BEFORE THE NEW MEXICO PUBLIC REGULATION COMMISSION

IN THE MATTER OF PUBLIC SERVICE COMPANY OF NEW MEXICO'S CONSOLIDATED APPLICATION FOR APPROVALS FOR THE ABANDONMENT, FINANCING, AND RESOURCE REPLACEMENT FOR SAN JUAN GENERATING STATION PURSUANT TO THE ENERGY TRANSITION ACT	)	**Case No. 19-00195-UT**

REBUTTAL TESTIMONY

OF

STEVEN L. MAESTAS

January 13, 2020

NMPRC CASE NO. 19-00195-UT
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WITNESS FOR
PUBLIC SERVICE COMPANY OF NEW MEXICO

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I. INTRODUCTION

Q. PLEASE STATE YOUR NAME, POSITION AND BUSINESS ADDRESS.

A. My name is Steven L. Maestas. I currently hold the position of Director, Wholesale Power Marketing for Public Service Company of New Mexico ("PNM" or "Company"). My business address is Public Service Company of New Mexico, 2401 Aztec Road NE, Albuquerque, NM 87107.

Q. PLEASE SUMMARIZE YOUR EDUCATIONAL BACKGROUND AND PROFESSIONAL QUALIFICATIONS.

A. My educational background and professional experience are summarized in PNM Exhibit SLM-1 (Rebuttal), which also identifies cases in which I have testified before the New Mexico Public Regulation Commission ("NMPRC" or "Commission").

Q. WHAT IS THE PURPOSE OF YOUR REBUTTAL TESTIMONY?

A. I provide an operational perspective on the San Juan Generating Station ("SJGS") replacement resource portfolio with a particular focus on the importance of reliability when considering various proposals of generation portfolios to replace San Juan Units 1 and 4. I emphasize the importance of maintaining reliability as PNM adds more renewable resources and battery storage technology as it transitions to a carbon-free future. I explain that the alternative "no gas" proposals of several intervenors that rely heavily on new renewables and new

batteries are not prudent from the perspective of overall system reliability and that PNM Scenario 1 is the most responsible means of replacing the resources at San Juan Units 1 and 4.

Q. PLEASE DESCRIBE YOUR RESPONSIBILITIES AS DIRECTOR OF WHOLESALE POWER MARKETING.

A. I am responsible for the day-to-day and long-term operations of PNM's Wholesale Power Marketing group. This group is responsible for all wholesale purchases and sales of electricity and purchases and sales of natural gas by PNM used in electric generation. The group is also responsible for generation dispatch, for acquiring ancillary services for the Balancing Authority ("BA"), and for complying with all North American Electric Reliability Corporation ("NERC") requirements.

Wholesale Power Marketing accomplishes these tasks with a group that includes Real-time Traders, Power Pre-schedulers, and power and gas schedulers. Real-time Traders are responsible for making hourly generation dispatch decisions, off-system sales and purchases, and electricity scheduling to meet PNM's loads. Importantly, the Real-time Traders are responsible for Disturbance Control Standard ("DCS") recovery, which means they must recover from the immediate loss of a PNM generating resource which could include PNM's Most Severe Single Contingency ("MSSC") within 15 minutes and then re-establish contingency reserves within sixty minutes after the DCS event and comply with

all NERC and Western Electric Coordinating Council ("WECC") standards. Power Pre-schedulers are responsible for balancing loads and generation on a day-ahead and longer-term basis in the most economical way possible while meeting all NERC and WECC reliability standards. The Power Pre-schedulers also manage all natural gas purchases and sales and all other activities to support PNM's gas-fired generation fleet.

Q. WHAT ARE NERC AND WECC?

A. NERC is a not-for-profit international regulatory authority whose mission is to assure the effective and efficient reduction of risks to the reliability and security of the electric grid. NERC develops and enforces system reliability standards; annually assesses seasonal and long□term grid reliability; monitors the bulk power system through system awareness; and educates, trains, and certifies industry personnel. NERC's area of responsibility spans the continental United States, Canada, and the northern portion of Baja California, Mexico. NERC is the electric reliability organization for North America, subject to oversight by the Federal Energy Regulatory Commission ("FERC") and governmental authorities in Canada. NERC's jurisdiction includes users, owners, and operators of the bulk power system, which serves more than 334 million people.

WECC is the Regional Entity responsible for compliance monitoring and enforcement and oversees reliability planning and assessments of bulk power systems. WECC promotes bulk power system reliability and security in the

Western Interconnection. There are six Regional Entities given authority by NERC and FERC. Of those six entities, WECC oversees the largest and most geographically diverse region, known as the Western Interconnection. WECC's footprint extends from Canada to Mexico and includes the provinces of Alberta and British Columbia, the northern portion of Baja California, Mexico, and all or portions of the 14 Western states between.

Q. WHOSE TESTIMONY ARE YOU REBUTTING?

A. I rebut the testimony of the Coalition for Clean Affordable Energy ("CCAE"), Sierra Club and Southwest Generation Operating Co., LLC ("SWG"). CCAE and Sierra Club recommend replacement portfolios for the abandonment of the San Juan coal plant that result in resources that are exclusively incremental renewable and batteries. CCAE and Sierra Club have eliminated any incremental gas generation in their suggested replacement portfolios. SWG asserts that much of the replacement resources can be obtained through market purchases. I provide my opinions on these recommendations from the perspectives of utility operations and compliance. I address utility system operations and reliability based on the practicalities learned from actual utility experience as contrasted with a theoretical or academic approach advocated by some of the intervenors in this case.

II. PNM SYSTEM OPERATION AND RELIABILITY

Q. WHAT ARE THE RELIABILITY REQUIREMENTS FOR PNM'S SYSTEM?

A. As both an electric utility and an area BA, PNM must operate its system to maintain safe and reliable service to customers in accordance with regulatory requirements and industry standards established by NERC and WECC. Among those standards are:

- BAL-002-3: Disturbance Control Performance Standard ("DCS")
- BAL-002- WECC-2: Contingency Reserves, and
- BAL-003-1: Frequency Response Requirements ("FRR")

PNM must meet these requirements with PNM-committed resources around the clock, every day of the year. PNM reduces the cost of meeting these requirements by participating in the Southwest Reserve Sharing Group ("SRSG"). NERC, WECC, and SRSG can assess monetary penalties for non-compliance with reliability requirements. The WECC Reliability Coordinator (which is the California Independent System Operator, or CAISO) can order the utility to shed load if required for the BA to re-establish compliance with these standards. To ensure compliance, PNM must maintain contingency reserves, which are resources under PNM's control that can be activated to respond to DCS events within the required time periods. An example of a typical DCS event would be the loss of a BA's single largest generator, also commonly referred to as the Single Largest Hazard. If PNM does not comply with these standards, not only

can monetary penalties be assessed, but PNM can also be exposed to a directive from the Reliability Coordinator to shed load, resulting in widespread outages on the system.

As I discuss in more detail later in this rebuttal testimony, PNM's anticipated move to an EIM in 2021 will not change PNM's reliability requirements or the manner in which PNM must meet those requirements.

Q. WHAT ARE YOUR OVERARCHING CONCERNS ABOUT ADDING SIGNIFICANT QUANTITIES OF INCREMENTAL RENEWABLE RESOURCES AND BATTERY STORAGE TECHNOLOGY TO PNM'S PORTFOLIO?

A. As I stated above, it is paramount that PNM operates its system to maintain safe and reliable electric service to customers in accordance with regulatory requirements and industry standards established by NERC and WECC. Relying entirely on incremental renewable resources (solar and wind) along with new battery storage to meet these requirements is problematic for this phase of PNM's resource transition. Solar and wind resources are variable by nature. Because of this inherent variability, they must be backed by a resource that has the potential to guarantee output when called upon. From PNM's experience with wind and solar resources, during the peak period of the day (both summer and winter), wind generally does not blow when PNM needs it, while solar has typically trailed off to little or no generation. PNM's renewable resources are already 16 percent of

PNM's resource portfolio. By June 2022, the percent of renewable resources in PNM's portfolio (not limited to the Renewable Portfolio Standard resources) is projected to be 40 percent. This means there will be more than a doubling of renewables in PNM's portfolio within two years. This significant increase of variable resources on PNM's system requires back-up from flexible and dispatchable resources.

As for battery storage, it does have a place in ensuring that reliability requirements will be covered in PNM's replacement resources. I discuss batteries in more detail later in my testimony. Batteries appear to be evolving as part of the long-term solution to achieve a carbon-free generation fleet. Battery storage will hopefully become an excellent physical and low-cost asset to have in a utility's portfolio. However, the initial phase of this new technology introduction requires additional time and planning to understand how batteries will integrate into the overall plan of operations to ensure reliability and so that PNM can optimize its total value. Utility-scale battery storage technology is entirely new to PNM and will require operational transformation. Relying on it as a replacement resource this soon or on a scale that some intervenors suggest (upwards of 450 MW of storage, as proposed by Sierra Club) is unreasonable at this time, given that the technology is relatively new to the industry and very new to PNM.

Q. CCAE IS PROPOSING NO NEW GAS AND SIGNIFICANTLY MORE BATTERY STORAGE AS PART OF PNM'S REPLACEMENT

RESOURCES. DO YOU AGREE THAT THE MODELING CCAE PERFORMED TO SUPPORT THEIR PORTFOLIO IS AS RELIABLE AS MODELING THAT INCLUDES FLEXIBLE GAS UNITS?

A. No. A resource mix that makes an overly large commitment to a new and relatively untested technology class is problematic. These problems are exacerbated since CCAE's proposals are based on modeling assumptions that do not necessarily always perform in the "real world" of operations. PNM has learned that diversity of resources is important, and battery resources seem likely to contribute to that diversity in valuable ways. But it is important that the integration of new, diverse resources be done responsibly.

Q. DOES PNM'S EXPERIENCE IN INTEGRATING RENEWABLE RESOURCES INTO ITS PORTFOLIO GIVE YOU ANY UNDERSTANDING OF THE RELIABILITY CHALLENGES PNM WILL FACE AS IT MOVES TO A CARBON-FREE PORTFOLIO?

A. Yes. PNM already faces numerous challenges balancing its current mix of thermal and renewable resources. Wholesale Power Marketing currently has to balance a portfolio of renewable resources in the PNM jurisdiction that consists of approximately 350 MW of wind and 205 MW of large-scale solar. This solar capacity does not include additional, behind-the-meter, distributed generation ("DG") solar that amounts to another approximately 125 MW. The total of renewable resources installed to serve load at full output can cover nearly 40% of the PNM load needs during a shoulder month, light-load day at full output. These

resources, plus other resources that are "must-take" resources, are not capable of providing enough flexibility to mitigate swings in wind and solar output. Therefore, PNM tends to rely on our current small fleet of flexible units (LM6000 units at Lordsburg and La Luz) to mitigate and manage the variability created by wind and solar to maintain a reliable system and stay in compliance with all NERC, WECC and regulatory requirements. There are times in the year, however, that PNM's current three LM6000s may not provide enough flexibility. Batteries can definitely be part of the solution, but PNM's schedulers and traders need time and experience to best utilize this tool to manage the reliability needs of the PNM system. It does not make sense to place the utility in a "learn as you go" operating condition with such a large amount of battery storage on a percentage basis of the system, as proposed by CCAE.

Q. IS THERE A PARTICULAR CHALLENGE THAT ILLUSTRATES THE CONCERNS YOU HAVE ABOUT INTEGRATING RENEWABLE RESOURCES?

A. Yes. One key area of concern that PNM system operators are finding more and more difficult to manage is around evening peak hours, when the sun begins to set and solar energy trails off. In addition to losing the utility-scale solar output, PNM loses DG output at the same time, while peak load continues to rise. Managing the intra-hour ramping of the evening peak load requires PNM to carry enough ready reserves (spinning or non-spinning) to follow the load rise. Summer peak and winter peak periods each have needs for flexible resources.

The winter peak day usually carries a morning ramp to manage with a load rise and solar rise that are not in sync, and an evening load rise when solar has already trailed off. The summer peak period, which occurs in the evening, can last four to five hours and typically extends three to four hours after solar has trailed off. PNM's existing fleet, while at times challenged, is capable of handling the current level of variability. However, the resources must be on-line and loaded in the right load point to follow wind/solar up or down and to handle load swings. System operators track hour-ahead forecasts for wind, solar, and load, but PNM has yet to find a forecasting tool that is capable of getting the forecast perfect, with wind forecasting being the most challenging.

III. RELIABILITY AND ITS RELATION TO MARKET DEPTH AND LIQUIDITY

Q. ARE THERE MARKET FACTORS THAT MAKE IT DIFFICULT TO USE MARKET RESOURCES TO MAINTAIN SYSTEM RELIABILITY?

A. Yes. Changes in market depth and liquidity impact the ability to consistently rely on market solutions. Market depth refers to the number of counter-parties that are actively buying and selling in the day-ahead and hour ahead market. Market liquidity refers to the same concept but, in addition, also refers to the amount of power that counter-parties are willing to transact (sell or purchase). The lack of either of the two can force a utility into a position where their reliability is at risk if they are unable to procure enough firm supply (market purchase) to restore the necessary reserves to comply with all NERC, WECC and other regulatory

requirements, to the point where the only option may be to shed firm load. These concepts are particularly relevant because of the testimonies of Sierra Club Witness Goggin and CCAE Witness Milligan and assumptions they make regarding potential import capabilities.

Q. WHAT HAS PNM OBSERVED REGARDING MARKET LIQUIDITY AND DEPTH?

A. Market liquidity and depth have declined over time. This deterioration is illustrated in PNM Table SLM-1 (Rebuttal) and is described later in my testimony.

PNM Table SLM-1 (Rebuttal)

Wholesale Purchase Transactions from Jan 1, 2013 - Aug 31, 2019			
Year	Unique Counterparties	No. of transactions	No. of hours
2013	44	2808	19496
2014	42	2841	18543
2015	41	2156	11063
2016	44	1730	9398
2017	45	1321	7754
2018	42	1650	8038
2019 (thru 8/31)	31	978	4141

A number of factors have contributed to the loss of market liquidity and depth, including the retirement of base load units throughout the western United States; market power concerns by some market entities and the loss of market-based rate authority; increased participation in the CAISO Energy Imbalance Market ("EIM"), which has created a tendency for formerly active market participants to back out and not transact into bilateral markets due to EIM-required timelines;

more stringent electricity scheduling rules; and a number of developments related to gas pipelines, including more stringent scheduling requirements on interstate pipelines and challenges in acquiring intra-day gas supply and transportation, and finally lack of interest by other utilities to transact during summer and winter peak hours due to uncertainty on accuracy of load forecasting and unit availability.

Q. ARE MARKET PURCHASES, SUCH AS THOSE SUGGESTED BY SWG WITNESS BABCOCK, A PRUDENT OPTION FOR COMPLYING WITH THE NERC, WECC, AND SRSG RELIABILITY REQUIREMENTS?

A. No. Market purchases are not a reliable option because the availability and deliverability of power in the market is very uncertain due to a number of factors. For example, PNM cannot depend on market purchases to comply with the fifteen-minute DCS recovery requirement. Market purchases are generally not dispatchable and a utility is required to take the entire schedule. Generally, intra-hour market purchases (outside of the CAISO EIM trading functions) are nonexistent unless a BA declares an emergency, at which point the BA itself is likely also to be shedding firm load due to the lack of market liquidity. Therefore, market purchases are not a dependable resource for meeting required regulatory standards. In addition, when system load and other factors call for market resources on the PNM system, they typically call for them on systems throughout the western United States, making market purchases least available at times when they might be most needed.

Q. IS IT REASONABLE TO ASSUME THAT PNM COULD CONSISTENTLY MEET ITS RELIABILITY REQUIREMENTS BY RELYING ON THE MARKET, AS SUGGESTED BY SWG WITNESS BABCOCK?

A. No, PNM cannot count on the market to meet reliability requirements. SWG witness Babcock incorrectly assumes that a generation resource available in other parts of New Mexico or neighboring states could readily be brought into the PNM portfolio to meet a firm resource requirement. This is incorrect unless firm transmission rights, which may or may not be available, can be acquired from potentially multiple systems at an added cost, as explained in the Rebuttal Testimony of PNM Witness Duane. Without firm transmission rights, these resources or market purchases cannot be relied on to meet PNM reliability requirements.

Also, SWG Witness Babcock is incorrect in his assertion because short-term firm capacity resources are not readily available. PNM needs firm resources within its BA area or with firm transmission rights to serve PNM's BA in order to meet the necessary reliability requirements. When buying firm energy from entities in Colorado, Wholesale Power Marketing has observed that those entities generally deliver the energy on non-firm transmission and it rarely ever shows up, and is cut due to the owners of firm transmission rights calling back their rights. PNM cannot rely on this type of purchase to count towards our reserve requirements or to cover load. The same is true for energy being delivered out of the Southwest

Power Pool ("SPP") market. Firm transmission is not available into the PNM load center from the SPP.

Q. ARE YOU AWARE OF THE QUESTION BY SOME INTERVENORS, INCLUDING SIERRA CLUB'S WITNESS GOGGIN, ABOUT THE 200-300 MW ASSUMPTION FOR SYSTEM PURCHASES USED IN PNM'S RESOURCE MODELING?

A. Yes. I provided input on PNM's modeling and reviewed the values being used and how the values were input into the model. As a real-world scheduler, I agree with PNM's modeling results and disagree with Sierra Club's assumptions regarding system purchase availability. Sierra Club Witness Goggin argues at pages 25 and 26 of his testimony that PNM has been able to acquire more than 300 MW of purchases during certain peak period times, and therefore the full 300 MW should be available at all peak times. I can counter, however, that there have been other times during super critical peak periods that PNM was unable to procure or find market purchases to cover the reserves needed to restore the PNM system in a contingency event. The stochastic approach used by PNM in modeling appropriately limits the market during the peak periods, and actually represents an optimistic approach to planning a utility system as discussed by PNM Witness Wintermantel. From an operational perspective, the assumption of the 200-300MW range used in modeling by Astrape is necessary and important to place more realistic boundaries on the availability of market resources.

Q. WILL PNM BE ALLOWED TO UTILIZE THE CAISO EIM MARKET TO MEET ITS RELIABILITY REQUIREMENTS, AS PROPOSED IN SWG BABCOCK'S TESTIMONY?

A. No. As a preliminary matter, note that PNM is not currently a member of EIM. PNM intends to participate in the EIM effective in April, 2021. The EIM market is an energy-only market. This means that PNM will not be able to rely on the EIM to meet any capacity or reliability needs. In fact, in order to participate in the EIM market, PNM must first demonstrate, for every hour, that it meets certain resource adequacy requirements to cover PNM's own system load to ensure PNM is not leaning on the EIM system for these capacity requirements. Each EIM entity must retain and fulfill their BA responsibilities. EIM is an intra-hour energy imbalance market and it does not allow for the buying and selling of capacity and/or ancillary services.

Q. MR. GOGGIN STATES THAT PNM DID NOT PROPERLY ACCOUNT FOR RELIABILITY BENEFITS OF THE EIM. WILL PNM'S ENTRY TO EIM SOLVE ALL OF THE PROBLEMS WITH THE RELIABILITY CONCERNS YOU JUST DISCUSSED?

A. No. As mentioned earlier, EIM is not intended to relieve a utility of its reliability requirements. Each entity must still ensure it brings with it the necessary operating reserves needed to serve its own load and balance its own system in the event it were to disconnect from the EIM footprint and stand on its own. The EIM is an energy imbalance market. As such, it may help PNM integrate

renewables by looking across a larger footprint to determine the least-cost dispatch order, resulting in the most economical bids available to meet imbalances. Participation in the EIM gives PNM the ability to make five-minute intra-hour purchases and sales that might otherwise be unavailable due to the structure of the bilateral market that does not allow for intra-hour transactions. EIM is an additional trading option that will assist PNM, but it does not solve PNM's reliability concerns or obligations.

IV. RENEWABLE ENERGY INTEGRATION

Q. FROM AN OPERATIONAL PERSPECTIVE, DO YOU HAVE CONCERNS WITH SIERRA CLUB'S ALTERNATIVE PORTFOLIOS THAT INCLUDE INTRODUCING ADDITIONAL LARGE AMOUNTS OF RENEWABLES AND STORAGE?

A. Yes. Sierra Club Witness Goggin's testimony, while perhaps helpful in understanding the general dynamics of renewables in the United States overall, does not address the challenges that a utility, and PNM in particular, has to meet to successfully integrate large quantities of renewable energy into its portfolio on a day-to-day and an hourly basis while meeting its BA reliability obligations.

Q. YOU MENTION THE SPECIFIC CHALLENGES THAT PNM HAS FACED. WHAT CHANGES IN THE PNM SYSTEM HAVE YOU SEEN

WITH THE INTRODUCTION OF MORE RENEWABLE ENERGY RESOURCES?

A. Renewable energy resources can provide low-cost energy to PNM customers and result in environmental benefits to the state. However, renewable resources, by nature of their attributes, are much more volatile than thermal resources and predicting their output is an imperfect science, particularly for wind. PNM Exhibit SLM-2 (Rebuttal) is an example of the significant changes that PNM can experience with the wind resources given PNM's balancing responsibility over an hourly period. It depicts an approximate 150 MW increase swing in less than 30 minutes, a subsequent reverse swing of approximately 125 MWs in less than 20 minutes, and lastly, a swing back up of approximately 100 MWs in the final 10 minutes of the hour. This depicts an average integrated wind value of approximately 222 MWhs.

Further, PNM has to plan for an additional 140MW of wind energy to come on-line in September of 2021. In order to manage these rapid fluctuations shown in the example, PNM operators need to ensure that they have enough spinning reserves or off-line, ready-to-start flexible resources to manage the down swing of 125+ MWs. They also must be able to mitigate the upswing as it occurs and either take units off-line or back down on-line resources (that have room to back down) to accommodate the wind as it ramps back up. To further illustrate the challenges, note that the Day Ahead projected wind output used for planning resources predicted an integrated average forecast of approximately only 44

MWhs for this particular hour in this example. As it turned out, the actual wind output was nearly five times the forecast amount.

Q. HAS THE INTRODUCTION OF MORE RENEWABLES CHANGED HOW YOU RELY ON OTHER PNM GENERATION RESOURCES?

A. Yes. As the percentage of renewables has increased in the PNM portfolio, there has been an increasing need for fast, flexible, firm capacity resources such as the LM6000 gas units. PNM's Scenario 1 will add significant renewable resources, including 350 MW of new solar, thus compounding the need for flexible resources. LM6000 resources are capable of starting and stopping in each hour, while also going from off-line to full load in ten minutes and then back down to minimum or off-line just as quickly. These assets provide the necessary flexibility to mitigate large swings caused by the variability of wind and solar as well as contingencies on PNM's larger thermal-based plants.

V. INTEGRATING BATTERY STORAGE INTO PNM'S PORTFOLIO

Q. PLEASE EXPLAIN PNM'S CURRENT EXPERIENCE WITH BATTERY STORAGE TECHNOLOGY AND ITS VALUE TO SUPPORT PNM's RELIABILITY OBLIGATIONS AS A BALANCING AUTHORITY.

A. PNM's experience with battery technology to date is limited to a small battery that provides less than 1 MW on the PNM grid. The battery is not dispatched in the same manner as the rest of the PNM resources. It is controlled electronically

based on a programmed algorithm that is set to simply charge and discharge. It provides no regulation functionality and is not dispatchable. This simplistic operating method does not support BA-related reliability obligations because it does not allow the system operator to dispatch in accordance with market or system reliability requirements. This nominal amount of battery storage, while useful as a learning tool, has not provided PNM a sufficient foundation to fully implement utility-scale battery storage.

Q. WHY IS ADDITIONAL EXPERIENCE SO IMPORTANT IF PNM ALREADY HAS EXPERIENCE IN PROGRAMMING AN INTEGRATED BATTERY AND CAN LOOK TO OTHER UTILITIES THAT ARE INTEGRATING LARGE-SCALE BATTERIES ON THEIR SYSTEMS?

A. PNM has much to learn in order to properly integrate and utilize large-scale batteries into the PNM grid. Additionally, PNM will need to understand how batteries should be operated to preserve the longevity of the asset without forcing serious damage on them or reducing their useful life due to suboptimal use. Programming the algorithms that allow a battery to do more than simply charge and discharge on a regular schedule and actually integrate the battery into the system to provide real-time support for variable renewable energy production is quite complex. PNM will have to establish protocols and strategies on how to cycle, charge, and discharge the battery banks by working with software developers who can help derive the algorithms necessary to integrate them effectively. It is also necessary to account for and to ensure proper use of the

cycling patterns enforced by the battery manufacturers and contractual terms of the applicable energy storage agreements. A controlled, well-thought-out transition, which includes reasonable limitations on the initial amount of battery capacity, is necessary to ensure that system reliability is protected while giving us time to learn, control, and optimize this new technology.

Q. SEVERAL INTERVENORS BELIEVE PNM SHOULD HAVE INCLUDED MORE BATTERY STORAGE IN ITS REPLACEMENT RESOURCES. HOW DO YOU SEE BATTERY INTEGRATION PROVIDING SUPPORT FOR PNM'S RELIABILITY REQUIREMENTS?

A. The current lithium-ion batteries available to the industry can provide short-term support for both meeting the volatility of increasing renewables, and for providing ancillary services such as frequency support, voltage support, spinning reserve requirements, and ramping capabilities. As I stated earlier, large-scale battery storage technology is new to PNM and there is much to learn. It would be unwise to start with such a large amount of batteries (as suggested by CCAE) so early on while the technology is still evolving. PNM's schedulers and traders will need time to learn how to integrate and utilize the batteries to ensure PNM fully optimizes the asset while also making sure the longevity of the assets is not harmed. In addition, there appear to have been battery failures in the industry (as described by PNM Witness Kemp) due to installation issues, material defects, and operational control interface issues. In this initial transition to significant incremental renewable resources, a total of approximately 130 MW of battery

storage, with each facility limited to 40 MW, is appropriate for a system of PNM's size.

Q. WILL THE PINON GAS PLANT AND THE 130 MW OF BATTERY STORAGE HELP PNM'S TRANSITION TO INTEGRATE NEW RENEWABLE RESOURCES AND ENSURE RELIABLE SERVICE?

A. Yes. The Pinon gas plant provides the longer duration support for the significant renewables that are being added to the system. The combination of gas and battery storage will greatly support PNM's integration of new incremental renewables while also adding to the pool of flexible resources needed to properly, effectively, and more economically handle the necessary NERC, WECC, and other regulatory requirements for our customers. Batteries may also assist with the flexibility resource requirements necessary during evening and morning peak hours, while also providing a tool to assist with storing excess solar and wind energy.

Q. IF THE COMMISSION WERE TO ADOPT THE ALTERNATIVE PROPOSALS TO REMOVE THE PINON GAS PLANT AND INSTEAD REQUIRE PNM TO ADD 450 MW OF BATTERY STORAGE TO THE SYSTEM (INSTEAD OF 130 MW), WITH BATTERIES AS LARGE AS 200 MW, WOULD YOUR RESPONSES TO THE PREVIOUS QUESTION BE DIFFERENT?

A. Yes. My concern would be suboptimal or inadvertent misuse of the battery technology could cause damage or shorten the life of the asset that ultimately could also create a reliability concern if the asset(s) were severely damaged. If PNM chose to take a more conservative approach in their use to protect batteries, it would potentially place the PNM system into a much more unreliable operating position and possibly violate multiple NERC, WECC, and other regulatory requirements.

Q. AS THE BALANCING AUTHORITY THAT IS REQUIRED TO MAINTAIN SYSTEM RELIABILITY, WHAT IS YOUR OPINION ON THE AMOUNT OF BATTERY INTEGRATION PROPOSED IN PNM'S SCENARIO 1?

A. I believe the introduction of 130 MW of total battery capacity and the 40 MW limit at any single location will allow PNM to prudently introduce batteries into the PNM portfolio. It will allow our operators (who are required to maintain system reliability) to understand how batteries interact with the system and how PNM can best operate this new resource type in conjunction with PNM's existing fleet to deliver reliable, low-cost energy to PNM customers. Furthermore, the first 70MW of fully controlled utility battery storage as called out in PNM's Scenario 1 provides a high value for ancillary services as required in NERC and WECC standards.

Q. DO YOU HAVE AN OPINION ABOUT THE BENEFITS OF HAVING SMALLER BATTERY FACILITIES SPREAD OVER A GEOGRAPHICALLY DIVERSE AREA?

A. Yes. From the perspective of system operations, it would be far better to have four small batteries than one large battery. A failure of a 40 MW battery would be much more manageable than a failure of a 400 MW battery. A good analogy here is with flexible gas units. The LMS 6000 is rated at 40 MW. Losing one or two LM6000s is much better for system operations and reliability than losing a battery bank that could be as large as 100 or 150MW.

Q. DO YOU HAVE CONCERNS WITH SIERRA CLUB WITNESS GOGGIN INDICATING THAT MODELING SUPPORTS SYSTEM OPERATION WITH ONLY BATTERY INSTALLATION AND NO GAS GENERATION ADDITIONS?

A. Yes. Models, while essential for planning, are not the real world. I would strongly encourage the Commission to err on the side of ensuring system reliability as PNM transitions to a 100% carbon-free grid. A rapid introduction of large amounts of batteries would cause our system operators to have great concern over maintaining system reliability with this unknown and untested resource in the PNM portfolio. While it appears that batteries will become a useful tool for meeting short-term transient conditions, batteries have a limited duration usage. Modern, flexible gas turbines can also provide the necessary quick response,

while also having the value of providing a longer duration energy source for a more reliable portfolio.

Q. IN HIS COMMENTS ABOUT SERVM MODELING, SIERRA CLUB WITNESS GOGGIN SUGGESTS THAT PNM THERMAL GENERATION DEVIATES FROM ITS SCHEDULED OUTPUT. IS THIS CORRECT?

A. No. PNM's thermal fleet has a winter rating and a summer rating to account for deviations on unit output due to ambient temperatures that derate their efficiencies. PNM routinely accommodates derates on units due to a number of reasons. There is no evidence to support a claim that thermal ratings deviate from their operating range.

Q. GIVEN THE CONCERNS YOU HAVE JUST DISCUSSED, DO YOU HAVE A RECOMMENDATION ON HOW NEW BATTERY RESOURCES SHOULD BE ADDED TO PNM'S PORTFOLIO?

A. The proposal laid out in PNM Scenario 1 is prudent from the perspective of system operations. Starting with significant but limited amounts of batteries (130 MW), while also installing smaller quick-start gas units will provide the needed flexible resources to manage the existing variability that PNM faces. These resources should also provide enough flexible reserves to absorb the anticipated additional 490 MW of solar and wind as the company heads toward retiring more fossil fuel assets. This will also provide time for the necessary learning curve to properly manage and leverage battery storage so that PNM's system operators can

develop training protocols and the algorithms for control and operation of the batteries. As PNM becomes more proficient in integrating incremental wind and solar into its generation portfolio, PNM can also add more batteries and renewable resources in future years to meet the combined 100% carbon-free mandate over time. PNM also needs time for the technology to be proven, tested, and new tools and software be created to assist with their implementation and integration. For many of these same reasons, there is a preference for utility-owned batteries at this stage of development. If new battery storage were provided via a power purchase agreement ("PPA"), PNM would not have the flexibility needed to accomplish the training and development that I have outlined here.

VI. RELIABILITY CONCERNS RELATED TO CARBON CAPTURE UTILIZATION AND STORAGE

Q. THE SAN JUAN ENTITIES ARE SUGGESTING THAT PNM DELAY PORTFOLIO CHANGES TO ALLOW FOR SUBSTITUTION OF A CARBON CAPTURE UTILIZATION AND STORAGE RETROFIT PPA. WOULD YOU HAVE CONCERNS ABOUT RELIABILTY IF CCUS WERE REQUIRED AS PART OF PNM'S REPLACEMENT RESOURCES?

A. Yes, I would. As I explained above, the new flexible LM6000 units proposed as part of Scenario 1 have important reliability benefits that are critical to supporting the additional renewable resources that are part of Scenario 1. CCUS is not as

dispatchable as an LM6000 resource. The operating characteristics of a possible CCUS resource at San Juan are entirely unknown at this time, so it is difficult to provide specific projections. However, as an example, if a PPA for the output of a CCUS plant were for a fixed flat amount of 280 MW of supply that would be unit-contingent, with a minimal dispatch range, the CCUS resource would not provide the flexibility needed in the PNM portfolio. Therefore, replacing the proposed LM6000 additions with CCUS would not provide the support that the system needs to integrate additional wind and solar power into PNM's portfolio. In fact, adding CCUS in place of flexible gas resources would likely cause a curtailment of both wind and solar generation. The proposed gas units that are part of Scenario 1 are not only quick-start, but they are modular, meaning we will be able to start or stop a single unit, or all of the units, as the system's needs dictate in order to serve load and balance variable energy resources. PNM Witness Phillips also discusses this in his Rebuttal Testimony.

VII. CONCLUSION

Q. PLEASE SUMMARIZE YOUR TESTIMONY.

A. From the perspective of a person who is charged with "keeping the lights on," my rebuttal testimony emphasizes the importance of maintaining reliability as PNM adds more renewable resources and battery storage technology as it transitions to a carbon-free future. I support PNM Scenario 1 as the most responsible means of replacing the resources at San Juan Units 1 and 4. I have also explained why some of the intervenors' alternative "no gas" proposals that rely heavily on new

renewables and new batteries are not prudent from the perspective of overall system reliability. PNM's more balanced approach to flexible resources that support renewable additions also leaves room for a greater integration of battery storage technology as PNM continues to transition its generation portfolio over the next several years.

Q. DOES THIS CONCLUDE YOUR TESTIMONY?

A. Yes, it does.

GCG#526586

Educational and Professional Summary of Steven L. Maestas

PNM Exhibit SLM-1 (Rebuttal)

Is contained in the following 2 pages.

STEVEN L. MAESTAS
EDUCATIONAL AND PROFESSIONAL SUMMARY

Name: Steven L. Maestas

Address: Public Service Company of New Mexico ("PNM")
2401 Aztec Rd. NE
Albuquerque, NM 87107

Position: Director, Wholesale Power Marketing

Education: B.S., Electrical Engineering, New Mexico State University, 1991

M.S., Electrical Engineering with Emphasis in Electrical Power Systems (Electrical Utility Management Program), New Mexico State University, 1992

Employment: Public Service Company of New Mexico since May 2007.
Positions held within PNM:

Director, Wholesale Power Marketing
Manager, Forward Power Trading

Arizona Public Service Company ("APS"), Phoenix AZ 1993 – May 2007.
Positions held while employed at APS include:

Portfolio Manager, Unregulated Trading Department
Portfolio Manager, Regulated Trading Department
Manager, Trading & Operations - Regulated & Unregulated
Sr. Transmission Trader
Term Trader
Sr. Short Term Trader
Short Term Trader
Electrical Engineer/Financial Engineer II/I

Testimony Filed:

- In the Matter of Public Service Company of New Mexico's Application for Approval of a Plan to Manage Fuel and Purchased Power Costs by Entering into Certain Forward Market Transaction, Case No. 09-00321-UT, filed August 20, 2009.

- In the Matter of the Application of Public Service Company of New Mexico for Continued Use of its Fuel and Purchased Power Adjustment Clause, Case No. 13-00187-UT, filed May 28, 2013.

- In the Matter of Public Service Company of New Mexico's Application for Continuation of a Plan to Manage Fuel and Purchased Power Costs by Entering into Certain Forward Market Transactions, Case No. 14-00190-UT, filed June 30, 2014.

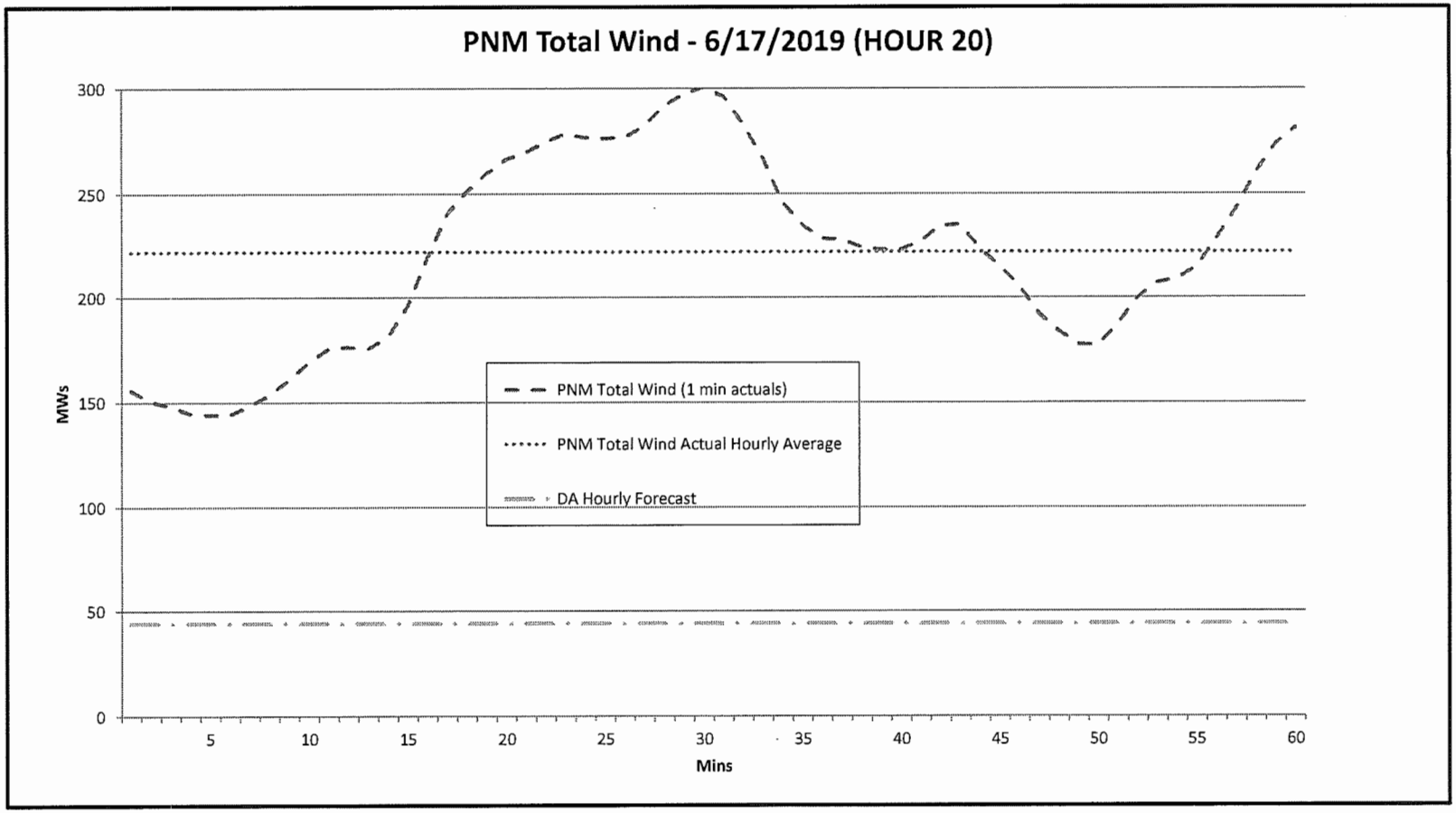
- In the Matter of the Application of Public Service Company of New Mexico for Approvals to enter into a Long-Term Hazard Sharing Agreement with Tri-State Generation and Transmission Association, Inc., Case No. 16-00315-UT, filed November 30, 2016.

- In the Matter of the Application of Public Service Company of New Mexico for Continued Use of its Fuel and Purchased Power Adjustment Clause, Case No. 18-00096-UT, filed April 23, 2018.

PNM Total Wind - 6/17/2019 (HOUR 20)

PNM Exhibit SLM-2 (Rebuttal)

Is contained in the following 1 page.



PNM Exhibit SLM-2 (Rebuttal)
Page 1 of 1

BEFORE THE NEW MEXICO PUBLIC REGULATION COMMISSION

IN THE MATTER OF PUBLIC SERVICE COMPANY OF NEW MEXICO'S CONSOLIDATED APPLICATION FOR APPROVALS FOR THE ABANDONMENT, FINANCING, AND RESOURCE REPLACEMENT FOR SAN JUAN GENERATING STATION PURSUANT TO THE ENERGY TRANSITION ACT	)	**Case No. 19-00195-UT**

AFFIDAVIT

STATE OF NEW MEXICO)
) ss
COUNTY OF BERNALILLO)

STEVEN L. MAESTAS, Director, Wholesale Power Marketing at Public Service Company of New Mexico, upon being duly sworn according to law, under oath, deposes and states: I have read the foregoing **Rebuttal Testimony of Steven L. Maestas** and it is true and accurate based on my own personal knowledge and belief.

SIGNED this 19th day of December 2019.

STEVEN L. MAESTAS

SUBSCRIBED AND SWORN to before me this 19th day of December 2019.

NOTARY PUBLIC IN AND FOR
THE STATE OF NEW MEXICO

My Commission Expires:

September 14, 2022