LAKE WILSON SOLAR ENERGY LLC

MINNESOTA PUBLIC UTILITIES COMMISSION

MPUC DOCKET NO. IP-7070/GS-21-792
MPUC DOCKET NO. IP-7070/CN-21-791
OAH DOCKET NO. 5-2500-39336

DIRECT TESTIMONY OF LANCE PAN

November 14, 2023

I. INTRODUCTION AND QUALIFICATIONS

Q. Please state your name, employer, and business address.

A. My name is Lance Pan. I am a Senior Project Engineer, with Invenergy LLC. My business address is One South Wacker Drive, Suite 1800 Chicago, IL 60606.

Q. Please briefly describe your educational and professional background and experience.

A. I am a Senior Project Engineer on Invenergy's Renewable Engineering team, working on energy storage projects. At Invenergy, I am responsible for leading and advising on technical matters in relation to development, engineering, and construction of energy storage projects. During my time at Invenergy, I have worked as the project engineer on over 500 megawatt hours (MWh) of energy storage projects and have provided technical assistance in over 1 gigawatt hours (GWh) over projects in development.

I hold a Bachelor's of Science in Electrical Engineering from the University of Illinois at Urbana-Champaign.

Q. What is your role with respect to the proposed Lake Wilson Solar Energy Center?

A. My role is to advise and consult Lake Wilson Solar Energy LLC (Lake Wilson Solar) on technical matters as it pertains to battery storage.

Q. What schedules are attached to your Direct Testimony?

A. My Statement of Qualifications is attached as **<u>Schedule A</u>** to my Direct Testimony.

II. OVERVIEW

Q. What is the purpose of your Direct Testimony?

A. The purpose of my testimony is to provide an overview of the proposed 95 megawatt alternating current (MWac) / 380 MWh battery energy storage system (BESS) that will be a part of the Lake Wilson Solar Energy Center (Project).

III. PROJECT DESCRIPTION

Q. Please provide a description of the proposed BESS.

A. The BESS is designed for 95 MWac and 380 MWac hours of storage capacity. A BESS is accredited capacity based on how much energy it can provide for a minimum of four continuous hours each day. The purpose of the BESS is to shift energy output generated by the solar panels as it is distributed to the overall electric grid. The BESS design is expected to reduce costs and improve wholesale market competition, allowing Lake Wilson Solar to create additional energy and capacity value. The proposed BESS will dispatch stored power during times when less solar energy is being produced. A generator interconnection agreement (GIA) for both the solar and BESS portions of the Project was executed with Midcontinent Independent System Operator (MISO) and allows for a maximum injection of 170 MWac to the grid at the Point of Interconnect (POI), consisting of 150 MWac of solar generation and 20 MWac of energy stored by the BESS and later released to the grid. For example, during off-peak times, if the Project is producing 100 MWac of solar generation, the BESS could dispatch up to an additional 70 MWac of power to fully utilize the 170 MWac of capacity allowed under the GIA.

Lake Wilson Solar anticipates a centralized, alternating current-coupled system for the BESS (i.e., all batteries being in one location as opposed to distributed throughout the Project) with a footprint of approximately 4 acres for the BESS infrastructure, and approximately 2 additional acres when including setbacks and fencing. This type of system allows for more efficient access, monitoring, and maintenance; has more flexible energy and power capacity sizing; and has more flexible dispatch capabilities. The centralized design is also more technologically developed.

The BESS will be comprised of battery cells arranged in modules for efficient operations. The batteries will be housed in racks within a series of standard ISO-style steel shipping containers, outdoor-rated modular enclosures, or similar enclosures. Standalone enclosures are necessary, as opposed to a large warehouse or storage building, to ensure people cannot enter into the enclosures with the batteries for safety reasons. The BESS will include rows of inverters and medium voltage transformers to transfer the energy to and from the batteries (power conversion system). The BESS yard will be filled with crushed rock yard-stone and no vegetation will be allowed to grow in the BESS yard to avoid fire risk.

Visually, the impact of the BESS would not be entirely out of character with the rest of the Project as the enclosures are relatively low height (standard battery storage enclosures are typically 20 feet long, 8 feet wide, and 9.5 feet high (20 ft x 8 ft x 9.5 ft)).

From the BESS container, low voltage direct current cables will connect to a pad-mounted combined inverter and transformer, then short segments of 34.5 kilovolt (kV) feeder cabling will transfer the power to a common bus which will connect directly to the project substation. The project substation will interconnect to the electrical grid via a 200–400-foot-long project generation intertie line to a new Xcel Energy Switchyard (Xcel Switchyard), which facilitates the interconnection to the existing Northern States Power Company, d/b/a Xcel Energy Fenton - Chanarambie 115 kV high voltage transmission line transecting the Project area. The Xcel Switchyard will serve as the POI for the Project to the MISO grid system. Auxiliary power for the heating, lighting and cooling systems for the BESS containers will be routed from the project substation to the BESS at 34.5 kV underground cabling.

As with the substation, fencing for the BESS will likely be a 7-foot chain link fence topped with one foot of barbed wire in accordance with National Electrical Safety Code security requirements.

Q. Please provide a description of the proposed battery technologies Lake Wilson intends to utilize for the BESS.

A. The BESS industry is currently deploying two main types of lithium-ion battery chemistries: nickel manganese cobalt oxide (NMC), and lithium iron phosphate (LFP). Lake Wilson Solar intends to use LFP due to its superior safety profile when compared to NMC. However, technology related to solar generation and battery storage is advancing at a rapid pace. Similar to other infrastructure components such as solar panels, the options available for the BESS when the Project begins procuring infrastructure could be significantly more advanced than those currently available. As such, it is important to maintain as much flexibility in the individual supplier and technology choice as possible until just before procurement to ensure selection of the best equipment to fit the Project at that time.

Q. Please provide a description of the safety precautions Lake Wilson has incorporated into the proposed BESS.

A. Lake Wilson Solar has proactively incorporated the following safety precautions into the design of the proposed BESS:

(1) The BESS system will incorporate LFP batteries. LFP batteries are more stable than NMC and have a lower risk for thermal runaway propagation or a deflagration event, which means in the unlikely event of a battery cell failure, the failure is less likely to spread.

(2) Lake Wilson Solar's equipment suppliers manufacture to stringent quality standards and equipment must be tested and certified by third party professionals. Standards, certifications, and code requirements from multiple nationally recognized organizations will be required for the engineering, design, manufacture, and testing of the enclosures and equipment included in the BESS.

(3) The BESS will include a complex monitoring system that monitors many different aspects within the system. Each battery system is equipped with cell level, module level, rack level, and system level monitoring points. These points produce real-time data that feeds into automatic control logic housed in the battery management system (BMS)

and site controller. The BMS and site controller ensure that both BESS components of the Project are operating within the original equipment manufacturer's operating parameters and warranty requirements.

(4) The BESS will be certified to National Fire Protection Association 69 (Standard on Explosion Prevention Systems). In the unlikely event of a battery off-gas failure, the heating, ventilation, and air conditioning system within each enclosure will evacuate combustible gases. The ventilation system is designed to dilute any combustible gases to well below their lower flammability limit.

(5) Lake Wilson Solar plans to house the BESS in separate containers rather than one building. A non-occupiable containerized solution provides natural segmentation and spatial separation of the BESS components, greatly reducing the risk of fire propagation at the Project and preventing people from getting trapped inside if a fire occurs.

(6) The BESS incorporates backup diesel generators, mounted on a concrete foundation, to provide standby power to ensure emergency functions can still be activated when there is a grid failure or power outage for at least two hours.

Additional detail is provided in Section 3.1.4 of the Project's Site Permit Application.

IV. CONCLUSION

Q. Does this conclude your Direct Testimony?

A. Yes.

Schedule A

Lance Pan

312-582-1429 | lpan@invenergy.com | www.linkedin.com/in/lance-pan
1 S. Wacker Drive, Chicago, IL, 60606

EXPERIENCE

Invenergy, Chicago, IL

Senior Project Engineer – Renewable Engineering, Energy Storage 2023-Present

- As the most senior storage engineer at Invenergy, responsible for technical direction on long-term initiatives and complex analyses.
- Project engineer on a 300 MWh storage plant, the company's largest storage facility in construction to date.
- Mentored summer interns and onboarded new hires.

Project Engineer – Renewable Engineering, Energy Storage 2022-2023

- Achieved substantial completion on 450+ MWh of energy storage projects.
- Played a leading role in the development, pricing, negotiation, and contracting 500+ MWh of projects.

Senior Staff Engineer – Renewable Engineering, Energy Storage 2021-2022

- Assisted in negotiations for an energy storage portfolio of 420+ MWh and served as project engineer for the entire portfolio.
- Executed financial modeling, engineering drawing review, and performance testing procedure development on 450+ MWh of energy storage projects.
- Developed and led onboarding program for new hires.

Staff Engineer – Renewable Engineering 2019-2021

- Joined Invenergy as part of an engineering rotational program, participating in the Storage Development and Renewable Electrical Engineering teams.
- Project engineer for a 200 MW wind farm in Iowa, oversaw engineering design from 30% to issued for construction.

EDUCATION

University of Illinois at Urbana Champaign

Bachelor of Science, Electrical Engineering June 2019

PROFESSIONAL SKILLS

- Skills: Microsoft Office (Excel, Powerpoint, Word), Financial Modeling, Project Design and Optimization
- Technical Skills: Layout Generation, Engineering Drawing Review, Capacity Modeling
- Soft Skills: Communication, Technical Writing, Problem Solving, Technical Training
- Languages: English (Native), Mandarin (Native)
- Certifications: OSHA 10 Certification