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

NICK WINTERMANTEL

January 13, 2020

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

REBUTTAL TESTIMONY
OF NICK WINTERMANTEL
NMPRC CASE NO. 19-00195-UT

I. INTRODUCTION

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is Nick Wintermantel, and my business address is Astrapé Consulting ("Astrapé"), 1935 Hoover Court, Hoover, Alabama, 35226.

Q. HAVE YOU PREVIOUSLY FILED TESTIMONY IN THIS CASE?

A. Yes, I submitted direct testimony on July 1, 2019 and direct errata testimony on September 20, 2019.

Q. PLEASE SUMMARIZE YOUR REBUTTAL TESTIMONY

A. My rebuttal testimony responds to testimony from the intervenors addressing Public Service Company of New Mexico's ("PNM" or "Company") SERVM modeling for this case. Specifically, I respond to testimony submitted by the Coalition for Clean Affordable Energy ("CCAE"), the Sierra Club, and Southwest Generation Operating Company, LLC ("SWG"). I make an effort to respond to all of the intervenors' testimony regarding SERVM. However, if I do not address a particular point by an intervenor in my rebuttal, it should not be construed as PNM's agreement with the intervenor on that point.

Q. WHAT BENEFITS DOES THE SERVM ANALYSIS PROVIDE PNM'S RESOURCE PLANNING ANALYSIS?

A. SERVM provides intra-hour modeling and the capability to determine reliability from a capacity and flexibility standpoint in addition to providing economics. With a growing level of renewable resources on PNM's system, it is important to calculate reliability based on chronological commitment and dispatch that also takes into account unit generator constraints and resource characteristics of the renewable fleet under a wide range of weather, load, and unit performance uncertainties. Analyzing only average conditions provides a limited indication of system reliability. By modeling intra-hour time steps, the SERVM modeling also captures the reliability and efficiency benefits of more flexible resources and the ramping needs caused by variable energy resources.

Q. AFTER REVIEWING THE DIRECT TESTIMONIES SUBMITTED BY INTERVENORS, DO YOU STILL SUPPORT PNM SCENARIO 1?

A. Yes. PNM Scenario 1 provides PNM's customers with the best mix of replacement resources to meet system reliability at a reasonable cost. PNM Scenario 1 makes use of the best in class resources across several technologies and provides additional diversity benefit to customers.

Q. IS THE PINON GAS PLANT AN ESSENTIAL ELEMENT OF PNM SCENARIO 1?

A. Yes. As shown in PNM Table NW-6 and NW-7 in my Direct Testimony, the Pinon Gas Plant was part of the optimal replacement portfolio in the SERVM model analysis regardless of whether any limitation was applied on batteries. The Pinon Gas Plant provides an economic capacity option to ensure reliability during periods of low renewable output and also provides flexibility to integrate future renewables.

Q. WILL PNM BE ABLE TO PROVIDE RELIABLE SERVICE AT A REASONABLE PRICE WITHOUT INCLUDING THE PINON GAS PLANT IN ITS REPLACEMENT RESOURCE PORTFOLIO?

A. I do not believe so. I disagree with the assertions to the contrary made by CCAE and Sierra Club witnesses. As I explain in greater detail later in my rebuttal testimony, CCAE witness Michael Milligan used flawed modeling assumptions in his analysis. Even with these flawed assumptions, PNM Scenario 1 is more reliable and lower-cost than CCAE's recommended portfolios. For its part, Sierra Club suggests several alternative replacement resource portfolios in Michael Goggin's direct testimony, but none of these portfolios are as economic as PNM Scenario 1 when taking into account reliability and technology risk.

II. RESPONSE TO CCAE'S DIRECT TESTIMONIES

Q. TO WHAT PORTIONS OF CCAE'S DIRECT TESTIMONIES ARE YOU RESPONDING?

A. I respond to Dr. Michael Milligan's Direct Testimony on behalf of CCAE that addresses CCAE's SERVM modeling inputs. I also respond to Dr. Milligan's criticism of SERVM's $LOLE_{FLEX}$ metric.

Q. WHAT RELIABILITY ASSUMPTIONS DID CCAE MAKE IN ITS SERVM ANALYSIS?

A. CCAE's modeling includes three substantial and unreasonable changes to the assumptions PNM used in its SERVM reliability analysis. These assumption changes are not reasonable for modeling purposes because they artificially improve system reliability across every replacement resource portfolio modeled by CCAE. CCAE's first unreasonable assumption is a decrease in the equivalent forced outage rate ("EFOR") for Four Corners Generating Station ("Four Corners") Units 4 and 5 from 20% to 8.9%.[1] The second is a change to the import limit modeling by increasing the import capability to a constant 300 MW from the 200 MW to 300 MW distribution modeled by Astrapé and the Company.[2] The third is a 42 MW increase in energy efficiency ("EE") and demand response ("DR") capability beyond what PNM is forecasting will be available in 2023.[3]

[1] Milligan Direct at 7-8.
[2] Milligan Direct at 6-7.
[3] Milligan Direct at 5-6.

Q. WHY IS CCAE'S ADJUSTMENT TO THE FOUR CORNERS UNITS 4 AND 5 EFOR FROM 20% TO 8.9% UNREASONABLE?

A. The 8.9% used by CCAE is unreasonable because it is based on a North American Electric Reliability Corporation ("NERC") average that does not reflect actual historical performance of Four Corners Units 4 and 5. As PNM witness Nicholas Phillips explains in more detail in his rebuttal testimony, PNM's 20% assumption is more appropriate for modeling purposes because it is based on a three-year historical average, from 2016 to 2018, of actual Four Corners' performance adjusted for known improvements. Four Corners Units 4 and 5 demonstrated an EFOR greater than 20% in each of these three years.

Q. WHAT ASSUMPTIONS REGARDING IMPORT LIMITS DURING PEAK LOAD PERIODS DID ASTRAPÉ MODEL?

A. Astrapé assumed that PNM could meet up to 15% of its peak load (300 MW / 2,000 MW peak) from neighboring systems to assist in avoiding loss of load events. Astrapé modeled the 300 MW maximum import limit during peak periods as a uniform distribution, which ranged from 200 MW – 300 MW when load was higher than 85% of the peak forecast. The values included in the distribution were 200 MW, 225 MW, 250 MW, 250 MW, 275 MW, and 300 MW. The SERVM model randomly drew from the distribution when load was higher than 85% of the forecasted peak load to limit opportunity purchases from external neighbors. For the majority of hours when loads were below 85%, the maximum

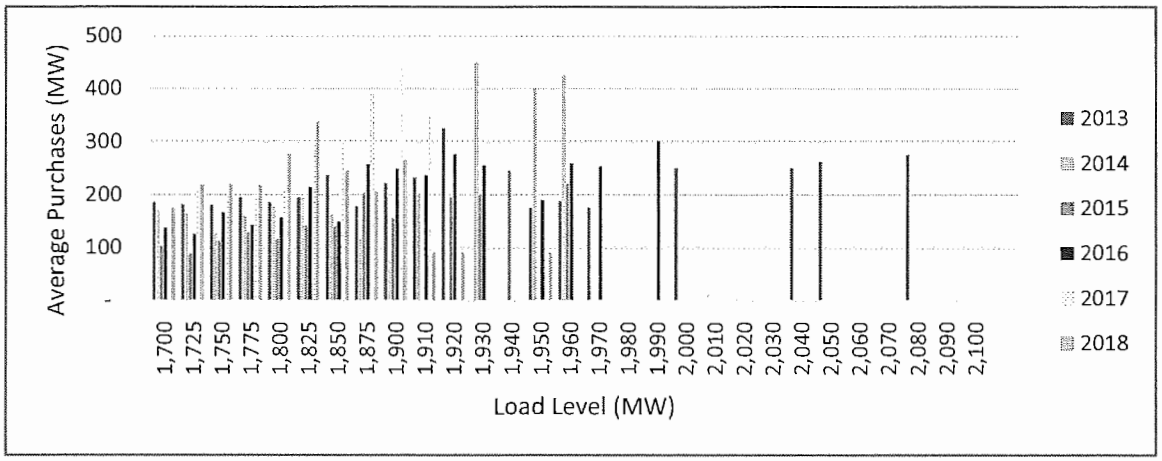
constraint was 5,000 MW, which essentially meant there was no constraint applied outside of the normal transmission topology.

PNM provided these modeling assumptions, and all other modeling assumptions supporting the SERVM analysis, to intervenors through discovery by providing intervenors access to the models themselves and by hosting informal modeling meetings for parties to ask PNM questions about the modeling software and assumptions.

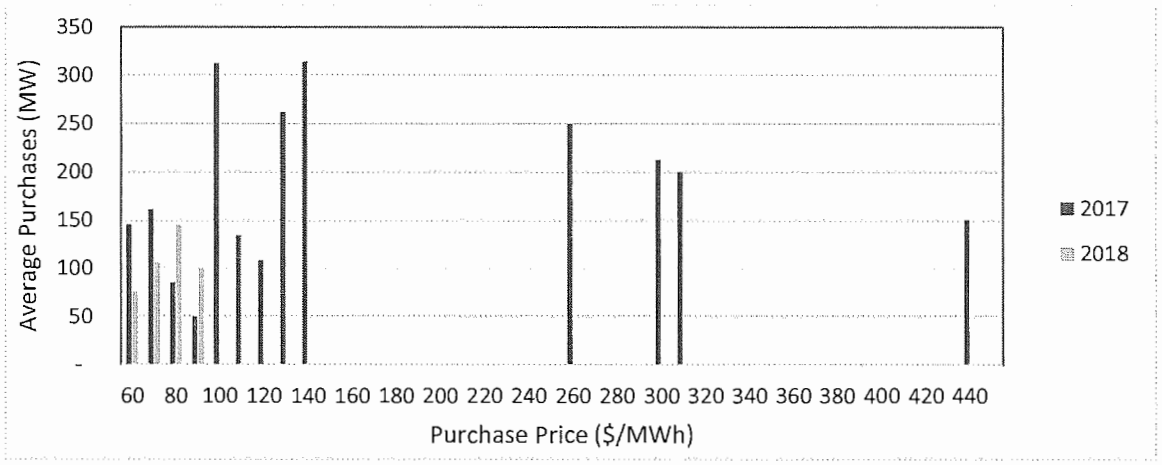
Q. WHAT IS YOUR RESPONSE TO CCAE'S CLAIM THAT A CONSTANT IMPORT LIMIT OF 300 MW SHOULD BE ASSUMED FOR ALL PEAK HOUR PURCHASES IN THE SERVM MODELING?

A. CCAE's assumption is unreasonable because it is not consistent with the historical data provided by PNM. The following two charts, which were provided to the parties in discovery, show historical market purchases during peak load hours and high market price hours. The historical data clearly shows that during peak periods PNM has not always purchased 300 MW. The historical data further shows it is reasonable to cap the maximum import capability during peak periods at 300 MW and capture a range of purchases from 200 MW to 300 MW as modeled in SERVM.

PNM Chart NW-1 (Rebuttal)



PNM Chart NW-2 (Rebuttal)



Q. PLEASE EXPLAIN FURTHER HOW ASTRAPÉ DERIVED THE IMPORT ASSUMPTION USED IN THE SERVM MODELING.

A. Astrapé reflected PNM's recommended transmission limit of 150 MW for day ahead purchases and up to 150 MW of hourly non-firm purchases for a maximum limit of up to 300 MW by modeling the transmission limit between 200 MW to 300 MW. The day ahead purchase capability was always included and the hourly

non-firm purchases were captured at 50 – 150 MW. This appropriately captures the stochastic nature of hourly real-time purchase capability as supported by PNM.

Q. IS THERE ANY GUARANTEE THAT PNM WILL BE ABLE TO RELY ON ANY AMOUNT OF EXTERNAL MARKET PURCHASES IN THE FUTURE?

A. No. As explained in greater detail by PNM Witness Steven Maestas, market purchases are not a reliable resource option to meet required NERC reliability standards because the availability and deliverability of power in the market is uncertain. Further, as also discussed by PNM Witness Maestas, market liquidity and depth has declined over time, providing further evidence around the uncertainty of future market purchase capability. While PNM is part of a larger interconnection and there is expected to be some market assistance benefit, PNM's surrounding utilities do not conduct planning in order to meet PNM's peak load and have no obligation to serve PNM's load. It is PNM's responsibility to plan for and maintain its own reliability as the Balancing Authority. While system operators make use of interconnections on a daily basis, there is no guarantee the capacity will be there during PNM's peak need.

Because of this uncertainty, Astrapé and PNM's modeling import assumption is, if anything, optimistic, as also discussed by PNM Witnesses Dorris and Maestas.

In any event, it would not be reasonable to increase the modeled import assumption as CCAE suggests.

Q. HAS ASTRAPÉ PERFORMED SENSITIVITY ANALYSES TO DETERMINE HOW IMPORT LIMIT ASSUMPTIONS IMPROVE RELIABLITY?

A. Yes. Astrapé performed a SERVM sensitivity that removed all market assistance in its reliability modeling to understand the impact. This sensitivity demonstrates that the market assistance assumptions utilized by PNM already greatly improve reliability. PNM's Scenario 1 $LOLE_{CAP}$ in 2023 increases from 0.17 events per year to 3.0 events per year if all external balancing authority assistance is removed from the modeling. While Astrapé does not believe it is appropriate to remove all market assistance, it is clear that the assumptions used by Astrapé already provide substantial market assistance benefit and should not be stretched further as CCAE recommends. Stretching these assumptions further would be irresponsible from a reliability planning perspective and increase risks for system operators within the PNM Balancing Area.

Q. HAS THE NORTH AMERICAN RELIABILITY CORPORATION ("NERC") CONDUCTED LONG TERM RELIABILITY ASSESSMENTS REGARDING ANTICIPATED RESERVE MARGINS IN THE SOUTHWEST REGION OF THE COUNTRY?

A. Yes. The 2019 NERC reports show reserve margins in the southwest region are currently at 20% and are expected to decrease to 16.8% by 2023 and 14.5% by 2024.[4]

Q. WHAT DO THESE DECREASES IN RESERVE MARGINS SUGGEST ABOUT PNM'S FUTURE PURCHASE CAPABILITY DURING PEAK LOAD PERIODS?

A. The lower reserve margins in 2023 for the southwest region suggest that market purchase capability in the future will be less than historical market purchase capability. With the expectation of lower reserve margins, PNM's modeled import limit, which reasonably corresponds to historical data, should not be increased.

Q. WHAT ENERGY EFFICIENT ("EE") AND DEMAND RESPONSE ("DR") ASSUMPTIONS DID CCAE MAKE IN ITS RELIABILITY MODELING?

A. CCAE modeled an incremental assumption of approximately 12 MW of EE and 31 MW of DR in its SERVM reliability modeling for 2023. These assumptions, which are discussed in detail by PNM Witness Phillips, artificially lower PNM's peak load by approximately 42 MW in the modeling and overstate reliability for every replacement resource combination.

[4] https://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/NERC_LTRA_2019.pdf at page 41.

Q. WOULD THE RESOURCE PORTFOLIOS PRESENTED BY CCAE BE RELIABLE WITHOUT MAKING CCAE'S UNREASONABLE CHANGES TO THREE KEY ASSUMPTIONS IN THE MODEL?

A. No. PNM obtained CCAE's modeling inputs in discovery. Using those inputs, Astrapé simulated the CCAE 1 Portfolio presented in the Direct Testimony of Anna Sommer with the original Four Corners EFOR assumption of 20%, the PNM forecasted EE and DR assumptions, and the import limit modeled as a distribution of 200 MW to 300 MW. With these original assumptions, the 2023 $LOLE_{CAP}$ of the CCAE 1 Portfolio increases from 0.14 events to 0.63 events per year. Under the original assumptions used by PNM, this 0.63 events per year for the CCAE 1 Portfolio compares to 0.17 events per year for PNM Scenario 1.

Q. ARE CCAE'S PORTFOLIOS AS ECONOMIC AS PNM SCENARIO 1?

A. No. In its direct testimonies, CCAE presented economic analysis performed only in EnCompass, and not in SERVM. Considering just the analysis from EnCompass and incorporating CCAE's flawed assumptions, PNM Scenario 1 is not only more reliable but also more economic than the replacement resource combinations CCAE developed. In order to ensure the CCAE portfolio is reliable, additional capacity must be added to the portfolio, which would increase CCAE's portfolio cost even further and make PNM Scenario 1 even more economical in comparison.

Q. TURNING NOW TO $LOLE_{FLEX}$, PLEASE EXPLAIN ITS BENEFITS AND WHY A FLEXIBILITY METRIC SUCH AS $LOLE_{FLEX}$ IS IMPORTANT FOR RELIABILITY PLANNING.

A. $LOLE_{FLEX}$, as developed by Astrapé, provides a reasonable means of comparing system flexibility across different portfolios. $LOLE_{FLEX}$ measures the electric system's ability to meet net load obligations in the next five minutes given perfect foresight. In other words, $LOLE_{FLEX}$ shows whether the system has enough flexibility to meet a known five-minute net load ramp. With the significant addition of variable energy resources on PNM's system, it is important that planners ensure the system has sufficient flexibility to meet reliability needs. As PNM adds more variable resources to its system over time, a metric such as $LOLE_{FLEX}$ will become increasingly important in resource planning. Mr. Phillips further explains the benefits of $LOLE_{FLEX}$ analysis in his rebuttal testimony.

Q. DO YOU AGREE WITH DR. MILLIGAN'S CRITIQUES OF $LOLE_{FLEX}$?

A. No. Dr. Milligan's critiques overstate the significance of $LOLE_{FLEX}$ in PNM's portfolio analysis. Each of the replacement portfolios PNM modeled with flexible gas or batteries can meet the $LOLE_{FLEX}$ of 0.2 events per year. In general, resource portfolios with quick start gas and/or storage units, such as PNM Scenario 1, can manage the unexpected ramps in variable energy resources in an efficient manner and demonstrate an $LOLE_{FLEX}$ of 0.2 events per year or better. The more binding reliability metric in PNM's analysis was $LOLE_{CAP}$; the PNM scenarios that do not provide adequate reliability fail because they do not meet the

$LOLE_{CAP}$ threshold of 0.2 events per year. $LOLE_{CAP}$ measures capacity shortfalls and meeting this criterion ensures PNM has sufficient capacity to meet peak demand periods during its first step under the Energy Transition Act.

In addition, Dr. Milligan draws an incorrect comparison between $LOLE_{FLEX}$, which is calculated in the SERVM planning tool with 5-minute ahead perfect foresight, with real time area control error ("ACE") deviations, which result from system operators constantly trying to balance net load on a second by second basis.[5] Real time ACE deviations will always be far greater in frequency and magnitude than $LOLE_{FLEX}$ violations as calculated in SERVM. Dr. Milligan acknowledged in discovery, in response to PNM interrogatory 1-16, that SERVM does not calculate ACE deviations. Accordingly, Dr. Milligan's comparison of ACE deviations with $LOLE_{FLEX}$ should be rejected.

III. RESPONSE TO SIERRA CLUB'S DIRECT TESTIMONY

Q. TO WHAT PORTIONS OF SIERRA CLUB WITNESS MICHAEL GOGGIN'S TESTIMONY ARE YOU RESPONDING?

A. I am responding to the following claims made by Sierra Club Witness Goggin:

- PNM did not account for how the energy imbalance market ("EIM") will reduce its flexibility requirements;[6]
- the 200 MW to 300 MW import limit is not reasonable;[7]

[5] Milligan Direct at 9-10.
[6] Goggin Direct at 21-22.

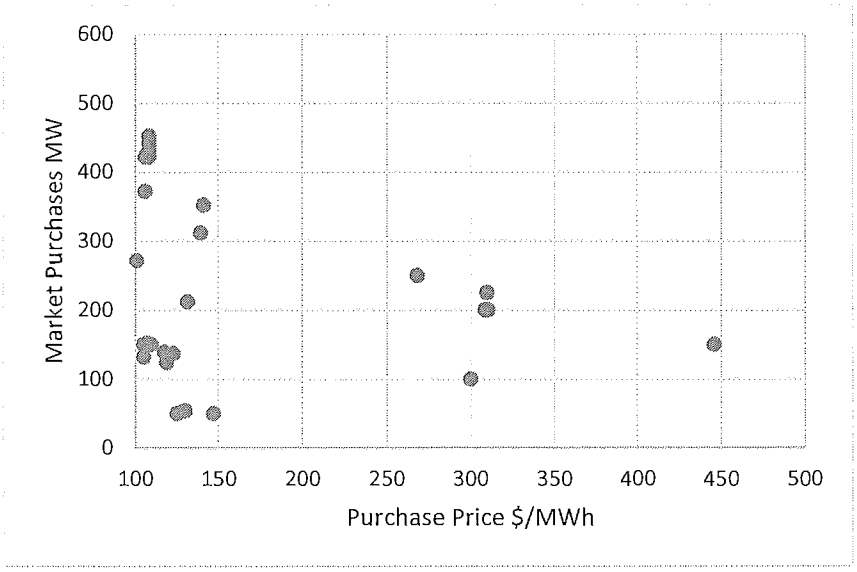
- PNM did not fully account for the impact of technology improvements in renewable generation profiles;[8]
- PNM did not account for conventional generators deviating from their scheduled output;[9]
- SERVM relied entirely on fast-acting spinning reserves and did not make use of non-spinning reserves to accommodate renewable variability;[10]
- "batteries appear not to have been fully valued because SERVM and other tools do not have sufficient chronological modeling resolution to recognize benefits of extremely fast response." Sierra Club Witness Goggin also claims PNM never considered grid charging on hybrid solar-storage modeling which could improve reliability;[11]
- PNM overstated the reliability of gas due to not modeling correlated gas outages;[12] and
- flexibility and capacity shortfalls modeled in SERVM will not necessarily result in loss of load events.[13]

[7] Goggin Direct at 24-26.
[8] Goggin Direct at 29-30.
[9] Goggin Direct at 30-31.
[10] Goggin Direct at 31.
[11] Goggin Direct at 35-37.
[12] Goggin Direct at 41-49.
[13] Goggin Direct at 39-41.

Q. PLEASE RESPOND TO MR. GOGGIN'S CLAIM THAT THE IMPORT LIMIT WAS TOO LOW.

A. As I explained above in my response to CCAE, Astrapé developed the import limit assumptions based on historical purchase data and PNM's recommendations. It is important that PNM not overstate market assistance in order to accurately model system reliability. Despite this, Sierra Club Witness Goggin quotes specific market purchase values greater than 300 MW during hours when demand was above 1,850 MW of load and market prices were above $100/MWh. However, the hours Mr. Goggin cites represent only seven hours across two days and are not representative of the historical data. The chart below, PNM Chart NW-3 (Rebuttal), shows all market prices above $100/MWh in the dataset provided by PNM in discovery. The chart provides further evidence that Astrapé's distribution of 200 MW – 300 MW is reasonable and, in fact, may be optimistic given the uncertainty of whether market purchases will be available in the future.

PNM Chart NW-3(Rebuttal)



Mr. Goggin also points to PJM's reliance on external neighbor assistance[14] in its modeling. PJM is a regional transmission organization ("RTO") that is part of the Eastern interconnection grid, and as the nation's largest RTO provides transmission service across thirteen states and the District of Columbia. In fact, PJM's modeling is very similar to PNM's own modeling because PJM limits market imports at 3,500 MW,[15] which is below the physical transmission capability and equal to 2.3% of the peak load (3,500 MW/150,000 MW). PJM uses the assumption during all hours in its modeling, not just during peak hours. As a result, PJM counts on substantially less external capacity as a percentage of

[14] Goggin Direct at 27.
[15] https://www.pjm.com/-/media/committees-groups/subcommittees/raas/20181004/20181004-pjm-reserve-requirement-study-draft-2018.ashx at 32

peak load (2.3%) in modeling than PNM, which counted on up to 15% of peak load (300 MW/2,000 MW).

Q. PLEASE RESPOND TO SIERRA CLUB WITNESS GOGGIN'S CRITIQUE OF PNM'S CONSIDERATION OF THE EIM IN ITS SERVM MODELING.

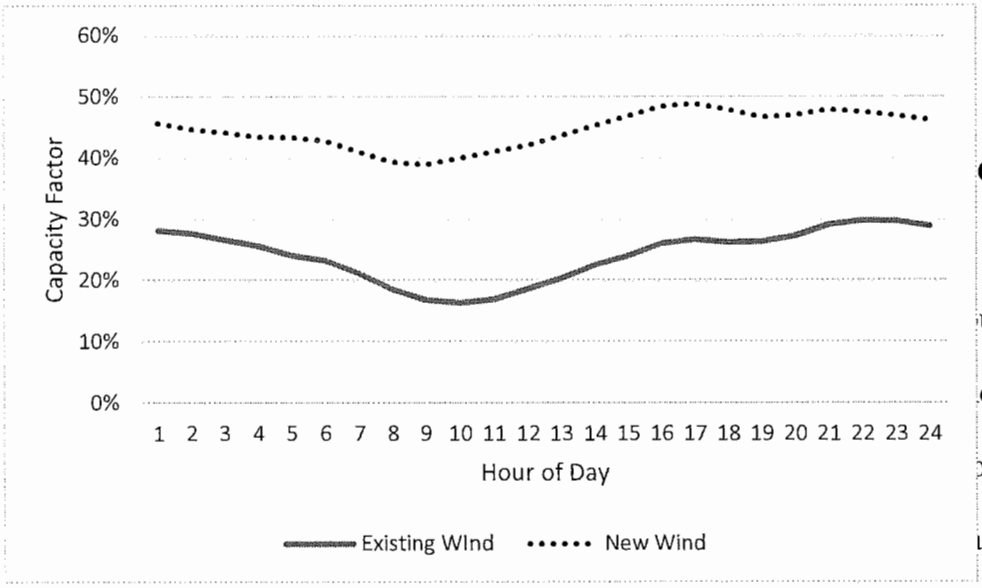
A. As discussed by PNM Witness Maestas in more detail, as a balancing authority PNM is responsible for supplying its own capacity to meet load, ramping and reserve requirements and will be prohibited from leaning on other EIM participants for capacity needs. Accordingly, Mr. Goggin's critique that PNM should have relied on the EIM for capacity in its modeling should be rejected.

As I discussed above, SERVM modeling extensively, and optimistically, captures market assistance and diversity benefits from PNM's interconnections with other utilities and sees a significant reduction in $LOLE_{CAP}$ as a result of these benefits. $LOLE_{CAP}$ is reduced from 3.0 events per year down to 0.17 events per year when the interconnections are modeled for PNM Scenario 1. From a flexibility standpoint, renewable curtailment is reduced by almost 50% by capturing the market assistance in SERVM.

Q. PLEASE RESPOND TO SIERRA CLUB WITNESS GOGGIN'S CRITIQUE OF RENEWABLE OUTPUT PATTERNS IN THE SERVM MODELING.

A. Sierra Club Witness Goggin provides no analysis to support his claim that the renewable patterns in SERVM do not take into account technological advancements. In fact, the following chart, PNM Chart NW-4 (Rebuttal), shows average wind shape based on the data provided by PNM to the parties in discovery for existing and new wind resources. The figure clearly shows that the hourly output for new wind resources is higher in all hours and that the relative outperformance is even more noticeable during lower wind output hours such as hours 8-12.

PNM Chart NW-4 (Rebuttal)



Q. **GIN'S**

A. unt for erators odeling ge and full outages, startup times, ramp rates, and minimum up and down times similar to what system operators would see in real time operations. Sierra Club Witness Goggin has supplied no evidence that PNM conventional generators significantly deviate from their scheduled output.

Further, after reviewing the material cited by Sierra Club Witness Goggin in his direct testimony, Astrapé found no additional evidence that dispatchable generation should be modeled with additional deviations. In fact, a portion of the PacificCorp study relied on by Witness Goggin stated the opposite:

> In the Regulation Reserve Study, resources that provide contingency or regulation reserve are considered a separate, dispatchable resource class. The dispatchable resource class compensates for deviations resulting from other users of the transmission system in all hours. While non-dispatchable resources may offset deviations in Loads and other resources in some hours, they are not in the control of the system operator and contribute to the overall requirement in other hours. Because the dispatchable resource class is a net provider rather than a user of regulation reserve service, its stand-alone regulation reserve requirement is zero (or negative), and its share of the system regulation reserve requirement is also zero.[16]

Q. PLEASE RESPOND TO SIERRA CLUB WITNESS GOGGIN'S CRITIQUE OF SERVM MODELING OF OPERATING RESERVES.

A. Sierra Club Witness Goggin's statement that "SERVM only appears to rely entirely on fast-acting spinning reserve to accommodate renewable variability" is inaccurate. SERVM fully optimizes around all attributes of generators to address net load variability including ramp rates, operating ranges, and capabilities to serve various ancillary services including regulating reserves, spinning reserves, and non-spinning reserves. During capacity constrained periods, spinning reserves and non-spinning reserves are foregone to ensure peak demand is met and reliability is maintained. Renewables are modeled as flexible in that the model curtails them during overgeneration periods.

[16] See PacifiCorp filing in FERC Docket ER17-219-000, at 7&8 *available at* https://elibrary.ferc.gov/idmws/common/OpenNat.asp?fileID=14386396

Q. PLEASE RESPOND TO SIERRA CLUB WITNESS GOGGIN'S CLAIM THAT SERVM DOES NOT CAPTURE THE FAST START CAPABILITY OF BATTERIES.

A. This claim is also incorrect. The SERVM model fully captures the fast start capability of batteries by allowing modeled batteries to shift from fully charging to dispatching instantaneously, with no constraints on the amount of cycles. Conventional resources are modeled accurately with proper constraints including minimum capability, ramp rates, minimum up and down times, start-up times, and full heat rate curves. SERVM's capability to model intra hour, system flexibility, and capture the value of energy storage were the primary reasons PNM performed additional modeling in SERVM to support the Encompass modeling effort.

Witness Goggin's critique that models should be at a lower resolution than five minutes should be rejected. The SERVM five-minute modeling is appropriate to capture the flexibility benefit of flexible resources, and I am not aware of any common resource planning modeling tool that is utilized at a lower resolution to model multiple years in the future.

Q. PLEASE RESPOND TO SIERRA CLUB WITNESS GOGGIN'S CLAIM THAT PNM DID NOT ALLOW GRID CHARGING FOR BATTERIES PAIRED WITH SOLAR.

A. In response to Mr. Goggin's Direct Testimony, Astrapé performed a sensitivity on PNM Scenario 3 to understand the impact of restricting the hybrid battery projects

to grid charging. In PNM Scenario 3, it is assumed that all charging of batteries in paired projects for the first five years must come from the associated solar. The sensitivity removed the charging restrictions on hybrid solar-battery projects in all hours, which would require the battery owner to forego all Investment Tax Credit benefit, and the $LOLE_{CAP}$ for 2023 only shifted modestly from 0.39 to 0.35 events per year. In this sensitivity, the resulting cost increases from the loss of tax credits would outweigh any potential benefit from this shift in the $LOLE_{CAP}$.

PNM witness Thomas Fallgren presents the energy storage agreements for the Jicarilla and Arroyo storage projects, which describe the allowed operation of the batteries, in his direct testimony.

Q. PLEASE RESPOND TO SIERRA CLUB WITNESS GOGGIN'S CRITIQUE OF CORRELATED GAS OUTAGES IN SERVM.

A. The correlated gas events that Sierra Club Witness Goggin references are rare and expected to occur in the winter peak demand periods[17] when PNM loads are lower than in the summer. All of the $LOLE_{CAP}$ in the SERVM modeling occurs during the summer months so it is unlikely that any additional risk in the winter modeling would increase $LOLE_{CAP}$. PNM Witness Phillips addresses the risk of correlated gas outages on PNM's system in more detail in his rebuttal testimony.

[17] Goggin at 41 ("During several recent winter peak demand periods, gas generators have been forced offline by fuel supply limitations or interruptions.")

More importantly, the data indicates correlated outages are a de minimis occurrence on PNM's system historically. I have reviewed the gas generator Generation Availability Data System data that Sierra Club Witness Goggin bases his correlated outage claims on. Sierra Club provided the data in discovery. It shows that only approximately twenty-five hours out of the last eight and half years showed a common mode failure occurred across multiple generator outages.[18] This represents only 0.03% of all the hours. I note there is a distinction between common mode failures and simply generators failing at the same time due to independent causes, and that the SERVM modeling already captures independent failures occurring across multiple units.

Q. SIERRA CLUB WITNESS GOGGIN CLAIMS THAT PNM INCORRECTLY ASSUMED THAT FLEXIBILITY OR CAPACITY SHORTFALLS WILL NECESSARILY RESULT IN LOSS OF LOAD EVENTS. HOW DO YOU RESPOND?

A. Mr. Goggin is incorrect. Contrary to his assertion, solutions such as external assistance and reducing operating reserves were utilized in the SERVM modeling to mitigate loss of load events. A loss of load event due to capacity shortages, defined as $LOLE_{CAP,}$ occurs only after exhausting all generating resources, including demand response resources, exhausting neighbor external assistance,

[18] Afton and Luna CCs are already modeled as single units in SERVM so common mode failures across the gas CT and ST portion of a combined cycle were not and should not be included in this analysis.

and foregoing all spinning and non-spinning reserves similar to real time operations.

Loss of load violations in the SERVM model caused by flexibility, defined as $LOLE_{FLEX}$, are mitigated by increasing online ramping capability within the unit commitment to reduce these events. Similar to $LOLE_{CAP}$ events, all generating resources including demand response resources, neighbor external assistance, and spinning and non-spinning reserves were utilized. As discussed above in my responses to CCAE Witness Milligan, $LOLE_{FLEX}$ as developed by Astrapé provides a means of comparing portfolios to ensure system flexibility is comparable across the different portfolios and was a metric that could be met by all portfolios that contained the addition of flexible gas or battery in each of the replacement resource portfolios.

IV. RESPONSE TO SWG'S DIRECT TESTIMONY

Q. WHAT IS YOUR RESPONSE TO SWG WITNESS BABCOCK'S CLAIM THAT SERVM DOES NOT CONSIDER REACTIVE POWER FLOW, VOLTAGE SAGS OR VOLTAGE SPIKES, SYSTEM INERTIA, OR SYSTEM FREQUENCY AND PHASE ANGLE?[19]

A. Capacity expansion and production cost models such as the EnCompass, PowerSimm, and SERVM models are not designed to examine reactive power

[19] Babcock Direct at 21-22.

flow, voltage sags/spikes, system inertia, or system frequency and phase angle. As explained by PNM Witness Thomas Duane, the assessment of these items is accounted for in the transmission system impact studies that are performed before interconnecting generation facilities to the transmission system.

Q. WHAT IS YOUR RESPONSE TO SWG WITNESS BABCOCK'S CLAIM THAT ASTRAPÉ'S RESULTS SHOW THAT A REPLACEMENT PORTFOLIO WITH NO NEW GAS IS COMPETITIVE (WITHIN $25-115 MILLION) AND AS RELIABLE AS PNM'S SCENARIO 1?[20]

A. The only no gas replacement portfolios mentioned by SWG Witness Babcock are portfolios that did not adhere to the appropriate battery levels applied by PNM, which assumed battery project sizes no greater than 40 MW and a total battery capacity of 130 MW. These no gas replacement portfolios contain batteries that are 150 MW and greater. However, even without applying the battery limitation, these no gas portfolios are more expensive than PNM Scenario 1. As described in my Direct Testimony, if PNM's battery limitations are not applied, then the SERVM modeling identifies Tier 2-2 as the optimal portfolio which still contains 231 MW of gas, 170 MW of battery, and 350 MW solar. No party in this preceding to my knowledge has identified a portfolio that is both reliable and less expensive than PNM Scenario 1 and also adheres to the battery levels applied by PNM.

[20] Babcock Direct at 56-63.

Q. WHAT IS YOUR RESPONSE TO SWG WITNESS BABCOCK'S CLAIM THAT ASTRAPÉ IMPOSED UNREASONABLE BATTERY CONSTRAINTS IN ITS MODELING?[21]

A. PNM Witnesses Kemp, Maestas and Fallgren have provided testimony supporting PNM's appropriate level of initial battery storage. As discussed above, Astrapé's analysis shows that even without battery limitations applied, the Pinon Gas Plant should be part of the replacement resource portfolio to provide reliability and the least cost replacement portfolio for customers. As demonstrated in PNM Exhibit NW-2 to my Direct Testimony, the optimal level of initial battery deployment supported in the SERVM unconstrained battery analysis was 150MW - 170 MW. The results of incorporating the 40 MW project size limitation was an economical introduction of battery storage at 130 MW total, which aligns with PNM Witness Kemp's recommendation regarding limiting battery capacity to not more than 130 MW or approximately 5% of peak load (based on the Balancing Area load).

V. CONCLUSION

Q. PLEASE SUMMARIZE THE CONCLUSIONS YOU HAVE REACHED IN RESPONSE TO INTERVENOR TESTIMONIES.

A. SERVM complements the other modeling tools supporting PNM's Consolidated Application by providing important intra-hour modeling and the capability to determine reliability from a capacity and flexibility standpoint in addition to

[21] Babcock Direct at 53-55.

providing economics. PNM's SERVM modeling assumptions were based on available historical data and are reasonable for modeling purposes The SERVM modeling in this case based on those assumptions demonstrates that PNM Scenario 1 provides the best balance of economic and reliable resources that will place PNM firmly on the path toward achieving a carbon free portfolio consistent with the Energy Transition Act. The changes to and criticisms of the SERVM modeling assumptions by intervenors are unsupported by data and facts. Those changes and assumptions made by intervenors lead to unreliable and more expensive alternative portfolios than PNM's Scenario 1.

Q. DOES THIS CONCLUDE YOUR REBUTTAL TESTIMONY?

A. Yes, it does.

GCG#526584

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 ALABAMA)
) ss
COUNTY OF JEFFERSON)

NICK WINTERMANTEL, Principal, Astrape Consulting, upon being duly sworn according to law, under oath, deposes and states: I have read the foregoing **Rebuttal Testimony of Nick Wintermantel** and it is true and accurate based on my own personal knowledge and belief.

SIGNED this 20 day of December, 2019.

NICK WINTERMANTEL

SUBSCRIBED AND SWORN to before me this 20 day of December, 2019.

NOTARY PUBLIC IN AND FOR
THE STATE OF ALABAMA

My Commission Expires:

5/31/22

STATE OF ALABAMA NOTARY PUBLIC

TAYLOR KNOX
My Commission Expires
May 31, 2022