STATE OF NEW HAMPSHIRE

BEFORE THE

NEW HAMPSHIRE PUBLIC UTILITIES COMMISSION

DOCKET NO. DE 19-XXX

WESTMORELAND CLEAN INNOVATION PROJECT

DIRECT TESTIMONY OF

CHARLOTTE B. ANCEL

Request for Project Preauthorization

On behalf of Public Service Company of New Hampshire

d/b/a Eversource Energy

July 31, 2019

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I. INTRODUCTION

Q. 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. What is the purpose of your testimony?

A. My testimony is provided on behalf of PSNH in support of the Company's request for preauthorization for a proposed demonstration project that will serve as an important learning opportunity as the Company continues to enable the integration of new and emerging clean energy technologies into the electric distribution system. The project

described in my testimony is the Westmoreland Clean Innovation Project (also referred to in my testimony as the "Westmoreland Project").

Q. 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. Is the Westmoreland Clean Innovation Project one of the two demonstration projects initially presented by the Company in Docket No. DE 19-057?

A. Yes. The Company presented this project in conjunction with its Grid Transformation and Enablement Program ("GTEP") proposal that is pending in Docket No. DE 19-057. The GTEP is a broader 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 Westmoreland Clean Innovation Project is one of the two demonstration projects described in my joint testimony with Jennifer A. Schilling in Docket No. DE 19-057.

If approved by the Commission, the GTEP would enable the Company to identify, plan, and develop projects, such as the Westmoreland Clean Innovation Project, to meet customer demand for increased system integration of clean energy technologies in the future.

Q. Does your testimony address the Oyster River Clean Innovation Project, which was the other demonstration project presented initially in Docket No. DE 19-057?

A. No. PSNH will file a separate petition for preauthorization of the Oyster River Clean Innovation Project at a later date, including testimony sponsored by Ms. Schilling.

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

A. Yes, I am presenting the following four attachments in support of this testimony:

Attachment	Purpose/Description
Attachment CBA-1	Pictures of Westmoreland Town Center and Residences
Attachment CBA-2	Eversource Report – Westmoreland
Attachment CBA-3	Doosan GridTech Report
Attachment CBA-4	Benefit/Cost Analysis

Q. How is your testimony organized?

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

- Section II presents the background and description for the Westmoreland Clean Innovation Project.
- Section III describes the Company's request for project preauthorization and the plan for future recovery of project costs.

Q. Are there costs associated with this demonstration project 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 project. The mechanism for recovery of these costs (and all GTEP-related costs) is presented for approval in Docket No. DE 19-057 in the joint testimony of Company witnesses Eric H. Chung and Troy M. Dixon in that docket, and is further articulated in the testimony of Company witness Eric H. Chung that is part of this filing. The Company's intention is to recover costs under the approved mechanism and return to the Commission at a later date to reconcile the actual project revenue requirement versus the amount in rates. At this time, the Company's request in this docket is limited to obtaining project preauthorization.

II. PROJECT BACKGROUND AND DESCRIPTION

Q. 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.

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 and thermostats , 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 greater than 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. 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 of 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.

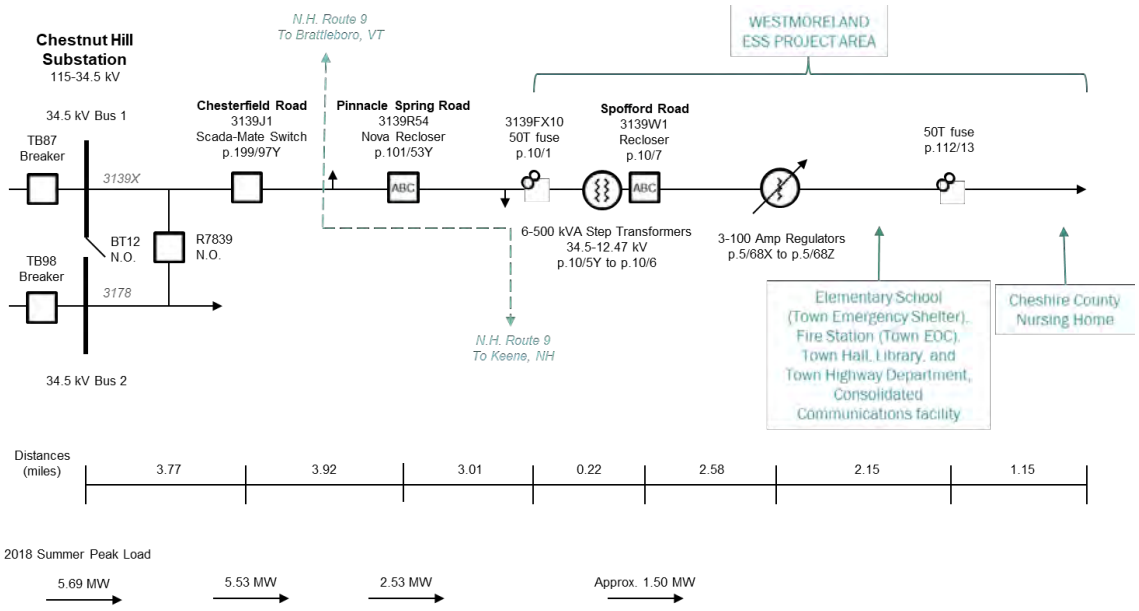
A. Westmoreland, New Hampshire

Q. Please describe the town 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 CBA-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. The Value of the Demonstration Project

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 CBA-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 the existing 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 targeted 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 degrees 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 allowed 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 Docket No. 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 CBA-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. Benefit-Cost Ratio

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 CBA-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.

Benefits:

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.

[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.

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-Yr and grows 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 benefits by the net present value of the costs (revenue requirement of the battery project) by 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 also held 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.

(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. PROJECT PREAUTHORIZATION AND COST RECOVERY

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 Docket No. DE 19-057. Instead, the Company is requesting the Commission's approval of a separate rate mechanism in that docket 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. How does the Company anticipate addressing cost recovery for the Westmoreland Project?

A. As part of this filing, Company witness Eric H. Chung has provided testimony on the revenue requirements for the Westmoreland Project, including an attachment showing an illustrative revenue requirement. As noted in Mr. Chung's testimony, the Company has proposed a cost recovery mechanism as part of Docket No. DE 19-057, under which the project's revenue requirement would be placed into rates subject to future reconciliation. Please refer to Mr. Chung's testimony for a further description of the Company's cost recovery proposal.

Q. What is the requested timeframe for approval in this docket?

A. The Company hopes to move forward on this docket in the near term, consistent with the expected date for final approval of its base rates in Docket No. DE 19-057. The Company respectfully requests that, given the relationship between the Westmoreland Project and the proposed rate mechanisms in Docket No. DE 19-057, an order be issued by the Commission regarding the Westmoreland Project no later than the date of a final order setting permanent rates in that rate case.

Q. Does this conclude your testimony?

A. Yes, it does.