

EXHIBIT 12

Shadow Flicker Analysis Report

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Technical Memorandum

TO: Scott Koziar, Senior Project Manager

FROM: Scott Zeimetz, Senior GIS Specialist

DATE: December 2, 2011

SUBJECT: Shadow Flicker Analysis - New Frontier Wind Energy Project

1.0 Introduction

A shadow flicker modeling analysis was completed for the proposed turbine layout of the New Frontier Wind Energy Project (Project) in McHenry County, North Dakota. The intent of this analysis was to estimate shadow flicker potentially associated with operation of the Project. Although six turbine models are currently under consideration for the Project, the largest turbine – the Siemens 2.3 MW 113 – was used for purposes of modeling shadow flicker. Because this turbine is the largest with the longest blade lengths, it provides the most conservative (worst-case) shadow flicker scenario.

Shadow flicker caused by wind turbines is commonly defined as alternating changes in light intensity at a given stationary location, or receptor, such as the window of a home. In order for shadow flicker to occur, three conditions must be met:

- the sun must be shining with no clouds obscuring the sun;
- the rotor blades must be spinning and be located between the receptor and the sun; and
- the receptor must be sufficiently close to the turbine to be able to distinguish a shadow created by the turbine.

The shadow flicker intensity and frequency of occurrence at a given receptor are determined by a number of interacting factors:

- **Sun angle and sun path.** As the sun moves across the sky on a given day, shadows are longest during periods nearest sunrise and sunset, and shortest nearest midday. Shadows are also longer in winter than in summer. On the longest day of the year (the summer solstice), the sun's path tracks much farther to the north (in the Northern Hemisphere) and much higher in the sky than on the shortest day of the year (the winter solstice). As a result of the daily change in sun path, the duration of shadow flicker at a given receptor will change subtly from one day to the next, but significantly from one season to the next.
- **Turbine and receptor geometry.** The frequency of occurrence of shadow flicker at a given receptor tends to decrease with increasing distance between turbine and receptor. The frequency of occurrence is also affected by the direction of sightline between turbine and receptor. A turbine placed 1,000 feet due east of a given receptor with no terrain change will

cause shadow flicker (assuming operation and sunshine) at the receptor at some point during the year while a turbine placed due north of the same receptor at the same distance will not, due to the path of the sun. Additionally, the intensity of shadow flicker at a given receptor also decreases with increasing distance between turbine and receptor because the width of the rotor blade will cover less of the sun.

- **Cloud cover and degree of visibility.** As noted above, shadow flicker will not occur when the sun is obscured by clouds. A clear day has more opportunity for shadow flicker than a partly cloudy day (a cloudy day has zero potential if the sun is obscured all day). Likewise, smoke, fog, haze, or other phenomena limiting visibility would reduce the intensity of the shadow flicker.
- **Wind Direction.** The size of the area potentially affected by shadow flicker caused by a single wind turbine is based on the direction that the turbine is facing in relation to the sun and location of the receptor. The turbine is designed to face into the wind and, as a result, turbine orientation is determined by wind direction. Shadow flicker will affect a larger area if the wind is blowing from a direction so that the turbine rotor is near perpendicular to the sun-receptor view line. Similarly, shadow flicker will affect a smaller area if the wind is blowing from a direction so that the turbine rotor is near parallel to the sun-receptor view line.
- **Wind Speed.** As noted above, shadow flicker can only occur if the turbine is in operation. Turbines are designed to operate within a specific range of wind speeds. If the wind speed is too low (cut-in speed) or too high (cut-out speed), the turbine will not operate. However, most turbines still rotate slowly even below their cut-in wind speeds to maintain lubrication to all parts.
- **Local topography.** Changes in elevation between the turbine location and the receptor can either reduce or increase frequency of occurrence of shadow flicker due to that turbine, compared to flat terrain.
- **Maintenance.** Turbines which are inoperable for maintenance reasons will not cause occurrence of shadow flicker.

Because wind turbines are usually located relatively far from potential shadow receptors, shadow flicker typically occurs only at times and locations of low sun angles. This is most common just after sunrise and just before sunset, and in relatively higher latitudes (e.g., more northerly areas in the Northern Hemisphere). While shadow flicker can be perceived outdoors, it tends to be more noticeable in rooms with windows oriented to the shadows. Shadow flicker usually lasts less than 20 minutes at a typical receptor each day (AWEA, 2008).

2.0 Methodology

The shadow flicker impacts were modeled using the SHADOW module in the WindPRO version 2.7.473 software package. This software models shadow flicker at individual receptors by performing a complete simulation of the sun path throughout a whole year in user-definable time steps. Real-case shadow flicker impacts in the area surrounding the wind turbines were calculated based on data inputs including: location of the wind turbines based on the latest turbine layout, location of all nearby residences, wind turbine dimensions (113-meter rotor diameter, 80-meter hub height), sunshine probability, wind directional data, and terrain data. Based on these data, the model was able to

incorporate the appropriate sun angle and maximum daily sunlight for this latitude into the calculations. The model assumed a turbine would be located at each of 66 turbine locations – a conservative assumption since this includes a number of alternative locations where a turbine would not likely be built (e.g., if a Siemens 2.3 101 turbine is used, only 44 turbine locations out of the 66 possible turbine locations would actually be used).

The locations of the residences were digitized in ESRI’s ArcMap based on 2010 aerial imagery obtained from the Farm Service Agency’s (FSA) National Aerial Imagery Program (NAIP). This data was further refined by field visits to determine if the residence were potentially occupiable. A base elevation was assigned to each wind turbine and residence using Digital Elevation Models (DEM), with a 10 meter resolution, obtained from the United States Geological Survey (USGS). The attached map shows the location of the wind turbines and residences included in this analysis. During the initial model run, every residence was assumed to have windows facing all directions (“greenhouse” mode) which yield conservative results.

In addition, shadow flicker impacts were calculated only when the angle of the sun was at least 3° above the horizon. Monthly sunshine probability values were input for each month from January to December. These numbers were provided by the WindPRO software which chooses the nearest weather station to the project being analyzed that it has within its databases. Data for this analysis came from the National Weather Service (NWS) airport station in Bismarck, North Dakota. The table below shows average daily sunshine hours by month used in the shadow flicker modeling.

Sunshine Probability (Average Daily Sunshine Hours)											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
4.92	5.13	7.45	8.03	10.2	11.21	11.69	10.35	8.68	5.69	4.02	3.69

Wind directional data was also used in this analysis. This was completed by calculating the number of hours that the wind could be blowing in 18 different directional sectors (20° sectors). Information for this analysis was based on actual wind direction data collected by four on-site meteorological towers that were installed between November 2007 and July 2008 and collected data used for this analysis until October 2011. This analysis assumed that there would be adequate wind to operate the turbines 100 percent of the time (8,760 hours per year) – another conservative assumption. The table below shows the hourly distribution for the 18 wind directions and their corresponding number of hours per wind direction used in the shadow flicker modeling. These percentages are on an annual basis.

Operational Hours by Direction																			
20° Sectors	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total
Percent	4.1	1.7	1.3	1.4	1.1	2.0	2.9	4.5	7.4	9.4	9.1	6.5	5.5	5.7	7.4	9.8	11.5	8.6	99.9
Hrs/Year	363	149	116	119	94	177	252	397	652	825	800	568	479	501	651	856	1006	754	8,759

After the initial run of the model, only three residences showed an excess of 30 hours per year of shadow flicker using this conservative “green house” method. These three homes are participating landowners within the Project. An onsite visit was made to the three homes to confirm real variables including vegetation screening and window size to arrive at a more realistic estimate. This included digitizing hedge rows or trees around the houses using aerial imagery. These features were then

included in the WindPRO software as “obstacles” as an update to the initial run. Additionally, a second model was run which included one 1x1 meter window on each wall of the residences with over 30 hours of shadow flicker.

3.0 Modeling Results

The table below summarizes the results of the WindPRO model runs at the nearby residences.

Residence	Status	Distance to Turbine (ft)	Closest Turbine #	Flicker Greenhouse Mode (hours/year)	Flicker Highest Single Window (hours/year)
M	Participant	1436	24	74.77	58.08
H	Participant	1414	8	54.63	49.13
O	Participant	1478	33	48.77	37.04
K	Participant	1411	49	28.80	NA
L	Participant	2257	50	28.25	NA
P	Participant	1715	32	21.43	NA
J	Participant	1403	15	20.37	NA
I	Participant	1894	8	19.10	NA
F	Participant	2792	46	17.40	NA
G	Participant	1953	6	13.85	NA
B	Non-Participant	2928	1	8.07	NA
R	Non-Participant	4258	46	7.57	NA
A	Non-Participant	2937	1	7.07	NA
E	Non-Participant	2745	19	6.50	NA
S	Non-Participant	2963	46	6.33	NA
N	Non-Participant	4372	64	4.65	NA
T	Non-Participant	2596	34	4.47	NA
U	Non-Participant	3182	59	3.20	NA
D	Non-Participant	5044	21	2.23	NA
AF	Non-Participant	2684	34	0.58	NA
V	Non-Participant	4764	53	0.08	NA
W	Non-Participant	4078	30	0.00	NA
X	Non-Participant	4918	30	0.00	NA
Y	Non-Participant	5426	30	0.00	NA
AD	Non-Participant	4141	30	0.00	NA
AE	Non-Participant	4559	30	0.00	NA
Z	Non-Participant	5425	34	0.00	NA
AA	Non-Participant	5175	34	0.00	NA
AB	Non-Participant	3582	34	0.00	NA
AC	Non-Participant	5869	34	0.00	NA
Q	Non-Participant	2540	1	0.00	NA
C	Non-Participant	3099	46	0.00	NA

Maps illustrating the modeling results are attached. Additionally, the raw WindPRO data sheets are also attached.

4.0 Discussion/Conclusion

There is no federal, state, or local regulations related to allowable shadow flicker levels associated with wind farms at the Project location. Many shadow flicker analyses and discussions of potentially adoptable thresholds make reference to a value at or around 30 hours per year. Several countries (at varying levels of governance) are recommending or have adopted an unofficial not-to-exceed threshold of 30 hours per year, or 30 minutes per day. It is not entirely clear the basis of this threshold, although it appears to have been derived from a 1996 meeting of experts in Germany’s State Environmental Office - Staatlichen Umweltamt Schleswig (OVG NRW Urteil, 1998; Klemm & Partner Rechtsanwälte) and gained broader recognition since that time. There are no definitive studies that clearly show that 30 hours/year

of shadow flicker consistently result in annoyances to residents. Currently, no published scientific evidence positively links wind turbines with adverse health effects, and shadow flicker from wind turbines does not cause seizures in persons with photosensitive epilepsy (National Health and Medical Research Council, 2010).

As indicated above, a total of three occupiable structures on participating landowner's properties (residences M, H, and O) are predicted to experience more than 30 hours of shadow flicker per year. Under likely real-case scenarios incorporating conservative data this could be as much as 48.8 to 74.8 hours of shadow flicker per year; under more likely conditions these values would range from 37.0 to 58.0 hours per year. No non-participating residential structures are expected to have more than 8.1 hours of shadow flicker per year. As is Meadowlark Wind I LLC's standard practice, complaints from any landowner will be addressed on a case-by-case basis. A number of options exist to mitigate shadow flicker impacts including adding window shades and/or planting screening vegetation.

5.0 References

American Wind Energy Association. 2008. Wind Energy Siting Handbook. February 2008. Prepared by Tetra Tech EC, Inc. & Nixon Peabody LLP

American Wind Energy Association. Windpower Siting Workshop. March 1-2, 2011. Kansas City. Narum AWEA Siting Workshop 2011.ppt.
http://www.awea.org/_cs_upload/events/presentations/5418_1.pdf

Klemm & Partner Rechtsanwälte. (n.d.). *Störung durch Schattenwurf einer Windenergieanlage*.
<http://www.klemmpartner.de/veroeffentlichungen/46/217/p1/>

National Health and Medical Research Council. (2010, July). *Wind Turbines and Health*.
http://www.nhmrc.gov.au/_files_nhmrc/file/publications/synopses/public_statement_wind_turbines_and_health.pdf

OVG NRW Urteil, 7 B 956/98 (Oberverwaltungsgericht NRW July 13, 1998)

Maps

Results of Shadow Flicker Model in Relation to Occupiable Structures

WindPRO Data Sheets

Project:
New_Frontier_11117

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12/5/2011 12:01 PM / 1
Licensed user:
Element Power
421 SW 6th Ave., Suite 1000
US-PORTLAND, OR 97204
6027705189
Scott Zeimetz / scott.zeimetz@elpower.com
Calculated:
12/5/2011 11:51 AM/2.7.473

SHADOW - Main Result

Calculation: SWT 113 on 80m w obstacles

Assumptions for shadow calculations

Maximum distance for influence 2,000 m
Minimum sun height over horizon for influence 3 °
Day step for calculation 1 days
Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69

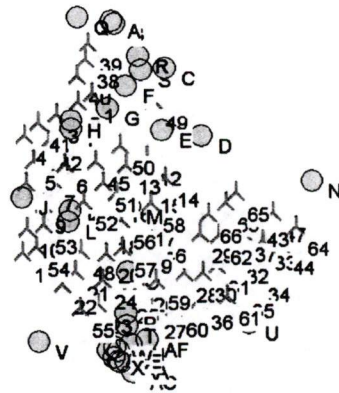
Operational time
0 1 2 3 4 5 6 7 8 9 10 11
363 149 116 119 94 177 252 397 652 825 800 568

12 13 14 15 16 17 Sum
479 501 651 856 1,006 754 8,759

Idle start wind speed: Cut in wind speed from power curve

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:

Height contours used: Height Contours: Cont_2m_opt.wpo (2)
Obstacles used in calculation
Eye height: 1.5 m
Grid resolution: 10 m



WTGs

UTM NAD83 Zone: 14				WTG type		Power, rated [kW]	Rotor diameter [m]	Hub height [m]	RPM [RPM]		
East	North	Z	Row data/Description	Valid	Manufact. Type-generator						
UTM NAD83 Zone: 14			[m]								
1	354,684.90	5,307,345.60	624.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
2	354,317.45	5,307,106.32	642.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
3	353,722.96	5,306,779.95	651.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
4	352,817.18	5,306,183.44	654.7	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
5	353,069.42	5,305,498.97	660.2	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
6	353,954.72	5,305,406.57	644.9	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
7	353,624.15	5,304,958.49	656.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
8	352,865.53	5,304,888.50	653.3	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
9	353,357.51	5,304,316.72	655.7	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
10	352,900.35	5,303,634.39	656.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
11	352,780.38	5,302,971.62	658.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
12	356,156.06	5,305,596.04	634.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
13	355,618.51	5,305,385.20	640.8	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
14	356,642.05	5,305,015.13	634.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
15	356,196.77	5,304,854.09	642.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
16	355,352.86	5,304,613.58	648.9	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
17	356,028.45	5,303,951.33	644.9	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
18	355,052.31	5,303,745.36	652.3	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
19	355,911.51	5,303,196.30	654.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
20	355,083.30	5,302,949.79	658.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
21	354,222.64	5,302,470.88	648.5	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
22	353,880.16	5,302,117.68	652.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
23	354,845.27	5,301,562.12	652.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
24	354,964.81	5,302,233.41	659.9	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
25	355,551.10	5,301,846.75	658.8	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
26	356,007.28	5,302,154.02	654.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
27	356,292.35	5,301,421.86	655.6	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0

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Project:
New_Frontier_11117

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12/5/2011 12:01 PM / 2
Licensed user:
Element Power
421 SW 6th Ave., Suite 1000
US-PORTLAND, OR 97204
6027705189
Scott Zeimetz / scott.zeimetz@elpower.com
Calculated:
12/5/2011 11:51 AM/2.7.473

SHADOW - Main Result

Calculation: SWT 113 on 80m w obstacles

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UTM NAD83 Zone: 14			WTG type									
East	North	Z	Row data/Description	Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	RPM		
UTM NAD83 Zone: 14			[m]				[kW]	[m]	[m]	[RPM]		
28	357,169.95	5,302,410.18	644.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0	
29	357,592.26	5,303,490.34	632.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0	
30	357,669.32	5,302,412.86	646.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0	
31	358,049.42	5,302,623.53	649.5	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0	
32	358,568.17	5,302,932.69	643.4	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0	
33	359,334.06	5,307,835.27	628.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0	
34	359,155.93	5,302,405.91	638.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0	
35	358,729.16	5,301,972.85	638.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0	
36	357,582.13	5,301,673.51	642.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0	
37	358,805.35	5,303,512.73	628.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0	
38	354,503.62	5,308,282.26	606.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0	
39	354,583.85	5,308,718.69	595.2	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0	
40	354,278.58	5,307,835.27	622.7	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0	
41	353,217.36	5,306,549.18	663.3	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0	
42	353,477.02	5,306,042.92	650.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0	
43	359,128.80	5,303,916.93	616.1	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0	
44	359,846.75	5,303,158.30	618.3	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0	
45	354,785.53	5,305,478.69	621.6	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0	
46	356,307.54	5,303,477.12	636.9	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0	
47	359,614.17	5,304,042.60	600.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0	
48	354,387.00	5,303,038.03	644.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0	
49	356,350.68	5,307,133.73	596.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0	
50	355,462.34	5,305,921.48	626.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0	
51	354,993.26	5,304,891.83	634.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0	
52	354,446.88	5,304,383.74	634.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0	
53	353,354.94	5,303,744.33	654.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0	
54	353,156.97	5,303,125.82	649.7	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0	
55	354,356.64	5,301,473.64	644.5	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0	
56	355,470.76	5,303,863.43	652.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0	
57	355,516.48	5,303,115.24	656.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0	
58	356,270.80	5,304,317.44	640.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0	
59	356,404.56	5,302,223.42	647.1	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0	
60	356,890.59	5,301,473.85	640.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0	
61	358,333.55	5,301,769.19	637.6	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0	
62	358,100.22	5,303,431.13	634.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0	
63	358,303.12	5,304,341.26	609.6	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0	
64	360,239.00	5,303,663.03	597.4	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0	
65	358,583.00	5,304,623.03	598.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0	
66	357,825.38	5,304,014.60	619.7	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0	

Shadow receptor-Input

UTM NAD83 Zone: 14										
No.	East	North	Z	Width	Height	Height a.g.l.	Degrees from south cw	Slope of window	Direction mode	
	[m]	[m]	[m]	[m]	[m]	[m]	[°]	[°]		
A	355,226.56	5,309,341.77	581.9	1.0	1.0	1.0	-180.0	0.0	"Green house mode"	
B	355,287.94	5,309,266.92	582.0	1.0	1.0	1.0	-180.0	0.0	"Green house mode"	
C	356,648.32	5,308,030.23	585.5	1.0	1.0	1.0	-180.0	0.0	"Green house mode"	
D	357,647.07	5,306,178.72	589.5	1.0	1.0	1.0	-180.0	0.0	"Green house mode"	
E	356,582.26	5,306,316.13	589.0	1.0	1.0	1.0	-180.0	0.0	"Green house mode"	
F	355,604.62	5,307,543.13	594.0	1.0	1.0	1.0	-180.0	0.0	"Green house mode"	
G	355,125.24	5,306,945.19	605.4	1.0	1.0	1.0	-180.0	0.0	"Green house mode"	
H	354,119.43	5,306,611.00	642.1	1.0	1.0	1.0	-180.0	0.0	"Green house mode"	

To be continued on next page...

Project:
New_Frontier_11117

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12/5/2011 12:01 PM / 3
Licensed user:
Element Power
421 SW 6th Ave., Suite 1000
US-PORTLAND, OR 97204
6027705189
Scott Zeimet / scott.zeimet@elpower.com
Calculated:
12/5/2011 11:51 AM/2.7.473

SHADOW - Main Result

Calculation: SWT 113 on 80m w obstacles

...continued from previous page

UTM NAD83 Zone: 14

No.	East	North	Z	Width	Height	Height a.g.l.	Degrees from south cw	Slope of window	Direction mode
			[m]	[m]	[m]	[m]	[°]	[°]	
I	354,133.28	5,306,374.07	643.1	1.0	1.0	1.0	-180.0	0.0	"Green house mode"
J	352,764.76	5,304,473.06	650.7	1.0	1.0	1.0	-180.0	0.0	"Green house mode"
K	354,097.00	5,304,133.53	636.9	1.0	1.0	1.0	-180.0	0.0	"Green house mode"
L	354,038.59	5,303,820.90	637.3	1.0	1.0	1.0	-180.0	0.0	"Green house mode"
M	355,699.34	5,304,240.10	649.3	1.0	1.0	1.0	-180.0	0.0	"Green house mode"
N	360,718.72	5,304,906.41	571.1	1.0	1.0	1.0	-180.0	0.0	"Green house mode"
O	355,661.11	5,302,442.52	652.5	1.0	1.0	1.0	-180.0	0.0	"Green house mode"
P	355,605.19	5,301,326.71	654.0	1.0	1.0	1.0	-180.0	0.0	"Green house mode"
Q	354,310.34	5,309,442.94	586.0	1.0	1.0	1.0	-180.0	0.0	"Green house mode"
R	355,940.03	5,308,365.04	585.0	1.0	1.0	1.0	-180.0	0.0	"Green house mode"
S	356,023.22	5,307,975.51	588.1	1.0	1.0	1.0	-180.0	0.0	"Green house mode"
T	355,634.43	5,300,982.36	647.3	1.0	1.0	1.0	-180.0	0.0	"Green house mode"
U	358,960.54	5,301,029.04	616.0	1.0	1.0	1.0	-180.0	0.0	"Green house mode"
V	353,242.76	5,300,542.14	637.2	1.0	1.0	1.0	-180.0	0.0	"Green house mode"
W	355,305.26	5,300,407.50	639.6	1.0	1.0	1.0	-180.0	0.0	"Green house mode"
X	355,287.22	5,300,129.80	634.7	1.0	1.0	1.0	-180.0	0.0	"Green house mode"
Y	355,400.97	5,300,004.29	632.0	1.0	1.0	1.0	-180.0	0.0	"Green house mode"
Z	355,446.47	5,300,001.15	632.0	1.0	1.0	1.0	-180.0	0.0	"Green house mode"
AA	355,618.26	5,299,995.66	632.6	1.0	1.0	1.0	-180.0	0.0	"Green house mode"
AB	355,727.81	5,300,487.28	637.9	1.0	1.0	1.0	-180.0	0.0	"Green house mode"
AC	355,797.03	5,299,702.85	629.5	1.0	1.0	1.0	-180.0	0.0	"Green house mode"
AD	355,109.73	5,300,327.92	640.6	1.0	1.0	1.0	-180.0	0.0	"Green house mode"
AE	355,413.02	5,300,293.85	635.7	1.0	1.0	1.0	-180.0	0.0	"Green house mode"
AF	356,159.63	5,300,614.54	639.4	1.0	1.0	1.0	-180.0	0.0	"Green house mode"

Calculation Results

Shadow receptor

No.	Shadow, worst case		Shadow, expected values	
	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow hours per year [h/year]
A	27:24	60	0:32	7:04
B	30:27	86	0:31	8:04
C	0:00	0	0:00	0:00
D	8:26	48	0:17	2:14
E	24:10	92	0:22	6:30
F	47:26	158	0:35	17:24
G	35:40	116	0:46	13:51
H	131:07	189	1:04	54:38
I	61:03	197	0:37	19:06
J	51:46	135	0:42	20:22
K	81:50	229	0:59	28:48
L	82:00	184	1:02	28:15
M	229:35	200	2:12	74:46
N	17:37	86	0:20	4:39
O	137:06	210	1:12	48:46
P	51:37	90	0:59	21:26
Q	0:00	0	0:00	0:00
R	23:50	124	0:17	7:34
S	17:12	100	0:18	6:20
T	10:20	56	0:24	4:28
U	6:35	35	0:17	3:12
V	0:14	7	0:02	0:05

To be continued on next page...

Project:
New_Frontier_111117

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12/5/2011 12:01 PM / 4
Licensed user:
Element Power
421 SW 6th Ave., Suite 1000
US-PORTLAND, OR 97204
6027705189
Scott Zeimetz / scott.zeimetz@elpower.com
Calculated:
12/5/2011 11:51 AM/2.7.473

SHADOW - Main Result

Calculation: SWT 113 on 80m w obstacles

...continued from previous page

No.	Shadow, worst case		Shadow, expected values	
	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow hours per year [h/year]
W	0:00	0	0:00	0:00
X	0:00	0	0:00	0:00
Y	0:00	0	0:00	0:00
Z	0:00	0	0:00	0:00
AA	0:00	0	0:00	0:00
AB	0:00	0	0:00	0:00
AC	0:00	0	0:00	0:00
AD	0:00	0	0:00	0:00
AE	0:00	0	0:00	0:00
AF	1:12	17	0:06	0:35

Total amount of flickering on the shadow receptors caused by each WTG

No.	Name	Worst case [h/year]	Expected [h/year]
1	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (2)	30:19	9:01
2	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (3)	29:36	11:10
3	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (4)	97:52	47:02
4	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (5)	4:32	1:37
5	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (6)	14:21	3:44
6	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (7)	0:00	0:00
7	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (8)	16:27	6:18
8	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (9)	0:00	0:00
9	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (10)	53:52	22:30
10	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (11)	13:39	4:28
11	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (12)	11:46	3:09
12	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (13)	4:25	1:16
13	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (14)	17:13	4:35
14	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (15)	0:00	0:00
15	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (16)	4:01	0:58
16	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (17)	11:47	4:43
17	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (18)	101:13	32:39
18	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (19)	53:41	17:47
19	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (20)	0:00	0:00
20	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (21)	11:34	3:27
21	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (22)	2:37	1:03
22	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (23)	2:07	0:52
23	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (24)	21:13	9:19
24	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (25)	21:00	7:10
25	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (26)	0:00	0:00
26	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (27)	85:29	29:45
27	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (28)	25:34	10:11
28	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (29)	2:06	0:51
29	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (30)	0:00	0:00
30	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (31)	0:00	0:00
31	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (32)	0:00	0:00
32	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (33)	0:00	0:00
33	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (34)	0:00	0:00
34	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (35)	0:00	0:00
35	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (36)	0:00	0:00
36	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (37)	6:34	3:12
37	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (38)	0:00	0:00
38	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (39)	13:14	5:56
39	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (40)	63:22	18:21

To be continued on next page...

Project:

New_Frontier_111117

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12/5/2011 12:01 PM / 5

Licensed user:

Element Power

421 SW 6th Ave., Suite 1000

US-PORTLAND, OR 97204

6027705189

Scott Zeimetz / scott.zeimetz@elpower.com

Calculated:

12/5/2011 11:51 AM/2.7.473

SHADOW - Main Result**Calculation: SWT 113 on 80m w obstacles**

...continued from previous page

No.	Name	Worst case [h/year]	Expected [h/year]
40	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (41)	11:42	4:29
41	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (42)	16:57	6:52
42	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (43)	58:43	15:45
43	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (44)	3:56	1:02
44	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (45)	0:00	0:00
45	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (46)	1:58	0:31
46	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (47)	0:00	0:00
47	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (48)	13:40	3:37
48	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (49)	4:22	2:07
49	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (50)	20:56	7:23
50	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (51)	12:49	3:57
51	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (52)	0:00	0:00
52	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (53)	4:19	1:42
53	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (54)	47:55	16:05
54	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (55)	20:15	5:51
55	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (56)	13:12	5:23
56	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (57)	65:41	20:10
57	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (58)	3:34	1:14
58	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (59)	36:07	13:59
59	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (60)	16:12	5:44
60	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (61)	12:03	4:38
61	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (62)	0:00	0:00
62	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (63)	0:00	0:00
63	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (64)	0:00	0:00
64	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (65)	0:00	0:00
65	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (66)	0:00	0:00
66	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (67)	0:00	0:00

Project:
111202 NFW Windows

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12/5/2011 1:37 PM / 1
Licensed user:
Element Power
421 SW 6th Ave., Suite 1000
US-PORTLAND, OR 97204
6027705189
Scott Zeimetz / scott.zeimetz@elpower.com
Calculated:
12/5/2011 1:37 PM/2.7.473

SHADOW - Main Result

Calculation: SWT 113 on 80m Windows w obstacles

Assumptions for shadow calculations

Maximum distance for influence 2,000 m
Minimum sun height over horizon for influence 3 °
Day step for calculation 1 days
Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [BISMARCK]
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
4.92 5.13 7.45 8.03 10.20 11.21 11.69 10.35 8.68 5.69 4.02 3.69

Operational time
0 1 2 3 4 5 6 7 8 9 10 11
363 149 116 119 94 177 252 397 652 825 800 568

12 13 14 15 16 17 Sum
479 501 651 856 1,006 754 8,759

Idle start wind speed: Cut in wind speed from power curve

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:
Height contours used: Height Contours: Cont_2m_opt.wpo (2)
Obstacles used in calculation

Eye height: 1.5 m
Grid resolution: 10 m



Scale 1:125,000
New WTG Shadow receptor

WTGs

UTM NAD83 Zone: 14				WTG type		Power rated [kW]	Rotor diameter [m]	Hub height [m]	RPM [RPM]	
East	North	Z	Row data/Description	Valid	Manufact. Type-generator					
UTM NAD83 Zone: 14 [m]										
1	354,684.90	5,307,345.60	624.0	Siemens SWT-2.3-113 2300 1... Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
2	354,317.45	5,307,106.32	642.0	Siemens SWT-2.3-113 2300 1... Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
3	353,722.96	5,306,779.95	651.0	Siemens SWT-2.3-113 2300 1... Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
4	352,817.18	5,306,183.44	654.7	Siemens SWT-2.3-113 2300 1... Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
5	353,069.42	5,305,498.97	660.2	Siemens SWT-2.3-113 2300 1... Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
6	353,954.72	5,305,406.57	644.9	Siemens SWT-2.3-113 2300 1... Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
7	353,624.15	5,304,958.49	656.0	Siemens SWT-2.3-113 2300 1... Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
8	352,865.53	5,304,888.50	653.3	Siemens SWT-2.3-113 2300 1... Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
9	353,357.51	5,304,316.72	655.7	Siemens SWT-2.3-113 2300 1... Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
10	352,900.35	5,303,634.39	656.0	Siemens SWT-2.3-113 2300 1... Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
11	352,780.38	5,302,971.62	658.0	Siemens SWT-2.3-113 2300 1... Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
12	356,156.06	5,305,596.04	634.0	Siemens SWT-2.3-113 2300 1... Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
13	355,618.51	5,305,385.20	640.8	Siemens SWT-2.3-113 2300 1... Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
14	356,642.05	5,305,015.13	634.0	Siemens SWT-2.3-113 2300 1... Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
15	356,196.77	5,304,854.09	642.0	Siemens SWT-2.3-113 2300 1... Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
16	355,352.86	5,304,613.58	648.9	Siemens SWT-2.3-113 2300 1... Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
17	356,028.45	5,303,951.33	644.9	Siemens SWT-2.3-113 2300 1... Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
18	355,052.31	5,303,745.36	652.3	Siemens SWT-2.3-113 2300 1... Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
19	355,911.51	5,303,196.30	654.0	Siemens SWT-2.3-113 2300 1... Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
20	355,083.30	5,302,949.79	658.0	Siemens SWT-2.3-113 2300 1... Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
21	354,222.64	5,302,470.88	648.5	Siemens SWT-2.3-113 2300 1... Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
22	353,880.16	5,302,117.68	652.0	Siemens SWT-2.3-113 2300 1... Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
23	354,845.27	5,301,562.12	652.0	Siemens SWT-2.3-113 2300 1... Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
24	354,964.81	5,302,233.41	659.9	Siemens SWT-2.3-113 2300 1... Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
25	355,551.10	5,301,846.75	658.8	Siemens SWT-2.3-113 2300 1... Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
26	356,007.28	5,302,154.02	654.0	Siemens SWT-2.3-113 2300 1... Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
27	356,292.35	5,301,421.86	655.6	Siemens SWT-2.3-113 2300 1... Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0

To be continued on next page...

Project:
111202 NFW Windows

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12/5/2011 1:37 PM / 2
Licensed user:
Element Power
421 SW 6th Ave., Suite 1000
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6027705189
Scott Zeimetz / scott.zeimetz@elpower.com
Calculated:
12/5/2011 1:37 PM/2.7.473

SHADOW - Main Result

Calculation: SWT 113 on 80m Windows w obstacles

...continued from previous page

UTM NAD83 Zone: 14				WTG type		Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	RPM [RPM]	
East	North	Z	Row data/Description	Valid	Manufact.						
UTM NAD83 Zone: 14			[m]								
28	357,169.95	5,302,410.18	644.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
29	357,592.26	5,303,490.34	632.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
30	357,669.32	5,302,412.86	646.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
31	358,049.42	5,302,623.53	649.5	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
32	358,568.17	5,302,932.69	643.4	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
33	359,334.06	5,303,282.30	628.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
34	359,155.93	5,302,405.91	638.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
35	358,729.16	5,301,972.85	638.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
36	357,582.13	5,301,673.51	642.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
37	358,805.35	5,303,512.73	628.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
38	354,503.62	5,308,282.26	606.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
39	354,583.85	5,308,718.69	595.2	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
40	354,278.58	5,307,835.27	622.7	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
41	353,217.36	5,306,549.18	663.3	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
42	353,477.02	5,306,042.92	650.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
43	359,128.80	5,303,916.93	616.1	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
44	359,846.75	5,303,038.03	618.3	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
45	354,785.53	5,305,478.69	621.6	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
46	356,307.54	5,303,477.12	636.9	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
47	359,614.17	5,304,042.60	600.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
48	354,387.00	5,303,038.03	644.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
49	356,350.68	5,307,133.73	596.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
50	355,462.34	5,305,921.48	626.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
51	354,993.26	5,304,891.83	634.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
52	354,446.88	5,304,383.74	634.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
53	353,354.94	5,303,744.33	654.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
54	353,156.97	5,303,125.82	649.7	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
55	354,356.64	5,301,473.64	644.5	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
56	355,470.76	5,303,863.43	652.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
57	355,516.48	5,303,115.24	656.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
58	356,270.80	5,304,317.44	640.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
59	356,404.56	5,302,223.42	647.1	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
60	356,890.59	5,301,473.85	640.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
61	358,333.55	5,301,769.19	637.6	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
62	358,100.22	5,303,431.13	634.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
63	358,303.12	5,304,341.26	609.6	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
64	360,239.00	5,303,663.03	597.4	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
65	358,583.00	5,304,623.03	598.0	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0
66	357,825.38	5,304,014.60	619.7	Siemens SWT-2.3-113 2300 1...	Yes	Siemens	SWT-2.3-113-2,300	2,300	113.0	80.0	0.0

Shadow receptor-Input

UTM NAD83 Zone: 14									
No.	East	North	Z	Width	Height	Height a.g.l.	Degrees from south cw	Slope of window	Direction mode
				[m]	[m]	[m]	[°]	[°]	
A	354,119.43	5,306,611.00	642.1	1.0	1.0	1.0	-180.0	90.0	Fixed direction
B	354,124.45	5,306,610.87	642.0	1.0	1.0	1.0	-90.0	90.0	Fixed direction
C	354,124.45	5,306,610.87	642.0	1.0	1.0	1.0	0.0	90.0	Fixed direction
D	354,124.05	5,306,594.87	642.1	1.0	1.0	1.0	90.0	90.0	Fixed direction
E	355,699.34	5,304,240.10	649.3	1.0	1.0	1.0	-180.0	90.0	Fixed direction
F	355,697.00	5,304,240.13	649.3	1.0	1.0	1.0	-90.0	90.0	Fixed direction
G	355,695.00	5,304,240.16	649.3	1.0	1.0	1.0	0.0	90.0	Fixed direction
H	355,694.00	5,304,240.19	649.3	1.0	1.0	1.0	90.0	90.0	Fixed direction

To be continued on next page...

Project:
111202 NFW Windows

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Licensed user:
Element Power
421 SW 6th Ave., Suite 1000
US-PORTLAND, OR 97204
6027705189
Scott Zeimet / scott.zeimet@elpower.com
Calculated:
12/5/2011 1:37 PM/2.7.473

SHADOW - Main Result

Calculation: SWT 113 on 80m Windows w obstacles

...continued from previous page

UTM NAD83 Zone: 14

No.	East	North	Z	Width	Height	Height	Degrees from	Slope of	Direction mode
				[m]	[m]	a.g.l.	south cw	window	
			[m]	[m]	[m]	[m]	[°]	[°]	
I	355,659.00	5,302,438.03	652.6	1.0	1.0	1.0	-45.0	90.0	Fixed direction
J	355,661.11	5,302,440.03	652.6	1.0	1.0	1.0	-135.0	90.0	Fixed direction
K	355,660.00	5,302,439.03	652.6	1.0	1.0	1.0	-45.0	90.0	Fixed direction
L	355,656.00	5,302,438.06	652.6	1.0	1.0	1.0	45.0	90.0	Fixed direction
M	355,655.00	5,302,439.03	652.6	1.0	1.0	1.0	135.0	90.0	Fixed direction

Calculation Results

Shadow receptor

No.	Shadow, worst case			Shadow, expected values
	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow hours per year [h/year]
A	93:07	100	1:04	45:18
B	3:55	42	0:10	1:21
C	38:31	90	0:39	10:23
D	118:44	169	1:04	49:13
E	39:16	75	0:46	15:13
F	133:58	193	1:02	48:45
G	187:08	126	2:11	58:08
H	93:10	110	1:18	25:32
I	101:43	169	1:00	36:36
J	95:58	175	0:58	34:32
K	103:07	174	1:00	37:04
L	36:56	163	0:40	12:36
M	33:09	129	0:40	11:14

Total amount of flickering on the shadow receptors caused by each WTG

No.	Name	Worst case [h/year]	Expected [h/year]
1	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (2)	0:00	0:00
2	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (3)	0:00	0:00
3	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (4)	98:58	48:16
4	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (5)	0:00	0:00
5	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (6)	0:00	0:00
6	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (7)	0:00	0:00
7	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (8)	0:00	0:00
8	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (9)	0:00	0:00
9	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (10)	0:00	0:00
10	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (11)	0:00	0:00
11	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (12)	0:00	0:00
12	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (13)	0:00	0:00
13	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (14)	1:51	0:35
14	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (15)	0:00	0:00
15	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (16)	0:00	0:00
16	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (17)	0:00	0:00
17	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (18)	98:53	33:11
18	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (19)	34:12	9:54
19	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (20)	0:00	0:00
20	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (21)	0:00	0:00
21	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (22)	2:39	1:04
22	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (23)	1:01	0:19
23	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (24)	0:00	0:00

To be continued on next page...

Project:
111202 NFW Windows

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 12/5/2011 1:37 PM / 4
 Licensed user:
Element Power
 421 SW 6th Ave., Suite 1000
 US-PORTLAND, OR 97204
 6027705189
 Scott Zeimetz / scott.zeimetz@elpower.com
 Calculated:
 12/5/2011 1:37 PM/2.7.473

SHADOW - Main Result

Calculation: SWT 113 on 80m Windows w obstacles

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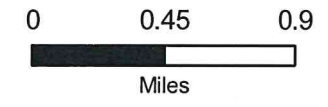
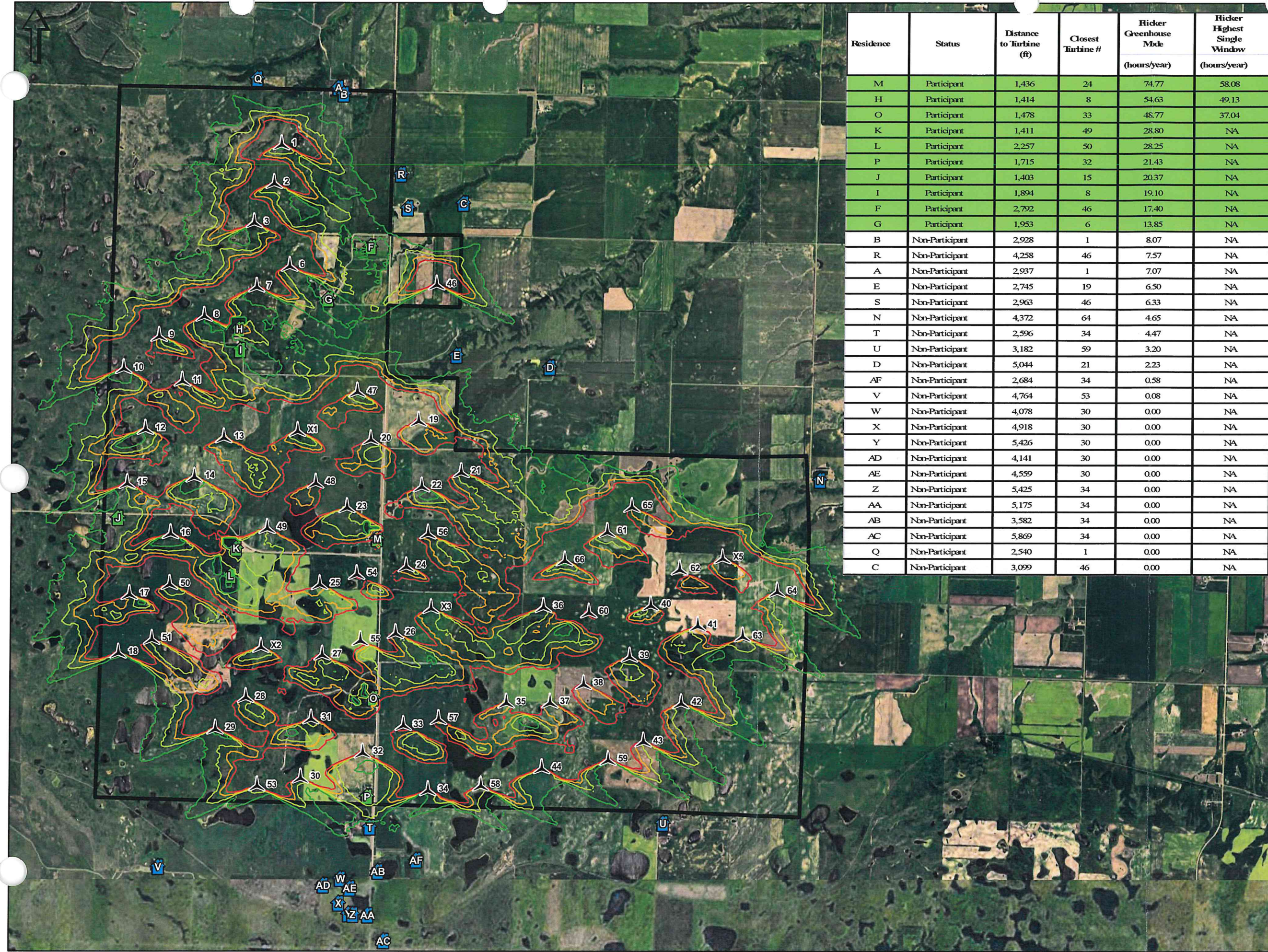
No.	Name	Worst case [h/year]	Expected [h/year]
24	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (25)	21:40	6:52
25	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (26)	0:00	0:00
26	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (27)	86:24	30:28
27	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (28)	0:00	0:00
28	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (29)	2:05	0:50
29	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (30)	0:00	0:00
30	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (31)	0:00	0:00
31	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (32)	0:00	0:00
32	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (33)	0:00	0:00
33	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (34)	0:00	0:00
34	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (35)	0:00	0:00
35	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (36)	0:00	0:00
36	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (37)	0:00	0:00
37	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (38)	0:00	0:00
38	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (39)	0:00	0:00
39	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (40)	0:00	0:00
40	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (41)	0:00	0:00
41	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (42)	0:00	0:00
42	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (43)	38:30	10:10
43	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (44)	0:00	0:00
44	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (45)	0:00	0:00
45	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (46)	0:00	0:00
46	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (47)	0:00	0:00
47	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (48)	0:00	0:00
48	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (49)	4:25	2:09
49	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (50)	0:00	0:00
50	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (51)	2:02	0:41
51	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (52)	0:00	0:00
52	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (53)	3:29	1:22
53	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (54)	0:00	0:00
54	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (55)	0:00	0:00
55	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (56)	3:36	1:00
56	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (57)	56:20	15:49
57	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (58)	0:00	0:00
58	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (59)	35:59	13:54
59	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (60)	16:30	6:19
60	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (61)	3:24	1:12
61	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (62)	0:00	0:00
62	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (63)	0:00	0:00
63	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (64)	0:00	0:00
64	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (65)	0:00	0:00
65	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (66)	0:00	0:00
66	Siemens SWT-2.3-113 2300 113.0 !O! hub: 80.0 m (67)	0:00	0:00

Flicker Modeling Flicker Contours Siemens 2.3 113

New Frontier Wind Energy Project McHenry County, North Dakota

- Project Area
- Turbine Location
- Occupiable Structures**
 - Participant
 - Non-Participant
- Flicker Contour (hr/yr)**
 - 15
 - 30
 - 45
 - 60

Residence	Status	Distance to Turbine (ft)	Closest Turbine #	Hicker Greenhouse Mde	Hicker Highest Single Window
				(hours/year)	(hours/year)
M	Participant	1,436	24	74.77	58.08
H	Participant	1,414	8	54.63	49.13
O	Participant	1,478	33	48.77	37.04
K	Participant	1,411	49	28.80	NA
L	Participant	2,257	50	28.25	NA
P	Participant	1,715	32	21.43	NA
J	Participant	1,403	15	20.37	NA
I	Participant	1,894	8	19.10	NA
F	Participant	2,792	46	17.40	NA
G	Participant	1,953	6	13.85	NA
B	Non-Participant	2,928	1	8.07	NA
R	Non-Participant	4,258	46	7.57	NA
A	Non-Participant	2,937	1	7.07	NA
E	Non-Participant	2,745	19	6.50	NA
S	Non-Participant	2,963	46	6.33	NA
N	Non-Participant	4,372	64	4.65	NA
T	Non-Participant	2,596	34	4.47	NA
U	Non-Participant	3,182	59	3.20	NA
D	Non-Participant	5,044	21	2.23	NA
AF	Non-Participant	2,684	34	0.58	NA
V	Non-Participant	4,764	53	0.08	NA
W	Non-Participant	4,078	30	0.00	NA
X	Non-Participant	4,918	30	0.00	NA
Y	Non-Participant	5,426	30	0.00	NA
AD	Non-Participant	4,141	30	0.00	NA
AE	Non-Participant	4,559	30	0.00	NA
Z	Non-Participant	5,425	34	0.00	NA
AA	Non-Participant	5,175	34	0.00	NA
AB	Non-Participant	3,582	34	0.00	NA
AC	Non-Participant	5,869	34	0.00	NA
Q	Non-Participant	2,540	1	0.00	NA
C	Non-Participant	3,099	46	0.00	NA



Source: ESRI (2011), NGS USA Topo (2011) / USGS 24k quad, WindPRO DECIBEL (2011).

