of New Hampshire

d/b/a Eversource Energy

May 28, 2019

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I. INTRODUCTION

Q. Ms. Ancel, please state your name, position and business address.

A. My name is Charlotte Barlow Ancel. I am Director of Clean Energy Strategy, Policy, and Development for Eversource Energy ("Eversource"). My business address is 780 North Commercial Street, Manchester, New Hampshire 03101.

Q. What are your principal responsibilities in this position?

A. On behalf of all of the Eversource operating companies including Public Service Company of New Hampshire d/b/a Eversource Energy ("PSNH" or the "Company"), I oversee and lead clean energy strategy and policy initiatives enterprise-wide, including the development of clean energy proposals like electric vehicles and battery storage.

Q. Please summarize your professional experience.

A. I joined Eversource in March 2018. For four years prior to that, I was Vice President of Power Supply and General Counsel at Green Mountain Power in Vermont. Previous to Green Mountain Power, I was a partner at the Burlington, Vermont law firm of Sheehey Furlong & Behm where I specialized in energy law.

Q. Please summarize your educational background.

A. In 2007, I received a Juris Doctor degree *magna cum laude* from the University of New Hampshire School of Law, where I served as Editor-in-Chief of the Law Review. Prior to attending law school, I taught high-school math and science to at-risk youth, first at Centerpoint School in Winooski, Vermont from 2001 to 2003, and then at Sand Paths Academy in the Mission District of San Francisco for the 2003 to 2004 school year. In 2000, I received a Bachelor of Arts degree *magna cum laude* from Boston College.

Q. Have you previously testified before the New Hampshire Public Utilities Commission or other regulatory agencies?

A. I provided testimony at the Vermont Public Utility Commission in Docket 17-3112 (Green Mountain Power rate case), Docket 8525 (rate integration and rate design), Docket 8794 (innovative services), Docket 8871 (regulation plan extension), and Docket 17-3232-8 (temporary limited regulation plan). I have not previously testified before the New Hampshire Public Utilities Commission (the "Commission").

Q. Ms. Schilling, please state your full name, position and business address.

A. My name is Jennifer A. Schilling. I am the Director of Grid Modernization for Eversource Energy. My business address is 247 Station Drive, Westwood, Massachusetts 02090.

Q. What are your principal responsibilities in this position?

A. On behalf of all of the Eversource operating companies including PSNH, I am responsible for developing strategies to increase the capacity of the Eversource Energy electric distribution system to optimize the integration of distributed energy resources, while improving the safety, security, reliability and cost-effectiveness of the system. I am also responsible for grid-modernization portfolio management, as well as coordination and implementation of grid-modernization technology programs.

Q. Please summarize your professional experience.

A. From 2001 to 2008, I held a number of positions at Reliant Energy in Houston Texas, ending my tenure in the position of Director, Corporate Strategy. In 2008, I joined the Northeast Utilities System as the Director of Business Planning for Western Massachusetts Electric Company ("WMECO"). I subsequently accepted the role of Director, Asset Management for WMECO and then Director, Distribution Engineering for Eversource, prior to assuming my current role.

Q. Please summarize your educational background.

A. I graduated with a Bachelor of Arts degree in environmental science and political science from Barnard College, Columbia University in 1995. In 2001, I earned a Master of Business Administration from Duke University.

Q. Have you previously testified before the Commission?

A. No, I have not previously testified before the Commission. I have testified before the Massachusetts Department of Public Utilities in relation to grid-modernization and distribution planning matters as part of several different proceedings including D.P.U. 17-05 and D.P.U. 15-121/15-122.

Q. What is the purpose of your testimony?

A. Our testimony is provided on behalf of PSNH in support of the Company's Grid Transformation and Enablement Program ("GTEP"), which is a program to raise the condition of the Company's distribution system in the State of New Hampshire to a level that is necessary to meet the growing expectations of customers for fewer service interruptions; shorter restoration times, particularly following major weather events; and the integration of a range of advanced energy solutions that achieve operational goals, while at the same time reducing greenhouse gas emissions. The GTEP would operate in concert with the Company's core capital program to provide critical support for accelerated investments targeted to fortify the overhead distribution system with more resilient equipment and materials, while at the same time creating the operating platform necessary to enable the integration of advanced technology solutions on a cost effective and lasting basis.

If approved by the Commission, the GTEP would enable the Company to identify, plan and develop projects to meet customer demand for increased system integration of clean energy technologies in the future. As described in the joint testimony of Company Witnesses Joseph A. Purington and Lee G. Lajoie, the Company's GTEP testimony is provided in two parts. Our testimony is the second part of the GTEP testimony, describing two proposed demonstration projects that will serve as important learning opportunities as the Company continues to enable the integration of new and emerging clean energy technologies into the electric distribution system. These two projects are the Westmoreland Clean Innovation Project and the Oyster River Clean Innovation Project.

Q. What was your role in developing the demonstration projects discussed in this testimony?

A. Ms. Ancel is principally responsible for the development and presentation of the Westmoreland Clean Innovation Project. Ms. Schilling is principally responsible for the development and presentation of the Oyster River Clean Innovation Project.

Q. Ms. Ancel, would you please describe the Westmoreland Clean Innovation Project?

A. Yes. The Westmoreland Clean Innovation Project is designed to provide back-up power for hundreds of rural customers and critical town facilities, while avoiding construction of a new electric distribution line and helping to reduce peak energy costs and greenhouse gas emissions for all New Hampshire customers. This non-wires alternative project would serve as an important demonstration for future energy storage projects in New Hampshire. Therefore, the Company is proposing to include this demonstration project in the GTEP.

Q. Ms. Schilling, would you please describe the Oyster River Clean Innovation Project.

A. Yes. The Oyster River Clean Innovation Project will be aimed at creating greater resiliency for electric service, while serving as an important learning opportunity to advance knowledge and expertise in relation to the deployment of other, future microgrid projects in New Hampshire. In partnership with the University of New Hampshire ("UNH"), the Town of Durham, and by pursuing research grant opportunities, the Company would construct a clean energy microgrid that will advance the use of technologies to improve system visibility and control capabilities, reduce greenhouse gas emissions, and allow the campus and adjacent portions of the Town of Durham to remain energized during a widespread power interruption. Therefore, the Company is proposing to include this demonstration project in the GTEP.

Q. Are you presenting any attachments in support of your testimony?

A. Yes, we are presenting the following six attachments in support of this testimony:

Attachment	Purpose/Description
Attachment GTEP-1	Pictures of Westmoreland Town Center and Residences
Attachment GTEP-2	Eversource Report – Westmoreland
Attachment GTEP-3	Doosan GridTech Report
Attachment GTEP-4	Benefit/Cost Analysis
Attachment GTEP-5	Oyster River Project Memorandum of Understanding

Q. How is your testimony organized?

A. In addition to this introductory section, our testimony is organized into the following sections:

- Section II presents the Company's proposal for the Westmoreland Clean Innovation Project. Ms. Ancel is principally responsible for this section of the testimony.
- Section III presents the Company's proposal for the Oyster River Clean Innovation Project. Ms. Schilling is principally responsible for this section of the testimony.

Q. Are there costs associated with these two demonstration projects and, if so, does your testimony address the Company's proposal for cost recovery?

A. Yes, there are certain capital costs and operating and maintenance ("O&M") expenses that the Company would incur to execute on the proposed demonstration projects. Recovery of these costs is discussed in the joint testimony of Company witnesses Eric H. Chung and Troy M. Dixon.

II. WESTMORELAND CLEAN INNOVATION PROJECT

Q. Ms. Ancel, what is your assessment of the current energy landscape?

A. The electric distribution grid was constructed using materials and construction methods prevailing a century ago, under circumstances where customers were served from a few large, centralized, and mostly fossil fuel-based generators. Electric use grew year-over-year providing revenues between base-rate cases.

Today, the script has flipped. In 1990, there were approximately 2,000 grid-connected generators in New England. Today, there are over 125,000 with exponential growth expected over the next decade. The emergence of distributed energy resources ("DER"), in particular solar photovoltaic, and on-shore and off-shore wind generation resources has taken hold as a result of precipitously declining costs and the availability of state and federal incentives.

As an example, in the summer of 2018 Massachusetts completed its first competitive off-shore wind procurement. The winning bid was to provide energy and renewable energy credits at a levelized cost of 6.5 cent / kWh. This is approaching the current 4.2 cent / kWh cost of buying on the wholesale ISO New England market (which is predominantly gas-fired). Five years ago off-shore wind cost around 20 cent / kWh. And subsequent off-shore wind procurements have the potential to decline from 6.5 cents.

PSNH is seeing similar transformation with respect to electric sales. Electric sales are now flat or declining in most of the country, including New England.

Electric sales are declining for positive reasons. First, energy efficiency has made significant gains, both at the state (energy efficiency program and building codes) and federal (increased research and development and appliance standards) levels. The proliferation of solar photovoltaic DER is also contributing to the decline of electric sales. These declines are partially offset by New Hampshire's economic growth.

With declining sales, customer rates will go up – even before taking into account other increasing costs. This is because there are fewer units (i.e., kilowatt hours) over which to spread the fixed costs of utility delivery infrastructure. This requires a reimagining of the electric grid and of the way in which PSNH serves its customers. We will need to move swiftly toward a decarbonized, decentralized future, while also maintaining a safe, reliable, and affordable electric system.

Q. Please describe the need for the Westmoreland Clean Innovation Project.

A. The electric grid is becoming increasingly reliant on flexible energy resources that can be turned up or down depending on whether the wind stops blowing, the sun goes behind a cloud, or if customers' energy use suddenly spikes. To properly manage the grid under these conditions, PSNH will need to strengthen its ability to optimize battery storage, energy efficiency, and demand response (including aggregated thermostats, electric vehicle chargers, water heaters, residential scale batteries, and other customer-owned and -sited devices).

The path for how these flexible resources will be integrated into the New Hampshire grid is less developed than for renewable resources, though the Commission and other stakeholders are currently evaluating options as part of the Grid Modernization Docket.

The use of flexible resources to better serve customers, to increase resiliency, and to reduce system costs and greenhouse gas emissions is of paramount importance to the future. It is with these values in mind that the Company has developed the Westmoreland Clean Innovation Project (the "Westmoreland Project").

Q. Would you please provide an overview of the Westmoreland Project?

A. The Westmoreland Project will involve the creation of a coordinated portfolio comprised of three components: energy efficiency, demand response in the form of a "bring-your-own-device" program that provides incentives for customer-owned batteries, thermostats and battery storage, and a PSNH-owned battery-storage unit. This coordinated portfolio will enable PSNH to avoid construction of a 10-mile overhead distribution circuit, dramatically improving reliability on a circuit that has historically experienced performance deficiencies. This coordinated portfolio will also reduce yearly and monthly peak demand, reducing costs for all New Hampshire customers.

The Westmoreland Project will make a small, rural New Hampshire town an object lesson in clean energy transformation, enabling a lower carbon, more distributed, and more resilient grid. The Westmoreland Project has benefit-cost ratio of above 1, so that it is anticipated to produce approximately $1.9 million in net savings for customers over its life, relative to alternatives. PSNH will rely on the Westmoreland Project to test and refine the vision for a larger, clean energy transformation model that we would look to roll out in New Hampshire—in partnership with other stakeholders—over the next several years.

Q. What is the scope of authorization that PSNH seeks in this case for the Westmoreland Project?

A. As I noted above, the Westmoreland Project will involve the creation of a coordinated portfolio of comprised of three components: energy efficiency, demand response in the form of a "bring-your-own-device" incentive program, and a PSNH-owned battery-storage unit.

In terms of the energy efficiency component, PSNH is requesting approval to utilize additional marketing and outreach efforts to target energy efficiency projects in Westmoreland as part of the Westmorland Project.

In terms of the demand-response component, PSNH intends to propose a Residential Demand Reduction Initiative as part of the 2020 Update for energy efficiency programs to be submitted in September 2019 as part of Docket No. DE 17-136. The targeted component of the Westmoreland Project will present customer opportunities for participation. PSNH does not request specific approval of the demand response component in this docket.

In terms of the PSNH-owned battery storage component, PSNH is requesting that the Commission review the Company's proposed Westmoreland demonstration project in this case and pre-authorize the Company's capital expenditure related to this program, estimated at $7 million as well as annual average of $140,000 in O&M expense for the battery component, as it did in Docket No. DE 17-189 for Liberty Utilities. The Company is not proposing to recover these amounts through the base rates that the Commission will set in this docket. Instead, the Company is requesting the Commission's approval of a separate rate mechanism through which recovery of costs for projects such as the Westmoreland Project could take place. In approving the Liberty Powerwall Pilot, the Commission stated that its pre-authorization meant that the utility's decision to commence development of the project would be deemed prudent, but that the

Commission would retain the ability to review the prudency of the utility's execution of the development of the project when the utility sought rate recovery of the fully-commissioned project at a later date. PSNH respectfully requests the same treatment here.

Q. Please provide an overview of the topics you will address.

A. First, I provide an overview of Westmoreland, New Hampshire and describe its current significant reliability challenges. Second, I describe the Company's internal process to evaluate a traditional poles and wires solution versus non-wires alternatives (i.e., efficiency, demand response, and distributed resources) to address the Westmoreland reliability challenge. Third, I describe the independent analysis if the Company's third-party consultant, Doosan GridTech, which examined technical feasibility, sizing and associated cost of the battery storage component of the non-wires alternative. Fourth, I lay out each aspect of the Westmoreland Project, including benefit-cost analyses and projected implementation schedule. Fifth, I explain the Company's plans to competitively bid the battery storage component of the Westmoreland Project and the advance community outreach that has already been done in Westmoreland. Lastly, I describe how the Westmoreland Project satisfies each of the criteria laid out in RSA 374-G:5.

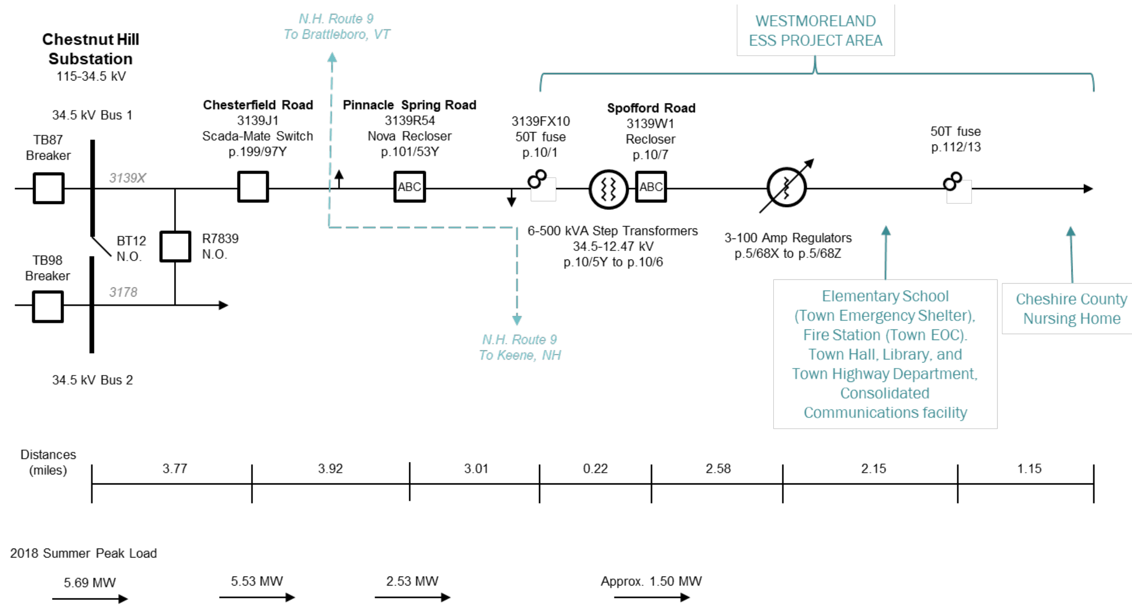
A. Westmoreland, New Hampshire

Q. Please describe the municipality of Westmoreland, New Hampshire.

A. Westmoreland is located in Cheshire County in the southwest corner of the state. Its population is around 1,870 residents, consisting of around 570 households. A handful of small commercial customers are located in the town center, including an Elementary School, a Town Fire Station, a Town Hall, a Post Office, a General Store, a Consolidated Communications facility, and a Nursing Home. Westmoreland is mainly rural in character with a rolling landscape and a lot of tree cover. Pictures of the town center and some representative buildings are included as Attachment GTEP-1.

Most of the Company's customers in Westmoreland are served by a distribution circuit designated as "Line 3139X." The backbone of Line 3139X is a radial 34.5 kV line (not looped and therefore more prone to outages) that is approximately 16 miles long, connecting into the Chestnut Hill Substation in Hinsdale, New Hampshire and upstream of the Spofford Road transformers.

Visually, Line 3139X has the following configuration:



The Westmoreland town center is located approximately 14 line miles from the Chestnut Hill Substation and hosts critical loads including an elementary school (that serves as the town emergency shelter), the Town Fire Station, Town Hall, the Post Office, a General Store and a Consolidated Communications facility. The Cheshire County Nursing Home is located an additional two miles downstream of the town center.

Currently, service to these critical facilities is interrupted during outages in the upstream distribution system and there are no alternate sources of electricity available in the current system reconfiguration.

Since November 2012, there have been 13 outages on Line 3139X upstream of the Spofford step transformers (with an average duration of 2.2 hours and a maximum duration of 6.87 hours) and 24 outages downstream of the Spofford step transformers (with an average duration of 2.8 hours and a maximum duration of 8.68 hours).

All-in, customers in Westmoreland have experienced a total of 27 outages with a total duration of 97 hours with an average of 2.6 outage hours since November 2012. This is one of PSNH's worst performing circuits.

The traditional poles and wires solution to address this issue would be to construct a new, 10-mile distribution circuit serving the portion of Line 3139X downstream from the Spofford step transformers, feeding from the Emerald Street Substation in Keene, New Hampshire. The cost of this solution is estimated at approximately $6 million.

B. <u>The Value of the Demonstration Project</u>

Q. What is the Company's plan to address the limitations of service on Line 3139X?

A. Over time, the Company has evaluated options to change the situation on Line 3139X, but options for doing so are limited. In the past PSNH has generally reviewed potential non-wires alternative projects in conjunction with its system-planning efforts but has not had the opportunity or flexibility to develop creative solutions involving technology that is only recently emerging in the marketplace. Today, options are emerging as "non-wires alternatives," which are configurations that use non-traditional transmission and distribution ("T&D") solutions, such as energy efficiency, demand response, distributed generation, energy storage, and/or grid software and controls to defer or replace the need for specific equipment upgrades such as T&D lines or transformers, such as by reducing load at a substation or circuit level to alleviate a capacity constraint, or by providing an alternative solution to a reliability concern. Where non-wires alternatives can be utilized, there is the potential to produce multi-dimensional benefits for customers in the form of cost savings, reliability improvement and peak demand reduction that would not be available with the straightforward replacement or installation of a new distribution circuit.

In mid-2018, PSNH commenced a cross-functional review of potential opportunities across the system to implement non-wires alternative projects as part of an overall transition that would accelerate investment for targeted replacement of overhead distribution infrastructure and upgrade the condition of the distribution system to meet customer demands. As part of that effort, PSNH considered the following factors:

- Whether loads exist in the area at reasonable levels for demonstration project sizing;
- Whether reliability, capacity, or power quality issues are present that could be solved by the project;
- Extent of DER penetration;
- Whether the project would enable the Company to avoid or defer traditional system upgrades – especially in difficult to reach locations which lead to higher costs, considering the following:
    - Substation loadings
    - Feeder loadings
    - Back-up capabilities – single feed or single transformer substations, no current alternate distribution line loops

   - Critical customer locations.
- Land availability in the area.

The highest scoring project among 11 potential sites across New Hampshire identified by PSNH was the Westmoreland Project, involving a combination of energy efficiency, demand response, and battery storage for Line 3139X in lieu of installing a traditional 10-mile distribution circuit. This project scored highest due to reliability and power quality needs in the area; the need for back-up capability in a difficult location to provide traditional solution; expected land availability in the area; and, loads at levels appropriate for demonstration project sizing.

Q. How did PSNH approach the targeted energy efficiency component of demonstration project?

A. PSNH's Energy Efficiency team evaluated the potential to concentrate additional efficiency investments into the Town of Westmoreland as part of the effort to avoid the traditional distribution upgrade. From a customer-base perspective, the Town of Westmoreland encompasses:

- 3 large commercial customers (with one customer accounting for the bulk of annual kilowatt usage);
- 76 smaller commercial customers (with 16 customers accounting for the top usage);
- 13 interruptible electric heat customers; and
- 448 residential customers.

PSNH plans to use additional marketing and outreach to target these customers for participation in the Company's existing programs. This will include reviewing the usage of customers downstream from the battery, identifying energy efficiency opportunities at commercial, industrial, municipal and residential customer sites, and working directly with those customers to implement energy efficiency improvements. The Company's strategy will use direct customer contact via account executives to commercial, industrial and municipal customers as well as direct mail marketing to the residential customers who are identified as qualifying for weatherization or replacement of / upgrading to more efficient lighting and appliances. Based on all these efforts, the Company expects to obtain approximately 50 kW of additional reduced load in the Town of Westmoreland. A detailed report laying out this proposal is attached as Attachment GTEP-2.

Q. Would this targeted energy efficiency effort require incremental funding through the Company's proposed mechanism?

A. No. PSNH is not proposing funding for this component as part of the demonstration project. Instead, this effort could be funded through programs already in place and funded by <u>existing</u> system benefits charge ("SBC"). In that regard, RSA 374-F:4, VIII(e) states that utilities *shall* make a proposal for use of SBC funds that are used as a part of a targeting strategy to minimize distribution costs and that such proposals would be implemented on a pilot basis. This is such a project. Therefore, PSNH is proposing to use existing energy efficiency program offerings to implement efficiency projects in Westmoreland, including additional outreach and marketing to encourage uptake from customers in the community.

Q. You also mentioned a targeted demand response effort as part of the Westmoreland Project. What does this mean?

A. Yes. PSNH has developed the concept of establishing a "Bring Your Own Device" Program ("BYOD") throughout its New Hampshire service territory, with a targeted quantity of 65 kW of such devices in Westmoreland serving as one of the first locations.

Q. What is a "Bring Your Own Device" Program?

A. The BYOD design would enable PSNH to pay an incentive for verifiable load reductions using a customer-owned behind the meter device based on actual performance (meaning the customer's behind the meter device actually responded to the utility's dispatch signal). This design would protect non-participating customers because, where a customer who has received an up-front incentive does not perform, the utility typically has little actual recourse to recoup any of the large upfront funds paid to the participating customer. This outcome represents a loss to all non-participating customers who have paid into the energy efficiency fund. Within the Company's concept, non-participating customers are protected against non-performance by utilizing a design that only pays for actual dispatches and load reductions rather than an up-front incentive payment.

In this model, PSNH would send a signal to the device manufacturer or customer to execute a command and the device manufacturer or customer will then send a signal to each device to temporarily change their normal operations, resulting in load reductions. PSNH would then pay an incentive based on a customer's performance. Typical devices that participate in BYOD programs include wi-fi thermostats connected to central cooling systems, behind the meter battery storage systems, water heaters, and electric vehicle chargers. The Company's goal would be to produce approximately 65 kilowatts of demand reduction in the Town of Westmoreland.

Customers who are able to utilize their own onsite battery storage during an outage will not be reliant on the larger battery for power in the case of an outage. This allows PSNH to reduce the size of the front of the meter storage system to effectively meet its goals to significantly improve reliability for the Town.

As part of this initiative, PSNH would reserve a number of participant opportunities (likely 10 out of a potential 50 total for battery storage; 30 out of a potential 250 for communicating thermostats) for customers located in Westmoreland, to provide the opportunity for further kilowatt reduction in the community, additional peak shaving impact, as well as added resiliency for residents utilizing their own batteries. If customers in the town of Westmoreland do not sign up for all of the set aside participant opportunities by May 1, 2020 those "reserved" opportunities will be opened up to customers in the rest of the state.

The Company envisions a typical customer offering under the BYOD Program would be as follows: For a customer with an existing wi-fi thermostat and central cooling, PSNH would offer the customer a $25 sign-up bonus and an annual $20 performance payment for allowing PSNH to increase the customer's thermostat set point by up to 4 degree for 3 hours at a time, 15-18 times per year.

Similarly, PSNH would pay an incentive to a customer that installed a residential battery storage system and allow the Company to dispatch that battery some number of hours per year. A typical example would be as follows: A customer installs a Tesla Powerwall and allows PSNH to dispatch the Powerwall multiple times over the summer for PSNH to reduce its annual peak load. The customer would receive $200/kW which translates to earning $1,000/year.

There are typically variations of the incentive level depending on how often the battery is controlled by the utility. PSNH would consider integrating other devices that customers may already have in their homes and that could connect to a central platform in order to receive dispatch instructions. The incentive would be based on how frequently these devices could be dispatched and the level of load reduction that device could provide. Actual incentive levels will be determined during the 2020 Update in DE 17-136.

All of these offerings will be wholly voluntary and consistent with RSA 374:62.

Q. Is PSNH proposing to own any of these behind the meter batteries or other devices?

A. No.

Q. How is PSNH proposing to fund the BYOD Program?

A. PSNH, along with the other New Hampshire utilities, will file a 2020 Update for energy efficiency programs in September of 2019 in Docket No. DE 17-136. As part of that

2020 Update, PSNH intends to propose a Residential Demand Reduction Initiative. This residential effort will build off the C&I Demand Reduction Initiative that was included in the 2019 energy efficiency programs and approved by the Commission in Order No. 26,232 (April 5, 2019).

The overall demonstration project for Westmoreland would use the "reserved" portion of the BYOD as described above; however, the Company's statewide proposal and the associated funding would be included in the 2020 Update. Assuming the residential demand reduction proposal in the 2020 Update is approved, it would be implemented statewide with PSNH focusing on deployment in Westmoreland as a demonstration project proposed in this case.

Q. Would you please summarize the level of kilowatt hour savings you are expecting in total from the geotargeted efficiency and demand response components of the Westmoreland Project?

A. Yes. The estimated summer demand reductions resulting from these energy efficiency and demand reduction initiative are estimated as follows:

	Westmoreland		Statewide	
Project Component	**Quantity**	**Total kW**	**Quantity**	**Total kW**
Energy Efficiency	15	50		
Residential Batteries	10	50	50	250
Communicating Thermostats	30	15	250	125
Total	**55**	**115**	**300**	**375**

Q. Did the Company consider whether the reliability issue could be addressed by other alternatives such as adding a new generation source at the end of the circuit?

A. Yes, but PSNH determined that this alternative would be significantly more expensive than the battery solution. Moreover, there would not be enough energy efficiency and/or demand response to offset reliability concerns.

C. Third Party Analysis

Q. What steps did PSNH take to confirm the foundational concepts of this demonstration project with an industry expert?

A. To confirm the foundational elements of the demonstration projects, PSNH commissioned Doosan GridTech ("Doosan") to evaluate the feasibility, sizing, and cost of the Westmoreland Project (focusing specifically on the battery storage component). Doosan examined the Line 3139X electrical system, presented a conceptual design for battery storage paired with efficiency and demand response, and assessed the benefits achievable through such a portfolio of approaches connected in Westmoreland. Doosan's full report is provided herewith as Attachment GTEP-3.

Q. Would you describe Doosan's conclusions?

A. Yes. Doosan recommended a 1.7 MW / 7.1 MWh lithium ion battery to avoid construction of the 10-mile distribution line.

Doosan determined that a 1.7 MW / 7.1 MWh system would support all commercial and residential loads downstream of the Spofford step transformers through all upstream outages up to 4-hours in duration based on projected load through 2028. The 1.7 MW / 7.1 MWh rating is an "end-of-life" rating, thus accounting for degradation. I refer to the "end-of-life" value as that is the size needed to avoid the traditional "poles-and-wires" asset.

The battery is a favorable solution for Westmoreland as it will significantly reduce the number of outages at a comparable level to a traditional "poles-and-wires" solution. A new distribution circuit would not have the duration constraints of a battery but would be more prone to outages caused by storms and other upstream issues. Based on historic data, we estimate that the battery would have improved reliability by approximately 80% had it been service since November 2012.

Doosan also determined that additional qualitative benefits could result from the project, such as the potential for primary frequency response capability and the development of expertise in leveraging the benefits of battery storage by the PSNH team. These benefits are not directly quantifiable and are not included in the Company's benefit-cost analysis.

Doosan recommended lithium ion battery technology based on its technological maturity and suitability to perform the recommended use cases. Doosan also relied on PSNH's energy efficiency projections that an additional 50 kW could be obtained through energy efficiency measures and 65 kW through demand response. These demand reductions increase the ability of the proposed energy storage system to serve longer duration outage events beyond the 4-hour window provided by the utility-scale battery.

Doosan estimated that the all-in capital cost of the battery storage component of the Westmoreland Project would be approximately $7 million based on its expertise regarding expected engineering, procurement and construction ("EPC") pricing, as well as its knowledge of indicative pricing, market research they performed, and third-party market analyst numbers. Doosan also considered cost estimates for development, siting and permitting, interconnection costs and other PSNH-specific costs to implement and commission this type of project.

The estimate is summarized as follows:

Capital Cost Elements	Amount ($000)
EPC costs	$4,328
Permitting and Site Development	$738
Interconnection and Integration	$344
Engineering, Project Management, and other internal costs	$1,491
Total Capital Cost	$7,002

The battery would also require an average of $140,000 in O&M per year. This would cover station service, service/maintenance, warranty, and insurance. Doosan estimated that the battery storage component of the Westmoreland Project would take approximately 18 months to implement from issuance of a Commission decision approving this proposal.

Based its comprehensive analysis, Doosan concluded that the Westmoreland location is uniquely situated to use energy storage, energy efficiency and demand response to avoid construction of a new 10-mile distribution circuit.

D. <u>Benefit-Cost Ratio</u>

Q. Has PSNH evaluated the direct savings from the Westmoreland Project as compared to its costs?

A. Yes. PSNH evaluated the benefits and costs of the battery storage component as that is the only aspect of the Westmoreland Project that would be included in the cost-recovery mechanism for the Grid Transformation and Enablement Program. Cost-effectiveness screening for the efficiency and demand response components would be determined in the respective dockets, as described above.

The battery installation has a benefit/cost ratio of 1.19. The benefit-cost analysis model is provided herewith as Attachment GTEP-4.

The benefit-cost analysis is based on a Utility Cost Test ("UCT") which considers the costs and benefits from the perspective of all PSNH customers. A net benefit flows directly to customers. The analysis includes only direct costs and benefits, and not other non-energy benefits. Over the Westmoreland Project's lifetime, the net present value of the net benefits it will provide for customers is approximately $2 million.

Q. Would the battery have benefits beyond avoiding a new 10-mile distribution line?

A. Yes. Along with avoiding the 10-mile distribution line, the battery would also be used to reduce monthly and annual peak demand. Reducing peak demand results in benefits associated with energy supply and transmission. I will describe these benefits in greater detail in just a moment.

Q. Would you please discuss the benefit-cost analysis that PSNH conducted for the battery storage component of the Westmoreland Project in greater detail?

A. Yes. I will describe the analysis behind costs, benefits, and how PSNH uses those numbers to calculate the benefit-cost ratio.

Costs:

As discussed above, PSNH commissioned Doosan to develop cost estimates—both capital and O&M—for the battery component of the Westmoreland Project. The Company validated Doosan's cost estimates by reviewing the estimates alongside contracts for battery projects that the Company's affiliate is developing in Massachusetts.

After validating Doosan's estimates, the Company calculated the annual revenue requirement associated with the capital for the battery. The Company conducted a separate analysis to calculate the revenue requirement associated with the non-battery aspects, such as the site preparation and interconnection, and the revenue requirement associated with the lithium-ion specific components, which have a shorter life due to degradation of the battery cells. PSNH also assumed, under the guidance of Doosan, that $1.2 million in capital would need to be deployed after 12 years due to the degradation of lithium-ion cells. The Company included that capital addition in its analysis as a conservative assumption and to not misrepresent total lifetime costs, though PSNH is not requesting approval for those expenditures at this time.

<u>Benefits</u>:

There are two categories of benefits for the battery. The first category is the avoidance of a traditional "poles and wire" solution. As discussed above, the battery will be part of a non-wires alternative that enables PSNH to avoid building a 10-mile distribution circuit, at an estimated cost of approximately $6 million. The Company calculated the revenue requirement associated with the traditional solution as the traditional asset avoidance benefit.

The second category of benefits is peak reduction. Reducing peak load enables PSNH to avoid costs relating to the bulk transmission system (called Regional Network Service, ("RNS")), local transmission network (called Local Network Service, ("LNS")), and supply (by avoiding capacity payment obligations in the Forward Capacity Market ("FCM")). As discussed above, the 1.7 MW / 7.1 MWh rating is the "end-of-life" rating for the battery. We use the "end-of-life" rating, which accounts for degradation, instead of the "beginning-of-life" rating as a conservative assumption.

In Docket No. DE 17-189, the Commission approved Liberty Utility's Tesla Powerwall pilot, which included assumptions for both RNS and FCM avoidance. We have followed the approach that was approved in that docket.

RNS: In Docket No. DE 17-189, Liberty utilized a forecast of RNS through 2022, then assumed an increase of 4.66% year-over-year for the remaining years of the analysis.[1] That increase is consistent with the implied year-over-year increase in the RNS forecast utilized by Liberty. Our analysis utilizes the same RNS levels and growth rate as Liberty's analysis.[2]

FCM: In Docket No. DE 17-189, Liberty included an FCM rate consistent with the Avoided Energy Supply Costs ("AESC") 2018 Wholesale Capacity Value pricing, which New Hampshire utilities use to calculate cost avoidance for energy efficiency programs.[3] This forecast includes Forward Capacity Auction ("FCA") prices ranging from $100/kW-Yr on the high end to $57.6/kW-Yr on the low end, with year-over-year changes that vary. With respect to historical auction prices, the most recent auction, FCA 13, cleared at $45.6/kW-Yr, while previous auctions have been above $100/kW-Yr, with volatility from one auction to the next. The average of the last five auctions has been approximately $79.5/kW-Yr. The analysis uses the FCA 11 clearing price of $63.6/kW-

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1 Docket No. DE 17-189, Technical Statement of Heather M. Tebbetts, Nov. 15, 2018 at 4 (submitted as part of a settlement agreement on Liberty's proposal).

2 RNS Rates: 2018-2022 PTF Forecast, presented at the NEPOOL Reliability Committee/Transmission Committee Summer Meeting, Aug. 7-8, 2018 and available at the following link: https://www.iso-ne.com/static-assets/documents/2018/08/a2.0_2018_08_07_08_rc_tc_ptoac_forecast.pptx

3 Docket No. DE 17-189, Technical Statement of Heather M. Tebbetts, Nov. 15, 2018 at 4.

Yr and grow it at inflation (2%) to represent a reasonable price given historical volatility. This assumption results in similar values to what Liberty included in its analysis; but, has less year-over-year volatility.

LNS: In Docket No. DE 17-189, Liberty reviewed its bills associated with LNS to develop a $/kW-Yr LNS rate starting in the mid-$20 range. The analysis includes a lower LNS rate—starting at $10/kW-Yr and growing at inflation (2%). This is consistent with a review of the Company's historical data. While there is inherent uncertainty around LNS rates on a year-over-year basis, PSNH chose to use the lesser rate as a conservative assumption.

After calculating the revenue requirement necessary for the traditional "poles and wires" solution and adding the RNS benefit to the FCM benefit to calculate a total peak reduction benefit, PSNH calculated the net present value of all the benefits. The Company then divided the net present value of the costs (revenue requirement of the battery project) by the net present value of the benefits to calculate the benefit/cost ratio for the utility-scale battery project of 1.19.

Q. Overall, how do the assumptions underlying the PSNH benefit-cost analysis differ from what was approved in Docket No. DE 17-189?

A. The Company's analysis follows the same structure as what was approved as part of the Settlement Agreement in Docket No. DE 17-189, but with a few key differences which I will discuss.

First, with respect to costs, the Company models costs being recovered for the battery over a 25-year horizon with the battery's lithium ion cells being replaced after 12 years. Liberty's Battery Pilot Project will recover costs for the battery component over a 10-year period, consistent with the warranty for the Tesla Powerwall. While the 10-year horizon was appropriate for Liberty's approach to deploying small, distributed batteries, the 25-year horizon is appropriate for a large, utility-scale project.

Liberty's pilot also included a customer Contribution In Aid of Construction ("CIAC"). The Project is a front-of-the-meter project which does not include a customer contribution. The full cost of the battery is thus included in the calculation for the revenue requirement associated with the costs in the benefit-cost analysis.

With respect to benefits, Liberty assumed that the Tesla Powerwalls would have a 15-year useful life. That is 5-years behind the book life used to calculate the annual revenue requirement for the Tesla Powerwalls and is consistent with industry expectation for Tesla Powerwalls. The Company models benefits on the same time horizon as cost recovery—25 years. While the useful life of the proposed battery at Westmoreland may be beyond 25-years, we used the same time horizon as the cost recovery of the project to be conservative in the analysis.

Some of the benefits included in the model also differ from what was approved in Docket No. DE 17-189. As discussed above, the analysis uses the same forecast for RNS, lower rates for LNS, and relatively similar rates for FCM (but with less volatility). The analysis also assumes that PSNH will be able to hit 83.3% of peaks, meaning that PSNH intends to hit the annual peak in most years, and in 10 of 12 monthly peaks in an average year. In Docket No. DE 17-189, Liberty assumed it would hit 75% of peaks, or hitting the annual peak in most years and 9 of 12 monthly peaks in an average year. The proposed Westmoreland battery is a longer duration (4-hours) than the Tesla Powerwalls included in Docket No. DE 17-189 (2.7 hours). A longer-duration battery can discharge over a longer timeframe thus easing the ability to hit a specific one-hour peak. Furthermore, a single, front-of-the-meter battery should have fewer dispatch issues than behind-the-meter assets, as there will be no opt-out or premise-specific issues.

The analysis also includes the benefit of traditional asset avoidance. The project will avoid a $6 million distribution line. In Docket No. DE 17-189, Liberty discussed the possibility of asset deferral but did not include it in its financial analysis as a direct benefit. The project is being designed and sized for the primary purpose of meeting a local need and thus avoiding the development of a traditional asset.

E. __Peak Forecasting Methodology__

Q. Does Eversource have experience in forecasting peaks?

A. Eversource has been successful in dispatching resources to reduce annual peak load in Massachusetts. The methodology to forecast the annual peak hour will be expanded upon to forecast monthly peaks and dispatch resources accordingly for PSNH.

Currently, our peak forecast methodology has three pillars:

1. Third-party vendor: We employ a third-party vendor who uses a proprietary methodology to forecast if a peak day is in the near future. While we currently use the third-party vendor for insight on annual peaks, the methodology will be expanded to also forecast monthly peaks, as to realize RNS/LNS benefits.

2. ISO-NE 7-day forecast: ISO-NE publishes a 7-day forecast which is updated daily. We review the ISO forecast on a daily basis to gain insight into the outlook for regional peak demand.

3. Internal modeling: Our forecasting team generates a 7-day econometric forecast which considers weather, day type, month, holidays, and energy usage from previous days.

Our team reviews each of these sources to make a judgment whether there may be an upcoming peak. Leveraging multiple sources mitigates risks associated with forecast uncertainty.

Q. How will PSNH forecast monthly peaks?

Monthly peak forecasting presents a greater challenge than annual peak forecasts. This is because the annual peak is driven primarily by weather. Multiple hot and humid days will lead to peak conditions. The spring and fall months, however, often do not experience such a direct link between weather and peak conditions. This is because heating and air conditioning is less likely to be in use, regardless of moderate temperature fluctuations.

Leveraging multiple sources, along with historical data, will enable PSNH to hit peaks in the spring and fall months. While weather is not as highly correlated with consumption as in the summer, it is still one of the main drivers of peak load, especially because monthly peaks are often affected by the output of behind-the-meter solar, which is highly dependent on weather conditions.

Deploying the battery as a front-of-the-meter asset will further enable PSNH to hit monthly peaks. Customer-sited resources that a utility dispatches often have stipulations regarding how often the utility can send a dispatch signal. With respect to a front-of-the-meter battery, PSNH can frequently charge and discharge the battery without risking customer inconvenience or attrition. If forecasts indicate that there are multiple days which may be the monthly peak, we can dispatch the battery on any or all of those days.

F. Cybersecurity Risk Mitigation

Q. What protocols will PSNH follow to mitigate cybersecurity risk?

A. Rigorous cybersecurity standards will be in-place to ensure confidentiality with respect to Personal Identifiable Information and security with respect to Critical Infrastructure Information.

For the front-of-the-meter battery, PSNH will use established vendors and control systems with a proven track record of rigorous cybersecurity protocols. The developer of the battery will be required to adhere to the Company's strict security standards, consistent with RSA 363:38.

With respect to deploying behind-the-meter assets as part of the targeted energy efficiency and demand response program, PSNH will use the rigorous protocols Eversource has in place in Massachusetts. As I explained earlier, we have been successful in dispatching customer-sited resources in Massachusetts. Vendors who install and control customer-sited resources are required to go through rigorous review processes including a Due Diligence Questionnaire, a Project Security Sign-Off, and other process reviews.

G. Plans to Competitively Bid the Battery Storage and Local Outreach

Q. Is PSNH planning to competitively bid the battery storage component?

A. Yes. PSNH will solicit competitive bids for the EPC contract associated with the 1.7 MW/7.1 MWh battery storage component. In the context of this solicitation, the Company will follow a disciplined process conducted by the same procurement team that leads negotiation and vetting of all the Company's contracts, including major substation transformer projects.

The Company plans to issue its solicitation of bids to a broad field of leading energy storage EPC vendors. The Company will vet the bids submitted by participating vendors to develop a short list. This first-stage evaluation will be based on each vendor's safety record; financial solvency (particularly important given that the battery storage will be relatively new technology, but long-lived assets); prior similar battery storage projects completed on time and on budget); and, engineering and project management expertise. The Company will then seek full and formal bids from these short-listed vendors. A cross-functional team will review and rank the bids based on cost and the strength of the technical design and project plans. PSNH will complete negotiations with the leading vendor on terms that are cost-effective for customers and include appropriate warranties and other protections. The successful vendor will then complete in full the design portion of the battery storage component, procure all necessary equipment, and construct and commission the battery.

Q. How are you proposing to measure the battery's ability to deliver all the values to PSNH customers that you have described?

A. PSNH expects to finalize the specific areas of study prior to commencement of the project as well as specific use cases, data gathering and measurement, and assumptions the Company is seeking to validate. To evaluate the technical and non-technical benefits of the Westmoreland Project on an on-going basis, the Company expects to complete an annual report for each year of the project and to file these annual reports with the Commission.

Q. Would you please describe the outreach that the Company has made with the Town of Westmoreland on the project?

A. We have briefed town leadership (Town Manager, Town Select Board, Town Facilities Officer, county leadership (County Commissioners), and other town representatives (school, nursing home, and local businesses) on the Project. Responses have been uniformly positive. We are also planning an open house event in June to brief town residents and businesses.

H. Compliance with RSA 374-G:5

Q. Would you please explain how the Westmoreland Project satisfies each of the criteria laid out under RSA 374-G:5?

A. Yes. The PSNH-owned battery component of the Westmoreland Project falls under the umbrella of projects covered by RSA chapter 374-G. Therefore, I will walk through the factors encompassed in RSA 374-G:5 and discuss the proposed demonstration project in relation to those factors.

Overall, the proposed project is a reasonable size given PSNH's significant footprint in New Hampshire. The project is an important demonstration of how a reimagined grid can be more cost effective, more reliable, and cleaner than the grid of the last century. The project will go out for competitive bids to promote market competition. Furthermore, the project will result in better understanding with respect to DER integration issues, customer experience and participation, load shape forecasting, and peak load forecasting.

(a) Effect on the reliability, safety, and efficiency of electric service.

The Westmoreland Project will significantly improve reliability and efficiency in relation to a distribution circuit that has experienced relatively frequent service interruptions. The battery will provide backup power to all customers in the area when there would otherwise be an outage. This includes providing power for critical loads such as an elementary school and a fire station.

When not serving as backup during an outage, the project will reduce peak load by shifting load from peak hours to hours when demand is lower. This will increase the overall efficiency of the grid.

The battery component will be competitively procured under the highest standards for safety and efficiency. The battery technology is a relatively mature technology (lithium ion) and will be developed by a thoroughly vetted and well-qualified developer. The battery's operations will leverage established control systems. The efficiency and demand response components will likewise follow best practices.

(b) Efficient and cost-effective realization of the purposes of the renewable portfolio standards of RSA 362-F and the restructuring policy principles of RSA 374-F:3.

Although the Westmoreland Project will not directly produce renewable energy certificates to meet the renewable portfolio standard, the battery will nonetheless support a cleaner grid. During peak hours, demand is met by dispatching thermal generators that are less efficient than generators that run when demand is lower. By exporting energy at peak hours, the battery will reduce overall emissions from these less efficient thermal generators. The Westmoreland Project will also foster competitive markets by (1) ensuring customer and third-party ownership of the behind the meter batteries, and (2) putting the engineering, procurement, and construction of the battery component out for competitive bid by third parties.

(c) Energy security benefits of the investment to the State of New Hampshire.

The Westmoreland Project will provide an opportunity to test and refine the PSNH vision for a clean energy transformation model that the Company is advancing in New Hampshire—in partnership with other stakeholders—over the next several years. During service interruptions, the battery component will be able to provide energy to keep the lights on for Westmoreland customers. The efficiency and demand response components will make the duration of the battery last longer by reducing the amount of load to be served on the circuit. This will decrease the exposure of New Hampshire customers to regional grid outage events.

(d) Environmental benefits of the investment to the State of New Hampshire.

The Westmoreland Project is anticipated to reduce overall load and also to shift load away from hours when customer requirements would otherwise be met with higher-emitting, lower-efficiency generators. Therefore, peak reductions are expected as a direct result of the Westmoreland Project.

Furthermore, the project will be an important demonstration of how a reimagined grid can be more cost effective, more reliable, and cleaner than the grid of the last century. The success of this project will further open the toolboxes of New Hampshire's utilities to provide more resources to realize a cleaner and more reliable grid of the future.

(e) Economic development benefits and liabilities of the investment to the State of New Hampshire.

With respect to economic development and liabilities of the investment, PSNH will utilize local labor as much as possible to deploy the project via competitive procurement. Local labor will gain experience working with a newer technology, which will become more and more prominent in utility toolboxes in the future. With respect to economic "liabilities," the costs associated with the project will be recovered from PSNH customers to the extent that costs are determined by the Commission to be prudently incurred. The benefit/cost ratio for the project is greater than 1.0, which means that the project is expected to result in net savings relative to other alternatives.

(f) Effect on competition within the region's electricity markets and the state's energy services market.

The Westmoreland Project is designed to promote market competition and to reduce costs. PSNH plans to competitively bid the battery component of the project and is not proposing to own any behind the meter resources. Instead, PSNH will work with customers to help maximize the value of their assets, which would be provided by competitive vendors without restriction by PSNH.

(g) Costs and benefits to the utility's customers, including but not limited to the demonstration that the company has exercised competitive processes to reasonably minimize costs of the project to ratepayers and to maximize private investment in the project.

The battery component of the project will have a benefit/cost ratio of greater than 1.0, meaning that there will be net savings for customers when compared to other alternatives. Furthermore, the Westmoreland Project is designed to rely heavily on competitive procurements for the utility-scale battery. For the targeted energy efficiency and demand response component, PSNH does not intend to own any behind-the-meter resources, ensuring that customers can realize the full benefits of market competition. To the extent that other customer funds might be used for the energy efficiency and BYOD segments of the project, the benefit-cost analysis would take place in that context.

(h) Whether the expected value of the economic benefits of the investment to the utility's ratepayers over the life of the investment outweigh the economic costs to the utility's ratepayers.

There is overlap between this point and the previous point, and as such, this requirement is already addressed in part (g). That is, the benefit-cost ratio for this program is greater than 1.0.

(i) Costs and benefits to any participating customer or customers.

The battery component of the Westmoreland Project is a front-of-the-meter project that does not necessitate participation from specific customers. The behind-the-meter aspect of the project will enable participating customers to realize increased reliability and resiliency, along with any other value streams the host customer sees fit to pursue. PSNH is proposing entirely voluntary participation, so each individual customer can decide if the relevant benefits and costs make sense for their individual situation.

Q. Is the Westmoreland Project consistent with PSNH's planning process, as discussed in the Least Cost Integrated Resource Plan ("LCIRP")?

A. Yes. PSNH developed the proposed Westmoreland Project consistent with the planning process discussed in the Company's most recent LCIRP submitted in Docket No. DE 15-248. Appendix A of the LCIRP discusses the four major stages of the Company's planning process. These stages are:

1) the gathering of historical loading, equipment, and reliability data;
2) preparing the forecast for peak electric demand;

3) evaluating the alternative solutions to projected overloads or operating violations, including potential elements of transmission, substation, distribution line, conservation & load management and/or distributed generation; and

4) determining the load-driven, aging infrastructure, and reliability projects that will be supported by the capital budget by review of various factors including equipment loading risk, equipment failure risk, reliability benefit, regulatory requirement, safety, and environmental impacts or benefits.

The Westmoreland Project was devised through a rigorous process consistent with these planning stages. The process to identify Westmoreland included gathering data related to reliability, capacity, power quality, loading and DER penetration. PSNH's cross-functional team identified historical reliability and power-quality issues in the Westmoreland Project area and then reviewed the forecast for peak electric demand to ascertain if the issues may persist.

In evaluating potential alternative solutions, the team identified battery storage in combination with targeted energy efficiency as a solution to reliability and power quality issues in Westmoreland. The Westmoreland Project was proposed for inclusion based upon its reliability and environmental benefits and will result in net benefits for New Hampshire customers, supporting the intent of the "least cost" philosophy.

III. OYSTER RIVER CLEAN INNOVATION PROJECT

Q. Ms. Schilling, why is it important for the Company to submit this proposal at this time?

A. The traditional electric utility business model is evolving and the pace of change is rapid and accelerating. There are three transformational forces driving change in the utility industry: (1) state energy and environmental policy; (2) changing customer expectations and the level of customer engagement; and (3) new and emerging technologies that are declining in cost over time.

At the state level, the *New Hampshire 10-Year State Energy Strategy*, identifies "[e]nsuring a secure, reliable, and resilient energy system" as one of the key goals to improve state energy policy to better meet consumer needs.[4] In addition, electric system resiliency is becoming increasingly important as virtually every sector of the state's economy depends on electricity as homes and businesses come to rely more and more on technologies that require electricity. The extent of this dependence is underlined when a significant storm event is experienced in the region. Overlaying this backdrop of state energy policy and customer expectations are advances in clean renewable energy, battery storage, and automated distribution system technologies that are evolving at a rapid pace.

These transformational forces are changing the way in which electricity is generated, distributed, managed, and consumed. To keep up with the pace of change, and enable continued progress, the Company must explore new business models and embrace new technologies that will further enhance resiliency, meet changing customer expectations, and promote the state's energy and environmental priorities. Microgrids have emerged as an innovative platform to integrate clean renewable generation, energy storage, and improve the resiliency of the electrical grid. Accordingly, the Company is proposing to

[4] *New Hampshire 10-Year Energy Strategy*, New Hampshire Office of Strategic Initiatives, April 2018, at 5.

include a microgrid demonstration project as part of its Grid Transformation and Enablement Program.

Q. What is a microgrid?

A. The U.S. Department of Energy ("DOE") defines a microgrid as:

> A group of interconnected loads and distributed energy resources with clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid [and can] connect and disconnect from the grid to enable it to operate in both grid connected or island mode."[5]

Microgrids typically include DERs, such as combined heat and power systems or solar photovoltaic generating systems and may be accompanied by a form of energy storage, customarily a battery or bank of batteries. A microgrid provides resiliency by balancing supply and demand resources within a defined area. Effectively, a microgrid is an "island" within the larger utility grid, shielding the customer(s) during extreme weather events with widespread power interruptions.

There are two broad categories of microgrids: (1) single-user microgrids; and (2) multi-user microgrids. Under the single-user model, there is one user, all the assets are typically owned by one entity, and the microgrid is usually contained within a single contiguous building or property. The single-user model is nothing new and it has been deployed on college campus and hospital settings across the country for decades. The multi-user model is relatively newer and represents an evolving approach, expanding the

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[5] *Summary Report*, 2012 DOE Microgrid Workshop, Office of Electricity Delivery and Energy Reliability at 1 (July 30-31, 2012), available at: https://www.energy.gov/oe/downloads/2012-doe-microgrid-workshop-summary-report-september-2012

microgrid architecture to serve multiple customers, multiple customer meters and multiple facilities.

Q. What are the benefits of microgrids to the distribution system?

A. The primary benefit of microgrids to the distribution system is enhanced operational flexibility to support improved reliability. The traditional distribution system design is radial, with power flowing one-way from the transmission system through bulk substations and out to load. In recent years, the Company has invested in distribution automation that has given operators tools to isolate outages on the distribution system to a defined segment and re-feed the unaffected segments from an alternate source of supply. The operational flexibility provided by this automation has provided significant benefit to customers by reducing the number of customers affected by an outage event.

Microgrids provide another layer of operational flexibility in system design to support extremely high reliability, regardless of the nature of the outage event. In the traditional model of system design, the ability to transfer load and re-feed customers in the event of an outage is limited by the ability of the distribution system to provide sufficient supply from an alternate source. In the event of a wide-spread area outage, for instance, it may only be possible to re-feed portions of the distribution system.

System designs that incorporate microgrid technology provide system operators with options to maintain service to customers, even when traditional supply options are limited. On normal "blue sky" days, load in the microgrid can be served by the traditional distribution system. In the event of loss of supply to the area, the system operator can disconnect or "island" the microgrid area, supplying load with local distributed energy resources.

Q. What are some of the other benefits that microgrids provide?

A. Microgrids create opportunities to increase the use of cost-effective clean energy technologies. For example, adding solar generation paired with battery energy storage to a microgrid enables the facility to provide additional resiliency benefit in addition to its other use cases. As a result, clean energy technologies used in microgrid applications are typically more cost effective than similar stand-alone facilities.

In addition, the resiliency improvements associated with microgrids result in additional economic and safety benefits. Economic costs associated with power outages can be substantial. This is particularly true for large research or industrial facilities that are not designed to handle sustained outages. Community microgrids that incorporate critical municipal loads have significant safety benefit by providing power to facilities such as police, fire and services such as wastewater treatment. Critical loads may also include facilities that can serve as shelters for local residents.

Q. Please provide an overview of the Company's proposed Oyster River Clean Innovation Project.

A. The Company, in collaboration with UNH and the Town of Durham, is proposing to develop a community multi-user microgrid to optimize the integration and dispatch of DER, improve resiliency, and provide environmental benefits all in a safe and secure manner. The proposed demonstration would group multiple customers on a designated portion of the electric system and provide power to them from existing local energy sources and newly installed local solar generation. A battery would also be installed on the system to provide "stored" electricity during a power interruption or when solar generation is not available.

Q. What is the scope of authorization that PSNH seeks in this case for the Oyster River Clean Innovation Project?

A. Similar to the Westmoreland Project described above, PSNH is requesting that the Commission review the Company's proposed Oyster River Clean Innovation Project ("Oyster River Project") in this case and pre-authorize the Company's capital expenditure related to this program, estimated at $15 million as well as incremental O&M expenditures related to the microgrid. The Company is not proposing to recover these amounts through the base rates that the Commission will set in this docket. Instead, the Company is requesting the Commission's approval of a separate rate mechanism through which recovery of costs for projects such as the Oyster River Project could take place.

Q. Why are demonstration projects important?

A. A demonstration project is an opportunity to deliver near terms benefits while also advancing the body of knowledge in the field of cutting-edge energy technologies—including solar and energy storage operated in a microgrid context—and to inform future deployments of such technologies.

Q. Why is the Company targeting UNH and critical infrastructure in the surrounding Town of Durham as the location for the proposed Oyster River Project.

A. Generally speaking, college campuses are excellent candidates for microgrid development because of the self-contained nature and the 24/7 energy needs. The Company will be able to leverage some of the existing infrastructure on the UNH campus for purposes of the demonstration project. The UNH campus currently has extensive infrastructure that supports reliable service to its buildings. The Oyster River Project will augment this infrastructure to further enhance the resiliency of the campus system. The Town of Durham has a relatively substantial proportion of critical load located in close proximity to the UNH campus that could be incorporated into the microgrid with limited impact to the existing electrical distribution system. Both UNH and the Town of Durham have demonstrated commitment to advancing clean energy objectives. UNH is home to the oldest endowed university sustainability program in the United States and the Town of Durham is actively pursuing opportunities to incorporate solar generation into its energy supply strategy.

Moreover, as a top-tier research institution, UNH will be able to leverage the microgrid demonstration project to conduct study into various microgrid technologies contributing to the knowledge base for a multi-user microgrid application. With the addition of solar generation and energy storage, the UNH campus and infrastructure in the surrounding Town of Durham will provide a unique research platform to investigate different aspects of the performance of a multi-user microgrid.

Q. Please describe the types of investments will be necessary to enable the Oyster River Project?

A. The Oyster River Project is expected to consist of the following five investment types:

- Energy storage will be used to help balance load and generation in the microgrid and support the inclusion of intermittent solar generation in the microgrid.
- Solar generation will be used to demonstrate the use of intermittent distributed energy resources in a resiliency application.
- Microgrid controller software technology will be used to control microgrid resources to balance load and generation in the island configuration.
- Limited additional distribution infrastructure will be required to electrically isolate load included in the microgrid.
- Communications infrastructure may be required to augment existing systems to ensure robust secure communications to and from resources in the microgrid.

Q. Why is PSNH including solar and energy storage as part of the Oyster River Project?

A. The Company proposes to include solar and energy storage to enhance the clean energy and greenhouse gas reduction benefits of the project. In addition, the Company is deploying these specific technologies together to better understand how battery storage can be used to optimize the operation of an intermittent generation resource like solar. For example, when solar generation is paired with battery storage, the battery can be used to provide stored power during the nighttime or on cloudy days when solar panels are not producing electricity.

Q. What is the current status of development for the Oyster River Project?

A. The Oyster River Project is in the early stages of development. The Company has established weekly meetings with UNH and executed a Memorandum of Understanding ("MOU") with UNH to govern the development of the project. The MOU is provided in Attachment GTEP-5. The Company has also had preliminary discussions with representatives from the Town of Durham and expects to continue the dialogue regarding the role of the town in this project.

Q. What is the proposed ownership model for the assets that will be developed as part of the proposed Oyster River Project?

A. The Company will own, operate, and maintain all the front-of-meter assets associated with the demonstration project including the solar generation, battery storage, any required distribution system upgrades, and the microgrid control infrastructure needed to ensure load and generation are balanced in an islanded configuration. In addition, to the extent that any additional advanced sensing and communications equipment is necessary, PSNH expects to own, operate and maintain those assets that are supported by customer rates.

Q. What is the current estimated cost for the Oyster River Project?

A. The Company's preliminary cost estimate for this project is in the range of approximately $15 million. This estimate reflects the early-stage of scoping and conceptual design that has been conducted for the Oyster River Project thus far. The Company will be conducting a more comprehensive analysis of this project and expects to have additional information on project scope, schedule and budget to provide to the Commission at a later stage of this proceeding.

Q. How does the Company plan on procuring the assets associated with the Oyster River Project?

A. PSNH will employ a competitive procurement process to secure all necessary services and physical assets that will be deployed in connection with this project to ensure that it is conducted on a cost-effective basis.

Q. Is PSNH planning to seek any external funding for the Oyster River Project?

A. Yes. The Company has developed a research statement and is preparing a proposal to seek external federal funding for this demonstration project. The Company is monitoring DOE grant and funding announcements for opportunities for which the Oyster River Project may be eligible. Any application for external federal funding would be contingent upon prior state regulatory approval of the demonstration project by the Commission. Should the Company be awarded any external federal funding, those funds would be used to offset the costs of the demonstration project.

Q. Is the Oyster River Project contingent upon receiving external funding?

A. The project is not contingent on receiving external funding. PSNH sees value in moving forward with this project, subject to Commission approval, because the customer benefits and learning opportunity from the project are important regardless of the availability of external federal funding.

Q. What are some of the areas that the Company would like to study as part of the proposed Oyster River Project?

A. PSNH is planning to study: (1) Advanced Sensor Networks; (2) Optimization and Control; and (3) Cybersecurity, in the context of the Oyster River Project. These specific areas of anticipated study are designed to add to the state's and the broader utility industry's knowledge base with respect to the deployment and operation of multi-user microgrids. As the demonstration project is further developed and refined, there may be additional areas of study that may be identified by the Company and its partners at UNH and the Town of Durham.

Q. Please provide more detail regarding the anticipated areas of study related to sensing networks and distributed control.

A. One key research objective would be to develop robust sensing and monitoring architectures that consider the latency constraints (i.e., the delay between when information is sent and when it is available at the other end of the communication system) in sensing and communication signals and unstable communication between neighboring energy sources and users.

In addition, achieving reliable and efficient operation of micro-grids can be challenging. Balancing customer load and generation on the relatively small scale of a microgrid means that both supply and demand are likely to be quite variable when intermittent DERs, such as solar energy, are used for energy generation. The imbalance between supply and demand can be mitigated by using energy storage, using diverse energy sources, and predicting and scaling demand. Accordingly, the Company expects to work collaboratively with UNH to evaluate ways in which tools and techniques can be employed to optimize supply and demand within the proposed microgrid demonstration project.

Q. Please provide more detail regarding the anticipated Cybersecurity area of study.

A. Cybersecurity is a critical component of smart grid and microgrid environment programs. In addition to utilizing the Company's robust and proven standard practices with respect to integrating technology securely onto its electric power system, the Company and UNH have identified opportunities to gain greater insight into the use of advanced sensing technologies for the purposes of adding additional threat detection capabilities. The timing of powering on additional sources or engaging storage facilities takes timing coordination. Phasor Measurement Units (PMUs) are modern approaches to monitor and stabilize the grid's power and utilize networking and time synchronization to perform distributed measurements. Time sensitive networking is a more recent entrant to assist in microgrids, assisting in improved control of such elements as inverters. Disruption of these networking systems can potentially result in false measurements leading to actions that have the potential to disrupt grid operations.

Q. Please describe the Company's proposed evaluation plan for the demonstration project.

A. PSNH expects to finalize the specific areas of study prior to commencement of the project as well as specific use cases, data gathering and measurement, and assumptions the Company is seeking to validate. The Company would file this initial scoping report with the Commission. To evaluate the technical and non-technical benefits of the demonstration project on an on-going basis, the Company expects to complete an annual report for each year of the demonstration project and to file these annual reports with the Commission. In addition, the Company would file a final report with the Commission upon completion of construction and when the demonstration project is in service.

Q. Will the Commission retain oversight of the Oyster River Project?

A. Yes. The Company recognizes that its efforts to develop and implement this microgrid demonstration project are at a beginning stage. Therefore, the Company will periodically provide progress reports to the Commission regarding the direction and progress of the Company's efforts in the preliminary design and engineering of the project. Also, as noted above, the Company will file annual reports with the Commission on its findings as well as a summary report at the end of the demonstration project. The Company will provide the Commission with further information on this project as it makes further progress on the preliminary design and engineering.

Q. Does this conclude your testimony?

A. Yes, it does.