MP EXHIBIT 9

BEFORE THE STATE OF NORTH DAKOTA
PUBLIC SERVICE COMMISSION

KEITH AND DEANNA KESSLER

V.

MINNESOTA POWER, A DIVISION OF ALLETE, INC.

CASE NO. PU-20-194

PRE-FILED TESTIMONY OF JAY HALEY
ON BEHALF OF MINNESOTA POWER

March 25, 2021

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Exhibit MP-9 - Jay Haley Written Direct Testimony

Allete, Inc.

I. INTRODUCTION AND QUALIFICATIONS

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

A. My name is Jay Haley. I am a Mechanical Engineer and Wind Resource Specialist with Westwood Professional Services, Inc. ("Westwood"). My business address is 12701 Whitewater Drive, Suite 300, Minnetonka, MN 55343.

Q. Briefly describe your work history and education.

A. I have been involved in the wind energy since 1983, and have assisted with the planning, permitting, design, construction and operation of wind farms in several states, including North Dakota. I have performed or supervised wind resource and energy assessments for hundreds of projects totaling more than 40,000 MW, with more than 8,000 MW currently in operation. I have also provided Independent Engineering reviews of other consultant's wind assessment reports for various potential investors on over 50 projects totaling more than 5,000 MW. I am a certified WAsP user and WindPRO training instructor and have trained more than 500 wind industry personnel in the proper use of WindPRO and WAsP related to wind resource and energy assessment and site suitability.

I have been a member of the National Wind Coordinating Committee, the North Dakota Wind Coordinating Committee, Co-Chair of the Energy Cluster of North Dakota's New Economy Initiative, Vice-Chairman of the North Dakota Renewable Energy Partnership, founding Executive Board Member of the North Dakota Sustainable Energy and Economic Development Coalition, a member of U.S. Senator Dorgan's wind conference planning committee, and served as the founding Chairman of the Wind Energy Council, a regional trade organization in the upper Midwest. I also served as a technical expert representing the U.S. delegation on the International Standards Committee IEC 61400-15 – *Assessment of Wind Resource, Energy Yield and Site Suitability Input Conditions for Wind Power Plants.*

I have a Bachelor of Science in Mechanical Engineering from the University of North Dakota in Grand Forks and I am a licensed professional engineer in the state of North Dakota. A copy of my resume is provided as proposed **Exhibit 9-1**.

Q. What is your connection to Minnesota Power, a division of ALLETE, Inc. ("Minnesota Power"), and the Bison 4 Wind Project ("Project")?

A. EAPC (which was recently acquired by Westwood) was retained by Minnesota Power to assist with site assessment and layout design for the Project, and I supervised those efforts on behalf of EAPC. EAPC's work included conducting sound and shadow flicker modeling for the Project in 2013, and the modeling results were filed with North Dakota Public Service Commission ("PSC") to support the Project's Certificate of Site Compatibility ("CSC") Application. In September 2020, EAPC conducted updated sound and shadow flicker modeling for the Project at Minnesota Power's request.

II. PURPOSE OF TESTIMONY

Q. What is the purpose of your Direct Testimony?

A. The purpose of my testimony is to discuss the updated sound and shadow flicker modeling conducted for the Project. I will also explain how the updated modeling conducted demonstrates that the Project complies with the applicable PSC sound requirement at all modeled receptors, including the receptor located in Section 15, Township 141 North, Range 87 West, Oliver County, North Dakota ("Section 15 Structure").

Q. What proposed hearing exhibits are provided with your testimony?

A. The following proposed hearing exhibits accompany my testimony:

- Exhibit 9-1: Haley Resume
- Exhibit 9-2: Updated Bison 4 Sound and Shadow Flicker Studies Memo, dated September 23, 2020
- Exhibit 9-3: Updated Bison 4 Sound Modeling Results, dated March 18, 2021

III. OVERVIEW OF 2013 SOUND AND SHADOW FLICKER STUDIES

Q. Please discuss briefly the sound and shadow flicker modeling conducted for the Project in connection with PSC permitting.

A. EAPC conducted sound and shadow flicker modeling for the Project in July 2013, which was filed by Minnesota Power with the PSC on August 7, 2013 as part of supplemental application materials. The same supplemental application materials were also provided as Exhibit 2 at the public hearing on the CSC Application conducted by the PSC on September 13, 2013.

Based on the modeling conducted, the Project met the applicable PSC sound level requirement of 50 dBA within 100 feet of an inhabited residence or community building at all receptors modeled. Additionally, the Project met the PSC's recommendation of 30 hours per year or less of shadow flicker at occupied residences at all receptors modeled.

IV. UPDATED SOUND STUDY METHODOLOGY AND RESULTS

Q. Why did you conduct updated sound and shadow flicker modeling for the Project?

A. Minnesota Power asked EAPC to conduct the updated modeling summarized in **Exhibit 9-2** by adding the Section 15 Structure as a receptor for modeling purposes.

Q. Please describe the methodology used for the updated sound modeling.

A. In the September 2020 modeling (as in the July 2013 modeling), we modeled sound levels at the receptors, and then determined the distance from each receptor where the sound level reached 50 dBA. More recently, I conducted sound modeling for the Project that included three receptors 115 feet from the perimeter of the Section 15 Structure in order to provide sound modeling results specifically for points greater than 100 feet from the structure. In both cases, we used WindPRO to conduct the modeling, which is software commonly used throughout the industry to conduct sound modeling. The software incorporates the ISO 9613-2 international standard for sound propagation (Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation), which is an internationally-recognized standard used for wind turbine sound modeling.

Q. How does the methodology used for the updated sound modeling compare to the methodology used for the modeling conducted for the Project in July 2013?

A. The only substantive change in the updated modeling was adding receptors for the Section 15 Structure (and for the Aasmundstad residence, receptor SSA032, which I will discuss later in my testimony). For the updated modeling, we also used the as-built turbine locations (which included three slight turbine shifts) and a newer version of WindPRO; however, neither of these changes significantly impacted the modeling results. Otherwise, the methodology and all of the modeling parameters – including other receptor locations, wind data, turbine model specifications, topography, sound data and operational data – were the same as those used in the 2013 modeling.

Q. What was the modeled sound level at the Section 15 Structure?

A. As indicated in **Exhibit 9-2**, the modeled sound level at the Section 15 Structure was 47.9 dBA.

Q. If the limit of 50 dBA within 100 feet of an inhabited residence were applicable to the Section 15 Structure, is the sound level in compliance?

A. Yes. As provided in **Exhibit 9-2**, sound levels reach 50 dBA just over 311 feet (95 meters) from the Section 15 Structure. Additionally, when we added receptors 115 feet from the perimeter of the Section 15 Structure, the maximum sound level at the 115-foot receptors was 48.8 dBA, which further confirms the sounds level within 100 feet of the Section 15 Structure would comply with the limit of 50 dBA. The results of the modeling including 115-foot receptors are provided in **Exhibit 9-3**.

Q. Does the methodology used for both the original and the updated sound modeling include conservative inputs?

A. Yes. The conservative assumptions are:

- All turbines are operating simultaneously at maximum noise output levels.
- All turbines are assumed to be upwind of all receptors.
- Atmospheric conditions are most favorable for noise propagation.

Q. In your experience, how accurate is the methodology you used for the updated sound modeling in predicting post-construction sound levels?

A. The methodology used in this study, including the conservative assumptions, has proven to be accurate in over-predicting the sound levels slightly when compared with post-construction sound measurements.

Q. Are you aware of any post-construction sound studies for wind farms that support the accuracy and conservativeness of the sound modeling you conducted for the Project?

A. Yes. In 2015, Barr Engineering conducted a post-construction sound study at a receptor within the Project on behalf of Minnesota Power. My understanding is that the study was conducted after a noise complaint was submitted to the PSC by the Aasmundstads, participating landowners who live within the Project, and the study was intended to measure the sound levels in proximity to the Aasmundstads' residence. The Barr Engineering sound study was filed with the PSC on March 20, 2015 in Case No. PU-13-127.

When we modeled 115-foot receptors for the Section 15 Structure, we included a receptor at the same location as was used for the Barr Engineering post-construction sound study (designated as SA032-2), and the modeling results are provided in **Exhibit 9-3**. Barr Engineering measured sound levels between 42.5 and 46.7 dBA. Our modeling result at the same location used by Barr Engineering was 47.3 dBA. Thus, our sound modeling for the receptor was higher than the sound levels actually measured.

In addition, EAPC provided sound modeling for the 300 MW Crowned Ridge I and 300 MW Crowned Ridge II wind projects in South Dakota. Two post-construction sound measurement campaigns were conducted for those projects: one in the fall and one in the winter. In both cases, our predicted (modeled) levels were slightly higher than what was measured in the verification studies.

Q. Based on your experience, would you expect the results of a post-construction sound study at the Section 15 Structure to differ from the results of the updated sound studies you have conducted?

A. No.

V. UPDATED SHADOW FLICKER STUDY METHODOLOGY AND RESULTS

Q. Please describe the methodology used for the updated shadow flicker modeling.

A. EAPC used WindPRO to conduct the modeling, which is also commonly used throughout the industry to conduct shadow flicker modeling. Calculating potential shadow flicker at each receptor is done by the software simulating the environment near the wind turbines and the receptors. The sun's path with respect to each wind turbine location is calculated by the software to determine the paths of cast shadows for every minute of every day over a full year. The turbine runtime and direction are calculated from the site's long-term wind speed and direction distribution. Finally, the effects of cloud cover are calculated using long-term reference data (monthly average daily sunshine hours) to arrive at the projected annual flicker time at each receptor.

Q. How does the methodology used for the updated shadow flicker modeling compare to the methodology used for the modeling EAPC conducted for the Project in July 2013?

A. With the exception of adding the Section 15 Structure as a receptor, using the as-built turbine locations, and using a newer version of WindPRO, the methodology and all of the modeling parameters – including receptor locations, turbine model specifications, monthly average daily sunshine hours, joint wind speed and direction frequency distribution, and height contour data – were the same as those used in the 2013 modeling. As discussed previously, using as-built turbine locations and a newer version of WindPRO did not have a significant impact on the modeling results.

Q. Does the methodology used for the updated shadow flicker modeling include conservative inputs?

A. Yes. The conservative assumptions are:

- The study assumes 100% turbine availability.
- The receptors were omni-directional rather than modeling specific facades of buildings.
- No credit was taken for the blocking effects of trees or buildings.
- The turbine rotor is always facing the sun.

Q. What was the modeled annual shadow flicker at the Section 15 Structure?

A. The modeled annual shadow flicker at the Section 15 Structure was 66:02 hr/yr.

Q. Are there any state or local shadow flicker requirements that apply to the Project?

A. No shadow flicker regulations are specified at the PSC or local level. However, for this Project, Minnesota Power applied the PSC's recommendation of 30 hours per year or less at occupied residences.

Q. In your experience, how would you expect the modeled shadow flicker levels to compare to actual post-construction shadow flicker levels?

A. I would expect them to closely compare.

Q. Are you aware of any post-construction monitoring conducted to verify the modeling methodology you applied?

A. The shadow model has been verified by post-construction monitoring and has been shown to be quite accurate.

Q. What are options for reducing shadow flicker at a receptor?

A. Options to reduce shadow flicker would include applying shades to windows and doors, planting trees or shrubs in strategic locations to block the shadow, or curtailing the contributing wind turbine(s) at the appropriate times when shadow flicker would be occurring at the structure.

VI. CONCLUSION

Q. Does this conclude your Direct Testimony?

A. Yes.