THE STATE OF NEW HAMPSHIRE
BEFORE THE
PUBLIC UTILITIES COMMISISON

DE 17-189

Liberty Utilities (Granite State Electric) Corp. d/b/a Liberty Utilities
Petition to Approve Battery Storage Pilot Program

City of Lebanon, NH

Testimony of Clifton C. Below

May 1, 2018

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I. Introduction and Qualifications

Q. Please state your name, business address and position with regard to the docket.

A. My name is Clifton C. Below and my office address is 1 Court Street, Suite 300, Lebanon, NH 03766. I am a Lebanon City Councilor and Chair of the Lebanon Energy Advisory Committee created by the Council. I am authorized by the City Manager to represent the City in this proceeding on a volunteer basis.

Q. Have you previously testified before this Commission?

A. Yes, I provided pre-filed direct and rebuttal testimony and live testimony in DE 16-576 concerning the development of alternative net metering tariffs on behalf of the City of Lebanon.

Q. Please describe your relevant experience and expertise with regards to evaluating this battery storage pilot proposal.

A. A detailed statement of my background can be found on pp. 1-3 and in my direct testimony in DE 16-576 and Attachment A thereto.[1] I will only highlight a few keys elements of my background as they relate to this docket. During my tenure as a State Representative from 1992-1998 I served on the House Science, Technology, and Energy Committee where I was heavily involved in energy and regulatory legislation. As Chair of the Policy Principles, Social and Environmental Issues Subcommittee of the Retail Wheeling and Restructuring Study Committee in 1995 I facilitated a consensus building legislative and stakeholder process that resulted in recommended "Restructuring Policy Principles" that became the core of NH's Electric Utility Restructuring statute, RSA 374-F. In 1998 I was elected to the NH Senate and from 1997-2004 I served on the Advisory Council on Energy of the National Conference of

[1] Found at: https://www.puc.nh.gov/Regulatory/Docketbk/2016/16-576/TESTIMONY/16-576_2016-10-24_LEBANON_DTESTIMONY_C_BELOW.PDF and https://www.puc.nh.gov/Regulatory/Docketbk/2016/16-576/TESTIMONY/16-576_2016-10-24_LEBANON_ATT_DTESTIMONY_C_BELOW.PDF.

State Legislatures (NCSL), including 3 years as Chair, which advised NCSL on emerging energy issues. I also served on the Energy & Electric Utilities Committee, Assembly on Federal Issues of NCSL where, as Chair in 2000-2001, I facilitated a consensus based comprehensive update of NCSL's National Energy Policy. I testified on behalf of NCSL before the United States Senate Committee on Energy and Natural Resources on "Electric Industry Restructuring," focusing on transmission and jurisdictional issues. I also served as a member of the National Council on Electricity Policy Steering Committee from 2001-2004, which was a policy collaborative with NARUC, NGA, and NASEO.

In late 2005 I was appointed to serve as a NHPUC Commissioner with my tenure ending in February 2012. During that time, I served on the FERC-NARUC Smart Grid and Demand Response Collaborative, 2008-2011 and on the Electric Power Research Institute (EPRI) Advisory Council, 2009-2011 and its Energy Efficiency/Smart Grid Public Advisory Group, 2008-2010. Through my involvement in NCSL, NARUC, NECPUC, ISO New England stakeholder processes and particularly with EPRI I was fortunate to enjoy numerous deep dives into emerging issues in the electric utility industry at the intersection of technology, science, policy, markets, and regulation, including grid modernization, smart rates, market design, energy storage, and other distributed energy resource issues. I also organized and moderated expert panels on energy storage for both NARUC and NECPUC and have read extensively on the topic. In 2008 I helped direct the PUC's position with regard SB 451 which created RSA 374-G "Electric Utility Investment in Distributed Energy Resources" and, along with then PUC General Counsel Donald Kreis, testified on behalf of the PUC in the NH House on this legislation. I participated in the adjudication of the first PUC proceeding involving RSA 374-G, DE 09-037, resulting in Order No. 25,111 in June, 2011.

More recently I also fully participated in the PUC's Grid Modernization Working Group in IR 15-295 and in DE 16-576 on behalf of the City of Lebanon where I proposed a pilot using NH's municipal aggregation statute and the use of real time pricing (RTP) in conjunction with net metering that was endorsed by the Commission in Order No. 26,029. Our Lebanon Energy Advisory Committee and its aggregation subcommittee have continued to work to advance that pilot plan, which is now being called Lebanon Community Power (LCP).

II. Overview of the City's Position and Proposed Conditions

Q. Would you summarize the City of Lebanon's position on Liberty's Battery Storage Pilot proposal?

A. Yes. In general, the City is supportive and enthusiastic about Liberty's innovative proposal, both the large scale and relatively rapid deployment of battery storage on its distribution grid, and its innovative and progressive time-of-use (TOU) pilot of transmission and distribution (T&D) rates. However, to ensure that the pilot is in the public interest and consistent with applicable statutory goals and requirements, the City proposes that the Commission's approval be subject to the following conditions:

1) Within the 11L1 circuit where there is likely value to battery deployment as a non-wires alternative (NWA) to traditional distribution capacity investment, if sufficient residential interest is not achieved on a timely basis Liberty shall open the battery pilot to small commercial customers on the G3 rate, which uses the same T&D rate structure as residential classes, on similar terms, except that such customers may have the option to deploy up to 5 batteries behind one meter and gateway, as appropriate.

2) Liberty shall work with the City to co-promote solar with storage initiatives (and possibly participation in the City LCP RTP pilot) that might be collaboratively offered and targeted to the 11L1 circuit area to enhance the likelihood that NWA objectives of the pilot will be achieved in a cost-effective manner.

3) Once the goal for deployment of batteries within the 11L1 circuit area (or any other NWA target circuit areas that may be subsequently identified) is achieved, and if customer demand for participation in the battery pilot is expected to exceed capacity, then Liberty shall implement an auction mechanism whereby customers that will pay more than $1,000 upfront or $10/month are given preference for installation of batteries as part of this limited pilot.

4) Within approximately one year of approval of the pilot Liberty shall propose similar TOU T&D pilot rates that could be offered to customers in all customer classes that choose to opt-in to such rates in conjunction with opting-in to the LCP municipal aggregation with RTP. For large customer classes (G1 and G2) with demand charges such TOU T&D rates would likely retain current weights for demand charges versus kWh-based T&D charges but differentiate in rates based on when demand is incurred by TOU.

5) Liberty shall incorporate into its TOU T&D pilot tariffs a revenue decoupling mechanism in which, at least annually, Liberty computes any reduction (or increase) in distribution revenue from its pilot rates compared with standard distribution tariff rates, and shall be allowed to annually proportionately adjust all distribution rates, including TOU pilot rates, such that Liberty is made whole with regard to revenue loss from the pilot TOU rates and is thus not disincentivized from promoting the load shifting value of such pilot rates. The existing Transmission Cost Adjustment Mechanism (TCAM) should already provide an

appropriate revenue decoupling and rate adjustment mechanism for transmission cost under- or over-recovery from TOU transmission pilot rates compared with standard tariff rates.

6) Liberty shall work with the City to solicit, evaluate, and seriously consider alternative metering solutions that might work optimally with both the City's LCP municipal aggregation pilot with RTP and Liberty's battery pilot, at least for meter locations participating in both pilots (where the pilots overlap).

7) Liberty shall explore with Tesla if there is a means by which customers, or a vendor supporting them, such as through LCP, could have greater control over precise battery dispatch times (charging and discharging) when Liberty is not controlling such to meet possible co-incident peaks to optimize customer value such as when used with RTP. This might include enabling customers to discharge power from storage onto the grid at times other than possible coincident peaks, if and when allowed by the Commission. If a means is identified that is feasible (technically and in terms of cybersecurity) and affordable, then Liberty will endeavor to make it available within reasonable parameters.

8) If a customer-generator that is currently grandfathered under the original net metering tariffs (kWh credits) elects to participate in this battery pilot and thus moves to the new net metering tariff, then they shall be allowed a one-time election to return to the grandfathered tariff upon termination of the pilot or their withdrawal from the pilot and the payment of any applicable early termination fees and if the battery is returned to Liberty.

9) When Liberty is forecasting a possible monthly or annual co-incident peak for the next day (or same day as circumstances change) and takes control of batteries in the pilot it shall provide public notice of such, such as through its website, since the work to provide such forecasting is proposed to be paid for through distribution rates paid by all customers

10) Liberty shall include in its analysis and reporting on the pilot certain information including the amount of power discharged from the batteries in kWh, either offsetting behind-the-meter (BTM) load or exported to grid, during each monthly hour of coincident peak, and the resulting avoided transmission charges, and for the annual hour of system coincident peak, the resulting avoided capacity market charges, if knowable. Metrics on the extent to which the battery pilot serves as an NWA should also be required.

Beyond these proposed conditions this proceeding provokes the question of what terms and conditions or tariffs are appropriate to enable customers to discharge power from energy storage onto the distribution grid. This question is discussed at the end of this testimony.

III. Detailed Discussion of the Issues and Proposed Conditions

Q. Before discussing your rationale for each proposed condition for approval, what statutes do you consider to be particularly relevant in evaluating this proposal?

A. Obviously the principle statute that applies is RSA 374-G and particularly the filing requirements and factors to weigh in determining the public interest found in RSA 374-G:5. The extent to which the proposal, per RSA 375-G:5, II(b) supports "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" implicates those two statutes. The New Hampshire Energy Policy in RSA 378:37 is also applicable, especially considering that part of the value proposition is an NWA in the context of least cost distribution planning.

Q. As a threshold question regarding factor (h) under RSA 374-G:5, II, do you see "the expected value of the economic benefits of the proposed investment to the utility's

ratepayers over the life of the investment" as outweighing "the economic costs to the utility's ratepayers"?

A. Yes, based on the available evidence and my own analysis I believe that it is more likely than not that the economic benefits will outweigh the costs. My starting point is the updated Benefit/Cost Analysis provided with the Technical Statement of Heather M. Tebbetts filed by Liberty on or about April 6 in this proceeding. This reflects a more reasonable set of assumptions than previous analyses but indicates a net present value (NPV) of ($1,766,777) (negative NPV) for the manually read Probe Meter option and an NPV of ($1,102,900) for the Cellular Based Metering Option #2. Subsequently on 4/16 in response to a Staff Tech 3-1 data request Liberty provided a Total Resource Cost Test analysis based on the most recent Benefit/Cost analysis that showed a positive NPV of $2,965,867 for meter Option #2 (the more cost-effective option).

However, my review of this model indicates material technical errors in the estimation of "Customer Savings" (for program participants). Correcting four distinct errors in this calculation reduced the 15-year nominal estimated Customer Savings from $3,759,402 to $995,247. I also chose to use much more conservative assumptions about "Avoided Cost" savings to all customers, or avoided FCM Capacity Charges, that reduced these 15-year nominal savings from $4,220,151 to $2,924,935. These modifications resulted in an estimated positive NPV of $886,488 and can be seen in Attachment A, p. 1. (Bates p.23) The Avoided FCM Capacity Charges would result from lowering Liberty's overall share of the region's coincident peak and the resulting cumulative capacity tags assigned to Liberty Customers that are then applied against the Effective Charge-Rate to load for the FCM in the following power year. Liberty is not proposing to assign power exported from batteries at the system peak hour

to any particular Load Serving Entity (LSE), but would use what might otherwise be thought of as negative capacity tags to reduce the effective load adjustment factors, nominally the line losses (but not actual line losses) used to gross up retail load to match wholesale supply. The effect of this to spread much of the benefit of avoided FCM costs across all customers.

The same can't actually be said for Customer Savings which would accrue only to participating customers from the arbitrage in avoiding critical-peak TOU T&D rates from battery discharge BTM and shifting the battery charge (energy consumption) to the very low cost off-peak period. In fact, some portion, if not all, of such savings may be recouped from ratepayers across the board through the TCAM, and either the proposed revenue decoupling or subsequent distribution rate cases. The actual reduced T&D revenue requirements are already accounted for in lines 5, 6 and 7 of the TRC in the form of avoided RNS and LNS charges and the delayed or avoided "Distribution Circuit Upgrade." Therefore, I further modified the TRC to not count participant Customer Savings, resulting in a reduced but still positive NPV of $371,438 as shown on p. 2 of Attachment A. (Bates p. 24)

There is at least some chance of additional pilot cost reduction in the event the City and Liberty collaborate in soliciting proposals for alternative metering solutions that could work where the City's LCP pilot overlaps with this proposed battery pilot. For example, since pilot participants are required to have an internet connection, there may be a yet to be identified metering and communication solution that could use existing internet connections with satisfactory cybersecurity and technical features.[2] If the monthly cellular meter reading cost could be eliminated, that would boost the estimated NPV of the pilot by $283,46 to $654,901,

[2] Although the Tesla gateway comes equipped with its own revenue grade meter, which Liberty will own and which securely communicates over the internet, it apparently can't function as a service meter if there is any BTM generation.

counting no customer savings and using conservative avoided FCM cost assumptions. This result is shown on p. 3 of Attachment A. (Bates p. 25)

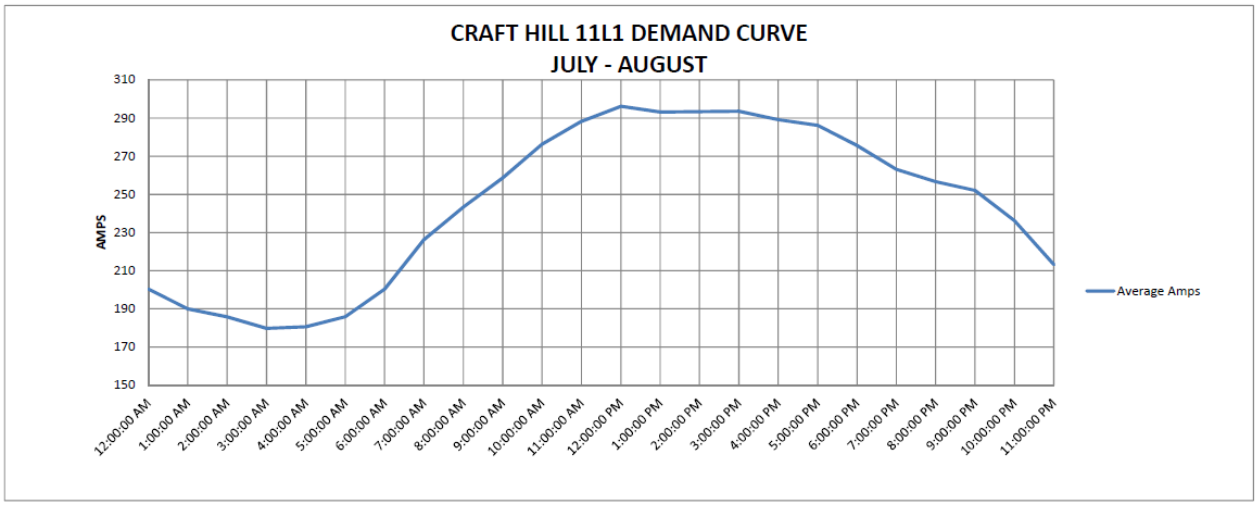
Not counted in this analysis is the benefit of Demand Reduction Induced Price Effect (DRIPE). With up to 5 MW (about 2.5% of Liberty's peak demand) of battery discharge peak load reduction, this could be significant. As the 2018 Avoided Energy Supply Cost (AESC) study points out at p. 175, the slope of the supply curve is steepest during peak hours, and "[d]uring these very high load hours, a modest reduction in demand will tend to yield significantly lower market prices." Such DRIPE benefits would benefit all electric customers, helping to support a conclusion that this pilot is more likely than not to yield net positive economic benefits.

Q. Would you explain your rationale for your first two proposed conditions?

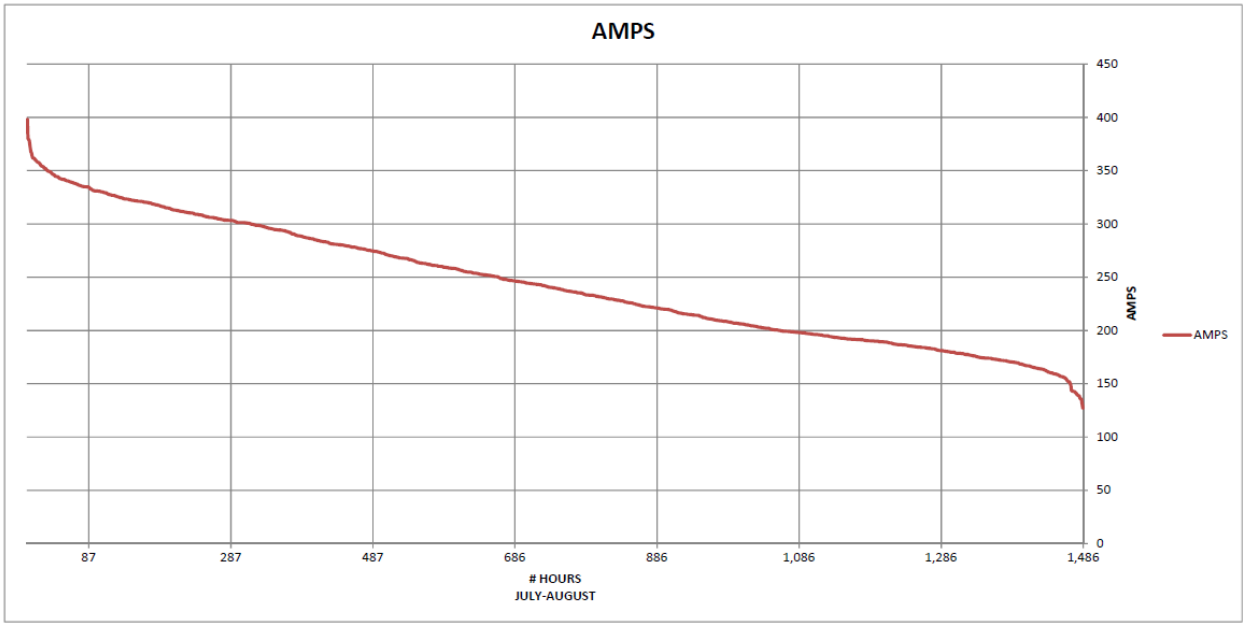
A. Since one of the main purposes and economic justifications for this proposed pilot is to test these batteries as an NWA for a circuit in Lebanon, known as Craft Hill 11L1, it would be in the public interest to add conditions to help ensure the success of the program and reduce risk to ratepayers. Liberty seeks to deploy 300 batteries among 1,412 (on 11L1) to 1,493 (with neighboring 11L2 circuit) residential customers. That is about one battery for every 5 residential customers by the end of next year, a rather ambitious and concentrated adoption rate for which there is little precedence. While many of these customers are in owner-occupied single-family homes, many are in rental and multi-family units that may have little interest in this offering. If the uptake rate among residential customers is falling short of the targeted goal, why not open the program up to the significant number of small businesses in this area that might be interested in having some battery backup, such as small restaurants and convenience stores with high loss potential from lack of refrigeration. While a single battery

may not buy much time with refrigeration, the Tesla batteries can be deployed in banks of up to 5 batteries behind a single gateway, perhaps buying enough time for deployment of an emergency generator in an extended outage. Or some battery back-up might be combined with solar or thermal energy storage (TES) that can be retrofitted into walk-in coolers for more extended outages. Opening the pilot to small business with the same T&D rate structure as residential customers should be relatively easy to implement on this targeted pilot basis and would support the restructuring policy principles of benefits for all consumers (374-F:3, VI) and Customer Choice (II) enabling customers, at least on a limited pilot basis, "to choose among options such as levels of service reliability . . . ."

An interesting aspect of this feeder is the fact that during the summer it has an extended peak period that starts in the late morning and continues through mid-day and into the afternoon. This is illustrated by the July-August daily Demand Curve for this circuit supplied by Liberty in response to the City's (CoL) data request 1-12:



The challenge is shaving a small number of high demand hours off the load duration curve, even though they may be spread from late morning through the mid-day and afternoon:



For example, in 2016, 7 of the top 12 load hours were the 7 hours from 10 am to 5 pm on a single day, 8/12. (From response to OCA 1-38.) One concern expressed in technical sessions has been whether the proposed batteries can adequately cover such extended peak demands on this one circuit, while also helping to reduce the more targeted co-incident peaks between 2 pm and 7 pm. There is apparently relatively little net metered solar PV on this circuit that would tend to lower mid-day net load. This could be starting to change and co-promoting solar and storage on this circuit could provide a more optimal NWA solution than battery storage (or solar) alone. The Lebanon School District (SAU #88) has already approved an energy performance contract that includes the planned installation of a 79.4 kW AC (90.4 kW DC) rooftop PV system at the Mt. Lebanon School on this circuit. Although this circuit has been described as a West Lebanon circuit, according to the plan of the circuit provided in response to CoL 3-2 it runs right into the heart of downtown Lebanon along the US Route 4 corridor at its eastern terminus. Both of the City's two staffed fire stations (#1 and #2) are apparently on

this circuit, along with the Kilton Library in West Lebanon. The City is developing plans to add solar to rooftops of City facilities wherever feasible in conjunction with the development of LCP. These 3 buildings appear to have on the order of 15,000 to 18,000 square feet of roof area that might be appropriate for solar, which might provide another 150 to 180 kW of PV generating capacity on this circuit. Between the two fire stations there is also 65 kW of propane fired emergency generation that might be possible to dispatch during critical peak periods, contributing to the NWA using a variety of DERs.

The City would welcome the opportunity to collaborate with Liberty in a targeted joint promotion of solar with storage on this circuit. We have had very successful volunteer driven solarize and weatherize campaigns in the City and there is a great deal of interest in doing more. In response to the release of our Lebanon Community Power Update #1 (Attachment B at Bates p. 26) through the City's social media one West Lebanon resident, located on this circuit emailed me the following:

"Many thanks for sharing the informative update on LEAC's progress. It's exciting to know what the committee has in the works. Our family is very glad to see our city prioritizing efficiency and sustainability.

"I'd especially be interested to hear more details on plans for community-scale solar power. I'm no expert in power or engineering, but it has seemed to me that there is so much potential for shared solar if municipalities could partner with neighborhoods on installation costs and coordinate transmission.

"For example, we own a barn with a large, sunny roof in the heart of a West Leb neighborhood. The roof would accommodate a significant number of solar panels--enough, I'd imagine, to provide power to several homes in our neighborhood. We would love to see our property put to use to serve the community in this way, and I'm sure there are many others like us."

Q. How would your 3rd proposed condition help to satisfy the public interest.

A. There is a distinct possibility that once this pilot is launched there may be more demand for participation than supply – which would suggest that customers value the benefits of

participation more than the costs. If such a circumstance arises, rather than create a first come first served queue, it would be reasonable to utilize a competitive process, such as a reverse auction, "to reasonably minimize costs of the project to ratepayers and to maximize private investments in the project" as one of the factors to consider in determining the public interest calls for. (374-G:3, II(g).) Since significant benefits of this pilot will accrue to the participants in the form of increased reliability and resiliency of their electric service, as well as savings from the TOU pilot rates enabled by the battery, it makes sense to use a market-based mechanism to value those participant benefits, with currently proposed terms as a floor, to minimize the risk that non-participant ratepayers will end up subsidizing participants.

Q. What is the basis for your 4th recommended condition that Liberty extend its piloting of TOU T&D rates beyond the battery pilot and residential customer class as an opt-in option for participants in the City's Lebanon Community Power municipal aggregation with real time pricing pilot?

A. This proposed condition goes to the very core of determining the public interest in this case. New Hampshire's Energy Policy (RSA 378:37), dating back to 1990, declares that it is the "policy of this state to meet the energy needs of" its citizens and businesses "at the lowest reasonable cost while providing for the reliability and diversity of energy sources; to maximize the use of cost effective energy efficiency and other demand side resources . . . ." The purposes of NH's restructuring statute amplify this notion of efficiency:

374-F:1 Purpose. –

I. The most compelling reason to restructure the New Hampshire electric utility industry is to **reduce costs for all consumers of electricity by harnessing the power of competitive markets**. . . . **Increased customer choice and the development of competitive markets for wholesale and retail electricity services are key elements in a restructured industry** . . .

II. . . . **Competitive markets should** provide electricity suppliers with incentives to operate efficiently and cleanly, **open markets for new and improved technologies**, **provide electricity buyers and sellers with appropriate price signals**, and improve public confidence in the electric utility industry."

374-F:3 Restructuring Policy Principles. – . . .

II. Customer Choice. . . . **Customers should be able to choose among options such as** levels of service reliability, **real time pricing,** and generation sources including interconnected self generation . . . ."

The proposed battery pilot will give customers a meaningful option to up their level of service reliability for a modest premium, however, as proposed it does little to help develop competitive markets for retail electricity services. The proposed innovative TOU T&D rates are an important advance in providing buyers and sellers with appropriate price signals, but not so much if they are limited to just one class of customers and only one highly regulated and monopoly-controlled pilot. One might quibble over the science or art of 70%, 30%, and 10% allocation of T&D costs to 14%, 17%, and 69% of all hours respectively, based on general patterns of demand, but these proposed rates are a vast improvement over flat T&D rates that give no temporal price signal as to what drives marginal costs in T&D capacity.

The wholesale T rate pricing is an extremely strong marginal cost price signal based on a single hour of each month's coincident peak and Liberty's proposal begins to provide meaningful translation of that price signal at the retail level and for the first time in NH it would really begin to align a retail transmission rate with cost causation. In the Grid Modernization Investigation Working Group there was a consensus of the non-utility stakeholders that time-varying rates for T&D could and should be implemented in the near future by using simple TOU periods. (p. 14 of the Grid Mod Report.) The utilities asserted that TVR for T&D is not practical. Liberty has clearly had second thoughts and is now leading the way.

In my direct testimony in DE 16-576 on behalf of the City I argued that the ideal rate design for net metering – really for the buying and selling of electricity and related services – would translate wholesale marginal cost prices signals, such as RTP, and co-incident peak demand charges for transmission services, to a retail market place as well as providing marginal cost price signals for distribution services. Ultimately this is likely to be key to cost-effectively integrating variable renewable energy resources at scale – to realize the purpose of RSA 362-F, the RPS statute: that states that it is "in the public interest to stimulate investment in low emission renewable energy generation technologies" in New Hampshire for a host of reasons, not the least of which is "mitigating against the risks of climate change." (362-F:1). The deployment of storage technologies such as Liberty's proposed piloting of electric batteries at scale is another key enabler to cost-effectively integrating renewables at scale.

By developing and piloting opt-in TOU T&D rates in conjunction with the choice of RTP through LCP, synergies, savings and innovations might be realized that may otherwise be lost opportunities. Specifically, the City is beginning to consider HVAC upgrades to Fire Station #1, which also doubles as the City's emergency management center and back-up public safety dispatch center. It is located on the 11L1 circuit. Currently about 9 individual room air conditioners are used to cool the building. One option that could be considered is an Ice Bear DX packaged TES chiller by Ice Energy[3] that can work with mini-split interior terminals and take air conditioning load off-peak. Attachment C is a set of excerpts from a January 2018 EPRI technical update on the evaluation of permanent load shifting (PLS) technologies.[4] TST1 on Bates p. 34 is one of the Ice Bear products. The EPRI analysis found that the

[3] https://www.ice-energy.com/
[4] *Evaluation of Permanent Load Shift (PLS) Technologies and Development of Energy Savings Tool.* EPRI, Palo Alto, CA: 2018. 3002011344.

installed cost is approximately $300/kWh of daily PLS capability. The Tesla Battery is about twice that cost at $7,200/10.8 kWh shifted = $666/kWh PLS. Using the full discharging capability of the battery (no reserve for outages) lowers the cost of the Tesla Powerwall to $553/kWh. An investment in TES (or battery) technology may not be cost-effective without TOU T&D rates.

Another example of TES that may be more cost effective than the Tesla Powerwall and might be an economically justified investment with the alignment of T&D TOU and RTP is that described as TST3 in the EPRI analysis (Bates p. 36). That is the Calmac (www.calmac.com) ice storage system that EPRI characterizes as having an incremental installation cost on the order of $100/kWh and a round trip energy efficiency that "varies between 90-110%." (p. 3-5 and 3-6). This obviously compares quite favorably to the Tesla Powerwall cost per kWh and round-trip efficiency which is always less than 100% with an electric battery. The reason why TES systems can have a round-trip efficiency of 100% or more is because air cooled chiller equipment operates much more efficiently in lower ambient temperatures during the middle of the night than in the heat of a hot afternoon, just like thermal power plants and transmission lines. Right now the City has consulting engineers evaluating HVAC upgrades to the Lebanon Police Station, the City's 4th single largest load and just across the street from the Slayton Hill substation. Their evaluation specifically includes looking at this TES system. In a sense the City would like to see TES be able to "compete" with the Tesla Powerwall for most economical load shifting technology, but that will likely only be possible with comparable TOU price signals. EPRI TST6 (smart hot water heaters) is another very low-cost TES that works year around and is described on the last page of Attachment C.

There is yet another TES technology that may have economic viability, including within the 11L1 circuit area, which is from Viking Cold Solutions, Inc. (www.vikingcold.com). They make phase change modular packets that can fit under the ceiling or on top of shelving units in walk-in coolers and freezers and allow cooling loads to be shifted off-peak. There appears to be two supermarkets on the 11L1 circuit and numerous convenience stores and restaurants that might be able to economically deploy this or other TES systems if given access to the appropriate price signals.

I have evaluated RTP and ancillary services (those used in NH net metering surplus generation compensation) for all the hours in 2016 relative to Liberty's proposed TOU periods. Grossed up for distribution system line losses the average hourly RTP + ancillaries during Critical Peak hours was 4.6¢/kWh; for On-Peak: 3.7¢/kWh; and for Off-Peak: 2.9¢/kWh. So as expected, RTP should work synergistically with TOU T&D rates to enable savings for permanent load shifting and demand response, including time of electric vehicle charging.

The City's 4th proposed condition will effectively cure any deficiency that Liberty's proposal has regarding the use of competitive procurement processes and lack of evaluation of other NWA options by supporting the development of a robust retail electricity market. It will also support the RSA 374-F:3, XIV restructuring principle of replacing "traditional planning mechanisms with market driven choice as the means of supplying resource needs."

Q. What is the reason for your 5th proposed condition to decouple revenue from TOU pilot rates?

A. While Liberty designed their TOU rates to be revenue neutral based on class average load shape, if the pilot works as intended, it will result in decreased load and revenues from the

critical peak period. Reductions in distribution revenue on the margin tend to flow directly to the bottom line – return on equity – as operating costs and interest on debt must be paid first. In order to give Liberty the structural incentive to maximize success in shifting load off-peak, and encouraging expanded piloting of TOU rates, they should be not be financially penalized for programmatic success. A targeted TCAM like rate adjustment mechanism that is limited to the difference between actual collected distribution revenue and what they would have earned under conventional rates will be just and reasonable, help limit the need for expensive distribution rate cases, and in doing so make regulation more efficient consistent with principle XIV.

Q. Regarding your 6th proposed condition, what is the issue with meters?

A. In short, finding an affordable and mutually agreeable metering solution that meets the needs of the City's proposed LCP pilot and that works with Liberty's systems and addresses their cybersecurity concerns has been a barrier to progress in the City's pilot, endorsed by the Commission in DE 16-576. In researching smart street lighting communication systems we have found that a number of meter vendors have been developing innovative solutions that might meet both our needs, especially where they may overlap with customers wanting to participate in both pilots. Liberty did not use any competitive processes to select the meter or communication system being proposed for use in this pilot which is factor to consider pursuant to 374-G:5, I(d) and II(g).[5] Liberty's willingness to collaborate with the City in an open solicitation for a possible better metering solution, such as presented in the middle section of the draft RFI for services shown in Attachment D (at Bates p. 42) will cure that deficiency in their proposal.

[5] The City does not have any issue with the fact that Liberty's consultant, Alectra Energy Solutions, Inc. was selected based on qualifications and experience, without an RFP process. National, state, and municipal government procurement policies often allow for qualification-based selection (QBS) of design professionals, such as architects and engineers, and in some cases, such as this City's, other consultants and professional services.

Q. Why does the City ask for its 7th condition that Liberty investigate allowing a customer to have more specific control of battery dispatch and charging times?

A. As currently proposed only Liberty will have the ability to direct the battery to charge or discharge at specific times. For most of the time when Liberty isn't controlling the battery to target potential coincident peaks, it is the City's understanding that they plan to constrain the battery, so it can only charge during off-peak period and discharge during critical peaks, so customers don't get burned on TOU rate differentials. The customer might be able to set similar broad TOU periods for charging and discharging but won't be able turn the battery on or off at specific times such as when RTPs go negative. Liberty estimates, based on load research data, that most customers will be able to offset all of their load during the critical peak period on a daily basis so the main issue is when the battery charges. RTPs can vary quite a bit from hour to hour. For example, on 1/6/16 the RTP with generation related ancillary services was 11.6¢/kWh from midnight to 1 am, but dropped to 4.9¢/kWh at hour ending 5 am. On average the lowest cost hours in 2016 were from 2 am to 4 am. This may be minor in the scheme of things but may be desirable for some situations and persons if technically feasible at a reasonable cost.

Q. What is the reason for your 8th recommended condition that customer-generators who operate under grandfathered net metering tariffs but participate in the battery pilot be allowed to return to those tariffs after their participation ends?

A. Some grandfathered net metered customer-generators may hesitate to join the pilot if they don't have the option to return to their grandfathered status when the program ends or they drop out (in accordance with early termination provisions of the tariff). Allowing the option to return

may encourage more participation, including in the 11L1 circuit area. Liberty has indicated that they don't have any objection to such a provision if the Commission approves.

Q. Finally, what are the reasons for your 9th and 10th proposed conditions?

A. The 9th condition for Liberty to publicly notice when it expects possible coincident peaks, simply reflects that any interested customer that is paying for that service through their rates should have access to that information The 10th proposed condition concerns certain details of data collection that will help evaluate the success of the program compared with market-based alternatives that might only get credit for actual avoided transmission or FCM charges.

Q. Is it appropriate to use new alternative net metering tariffs for this pilot or other electric storage applications?

A. While the legislature has mandated the availability and some of the parameters of net metering tariffs for certain types of distributed generation I don't see any statutory impediment to the Commission using its general rate making authority to approve the use of net metering tariffs, or other tariff terms, for interconnected electric energy storage systems. The City urges the Commission to open a proceeding to consider such tariffs beyond the immediate context.

Q. Does that conclude your testimony?

A. Yes it does.