BEFORE THE NEW MEXICO PUBLIC REGULATION COMMISSION

IN THE MATTER OF PUBLIC SERVICE COMPANY OF NEW MEXICO'S APPLICATION FOR A CERTIFICATE OF PUBLIC CONVENIENCE AND NECCESITY TO PURCHASE, OWN, AND OPERATE TWELVE MEGAWATTS OF BATTERY STORAGE FACILITIES	)	**Case No. 23-00162- UT**
PUBLIC SERVICE COMPANY OF NEW MEXICO,	)	
Applicant	)	

DIRECT TESTIMONY

OF

OMNI WARNER

May 3, 2023

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OMNI WARNER

WITNESS FOR
PUBLIC SERVICE COMPANY OF NEW MEXICO

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I. INTRODUCTION AND PURPOSE

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

A. My name is Omni Warner. I am the Director of Distribution Engineering for Public Service Company of New Mexico ("PNM"). In this role, I am primarily responsible for PNM's Distribution Engineering services, which includes distribution system planning, new service delivery, distribution standards, distribution design, and other technical aspects of the distribution system. My office address is 4201 Edith Blvd. NE, Albuquerque, New Mexico 87107.

Q. HAVE YOU PREPARED A STATEMENT OF YOUR QUALIFICATIONS?

A. Yes. My Statement of Qualifications is attached as PNM Exhibit OW-1.

Q. HAVE YOU PREVIOUSLY FILED TESTIMONY IN COMMISSION PROCEEDINGS?

A. Yes, I filed testimony and testified in support of PNM's grid modernization application in Case No. 22-00058-UT.

Q. WHAT IS PNM REQUESTING IN THIS CASE?

A. PNM is seeking a certificate of public convenience and necessity ("CCN") for 12 MW of battery energy storage systems ("BESS") consisting of two 6 MW, 4-hour Lithium Iron Phosphate ("LFP") batteries on two PNM-controlled solar photovoltaic ("PV") sites (hereinafter the "BESS Project"). The BESS Project will be located on PNM's distribution system. Distributed energy storage systems of the size proposed offer system-wide grid benefits, can improve service quality at the distribution level, and are a quick and flexible solution to increase the effective hosting capacity for distributed generation ("DG") on PNM's distribution feeders. Twenty feeders are already hosting DG facilities (mostly solar), that in the aggregate, exceed circuit capacity. As a result, PNM is currently unable to accommodate additional solar DG connections on these feeders. Additionally, these feeders are operating at increasing levels of risk where the overcapacity of connected solar DG may negatively impact the quality (voltage) of power delivered to other customers or cause thermal overloads that could lead to failed equipment and power outages.

Q. WHERE DOES PNM PROPOSE TO DEPLOY BESS AS PART OF THIS APPLICATION?

A. PNM proposes to locate the BESS Project at two locations as described below. These two locations are outside of any municipal limit.

South Coors 12 Feeder – A 6 MW BESS of four-hour storage duration located adjacent to the South Valley Solar site. There are currently 59 pending solar interconnections (391 kW total) on hold because this feeder is currently overcapacity.

Tome 12 Feeder – A 6 MW BESS of four-hour duration located adjacent to the Rio Del Oro Solar site. There are currently 28 pending solar interconnections (165 kW total) on hold due to this feeder currently being overcapacity.

The BESS Project will increase the effective hosting capacity of these feeders and defer the need for distribution feeder construction to accommodate growing PV interconnections and customer load requirements.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?

A. My testimony supports the technical need for the BESS Project and confirms that the project meets the criteria for a CCN listed in Section 62-9-1(D)(1), (3), (4), (6), and (7) of the Public Utility Act ("PUA"). To that end, I describe PNM's distribution feeders and the current situation and risks where these feeders are at overcapacity. I address the various solutions PNM can deploy to unlock more hosting capacity for DG while maintaining safe operations and explain why the BESS Project is an important step in expanding the options to meet this DG need. My testimony describes the direct and indirect benefits of the BESS Project on PNM's system. Finally, I discuss the opportunity for the BESS solution to modernize PNM's ability to deliver reliable and safe energy while also enabling more DG integration to support a future carbon-free system.

II. HOSTING CAPACITY OF THE PNM DISTRIBUTION SYSTEM

Q. WHAT IS AN ELECTRIC UTILITY DISTRIBUTION FEEDER?

A. Traditional distribution lines, or feeders, transmit electrical power from a distribution substation to a customer's point of connection. Distribution feeders can be constructed overhead or underground and are generally comprised of electrical components such as breakers, relays, underground cable or overhead conductor, poles, reclosers, switchgear, voltage regulators, capacitors, switches, fuses, and load servicing transformers.

Q. DO DISTRIBUTION FEEDERS HAVE STANDARDS AND LIMITATIONS ON HOW MUCH ENERGY THEY CAN DELIVER?

A. Yes. Distribution feeders must be able to deliver energy produced (supply) to serve energy demand (load). Feeder capacities are determined by how much energy can flow through equipment and conductors while maintaining parameters set by national standards (e.g., American National Standards Institute or "ANSI") and equipment specifications. This is necessary for both the system and customer equipment to function properly. A PNM distribution feeder's hosting capacity is defined by the maximum peak power flow the feeder equipment can handle without risking impact to the power quality delivered to customers or risking equipment failure. The capacity of the two distribution feeders (South Coors 12 and Tome 12) covered in this application happen to both be 8.359 MW. However, the capacity among feeders can vary based on a number of factors.

Voltage limits are established to ensure customer-owned equipment functions properly and safely. Customer and utility equipment can fail if the system exceeds the standard voltage for prolonged periods of time. Adherence to voltage limits is required by ANSI standards and is important for the maintenance and protection of equipment and appliances used by our customers as well as utility equipment on the distribution system. When the distribution feeder operates within its target voltage range, the distribution feeder equipment and customer equipment will perform in conformity with product standards throughout the voltage range.

Distribution feeders also have an ampere (amp) rating which sets the maximum amount of current that can safely flow through these feeders. Heat is produced as energy (current) flows through conductors, cables, breakers, switches, and devices. As current increases, the distribution feeder risks approaching thermal limits established by design criteria and equipment ratings (conductor, cable, breakers, switches, etc.). Exceeding these thermal limits can degrade equipment leading to failure. In the electric industry, a general reference to a feeder rating usually refers to the feeder's thermal rating.

Q. HOW DOES DG INCREASE FEEDER CAPACITY RISKS FOR PNM?

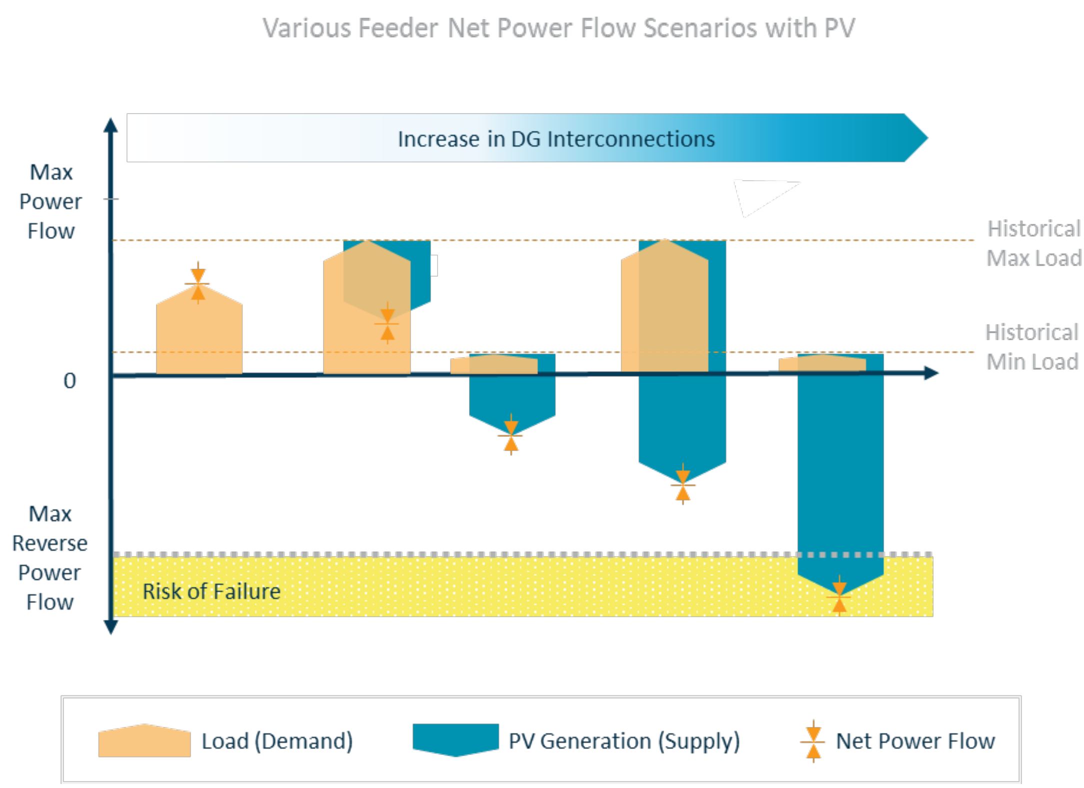
A. Traditionally, feeders deliver power in one direction, from substations to the connected customers. DG, including ground-mount and rooftop solar interconnected to distribution feeders, inject intermittent energy on the system that can exceed local loads. That additional energy can exceed load significantly and drive reverse power flow to magnitudes beyond equipment ratings and safety limits. Each distribution feeder must be sized so that energy flow in either direction, at any point in time, does not exceed the capacity of its equipment (conductor, insulators, breakers, etc.). When net load or generated energy capacity exceed equipment ratings, the components of the feeder begin to deteriorate and negatively impact the quality (voltage) of power delivered to other customers and can cause thermal overloads that could lead to failed equipment and power outages. PNM refers to this as "Solar Saturation" which is the maximum DG capacity allowed to safely operate on the system without changes to infrastructure.

A recent National Renewable Energy Laboratory ("NREL") publication on PV hosting capacity explains that "The fast deployment of distributed solar photovoltaics (PV) stretches the electric grid toward limitations and creates operational concerns for utilities."[1] PNM Figure OW-1 below shows different

[1] Wang, Wenbo, Daniel Thom, et.al. 2022. PV Hosting Capacity Estimation: Experiences with Scalable Framework; Preprint. Golden, CO: National Renewable Energy Laboratory. NREL/CP-6A40-81851. https://www.nrel.gov/docs/fy22osti/81851.pdf.

scenarios where a feeder's load can be counterbalanced by PV generation. As more DG is interconnected, the energy supplied back into the grid continues to approach safety limits (feeder rating). If load happens to drop during maximum PV output, the net energy can potentially exceed the safety limit (feeder rating).

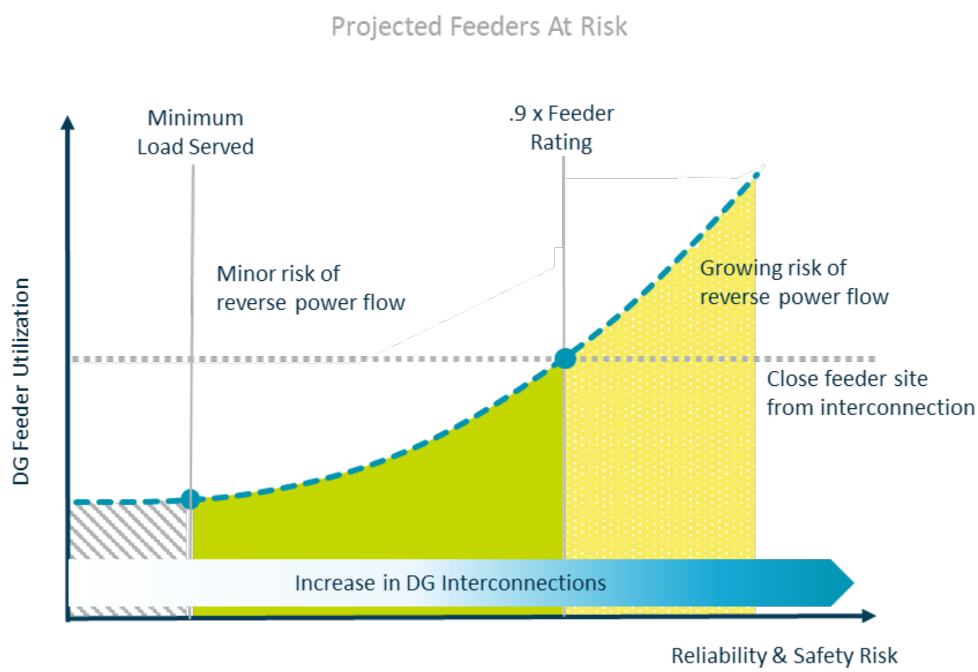
PNM Figure OW-1



Q. DO YOU HAVE AN ILLUSTRATION OF HOW INCREASED DG ON A DISTRIBUTION FEEDER IMPACTS THE SYSTEM?

A. Yes. PNM Figure OW-2 below demonstrates how a distribution feeder operates with increasing risk of failure as it hosts additional DG capacity. As more feeders exceed their existing hosting capacity limits, PNM must take strategic action to maintain and continue safe operations while continuing to accommodate DG facilities, especially those supported by programs like New Mexico's Community Solar program. An additional 125 MW of solar DG are expected to be added to the PNM distribution system during the initial phase of implementation of the Community Solar Rule.

PNM Figure OW-2



Q. HOW DOES PNM ENSURE NEW DG INTERCONNECTIONS DO NOT NEGATIVELY IMPACT THE GRID?

A. PNM follows NMPRC Rule 17.9.568 NMAC to screen and safely interconnect DG that is no greater than 10 MW to the distribution system. Before connecting DG to the electric grid, PNM conducts a preliminary evaluation to determine the availability of capacity on the feeder to ensure that the amount of DG does not exceed the rated capacity of the feeder. Depending on size and location, Rule 568 provides for simplified and fast track screening of smaller facilities, while larger (greater than 5 MW and up to 10 MW) DG resources require more extensive interconnection studies and modeling to determine if a feeder can safely host energy exported from the proposed site. The study assesses the impacts that the DG might produce on the thermal rating of the feeder and if the DG might cause high voltage on the feeder. The list of applications or requests in this process are known as "interconnection queues" and are evaluated on a "first come, first served" basis.

Q. HOW DOES PNM DETERMINE IF A PROPOSED DG INTERCONNECTION MAY LEAD TO SOLAR SATURATION?

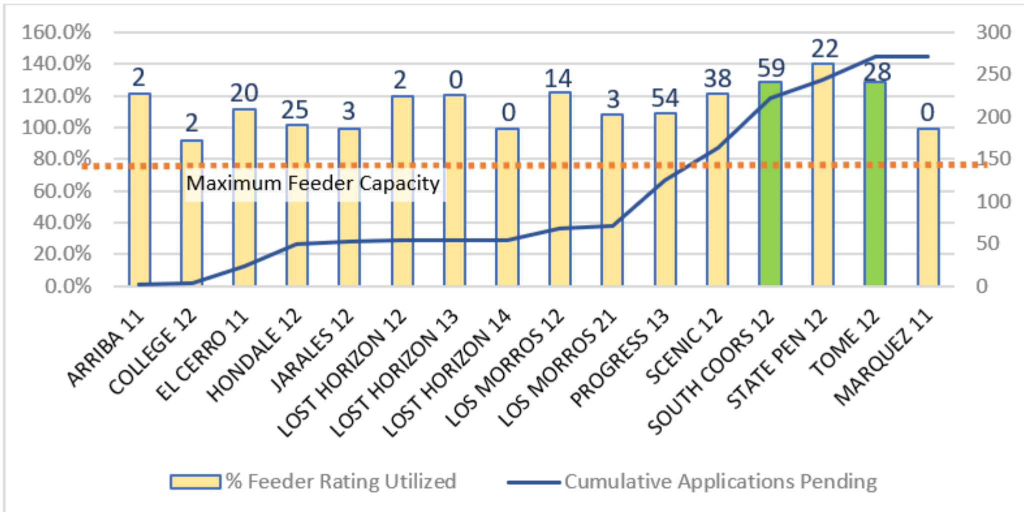
A. PNM considers feeders with an aggregated interconnected DG nameplate capacity equal to 90% or greater of the feeder rating to be near Solar Saturation. Solar Saturation presents a risk that the reverse power flow from interconnected DG can exceed safety limits if load is low while solar output is high. As feeders reach Solar Saturation, no additional solar PV can be safely interconnected to the feeder and any requests to interconnect on that feeder are placed on hold until system improvements are completed. PNM engineers then determine the scope and cost of necessary upgrades to the feeder to accommodate additional DG safely and reliably, if possible. This estimate is then provided back to the requester as an additional cost to complete the interconnection. The time required to follow this process varies based on the size and location of the generator. Sometimes, the generators/customers must consider whether to: 1) pay for the necessary grid upgrades; 2) downsize the proposed generator system to eliminate risk of load violations and reduce interconnection costs; or 3) install controls to limit the amount of energy from the DG system that can be exported to the grid to eliminate risks. These choices can result in further delays, and customers may instead choose to withdraw their interconnection applications.

Q. DOES PNM ALREADY HAVE FEEDERS WITH AGGREGATE DG CONNECTED NEAR OR EXCEEDING SOLAR SATURATION?

A. Yes. Currently there are 20 distribution feeders that are at or near maximum solar DG capacity. PNM Figure OW-3 below summarizes 16 feeders that are currently at or above capacity. Some are operating at risk of failure, especially if more generating capacity is interconnected. Many of these feeders have additional pending interconnection applications (quantity shown by blue numbers above the bars) that are on hold until more feeder capacity is added.

PNM Figure OW-3

Feeders Exceeding At-Capacity Limit & Corresponding Applications on Hold



Based on known interconnection requests pending in the queue, the highlighted feeders at above capacity have the potential for interconnection of 2.6 MW of additional solar production. These distribution feeders likely cannot accommodate Community Solar projects without system improvements.

III. POTENTIAL SOLUTIONS TO RELIEVE FEEDER SOLAR SATURATION

Q. WHAT OPTIONS DOES PNM HAVE TO RELIEVE SOLAR SATURATION AND ENABLE ADDITIONAL DG TO INTERCONNECT TO THESE FEEDERS?

A. Potential solutions to the distribution feeder capacity issues include:

(1) constructing a dedicated feeder to connect certain solar facilities directly back to substations;

(2) upgrading the overall power capacity of existing distribution feeders and substations;

(3) installing control devices on solar DG that can curtail generation at times of potential overload; or

(4) installing energy storage systems that can absorb excess generation from solar DG and store the energy until it can safely be delivered.

Q. PLEASE DESCRIBE THESE POTENTIAL SOLUTIONS.

A. The potential solutions are described in further detail as follows:

Dedicated Feeder - The first option includes constructing dedicated feeders to connect certain solar sites directly to the nearest distribution substation. This solution requires land easements, construction of a new dedicated conductor along with structures, and in many cases requires substation upgrades or expansions to source a new feeder. The acquisition, permitting and construction activities can be cumbersome, have impacts on local communities, and are typically time consuming and expensive, especially when substation upgrades are needed. This option is a traditional "wires" solution.

Upgrade Feeder - Upgrading an existing feeder to enable it to support higher energy capacity also involves significant resources and cost due to the needed removal and installation of replacement line transformers, switchgear, breakers, new conductor, structures, and substation upgrades. This option requires disruptions in service to customers at periods of time during the process, resulting in customer inconvenience. This will also result in PNM needing to establish new engineering design standards for high-capacity line design and construction, creating ripple effects throughout operations and supply chains. This represents a non-traditional “wires” solution.

Curtailment Controls - The third option involves establishing control capabilities on the solar sites that temporarily limit the generation output when a distribution feeder would otherwise experience excess power flow or non-compliant voltage. This process is known as curtailment. To equitably control the production to keep power flow on the feeder within design limits this option would require deploying controls to each solar production site, both the larger solar sites as well as residential and commercial DG. Solar curtailment would require establishing or revising special agreements with solar DG sites and owners\customers. While this solution can prevent stress on the feeders, it would result in limiting solar DG production under curtailment conditions and reduce the value of the DG.

Battery Energy Storage - The fourth option, installation of BESS, offers a flexible mitigation solution that involves utility-controlled storage connected to the feeders that can absorb excess solar production and then discharge that stored energy later when the system can use it safely. BESS, deployed and directed in this way, can avoid or defer the more cumbersome, expensive and disruptive construction options described above. Installing BESS on feeders with high amounts of connected solar will increase hosting capacity and eliminate the need to curtail solar energy production to protect the safety and reliability of the distribution system. BESS can be installed relatively quickly and incrementally, as needed. BESS can enable full solar utilization and has the potential to provide future ancillary grid functions. BESS is the most cost-effective solution taking into account the multiple functions that it performs and the system benefits that it provides.

Q. IS THE BESS PROJECT THE MOST COST EFFECTIVE AMONG FEASIBLE ALTERNATIVES AS REQUIRED UNDER SECTION 62-9-1(D)(7)?

A. Yes. Considering the value of BESS identified in this testimony as well as those outlined in the testimony of PNM witness Jones, BESS is the most cost-effective for the functions that it is performing and the benefits that it is providing. This is the only feasible alternative that provides a timely resolution for PNM's overloaded distribution feeders. PNM Table OW-1 below summarizes the benefits of each of the alternatives available to PNM to resolve constraints from existing Solar Saturation on distribution feeders.

PNM Table OW-1

		PNM Solution Options			
Project Value	Definition	Option 1 - Deploy 6 MW of BESS at Each of Two Solar Sites	Option 2 - Add Dedicated Feeders to Two Solar Sites	Option 3 - Upgrade both Feeders to Higher Capacity	Remarks
Project Cost:	Cost to implement the solution including planning, design, construction, commission	$25.8 M	~$23 M	$30 - 50 M	Option 2 is similar cost to Option 1 but does not provide the following added benefits.
Time to Implement:	Length of time to implement the solution from inception to energization	< 1 year	1-2 years	2-4 years	Option 1 facilitated by construction on existing site with existing infrastructure.
Project Risks:	Timing and uncertainty of obtaining construction permits and rights of way	Low	Moderate	High	Option 1 facilitated by construction on existing site with existing infrastructure.
Operational Risk:	Current risk to the safe and reliable operation of the distribution feeder	Low	Low	Moderate	Option 1 &2 involve limited interface with / outage for distribution feeder.
Add Resource Capacity:	Ability to meet generation requirements at peak customer load hours across system	Yes	No	No	Option 1 adds resource capacity while others do not.
System Capacity:	Accommodate additional renewable resources without curtailment	>$8 kW - month $18M in offsets over 20 yrs	Adds local capacity only	Adds local capacity only	Option 1 benefits system in total while Options 2 & 3 benefit local area only.
Energy Arbitrage:	Store low-cost excess electricity to serve customers later to avoid high prices	Yes, up to $500,000 in offsets per year	No	No	Option 1 better utilizes available system renewable energy.
Voltage Regulation:	Provides fast energy responses to prevent voltage fluctuations	Yes	No	No	Option 1 offers ancillary services while other options do not.
Frequency Regulation:	Provides fast energy responses to prevent frequency fluctuations	Yes	No	No	Option 1 offers ancillary services while other options do not.
Renewable Curtailment Reduction:	Reduce need to curtail during generation over supply	Avoidance of ~75,000 MWhr over 20 yrs	NA	NA	Option 1 better delivers renewable energy during peak demand periods.
Operational Flexibility:	Ability to flexibly manage power flows to meet evolving grid operational needs	Yes	No	No	Option 1 offers ancillary services and contingency reserves - other options do not.
Reduce Carbon Emissions:	Reduce emissions by maximizing renewables and avoiding fossil fuel peak generators	Reduction of ~70,000 tons of CO2 over 20 yrs	No	No	Option 1 offsets fossil fueled generation while other options do not.
		Highest Net Value			

Q. HOW WILL PNM APPLY BESS SOLUTIONS ACROSS ITS SYSTEM?

A. BESS will be evaluated by PNM on a case-by-case basis to affordably maintain safe and reliable grid operation while maximizing the use of available renewable energy from distributed resources. Curtailment will be a solution of last resort to avoid impairing the supply of renewable energy. BESS can provide multiple risk mitigation benefits arising from high penetration of solar DG on feeders and fully optimize the existing feeder infrastructure. Dedicated feeders can be an expensive option that does not balance generation and load on the same feeder. Upgrading feeders to increase the overall capabilities of PNM's distribution system for the long-term will increase its ability to connect growing distributed renewable energy for existing and future load growth.

In each situation, PNM will assess overload risk and determine which solution(s) is best suited to meet customer needs through a balanced evaluation of costs, timing, urgency, benefits, and impact to customers.

Q. DOES PNM HAVE EXPERIENCE DEPLOYING, OPERATING AND MAINTAINING ENERGY STORAGE SYSTEMS, PARTICULARLY BATTERIES?

A. Yes. PNM has deployed a BESS solution in the past but not for this specific application. The PNM Prosperity Energy Storage Project, in partnership with the U.S. Department of Energy, Sandia National Laboratories, the University of New Mexico, Northern New Mexico College and Ecoult/East Penn Manufacturing (the battery maker), implemented the nation's first solar storage facility fully integrated into a utility power grid. This project uses smart grid technology to advance renewable energy. The knowledge gained from this project has allowed PNM to plan for other parts of PNM's system, including the BESS Project. In addition to the Prosperity Energy Storage Project (commissioned in 2011), PNM is under contract to add the Jicarilla Storage project (20 MW) in the Jicarilla Apache Nation, and the Arroyo Storage project (150 MW) in McKinley County in 2023.

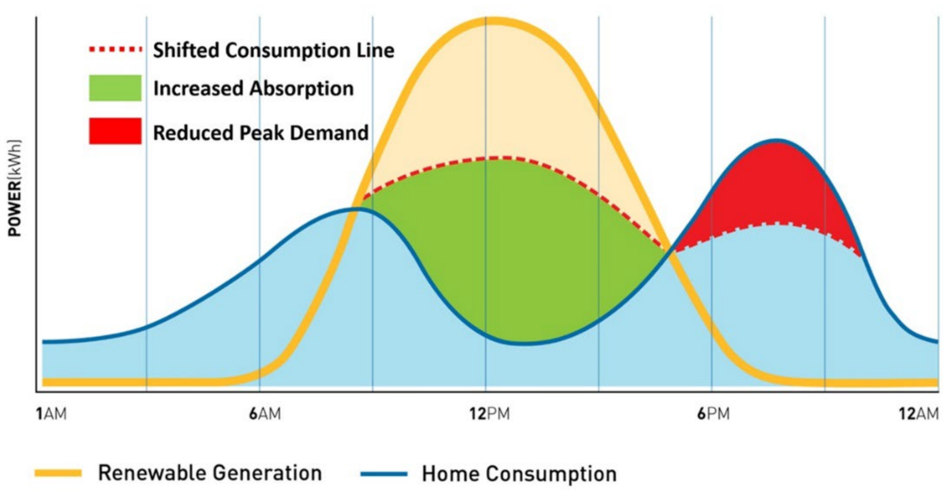
These previously mentioned BESS projects serve different primary use cases than the BESS Project in this proceeding. The use of BESS to manage interconnected solar DG risk on the distribution system is a new use case that can be scaled across PNM's operations and practices for future grid planning and design. The BESS Project is a new endeavor for PNM and a fundamental first step in PNM's solution for maintaining an increasingly decentralized and multi-directional grid in a safe, reliable, and resilient manner.

Q. HOW DOES BESS MITIGATE SOLAR SATURATION RISK ON THE DISTRIBUTION SYSTEM?

A. BESS provides a dispatchable resource that can help balance supply and demand on the grid, especially when controlled by the utility based on the utility's knowledge of how power is flowing on the feeder (load, production, and storage). PNM intends to establish this model to help manage hosting capacity constraints across its distribution system to further enable a carbon-free grid by maximizing the production and use of distributed renewable energy safely and reliably.

PNM Figure OW-4 below illustrates the flexibility that BESS can provide in addressing PNM's hosting capacity constraints. In most cases, this will involve absorbing energy from solar DG not currently needed to serve load and discharging the energy for customer use later in the day. BESS also provides an additional method to help maintain voltage and thermal limits within design parameters. The balance of energy between the solar facility and BESS can also be coordinated to enhance the overall performance and reliability to the customers across the system as this renewable energy is maximized to serve the full PNM customer community.

PNM Figure OW-4[2]



With BESS on the distribution system, PNM will have the ability to absorb excess renewable energy (with minimal losses) and use that energy for all customers when needed - creating less strain on the system, allowing for enhanced safety and more reliable operations. BESS will also aid in maximizing the value and utilization of

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[2] Source: https://aurora-power.co.uk/battery-energy-storage-systems-power-arbitrage/

carbon-free energy from existing and future solar sites to help enable a carbon-free grid for PNM customers.

Q. HAS PNM PERFORMED OR ENLISTED ANY CONSULTANTS TO STUDY DISTRIBUTION LEVEL STORAGE?

A. Yes. PNM enlisted the support of Burns & McDonnell Engineering Co. ("Burns & McDonnel") to assist PNM with the study and evaluation of the effectiveness of various energy storage deployment approaches within PNM's service territories. PNM witness Lucas McIntosh of Burns & McDonnell provides supporting testimony to describe this study in more detail and discusses the broader industry context for applying energy storage to the electric distribution system.

Q. WHY WAS BURNS & MCDONNELL SELECTED BY PNM AND WHAT ASSISTANCE DID IT PROVIDE?

A. Burns & McDonnell was selected based on their demonstrated expertise in BESS projects and system studies involving integration of modern technologies, including BESS. Through the study, Burns & McDonnell helped PNM screen and evaluate potential battery co-location opportunities, including evaluation of existing PV sites identified by PNM and estimating the associated distribution feeder and substation impacts. Burns & McDonnell also helped explore additional potential use cases for storage across multiple sites through operational simulation and preliminary economic analysis to further assess sizing, configuration, and operational strategies of potential storage systems interconnected to PNM's distribution system. The Burns & McDonnell analyses were leveraged to develop strategic plans and siting locations for securing storage capacity as a solution to alleviate constraints on PNM's system.

The Burns & McDonnell study helped target the minimum size BESS, assumed to be located in the vicinity of the solar resources, expected to yield targeted improvements to solar DG hosting capacities. For example, PNM Figure LM-1 in the Direct Testimony of PNM witness McIntosh shows an analysis of the South Coors 12 feeder located adjacent to the South Valley Solar site. For this 8.359 MW rated feeder, a BESS of 5 MW and 4-hour duration or greater was estimated to be sufficient to bring the number of hours of interconnected solar generation to zero – meaning a 5 MW battery or greater should manage to keep voltage and thermal impact below the circuit constraints given current solar DG hosted. The battery size of 6 MW was selected based on vendor availability, minimum sizing to increase hosting capacity, and BESS capacity to account for degradation and future DG interconnections.

Q. HOW WERE THE FEEDER LOCATIONS FOR THE BESS PROJECT SELECTED?

A. Four main factors were considered to determine the two selected feeders and sites: (1) Both of the selected feeders ranked among the highest in percentage DG interconnection over-capacity relative to feeder ratings and are among the highest in pending interconnection applications. These hosting capacity constraints inhibit customers from incorporating additional DG and delays PNM's strategy to integrate more DG resources on the system to support a carbon-free grid that is reliable and safe.

PNM Table OW-2 below details the customer type and count served on each feeder.

PNM Table OW-2

Feeder	Residential Customers	Commercial Customers	Total Customers
South Coors 12	2668	154	2822
Tome 12	1752	85	1837

(2) Both feeders support a comparable economic case to deploy BESS relative to the deferred cost of necessary infrastructure upgrade investments.

(3) An Integrated Capacity Analysis was performed by applying PNM's criteria to calculate the hosting capacity on each feeder, then scored based on hosting capacity enablement with the addition of various sizes of BESS.

(4) Both feeders also underwent technical feasibility studies to ensure minimal negative impact of integrating a BESS to the feeder. PNM Table OW-3 below summarizes key characteristics and estimates for these two feeders and proposed BESS deployments.

PNM Table OW-3

Feeder Name	Solar DG Hosted	BESS Size	Pending Interconnect (kW)	Est. BESS Install Cost	Est. Deferred Cost of T&D Investments
South Coors 12	129.6%	6 MW / 24 MWH	391 kW	$12,900,000	$9,5000,000
Tome 12	128.7%	6 MW / 24 MWH	165 kW	$12,900,000	$12,0000,000

Q. **WILL THE BESS PROJECT RELIEVE FEEDER THERMAL AND OVERVOLTAGE ISSUES?**

A. Yes. The BESS Project will be operated to bring the voltage and thermal issues into the operational rating of the feeders.

Q. **WILL THE BESS PROJECT INCREASE HOSTING CAPACITY AND ENABLE CURRENT DG INTERCONNECTION APPLICATIONS ON HOLD TO INTERCONNECT**?

A. Yes, the BESS Project will increase the hosting capacity on the distribution feeders as demonstrated in the Burns & McDonnell analysis. As the BESS Project is installed and configured to bring the feeders within safety and reliability standards, PNM will leverage the knowledge from the BESS operation to assess hosting capacity on the feeders to evaluate the additional solar interconnection requests. PNM will iteratively conduct hosting capacity analyses on the feeders to determine and help assure the safe and reliable operation of the feeders with increased DG interconnections.

IV. PROPOSED BESS PROJECT

Q. DOES PNM INTEND TO OWN AND OPERATE THE BESS PROJECT?

A. Yes. PNM intends to own and operate the BESS Project. BESS deployed onto PNM's distribution system to serve this function is expected to become a core component of PNM's strategy and mandate to operate and maintain a safe and reliable network while accommodating growing solar DG. This technology and the use case described for addressing feeder capacity risks will become a normal component of PNM's system planning and will be critical to providing affordable service to our customers while enabling PNM to facilitate the transition towards a cleaner and more advanced and decentralized system. PNM ownership of the BESS facility will allow full control and monitoring of the feeder, load, production, and storage to maximize use and benefit as well as feeder safety.

Q. WHY IS UTILITY OWNERSHIP OF DISTRIBTION SYSTEM BESS PREFERABLE TO THIRD-PARTY OWNERSHIP FOR PNM'S CUSTOMERS?

A. By owning and operating the BESS facility, PNM will ensure the distribution system is managed to support the stability of PNM's distribution network. Direct monitoring and control of storage capacity and feeders will maintain safety and quality of power flows around the clock. Additionally, PNM believes that battery storage will be a standard option to be considered in the ordinary course of managing electric service to customers and can continue to improve its practices for owning and operating BESS at scale for optimal system planning and design across other areas of PNM's network. PNM can also leverage additional ancillary services as they evolve and as needed for the electric grid. Utility ownership allows the flexibility to expand the use case and benefits to the overall system performance. Conversely, contracts with third-party owners can restrict the operation of batteries for ancillary services and fix operational parameters at time of contract execution, with little or no future flexibility. It is also worth noting that these installations are located on PNM-owned and operated locations that have existing interconnections allowing for rapid installation of these BESS solutions.

In addition, PNM ownership of the BESS Project will allow the utility full control over the safety protocols and installation requirements that maximize safe operation as further described below, as well as the ability to work closely with the community on the siting and aesthetics of the BESS installation.

Q. IS UTILITY OWNERSHIP OF THE BESS PROJECT CONSISTENT WITH THE CCN STANDARDS UNDER SECTION 62-9-1(D)(6) FOR APPROVAL OF ENERGY STORAGE SYSTEMS?

A. Yes. Based on my understanding of the CCN standards applicable to energy storage systems. Under Section 62-9-1(D)(6) one of the standards for approval is that the proposed energy storage system project "provide the public utility with the discretion, subject to applicable laws and rules, to operate, maintain and control energy storage systems so as to ensure reliable and efficient service to customers." As discussed above, PNM's ownership of the BESS Project will ensure this criterion for approval is satisfied.

Q. WILL DISTRIBUTED BESS BE APPLIED SOLELY TO ADDRESS SOLAR SATURATION CONSTRAINTS?

A. No. While BESS can build a buffer into the system in the form of on-demand load capacity and responsive balancing capabilities, its role in grid planning and operations is expected to evolve. As more information is collected and industry adapts BESS to other system applications, the approaches and scenarios for deploying these flexible solutions will evolve and mature. PNM posits that the deployment of BESS can be applied to other grid management objectives. These include the following:

System Resiliency - The traditional single directional flow of the distribution electrical system makes it vulnerable to the threat of major natural disasters or extreme weather events. BESS could help reduce customer impacts from unexpected blackouts and surges if configured correctly as a potential, but limited, backup power supply. BESS could provide emergency electrical supply for all or portions of a feeder to ensure that critical emergency functions or facilities have power, including schools, hospitals, police and fire stations, and communications networks. Additional steps would need to be taken to configure BESS and the feeder to accomplish this objective.

Energy Supply Capacity – As traditional fossil fuel power plants shut down and load evolves, distributed BESS may serve as broader system supply capacity to help mitigate regional and temporary misalignment of load and supply capabilities through traditional transmission systems.

Ancillary Services – Historically performed by fossil fuel generating resources, BESS can help ensure that the electrical grid is functioning properly by providing frequency regulation, voltage control (coupled with volt-VAR initiatives referenced in PNM's grid modernization plan), spinning reserves, and load-following services with less marginal costs and less environmental impact than traditional generation.

Bulk System Planning - PNM envisions integration of BESS to play a major role in supporting bulk energy system planning. Aggregating energy storage and pairing BESS with the transmission grid could provide synergies to help with congestion relief, voltage support, regulation, and several other applications that are important to maintaining the safe, consistent operation of PNM's bulk electric grid.

Energy Equity – Batteries can help support PNM's objectives to enable underserved communities to access clean and affordable energy. By shifting stored electricity to manage costs when electricity is more expensive (during peak hours), and unlocking additional capacity for community solar projects, these communities can gain access to renewable energy without exposure to dramatic upfront costs.

Q. HOW WILL PNM ENSURE OPTIMAL DEPLOYMENT OF THE BESS PROJECT?

A. PNM's BESS Project deployment will balance technical optimization for reducing capacity risk, increasing system flexibility, and building in more resiliency while also ensuring alignment with community expectations for acceptance. Technical location siting of BESS Project connects storage close to the electric load, minimizing system losses, while improving power quality and voltage support. Additionally, optimal siting can help expedite the permitting process and allow for non-disruptive operations during normal maintenance or end-of-life management practices including recycling and decommissioning. While BESS projects can be sited with the primary intent to address feeder capacity risk, siting location can also enable other use cases as described previously.

Q. HAS PNM CONSIDERED ANY ENVIROMENTAL JUSTICE IMPLICATIONS OF THE BESS PROJECT?

A. Yes. PNM performed an initial Environmental Justice ("EJ") review using EPA's EJScreen, an EPA mapping and screening tool, of both sites planned for the BESS Project and there were no EJ findings that would trigger any significant mitigation recommendations. One reason there are no significant recommendations that result from the EJ screening process is because these BESS Projects are co-located on existing 10 MW solar generation sites with grid interconnection facilities and no general expansion of either site is required.

Based on the data from the EPA's EJScreen, data evaluation and a field review, the 1-mile radius around the South Valley Solar site is an area that meets thresholds for four of 10 environmental justice review criteria: (1) minority community; (2) lowincome community; (3) English as a second language; and (4) education level. These findings will guide PNM's communication efforts about the project in the local community. At minimum, such communications will be conducted in English and in Spanish.

For the Rio Del Oro site, there is only one household, consisting of five persons, within a 1-mile radius. PNM will notify the household of the project plans and construction activities.

Q. HOW WILL PNM MITIGATE THE IMPACTS TO THE SURROUNDING COMMUNITIES FROM THE BESS PROJECT?

A. PNM is taking a proactive approach to minimize disruption and impact to the communities near the BESS Project locations. To that end, PNM will consider: potential undergrounding of on-site utility lines; maintaining the site free of unwanted vegetation; following noise, height, and setback requirements; fencing or enclosing the site; and installing screening or other measures to minimize visibility impacts.

Significant mitigations measures will include:

- A 10-foot buffer surrounding the BESS Project installations will be cleared of combustible vegetation. Beyond this buffer, it is preferable to maintain any vegetation that provides aesthetic value to the community.
- Noise produced by the BESS and associated equipment will be kept below a 1-hour average of 60 A-weighted decibels (dBA), based on measurements taken at the outside wall of any nearby unaffiliated building that is currently in use. Any setback requirements for primary structures in applicable zoning regulations will be applied to the BESS Project installations.
- Any building height limits in applicable zoning regulations will be applied to the BESS Project installations. Unless secured within a dedicated-use building, all BESS components and mechanical equipment will be protected by a 7-foot-high fence with a self-locking gate. The BESS Project installations will be screened from adjacent properties using architectural features, earth berms, landscaping, or other methods that complement the character of the area without compromising BESS ventilation.

Q. HOW WILL PNM ENSURE THE BESS DEPLOYMENT WILL BE SAFE?

A. The potential for thermal, weather, environmental, and other operational hazards vary significantly depending on the type of BESS technology that is selected. PNM has chosen Powin Energy, LLC ("Powin") as its turnkey BESS software and hardware provider for these initial deployments. With over a decade of energy storage experience, Powin has built over 2,500 MWh of BESS and has an awarded and contracted pipeline to supply over 10,000 MWh of BESS globally over the next five years. With over 500,000 hours of incident-free operations, Powin has developed a proven track record of safe, reliable hardware operations in the field.

PNM will implement the project to meet national codes and standards promulgated by the National Fire Protection Association, ANSI, the Institute of Electrical and Electronics Engineers and national laboratory standards. A safety plan will include: hazard detection systems; means of protecting against incipient fires; and ventilation and/or cooling strategies for protecting against thermal runaway, fires, and explosions. As a corollary, training will be provided to local responders so that they are equipped to recognize and handle any of these potential emergencies—which require substantially different firefighting tactics—as safely as possible. The BESS Project will also include plans to address extreme weather, earthquakes, or other environmental threats that may occur.

PNM will also follow the state and county requirements for building, fire and zoning codes in addition to taking additional safety measures for extra assurance, including: Hazard Detection Systems, Thermal Runaway Prevention, Compliance Electrical Components, Ground Fault Detection, Ventilation, Deflagration Venting System, Remote Monitoring (including extreme weather and hazards), and Resiliency Protection.

PNM Witness Jones also addresses safety considerations and measures in his testimony.

Q. DOES PNM ANTICIPATE THAT THE ADDITION OF BESS AT THE DISTRIBUTION FEEDER LEVEL WILL BE PART OF THE ORDINARY COURSE OF BUSINESS TO ADDRESS TYPICAL DISTRIBUTION SYSTEM CONSTRAINTS GOING FORWARD?

A. Yes. As I explain above, where distribution feeders are at or above maximum capacity, the system requires localized expansion in the ordinary course of serving customers within PNM's existing service areas. Battery additions can be a reasonable and swift alternative to upgrading the feeders and substations PNM normally constructs to address distribution line constraints. Additionally, batteries are likely to have overall fewer physical impacts on nearby customers and communities.

Q. HOW DOES PNM PLAN TO DESIGN, PROCURE, INTEGRATE, AND OPERATE BESS SOLUTIONS MOVING FORWARD?

A. PNM expects BESS and future storage technologies on utility distributions systems to become more common and the associated equipment will be deployed, operated, and maintained by the utility as a part of its distribution system, like power transformers, switchgear, reclosers, voltage regulators, and other such equipment.

Future deployments of distribution system BESS will be coordinated by the following:

Planning: Planners will be trained to identify the circumstances and criteria under which to apply BESS accurately and appropriately to maintain safe operations of the grid.

Design: Standard designs for balance of facility, interconnection, and control equipment will be established and followed for all installations to increase consistency, familiarity, spare part efficiency, and safety. PNM will employ quality BESS equipment to ensure reliability and safety for employees and customers.

Procurement: Relationships with vendors and product models (more than one for supply resiliency) will be established to ensure consistent and reliable supply of assemblies for installation and components for maintenance.

Operations: A standard communication and control protocol will be established for all BESS sites deployed to serve hosting capacity expansion purposes.

Maintenance: Inspections and regular maintenance protocols for all BESS distribution system assets will be established and carried out by specialized maintenance teams who will likely be dedicated to these types of assets due to the specificity of the required training.

V. PUBLIC INTEREST AND CCN CRITERIA

Q. HOW DOES THE BESS PROJECT SERVE THE PUBLIC INTEREST?

A. The proposed BESS Project in this case will address feeder overloads and well-documented constraints on two distribution feeders, thereby enhancing both safety and reliability on PNM's system. In the absence of the BESS Project, PNM would need to undertake one of the other solutions described above, none of which provide the same level of benefits or flexibility as the BESS Project. Nor can any of these other solutions be implemented as promptly as the BESS Project.

More generally, energy storage is a critical component of the modern carbon-free energy grid. BESS connected to utility distribution feeders increases hosting capacity and provides a controllable, dispatchable resource that allows optimal utilization of solar DG installations. The use of BESS at the distribution system level can be expanded to other distribution feeders to match the production of solar to provide a dispatchable/controllable resource necessary for the safe and reliable operation of the electric grid.

Q. WILL THE BESS PROJECT HELP TO REDUCE COSTS TO PNM'S CUSTOMERS BY AVOIDING OR DEFERRING THE NEED FOR INVESTMENT IN NEW GENERATION OR FOR UPGRADES TO SYSTEMS FOR THE TRANSMISSION AND DISTRIBUTION OF ENERGY AS REQUIRED UNDER SECTION 62-9-1(D)(1) OF THE PUA?

A. Yes. The BESS Project installations are going to be co-located with existing solar facilities can be installed in a relatively short time frame, and do not require the same geographical needs and planning associated with the construction of new feeders and substations. The existing solar sites are established, have available secured land, there are existing interconnection contracts in place, and key infrastructure is already installed to provide a timely benefit to increase hosting capacity, defer transmission or distribution investments, and increase reliability and resiliency for customers**.** And the BESS Project will provide generation grid benefits through shifting of energy from the high solar production hours to peak demand times when solar production is minimal on these distribution feeders.

Q. WILL THE BESS PROJECT ASSIST IN ENSURING GRID RELIABILITY, INCLUDING TRANSMISSION AND DISTRIBUTION SYSTEM STABILITY, WHILE INTEGRATING SOURCES OF RENEWABLE ENERGY INTO THE GRID AS REQUIRED UNDER SECTION 62-9-1(D)(3) OF THE PUA?

A. Yes. The BESS Project offers extremely flexible and responsive capacity to the distribution system and potentially back feed into the transmission system. With the ability to start and reach full discharge capacity (reflecting a system generator) or full charging capacity (reflecting a system load) within seconds it provides very favorable ancillary service capabilities to facilitate grid reliability and system stability. Ancillary service capabilities that can be provided include contingency reserves, regulation (up and down), voltage control, and frequency response, among others. All these services facilitate the increased integration of variable, renewable energy resources. As explained earlier in my testimony, BESS also provides a dispatchable resource that can help manage hosting capacity constraints, unlocking the ability to interconnect additional DG on feeders at solar saturation.

Q. WILL THE BESS PROJECT SUPPORT DIVERSIFICATION OF ENERGY RESOURCES AND ENHANCE GRID SECURITY AS REQUIRED UNDER SECTION 62-9-1(D)(4) OF THE PUA?

A. Yes. The BESS project will increase hosting capacity on the distribution feeders safely allowing additional customer-owned DG interconnections to the feeders. The nature of customer sited DG is a diversification of energy resources on the system.

Q. WILL THE BESS PROJECT PROVIDE PNM WITH THE DISCRETION, SUBJECT TO APPLICABLE LAWS AND RULES, TO OPERATE, MAINTAIN AND CONTROL ENERGY STORAGE SYSTEMS SO AS TO ENSURE RELIABLE AND EFFICIENT SERVICE TO CUSTOMERS AS REQUIRED BY SECTION 62-9-1(D)(6) OF THE PUA?

A. Yes. Given PNM's procurement, ownership, and operations of the BESS project, PNM will have full control and management of the dispatch and maintenance of the project within the operating requirements of the BESS and battery cell manufacturer. PNM will be able to directly control the preventative, predictive, and unplanned maintenance activities associated with the BESS equipment to timely address any equipment issues and to ensure reliable and efficient service to customers. Other details were provided earlier in SECTION IV. PROPOSED BESS PROJECTS of my testimony.

Q. IS THE BESS PROJECT THE MOST COST EFFECTIVE AMONG FEASIBLE ALTERNATIVES AS REQUIRED UNDER SECTION 62-9-1(D)(7) OF PUA?

A. Yes. As outlined in PNM Table OW-1, the BESS Project delivers the most cost effective and timely solution to feeder overload and DG integration that provides multiple benefits. Additional support for this conclusion is provided in SECTION III. PROPOSED SOLUTIONS TO LIMITED CAPACITY earlier in my testimony.

VI. CONCLUSION

Q. PLEASE SUMMARIZE YOUR TESTIMONY.

A. PNM has numerous distribution feeders that are fully constrained which prohibits those customers located on the feeders from exercising their choice for rooftop solar as well as exposing them to increased reliability issues. This BESS Project relieves two of the most constrained and overloaded feeders on PNM system and provides a full suite of customer and system benefits compared to permitting and constructing additional feeders or curtailing solar. The BESS Project can also be implemented more quickly. BESS is a "non-wires" solution to defer distribution and transmission investments. The BESS Project will allow PNM to evaluate BESS under real world operations to inform future expansion of this solution to address solar facilities on constrained distribution feeders.

PNM sees BESS on the distribution system as an integral part of the future carbon-free grid and customer choice. BESS provides a dispatchable resource capability that complements solar production. It is also key to providing reliable service to customers due to the intermittency of solar. BESS coupled at the distribution level at scale will increase the hosting capacity of future solar interconnection and provide resiliency for customers. Energy storage and solar production are key components of the carbon-free grid and increasing the hosting capacity of distribution will increase customer participation toward the goal of achieving a carbon-free system. PNM requests that the Commission approve this application.

Q. DOES THIS CONCLUDE YOUR TESTIMONY?

A. Yes.

GCG#530827

PNM Exhibit OW-1

Is contained in the following 1 page.

Omni B. Warner
Educational and Professional Summary

Name: Omni B. Warner

Address: PNM
MS ES24
4201 Edith Blvd. NE
Albuquerque, NM 87107

Position: Director, Distribution Engineering

Education: Bachelor of Science in Electrical Engineering, New Mexico State University, 2001
Master of Science in Electrical Engineering, New Mexico State University, 2009
Energy Executive Course, The University of Idaho, 2019
Professional Engineering in the State of New Mexico, license #18406, 2008

Employment: Employed by PNM since 2011.
Positions held with the Company include:
- Director, Distribution Engineering
- Managing Director, PNM Generation
- Director, SJGS Plant Manager
- Manager, SJGS Maintenance
- Team Manager, SJGS Engineering
- Sr. Engineer, Power Production