

**STATE OF VERMONT
PUBLIC UTILITY COMMISSION**

McLane complaint re: Georgia Mountain	)	
Community Wind, LLC wind electric generation	)	
facility in Georgia, Vermont, turbine operation	)	Case No. 18-1040-INV
in icing conditions on April 15, 2018	)	

**RESPONSE OF GEORGIA MOUNTAIN COMMUNITY WIND
TO MCLANE COMPLAINT**

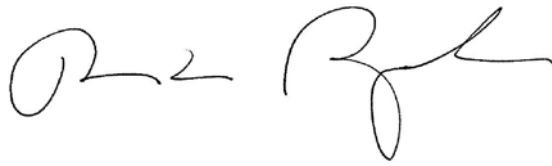
Georgia Mountain Community Wind, LLC (“GMCW”) respectfully provides the following response, as directed by the Public Utility Commission (“Commission”) in its Procedural Order of April 20, 2018, to Melodie McLane’s email of April 15, 2018. The Commission directed GMCW to state whether the turbines at the GMCW Wind Project (“Project”) were operating with ice on the blades at the time described in Ms. McLane’s email.

With this response, GMCW is providing a memorandum by Matthew Murphy, the Vice President of Fleet Management at GMCW’s owner, Greenbacker Renewable Energy Company. As Mr. Murphy indicates, on the day and time in question the Project was operating in compliance with GMCW’s Commission-approved revised Winter Operating Protocol (“Revised WOP”). The Project’s data indicates that the turbines were not operating with ice on the blades. Moreover, the Project was automatically placed in pause mode approximately half an hour after Ms. McLane called GMCW, not in response to her call, but because the Revised WOP detected changing climatic conditions that could lead to icing. The Project thereafter remained shut down for approximately 21 hours until climatic conditions no longer triggered the Revised WOP’s automatic shutdown protocol.

Accordingly, GMCW respectfully submits that this matter does not require a formal investigation by the Commission and should be closed.

Dated at Burlington, Vermont, this 25th day of April, 2018.

GEORGIA MOUNTAIN COMMUNITY WIND, LLC

A handwritten signature in black ink, appearing to read 'Andrew N. Raubvogel', written over a horizontal line.

By:

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TO: Vermont Public Utility Commission

FROM: Matthew Murphy, Vice President of Fleet Management
Greenbacker Renewable Energy Company

RE: Operation of the GMCW Project on April 15, 2018

DATE: April 25, 2018

On behalf of CPG Holder Georgia Mountain Community Wind, LLC ("GMCW") and its owner, Greenbacker Renewable Energy Company, I am responding to the Public Utility Commission's ("Commission") Procedural Order dated April 20, 2018, concerning an e-mail received by the Commission from Melodie McLane in which she stated that the GMCW Project's turbines were "running iced" on April 15, 2018 at 3:38 PM. The Commission requested a response from GMCW, including whether the turbines were operating with ice on the blades at the time described in Ms. McLane's email and an explanation supporting its response.

I have investigated the operation of the GMCW Project on the day and time in question. As explained further below, the Project was operating in compliance with GMCW's Commission-approved revised Winter Operating Protocol ("Revised WOP").¹ The Project's data indicates that the turbines were not operating with ice on the blades. Moreover, the Project was automatically placed in pause mode approximately half an hour after Ms. McLane called GMCW, not due to her call, but because the Revised WOP detected changing climatic conditions that could lead to icing. The Project thereafter remained shut down for approximately 21 hours until climatic conditions no longer triggered the Revised WOP's automatic shutdown protocol.

As the Commission is aware, GMCW developed the Revised WOP, which was subject to review by the docket parties and approval by the PUC, to automatically shut down the turbines at times when climatic conditions are conducive to ice formation.² Under the Revised WOP, the trigger values were initially set at an air temperature of 1° C and relative humidity of 93% or higher. These were set conservatively in order to gain experience on the Revised WOP's implementation and accuracy, as the document reflects:

¹ Approved by the Commission on August 24, 2017, and submitted by GMCW in final form on January 5, 2018.

² See the Commission's Order of May 31, 2011 in Docket No. 7508.

Through further testing, starting in the winter of 2017-2018, GMCW will refine threshold values or ranges which are best suited to achieve the goal of the updated WOP. As GMCW gathers additional data and experience, it will iteratively update the SCADA system to incorporate the test results.

See Revised WOP, Appendix A at pages 2-3. In practice, GMCW has set the trigger values even more conservatively than stated in the Revised WOP, at 2° C and relative humidity of 92% or higher.

The specified climatic conditions that would trigger an automatic shutdown under the Revised WOP were not present at the time of Ms. McLane's call to the GMCW phone line.³ See *Attachment 1 (e-mail from Project operator)*. Likewise, the power output from the turbines during that time was as expected, i.e., there were no aberrations or lower values that would indicate the presence of ice on the blades. See the power curve from April 15th, *Attachment 2*. Icing will manifest itself in a reduction of turbine efficiency which results in a power curve with lower values than average. The black line on Attachment 2 denotes the expected average output of the turbines in relation to given wind speeds, and the four colored lines denote the actual power output by windspeed of the turbines on April 15th. The power curve shows that the turbines were operating consistently at or above the average, indicating that the turbines were not being hindered by ice.⁴

At 4:06 PM, less than 30 minutes after Ms. McLane's call, changing climatic conditions at the site triggered an automatic shutdown of the turbines, as called for by the Revised WOP. See *Attachment 1 (e-mail)* and *Attachment 3 (power output showing shutdown)*. Note that the automatic shutdown is initiated within "real time", i.e., under a minute, of the climatic conditions being detected by on-site weather sensors and relayed through the SCADA system. Once the turbines were placed in pause mode, the Project's operators did not find any indication of ice on the turbine blades, as confirmed by power curves that were as expected and showed no significant deviations that would indicate the presence of ice. See *Attachment 2*. The Project was restarted 21 hours and 45 minutes after the shutdown at 1:52 P.M. on 4/16, once the temperature and humidity were below the Revised WOP trigger values and GMCW personnel on-site confirmed there was no icing on the blades.

In sum, the Revised WOP worked as intended in shutting down the Project under specified climatic conditions that are conducive to ice formation, and the Project data indicates that the turbines did not operate in an iced condition. GMCW does not have any further information on what Ms. McLane heard or observed during the afternoon of April 15. Nonetheless, GMCW's new owner Greenbacker is 100% committed to being responsive to the surrounding community, and thus would be more than willing to meet with Ms. McLane to discuss our operating protocols and any of her concerns.

³ Ms. McLane's message on the phone line requested that GMCW either call her back or shut down the turbines.

⁴ The effect of icing on power production is well-documented. See the report of the Finnish Meteorological Institute at <https://www.researchgate.net/publication/304177168> *Production of a Numerical Icing Atlas for Finland*. The report includes a comparison of ice-free turbine output versus three icing conditions. See https://www.researchgate.net/figure/The-power-curve-for-a-clean-WinWind3-wind-turbine-green-line-and-three-icing-cases_fig3_304177168.

Finally, GMCW would like to take this opportunity to provide the PUC with a preview of GMCW's experience thus far implementing the Revised WOP during the 2018 winter season. Under the Revised WOP, GMCW is to file a report:

by July 1 for each of the five years following approval of this Revised WOP identifying any icing events and explaining any adjustments made to the thresholds used in the testing provided in Appendix A during the prior winter.

The data collected thus far indicates that the trigger values in the Revised WOP are overly conservative and have resulted in turbine shutdowns when ice is not present. For instance, during the month of February 2018 the Project's turbines were taken offline for approximately 512 turbine hours due to the Revised WOP. However, there was no indication of ice on the turbines during approximately 20% of those hours. Likewise, during March 2018 the Revised WOP resulted in shutdowns totaling approximately 1317 turbine hours. No ice was found on the turbines for approximately 35% of those hours but the turbines remained offline because the WOP parameters were still active. The net result of the Revised WOP's over-conservatism is that during those two months alone, the GMCW Project lost approximately 563 MWh of production during times when ice was not present, with the resulting energy, capacity, and RECs not being transferred to Burlington Electric Department under the Power Purchase Agreement. GMCW therefore believes that it may be appropriate to recalibrate the trigger values in the Revised WOP to reduce the number of false positives. The first annual report in July will provide an appropriate opportunity to present the available data to the Commission and propose any changes to the Revised WOP.

Attachment 1 – E-mail from Project Operator concerning climatic conditions on 4/15/18

Attachment 2 – Power curve: Average vs. Actual on 4/15 (relative to wind speed)

Attachment 3 – Power curve on 4/15 showing shutdown

From: Michael Liska [<mailto:mliska@goldwindamericas.com>]
Sent: Wednesday, April 25, 2018 2:51 PM
To: Matthew Murphy <matthew.murphy@greenbackercapital.com>
Subject: RE: Request for data points from GMCW

Matt,

I've attached two files showing those conditions at GMCW for the below timeframes. The project was shutdown at 4:06PM once the conditions exceeded the thresholds for the WOP algorithm. Let me know if you have any questions.

Thanks,

Mike Liska
SCADA Engineer

T 1.312.948.8044

M 1.630.272.4937

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From: Matthew Murphy <matthew.murphy@greenbackercapital.com>
Sent: Wednesday, April 25, 2018 1:14 PM
To: Michael Liska <mliska@goldwindamericas.com>
Subject: Request for data points from GMCW

Hi Mike,

Using the Icing Software Data for the GMCW Project, please provide: (i) the temperature and humidity readings at the Project at 3:38 PM on 4/15/18, and (ii) the temperature, humidity, and time of day on 4/15/18 when the Project was automatically shut down under the Revised Winter Operating Protocol.

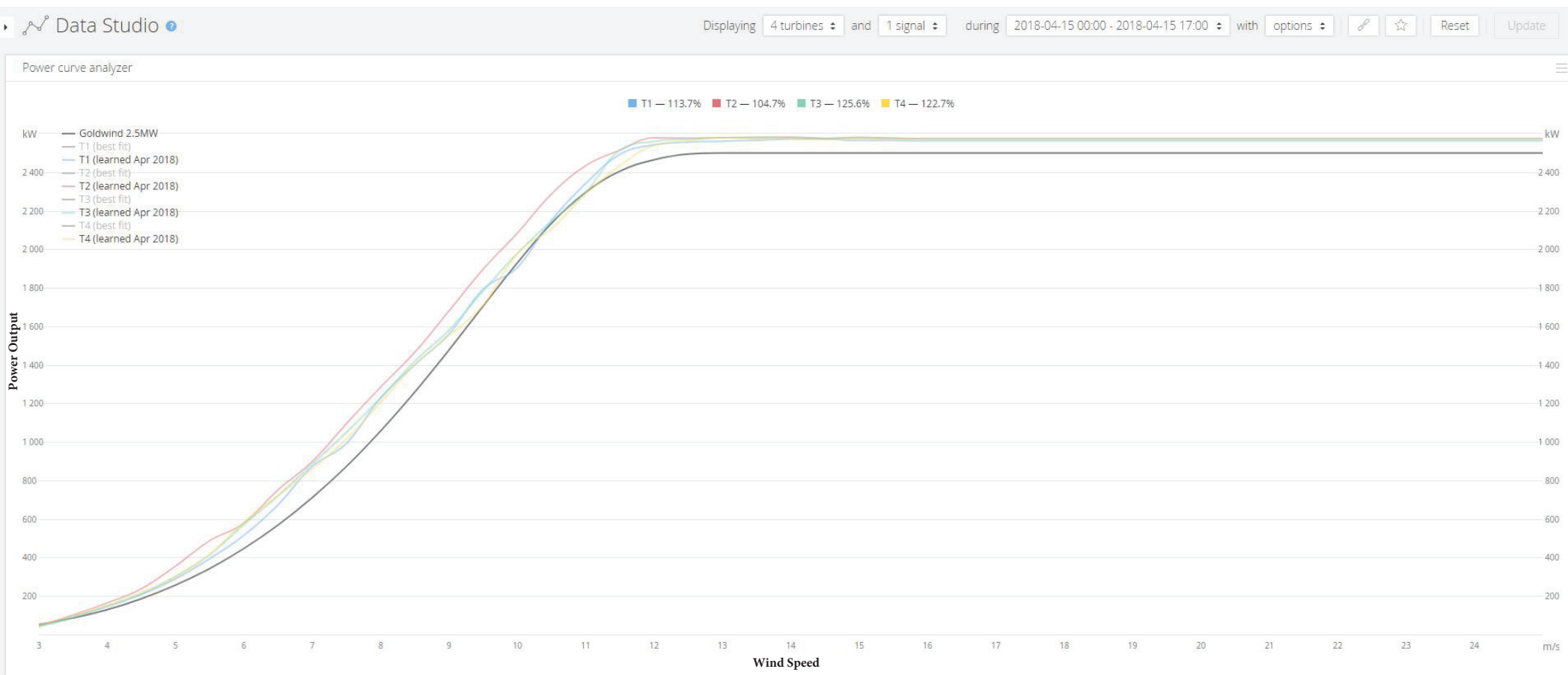
Thank you,

- Matt

Matt Murphy
Vice President of Fleet Management
Greenbacker Group
www.greenbackerrenewableenergy.com
(O) 207-352-0501

rectime	temp_avg	RH_avg	WD_SD	WSA_avg	WSA_SD	WSB_avg	WSC_avg
4/15/2018 15:37	-2.72	91.84	4.47	8.16	0.45	7.8	7.64
4/15/2018 15:38	-2.71	91.86	4.41	8.21	0.51	7.81	7.66
4/15/2018 15:39	-2.7	91.87	6.32	8.09	0.66	7.67	7.53
4/15/2018 16:03	-2.52	91.93	13.14	6.03	1.23	5.45	5.21
4/15/2018 16:04	-2.52	91.98	10.62	6.34	1.32	5.77	5.55
4/15/2018 16:05	-2.52	92	7.77	6.69	1.21	6.11	5.92
4/15/2018 16:06	-2.52	92.06	8.03	7	0.75	6.4	6.24
4/15/2018 16:07	-2.51	92.13	9.02	6.68	0.89	6.02	5.93
4/15/2018 16:08	-2.5	92.09	9.27	6.59	0.87	5.95	5.83

Power Curve - Average vs. Actual on 4/15



Power Output on 4/15, By Hour

