EXHIBIT
#14
DE 17-189

STATE OF NEW HAMPSHIRE
PUBLIC UTILITIES COMMISSION

DOCKET DE 17-189

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

DIRECT TESTIMONY

OF

Kurt Demmer
Utility Analyst NHPUC

May 2, 2018

Q. Please state your full name.

A. Kurt Demmer.

Q. By whom are you employed and what is your business address?

A. I am employed as a Utility Analyst in the Electric Division of the New Hampshire Public Utilities Commission (Commission or PUC). My business address is 21 South Fruit St., Suite 10, Concord, NH, 03301.

Q. Please summarize your education and professional work experience.

A. I graduated from Merrimack College in North Andover, Massachusetts with a Bachelor of Science degree in Electrical Engineering in 1987. In 2002, I received a Master's degree in Electrical Engineering and Power Systems Management from Worcester Polytechnic Institute in Worcester, Massachusetts. I am a registered professional engineer in the State of New Hampshire.

In June 1988, I joined Massachusetts Electric Company as an Operations Field Engineer. In 1996, I became a Senior Engineer for Massachusetts Electric Company. In 1999, my area of responsibility expanded to include distribution planning engineering. In 2000, I accepted a position as Area Supervisor for the Salem area of National Grid USA and was responsible for all distribution engineering, distribution construction, and warehousing in the Salem/Pelham area. In 2002, I was promoted to Superintendent of Electric Operations in the Beverly/Gloucester Massachusetts area. In 2005, as Superintendent of Electric Operations, I was assigned to the Merrimack Valley district area in Massachusetts. In 2008, I was promoted to Manager of Electric Operations in New Hampshire for National Grid, responsible for the operations, construction, and maintenance functions for the electric distribution organization. In 2010, I was promoted to Acting Director of Electrical Operations in New Hampshire for National Grid. In 2012, I became Director of Electrical Operations in New Hampshire for Liberty Utilities (Liberty). My continued areas of responsibility were to oversee the construction, maintenance, and operation of the electric distribution system. Since 2017, I have been employed as a Utility Analyst in the Electric Division for the Commission.

Q. What is the purpose of your testimony in this proceeding?

A. My testimony discusses the technical limitations and feasibility of the pilot as it pertains to: the capacity of Tesla Powerwall 2 Lithium Ion (Li-Ion) battery storage over the lifetime of the battery; the duration of the battery as it relates to discharge rate and storage capacity over time; the transmission RNS charge savings; the transmission LNS charge savings; the Non-Wires Alternative (NWA) distribution feeder upgrade deferral; and applicability under Liberty's existing NWA selection criteria and distribution planning criteria. My testimony is intended to support the revised assumptions used in the alternative benefit-cost analyses of Liberty's proposed pilot program performed by Staff and described in Staff witness Elizabeth Nixon's direct testimony.

Q. Have you previously testified before the Commission?

A. Yes. I have previously testified before the Commission while I was an employee of Liberty.

Q. Please describe Liberty's battery storage capacity and continuous output power.

A. The Tesla Powerwall 2 (Powerwall) battery has a rated usable energy (storage capacity) of 13.5 kWh with a maximum continuous output power of 5kW. See Supplemental Testimony of Heather Tebbetts, Attachment B, "The Powerwall (Guide)", Bates page 44.

Q. What is the difference between battery storage capacity and continuous output power?

A. Battery storage capacity is the amount of energy (kWh) that is available to be used either by the customer for reducing load behind the meter or by the utility for discharging into the distribution grid during times of system coincident peak demand. The continuous output power is the instantaneous power that the battery will provide. For example, a discharge rate of 5kW output power over an hour duration is equivalent to 5kWh. Therefore, a 10kWh storage capacity battery can discharge at a rate of 5kW for 2 hours.

Q. What is degradation and how does it affect battery storage, lifespan, and power output?

A. Battery degradation may be defined as battery storage capacity loss or fade as expressed as a percentage of the initial battery capacity. There are many factors that determine a Li-Ion battery's degradation rate. These include, but are not limited to: length of service, the environment of the battery location (i.e., temperature and cooling capacity), the typical rate of discharge, the number of charging cycles, and the depth of discharge (DOD), i.e., the percentage of energy discharged before recharging. The Powerwall Limited Warranty (USA) references a 70% Energy Retention at 10 years following initial installation date. See Supplemental Testimony of Heather Tebbetts, Attachment D, Bates page 076. The actual annual degradation was not provided by the manufacturer, either in Liberty's testimony or in response to Staff data requests. Although the actual year-to-year degradation information was not given to Staff, Liberty Utilities did provide some insight into how battery degradation can be treated. Liberty witness Tebbetts stated that "Tesla believes the approach of daily cycling of the batteries, as is expected for customers participating in the pilot, is similar to the baseline Powerwall use case, and will result in a three percent degradation each year." See Technical Statement of Heather Tebbetts, dated April 6, 2018, Section B, Subsection 2. A Li-Ion battery with similar composite materials of nickel, manganese, and cobalt exhibits a non-linear degradation due to ambient temperature, DOD, and number of charge cycles. Although non-linear, the discharge rate for an inside installation can be approximated as a linear degradation. To avoid assigning proxy values to multiple variables, Staff has assumed a linear degradation rate from 0 years to 10 years. The output power does degrade over time, however, since the amount of power output can vary up to 10% less than nameplate under certain operating criteria, Staff decided to limit its analysis to storage capacity due to aging and the lifespan of the battery.

Q. How does temperature factor into the installation, capacity, lifespan, and overall performance of the battery?

A. Alectra Energy Solutions, the consultant assisting Liberty with the battery storage pilot program, provided a justification document to sole source the vendor. See Supplemental Testimony of Heather Tebbetts dated February 9, 2018, Attachment C, Bates page 65. Alectra stated that the battery "also has a small foot print, can be installed indoors or outside, and has a modular design creating a high level of flexibility for installations. This flexibility, form factor and design will be essential as it will help to ensure that LU can meet its enrollment targets." The Powerwall being proposed for Liberty's pilot has an active thermal management system which allows for varying ambient temperatures; however, performance is limited at lower outside temperatures where outside installations are permitted. In addition, Liberty's data response Staff Tech 4-1 states that the "Powerwall will not perform to technical specification until the battery temperature rises into the operating regime." According to the National Renewable Energy Laboratory (NREL),[1] "if a thermal management system were added to maintain battery cell temperatures within a 20°-30°C operating range year-round, the battery life would be extended from 4.9 years to 7.0 years cycling the battery at 74% DOD. Battery life is improved to 10 years using the same thermal management and further restricting DOD to 54%." This differs significantly from indoor installations, where both the customer's flexibility to fully discharge the battery (i.e., 100% DOD) and Liberty's flexibility to discharge the battery at 80% back into the grid during winter distribution system coincident peaks when temperatures are at their lowest values are potentially available. Li-Ion batteries are also sensitive to heat. Although the operating temperature is -4°F to 122°F, the optimum temperature for the Powerwall is 32°F to 86°F. During the summer months, when loads are at their highest and temperatures may exceed 90°F, the thermal management system will need to cool the battery, and that cooling will reduce the storage capacity, as the 13.5kWh rating is based on an ambient temperature of 77°F and a maximum discharge of 3.3kW. See Supplemental Testimony of Heather Tebbetts, Bates page 44, Powerwall 2 Welcome Guide , Tesla Powerwall 2 Datasheet. This inherent issue with Li-Ion batteries may present a limiting factor in discharge duration for utility-discharged RNS/LNS reductions during extreme weather events and also for customer load offset purposes.

[1] NREL, "Life Prediction Model for Grid Connected Li-Ion Battery Energy Storage System", Smith/Saxon/Keyser/Lundstrom, August 2017.

Q. Please describe the degradation rate per year as it applies to the Powerwall's storage capacity and how Staff's capacity rating differs from Liberty's?

A. As stated previously, the storage capacity (kWh) for the Powerwall battery is initially rated at 13.5 kWh. The linear degradation is 0.405kWh (3% of 13.5kWh) per year. The battery storage degradation for Year 0 through Year 10 is depicted in Attachment KFD-1. The Year 10 capacity storage matches the Powerwall Limited Warranty (USA).

See Supplemental Testimony of Heather Tebbetts, Attachment D, Bates page 076.

Liberty's response in Staff Tech 4-11(d) assigns a 3% rate as found in the Technical Statement of Heather Tebbetts dated April 6, 2018, Section B, Subsection 2. Liberty has calculated a 3% reduction annually based on the previous year. The battery storage degradation for Year 0 through Year 10 is depicted in Attachment KFD-1. The Year 10 capacity storage does not match the Powerwall Limited Warranty (USA). The 10-year degradation rate in the Liberty calculation is 74%, which does not match the level specified in the warranty.

Q. What is the relationship between the discharge rate of the battery and the storage capacity of the battery?

A. There are various discharge rates that are available on the Powerwall battery. There is a self-consumption discharge rate that allows the customer to offset the load behind the meter at a discharge rate set by the customer. The discharge rate for Liberty's RNS/LNS charge reduction strategy is 5kW per hour or 5kWh energy usage every hour. The useable storage for a system discharge is 80% of the battery's available storage capacity. As the battery degrades from year 0 to year 10, the discharge rate remains at 5kW, however the length of time that the battery can discharge at full capacity is reduced. To maximize the RNS/LNS reduction savings, the discharge rate is set at the maximum of 5kW per hour; however, the maximum discharge also depletes the battery within approximately 2 hours in the first 4 years and under 2 hours in years 5 through 10. The discharge rate for Liberty's NWA strategy is 1.5kW per hour or 1.5kWh energy usage every hour. The NWA discharge rate is significantly lower than the RNS/LNS charge reduction discharge rate. This is due to the length of time required to reduce the load on the Craft Hill 11L1 distribution feeder to eliminate the distribution circuit design criteria violation. The elimination of this violation through load reduction allows the deferral of the distribution feeder upgrade that would otherwise be required sooner. On certain days, the reduction must span a period of over 6 hours. The RNS/LNS and NWA discharge rates and durations are listed in the table in Attachment KFD-1. Since Liberty's and Staff's degradation rates differ, the duration for the discharge rates will also differ.

Q. Is the discharge rate of 5kW for the RNS/LNS charge reduction benefit and the discharge rate of 1.5kW for the NWA reflected accurately in Liberty's Benefit-Cost Analysis?

A. No, it is not. The first discrepancy in Liberty's benefit-cost analysis is the amount of transmission charge (RNS and LNS) reduction through the summer months of June, July, and August. In those months, the NWA (Craft Hill 11L1 distribution circuit) batteries will be discharged at a reduced rate for the time required to cover the criteria violation as the violation occurs multiple times throughout the summer. The days for this NWA discharge include the system coincident peaks in all three months since temperature is the driving factor in both the NWA and the system coincident peak during the summer months. The 300 batteries on the Craft Hill 11L1 circuit will only provide the aggregate output determined by the discharge rate of those 300 batteries. Since the summer period system coincident peaks occur within the timeframe of the NWA discharge period, the NWA reduction will contribute only 450kW (0.45 MW) towards the RNS reduction (i.e., 300 batteries x 1.5kW discharge per hour). During other times of the year, when the criteria violation does not exist, the 300 11L1 circuit batteries can be utilized in a similar manner and discharge rate as the other 700 batteries. Therefore, the annual transmission reduction benefits should reflect the reduced coincident peak demand reductions possible during the summer months.

Q. Are there issues with depleting the 700 batteries using the 5kW discharge for the RNS reduction strategy?

A. As previously stated, the 700 batteries during the summer months and the additional 300 batteries during the 11L1 off-peak months are discharged at 5kW per hour. The historical system peak for the last 8 years is shown in AttachmentKFD-2. Since 2010, the ISO-NE annual system peak has occurred either from 2:00 p.m. to 3:00 p.m. or from 4:00 p.m. to 5:00 p.m. The probability has been 50% for either timeframe for the ISO-NE annual system peak. The 700 batteries discharging at 5kW/hour have a two-hour or more duration for the first 4 years. For the remaining 6 years, the duration is under 2 hours. In order to achieve the transmission reduction benefit, Liberty is required to reduce its system load during the ISO-NE system coincident peak hour. Once the full discharge duration of the battery is less than 2 hours, then Liberty is only capable of reducing its demand for one system peak hour. For example, the duration is 1 hour and 50 minutes in Year 5. If the battery is discharged at 3:00

p.m., the discharge will only reduce Liberty's distribution load until 4:50 p.m. (1 hour 50 minutes). Once discharged by 80%, the battery will no longer reduce the distribution peak load, and the load will increase to full demand in the last 10 minutes of the hour, eliminating any reduction during that hour if that hour is determined in retrospect to be the system peak hour by ISO-NE.

Q. Is there an algorithm or predetermination method that Liberty can use to accurately predict the monthly ISO-NE system coincident peaks, including the annual system coincident peak?

A. The issue with determining the system coincident peaks is that unknown variables can shift the peak loading throughout the day. Factors such as solar photovoltaic (PV) performance, weather instability, and unplanned load interruptions all factor into the probability of each hour within Liberty' critical peak period (2pm-7pm) being the system peak hour. In some cases, as in March 2017 and April 2017, the monthly system coincident peak occurred at 8:00 p.m., after the end of the Liberty critical peak period. The table in Staff Tech 4-11(g) shows a sample discharge of the battery in Year 0. This example works in Year 0 through year 4 only if the system peak is known to occur between 3:00 p.m. and 5:00 p.m. If the region's weather were to destabilize with unplanned weather events occurring during that timeframe and the system peak was determined to be between 2:00 p.m. and 3:00 p.m., Liberty would have missed the reduction. A 1.5 to 2.2 hour discharge duration in a system peak timeframe of 4-5 hours, coupled with the 50% probability of a 2:00 p.m.- 3:00 p.m. or a 4:00 p.m. – 5:00 p.m. system peak hour, substantially reduces the probability of achieving the annual system peak reduction. The remaining 11 month coincident system peaks also produce an uncertain probability of reduction due to the small duration of discharge available to address the peak period varying times. The algorithm proposed by Liberty, if and when it becomes available, would provide invaluable insight into the ability to pinpoint system coincident peaks, thereby reducing the need to oversize the battery storage capacity and maximize the output discharge at with a lower capital outlay. In the absence of this algorithm, other utilities with "in front of the meter" grid battery storage projects have recognized this duration issue and have oversized their storage capacity to compensate for the degradation and increased the discharge durations to a minimum of 4 hours, with degradation designed into the capacity of the system, in order to capture all of the historic peak times with some degree of certainty. In lieu of oversizing the battery capacity to allow for a 4 hour battery discharge duration, other utilities have chosen to pair PV with battery storage to reduce the amount of discharge required from the battery in order to increase discharge duration. Unfortunately, if the annual system peak day is overcast, the PV system will not provide the same degree of discharge duration certainty as a 4-hour duration oversized battery system.

Q. Does the discharge duration of the 700 transmission reduction batteries and the 300 NWA strategy batteries affect the benefits probability, as reflected in the Benefit-Cost Analysis?

A. As previously stated in my testimony, the annual system coincident peak and monthly system coincident peaks are not consistent year-over-year and, without a proven algorithm to ensure the accuracy of reducing the distribution load at the right hour of the day, the probability relies heavily on the duration of the battery to cover a number of timeframes. The 700 batteries for the transmission reduction have an expected duration of at least 2 hours from year 0 through year 4. This allows some flexibility for Liberty to reduce the distribution system coincident peaks, including the annual system peak. Staff has assigned a 75% probability for Liberty's ability to determine and execute during those peak times. Once the battery discharge duration is reduced to under 2 hours, Liberty has effectively one hour it can reduce its distribution load, limiting its flexibility to meet the 12 months of system coincident peaks, including the annual system peak. Staff has assigned a 50% probability for Liberty's ability to determine and execute during those peak times for years 5 through 10.

The 300 NWA strategy batteries located on the Craft Hill 11L1 feeder require a different probability analysis than the other 700 pilot program batteries. The NWA batteries have a lower discharge rate (1.5kW) in order to reduce the extended duration of the 11L1 loading. For the first 4 years (2019-2022) of the program, while they remain effective in reducing the 11L1 loading, they also have at least 6.5 hours of discharge duration. This length of discharge will envelope a significant portion of the annual system coincident peak probabilities and provides additional flexibility in meeting the summer system coincident peaks. Since the NWA timeframe for reducing the 11L1 loading coincides with all three summer months' system coincident peaks, the same duration benefit exists. Staff has assigned a 100% probability for Liberty Utilities meeting those peak times at 1.5kW per hour.

With respect to tthe remaining 9 month of the year, Staff has assumed that the 300 NWA batteries will be utilized in a similar strategy as the other 700 batteries and will be assigned similar probabilities as those batteries due to their higher hourly discharge rate.

Q. Does the 11L1 NWA strategy look similar to the transmission reduction strategy?

A. No, it does not. The transmission reduction strategy portion of the pilot relies on Liberty discharging the batteries to reduce the Liberty's distribution system load at the time of the ISO-NE system coincident peak. The NWA strategy in the pilot is targeted to use of the 11L1 batteries to reduce the distribution feeder criteria violation through reduced loading.

Q. What is the 11L1 feeder criteria violation and its significance to determining the timing of the NWA strategy throughout the summer months of June, July, and August?

A. The 11L1 criteria violation is based on a circuit breaker relay setting value. This relay setting value of the 11L1 station breaker is similar to a 20 Amp house circuit breaker. Depending on the manufacturer, the precision of tolerance in the breaker, and the type of electrical load, the 20 amp breaker may trip, disconnecting the electrical load as the load approaches or reaches the 20 amp breaker setting. The type of breaker value on the 11L1 circuit also has a tolerance level. Liberty calculates that tolerance and places a 75% threshold on that value per Liberty's Distribution System Design Criteria Summary. See Liberty Utilities' response to Staff 1-4, including Table 3.

In this case, the threshold is 357 Amps. Any phase load on the 11L1 that exceeds 357 Amps is a violation of the circuit criteria. During the summer months, the loading of the circuit exceeds this threshold, creating a criteria violation. The original planning recommendation was to install an additional circuit out of a nearby substation to allow the 11L1 circuit to offload some of its load, reducing the 11L1 circuit to acceptable loading.

During the summer months of 2016 and 2017, the 11L1 feeder exceeds the threshold criteria for multiple hours. See Attachment KFD-3.

Q. Please explain the importance of Liberty Utilities' Distribution System Design Criteria Summary as it relates to distribution upgrades and NWA selection.

A. The distribution feeder upgrade originally proposed for the 11L1 circuit is described in Liberty's Data Response Attachment Staff 1-7. Prior to engineering submitting an Engineering Report for distribution investment, the circuit must go through the planning process. In Liberty's Least Cost Integrated Resource Plan (LCIRP) submitted in Docket 16-097, Bates page 32, the planning process identifies system deficiencies. Part of that task is to review system performance as noted in Section 4.4, subbullet 2, "Power quality and voltage performance." Included in the power quality is ensuring that circuits have acceptable levels of power factor in both lightly-loaded and heavily-loaded periods of the year. Power factor in a circuit is an indicator of loss efficiency due to motor loads. In correcting for a poor power factor, a circuit will gain many benefits, including better voltage support and regulation through the different loading period, a lower kVA demand on the circuit, and lower load current which also leads to lower line losses. When Staff inquired about the real time power factor on the 11L1 circuit during peak times, Liberty responded in Staff Tech 1-1 that "the 11L1 is currently not able to be retrieved from the SCADA servers." The only power factor available was on the supply circuit to the Craft Hill substation, the 1333 line. In Liberty Utilities' response in Staff Tech 2-3, the 1333 line has a 1200 kVAR capacitor bank. The power factor on the 1333 line not only reflected the Craft Hill substation, which contains both the 11L1 and the 11L2 circuit, but also the capacitor bank on the line. The power factor for the 11L1 circuit cannot be derived with any degree of accuracy due to the lack of granularity in the data.

The continued use of the "average load amps" is also somewhat misleading. The utilization of average load amps is generally for an indication or trending of a circuit's demand. The required balancing of the 11L1 circuit is noted in Liberty Utilities' Distribution System Design Criteria Summary. See Liberty's response to Staff 1-4, including Table 3. Liberty's response to Staff Tech 4-25 indicates that the 11L1 circuit does meet the feeder balancing criteria; however, the criteria violation is based on any phase exceeding 357 amps. Liberty stated in Staff Tech 4-25 that it "will attempt to perform phase balance so that the middle phase is reduced by 10-15A and all three phases are evenly-loaded. Based on my 25 years of experience in balancing feeders in the legacy National Grid areas, including Granite State Electric, balancing feeders to an evenly-loaded condition can be very difficult to do, considering the 11L1 has a mixed residential and commercial loading, residential and small commercial metering that provides only kWh monthly readings, unmeasured transformer demand, and an overall lack of real time data granularity at the sub-circuit level. In addition, fine tuning the phase balancing may require significant construction investment due to the single phase and three phase geography present on the circuit. Staff, however, did reflect the 15 amp transfer of load from the "high" phase in the estimated 2018 through 2022 11L1 loading data. See Attachment KFD-3.

These considerations and action items presented by Liberty indicate a further need for Liberty to address system deficiencies, including the lack of real time data, prior to selecting a circuit for an NWA. The NWA strategy of the pilot may not create a significant benefit under the benefit-cost analysis and may delay the implementation of the permanent distribution investment.

Q. Are there other concerns regarding the NWA proposal as stated in Liberty's Benefit-Cost Analysis and Testimony?

A. My analysis is focused on three key issues relative to the NWA proposal: the discharge rate of the NWA batteries as it relates to the required duration needed to reduce the 11L1 loading during criteria violation periods, the estimated 2018 through 2022 11L1 circuit loading adjusted for circuit rebalancing in 2018, and the total reduction in kW during the criteria violation period.

My assumptions are that the 11L1 circuit power factor is compliant with Liberty's design criteria, the feeder balancing achieves further reduction in "the high phase," achieving a more balanced feeder in Fall 2018, and the output power of the battery is set at unity power factor (kW=kVA). The last assumption is based on the absence of the power factor direction (leading or lagging) in the circuit during NWA reduction times eliminating the possibility of increasing loading on the circuit by making the power factor worse.

The first issue is the required duration for the 11L1 circuit NWA batteries. Based on the table in Attachment KFD-3, there are a number of long duration criteria violation (357 Amp phase exceedance) days that begin before 11:30 a.m. and do not end until 5:00 p.m. Although the loading can be roughly predicted utilizing weather data and historic circuit performance based on weather parameters, other factors similar to predicting the annual system coincident peak are present. The large industrial load on the feeder may also contribute to the unpredictability of the duration as Liberty does not have a binding load curtailment agreement with that customer. This uncertainty will require Liberty to conservatively set the discharge rate to 1.5kW on the 300 11L1 batteries. Similar to the annual system coincident peak prediction, without a proven algorithm to forecast loading and duration, a conservative measure must be implemented.

The second issue is the 11L1 load data table with 2018-2022 estimated load data. The table in Attachment KFD-3 estimates the 2018 through 2022 load based on an annual increase of 0.7%. This increase was provided by Liberty in Tech Staff 2-1 iii and in the Staff Tech 4-10 embedded table. As previously mentioned, the table also reflects the Optimized Balancing.

The third issue is the total reduction. The reduction is based on 300 batteries installed on the 11L1 feeder for NWA purposes. Balancing the feeder further creates some decreases in the “high phase” or “B” phase, but it also shifts the installation to be installed on all three phases since the load is better balanced. The 300 total batteries will need to be installed in equal amounts on all three phases. If the batteries are not installed equally, then the reduction in load will not be effective for the phase that has the least amount of batteries. After installing 100 batteries per phase, the discharge of 1.5kW will produce 150kW per phase or approximately 20 amps of reduction per phase.

Liberty had used a different value for the load reduction in the NWA battery discharge scenario. See Liberty’s response to Staff Tech 4-10 h. The 23 amps stated in the table is based on a 1.5kW output but at 0.85 power factor. Staff also utilized Liberty’s load reduction of 23 amps in Attachment KFD-3 for comparative analysis.

Note that the duration for the days where the load exceeds the criteria has shortened; however, as I noted previously, without a proven peak prediction algorithm, a higher discharge rate would reduce the duration of discharge and increase the risk of not covering for a violation due to excess discharge.

Q. What is your conclusion for the distribution deferral on the 11L1 circuit based on the calculated discharge and feeder balancing?

A. The batteries are not in service until 2019, which adds another year of increasing load on the 11L1 circuit that presently is already in violation of the applicable design criteria. In 2022, the feeder has multiple days of design criteria violation, using Staff's discharge calculation. In 2022, the feeder has fewer days and times where the criteria violation will occur, using Liberty's discharge calculation. Since there is a discrepancy between Staff's calculation and Liberty's calculation, further consideration must be given to Liberty's calculation, because the additional reduction will not significantly decrease discharge duration. Utilizing Liberty's discharge calculation of 23 amps, Staff recommends that the distribution investment for 11L1 will need to occur in 2023 for a distribution investment deferral of 3 years total rather than Liberty's proposed 10 year deferral. The NWA batteries will be utilized through the summer months of years 2019 through 2022. After year 2022, the 300 11L1 batteries would be discharged in the same manner as the other 700 batteries. See Attachment KFD-3 for further detail.

Q. Does this conclude your testimony?

A. Yes.