BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF SOUTH DAKOTA

IN THE MATTER OF THE COMPLAINT FILED BY AMBER CHRISTENSON, LINDA LINDGREN AND TIMOTHY LINDGREN AGAINST CROWNED RIDGE WIND, LLC REGARDING PROJECT SOUND LEVEL COMPLIANCE

Docket No. CE22-001

TESTIMONY

OF RICHARD LAMPETER

August 7, 2023

INTRODUCTION AND QUALIFICATIONS

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is Richard Lampeter. My business address is 3 Mill & Main Place, Suite 250, Maynard, MA 01754.

Q. **BY WHOM ARE YOU EMPLOYED AND IN WHAT CAPACITY?**

A. I am employed at Epsilon Associates, Inc. ("Epsilon"). I am a Principal at the company and manage the Acoustics Group.

Q. **WHAT ARE YOUR RESPONSIBILITIES RELATED TO THE POST-CONSTRUCTION SOUND STUDIES?**

A. I was engaged by Crowned Ridge Wind, LLC ("Crowned Ridge" or "CRW") to conduct three (3) post-construction sound studies, including development of protocols for the sound studies, conducting and supervising the sound studies, and drafting the reports associated with the three post-construction sound studies.

Q. WHAT IS YOUR PROFESSIONAL AND EDUCATIONAL BACKGROUND?

A. I have over 20 years of experience in conducting community sound level impact assessments. My areas of expertise include the measurement of ambient sound levels, modeling sound levels from proposed developments, evaluation of conceptual mitigation, and compliance sound level measurements. I have conducted impact assessments for power generating facilities, commercial developments, industrial facilities, and transfer stations. Prior to joining Epsilon, I earned a BS in Environmental Science from Lyndon State College in 2001.

Since 2004, I have been involved in renewable energy projects across the United States. During that time, I provided acoustical consulting on over 80 wind energy projects. I frequently present key aspects of analyses to boards and committees and have provided sworn expert testimony.

I have co-authored several papers ranging in topics from wind energy to metal shredders, one of which appeared in a peer-reviewed journal, and I am a member of the Institute of Noise Control Engineering. My resume is attached as Exhibit RL-1.

Q. HAS THIS REBUTTAL TESTIMONY BEEN PREPARED BY YOU OR UNDER YOUR DIRECT SUPERVISION?

A. Yes.

Q. HAVE YOU PREVIOUSLY APPEARED BEFORE THE COMMISSION?

A. Yes, in Docket Nos. EL19-003 and EL19-027.

Q. PLEASE DESCRIBE THE PURPOSE OF YOUR REBUTTAL TESTIMONY.

A. The purpose of my testimony is to address the testimony of Complainant Amber Christenson.

2020 SOUND STUDY

Q. PLEASE PROVIDE A BRIEF OVERVIEW OF HOW THE 2020 SOUND STUDY WAS CONDUCTED.

A. In order to address the requirements within the temporary waiver granted on January 9, 2020, a sound level program following the installation of leading edge noise reduction blades for all Crowned Ridge wind turbines was conducted to evaluate compliance with the sound level limits within the wind project's permit condition. Prior to the commencement of the sound level measurement program, a Protocol was developed by Epsilon and provided to the South Dakota Public Service Commission ("SD PUC" or "Commission") by Crowned Ridge for review. The Protocol outlined the measurement methodology, measurement locations, instrumentation, approach for implementing wind turbine shutdowns, and evaluation criteria to be used in the analysis. On October 2, 2020, the SD PUC issued an order approving the Protocol.

Sound levels were measured at six (6) locations across the interior and at the perimeter of the Crowned Ridge wind project. The sound level measurement locations were selected based on the modeled sound levels, proximity of residential locations to the wind turbines, proximity to other measurement locations in the measurement program, and a complaint. Continuous programmable unattended sound level meters were placed at these six (6) locations. These monitors continuously measured sound levels from as early as Tuesday, October 20, 2020 to Tuesday, November 10, 2020. In addition to the collection of sound level data, ground-level wind speeds were continuously measured and logged at each location as per the SD PUC Final Decision. Precipitation was also logged at one location and used to determine 10-minute periods with precipitation during the measurement program. The intent of the sound level measurement program was to collect and evaluate sound data during periods meeting the criteria outlined in the Protocol that would be representative of worst-case conditions. As discussed in the SD PUC approved Protocol, the 'total' A-weighted L_{eq} sound level (wind turbines + background) measured during each of at least 10 periods meeting the conditions specified in the Final Decision were initially compared to the wind energy facility limits. As necessary, a representative background sound level was subtracted (on an energy basis) from the operational sound level to obtain the "wind turbine only" L_{eq} sound pressure level. The wind turbine only sound pressure level was then compared to the wind energy facility limits.

Q. PLEASE PROVIDE A BRIEF OVERVIEW OF THE CONCLUSIONS FROM 2020 SOUND STUDY.

A. The results of the Epsilon 2020 post-construction measurement program show that sound pressure levels due to the wind turbines under wind speed and operational conditions identified as conditions resulting in maximum sound power levels met the sound level limits set forth in the SD PUC Final Decision for Crowned Ridge at each of the monitoring locations. The wind turbine only 10-minute L_{eq} sound levels ranged from 34 to 44 dBA at the five (5) non-participating monitoring locations and from 42 to 49 dBA at the one (1) participating monitoring location. The results of this sound level compliance assessment show (1) that Crowned Ridge Wind was in compliance with the SD PUC sound thresholds at the measured locations; and (2) because the measured locations were selected due in part

to higher modeled sound levels, it follows that participant and non-participant residences not specifically evaluated during this program will also be below the applicable SD PUC sound level thresholds.

Q. COMPLAINANT CHRISTENSON (PAGE 2) ASSERTS THAT EQUIPMENT ASSOCIATED WITH ONE OF THE MEASURED LOCATIONS IN THE 2020 SOUND STUDY WAS IMPROPERLY PLACED FURTHER FROM THE HOME FOR CROWNED RIDGE'S BENEFIT. CAN YOU DETERMINE WHAT LOCATION SHE IS REFERRING TO?

A. The 2020 Epsilon Sound Study report identifies the position of all measurement locations. Sound levels were measured approximately 85 feet from the residential structure on the non-participating parcel located at 46763 159th Street which is Location 2. Based on consultation with the homeowner at this location, the sound level was placed on a different side of the residence than the previous program.

Q. DO YOU AGREE WITH COMPLAINANT'S ASSERTION THAT EQUIPMENT ASSOCIATED WITH THIS LOCATION WAS PLACED FURTHER FROM THE HOME THAN WAS APPROPRIATE TO BENEFIT CROWNED RIDGE?

A. No. The equipment at Location 2 was not placed further away from the home in order to benefit Crowned Ridge, but instead was placed at that location in order to be responsive to the request of the homeowner who requested measurements on a different side of the home as compared to the previous measurement location while also considering limitations with respect to vegetation and terrain southeast of the home. Following the 2020 Sound Study the homeowner entered into a participation agreement, resulting in no additional testing being necessary at this property. Complainant's concern that there was a fourth property exceeding sound limits is incorrect, as Location 2 was already identified in Staff expert David Hessler's report as one of the locations to be over the limit for a very limited time period.

Q. COMPLAINANT CHRISTENSON (PAGE 2) ASSERTS THAT ANSI S12.9, PART 3 WAS NOT PROPERLY APPLIED TO THE 2020 SOUND STUDY RESULTS. DO YOU AGREE?

A. No. Although ANSI S12.9 Part 3 describes the procedure identified by the complainant, this standard pertains to short-term attended measurements and the sound study program executed by Epsilon in 2020 was mostly unattended. ANSI standard S12.100-2014 discusses the removal of high frequency natural sounds ("HFNS") from sound level measurements. The adjustment, called "ANS-weighting", requires the removal of all sound level data from octave bands above the 1,000 Hz band. Sound from wind turbines is generally broadband in nature from the aerodynamic sound caused by the rotating blades. Therefore, performing ANS-weighting would not only remove HFNS, but, also, would remove some wind turbine contribution from the measured sound level and be unrepresentative of the full contribution from the wind project. Therefore, no ANS-weighting was performed for this sound study or prior post-construction studies performed for Crowned Ridge.

Q. COMPLAINANT CHRISTENSON (PAGE 2) ASSERTS THAT "NO TRUE TURBINE SOUND PROFILE WAS THUS GATHERED" AT LOCATION 6. DO YOU AGREE?

A. The purpose of the sound study was not to establish a turbine sound profile. Instead, consistent with the Commission's Final Decision, the purpose was to evaluate compliance with the following limit:

> The Project, exclusive of all unrelated background noise, shall not generate a sound pressure level (10-minute equivalent continuous sound level, Leq) of more than 45 dBA as measured within 25 feet of any non-participating residence unless the owner of the residence has signed a waiver, or more than 50 dBA (10-minute equivalent continuous sound level, Leq) within 25 feet of any participating residence unless the owner of the residence has signed a waiver.

The SD PUC's sound threshold is a broadband, A-weighted, project only sound level limit. Conservatively, total sound levels were initially compared to the limit. In certain instances, project-only sound levels were calculated from measured total sound levels by subtracting

representative background from measured total sound levels. These project-only sound levels were then compared to the applicable limit.

Q. COMPLAINANT CHRISTENSON ASSERTS THAT LOCATION 3 (WELDER) WAS OUT OF COMPLIANCE WITH THE COMMISSION'S SOUND THRESHOLDS. PLEASE COMMENT.

A. The results of the 2020 Sound Study show that sound pressure levels due to the wind turbines under conditions meeting the evaluation criteria established are in compliance with the SD PUC Final Decision sound level limit of 45 dBA at non-participating residence at Location 3. Under these conditions, wind turbine only sound levels (Leq) ranged from 38 to 43 dBA. When evaluating additional periods, Staff expert David Hessler identified three (3) locations with overages. His report concludes that, "In essence, our analysis indicates that the project sound level was compliant with the stipulated noise limits at Positions 1-3 for 96% of the survey period and for 100% at the remaining positions." With respect to compliance, David Hessler's report concludes, "Because the overages occurred only once at only three of the six test positions…we would conclude that the project has been appropriately designed and is meeting, in good faith, the intent of the permit noise limits."

Q. COMPLAINANT CHRISTENSON (PAGES 1 AND 3) ASSERTS THAT 50% OF THE MEASURED LOCATIONS IN THE 2020 SOUND STUDY FAILED TO COMPLY WITH THE COMMISSION'S SOUND THRESHOLDS. DO YOU AGREE?

A. No, I do not. The results of the Epsilon Sound Study show that sound pressure levels due to the wind turbines under conditions meeting the evaluation criteria established are in compliance with the SD PUC Final Decision sound level limit of 50 dBA at participating residences and 45 dBA at non-participating residences. When evaluating additional periods, Staff expert David Hessler, identified three (3) locations with overages. As explained, his report concludes that, "In essence, our analysis indicates that the project sound level was compliant with the stipulated noise limits at Positions 1-3 for 96% of the survey period and for 100% at the remaining positions." In addition, his report concludes,

"…we would conclude that the project has been appropriately designed and is meeting, in good faith, the intent of the permit noise limits."

2021 SOUND STUDY

Q. COMPLAINANT CHRISTENSON ASSERTS THE 2021 SOUND STUDY WAS NOT CONDUCTED PROPERLY. PLEASE PROVIDE AN OVERVIEW OF HOW THE 2021 SOUND STUDY WAS CONDUCTED.

A. Following the 2020 Sound Study, Crowned Ridge drafted a Mitigation Plan dated March 18, 2021 that was approved by the SD PUC on April 9, 2021. The Mitigation Plan committed Crowned Ridge to conduct a follow-up sound study. The Order Granting Petition for Reconsideration and Order Granting Motion to Amend Sound Study Mitigation Plan in Part on Reconsideration dated September 20, 2021 modified the components of the follow-up sound study. The 2021 Sound Study was designed to fulfill the requirements of those Orders.

Sound levels were measured at five (5) locations across the interior and at the perimeter of the Crowned Ridge wind energy center. Three of the five locations (Locations 3A, 7, and 8) were selected as representative of the locations showing sound level exceedances in the Hessler Report based on proximity to the original locations, modeled sound levels, and participation status. The additional two locations (Locations 6 and 9) were as ordered by the SD PUC. Programmable, generally unattended sound level meters were placed at the five (5) monitoring locations. These monitors continuously measured sound levels from as early as Tuesday, November 2, 2021 to as late as Thursday, November 18, 2021. In addition to the collection of sound level data, ground-level wind speeds were continuously measured and logged at each location as per the Final Decision. Precipitation was also logged at one location and used to determine 10-minute periods with precipitation during the measurement program. Epsilon personnel visited each location for observations at least once every day and checked on the integrity of the monitoring equipment several times throughout the program. In some cases, a location was visited multiple times in a 24-hour period depending on operational or meteorological conditions.

The intent of the sound level measurement program was to collect and evaluate sound data per the conditions described in the Mitigation Plan and as modified in the April 9, 2021 and September 20, 2021 Orders with a focus on periods close in time to wind turbine shutdowns. From the 'total' A-weighted L_{eq} sound levels (wind turbines + background) measured during periods meeting the conditions specified in the Mitigation Plan, background sound levels were subtracted (on an energy basis) to obtain the "wind turbine only" L_{eq} sound pressure levels. The wind turbine-only sound pressure level was then compared to the SD PUC sound thresholds. The 2021 sound study was conducted properly and met the requirements of the SD PUC's previous orders which detailed the necessary components of the study.

Q. PLEASE PROVIDE A BRIEF OVERVIEW OF THE CONCLUSIONS FROM 2021 SOUND STUDY.

A. The results of the measurement program show that calculated wind turbine only sound pressure levels, under conditions meeting the established evaluation criteria, comply with the SD PUC Final Decision sound level limit of 50 dBA at participating residences and 45 dBA at non-participating residences. The wind turbine only 10-minute L_{eq} sound levels range from 25 to 45 at the five (5) non-monitoring locations.

Q. COMPLAINANT CHRISTENSON (PAGE 3) ASSERTS THAT THE 2021 SOUND STUDY WAS NOT CONDUCTED CONSISTENT WITH THE COMMISSION APPROVED MITIGATION PLAN. DO YOU AGREE?

A. No, I do not.

Q. COMPLAINANT CHRISTENSON (PAGES 3 AND 5) CLAIMS THE MITIGATION PLAN WAS NOT FOLLOWED BECAUSE THE SOUND STUDY DID NOT COMPLY WITH THE SHUTDOWN REQUIREMENT AND MISSED SHUTDOWNS. PLEASE COMMENT.

A. The Mitigation Plan called for four (4) shutdowns daily at 1:00 a.m., 7:00 a.m., 1:00 p.m., and 7:00 p.m. for wind turbines within 1.75 miles of a measurement location.

A total of 58 shutdowns were coordinated and performed by the NEER Renewable Operations Control Center during the measurement program targeting 1:00, 7:00, 13:00, and 19:00 daily. The 58 total shutdowns include three shutdowns specific to Location 6 only, which were conducted at 19:00 on November 17, 1:00 on November 18, and 7:00 on November 18.

For all five (5) measurement locations there were three (3) scheduled shutdowns that were not implemented, or otherwise delayed; therefore, no evaluations were performed during these times: November 7 at 1:00 (Daylight Savings Time Change), November 7 at 13:00, and November 11 at 13:00.

Specific to Location 6, there were five (5) additional shutdowns which can be classified as "missed" as the shutdowns at CRW and CRWII did not occur simultaneously. These were at 16:00 on November 11, 7:20 on November 12, 7:30 on November 13, 7:10 on November 15, and 7:30 on November 17. This information is presented as part of Table 6-4 of the 2021 Sound Study Report. Due to a typographical error in the report, this table did not contain the appropriate note for two periods (16:00 on November 11 and 7:20 on November 12). Additionally, an extra shutdown planned at Location 6 for 13:00 on November 17 was not synchronized between CRW and CRWII; therefore, that period could not be used for additional evaluations.

Q. COMPLAINANT CHRISTENSON (PAGE 3) CLAIMS THE MITIGATION PLAN WAS NOT FOLLOWED BECAUSE THE SOUND STUDY WAS NOT CONDUCTED IN THE FALL OF 2021 DURING SIMILAR WEATHER CONDITIONS TO THE OCTOBER 2020 SOUND STUDY. PLEASE COMMENT.

A. A tabulated comparison of the meteorological conditions measured during the October 2020 and the 2021 studies is provided below. Temperatures measured at the onsite meteorological tower were very similar between the two programs with the same averages. The 2020 program had more 10-minute periods below freezing, but that program was also approximately 5 days longer. Wind speeds at hub height were very similar between the

program and had strong wind speeds (≥ 9 m/s) for about the same percentage of the respective programs.

	Program Duration	Temperature @ HH (°F)				HH WS (m/s)				GL WS (m/s)			HH WD	WT 38 Output
		Avg.	Max.	Min.	Periods Below Freezing	Avg.	Max.	Min.	Periods ≥ 9 m/s	Avg.	Max.	Min.	All 16 Sectors?	Range (kW)
2020	~20 Days	40	74	12	1,221 (42%)	9	23	1	1,290 (45%)	3	13	0	Yes	0 to 2300
2021	~15 Days	40	67	21	576 (27%)	9	29	1	983 (46%)	4	14	0	Yes	0 to 2300

Q. COMPLAINANT CHRISTENSON (PAGE 3) CLAIMS THE MITIGATION PLAN WAS NOT FOLLOWED BECAUSE THE SOUND STUDY DID NOT COMPLY WITH ANSI S12.18 RELATED TO WIND DIRECTION. PLEASE COMMENT.

A. The Mitigation Plan referenced by Complainant does identify specific ANSI standards. Condition 26 Part A of the Final Decision reads, "The post construction monitoring survey shall be conducted following applicable ANSI methods." The September 16, 2020 Protocol states, "The monitoring program will generally follow Method #1: "General method for routine measurements" in ANSI S12.18-1994 (R2019) "Procedures for Outdoor Measurement of Sound Pressure Level"."

According to ANSI S12.18, sound level measurements are to be during a wind direction under which the measurement location is ± 45 degrees within the downwind direction of the sound source. Evaluating only downwind periods is not a specific requirement identified in the conditions of the Final Decision. In addition, according to a 2016 Massachusetts Clean Energy Center report on wind turbine acoustics, wind direction only affects sound levels by "generally less than 1 dB". Therefore, it is reasonable to include additional wind directions in the analysis when downwind periods meeting the other criteria are not present and potentially uncommon.

Q. COMPLAINANT CHRISTENSON (PAGE 3) CLAIMS THE MITIGATION PLAN WAS NOT FOLLOWED BECAUSE THE SOUND STUDY DID NOT USE COMPLIANCE EVALUATION PERIODS WHEN THE FIVE CLOSEST WIND TURBINES WERE OPERATING AND WHEN THE CLOSEST WIND TURBINE WAS AT MAXIMUM SOUND POWER. PLEASE COMMENT.

A. The complainant's assertion that "there was no action by the PUC to remove that requirement in the 2021 protocol" is incorrect.

Based on the findings of the 2020 Epsilon Study, which followed the protocol and operating condition requirements, no evaluation periods at any of the measurement locations exceeded the sound level limits. Due to Staff expert David Hessler's inclusion of additional measurement periods in his review of the 2020 Sound Study, the approach for selecting evaluation periods was modified as stated in the Mitigation Plan:

> The sound study will use the protocols approved by the Commission on October 2, 2020, with the following changes:
> (2) require that the study and report focus on time periods near wind turbine shutdowns;

In both the 2020 and 2021 Sound Studies, a period was only considered for evaluation if at least the closest 5 wind turbines were operational. The electrical output from these wind turbines is presented for all periods of all locations in Appendix D of the 2021 Sound Study. The evaluations conducted in the 2020 Sound Study reviewed only periods when electrical output at the closest wind turbine was at its rated maximum, *i.e.,* 2,300 kilowatt. This output was considered to provide 'worst-case' sound levels from the wind turbines.

In the review of the 2020 study prepared by Hessler Associates, Inc., Mr. Hessler identified periods when wind turbines were operating below maximum output with exceedances. In order to consider periods during which a wind turbine may not be at full power but still emits elevated sound levels and to minimize uncertainty due to variability in ambient conditions, the additional sound study was to, "focus on time periods near wind turbine

shutdowns." Therefore, in order to address this requirement of the Mitigation Plan, the 2021 Sound Study did not evaluate all periods during high electrical output regardless of how many hours they were from the most recent shutdown (this was the approach applied in the 2020 Sound Study), but instead focused on periods in close proximity to a shutdown. Although a limitation on the wind turbine power output for evaluation periods was not set, there were multiple evaluation periods at all 5 locations with a wind turbine only and/or a total sound level under maximum output conditions at the closest wind turbine.

Q. COMPLAINANT CHRISTENSON (PAGES 5 AND 6) CLAIMS THERE WAS A MISSED SHUTDOWN ON NOVEMBER 11 THAT IMPACTED THE SOUND STUDY'S ABILITY TO DETERMINE COMPLIANCE BECAUSE THE PROJECT WAS RUNNING AT OR NEAR FULL POWER AND THE CONDITIONS WERE COMPARABLE TO THE WELDER LOCATION STUDIED IN THE 2020 SOUND STUDY. PLEASE COMMENT.

A. There was a missed shutdown on November 11 at 13:00. An alternate shutdown was conducted for four of the five sound level measurement locations at 16:00, and precipitation was identified during that time period.

There were very strong winds on November 11, at 13:00. The wind was from the west with hub height winds at 18 m/s and the speed at Location 3A was 11 m/s, which is well above the ANSI threshold for sound measurements. Location 6 is well shielded from westerly winds, but the trees there generate noise from that wind and impact the levels at this measurement location. This wind condition was confirmed with a review of the audio recordings at Location 6, and wind turbine noise was inaudible during adjacent periods. Therefore, this time period was not critical to the sound level evaluation.

Q. COMPLAINANT CHRISTENSON (PAGES 5 AND 6) ASSERTS THE SOUND STUDY WAS IMPACTED BY PROJECT CURTAILMENTS. PLEASE COMMENT.

A. As stated in the 2021 Sound Study report, MISO curtailments impacted the operation of the wind turbines. These impacts were limited to periods when curtailments occurred. It

is Epsilon's understanding that the curtailments were based on decisions by MISO, were unscheduled (*i.e.,* dependent upon real time conditions), and were not within the control of Crowned Ridge operations. Even though these curtailments occurred throughout the program, a compliance evaluation was able to be conducted. Also as stated in the 2021 Sound Study Report, "the results of the measurement program show that calculated wind turbine only sound pressure levels, under conditions meeting the established evaluation criteria, meet the sound level limits set forth in the SD PUC Final Decision for CRW at each of the measurement locations."

Q. COMPLAINANT CHRISTENSON (PAGE 5) ASSERTS THAT ACTIONS WERE TAKEN TO MANIPULATE THE DATA COLLECTION PROCESS. DO YOU AGREE?

A. No, I do not. Epsilon did not manipulate data collection.

Q. COMPLAINANT CHRISTENSON (PAGES 5-6) CLAIMS THAT THE STUDY PERIOD SHOULD HAVE BEEN EXTENDED BEYOND THE TWO WEEK STUDY PERIOD. PLEASE COMMENT.

A. Since conclusions were able to be drawn regarding compliance with the sound level limits, an extension beyond the 2-week period was unnecessary.

Q. COMPLAINANT CHRISTENSON (PAGE 6) CLAIMS THAT DATA WAS "CHERRY PICKED" FOR "BLUEBIRD DAYS" AND LOW POWER OUTPUT TIMES. PLEASE COMMENT.

A. The sound level analysis did not involve "cherry picking" periods. Instead, the 2021 Sound Study performed by Epsilon involved a methodical data analysis procedure described in the report which followed requirements outlined in the Mitigation Plan. In addition, Mr Hessler said the following in his report following his review of the study, "Additionally, we find no faults or errors in Epsilon's final report on the survey and agree with its conclusions. In fact, Epsilon should be commended for the massive amount of time and effort that went into properly carrying out this lengthy field survey during difficult wintertime conditions."

Q. COMPLAINANT CHRISTENSON (PAGE 6) ASSERTS THAT THERE WERE EFFORTS MADE DURING THE SOUND STUDY TO ENSURE THERE WOULD BE NO SHOWING OF ADDITIONAL NOISE OVERAGES. DO YOU AGREE?

A. No, I do not. As I previously stated, the 2021 Sound Study performed by Epsilon involved a methodical data analysis procedure described in the report which followed requirements outlined in the Mitigation Plan. In addition, as explained above, Staff expert Hessler concluded the following in his report following his review of the study, "Additionally, we find no faults or errors in Epsilon's final report on the survey and agree with its conclusions. In fact, Epsilon should be commended for the massive amount of time and effort that went into properly carrying out this lengthy field survey during difficult wintertime conditions."

Q. COMPLAINANT CHRISTENSON (PAGE 6) CLAIMS THAT MISSED SHUTDOWNS AND CURTAILMENTS "ROBBED" THE CITIZENS OF VALUABLE SOUND STUDY SAMPLES. DO YOU AGREE?

A. No. There were only a limited number of shutdowns that were missed during the program. Although curtailments occurred during 10 of the 14 days of the program, there was a significant range in the duration of the curtailments from 10 minutes to the majority of a given day. To put the duration into perspective, 19% of the sound level measurements at Location 6 were during a curtailment. When these curtailments did occur in close proximity to a shutdown, there were often other factors which would have resulted in removing the period from the evaluation regardless of wind turbine electrical output, *e.g.*, precipitation or high winds. Although these curtailments reduced the number of evaluation periods and/or periods under high electrical output, sufficient data was collected in order to evaluate compliance with respect to the sound level limits.

Q. COMPLAINANT CHRISTENSON (PAGE 6) ASSERTS THAT EPSILON INDICATED IN THE SOUND STUDY THAT THE CROWNED RIDGE WIND FARM WAS OPERATING ABNORMALLY. PLEASE COMMENT.

A. The 2021 Sound Study Report does not use the "word abnormal" or "abnormally." The report does identify the periods that were during a MISO curtailment.

Q. COMPLAINANT CHRISTENSON (PAGE 6) CLAIMS THAT MISSED SHUTDOWNS WERE DURING "HIGH OUTPUT, POTENTIAL ICING PERIODS, AND LONG PERIODS OF CURTAILMENT" ALL OF WHICH IMPACTED THE VALIDITY OF THE SOUND STUDY. PLEASE COMMENT.

A. Specific to Location 6, the missed shutdowns are as follows with context of the conditions during those times:

- November 7 at 1:00 – During the early hours of November 7, the winds were strong out of the south. Audio recordings from Location 6 at the 1:00 AM hour on November 7 include significant wind and/or tree noise and the wind turbines are inaudible as there were strong winds from the south. The Leq sound levels during this hour (2nd occurrence with output data due to DST) ranged from 46 to 47 dBA, which contain significant contribution from background. The winds decreased slightly over the next hour, and with the closest 5 wind turbines at maximum output, the Leq sound level at 3:00 AM and 3:10 AM is 43 dBA. This indicates that CRW conservatively is contributing no more than 43 dBA at this location and is in compliance.
- November 7 at 13:00 – Wind turbines were not operating due to light winds at hub height; therefore, this period did not impact the sound study.
- November 11 at 13:00 - There were very strong winds at this time. The wind was from the west with hub height winds at 18 m/s and the speed at Location 3A was 11 m/s, which is well above the ANSI threshold for sound measurements. Location 6 is well shielded from westerly winds, but the trees there generate noise from that wind and impact the levels at the measurement location. This wind condition was confirmed with a review of the audio recordings, and wind turbine noise was inaudible during adjacent periods. Additionally, there was measurable precipitation recorded by the National Weather Service; therefore, no evaluation would have been conducted around this period.
- November 11 at 16:00 – Period classified as missed because the shutdown was not synchronized between CRW and CRWII. There were very strong winds at this time. The wind was from the west with hub height winds at 18 m/s and the speed at Location 3A was 8 m/s, which is well above the ANSI threshold for sound measurements. Location 6 is well shielded from westerly winds, but the trees there generate noise from that wind and impact the levels at the measurement location. The audio recording from adjacent periods revealed

significant contribution from birds, and wind turbine noise was not discernible. Additionally, there was measurable precipitation recorded by the National Weather Service; therefore, no evaluation would have been conducted around this period.

- November 12 at 7:20 – Period classified as missed because the shutdown was not synchronized between CRW and CRWII. There was measurable precipitation recorded by the National Weather Service; therefore, no evaluation would have been conducted around this period, and therefore this period did not impact the sound study.
- November 13 at 7:30 – Period classified as missed because the shutdown was not synchronized between CRW and CRWII. Wind turbines were operating at very low output around this period due to light winds at hub height; therefore, this period did not impact the sound study.
- November 15 at 7:10 – Period classified as missed because the shutdown was not synchronized between CRW and CRWII. Periods around this time would not have met the evaluation criteria due to unsteady sound, and therefore this period did not impact the sound study.
- November 17 at 7:30 - Period classified as missed because the shutdown was not synchronized between CRW and CRWII. There were very strong winds at this time. The wind was from the west with hub height winds at 15 m/s and the speed at Location 3A was 10 m/s, which is well above the ANSI threshold for sound measurements. Location 6 is well shielded from westerly winds, but the trees along the property line generate noise from that wind and impact the levels at the measurement location. During adjacent periods the wind turbine noise was inaudible in the audio recordings.

  November 17 at 13:00 - Period classified as missed because the shutdown was not synchronized between CRW and CRWII. There were very strong winds at this time. The wind was from the west-northwest with hub height winds at 18 m/s and the speed at Location 3A was 13 m/s, which is well above the ANSI threshold for sound measurements. Location 6 is well shielded from westerly winds, but the trees generate noise from that wind and impact the levels at the measurement location. This was confirmed with a review of the audio recording, and wind turbine noise was not clearly discernible. Therefore, these missed shutdowns were not critical to the evaluation of the sound level limit. The data

collected from the entire site was sufficient to allow for an evaluation of the sound levels from Crowned Ridge

COMPLAINANT CHRISTENSON'S SOUND MEASUREMENTS

Q. COMPLAINANT CHRISTENSON (PAGE 2) ASSERTS THAT THE 2021 SOUND STUDY DID NOT APPLY ANSI S12.9, PART 3 TO ELIMINATE THE LEAF RUSTLE AND INSECT NOISE. PLEASE COMMENT.

A. Although ANSI S12.9 Part 3 describes the procedure identified by the complainant, this standard pertains to short-term attended measurements and this program was mostly unattended. ANSI standard S12.100-2014 discusses the removal of high frequency natural sounds (HFNS) from sound level measurements. The adjustment, called "ANS-weighting", requires the removal of all sound level data from octave bands above the 1,000 Hz band. Sound from wind turbines is generally broadband in nature from the aerodynamic sound caused by the rotating blades. Therefore, performing ANS-weighting would not only remove HFNS but also remove some wind turbine contribution from the measured sound level and be unrepresentative of the full contribution from the project.

As already explained, no ANS-weighting was performed for this sound study or prior post-construction studies performed for Crowned Ridge as it would not have been appropriate to do so.

Q. COMPLAINANT CHRISTENSON (PAGE 6) CLAIMS THAT THERE WERE TIMES WHEN THE WIND TURBINE THAT MOST AFFECTS SOUND AT HER PROPERTY WAS TURNED OFF. SHE ADDS (PAGE 6) THAT DURING TIMES WHEN THE WIND DIRECTION AND WIND SPEED THAT MOST IMPACTS SOUND AT HER PROPERTY WERE PRESENT THE WIND TURBINE WAS SUDDENLY SHUT DOWN, WHICH RESULTED IN A FLAWED SOUND STUDY. PLEASE COMMENT.

A. It is presumed that the comment regarding sudden shutdowns pertains to the unscheduled MISO curtailments although not all curtailments resulted in the complete shutdown of the wind turbines. MISO curtailments occurred during potential evaluation periods before or after the shutdown periods listed below. Additional context regarding the evaluation, sound levels, and/or meteorological conditions is included below.

- November 5 at 1:00 – Elevated ambient sound levels (49-56 dBA). Personal observations at 9:40 indicate wind in trees as primary sound source.
- November 5 at 7:00 – Elevated ambient sound levels (49-56 dBA). Personal observations at 9:40 indicate wind in trees as primary sound source.
- November 5 at 13:00 – Elevated ambient sound levels (49-56 dBA). Personal observations at 9:40 indicate wind in trees as primary sound source.
- November 5 at 19:00 – Periods were evaluated in the report.
- November 10 at 19:00 – Measurable precipitation onsite.
- November 11 at 1:00 – Periods were evaluated in the report.
- November 11 at 7:00 - Periods were evaluated in the report.
- November 12 at 13:00 – A period was evaluated in the report. Other periods had unsteady sound.
- November 12 at 19:00 – Measurable precipitation by National Weather Service.
- November 14 at 1:00 - Periods were evaluated in the report.
- November 15 at 19:00 – Hub height wind speeds were low and periods were evaluated in the report.
- November 16 at 1:00 - Periods were evaluated in the report.
- November 16 at 7:00 – Most periods had unsteady sound around this period.
- November 16 at 13:00 - Most periods had unsteady sound around this period and hub height wind speeds were generally low.
- November 16 at 19:00 - Periods were evaluated in the report.
- November 17 at 1:00 - Periods were evaluated in the report.
- November 17 at 19:00 – A period was evaluated in the report.
- November 18 at 7:00 – Measurable precipitation by National Weather Service.

Q. COMPLAINANT CHRISTENSON (PAGE 6) CLAIMS THAT EPSILON INCORRECTLY CONCLUDED THAT WIND TURBINE SOUND AT HER PROPERTY WAS MASKED BY BACKGROUND SOUND. PLEASE COMMENT.

A. In certain instances, the measured total sound levels were within 4.0 dBA of the background sound level. As per ANSI S12.18, the source (wind turbine) sound is identified as "masked" by background sound levels and a wind turbine only level cannot be calculated. This does mean that the wind turbines are completely inaudible, but the contribution of the non-wind turbine sound levels to the total sound level is such that the wind turbine only sound level cannot be isolated under those conditions. Therefore, the term "masked" was used appropriately in the analysis.

Q. COMPLAINANT CHRISTENSON (PAGES 6-7) CLAIMS THAT THE FIXED POSITION OF THE SOUND MEASURING EQUIPMENT RESULTED IN FAULTY MEASUREMENTS BECAUSE IT WAS LOCATED ON THE EAST SIDE OF HER HOUSE INSTEAD OF THE WEST SIDE, BECAUSE THE WEST SIDE OF HER HOUSE EXPERIENCES HIGH SOUND LEVELS FROM WIND TURBINES. PLEASE COMMENT.

A. In order to allow for consistency throughout the measurement program a given measurement location should remain static for the duration of the program. The complainant directed Epsilon regarding the original placement of the sound level meter during the 2021 Sound Study. In addition, the complainant had an opportunity to relocate the sound level meter when she requested the meter be placed closer to her home but elected to have it placed the same general area just closer. Given that the residence is over 4,000 feet from the closest wind turbine, placement on the east or west corner of the residence would have no appreciable difference in the sound levels from the wind turbines.

Q. COMPLAINANT CHRISTENSON (PAGE 7) ASSERTS THAT A WINTER SOUND STUDY SHOULD BE CONDUCTED TO DETERMINE COMPLIANCE WITH THE COMMISSION'S SOUND THRESHOLDS, CLAIMING THAT

EPSILON CONDUCTED A WINTER STUDY AT A WIND ENERGY PROJECT IN NEW HAMPSHIRE. PLEASE COMMENT.

A. Epsilon has conducted post-construction sound level measurement programs during a variety of seasons. It is my understanding that the study complainant Christenson is referring to is the 2014 Sound Level Assessment Report for the Groton Wind Farm in New Hampshire. This jurisdiction required both summer and winter testing. Specific to this New Hampshire program, shutdowns were delayed approximately one week due to the very cold temperatures at the start of the winter program. The Final Decision for Crowned Ridge did not require a particular season for post-construction sound level measurements. The Mitigation Plan has the following requirement for the timing of the sound study:

> (4) perform the study in the Fall of 2021 during similar weather patterns and wind turbine output ranges that were present in October of 2020.

The 2021 Sound Study met this requirement.

In addition, sound level measurement programs in the winter introduce additional challenges which include but are not limited to, freeze\thaw cycles which can impact the stability of the equipment and can potentially damage the microphone, operational issues involving the use of electronics in very cold temperatures, properly securing equipment in deep snow cover, and power concerns related to snow cover and solar panels.

Also, according to ANSI S12.18, "Measurements during precipitation or when the ground is wet or snow covered is highly discouraged."

Q. DID EPSILON MEASURE SOUND LEVELS AT COMPLAINANT CHRISTENSON'S RESIDENCE DURING THE 2020 SOUND STUDY?

A. Sound levels were measured on the complainant's property but not at the residence. Sound levels were measured on the northern property line of the non-participating parcel for evaluation of the Codington County property line limit. Sound levels were conservatively evaluated against the limit set forth in the Final Decision at a non-participating residence

as opposed to the Codington County limit of 50 dBA at a property line in the 2020 Sound Study.

Q. DID EPSILON MEASURE SOUND LEVELS AT COMPLAINANT CHRISTENSON'S RESIDENCE DURING THE 2021 SOUND STUDY?

A. Yes.

Q. WHAT IS THE COMMISSION'S SOUND THRESHOLD FOR A NON-PARTICIPANT, SUCH AS COMPLAINANT CHRISTENSON?

A. The Project, exclusive of all unrelated background noise, shall not generate a sound pressure level (10-minute equivalent continuous sound level, Leq) of more than 45 dBA as measured within 25 feet of any non-participating residence.

Q. HAVE YOU FORMED AN OPINION ON WHETHER COMPLAINANT CHRISTENSON'S LOCATION IS COMPLAINANT WITH THE COMMISSION'S SOUND THRESHOLD FOR A NON-PARTICIPANT.

A. All of the modeling I have reviewed and post-construction sound level measurement programs I have conducted show that Crowned Ridge is compliant with the Commission's sound thresholds as they pertain to Complainant Christenson, and nothing in the Complaint filed by the Complainants or Complainant Christenson's testimony changes or impacts my opinion. I do not find that Complainant Christenson's claims of personnel observations on sound from the wind turbines can outweigh the evidence provided in the 2020 and 2021 sound studies that show her property is well below the Commission's sound thresholds.

Q. BASED ON YOUR REVIEW OF THE COMPLAINT, TESTIMONY, AND EXHIBITS OF THE COMPLAINANTS, HAVE YOU REACHED A CONCLUSION ON WHETHER AN ADDITIONAL SOUND STUDY IS NEEDED TO SHOW CROWNED RIDGE IS IN COMPLIANCE WITH THE SD PUC SOUND STUDIES?

A. Yes, I have. An additional sound study is not needed to show Crowned Ridge is in compliance with the SD PUC sound studies. As stated in the 2021 Sound Study Report, "The results of this sound level compliance assessment show (1) that under conditions when wind turbine sound levels can be accurately calculated, CRW complies with the SD PUC sound thresholds at the measured locations; and (2) because the measured locations were selected due in part to higher modeled sound levels, it follows that participant and non-participant residences not specifically evaluated during this program will also be below the applicable sound level limit."

Q. DOES THIS CONCLUDE YOUR TESTIMONY?

A. Yes.

STATE OF MASSACHUSETTS)
) ss
COUNTY OF MIDDLESEX)

I, Richard Lampeter, being duly sworn on oath, depose and state that I am the witness identified in the foregoing prepared testimony and I am familiar with its contents, and that the facts set forth are true to the best of my knowledge, information and belief.

Richard Lampeter

Subscribed and sworn to before me this 3rd day of August, 2023.

SEAL

Notary Public

My Commission Expires

KAREN LYN ROTH
Notary Public
Commonwealth of Massachusetts
My Commission Expires
April 10, 2026