FINAL

SHADOW FLICKER REPORT FOR THE DEVELOPMENT OF WIND ENERGY FACILITIES AT NAVSTA NEWPORT, RHODE ISLAND

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EXECUTIVE SUMMARY

The U.S. Naval Station (NAVSTA) Newport proposes to build a wind energy project with a potential to support up to 9 megawatts (MW) at 12 potential wind turbine sites in Newport, Rhode Island. This report summarizes the results of a computer model study to determine the extent of 'shadow flicker' on receptors in the vicinity of the following wind turbine models: PowerWind 56–900 kilowatt (kW) at Sites 1, 2, and 4, GE 1.5 MW sle at Sites 3, 5, 6, and 8, and Vestas V112–3.0 MW at Sites 7, 9, 10a, 10b, and 11.

Shadow flicker is the term used to describe an intermittent change in the intensity of light in a given area resulting from the operation of a wind turbine. This is a result of the sun casting intermittent shadows from the rotating blades of wind turbine onto a sensitive receptor such as a window in a building. The 'flicker' is due to alternating light intensity between the direct beam of sunlight and the shadow from the turbine blade. Base on current design and operation of typical wind turbines, shadow flicker impacts are generally an annoyance issue but not a health concern.

The shadow-flicker impacts were modeled using the *WindPRO 2.7 Basis software* (WindPRO), and associated shadow module *version 2.7.473.* Worst-case shadow flicker impacts in the area surrounding the wind turbines were calculated based on the following data inputs: wind turbine locations, all receptor locations within 1,000 feet (3,281 meters) of the wind turbines, wind turbine dimensions, and terrain data. Based on these data, the model was able to incorporate the appropriate sun angle and maximum daily sunlight for this latitude. The model was further refined by incorporating sunshine probabilities and wind turbine operational estimates by wind direction over the course of a year. Every receptor was assumed to have windows facing all directions ("greenhouse" mode) which yields conservative results. Any obstacles (structures or vegetation lying between a receptor and wind turbine) and existing wind treatment (awnings, shades, or blinds) were excluded from the full analysis. In addition, shadow flicker impacts were calculated only when the angle of the sun was at least 3° above the horizon.

Using the assumptions stated above, *WindPRO* calculated shadow flicker for 172 receptors nearest to each of the proposed 12 wind turbines. Twelve of the 172 receptors were predicted to have total annual impacts over 30 hours per year (hr/yr) exceeding the allowable calculated shadow flicker limits based on the German "*Hinweise*". These worse-case receptors/wind turbine sites were predicted to have a combined total of 894 hours 33 minutes for the following 12 sites:

- Receptor 9A Baseball Field NAVSTA/Bishop Rock – 39:46 hours: minutes per year (hr:min/yr),
- Receptor 10aB Nimitz Field NAVSTA/10a Prichard Field North – 52:09 hr:min/yr,
- Receptor 10aC Building 440 A/C Classrooms NAVSTA/10a Prichard Field North – 52:02 hr:min/yr,
- Receptor 10aI Building 291 NAVSTA/10a Prichard Field North – 44:27 hr:min/yr,
- Receptor 10aK Building 292 NAVSTA/10a Prichard Field North – 64:08 hr:min/yr,
- Receptor 10aL Building 1372 NAVSTA/10a Prichard Field North – 53:00 hr:min/yr,
- Receptor 10aM Building 197 NAVSTA/10a Prichard Field North – 175:77 hr:min/yr,
- Receptor 10aO Harbor Seal Haul-out Site – 55:51 hr:min/yr,
- Receptor 10bA Baseball Field NAVSTA/10b Prichard Field South – 227:34 hr:min/yr,

- Receptor 10bD Building 440 A/C Classrooms NAVSTA/10a Prichard Field North – 32:14 hr:min/yr.
- Receptor 10bM Building 1372 NAVSTA/10b Prichard Field South – 43:11 hr:min/yr, and
- Receptor 10bO Building 1172 Chapel NAVSTA/10b Prichard Field South – 82:45 hr:min/yr,

In addition, one receptor/site (Receptor 10bC Nimitz Field/10b Prichard Field South - 29:04 hr:min/yr) was border-line in respect to the allowable calculated flicker limits.

In conclusion, the conservative predicted levels of shadow flicker at 12 of these receptor locations ranged from higher to excessively higher (1.1 to 7.6 times) than the 30-hr/yr threshold. Wind turbine Site 9 exhibit one receptor location exceeding the 30-hr/yr threshold, while wind turbine Sites 10a and 10b had seven and four receptor locations for each site exceeding the 30-hr/yr threshold.

The majority of the receptor building sites (wind turbine Sites 6 through 11) on NAVSTA Newport would experience shadow flicker effects in the daylight hours before or after 16:00 from late fall to early spring, while the remaining receptor building sites would receive shadow flicker effects in early morning (6:00 – 8:00) or during mid daylight hours (12:30 – 15:30) in the summer months. Overall, shadow flicker effects during NAVSTA normal operating hours (7:30 – 16:00) would be extremely low. More than half of the residential receptor sites (wind turbine Sites 1 through 8) affected by shadow flickers effects would occur from the daylight hours after 16:00 up to 19:00 for a month long period in early to late spring and fall. The remaining receptor residential sites would occur during the same hourly timeframe predominately in the winter months.

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WindPRO Shadow Flicker Analysis: main result, calendar tabular per receptor, calendar graphic per receptor, calendar tabular per WTG, calendar graphic per WTG, and contour map

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LIST OF ACRONYMS AND ABBREVIATIONS

^{o}	Degree(s)
ac	Acre(s)
ASL	Above Sea Level
DEM	Digital Elevation Model
FAA	Federal Aviation Administration
ft	Foot(Feet)
ha	Hectare(s)
hr(s):min/day	Hour(s):Minutes per Day
hr(s):min/yr	Hour(s):Minutes per Year
hr(s)/yr	Hour(s) per Year
Hz	Hertz
km	Kilometer(s)
kW	Kilowatt(s)
m	Meter(s)
m^2	Square Meter(s)
mi	Mile(s)
MW	Megawatt(s)
NAVSTA	Naval Station
NUWC	Naval Undersea Warfare Center
U.S.	United States
USGS	United States Geological Survey
USN	United States Navy
WTG	Wind Turbine Generator

1.0 PROJECT OVERVIEW

The United States Navy (USN) proposes to construct, operate, and maintain a wind turbine project at Naval Station (NAVSTA) Newport, Rhode Island. The NAVSTA Newport project would consists of up to 12 wind turbines with a capacity to generate up to 9 megawatts (MW) of power. The total power generated by these turbines would help offset NAVSTA Newport's base electrical usage load of 10 MW.

The potential wind turbine locations include eight sites on the NAVSTA Newport main base and four sites on naval land located north of the main base. NAVSTA Newport is located partially within the City of Newport and extends northward incorporating the entire western shoreline of the Town of Middletown and about one-fifth of the Town of Portsmouth's west shoreline (**Figure 1**). Aquidneck Island, measuring 15 miles (mi; 24.1 kilometers [km]) from north to south and less than 5 mi (8 km) in width, is surrounded by Narragansett Bay to the west, Rhode Island Sound to the south, the Sakonnet River to the east, and Mount Hope Bay to the north. The 1,388-acre (ac; 561.7-hectare [ha]) naval complex is situated along the west shore of the island with over 10 mi (16.1 km) of frontage on the East Passage of Narragansett Bay (The Louis Berger Group 2001; NAVFAC 2008).

The upland topography of the project study area is irregular. The west side of Aquidneck Island slopes up from sea level to an average elevation of about 100 feet (ft; 30.48 meters [m]) within 0.5 mi (0.805 km) of the shoreline. At the north end of NAVSTA Newport, elevations exceed 150 ft (492.2 m), within 2,000 ft (609.6 m) of the shore. These relatively steep hillsides were carved for the installation of underground fuel tanks at the Melville area. The Naval Undersea Warfare Center (NUWC), in Middletown, encompasses the crest and flanks of a hill rising to about 80 ft (24.38 m) above sea level (ASL). In contrast, the Naval Hospital, Coddington Point, and the shoreside portions of Coddington Cove and Melville lie on nearly flat terrain. Coasters Harbor Island is essentially a large outcropping of bedrock that slopes upward to an elevation of approximately 50 ft (15.24 m) near the center of the island. Land use adjacent to the main NAVSTA Newport vicinity is predominately urban (e.g., commercial, industrial, or residential), while the outlying land parcels north of the base are rural (agricultural) or recreational (golf courses) in nature (The Cecil Group et al. 2005; NAVFAC 2010).

The study assumes that three potential wind turbine types will be utilized depending on the site location (**Figure 1** and **Table 1**). These wind turbine types include the following models: PowerWind 56-900 kilowatt (kW), GE 1.5 MW sle, or Vestas V112-3.0 MW. The major components of these wind turbines include the blades and hub (collectively called the rotor), the nacelle, and the tower. Inside the nacelle are the gearbox, generator, and various other components critical for operation of the wind turbine. **Figure 2** provides a generalized representation of a wind turbine. The actual range of dimensions for these wind turbines include the height of the tower, or "hub height" (height from the foundation to the top of the tower) which ranges from 193.6 to 275.6 ft (59 to 84 m). The nacelle sits atop the tower and the rotor hub is mounted to the nacelle. The rotor diameter ranges from 183.7 to 367.5 ft (56 to 112 m) with their total turbine heights (i.e., the height with the blade tip in the highest position) ranging from 285.4 to 459.3 ft (87 to 140 m).

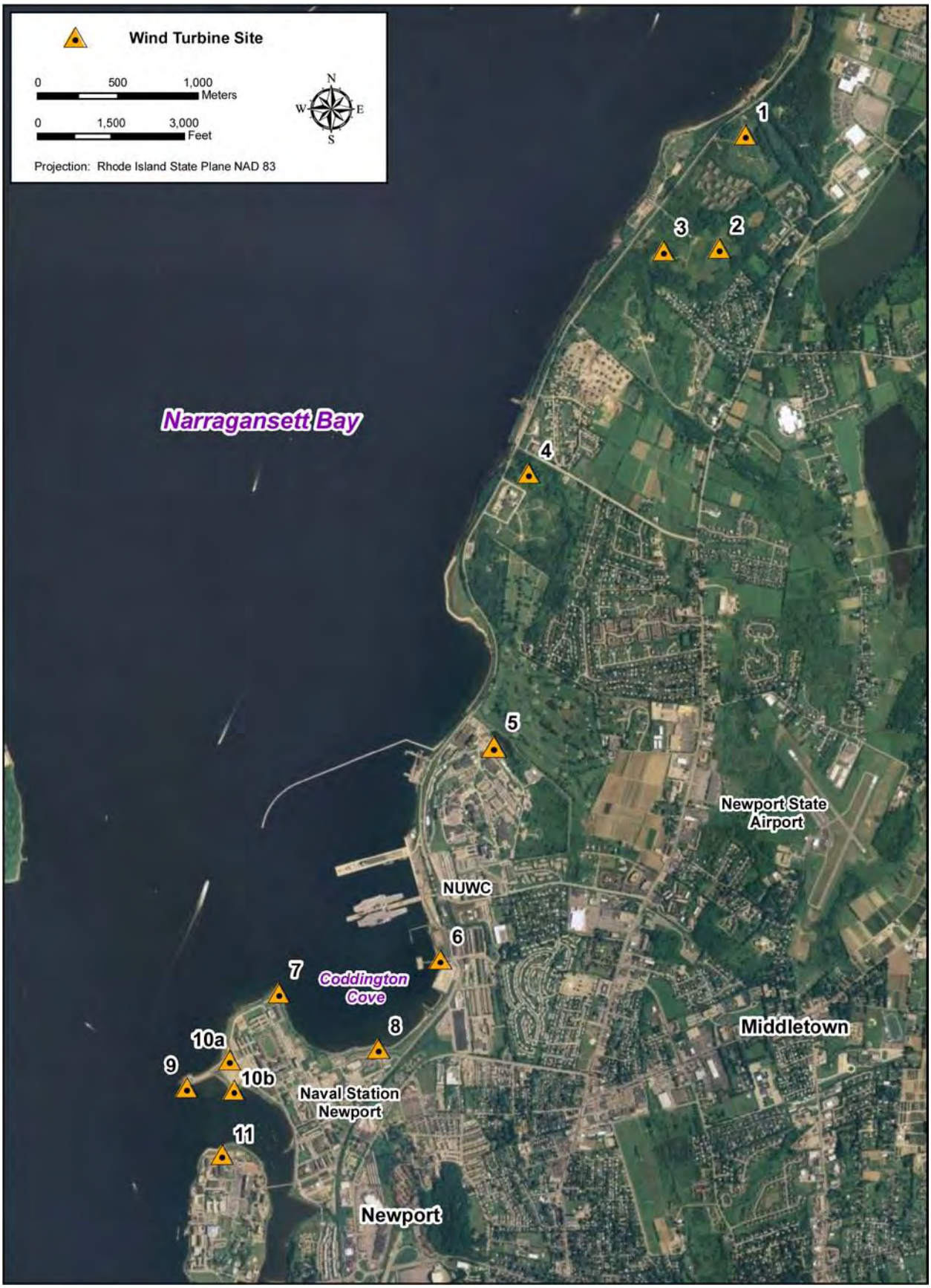

Figure 1. Potential Wind Turbine Locations at NAVSTA Newport.

Table 1
Potential Wind Turbine Site Information for NAVSTA Newport

Turbine Site Number	Turbine Site Name	FAA Maximum Height (ft/m)	Maximum Turbine Size Model
1	Tank Farm 3[1]	307 / 93.6	PowerWind 56-900 kW
2	Tank Farm 4B[1]	290 / 88.4	PowerWind 56-900 kW
3	Tank Farm 4A[1]	339 / 103	GE 1.5 MW sle
4	Tank Farm 5C[1]	296 / 90.2	PowerWind 56-900 kW
5	Naval Undersea Warfare Center (NUWC)[2]	324 / 98.8	GE 1.5 MW sle
6	Building 6 (Derecktor Shipyard)[3]	335 / 102	GE 1.5 MW sle
7	Building 1112 (Coddington Point)[4]	459 / 140	Vestas V112-3.0 MW
8	Building 1285 (Navy Lodge)[5]	345 / 105	GE 1.5 MW sle
9	Bishop Rock[6]	459 / 140	Vestas V112-3.0 MW
10a	Prichard Field North[7]	459 / 140	Vestas V112-3.0 MW
10b	Prichard Field South[8]	459 / 140	Vestas V112-3.0 MW
11	Katy Field[9]	459 / 140	Vestas V112-3.0 MW

FAA = Federal Aviation Administration; ft = feet; m = meters; kW = kilowatt; MW = megawatt

[1] Navy property north of main NAVSTA Newport formerly used for fueling operations. Currently unused open space.

[2] Navy property operated by NUWC in close proximity to the Narragansett Bay shoreline and NUWC gate 32.

[3] Formerly used shipyard adjacent to Coddington Cove.

[4] Area extending out into the western portion of Coddington Cove.

[5] Are adjacent to the southern portion of Coddington Cove and the Navy Lodge.

[6] Area on peninsula adjacent to Narragansett Bay.

[7] Area adjacent to Narragansett Bay.

[8] Area adjacent to Coasters Harbor.

[9] Northern most point of Coasters Harbor Island.

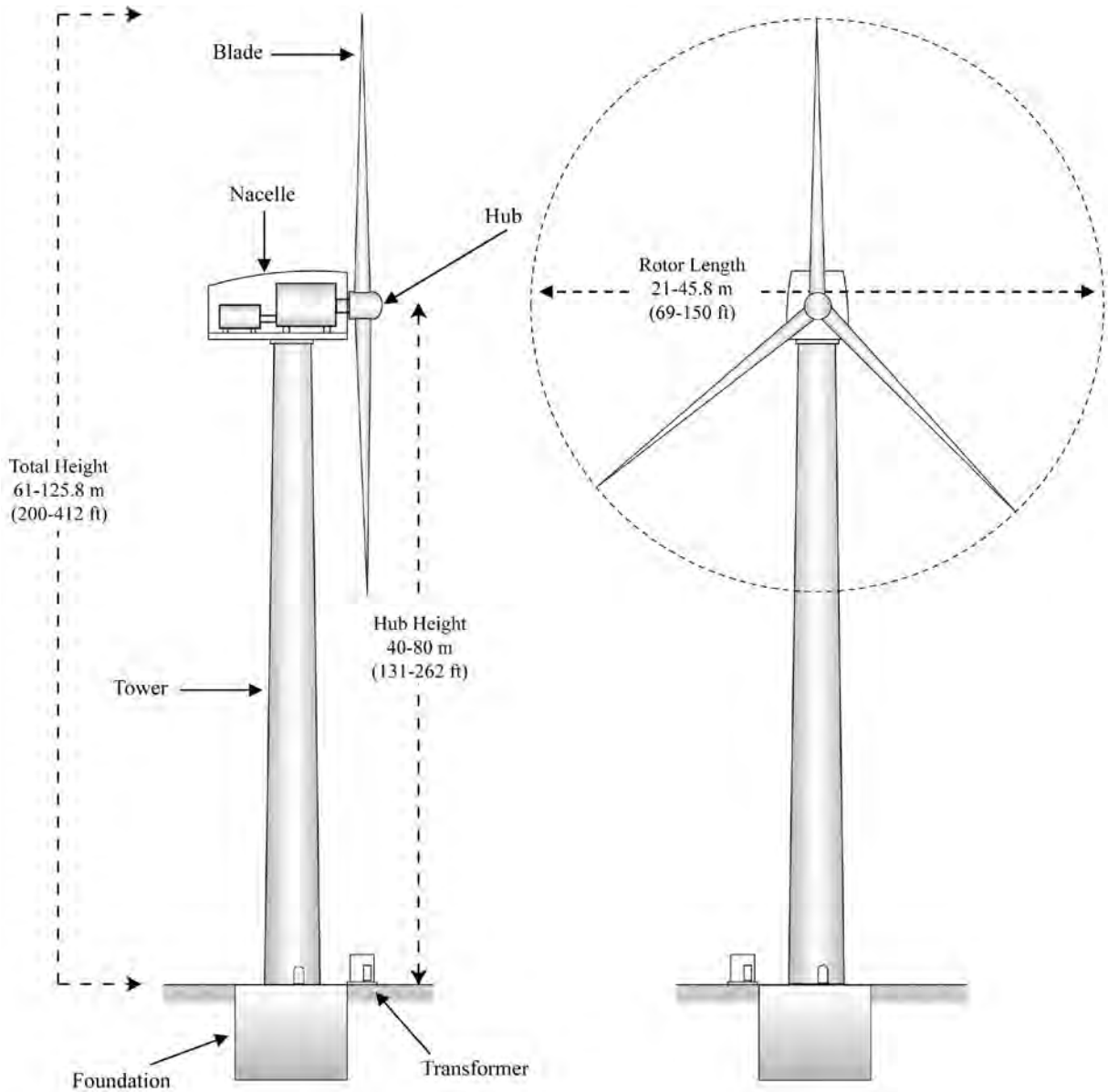

Figure 2. Typical Wind Turbine Components.

2.0 INTRODUCTION

Shadow flicker refers to the shadows that a wind turbine casts over structures and observers at times of the day when the sun is directly behind the turbine rotor from an observer's position. Shadow flicker is most pronounced in northern latitudes during winter months because of the lower angle of the sun in the winter sky; however, it is possible to encounter shadow flicker anywhere for brief periods after sunrise and before sunset (USDOI 2005). During intervals of sunshine, wind turbine generators (WTGs) will cast a shadow on surrounding areas as the rotor blades pass in front of the sun, causing a flickering effect while the rotor is in motion. Shadow flicker does not occur when fog or clouds obscure the sun, or when turbines are not operating.

Shadow flicker can be experienced by residents living near wind turbines, when the turbine is located in proximity to a residence, and the turbine rotor is between low angle sunlight and the residence. While shadow flicker is recognized as an important issue in Europe, it is generally not considered as significant in the United States (U.S.) (Gipe 1995). Specifically, in northern Europe the sun shines at an oblique angle for more hours of the day and more days of the year than in the U.S.; however, it is appropriate to analyze the potential effects of shadow flicker on nearby residences, regardless of where a wind power project is proposed. The distance between a wind turbine and a potential shadow flicker receptor affects the intensity of the shadows cast by the blades, and therefore, the intensity of flickering. Shadows cast close to a turbine will be more intense, distinct, and focused. This is because a greater proportion of the sun's disc is intermittently blocked by the turbine (BERR 2009). Obstacles such as terrain, vegetation, and/or buildings occurring between residences and wind turbines may significantly reduce or eliminate shadow flicker effects.

The location of shadow flicker can be predicted quite accurately using computer modeling programs and input data defining a "worst case" scenario. A "worst case scenario" would occur only when there are no clouds or fog, wind conditions allow continuous turbine operation, and the turbine rotor is continuously perpendicular to the sun and between the observer/residence and the sun; however, this "worst case" is not what residents would actually experience, as turbines are not in continuous operation, are not always aligned perpendicular to the sun, and are not always between the residence and the sun. In addition, sunlight conditions vary daily and seasonally, sun intensity and duration varies seasonally, and obstacles that block shadows (e.g., vegetation, buildings, and terrain) exist in the landscape.

Shadow flicker effects are expressed in terms of frequency (hours per year [hrs/yr]) on receptors. Effects are not expressed in terms of potential health-related impacts, as blade pass frequencies for modern commercial scale wind turbines are so low they are considered harmless. According to the British Epilepsy Association (2007) and Harding et al. (2008), less than 0.5% of the population is subject to epileptic seizures with approximately 5% of individuals with epilepsy sensitive to strobing light. Most people with photosensitive seizures (epilepsy) are affected by frequencies in excess of 8 Hertz (Hz = 1 flash per second) with flickering around 16 to 25 Hz, although some people may be sensitive to rates as low as 3 Hz and as high as 60 Hz (British Epilepsy Association 2007). Specific to wind power projects, the British Epilepsy Association (2007) states that there is no evidence that wind turbines can trigger seizures, and newer wind turbines are usually built to operate at a frequency of 1 Hz or less. Therefore, health effects due to projected shadow flicker are not anticipated or further evaluated. The primary concern with shadow flicker is the annoyance it could cause for adjacent residences, business, and public areas.

3.0 METHODS

The shadow-flicker modeling analysis was conducted using *WindPRO 2.7 Basis software* (WindPRO), and associated shadow module *version 2.7.473*, which is a widely accepted modeling software package developed specifically for the design and evaluation of wind power projects. Input variables and assumptions used for shadow flicker modeling calculations for the development of wind energy facilities at NAVSTA Newport include:

- Wind turbine locations (longitude/latitude coordinates)

- Coordinates (longitude/latitude) for structures (i.e., residences, businesses, schools, or hospitals) and/or recreational areas (i.e., golf courses, athletic fields, or historic sites) located within 3,281 ft (1,000 m) of a wind turbine

- U.S. Geological Survey (USGS) 1:25,000 topographic mapping and USGS digital elevation model (DEM) highlighting terrain heights (USGS 2009)

- The hub height and rotor diameter for the Vestas V112-3.0 MW (275.6-ft [84-m] hub height and 367.5-ft [112-m] rotor diameter); GE 1.5 MW sle (213.3-ft [65-m] hub height and 252.6-ft [77-m] rotor diameter; and PowerWind 56-900 kW (193.6-ft [59-m] hub height and 183.7-ft [56-m] rotor diameter)

- The annual wind rose depicted in **Table 2** was used to determine the directional frequency with which the proposed wind turbines would be oriented throughout the year (AWS Truewind 2008; DNV Global Energy Concepts Inc. 2010)

- The average sunshine monthly percent possible and average daily sunshine hours (see **Table 3**; NOAA 2010; SunriseSunset 2011)

- No allowance was made for wind being below or above generation speeds. Blades are assumed to be moving during all daylight hours, thereby creating a more conservative estimate of the amount of time the rotors are moving (“greenhouse” mode)

- There is no shadow impact when the sun’s elevation is less than 3 degrees ($^{\circ}$) above the horizon (due to the scattering effect of the atmosphere on low angle sunlight)

- There is no shadow impact when less than 20% of the sun is masked by the turbine blades, because this is not enough masking to create a detectable shadow

- Shadow isolines (i.e., contours indicating total number of hours of shadowing per average year) were calculated based on the data and assumptions outlined above, using a 32.8-ft (10-m) x 32.8-ft (10-m) grid from the USGS DEM. The computer model does not take into account the screening effects of existing vegetation, and therefore the isolines are conservative

Table 2
Wind Rose Data (Frequency [%] of Time Wind Comes from a Given Direction)

Wind Rose Data (used to determine hours of operation)									
Sector	**N**	**NNE**	**NE**	**ENE**	**E**	**ESE**	**SE**	**SSE**	
Frequency	8	5	3	2	2	2	5	6	
Hours of Operation	691.2	432.0	259.2	155.1	155.1	155.1	432.0	518.4	
Sector	**S**	**SSW**	**SW**	**WSW**	**W**	**WNW**	**NW**	**NNW**	**Total**
Frequency	11	14	10	6	5	7	8	8	6.38
Hours of Operation	950.4	1,209.7	864.0	518.4	432.0	604.8	691.2	691.2	8,756

Source: AWS Truewind 2008; DNV Global Energy Concepts Inc. 2010

Table 3
Sunshine Probability Data

Month	**January**	**February**	**March**	**April**	**May**	**June**
Average Monthly Percentage of Sunshine	56	58	58	57	58	61
Average Daily Hours of Sunshine	5.33	6.13	6.91	7.59	8.42	9.24
Month	**July**	**August**	**September**	**October**	**November**	**December**
Average Monthly Percentage of Sunshine	63	62	62	61	50	52
Average Daily Hours of Sunshine	9.37	8.58	7.75	6.77	4.93	4.78

Source: NOAA 2010; SunriseSunset 2011

Based on these variables, *WindPRO 2.7* was used to calculate the theoretical number of hours per year that shadow flicker would occur at any given location in the vicinity of the proposed wind turbines. It should be noted that at distances beyond 10 rotor diameters (maximum of 3,281 ft [1,000 m] for these various wind turbines), shadow flicker effects are essentially undetectable (USDOI 2005; BERR 2008). Therefore, the analysis presented herein is expected to be an inclusive (and conservative) projection of the shadow flicker effects for the development of 12 proposed wind energy facilities at NAVSTA Newport.

The model calculation includes the cumulative sum of shadow hours for all wind turbines. This omni-directional approach reports total shadow-flicker results at a receptor regardless of the presence or orientation of windows at the receptor residence (i.e., it assumes shadows from all directions can be perceived at a residence, which may or may not be true). A receptor in the model is defined as a one-square meter (m^2) area, one meter above ground level; the actual dimensions of the house are not taken into consideration.

4.0 RESULTS

Output from the *WindPRO 2.7* model includes the following information:

- Calculated shadow flicker time (hr/yr) at receptors within 3,281 ft (1,000 m) of each of the 12 proposed wind turbines
- Tabulated and plotted time that receptors receive shadow flicker
- Provided data showing each of the wind turbine locations, their shadow-flicker receptors, and projected shadow flicker time (hr/yr) for each of the receptor sites (see **Appendices 1 through 12**)

Each inventoried structure was evaluated to determine projected shadow flicker. Of the 172 structures identified within 3,281 ft (1,000 m) of any wind turbine and evaluated in this study:

- 101 (58.7%) will not be affected at all,
- 5 (2.9%) will be affected less than 1.0 hours:minutes per year [hr:min/yr]) (range 0:16 to 0:54 hr:min/yr),
- 38 (22.1%) will be affected 1.0 to 10 hrs/yr (range 1.0 to 9.0 hr/yr),
- 9 (5.2%) will be affected 10 to 20 hrs/yr (range 10 to 17 hr/yr),
- 7 (4.1%) will be affected 20 to 30 hrs/yr (range 23 to 29 hr/yr), and
- 12 (7.0%) will be affected greater than 30 hrs/yr (range 32 to 227 hr/yr).

Figures A-1 through **A-12** illustrates the predicted shadow flicker contour effects by each wind turbine model for each proposed wind turbines sites. **Table 4** summarizes the predicted shadow flicker data for all the receptor locations calculated to experience effects.

Table 4
Predicted Shadow Flicker Data for Receptor Locations Projected to Experience Impacts

Wind Turbine Site Number/ Name	Receptor ID	Possible Shadow Flicker Days (days/year)	Maximum Flicker Hours per Day (hr:min/day)	Predicted Shadow Flicker (hr:min/year)	Receptor Location: Distance from Wind Turbine (ft/m)
1/Tank Farm 3	A 1A	77	0:32	10:02	Carr Point Recreation Point: 1,385.6 / 422.3
	A 1N	18	0:10	0:41	Raytheon: 2,238.3 / 682.2
2/Tank Farm 4B	F 2F	42	0:21	2:49	Residence Town of Portsmouth: 2,094.9 / 638.5
	G 2G	48	0:28	4:41	Residence Town of Portsmouth: 1,588.3 / 484.1
	H 2H	33	0:23	2:37	Business Town of Portsmouth: 1,579.5 / 481.4
	I 2I	65	0:28	8:15	Residence Town of Portsmouth: 1,305.8 / 398
	Q 2Q	53	0:40	8:02	Bay View High Rise Apartments: 1,078.1 / 328.6
3/Tank Farm 4A	C 3C	32	0:20	2:37	Residence Town of Portsmouth: 2,201.2 / 670.9
	D 3D	25	0:12	1:00	Residence Town of Portsmouth: 3,091 / 942.1
	E 3E	25	0:13	1:11	Residence Town of Portsmouth: 2,669.4 / 813.6
	F 3F	18	0:08	0:33	Business Town of Portsmouth: 2,735.4 / 833.7
	G 3G	60	0:33	7:41	Residence Town of Portsmouth: 1,685.1 / 513.6
	M 3M	28	0:16	1:39	Bay View High Rise Apartments: 2,216.6 / 675.6

Table 4 (*continued*)
Predicted Shadow Flicker Summary for Receptor Locations Projected to Experience Impacts

Wind Turbine Site Number/ Name	Receptor ID	Possible Shadow Flicker Days (days/year)	Maximum Flicker Hours per Day (hr:min/day)	Predicted Shadow Flicker (hr:min/year)	Receptor Location: Distance from Wind Turbine (ft/m)
4/Tank Farm 5	A 4A	56	1:05	17:52	Residence Town of Portsmouth: 551.5 / 168.1
	E 4E	48	0:19	3:59	Baseball Field Town of Portsmouth: 1,908.2 / 581.6
	F 4F	15	0:04	0:16	Farm Town of Portsmouth: 2,515.2 / 766.6
	G 4G	68	0:43	11:55	Residence Town of Middletown: 1,024 / 312.1
	H 4H	38	0:12	1:58	Residence Town of Middletown: 2,025 / 617.2
5/Naval Undersea Warfare Center (NUWC)	A 5A	38	0:48	9:24	Wanumetonomy Golf & Country Club Green: 742.9 / 226.4
	F 5F	40	0:28	4:06	Wanumetonomy Golf & Country Club Green: 1,896.4 / 578
	G 5G	103	0:44	22:29	Wanumetonomy Golf & Country Club Green: 1455.1 / 443.5
6/Building 6 (Derecktor Shipyard)	C 6C	40	0:13	1:37	Residence Town of Middletown: 2,591 / 789.7
	D 6D	27	0:14	1:21	Residence Town of Middletown: 2,260.3 / 688.9
	E 6E	38	0:22	3:07	Residence Coddington Cove Housing: 1,789.8 / 545.5
	F 6F	43	0:12	2:16	Residence Coddington Cove Housing: 2,007 / 611.7
	L 6L	64	0:41	9:14	Building 1CC PWD NAVSTA: 1,294 / 394.4

Table 4 (*continued*)
Predicted Shadow Flicker Summary for Receptor Locations Projected to Experience Impacts

Wind Turbine Site Number/ Name	Receptor ID	Possible Shadow Flicker Days (days/year)	Maximum Flicker Hours per Day (hr:min/day)	Predicted Shadow Flicker (hr:min/year)	Receptor Location: Distance from Wind Turbine (ft/m)
7/Building 1112 (Coddington Point)	G 7G	91	0:58	25.28	Harbor Seal Haul-out Site: 1,567.7 / 477.8
8/Building 1285 (Navy Lodge)	A 8A	30	0:12	1:08	Residence Coddington Cove Housing: 3,021.2 / 920.8
	B 8B	21	0:12	0:54	Residence Coddington Cove Housing: 2,865 / 872.3
	C 8C	34	0:21	2:38	Residence Town of Middletown: 2,355.4 / 717.9
	K 8K	46	0:27	4:19	Building 440 A/C Classrooms NAVSTA: 1,977.8 / 602.8
	L 8L	28	0:18	1:43	Baseball Field NAVSAT: 2,988.7 / 910.9
	M 8M	34	0:24	2:54	Nimitz Field NAVSTA: 2,183.2 / 665.4
	N 8N	37	0:25	3:29	Building 1112 MARDET (marines) School NAVSTA: 2,125.4 / 647.8
	O 8O	38	0:23	3:16	Building 1172 Chapel NAVSTA: 2,447.9 / 746.1
	Q 8Q	108	0:49	23:54	Building 1373 NAVSTA: 1,266.8 / 386.1
	R 8R	40	0:30	4:36	Building 451 NAVSTA: 1,079.8 / 329.1
	S 8S	40	0:28	3:57	Building 1372 NAVSTA: 2074.9 / 632.4
	T 8T	19	0:14	0:57	Harbor Seal Haul-out Site: 3,529.7 / 1,075.8

Table 4 (*continued*)
Predicted Shadow Flicker Summary for Receptor Locations Projected to Experience Impacts

Wind Turbine Site Number/ Name	Receptor ID	Possible Shadow Flicker Days (days/year)	Maximum Flicker Hours per Day (hr:min/day)	Predicted Shadow Flicker (hr:min/year)	Receptor Location: Distance from Wind Turbine (ft/m)
9/Bishop Rock	*A 9A*	111	1:25	*39:46*	*Baseball Field NAVSTA: 959 / 292.3*
	B 9B	56	0:43	8:39	Building 440 A/C Classrooms NAVSTA: 1,926.9 / 587.3
	C 9C	72	0:46	11:34	Nimitz Field NAVSTA: 1,880.7 / 573.2
	D 9D	64	0:37	10:22	Building 1112 MARDET (marines) School NAVSTA: 2,422 / 738.2
	H 9H	62	0:44	11:29	Building 291 NAVSTA: 2,022.4 / 616.4
	I 9I	56	0:38	9:07	Building 370 NAVSTA: 2,304.9 / 702.5
	J 9J	54	0:45	10:30	Building 292 NAVSTA: 1,708.7 / 520.8
	K 9K	57	0:44	9:22	Building 1372 NAVSTA: 1,940.7 /591.5
	L 9L	55	0:41	8:23	Building 440 NAVSTA: 1,954.5 / 595.7
	M 9M	114	1:00	27:06	Building 197 NAVSTA: 1,500.1 / 457.2
	N 9N	68	0:53	14:57	Building 1172 Chapel NAVSTA: 1,585.7 / 483.3

Table 4 (*continued*)
Predicted Shadow Flicker Summary for Receptor Locations Projected to Experience Impacts

Wind Turbine Site Number/ Name	Receptor ID	Possible Shadow Flicker Days (days/year)	Maximum Flicker Hours per Day (hr:min/day)	Predicted Shadow Flicker (hr:min/year)	Receptor Location: Distance from Wind Turbine (ft/m)
10a/Prichard Field North	A 10aA	89	1:07	26:57	Building 1112 MARDET (marines) School NAVSTA: 1,380.6 / 420.8
	B 10aB	131	1:38	***52:09***	***Nimitz Field NAVSTA: 835.7 / 254.7***
	C 10aC	140	1:18	***52:02***	***Building 440 A/C Classrooms NAVSTA: 1,122.4 / 342.1***
	D 10aD	38	0:29	4:06	Building 1354 Navy Lodge NAVSTA: 2,908.9 / 886.6
	I 10aI	104	1:32	***44:27***	***Building 291 NAVSTA: 988.6 / 301.3***
	J 10aJ	84	1:10	26:05	Building 370 NAVSTA: 1,301.6 / 396.7
	K 10aK	106	2:02	***64:08***	***Building 292 NAVSTA: 719.2 / 219.2***
	L 10aL	168	1:22	***53:00***	***Building 1372 NAVSTA: 1,020.4 / 311***
	M 10aM	233	2:47	***175.77***	***Building 197 NAVSTA: 467.5 / 142.5***
	N 10aN	36	0:49	8:41	Building 1172 Chapel NAVSTA: 808.4 / 246.4
	O 10aO	106	1:39	***55:51***	***Harbor Seal Haul-out Site: 876 / 267***
10b/Prichard Field South	***A 10bA***	191	3:11	***227:34***	***Baseball Field NAVSTA: 385.5 / 117.5***
	C 10bC	84	1:17	29:04	Nimitz Field NAVSTA: 1,143.1 / 348.4
	D 10bD	107	1:19	***32:14***	***Building 440 A/C Classrooms NAVSTA: 1,069.6 / 326***

Table 4 (*continued*)
Predicted Shadow Flicker Summary for Receptor Locations Projected to Experience Impacts

Wind Turbine Site Number/ Name	Receptor ID	Possible Shadow Flicker Days (days/year)	Maximum Flicker Hours per Day (hr:min/day)	Predicted Shadow Flicker (hr:min/year)	Receptor Location: Distance from Wind Turbine (ft/m)
10b/Prichard Field South	E 10bE	38	0:28	3:52	Building 1354 Navy Lodge NAVSTA: 2,827.6 / 861.8
	M 10bM	137	1:21	***43:11***	***Building 1372 NAVSTA: 1,055.2 / 321.6***
	O 10bO	167	2:01	***82:45***	***Building 1172 Chapel NAVSTA: 647.7 / 197.4***
11/Katy Field	E 11E	78	0:49	15:21	Building 360 Naval Justice School NAVSTA: 1,785.8 / 544.3
	F 11F	31	0:48	7:25	Fitness Facility NAVSTA: 607 / 185

Bolded and italicized wind turbine locations, predicted shadow flicker hr:min/yr, and receptor sites/distances exceed the recommended 30 hours of shadow flicker per year
hr:min/day = hours:minutes per day
hr:min/yr = hours:minutes per year
ft = feet; m = meters

5.0 DISCUSSION

As described above, this analysis focuses on receptors within 3,281 ft (1,000 m) of the proposed 12 wind turbine sites, since shadow flicker effects are essentially undetectable beyond that distance (USDOI 2005; BERR 2009). This is because shadow flicker intensity usually diminishes as the distance between receptors and wind turbines increases (Osten and Pahkle 1998).

The shadow flicker assumptions applied to the model for these proposed 12 wind turbine sites are conservative, and as such, the analysis is expected to over-predict the actual impacts. Trees and nearby buildings (such as garages) will likely further reduce or eliminate shadow flicker impacts at these receptor locations, such as the existing tree line on the north, east, and south sides of wind turbine Sites 1 through 4 .

Thee are no national, state, county, or local standards regulating the frequency or duration of shadow flicker for the proposed 12 wind turbine sites; however, international regulations, studies, and guidelines from Europe, Canada, and Australia have suggested 30 hours of shadow flicker per year as the threshold of significant impact, or the point at which shadow flicker is commonly perceived as an annoyance. Currently, shadow flicker regulations are based on a detailed set of German "*Hinweise*" (translating to hints, tips, or references) on specifications for calculating shadow flicker --- "*Hinweise zur Ermittlung und Beurteilung der optischen Immissionen von Windenergieanlagen* (*WEA-Schattenwurf-Hinweise*)" dated March 12, 2002. The *Hinweise* prescribe the allowable limits of calculated shadow flicker on a receptor as follows:

- 30 minutes per day of astronomical case
- 30 hr/yr of astronomical case
- Blade should cover at least 20% of the sun's disk
- Sun should be at least 3 degrees (°) over the horizon

Germany established guidelines limiting shadow flicker effects to 30 hr/yr at residences, hospitals, schools, offices, and similar uses (WEA-Schatten-Hinweise 2002; Klepinger 2007). In Austria, Dobesch and Kury (2001) recommended that shadow flicker should not exceed 30 hr/yr at a neighbor's property. Guidelines for wind power development in the State of Victoria, Australia specify that shadow flicker may not exceed 30 hr/yr at any dwelling in the surrounding area (Sustainable Energy Authority Victoria 2003). The Irish Wind Energy Association suggests that a radial distance equivalent to ten times the rotor diameter be used to predict the potential effects of shadow flicker (IWEA 2008). In addition, a 30-hr/yr limit has been adopted by multiple communities (i.e., Maine, New Hampshire, Massachusetts, Michigan, and Minnesota) in the U.S. (Lampeter 2011).

Accordingly, a threshold of 30 hours of shadow flicker per year was used in the analysis to evaluate potential shadow flicker impacts to area residences for the proposed wind turbines. Of the 71 receptor locations predicted to receive any shadow flicker effect, 12 will exceed the 30-hr/yr threshold ranging 32 to 227 hr/yr (see **Table 4**). **Appendices 1** through **12** contain the predicted shadow flicker analysis: main result, calendar tabular per receptor, calendar graphic per receptor, calendar tabular per WTG, calendar graphic per WTG, and contour map produced by

WindPRO 2.7 model *version 2.7.473* that illustrate the times of year and day when receptors are anticipated to receive shadow flicker effects per wind turbine site.

It should also be reiterated that these calculations do not take into account the screening effects associated with existing site-specific conditions such as vegetation and/or buildings. Furthermore, this analysis assumes that there are windows on every side of the identified structures ("greenhouse" mode), and all identified structures are receptor residences and/or outdoor recreational facilities. Therefore, the predicted levels of shadow flicker at 12 of these receptor locations are almost certainly higher to excessively higher (1.1 to 7.6 times) than the allowable 30-hr/yr threshold. Wind turbine Site 9 exhibit one receptor location that exceeded the 30-hr/yr threshold, while wind turbine Sites 10a and 10b had seven and four receptor locations respectfully that exceeded the 30-hr/yr threshold. Wind turbine Sites 7 and 10a exhibit shadow flicker effects for the harbor seal haul-out site located in the East Passage of Narragansett Bay (see **Table 4**). Wind turbine Site 7 would be affected less than 30 hr/yr between 6:00 and 7:00 am from early May to early August, whereas wind turbine site 10a would encounter shadow flickering more than 30 hr/yr between 9:00 and 11:00 am from late October to mid February (see **Appendices 7** and **10 – calendar graphic per receptor**).

Table 5 lists the months and daylight hours that shadow flicker effects exceeding 30 hr/yr would occur at the various receptor wind turbines sites. Approximately 74% of the receptor building sites (wind turbine Sites 6 through 11) on NAVSTA Newport would experience shadow flicker effects in the daylight hours before or after 16:00 from late fall to early spring. The remaining receptor building sites would receive shadow flicker effects in early morning (6:00 – 8:00) or during mid daylight hours (12:30 – 15:30) in the summer months (see **Appendices 6 – 11 calendar-graphic-per-receptor**). Overall, shadow flicker effects during NAVSTA normal operating hours (7:30 to 16:00) would be extremely low (19%). Fifty-eight percent of the residential receptor sites (wind turbine Sites 1 through 8) affected by shadow flickers effects would occur from the daylight hours after 16:00 up to 19:00 for a month long period in early to late spring and fall. The remaining receptor residential sites would occur during the same hourly timeframe predominately in the winter months (see **Appendices 1 – 8 calendar-graphic-per-receptor**).

Per accepted international standards, shadow flicker affecting a particular receptor location above 30 hr/yr is considered a potential nuisance. While the turbine's shadow will affect some (41.3%) of the 172 receptor locations encompassing the 12 proposed wind turbine sites, only 12 (7.0%) recreational, wildlife, and NAVSTA buildings locations will receive more than 30 hours of shadow per year. Other factors that mitigate the shadows' impact include:

- Shadow intensity drops off with distance. Shadow edges often soften and shadow bodies become more muted. Shadows beyond ten rotor diameters from the tower base are considered negligible while shadows within five rotor diameters are the most significant. For example, the GE 1.5 MW sle has a five-rotor diameter distance of *1,066.3* (*325 m)* which substantiates the higher shadow flicker effects noted at wind turbine Site 9 (959 ft/292.3 m), while the Vestas V112-3.0 MW has a five rotor diameter distance of *1,837.4 ft* (*560 m*) which shows the higher shadow effects observed at: wind turbine Sites 10a (average 861.3 ft/262.5 m) and 10b (average 789.4 ft/240.6 m)
- Shadows move and do not remain in one spot for extended periods of time

- The longest extended period that shadows occur are in winter when there are fewer sunny days
- Many local natural and built environmental elements (i.e., trees) will block or diffuse shadows

Table 5
Months and Daylight Hours of Predicted Shadow Flicker Effects for Receptor Wind Turbine Locations Exceeding 30 Hours per Year

Wind Turbine Site/ Receptor Location	Months Receiving Highest Shadow Flicker Effects	Daylight Hours Receiving Shadow Flicker Effects	Percent of Daylight Hours Receiving Shadow Flicker Effects
Site 9A – Baseball Field NAVSTA	Mid February – April and Early September – November	15:00 – 18:00 and 16:00 – 17:30	6.98 and 8.5
Site 10aB – Nimitz Field NAVSTA	Mid February – Mid April and Late August – November	16:00 – 18:00	9.4 and 7.2
Site 10aC Building 440 A/C Classrooms NAVSTA	Mid April – August	18:00 – 19:30	6.95
Site 10aI – Building 291 NAVSTA	November – Mid February	14:00 – 15:30	11.4
Site 10aK – Building 292 NAVSTA	November – Mid February	12:30 – 14:30	15.1
Site 10aL –Building 1373 NAVSTA	April – October	18:00 – 19:00	5.1
Site 10aM – Building 197 NAVSTA	September – Mid April	13:00 – 17:00	19.3
Site 10aO – Harbor Seal Haul-out Site	Late October – Mid February	9:00 – 11:00	15.5
Site 10bA – Baseball Field NAVSTA	Mid September - April	9:30 – 14:00	24.4
Sit 10bD – Building 440 A/C Classrooms NAVSTA	February – Late March and Mid September – Early November	16:00 – 18:00 and 16:30 – 18:00	7.4 and 4.9
Site 10bM – Building 1372 NAVSTA	Early January – Mid March and October – Early December	15:30 – 16:30 and 15:00 – 17:00	6.98 and 9.3
Site 10bO – Building 1172 Chapel NAVSTA	Early February – May and Mid August - November	15:00 – 18:00 and 16:00 – 18:00	11.8 and 11.3

If extended adverse shadows should impact a particular dwelling, the wind turbine site owner may incorporate one or more of the following mitigation measures:

- Plant evergreen trees to block the shadow
- Provide blinds, shades, or curtains for the dwelling
- Turn off the turbine during shadowing periods that excessively affect the dwelling

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APPENDICES

APPENDIX 1

WIND TURBINE SITE 1 TANK FARM 3

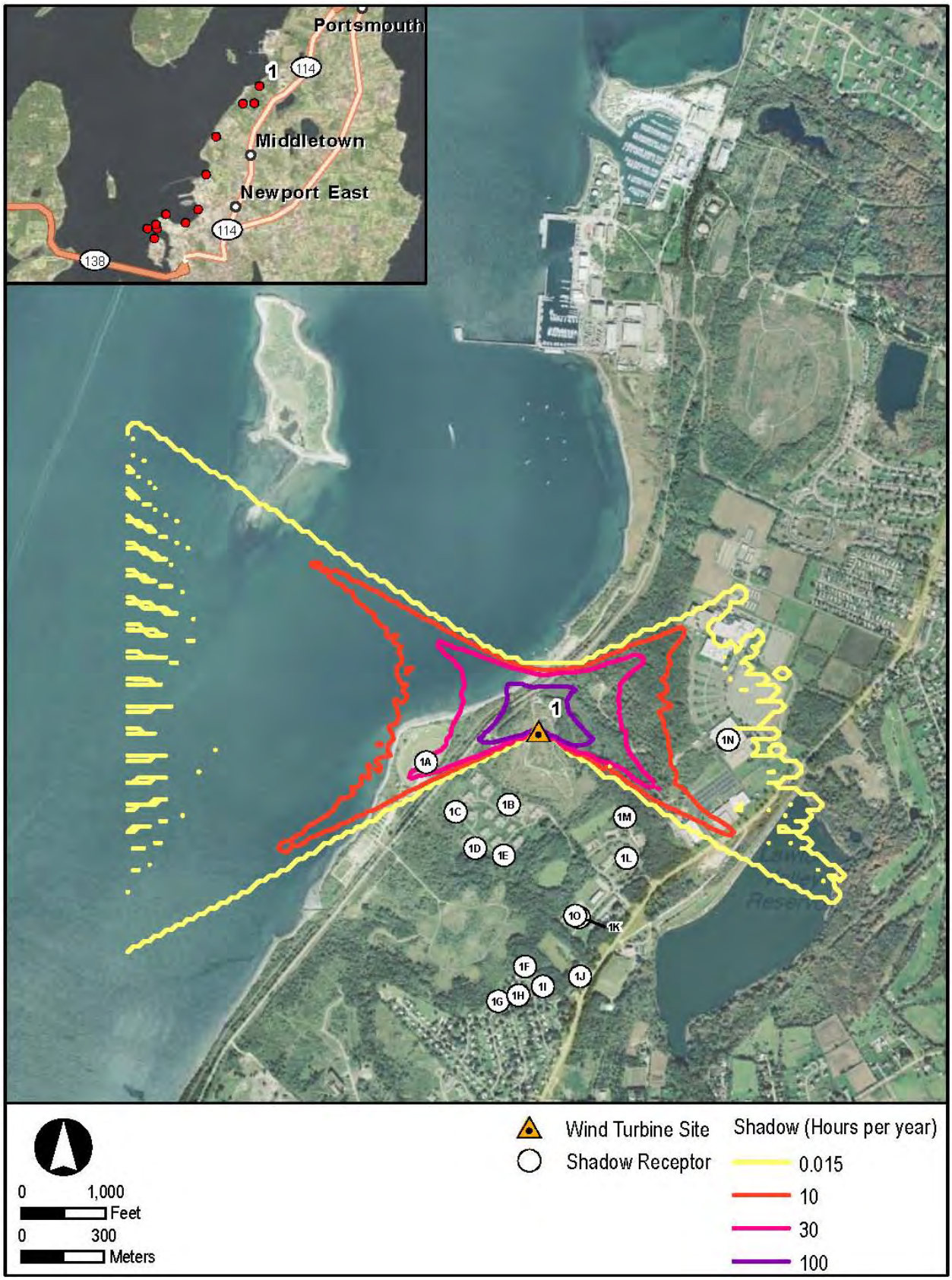

Figure A-1. Maximum predicted shadow flicker levels (hours per year) for a Power Wind 56-90 kW Model at Wind Turbine Site 1 (Tank Farm 3).

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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SHADOW - Main Result

Assumptions for shadow calculations

Maximum distance for influence
Calculate only when more than 20 % of sun is covered by the blade
Please look in WTG table

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

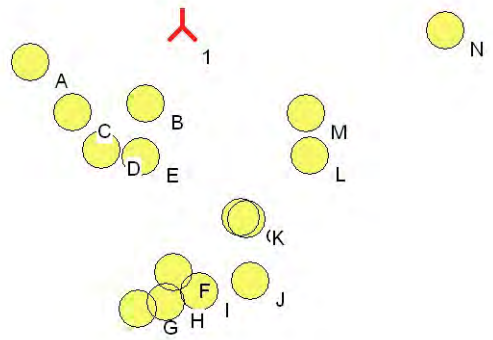
Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW
691	432	259	155	155	155	432	518	950	1,209	864	518

W	WNW	NW	NNW	Sum
432	604	691	691	8,756

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: Line object
Obstacles used in calculation
Eye height: 1.5 m
Grid resolution: 10 m



Scale 1:20,000
New WTG
Shadow receptor

WTGs

	Geo DD: WGS 84 Longitude	Latitude	Z [m]	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Shadow data Calculation distance [m]	RPM [RPM]
1	-71.288437° East	41.571277° North	24.4	Tank Farm 3	No	POWER MILLS	PowerWind G56-900 KW-900	900	56.0	59.0	2,000	0.0

Shadow receptor-Input

No.	Name	Geo DD: WGS 84 Longitude	Latitude	Z [m]	Width [m]	Height [m]	Height a.g.l. [m]	Degrees from south cw [°]	Slope of window [°]	Direction mode
A	1A	-71.293272° East	41.570168° North	9.3	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
B	1B	-71.289597° East	41.568837° North	27.6	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
C	1C	-71.291910° East	41.568550° North	16.0	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
D	1D	-71.291015° East	41.567368° North	26.3	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
E	1E	-71.289766° East	41.567160° North	29.8	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
F	1F	-71.288707° East	41.563509° North	40.8	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
G	1G	-71.289844° East	41.562342° North	41.5	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
H	1H	-71.288962° East	41.562556° North	41.6	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
I	1I	-71.287889° East	41.562874° North	42.0	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
J	1J	-71.286278° East	41.563234° North	51.8	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
K	1K	-71.286405° East	41.565182° North	47.8	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
L	1L	-71.284386° East	41.567177° North	41.1	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
M	1M	-71.284508° East	41.568531° North	35.1	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
N	1N	-71.280083° East	41.571164° North	50.9	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
O	1O	-71.286569° East	41.565235° North	48.2	1.0	1.0	1.0	-180.0	90.0	"Green house mode"

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Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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SHADOW - Main Result

Calculation Results

Shadow receptor

		Shadow, worst case			Shadow, expected values
No.	Name	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	1A	30:44	77	0:32	10:02
B	1B	0:00	0	0:00	0:00
C	1C	0:00	0	0:00	0:00
D	1D	0:00	0	0:00	0:00
E	1E	0:00	0	0:00	0:00
F	1F	0:00	0	0:00	0:00
G	1G	0:00	0	0:00	0:00
H	1H	0:00	0	0:00	0:00
I	1I	0:00	0	0:00	0:00
J	1J	0:00	0	0:00	0:00
K	1K	0:00	0	0:00	0:00
L	1L	0:00	0	0:00	0:00
M	1M	0:00	0	0:00	0:00
N	1N	2:06	18	0:10	0:41
O	1O	0:00	0	0:00	0:00

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

No.	Name	Worst case [h/year]	Expected [h/year]
1	Tank Farm 3	32:49	10:43

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 11:25 AM/2.7.473

SHADOW - Calendar

Shadow receptor: A - 1A

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May		June		July		August		September	October	November	December
1	07:12	06:58	06:22	06:30	05:44		05:14		06:16 (1)	05:15		05:39		06:21 (1)	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10	19:43		20:12	20	06:36 (1)	20:24		20:05	31	06:52 (1)	19:20	18:29	16:41	16:17
2	07:13	06:57	06:20	06:28	05:42		06:23 (1)	05:14		06:17 (1)	05:15		05:40		06:20 (1)	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	6	06:29 (1)	20:13	19	06:36 (1)	20:24		20:04	30	06:50 (1)	19:18	18:27	16:40	16:16
3	07:13	06:56	06:18	06:27	05:41		06:19 (1)	05:13		06:17 (1)	05:16		05:41		06:21 (1)	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	14	06:33 (1)	20:14	18	06:35 (1)	20:24		20:03	29	06:50 (1)	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40		06:17 (1)	05:13		06:19 (1)	05:17		06:30 (1)	05:42		06:21 (1)	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	18	06:35 (1)	20:14	16	06:35 (1)	20:23	5	06:35 (1)	20:02	28	06:49 (1)	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:38		06:15 (1)	05:13		06:20 (1)	05:17		06:29 (1)	05:43		06:22 (1)	06:15	06:46	06:22	06:56
	16:29	17:06	17:40	19:15	19:47	21	06:36 (1)	20:15	14	06:34 (1)	20:23	9	06:38 (1)	20:01	26	06:48 (1)	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37		06:14 (1)	05:12		06:20 (1)	05:18		06:27 (1)	05:44		06:23 (1)	06:16	06:47	06:23	06:57
	16:30	17:07	17:41	19:16	19:48	23	06:37 (1)	20:16	13	06:33 (1)	20:23	11	06:38 (1)	19:58	25	06:48 (1)	19:12	18:20	16:35	16:16
7	07:13	06:52	06:12	06:20	05:36		06:13 (1)	05:12		06:22 (1)	05:18		06:27 (1)	05:45		06:24 (1)	06:17	06:48	06:24	06:58
	16:31	17:08	17:42	19:17	19:49	25	06:38 (1)	20:16	10	06:32 (1)	20:23	13	06:40 (1)	19:57	22	06:46 (1)	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18	05:35		06:12 (1)	05:12		06:24 (1)	05:19		06:26 (1)	05:46		06:25 (1)	06:18	06:49	06:25	06:59
	16:32	17:10	18:44	19:18	19:50	27	06:39 (1)	20:17	7	06:31 (1)	20:22	15	06:41 (1)	19:56	20	06:45 (1)	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34		06:11 (1)	05:12		06:27 (1)	05:20		06:25 (1)	05:47		06:27 (1)	06:19	06:50	06:26	07:00
	16:33	17:11	18:45	19:19	19:51	29	06:40 (1)	20:18	2	06:29 (1)	20:22	17	06:42 (1)	19:54	16	06:43 (1)	19:07	18:15	16:32	16:16
10	07:12	06:48	07:07	06:15	05:32		06:11 (1)	05:11			05:20		06:25 (1)	05:48		06:29 (1)	06:20	06:51	06:28	07:01
	16:34	17:12	18:46	19:20	19:52	29	06:40 (1)	20:18			20:22	18	06:43 (1)	19:53	12	06:41 (1)	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:13	05:31		06:10 (1)	05:11			05:21		06:24 (1)	05:49			06:21	06:52	06:29	07:02
	16:35	17:13	18:47	19:21	19:53	31	06:41 (1)	20:19			20:21	20	06:44 (1)	19:52			19:03	18:12	16:30	16:16
12	07:12	06:46	07:04	06:12	05:30		06:10 (1)	05:11			05:22		06:23 (1)	05:50			06:22	06:54	06:30	07:03
	16:37	17:15	18:48	19:22	19:54	31	06:41 (1)	20:19			20:21	21	06:44 (1)	19:50			19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29		06:10 (1)	05:11			05:23		06:23 (1)	05:51			06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:56	31	06:41 (1)	20:20			20:20	22	06:45 (1)	19:49			19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28		06:09 (1)	05:11			05:23		06:23 (1)	05:53			06:24	06:56	06:32	07:04
	16:39	17:17	18:50	19:24	19:57	32	06:41 (1)	20:20			20:20	23	06:46 (1)	19:48			18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27		06:09 (1)	05:11			05:24		06:23 (1)	05:54			06:25	06:57	06:34	07:05
	16:40	17:18	18:52	19:25	19:58	32	06:41 (1)	20:21			20:19	24	06:47 (1)	19:46			18:56	18:06	16:26	16:16
16	07:10	06:41	06:57	06:06	05:26		06:09 (1)	05:11			05:25		06:21 (1)	05:55			06:26	06:58	06:35	07:06
	16:41	17:20	18:53	19:27	19:59	32	06:41 (1)	20:21			20:19	26	06:47 (1)	19:45			18:55	18:04	16:25	16:17
17	07:10	06:39	06:55	06:04	05:25		06:09 (1)	05:11			05:26		06:21 (1)	05:56			06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	20:00	32	06:41 (1)	20:22			20:18	27	06:48 (1)	19:43			18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:02	05:24		06:09 (1)	05:11			05:27		06:21 (1)	05:57			06:28	07:00	06:37	07:07
	16:43	17:22	18:55	19:29	20:00	32	06:41 (1)	20:22			20:17	28	06:49 (1)	19:42			18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:23		06:09 (1)	05:11			05:27		06:21 (1)	05:58			06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30	20:01	32	06:41 (1)	20:22			20:17	29	06:50 (1)	19:41			18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:22		06:09 (1)	05:11			05:28		06:21 (1)	05:59			06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	31	06:40 (1)	20:23			20:16	29	06:50 (1)	19:39			18:48	17:58	16:22	16:18
21	07:07	06:34	06:49	05:58	05:22		06:10 (1)	05:12			05:29		06:21 (1)	06:00			06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	31	06:41 (1)	20:23			20:15	30	06:51 (1)	19:38			18:46	17:57	16:22	16:18
22	07:07	06:32	06:47	05:56	05:21		06:10 (1)	05:12			05:30		06:20 (1)	06:01			06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	31	06:41 (1)	20:23			20:15	30	06:50 (1)	19:36			18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20		06:10 (1)	05:12			05:31		06:20 (1)	06:02			06:33	07:06	06:43	07:10
	16:49	17:28	19:00	19:34	20:04	30	06:40 (1)	20:23			20:14	31	06:51 (1)	19:34			18:43	17:54	16:20	16:19
24	07:05	06:29	06:44	05:53	05:19		06:11 (1)	05:12			05:32		06:20 (1)	06:03			06:34	07:07	06:44	07:10
	16:51	17:29	19:02	19:35	20:05	29	06:40 (1)	20:24			20:13	31	06:51 (1)	19:33			18:41	17:52	16:20	16:20
25	07:05	06:28	06:42	05:52	05:19		06:11 (1)	05:13			05:33		06:20 (1)	06:04			06:35	07:08	06:45	07:11
	16:52	17:31	19:03	19:36	20:06	29	06:40 (1)	20:24			20:12	31	06:51 (1)	19:31			18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:50	05:18		06:12 (1)	05:13			05:34		06:20 (1)	06:05			06:36	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	27	06:39 (1)	20:24			20:11	32	06:52 (1)	19:30			18:37	17:49	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17		06:13 (1)	05:13			05:35		06:20 (1)	06:06			06:37	07:11	06:48	07:11
	16:54	17:33	19:05	19:39	20:08	26	06:39 (1)	20:24			20:10	32	06:52 (1)	19:28			18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17		06:13 (1)	05:14			05:36		06:20 (1)	06:07			06:39	07:12	06:49	07:12
	16:56	17:34	19:06	19:40	20:09	25	06:38 (1)	20:24			20:09	32	06:52 (1)	19:27			18:34	17:47	16:18	16:23
29	07:01		06:35	05:46	05:16		06:14 (1)	05:14			05:36		06:20 (1)	06:08			06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	24	06:38 (1)	20:24			20:08	32	06:52 (1)	19:25			18:32	17:45	16:17	16:23
30	07:00		06:33	05:45	05:15		06:14 (1)	05:14			05:37		06:20 (1)	06:09			06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	23	06:37 (1)	20:24			20:07	32	06:52 (1)	19:23			18:30	17:44	16:17	16:24
31	06:59		06:32		05:15		06:16 (1)				05:38		06:20 (1)	06:10				07:15		07:12
	16:59		19:09		20:11	21	06:37 (1)				20:06	32	06:52 (1)	19:22				17:43		16:25
Potential sun hours	296	297	370	400	450			454			461			429			375	344	296	286
Total, worst case						804			119			682			239					
Sun reduction						0.58			0.61			0.63			0.62					
Oper. time red.						1.00			1.00			1.00			1.00					
Wind dir. red.						0.54			0.54			0.54			0.54					
Total reduction						0.31			0.33			0.34			0.33					
Total, real						252			39			232			80					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
2/24/2011 11:31 AM / 2

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 11:25 AM/2.7.473

SHADOW - Calendar

Shadow receptor: B - 1B

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:14	05:15	05:39	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:41	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:15	05:40	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:16
3	07:13	06:56	06:18	06:27	05:41	05:13	05:16	05:41	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:42	06:14	06:45	06:20	06:55
	16:28	17:04	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:38	05:13	05:17	05:43	06:15	06:46	06:22	06:56
	16:29	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:12	05:18	05:44	06:16	06:47	06:23	06:57
	16:30	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:35	16:16
7	07:13	06:52	06:12	06:20	05:36	05:12	05:18	05:45	06:17	06:48	06:24	06:58
	16:31	17:08	17:42	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18	05:35	05:12	05:19	05:46	06:18	06:49	06:25	06:59
	16:32	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:47	06:19	06:50	06:26	07:00
	16:33	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	16:15
10	07:12	06:48	07:07	06:15	05:32	05:11	05:20	05:48	06:20	06:51	06:28	07:01
	16:34	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:13	05:31	05:11	05:21	05:49	06:21	06:52	06:29	07:02
	16:35	17:13	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:12	06:46	07:04	06:12	05:30	05:11	05:22	05:50	06:22	06:54	06:30	07:02
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	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:23	05:52	06:24	06:56	06:32	07:04
	16:39	17:17	18:50	19:24	19:57	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
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	16:41	17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:25	16:17
17	07:10	06:39	06:55	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
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18	07:09	06:38	06:54	06:02	05:24	05:11	05:26	05:57	06:28	07:00	06:37	07:07
	16:43	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:23	05:11	05:27	05:58	06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30	20:00	20:22	20:17	19:40	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:22	05:11	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22	16:18
21	07:07	06:34	06:49	05:58	05:22	05:11	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:37	18:46	17:57	16:22	16:18
22	07:07	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:49	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:42	17:54	16:20	16:19
24	07:05	06:29	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:29	19:01	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:50	05:18	05:13	05:34	06:05	06:36	07:10	06:47	07:11
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27	07:03	06:25	06:38	05:49	05:17	05:13	05:35	06:06	06:37	07:11	06:48	07:11
	16:54	17:33	19:05	19:38	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:38	07:12	06:49	07:12
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:46	05:16	05:14	05:36	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:17	16:23
30	07:00		06:33	05:45	05:15	05:14	05:37	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:30	17:44	16:17	16:24
31	06:59		06:32		05:15		05:38	06:10		07:15		07:12
	16:59		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	296	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 11:25 AM/2.7.473

SHADOW - Calendar

Shadow receptor: C - 1C

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:14	05:15	05:39	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:41	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:15	05:40	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:16
3	07:13	06:56	06:18	06:27	05:41	05:13	05:16	05:41	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:42	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:38	05:13	05:17	05:43	06:15	06:46	06:22	06:56
	16:29	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:12	05:18	05:44	06:16	06:47	06:23	06:57
	16:30	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:35	16:16
7	07:13	06:52	06:12	06:20	05:36	05:12	05:18	05:45	06:17	06:48	06:24	06:58
	16:31	17:08	17:42	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18	05:35	05:12	05:19	05:46	06:18	06:49	06:25	06:59
	16:32	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:47	06:19	06:50	06:26	07:00
	16:33	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	16:16
10	07:12	06:48	07:07	06:15	05:32	05:11	05:20	05:48	06:20	06:51	06:28	07:01
	16:34	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:13	05:31	05:11	05:21	05:49	06:21	06:52	06:29	07:02
	16:35	17:13	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:12	06:46	07:04	06:12	05:30	05:11	05:22	05:50	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:51	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:56	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:23	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:50	19:24	19:57	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:18	18:52	19:25	19:58	20:21	20:19	19:46	18:56	18:06	16:26	16:16
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:06
	16:41	17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:25	16:17
17	07:10	06:39	06:55	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	20:00	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:02	05:24	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:43	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:23	05:11	05:27	05:58	06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30	20:00	20:22	20:17	19:40	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:22	05:11	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:18
22	07:07	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:49	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:42	17:54	16:20	16:19
24	07:05	06:29	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:29	19:02	19:35	20:05	20:24	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:50	05:18	05:13	05:34	06:05	06:36	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:49	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:13	05:35	06:06	06:37	07:11	06:48	07:11
	16:54	17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:12
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:46	05:16	05:14	05:36	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:17	16:23
30	07:00		06:33	05:45	05:15	05:14	05:37	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:30	17:44	16:17	16:24
31	06:59		06:32		05:15		05:38	06:10		07:15		07:12
	16:59		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	296	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 11:25 AM/2.7.473

SHADOW - Calendar

Shadow receptor: D - 1D

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:14	05:15	05:39	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:41	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:15	05:40	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:16
3	07:13	06:56	06:18	06:27	05:41	05:13	05:16	05:41	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:42	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:38	05:13	05:17	05:43	06:15	06:46	06:22	06:56
	16:29	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:12	05:18	05:44	06:16	06:47	06:23	06:57
	16:30	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:35	16:16
7	07:13	06:52	06:12	06:20	05:36	05:12	05:18	05:45	06:17	06:48	06:24	06:58
	16:31	17:08	17:42	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
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	16:32	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:47	06:19	06:50	06:26	07:00
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10	07:12	06:48	07:07	06:15	05:32	05:11	05:20	05:48	06:20	06:51	06:28	07:01
	16:34	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:13	05:31	05:11	05:21	05:49	06:21	06:52	06:29	07:02
	16:35	17:13	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:12	06:46	07:04	06:12	05:30	05:11	05:22	05:50	06:22	06:54	06:30	07:02
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	16:51	17:29	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
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Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 11:25 AM/2.7.473

SHADOW - Calendar

Shadow receptor: E - 1E

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:14	05:15	05:39	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:41	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:15	05:40	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:16
3	07:13	06:56	06:18	06:27	05:41	05:13	05:16	05:41	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:42	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:38	05:13	05:17	05:43	06:15	06:46	06:22	06:56
	16:29	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:12	05:18	05:44	06:16	06:47	06:23	06:57
	16:30	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:35	16:16
7	07:13	06:52	06:12	06:20	05:36	05:12	05:18	05:45	06:17	06:48	06:24	06:58
	16:31	17:08	17:42	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18	05:35	05:12	05:19	05:46	06:18	06:49	06:25	06:59
	16:32	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:47	06:19	06:50	06:26	07:00
	16:33	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	16:15
10	07:12	06:48	07:07	06:15	05:32	05:11	05:20	05:48	06:20	06:51	06:28	07:01
	16:34	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:13	05:31	05:11	05:21	05:49	06:21	06:52	06:29	07:02
	16:35	17:13	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:12	06:46	07:04	06:12	05:30	05:11	05:22	05:50	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:51	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:23	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:50	19:24	19:57	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:18	18:52	19:25	19:58	20:21	20:19	19:46	18:56	18:06	16:26	16:16
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:06
	16:41	17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:25	16:17
17	07:10	06:39	06:55	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	20:00	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:02	05:24	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:43	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:23	05:11	05:27	05:58	06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30	20:00	20:22	20:17	19:40	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:22	05:11	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22	16:18
21	07:07	06:34	06:49	05:58	05:22	05:11	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:37	18:46	17:57	16:22	16:18
22	07:07	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:49	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:42	17:54	16:20	16:19
24	07:05	06:29	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:29	19:01	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:50	05:18	05:13	05:34	06:05	06:36	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:49	16:19	16:21
27	07:03	06:25	06:38	05:49	05:17	05:13	05:35	06:06	06:37	07:11	06:48	07:11
	16:54	17:33	19:05	19:38	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:38	07:12	06:49	07:12
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:46	05:16	05:14	05:36	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:17	16:23
30	07:00		06:33	05:45	05:15	05:14	05:37	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:30	17:44	16:17	16:24
31	06:59		06:32		05:15		05:38	06:10		07:15		07:12
	16:59		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	296	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
2/24/2011 11:31 AM / 6

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 11:25 AM/2.7.473

SHADOW - Calendar

Shadow receptor: F - 1F

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:14	05:15	05:39	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:41	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:15	05:40	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:16
3	07:13	06:56	06:18	06:27	05:41	05:13	05:16	05:41	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:42	06:14	06:45	06:20	06:55
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7	07:12	06:52	06:12	06:20	05:36	05:12	05:18	05:45	06:17	06:48	06:24	06:58
	16:31	17:08	17:42	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18	05:35	05:12	05:19	05:46	06:18	06:49	06:25	06:59
	16:32	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
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	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
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	16:39	17:17	18:50	19:24	19:56	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:18	18:52	19:25	19:58	20:21	20:19	19:46	18:56	18:06	16:26	16:16
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:25	16:17
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18	07:09	06:38	06:54	06:02	05:24	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:43	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:23	05:11	05:27	05:58	06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30	20:00	20:22	20:17	19:40	18:49	18:00	16:23	16:18
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	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:37	18:46	17:57	16:22	16:18
22	07:07	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:49	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:42	17:54	16:20	16:19
24	07:05	06:29	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
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28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:38	07:12	06:49	07:12
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:46	05:16	05:14	05:36	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:17	16:23
30	07:00		06:33	05:45	05:15	05:14	05:37	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:30	17:44	16:17	16:24
31	06:59		06:32		05:15		05:38	06:10		07:15		07:12
	16:59		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	296	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 11:31 AM / 7

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 11:25 AM/2.7.473

SHADOW - Calendar

Shadow receptor: G - 1G

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:14	05:15	05:39	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:41	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:15	05:40	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:16
3	07:13	06:56	06:18	06:27	05:41	05:13	05:16	05:41	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:42	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:13	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:38	05:13	05:17	05:43	06:15	06:46	06:21	06:56
	16:29	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:12	05:18	05:44	06:16	06:47	06:23	06:57
	16:30	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:35	16:16
7	07:13	06:52	06:12	06:20	05:36	05:12	05:18	05:45	06:17	06:48	06:24	06:58
	16:31	17:08	17:42	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18	05:35	05:12	05:19	05:46	06:18	06:49	06:25	06:59
	16:32	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:47	06:19	06:50	06:26	07:00
	16:33	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	16:16
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	16:34	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
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12	07:11	06:46	07:04	06:12	05:30	05:11	05:22	05:50	06:22	06:54	06:30	07:02
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13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:51	06:23	06:55	06:31	07:03
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15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
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	16:42	17:21	18:54	19:28	19:59	20:22	20:18	19:43	18:53	18:03	16:25	16:17
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	16:43	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
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	16:45	17:23	18:56	19:30	20:00	20:22	20:17	19:40	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:22	05:11	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22	16:18
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	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:49	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:42	17:54	16:20	16:19
24	07:05	06:29	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
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	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:50	05:18	05:13	05:34	06:05	06:36	07:09	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:49	16:19	16:21
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	16:54	17:33	19:05	19:38	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:38	07:12	06:49	07:12
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
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	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:30	17:44	16:17	16:24
31	06:59		06:32		05:15		05:38	06:10		07:15		07:12
	16:59		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	296	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 11:31 AM / 8

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 11:25 AM/2.7.473

SHADOW - Calendar

Shadow receptor: H - 1H

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:14	05:15	05:39	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:41	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:15	05:40	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:16
3	07:13	06:56	06:18	06:27	05:41	05:13	05:16	05:41	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:42	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:13	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:38	05:13	05:17	05:43	06:15	06:46	06:21	06:56
	16:29	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:12	05:18	05:44	06:16	06:47	06:23	06:57
	16:30	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:35	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12	05:18	05:45	06:17	06:48	06:24	06:58
	16:31	17:08	17:42	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18	05:35	05:12	05:19	05:46	06:18	06:49	06:25	06:59
	16:32	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:47	06:19	06:50	06:26	07:00
	16:33	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	16:16
10	07:12	06:48	07:07	06:15	05:32	05:11	05:20	05:48	06:20	06:51	06:28	07:01
	16:34	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:05	06:13	05:31	05:11	05:21	05:49	06:21	06:52	06:29	07:02
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	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
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15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:18	18:52	19:25	19:57	20:21	20:19	19:46	18:56	18:06	16:26	16:16
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:58	20:21	20:19	19:45	18:55	18:04	16:25	16:17
17	07:10	06:39	06:55	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	19:59	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:02	05:24	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:43	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:36	06:52	06:01	05:23	05:11	05:27	05:58	06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30	20:00	20:22	20:17	19:40	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:22	05:11	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:37	18:46	17:57	16:22	16:18
22	07:07	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:49	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:42	17:54	16:20	16:19
24	07:05	06:29	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:29	19:01	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:50	05:18	05:13	05:34	06:05	06:36	07:09	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:49	16:19	16:21
27	07:03	06:25	06:38	05:49	05:17	05:13	05:35	06:06	06:37	07:11	06:48	07:11
	16:54	17:33	19:05	19:38	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:38	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:46	05:16	05:14	05:36	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:17	16:23
30	07:00		06:33	05:45	05:15	05:14	05:37	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:30	17:44	16:17	16:24
31	06:59		06:32		05:15		05:38	06:10		07:15		07:12
	16:59		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	296	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 11:31 AM / 9

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 11:25 AM/2.7.473

SHADOW - Calendar

Shadow receptor: I - 1I

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:14	05:15	05:39	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:41	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:15	05:40	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:16
3	07:13	06:56	06:18	06:27	05:41	05:13	05:16	05:41	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:42	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:13	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:38	05:13	05:17	05:43	06:15	06:46	06:21	06:56
	16:29	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:12	05:18	05:44	06:16	06:47	06:23	06:57
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14	07:11	06:43	07:00	06:09	05:28	05:11	05:23	05:53	06:24	06:56	06:32	07:04
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15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:18	18:52	19:25	19:57	20:21	20:19	19:46	18:56	18:06	16:26	16:16
16	07:10	06:41	06:57	06:05	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:58	20:21	20:19	19:45	18:55	18:04	16:25	16:17
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	16:42	17:21	18:54	19:28	19:59	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:02	05:24	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:43	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:36	06:52	06:01	05:23	05:11	05:27	05:58	06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30	20:00	20:22	20:17	19:40	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:22	05:11	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
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	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:49	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:42	17:54	16:20	16:19
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	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:50	05:18	05:13	05:34	06:05	06:36	07:09	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:49	16:19	16:21
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	16:54	17:33	19:05	19:38	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:38	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
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30	07:00		06:33	05:45	05:15	05:14	05:37	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:30	17:44	16:17	16:24
31	06:59		06:32		05:15		05:38	06:10		07:15		07:12
	16:59		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	296	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 11:31 AM / 10

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 11:25 AM/2.7.473

SHADOW - Calendar

Shadow receptor: J - 1J

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:14	05:15	05:39	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:41	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:15	05:40	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:16
3	07:13	06:56	06:18	06:27	05:41	05:13	05:16	05:41	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:42	06:14	06:45	06:20	06:55
	16:28	17:04	17:39	19:13	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:38	05:13	05:17	05:43	06:15	06:46	06:21	06:56
	16:29	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:12	05:18	05:44	06:16	06:47	06:23	06:57
	16:30	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:35	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12	05:18	05:45	06:17	06:48	06:24	06:58
	16:31	17:08	17:42	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18	05:35	05:12	05:19	05:46	06:18	06:49	06:25	06:59
	16:32	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:47	06:19	06:50	06:26	07:00
	16:33	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	16:15
10	07:12	06:48	07:07	06:15	05:32	05:11	05:20	05:48	06:20	06:51	06:28	07:01
	16:34	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
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	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
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	16:40	17:18	18:52	19:25	19:57	20:21	20:19	19:46	18:56	18:06	16:26	16:16
16	07:10	06:41	06:57	06:05	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:58	20:21	20:19	19:45	18:55	18:04	16:25	16:17
17	07:10	06:39	06:55	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	19:59	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:02	05:24	05:11	05:26	05:57	06:28	07:00	06:37	07:07
	16:43	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:36	06:52	06:01	05:23	05:11	05:27	05:58	06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30	20:00	20:22	20:17	19:40	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:22	05:11	05:28	05:59	06:30	07:02	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22	16:18
21	07:07	06:34	06:49	05:58	05:22	05:11	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:37	18:46	17:57	16:22	16:18
22	07:07	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:49	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:42	17:54	16:20	16:19
24	07:05	06:29	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:29	19:01	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
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	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:50	05:18	05:13	05:34	06:05	06:36	07:09	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:49	16:19	16:21
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28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:38	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:46	05:16	05:14	05:36	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:17	16:23
30	07:00		06:33	05:45	05:15	05:14	05:37	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:30	17:44	16:17	16:24
31	06:59		06:32		05:15		05:38	06:10		07:15		07:12
	16:59		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	296	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 11:31 AM / 11

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 11:25 AM/2.7.473

SHADOW - Calendar

Shadow receptor: K - 1K

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:14	05:15	05:39	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:41	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:15	05:40	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:16
3	07:13	06:56	06:18	06:27	05:41	05:13	05:16	05:41	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:42	06:14	06:45	06:20	06:55
	16:28	17:04	17:39	19:13	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:38	05:13	05:17	05:43	06:15	06:46	06:21	06:56
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6	07:13	06:53	06:14	06:22	05:37	05:12	05:18	05:44	06:16	06:47	06:23	06:57
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	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:37	18:46	17:57	16:22	16:18
22	07:07	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:49	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:42	17:54	16:20	16:19
24	07:05	06:29	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:29	19:01	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:50	05:18	05:13	05:34	06:05	06:36	07:09	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:49	16:19	16:21
27	07:03	06:25	06:38	05:49	05:17	05:13	05:35	06:06	06:37	07:11	06:48	07:11
	16:54	17:33	19:05	19:38	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:38	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
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	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:17	16:23
30	07:00		06:33	05:45	05:15	05:14	05:37	06:09	06:41	07:14	06:51	07:12
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31	06:59		06:32		05:15		05:38	06:10		07:15		07:12
	16:59		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	296	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 11:31 AM / 12

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 11:25 AM/2.7.473

SHADOW - Calendar

Shadow receptor: L - 1L

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:14	05:15	05:39	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:41	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:15	05:40	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:16
3	07:13	06:56	06:18	06:27	05:41	05:13	05:16	05:41	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:16	05:42	06:14	06:45	06:20	06:55
	16:28	17:04	17:39	19:13	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:38	05:13	05:17	05:43	06:15	06:46	06:21	06:56
	16:29	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:12	05:18	05:44	06:16	06:47	06:23	06:57
	16:30	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:35	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12	05:18	05:45	06:17	06:48	06:24	06:58
	16:31	17:08	17:42	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18	05:35	05:12	05:19	05:46	06:18	06:49	06:25	06:59
	16:32	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:15
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:47	06:19	06:50	06:26	07:00
	16:33	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	16:15
10	07:12	06:48	07:07	06:15	05:32	05:11	05:20	05:48	06:20	06:51	06:28	07:01
	16:34	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:05	06:13	05:31	05:11	05:21	05:49	06:21	06:52	06:29	07:02
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	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:00	06:09	05:28	05:11	05:23	05:52	06:24	06:56	06:32	07:04
	16:39	17:17	18:50	19:24	19:56	20:20	20:20	19:48	18:58	18:07	16:27	16:16
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	16:40	17:18	18:52	19:25	19:57	20:21	20:19	19:46	18:56	18:06	16:26	16:16
16	07:10	06:41	06:57	06:05	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:58	20:21	20:19	19:45	18:55	18:04	16:25	16:16
17	07:10	06:39	06:55	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
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18	07:09	06:38	06:54	06:02	05:24	05:11	05:26	05:57	06:28	07:00	06:37	07:07
	16:43	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:36	06:52	06:01	05:23	05:11	05:27	05:58	06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30	20:00	20:22	20:17	19:40	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:22	05:11	05:28	05:59	06:30	07:02	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22	16:18
21	07:07	06:34	06:49	05:58	05:22	05:11	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:37	18:46	17:57	16:22	16:18
22	07:07	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:49	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:42	17:54	16:20	16:19
24	07:05	06:29	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:29	19:01	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:12	05:33	06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:50	05:18	05:13	05:34	06:05	06:36	07:09	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:49	16:19	16:21
27	07:03	06:25	06:38	05:49	05:17	05:13	05:35	06:06	06:37	07:11	06:48	07:11
	16:54	17:33	19:05	19:38	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:35	06:07	06:38	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:46	05:16	05:14	05:36	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:17	16:23
30	07:00		06:33	05:45	05:15	05:14	05:37	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:30	17:44	16:17	16:24
31	06:59		06:32		05:15		05:38	06:10		07:15		07:12
	16:59		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	296	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 11:31 AM / 13

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 11:25 AM/2.7.473

SHADOW - Calendar

Shadow receptor: M - 1M

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:14	05:15	05:39	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:41	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:15	05:40	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:16
3	07:13	06:56	06:18	06:27	05:41	05:13	05:16	05:41	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:16	05:42	06:14	06:45	06:20	06:55
	16:28	17:04	17:39	19:13	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:38	05:13	05:17	05:43	06:15	06:46	06:21	06:56
	16:29	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:12	05:18	05:44	06:16	06:47	06:23	06:57
	16:30	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:35	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12	05:18	05:45	06:17	06:48	06:24	06:58
	16:31	17:08	17:42	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
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	16:32	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:15
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	16:34	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:15
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14	07:11	06:43	07:00	06:09	05:28	05:11	05:23	05:52	06:24	06:56	06:32	07:04
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29	07:01		06:35	05:46	05:16	05:14	05:36	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:17	16:23
30	07:00		06:33	05:45	05:15	05:14	05:37	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:30	17:44	16:17	16:24
31	06:59		06:32		05:15		05:38	06:10		07:15		07:12
	16:59		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	296	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
2/24/2011 11:31 AM / 14

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 11:25 AM/2.7.473

SHADOW - Calendar

Shadow receptor: N - 1N

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March			April			May	June	July	August	September			October	November	December
1	07:12	06:58	06:22			06:30		18:40 (1)	05:44	05:14	05:15	05:39	06:11			06:42	06:17	06:52
	16:26	17:01	17:35			19:10	9	18:49 (1)	19:43	20:12	20:24	20:05	19:20			18:29	16:41	16:17
2	07:13	06:57	06:20			06:28			05:42	05:14	05:15	05:40	06:12			06:43	06:18	06:53
	16:27	17:02	17:37			19:11			19:44	20:13	20:24	20:04	19:18			18:27	16:40	16:16
3	07:13	06:56	06:18			06:27			05:41	05:13	05:16	05:41	06:13			06:44	06:19	06:54
	16:28	17:03	17:38			19:12			19:45	20:14	20:24	20:03	19:17			18:25	16:39	16:16
4	07:13	06:55	06:17			06:25			05:40	05:13	05:16	05:42	06:14			06:45	06:20	06:55
	16:28	17:04	17:39			19:13			19:46	20:14	20:23	20:02	19:15			18:24	16:38	16:16
5	07:13	06:54	06:15			06:23			05:38	05:13	05:17	05:43	06:15			06:46	06:21	06:56
	16:29	17:06	17:40			19:15			19:47	20:15	20:23	20:01	19:13			18:22	16:37	16:16
6	07:13	06:53	06:14			06:22			05:37	05:12	05:18	05:44	06:16			06:47	06:23	06:57
	16:30	17:07	17:41			19:16			19:48	20:16	20:23	19:58	19:12			18:20	16:35	16:16
7	07:12	06:52	06:12			06:20			05:36	05:12	05:18	05:45	06:17			06:48	06:24	06:58
	16:31	17:08	17:42			19:17			19:49	20:16	20:23	19:57	19:10			18:19	16:34	16:16
8	07:12	06:51	07:10			06:18			05:35	05:12	05:19	05:46	06:18			06:49	06:25	06:59
	16:32	17:10	18:44			19:18			19:50	20:17	20:22	19:56	19:08			18:17	16:33	16:15
9	07:12	06:50	07:09			06:17			05:34	05:12	05:20	05:47	06:19			06:50	06:26	07:00
	16:33	17:11	18:45			19:19			19:51	20:18	20:22	19:54	19:07			18:15	16:32	16:15
10	07:12	06:48	07:07			06:15			05:32	05:11	05:20	05:48	06:20			06:51	06:28	07:01
	16:34	17:12	18:46			19:20			19:52	20:18	20:22	19:53	19:05			18:14	16:31	16:15
11	07:12	06:47	07:05			06:13			05:31	05:11	05:21	05:49	06:21		18:32 (1)	06:52	06:29	07:02
	16:35	17:13	18:47			19:21			19:53	20:19	20:21	19:52	19:03	8	18:40 (1)	18:12	16:30	16:16
12	07:11	06:46	07:04			06:12			05:30	05:11	05:22	05:50	06:22		18:30 (1)	06:53	06:30	07:02
	16:37	17:15	18:48			19:22			19:54	20:19	20:21	19:50	19:01	9	18:39 (1)	18:10	16:29	16:16
13	07:11	06:45	07:02			06:10			05:29	05:11	05:22	05:51	06:23		18:28 (1)	06:55	06:31	07:03
	16:38	17:16	18:49			19:23			19:55	20:20	20:20	19:49	19:00	9	18:37 (1)	18:09	16:28	16:16
14	07:11	06:43	07:00			06:09			05:28	05:11	05:23	05:52	06:24		18:27 (1)	06:56	06:32	07:04
	16:39	17:17	18:50			19:24			19:56	20:20	20:20	19:48	18:58	9	18:36 (1)	18:07	16:27	16:16
15	07:10	06:42	06:59			06:07			05:27	05:11	05:24	05:53	06:25		18:26 (1)	06:57	06:34	07:05
	16:40	17:18	18:51			19:25			19:57	20:21	20:19	19:46	18:56	8	18:34 (1)	18:06	16:26	16:16
16	07:10	06:41	06:57			06:05			05:26	05:11	05:25	05:55	06:26		18:25 (1)	06:58	06:35	07:05
	16:41	17:20	18:53			19:27			19:58	20:21	20:19	19:45	18:55	7	18:32 (1)	18:04	16:25	16:16
17	07:09	06:39	06:55			06:04			05:25	05:11	05:26	05:56	06:27		18:25 (1)	06:59	06:36	07:06
	16:42	17:21	18:54			19:28			19:59	20:22	20:18	19:43	18:53	6	18:31 (1)	18:03	16:25	16:17
18	07:09	06:38	06:54			06:02			05:24	05:11	05:26	05:57	06:28		18:25 (1)	07:00	06:37	07:07
	16:43	17:22	18:55			19:29			20:00	20:22	20:17	19:42	18:51	4	18:29 (1)	18:01	16:24	16:17
19	07:08	06:36	06:52			06:01			05:23	05:11	05:27	05:58	06:29		18:25 (1)	07:01	06:38	07:07
	16:45	17:23	18:56			19:30			20:00	20:22	20:17	19:40	18:49	2	18:27 (1)	18:00	16:23	16:17
20	07:08	06:35	06:50			05:59			05:22	05:11	05:28	05:59	06:30			07:02	06:40	07:08
	16:46	17:25	18:57			19:31			20:01	20:23	20:16	19:39	18:48			17:58	16:22	16:18
21	07:07	06:34	06:49			05:58			05:22	05:11	05:29	06:00	06:31			07:04	06:41	07:09
	16:47	17:26	18:58			19:32			20:02	20:23	20:15	19:37	18:46			17:57	16:22	16:18
22	07:07	06:32	06:47			05:56			05:21	05:12	05:30	06:01	06:32			07:05	06:42	07:09
	16:48	17:27	18:59			19:33			20:03	20:23	20:14	19:36	18:44			17:55	16:21	16:19
23	07:06	06:31	06:45			05:55			05:20	05:12	05:31	06:02	06:33			07:06	06:43	07:10
	16:49	17:28	19:00			19:34			20:04	20:23	20:14	19:34	18:42			17:54	16:20	16:19
24	07:05	06:29	06:44		18:39 (1)	05:53			05:19	05:12	05:32	06:03	06:34			07:07	06:44	07:10
	16:51	17:29	19:01	2	18:40 (1)	19:35			20:05	20:23	20:13	19:33	18:41			17:52	16:20	16:20
25	07:04	06:28	06:42		18:37 (1)	05:52			05:18	05:12	05:33	06:04	06:35			07:08	06:45	07:10
	16:52	17:31	19:03	4	18:41 (1)	19:36			20:06	20:24	20:12	19:31	18:39			17:51	16:19	16:20
26	07:04	06:26	06:40		18:37 (1)	05:50			05:18	05:13	05:34	06:05	06:36			07:09	06:47	07:11
	16:53	17:32	19:04	5	18:42 (1)	19:37			20:07	20:24	20:11	19:30	18:37			17:49	16:19	16:21
27	07:03	06:25	06:38		18:36 (1)	05:49			05:17	05:13	05:35	06:06	06:37			07:11	06:48	07:11
	16:54	17:33	19:05	7	18:43 (1)	19:38			20:08	20:24	20:10	19:28	18:36			17:48	16:18	16:22
28	07:02	06:23	06:37		18:36 (1)	05:48			05:16	05:14	05:35	06:07	06:38			07:12	06:49	07:11
	16:56	17:34	19:06	9	18:45 (1)	19:40			20:09	20:24	20:09	19:27	18:34			17:47	16:18	16:22
29	07:01		06:35		18:36 (1)	05:46			05:16	05:14	05:36	06:08	06:40			07:13	06:50	07:12
	16:57		19:07	9	18:45 (1)	19:41			20:10	20:24	20:08	19:25	18:32			17:45	16:17	16:23
30	07:00		06:33		18:37 (1)	05:45			05:15	05:14	05:37	06:09	06:41			07:14	06:51	07:12
	16:58		19:08	9	18:46 (1)	19:42			20:10	20:24	20:07	19:23	18:30			17:44	16:17	16:24
31	06:59		06:32		18:38 (1)				05:15		05:38	06:10				07:15		07:12
	16:59		19:09	10	18:48 (1)				20:11		20:06	19:22				17:43		16:25
Potential sun hours	296	297	370			400			450	454	461	429	375			344	296	286
Total, worst case				55			9							62				
Sun reduction				0.58			0.57							0.62				
Oper. time red.				1.00			1.00							1.00				
Wind dir. red.				0.54			0.54							0.54				
Total reduction				0.31			0.31							0.34				
Total, real				17			3							21				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 11:31 AM / 15

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 11:25 AM/2.7.473

SHADOW - Calendar

Shadow receptor: O - 1O

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:14	05:15	05:39	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:41	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:15	05:40	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:16
3	07:13	06:56	06:18	06:27	05:41	05:13	05:16	05:41	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:42	06:14	06:45	06:20	06:55
	16:28	17:04	17:39	19:13	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:38	05:13	05:17	05:43	06:15	06:46	06:21	06:56
	16:29	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:12	05:18	05:44	06:16	06:47	06:23	06:57
	16:30	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:35	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12	05:18	05:45	06:17	06:48	06:24	06:58
	16:31	17:08	17:42	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18	05:35	05:12	05:19	05:46	06:18	06:49	06:25	06:59
	16:32	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:47	06:19	06:50	06:26	07:00
	16:33	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	16:15
10	07:12	06:48	07:07	06:15	05:32	05:11	05:20	05:48	06:20	06:51	06:28	07:01
	16:34	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:05	06:13	05:31	05:11	05:21	05:49	06:21	06:52	06:29	07:02
	16:35	17:13	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:11	06:46	07:04	06:12	05:30	05:11	05:22	05:50	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:01	18:10	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:22	05:51	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:00	06:09	05:28	05:11	05:23	05:52	06:24	06:56	06:32	07:04
	16:39	17:17	18:50	19:24	19:56	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:18	18:52	19:25	19:57	20:21	20:19	19:46	18:56	18:06	16:26	16:16
16	07:10	06:41	06:57	06:05	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:58	20:21	20:19	19:45	18:55	18:04	16:25	16:17
17	07:10	06:39	06:55	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	19:59	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:02	05:24	05:11	05:26	05:57	06:28	07:00	06:37	07:07
	16:43	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:36	06:52	06:01	05:23	05:11	05:27	05:58	06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30	20:00	20:22	20:17	19:40	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:22	05:11	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22	16:18
21	07:07	06:34	06:49	05:58	05:22	05:11	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:37	18:46	17:57	16:22	16:18
22	07:07	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:49	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:42	17:54	16:20	16:19
24	07:05	06:29	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:29	19:01	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:50	05:18	05:13	05:34	06:05	06:36	07:09	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:49	16:19	16:21
27	07:03	06:25	06:38	05:49	05:17	05:13	05:35	06:06	06:37	07:11	06:48	07:11
	16:54	17:33	19:05	19:38	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:38	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:46	05:16	05:14	05:36	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:17	16:23
30	07:00		06:33	05:45	05:15	05:14	05:37	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:30	17:44	16:17	16:24
31	06:59		06:32		05:15		05:38	06:10		07:15		07:12
	16:59		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	296	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

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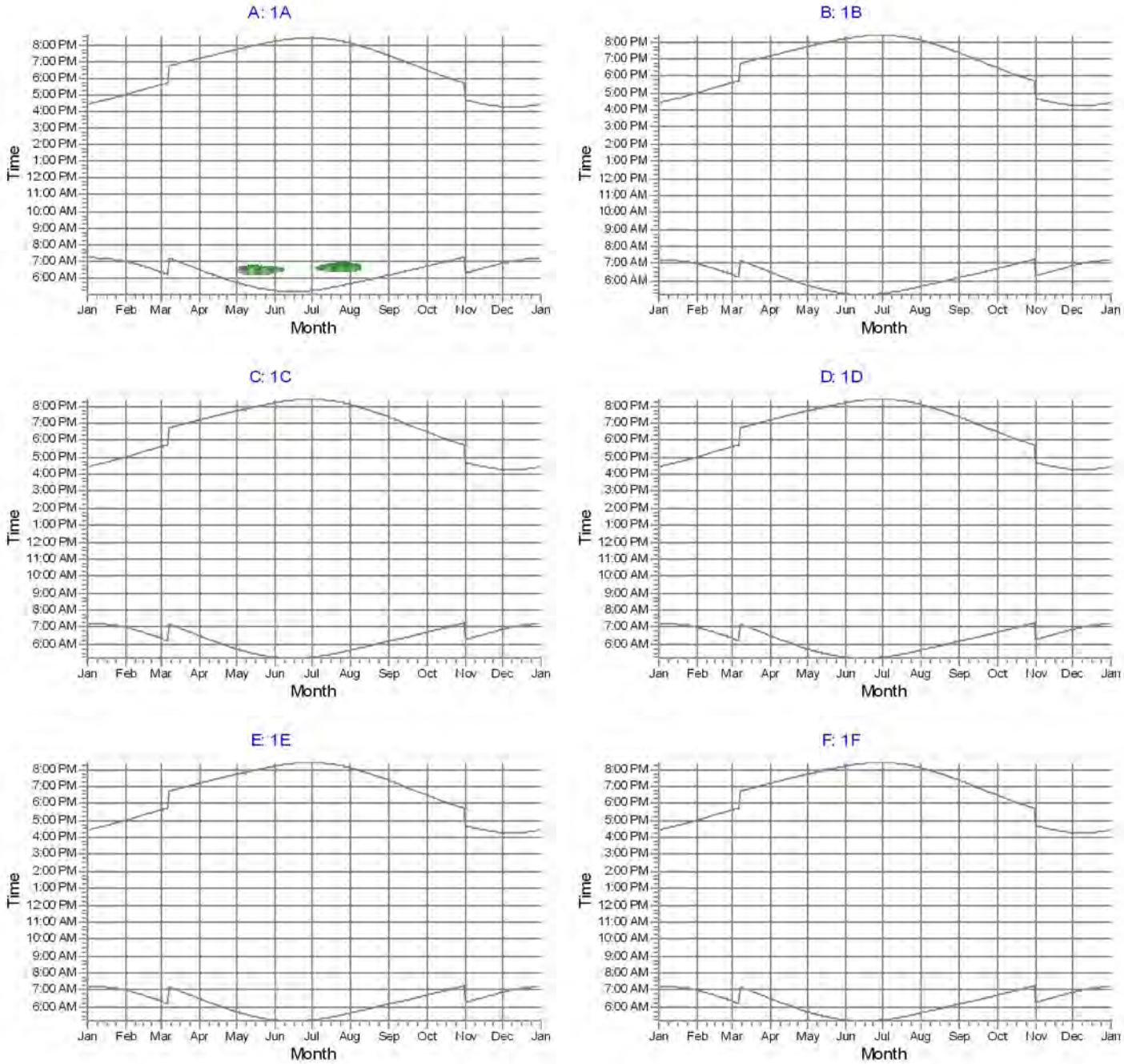
SHADOW - Calendar, graphical



WTGs

1: Tank Farm 3

Project:

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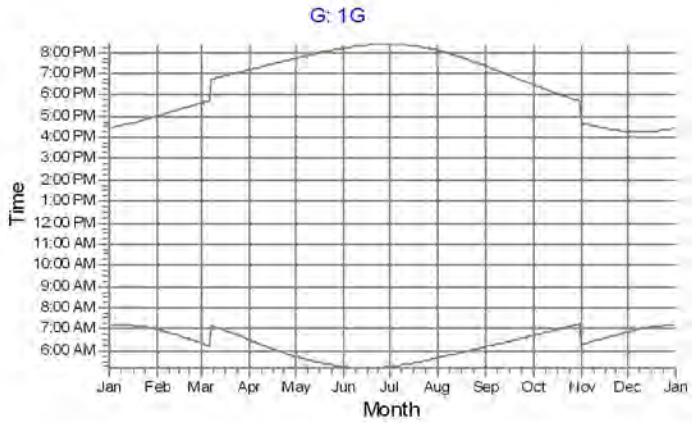
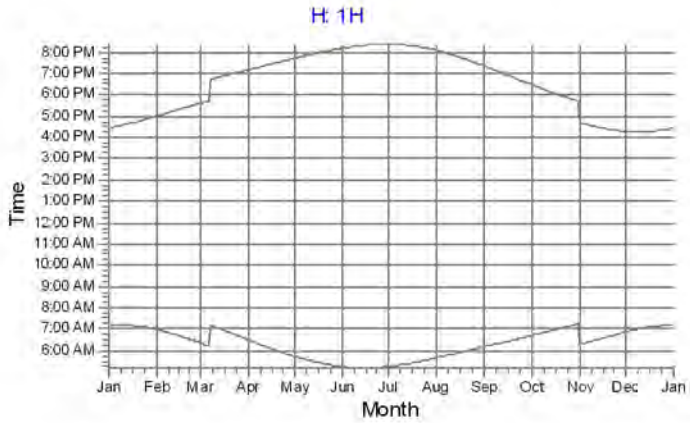
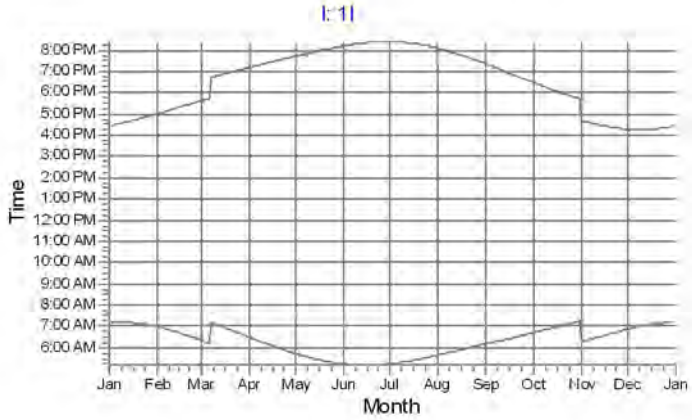
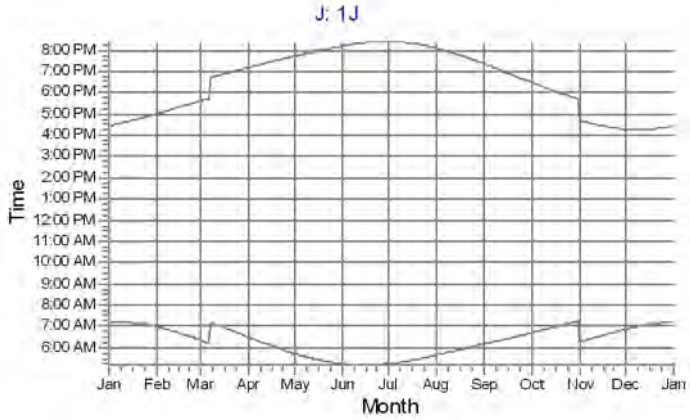
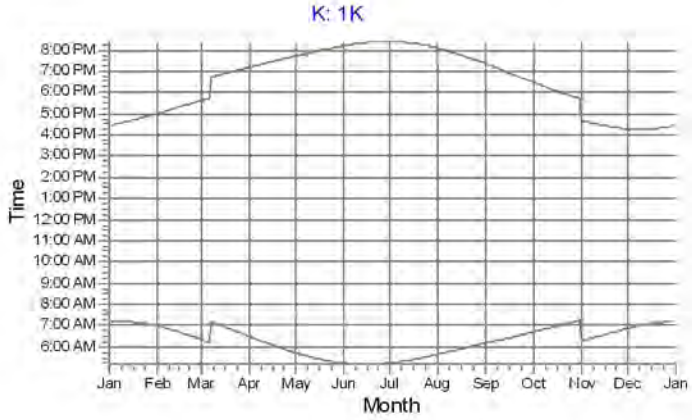
SHADOW - Calendar, graphical

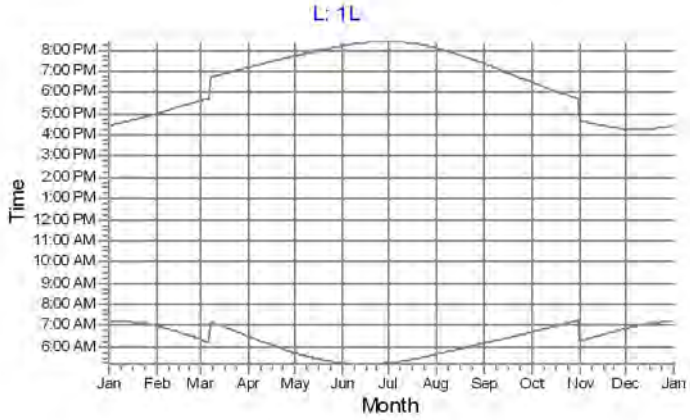












WTGs

Project:

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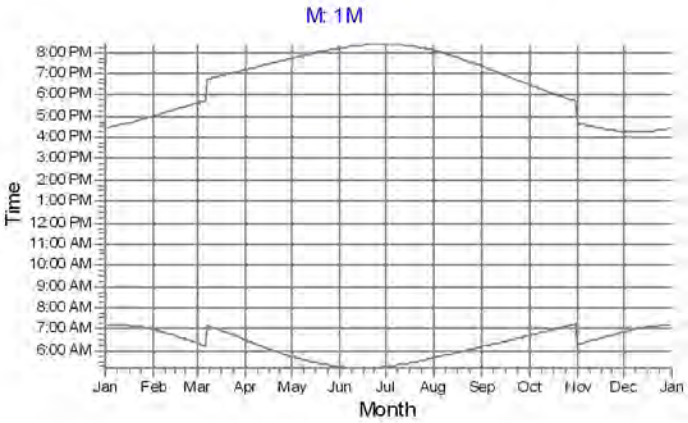
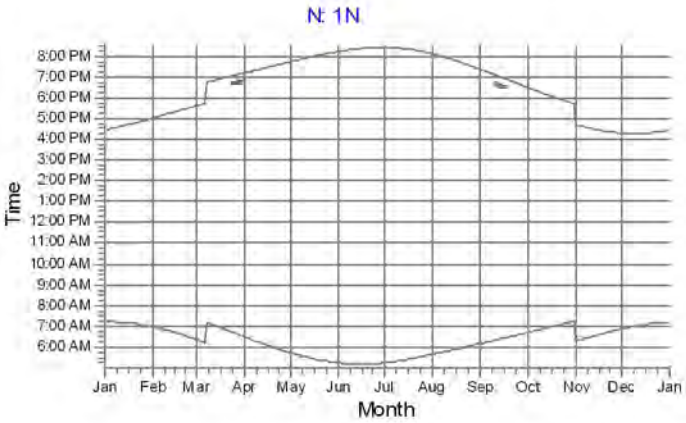
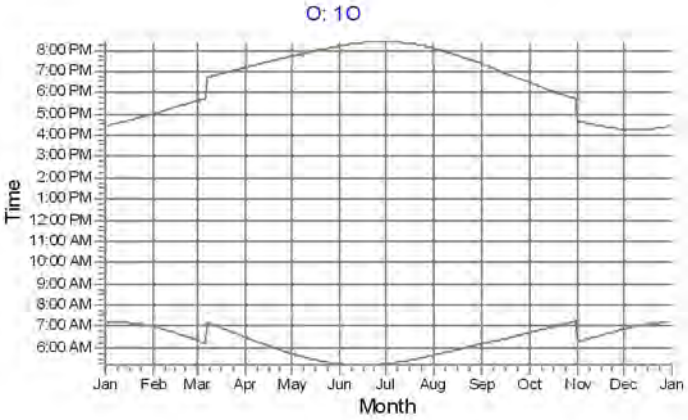
SHADOW - Calendar, graphical







WTGs

1: Tank Farm 3

Project:

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SHADOW - Calendar per WTG

WTG: 1 - Tank Farm 3

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March		April		May		June	
1	07:12	06:58	06:22		06:30	18:40-18:49/9	05:44		05:14	06:16-06:36/20
	16:26	17:01	17:35		19:10		19:43		20:12	
2	07:13	06:57	06:20		06:28		05:42	06:23-06:29/6	05:14	06:17-06:36/19
	16:27	17:02	17:37		19:11		19:44		20:13	
3	07:13	06:56	06:18		06:27		05:41	06:19-06:33/14	05:13	06:17-06:35/18
	16:28	17:03	17:38		19:12		19:45		20:14	
4	07:13	06:55	06:17		06:25		05:40	06:17-06:35/18	05:13	06:19-06:35/16
	16:28	17:04	17:39		19:13		19:46		20:14	
5	07:13	06:54	06:15		06:23		05:38	06:15-06:36/21	05:13	06:20-06:34/14
	16:29	17:06	17:40		19:15		19:47		20:15	
6	07:13	06:53	06:14		06:22		05:37	06:14-06:37/23	05:12	06:20-06:33/13
	16:30	17:07	17:41		19:16		19:48		20:16	
7	07:13	06:52	06:12		06:20		05:36	06:13-06:38/25	05:12	06:22-06:32/10
	16:31	17:08	17:42		19:17		19:49		20:16	
8	07:12	06:51	07:10		06:18		05:35	06:12-06:39/27	05:12	06:24-06:31/7
	16:32	17:10	18:44		19:18		19:50		20:17	
9	07:12	06:50	07:09		06:17		05:34	06:11-06:40/29	05:12	06:27-06:29/2
	16:33	17:11	18:45		19:19		19:51		20:18	
10	07:12	06:48	07:07		06:15		05:32	06:11-06:40/29	05:11	
	16:34	17:12	18:46		19:20		19:52		20:18	
11	07:12	06:47	07:05		06:13		05:31	06:10-06:41/31	05:11	
	16:35	17:13	18:47		19:21		19:53		20:19	
12	07:12	06:46	07:04		06:12		05:30	06:10-06:41/31	05:11	
	16:37	17:15	18:48		19:22		19:54		20:19	
13	07:11	06:45	07:02		06:10		05:29	06:10-06:41/31	05:11	
	16:38	17:16	18:49		19:23		19:55		20:20	
14	07:11	06:43	07:01		06:09		05:28	06:09-06:41/32	05:11	
	16:39	17:17	18:50		19:24		19:57		20:20	
15	07:10	06:42	06:59		06:07		05:27	06:09-06:41/32	05:11	
	16:40	17:18	18:52		19:25		19:58		20:21	
16	07:10	06:41	06:57		06:05		05:26	06:09-06:41/32	05:11	
	16:41	17:20	18:53		19:27		19:59		20:21	
17	07:10	06:39	06:55		06:04		05:25	06:09-06:41/32	05:11	
	16:42	17:21	18:54		19:28		20:00		20:22	
18	07:09	06:38	06:54		06:02		05:24	06:09-06:41/32	05:11	
	16:43	17:22	18:55		19:29		20:00		20:22	
19	07:08	06:37	06:52		06:01		05:23	06:09-06:41/32	05:11	
	16:45	17:23	18:56		19:30		20:00		20:22	
20	07:08	06:35	06:50		05:59		05:22	06:09-06:40/31	05:11	
	16:46	17:25	18:57		19:31		20:01		20:23	
21	07:07	06:34	06:49		05:58		05:22	06:10-06:41/31	05:11	
	16:47	17:26	18:58		19:32		20:02		20:23	
22	07:07	06:32	06:47		05:56		05:21	06:10-06:41/31	05:12	
	16:48	17:27	18:59		19:33		20:03		20:23	
23	07:06	06:31	06:45		05:55		05:20	06:10-06:40/30	05:12	
	16:49	17:28	19:00		19:34		20:04		20:23	
24	07:05	06:29	06:44	18:39-18:40/1	05:53		05:19	06:11-06:40/29	05:12	
	16:51	17:29	19:01		19:35		20:05		20:24	
25	07:04	06:28	06:42	18:37-18:41/4	05:52		05:19	06:11-06:40/29	05:12	
	16:52	17:31	19:03		19:36		20:06		20:24	
26	07:04	06:26	06:40	18:37-18:42/5	05:50		05:18	06:12-06:39/27	05:13	
	16:53	17:32	19:04		19:37		20:07		20:24	
27	07:03	06:25	06:38	18:36-18:43/7	05:49		05:17	06:13-06:39/26	05:13	
	16:54	17:33	19:05		19:38		20:08		20:24	
28	07:02	06:23	06:37	18:36-18:45/9	05:48		05:17	06:13-06:38/25	05:14	
	16:56	17:34	19:06		19:40		20:09		20:24	
29	07:01		06:35	18:36-18:45/9	05:46		05:16	06:14-06:38/24	05:14	
	16:57		19:07		19:41		20:10		20:24	
30	07:00		06:33	18:37-18:46/9	05:45		05:15	06:14-06:37/23	05:14	
	16:58		19:08		19:42		20:10		20:24	
31	06:59		06:32	18:38-18:48/10			05:15	06:16-06:37/21		
	16:59		19:09				20:11			
Potential sun hours	296	297	370		400		450		454	
Sum of minutes with flicker	0	0	54		9		804		119	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

Project:

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SHADOW - Calendar per WTG

WTG: 1 - Tank Farm 3

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	July		August		September		October	November	December
1	05:15		05:39	06:21-06:52/31	06:11		06:42	06:17	06:52
	20:24		20:05		19:20		18:29	16:41	16:17
2	05:15		05:40	06:20-06:50/30	06:12		06:43	06:18	06:53
	20:24		20:04		19:18		18:27	16:40	16:16
3	05:16		05:41	06:21-06:50/29	06:13		06:44	06:19	06:54
	20:24		20:03		19:17		18:25	16:39	16:16
4	05:16	06:30-06:35/5	05:42	06:21-06:49/28	06:14		06:45	06:20	06:55
	20:23		20:02		19:15		18:24	16:38	16:16
5	05:17	06:29-06:38/9	05:43	06:22-06:48/26	06:15		06:46	06:22	06:56
	20:23		20:01		19:13		18:22	16:37	16:16
6	05:18	06:27-06:38/11	05:44	06:23-06:48/25	06:16		06:47	06:23	06:57
	20:23		19:58		19:12		18:20	16:35	16:16
7	05:18	06:27-06:40/13	05:45	06:24-06:46/22	06:17		06:48	06:24	06:58
	20:23		19:57		19:10		18:19	16:34	16:16
8	05:19	06:26-06:41/15	05:46	06:25-06:45/20	06:18		06:49	06:25	06:59
	20:22		19:56		19:08		18:17	16:33	16:15
9	05:20	06:25-06:42/17	05:47	06:27-06:43/16	06:19		06:50	06:26	07:00
	20:22		19:54		19:07		18:15	16:32	16:15
10	05:20	06:25-06:43/18	05:48	06:29-06:41/12	06:20		06:51	06:28	07:01
	20:22		19:53		19:05		18:14	16:31	16:16
11	05:21	06:24-06:44/20	05:49		06:21	18:32-18:40/8	06:52	06:29	07:02
	20:21		19:52		19:03		18:12	16:30	16:16
12	05:22	06:23-06:44/21	05:50		06:22	18:30-18:39/9	06:54	06:30	07:02
	20:21		19:50		19:02		18:10	16:29	16:16
13	05:22	06:23-06:45/22	05:51		06:23	18:28-18:37/9	06:55	06:31	07:03
	20:20		19:49		19:00		18:09	16:28	16:16
14	05:23	06:23-06:46/23	05:52		06:24	18:27-18:36/9	06:56	06:32	07:04
	20:20		19:48		18:58		18:07	16:27	16:16
15	05:24	06:23-06:47/24	05:54		06:25	18:26-18:34/8	06:57	06:34	07:05
	20:19		19:46		18:56		18:06	16:26	16:16
16	05:25	06:21-06:47/26	05:55		06:26	18:25-18:32/7	06:58	06:35	07:06
	20:19		19:45		18:55		18:04	16:25	16:16
17	05:26	06:21-06:48/27	05:56		06:27	18:25-18:31/6	06:59	06:36	07:06
	20:18		19:43		18:53		18:03	16:25	16:17
18	05:26	06:21-06:49/28	05:57		06:28	18:25-18:29/4	07:00	06:37	07:07
	20:17		19:42		18:51		18:01	16:24	16:17
19	05:27	06:21-06:50/29	05:58		06:29	18:25-18:27/2	07:01	06:38	07:07
	20:17		19:40		18:49		18:00	16:23	16:18
20	05:28	06:21-06:50/29	05:59		06:30		07:03	06:40	07:08
	20:16		19:39		18:48		17:58	16:22	16:18
21	05:29	06:21-06:51/30	06:00		06:31		07:04	06:41	07:09
	20:15		19:37		18:46		17:57	16:22	16:18
22	05:30	06:20-06:50/30	06:01		06:32		07:05	06:42	07:09
	20:14		19:36		18:44		17:55	16:21	16:19
23	05:31	06:20-06:51/31	06:02		06:33		07:06	06:43	07:10
	20:14		19:34		18:42		17:54	16:20	16:19
24	05:32	06:20-06:51/31	06:03		06:34		07:07	06:44	07:10
	20:13		19:33		18:41		17:52	16:20	16:20
25	05:33	06:20-06:51/31	06:04		06:35		07:08	06:45	07:10
	20:12		19:31		18:39		17:51	16:19	16:21
26	05:34	06:20-06:52/32	06:05		06:36		07:10	06:47	07:11
	20:11		19:30		18:37		17:49	16:19	16:21
27	05:35	06:20-06:52/32	06:06		06:37		07:11	06:48	07:11
	20:10		19:28		18:36		17:48	16:18	16:22
28	05:36	06:20-06:52/32	06:07		06:38		07:12	06:49	07:12
	20:09		19:27		18:34		17:47	16:18	16:23
29	05:36	06:20-06:52/32	06:08		06:40		07:13	06:50	07:12
	20:08		19:25		18:32		17:45	16:17	16:23
30	05:37	06:20-06:52/32	06:09		06:41		07:14	06:51	07:12
	20:07		19:23		18:30		17:44	16:17	16:24
31	05:38	06:20-06:52/32	06:10				07:15		07:12
	20:06		19:22				17:43		16:25
Potential sun hours	461		429		375		344	296	286
Sum of minutes with flicker		682		239		62	0	0	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

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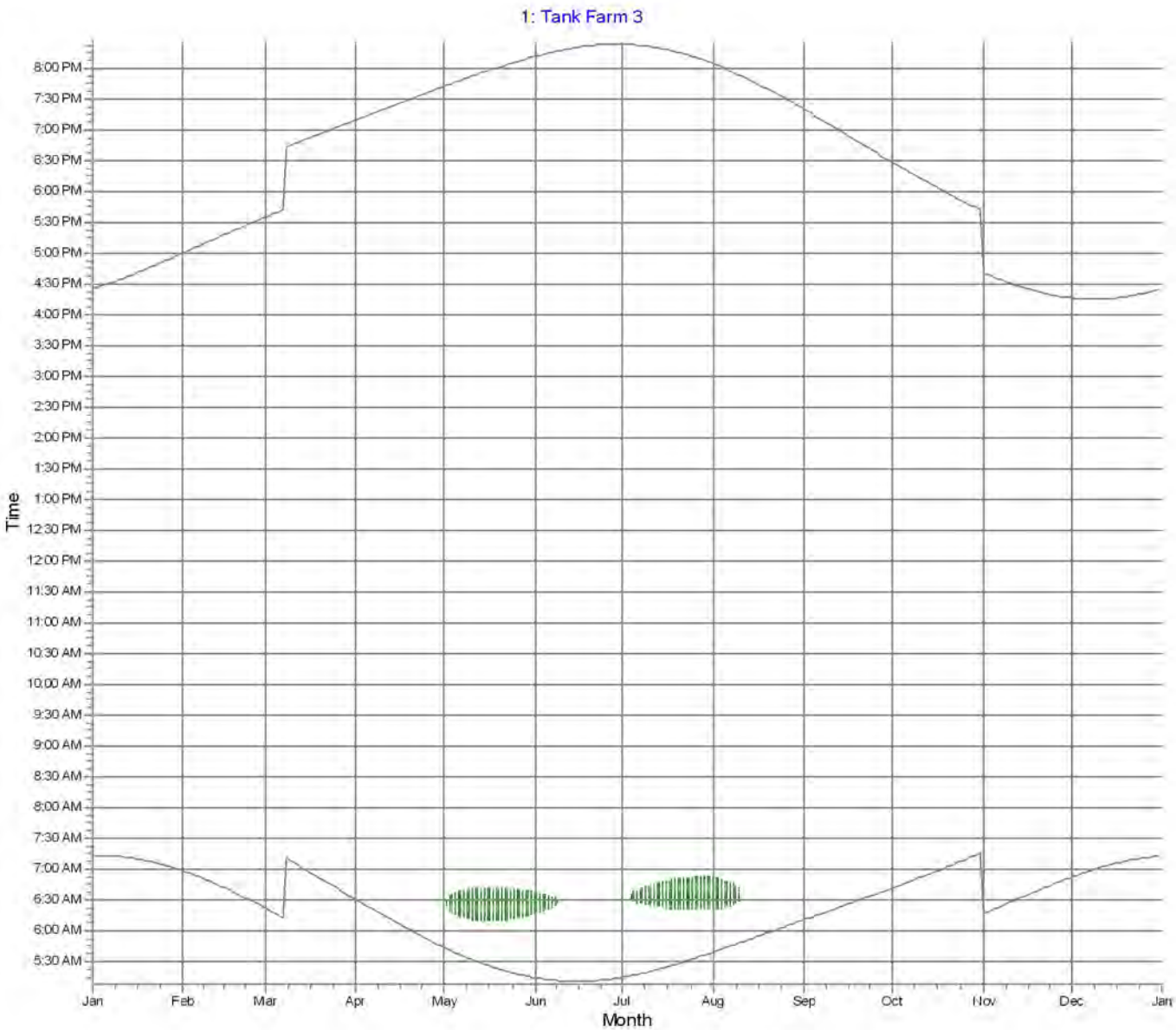
SHADOW - Calendar per WTG, graphical

WTG: 1 - Tank Farm 3



WTGs

A: 1A

Project:

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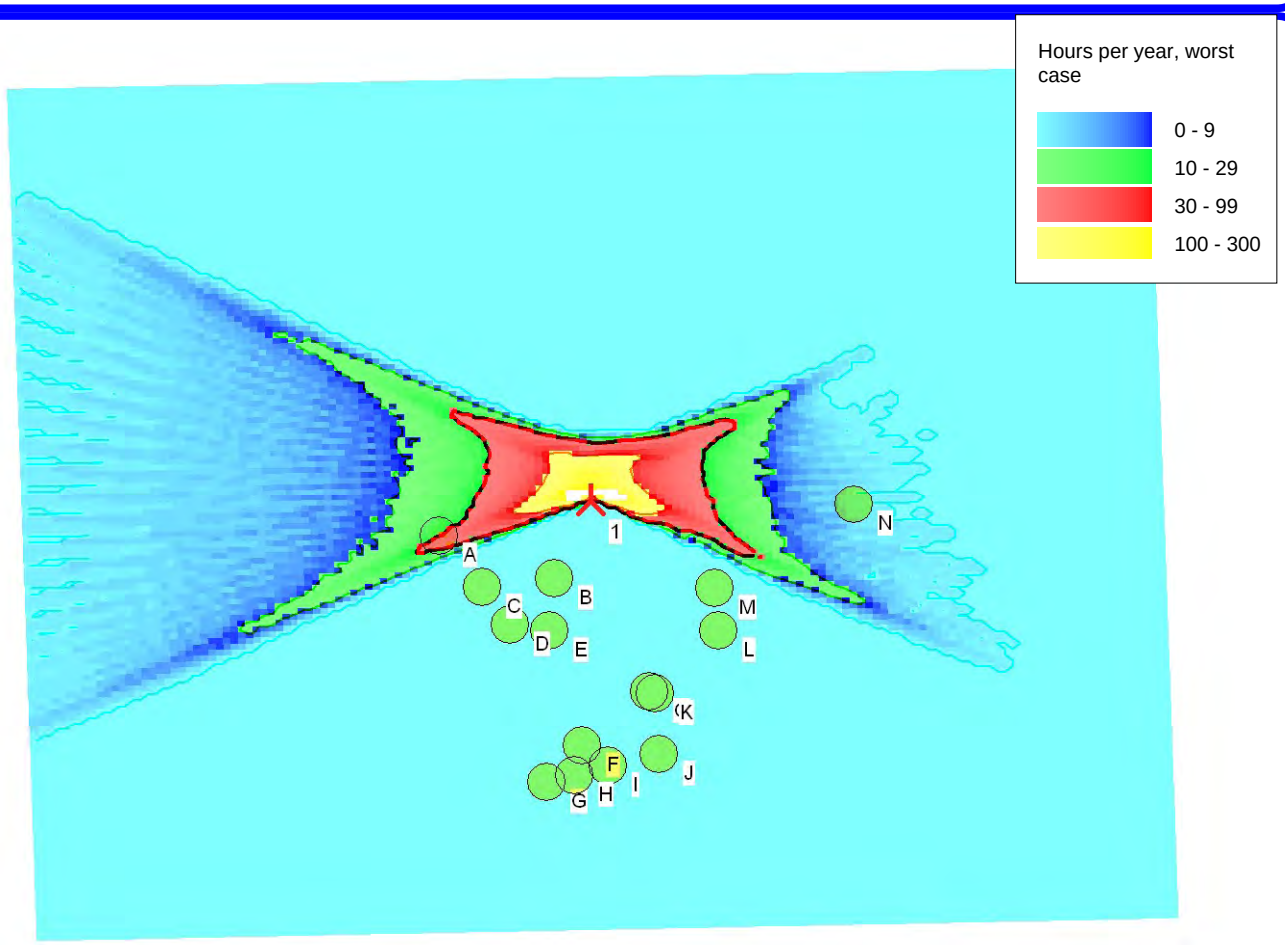
SHADOW - Map



0 250 500 750 1000m

Map: , Print scale 1:20,000, Map center Geo WGS 84 East: -71.288372° North: 41.571198°

New WTG
Shadow receptor

Isolines showing shadow in Hours per year, worst case

0 10 30 100

APPENDIX 2

WIND TURBINE SITE 2 TANK FARM 4B

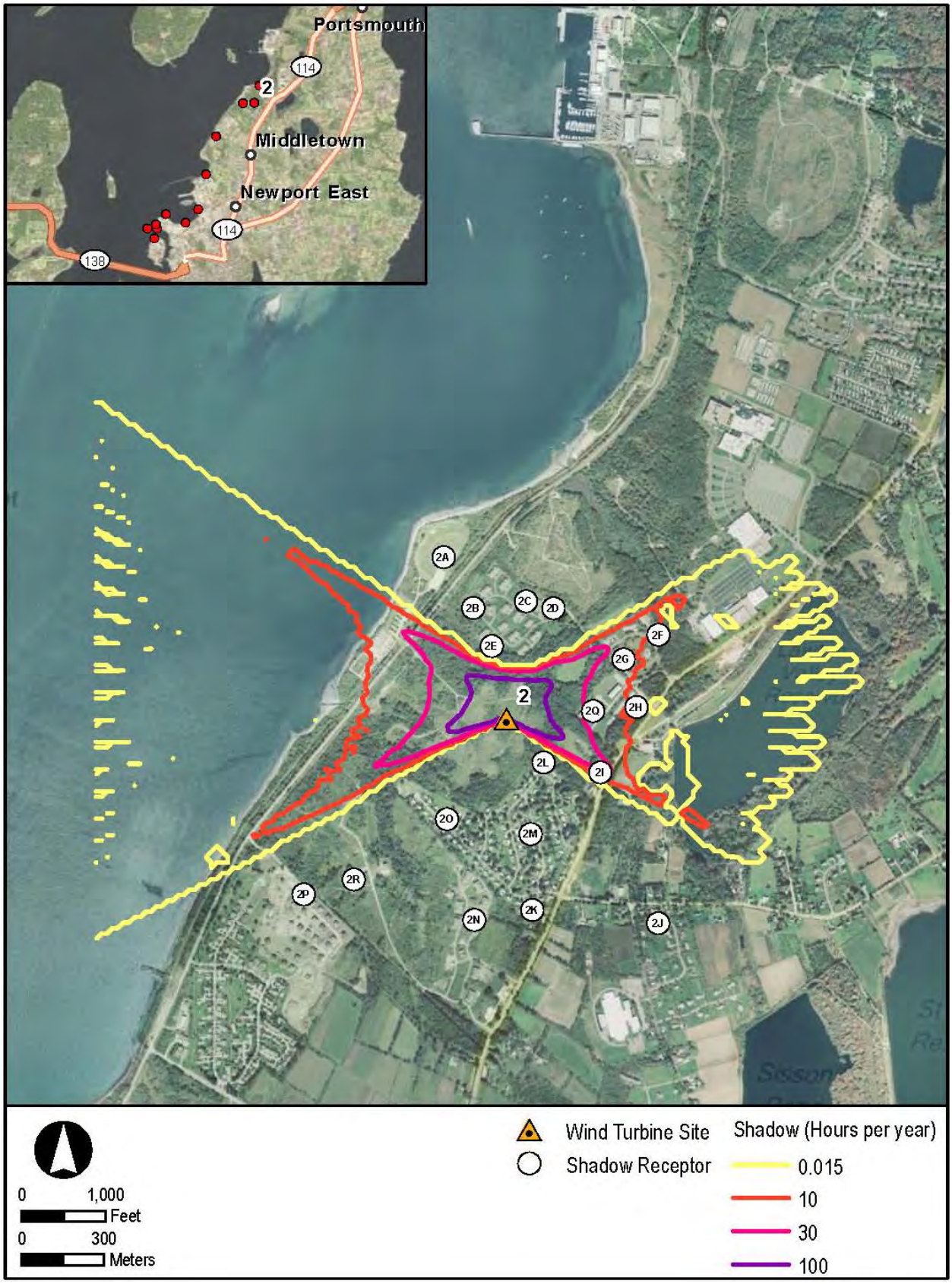


Figure A-2: Maximum predicted shadow flicker levels (hours per year) for a Power Wind 56-900 kW Model at Wind Turbine Site 2 (Tank Farm 4B).

Project:
Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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Calculated:
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SHADOW - Main Result

Assumptions for shadow calculations

Maximum distance for influence
Calculate only when more than 20 % of sun is covered by the blade
Please look in WTG table

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

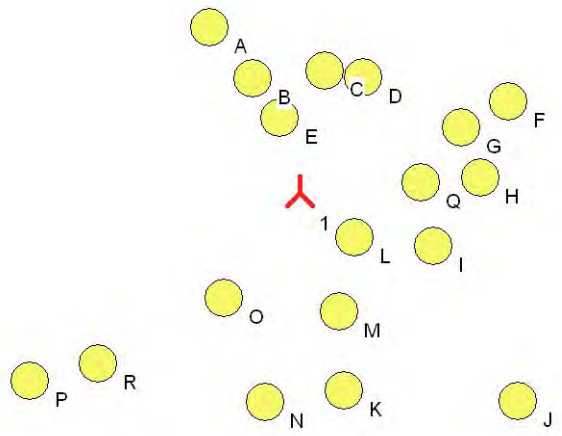
Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW
691	432	259	155	155	155	432	518	950	1,209	864	518

W	WNW	NW	NNW	Sum
432	604	691	691	8,756

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: Line object
Obstacles used in calculation
Eye height: 1.5 m
Grid resolution: 10 m



Scale 1:20,000
New WTG
Shadow receptor

WTGs

	Geo DD: WGS 84 Longitude	Latitude	Z [m]	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Shadow data Calculation distance [m]	RPM [RPM]
1	-71.290411° East	41.564888° North	29.4	Tank Farm 4B	No	POWER MILLS	PowerWind G56-900 KW-900	900	56.0	59.0	2,000	0.0

Shadow receptor-Input

No.	Name	Geo DD: WGS 84 Longitude	Latitude	Z [m]	Width [m]	Height [m]	Height a.g.l. [m]	Degrees from south cw [°]	Slope of window [°]	Direction mode
A	2A	-71.293287° East	41.570157° North	9.3	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
B	2B	-71.291931° East	41.568519° North	15.7	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
C	2C	-71.289627° East	41.568779° North	27.1	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
D	2D	-71.288415° East	41.568570° North	41.1	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
E	2E	-71.291071° East	41.567276° North	25.9	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
F	2F	-71.283794° East	41.567791° North	38.2	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
G	2G	-71.285296° East	41.566957° North	42.0	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
H	2H	-71.284677° East	41.565396° North	53.3	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
I	2I	-71.286175° East	41.563217° North	51.8	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
J	2J	-71.283486° East	41.558303° North	58.4	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
K	2K	-71.289002° East	41.558635° North	47.4	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
L	2L	-71.288677° East	41.563493° North	40.9	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
M	2M	-71.289159° East	41.561132° North	42.7	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
N	2N	-71.291527° East	41.558255° North	32.2	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
O	2O	-71.292833° East	41.561551° North	23.6	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
P	2P	-71.299019° East	41.558948° North	30.7	1.0	1.0	1.0	-180.0	90.0	"Green house mode"

To be continued on next page...

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SHADOW - Main Result

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No.	Name	Geo DD: WGS 84 Longitude	Latitude	Z [m]	Width [m]	Height [m]	Height a.g.l. [m]	Degrees from south cw [°]	Slope of window [°]	Direction mode
Q	2Q	-71.286567° East	41.565226° North	48.3	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
R	2R	-71.296841° East	41.559485° North	30.5	1.0	1.0	1.0	-180.0	90.0	"Green house mode"

Calculation Results

Shadow receptor

No.	Name	Shadow, worst case: Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow, expected values: Shadow hours per year [h/year]
A	2A	0:00	0	0:00	0:00
B	2B	0:00	0	0:00	0:00
C	2C	0:00	0	0:00	0:00
D	2D	0:00	0	0:00	0:00
E	2E	0:00	0	0:00	0:00
F	2F	9:24	42	0:21	2:49
G	2G	15:27	48	0:28	4:41
H	2H	8:12	33	0:23	2:37
I	2I	22:06	65	0:28	8:15
J	2J	0:00	0	0:00	0:00
K	2K	0:00	0	0:00	0:00
L	2L	0:00	0	0:00	0:00
M	2M	0:00	0	0:00	0:00
N	2N	0:00	0	0:00	0:00
O	2O	0:00	0	0:00	0:00
P	2P	0:00	0	0:00	0:00
Q	2Q	25:02	53	0:40	8:02
R	2R	0:00	0	0:00	0:00

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

No.	Name	Worst case [h/year]	Expected [h/year]
1	Tank Farm 4B	65:04	21:44

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SHADOW - Calendar

Shadow receptor: A - 2A

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:14	05:15	05:39	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:41	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:15	05:40	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:16
3	07:13	06:56	06:18	06:27	05:41	05:13	05:16	05:41	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:42	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:38	05:13	05:17	05:43	06:15	06:46	06:22	06:56
	16:29	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:12	05:18	05:44	06:16	06:47	06:23	06:57
	16:30	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:35	16:16
7	07:13	06:52	06:12	06:20	05:36	05:12	05:18	05:45	06:17	06:48	06:24	06:58
	16:31	17:08	17:42	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18	05:35	05:12	05:19	05:46	06:18	06:49	06:25	06:59
	16:32	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:47	06:19	06:50	06:26	07:00
	16:33	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	16:16
10	07:12	06:48	07:07	06:15	05:32	05:11	05:20	05:48	06:20	06:51	06:28	07:01
	16:34	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:13	05:31	05:11	05:21	05:49	06:21	06:52	06:29	07:02
	16:35	17:13	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:12	06:46	07:04	06:12	05:30	05:11	05:22	05:50	06:22	06:54	06:30	07:03
	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:51	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:56	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:23	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:50	19:24	19:57	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:18	18:52	19:25	19:58	20:21	20:19	19:46	18:56	18:06	16:26	16:16
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:06
	16:41	17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:25	16:17
17	07:10	06:39	06:55	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	20:00	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:02	05:24	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:43	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:23	05:11	05:27	05:58	06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30	20:01	20:22	20:17	19:41	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:22	05:11	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:18
22	07:07	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:15	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:49	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:20	16:19
24	07:05	06:29	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:29	19:02	19:35	20:05	20:24	20:13	19:33	18:41	17:52	16:20	16:20
25	07:05	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:11
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:50	05:18	05:13	05:34	06:05	06:36	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:49	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:13	05:35	06:06	06:37	07:11	06:48	07:11
	16:54	17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:12
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:46	05:16	05:14	05:36	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:17	16:23
30	07:00		06:33	05:45	05:15	05:14	05:37	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:30	17:44	16:17	16:24
31	06:59		06:32		05:15		05:38	06:10		07:15		07:12
	16:59		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	296	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

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SHADOW - Calendar

Shadow receptor: B - 2B

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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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

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	16:26	17:01	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:41	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:15	05:40	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:16
3	07:13	06:56	06:18	06:27	05:41	05:13	05:16	05:41	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:42	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:38	05:13	05:17	05:43	06:15	06:46	06:22	06:56
	16:29	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:12	05:18	05:44	06:16	06:47	06:23	06:57
	16:30	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:35	16:16
7	07:13	06:52	06:12	06:20	05:36	05:12	05:18	05:45	06:17	06:48	06:24	06:58
	16:31	17:08	17:42	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18	05:35	05:12	05:19	05:46	06:18	06:49	06:25	06:59
	16:32	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:47	06:19	06:50	06:26	07:00
	16:33	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	16:16
10	07:12	06:48	07:07	06:15	05:32	05:11	05:20	05:48	06:20	06:51	06:28	07:01
	16:34	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:13	05:31	05:11	05:21	05:49	06:21	06:52	06:29	07:02
	16:35	17:13	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:12	06:46	07:04	06:12	05:30	05:11	05:22	05:50	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:51	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:56	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:23	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:50	19:24	19:57	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:18	18:52	19:25	19:58	20:21	20:19	19:46	18:56	18:06	16:26	16:16
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:06
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	16:42	17:21	18:54	19:28	20:00	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:02	05:24	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:43	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:23	05:11	05:27	05:58	06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30	20:00	20:22	20:17	19:40	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:22	05:11	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
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	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:49	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:42	17:54	16:20	16:19
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	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:50	05:18	05:13	05:34	06:05	06:36	07:10	06:47	07:11
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28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:12
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
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31	06:59		06:32		05:15		05:38	06:10		07:15		07:12
	16:59		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	296	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 11:45 AM / 3

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 11:44 AM/2.7.473

SHADOW - Calendar

Shadow receptor: C - 2C

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:14	05:15	05:39	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:41	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:15	05:40	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:16
3	07:13	06:56	06:18	06:27	05:41	05:13	05:16	05:41	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:42	06:14	06:45	06:20	06:55
	16:28	17:04	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:38	05:13	05:17	05:43	06:15	06:46	06:22	06:56
	16:29	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:12	05:18	05:44	06:16	06:47	06:23	06:57
	16:30	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:35	16:16
7	07:13	06:52	06:12	06:20	05:36	05:12	05:18	05:45	06:17	06:48	06:24	06:58
	16:31	17:08	17:42	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18	05:35	05:12	05:19	05:46	06:18	06:49	06:25	06:59
	16:32	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:47	06:19	06:50	06:26	07:00
	16:33	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	16:15
10	07:12	06:48	07:07	06:15	05:32	05:11	05:20	05:48	06:20	06:51	06:28	07:01
	16:34	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
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	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
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	16:39	17:17	18:50	19:24	19:57	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:18	18:52	19:25	19:58	20:21	20:19	19:46	18:56	18:06	16:26	16:16
16	07:10	06:41	06:57	06:05	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:06
	16:41	17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:25	16:17
17	07:10	06:39	06:55	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
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18	07:09	06:38	06:54	06:02	05:24	05:11	05:26	05:57	06:28	07:00	06:37	07:07
	16:43	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:23	05:11	05:27	05:58	06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30	20:00	20:22	20:17	19:40	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:22	05:11	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22	16:18
21	07:07	06:34	06:49	05:58	05:22	05:11	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:37	18:46	17:57	16:22	16:18
22	07:07	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:49	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:42	17:54	16:20	16:19
24	07:05	06:29	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:29	19:01	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
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28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:38	07:12	06:49	07:12
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:46	05:16	05:14	05:36	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:17	16:23
30	07:00		06:33	05:45	05:15	05:14	05:37	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:30	17:44	16:17	16:24
31	06:59		06:32		05:15		05:38	06:10		07:15		07:12
	16:59		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	296	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 11:45 AM / 4

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 11:44 AM/2.7.473

SHADOW - Calendar

Shadow receptor: D - 2D

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:14	05:15	05:39	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:41	16:17
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	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:16
3	07:13	06:56	06:18	06:27	05:41	05:13	05:16	05:41	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39	16:16
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6	07:13	06:53	06:14	06:22	05:37	05:12	05:18	05:44	06:16	06:47	06:23	06:57
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	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:37	18:46	17:57	16:22	16:18
22	07:07	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:49	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:42	17:54	16:20	16:19
24	07:05	06:29	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:29	19:01	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:50	05:18	05:13	05:34	06:05	06:36	07:09	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:49	16:19	16:21
27	07:03	06:25	06:38	05:49	05:17	05:13	05:35	06:06	06:37	07:11	06:48	07:11
	16:54	17:33	19:05	19:38	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:38	07:12	06:49	07:12
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:46	05:16	05:14	05:36	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:17	16:23
30	07:00		06:33	05:45	05:15	05:14	05:37	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:30	17:44	16:17	16:24
31	06:59		06:32		05:15		05:38	06:10		07:15		07:12
	16:59		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	296	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 11:45 AM / 5

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 11:44 AM/2.7.473

SHADOW - Calendar

Shadow receptor: E - 2E

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:14	05:15	05:39	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:41	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:15	05:40	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:16
3	07:13	06:56	06:18	06:27	05:41	05:13	05:16	05:41	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:42	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:38	05:13	05:17	05:43	06:15	06:46	06:22	06:56
	16:29	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:12	05:18	05:44	06:16	06:47	06:23	06:57
	16:30	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:35	16:16
7	07:13	06:52	06:12	06:20	05:36	05:12	05:18	05:45	06:17	06:48	06:24	06:58
	16:31	17:08	17:42	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18	05:35	05:12	05:19	05:46	06:18	06:49	06:25	06:59
	16:32	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:47	06:19	06:50	06:26	07:00
	16:33	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	16:16
10	07:12	06:48	07:07	06:15	05:32	05:11	05:20	05:48	06:20	06:51	06:28	07:01
	16:34	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:13	05:31	05:11	05:21	05:49	06:21	06:52	06:29	07:02
	16:35	17:13	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:12	06:46	07:04	06:12	05:30	05:11	05:22	05:50	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:51	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:23	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:50	19:24	19:57	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:18	18:52	19:25	19:58	20:21	20:19	19:46	18:56	18:06	16:26	16:16
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:06
	16:41	17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:25	16:17
17	07:10	06:39	06:55	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	20:00	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:02	05:24	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:43	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:23	05:11	05:27	05:58	06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30	20:00	20:22	20:17	19:40	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:22	05:11	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:37	18:46	17:57	16:22	16:18
22	07:07	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:49	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:42	17:54	16:20	16:19
24	07:05	06:29	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:29	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:50	05:18	05:13	05:34	06:05	06:36	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:49	16:19	16:21
27	07:03	06:25	06:38	05:49	05:17	05:13	05:35	06:06	06:37	07:11	06:48	07:11
	16:54	17:33	19:05	19:38	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:12
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:46	05:16	05:14	05:36	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:17	16:23
30	07:00		06:33	05:45	05:15	05:14	05:37	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:30	17:44	16:17	16:24
31	06:59		06:32		05:15		05:38	06:10		07:15		07:12
	16:59		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	296	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 11:45 AM / 6

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 11:44 AM/2.7.473

SHADOW - Calendar

Shadow receptor: F - 2F

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January		February		March	April	May	June	July	August	September	October	November		December
1	07:12		06:58	16:13 (1)	06:22	06:30	05:44	05:14	05:15	05:39	06:11	06:42	06:17		06:52
	16:26		17:01	14 16:27 (1)	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:41		16:17
2	07:13		06:57	16:15 (1)	06:20	06:28	05:42	05:14	05:15	05:40	06:12	06:43	06:18		06:53
	16:27		17:02	11 16:26 (1)	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40		16:16
3	07:13		06:56	16:19 (1)	06:18	06:27	05:41	05:13	05:16	05:41	06:13	06:44	06:19		06:54
	16:28		17:03	4 16:23 (1)	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39		16:16
4	07:13		06:55		06:17	06:25	05:40	05:13	05:16	05:42	06:14	06:45	06:20		06:55
	16:28		17:04		17:39	19:13	19:46	20:14	20:23	20:02	19:15	18:24	16:38		16:16
5	07:13		06:54		06:15	06:23	05:38	05:13	05:17	05:43	06:15	06:46	06:21		06:56
	16:29		17:06		17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37		16:16
6	07:13		06:53		06:14	06:22	05:37	05:12	05:18	05:44	06:16	06:47	06:23		06:57
	16:30		17:07		17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:35		16:16
7	07:12		06:52		06:12	06:20	05:36	05:12	05:18	05:45	06:17	06:48	06:24		06:58
	16:31		17:08		17:42	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34		16:16
8	07:12		06:51		07:10	06:18	05:35	05:12	05:19	05:46	06:18	06:49	06:25	15:48 (1)	06:59
	16:32		17:10		18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	6 15:54 (1)	16:15
9	07:12		06:50		07:09	06:17	05:34	05:12	05:20	05:47	06:19	06:50	06:26	15:46 (1)	07:00
	16:33		17:11		18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	11 15:57 (1)	16:15
10	07:12		06:48		07:07	06:15	05:32	05:11	05:20	05:48	06:20	06:51	06:28	15:44 (1)	07:01
	16:34		17:12		18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	14 15:58 (1)	16:15
11	07:12		06:47		07:05	06:13	05:31	05:11	05:21	05:49	06:21	06:52	06:29	15:43 (1)	07:02
	16:35		17:13		18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16 15:59 (1)	16:16
12	07:11		06:46		07:04	06:12	05:30	05:11	05:22	05:50	06:22	06:53	06:30	15:42 (1)	07:02
	16:37		17:15		18:48	19:22	19:54	20:19	20:21	19:50	19:01	18:10	16:29	18 16:00 (1)	16:16
13	07:11		06:45		07:02	06:10	05:29	05:11	05:22	05:51	06:23	06:55	06:31	15:42 (1)	07:03
	16:38		17:16		18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	20 16:02 (1)	16:16
14	07:11		06:43	16:10 (1)	07:00	06:09	05:28	05:11	05:23	05:52	06:24	06:56	06:32	15:41 (1)	07:04
	16:39	2	17:17	16:12 (1)	18:50	19:24	19:56	20:20	20:20	19:48	18:58	18:07	16:27	21 16:02 (1)	16:16
15	07:10		06:42	16:09 (1)	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	15:41 (1)	07:05
	16:40	5	17:18	16:14 (1)	18:52	19:25	19:57	20:21	20:19	19:46	18:56	18:06	16:26	21 16:02 (1)	16:16
16	07:10		06:41	16:09 (1)	06:57	06:05	05:26	05:11	05:25	05:55	06:26	06:58	06:35	15:42 (1)	07:05
	16:41	7	17:20	16:16 (1)	18:53	19:27	19:58	20:21	20:19	19:45	18:55	18:04	16:25	20 16:02 (1)	16:16
17	07:10		06:39	16:08 (1)	06:55	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	15:42 (1)	07:06
	16:42	8	17:21	16:16 (1)	18:54	19:28	19:59	20:22	20:18	19:43	18:53	18:03	16:25	18 16:00 (1)	16:17
18	07:09		06:38	16:08 (1)	06:54	06:02	05:24	05:11	05:26	05:57	06:28	07:00	06:37	15:41 (1)	07:07
	16:43	9	17:22	16:17 (1)	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	18 15:59 (1)	16:17
19	07:08		06:36	16:08 (1)	06:52	06:01	05:23	05:11	05:27	05:58	06:29	07:01	06:38	15:42 (1)	07:07
	16:45	11	17:23	16:19 (1)	18:56	19:30	20:00	20:22	20:17	19:40	18:49	18:00	16:23	16 15:58 (1)	16:17
20	07:08		06:35	16:07 (1)	06:50	05:59	05:22	05:11	05:28	05:59	06:30	07:02	06:40	15:43 (1)	07:08
	16:46	13	17:25	16:20 (1)	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22	15 15:58 (1)	16:18
21	07:07		06:34	16:07 (1)	06:49	05:58	05:22	05:11	05:29	06:00	06:31	07:04	06:41	15:43 (1)	07:09
	16:47	14	17:26	16:21 (1)	18:58	19:32	20:02	20:23	20:15	19:37	18:46	17:57	16:22	14 15:57 (1)	16:18
22	07:07		06:32	16:08 (1)	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	15:43 (1)	07:09
	16:48	15	17:27	16:23 (1)	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	13 15:56 (1)	16:19
23	07:06		06:31	16:08 (1)	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	15:44 (1)	07:10
	16:49	16	17:28	16:24 (1)	19:00	19:34	20:04	20:23	20:14	19:34	18:42	17:54	16:20	11 15:55 (1)	16:19
24	07:05		06:29	16:07 (1)	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44	15:46 (1)	07:10
	16:51	18	17:29	16:25 (1)	19:01	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	9 15:55 (1)	16:20
25	07:04		06:28	16:08 (1)	06:42	05:52	05:19	05:12	05:33	06:04	06:35	07:08	06:45	15:46 (1)	07:10
	16:52	18	17:31	16:26 (1)	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	9 15:55 (1)	16:21
26	07:04		06:26	16:09 (1)	06:40	05:50	05:18	05:13	05:34	06:05	06:36	07:09	06:47	15:47 (1)	07:11
	16:53	20	17:32	16:29 (1)	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:49	16:19	7 15:54 (1)	16:21
27	07:03		06:25	16:09 (1)	06:38	05:49	05:17	05:13	05:35	06:06	06:37	07:11	06:48	15:48 (1)	07:11
	16:54	21	17:33	16:30 (1)	19:05	19:38	20:08	20:24	20:10	19:28	18:36	17:48	16:18	5 15:53 (1)	16:22
28	07:02		06:23	16:10 (1)	06:37	05:48	05:17	05:14	05:35	06:07	06:38	07:12	06:49	15:50 (1)	07:11
	16:56	20	17:34	16:30 (1)	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	2 15:52 (1)	16:23
29	07:01			16:10 (1)	06:35	05:46	05:16	05:14	05:36	06:08	06:40	07:13	06:50		07:12
	16:57	20		16:30 (1)	19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:17		16:23
30	07:00			16:11 (1)	06:33	05:45	05:15	05:14	05:37	06:09	06:41	07:14	06:51		07:12
	16:58	18		16:29 (1)	19:08	19:42	20:10	20:24	20:07	19:23	18:30	17:44	16:17		16:24
31	06:59			16:12 (1)	06:32		05:15		05:38	06:10		07:15			07:12
	16:59	16		16:28 (1)	19:09		20:11		20:06	19:22		17:43			16:25
Potential sun hours	296		297		370	400	450	454	461	429	375	344	296		286
Total, worst case		251		29										284	
Sun reduction		0.56		0.58										0.50	
Oper. time red.		1.00		1.00										1.00	
Wind dir. red.		0.57		0.57										0.57	
Total reduction		0.32		0.33										0.28	
Total, real		80		10										81	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
2/24/2011 11:45 AM / 7

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 11:44 AM/2.7.473

SHADOW - Calendar

Shadow receptor: G - 2G

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January		February		March	April	May	June	July	August	September	October		November		December
1	07:12		06:58	16:10 (1)	06:22	06:30	05:44	05:14	05:15	05:39	06:11	06:42		06:17	15:45 (1)	06:52
	16:26		17:01	26 16:36 (1)	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29		16:41	18 16:03 (1)	16:17
2	07:13		06:57	16:10 (1)	06:20	06:28	05:42	05:14	05:15	05:40	06:12	06:43		06:18	15:43 (1)	06:53
	16:27		17:02	28 16:38 (1)	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27		16:40	21 16:04 (1)	16:16
3	07:13		06:56	16:10 (1)	06:18	06:27	05:41	05:13	05:16	05:41	06:13	06:44		06:19	15:43 (1)	06:54
	16:28		17:03	28 16:38 (1)	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25		16:39	23 16:06 (1)	16:16
4	07:13		06:55	16:11 (1)	06:17	06:25	05:40	05:13	05:16	05:42	06:14	06:45		06:20	15:42 (1)	06:55
	16:28		17:04	27 16:38 (1)	17:39	19:13	19:46	20:14	20:23	20:02	19:15	18:24		16:38	24 16:06 (1)	16:16
5	07:13		06:54	16:10 (1)	06:15	06:23	05:38	05:13	05:17	05:43	06:15	06:46		06:21	15:41 (1)	06:56
	16:29		17:06	27 16:37 (1)	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22		16:37	26 16:07 (1)	16:16
6	07:13		06:53	16:11 (1)	06:14	06:22	05:37	05:12	05:18	05:44	06:16	06:47		06:23	15:41 (1)	06:57
	16:30		17:07	26 16:37 (1)	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20		16:35	27 16:08 (1)	16:16
7	07:12		06:52	16:12 (1)	06:12	06:20	05:36	05:12	05:18	05:45	06:17	06:48		06:24	15:41 (1)	06:58
	16:31		17:08	24 16:36 (1)	17:42	19:17	19:49	20:16	20:23	19:57	19:10	18:19		16:34	27 16:08 (1)	16:16
8	07:12		06:51	16:13 (1)	07:10	06:18	05:35	05:12	05:19	05:46	06:18	06:49		06:25	15:40 (1)	06:59
	16:32		17:10	23 16:36 (1)	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17		16:33	28 16:08 (1)	16:15
9	07:12		06:50	16:15 (1)	07:09	06:17	05:34	05:12	05:20	05:47	06:19	06:50		06:26	15:41 (1)	07:00
	16:33		17:11	20 16:35 (1)	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15		16:32	28 16:09 (1)	16:15
10	07:12		06:48	16:16 (1)	07:07	06:15	05:32	05:11	05:20	05:48	06:20	06:51		06:28	15:41 (1)	07:01
	16:34		17:12	17 16:33 (1)	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14		16:31	26 16:07 (1)	16:16
11	07:12		06:47	16:18 (1)	07:05	06:13	05:31	05:11	05:21	05:49	06:21	06:52		06:29	15:40 (1)	07:02
	16:35		17:13	13 16:31 (1)	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12		16:30	26 16:06 (1)	16:16
12	07:11		06:46	16:22 (1)	07:04	06:12	05:30	05:11	05:22	05:50	06:22	06:54		06:30	15:40 (1)	07:02
	16:37		17:15	6 16:28 (1)	18:48	19:22	19:54	20:19	20:21	19:50	19:01	18:10		16:29	25 16:05 (1)	16:16
13	07:11		06:45		07:02	06:10	05:29	05:11	05:22	05:51	06:23	06:55		06:31	15:42 (1)	07:03
	16:38		17:16		18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09		16:28	22 16:04 (1)	16:16
14	07:11		06:43		07:00	06:09	05:28	05:11	05:23	05:52	06:24	06:56		06:32	15:42 (1)	07:04
	16:39		17:17		18:50	19:24	19:56	20:20	20:20	19:48	18:58	18:07		16:27	21 16:03 (1)	16:16
15	07:10		06:42		06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57		06:34	15:42 (1)	07:05
	16:40		17:18		18:52	19:25	19:57	20:21	20:19	19:46	18:56	18:06		16:26	20 16:02 (1)	16:16
16	07:10		06:41		06:57	06:05	05:26	05:11	05:25	05:55	06:26	06:58		06:35	15:44 (1)	07:05
	16:41		17:20		18:53	19:27	19:58	20:21	20:19	19:45	18:55	18:04		16:25	18 16:02 (1)	16:16
17	07:10		06:39		06:55	06:04	05:25	05:11	05:26	05:56	06:27	06:59		06:36	15:44 (1)	07:06
	16:42		17:21		18:54	19:28	19:59	20:22	20:18	19:43	18:53	18:03		16:25	16 16:00 (1)	16:17
18	07:09		06:38		06:54	06:02	05:24	05:11	05:26	05:57	06:28	07:00		06:37	15:45 (1)	07:07
	16:43		17:22		18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01		16:24	14 15:59 (1)	16:17
19	07:08		06:36		06:52	06:01	05:23	05:11	05:27	05:58	06:29	07:01		06:38	15:46 (1)	07:07
	16:45		17:23		18:56	19:30	20:00	20:22	20:17	19:40	18:49	18:00		16:23	12 15:58 (1)	16:18
20	07:08		06:35	16:15 (1)	06:50	05:59	05:22	05:11	05:28	05:59	06:30	07:02		06:40	15:48 (1)	07:08
	16:46	5	17:25	16:20 (1)	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58		16:22	10 15:58 (1)	16:18
21	07:07		06:34	16:13 (1)	06:49	05:58	05:22	05:11	05:29	06:00	06:31	07:04		06:41	15:49 (1)	07:09
	16:47	8	17:26	16:21 (1)	18:58	19:32	20:02	20:23	20:15	19:37	18:46	17:57		16:22	8 15:57 (1)	16:18
22	07:07		06:32	16:13 (1)	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05		06:42	15:51 (1)	07:09
	16:48	10	17:27	16:23 (1)	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55		16:21	5 15:56 (1)	16:19
23	07:06		06:31	16:12 (1)	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06		06:43		07:10
	16:49	12	17:28	16:24 (1)	19:00	19:34	20:04	20:23	20:14	19:34	18:42	17:54		16:20		16:19
24	07:05		06:29	16:11 (1)	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07		06:44		07:10
	16:51	14	17:29	16:25 (1)	19:01	19:35	20:05	20:23	20:13	19:33	18:41	17:52		16:20		16:20
25	07:04		06:28	16:10 (1)	06:42	05:52	05:19	05:12	05:33	06:04	06:35	07:08		06:45		07:10
	16:52	16	17:31	16:26 (1)	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51		16:19		16:21
26	07:04		06:26	16:11 (1)	06:40	05:50	05:18	05:13	05:34	06:05	06:36	07:09		06:47		07:11
	16:53	18	17:32	16:29 (1)	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:49		16:19		16:21
27	07:03		06:25	16:10 (1)	06:38	05:49	05:17	05:13	05:35	06:06	06:37	07:11		06:48		07:11
	16:54	20	17:33	16:30 (1)	19:05	19:38	20:08	20:24	20:10	19:28	18:36	17:48		16:18		16:22
28	07:02		06:23	16:10 (1)	06:37	05:48	05:17	05:14	05:36	06:07	06:38	07:12		06:49		07:11
	16:56	21	17:34	16:31 (1)	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47		16:18		16:23
29	07:01			16:10 (1)	06:35	05:46	05:16	05:14	05:36	06:08	06:40	07:13		06:50		07:12
	16:57	22		16:32 (1)	19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45		16:17		16:23
30	07:00			16:10 (1)	06:33	05:45	05:15	05:14	05:37	06:09	06:41	07:14	16:51 (1)	06:51		07:12
	16:58	24		16:34 (1)	19:08	19:42	20:10	20:24	20:07	19:23	18:30	17:44	8 16:59 (1)	16:17		16:24
31	06:59			16:10 (1)	06:32		05:15		05:38	06:10		07:15	16:47 (1)			07:12
	16:59	25		16:35 (1)	19:09		20:11		20:06	19:22		17:43	14 17:01 (1)			16:25
Potential sun hours	296		297		370	400	450	454	461	429	375	344		296		286
Total, worst case		195		265									22		445	
Sun reduction		0.56		0.58									0.61		0.50	
Oper. time red.		1.00		1.00									1.00		1.00	
Wind dir. red.		0.57		0.57									0.57		0.57	
Total reduction		0.32		0.33									0.34		0.28	
Total, real		62		87									8		126	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 11:45 AM / 8

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US-75074-5977 Plano TX
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Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 11:44 AM/2.7.473

SHADOW - Calendar

Shadow receptor: H - 2H

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March			April	May	June	July	August	September			October			November	December
1	07:12	06:58	06:22			06:30	05:44	05:14	05:15	05:39	06:11			06:42		17:52 (1)	06:17	06:52
	16:26	17:01	17:35			19:10	19:43	20:12	20:24	20:05	19:20			18:29	15	18:07 (1)	16:41	16:17
2	07:13	06:57	06:20			06:28	05:42	05:14	05:15	05:40	06:12			06:43		17:52 (1)	06:18	06:53
	16:27	17:02	17:37			19:11	19:44	20:13	20:24	20:04	19:18			18:27	13	18:05 (1)	16:40	16:16
3	07:13	06:56	06:18			06:27	05:41	05:13	05:16	05:41	06:13			06:44		17:52 (1)	06:19	06:54
	16:28	17:03	17:38			19:12	19:45	20:14	20:24	20:03	19:17			18:25	11	18:03 (1)	16:39	16:16
4	07:13	06:55	06:17			06:25	05:40	05:13	05:16	05:42	06:14			06:45		17:53 (1)	06:20	06:55
	16:28	17:04	17:39			19:13	19:46	20:14	20:23	20:02	19:15			18:24	8	18:01 (1)	16:38	16:16
5	07:13	06:54	06:15			06:23	05:38	05:13	05:17	05:43	06:15			06:46		17:53 (1)	06:21	06:56
	16:29	17:06	17:40			19:15	19:47	20:15	20:23	20:01	19:13			18:22	7	18:00 (1)	16:37	16:16
6	07:13	06:53	06:14			06:22	05:37	05:12	05:18	05:44	06:16			06:47		17:55 (1)	06:23	06:57
	16:30	17:07	17:41			19:16	19:48	20:16	20:23	19:58	19:12			18:20	3	17:58 (1)	16:35	16:16
7	07:12	06:52	06:12		17:19 (1)	06:20	05:36	05:12	05:18	05:45	06:17			06:48			06:24	06:58
	16:31	17:08	17:42	2	17:20 (1)	19:17	19:49	20:16	20:23	19:57	19:10			18:19			16:34	16:16
8	07:12	06:51	07:10		18:18 (1)	06:18	05:35	05:12	05:19	05:46	06:18			06:49			06:25	06:59
	16:32	17:10	18:44	4	18:22 (1)	19:18	19:50	20:17	20:22	19:56	19:08			18:17			16:33	16:15
9	07:12	06:50	07:09		18:15 (1)	06:17	05:34	05:12	05:20	05:47	06:19			06:50			06:26	07:00
	16:33	17:11	18:45	8	18:23 (1)	19:19	19:51	20:18	20:22	19:54	19:07			18:15			16:32	16:15
10	07:12	06:48	07:07		18:14 (1)	06:15	05:32	05:11	05:20	05:48	06:20			06:51			06:28	07:01
	16:34	17:12	18:46	10	18:24 (1)	19:20	19:52	20:18	20:22	19:53	19:05			18:14			16:31	16:16
11	07:12	06:47	07:05		18:13 (1)	06:13	05:31	05:11	05:21	05:49	06:21			06:52			06:29	07:02
	16:35	17:13	18:47	13	18:26 (1)	19:21	19:53	20:19	20:21	19:52	19:03			18:12			16:30	16:16
12	07:11	06:46	07:04		18:12 (1)	06:12	05:30	05:11	05:22	05:50	06:22			06:53			06:30	07:02
	16:37	17:15	18:48	15	18:27 (1)	19:22	19:54	20:19	20:21	19:50	19:01			18:10			16:29	16:16
13	07:11	06:45	07:02		18:11 (1)	06:10	05:29	05:11	05:22	05:51	06:23			06:55			06:31	07:03
	16:38	17:16	18:49	16	18:27 (1)	19:23	19:55	20:20	20:20	19:49	19:00			18:09			16:28	16:16
14	07:11	06:43	07:00		18:11 (1)	06:09	05:28	05:11	05:23	05:52	06:24			06:56			06:32	07:04
	16:39	17:17	18:50	18	18:29 (1)	19:24	19:56	20:20	20:20	19:48	18:58			18:07			16:27	16:16
15	07:10	06:42	06:59		18:11 (1)	06:07	05:27	05:11	05:24	05:54	06:25			06:57			06:34	07:05
	16:40	17:18	18:52	19	18:30 (1)	19:25	19:57	20:21	20:19	19:46	18:56			18:06			16:26	16:16
16	07:10	06:41	06:57		18:11 (1)	06:05	05:26	05:11	05:25	05:55	06:26			06:58			06:35	07:05
	16:41	17:20	18:53	20	18:31 (1)	19:27	19:58	20:21	20:19	19:45	18:55			18:04			16:25	16:16
17	07:10	06:39	06:55		18:11 (1)	06:04	05:25	05:11	05:26	05:56	06:27			06:59			06:36	07:06
	16:42	17:21	18:54	22	18:33 (1)	19:28	19:59	20:22	20:18	19:43	18:53			18:03			16:25	16:17
18	07:09	06:38	06:54		18:11 (1)	06:02	05:24	05:11	05:26	05:57	06:28			07:00			06:37	07:07
	16:43	17:22	18:55	23	18:34 (1)	19:29	20:00	20:22	20:17	19:42	18:51			18:01			16:24	16:17
19	07:08	06:36	06:52		18:12 (1)	06:01	05:23	05:11	05:27	05:58	06:29			07:01			06:38	07:07
	16:45	17:23	18:56	22	18:34 (1)	19:30	20:00	20:22	20:17	19:40	18:49			18:00			16:23	16:18
20	07:08	06:35	06:50		18:12 (1)	05:59	05:22	05:11	05:28	05:59	06:30			07:02			06:40	07:08
	16:46	17:25	18:57	21	18:33 (1)	19:31	20:01	20:23	20:16	19:39	18:48			17:58			16:22	16:18
21	07:07	06:34	06:49		18:14 (1)	05:58	05:22	05:11	05:29	06:00	06:31		18:02 (1)	07:04			06:41	07:09
	16:47	17:26	18:58	18	18:32 (1)	19:32	20:02	20:23	20:15	19:37	18:46	11	18:13 (1)	17:57			16:22	16:18
22	07:07	06:32	06:47		18:16 (1)	05:56	05:21	05:12	05:30	06:01	06:32		17:59 (1)	07:05			06:42	07:09
	16:48	17:27	18:59	13	18:29 (1)	19:33	20:03	20:23	20:14	19:36	18:44	16	18:15 (1)	17:55			16:21	16:19
23	07:06	06:31	06:45		18:21 (1)	05:55	05:20	05:12	05:31	06:02	06:33		17:57 (1)	07:06			06:43	07:10
	16:49	17:28	19:00	2	18:23 (1)	19:34	20:04	20:23	20:14	19:34	18:42	20	18:17 (1)	17:54			16:20	16:19
24	07:05	06:29	06:44			05:53	05:19	05:12	05:32	06:03	06:34		17:56 (1)	07:07			06:44	07:10
	16:51	17:29	19:01			19:35	20:05	20:23	20:13	19:33	18:41	22	18:18 (1)	17:52			16:20	16:20
25	07:04	06:28	06:42			05:52	05:19	05:12	05:33	06:04	06:35		17:54 (1)	07:08			06:45	07:10
	16:52	17:31	19:03			19:36	20:06	20:24	20:12	19:31	18:39	22	18:16 (1)	17:51			16:19	16:21
26	07:04	06:26	06:40			05:50	05:18	05:13	05:34	06:05	06:36		17:53 (1)	07:09			06:47	07:11
	16:53	17:32	19:04			19:37	20:07	20:24	20:11	19:30	18:37	22	18:15 (1)	17:49			16:19	16:21
27	07:03	06:25	06:38			05:49	05:17	05:13	05:35	06:06	06:37		17:52 (1)	07:11			06:48	07:11
	16:54	17:33	19:05			19:38	20:08	20:24	20:10	19:28	18:36	21	18:13 (1)	17:48			16:18	16:22
28	07:02	06:23	06:37			05:48	05:17	05:14	05:36	06:07	06:38		17:51 (1)	07:12			06:49	07:11
	16:56	17:34	19:06			19:40	20:09	20:24	20:09	19:27	18:34	20	18:11 (1)	17:47			16:18	16:23
29	07:01		06:35			05:46	05:16	05:14	05:36	06:08	06:40		17:51 (1)	07:13			06:50	07:12
	16:57		19:07			19:41	20:10	20:24	20:08	19:25	18:32	18	18:09 (1)	17:45			16:17	16:23
30	07:00		06:33			05:45	05:15	05:14	05:37	06:09	06:41		17:52 (1)	07:14			06:51	07:12
	16:58		19:08			19:42	20:10	20:24	20:07	19:23	18:30	17	18:09 (1)	17:44			16:17	16:24
31	06:59		06:32				05:15		05:38	06:10				07:15				07:12
	16:59		19:09				20:11		20:06	19:22				17:43				16:25
Potential sun hours	296	297	370			400	450	454	461	429	375			344			296	286
Total, worst case				246								189			57			
Sun reduction				0.58								0.62			0.61			
Oper. time red.				1.00								1.00			1.00			
Wind dir. red.				0.54								0.54			0.54			
Total reduction				0.31								0.33			0.33			
Total, real				76								63			19			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 11:45 AM / 9

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 11:44 AM/2.7.473

SHADOW - Calendar

Shadow receptor: I - 2I

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May		June		July		August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44		05:14	19:27 (1)	05:15	19:32 (1)	05:39	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10	19:43		20:12	20 19:47 (1)	20:24	26 19:58 (1)	20:05	19:20	18:29	16:41	16:17
2	07:13	06:57	06:20	06:28	05:42		05:14	19:28 (1)	05:15	19:32 (1)	05:40	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44		20:13	20 19:48 (1)	20:24	26 19:58 (1)	20:04	19:18	18:27	16:40	16:16
3	07:13	06:56	06:18	06:27	05:41		05:13	19:27 (1)	05:16	19:33 (1)	05:41	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45		20:14	22 19:49 (1)	20:24	25 19:58 (1)	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40		05:13	19:27 (1)	05:17	19:32 (1)	05:42	06:14	06:45	06:20	06:55
	16:28	17:04	17:39	19:13	19:46		20:14	23 19:50 (1)	20:23	25 19:57 (1)	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:38		05:13	19:27 (1)	05:17	19:33 (1)	05:43	06:15	06:46	06:21	06:56
	16:29	17:06	17:40	19:15	19:47		20:15	23 19:50 (1)	20:23	25 19:58 (1)	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37		05:12	19:27 (1)	05:18	19:33 (1)	05:44	06:16	06:47	06:23	06:57
	16:30	17:07	17:41	19:16	19:48		20:16	23 19:50 (1)	20:23	24 19:57 (1)	19:58	19:12	18:20	16:35	16:16
7	07:12	06:52	06:12	06:20	05:36		05:12	19:27 (1)	05:18	19:34 (1)	05:45	06:17	06:48	06:24	06:58
	16:31	17:08	17:42	19:17	19:49		20:16	24 19:51 (1)	20:23	23 19:57 (1)	19:57	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18	05:35		05:12	19:27 (1)	05:19	19:34 (1)	05:46	06:18	06:49	06:25	06:59
	16:32	17:10	18:44	19:18	19:50		20:17	25 19:52 (1)	20:22	23 19:57 (1)	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34		05:12	19:28 (1)	05:20	19:34 (1)	05:47	06:19	06:50	06:26	07:00
	16:33	17:11	18:45	19:19	19:51		20:18	25 19:53 (1)	20:22	22 19:56 (1)	19:54	19:07	18:15	16:32	16:15
10	07:12	06:48	07:07	06:15	05:32		05:11	19:28 (1)	05:20	19:35 (1)	05:48	06:20	06:51	06:28	07:01
	16:34	17:12	18:46	19:20	19:52		20:18	25 19:53 (1)	20:22	21 19:56 (1)	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:05	06:13	05:31		05:11	19:28 (1)	05:21	19:35 (1)	05:49	06:21	06:52	06:29	07:02
	16:35	17:13	18:47	19:21	19:53		20:19	26 19:54 (1)	20:21	21 19:56 (1)	19:52	19:03	18:12	16:30	16:16
12	07:11	06:46	07:04	06:12	05:30		05:11	19:27 (1)	05:22	19:35 (1)	05:50	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54		20:19	27 19:54 (1)	20:21	20 19:55 (1)	19:50	19:01	18:10	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29		05:11	19:28 (1)	05:23	19:36 (1)	05:51	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:55		20:20	26 19:54 (1)	20:20	19 19:55 (1)	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:00	06:09	05:28		05:11	19:28 (1)	05:23	19:37 (1)	05:52	06:24	06:56	06:32	07:04
	16:39	17:17	18:50	19:24	19:56		20:20	27 19:55 (1)	20:20	17 19:54 (1)	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27		05:11	19:28 (1)	05:24	19:38 (1)	05:54	06:25	06:57	06:34	07:05
	16:40	17:18	18:52	19:25	19:57		20:21	27 19:55 (1)	20:19	16 19:54 (1)	19:46	18:56	18:06	16:26	16:16
16	07:10	06:41	06:57	06:05	05:26		05:11	19:28 (1)	05:25	19:37 (1)	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:58		20:21	27 19:55 (1)	20:19	16 19:53 (1)	19:45	18:55	18:04	16:25	16:17
17	07:10	06:39	06:55	06:04	05:25		05:11	19:29 (1)	05:26	19:38 (1)	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	19:59		20:22	28 19:57 (1)	20:18	14 19:52 (1)	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:02	05:24		05:11	19:29 (1)	05:26	19:39 (1)	05:57	06:28	07:00	06:37	07:07
	16:43	17:22	18:55	19:29	20:00		20:22	28 19:57 (1)	20:17	13 19:52 (1)	19:42	18:51	18:01	16:24	16:17
19	07:08	06:36	06:52	06:01	05:23		05:11	19:29 (1)	05:27	19:41 (1)	05:58	06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30	20:00		20:22	28 19:57 (1)	20:17	10 19:51 (1)	19:40	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:22		19:36 (1) 05:11	19:29 (1)	05:28	19:42 (1)	05:59	06:30	07:02	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	2	19:37 (1) 20:23	28 19:57 (1)	20:16	9 19:51 (1)	19:39	18:48	17:58	16:22	16:18
21	07:07	06:34	06:49	05:58	05:22		19:35 (1) 05:11	19:29 (1)	05:29	19:43 (1)	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	4	19:39 (1) 20:23	28 19:57 (1)	20:15	7 19:50 (1)	19:37	18:46	17:57	16:22	16:18
22	07:07	06:32	06:47	05:56	05:21		19:33 (1) 05:12	19:29 (1)	05:30	19:44 (1)	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	7	19:40 (1) 20:23	28 19:57 (1)	20:14	5 19:49 (1)	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20		19:32 (1) 05:12	19:30 (1)	05:31	19:46 (1)	06:02	06:33	07:06	06:43	07:10
	16:49	17:28	19:00	19:34	20:04	8	19:40 (1) 20:23	28 19:58 (1)	20:14	2 19:48 (1)	19:34	18:42	17:54	16:20	16:19
24	07:05	06:29	06:44	05:53	05:19		19:32 (1) 05:12	19:30 (1)	05:32		06:03	06:34	07:07	06:44	07:10
	16:51	17:29	19:01	19:35	20:05	10	19:42 (1) 20:23	28 19:58 (1)	20:13		19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19		19:30 (1) 05:13	19:30 (1)	05:33		06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	12	19:42 (1) 20:24	28 19:58 (1)	20:12		19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:50	05:18		19:29 (1) 05:13	19:31 (1)	05:34		06:05	06:36	07:09	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	14	19:43 (1) 20:24	27 19:58 (1)	20:11		19:30	18:37	17:49	16:19	16:21
27	07:03	06:25	06:38	05:49	05:17		19:29 (1) 05:13	19:31 (1)	05:35		06:06	06:37	07:11	06:48	07:11
	16:54	17:33	19:05	19:38	20:08	15	19:44 (1) 20:24	27 19:58 (1)	20:10		19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17		19:29 (1) 05:14	19:31 (1)	05:36		06:07	06:38	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20:09	15	19:44 (1) 20:24	27 19:58 (1)	20:09		19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:46	05:16		19:29 (1) 05:14	19:32 (1)	05:36		06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	17	19:46 (1) 20:24	26 19:58 (1)	20:08		19:25	18:32	17:45	16:17	16:23
30	07:00		06:33	05:45	05:15		19:28 (1) 05:14	19:31 (1)	05:37		06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	18	19:46 (1) 20:24	27 19:58 (1)	20:07		19:23	18:30	17:44	16:17	16:24
31	06:59		06:32		05:15		19:28 (1)		05:38		06:10		07:15		07:12
	16:59		19:09		20:11	19	19:47 (1)		20:06		19:22		17:43		16:25
Potential sun hours	296	297	370	400	450		454		461		429	375	344	296	286
Total, worst case						141		776		409					
Sun reduction						0.58		0.61		0.63					
Oper. time red.						1.00		1.00		1.00					
Wind dir. red.						0.61		0.61		0.61					
Total reduction						0.35		0.37		0.38					
Total, real						50		288		157					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 11:45 AM / 10

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 11:44 AM/2.7.473

SHADOW - Calendar

Shadow receptor: J - 2J

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:14	05:15	05:39	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:41	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:15	05:40	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:16
3	07:13	06:56	06:18	06:27	05:41	05:13	05:16	05:41	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:23	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:42	06:14	06:45	06:20	06:55
	16:29	17:04	17:39	19:13	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:38	05:13	05:17	05:43	06:15	06:46	06:21	06:56
	16:29	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:12	05:18	05:44	06:16	06:47	06:23	06:57
	16:30	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:35	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12	05:18	05:45	06:17	06:48	06:24	06:58
	16:31	17:08	17:42	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
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	16:32	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
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	16:33	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	16:16
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13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:51	06:23	06:55	06:31	07:03
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	16:43	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
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20	07:08	06:35	06:50	05:59	05:22	05:11	05:28	05:59	06:30	07:02	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
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	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:49	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:42	17:54	16:20	16:19
24	07:05	06:29	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
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	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:50	05:18	05:13	05:34	06:05	06:36	07:09	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:49	16:19	16:21
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28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:38	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
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	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:30	17:44	16:17	16:24
31	06:59		06:32		05:15		05:38	06:10		07:15		07:12
	16:59		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	296	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
2/24/2011 11:45 AM / 11

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 11:44 AM/2.7.473

SHADOW - Calendar

Shadow receptor: K - 2K

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:14	05:15	05:39	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:41	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:15	05:40	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:16
3	07:13	06:56	06:18	06:27	05:41	05:13	05:16	05:41	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:42	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:13	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:38	05:13	05:17	05:43	06:15	06:46	06:21	06:56
	16:29	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:12	05:18	05:44	06:16	06:47	06:23	06:57
	16:30	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:35	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12	05:18	05:45	06:17	06:48	06:24	06:58
	16:31	17:08	17:42	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18	05:35	05:12	05:19	05:46	06:18	06:49	06:25	06:59
	16:32	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
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	16:33	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	16:16
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	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
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	16:40	17:18	18:52	19:25	19:57	20:21	20:19	19:46	18:56	18:06	16:26	16:16
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:58	20:21	20:19	19:45	18:55	18:04	16:25	16:17
17	07:10	06:39	06:55	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
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18	07:09	06:38	06:54	06:02	05:24	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:43	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:36	06:52	06:01	05:23	05:11	05:27	05:58	06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30	20:00	20:22	20:17	19:40	18:49	18:00	16:23	16:18
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	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:37	18:46	17:57	16:22	16:18
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23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:49	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:42	17:54	16:20	16:19
24	07:05	06:29	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:29	19:01	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
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	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
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	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:17	16:23
30	07:00		06:33	05:45	05:15	05:14	05:37	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:30	17:44	16:17	16:24
31	06:59		06:32		05:15		05:38	06:10		07:15		07:12
	16:59		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	296	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 11:45 AM / 12

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 11:44 AM/2.7.473

SHADOW - Calendar

Shadow receptor: L - 2L

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:14	05:15	05:39	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:41	16:17
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	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:16
3	07:13	06:56	06:18	06:27	05:41	05:13	05:16	05:41	06:13	06:44	06:19	06:54
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5	07:13	06:54	06:15	06:23	05:38	05:13	05:17	05:43	06:15	06:46	06:21	06:56
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15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:18	18:52	19:25	19:58	20:21	20:19	19:46	18:56	18:06	16:26	16:16
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	16:41	17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:25	16:17
17	07:10	06:39	06:55	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	19:59	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:02	05:24	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:43	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:23	05:11	05:27	05:58	06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30	20:00	20:22	20:17	19:40	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:22	05:11	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:37	18:46	17:57	16:22	16:18
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	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:49	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:42	17:54	16:20	16:19
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	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:50	05:18	05:13	05:34	06:05	06:36	07:09	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:49	16:19	16:21
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	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
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31	06:59		06:32		05:15		05:38	06:10		07:15		07:12
	16:59		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	296	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 11:45 AM / 13

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 11:44 AM/2.7.473

SHADOW - Calendar

Shadow receptor: M - 2M

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:14	05:15	05:39	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:41	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:15	05:40	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:16
3	07:13	06:56	06:18	06:27	05:41	05:13	05:16	05:41	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:42	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:13	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:38	05:13	05:17	05:43	06:15	06:46	06:21	06:56
	16:29	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:12	05:18	05:44	06:16	06:47	06:23	06:57
	16:30	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:35	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12	05:18	05:45	06:17	06:48	06:24	06:58
	16:31	17:08	17:42	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18	05:35	05:12	05:19	05:46	06:18	06:49	06:25	06:59
	16:32	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
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	16:33	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	16:16
10	07:12	06:48	07:07	06:15	05:32	05:11	05:20	05:48	06:20	06:51	06:28	07:01
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	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:23	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:50	19:24	19:56	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:18	18:52	19:25	19:57	20:21	20:19	19:46	18:56	18:06	16:26	16:16
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:58	20:21	20:19	19:45	18:55	18:04	16:25	16:17
17	07:10	06:39	06:55	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	19:59	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:02	05:24	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:43	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:36	06:52	06:01	05:23	05:11	05:27	05:58	06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30	20:00	20:22	20:17	19:40	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:22	05:11	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:37	18:46	17:57	16:22	16:18
22	07:07	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:49	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:42	17:54	16:20	16:19
24	07:05	06:29	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:29	19:01	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
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	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
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	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:49	16:19	16:21
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28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:38	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:46	05:16	05:14	05:36	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:17	16:23
30	07:00		06:33	05:45	05:15	05:14	05:37	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:30	17:44	16:17	16:24
31	06:59		06:32		05:15		05:38	06:10		07:15		07:12
	16:59		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	296	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 11:45 AM / 14

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 11:44 AM/2.7.473

SHADOW - Calendar

Shadow receptor: N - 2N

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:14	05:15	05:39	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:41	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:15	05:40	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:16
3	07:13	06:56	06:18	06:27	05:41	05:13	05:16	05:41	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:42	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:38	05:13	05:17	05:43	06:15	06:46	06:21	06:56
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22	07:07	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:49	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:42	17:54	16:20	16:19
24	07:05	06:29	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:29	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:36	07:09	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:49	16:19	16:21
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	16:54	17:33	19:05	19:38	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
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30	07:00		06:33	05:45	05:15	05:14	05:37	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:30	17:44	16:17	16:24
31	06:59		06:32		05:15		05:38	06:10		07:15		07:12
	16:59		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	296	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 11:45 AM / 15

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 11:44 AM/2.7.473

SHADOW - Calendar

Shadow receptor: O - 2O

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:14	05:15	05:39	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:41	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:15	05:40	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:16
3	07:13	06:56	06:18	06:27	05:41	05:13	05:16	05:41	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:42	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:38	05:13	05:17	05:43	06:15	06:46	06:22	06:56
	16:29	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:12	05:18	05:44	06:16	06:47	06:23	06:57
	16:30	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:35	16:16
7	07:13	06:52	06:12	06:20	05:36	05:12	05:18	05:45	06:17	06:48	06:24	06:58
	16:31	17:08	17:42	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18	05:35	05:12	05:19	05:46	06:18	06:49	06:25	06:59
	16:32	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:47	06:19	06:50	06:26	07:00
	16:33	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:11	05:20	05:48	06:20	06:51	06:28	07:01
	16:34	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:13	05:31	05:11	05:21	05:49	06:21	06:52	06:29	07:02
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	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
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	16:39	17:17	18:50	19:24	19:57	20:20	20:20	19:48	18:58	18:07	16:27	16:16
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	16:40	17:18	18:52	19:25	19:58	20:21	20:19	19:46	18:56	18:06	16:26	16:16
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:25	16:17
17	07:10	06:39	06:55	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
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18	07:09	06:38	06:54	06:02	05:24	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:43	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:23	05:11	05:27	05:58	06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30	20:00	20:22	20:17	19:40	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:22	05:11	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:37	18:46	17:57	16:22	16:18
22	07:07	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:49	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:20	16:19
24	07:05	06:29	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:29	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:36	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:49	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:13	05:35	06:06	06:37	07:11	06:48	07:11
	16:54	17:33	19:05	19:38	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:12
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:46	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:17	16:23
30	07:00		06:33	05:45	05:15	05:14	05:37	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:30	17:44	16:17	16:24
31	06:59		06:32		05:15		05:38	06:10		07:15		07:12
	16:59		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	296	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 11:45 AM / 16

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 11:44 AM/2.7.473

SHADOW - Calendar

Shadow receptor: P - 2P

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:14	05:15	05:39	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:41	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:15	05:40	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:16
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:41	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:42	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:38	05:13	05:17	05:43	06:15	06:46	06:22	06:56
	16:29	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:12	05:18	05:44	06:16	06:47	06:23	06:57
	16:30	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:35	16:16
7	07:13	06:52	06:12	06:20	05:36	05:12	05:18	05:45	06:17	06:48	06:24	06:58
	16:31	17:08	17:42	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
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	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:17	16:23
30	07:00		06:33	05:45	05:15	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:30	17:44	16:17	16:24
31	06:59		06:32		05:15		05:38	06:10		07:15		07:12
	16:59		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	296	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
2/24/2011 11:45 AM / 17

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 11:44 AM/2.7.473

SHADOW - Calendar

Shadow receptor: Q - 2Q

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March		April			May	June	July	August	September		October			November	December
1	07:12	06:58	06:22		06:30		18:08 (1)	05:44	05:14	05:15	05:39	06:11		06:42		17:40 (1)	06:17	06:52
	16:26	17:01	17:35		19:10	7	18:15 (1)	19:43	20:12	20:24	20:05	19:20		18:29	27	18:07 (1)	16:41	16:17
2	07:13	06:57	06:20		06:28			05:42	05:14	05:15	05:40	06:12		06:43		17:40 (1)	06:18	06:53
	16:27	17:02	17:37		19:11			19:44	20:13	20:24	20:04	19:18		18:27	25	18:05 (1)	16:40	16:16
3	07:13	06:56	06:18		06:27			05:41	05:13	05:16	05:41	06:13		06:44		17:41 (1)	06:19	06:54
	16:28	17:03	17:38		19:12			19:45	20:14	20:24	20:03	19:17		18:25	22	18:03 (1)	16:39	16:16
4	07:13	06:55	06:17		06:25			05:40	05:13	05:17	05:42	06:14		06:45		17:43 (1)	06:20	06:55
	16:28	17:04	17:39		19:13			19:46	20:14	20:23	20:02	19:15		18:24	18	18:01 (1)	16:38	16:16
5	07:13	06:54	06:15		06:23			05:38	05:13	05:17	05:43	06:15		06:46		17:44 (1)	06:21	06:56
	16:29	17:06	17:40		19:15			19:47	20:15	20:23	20:01	19:13		18:22	16	18:00 (1)	16:37	16:16
6	07:13	06:53	06:14		06:22			05:37	05:12	05:18	05:44	06:16		06:47		17:47 (1)	06:23	06:57
	16:30	17:07	17:41		19:16			19:48	20:16	20:23	19:58	19:12		18:20	11	17:58 (1)	16:35	16:16
7	07:12	06:52	06:12		17:12 (1)	06:20		05:36	05:12	05:18	05:45	06:17		06:48		17:53 (1)	06:24	06:58
	16:31	17:08	17:42	8	17:20 (1)	19:17		19:49	20:16	20:23	19:57	19:10		18:19	2	17:55 (1)	16:34	16:16
8	07:12	06:51	07:10		18:09 (1)	06:18		05:35	05:12	05:19	05:46	06:18		06:49			06:25	06:59
	16:32	17:10	18:44	13	18:22 (1)	19:18		19:50	20:17	20:22	19:56	19:08		18:17			16:33	16:16
9	07:12	06:50	07:09		18:06 (1)	06:17		05:34	05:12	05:20	05:47	06:19		06:50			06:26	07:00
	16:33	17:11	18:45	17	18:23 (1)	19:19		19:51	20:18	20:22	19:54	19:07		18:15			16:32	16:15
10	07:12	06:48	07:07		18:03 (1)	06:15		05:32	05:11	05:20	05:48	06:20		06:51			06:28	07:01
	16:34	17:12	18:46	21	18:24 (1)	19:20		19:52	20:18	20:22	19:53	19:05		18:14			16:31	16:16
11	07:12	06:47	07:05		18:02 (1)	06:13		05:31	05:11	05:21	05:49	06:21	18:01 (1)	06:52			06:29	07:02
	16:35	17:13	18:47	24	18:26 (1)	19:21		19:53	20:19	20:21	19:52	19:03	4 18:05 (1)	18:12			16:30	16:16
12	07:11	06:46	07:04		18:00 (1)	06:12		05:30	05:11	05:22	05:50	06:22	17:55 (1)	06:54			06:30	07:02
	16:37	17:15	18:48	27	18:27 (1)	19:22		19:54	20:19	20:21	19:50	19:01	16 18:11 (1)	18:10			16:29	16:16
13	07:11	06:45	07:02		17:59 (1)	06:10		05:29	05:11	05:22	05:51	06:23	17:52 (1)	06:55			06:31	07:03
	16:38	17:16	18:49	28	18:27 (1)	19:23		19:55	20:20	20:20	19:49	19:00	21 18:13 (1)	18:09			16:28	16:16
14	07:11	06:43	07:00		17:58 (1)	06:09		05:28	05:11	05:23	05:52	06:24	17:50 (1)	06:56			06:32	07:04
	16:39	17:17	18:50	31	18:29 (1)	19:24		19:56	20:20	20:20	19:48	18:58	25 18:15 (1)	18:07			16:27	16:16
15	07:10	06:42	06:59		17:57 (1)	06:07		05:27	05:11	05:24	05:54	06:25	17:48 (1)	06:57			06:34	07:05
	16:40	17:18	18:52	33	18:30 (1)	19:25		19:57	20:21	20:19	19:46	18:56	28 18:16 (1)	18:06			16:26	16:16
16	07:10	06:41	06:57		17:56 (1)	06:05		05:26	05:11	05:25	05:55	06:26	17:46 (1)	06:58			06:35	07:05
	16:41	17:20	18:53	35	18:31 (1)	19:27		19:58	20:21	20:19	19:45	18:55	31 18:17 (1)	18:04			16:25	16:17
17	07:10	06:39	06:55		17:56 (1)	06:04		05:25	05:11	05:26	05:56	06:27	17:44 (1)	06:59			06:36	07:06
	16:42	17:21	18:54	37	18:33 (1)	19:28		19:59	20:22	20:18	19:43	18:53	34 18:18 (1)	18:03			16:25	16:17
18	07:09	06:38	06:54		17:55 (1)	06:02		05:24	05:11	05:26	05:57	06:28	17:43 (1)	07:00			06:37	07:07
	16:43	17:22	18:55	39	18:34 (1)	19:29		20:00	20:22	20:17	19:42	18:51	36 18:19 (1)	18:01			16:24	16:17
19	07:08	06:36	06:52		17:55 (1)	06:01		05:23	05:11	05:27	05:58	06:29	17:42 (1)	07:01			06:38	07:07
	16:45	17:23	18:56	39	18:34 (1)	19:30		20:00	20:22	20:17	19:40	18:49	37 18:19 (1)	18:00			16:23	16:18
20	07:08	06:35	06:50		17:54 (1)	05:59		05:22	05:11	05:28	05:59	06:30	17:41 (1)	07:03			06:40	07:08
	16:46	17:25	18:57	40	18:34 (1)	19:31		20:01	20:23	20:16	19:39	18:48	38 18:19 (1)	17:58			16:22	16:18
21	07:07	06:34	06:49		17:55 (1)	05:58		05:22	05:11	05:29	06:00	06:31	17:40 (1)	07:04			06:41	07:09
	16:47	17:26	18:58	40	18:35 (1)	19:32		20:02	20:23	20:15	19:37	18:46	39 18:19 (1)	17:57			16:22	16:18
22	07:07	06:32	06:47		17:55 (1)	05:56		05:21	05:12	05:30	06:01	06:32	17:39 (1)	07:05			06:42	07:09
	16:48	17:27	18:59	39	18:34 (1)	19:33		20:03	20:23	20:14	19:36	18:44	40 18:19 (1)	17:55			16:21	16:19
23	07:06	06:31	06:45		17:54 (1)	05:55		05:20	05:12	05:31	06:02	06:33	17:39 (1)	07:06			06:43	07:10
	16:49	17:28	19:00	39	18:33 (1)	19:34		20:04	20:23	20:14	19:34	18:42	40 18:19 (1)	17:54			16:20	16:19
24	07:05	06:29	06:44		17:55 (1)	05:53		05:19	05:12	05:32	06:03	06:34	17:38 (1)	07:07			06:44	07:10
	16:51	17:29	19:01	38	18:33 (1)	19:35		20:05	20:23	20:13	19:33	18:41	40 18:18 (1)	17:52			16:20	16:20
25	07:04	06:28	06:42		17:56 (1)	05:52		05:19	05:13	05:33	06:04	06:35	17:38 (1)	07:08			06:45	07:10
	16:52	17:31	19:03	35	18:31 (1)	19:36		20:06	20:24	20:12	19:31	18:39	38 18:16 (1)	17:51			16:19	16:21
26	07:04	06:26	06:40		17:56 (1)	05:50		05:18	05:13	05:34	06:05	06:36	17:38 (1)	07:09			06:47	07:11
	16:53	17:32	19:04	34	18:30 (1)	19:37		20:07	20:24	20:11	19:30	18:37	37 18:15 (1)	17:49			16:19	16:21
27	07:03	06:25	06:38		17:57 (1)	05:49		05:17	05:13	05:35	06:06	06:37	17:38 (1)	07:11			06:48	07:11
	16:54	17:33	19:05	32	18:29 (1)	19:38		20:08	20:24	20:10	19:28	18:36	35 18:13 (1)	17:48			16:18	16:22
28	07:02	06:23	06:37		17:58 (1)	05:48		05:17	05:14	05:36	06:07	06:38	17:38 (1)	07:12			06:49	07:11
	16:56	17:34	19:06	29	18:27 (1)	19:40		20:09	20:24	20:09	19:27	18:34	33 18:11 (1)	17:47			16:18	16:23
29	07:01		06:35		17:59 (1)	05:46		05:16	05:14	05:36	06:08	06:40	17:39 (1)	07:13			06:50	07:12
	16:57		19:07	26	18:25 (1)	19:41		20:10	20:24	20:08	19:25	18:32	31 18:10 (1)	17:45			16:17	16:23
30	07:00		06:33		18:01 (1)	05:45		05:15	05:14	05:37	06:09	06:41	17:39 (1)	07:14			06:51	07:12
	16:58		19:08	21	18:22 (1)	19:42		20:10	20:24	20:07	19:23	18:30	30 18:09 (1)	17:44			16:17	16:24
31	06:59		06:32		18:04 (1)			05:15		05:38	06:10			07:15				07:12
	16:59		19:09	16	18:20 (1)			20:11		20:06	19:22			17:43				16:25
Potential sun hours	296	297	370			400		450	454	461	429	375		344			296	286
Total, worst case				741			7						633			121		
Sun reduction				0.58			0.57						0.62			0.61		
Oper. time red.				1.00			1.00						1.00			1.00		
Wind dir. red.				0.54			0.54						0.54			0.54		
Total reduction				0.31			0.31						0.33			0.33		
Total, real				230			2						211			40		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 11:45 AM / 18

Licensed user:
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US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 11:44 AM/2.7.473

SHADOW - Calendar

Shadow receptor: R - 2R

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:14	05:15	05:39	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:41	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:15	05:40	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:16
3	07:13	06:56	06:18	06:27	05:41	05:14	05:16	05:41	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:42	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:38	05:13	05:17	05:43	06:15	06:46	06:22	06:56
	16:29	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:12	05:18	05:44	06:16	06:47	06:23	06:57
	16:30	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:35	16:16
7	07:13	06:52	06:12	06:20	05:36	05:12	05:18	05:45	06:17	06:48	06:24	06:58
	16:31	17:08	17:42	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18	05:35	05:12	05:19	05:46	06:18	06:49	06:25	06:59
	16:32	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:47	06:19	06:50	06:26	07:00
	16:33	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:11	05:20	05:48	06:20	06:51	06:28	07:01
	16:34	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:31	05:11	05:21	05:49	06:21	06:52	06:29	07:02
	16:36	17:13	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:12	06:46	07:04	06:12	05:30	05:11	05:22	05:51	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:23	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:50	19:24	19:57	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:18	18:52	19:25	19:58	20:21	20:19	19:46	18:56	18:06	16:26	16:16
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:06
	16:41	17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:10	06:39	06:55	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	20:00	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:02	05:24	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:43	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:23	05:11	05:27	05:58	06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30	20:00	20:22	20:17	19:41	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:23	05:11	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:18
22	07:07	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:49	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:20	16:19
24	07:05	06:29	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:29	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:36	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:49	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:13	05:35	06:06	06:37	07:11	06:48	07:11
	16:54	17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:12
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:46	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:17	16:23
30	07:00		06:33	05:45	05:15	05:15	05:37	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:30	17:44	16:17	16:24
31	06:59		06:32		05:15		05:38	06:10		07:15		07:12
	16:59		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	296	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

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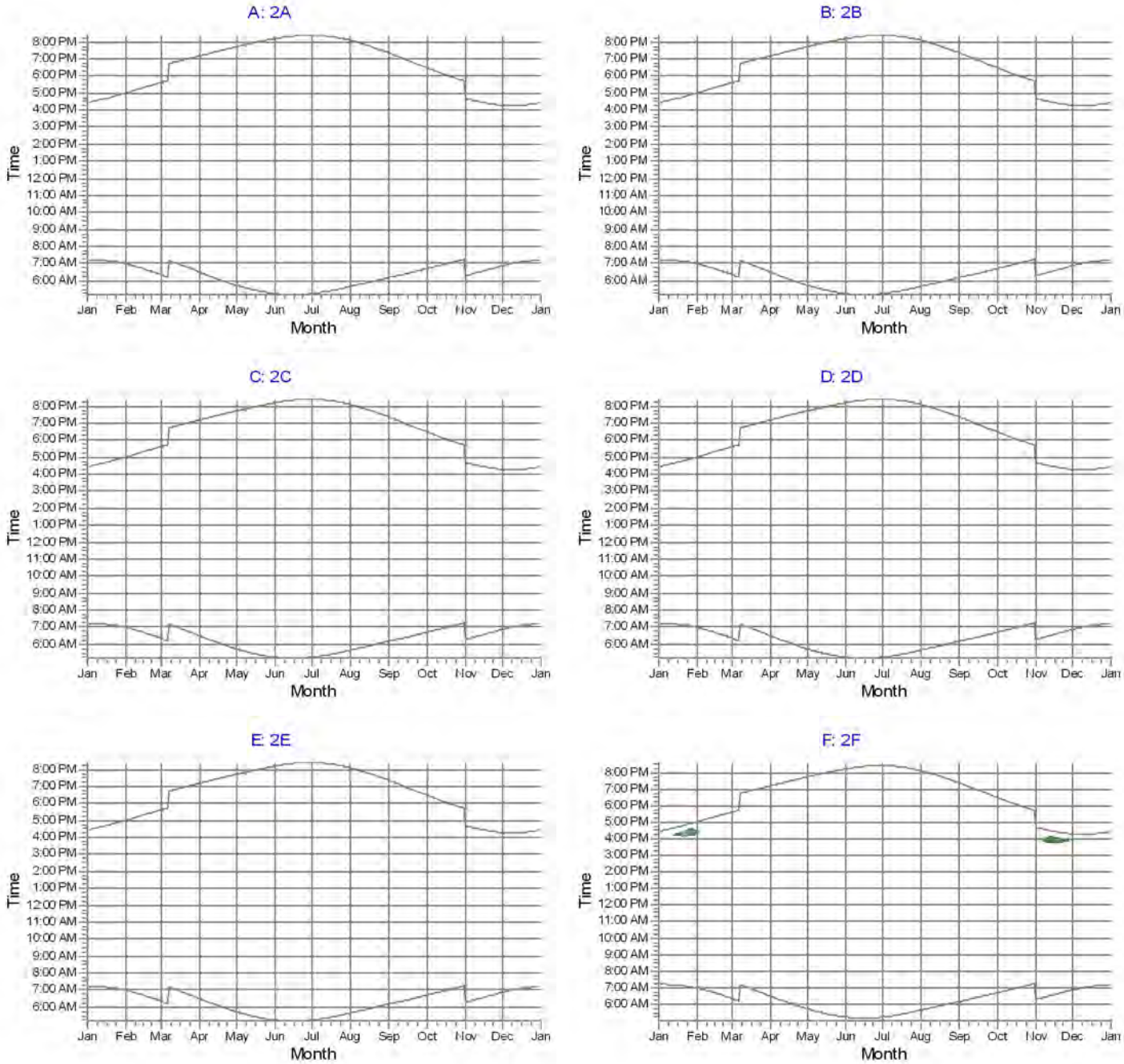
SHADOW - Calendar, graphical



WTGs

1: Tank Farm 4B

Project:

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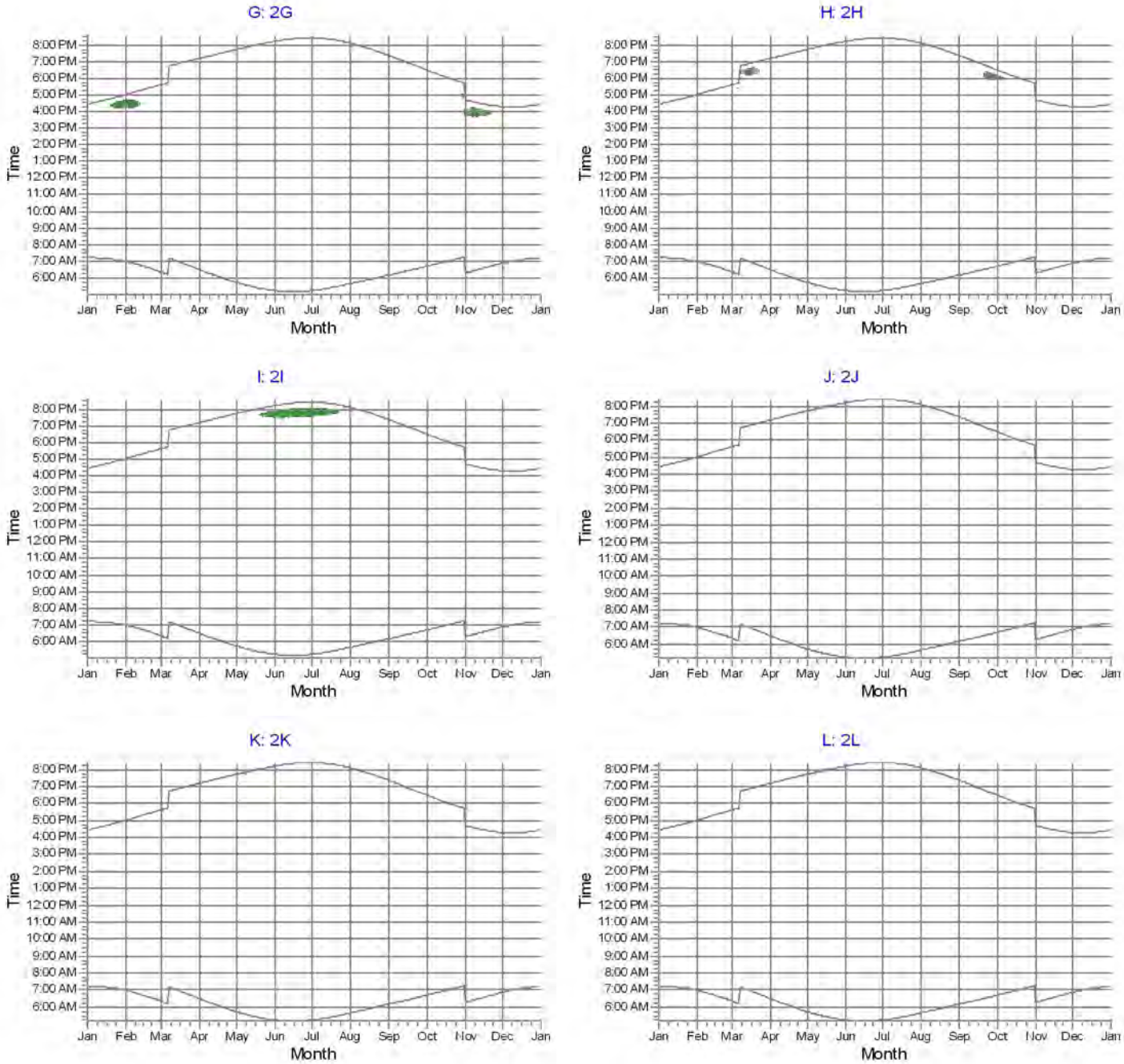
SHADOW - Calendar, graphical



WTGs

1: Tank Farm 4B

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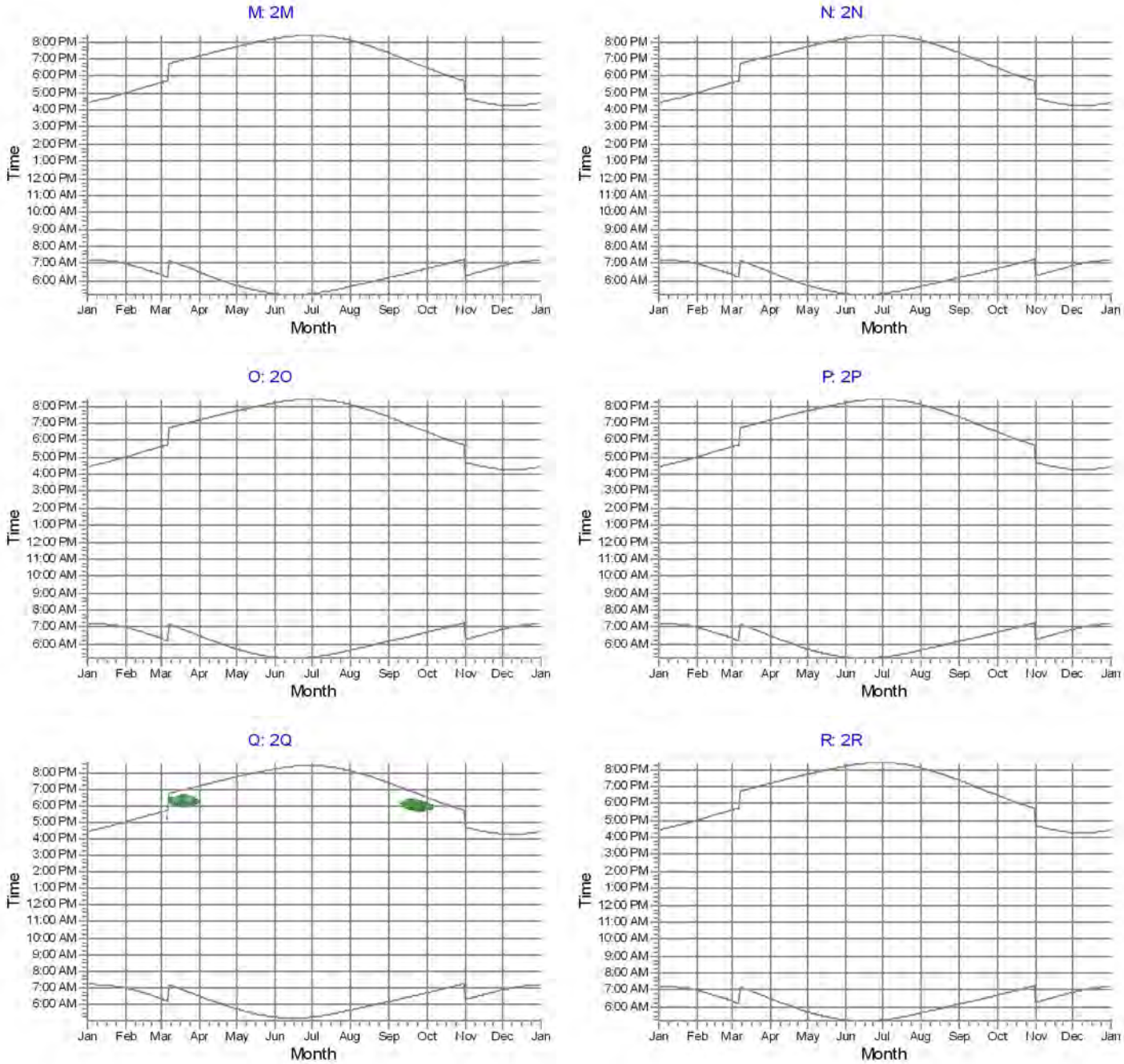
SHADOW - Calendar, graphical



WTGs

1: Tank Farm 4B

Project:

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SHADOW - Calendar per WTG

WTG: 1 - Tank Farm 4B

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June
1	07:12 16:26	06:58 16:10-16:36/26 17:01	06:22 17:35	06:30 18:08-18:15/7 19:10	05:44 19:43	05:14 19:27-19:47/20 20:12
2	07:13 16:27	06:57 16:10-16:38/28 17:02	06:20 17:37	06:28 19:11	05:42 19:44	05:14 19:28-19:48/20 20:13
3	07:13 16:28	06:56 16:10-16:38/28 17:03	06:18 17:38	06:27 19:12	05:41 19:45	05:13 19:27-19:49/22 20:14
4	07:13 16:29	06:55 16:11-16:38/27 17:05	06:17 17:39	06:25 19:14	05:40 19:46	05:13 19:27-19:50/23 20:14
5	07:13 16:29	06:54 16:10-16:37/27 17:06	06:15 17:40	06:23 19:15	05:38 19:47	05:13 19:27-19:50/23 20:15
6	07:13 16:30	06:53 16:11-16:37/26 17:07	06:14 17:41	06:22 19:16	05:37 19:48	05:12 19:27-19:50/23 20:16
7	07:13 16:31	06:52 16:12-16:36/24 17:08	06:12 17:12-17:20/8 17:42	06:20 19:17	05:36 19:49	05:12 19:27-19:51/24 20:16
8	07:12 16:32	06:51 16:13-16:36/23 17:10	07:10 18:09-18:22/13 18:44	06:18 19:18	05:35 19:50	05:12 19:27-19:52/25 20:17
9	07:12 16:33	06:50 16:15-16:35/20 17:11	07:09 18:06-18:23/17 18:45	06:17 19:19	05:34 19:51	05:12 19:28-19:53/25 20:18
10	07:12 16:34	06:48 16:16-16:33/17 17:12	07:07 18:03-18:24/21 18:46	06:15 19:20	05:32 19:52	05:11 19:28-19:53/25 20:18
11	07:12 16:35	06:47 16:18-16:31/13 17:13	07:06 18:02-18:26/24 18:47	06:13 19:21	05:31 19:53	05:11 19:28-19:54/26 20:19
12	07:11 16:37	06:46 16:22-16:28/6 17:15	07:04 18:00-18:27/27 18:48	06:12 19:22	05:30 19:54	05:11 19:27-19:54/27 20:19
13	07:11 16:38	06:45 17:16	07:02 17:59-18:27/28 18:49	06:10 19:23	05:29 19:55	05:11 19:28-19:54/26 20:20
14	07:11 16:10-16:12/2 16:39	06:43 17:17	07:01 17:58-18:29/31 18:50	06:09 19:24	05:28 19:57	05:11 19:28-19:55/27 20:20
15	07:10 16:09-16:14/5 16:40	06:42 17:18	06:59 17:57-18:30/33 18:52	06:07 19:25	05:27 19:58	05:11 19:28-19:55/27 20:21
16	07:10 16:09-16:16/7 16:41	06:41 17:20	06:57 17:56-18:31/35 18:53	06:06 19:27	05:26 19:59	05:11 19:28-19:55/27 20:21
17	07:10 16:08-16:16/8 16:42	06:39 17:21	06:55 17:56-18:33/37 18:54	06:04 19:28	05:25 20:00	05:11 19:29-19:57/28 20:22
18	07:09 16:08-16:17/9 16:43	06:38 17:22	06:54 17:55-18:34/39 18:55	06:02 19:29	05:24 20:00	05:11 19:29-19:57/28 20:22
19	07:08 16:08-16:19/11 16:45	06:37 17:23	06:52 17:55-18:34/39 18:56	06:01 19:30	05:23 20:00	05:11 19:29-19:57/28 20:22
20	07:08 16:07-16:20/13 16:46	06:35 17:25	06:50 17:54-18:34/40 18:57	05:59 19:31	05:22 19:36-19:37/1 20:01	05:11 19:29-19:57/28 20:23
21	07:07 16:07-16:21/14 16:47	06:34 17:26	06:49 17:55-18:35/40 18:58	05:58 19:32	05:22 19:35-19:39/4 20:02	05:12 19:29-19:57/28 20:23
22	07:07 16:08-16:23/15 16:48	06:32 17:27	06:47 17:55-18:34/39 18:59	05:56 19:33	05:21 19:33-19:40/7 20:03	05:12 19:29-19:57/28 20:23
23	07:06 16:08-16:24/16 16:49	06:31 17:28	06:45 17:54-18:33/39 19:00	05:55 19:34	05:20 19:32-19:40/8 20:04	05:12 19:30-19:58/28 20:23
24	07:05 16:07-16:25/18 16:51	06:29 17:29	06:44 17:55-18:33/38 19:02	05:53 19:35	05:19 19:32-19:42/10 20:05	05:12 19:30-19:58/28 20:23
25	07:04 16:08-16:26/18 16:52	06:28 17:31	06:42 17:56-18:31/35 19:03	05:52 19:36	05:19 19:30-19:42/12 20:06	05:13 19:30-19:58/28 20:24
26	07:04 16:09-16:29/20 16:53	06:26 17:32	06:40 17:56-18:30/34 19:04	05:50 19:37	05:18 19:29-19:43/14 20:07	05:13 19:31-19:58/27 20:24
27	07:03 16:09-16:30/21 16:54	06:25 17:33	06:38 17:57-18:29/32 19:05	05:49 19:38	05:17 19:29-19:44/15 20:08	05:13 19:31-19:58/27 20:24
28	07:02 16:10-16:31/21 16:56	06:23 17:34	06:37 17:58-18:27/29 19:06	05:48 19:40	05:17 19:29-19:44/15 20:09	05:14 19:31-19:58/27 20:24
29	07:01 16:10-16:32/22 16:57		06:35 17:59-18:25/26 19:07	05:46 19:41	05:16 19:29-19:46/17 20:10	05:14 19:32-19:58/26 20:24
30	07:00 16:10-16:34/24 16:58		06:33 18:01-18:22/21 19:08	05:45 19:42	05:15 19:28-19:46/18 20:10	05:14 19:31-19:58/27 20:24
31	06:59 16:10-16:35/25 16:59		06:32 18:04-18:20/16 19:09		05:15 19:28-19:47/19 20:11	
Potential sun hours	296	297	370	400	450	454
Sum of minutes with flicker	269	265	741	7	140	776

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

Project:

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SHADOW - Calendar per WTG

WTG: 1 - Tank Farm 4B

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	July		August	September		October		November		December
1	05:15 20:24	19:32-19:58/26	05:39 20:05	06:11 19:20		06:42 18:29	17:40-18:07/27	06:17 16:41	15:45-16:03/18	06:52 16:17
2	05:15 20:24	19:32-19:58/26	05:40 20:04	06:12 19:18		06:43 18:27	17:40-18:05/25	06:18 16:40	15:43-16:04/21	06:53 16:16
3	05:16 20:24	19:33-19:58/25	05:41 20:03	06:13 19:17		06:44 18:25	17:41-18:03/22	06:19 16:39	15:43-16:06/23	06:54 16:16
4	05:17 20:23	19:32-19:57/25	05:42 20:02	06:14 19:15		06:45 18:24	17:43-18:01/18	06:20 16:38	15:42-16:06/24	06:55 16:16
5	05:17 20:23	19:33-19:58/25	05:43 20:01	06:15 19:13		06:46 18:22	17:44-18:00/16	06:22 16:37	15:41-16:07/26	06:56 16:16
6	05:18 20:23	19:33-19:57/24	05:44 19:58	06:16 19:12		06:47 18:20	17:47-17:58/11	06:23 16:35	15:41-16:08/27	06:57 16:16
7	05:18 20:23	19:34-19:57/23	05:45 19:57	06:17 19:10		06:48 18:19	17:53-17:55/2	06:24 16:34	15:41-16:08/27	06:58 16:16
8	05:19 20:22	19:34-19:57/23	05:46 19:56	06:18 19:08		06:49 18:17		06:25 16:33	15:40-16:08/28	06:59 16:16
9	05:20 20:22	19:34-19:56/22	05:47 19:54	06:19 19:07		06:50 18:15		06:26 16:32	15:41-16:09/28	07:00 16:16
10	05:20 20:22	19:35-19:56/21	05:48 19:53	06:20 19:05		06:51 18:14		06:28 16:31	15:41-16:07/26	07:01 16:16
11	05:21 20:21	19:35-19:56/21	05:49 19:52	06:21 19:03	18:01-18:05/4	06:52 18:12		06:29 16:30	15:40-16:06/26	07:02 16:16
12	05:22 20:21	19:35-19:55/20	05:50 19:50	06:22 19:02	17:55-18:11/16	06:54 18:11		06:30 16:29	15:40-16:05/25	07:02 16:16
13	05:23 20:20	19:36-19:55/19	05:51 19:49	06:23 19:00	17:52-18:13/21	06:55 18:09		06:31 16:28	15:42-16:04/22	07:03 16:16
14	05:23 20:20	19:37-19:54/17	05:53 19:48	06:24 18:58	17:50-18:15/25	06:56 18:07		06:32 16:27	15:41-16:03/22	07:04 16:16
15	05:24 20:19	19:38-19:54/16	05:54 19:46	06:25 18:56	17:48-18:16/28	06:57 18:06		06:34 16:26	15:41-16:02/21	07:05 16:16
16	05:25 20:19	19:37-19:53/16	05:55 19:45	06:26 18:55	17:46-18:17/31	06:58 18:04		06:35 16:25	15:42-16:02/20	07:05 16:17
17	05:26 20:18	19:38-19:52/14	05:56 19:43	06:27 18:53	17:44-18:18/34	06:59 18:03		06:36 16:25	15:42-16:00/18	07:06 16:17
18	05:27 20:17	19:39-19:52/13	05:57 19:42	06:28 18:51	17:43-18:19/36	07:00 18:01		06:37 16:24	15:41-15:59/18	07:07 16:17
19	05:27 20:17	19:41-19:51/10	05:58 19:40	06:29 18:49	17:42-18:19/37	07:01 18:00		06:38 16:23	15:42-15:58/16	07:07 16:18
20	05:28 20:16	19:42-19:51/9	05:59 19:39	06:30 18:48	17:41-18:19/38	07:03 17:58		06:40 16:22	15:43-15:58/15	07:08 16:18
21	05:29 20:15	19:43-19:50/7	06:00 19:37	06:31 18:46	17:40-18:19/39	07:04 17:57		06:41 16:22	15:43-15:57/14	07:09 16:18
22	05:30 20:14	19:44-19:49/5	06:01 19:36	06:32 18:44	17:39-18:19/40	07:05 17:55		06:42 16:21	15:43-15:56/13	07:09 16:19
23	05:31 20:14	19:46-19:48/2	06:02 19:34	06:33 18:42	17:39-18:19/40	07:06 17:54		06:43 16:20	15:44-15:55/11	07:10 16:19
24	05:32 20:13		06:03 19:33	06:34 18:41	17:38-18:18/40	07:07 17:52		06:44 16:20	15:46-15:55/9	07:10 16:20
25	05:33 20:12		06:04 19:31	06:35 18:39	17:38-18:16/38	07:08 17:51		06:45 16:19	15:46-15:55/9	07:10 16:21
26	05:34 20:11		06:05 19:30	06:36 18:37	17:38-18:15/37	07:10 17:49		06:47 16:19	15:47-15:54/7	07:11 16:21
27	05:35 20:10		06:06 19:28	06:37 18:36	17:38-18:13/35	07:11 17:48		06:48 16:18	15:48-15:53/5	07:11 16:22
28	05:36 20:09		06:07 19:27	06:38 18:34	17:38-18:11/33	07:12 17:47		06:49 16:18	15:50-15:52/2	07:12 16:23
29	05:36 20:08		06:08 19:25	06:40 18:32	17:39-18:10/31	07:13 17:45		06:50 16:17		07:12 16:23
30	05:37 20:07		06:09 19:23	06:41 18:30	17:39-18:09/30	07:14 17:44	16:51-16:59/8	06:51 16:17		07:12 16:24
31	05:38 20:06		06:10 19:22			07:15 17:43	16:47-17:01/14			07:12 16:25
Potential sun hours	461		429	375		344		296		286
Sum of minutes with flicker		409	0		633		143		521	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

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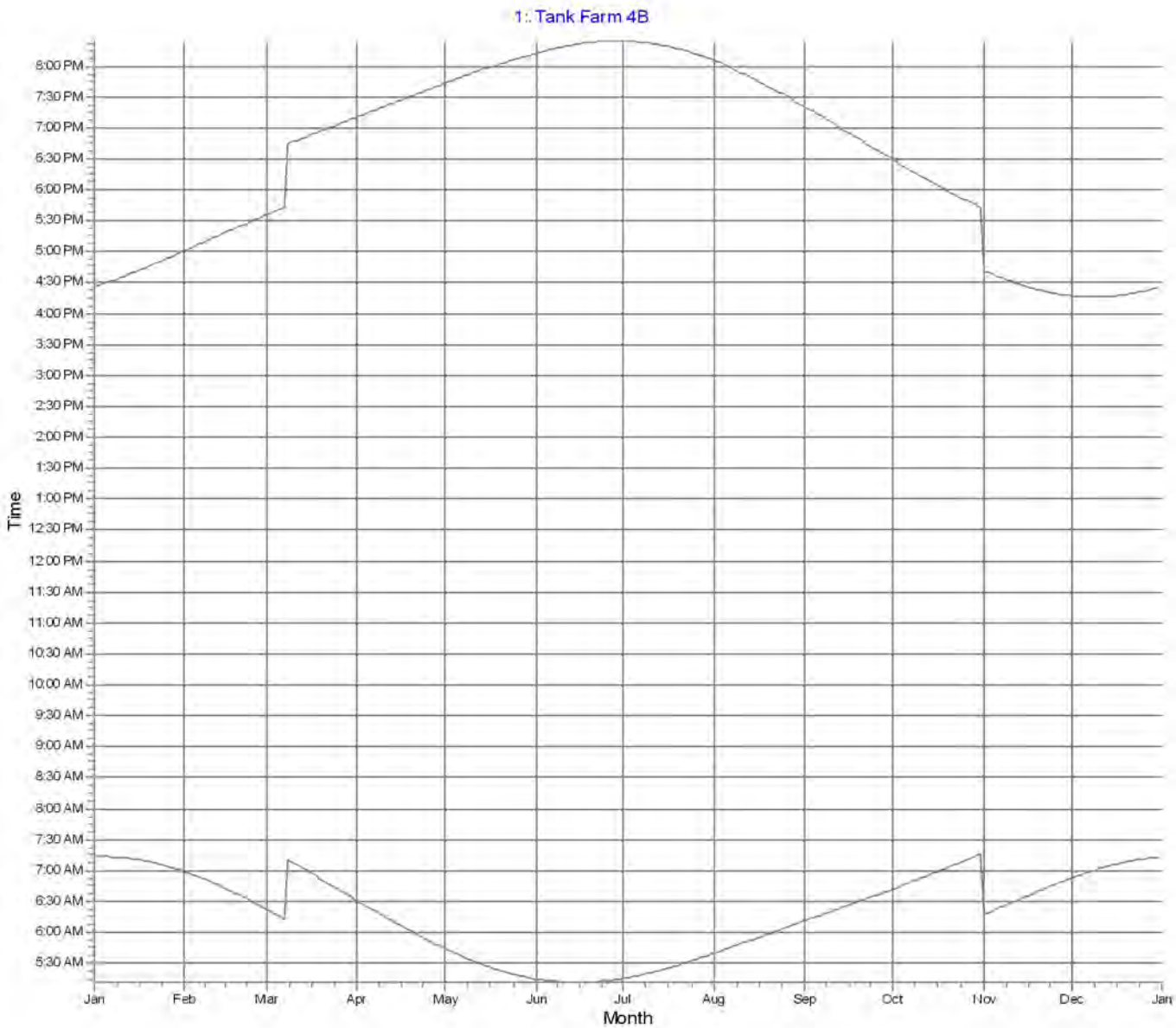
SHADOW - Calendar per WTG, graphical

WTG: 1 - Tank Farm 4B



WTGs

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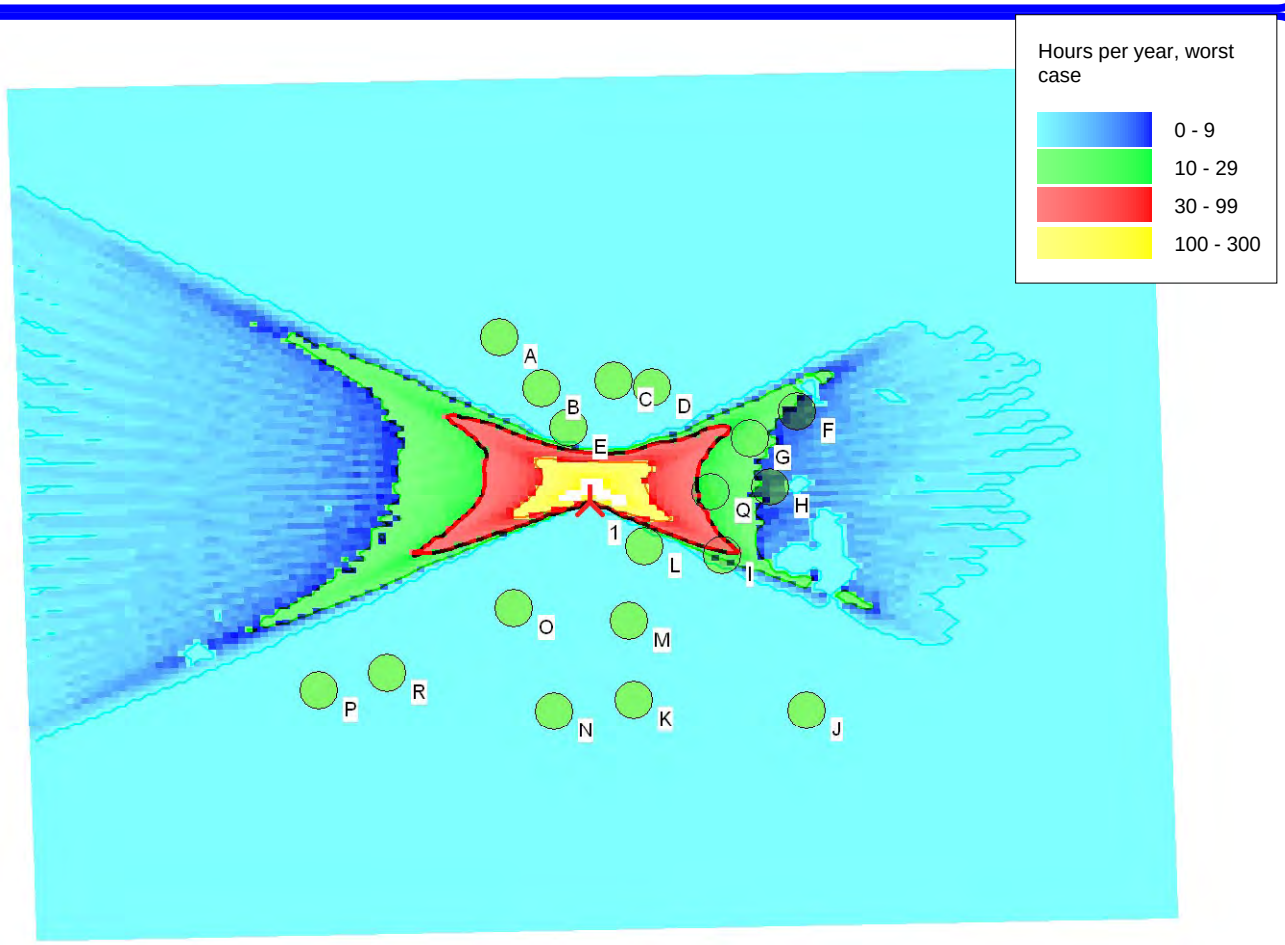
SHADOW - Map



0 250 500 750 1000m

Map: , Print scale 1:20,000, Map center Geo WGS 84 East: -71.290307° North: 41.564855°

New WTG
Shadow receptor

Isolines showing shadow in Hours per year, worst case

0 10 30 100

APPENDIX 3

WIND TURBINE SITE 3 TANK FARM 4A

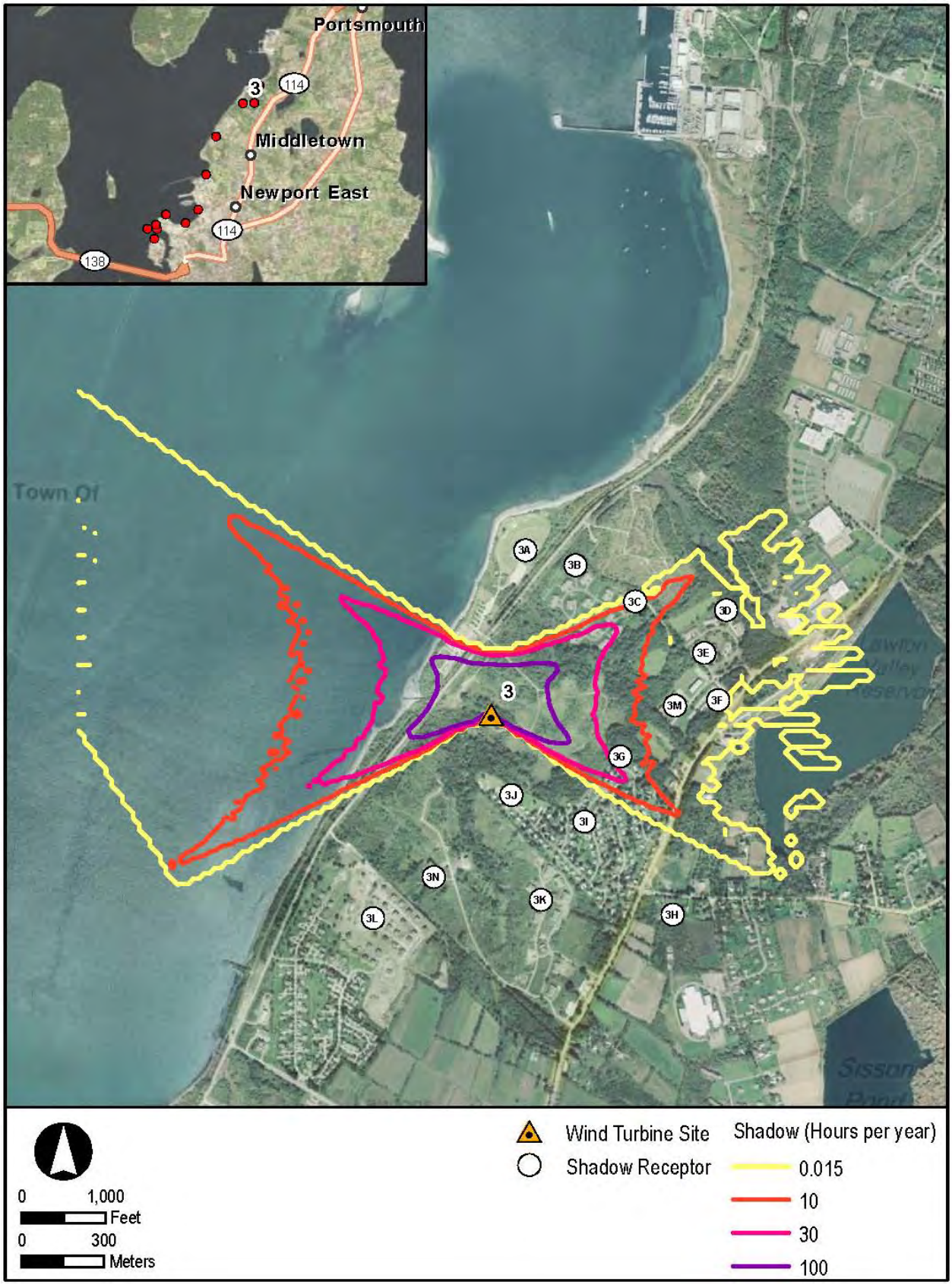


Figure A-3: Maximum predicted shadow flicker levels (hours per year) for a GE 1.5 MW sle Model at Wind Turbine Site 3 (Tank Farm 4A).

Project:

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SHADOW - Main Result

Assumptions for shadow calculations

Maximum distance for influence
Calculate only when more than 20 % of sun is covered by the blade
Please look in WTG table

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

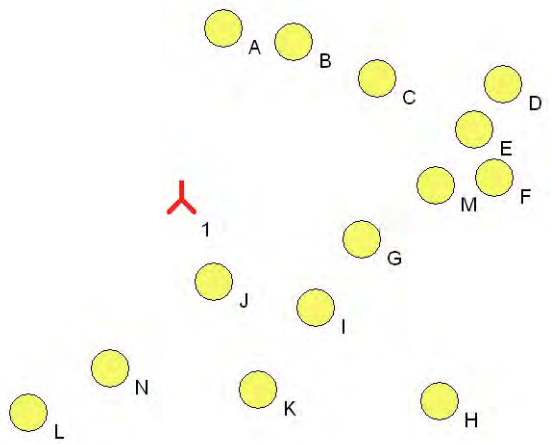
Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW
691	432	259	155	155	155	432	518	950	1,209	864	518

W	WNW	NW	NNW	Sum
432	604	691	691	8,756

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: Line object
Obstacles used in calculation
Eye height: 1.5 m
Grid resolution: 10 m



Scale 1:20,000
New WTG
Shadow receptor

WTGs

	Geo DD: WGS 84 Longitude	Latitude	Z [m]	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Shadow data Calculation distance [m]	RPM [RPM]
1	-71.294616° East	41.564759° North	17.1	Tank Farm 4A	Yes	GE WIND ENERGY	GE 1.5sle-1,500	1,500	77.0	65.0	2,000	20.0

Shadow receptor-Input

No.	Name	Geo DD: WGS 84 Longitude	Latitude	Z [m]	Width [m]	Height [m]	Height a.g.l. [m]	Degrees from south cw [°]	Slope of window [°]	Direction mode
A	3A	-71.293263° East	41.570189° North	9.2	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
B	3B	-71.291049° East	41.569744° North	20.1	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
C	3C	-71.288398° East	41.568598° North	41.1	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
D	3D	-71.284400° East	41.568393° North	35.5	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
E	3E	-71.285307° East	41.566969° North	41.9	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
F	3F	-71.284653° East	41.565440° North	53.3	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
G	3G	-71.288866° East	41.563496° North	39.4	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
H	3H	-71.286388° East	41.558351° North	54.9	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
I	3I	-71.290355° East	41.561326° North	41.0	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
J	3J	-71.293584° East	41.562136° North	19.2	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
K	3K	-71.292169° East	41.558715° North	25.9	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
L	3L	-71.299486° East	41.557977° North	33.5	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
M	3M	-71.286529° East	41.565210° North	48.4	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
N	3N	-71.296880° East	41.559381° North	30.5	1.0	1.0	1.0	-180.0	90.0	"Green house mode"

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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Calculated:
2/24/2011 11:55 AM/2.7.473

SHADOW - Main Result

Calculation Results

Shadow receptor

		Shadow, worst case			Shadow, expected values
No.	Name	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	3A	0:00	0	0:00	0:00
B	3B	0:00	0	0:00	0:00
C	3C	8:28	32	0:20	2:37
D	3D	3:20	25	0:12	1:00
E	3E	3:41	25	0:13	1:11
F	3F	1:43	18	0:08	0:33
G	3G	22:26	60	0:33	7:41
H	3H	0:00	0	0:00	0:00
I	3I	0:00	0	0:00	0:00
J	3J	0:00	0	0:00	0:00
K	3K	0:00	0	0:00	0:00
L	3L	0:00	0	0:00	0:00
M	3M	5:06	28	0:16	1:39
N	3N	0:00	0	0:00	0:00

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

No.	Name	Worst case [h/year]	Expected [h/year]
1	Tank Farm 4A	42:58	14:08

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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Calculated:
2/24/2011 11:55 AM/2.7.473

SHADOW - Calendar

Shadow receptor: A - 3A

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:14	05:15	05:39	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:41	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:15	05:40	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:16
3	07:13	06:56	06:18	06:27	05:41	05:13	05:16	05:41	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:42	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:38	05:13	05:17	05:43	06:15	06:46	06:22	06:56
	16:29	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:12	05:18	05:44	06:16	06:47	06:23	06:57
	16:30	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:35	16:16
7	07:13	06:52	06:12	06:20	05:36	05:12	05:18	05:45	06:17	06:48	06:24	06:58
	16:31	17:08	17:42	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18	05:35	05:12	05:19	05:46	06:18	06:49	06:25	06:59
	16:32	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:47	06:19	06:50	06:26	07:00
	16:33	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	16:16
10	07:12	06:48	07:07	06:15	05:32	05:11	05:20	05:48	06:20	06:51	06:28	07:01
	16:34	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:13	05:31	05:11	05:21	05:49	06:21	06:52	06:29	07:02
	16:35	17:13	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:12	06:46	07:04	06:12	05:30	05:11	05:22	05:50	06:22	06:54	06:30	07:03
	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:51	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:56	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:23	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:50	19:24	19:57	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:18	18:52	19:25	19:58	20:21	20:19	19:46	18:56	18:06	16:26	16:16
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:06
	16:41	17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:25	16:17
17	07:10	06:39	06:55	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	20:00	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:02	05:24	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:43	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:23	05:11	05:27	05:58	06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30	20:01	20:22	20:17	19:41	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:22	05:11	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:18
22	07:07	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:15	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:49	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:20	16:19
24	07:05	06:29	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:29	19:02	19:35	20:05	20:24	20:13	19:33	18:41	17:52	16:20	16:20
25	07:05	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:11
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:50	05:18	05:13	05:34	06:05	06:36	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:49	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:13	05:35	06:06	06:37	07:11	06:48	07:11
	16:54	17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:12
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:46	05:16	05:14	05:36	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:17	16:23
30	07:00		06:33	05:45	05:15	05:14	05:37	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:30	17:44	16:17	16:24
31	06:59		06:32		05:15		05:38	06:10		07:15		07:12
	16:59		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	296	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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Calculated:
2/24/2011 11:55 AM/2.7.473

SHADOW - Calendar

Shadow receptor: B - 3B

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:14	05:15	05:39	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:41	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:15	05:40	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:16
3	07:13	06:56	06:18	06:27	05:41	05:13	05:16	05:41	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:42	06:14	06:45	06:20	06:55
	16:28	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:38	05:13	05:17	05:43	06:15	06:46	06:22	06:56
	16:29	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:12	05:18	05:44	06:16	06:47	06:23	06:57
	16:30	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:35	16:16
7	07:13	06:52	06:12	06:20	05:36	05:12	05:18	05:45	06:17	06:48	06:24	06:58
	16:31	17:08	17:42	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18	05:35	05:12	05:19	05:46	06:18	06:49	06:25	06:59
	16:32	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:47	06:19	06:50	06:26	07:00
	16:33	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	16:15
10	07:12	06:48	07:07	06:15	05:32	05:11	05:20	05:48	06:20	06:51	06:28	07:01
	16:34	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:13	05:31	05:11	05:21	05:49	06:21	06:52	06:29	07:02
	16:35	17:13	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:12	06:46	07:04	06:12	05:30	05:11	05:22	05:50	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:51	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:56	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:23	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:50	19:24	19:57	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:18	18:52	19:25	19:58	20:21	20:19	19:46	18:56	18:06	16:26	16:16
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:06
	16:41	17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:25	16:17
17	07:10	06:39	06:55	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	20:00	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:02	05:24	05:11	05:26	05:57	06:28	07:00	06:37	07:07
	16:43	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:23	05:11	05:27	05:58	06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30	20:00	20:22	20:17	19:40	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:22	05:11	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22	16:18
21	07:07	06:34	06:49	05:58	05:22	05:11	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:18
22	07:07	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:49	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:42	17:54	16:20	16:19
24	07:05	06:29	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:29	19:02	19:35	20:05	20:24	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:50	05:18	05:13	05:34	06:05	06:36	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:49	16:19	16:21
27	07:03	06:25	06:38	05:49	05:17	05:13	05:35	06:06	06:37	07:11	06:48	07:11
	16:54	17:33	19:05	19:38	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:12
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:46	05:16	05:14	05:36	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:17	16:23
30	07:00		06:33	05:45	05:15	05:14	05:37	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:30	17:44	16:17	16:24
31	06:59		06:32		05:15		05:38	06:10		07:15		07:12
	16:59		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	296	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 11:55 AM / 3

Licensed user:
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2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 11:55 AM/2.7.473

SHADOW - Calendar

Shadow receptor: C - 3C

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January			February	March	April	May	June	July	August	September	October	November	December		
1	07:12		15:35 (1)	06:58	06:22	06:30	05:44	05:14	05:15	05:39	06:11	06:42	06:17	06:52		
	16:26	16	15:51 (1)	17:01	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:41	16:17		
2	07:13		15:36 (1)	06:57	06:20	06:28	05:42	05:14	05:15	05:40	06:12	06:43	06:18	06:53		
	16:27	15	15:51 (1)	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:16		
3	07:13		15:38 (1)	06:56	06:18	06:27	05:41	05:13	05:16	05:41	06:13	06:44	06:19	06:54		
	16:28	13	15:51 (1)	17:03	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39	16:16		
4	07:13		15:39 (1)	06:55	06:17	06:25	05:40	05:13	05:17	05:42	06:14	06:45	06:20	06:55		
	16:28	11	15:50 (1)	17:04	17:39	19:13	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16		
5	07:13		15:41 (1)	06:54	06:15	06:23	05:38	05:13	05:17	05:43	06:15	06:46	06:22	06:56		
	16:29	8	15:49 (1)	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16		
6	07:13		15:44 (1)	06:53	06:14	06:22	05:37	05:12	05:18	05:44	06:16	06:47	06:23	06:57		15:30 (1)
	16:30	4	15:48 (1)	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:35	16:16	3	15:33 (1)
7	07:13			06:52	06:12	06:20	05:36	05:12	05:18	05:45	06:17	06:48	06:24	06:58		15:28 (1)
	16:31			17:08	17:42	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16	8	15:36 (1)
8	07:12			06:51	07:10	06:18	05:35	05:12	05:19	05:46	06:18	06:49	06:25	06:59		15:27 (1)
	16:32			17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16	11	15:38 (1)
9	07:12			06:50	07:09	06:17	05:34	05:12	05:20	05:47	06:19	06:50	06:26	07:00		15:27 (1)
	16:33			17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	16:15	13	15:40 (1)
10	07:12			06:48	07:07	06:15	05:32	05:11	05:20	05:48	06:20	06:51	06:28	07:01		15:27 (1)
	16:34			17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16	14	15:41 (1)
11	07:12			06:47	07:05	06:13	05:31	05:11	05:21	05:49	06:21	06:52	06:29	07:02		15:25 (1)
	16:35			17:13	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16	16	15:41 (1)
12	07:11			06:46	07:04	06:12	05:30	05:11	05:22	05:50	06:22	06:54	06:30	07:02		15:26 (1)
	16:37			17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:10	16:29	16:16	16	15:42 (1)
13	07:11			06:45	07:02	06:10	05:29	05:11	05:22	05:51	06:23	06:55	06:31	07:03		15:26 (1)
	16:38			17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16	17	15:43 (1)
14	07:11			06:43	07:01	06:09	05:28	05:11	05:23	05:52	06:24	06:56	06:32	07:04		15:26 (1)
	16:39			17:17	18:50	19:24	19:57	20:20	20:20	19:48	18:58	18:07	16:27	16:16	18	15:44 (1)
15	07:10			06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05		15:27 (1)
	16:40			17:18	18:52	19:25	19:58	20:21	20:19	19:46	18:56	18:06	16:26	16:16	18	15:45 (1)
16	07:10			06:41	06:57	06:05	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:06		15:26 (1)
	16:41			17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:25	16:16	19	15:45 (1)
17	07:10			06:39	06:55	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06		15:27 (1)
	16:42			17:21	18:54	19:28	20:00	20:22	20:18	19:43	18:53	18:03	16:25	16:17	19	15:46 (1)
18	07:09			06:38	06:54	06:02	05:24	05:11	05:26	05:57	06:28	07:00	06:37	07:07		15:26 (1)
	16:43			17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17	20	15:46 (1)
19	07:08			06:37	06:52	06:01	05:23	05:11	05:27	05:58	06:29	07:01	06:38	07:07		15:27 (1)
	16:45			17:23	18:56	19:30	20:00	20:22	20:17	19:40	18:49	18:00	16:23	16:18	20	15:47 (1)
20	07:08			06:35	06:50	05:59	05:22	05:11	05:28	05:59	06:30	07:03	06:40	07:08		15:28 (1)
	16:46			17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22	16:18	20	15:48 (1)
21	07:07			06:34	06:49	05:58	05:22	05:11	05:29	06:00	06:31	07:04	06:41	07:09		15:28 (1)
	16:47			17:26	18:58	19:32	20:02	20:23	20:15	19:37	18:46	17:57	16:22	16:18	20	15:48 (1)
22	07:07			06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09		15:29 (1)
	16:48			17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19	20	15:49 (1)
23	07:06			06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10		15:29 (1)
	16:49			17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:42	17:54	16:20	16:19	20	15:49 (1)
24	07:05			06:29	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10		15:29 (1)
	16:51			17:29	19:01	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20	20	15:49 (1)
25	07:04			06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10		15:30 (1)
	16:52			17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21	20	15:50 (1)
26	07:04			06:26	06:40	05:50	05:18	05:13	05:34	06:05	06:36	07:09	06:47	07:11		15:31 (1)
	16:53			17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:49	16:19	16:21	19	15:50 (1)
27	07:03			06:25	06:38	05:49	05:17	05:13	05:35	06:06	06:37	07:11	06:48	07:11		15:31 (1)
	16:54			17:33	19:05	19:38	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22	19	15:50 (1)
28	07:02			06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:38	07:12	06:49	07:12		15:32 (1)
	16:56			17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23	19	15:51 (1)
29	07:01				06:35	05:46	05:16	05:14	05:36	06:08	06:40	07:13	06:50	07:12		15:33 (1)
	16:57				19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:17	16:23	18	15:51 (1)
30	07:00				06:33	05:45	05:15	05:14	05:37	06:09	06:41	07:14	06:51	07:12		15:34 (1)
	16:58				19:08	19:42	20:10	20:24	20:07	19:23	18:30	17:44	16:17	16:24	17	15:51 (1)
31	06:59				06:32		05:15		05:38	06:10		07:15		07:12		15:34 (1)
	16:59				19:09		20:11		20:06	19:22		17:43		16:25	17	15:51 (1)
Potential sun hours	296			297	370	400	450	454	461	429	375	344	296	286		
Total, worst case		67													441	
Sun reduction		0.56													0.52	
Oper. time red.		1.00													1.00	
Wind dir. red.		0.59													0.59	
Total reduction		0.33													0.31	
Total, real		22													135	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 11:55 AM / 4

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9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 11:55 AM/2.7.473

SHADOW - Calendar

Shadow receptor: D - 3D

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January		February		March	April	May	June	July	August	September	October	November		December
1	07:12		06:58	16:30 (1)	06:22	06:30	05:44	05:14	05:15	05:39	06:11	06:42	06:17	16:08 (1)	06:52
	16:26		17:01	6 16:36 (1)	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:41	4 16:12 (1)	16:17
2	07:13		06:57	16:30 (1)	06:20	06:28	05:42	05:14	05:15	05:40	06:12	06:43	06:18	16:05 (1)	06:53
	16:27		17:02	8 16:38 (1)	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	10 16:15 (1)	16:16
3	07:13		06:56	16:31 (1)	06:18	06:27	05:41	05:13	05:16	05:41	06:13	06:44	06:19	16:04 (1)	06:54
	16:28		17:03	8 16:39 (1)	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39	12 16:16 (1)	16:16
4	07:13		06:55	16:31 (1)	06:17	06:25	05:40	05:13	05:16	05:42	06:14	06:45	06:20	16:02 (1)	06:55
	16:28		17:04	10 16:41 (1)	17:39	19:13	19:46	20:14	20:23	20:02	19:15	18:24	16:38	12 16:14 (1)	16:16
5	07:13		06:54	16:31 (1)	06:15	06:23	05:38	05:13	05:17	05:43	06:15	06:46	06:21	16:01 (1)	06:56
	16:29		17:06	10 16:41 (1)	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	12 16:13 (1)	16:16
6	07:13		06:53	16:32 (1)	06:14	06:22	05:37	05:12	05:18	05:44	06:16	06:47	06:23	16:02 (1)	06:57
	16:30		17:07	11 16:43 (1)	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:35	10 16:12 (1)	16:16
7	07:12		06:52	16:33 (1)	06:12	06:20	05:36	05:12	05:18	05:45	06:17	06:48	06:24	16:01 (1)	06:58
	16:31		17:08	11 16:44 (1)	17:42	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	10 16:11 (1)	16:16
8	07:12		06:51	16:34 (1)	07:10	06:18	05:35	05:12	05:19	05:46	06:18	06:49	06:25	16:00 (1)	06:59
	16:32		17:10	12 16:46 (1)	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	9 16:09 (1)	16:15
9	07:12		06:50	16:36 (1)	07:09	06:17	05:34	05:12	05:20	05:47	06:19	06:50	06:26	16:01 (1)	07:00
	16:33		17:11	10 16:46 (1)	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	8 16:09 (1)	16:15
10	07:12		06:48		07:07	06:15	05:32	05:11	05:20	05:48	06:20	06:51	06:28	16:01 (1)	07:01
	16:34		17:12		18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	6 16:07 (1)	16:15
11	07:12		06:47		07:05	06:13	05:31	05:11	05:21	05:49	06:21	06:52	06:29	16:01 (1)	07:02
	16:35		17:13		18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	5 16:06 (1)	16:16
12	07:11		06:46		07:04	06:12	05:30	05:11	05:22	05:50	06:22	06:53	06:30	16:01 (1)	07:02
	16:37		17:15		18:48	19:22	19:54	20:19	20:21	19:50	19:01	18:10	16:29	4 16:05 (1)	16:16
13	07:11		06:45		07:02	06:10	05:29	05:11	05:22	05:51	06:23	06:55	06:31	16:03 (1)	07:03
	16:38		17:16		18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	2 16:04 (1)	16:16
14	07:11		06:43		07:00	06:09	05:28	05:11	05:23	05:52	06:24	06:56	06:32		07:04
	16:39		17:17		18:50	19:24	19:56	20:20	20:20	19:48	18:58	18:07	16:27		16:16
15	07:10		06:42		06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34		07:05
	16:40		17:18		18:52	19:25	19:57	20:21	20:19	19:46	18:56	18:06	16:26		16:16
16	07:10		06:41		06:57	06:05	05:26	05:11	05:25	05:55	06:26	06:58	06:35		07:05
	16:41		17:20		18:53	19:27	19:58	20:21	20:19	19:45	18:55	18:04	16:25		16:16
17	07:10		06:39		06:55	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36		07:06
	16:42		17:21		18:54	19:28	19:59	20:22	20:18	19:43	18:53	18:03	16:25		16:17
18	07:09		06:38		06:54	06:02	05:24	05:11	05:26	05:57	06:28	07:00	06:37		07:07
	16:43		17:22		18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24		16:17
19	07:08		06:36		06:52	06:01	05:23	05:11	05:27	05:58	06:29	07:01	06:38		07:07
	16:45		17:23		18:56	19:30	20:00	20:22	20:17	19:40	18:49	18:00	16:23		16:17
20	07:08		06:35		06:50	05:59	05:22	05:11	05:28	05:59	06:30	07:02	06:40		07:08
	16:46		17:25		18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22		16:18
21	07:07		06:34		06:49	05:58	05:22	05:11	05:29	06:00	06:31	07:04	06:41		07:09
	16:47		17:26		18:58	19:32	20:02	20:23	20:15	19:37	18:46	17:57	16:22		16:18
22	07:07		06:32		06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42		07:09
	16:48		17:27		18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21		16:19
23	07:06		06:31		06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43		07:10
	16:49		17:28		19:00	19:34	20:04	20:23	20:14	19:34	18:42	17:54	16:20		16:19
24	07:05		06:29		06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44		07:10
	16:51		17:29		19:01	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20		16:20
25	07:04		06:28		06:42	05:52	05:19	05:12	05:33	06:04	06:35	07:08	06:45		07:10
	16:52		17:31		19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19		16:21
26	07:04		06:26		06:40	05:50	05:18	05:13	05:34	06:05	06:36	07:09	06:47		07:11
	16:53		17:32		19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:49	16:19		16:21
27	07:03		06:25		06:38	05:49	05:17	05:13	05:35	06:06	06:37	07:11	06:48		07:11
	16:54		17:33		19:05	19:38	20:08	20:24	20:10	19:28	18:36	17:48	16:18		16:22
28	07:02		06:23		06:37	05:48	05:17	05:14	05:35	06:07	06:38	07:12	06:49		07:12
	16:56		17:34		19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18		16:23
29	07:01	16:31 (1)			06:35	05:46	05:16	05:14	05:36	06:08	06:40	07:13	06:50		07:12
	16:57	2 16:32 (1)			19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:17		16:23
30	07:00	16:31 (1)			06:33	05:45	05:15	05:14	05:37	06:09	06:41	07:14	06:51		07:12
	16:58	3 16:34 (1)			19:08	19:42	20:10	20:24	20:07	19:23	18:30	17:44	16:17		16:24
31	06:59	16:30 (1)			06:32		05:15		05:38	06:10		07:15			07:12
	16:59	5 16:35 (1)			19:09		20:11		20:06	19:22		17:43			16:25
Potential sun hours	296		297		370	400	450	454	461	429	375	344	296		286
Total, worst case		10		86										104	
Sun reduction		0.56		0.58										0.50	
Oper. time red.		1.00		1.00										1.00	
Wind dir. red.		0.56		0.56										0.56	
Total reduction		0.31		0.32										0.28	
Total, real		3		28										29	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 11:55 AM / 5

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 11:55 AM/2.7.473

SHADOW - Calendar

Shadow receptor: E - 3E

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February			March	April	May	June	July	August	September	October			November	December
1	07:12	06:58			06:22	06:30	05:44	05:14	05:15	05:39	06:11	06:42			06:17	06:52
	16:26	17:01			17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29			16:41	16:17
2	07:13	06:57			06:20	06:28	05:42	05:14	05:15	05:40	06:12	06:43			06:18	06:53
	16:27	17:02			17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27			16:40	16:16
3	07:13	06:56			06:18	06:27	05:41	05:13	05:16	05:41	06:13	06:44			06:19	06:54
	16:28	17:03			17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25			16:39	16:16
4	07:13	06:55			06:17	06:25	05:40	05:13	05:16	05:42	06:14	06:45			06:20	06:55
	16:28	17:04			17:39	19:13	19:46	20:14	20:23	20:02	19:15	18:24			16:38	16:16
5	07:13	06:54			06:15	06:23	05:38	05:13	05:17	05:43	06:15	06:46			06:21	06:56
	16:29	17:06			17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22			16:37	16:16
6	07:13	06:53			06:14	06:22	05:37	05:12	05:18	05:44	06:16	06:47			06:23	06:57
	16:30	17:07			17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20			16:35	16:16
7	07:12	06:52			06:12	06:20	05:36	05:12	05:18	05:45	06:17	06:48			06:24	06:58
	16:31	17:08			17:42	19:17	19:49	20:16	20:23	19:57	19:10	18:19			16:34	16:16
8	07:12	06:51			07:10	06:18	05:35	05:12	05:19	05:46	06:18	06:49			06:25	06:59
	16:32	17:10			18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17			16:33	16:15
9	07:12	06:50			07:09	06:17	05:34	05:12	05:20	05:47	06:19	06:50			06:26	07:00
	16:33	17:11			18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15			16:32	16:15
10	07:12	06:48			07:07	06:15	05:32	05:11	05:20	05:48	06:20	06:51			06:28	07:01
	16:34	17:12			18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14			16:31	16:16
11	07:12	06:47			07:05	06:13	05:31	05:11	05:21	05:49	06:21	06:52			06:29	07:02
	16:35	17:13			18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12			16:30	16:16
12	07:11	06:46			07:04	06:12	05:30	05:11	05:22	05:50	06:22	06:54			06:30	07:02
	16:37	17:15			18:48	19:22	19:54	20:19	20:21	19:50	19:01	18:10			16:29	16:16
13	07:11	06:45			07:02	06:10	05:29	05:11	05:22	05:51	06:23	06:55			06:31	07:03
	16:38	17:16			18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09			16:28	16:16
14	07:11	06:43			07:00	06:09	05:28	05:11	05:23	05:52	06:24	06:56			06:32	07:04
	16:39	17:17			18:50	19:24	19:56	20:20	20:20	19:48	18:58	18:07			16:27	16:16
15	07:10	06:42		16:54 (1)	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57		17:32 (1)	06:34	07:05
	16:40	17:18	2	16:56 (1)	18:52	19:25	19:57	20:21	20:19	19:46	18:56	18:06	5	17:37 (1)	16:26	16:16
16	07:10	06:41		16:53 (1)	06:57	06:05	05:26	05:11	05:25	05:55	06:26	06:58		17:28 (1)	06:35	07:05
	16:41	17:20	3	16:56 (1)	18:53	19:27	19:58	20:21	20:19	19:45	18:55	18:04	12	17:40 (1)	16:25	16:16
17	07:10	06:39		16:53 (1)	06:55	06:04	05:25	05:11	05:26	05:56	06:27	06:59		17:27 (1)	06:36	07:06
	16:42	17:21	5	16:58 (1)	18:54	19:28	19:59	20:22	20:18	19:43	18:53	18:03	13	17:40 (1)	16:25	16:17
18	07:09	06:38		16:53 (1)	06:54	06:02	05:24	05:11	05:26	05:57	06:28	07:00		17:25 (1)	06:37	07:07
	16:43	17:22	7	17:00 (1)	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	13	17:38 (1)	16:24	16:17
19	07:08	06:36		16:52 (1)	06:52	06:01	05:23	05:11	05:27	05:58	06:29	07:01		17:24 (1)	06:38	07:07
	16:45	17:23	8	17:00 (1)	18:56	19:30	20:00	20:22	20:17	19:40	18:49	18:00	13	17:37 (1)	16:23	16:18
20	07:08	06:35		16:52 (1)	06:50	05:59	05:22	05:11	05:28	05:59	06:30	07:02		17:23 (1)	06:40	07:08
	16:46	17:25	10	17:02 (1)	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	12	17:35 (1)	16:22	16:18
21	07:07	06:34		16:52 (1)	06:49	05:58	05:22	05:11	05:29	06:00	06:31	07:04		17:22 (1)	06:41	07:09
	16:47	17:26	11	17:03 (1)	18:58	19:32	20:02	20:23	20:15	19:37	18:46	17:57	11	17:33 (1)	16:22	16:18
22	07:07	06:32		16:53 (1)	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05		17:23 (1)	06:42	07:09
	16:48	17:27	12	17:05 (1)	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	9	17:32 (1)	16:21	16:19
23	07:06	06:31		16:53 (1)	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06		17:22 (1)	06:43	07:10
	16:49	17:28	13	17:06 (1)	19:00	19:34	20:04	20:23	20:14	19:34	18:42	17:54	9	17:31 (1)	16:20	16:19
24	07:05	06:29		16:54 (1)	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07		17:22 (1)	06:44	07:10
	16:51	17:29	13	17:07 (1)	19:01	19:35	20:05	20:23	20:13	19:33	18:41	17:52	7	17:29 (1)	16:20	16:20
25	07:04	06:28		16:55 (1)	06:42	05:52	05:19	05:12	05:33	06:04	06:35	07:08		17:22 (1)	06:45	07:10
	16:52	17:31	13	17:08 (1)	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	5	17:27 (1)	16:19	16:21
26	07:04	06:26		16:58 (1)	06:40	05:50	05:18	05:13	05:34	06:05	06:36	07:09		17:24 (1)	06:47	07:11
	16:53	17:32	10	17:08 (1)	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:49	3	17:27 (1)	16:19	16:21
27	07:03	06:25			06:38	05:49	05:17	05:13	05:35	06:06	06:37	07:11		17:24 (1)	06:48	07:11
	16:54	17:33			19:05	19:38	20:08	20:24	20:10	19:28	18:36	17:48	2	17:25 (1)	16:18	16:22
28	07:02	06:23			06:37	05:48	05:17	05:14	05:36	06:07	06:38	07:12			06:49	07:11
	16:56	17:34			19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47			16:18	16:23
29	07:01				06:35	05:46	05:16	05:14	05:36	06:08	06:40	07:13			06:50	07:12
	16:57				19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45			16:17	16:23
30	07:00				06:33	05:45	05:15	05:14	05:37	06:09	06:41	07:14			06:51	07:12
	16:58				19:08	19:42	20:10	20:24	20:07	19:23	18:30	17:44			16:17	16:24
31	06:59				06:32		05:15		05:38	06:10		07:15				07:12
	16:59				19:09		20:11		20:06	19:22		17:43				16:25
Potential sun hours	296	297			370	400	450	454	461	429	375	344			296	286
Total, worst case			107										114			
Sun reduction			0.58										0.61			
Oper. time red.			1.00										1.00			
Wind dir. red.			0.54										0.54			
Total reduction			0.31										0.33			
Total, real			33										38			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 11:55 AM / 6

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 11:55 AM/2.7.473

SHADOW - Calendar

Shadow receptor: F - 3F

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March		April	May	June	July	August	September		October		November	December
1	07:12	06:58	06:22		06:30	05:44	05:14	05:15	05:39	06:11		06:42	18:05 (1)	06:17	06:52
	16:26	17:01	17:35		19:10	19:43	20:12	20:24	20:05	19:20		18:29	2 18:07 (1)	16:41	16:17
2	07:13	06:57	06:20		06:28	05:42	05:14	05:15	05:40	06:12		06:43		06:18	06:53
	16:27	17:02	17:37		19:11	19:44	20:13	20:24	20:04	19:18		18:27		16:40	16:16
3	07:13	06:56	06:18		06:27	05:41	05:13	05:16	05:41	06:13		06:44		06:19	06:54
	16:28	17:03	17:38		19:12	19:45	20:14	20:24	20:03	19:17		18:25		16:39	16:16
4	07:13	06:55	06:17		06:25	05:40	05:13	05:16	05:42	06:14		06:45		06:20	06:55
	16:28	17:04	17:39		19:13	19:46	20:14	20:23	20:02	19:15		18:24		16:38	16:16
5	07:13	06:54	06:15		06:23	05:38	05:13	05:17	05:43	06:15		06:46		06:21	06:56
	16:29	17:06	17:40		19:15	19:47	20:15	20:23	20:01	19:13		18:22		16:37	16:16
6	07:13	06:53	06:14		06:22	05:37	05:12	05:18	05:44	06:16		06:47		06:23	06:57
	16:30	17:07	17:41		19:16	19:48	20:16	20:23	19:58	19:12		18:20		16:35	16:16
7	07:12	06:52	06:12		06:20	05:36	05:12	05:18	05:45	06:17		06:48		06:24	06:58
	16:31	17:08	17:42		19:17	19:49	20:16	20:23	19:57	19:10		18:19		16:34	16:16
8	07:12	06:51	07:10		06:18	05:35	05:12	05:19	05:46	06:18		06:49		06:25	06:59
	16:32	17:10	18:44		19:18	19:50	20:17	20:22	19:56	19:08		18:17		16:33	16:15
9	07:12	06:50	07:09		06:17	05:34	05:12	05:20	05:47	06:19		06:50		06:26	07:00
	16:33	17:11	18:45		19:19	19:51	20:18	20:22	19:54	19:07		18:15		16:32	16:15
10	07:12	06:48	07:07		06:15	05:32	05:11	05:20	05:48	06:20		06:51		06:28	07:01
	16:34	17:12	18:46		19:20	19:52	20:18	20:22	19:53	19:05		18:14		16:31	16:16
11	07:12	06:47	07:05		06:13	05:31	05:11	05:21	05:49	06:21		06:52		06:29	07:02
	16:35	17:13	18:47		19:21	19:53	20:19	20:21	19:52	19:03		18:12		16:30	16:16
12	07:11	06:46	07:04	18:25 (1)	06:12	05:30	05:11	05:22	05:50	06:22		06:53		06:30	07:02
	16:37	17:15	18:48	2 18:27 (1)	19:22	19:54	20:19	20:21	19:50	19:01		18:10		16:29	16:16
13	07:11	06:45	07:02	18:24 (1)	06:10	05:29	05:11	05:22	05:51	06:23		06:55		06:31	07:03
	16:38	17:16	18:49	3 18:27 (1)	19:23	19:55	20:20	20:20	19:49	19:00		18:09		16:28	16:16
14	07:11	06:43	07:00	18:25 (1)	06:09	05:28	05:11	05:23	05:52	06:24		06:56		06:32	07:04
	16:39	17:17	18:50	4 18:29 (1)	19:24	19:56	20:20	20:20	19:48	18:58		18:07		16:27	16:16
15	07:10	06:42	06:59	18:24 (1)	06:07	05:27	05:11	05:24	05:54	06:25		06:57		06:34	07:05
	16:40	17:18	18:52	6 18:30 (1)	19:25	19:57	20:21	20:19	19:46	18:56		18:06		16:26	16:16
16	07:10	06:41	06:57	18:24 (1)	06:05	05:26	05:11	05:25	05:55	06:26		06:58		06:35	07:05
	16:41	17:20	18:53	7 18:31 (1)	19:27	19:58	20:21	20:19	19:45	18:55		18:04		16:25	16:16
17	07:10	06:39	06:55	18:25 (1)	06:04	05:25	05:11	05:26	05:56	06:27		06:59		06:36	07:06
	16:42	17:21	18:54	8 18:33 (1)	19:28	19:59	20:22	20:18	19:43	18:53		18:03		16:25	16:17
18	07:09	06:38	06:54	18:26 (1)	06:02	05:24	05:11	05:26	05:57	06:28		07:00		06:37	07:07
	16:43	17:22	18:55	8 18:34 (1)	19:29	20:00	20:22	20:17	19:42	18:51		18:01		16:24	16:17
19	07:08	06:36	06:52	18:27 (1)	06:01	05:23	05:11	05:27	05:58	06:29		07:01		06:38	07:07
	16:45	17:23	18:56	7 18:34 (1)	19:30	20:00	20:22	20:17	19:40	18:49		18:00		16:23	16:18
20	07:08	06:35	06:50	18:29 (1)	05:59	05:22	05:11	05:28	05:59	06:30		07:02		06:40	07:08
	16:46	17:25	18:57	6 18:35 (1)	19:31	20:01	20:23	20:16	19:39	18:48		17:58		16:22	16:18
21	07:07	06:34	06:49		05:58	05:22	05:11	05:29	06:00	06:31		07:04		06:41	07:09
	16:47	17:26	18:58		19:32	20:02	20:23	20:15	19:37	18:46		17:57		16:22	16:18
22	07:07	06:32	06:47		05:56	05:21	05:12	05:30	06:01	06:32		07:05		06:42	07:09
	16:48	17:27	18:59		19:33	20:03	20:23	20:14	19:36	18:44		17:55		16:21	16:19
23	07:06	06:31	06:45		05:55	05:20	05:12	05:31	06:02	06:33	18:14 (1)	07:06		06:43	07:10
	16:49	17:28	19:00		19:34	20:04	20:23	20:14	19:34	18:42	6 18:20 (1)	17:54		16:20	16:19
24	07:05	06:29	06:44		05:53	05:19	05:12	05:32	06:03	06:34	18:11 (1)	07:07		06:44	07:10
	16:51	17:29	19:01		19:35	20:05	20:23	20:13	19:33	18:41	7 18:18 (1)	17:52		16:20	16:20
25	07:04	06:28	06:42		05:52	05:19	05:12	05:33	06:04	06:35	18:09 (1)	07:08		06:45	07:10
	16:52	17:31	19:03		19:36	20:06	20:24	20:12	19:31	18:39	7 18:16 (1)	17:51		16:19	16:21
26	07:04	06:26	06:40		05:50	05:18	05:13	05:34	06:05	06:36	18:07 (1)	07:09		06:47	07:11
	16:53	17:32	19:04		19:37	20:07	20:24	20:11	19:30	18:37	8 18:15 (1)	17:49		16:19	16:21
27	07:03	06:25	06:38		05:49	05:17	05:13	05:35	06:06	06:37	18:06 (1)	07:11		06:48	07:11
	16:54	17:33	19:05		19:38	20:08	20:24	20:10	19:28	18:36	7 18:13 (1)	17:48		16:18	16:22
28	07:02	06:23	06:37		05:48	05:17	05:14	05:36	06:07	06:38	18:05 (1)	07:12		06:49	07:11
	16:56	17:34	19:06		19:40	20:09	20:24	20:09	19:27	18:34	6 18:11 (1)	17:47		16:18	16:23
29	07:01		06:35		05:46	05:16	05:14	05:36	06:08	06:40	18:04 (1)	07:13		06:50	07:12
	16:57		19:07		19:41	20:10	20:24	20:08	19:25	18:32	5 18:09 (1)	17:45		16:17	16:23
30	07:00		06:33		05:45	05:15	05:14	05:37	06:09	06:41	18:05 (1)	07:14		06:51	07:12
	16:58		19:08		19:42	20:10	20:24	20:07	19:23	18:30	4 18:09 (1)	17:44		16:17	16:24
31	06:59		06:32			05:15		05:38	06:10			07:15			07:12
	16:59		19:09			20:11		20:06	19:22			17:43			16:25
Potential sun hours	296	297	370		400	450	454	461	429	375		344		296	286
Total, worst case				51							50		2		
Sun reduction				0.58							0.62		0.61		
Oper. time red.				1.00							1.00		1.00		
Wind dir. red.				0.54							0.54		0.54		
Total reduction				0.31							0.33		0.33		
Total, real				16							17		1		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 11:55 AM / 7

Licensed user:
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Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 11:55 AM/2.7.473

SHADOW - Calendar

Shadow receptor: G - 3G

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April			May			June	July			August			September	October	November	December
1	07:12	06:58	06:22	06:30			05:44		18:52 (1)	05:14	05:15			05:39		19:07 (1)	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10			19:43	27	19:19 (1)	20:12	20:24			20:05	29	19:36 (1)	19:20	18:29	16:41	16:17
2	07:13	06:57	06:20	06:28			05:42		18:53 (1)	05:14	05:15			05:40		19:05 (1)	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11			19:44	27	19:20 (1)	20:13	20:24			20:04	31	19:36 (1)	19:18	18:27	16:40	16:16
3	07:13	06:56	06:18	06:27			05:41		18:53 (1)	05:13	05:16			05:41		19:04 (1)	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12			19:45	29	19:22 (1)	20:14	20:24			20:03	33	19:37 (1)	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25			05:40		18:53 (1)	05:13	05:17			05:42		19:04 (1)	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:13			19:46	30	19:23 (1)	20:14	20:23			20:02	33	19:37 (1)	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23			05:38		18:52 (1)	05:13	05:17			05:43		19:03 (1)	06:15	06:46	06:21	06:56
	16:29	17:06	17:40	19:15			19:47	31	19:23 (1)	20:15	20:23			20:01	33	19:36 (1)	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22			05:37		18:53 (1)	05:12	05:18			05:44		19:03 (1)	06:16	06:47	06:23	06:57
	16:30	17:07	17:41	19:16			19:48	31	19:24 (1)	20:16	20:23			19:58	32	19:35 (1)	19:12	18:20	16:35	16:16
7	07:12	06:52	06:12	06:20			05:36		18:53 (1)	05:12	05:18			05:45		19:02 (1)	06:17	06:48	06:24	06:58
	16:31	17:08	17:42	19:17			19:49	32	19:25 (1)	20:16	20:23			19:57	31	19:33 (1)	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18			05:35		18:54 (1)	05:12	05:19			05:46		19:02 (1)	06:18	06:49	06:25	06:59
	16:32	17:10	18:44	19:18			19:50	32	19:26 (1)	20:17	20:22			19:56	30	19:32 (1)	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17			05:34		18:54 (1)	05:12	05:20			05:47		19:02 (1)	06:19	06:50	06:26	07:00
	16:33	17:11	18:45	19:19			19:51	33	19:27 (1)	20:18	20:22			19:54	29	19:31 (1)	19:07	18:15	16:32	16:16
10	07:12	06:48	07:07	06:15			05:32		18:55 (1)	05:11	05:20			05:48		19:01 (1)	06:20	06:51	06:28	07:01
	16:34	17:12	18:46	19:20			19:52	32	19:27 (1)	20:18	20:22			19:53	29	19:30 (1)	19:05	18:14	16:31	16:16
11	07:12	06:47	07:05	06:13			05:31		18:56 (1)	05:11	05:21			05:49		19:01 (1)	06:21	06:52	06:29	07:02
	16:35	17:13	18:47	19:21			19:53	30	19:26 (1)	20:19	20:21			19:52	28	19:29 (1)	19:03	18:12	16:30	16:16
12	07:11	06:46	07:04	06:12			05:30		18:57 (1)	05:11	05:22			05:50		19:01 (1)	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22			19:54	28	19:25 (1)	20:19	20:21			19:50	26	19:27 (1)	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10			05:29		18:57 (1)	05:11	05:23			05:51		19:01 (1)	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23			19:55	27	19:24 (1)	20:20	20:20			19:49	25	19:26 (1)	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09			05:28		18:58 (1)	05:11	05:23			05:53		19:01 (1)	06:24	06:56	06:32	07:04
	16:39	17:17	18:50	19:24			19:56	25	19:23 (1)	20:20	20:20			19:48	24	19:25 (1)	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07			05:27		19:00 (1)	05:11	05:24			05:54		19:01 (1)	06:25	06:57	06:34	07:05
	16:40	17:18	18:52	19:25			19:58	22	19:22 (1)	20:21	20:19			19:46	23	19:24 (1)	18:56	18:06	16:26	16:16
16	07:10	06:41	06:57	06:06			05:26		19:01 (1)	05:11	05:25			05:55		19:02 (1)	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27			19:59	20	19:21 (1)	20:21	20:19			19:45	20	19:22 (1)	18:55	18:04	16:25	16:17
17	07:10	06:39	06:55	06:04			05:25		19:02 (1)	05:11	05:26			05:56		19:02 (1)	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28			19:59	17	19:19 (1)	20:22	20:18			19:43	19	19:21 (1)	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:02			05:24		19:05 (1)	05:11	05:27			05:57		19:03 (1)	06:28	07:00	06:37	07:07
	16:43	17:22	18:55	19:29			20:00	11	19:16 (1)	20:22	20:17			19:42	16	19:19 (1)	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01			05:23		19:09 (1)	05:11	05:27			05:58		19:03 (1)	06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30			20:00	3	19:12 (1)	20:22	20:17			19:40	15	19:18 (1)	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59		19:04 (1)	05:22			05:11	05:28			05:59		19:04 (1)	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	5	19:09 (1)	20:01			20:23	20:16			19:39	13	19:17 (1)	18:48	17:58	16:22	16:18
21	07:07	06:34	06:49	05:58		19:01 (1)	05:22			05:12	05:29			06:00		19:05 (1)	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	8	19:09 (1)	20:02			20:23	20:15			19:37	10	19:15 (1)	18:46	17:57	16:22	16:18
22	07:07	06:32	06:47	05:56		19:00 (1)	05:21			05:12	05:30			06:01		19:06 (1)	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	11	19:11 (1)	20:03			20:23	20:14			19:36	8	19:14 (1)	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55		18:58 (1)	05:20			05:12	05:31			06:02		19:08 (1)	06:33	07:06	06:43	07:10
	16:49	17:28	19:00	19:34	13	19:11 (1)	20:04			20:23	20:14			19:34	4	19:12 (1)	18:42	17:54	16:20	16:19
24	07:05	06:29	06:44	05:53		18:57 (1)	05:19			05:12	05:32			06:03			06:34	07:07	06:44	07:10
	16:51	17:29	19:01	19:35	16	19:13 (1)	20:05			20:23	20:13			19:33			18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52		18:56 (1)	05:19			05:13	05:33		19:17 (1)	06:04			06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	17	19:13 (1)	20:06			20:24	20:12	8	19:25 (1)	19:31			18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:50		18:55 (1)	05:18			05:13	05:34		19:14 (1)	06:05			06:36	07:09	06:47	07:11
	16:53	17:32	19:04	19:37	19	19:14 (1)	20:07			20:24	20:11	14	19:28 (1)	19:30			18:37	17:49	16:19	16:21
27	07:03	06:25	06:38	05:49		18:55 (1)	05:17			05:13	05:35		19:12 (1)	06:06			06:37	07:11	06:48	07:11
	16:54	17:33	19:05	19:38	21	19:16 (1)	20:08			20:24	20:10	18	19:30 (1)	19:28			18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48		18:54 (1)	05:17			05:14	05:36		19:11 (1)	06:07			06:38	07:12	06:49	07:12
	16:56	17:34	19:06	19:40	22	19:16 (1)	20:09			20:24	20:09	21	19:32 (1)	19:27			18:34	17:47	16:18	16:23
29	07:01		06:35	05:46		18:53 (1)	05:16			05:14	05:36		19:10 (1)	06:08			06:40	07:13	06:50	07:12
	16:57		19:07	19:41	24	19:17 (1)	20:10			20:24	20:08	23	19:33 (1)	19:25			18:32	17:45	16:17	16:23
30	07:00		06:33	05:45		18:53 (1)	05:15			05:14	05:37		19:09 (1)	06:09			06:41	07:14	06:51	07:12
	16:58		19:08	19:42	26	19:19 (1)	20:10			20:24	20:07	25	19:34 (1)	19:23			18:30	17:44	16:17	16:24
31	06:59		06:32				05:15				05:38		19:08 (1)	06:10				07:15		07:12
	16:59		19:09				20:11				20:06	27	19:35 (1)	19:22				17:43		16:25
Potential sun hours	296	297	370	400			450			454	461			429			375	344	296	286
Total, worst case					182			487				136			541					
Sun reduction					0.57			0.58				0.63			0.62					
Oper. time red.					1.00			1.00				1.00			1.00					
Wind dir. red.					0.57			0.57				0.57			0.57					
Total reduction					0.33			0.33				0.36			0.35					
Total, real					59			162				49			192					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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Calculated:
2/24/2011 11:55 AM/2.7.473

SHADOW - Calendar

Shadow receptor: H - 3H

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:14	05:15	05:39	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:41	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:15	05:40	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:16
3	07:13	06:56	06:18	06:27	05:41	05:13	05:16	05:41	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:23	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:42	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:13	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:38	05:13	05:17	05:43	06:15	06:46	06:21	06:56
	16:29	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:12	05:18	05:44	06:16	06:47	06:23	06:57
	16:30	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:35	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12	05:18	05:45	06:17	06:48	06:24	06:58
	16:31	17:08	17:42	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18	05:35	05:12	05:19	05:46	06:18	06:49	06:25	06:59
	16:32	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:47	06:19	06:50	06:26	07:00
	16:33	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	16:16
10	07:12	06:48	07:07	06:15	05:32	05:11	05:20	05:48	06:20	06:51	06:28	07:01
	16:34	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:05	06:13	05:31	05:11	05:21	05:49	06:21	06:52	06:29	07:02
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15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
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17	07:09	06:39	06:55	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	19:59	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:02	05:24	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:43	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:36	06:52	06:01	05:23	05:11	05:27	05:58	06:29	07:01	06:38	07:07
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20	07:08	06:35	06:50	05:59	05:22	05:11	05:28	05:59	06:30	07:02	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22	16:18
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	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:49	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:42	17:54	16:20	16:19
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	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:50	05:18	05:13	05:34	06:05	06:36	07:09	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:49	16:19	16:21
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	16:54	17:33	19:05	19:38	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:38	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
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31	06:59		06:32		05:15		05:38	06:10		07:15		07:12
	16:59		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	296	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 11:55 AM / 9

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 11:55 AM/2.7.473

SHADOW - Calendar

Shadow receptor: I - 3I

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:14	05:15	05:39	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:41	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:15	05:40	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:16
3	07:13	06:56	06:18	06:27	05:41	05:13	05:16	05:41	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:42	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:13	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:38	05:13	05:17	05:43	06:15	06:46	06:21	06:56
	16:29	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:12	05:18	05:44	06:16	06:47	06:23	06:57
	16:30	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:35	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12	05:18	05:45	06:17	06:48	06:24	06:58
	16:31	17:08	17:42	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18	05:35	05:12	05:19	05:46	06:18	06:49	06:25	06:59
	16:32	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
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	16:33	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	16:16
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	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
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15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:18	18:52	19:25	19:58	20:21	20:19	19:46	18:56	18:06	16:26	16:16
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:25	16:17
17	07:10	06:39	06:55	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
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18	07:09	06:38	06:54	06:02	05:24	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:43	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:23	05:11	05:27	05:58	06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30	20:00	20:22	20:17	19:40	18:49	18:00	16:23	16:18
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21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:37	18:46	17:57	16:22	16:18
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	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:49	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:42	17:54	16:20	16:19
24	07:05	06:29	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:29	19:01	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
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	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:36	07:09	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:49	16:19	16:21
27	07:03	06:25	06:38	05:49	05:17	05:13	05:35	06:06	06:37	07:11	06:48	07:11
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28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:38	07:12	06:49	07:12
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
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	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:17	16:23
30	07:00		06:33	05:45	05:15	05:14	05:37	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:30	17:44	16:17	16:24
31	06:59		06:32		05:15		05:38	06:10		07:15		07:12
	16:59		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	296	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 11:55 AM / 10

Licensed user:
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2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 11:55 AM/2.7.473

SHADOW - Calendar

Shadow receptor: J - 3J

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:14	05:15	05:39	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:41	16:17
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	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:16
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	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:38	05:13	05:17	05:43	06:15	06:46	06:22	06:56
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	16:41	17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:25	16:17
17	07:10	06:39	06:55	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	20:00	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:02	05:24	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:43	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:23	05:11	05:27	05:58	06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30	20:00	20:22	20:17	19:40	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:22	05:11	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:18
22	07:07	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:49	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:20	16:19
24	07:05	06:29	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:29	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:36	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:49	16:19	16:21
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	16:54	17:33	19:05	19:38	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:12
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:46	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:17	16:23
30	07:00		06:33	05:45	05:15	05:14	05:37	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:30	17:44	16:17	16:24
31	06:59		06:32		05:15		05:38	06:10		07:15		07:12
	16:59		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	296	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 11:55 AM / 11

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 11:55 AM/2.7.473

SHADOW - Calendar

Shadow receptor: K - 3K

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:14	05:15	05:39	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:41	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:15	05:40	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:16
3	07:13	06:56	06:18	06:27	05:41	05:14	05:16	05:41	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:42	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:38	05:13	05:17	05:43	06:15	06:46	06:21	06:56
	16:29	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:12	05:18	05:44	06:16	06:47	06:23	06:57
	16:30	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:35	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12	05:18	05:45	06:17	06:48	06:24	06:58
	16:31	17:08	17:42	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18	05:35	05:12	05:19	05:46	06:18	06:49	06:25	06:59
	16:32	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:47	06:19	06:50	06:26	07:00
	16:33	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:11	05:20	05:48	06:20	06:51	06:28	07:01
	16:34	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:13	05:31	05:11	05:21	05:49	06:21	06:52	06:29	07:02
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13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:23	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:50	19:24	19:56	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:18	18:52	19:25	19:58	20:21	20:19	19:46	18:56	18:06	16:26	16:16
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:25	16:17
17	07:10	06:39	06:55	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	19:59	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:02	05:24	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:43	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:23	05:11	05:27	05:58	06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30	20:00	20:22	20:17	19:40	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:22	05:11	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:37	18:46	17:57	16:22	16:18
22	07:07	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:49	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:42	17:54	16:20	16:19
24	07:05	06:29	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:29	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:36	07:09	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:49	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:13	05:35	06:06	06:37	07:11	06:48	07:11
	16:54	17:33	19:05	19:38	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:12
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:46	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:17	16:23
30	07:00		06:33	05:45	05:15	05:14	05:37	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:30	17:44	16:17	16:24
31	06:59		06:32		05:15		05:38	06:10		07:15		07:12
	16:59		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	296	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 11:55 AM / 12

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2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 11:55 AM/2.7.473

SHADOW - Calendar

Shadow receptor: L - 3L

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:14	05:15	05:39	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:41	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:16	05:40	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:16
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:41	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:42	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:38	05:13	05:17	05:43	06:15	06:46	06:22	06:56
	16:29	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:12	05:18	05:44	06:16	06:47	06:23	06:57
	16:30	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:35	16:16
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	16:31	17:08	17:42	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
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10	07:12	06:48	07:07	06:15	05:33	05:11	05:20	05:48	06:20	06:51	06:28	07:01
	16:34	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
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	16:42	17:21	18:54	19:28	20:00	20:22	20:18	19:43	18:53	18:03	16:25	16:17
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	16:49	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:20	16:19
24	07:05	06:29	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:29	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:36	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:49	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:13	05:35	06:06	06:37	07:11	06:48	07:11
	16:54	17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:12
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:46	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:17	16:23
30	07:00		06:33	05:45	05:15	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:30	17:44	16:17	16:24
31	06:59		06:32		05:15		05:38	06:10		07:15		07:12
	16:59		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	296	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 11:55 AM / 13

Licensed user:
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2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 11:55 AM/2.7.473

SHADOW - Calendar

Shadow receptor: M - 3M

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March		April	May	June	July	August	September		October		November	December
1	07:12	06:58	06:22		06:30	05:44	05:14	05:15	05:39	06:11		06:42	18:04 (1)	06:17	06:52
	16:26	17:01	17:35		19:10	19:43	20:12	20:24	20:05	19:20		18:29	3 18:07 (1)	16:41	16:17
2	07:13	06:57	06:20		06:28	05:42	05:14	05:15	05:40	06:12		06:43		06:18	06:53
	16:27	17:02	17:37		19:11	19:44	20:13	20:24	20:04	19:18		18:27		16:40	16:16
3	07:13	06:56	06:18		06:27	05:41	05:13	05:16	05:41	06:13		06:44		06:19	06:54
	16:28	17:03	17:38		19:12	19:45	20:14	20:24	20:03	19:17		18:25		16:39	16:16
4	07:13	06:55	06:17		06:25	05:40	05:13	05:17	05:42	06:14		06:45		06:20	06:55
	16:28	17:04	17:39		19:13	19:46	20:14	20:23	20:02	19:15		18:24		16:38	16:16
5	07:13	06:54	06:15		06:23	05:38	05:13	05:17	05:43	06:15		06:46		06:21	06:56
	16:29	17:06	17:40		19:15	19:47	20:15	20:23	20:01	19:13		18:22		16:37	16:16
6	07:13	06:53	06:14		06:22	05:37	05:12	05:18	05:44	06:16		06:47		06:23	06:57
	16:30	17:07	17:41		19:16	19:48	20:16	20:23	19:58	19:12		18:20		16:35	16:16
7	07:12	06:52	06:12		06:20	05:36	05:12	05:18	05:45	06:17		06:48		06:24	06:58
	16:31	17:08	17:42		19:17	19:49	20:16	20:23	19:57	19:10		18:19		16:34	16:16
8	07:12	06:51	07:10		06:18	05:35	05:12	05:19	05:46	06:18		06:49		06:25	06:59
	16:32	17:10	18:44		19:18	19:50	20:17	20:22	19:56	19:08		18:17		16:33	16:16
9	07:12	06:50	07:09		06:17	05:34	05:12	05:20	05:47	06:19		06:50		06:26	07:00
	16:33	17:11	18:45		19:19	19:51	20:18	20:22	19:54	19:07		18:15		16:32	16:15
10	07:12	06:48	07:07		06:15	05:32	05:11	05:20	05:48	06:20		06:51		06:28	07:01
	16:34	17:12	18:46		19:20	19:52	20:18	20:22	19:53	19:05		18:14		16:31	16:16
11	07:12	06:47	07:05		06:13	05:31	05:11	05:21	05:49	06:21		06:52		06:29	07:02
	16:35	17:13	18:47		19:21	19:53	20:19	20:21	19:52	19:03		18:12		16:30	16:16
12	07:11	06:46	07:04		18:25 (1)	06:12	05:30	05:11	05:22	05:50	06:22		06:54		06:30	07:02
	16:37	17:15	18:48	2	18:27 (1)	19:22	19:54	20:19	20:21	19:50	19:01		18:10		16:29	16:16
13	07:11	06:45	07:02		18:23 (1)	06:10	05:29	05:11	05:22	05:51	06:23		06:55		06:31	07:03
	16:38	17:16	18:49	4	18:27 (1)	19:23	19:55	20:20	20:20	19:49	19:00		18:09		16:28	16:16
14	07:11	06:43	07:00		18:23 (1)	06:09	05:28	05:11	05:23	05:52	06:24		06:56		06:32	07:04
	16:39	17:17	18:50	6	18:29 (1)	19:24	19:56	20:20	20:20	19:48	18:58		18:07		16:27	16:16
15	07:10	06:42	06:59		18:22 (1)	06:07	05:27	05:11	05:24	05:54	06:25		06:57		06:34	07:05
	16:40	17:18	18:52	8	18:30 (1)	19:25	19:57	20:21	20:19	19:46	18:56		18:06		16:26	16:16
16	07:10	06:41	06:57		18:21 (1)	06:05	05:26	05:11	05:25	05:55	06:26		06:58		06:35	07:05
	16:41	17:20	18:53	10	18:31 (1)	19:27	19:58	20:21	20:19	19:45	18:55		18:04		16:25	16:17
17	07:10	06:39	06:55		18:21 (1)	06:04	05:25	05:11	05:26	05:56	06:27		06:59		06:36	07:06
	16:42	17:21	18:54	12	18:33 (1)	19:28	19:59	20:22	20:18	19:43	18:53		18:03		16:25	16:17
18	07:09	06:38	06:54		18:21 (1)	06:02	05:24	05:11	05:26	05:57	06:28	18:17 (1)	07:00		06:37	07:07
	16:43	17:22	18:55	13	18:34 (1)	19:29	20:00	20:22	20:17	19:42	18:51	5 18:22 (1)	18:01		16:24	16:17
19	07:08	06:36	06:52		18:21 (1)	06:01	05:23	05:11	05:27	05:58	06:29	18:12 (1)	07:01		06:38	07:07
	16:45	17:23	18:56	13	18:34 (1)	19:30	20:00	20:22	20:17	19:40	18:49	14 18:26 (1)	18:00		16:23	16:18
20	07:08	06:35	06:50		18:21 (1)	05:59	05:22	05:11	05:28	05:59	06:30	18:10 (1)	07:03		06:40	07:08
	16:46	17:25	18:57	14	18:35 (1)	19:31	20:01	20:23	20:16	19:39	18:48	15 18:25 (1)	17:58		16:22	16:18
21	07:07	06:34	06:49		18:22 (1)	05:58	05:22	05:11	05:29	06:00	06:31	18:08 (1)	07:04		06:41	07:09
	16:47	17:26	18:58	15	18:37 (1)	19:32	20:02	20:23	20:15	19:37	18:46	16 18:24 (1)	17:57		16:22	16:18
22	07:07	06:32	06:47		18:22 (1)	05:56	05:21	05:12	05:30	06:01	06:32	18:06 (1)	07:05		06:42	07:09
	16:48	17:27	18:59	16	18:38 (1)	19:33	20:03	20:23	20:14	19:36	18:44	16 18:22 (1)	17:55		16:21	16:19
23	07:06	06:31	06:45		18:23 (1)	05:55	05:20	05:12	05:31	06:02	06:33	18:05 (1)	07:06		06:43	07:10
	16:49	17:28	19:00	16	18:39 (1)	19:34	20:04	20:23	20:14	19:34	18:42	15 18:20 (1)	17:54		16:20	16:19
24	07:05	06:29	06:44		18:25 (1)	05:53	05:19	05:12	05:32	06:03	06:34	18:04 (1)	07:07		06:44	07:10
	16:51	17:29	19:01	15	18:40 (1)	19:35	20:05	20:23	20:13	19:33	18:41	14 18:18 (1)	17:52		16:20	16:20
25	07:04	06:28	06:42		18:28 (1)	05:52	05:19	05:13	05:33	06:04	06:35	18:03 (1)	07:08		06:45	07:10
	16:52	17:31	19:03	8	18:36 (1)	19:36	20:06	20:24	20:12	19:31	18:39	13 18:16 (1)	17:51		16:19	16:21
26	07:04	06:26	06:40			05:50	05:18	05:13	05:34	06:05	06:36	18:03 (1)	07:09		06:47	07:11
	16:53	17:32	19:04			19:37	20:07	20:24	20:11	19:30	18:37	12 18:15 (1)	17:49		16:19	16:21
27	07:03	06:25	06:38			05:49	05:17	05:13	05:35	06:06	06:37	18:03 (1)	07:11		06:48	07:11
	16:54	17:33	19:05			19:38	20:08	20:24	20:10	19:28	18:36	10 18:13 (1)	17:48		16:18	16:22
28	07:02	06:23	06:37			05:48	05:17	05:14	05:36	06:07	06:38	18:02 (1)	07:12		06:49	07:11
	16:56	17:34	19:06			19:40	20:09	20:24	20:09	19:27	18:34	9 18:11 (1)	17:47		16:18	16:23
29	07:01		06:35			05:46	05:16	05:14	05:36	06:08	06:40	18:03 (1)	07:13		06:50	07:12
	16:57		19:07			19:41	20:10	20:24	20:08	19:25	18:32	7 18:10 (1)	17:45		16:17	16:23
30	07:00		06:33			05:45	05:15	05:14	05:37	06:09	06:41	18:04 (1)	07:14		06:51	07:12
	16:58		19:08			19:42	20:10	20:24	20:07	19:23	18:30	5 18:09 (1)	17:44		16:17	16:24
31	06:59		06:32				05:15		05:38	06:10			07:15			07:12
	16:59		19:09				20:11		20:06	19:22			17:43			16:25
Potential sun hours	296	297	370		400	450	454	461	429	375		344		296	286
Total, worst case				152							151		3		
Sun reduction				0.58							0.62		0.61		
Oper. time red.				1.00							1.00		1.00		
Wind dir. red.				0.54							0.54		0.54		
Total reduction				0.31							0.33		0.33		
Total, real				48							51		1		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 11:55 AM / 14

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Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 11:55 AM/2.7.473

SHADOW - Calendar

Shadow receptor: N - 3N

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:14	05:15	05:39	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:41	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:15	05:40	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:16
3	07:13	06:56	06:18	06:27	05:41	05:14	05:16	05:41	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:42	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:38	05:13	05:17	05:43	06:15	06:46	06:22	06:56
	16:29	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:12	05:18	05:44	06:16	06:47	06:23	06:57
	16:30	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:35	16:16
7	07:13	06:52	06:12	06:20	05:36	05:12	05:18	05:45	06:17	06:48	06:24	06:58
	16:31	17:08	17:42	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18	05:35	05:12	05:19	05:46	06:18	06:49	06:25	06:59
	16:32	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:47	06:19	06:50	06:26	07:00
	16:33	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:11	05:20	05:48	06:20	06:51	06:28	07:01
	16:34	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:31	05:11	05:21	05:49	06:21	06:52	06:29	07:02
	16:36	17:13	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:12	06:46	07:04	06:12	05:30	05:11	05:22	05:51	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:23	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:50	19:24	19:57	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:18	18:52	19:25	19:58	20:21	20:19	19:46	18:56	18:06	16:26	16:16
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:06
	16:41	17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:10	06:39	06:55	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	20:00	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:02	05:24	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:43	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:23	05:11	05:27	05:58	06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30	20:00	20:22	20:17	19:41	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:23	05:11	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:18
22	07:07	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:49	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:20	16:19
24	07:05	06:29	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:29	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:36	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:49	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:13	05:35	06:06	06:37	07:11	06:48	07:11
	16:54	17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:12
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:46	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:17	16:23
30	07:00		06:33	05:45	05:15	05:15	05:37	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:30	17:44	16:17	16:24
31	06:59		06:32		05:15		05:38	06:10		07:15		07:12
	16:59		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	296	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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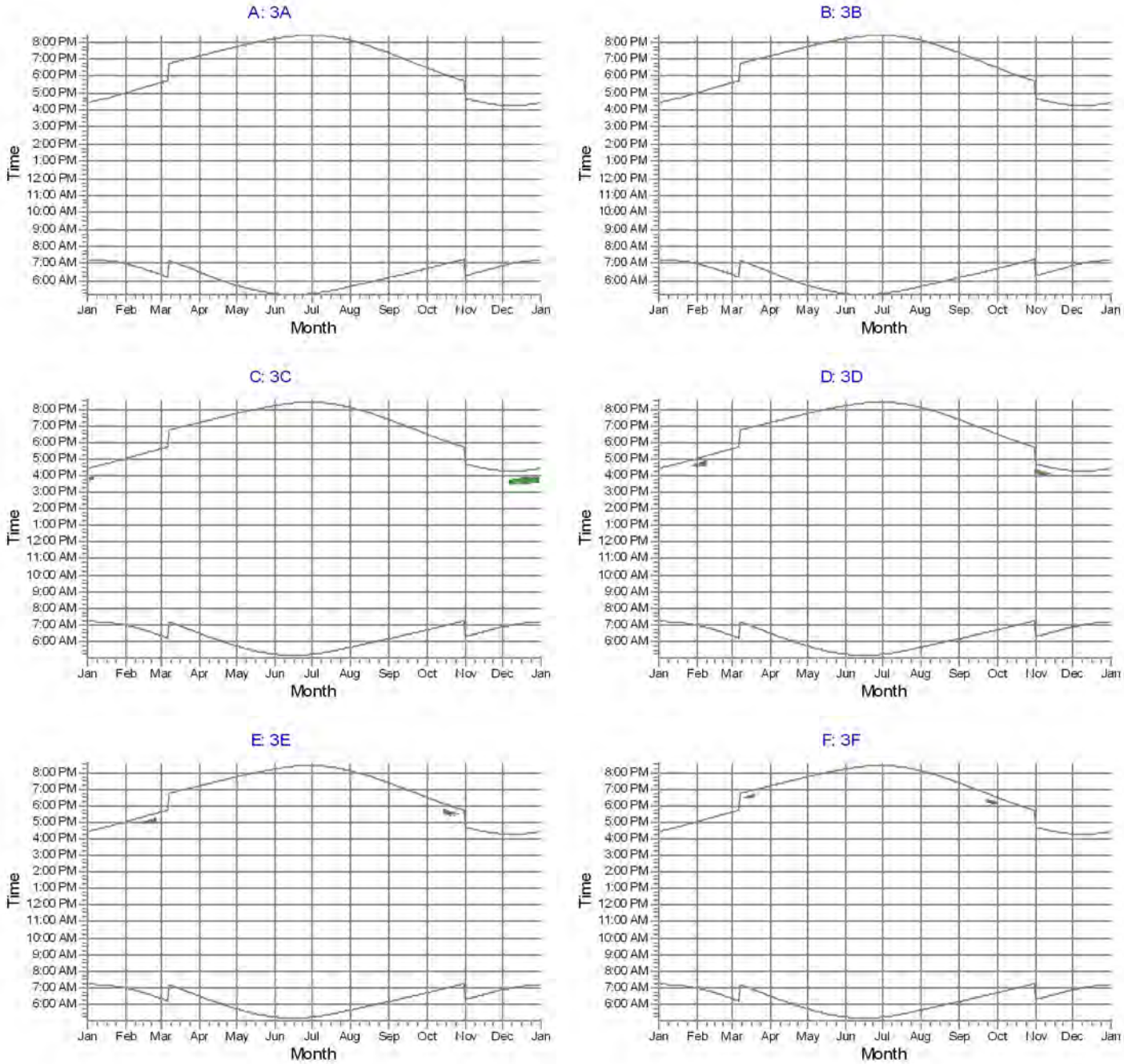
SHADOW - Calendar, graphical



WTGs

1: Tank Farm 4A

Project:

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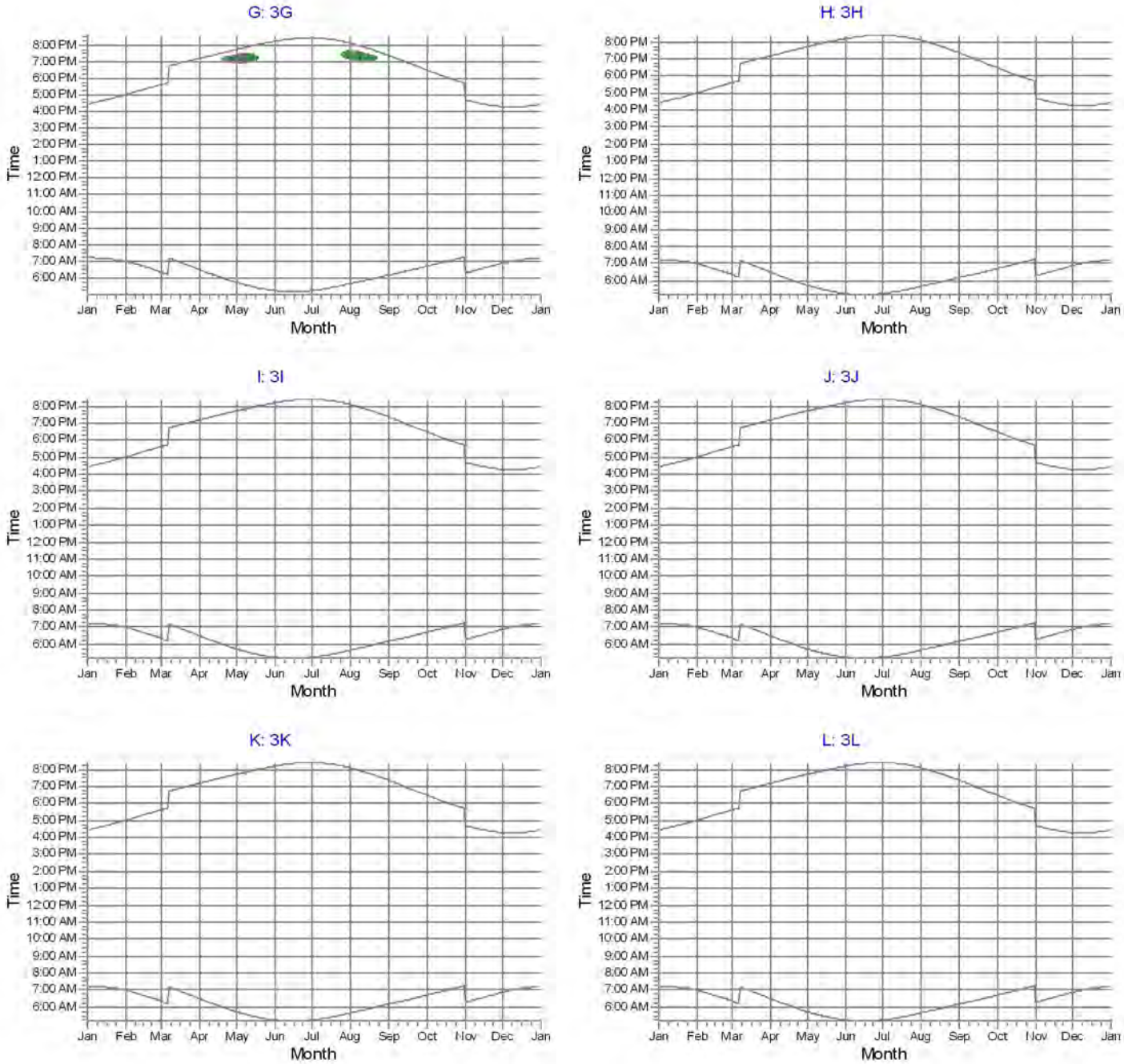
SHADOW - Calendar, graphical



WTGs

1: Tank Farm 4A

Project:
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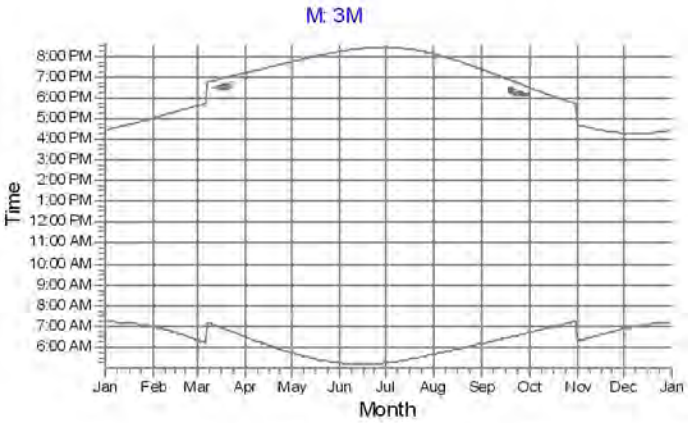
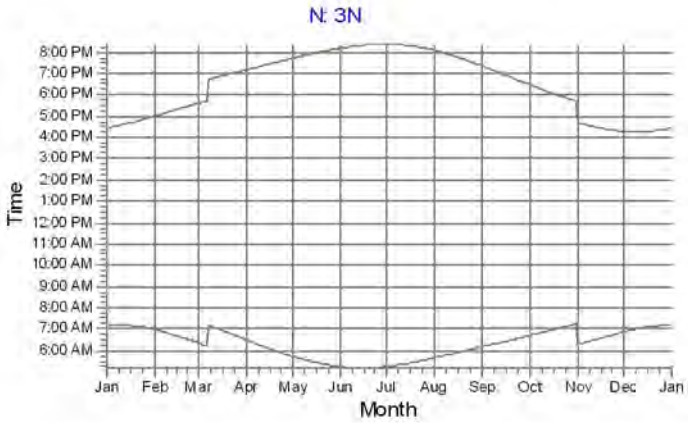
SHADOW - Calendar, graphical





WTGs

1: Tank Farm 4A

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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SHADOW - Calendar per WTG

WTG: 1 - Tank Farm 4A

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January		February		March		April		May		June	
1	07:12	15:35-15:51/16	06:58	16:30-16:36/6	06:22		06:30		05:44	18:52-19:19/27	05:14	
	16:26		17:01		17:35		19:10		19:43		20:12	
2	07:13	15:36-15:51/15	06:57	16:30-16:38/8	06:20		06:28		05:42	18:53-19:20/27	05:14	
	16:27		17:02		17:37		19:11		19:44		20:13	
3	07:13	15:38-15:51/13	06:56	16:31-16:39/8	06:18		06:27		05:41	18:53-19:22/29	05:13	
	16:28		17:03		17:38		19:12		19:45		20:14	
4	07:13	15:39-15:50/11	06:55	16:31-16:41/10	06:17		06:25		05:40	18:53-19:23/30	05:13	
	16:29		17:05		17:39		19:14		19:46		20:14	
5	07:13	15:41-15:49/8	06:54	16:31-16:41/10	06:15		06:23		05:38	18:52-19:23/31	05:13	
	16:29		17:06		17:40		19:15		19:47		20:15	
6	07:13	15:44-15:48/4	06:53	16:32-16:43/11	06:14		06:22		05:37	18:53-19:24/31	05:12	
	16:30		17:07		17:41		19:16		19:48		20:16	
7	07:13		06:52	16:33-16:44/11	06:12		06:20		05:36	18:53-19:25/32	05:12	
	16:31		17:08		17:42		19:17		19:49		20:16	
8	07:12		06:51	16:34-16:46/12	07:10		06:18		05:35	18:54-19:26/32	05:12	
	16:32		17:10		18:44		19:18		19:50		20:17	
9	07:12		06:50	16:36-16:46/10	07:09		06:17		05:34	18:54-19:27/33	05:12	
	16:33		17:11		18:45		19:19		19:51		20:18	
10	07:12		06:48		07:07		06:15		05:33	18:55-19:27/32	05:11	
	16:34		17:12		18:46		19:20		19:52		20:18	
11	07:12		06:47		07:06		06:13		05:31	18:56-19:26/30	05:11	
	16:36		17:13		18:47		19:21		19:53		20:19	
12	07:12		06:46		07:04	18:25-18:27/2	06:12		05:30	18:57-19:25/28	05:11	
	16:37		17:15		18:48		19:22		19:54		20:19	
13	07:11		06:45		07:02	18:23-18:27/4	06:10		05:29	18:57-19:24/27	05:11	
	16:38		17:16		18:49		19:23		19:56		20:20	
14	07:11		06:43		07:01	18:23-18:29/6	06:09		05:28	18:58-19:23/25	05:11	
	16:39		17:17		18:50		19:24		19:57		20:20	
15	07:10		06:42	16:54-16:56/2	06:59	18:22-18:30/8	06:07		05:27	19:00-19:22/22	05:11	
	16:40		17:18		18:52		19:25		19:58		20:21	
16	07:10		06:41	16:53-16:56/3	06:57	18:21-18:31/10	06:06		05:26	19:01-19:21/20	05:11	
	16:41		17:20		18:53		19:27		19:59		20:21	
17	07:10		06:39	16:53-16:58/5	06:55	18:21-18:33/12	06:04		05:25	19:02-19:19/17	05:11	
	16:42		17:21		18:54		19:28		20:00		20:22	
18	07:09		06:38	16:53-17:00/7	06:54	18:21-18:34/13	06:02		05:24	19:05-19:16/11	05:11	
	16:43		17:22		18:55		19:29		20:00		20:22	
19	07:08		06:37	16:52-17:00/8	06:52	18:21-18:34/13	06:01		05:23	19:09-19:12/3	05:11	
	16:45		17:23		18:56		19:30		20:00		20:22	
20	07:08		06:35	16:52-17:02/10	06:50	18:21-18:35/14	05:59	19:04-19:09/5	05:22		05:11	
	16:46		17:25		18:57		19:31		20:01		20:23	
21	07:07		06:34	16:52-17:03/11	06:49	18:22-18:37/15	05:58	19:01-19:09/8	05:22		05:12	
	16:47		17:26		18:58		19:32		20:02		20:23	
22	07:07		06:32	16:53-17:05/12	06:47	18:22-18:38/16	05:56	19:00-19:11/11	05:21		05:12	
	16:48		17:27		18:59		19:33		20:03		20:23	
23	07:06		06:31	16:53-17:06/13	06:45	18:23-18:39/16	05:55	18:58-19:11/13	05:20		05:12	
	16:49		17:28		19:00		19:34		20:04		20:23	
24	07:05		06:29	16:54-17:07/13	06:44	18:25-18:40/15	05:53	18:57-19:13/16	05:19		05:12	
	16:51		17:29		19:02		19:35		20:05		20:24	
25	07:04		06:28	16:55-17:08/13	06:42	18:28-18:36/8	05:52	18:56-19:13/17	05:19		05:13	
	16:52		17:31		19:03		19:36		20:06		20:24	
26	07:04		06:26	16:58-17:08/10	06:40		05:51	18:55-19:14/19	05:18		05:13	
	16:53		17:32		19:04		19:37		20:07		20:24	
27	07:03		06:25		06:39		05:49	18:55-19:16/21	05:17		05:13	
	16:54		17:33		19:05		19:39		20:08		20:24	
28	07:02		06:23		06:37		05:48	18:54-19:16/22	05:17		05:14	
	16:56		17:34		19:06		19:40		20:09		20:24	
29	07:01	16:31-16:32/1			06:35		05:46	18:53-19:17/24	05:16		05:14	
	16:57				19:07		19:41		20:10		20:24	
30	07:00	16:31-16:34/3			06:33		05:45	18:53-19:19/26	05:15		05:14	
	16:58				19:08		19:42		20:10		20:24	
31	06:59	16:30-16:35/5			06:32				05:15			
	16:59				19:09				20:11			
Potential sun hours	296		297		370		400		450		454	
Sum of minutes with flicker		76		193		152		182		487		0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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SHADOW - Calendar per WTG

WTG: 1 - Tank Farm 4A

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	July		August		September		October		November		December	
1	05:15		05:39	19:07-19:36/29	06:11		06:42	18:04-18:07/3	06:17	16:08-16:12/4	06:52	
	20:24		20:05		19:20		18:29		16:41		16:17	
2	05:15		05:40	19:05-19:36/31	06:12		06:43		06:18	16:05-16:15/10	06:53	
	20:24		20:04		19:18		18:27		16:40		16:16	
3	05:16		05:41	19:04-19:37/33	06:13		06:44		06:19	16:04-16:16/12	06:54	
	20:24		20:03		19:17		18:25		16:39		16:16	
4	05:17		05:42	19:04-19:37/33	06:14		06:45		06:20	16:02-16:14/12	06:55	
	20:23		20:02		19:15		18:24		16:38		16:16	
5	05:17		05:43	19:03-19:36/33	06:15		06:46		06:22	16:01-16:13/12	06:56	
	20:23		20:01		19:13		18:22		16:37		16:16	
6	05:18		05:44	19:03-19:35/32	06:16		06:47		06:23	16:02-16:12/10	06:57	15:30-15:33/3
	20:23		19:58		19:12		18:20		16:35		16:16	
7	05:18		05:45	19:02-19:33/31	06:17		06:48		06:24	16:01-16:11/10	06:58	15:28-15:36/8
	20:23		19:57		19:10		18:19		16:34		16:16	
8	05:19		05:46	19:02-19:32/30	06:18		06:49		06:25	16:00-16:09/9	06:59	15:27-15:38/11
	20:22		19:56		19:08		18:17		16:33		16:16	
9	05:20		05:47	19:02-19:31/29	06:19		06:50		06:26	16:01-16:09/8	07:00	15:27-15:40/13
	20:22		19:54		19:07		18:15		16:32		16:16	
10	05:20		05:48	19:01-19:30/29	06:20		06:51		06:28	16:01-16:07/6	07:01	15:27-15:41/14
	20:22		19:53		19:05		18:14		16:31		16:16	
11	05:21		05:49	19:01-19:29/28	06:21		06:52		06:29	16:01-16:06/5	07:02	15:25-15:41/16
	20:21		19:52		19:03		18:12		16:30		16:16	
12	05:22		05:50	19:01-19:27/26	06:22		06:54		06:30	16:01-16:05/4	07:02	15:26-15:42/16
	20:21		19:50		19:02		18:11		16:29		16:16	
13	05:23		05:52	19:01-19:26/25	06:23		06:55		06:31	16:03-16:04/1	07:03	15:26-15:43/17
	20:20		19:49		19:00		18:09		16:28		16:16	
14	05:23		05:53	19:01-19:25/24	06:24		06:56		06:32		07:04	15:26-15:44/18
	20:20		19:48		18:58		18:07		16:27		16:16	
15	05:24		05:54	19:01-19:24/23	06:25		06:57	17:32-17:37/5	06:34		07:05	15:27-15:45/18
	20:19		19:46		18:56		18:06		16:26		16:16	
16	05:25		05:55	19:02-19:22/20	06:26		06:58	17:28-17:40/12	06:35		07:06	15:26-15:45/19
	20:19		19:45		18:55		18:04		16:25		16:17	
17	05:26		05:56	19:02-19:21/19	06:27		06:59	17:27-17:40/13	06:36		07:06	15:27-15:46/19
	20:18		19:43		18:53		18:03		16:25		16:17	
18	05:27		05:57	19:03-19:19/16	06:28	18:17-18:22/5	07:00	17:25-17:38/13	06:37		07:07	15:26-15:46/20
	20:17		19:42		18:51		18:01		16:24		16:17	
19	05:27		05:58	19:03-19:18/15	06:29	18:12-18:26/14	07:01	17:24-17:37/13	06:38		07:07	15:27-15:47/20
	20:17		19:41		18:49		18:00		16:23		16:18	
20	05:28		05:59	19:04-19:17/13	06:30	18:10-18:25/15	07:03	17:23-17:35/12	06:40		07:08	15:28-15:48/20
	20:16		19:39		18:48		17:58		16:22		16:18	
21	05:29		06:00	19:05-19:15/10	06:31	18:08-18:24/16	07:04	17:22-17:33/11	06:41		07:09	15:28-15:48/20
	20:15		19:38		18:46		17:57		16:22		16:18	
22	05:30		06:01	19:06-19:14/8	06:32	18:06-18:22/16	07:05	17:23-17:32/9	06:42		07:09	15:29-15:49/20
	20:14		19:36		18:44		17:55		16:21		16:19	
23	05:31		06:02	19:08-19:12/4	06:33	18:05-18:20/15	07:06	17:22-17:31/9	06:43		07:10	15:29-15:49/20
	20:14		19:34		18:43		17:54		16:20		16:19	
24	05:32		06:03		06:34	18:04-18:18/14	07:07	17:22-17:29/7	06:44		07:10	15:29-15:49/20
	20:13		19:33		18:41		17:52		16:20		16:20	
25	05:33	19:17-19:25/8	06:04		06:35	18:03-18:16/13	07:08	17:22-17:27/5	06:45		07:10	15:30-15:50/20
	20:12		19:31		18:39		17:51		16:19		16:21	
26	05:34	19:14-19:28/14	06:05		06:36	18:03-18:15/12	07:10	17:24-17:27/3	06:47		07:11	15:31-15:50/19
	20:11		19:30		18:37		17:49		16:19		16:21	
27	05:35	19:12-19:30/18	06:06		06:37	18:03-18:13/10	07:11	17:24-17:25/1	06:48		07:11	15:31-15:50/19
	20:10		19:28		18:36		17:48		16:18		16:22	
28	05:36	19:11-19:32/21	06:07		06:39	18:02-18:11/9	07:12		06:49		07:12	15:32-15:51/19
	20:09		19:27		18:34		17:47		16:18		16:23	
29	05:37	19:10-19:33/23	06:08		06:40	18:03-18:10/7	07:13		06:50		07:12	15:33-15:51/18
	20:08		19:25		18:32		17:45		16:17		16:23	
30	05:37	19:09-19:34/25	06:09		06:41	18:04-18:09/5	07:14		06:51		07:12	15:34-15:51/17
	20:07		19:23		18:30		17:44		16:17		16:24	
31	05:38	19:08-19:35/27	06:10				07:15				07:12	15:34-15:51/17
	20:06		19:22				17:43				16:25	
Potential sun hours	461		429		375		344		296		286	
Sum of minutes with flicker		136		541		151		116		103		441

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

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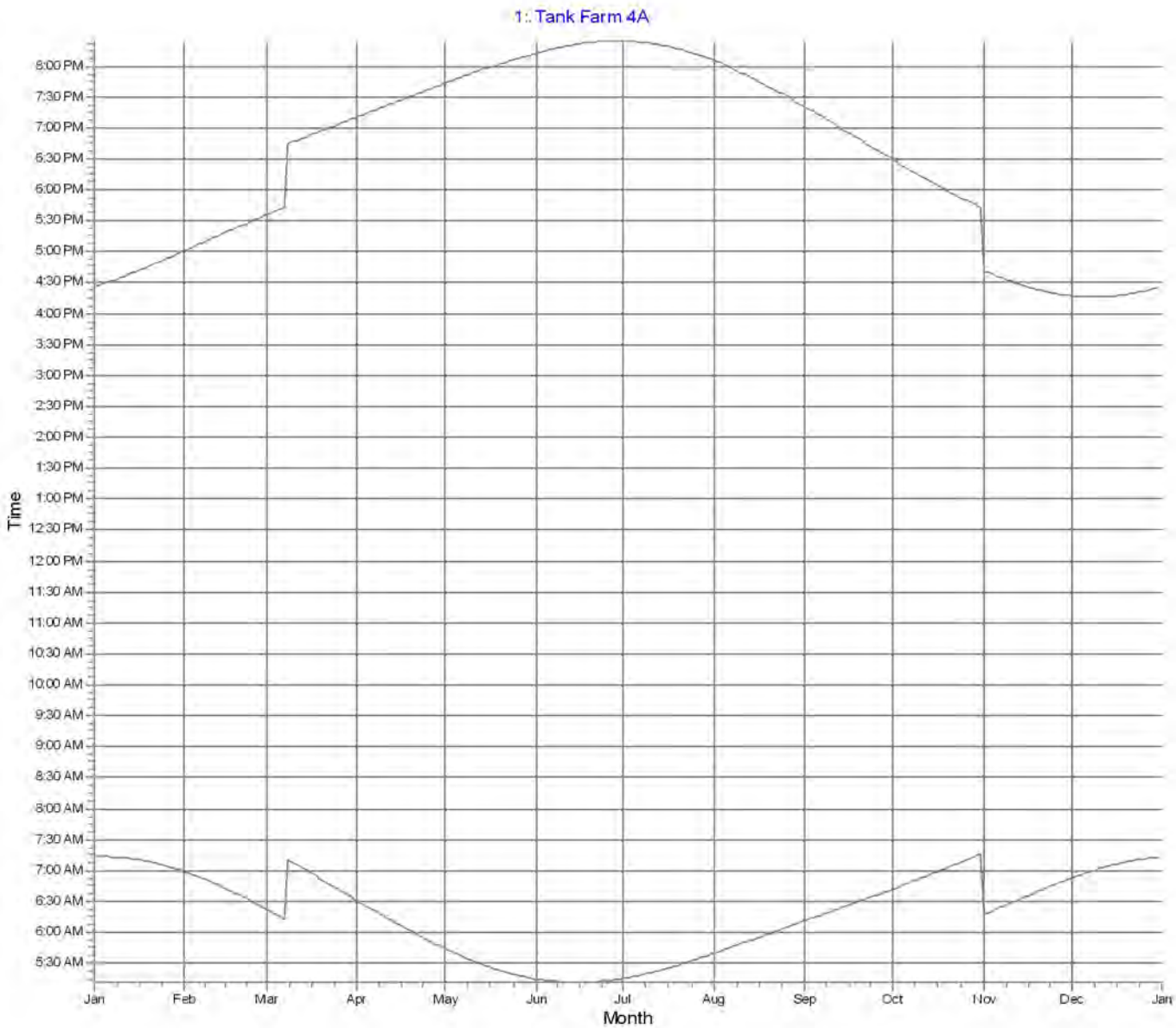
SHADOW - Calendar per WTG, graphical

WTG: 1 - Tank Farm 4A



WTGs

Project:
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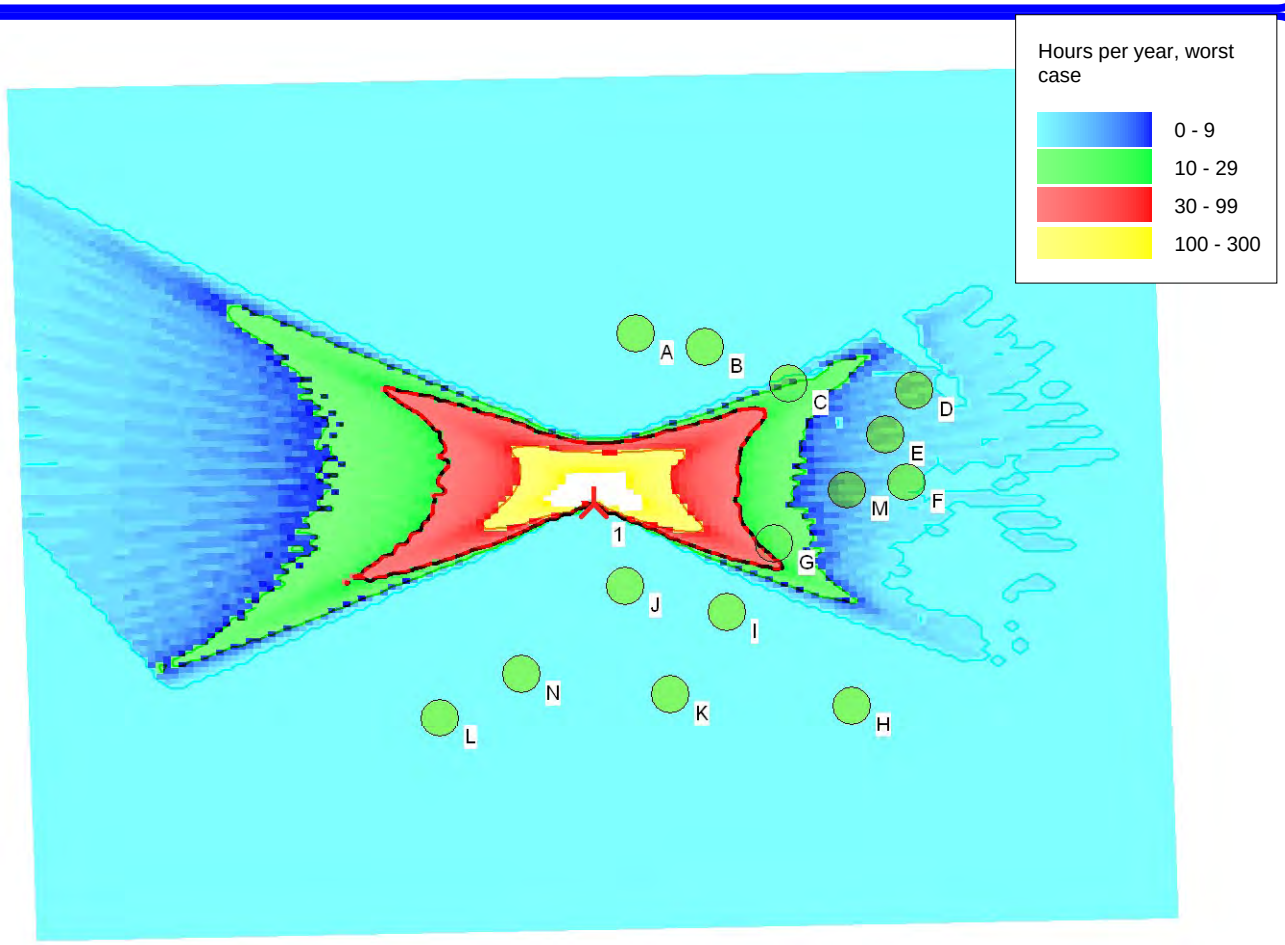
SHADOW - Map



0 250 500 750 1000m

Map: , Print scale 1:20,000, Map center Geo WGS 84 East: -71.294621° North: 41.564769°

New WTG
Shadow receptor

Isolines showing shadow in Hours per year, worst case

0 10 30 100

APPENDIX 4

WIND TURBINE SITE 4 TANK FARM 5

Figure A-4: Maximum predicted shadow flicker levels (hours per year) for a Power Wind 56-900 kW Model at Wind Turbine Site 4 (Tank Farm 5).

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SHADOW - Main Result

Assumptions for shadow calculations

Maximum distance for influence
Calculate only when more than 20 % of sun is covered by the blade
Please look in WTG table

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

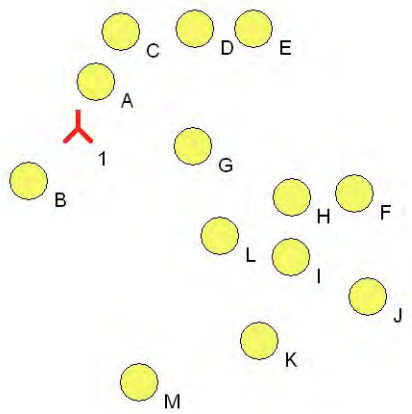
Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW
691	432	259	155	155	155	432	518	950	1,209	864	518

W	WNW	NW	NNW	Sum
432	604	691	691	8,756

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: Line object
Obstacles used in calculation
Eye height: 1.5 m
Grid resolution: 10 m



Scale 1:20,000
New WTG
Shadow receptor

WTGs

	Geo DD: WGS 84 Longitude	Latitude	Z [m]	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Shadow data Calculation distance [m]	RPM [RPM]
1	-71.304788° East	41.552236° North	12.6	Tank Farm 5	No	POWER MILLS	PowerWind G56-900 KW-900	900	56.0	59.0	2,000	0.0

Shadow receptor-Input

No.	Name	Geo DD: WGS 84 Longitude	Latitude	Z [m]	Width [m]	Height [m]	Height a.g.l. [m]	Degrees from south cw [°]	Slope of window [°]	Direction mode
A	4A	-71.304232° East	41.553688° North	16.6	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
B	4B	-71.306347° East	41.550538° North	18.3	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
C	4C	-71.303432° East	41.555270° North	21.2	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
D	4D	-71.301069° East	41.555388° North	28.4	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
E	4E	-71.299197° East	41.555368° North	36.4	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
F	4F	-71.296009° East	41.550159° North	47.6	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
G	4G	-71.301124° East	41.551640° North	30.1	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
H	4H	-71.297982° East	41.550032° North	43.4	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
I	4I	-71.298004° East	41.548119° North	48.1	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
J	4J	-71.295584° East	41.546880° North	53.2	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
K	4K	-71.299029° East	41.545467° North	50.8	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
L	4L	-71.300286° East	41.548813° North	32.5	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
M	4M	-71.302839° East	41.544147° North	29.7	1.0	1.0	1.0	-180.0	90.0	"Green house mode"

Project:

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SHADOW - Main Result

Calculation Results

Shadow receptor

		Shadow, worst case			Shadow, expected values
No.	Name	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	4A	48:34	56	1:05	17:52
B	4B	0:00	0	0:00	0:00
C	4C	0:00	0	0:00	0:00
D	4D	0:00	0	0:00	0:00
E	4E	13:04	48	0:19	3:59
F	4F	0:47	15	0:04	0:16
G	4G	36:06	68	0:43	11:55
H	4H	5:27	38	0:12	1:58
I	4I	0:00	0	0:00	0:00
J	4J	0:00	0	0:00	0:00
K	4K	0:00	0	0:00	0:00
L	4L	0:00	0	0:00	0:00
M	4M	0:00	0	0:00	0:00

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

No.	Name	Worst case [h/year]	Expected [h/year]
1	Tank Farm 5	103:56	36:01

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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Calculated:
2/24/2011 12:06 PM/2.7.473

SHADOW - Calendar

Shadow receptor: A - 4A

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January			February	March	April	May	June	July	August	September	October	November			December		
1	07:12		12:28 (1)	06:58	06:22	06:30	05:44	05:14	05:15	05:39	06:11	06:42	06:17			06:52		12:23 (1)
	16:26	61	13:29 (1)	17:01	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42			16:17	46	13:09 (1)
2	07:13		12:29 (1)	06:57	06:20	06:28	05:42	05:14	05:16	05:40	06:12	06:43	06:18			06:53		12:22 (1)
	16:27	60	13:29 (1)	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40			16:17	49	13:11 (1)
3	07:13		12:30 (1)	06:56	06:19	06:27	05:41	05:14	05:16	05:41	06:13	06:44	06:19			06:54		12:21 (1)
	16:28	59	13:29 (1)	17:03	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39			16:16	51	13:12 (1)
4	07:13		12:31 (1)	06:55	06:17	06:25	05:40	05:13	05:17	05:42	06:14	06:45	06:20			06:55		12:21 (1)
	16:29	58	13:29 (1)	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38			16:16	52	13:13 (1)
5	07:13		12:32 (1)	06:54	06:15	06:23	05:39	05:13	05:17	05:43	06:15	06:46	06:22			06:56		12:20 (1)
	16:30	57	13:29 (1)	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37			16:16	54	13:14 (1)
6	07:13		12:34 (1)	06:53	06:14	06:22	05:37	05:12	05:18	05:44	06:16	06:47	06:23			06:57		12:20 (1)
	16:30	55	13:29 (1)	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36			16:16	55	13:15 (1)
7	07:13		12:35 (1)	06:52	06:12	06:20	05:36	05:12	05:18	05:45	06:17	06:48	06:24			06:58		12:20 (1)
	16:31	54	13:29 (1)	17:08	17:42	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34			16:16	56	13:16 (1)
8	07:12		12:37 (1)	06:51	07:10	06:18	05:35	05:12	05:19	05:46	06:18	06:49	06:25			06:59		12:19 (1)
	16:32	52	13:29 (1)	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33			16:16	58	13:17 (1)
9	07:12		12:37 (1)	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26			07:00		12:19 (1)
	16:33	51	13:28 (1)	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32			16:16	59	13:18 (1)
10	07:12		12:39 (1)	06:48	07:07	06:15	05:33	05:12	05:20	05:49	06:20	06:51	06:28			07:01		12:19 (1)
	16:35	49	13:28 (1)	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31			16:16	60	13:19 (1)
11	07:12		12:41 (1)	06:47	07:06	06:14	05:31	05:11	05:21	05:50	06:21	06:52	06:29			07:02		12:18 (1)
	16:36	46	13:27 (1)	17:13	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30			16:16	61	13:19 (1)
12	07:12		12:42 (1)	06:46	07:04	06:12	05:30	05:11	05:22	05:51	06:22	06:54	06:30			07:02		12:19 (1)
	16:37	44	13:26 (1)	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29			16:16	61	13:20 (1)
13	07:11		12:45 (1)	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31			07:03		12:19 (1)
	16:38	40	13:25 (1)	17:16	18:49	19:23	19:56	20:20	20:20	19:49	19:00	18:09	16:28			16:16	62	13:21 (1)
14	07:11		12:47 (1)	06:43	07:01	06:09	05:28	05:11	05:23	05:53	06:24	06:56	06:32			07:04		12:19 (1)
	16:39	38	13:25 (1)	17:17	18:50	19:24	19:57	20:20	20:20	19:48	18:58	18:07	16:27			16:16	63	13:22 (1)
15	07:10		12:49 (1)	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34			07:05		12:20 (1)
	16:40	34	13:23 (1)	17:18	18:52	19:26	19:58	20:21	20:19	19:46	18:56	18:06	16:26			16:16	63	13:23 (1)
16	07:10		12:53 (1)	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35			07:06		12:19 (1)
	16:41	28	13:21 (1)	17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:26			16:17	64	13:23 (1)
17	07:10		12:56 (1)	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36			07:06		12:20 (1)
	16:42	22	13:18 (1)	17:21	18:54	19:28	20:00	20:22	20:18	19:43	18:53	18:03	16:25			16:17	64	13:24 (1)
18	07:09		13:01 (1)	06:38	06:54	06:02	05:24	05:11	05:27	05:57	06:28	07:00	06:37			07:07		12:20 (1)
	16:43	13	13:14 (1)	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24			16:17	64	13:24 (1)
19	07:08			06:37	06:52	06:01	05:23	05:11	05:27	05:58	06:29	07:01	06:38			07:07		12:20 (1)
	16:45			17:23	18:56	19:30	20:01	20:22	20:17	19:41	18:49	18:00	16:23			16:18	65	13:25 (1)
20	07:08			06:35	06:50	05:59	05:23	05:11	05:28	05:59	06:30	07:03	06:40			07:08		12:21 (1)
	16:46			17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22			16:18	65	13:26 (1)
21	07:07			06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41			07:09		12:21 (1)
	16:47			17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22			16:18	65	13:26 (1)
22	07:07			06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42			07:09		12:22 (1)
	16:48			17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21			16:19	65	13:27 (1)
23	07:06			06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43			07:10		12:22 (1)
	16:49			17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:20			16:20	65	13:27 (1)
24	07:05			06:29	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44		12:39 (1)	07:10		12:22 (1)
	16:51			17:30	19:02	19:35	20:05	20:24	20:13	19:33	18:41	17:52	16:20	13	12:52 (1)	16:20	65	13:27 (1)
25	07:05			06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45		12:34 (1)	07:10		12:23 (1)
	16:52			17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	22	12:56 (1)	16:21	65	13:28 (1)
26	07:04			06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:36	07:10	06:47		12:31 (1)	07:11		12:24 (1)
	16:53			17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:49	16:19	28	12:59 (1)	16:21	64	13:28 (1)
27	07:03			06:25	06:39	05:49	05:17	05:13	05:35	06:06	06:38	07:11	06:48		12:29 (1)	07:11		12:24 (1)
	16:54			17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:18	33	13:02 (1)	16:22	64	13:28 (1)
28	07:02			06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49		12:26 (1)	07:12		12:26 (1)
	16:56			17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	38	13:04 (1)	16:23	63	13:29 (1)
29	07:01				06:35	05:46	05:16	05:14	05:37	06:08	06:40	07:13	06:50		12:26 (1)	07:12		12:26 (1)
	16:57				19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:17	40	13:06 (1)	16:23	63	13:29 (1)
30	07:00				06:33	05:45	05:15	05:15	05:38	06:09	06:41	07:14	06:51		12:24 (1)	07:12		12:27 (1)
	16:58				19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	44	13:08 (1)	16:24	62	13:29 (1)
31	06:59				06:32		05:15		05:39	06:10		07:15				07:12		12:27 (1)
	17:00				19:09		20:11		20:06	19:22		17:43				16:25	62	13:29 (1)
Potential sun hours	296			297	370	400	450	454	461	429	375	344	297			286		
Total, worst case		821												218			1875	
Sun reduction		0.56												0.50			0.52	
Oper. time red.		1.00												1.00			1.00	
Wind dir. red.		0.70												0.70			0.70	
Total reduction		0.39												0.35			0.36	
Total, real		319												76			677	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

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Calculated:
2/24/2011 12:06 PM/2.7.473

SHADOW - Calendar

Shadow receptor: B - 4B

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:14	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:16	05:40	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:41	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:42	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:39	05:13	05:17	05:43	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:12	05:18	05:44	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36	16:16
7	07:13	06:52	06:12	06:20	05:36	05:12	05:18	05:45	06:17	06:48	06:24	06:58
	16:31	17:08	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59
	16:32	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:20	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:31	05:11	05:21	05:50	06:21	06:52	06:29	07:02
	16:36	17:13	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:12	06:46	07:04	06:12	05:30	05:11	05:22	05:51	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:56	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:23	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:50	19:24	19:57	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:26	19:58	20:21	20:19	19:46	18:56	18:06	16:26	16:16
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:06
	16:41	17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:10	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	20:00	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:02	05:24	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:43	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:23	05:11	05:27	05:58	06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30	20:01	20:22	20:17	19:41	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:23	05:11	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:20	16:20
24	07:05	06:29	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:05	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:36	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:49	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:13	05:35	06:06	06:38	07:11	06:48	07:11
	16:54	17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:12
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:46	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:18	16:23
30	07:00		06:33	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:15		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
2/24/2011 12:06 PM / 3

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 12:06 PM/2.7.473

SHADOW - Calendar

Shadow receptor: C - 4C

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:14	05:15	05:39	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:16	05:40	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:41	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:42	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:39	05:13	05:17	05:43	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:12	05:18	05:44	06:16	06:47	06:23	06:57
	16:30	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36	16:16
7	07:13	06:52	06:12	06:20	05:36	05:12	05:18	05:45	06:17	06:48	06:24	06:58
	16:31	17:08	17:42	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18	05:35	05:12	05:19	05:46	06:18	06:49	06:25	06:59
	16:32	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:47	06:19	06:50	06:26	07:00
	16:33	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:11	05:20	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:31	05:11	05:21	05:50	06:21	06:52	06:29	07:02
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12	07:12	06:46	07:04	06:12	05:30	05:11	05:22	05:51	06:22	06:54	06:30	07:02
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13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:56	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:23	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:50	19:24	19:57	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:18	18:52	19:25	19:58	20:21	20:19	19:46	18:56	18:06	16:26	16:16
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:06
	16:41	17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:10	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	20:00	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:02	05:24	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:43	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:23	05:11	05:27	05:58	06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30	20:01	20:22	20:17	19:41	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:23	05:11	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:18
22	07:07	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:49	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:20	16:19
24	07:05	06:29	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:24	20:13	19:33	18:41	17:52	16:20	16:20
25	07:05	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:36	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:49	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:13	05:35	06:06	06:38	07:11	06:48	07:11
	16:54	17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:12
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:46	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:17	16:23
30	07:00		06:33	05:45	05:15	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:15		07:12
	16:59		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 12:06 PM / 4

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 12:06 PM/2.7.473

SHADOW - Calendar

Shadow receptor: D - 4D

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:14	05:15	05:39	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:41	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:16	05:40	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:16
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:41	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:42	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:39	05:13	05:17	05:43	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:12	05:18	05:44	06:16	06:47	06:23	06:57
	16:30	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:35	16:16
7	07:13	06:52	06:12	06:20	05:36	05:12	05:18	05:45	06:17	06:48	06:24	06:58
	16:31	17:08	17:42	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18	05:35	05:12	05:19	05:46	06:18	06:49	06:25	06:59
	16:32	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:47	06:19	06:50	06:26	07:00
	16:33	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:11	05:20	05:48	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:31	05:11	05:21	05:50	06:21	06:52	06:29	07:02
	16:36	17:13	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:12	06:46	07:04	06:12	05:30	05:11	05:22	05:51	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:56	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:23	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:50	19:24	19:57	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:18	18:52	19:25	19:58	20:21	20:19	19:46	18:56	18:06	16:26	16:16
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:06
	16:41	17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:10	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	20:00	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:02	05:24	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:43	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:23	05:11	05:27	05:58	06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30	20:00	20:22	20:17	19:41	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:23	05:11	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:18
22	07:07	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:49	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:20	16:19
24	07:05	06:29	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:36	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:49	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:13	05:35	06:06	06:37	07:11	06:48	07:11
	16:54	17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:12
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:46	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:17	16:23
30	07:00		06:33	05:45	05:15	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:38	06:10		07:15		07:12
	16:59		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 12:06 PM / 5

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Calculated:
2/24/2011 12:06 PM/2.7.473

SHADOW - Calendar

Shadow receptor: E - 4E

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January			February	March	April	May	June	July	August	September	October	November			December		
1	07:12		15:41 (1)	06:58	06:22	06:30	05:44	05:14	05:15	05:39	06:11	06:42	06:17			06:52		15:32 (1)
	16:26	18	15:59 (1)	17:01	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:41			16:17	14	15:46 (1)
2	07:13		15:42 (1)	06:57	06:20	06:28	05:42	05:14	05:16	05:40	06:12	06:43	06:18			06:53		15:32 (1)
	16:27	18	16:00 (1)	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40			16:16	15	15:47 (1)
3	07:13		15:42 (1)	06:56	06:18	06:27	05:41	05:14	05:16	05:41	06:13	06:44	06:19			06:54		15:31 (1)
	16:28	19	16:01 (1)	17:03	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39			16:16	17	15:48 (1)
4	07:13		15:43 (1)	06:55	06:17	06:25	05:40	05:13	05:17	05:42	06:14	06:45	06:20			06:55		15:31 (1)
	16:29	19	16:02 (1)	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38			16:16	18	15:49 (1)
5	07:13		15:44 (1)	06:54	06:15	06:23	05:38	05:13	05:17	05:43	06:15	06:46	06:22			06:56		15:31 (1)
	16:30	19	16:03 (1)	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37			16:16	19	15:50 (1)
6	07:13		15:45 (1)	06:53	06:14	06:22	05:37	05:12	05:18	05:44	06:16	06:47	06:23			06:57		15:31 (1)
	16:30	19	16:04 (1)	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:35			16:16	19	15:50 (1)
7	07:13		15:46 (1)	06:52	06:12	06:20	05:36	05:12	05:18	05:45	06:17	06:48	06:24			06:58		15:31 (1)
	16:31	19	16:05 (1)	17:08	17:42	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34			16:16	19	15:50 (1)
8	07:12		15:47 (1)	06:51	07:10	06:18	05:35	05:12	05:19	05:46	06:18	06:49	06:25			06:59		15:31 (1)
	16:32	18	16:05 (1)	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33			16:16	19	15:50 (1)
9	07:12		15:47 (1)	06:50	07:09	06:17	05:34	05:12	05:20	05:47	06:19	06:50	06:26			07:00		15:31 (1)
	16:33	17	16:04 (1)	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32			16:16	19	15:50 (1)
10	07:12		15:49 (1)	06:48	07:07	06:15	05:33	05:11	05:20	05:48	06:20	06:51	06:28			07:01		15:32 (1)
	16:34	15	16:04 (1)	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31			16:16	18	15:50 (1)
11	07:12		15:50 (1)	06:47	07:06	06:14	05:31	05:11	05:21	05:50	06:21	06:52	06:29			07:02		15:31 (1)
	16:36	14	16:04 (1)	17:13	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30			16:16	18	15:49 (1)
12	07:12		15:51 (1)	06:46	07:04	06:12	05:30	05:11	05:22	05:51	06:22	06:54	06:30			07:02		15:32 (1)
	16:37	12	16:03 (1)	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29			16:16	18	15:50 (1)
13	07:11		15:53 (1)	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31			07:03		15:32 (1)
	16:38	9	16:02 (1)	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28			16:16	18	15:50 (1)
14	07:11		15:57 (1)	06:43	07:01	06:09	05:28	05:11	05:23	05:53	06:24	06:56	06:32			07:04		15:33 (1)
	16:39	3	16:00 (1)	17:17	18:50	19:24	19:57	20:20	20:20	19:48	18:58	18:07	16:27			16:16	17	15:50 (1)
15	07:10			06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34			07:05		15:33 (1)
	16:40			17:18	18:52	19:25	19:58	20:21	20:19	19:46	18:56	18:06	16:26			16:16	18	15:51 (1)
16	07:10			06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35			07:06		15:33 (1)
	16:41			17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:26			16:17	17	15:50 (1)
17	07:10			06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36			07:06		15:34 (1)
	16:42			17:21	18:54	19:28	20:00	20:22	20:18	19:43	18:53	18:03	16:25			16:17	17	15:51 (1)
18	07:09			06:38	06:54	06:02	05:24	05:11	05:27	05:57	06:28	07:00	06:37			07:07		15:34 (1)
	16:43			17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24			16:17	17	15:51 (1)
19	07:08			06:37	06:52	06:01	05:23	05:11	05:27	05:58	06:29	07:01	06:38			07:07		15:34 (1)
	16:45			17:23	18:56	19:30	20:00	20:22	20:17	19:41	18:49	18:00	16:23			16:18	17	15:51 (1)
20	07:08			06:35	06:50	05:59	05:23	05:11	05:28	05:59	06:30	07:03	06:40			07:08		15:35 (1)
	16:46			17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22			16:18	17	15:52 (1)
21	07:07			06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41			07:09		15:35 (1)
	16:47			17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22			16:18	17	15:52 (1)
22	07:07			06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42			07:09		15:36 (1)
	16:48			17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21			16:19	17	15:53 (1)
23	07:06			06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43			07:10		15:36 (1)
	16:49			17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:20			16:19	17	15:53 (1)
24	07:05			06:29	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44			07:10		15:36 (1)
	16:51			17:29	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20			16:20	17	15:53 (1)
25	07:04			06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45			07:10		15:38 (1)
	16:52			17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19			16:21	17	15:55 (1)
26	07:04			06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:36	07:10	06:47			07:11		15:38 (1)
	16:53			17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:49	16:19			16:21	17	15:55 (1)
27	07:03			06:25	06:39	05:49	05:17	05:13	05:35	06:06	06:37	07:11	06:48			07:11		15:38 (1)
	16:54			17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:18			16:22	17	15:55 (1)
28	07:02			06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49		15:36 (1)	07:12		15:39 (1)
	16:56			17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	3	15:39 (1)	16:23	18	15:57 (1)
29	07:01				06:35	05:46	05:16	05:14	05:37	06:08	06:40	07:13	06:50		15:34 (1)	07:12		15:40 (1)
	16:57				19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:17	9	15:43 (1)	16:23	17	15:57 (1)
30	07:00				06:33	05:45	05:15	05:15	05:38	06:09	06:41	07:14	06:51		15:33 (1)	07:12		15:40 (1)
	16:58				19:08	19:42	20:10	20:24	20:07	19:23	18:30	17:44	16:17	12	15:45 (1)	16:24	18	15:58 (1)
31	06:59				06:32		05:15		05:38	06:10		07:15				07:12		15:40 (1)
	16:59				19:09		20:11		20:06	19:22		17:43				16:25	18	15:58 (1)
Potential sun hours	296			297	370	400	450	454	461	429	375	344	297			286		
Total, worst case		219												24			541	
Sun reduction		0.56												0.50			0.52	
Oper. time red.		1.00												1.00			1.00	
Wind dir. red.		0.58												0.58			0.58	
Total reduction		0.32												0.29			0.30	
Total, real		71												7			162	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 12:06 PM / 6

Licensed user:
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US-75074-5977 Plano TX
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Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 12:06 PM/2.7.473

SHADOW - Calendar

Shadow receptor: F - 4F

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April			May			June	July	August			September	October	November	December
1	07:12	06:58	06:22	06:30			05:44		19:15 (1)	05:14	05:15	05:39			06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10			19:43	4	19:19 (1)	20:12	20:24	20:05			19:20	18:29	16:41	16:17
2	07:13	06:57	06:20	06:28			05:42		19:16 (1)	05:14	05:16	05:40			06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11			19:44	4	19:20 (1)	20:13	20:24	20:04			19:18	18:27	16:40	16:16
3	07:13	06:56	06:18	06:27			05:41		19:18 (1)	05:14	05:16	05:41			06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12			19:45	4	19:22 (1)	20:14	20:24	20:03			19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25			05:40		19:19 (1)	05:13	05:17	05:42			06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14			19:46	4	19:23 (1)	20:14	20:23	20:02			19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23			05:38		19:21 (1)	05:13	05:17	05:43			06:15	06:46	06:21	06:56
	16:30	17:06	17:40	19:15			19:47	2	19:23 (1)	20:15	20:23	20:01			19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22			05:37			05:12	05:18	05:44			06:16	06:47	06:23	06:57
	16:30	17:07	17:41	19:16			19:48			20:16	20:23	19:58			19:12	18:20	16:35	16:16
7	07:12	06:52	06:12	06:20			05:36			05:12	05:18	05:45			06:17	06:48	06:24	06:58
	16:31	17:08	17:42	19:17			19:49			20:16	20:23	19:57			19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18			05:35			05:12	05:19	05:46		19:30 (1)	06:18	06:49	06:25	06:59
	16:32	17:10	18:44	19:18			19:50			20:17	20:22	19:56	2	19:32 (1)	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17			05:34			05:12	05:20	05:47		19:27 (1)	06:19	06:50	06:26	07:00
	16:33	17:11	18:45	19:19			19:51			20:18	20:22	19:54	4	19:31 (1)	19:07	18:15	16:32	16:16
10	07:12	06:48	07:07	06:15			05:33			05:11	05:20	05:48		19:26 (1)	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20			19:52			20:18	20:22	19:53	4	19:30 (1)	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14			05:31			05:11	05:21	05:50		19:25 (1)	06:21	06:52	06:29	07:02
	16:36	17:13	18:47	19:21			19:53			20:19	20:21	19:52	4	19:29 (1)	19:03	18:12	16:30	16:16
12	07:11	06:46	07:04	06:12			05:30			05:11	05:22	05:51		19:24 (1)	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22			19:54			20:19	20:21	19:50	3	19:27 (1)	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10			05:29			05:11	05:23	05:52		19:23 (1)	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23			19:55			20:20	20:20	19:49	3	19:26 (1)	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09			05:28			05:11	05:23	05:53		19:23 (1)	06:24	06:56	06:32	07:04
	16:39	17:17	18:50	19:24			19:56			20:20	20:20	19:48	2	19:25 (1)	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07			05:27			05:11	05:24	05:54			06:25	06:57	06:34	07:05
	16:40	17:18	18:52	19:25			19:57			20:21	20:19	19:46			18:56	18:06	16:26	16:16
16	07:10	06:41	06:57	06:06			05:26			05:11	05:25	05:55			06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27			19:58			20:21	20:19	19:45			18:55	18:04	16:26	16:17
17	07:10	06:39	06:55	06:04			05:25			05:11	05:26	05:56			06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28			19:59			20:22	20:18	19:43			18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:02			05:24			05:11	05:27	05:57			06:28	07:00	06:37	07:07
	16:43	17:22	18:55	19:29			20:00			20:22	20:17	19:42			18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01			05:23			05:11	05:27	05:58			06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30			20:00			20:22	20:17	19:40			18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59			05:23			05:11	05:28	05:59			06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31			20:01			20:23	20:16	19:39			18:48	17:58	16:22	16:18
21	07:07	06:34	06:49	05:58			05:22			05:12	05:29	06:00			06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32			20:02			20:23	20:15	19:37			18:46	17:57	16:22	16:18
22	07:07	06:32	06:47	05:56			05:21			05:12	05:30	06:01			06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33			20:03			20:23	20:14	19:36			18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55			05:20			05:12	05:31	06:02			06:33	07:06	06:43	07:10
	16:49	17:28	19:00	19:34			20:04			20:23	20:14	19:34			18:43	17:54	16:20	16:19
24	07:05	06:29	06:44	05:53			05:19			05:12	05:32	06:03			06:34	07:07	06:44	07:10
	16:51	17:29	19:02	19:35			20:05			20:23	20:13	19:33			18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52			05:19			05:13	05:33	06:04			06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36			20:06			20:24	20:12	19:31			18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51			05:18			05:13	05:34	06:05			06:36	07:10	06:47	07:11
	16:53	17:32	19:04	19:37			20:07			20:24	20:11	19:30			18:37	17:49	16:19	16:21
27	07:03	06:25	06:39	05:49			05:17			05:13	05:35	06:06			06:37	07:11	06:48	07:11
	16:54	17:33	19:05	19:38			20:08			20:24	20:10	19:28			18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48		19:15 (1)	05:17			05:14	05:36	06:07			06:39	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	2	19:16 (1)	20:09			20:24	20:09	19:27			18:34	17:47	16:18	16:23
29	07:01		06:35	05:46		19:15 (1)	05:16			05:14	05:37	06:08			06:40	07:13	06:50	07:12
	16:57		19:07	19:41	2	19:17 (1)	20:10			20:24	20:08	19:25			18:32	17:45	16:17	16:23
30	07:00		06:33	05:45		19:16 (1)	05:15			05:15	05:38	06:09			06:41	07:14	06:51	07:12
	16:58		19:08	19:42	3	19:19 (1)	20:10			20:24	20:07	19:23			18:30	17:44	16:17	16:24
31	06:59		06:32				05:15				05:38	06:10				07:15		07:12
	16:59		19:09				20:11				20:06	19:22				17:43		16:25
Potential sun hours	296	297	370	400			450			454	461	429			375	344	297	286
Total, worst case					7			18					22					
Sun reduction					0.57			0.58					0.62					
Oper. time red.					1.00			1.00					1.00					
Wind dir. red.					0.58			0.58					0.58					
Total reduction					0.33			0.33					0.36					
Total, real					2			6					8					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
2/24/2011 12:06 PM / 7

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 12:06 PM/2.7.473

SHADOW - Calendar

Shadow receptor: G - 4G

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April			May			June	July			August			September	October	November	December
1	07:12	06:58	06:22	06:30			05:44		18:31 (1)	05:14	05:15			05:39		18:49 (1)	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10			19:43	42	19:13 (1)	20:12	20:24			20:05	26	19:15 (1)	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:28			05:42		18:31 (1)	05:14	05:16			05:40		18:48 (1)	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11			19:44	42	19:13 (1)	20:13	20:24			20:04	29	19:17 (1)	19:18	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27			05:41		18:32 (1)	05:14	05:16			05:41		18:46 (1)	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12			19:45	40	19:12 (1)	20:14	20:24			20:03	31	19:17 (1)	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25			05:40		18:33 (1)	05:13	05:17			05:42		18:45 (1)	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14			19:46	39	19:12 (1)	20:14	20:23			20:02	33	19:18 (1)	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23			05:39		18:32 (1)	05:13	05:17			05:43		18:44 (1)	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15			19:47	39	19:11 (1)	20:15	20:23			20:01	35	19:19 (1)	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22			05:37		18:33 (1)	05:12	05:18			05:44		18:43 (1)	06:16	06:47	06:23	06:57
	16:30	17:07	17:41	19:16			19:48	37	19:10 (1)	20:16	20:23			19:58	36	19:19 (1)	19:12	18:20	16:36	16:16
7	07:13	06:52	06:12	06:20			05:36		18:34 (1)	05:12	05:18			05:45		18:42 (1)	06:17	06:48	06:24	06:58
	16:31	17:08	17:42	19:17			19:49	35	19:09 (1)	20:16	20:23			19:57	38	19:20 (1)	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18			05:35		18:35 (1)	05:12	05:19			05:46		18:42 (1)	06:18	06:49	06:25	06:59
	16:32	17:10	18:44	19:18			19:50	34	19:09 (1)	20:17	20:22			19:56	38	19:20 (1)	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17			05:34		18:36 (1)	05:12	05:20			05:47		18:41 (1)	06:19	06:50	06:26	07:00
	16:33	17:11	18:45	19:19			19:51	32	19:08 (1)	20:18	20:22			19:54	40	19:21 (1)	19:07	18:15	16:32	16:16
10	07:12	06:48	07:07	06:15			05:33		18:37 (1)	05:11	05:20			05:49		18:41 (1)	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20			19:52	30	19:07 (1)	20:18	20:22			19:53	40	19:21 (1)	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14			05:31		18:38 (1)	05:11	05:21			05:50		18:40 (1)	06:21	06:52	06:29	07:02
	16:36	17:13	18:47	19:21			19:53	28	19:06 (1)	20:19	20:21			19:52	41	19:21 (1)	19:03	18:12	16:30	16:16
12	07:12	06:46	07:04	06:12			05:30		18:39 (1)	05:11	05:22			05:51		18:40 (1)	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22			19:54	25	19:04 (1)	20:19	20:21			19:50	42	19:22 (1)	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10		18:49 (1)	05:29		18:41 (1)	05:11	05:23			05:52		18:39 (1)	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	12	19:01 (1)	19:55	22	19:03 (1)	20:20	20:20			19:49	43	19:22 (1)	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09		18:46 (1)	05:28		18:43 (1)	05:11	05:23			05:53		18:39 (1)	06:24	06:56	06:32	07:04
	16:39	17:17	18:50	19:24	16	19:02 (1)	19:57	18	19:01 (1)	20:20	20:20			19:48	43	19:22 (1)	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07		18:43 (1)	05:27		18:45 (1)	05:11	05:24			05:54		18:39 (1)	06:25	06:57	06:34	07:05
	16:40	17:18	18:52	19:25	20	19:03 (1)	19:58	14	18:59 (1)	20:21	20:19			19:46	42	19:21 (1)	18:56	18:06	16:26	16:16
16	07:10	06:41	06:57	06:06		18:41 (1)	05:26		18:49 (1)	05:11	05:25			05:55		18:38 (1)	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	23	19:04 (1)	19:59	6	18:55 (1)	20:21	20:19			19:45	43	19:21 (1)	18:55	18:04	16:26	16:17
17	07:10	06:39	06:56	06:04		18:39 (1)	05:25			05:11	05:26			05:56		18:38 (1)	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	26	19:05 (1)	20:00			20:22	20:18			19:43	43	19:21 (1)	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:02		18:38 (1)	05:24			05:11	05:27			05:57		18:38 (1)	06:28	07:00	06:37	07:07
	16:43	17:22	18:55	19:29	29	19:07 (1)	20:00			20:22	20:17			19:42	41	19:19 (1)	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01		18:36 (1)	05:23			05:11	05:27			05:58		18:38 (1)	06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30	31	19:07 (1)	20:00			20:22	20:17			19:41	40	19:18 (1)	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59		18:36 (1)	05:23			05:11	05:28			05:59		18:39 (1)	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	33	19:09 (1)	20:01			20:23	20:16			19:39	38	19:17 (1)	18:48	17:58	16:22	16:18
21	07:07	06:34	06:49	05:58		18:34 (1)	05:22			05:12	05:29			06:00		18:39 (1)	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	35	19:09 (1)	20:02			20:23	20:15			19:38	36	19:15 (1)	18:46	17:57	16:22	16:18
22	07:07	06:32	06:47	05:56		18:34 (1)	05:21			05:12	05:30			06:01		18:39 (1)	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	37	19:11 (1)	20:03			20:23	20:14			19:36	35	19:14 (1)	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55		18:33 (1)	05:20			05:12	05:31			06:02		18:40 (1)	06:33	07:06	06:43	07:10
	16:49	17:28	19:00	19:34	38	19:11 (1)	20:04			20:23	20:14			19:34	32	19:12 (1)	18:43	17:54	16:20	16:19
24	07:05	06:29	06:44	05:53		18:33 (1)	05:19			05:12	05:32			06:03		18:40 (1)	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	39	19:12 (1)	20:05			20:23	20:13			19:33	31	19:11 (1)	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52		18:32 (1)	05:19			05:13	05:33			06:04		18:41 (1)	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	41	19:13 (1)	20:06			20:24	20:12			19:31	28	19:09 (1)	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51		18:32 (1)	05:18			05:13	05:34			06:05		18:42 (1)	06:36	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	42	19:14 (1)	20:07			20:24	20:11			19:30	26	19:08 (1)	18:37	17:49	16:19	16:21
27	07:03	06:25	06:39	05:49		18:32 (1)	05:17			05:13	05:35			06:06		18:43 (1)	06:37	07:11	06:48	07:11
	16:54	17:33	19:05	19:39	43	19:15 (1)	20:08			20:24	20:10			19:28	23	19:06 (1)	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48		18:31 (1)	05:17			05:14	05:36		18:57 (1)	06:07		18:45 (1)	06:39	07:12	06:49	07:12
	16:56	17:34	19:06	19:40	43	19:14 (1)	20:09			20:24	20:09	10	19:07 (1)	19:27	20	19:05 (1)	18:34	17:47	16:18	16:23
29	07:01		06:35	05:46		18:31 (1)	05:16			05:14	05:37		18:54 (1)	06:08		18:47 (1)	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	43	19:14 (1)	20:10			20:24	20:08	16	19:10 (1)	19:25	16	19:03 (1)	18:32	17:45	16:17	16:23
30	07:00		06:33	05:45		18:32 (1)	05:15			05:15	05:38		18:52 (1)	06:09		18:50 (1)	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	42	19:14 (1)	20:10			20:24	20:07	20	19:12 (1)	19:23	12	19:02 (1)	18:31	17:44	16:17	16:24
31	06:59		06:32				05:15				05:39		18:51 (1)	06:10				07:15		07:12
	16:59		19:09				20:11				20:06	23	19:14 (1)	19:22				17:43		16:25
Potential sun hours	296	297	370	400			450			454	461			429			375	344	297	286
Total, worst case					593			483				69			1021					
Sun reduction					0.57			0.58				0.63			0.62					
Oper. time red.					1.00			1.00				1.00			1.00					
Wind dir. red.					0.55			0.55				0.55			0.55					
Total reduction					0.31			0.32				0.35			0.34					
Total, real					187			155				24			350					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 12:06 PM / 8

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Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 12:06 PM/2.7.473

SHADOW - Calendar

Shadow receptor: H - 4H

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May		June	July		August		September	October	November	December
1	07:12	06:58	06:22	06:30	05:44		05:14	05:15		05:39	19:37 (1)	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10	19:43		20:12	20:24		20:05	4 19:41 (1)	19:20	18:29	16:41	16:17
2	07:13	06:57	06:20	06:28	05:42		05:14	05:16		05:40	19:38 (1)	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44		20:13	20:24		20:04	2 19:40 (1)	19:18	18:27	16:40	16:16
3	07:13	06:56	06:18	06:27	05:41		05:14	05:16		05:41		06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45		20:14	20:24		20:03		19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40		05:13	05:17		05:42		06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46		20:14	20:23		20:02		19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:39		05:13	05:17		05:43		06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47		20:15	20:23		20:01		19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37		05:12	05:18		05:44		06:16	06:47	06:23	06:57
	16:30	17:07	17:41	19:16	19:48		20:16	20:23		19:58		19:12	18:20	16:35	16:16
7	07:12	06:52	06:12	06:20	05:36		05:12	05:18		05:45		06:17	06:48	06:24	06:58
	16:31	17:08	17:42	19:17	19:49		20:16	20:23		19:57		19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18	05:35		05:12	05:19		05:46		06:18	06:49	06:25	06:59
	16:32	17:10	18:44	19:18	19:50		20:17	20:22		19:56		19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34		05:12	05:20		05:47		06:19	06:50	06:26	07:00
	16:33	17:11	18:45	19:19	19:51		20:18	20:22		19:54		19:07	18:15	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33		19:28 (1) 05:11	05:20		05:48		06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	2	19:29 (1) 20:18	20:22		19:53		19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:31		19:27 (1) 05:11	05:21		05:50		06:21	06:52	06:29	07:02
	16:36	17:13	18:47	19:21	19:53	3	19:30 (1) 20:19	20:21		19:52		19:03	18:12	16:30	16:16
12	07:11	06:46	07:04	06:12	05:30		19:27 (1) 05:11	05:22		05:51		06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	4	19:31 (1) 20:19	20:21		19:50		19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29		19:26 (1) 05:11	05:23		05:52		06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:55	6	19:32 (1) 20:20	20:20		19:49		19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28		19:26 (1) 05:11	05:23		05:53		06:24	06:56	06:32	07:04
	16:39	17:17	18:50	19:24	19:56	6	19:32 (1) 20:20	20:20		19:48		18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27		19:26 (1) 05:11	05:24	19:45 (1)	05:54		06:25	06:57	06:34	07:05
	16:40	17:18	18:52	19:25	19:58	7	19:33 (1) 20:21	20:19	4 19:49 (1)	19:46		18:56	18:06	16:26	16:16
16	07:10	06:41	06:57	06:06	05:26		19:26 (1) 05:11	05:25	19:43 (1)	05:55		06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:59	8	19:34 (1) 20:21	20:19	9 19:52 (1)	19:45		18:55	18:04	16:26	16:17
17	07:10	06:39	06:55	06:04	05:25		19:26 (1) 05:11	05:26	19:41 (1)	05:56		06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	19:59	9	19:35 (1) 20:22	20:18	11 19:52 (1)	19:43		18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:02	05:24		19:26 (1) 05:11	05:27	19:40 (1)	05:57		06:28	07:00	06:37	07:07
	16:43	17:22	18:55	19:29	20:00	10	19:36 (1) 20:22	20:17	12 19:52 (1)	19:42		18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:23		19:26 (1) 05:11	05:27	19:40 (1)	05:58		06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30	20:00	11	19:37 (1) 20:22	20:17	11 19:51 (1)	19:40		18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:23		19:27 (1) 05:11	05:28	19:39 (1)	05:59		06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	11	19:38 (1) 20:23	20:16	12 19:51 (1)	19:39		18:48	17:58	16:22	16:18
21	07:07	06:34	06:49	05:58	05:22		19:28 (1) 05:12	05:29	19:39 (1)	06:00		06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	11	19:39 (1) 20:23	20:15	11 19:50 (1)	19:37		18:46	17:57	16:22	16:18
22	07:07	06:32	06:47	05:56	05:21		19:28 (1) 05:12	05:30	19:37 (1)	06:01		06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	12	19:40 (1) 20:23	20:14	12 19:49 (1)	19:36		18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20		19:28 (1) 05:12	05:31	19:37 (1)	06:02		06:33	07:06	06:43	07:10
	16:49	17:28	19:00	19:34	20:04	12	19:40 (1) 20:23	20:14	11 19:48 (1)	19:34		18:43	17:54	16:20	16:19
24	07:05	06:29	06:44	05:53	05:19		19:30 (1) 05:12	05:32	19:37 (1)	06:03		06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	12	19:42 (1) 20:23	20:13	10 19:47 (1)	19:33		18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19		19:30 (1) 05:13	05:33	19:37 (1)	06:04		06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	12	19:42 (1) 20:24	20:12	10 19:47 (1)	19:31		18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18		19:31 (1) 05:13	05:34	19:37 (1)	06:05		06:36	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	12	19:43 (1) 20:24	20:11	9 19:46 (1)	19:30		18:37	17:49	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17		19:33 (1) 05:13	05:35	19:36 (1)	06:06		06:37	07:11	06:48	07:11
	16:54	17:33	19:05	19:38	20:08	10	19:43 (1) 20:24	20:10	9 19:45 (1)	19:28		18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17		19:34 (1) 05:14	05:36	19:37 (1)	06:07		06:39	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20:09	7	19:41 (1) 20:24	20:09	7 19:44 (1)	19:27		18:34	17:47	16:18	16:23
29	07:01		06:35	05:46	05:16		05:14	05:37	19:37 (1)	06:08		06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10		20:24	20:08	7 19:44 (1)	19:25		18:32	17:45	16:17	16:23
30	07:00		06:33	05:45	05:15		05:15	05:38	19:37 (1)	06:09		06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10		20:24	20:07	6 19:43 (1)	19:23		18:30	17:44	16:17	16:24
31	06:59		06:32		05:15			05:38	19:37 (1)	06:10			07:15		07:12
	16:59		19:09		20:11			20:06	5 19:42 (1)	19:22			17:43		16:25
Potential sun hours	296	297	370	400	450		454	461		429		375	344	297	286
Total, worst case						165			156		6				
Sun reduction						0.58			0.63		0.62				
Oper. time red.						1.00			1.00		1.00				
Wind dir. red.						0.60			0.60		0.60				
Total reduction						0.35			0.38		0.37				
Total, real						57			59		2				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 12:06 PM / 9

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9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 12:06 PM/2.7.473

SHADOW - Calendar

Shadow receptor: I - 4I

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:14	05:15	05:39	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:41	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:16	05:40	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:17
3	07:13	06:56	06:18	06:27	05:41	05:14	05:16	05:41	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:42	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:39	05:13	05:17	05:43	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:12	05:18	05:44	06:16	06:47	06:23	06:57
	16:30	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:35	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12	05:18	05:45	06:17	06:48	06:24	06:58
	16:31	17:08	17:42	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18	05:35	05:12	05:19	05:46	06:18	06:49	06:25	06:59
	16:32	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:47	06:19	06:50	06:26	07:00
	16:33	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:11	05:20	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:31	05:11	05:21	05:50	06:21	06:52	06:29	07:02
	16:36	17:13	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:11	06:46	07:04	06:12	05:30	05:11	05:22	05:51	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:23	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:50	19:24	19:56	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:18	18:52	19:25	19:57	20:21	20:19	19:46	18:56	18:06	16:26	16:16
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:58	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:10	06:39	06:55	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	19:59	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:02	05:24	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:43	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:23	05:11	05:27	05:58	06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30	20:00	20:22	20:17	19:40	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:23	05:11	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:37	18:46	17:57	16:22	16:18
22	07:07	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:49	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:20	16:19
24	07:05	06:29	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:36	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:49	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:13	05:35	06:06	06:37	07:11	06:48	07:11
	16:54	17:33	19:05	19:38	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:46	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:17	16:23
30	07:00		06:33	05:45	05:15	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:30	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:15		07:12
	16:59		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 12:06 PM / 10

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 12:06 PM/2.7.473

SHADOW - Calendar

Shadow receptor: J - 4J

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:14	05:15	05:39	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:41	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:16	05:40	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:16
3	07:13	06:56	06:18	06:27	05:41	05:14	05:16	05:41	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:23	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:42	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:39	05:13	05:17	05:43	06:15	06:46	06:21	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:12	05:18	05:44	06:16	06:47	06:23	06:57
	16:30	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:35	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12	05:18	05:45	06:17	06:48	06:24	06:58
	16:31	17:08	17:42	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18	05:35	05:12	05:19	05:46	06:18	06:49	06:25	06:59
	16:32	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:47	06:19	06:50	06:26	07:00
	16:33	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:11	05:20	05:48	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:31	05:11	05:21	05:50	06:21	06:52	06:29	07:02
	16:36	17:13	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:11	06:46	07:04	06:12	05:30	05:11	05:22	05:51	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:23	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:50	19:24	19:56	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:18	18:52	19:25	19:57	20:21	20:19	19:46	18:56	18:06	16:26	16:16
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:58	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:09	06:39	06:55	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	19:59	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:02	05:24	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:43	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:23	05:11	05:27	05:58	06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30	20:00	20:22	20:17	19:40	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:23	05:11	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:37	18:46	17:57	16:22	16:18
22	07:07	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:49	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:20	16:19
24	07:05	06:29	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:29	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:36	07:09	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:49	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:13	05:35	06:06	06:37	07:11	06:48	07:11
	16:54	17:33	19:05	19:38	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
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	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:17	16:23
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	16:59		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 12:06 PM / 11

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Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 12:06 PM/2.7.473

SHADOW - Calendar

Shadow receptor: K - 4K

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
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	16:28	17:03	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39	16:16
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	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:12	05:18	05:44	06:16	06:47	06:23	06:57
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	16:31	17:08	17:42	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
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	16:32	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:47	06:19	06:50	06:26	07:00
	16:33	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:20	05:49	06:20	06:51	06:28	07:01
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	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
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	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:23	05:53	06:24	06:56	06:32	07:04
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15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
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16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
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Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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Licensed user:
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9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 12:06 PM/2.7.473

SHADOW - Calendar

Shadow receptor: L - 4L

Assumptions for shadow calculations

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	16:28	17:03	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:42	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:39	05:13	05:17	05:43	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:12	05:18	05:44	06:16	06:47	06:23	06:57
	16:30	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36	16:16
7	07:13	06:52	06:12	06:20	05:36	05:12	05:18	05:45	06:17	06:48	06:24	06:58
	16:31	17:08	17:42	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18	05:35	05:12	05:19	05:46	06:18	06:49	06:25	06:59
	16:32	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:47	06:19	06:50	06:26	07:00
	16:33	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:20	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
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	16:36	17:13	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
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	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
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	16:39	17:17	18:50	19:24	19:56	20:20	20:20	19:48	18:58	18:07	16:27	16:16
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	16:40	17:18	18:52	19:25	19:58	20:21	20:19	19:46	18:56	18:06	16:26	16:16
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	16:41	17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:10	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	19:59	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:02	05:24	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:43	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
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	16:45	17:23	18:56	19:30	20:00	20:22	20:17	19:40	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:23	05:11	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:18
22	07:07	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:49	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:20	16:20
24	07:05	06:29	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:36	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:49	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:13	05:35	06:06	06:37	07:11	06:48	07:11
	16:54	17:33	19:05	19:38	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:12
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:46	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:17	16:23
30	07:00		06:33	05:45	05:15	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:15		07:12
	16:59		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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SHADOW - Calendar

Shadow receptor: M - 4M

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:14	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:16	05:40	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:41	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:42	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:39	05:13	05:17	05:43	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:44	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12	05:18	05:45	06:17	06:48	06:24	06:58
	16:31	17:08	17:42	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59
	16:32	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:20	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:31	05:11	05:21	05:50	06:21	06:52	06:29	07:02
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	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
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15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:18	18:52	19:25	19:58	20:21	20:19	19:46	18:56	18:06	16:26	16:16
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
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	16:42	17:21	18:54	19:28	19:59	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:02	05:24	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:43	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:23	05:11	05:27	05:58	06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30	20:00	20:22	20:17	19:41	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:23	05:11	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:20	16:20
24	07:05	06:29	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:36	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:49	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:13	05:35	06:06	06:38	07:11	06:48	07:11
	16:54	17:33	19:05	19:38	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:46	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:18	16:23
30	07:00		06:33	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:15		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

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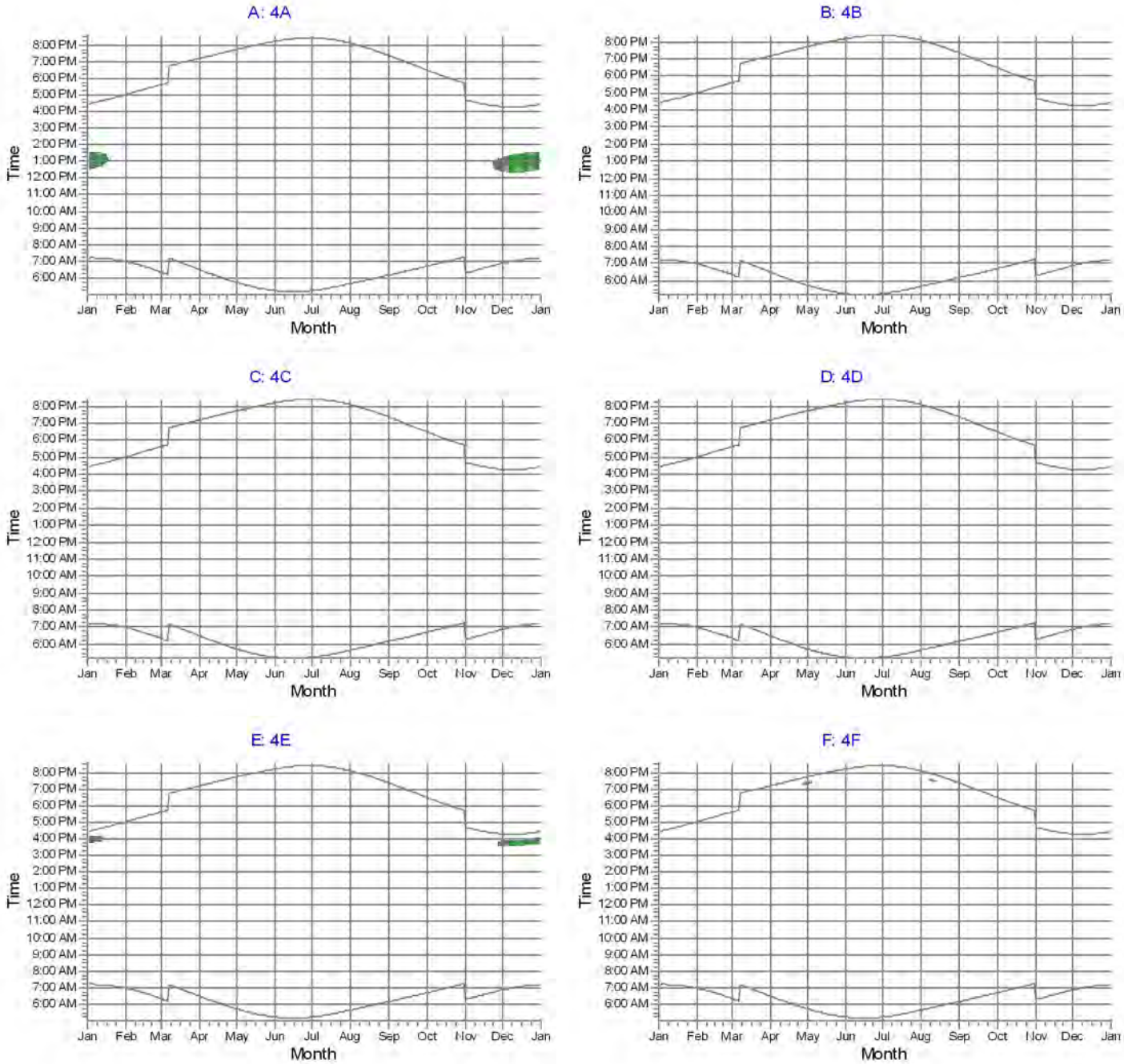
SHADOW - Calendar, graphical



WTGs

1: Tank Farm 5

Project:

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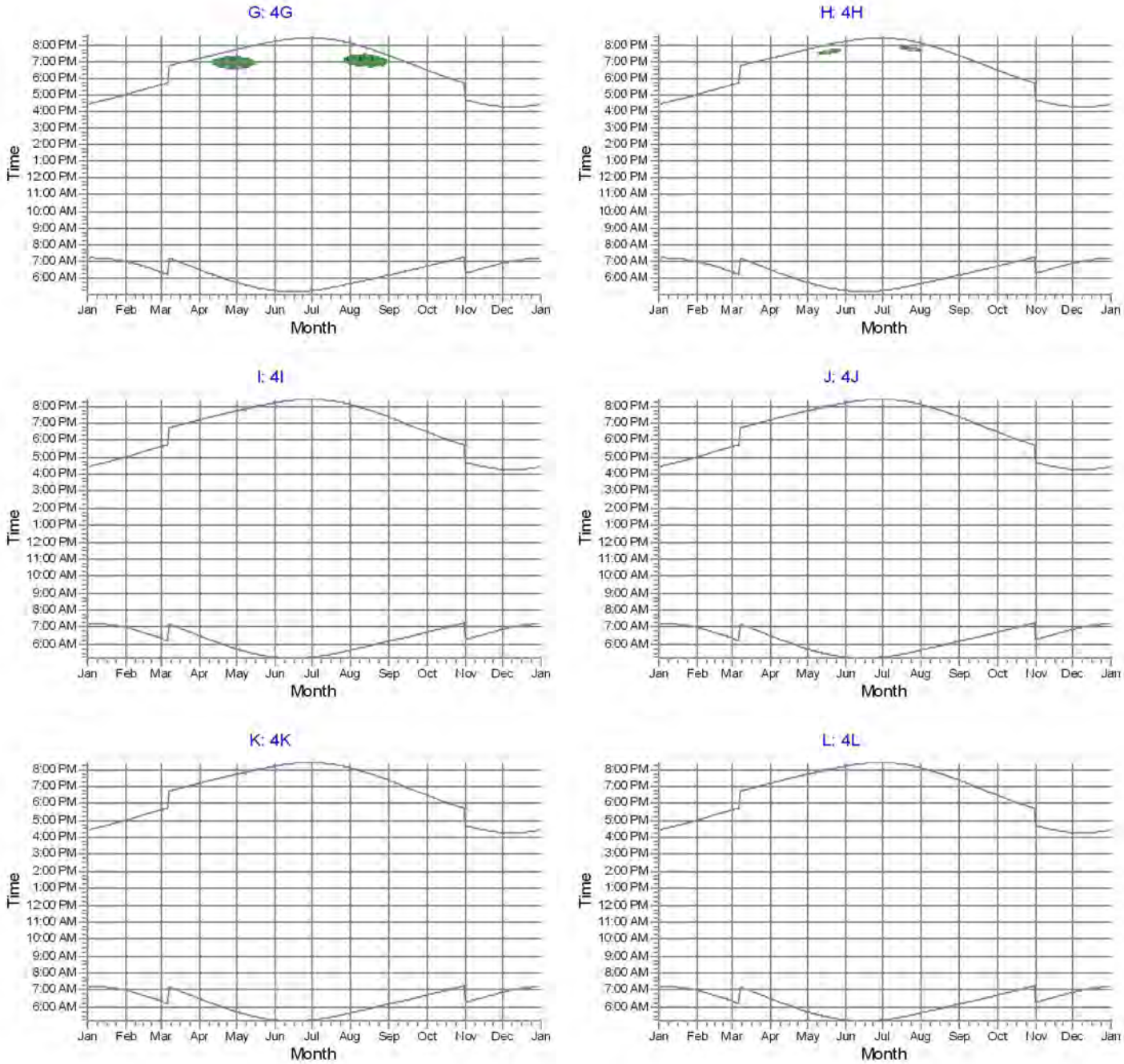
SHADOW - Calendar, graphical



WTGs

1: Tank Farm 5

Project:

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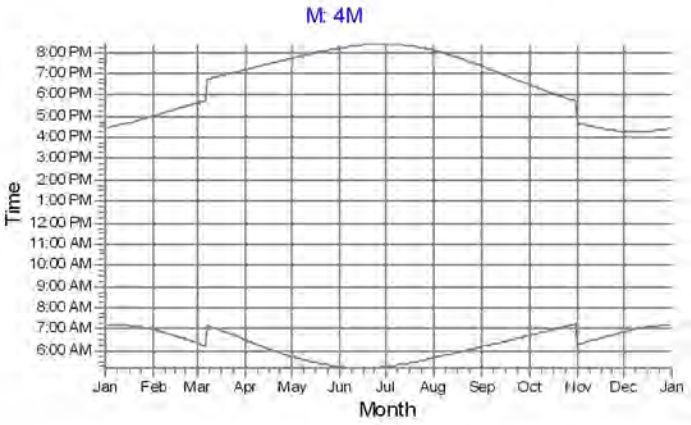
SHADOW - Calendar, graphical



WTGs

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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SHADOW - Calendar per WTG

WTG: 1 - Tank Farm 5

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June
1	07:12 12:28-13:29/61	06:58	06:22	06:30	05:44 18:31-19:13/42	05:14
	16:26 15:41-15:59/18	17:01	17:35	19:10	19:43 19:15-19:19/4	20:12
2	07:13 12:29-13:29/60	06:57	06:20	06:28	05:42 18:31-19:13/42	05:14
	16:27 15:42-16:00/18	17:02	17:37	19:11	19:44 19:16-19:20/4	20:13
3	07:13 12:30-13:29/59	06:56	06:19	06:27	05:41 18:32-19:12/40	05:14
	16:28 15:42-16:01/19	17:03	17:38	19:12	19:45 19:18-19:22/4	20:14
4	07:13 12:31-13:29/58	06:55	06:17	06:25	05:40 18:33-19:12/39	05:13
	16:29 15:43-16:02/19	17:05	17:39	19:14	19:46 19:19-19:23/4	20:14
5	07:13 12:32-13:29/57	06:54	06:15	06:23	05:39 18:32-19:11/39	05:13
	16:30 15:44-16:03/19	17:06	17:40	19:15	19:47 19:21-19:23/2	20:15
6	07:13 12:34-13:29/55	06:53	06:14	06:22	05:37 18:33-19:10/37	05:12
	16:30 15:45-16:04/19	17:07	17:41	19:16	19:48	20:16
7	07:13 12:35-13:29/54	06:52	06:12	06:20	05:36 18:34-19:09/35	05:12
	16:31 15:46-16:05/19	17:08	17:43	19:17	19:49	20:16
8	07:12 12:37-13:29/52	06:51	07:10	06:18	05:35 18:35-19:09/34	05:12
	16:32 15:47-16:05/18	17:10	18:44	19:18	19:50	20:17
9	07:12 12:37-13:28/51	06:50	07:09	06:17	05:34 18:36-19:08/32	05:12
	16:33 15:47-16:04/17	17:11	18:45	19:19	19:51	20:18
10	07:12 12:39-13:28/49	06:48	07:07	06:15	05:33 18:37-19:07/30	05:12
	16:35 15:49-16:04/15	17:12	18:46	19:20	19:52 19:28-19:29/1	20:18
11	07:12 12:41-13:27/46	06:47	07:06	06:14	05:31 18:38-19:06/28	05:11
	16:36 15:50-16:04/14	17:13	18:47	19:21	19:53 19:27-19:30/3	20:19
12	07:12 12:42-13:26/44	06:46	07:04	06:12	05:30 18:39-19:04/25	05:11
	16:37 15:51-16:03/12	17:15	18:48	19:22	19:54 19:27-19:31/4	20:19
13	07:11 12:45-13:25/40	06:45	07:02	06:10 18:49-19:01/12	05:29 18:41-19:03/22	05:11
	16:38 15:53-16:02/9	17:16	18:49	19:23	19:56 19:26-19:32/6	20:20
14	07:11 12:47-13:25/38	06:43	07:01	06:09 18:46-19:02/16	05:28 18:43-19:01/18	05:11
	16:39 15:57-16:00/3	17:17	18:50	19:24	19:57 19:26-19:32/6	20:20
15	07:10 12:49-13:23/34	06:42	06:59	06:07 18:43-19:03/20	05:27 18:45-18:59/14	05:11
	16:40	17:18	18:52	19:26	19:58 19:26-19:33/7	20:21
16	07:10 12:53-13:21/28	06:41	06:57	06:06 18:41-19:04/23	05:26 18:49-18:55/6	05:11
	16:41	17:20	18:53	19:27	19:59 19:26-19:34/8	20:21
17	07:10 12:56-13:18/22	06:39	06:56	06:04 18:39-19:05/26	05:25 19:26-19:35/9	05:11
	16:42	17:21	18:54	19:28	20:00	20:22
18	07:09 13:01-13:14/13	06:38	06:54	06:02 18:38-19:07/29	05:24 19:26-19:36/10	05:11
	16:43	17:22	18:55	19:29	20:00	20:22
19	07:08	06:37	06:52	06:01 18:36-19:07/31	05:23 19:26-19:37/11	05:11
	16:45	17:23	18:56	19:30	20:01	20:22
20	07:08	06:35	06:50	05:59 18:36-19:09/33	05:23 19:27-19:38/11	05:11
	16:46	17:25	18:57	19:31	20:01	20:23
21	07:07	06:34	06:49	05:58 18:34-19:09/35	05:22 19:28-19:39/11	05:12
	16:47	17:26	18:58	19:32	20:02	20:23
22	07:07	06:32	06:47	05:56 18:34-19:11/37	05:21 19:28-19:40/12	05:12
	16:48	17:27	18:59	19:33	20:03	20:23
23	07:06	06:31	06:45	05:55 18:33-19:11/38	05:20 19:28-19:40/12	05:12
	16:49	17:28	19:00	19:34	20:04	20:23
24	07:05	06:29	06:44	05:53 18:33-19:12/39	05:19 19:30-19:42/12	05:12
	16:51	17:30	19:02	19:35	20:05	20:23
25	07:05	06:28	06:42	05:52 18:32-19:13/41	05:19 19:30-19:42/12	05:13
	16:52	17:31	19:03	19:36	20:06	20:24
26	07:04	06:26	06:40	05:51 18:32-19:14/42	05:18 19:31-19:43/12	05:13
	16:53	17:32	19:04	19:37	20:07	20:24
27	07:03	06:25	06:39	05:49 18:32-19:15/43	05:17 19:33-19:43/10	05:13
	16:54	17:33	19:05	19:39	20:08	20:24
28	07:02	06:23	06:37	05:48 18:31-19:14/43	05:17 19:34-19:41/7	05:14
	16:56	17:34	19:06	19:40 19:15-19:16/1	20:09	20:24
29	07:01		06:35	05:46 18:31-19:14/43	05:16	05:14
	16:57		19:07	19:41 19:15-19:17/2	20:10	20:24
30	07:00		06:33	05:45 18:32-19:14/42	05:15	05:15
	16:58		19:08	19:42 19:16-19:19/3	20:10	20:24
31	06:59		06:32		05:15	
	17:00		19:09		20:11	
Potential sun hours	296	297	370	400	450	454
Sum of minutes with flicker	1040	0	0	599	665	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

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SHADOW - Calendar per WTG

WTG: 1 - Tank Farm 5

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	July		August		September	October	November		December	
1	05:15		05:39	18:49-19:15/26	06:11	06:42	06:17		06:52	12:23-13:09/46
	20:24		20:05	19:37-19:41/4	19:20	18:29	16:42		16:17	15:32-15:46/14
2	05:16		05:40	18:48-19:17/29	06:12	06:43	06:18		06:53	12:22-13:11/49
	20:24		20:04	19:38-19:40/2	19:18	18:27	16:40		16:17	15:32-15:47/15
3	05:16		05:41	18:46-19:17/31	06:13	06:44	06:19		06:54	12:21-13:12/51
	20:24		20:03		19:17	18:25	16:39		16:16	15:31-15:48/17
4	05:17		05:42	18:45-19:18/33	06:14	06:45	06:20		06:55	12:21-13:13/52
	20:23		20:02		19:15	18:24	16:38		16:16	15:31-15:49/18
5	05:17		05:43	18:44-19:19/35	06:15	06:46	06:22		06:56	12:20-13:14/54
	20:23		20:01		19:13	18:22	16:37		16:16	15:31-15:50/19
6	05:18		05:44	18:43-19:19/36	06:16	06:47	06:23		06:57	12:20-13:15/55
	20:23		19:58		19:12	18:20	16:36		16:16	15:31-15:50/19
7	05:18		05:45	18:42-19:20/38	06:17	06:48	06:24		06:58	12:20-13:16/56
	20:23		19:57		19:10	18:19	16:34		16:16	15:31-15:50/19
8	05:19		05:46	18:42-19:20/38	06:18	06:49	06:25		06:59	12:19-13:17/58
	20:22		19:56	19:30-19:32/2	19:08	18:17	16:33		16:16	15:31-15:50/19
9	05:20		05:48	18:41-19:21/40	06:19	06:50	06:26		07:00	12:19-13:18/59
	20:22		19:54	19:27-19:31/4	19:07	18:15	16:32		16:16	15:31-15:50/19
10	05:20		05:49	18:41-19:21/40	06:20	06:51	06:28		07:01	12:19-13:19/60
	20:22		19:53	19:26-19:30/4	19:05	18:14	16:31		16:16	15:32-15:50/18
11	05:21		05:50	18:40-19:21/41	06:21	06:52	06:29		07:02	12:18-13:19/61
	20:21		19:52	19:25-19:29/4	19:03	18:12	16:30		16:16	15:31-15:49/18
12	05:22		05:51	18:40-19:22/42	06:22	06:54	06:30		07:02	12:19-13:20/61
	20:21		19:50	19:24-19:27/3	19:02	18:11	16:29		16:16	15:32-15:50/18
13	05:23		05:52	18:39-19:22/43	06:23	06:55	06:31		07:03	12:19-13:21/62
	20:20		19:49	19:23-19:26/3	19:00	18:09	16:28		16:16	15:32-15:50/18
14	05:23		05:53	18:39-19:22/43	06:24	06:56	06:32		07:04	12:19-13:22/63
	20:20		19:48	19:23-19:25/2	18:58	18:07	16:27		16:16	15:33-15:50/17
15	05:24	19:45-19:49/4	05:54	18:39-19:21/42	06:25	06:57	06:34		07:05	12:20-13:23/63
	20:19		19:46		18:56	18:06	16:26		16:16	15:33-15:51/18
16	05:25	19:43-19:52/9	05:55	18:38-19:21/43	06:26	06:58	06:35		07:06	12:19-13:23/64
	20:19		19:45		18:55	18:04	16:26		16:17	15:33-15:50/17
17	05:26	19:41-19:52/11	05:56	18:38-19:21/43	06:27	06:59	06:36		07:06	12:20-13:24/64
	20:18		19:43		18:53	18:03	16:25		16:17	15:34-15:51/17
18	05:27	19:40-19:52/12	05:57	18:38-19:19/41	06:28	07:00	06:37		07:07	12:20-13:24/64
	20:17		19:42		18:51	18:01	16:24		16:17	15:34-15:51/17
19	05:27	19:40-19:51/11	05:58	18:38-19:18/40	06:29	07:01	06:38		07:07	12:20-13:25/65
	20:17		19:41		18:49	18:00	16:23		16:18	15:34-15:51/17
20	05:28	19:39-19:51/12	05:59	18:39-19:17/38	06:30	07:03	06:40		07:08	12:21-13:26/65
	20:16		19:39		18:48	17:58	16:22		16:18	15:35-15:52/17
21	05:29	19:39-19:50/11	06:00	18:39-19:15/36	06:31	07:04	06:41		07:09	12:21-13:26/65
	20:15		19:38		18:46	17:57	16:22		16:18	15:35-15:52/17
22	05:30	19:37-19:49/12	06:01	18:39-19:14/35	06:32	07:05	06:42		07:09	12:22-13:27/65
	20:14		19:36		18:44	17:55	16:21		16:19	15:36-15:53/17
23	05:31	19:37-19:48/11	06:02	18:40-19:12/32	06:33	07:06	06:43		07:10	12:22-13:27/65
	20:14		19:34		18:43	17:54	16:20		16:20	15:36-15:53/17
24	05:32	19:37-19:47/10	06:03	18:40-19:11/31	06:34	07:07	06:44	12:39-12:52/13	07:10	12:22-13:27/65
	20:13		19:33		18:41	17:52	16:20		16:20	15:36-15:53/17
25	05:33	19:37-19:47/10	06:04	18:41-19:09/28	06:35	07:08	06:45	12:34-12:56/22	07:10	12:23-13:28/65
	20:12		19:31		18:39	17:51	16:19		16:21	15:38-15:55/17
26	05:34	19:37-19:46/9	06:05	18:42-19:08/26	06:36	07:10	06:47	12:31-12:59/28	07:11	12:24-13:28/64
	20:11		19:30		18:37	17:49	16:19		16:21	15:38-15:55/17
27	05:35	19:36-19:45/9	06:06	18:43-19:06/23	06:38	07:11	06:48	12:29-13:02/33	07:11	12:24-13:28/64
	20:10		19:28		18:36	17:48	16:18		16:22	15:38-15:55/17
28	05:36	18:57-19:07/10	06:07	18:45-19:05/20	06:39	07:12	06:49	12:26-13:04/38	07:12	12:26-13:29/63
	20:09	19:37-19:44/7	19:27		18:34	17:47	16:18	15:36-15:39/3	16:23	15:39-15:57/18
29	05:37	18:54-19:10/16	06:08	18:47-19:03/16	06:40	07:13	06:50	12:26-13:06/40	07:12	12:26-13:29/63
	20:08	19:37-19:44/7	19:25		18:32	17:45	16:17	15:34-15:43/9	16:23	15:40-15:57/17
30	05:38	18:52-19:12/20	06:09	18:50-19:02/12	06:41	07:14	06:51	12:24-13:08/44	07:12	12:27-13:29/62
	20:07	19:37-19:43/6	19:23		18:31	17:44	16:17	15:33-15:45/12	16:24	15:40-15:58/18
31	05:39	18:51-19:14/23	06:10			07:15			07:12	12:27-13:29/62
	20:06	19:37-19:42/5	19:22			17:43			16:25	15:40-15:58/18
Potential sun hours	461		429		375	344	297		286	
Sum of minutes with flicker		225		1049	0	0		242		2416

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

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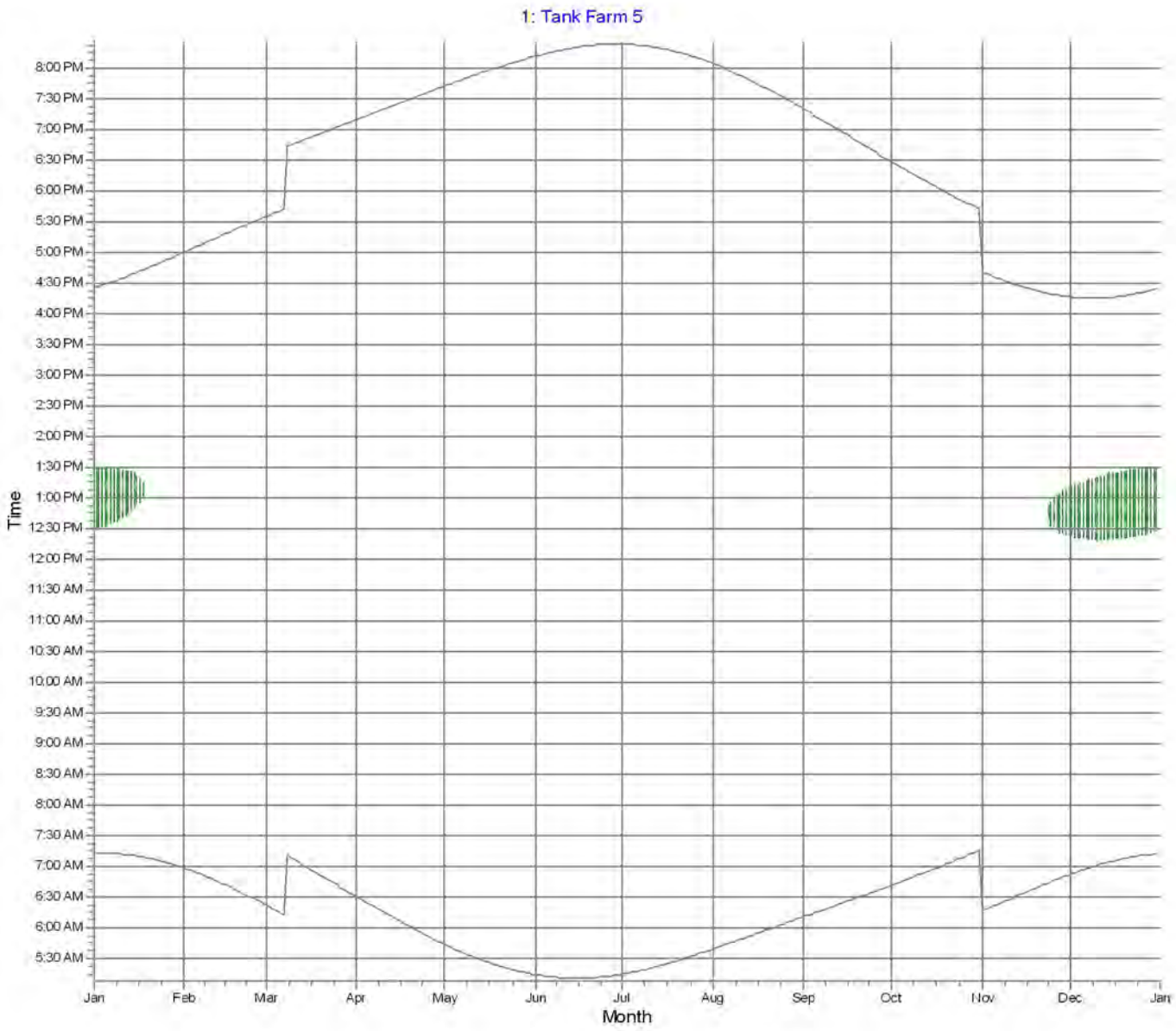
SHADOW - Calendar per WTG, graphical

WTG: 1 - Tank Farm 5



WTGs

A: 4A

Project:

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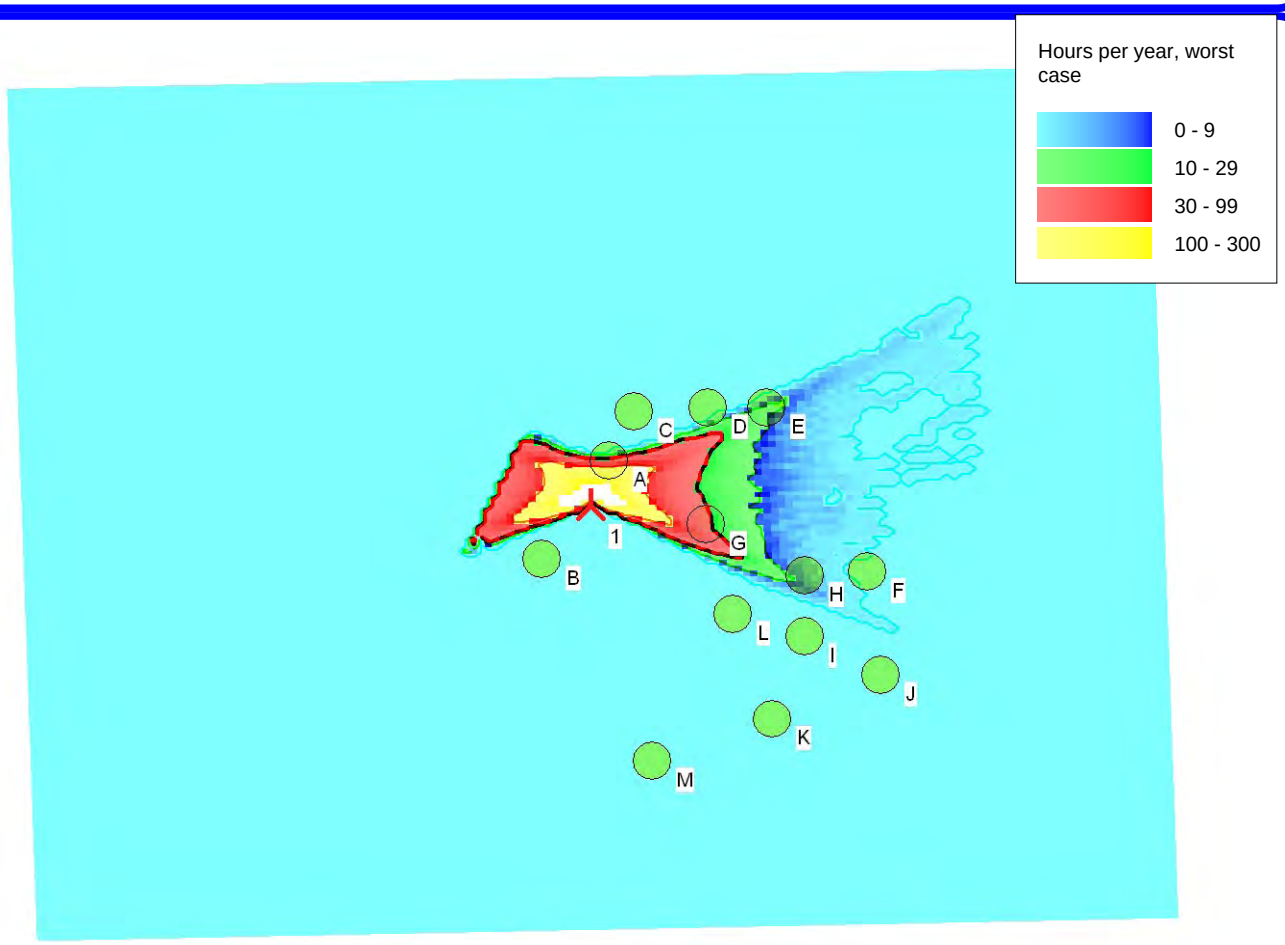
SHADOW - Map



0 250 500 750 1000m

Map: , Print scale 1:20,000, Map center Geo WGS 84 East: -71.304731° North: 41.552319°

New WTG Shadow receptor

Isolines showing shadow in Hours per year, worst case

0 10 30 100

APPENDIX 5

WIND TURBINE SITE 5 NUWC

Figure A-5: Maximum predicted shadow flicker levels (hours per year) for a GE 1.5 MW sle Model at Wind Turbine Site 5 (NUWC).

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SHADOW - Main Result

Assumptions for shadow calculations

Maximum distance for influence
Calculate only when more than 20 % of sun is covered by the blade
Please look in WTG table

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

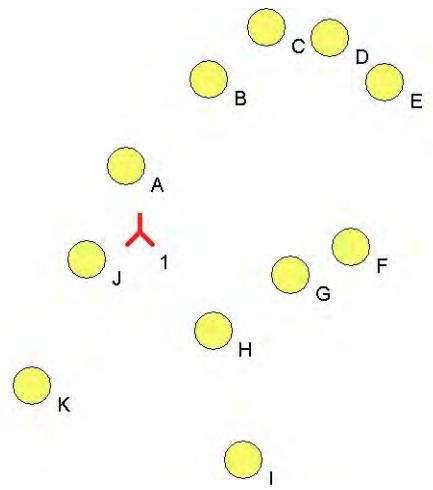
Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW
691	432	259	155	155	155	432	518	950	1,209	864	518

W	WNW	NW	NNW	Sum
432	604	691	691	8,756

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: Line object
Obstacles used in calculation
Eye height: 1.5 m
Grid resolution: 10 m



Scale 1:20,000
New WTG
Shadow receptor

WTGs

	Geo DD: WGS 84 Longitude	Latitude	Z [m]	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Shadow data Calculation distance [m]	RPM [RPM]
1	-71.307428° East	41.536819° North	17.8	NUWC Stillwater Basin	Yes	GE WIND ENERGY	GE 1.5sle-1,500	1,500	77.0	65.0	2,000	20.0

Shadow receptor-Input

No.	Name	Geo DD: WGS 84 Longitude	Latitude	Z [m]	Width [m]	Height [m]	Height a.g.l. [m]	Degrees from south cw [°]	Slope of window [°]	Direction mode
A	5A	-71.307865° East	41.538890° North	7.6	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
B	5B	-71.305212° East	41.541668° North	20.0	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
C	5C	-71.303402° East	41.543298° North	26.1	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
D	5D	-71.301385° East	41.542957° North	44.4	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
E	5E	-71.299620° East	41.541567° North	57.7	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
F	5F	-71.300715° East	41.536324° North	37.7	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
G	5G	-71.302621° East	41.535465° North	25.5	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
H	5H	-71.305068° East	41.533669° North	27.0	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
I	5I	-71.304137° East	41.529592° North	27.8	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
J	5J	-71.309099° East	41.535946° North	26.4	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
K	5K	-71.310849° East	41.531942° North	35.1	1.0	1.0	1.0	-180.0	90.0	"Green house mode"

Project:

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Calculated:
5/3/2011 4:53 PM/2.7.473

SHADOW - Main Result

Calculation Results

Shadow receptor

		Shadow, worst case			Shadow, expected values
No.	Name	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	5A	24:22	38	0:48	9:24
B	5B	0:00	0	0:00	0:00
C	5C	0:00	0	0:00	0:00
D	5D	0:00	0	0:00	0:00
E	5E	0:00	0	0:00	0:00
F	5F	12:41	40	0:28	4:06
G	5G	62:45	103	0:44	22:29
H	5H	0:00	0	0:00	0:00
I	5I	0:00	0	0:00	0:00
J	5J	0:00	0	0:00	0:00
K	5K	0:00	0	0:00	0:00

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

No.	Name	Worst case [h/year]	Expected [h/year]
1	NUWC Stillwater Basin	99:48	35:59

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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Calculated:
5/3/2011 4:53 PM/2.7.473

SHADOW - Calendar

Shadow receptor: A - 5A

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January			February	March	April	May	June	July	August	September	October	November	December		
1	07:12		10:46 (1)	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52		
	16:26	41	11:27 (1)	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17		
2	07:13		10:47 (1)	06:57	06:20	06:28	05:42	05:14	05:16	05:41	06:12	06:43	06:18	06:53		
	16:27	39	11:26 (1)	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:17		
3	07:13		10:48 (1)	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54		10:47 (1)
	16:28	38	11:26 (1)	17:03	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39	16:16	11	10:58 (1)
4	07:13		10:50 (1)	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55		10:44 (1)
	16:29	35	11:25 (1)	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16	19	11:03 (1)
5	07:13		10:52 (1)	06:54	06:15	06:23	05:39	05:13	05:17	05:44	06:15	06:46	06:22	06:56		10:41 (1)
	16:30	32	11:24 (1)	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16	25	11:06 (1)
6	07:13		10:54 (1)	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57		10:40 (1)
	16:31	29	11:23 (1)	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36	16:16	29	11:09 (1)
7	07:13		10:56 (1)	06:52	06:12	06:20	05:36	05:12	05:18	05:46	06:17	06:48	06:24	06:58		10:39 (1)
	16:32	25	11:21 (1)	17:08	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16	32	11:11 (1)
8	07:12		10:59 (1)	06:51	07:10	06:18	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59		10:38 (1)
	16:33	20	11:19 (1)	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16	35	11:13 (1)
9	07:12		11:03 (1)	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00		10:37 (1)
	16:34	12	11:15 (1)	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	16:16	38	11:15 (1)
10	07:12			06:48	07:07	06:15	05:33	05:12	05:20	05:49	06:20	06:51	06:28	07:01		10:37 (1)
	16:35			17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16	39	11:16 (1)
11	07:12			06:47	07:06	06:14	05:32	05:11	05:21	05:50	06:21	06:52	06:29	07:02		10:36 (1)
	16:36			17:14	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16	41	11:17 (1)
12	07:11			06:46	07:04	06:12	05:30	05:11	05:22	05:51	06:22	06:54	06:30	07:02		10:36 (1)
	16:37			17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16	42	11:18 (1)
13	07:11			06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03		10:36 (1)
	16:38			17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16	43	11:19 (1)
14	07:11			06:43	07:01	06:09	05:28	05:11	05:23	05:53	06:24	06:56	06:32	07:04		10:36 (1)
	16:39			17:17	18:50	19:24	19:57	20:20	20:20	19:48	18:58	18:07	16:27	16:16	45	11:21 (1)
15	07:10			06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05		10:35 (1)
	16:40			17:19	18:52	19:25	19:58	20:21	20:19	19:46	18:56	18:06	16:26	16:16	46	11:21 (1)
16	07:10			06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05		10:36 (1)
	16:41			17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:26	16:17	46	11:22 (1)
17	07:10			06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06		10:36 (1)
	16:42			17:21	18:54	19:28	20:00	20:22	20:18	19:43	18:53	18:03	16:25	16:17	47	11:23 (1)
18	07:09			06:38	06:54	06:03	05:24	05:11	05:27	05:57	06:28	07:00	06:37	07:07		10:36 (1)
	16:44			17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17	47	11:23 (1)
19	07:08			06:37	06:52	06:01	05:23	05:11	05:28	05:58	06:29	07:01	06:38	07:07		10:37 (1)
	16:45			17:23	18:56	19:30	20:00	20:22	20:17	19:41	18:49	18:00	16:23	16:18	47	11:24 (1)
20	07:08			06:35	06:50	05:59	05:23	05:11	05:28	05:59	06:30	07:03	06:40	07:08		10:37 (1)
	16:46			17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22	16:18	48	11:25 (1)
21	07:07			06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09		10:37 (1)
	16:47			17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:19	48	11:25 (1)
22	07:07			06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09		10:38 (1)
	16:48			17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19	48	11:26 (1)
23	07:06			06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10		10:38 (1)
	16:50			17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:21	16:20	48	11:26 (1)
24	07:05			06:29	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10		10:38 (1)
	16:51			17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20	48	11:26 (1)
25	07:04			06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10		10:40 (1)
	16:52			17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21	47	11:27 (1)
26	07:04			06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:36	07:10	06:47	07:11		10:40 (1)
	16:53			17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	16:21	47	11:27 (1)
27	07:03			06:25	06:39	05:49	05:17	05:13	05:35	06:06	06:38	07:11	06:48	07:11		10:40 (1)
	16:55			17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22	47	11:27 (1)
28	07:02			06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:11		10:42 (1)
	16:56			17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23	46	11:28 (1)
29	07:01				06:35	05:46	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12		10:43 (1)
	16:57				19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:18	16:23	45	11:28 (1)
30	07:00				06:33	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12		10:44 (1)
	16:58				19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24	44	11:28 (1)
31	06:59				06:32		05:15		05:39	06:10		07:15		07:12		10:44 (1)
	17:00				19:09		20:11		20:06	19:22		17:43		16:25	43	11:27 (1)
Potential sun hours	296			297	370	400	450	454	461	429	375	344	297	286		
Total, worst case		271													1191	
Sun reduction		0.56													0.52	
Oper. time red.		1.00													1.00	
Wind dir. red.		0.74													0.74	
Total reduction		0.41													0.38	
Total, real		111													453	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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Calculated:
5/3/2011 4:53 PM/2.7.473

SHADOW - Calendar

Shadow receptor: B - 5B

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:14	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:42	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:39	05:13	05:17	05:43	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12	05:18	05:46	06:17	06:48	06:24	06:58
	16:32	17:08	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:20	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:31	05:11	05:21	05:50	06:21	06:52	06:29	07:02
	16:36	17:13	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:11	06:46	07:04	06:12	05:30	05:11	05:22	05:51	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:23	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:50	19:24	19:57	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:25	19:58	20:21	20:19	19:46	18:56	18:06	16:26	16:16
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:10	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	19:59	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:02	05:24	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:23	05:11	05:27	05:58	06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30	20:00	20:22	20:17	19:41	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:23	05:11	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:20	16:20
24	07:05	06:29	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:36	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:49	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:13	05:35	06:06	06:38	07:11	06:48	07:11
	16:54	17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:46	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:18	16:23
30	07:00		06:33	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:15		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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5/3/2011 4:56 PM / 3

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US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
5/3/2011 4:53 PM/2.7.473

SHADOW - Calendar

Shadow receptor: C - 5C

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:14	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:41	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:42	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:39	05:13	05:17	05:43	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:44	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12	05:18	05:45	06:17	06:48	06:24	06:58
	16:31	17:08	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59
	16:32	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:20	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:31	05:11	05:21	05:50	06:21	06:52	06:29	07:02
	16:36	17:13	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:11	06:46	07:04	06:12	05:30	05:11	05:22	05:51	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:23	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:50	19:24	19:56	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:25	19:58	20:21	20:19	19:46	18:56	18:06	16:26	16:16
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:10	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	19:59	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:02	05:24	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:23	05:11	05:27	05:58	06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30	20:00	20:22	20:17	19:41	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:23	05:11	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:20	16:20
24	07:05	06:29	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:36	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:49	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:13	05:35	06:06	06:38	07:11	06:48	07:11
	16:54	17:33	19:05	19:38	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
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	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:18	16:23
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Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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5/3/2011 4:56 PM / 4

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Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
5/3/2011 4:53 PM/2.7.473

SHADOW - Calendar

Shadow receptor: D - 5D

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:14	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:16	05:40	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:17
3	07:13	06:56	06:18	06:27	05:41	05:14	05:16	05:41	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:42	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:39	05:13	05:17	05:43	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:44	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12	05:18	05:45	06:17	06:48	06:24	06:58
	16:31	17:08	17:42	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59
	16:32	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:20	05:49	06:20	06:51	06:28	07:01
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	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
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	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
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Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
5/3/2011 4:53 PM/2.7.473

SHADOW - Calendar

Shadow receptor: E - 5E

Assumptions for shadow calculations

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1	07:12	06:58	06:22	06:30	05:44	05:14	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:16	05:40	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:17
3	07:13	06:56	06:18	06:27	05:41	05:14	05:16	05:41	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:23	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:42	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:39	05:13	05:17	05:43	06:15	06:46	06:21	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:12	05:18	05:44	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12	05:18	05:45	06:17	06:48	06:24	06:58
	16:31	17:08	17:42	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18	05:35	05:12	05:19	05:46	06:18	06:49	06:25	06:59
	16:32	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:20	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:31	05:11	05:21	05:50	06:21	06:52	06:29	07:02
	16:36	17:13	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:11	06:46	07:04	06:12	05:30	05:11	05:22	05:51	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:23	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:50	19:24	19:56	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:18	18:52	19:25	19:57	20:21	20:19	19:46	18:56	18:06	16:26	16:16
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:58	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:09	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	19:59	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:02	05:24	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:43	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:23	05:11	05:27	05:58	06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30	20:00	20:22	20:17	19:40	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:23	05:11	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:37	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:20	16:20
24	07:05	06:29	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:36	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:49	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:13	05:35	06:06	06:37	07:11	06:48	07:11
	16:54	17:33	19:05	19:38	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:46	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:18	16:23
30	07:00		06:33	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:15		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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5/3/2011 4:56 PM / 6

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US-75074-5977 Plano TX
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Alec Richardson / arichardson@geo-marine.com

Calculated:
5/3/2011 4:53 PM/2.7.473

SHADOW - Calendar

Shadow receptor: F - 5F

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March			April			May	June	July	August			September			October	November	December
1	07:12	06:58	06:22			06:30		18:39 (1)	05:44	05:14	05:15	05:40			06:11		18:32 (1)	06:42	06:17	06:52
	16:26	17:01	17:35			19:10	10	18:49 (1)	19:43	20:12	20:24	20:05			19:20	26	18:58 (1)	18:29	16:42	16:17
2	07:13	06:57	06:20			06:28		18:37 (1)	05:42	05:14	05:16	05:41			06:12		18:31 (1)	06:43	06:18	06:53
	16:27	17:02	17:37			19:11	12	18:49 (1)	19:44	20:13	20:24	20:04			19:18	26	18:57 (1)	18:27	16:40	16:17
3	07:13	06:56	06:18			06:27		18:36 (1)	05:41	05:14	05:16	05:41			06:13		18:31 (1)	06:44	06:19	06:54
	16:28	17:03	17:38			19:12	15	18:51 (1)	19:45	20:14	20:23	20:03			19:17	24	18:55 (1)	18:25	16:39	16:16
4	07:13	06:55	06:17			06:25		18:35 (1)	05:40	05:13	05:17	05:42			06:14		18:30 (1)	06:45	06:20	06:55
	16:29	17:05	17:39			19:14	17	18:52 (1)	19:46	20:14	20:23	20:02			19:15	23	18:53 (1)	18:24	16:38	16:16
5	07:13	06:54	06:15			06:23		18:34 (1)	05:39	05:13	05:17	05:43			06:15		18:30 (1)	06:46	06:21	06:56
	16:30	17:06	17:40			19:15	18	18:52 (1)	19:47	20:15	20:23	20:01			19:13	22	18:52 (1)	18:22	16:37	16:16
6	07:13	06:53	06:14			06:22		18:34 (1)	05:37	05:13	05:18	05:44			06:16		18:30 (1)	06:47	06:23	06:57
	16:31	17:07	17:41			19:16	20	18:54 (1)	19:48	20:16	20:23	19:58			19:12	20	18:50 (1)	18:20	16:36	16:16
7	07:12	06:52	06:12			06:20		18:33 (1)	05:36	05:12	05:18	05:46			06:17		18:30 (1)	06:48	06:24	06:58
	16:32	17:08	17:42			19:17	22	18:55 (1)	19:49	20:16	20:23	19:57			19:10	19	18:49 (1)	18:19	16:34	16:16
8	07:12	06:51	07:10			06:18		18:32 (1)	05:35	05:12	05:19	05:47			06:18		18:30 (1)	06:49	06:25	06:59
	16:32	17:10	18:44			19:18	23	18:55 (1)	19:50	20:17	20:22	19:56			19:08	17	18:47 (1)	18:17	16:33	16:16
9	07:12	06:50	07:09			06:17		18:33 (1)	05:34	05:12	05:20	05:48			06:19		18:30 (1)	06:50	06:26	07:00
	16:34	17:11	18:45			19:19	24	18:57 (1)	19:51	20:18	20:22	19:54			19:07	15	18:45 (1)	18:15	16:32	16:16
10	07:12	06:48	07:07			06:15		18:32 (1)	05:33	05:12	05:20	05:49			06:20		18:30 (1)	06:51	06:28	07:01
	16:35	17:12	18:46			19:20	26	18:58 (1)	19:52	20:18	20:22	19:53			19:05	13	18:43 (1)	18:14	16:31	16:16
11	07:12	06:47	07:06			06:14		18:33 (1)	05:31	05:11	05:21	05:50			06:21		18:31 (1)	06:52	06:29	07:02
	16:36	17:13	18:47			19:21	26	18:59 (1)	19:53	20:19	20:21	19:52			19:03	10	18:41 (1)	18:12	16:30	16:16
12	07:11	06:46	07:04			06:12		18:33 (1)	05:30	05:11	05:22	05:51			06:22		18:32 (1)	06:54	06:30	07:02
	16:37	17:15	18:48			19:22	27	19:00 (1)	19:54	20:19	20:21	19:50			19:02	7	18:39 (1)	18:11	16:29	16:16
13	07:11	06:45	07:02			06:10		18:33 (1)	05:29	05:11	05:23	05:52			06:23		18:33 (1)	06:55	06:31	07:03
	16:38	17:16	18:49			19:23	28	19:01 (1)	19:55	20:20	20:20	19:49			19:00	4	18:37 (1)	18:09	16:28	16:16
14	07:11	06:43	07:01			06:09		18:34 (1)	05:28	05:11	05:23	05:53			06:24			06:56	06:32	07:04
	16:39	17:17	18:50			19:24	26	19:00 (1)	19:56	20:20	20:20	19:48			18:58			18:07	16:27	16:16
15	07:10	06:42	06:59			06:07		18:34 (1)	05:27	05:11	05:24	05:54			06:25			06:57	06:34	07:05
	16:40	17:19	18:52			19:25	24	18:58 (1)	19:57	20:21	20:19	19:46			18:56			18:06	16:26	16:16
16	07:10	06:41	06:57			06:06		18:36 (1)	05:26	05:11	05:25	05:55			06:26			06:58	06:35	07:05
	16:41	17:20	18:53			19:27	21	18:57 (1)	19:58	20:21	20:19	19:45			18:55			18:04	16:26	16:17
17	07:09	06:39	06:56			06:04		18:37 (1)	05:25	05:11	05:26	05:56			06:27			06:59	06:36	07:06
	16:42	17:21	18:54			19:28	17	18:54 (1)	19:59	20:22	20:18	19:43			18:53			18:03	16:25	16:17
18	07:09	06:38	06:54			06:02		18:40 (1)	05:24	05:11	05:27	05:57			06:28			07:00	06:37	07:07
	16:44	17:22	18:55			19:29	12	18:52 (1)	20:00	20:22	20:17	19:42			18:51			18:01	16:24	16:17
19	07:08	06:37	06:52			06:01			05:23	05:11	05:27	05:58			06:29			07:01	06:38	07:07
	16:45	17:23	18:56			19:30			20:00	20:22	20:17	19:40			18:49			18:00	16:23	16:18
20	07:08	06:35	06:50			05:59			05:23	05:11	05:28	05:59			06:30			07:03	06:40	07:08
	16:46	17:25	18:57			19:31			20:01	20:23	20:16	19:39			18:48			17:58	16:22	16:18
21	07:07	06:34	06:49			05:58			05:22	05:12	05:29	06:00			06:31			07:04	06:41	07:09
	16:47	17:26	18:58			19:32			20:02	20:23	20:15	19:37			18:46			17:57	16:22	16:19
22	07:07	06:32	06:47			05:56			05:21	05:12	05:30	06:01			06:32			07:05	06:42	07:09
	16:48	17:27	18:59			19:33			20:03	20:23	20:14	19:36			18:44			17:55	16:21	16:19
23	07:06	06:31	06:45			05:55			05:20	05:12	05:31	06:02			06:33			07:06	06:43	07:10
	16:50	17:28	19:00			19:34			20:04	20:23	20:14	19:34			18:43			17:54	16:20	16:20
24	07:05	06:29	06:44			05:53			05:19	05:12	05:32	06:03			06:34			07:07	06:44	07:10
	16:51	17:30	19:02			19:35			20:05	20:23	20:13	19:33			18:41			17:52	16:20	16:20
25	07:04	06:28	06:42			05:52			05:19	05:13	05:33	06:04		18:43 (1)	06:35			07:08	06:45	07:10
	16:52	17:31	19:03			19:36			20:06	20:24	20:12	19:31	12	18:55 (1)	18:39			17:51	16:19	16:21
26	07:04	06:26	06:40			05:51			05:18	05:13	05:34	06:05		18:40 (1)	06:36			07:09	06:47	07:11
	16:53	17:32	19:04			19:37			20:07	20:24	20:11	19:30	18	18:58 (1)	18:37			17:49	16:19	16:21
27	07:03	06:25	06:39			05:49			05:17	05:13	05:35	06:06		18:38 (1)	06:37			07:11	06:48	07:11
	16:54	17:33	19:05			19:38			20:08	20:24	20:10	19:28	21	18:59 (1)	18:36			17:48	16:18	16:22
28	07:02	06:23	06:37			05:48			05:17	05:14	05:36	06:07		18:36 (1)	06:39			07:12	06:49	07:11
	16:56	17:34	19:06			19:40			20:09	20:24	20:09	19:27	24	19:00 (1)	18:34			17:47	16:18	16:23
29	07:01		06:35			05:46			05:16	05:14	05:37	06:08		18:35 (1)	06:40			07:13	06:50	07:12
	16:57		19:07			19:41			20:10	20:24	20:08	19:25	26	19:01 (1)	18:32			17:45	16:18	16:23
30	07:00		06:33		18:42 (1)	05:45			05:16	05:15	05:38	06:09		18:34 (1)	06:41			07:14	06:51	07:12
	16:58		19:08	4	18:46 (1)	19:42			20:10	20:24	20:07	19:23	28	19:02 (1)	18:31			17:44	16:17	16:24
31	06:59		06:32		18:41 (1)				05:15		05:39	06:10		18:33 (1)				07:15		07:12
	17:00		19:09	7	18:48 (1)				20:11		20:06	19:22	27	19:00 (1)				17:43		16:25
Potential sun hours	296	297	370			400			450	454	461	429			375			344	297	286
Total, worst case				11			368						156			226				
Sun reduction				0.58			0.57						0.62			0.62				
Oper. time red.				1.00			1.00						1.00			1.00				
Wind dir. red.				0.54			0.54						0.54			0.54				
Total reduction				0.31			0.31						0.34			0.34				
Total, real				3			114						53			76				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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5/3/2011 4:56 PM / 7

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9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
5/3/2011 4:53 PM/2.7.473

SHADOW - Calendar

Shadow receptor: G - 5G

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May		June		July		August		September	October	November	December
1	07:12	06:58	06:22	06:30	05:44		19:13 (1)	05:15		18:54 (1)	05:15		19:03 (1)	05:40		19:05 (1)	06:11	06:42	06:17	06:52
	16:26	17:01	17:35	19:10	19:43	2	19:15 (1)	20:12	42	19:36 (1)	20:24	37	19:40 (1)	20:05	36	19:41 (1)	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:28	05:42		19:07 (1)	05:14		18:55 (1)	05:16		19:03 (1)	05:41		19:05 (1)	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	13	19:20 (1)	20:13	41	19:36 (1)	20:24	37	19:40 (1)	20:04	35	19:40 (1)	19:18	18:27	16:40	16:17
3	07:13	06:56	06:18	06:27	05:41		19:04 (1)	05:14		18:55 (1)	05:16		19:03 (1)	05:42		19:06 (1)	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	17	19:21 (1)	20:14	40	19:35 (1)	20:23	38	19:41 (1)	20:03	33	19:39 (1)	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40		19:02 (1)	05:13		18:56 (1)	05:17		19:03 (1)	05:43		19:06 (1)	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	21	19:23 (1)	20:14	40	19:36 (1)	20:23	38	19:41 (1)	20:02	31	19:37 (1)	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:39		19:01 (1)	05:13		18:56 (1)	05:17		19:03 (1)	05:44		19:06 (1)	06:15	06:46	06:21	06:56
	16:30	17:06	17:40	19:15	19:47	23	19:24 (1)	20:15	40	19:36 (1)	20:23	38	19:41 (1)	20:01	30	19:36 (1)	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37		18:59 (1)	05:13		18:57 (1)	05:18		19:03 (1)	05:45		19:07 (1)	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	25	19:24 (1)	20:16	39	19:36 (1)	20:23	39	19:42 (1)	19:58	28	19:35 (1)	19:12	18:20	16:36	16:16
7	07:12	06:52	06:12	06:20	05:36		18:57 (1)	05:12		18:57 (1)	05:18		19:03 (1)	05:46		19:09 (1)	06:17	06:48	06:24	06:58
	16:32	17:08	17:43	19:17	19:49	28	19:25 (1)	20:16	38	19:35 (1)	20:23	39	19:42 (1)	19:57	24	19:33 (1)	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18	05:35		18:57 (1)	05:12		18:57 (1)	05:19		19:03 (1)	05:47		19:10 (1)	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50	29	19:26 (1)	20:17	38	19:35 (1)	20:22	40	19:43 (1)	19:56	22	19:32 (1)	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34		18:56 (1)	05:12		18:58 (1)	05:20		19:02 (1)	05:48		19:12 (1)	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	31	19:27 (1)	20:18	38	19:36 (1)	20:22	40	19:42 (1)	19:54	19	19:31 (1)	19:07	18:15	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33		18:55 (1)	05:12		18:58 (1)	05:20		19:02 (1)	05:49		19:14 (1)	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	33	19:28 (1)	20:18	38	19:36 (1)	20:22	41	19:43 (1)	19:53	16	19:30 (1)	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:31		18:54 (1)	05:11		18:59 (1)	05:21		19:03 (1)	05:50		19:17 (1)	06:21	06:52	06:29	07:02
	16:36	17:13	18:47	19:21	19:53	36	19:30 (1)	20:19	37	19:36 (1)	20:21	41	19:44 (1)	19:52	12	19:29 (1)	19:03	18:12	16:30	16:16
12	07:11	06:46	07:04	06:12	05:30		18:54 (1)	05:11		18:59 (1)	05:22		19:03 (1)	05:51			06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	36	19:30 (1)	20:19	37	19:36 (1)	20:21	41	19:44 (1)	19:50			19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29		18:53 (1)	05:11		19:00 (1)	05:23		19:02 (1)	05:52			06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:55	38	19:31 (1)	20:20	36	19:36 (1)	20:20	42	19:44 (1)	19:49			19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28		18:53 (1)	05:11		19:00 (1)	05:23		19:02 (1)	05:53			06:24	06:56	06:32	07:04
	16:39	17:17	18:50	19:24	19:56	39	19:32 (1)	20:20	36	19:36 (1)	20:20	43	19:45 (1)	19:48			18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27		18:53 (1)	05:11		19:01 (1)	05:24		19:02 (1)	05:54			06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:25	19:57	40	19:33 (1)	20:21	35	19:36 (1)	20:19	43	19:45 (1)	19:46			18:56	18:06	16:26	16:16
16	07:10	06:41	06:57	06:06	05:26		18:52 (1)	05:11		19:01 (1)	05:25		19:03 (1)	05:55			06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:58	42	19:34 (1)	20:21	35	19:36 (1)	20:19	43	19:46 (1)	19:45			18:55	18:04	16:26	16:17
17	07:09	06:39	06:56	06:04	05:25		18:52 (1)	05:11		19:01 (1)	05:26		19:02 (1)	05:56			06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	19:59	43	19:35 (1)	20:22	35	19:36 (1)	20:18	43	19:45 (1)	19:43			18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:02	05:24		18:52 (1)	05:11		19:01 (1)	05:27		19:02 (1)	05:57			06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00	43	19:35 (1)	20:22	35	19:36 (1)	20:17	44	19:46 (1)	19:42			18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:23		18:52 (1)	05:11		19:02 (1)	05:27		19:02 (1)	05:58			06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30	20:00	43	19:35 (1)	20:22	34	19:36 (1)	20:17	44	19:46 (1)	19:40			18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:23		18:52 (1)	05:11		19:02 (1)	05:28		19:02 (1)	05:59			06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	44	19:36 (1)	20:23	34	19:36 (1)	20:16	44	19:46 (1)	19:39			18:48	17:58	16:22	16:18
21	07:07	06:34	06:49	05:58	05:22		18:52 (1)	05:12		19:02 (1)	05:29		19:02 (1)	06:00			06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	44	19:36 (1)	20:23	34	19:36 (1)	20:15	44	19:46 (1)	19:37			18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:56	05:21		18:52 (1)	05:12		19:03 (1)	05:30		19:03 (1)	06:01			06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	44	19:36 (1)	20:23	34	19:37 (1)	20:14	44	19:47 (1)	19:36			18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20		18:52 (1)	05:12		19:03 (1)	05:31		19:02 (1)	06:02			06:33	07:06	06:43	07:10
	16:50	17:28	19:00	19:34	20:04	44	19:36 (1)	20:23	34	19:37 (1)	20:14	44	19:46 (1)	19:34			18:43	17:54	16:20	16:20
24	07:05	06:29	06:44	05:53	05:19		18:53 (1)	05:12		19:02 (1)	05:32		19:02 (1)	06:03			06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	44	19:37 (1)	20:23	35	19:37 (1)	20:13	44	19:46 (1)	19:33			18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19		18:52 (1)	05:13		19:02 (1)	05:33		19:02 (1)	06:04			06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	44	19:36 (1)	20:24	35	19:37 (1)	20:12	44	19:46 (1)	19:31			18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18		18:52 (1)	05:13		19:03 (1)	05:34		19:02 (1)	06:05			06:36	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	44	19:36 (1)	20:24	35	19:38 (1)	20:11	44	19:46 (1)	19:30			18:37	17:49	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17		18:53 (1)	05:13		19:03 (1)	05:35		19:03 (1)	06:06			06:37	07:11	06:48	07:11
	16:54	17:33	19:05	19:38	20:08	43	19:36 (1)	20:24	35	19:38 (1)	20:10	42	19:45 (1)	19:28			18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17		18:53 (1)	05:14		19:02 (1)	05:36		19:03 (1)	06:07			06:39	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20:09	43	19:36 (1)	20:24	36	19:38 (1)	20:09	41	19:44 (1)	19:27			18:34	17:47	16:18	16:23
29	07:01		06:35	05:46	05:16		18:54 (1)	05:14		19:03 (1)	05:37		19:03 (1)	06:08			06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	42	19:36 (1)	20:24	36	19:39 (1)	20:08	40	19:43 (1)	19:25			18:32	17:45	16:18	16:23
30	07:00		06:33	05:45	05:16		18:54 (1)	05:15		19:03 (1)	05:38		19:04 (1)	06:09			06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	42	19:36 (1)	20:24	36	19:39 (1)	20:07	39	19:43 (1)	19:23			18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		18:54 (1)				05:39		19:04 (1)	06:10				07:15		07:12
	17:00		19:09		20:11	42	19:36 (1)				20:06	38	19:42 (1)	19:22				17:43		16:25
Potential sun hours	296	297	370	400	450			454			461			429			375	344	297	286
Total, worst case						1102			1098			1279			286					
Sun reduction						0.58			0.61			0.63			0.62					
Oper. time red.						1.00			1.00			1.00			1.00					
Wind dir. red.						0.59			0.59			0.59			0.59					
Total reduction						0.34			0.36			0.37			0.36					
Total, real						376			394			474			104					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
5/3/2011 4:56 PM / 8

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
5/3/2011 4:53 PM/2.7.473

SHADOW - Calendar

Shadow receptor: H - 5H

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:23	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:39	05:13	05:17	05:44	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12	05:18	05:46	06:17	06:48	06:24	06:58
	16:32	17:08	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:20	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:32	05:11	05:21	05:50	06:21	06:52	06:29	07:02
	16:36	17:14	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:11	06:46	07:04	06:12	05:30	05:11	05:22	05:51	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:23	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:50	19:24	19:56	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:25	19:57	20:21	20:19	19:46	18:56	18:06	16:26	16:16
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:58	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:09	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	19:59	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:02	05:24	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:23	05:11	05:28	05:58	06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30	20:00	20:22	20:17	19:40	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:23	05:12	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:36	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:13	05:35	06:06	06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:38	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:46	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:18	16:23
30	07:00		06:33	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:15		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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5/3/2011 4:56 PM / 9

Licensed user:
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2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
5/3/2011 4:53 PM/2.7.473

SHADOW - Calendar

Shadow receptor: I - 5I

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:12	06:57	06:20	06:28	05:42	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:17
3	07:13	06:56	06:18	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:23	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:39	05:13	05:17	05:44	06:15	06:46	06:21	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12	05:18	05:46	06:17	06:48	06:24	06:58
	16:32	17:08	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:20	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:32	05:11	05:21	05:50	06:21	06:52	06:29	07:02
	16:36	17:14	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:11	06:46	07:04	06:12	05:30	05:11	05:22	05:51	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:23	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:50	19:24	19:56	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:25	19:57	20:21	20:19	19:46	18:56	18:06	16:26	16:16
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:58	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:09	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	19:59	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:02	05:24	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:24	05:11	05:28	05:58	06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30	20:00	20:22	20:17	19:40	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:23	05:12	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:37	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:36	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:13	05:35	06:06	06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:38	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:46	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:18	16:23
30	07:00		06:33	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:15		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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5/3/2011 4:56 PM / 10

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
5/3/2011 4:53 PM/2.7.473

SHADOW - Calendar

Shadow receptor: J - 5J

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:39	05:13	05:17	05:44	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12	05:18	05:46	06:17	06:48	06:24	06:58
	16:32	17:08	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
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	16:33	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	16:16
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	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:32	05:11	05:21	05:50	06:21	06:52	06:29	07:02
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	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
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19	07:08	06:37	06:52	06:01	05:24	05:11	05:28	05:58	06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30	20:00	20:22	20:17	19:41	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:23	05:12	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
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27	07:03	06:25	06:39	05:49	05:17	05:13	05:35	06:06	06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:11
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	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:18	16:23
30	07:00		06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:15		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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5/3/2011 4:56 PM / 11

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
5/3/2011 4:53 PM/2.7.473

SHADOW - Calendar

Shadow receptor: K - 5K

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:39	05:13	05:17	05:44	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24	06:58
	16:32	17:08	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:32	05:11	05:21	05:50	06:21	06:52	06:29	07:02
	16:36	17:14	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:11	06:46	07:04	06:12	05:30	05:11	05:22	05:51	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:23	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:51	19:24	19:56	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:25	19:58	20:21	20:19	19:46	18:56	18:06	16:26	16:16
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:10	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	19:59	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:03	05:24	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:24	05:11	05:28	05:58	06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30	20:00	20:22	20:17	19:41	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:23	05:12	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:36	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:13	05:35	06:06	06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:46	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:18	16:23
30	07:00		06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:15		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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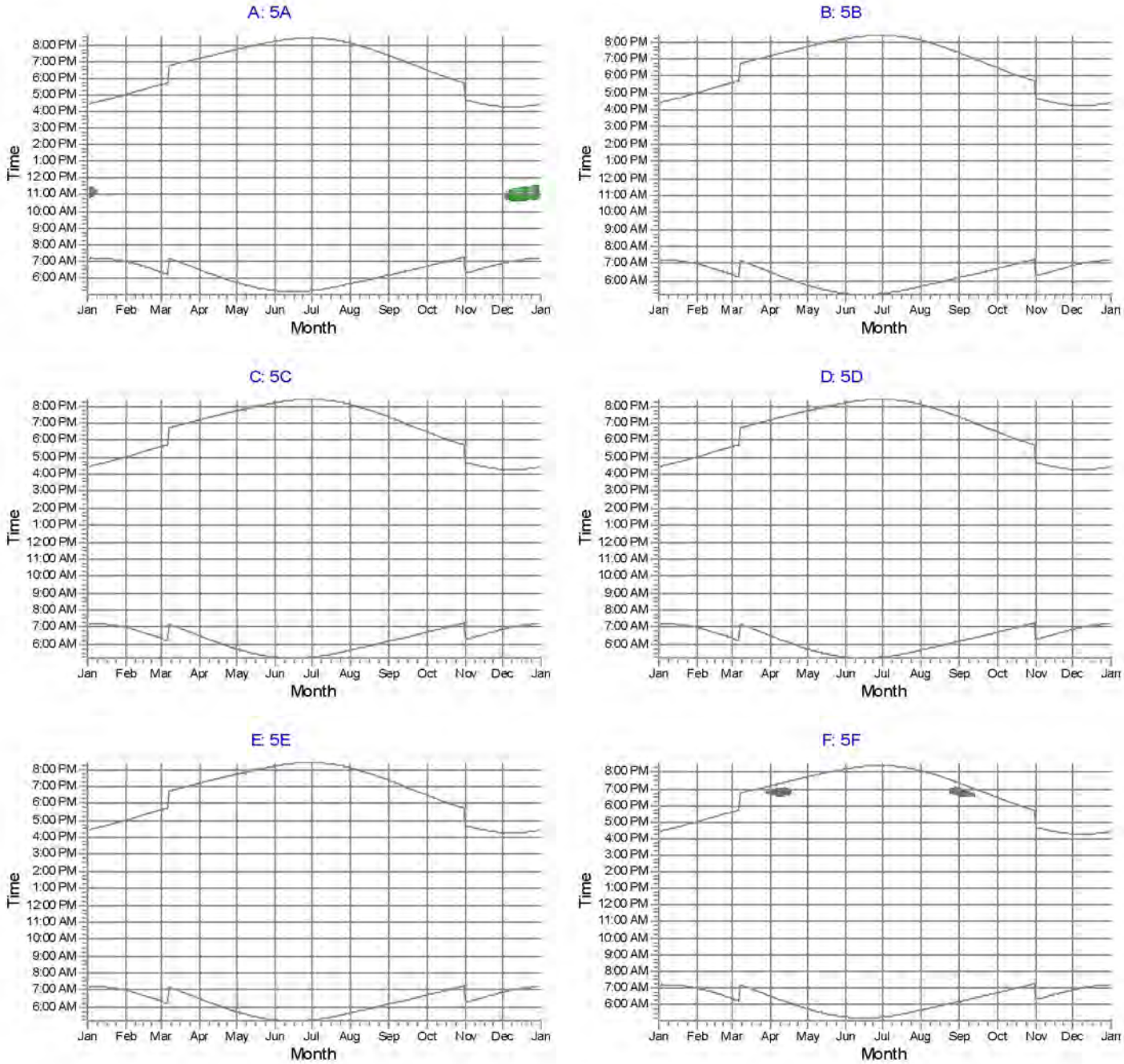
Calculated:
5/3/2011 4:53 PM/2.7.473

SHADOW - Calendar, graphical



WTGs

1: NUWC Stillwater Basin

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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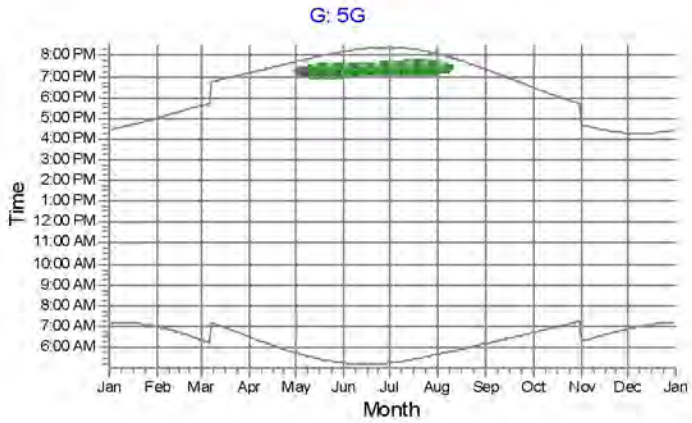
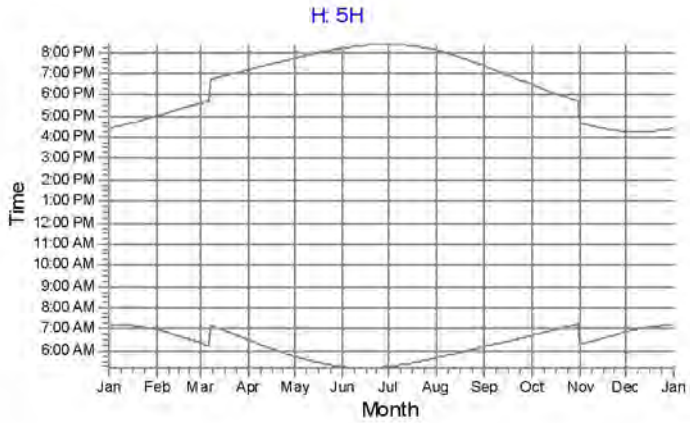
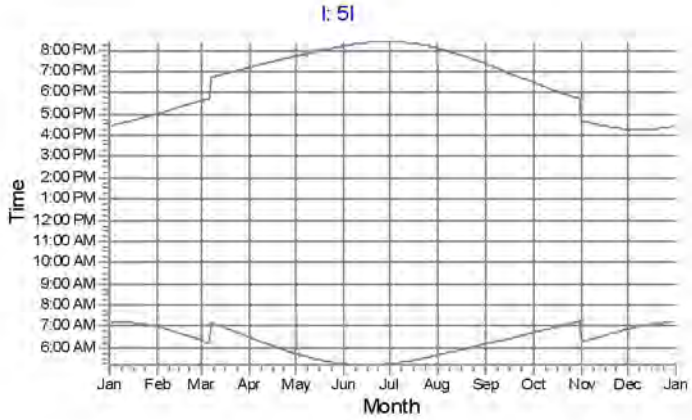
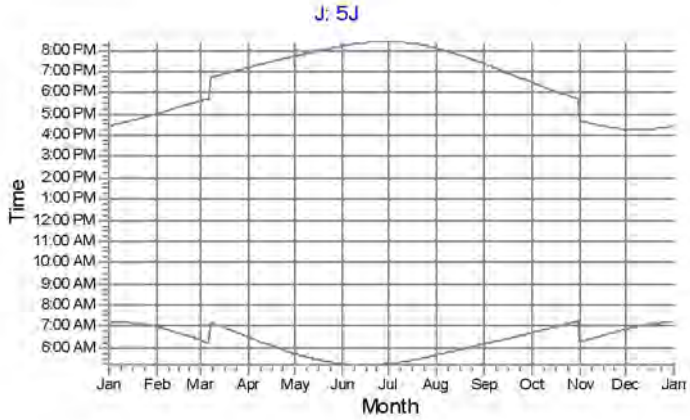
5/3/2011 4:53 PM/2.7.473

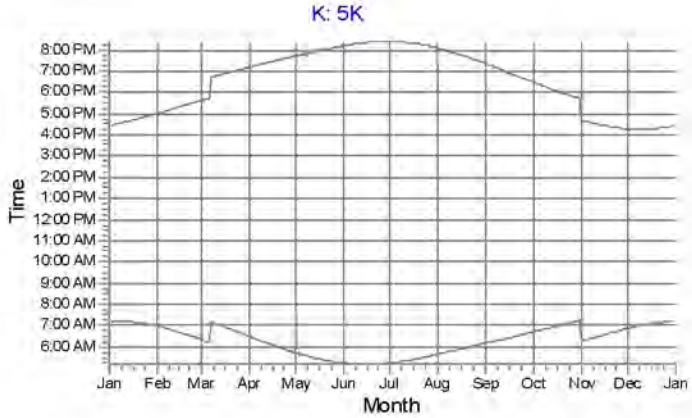
SHADOW - Calendar, graphical











WTGs

1: NUWC Stillwater Basin

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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Calculated:
5/3/2011 4:53 PM/2.7.473

SHADOW - Calendar per WTG

WTG: 1 - NUWC Stillwater Basin

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June
1	07:12 10:46-11:27/41 16:26	06:58 17:01	06:22 17:36	06:30 18:39-18:49/10 19:10	05:44 19:13-19:15/2 19:43	05:15 18:54-19:36/42 20:12
2	07:13 10:47-11:26/39 16:27	06:57 17:02	06:20 17:37	06:28 18:37-18:49/12 19:11	05:42 19:07-19:20/13 19:44	05:14 18:55-19:36/41 20:13
3	07:13 10:48-11:26/38 16:28	06:56 17:03	06:19 17:38	06:27 18:36-18:51/15 19:12	05:41 19:04-19:21/17 19:45	05:14 18:55-19:35/40 20:14
4	07:13 10:50-11:25/35 16:29	06:55 17:05	06:17 17:39	06:25 18:35-18:52/17 19:14	05:40 19:02-19:23/21 19:46	05:13 18:56-19:36/40 20:14
5	07:13 10:52-11:24/32 16:30	06:54 17:06	06:15 17:40	06:23 18:34-18:52/18 19:15	05:39 19:01-19:24/23 19:47	05:13 18:56-19:36/40 20:15
6	07:13 10:54-11:23/29 16:31	06:53 17:07	06:14 17:41	06:22 18:34-18:54/20 19:16	05:37 18:59-19:24/25 19:48	05:13 18:57-19:36/39 20:16
7	07:12 10:56-11:21/25 16:32	06:52 17:08	06:12 17:43	06:20 18:33-18:55/22 19:17	05:36 18:57-19:25/28 19:49	05:12 18:57-19:35/38 20:16
8	07:12 10:59-11:19/20 16:33	06:51 17:10	07:10 18:44	06:18 18:32-18:55/23 19:18	05:35 18:57-19:26/29 19:50	05:12 18:57-19:35/38 20:17
9	07:12 11:03-11:15/12 16:34	06:50 17:11	07:09 18:45	06:17 18:33-18:57/24 19:19	05:34 18:56-19:27/31 19:51	05:12 18:58-19:36/38 20:18
10	07:12 16:35	06:48 17:12	07:07 18:46	06:15 18:32-18:58/26 19:20	05:33 18:55-19:28/33 19:52	05:12 18:58-19:36/38 20:18
11	07:12 16:36	06:47 17:14	07:06 18:47	06:14 18:33-18:59/26 19:21	05:32 18:54-19:30/36 19:53	05:11 18:59-19:36/37 20:19
12	07:11 16:37	06:46 17:15	07:04 18:48	06:12 18:33-19:00/27 19:22	05:30 18:54-19:30/36 19:54	05:11 18:59-19:36/37 20:19
13	07:11 16:38	06:45 17:16	07:02 18:49	06:10 18:33-19:01/28 19:23	05:29 18:53-19:31/38 19:55	05:11 19:00-19:36/36 20:20
14	07:11 16:39	06:43 17:17	07:01 18:50	06:09 18:34-19:00/26 19:24	05:28 18:53-19:32/39 19:56	05:11 19:00-19:36/36 20:20
15	07:10 16:40	06:42 17:19	06:59 18:52	06:07 18:34-18:58/24 19:25	05:27 18:53-19:33/40 19:58	05:11 19:01-19:36/35 20:21
16	07:10 16:41	06:41 17:20	06:57 18:53	06:06 18:36-18:57/21 19:27	05:26 18:52-19:34/42 19:59	05:11 19:01-19:36/35 20:21
17	07:10 16:42	06:39 17:21	06:56 18:54	06:04 18:37-18:54/17 19:28	05:25 18:52-19:35/43 19:59	05:11 19:01-19:36/35 20:22
18	07:09 16:44	06:38 17:22	06:54 18:55	06:03 18:40-18:52/12 19:29	05:24 18:52-19:35/43 20:00	05:11 19:01-19:36/35 20:22
19	07:08 16:45	06:37 17:23	06:52 18:56	06:01 19:30	05:23 18:52-19:35/43 20:00	05:11 19:02-19:36/34 20:22
20	07:08 16:46	06:35 17:25	06:50 18:57	05:59 19:31	05:23 18:52-19:36/44 20:01	05:12 19:02-19:36/34 20:23
21	07:07 16:47	06:34 17:26	06:49 18:58	05:58 19:32	05:22 18:52-19:36/44 20:02	05:12 19:02-19:36/34 20:23
22	07:07 16:48	06:32 17:27	06:47 18:59	05:56 19:33	05:21 18:52-19:36/44 20:03	05:12 19:03-19:37/34 20:23
23	07:06 16:50	06:31 17:28	06:45 19:00	05:55 19:34	05:20 18:52-19:36/44 20:04	05:12 19:03-19:37/34 20:23
24	07:05 16:51	06:29 17:30	06:44 19:02	05:53 19:35	05:19 18:53-19:37/44 20:05	05:12 19:02-19:37/35 20:23
25	07:04 16:52	06:28 17:31	06:42 19:03	05:52 19:36	05:19 18:52-19:36/44 20:06	05:13 19:02-19:37/35 20:24
26	07:04 16:53	06:26 17:32	06:40 19:04	05:51 19:37	05:18 18:52-19:36/44 20:07	05:13 19:03-19:38/35 20:24
27	07:03 16:55	06:25 17:33	06:39 19:05	05:49 19:39	05:17 18:53-19:36/43 20:08	05:13 19:03-19:38/35 20:24
28	07:02 16:56	06:23 17:34	06:37 19:06	05:48 19:40	05:17 18:53-19:36/43 20:09	05:14 19:02-19:38/36 20:24
29	07:01 16:57		06:35 19:07	05:46 19:41	05:16 18:54-19:36/42 20:10	05:14 19:03-19:39/36 20:24
30	07:00 16:58		06:33 18:42-18:46/4 19:08	05:45 19:42	05:16 18:54-19:36/42 20:10	05:15 19:03-19:39/36 20:24
31	06:59 17:00		06:32 18:41-18:48/7 19:09		05:15 18:54-19:36/42 20:11	
Potential sun hours	296	297	370	400	450	454
Sum of minutes with flicker	271	0	11	368	1102	1098

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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SHADOW - Calendar per WTG

WTG: 1 - NUWC Stillwater Basin

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	July		August		September		October	November	December	
1	05:15 20:24	19:03-19:40/37	05:40 20:05	19:05-19:41/36	06:11 19:20	18:32-18:58/26	06:42 18:29	06:17 16:42	06:52 16:17	
2	05:16 20:24	19:03-19:40/37	05:41 20:04	19:05-19:40/35	06:12 19:18	18:31-18:57/26	06:43 18:27	06:18 16:40	06:53 16:17	
3	05:16 20:24	19:03-19:41/38	05:42 20:03	19:06-19:39/33	06:13 19:17	18:31-18:55/24	06:44 18:25	06:19 16:39	06:54 16:16	10:47-10:58/11
4	05:17 20:23	19:03-19:41/38	05:43 20:02	19:06-19:37/31	06:14 19:15	18:30-18:53/23	06:45 18:24	06:20 16:38	06:55 16:16	10:44-11:03/19
5	05:17 20:23	19:03-19:41/38	05:44 20:01	19:06-19:36/30	06:15 19:13	18:30-18:52/22	06:46 18:22	06:22 16:37	06:56 16:16	10:41-11:06/25
6	05:18 20:23	19:03-19:42/39	05:45 19:58	19:07-19:35/28	06:16 19:12	18:30-18:50/20	06:47 18:20	06:23 16:36	06:57 16:16	10:40-11:09/29
7	05:18 20:23	19:03-19:42/39	05:46 19:57	19:09-19:33/24	06:17 19:10	18:30-18:49/19	06:48 18:19	06:24 16:34	06:58 16:16	10:39-11:11/32
8	05:19 20:22	19:03-19:43/40	05:47 19:56	19:10-19:32/22	06:18 19:08	18:30-18:47/17	06:49 18:17	06:25 16:33	06:59 16:16	10:38-11:13/35
9	05:20 20:22	19:02-19:42/40	05:48 19:54	19:12-19:31/19	06:19 19:07	18:30-18:45/15	06:50 18:15	06:26 16:32	07:00 16:16	10:37-11:15/38
10	05:20 20:22	19:02-19:43/41	05:49 19:53	19:14-19:30/16	06:20 19:05	18:30-18:43/13	06:51 18:14	06:28 16:31	07:01 16:16	10:37-11:16/39
11	05:21 20:21	19:03-19:44/41	05:50 19:52	19:17-19:29/12	06:21 19:03	18:31-18:41/10	06:52 18:12	06:29 16:30	07:02 16:16	10:36-11:17/41
12	05:22 20:21	19:03-19:44/41	05:51 19:50		06:22 19:02	18:32-18:39/7	06:54 18:11	06:30 16:29	07:02 16:16	10:36-11:18/42
13	05:23 20:20	19:02-19:44/42	05:52 19:49		06:23 19:00	18:33-18:37/4	06:55 18:09	06:31 16:28	07:03 16:16	10:36-11:19/43
14	05:23 20:20	19:02-19:45/43	05:53 19:48		06:24 18:58		06:56 18:07	06:32 16:27	07:04 16:16	10:36-11:21/45
15	05:24 20:19	19:02-19:45/43	05:54 19:46		06:25 18:56		06:57 18:06	06:34 16:26	07:05 16:16	10:35-11:21/46
16	05:25 20:19	19:03-19:46/43	05:55 19:45		06:26 18:55		06:58 18:04	06:35 16:26	07:05 16:17	10:36-11:22/46
17	05:26 20:18	19:02-19:45/43	05:56 19:43		06:27 18:53		06:59 18:03	06:36 16:25	07:06 16:17	10:36-11:23/47
18	05:27 20:17	19:02-19:46/44	05:57 19:42		06:28 18:51		07:00 18:01	06:37 16:24	07:07 16:17	10:36-11:23/47
19	05:28 20:17	19:02-19:46/44	05:58 19:41		06:29 18:49		07:01 18:00	06:38 16:23	07:07 16:18	10:37-11:24/47
20	05:28 20:16	19:02-19:46/44	05:59 19:39		06:30 18:48		07:03 17:58	06:40 16:22	07:08 16:18	10:37-11:25/48
21	05:29 20:15	19:02-19:46/44	06:00 19:38		06:31 18:46		07:04 17:57	06:41 16:22	07:09 16:19	10:37-11:25/48
22	05:30 20:14	19:03-19:47/44	06:01 19:36		06:32 18:44		07:05 17:55	06:42 16:21	07:09 16:19	10:38-11:26/48
23	05:31 20:14	19:02-19:46/44	06:02 19:34		06:33 18:43		07:06 17:54	06:43 16:21	07:10 16:20	10:38-11:26/48
24	05:32 20:13	19:02-19:46/44	06:03 19:33		06:34 18:41		07:07 17:52	06:44 16:20	07:10 16:20	10:38-11:26/48
25	05:33 20:12	19:02-19:46/44	06:04 19:31	18:43-18:55/12	06:35 18:39		07:08 17:51	06:45 16:19	07:10 16:21	10:40-11:27/47
26	05:34 20:11	19:02-19:46/44	06:05 19:30	18:40-18:58/18	06:36 18:37		07:10 17:50	06:47 16:19	07:11 16:21	10:40-11:27/47
27	05:35 20:10	19:03-19:45/42	06:06 19:28	18:38-18:59/21	06:38 18:36		07:11 17:48	06:48 16:18	07:11 16:22	10:40-11:27/47
28	05:36 20:09	19:03-19:44/41	06:07 19:27	18:36-19:00/24	06:39 18:34		07:12 17:47	06:49 16:18	07:11 16:23	10:42-11:28/46
29	05:37 20:08	19:03-19:43/40	06:08 19:25	18:35-19:01/26	06:40 18:32		07:13 17:45	06:50 16:18	07:12 16:23	10:43-11:28/45
30	05:38 20:07	19:04-19:43/39	06:09 19:23	18:34-19:02/28	06:41 18:31		07:14 17:44	06:51 16:17	07:12 16:24	10:44-11:28/44
31	05:39 20:06	19:04-19:42/38	06:10 19:22	18:33-19:00/27			07:15 17:43		07:12 16:25	10:44-11:27/43
Potential sun hours	461		429		375		344	297	286	
Sum of minutes with flicker		1279		442		226	0	0		1191

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

Project:
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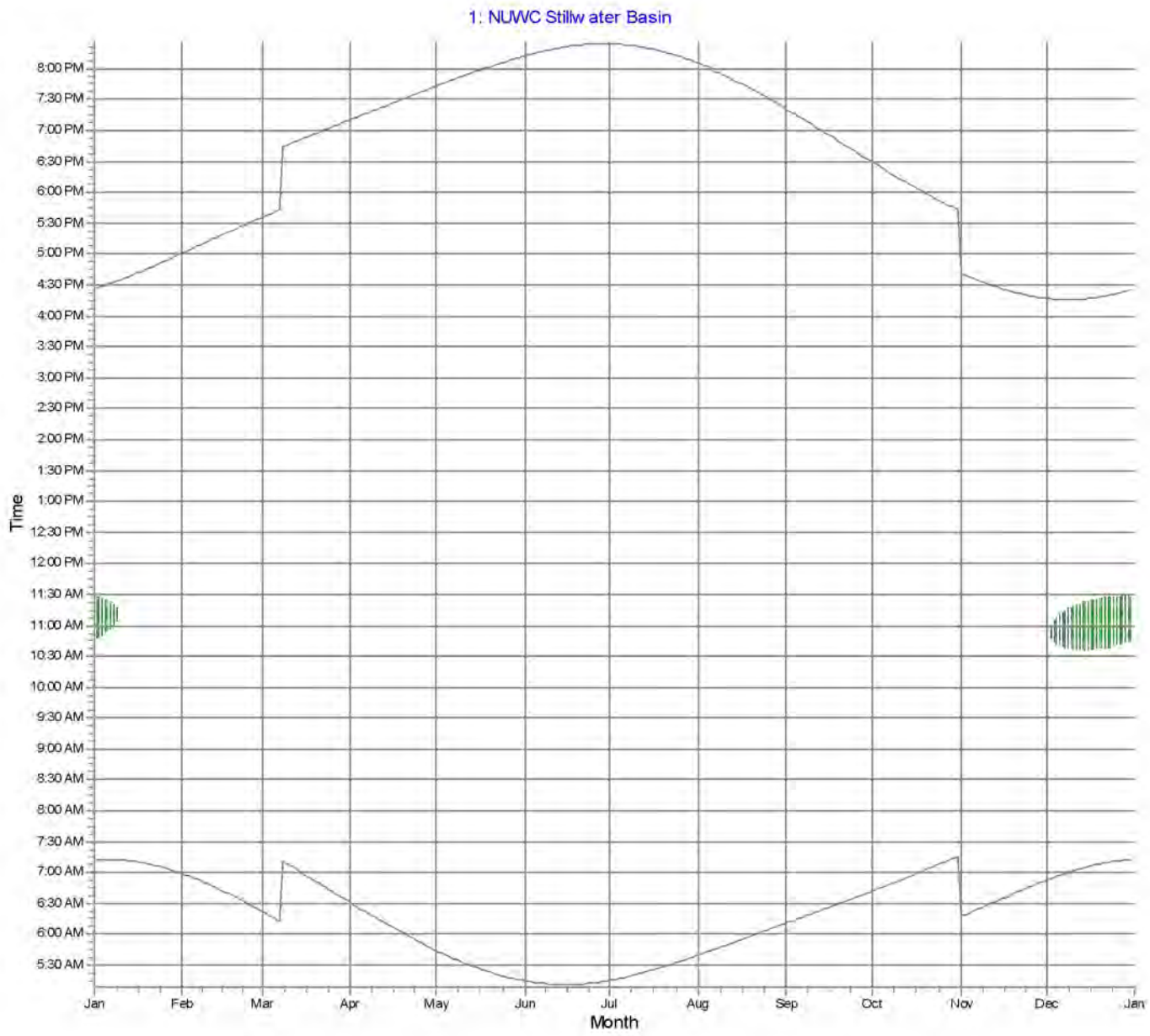
SHADOW - Calendar per WTG, graphical

WTG: 1 - NUWC Stillwater Basin



WTGs

A: 5A

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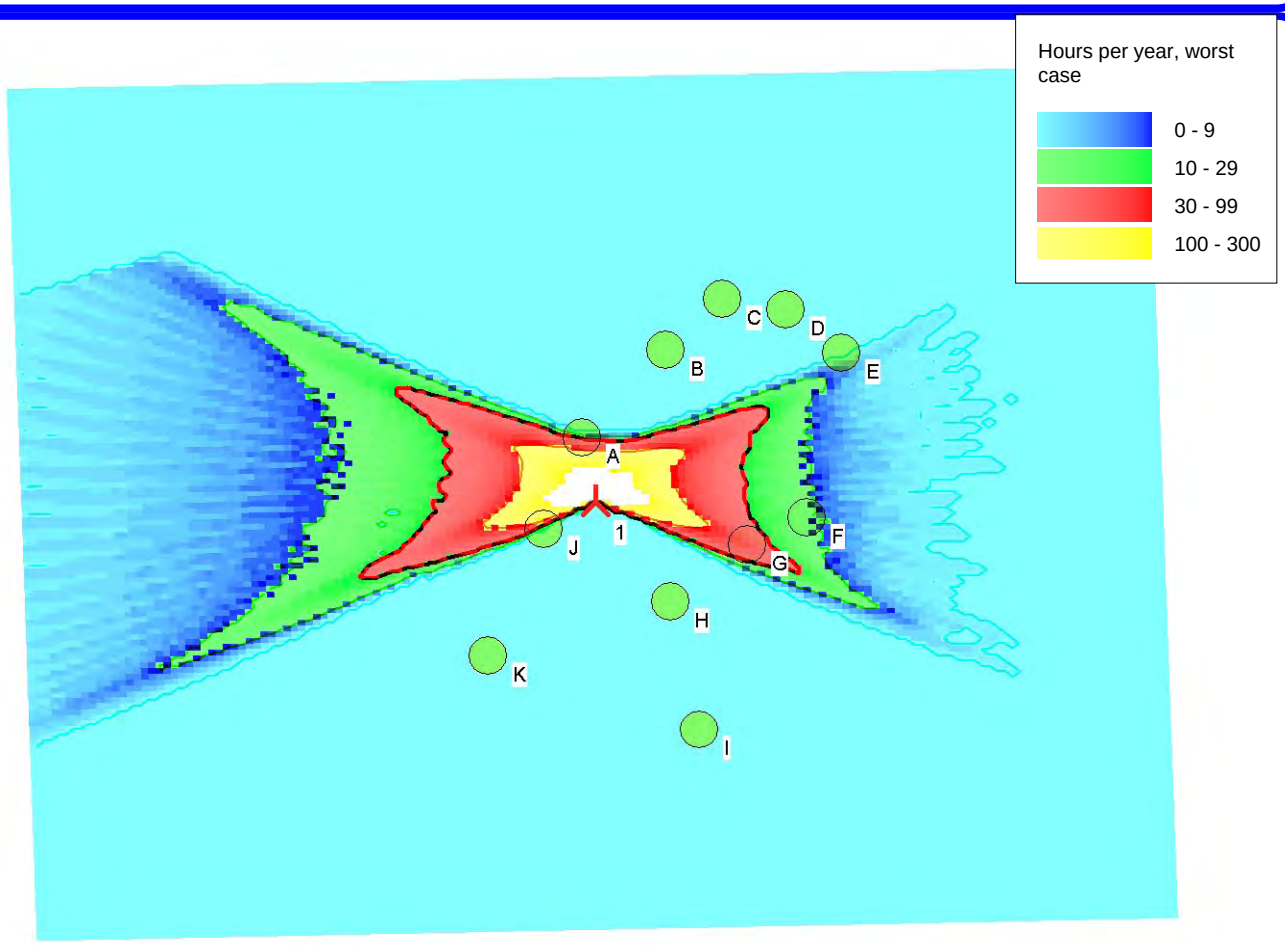
SHADOW - Map



0 250 500 750 1000m

Map: , Print scale 1:20,000, Map center Geo WGS 84 East: -71.307535° North: 41.536772°

New WTG Shadow receptor

Isolines showing shadow in Hours per year, worst case

0 10 30 100

APPENDIX 6

WIND TURBINE SITE 6 BUILDING 6 (DERECKTOR SHIPYARD)

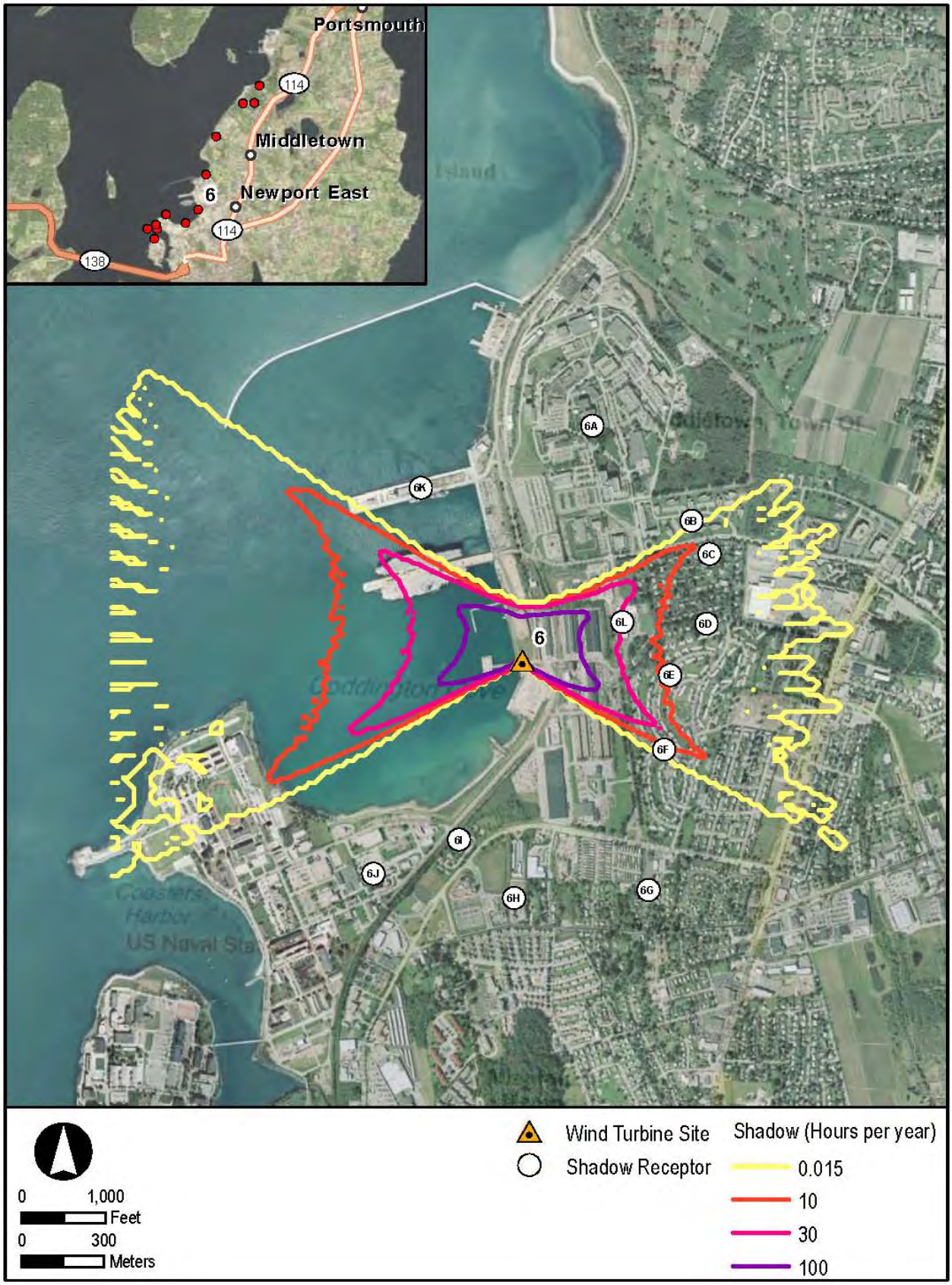


Figure A-6: Maximum predicted shadow flicker levels (hours per year) for a GE 1.5 MW sle Model at Wind Turbine Site 6 (Building 6 – Derecktor Shipyard).

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Calculated:
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SHADOW - Main Result

Assumptions for shadow calculations

Maximum distance for influence
Calculate only when more than 20 % of sun is covered by the blade
Please look in WTG table

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

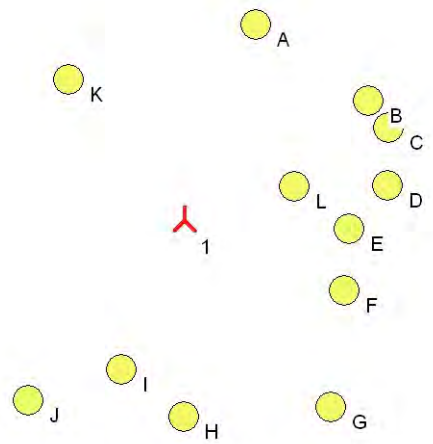
Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW
691	432	259	155	155	155	432	518	950	1,209	864	518

W	WNW	NW	NNW	Sum
432	604	691	691	8,756

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: Line object
Obstacles used in calculation
Eye height: 1.5 m
Grid resolution: 10 m



Scale 1:25,000
New WTG
Shadow receptor

WTGs

	Geo DD: WGS 84 Longitude	Latitude	Z [m]	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Shadow data Calculation distance [m]	RPM [RPM]
1	-71.311514° East	41.524852° North	0.0	Bldg 6 DS	Yes	GE WIND ENERGY	GE 1.5sle-1,500	1,500	77.0	65.0	2,000	20.0

Shadow receptor-Input

No.	Name	Geo DD: WGS 84 Longitude	Latitude	Z [m]	Width [m]	Height [m]	Height a.g.l. [m]	Degrees from south cw [°]	Slope of window [°]	Direction mode
A	6A	-71.308678° East	41.532637° North	41.1	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
B	6B	-71.304222° East	41.529604° North	27.8	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
C	6C	-71.303408° East	41.528525° North	31.9	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
D	6D	-71.303461° East	41.526237° North	34.0	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
E	6E	-71.304985° East	41.524518° North	33.2	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
F	6F	-71.305172° East	41.522067° North	29.1	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
G	6G	-71.305689° East	41.517446° North	27.4	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
H	6H	-71.311543° East	41.517063° North	19.5	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
I	6I	-71.314029° East	41.518928° North	9.1	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
J	6J	-71.317729° East	41.517730° North	10.5	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
K	6K	-71.316111° East	41.530448° North	1.5	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
L	6L	-71.307139° East	41.526217° North	28.2	1.0	1.0	1.0	-180.0	90.0	"Green house mode"

Project:

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SHADOW - Main Result

Calculation Results

Shadow receptor

		Shadow, worst case			Shadow, expected values
No.	Name	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	6A	0:00	0	0:00	0:00
B	6B	0:00	0	0:00	0:00
C	6C	5:23	40	0:13	1:37
D	6D	4:22	27	0:14	1:21
E	6E	9:39	38	0:22	3:07
F	6F	6:02	43	0:12	2:16
G	6G	0:00	0	0:00	0:00
H	6H	0:00	0	0:00	0:00
I	6I	0:00	0	0:00	0:00
J	6J	0:00	0	0:00	0:00
K	6K	0:00	0	0:00	0:00
L	6L	28:45	64	0:41	9:14

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

No.	Name	Worst case [h/year]	Expected [h/year]
1	Bldg 6 DS	54:07	17:36

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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Calculated:
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SHADOW - Calendar

Shadow receptor: A - 6A

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:23	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:39	05:13	05:17	05:44	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24	06:58
	16:32	17:08	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:32	05:11	05:21	05:50	06:21	06:52	06:29	07:02
	16:36	17:14	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:11	06:46	07:04	06:12	05:30	05:11	05:22	05:51	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:23	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:50	19:24	19:56	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:25	19:57	20:21	20:19	19:46	18:56	18:06	16:26	16:16
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:58	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:10	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	19:59	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:03	05:24	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:24	05:11	05:28	05:58	06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30	20:00	20:22	20:17	19:41	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:23	05:12	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:36	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:13	05:35	06:06	06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:46	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:18	16:23
30	07:00		06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:15		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 12:26 PM / 2

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 12:26 PM/2.7.473

SHADOW - Calendar

Shadow receptor: B - 6B

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:12	06:57	06:20	06:28	05:42	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:17
3	07:13	06:56	06:18	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:23	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:39	05:13	05:17	05:44	06:15	06:46	06:21	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12	05:18	05:46	06:17	06:48	06:24	06:58
	16:32	17:08	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:20	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:32	05:11	05:21	05:50	06:21	06:52	06:29	07:02
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12	07:11	06:46	07:04	06:12	05:30	05:11	05:22	05:51	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:23	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:50	19:24	19:56	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:25	19:57	20:21	20:19	19:46	18:56	18:06	16:26	16:16
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:58	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:09	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	19:59	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:02	05:24	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:24	05:11	05:28	05:58	06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30	20:00	20:22	20:17	19:40	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:23	05:12	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:37	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:36	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:13	05:35	06:06	06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:38	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:46	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:18	16:23
30	07:00		06:33	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:15		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 12:26 PM / 3

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2201 K Avenue Suite A2
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9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 12:26 PM/2.7.473

SHADOW - Calendar

Shadow receptor: C - 6C

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January		February	March	April	May	June	July	August	September	October	November		December		
1	07:12		06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17		06:52		15:49 (1)
	16:26		17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42		16:17	3	15:52 (1)
2	07:12		06:57	06:20	06:28	05:42	05:14	05:16	05:41	06:12	06:43	06:18		06:53		15:49 (1)
	16:27		17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40		16:17	3	15:52 (1)
3	07:13		06:56	06:18	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19		06:54		15:50 (1)
	16:28		17:03	17:38	19:12	19:45	20:14	20:23	20:03	19:17	18:25	16:39		16:16	2	15:51 (1)
4	07:13		06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20		06:55		15:50 (1)
	16:29		17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38		16:16	2	15:51 (1)
5	07:13		06:54	06:15	06:23	05:39	05:13	05:17	05:44	06:15	06:46	06:21		06:56		
	16:30		17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37		16:16		
6	07:13		06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23		06:57		
	16:31		17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36		16:16		
7	07:12		06:52	06:12	06:20	05:36	05:12	05:18	05:46	06:17	06:48	06:24		06:58		
	16:32		17:08	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34		16:16		
8	07:12		16:05 (1)	06:51	07:10	06:18	05:35	05:12	05:19	05:47	06:18	06:49	06:25		06:59	
	16:33	2	16:06 (1)	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33		16:16	
9	07:12		16:05 (1)	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26		07:00	
	16:34	2	16:07 (1)	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32		16:16	
10	07:12		16:06 (1)	06:48	07:07	06:15	05:33	05:12	05:20	05:49	06:20	06:51	06:28		07:01	
	16:35	2	16:08 (1)	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31		16:16	
11	07:12		16:06 (1)	06:47	07:06	06:14	05:32	05:11	05:21	05:50	06:21	06:52	06:29		07:02	
	16:36	4	16:10 (1)	17:14	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30		16:16	
12	07:11		16:06 (1)	06:46	07:04	06:12	05:30	05:11	05:22	05:51	06:22	06:54	06:30		07:02	
	16:37	4	16:10 (1)	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29		16:16	
13	07:11		16:07 (1)	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31		07:03	
	16:38	5	16:12 (1)	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28		16:16	
14	07:11		16:06 (1)	06:43	07:01	06:09	05:28	05:11	05:23	05:53	06:24	06:56	06:32		07:04	
	16:39	7	16:13 (1)	17:17	18:50	19:24	19:56	20:20	20:20	19:48	18:58	18:07	16:27		16:16	
15	07:10		16:07 (1)	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	15:51 (1)	07:05	
	16:40	7	16:14 (1)	17:19	18:52	19:25	19:57	20:21	20:19	19:46	18:56	18:06	16:26	9 16:00 (1)	16:16	
16	07:10		16:07 (1)	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	15:50 (1)	07:05	
	16:41	8	16:15 (1)	17:20	18:53	19:27	19:58	20:21	20:19	19:45	18:55	18:04	16:26	12 16:02 (1)	16:17	
17	07:09		16:08 (1)	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	15:48 (1)	07:06	
	16:42	9	16:17 (1)	17:21	18:54	19:28	19:59	20:22	20:18	19:43	18:53	18:03	16:25	13 16:01 (1)	16:17	
18	07:09		16:08 (1)	06:38	06:54	06:02	05:24	05:11	05:27	05:57	06:28	07:00	06:37	15:47 (1)	07:07	
	16:44	10	16:18 (1)	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	12 15:59 (1)	16:17	
19	07:08		16:09 (1)	06:37	06:52	06:01	05:24	05:11	05:28	05:58	06:29	07:01	06:38	15:46 (1)	07:07	
	16:45	10	16:19 (1)	17:23	18:56	19:30	20:00	20:22	20:17	19:40	18:49	18:00	16:23	12 15:58 (1)	16:18	
20	07:08		16:10 (1)	06:35	06:50	05:59	05:23	05:12	05:28	05:59	06:30	07:03	06:40	15:47 (1)	07:08	
	16:46	10	16:20 (1)	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22	11 15:58 (1)	16:18	
21	07:07		16:10 (1)	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	15:46 (1)	07:09	
	16:47	11	16:21 (1)	17:26	18:58	19:32	20:02	20:23	20:15	19:37	18:46	17:57	16:22	11 15:57 (1)	16:19	
22	07:07		16:11 (1)	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	15:46 (1)	07:09	
	16:48	12	16:23 (1)	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	10 15:56 (1)	16:19	
23	07:06		16:12 (1)	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	15:45 (1)	07:10	
	16:50	12	16:24 (1)	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:21	10 15:55 (1)	16:20	
24	07:05		16:13 (1)	06:29	06:44	05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44	15:46 (1)	07:10	
	16:51	13	16:26 (1)	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	10 15:56 (1)	16:20	
25	07:04		16:14 (1)	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	15:46 (1)	07:10	
	16:52	13	16:27 (1)	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	9 15:55 (1)	16:21	
26	07:04		16:16 (1)	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:36	07:09	06:47	15:46 (1)	07:11	
	16:53	12	16:28 (1)	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	8 15:54 (1)	16:21	
27	07:03		16:19 (1)	06:25	06:39	05:49	05:17	05:13	05:35	06:06	06:38	07:11	06:48	15:46 (1)	07:11	
	16:55	9	16:28 (1)	17:33	19:05	19:38	20:08	20:24	20:10	19:28	18:36	17:48	16:18	7 15:53 (1)	16:22	
28	07:02			06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	15:46 (1)	07:11	
	16:56			17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	7 15:53 (1)	16:23	
29	07:01				06:35	05:46	05:16	05:14	05:37	06:08	06:40	07:13	06:50	15:47 (1)	07:12	
	16:57				19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:18	5 15:52 (1)	16:23	
30	07:00				06:33	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	15:48 (1)	07:12	
	16:58				19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	5 15:53 (1)	16:24	
31	06:59				06:32		05:15		05:39	06:10		07:15			07:12	
	17:00				19:09		20:11		20:06	19:22		17:43			16:25	
Potential sun hours	296		297	370	400	450	454	461	429	375	344	297		286		
Total, worst case		162											151			10
Sun reduction		0.56											0.50			0.52
Oper. time red.		1.00											1.00			1.00
Wind dir. red.		0.57											0.57			0.57
Total reduction		0.32											0.28			0.29
Total, real		51											43			3

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 12:26 PM / 4

Licensed user:
Geo-Marine.Inc
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9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 12:26 PM/2.7.473

SHADOW - Calendar

Shadow receptor: D - 6D

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36 11	17:03 (1) 17:14 (1)	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:12	06:57	06:20	17:03 (1)	06:28	05:42	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37 12	17:15 (1)	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:17
3	07:13	06:56	06:18	17:03 (1)	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38 13	17:16 (1)	19:12	19:45	20:14	20:23	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	17:03 (1)	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39 14	17:17 (1)	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	17:05 (1)	06:23	05:39	05:13	05:17	05:44	06:15	06:46 17:50 (1)	06:21	06:56
	16:30	17:06	17:40 14	17:19 (1)	19:15	19:47	20:15	20:23	20:01	19:13	18:22 2 17:52 (1)	16:37	16:16
6	07:13	06:53	06:14	17:06 (1)	06:22	05:37	05:13	05:18	05:45	06:16	06:47 17:45 (1)	06:23	06:57
	16:31	17:07	17:41 14	17:20 (1)	19:16	19:48	20:16	20:23	19:58	19:12	18:20 12 17:57 (1)	16:36	16:16
7	07:12	06:52	06:12	17:07 (1)	06:20	05:36	05:12	05:19	05:46	06:17	06:48 17:42 (1)	06:24	06:58
	16:32	17:08	17:43 13	17:20 (1)	19:17	19:49	20:16	20:23	19:57	19:10	18:19 14 17:56 (1)	16:34	16:16
8	07:12	06:51	07:10	18:10 (1)	06:18	05:35	05:12	05:19	05:47	06:18	06:49 17:40 (1)	06:25	06:59
	16:33	17:10	18:44 9	18:19 (1)	19:18	19:50	20:17	20:22	19:56	19:08	18:17 14 17:54 (1)	16:33	16:16
9	07:12	06:50	07:09		06:17	05:34	05:12	05:20	05:48	06:19	06:50 17:39 (1)	06:26	07:00
	16:34	17:11	18:45		19:19	19:51	20:18	20:22	19:54	19:07	18:15 13 17:52 (1)	16:32	16:16
10	07:12	06:48	07:07		06:15	05:33	05:12	05:21	05:49	06:20	06:51 17:37 (1)	06:28	07:01
	16:35	17:12	18:46		19:20	19:52	20:18	20:22	19:53	19:05	18:14 14 17:51 (1)	16:31	16:16
11	07:12	06:47	07:06		06:14	05:32	05:11	05:21	05:50	06:21	06:52 17:37 (1)	06:29	07:02
	16:36	17:14	18:47		19:21	19:53	20:19	20:21	19:52	19:03	18:12 13 17:50 (1)	16:30	16:16
12	07:11	06:46	07:04		06:12	05:30	05:11	05:22	05:51	06:22	06:54 17:37 (1)	06:30	07:02
	16:37	17:15	18:48		19:22	19:54	20:19	20:21	19:50	19:02	18:11 11 17:48 (1)	16:29	16:16
13	07:11	06:45	07:02		06:10	05:29	05:11	05:23	05:52	06:23	06:55 17:36 (1)	06:31	07:03
	16:38	17:16	18:49		19:23	19:55	20:20	20:20	19:49	19:00	18:09 10 17:46 (1)	16:28	16:16
14	07:11	06:43	07:01		06:09	05:28	05:11	05:23	05:53	06:24	06:56 17:36 (1)	06:32	07:04
	16:39	17:17	18:50		19:24	19:56	20:20	20:20	19:48	18:58	18:07 9 17:45 (1)	16:27	16:16
15	07:10	06:42	06:59		06:07	05:27	05:11	05:24	05:54	06:25	06:57 17:35 (1)	06:34	07:05
	16:40	17:19	18:52		19:25	19:57	20:21	20:19	19:46	18:56	18:06 8 17:43 (1)	16:26	16:16
16	07:10	06:41	06:57		06:06	05:26	05:11	05:25	05:55	06:26	06:58 17:35 (1)	06:35	07:05
	16:41	17:20	18:53		19:27	19:58	20:21	20:19	19:45	18:55	18:04 6 17:41 (1)	16:26	16:17
17	07:09	06:39	06:56		06:04	05:25	05:11	05:26	05:56	06:27	06:59 17:36 (1)	06:36	07:06
	16:42	17:21	18:54		19:28	19:59	20:22	20:18	19:43	18:53	18:03 4 17:40 (1)	16:25	16:17
18	07:09	06:38	06:54		06:03	05:24	05:11	05:27	05:57	06:28	07:00 17:37 (1)	06:37	07:07
	16:44	17:22	18:55		19:29	20:00	20:22	20:17	19:42	18:51	18:01 2 17:39 (1)	16:24	16:17
19	07:08	06:37	06:52		06:01	05:24	05:11	05:28	05:58	06:29	07:01	06:38	07:07
	16:45	17:23	18:56		19:30	20:00	20:22	20:17	19:40	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50		05:59	05:23	05:12	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57		19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:22	16:18
21	07:07	06:34	06:49		05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58		19:32	20:02	20:23	20:15	19:37	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47		05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59		19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45		05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:00		19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:21	16:20
24	07:05	06:29 17:05 (1)	06:44		05:53	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30 2 17:07 (1)	19:02		19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28 17:04 (1)	06:42		05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10
	16:52	17:31 4 17:08 (1)	19:03		19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26 17:04 (1)	06:40		05:51	05:18	05:13	05:34	06:05	06:36	07:09	06:47	07:11
	16:53	17:32 6 17:10 (1)	19:04		19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	16:21
27	07:03	06:25 17:03 (1)	06:39		05:49	05:17	05:13	05:35	06:06	06:38	07:11	06:48	07:11
	16:55	17:33 8 17:11 (1)	19:05		19:38	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23 17:03 (1)	06:37		05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:11
	16:56	17:34 10 17:13 (1)	19:06		19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35		05:46	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07		19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:18	16:23
30	07:00		06:33		05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08		19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32			05:15		05:39	06:10		07:15		07:12
	17:00		19:09			20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case		30	100							132		
Sun reduction		0.58	0.58							0.61		
Oper. time red.		1.00	1.00							1.00		
Wind dir. red.		0.52	0.52							0.52		
Total reduction		0.30	0.30							0.32		
Total, real		9	30							42		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 12:26 PM / 5

Licensed user:
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US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 12:26 PM/2.7.473

SHADOW - Calendar

Shadow receptor: E - 6E

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March		April			May	June	July	August		September			October	November	December
1	07:12	06:58	06:22		06:30		18:33 (1)	05:44	05:15	05:15	05:40		06:11		18:37 (1)	06:42	06:17	06:52
	16:26	17:01	17:36		19:10	16	18:49 (1)	19:43	20:12	20:24	20:05		19:20	19	18:56 (1)	18:29	16:42	16:17
2	07:12	06:57	06:20		06:28		18:33 (1)	05:42	05:14	05:16	05:41		06:12		18:35 (1)	06:43	06:18	06:53
	16:27	17:02	17:37		19:11	16	18:49 (1)	19:44	20:13	20:24	20:04		19:18	22	18:57 (1)	18:27	16:40	16:17
3	07:13	06:56	06:18		06:27		18:33 (1)	05:41	05:14	05:16	05:42		06:13		18:33 (1)	06:44	06:19	06:54
	16:28	17:03	17:38		19:12	18	18:51 (1)	19:45	20:14	20:23	20:03		19:17	22	18:55 (1)	18:25	16:39	16:16
4	07:13	06:55	06:17		06:25		18:33 (1)	05:40	05:13	05:17	05:43		06:14		18:31 (1)	06:45	06:20	06:55
	16:29	17:05	17:39		19:14	19	18:52 (1)	19:46	20:14	20:23	20:02		19:15	22	18:53 (1)	18:24	16:38	16:16
5	07:13	06:54	06:15		06:23		18:32 (1)	05:39	05:13	05:17	05:44		06:15		18:30 (1)	06:46	06:21	06:56
	16:30	17:06	17:40		19:15	20	18:52 (1)	19:47	20:15	20:23	20:01		19:13	22	18:52 (1)	18:22	16:37	16:16
6	07:13	06:53	06:14		06:22		18:33 (1)	05:37	05:13	05:18	05:45		06:16		18:29 (1)	06:47	06:23	06:57
	16:31	17:07	17:41		19:16	21	18:54 (1)	19:48	20:16	20:23	19:58		19:12	21	18:50 (1)	18:20	16:36	16:16
7	07:12	06:52	06:12		06:20		18:33 (1)	05:36	05:12	05:19	05:46		06:17		18:28 (1)	06:48	06:24	06:58
	16:32	17:08	17:43		19:17	22	18:55 (1)	19:49	20:16	20:23	19:57		19:10	21	18:49 (1)	18:19	16:34	16:16
8	07:12	06:51	07:10		06:18		18:33 (1)	05:35	05:12	05:19	05:47		06:18		18:28 (1)	06:49	06:25	06:59
	16:33	17:10	18:44		19:18	22	18:55 (1)	19:50	20:17	20:22	19:56		19:08	19	18:47 (1)	18:17	16:33	16:16
9	07:12	06:50	07:09		06:17		18:35 (1)	05:34	05:12	05:20	05:48		06:19		18:27 (1)	06:50	06:26	07:00
	16:34	17:11	18:45		19:19	22	18:57 (1)	19:51	20:18	20:22	19:54		19:07	18	18:45 (1)	18:15	16:32	16:16
10	07:12	06:48	07:07		06:15		18:36 (1)	05:33	05:12	05:21	05:49		06:20		18:26 (1)	06:51	06:28	07:01
	16:35	17:12	18:46		19:20	22	18:58 (1)	19:52	20:18	20:22	19:53		19:05	17	18:43 (1)	18:14	16:31	16:16
11	07:12	06:47	07:06		06:14		18:38 (1)	05:32	05:11	05:21	05:50		06:21		18:26 (1)	06:52	06:29	07:02
	16:36	17:14	18:47		19:21	19	18:57 (1)	19:53	20:19	20:21	19:52		19:03	15	18:41 (1)	18:12	16:30	16:16
12	07:11	06:46	07:04		06:12		18:39 (1)	05:30	05:11	05:22	05:51		06:22		18:25 (1)	06:54	06:30	07:02
	16:37	17:15	18:48		19:22	15	18:54 (1)	19:54	20:19	20:21	19:50		19:02	14	18:39 (1)	18:11	16:29	16:16
13	07:11	06:45	07:02		06:10		18:43 (1)	05:29	05:11	05:23	05:52		06:23		18:26 (1)	06:55	06:31	07:03
	16:38	17:16	18:49		19:23	6	18:49 (1)	19:55	20:20	20:20	19:49		19:00	11	18:37 (1)	18:09	16:28	16:16
14	07:11	06:43	07:01		06:09			05:28	05:11	05:23	05:53		06:24		18:26 (1)	06:56	06:32	07:04
	16:39	17:17	18:50		19:24			19:56	20:20	20:20	19:48		18:58	10	18:36 (1)	18:07	16:27	16:16
15	07:10	06:42	06:59		06:07			05:27	05:11	05:24	05:54		06:25		18:26 (1)	06:57	06:34	07:05
	16:40	17:19	18:52		19:25			19:57	20:21	20:19	19:46		18:56	8	18:34 (1)	18:06	16:26	16:16
16	07:10	06:41	06:57		06:06			05:26	05:11	05:25	05:55		06:26		18:27 (1)	06:58	06:35	07:05
	16:41	17:20	18:53		19:27			19:58	20:21	20:19	19:45		18:55	5	18:32 (1)	18:04	16:26	16:17
17	07:09	06:39	06:56		06:04			05:25	05:11	05:26	05:56		06:27		18:28 (1)	06:59	06:36	07:06
	16:42	17:21	18:54		19:28			19:59	20:22	20:18	19:43		18:53	3	18:31 (1)	18:03	16:25	16:17
18	07:09	06:38	06:54		06:03			05:24	05:11	05:27	05:57		06:28			07:00	06:37	07:07
	16:44	17:22	18:55		19:29			20:00	20:22	20:17	19:42		18:51			18:01	16:24	16:17
19	07:08	06:37	06:52		06:01			05:24	05:11	05:28	05:58		06:29			07:01	06:38	07:07
	16:45	17:23	18:56		19:30			20:00	20:22	20:17	19:40		18:49			18:00	16:23	16:18
20	07:08	06:35	06:50		05:59			05:23	05:12	05:28	05:59		06:30			07:03	06:40	07:08
	16:46	17:25	18:57		19:31			20:01	20:23	20:16	19:39		18:48			17:58	16:23	16:18
21	07:07	06:34	06:49		05:58			05:22	05:12	05:29	06:00		06:31			07:04	06:41	07:09
	16:47	17:26	18:58		19:32			20:02	20:23	20:15	19:37		18:46			17:57	16:22	16:19
22	07:07	06:32	06:47		05:56			05:21	05:12	05:30	06:01		06:32			07:05	06:42	07:09
	16:48	17:27	18:59		19:33			20:03	20:23	20:14	19:36		18:44			17:55	16:21	16:19
23	07:06	06:31	06:45		05:55			05:20	05:12	05:31	06:02		06:33			07:06	06:43	07:10
	16:50	17:28	19:00		19:34			20:04	20:23	20:14	19:34		18:43			17:54	16:21	16:20
24	07:05	06:29	06:44		05:54			05:19	05:12	05:32	06:03		06:34			07:07	06:44	07:10
	16:51	17:30	19:02		19:35			20:05	20:23	20:13	19:33		18:41			17:52	16:20	16:20
25	07:04	06:28	06:42		05:52			05:19	05:13	05:33	06:04		06:35			07:08	06:45	07:10
	16:52	17:31	19:03		19:36			20:06	20:24	20:12	19:31		18:39			17:51	16:19	16:21
26	07:04	06:26	06:40		18:40 (1)	5:51		05:18	05:13	05:34	06:05		06:36			07:09	06:47	07:11
	16:53	17:32	19:04	2	18:42 (1)	19:37		20:07	20:24	20:11	19:30		18:37			17:50	16:19	16:21
27	07:03	06:25	06:39		18:39 (1)	5:49		05:17	05:13	05:35	06:06		06:38			07:11	06:48	07:11
	16:55	17:33	19:05	5	18:44 (1)	19:38		20:08	20:24	20:10	19:28		18:36			17:48	16:18	16:22
28	07:02	06:23	06:37		18:37 (1)	5:48		05:17	05:14	05:36	06:07		06:39			07:12	06:49	07:11
	16:56	17:34	19:06	8	18:45 (1)	19:40		20:09	20:24	20:09	19:27		18:34			17:47	16:18	16:23
29	07:01		06:35		18:36 (1)	5:46		05:16	05:14	05:37	06:08		06:40			07:13	06:50	07:12
	16:57		19:07	9	18:45 (1)	19:41		20:10	20:24	20:08	19:25		18:32			17:45	16:18	16:23
30	07:00		06:33		18:34 (1)	5:45		05:16	05:15	05:38	06:09		18:43 (1)	06:41		07:14	06:51	07:12
	16:58		19:08	12	18:46 (1)	19:42		20:10	20:24	20:07	19:23	7	18:50 (1)	18:31		17:44	16:17	16:24
31	06:59		06:32		18:34 (1)			05:15		05:39	06:10		18:39 (1)			07:15		07:12
	17:00		19:09	14	18:48 (1)			20:11		20:06	19:22	15	18:54 (1)			17:43		16:25
Potential sun hours	296	297	370			400		450	454	461	429			375		344	297	286
Total, worst case				50			238					22			269			
Sun reduction				0.58			0.57					0.62			0.62			
Oper. time red.				1.00			1.00					1.00			1.00			
Wind dir. red.				0.54			0.54					0.54			0.54			
Total reduction				0.31			0.31					0.34			0.34			
Total, real				16			74					7			91			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 12:26 PM / 6

Licensed user:
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US-75074-5977 Plano TX
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Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 12:26 PM/2.7.473

SHADOW - Calendar

Shadow receptor: F - 6F

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May			June			July			August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44			05:15		19:45 (1)	05:15		19:48 (1)	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43			20:12	2	19:47 (1)	20:24	10	19:58 (1)	20:05	19:20	18:29	16:42	16:17
2	07:12	06:57	06:20	06:28	05:42			05:14		19:45 (1)	05:16		19:48 (1)	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44			20:13	3	19:48 (1)	20:24	9	19:57 (1)	20:04	19:18	18:27	16:40	16:17
3	07:13	06:56	06:18	06:27	05:41			05:14		19:45 (1)	05:16		19:49 (1)	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45			20:14	4	19:49 (1)	20:23	9	19:58 (1)	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40			05:13		19:44 (1)	05:17		19:49 (1)	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46			20:14	5	19:49 (1)	20:23	8	19:57 (1)	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:39			05:13		19:44 (1)	05:17		19:50 (1)	05:44	06:15	06:46	06:21	06:56
	16:30	17:06	17:40	19:15	19:47			20:15	6	19:50 (1)	20:23	7	19:57 (1)	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37			05:13		19:44 (1)	05:18		19:50 (1)	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48			20:16	7	19:51 (1)	20:23	8	19:58 (1)	19:58	19:12	18:20	16:36	16:16
7	07:12	06:52	06:12	06:20	05:36			05:12		19:44 (1)	05:19		19:50 (1)	05:46	06:17	06:48	06:24	06:58
	16:32	17:08	17:43	19:17	19:49			20:16	7	19:51 (1)	20:23	7	19:57 (1)	19:57	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18	05:35			05:12		19:44 (1)	05:19		19:51 (1)	05:47	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50			20:17	8	19:52 (1)	20:22	6	19:57 (1)	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34			05:12		19:44 (1)	05:20		19:52 (1)	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51			20:18	9	19:53 (1)	20:22	5	19:57 (1)	19:54	19:07	18:15	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33			05:12		19:44 (1)	05:21		19:52 (1)	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52			20:18	9	19:53 (1)	20:22	4	19:56 (1)	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:32			05:11		19:44 (1)	05:21		19:53 (1)	05:50	06:21	06:52	06:29	07:02
	16:36	17:14	18:47	19:21	19:53			20:19	10	19:54 (1)	20:21	3	19:56 (1)	19:52	19:03	18:12	16:30	16:16
12	07:11	06:46	07:04	06:12	05:30			05:11		19:44 (1)	05:22		19:54 (1)	05:51	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54			20:19	10	19:54 (1)	20:21	2	19:56 (1)	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29			05:11		19:45 (1)	05:23			05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:55			20:20	10	19:55 (1)	20:20			19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28			05:11		19:45 (1)	05:23			05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:50	19:24	19:56			20:20	10	19:55 (1)	20:20			19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27			05:11		19:45 (1)	05:24			05:54	06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:25	19:57			20:21	11	19:56 (1)	20:19			19:46	18:56	18:06	16:26	16:16
16	07:10	06:41	06:57	06:06	05:26			05:11		19:45 (1)	05:25			05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:58			20:21	11	19:56 (1)	20:19			19:45	18:55	18:04	16:26	16:17
17	07:09	06:39	06:56	06:04	05:25			05:11		19:45 (1)	05:26			05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	19:59			20:22	11	19:56 (1)	20:18			19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:03	05:24			05:11		19:45 (1)	05:27			05:57	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00			20:22	12	19:57 (1)	20:17			19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:24			05:11		19:45 (1)	05:28			05:58	06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30	20:00			20:22	12	19:57 (1)	20:17			19:40	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:23			05:12		19:45 (1)	05:28			05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01			20:23	12	19:57 (1)	20:16			19:39	18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58	05:22			05:12		19:45 (1)	05:29			06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02			20:23	12	19:57 (1)	20:15			19:37	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:56	05:21			05:12		19:46 (1)	05:30			06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03			20:23	12	19:58 (1)	20:14			19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20			05:12		19:46 (1)	05:31			06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:00	19:34	20:04			20:23	12	19:58 (1)	20:14			19:34	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54	05:19			05:12		19:46 (1)	05:32			06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05			20:23	12	19:58 (1)	20:13			19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19			05:13		19:46 (1)	05:33			06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06			20:24	11	19:57 (1)	20:12			19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18			05:13		19:47 (1)	05:34			06:05	06:36	07:09	06:47	07:11
	16:53	17:32	19:04	19:37	20:07			20:24	11	19:58 (1)	20:11			19:30	18:37	17:50	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17			05:13		19:47 (1)	05:35			06:06	06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:38	20:08			20:24	11	19:58 (1)	20:10			19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17			05:14		19:48 (1)	05:36			06:07	06:39	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20:09			20:24	11	19:59 (1)	20:09			19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:46	05:16			05:14		19:48 (1)	05:37			06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10			20:24	10	19:58 (1)	20:08			19:25	18:32	17:45	16:18	16:23
30	07:00		06:33	05:45	05:16			05:15		19:47 (1)	05:38			06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10			20:24	11	19:58 (1)	20:07			19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		19:46 (1)				05:39			06:10		07:15		07:12
	17:00		19:09		20:11	2	19:47 (1)				20:06			19:22		17:43		16:25
Potential sun hours	296	297	370	400	450			454			461			429	375	344	297	286
Total, worst case						2			282			78						
Sun reduction						0.58			0.61			0.63						
Oper. time red.						1.00			1.00			1.00						
Wind dir. red.						0.61			0.61			0.61						
Total reduction						0.36			0.37			0.39						
Total, real						1			106			30						

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 12:26 PM / 7

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
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Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 12:26 PM/2.7.473

SHADOW - Calendar

Shadow receptor: G - 6G

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:12	06:57	06:20	06:28	05:42	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:17
3	07:13	06:56	06:18	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:13	20:23	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:39	05:13	05:17	05:44	06:15	06:46	06:21	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24	06:58
	16:32	17:08	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:32	05:11	05:21	05:50	06:21	06:52	06:29	07:02
	16:36	17:14	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:11	06:46	07:04	06:12	05:30	05:11	05:22	05:51	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:23	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:50	19:24	19:56	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:25	19:57	20:21	20:19	19:46	18:56	18:06	16:26	16:16
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:58	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:09	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	19:59	20:21	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:03	05:24	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:24	05:11	05:28	05:58	06:29	07:01	06:38	07:07
	16:45	17:23	18:56	19:30	20:00	20:22	20:17	19:40	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:23	05:12	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:22	20:16	19:39	18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:37	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:21	16:20
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	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
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	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:36	07:09	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	16:21
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	16:55	17:33	19:05	19:38	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
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31	06:59		06:32		05:15		05:39	06:10		07:15		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 12:26 PM / 8

Licensed user:
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2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 12:26 PM/2.7.473

SHADOW - Calendar

Shadow receptor: H - 6H

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:12	06:57	06:20	06:28	05:42	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:23	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:39	05:13	05:17	05:44	06:15	06:46	06:21	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24	06:58
	16:32	17:09	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:19	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
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	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:24	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:51	19:24	19:56	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:25	19:57	20:21	20:19	19:46	18:56	18:06	16:27	16:16
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:58	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:09	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	19:59	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:03	05:24	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:24	05:11	05:28	05:58	06:29	07:01	06:38	07:07
	16:45	17:24	18:56	19:30	20:00	20:22	20:17	19:40	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:23	05:12	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:37	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:36	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:13	05:35	06:06	06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:38	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:46	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:18	16:24
30	07:00		06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:15		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 12:26 PM / 9

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2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 12:26 PM/2.7.473

SHADOW - Calendar

Shadow receptor: I - 6I

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:23	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:39	05:13	05:17	05:44	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36	16:16
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	16:32	17:09	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
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	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
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	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:13	05:35	06:06	06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:38	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:46	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:18	16:24
30	07:00		06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:15		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 12:26 PM / 10

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 12:26 PM/2.7.473

SHADOW - Calendar

Shadow receptor: J - 6J

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:23	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:39	05:13	05:17	05:44	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24	06:58
	16:32	17:09	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:35	16:16
8	07:12	06:51	07:11	06:19	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:32	05:12	05:21	05:50	06:21	06:52	06:29	07:02
	16:36	17:14	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:11	06:46	07:04	06:12	05:31	05:11	05:22	05:51	06:22	06:54	06:30	07:02
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13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:24	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:51	19:24	19:56	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:26	19:57	20:21	20:19	19:46	18:56	18:06	16:27	16:17
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:58	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:10	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	19:59	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:03	05:24	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:24	05:11	05:28	05:58	06:29	07:01	06:38	07:07
	16:45	17:24	18:56	19:30	20:00	20:22	20:17	19:41	18:50	18:00	16:23	16:18
20	07:08	06:35	06:51	06:00	05:23	05:12	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:57	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:01	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54	05:20	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:13	05:35	06:06	06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:47	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:46	16:18	16:24
30	07:00		06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:15		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 12:26 PM / 11

Licensed user:
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2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 12:26 PM/2.7.473

SHADOW - Calendar

Shadow receptor: K - 6K

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:24	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:39	05:13	05:17	05:44	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36	16:16
7	07:13	06:52	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24	06:58
	16:32	17:08	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
8	07:12	06:51	07:11	06:19	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:32	05:11	05:21	05:50	06:21	06:52	06:29	07:02
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	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
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19	07:08	06:37	06:52	06:01	05:24	05:11	05:28	05:58	06:29	07:01	06:38	07:07
	16:45	17:24	18:56	19:30	20:00	20:22	20:17	19:41	18:50	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:23	05:12	05:28	05:59	06:30	07:03	06:40	07:08
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21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
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28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:12
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	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:18	16:23
30	07:00		06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:16		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 12:26 PM / 12

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 12:26 PM/2.7.473

SHADOW - Calendar

Shadow receptor: L - 6L

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January		February		March		April	May	June	July	August	September	October		November		December
1	07:12		06:58	16:25 (1)	06:22	16:37 (1)	06:30	05:44	05:15	05:15	05:40	06:11	06:42		06:17	15:49 (1)	06:52
	16:26		17:01	12 16:37 (1)	17:36	9 16:46 (1)	19:10	19:43	20:12	20:24	20:05	19:20	18:29		16:42	29 16:18 (1)	16:17
2	07:12		06:57	16:24 (1)	06:20		06:28	05:42	05:14	05:16	05:41	06:12	06:43		06:18	15:49 (1)	06:53
	16:27		17:02	14 16:38 (1)	17:37		19:11	19:44	20:13	20:24	20:04	19:18	18:27		16:40	27 16:16 (1)	16:17
3	07:13		06:56	16:23 (1)	06:19		06:27	05:41	05:14	05:16	05:42	06:13	06:44		06:19	15:50 (1)	06:54
	16:28		17:03	17 16:40 (1)	17:38		19:12	19:45	20:14	20:23	20:03	19:17	18:25		16:39	26 16:16 (1)	16:16
4	07:13		06:55	16:23 (1)	06:17		06:25	05:40	05:13	05:17	05:43	06:14	06:45		06:20	15:50 (1)	06:55
	16:29		17:05	18 16:41 (1)	17:39		19:14	19:46	20:14	20:23	20:02	19:15	18:24		16:38	24 16:14 (1)	16:16
5	07:13		06:54	16:21 (1)	06:15		06:23	05:39	05:13	05:17	05:44	06:15	06:46		06:21	15:51 (1)	06:56
	16:30		17:06	21 16:42 (1)	17:40		19:15	19:47	20:15	20:23	20:01	19:13	18:22		16:37	22 16:13 (1)	16:16
6	07:13		06:53	16:21 (1)	06:14		06:22	05:37	05:13	05:18	05:45	06:16	06:47		06:23	15:52 (1)	06:57
	16:31		17:07	22 16:43 (1)	17:41		19:16	19:48	20:16	20:23	19:58	19:12	18:20		16:36	20 16:12 (1)	16:16
7	07:12		06:52	16:20 (1)	06:12		06:20	05:36	05:12	05:19	05:46	06:17	06:48		06:24	15:53 (1)	06:58
	16:32		17:08	25 16:45 (1)	17:43		19:17	19:49	20:16	20:23	19:57	19:10	18:19		16:34	18 16:11 (1)	16:16
8	07:12		06:51	16:20 (1)	07:10		06:18	05:35	05:12	05:19	05:47	06:18	06:49		06:25	15:53 (1)	06:59
	16:33		17:10	26 16:46 (1)	18:44		19:18	19:50	20:17	20:22	19:56	19:08	18:17		16:33	16 16:09 (1)	16:16
9	07:12		06:50	16:20 (1)	07:09		06:17	05:34	05:12	05:20	05:48	06:19	06:50		06:26	15:55 (1)	07:00
	16:34		17:11	28 16:48 (1)	18:45		19:19	19:51	20:18	20:22	19:54	19:07	18:15		16:32	14 16:09 (1)	16:16
10	07:12		06:48	16:19 (1)	07:07		06:15	05:33	05:12	05:21	05:49	06:20	06:51		06:28	15:56 (1)	07:01
	16:35		17:12	29 16:48 (1)	18:46		19:20	19:52	20:18	20:22	19:53	19:05	18:14		16:31	12 16:08 (1)	16:16
11	07:12		06:47	16:19 (1)	07:06		06:14	05:32	05:11	05:21	05:50	06:21	06:52		06:29	15:57 (1)	07:02
	16:36		17:14	31 16:50 (1)	18:47		19:21	19:53	20:19	20:21	19:52	19:03	18:12		16:30	9 16:06 (1)	16:16
12	07:11		06:46	16:19 (1)	07:04		06:12	05:30	05:11	05:22	05:51	06:22	06:54		06:30	15:58 (1)	07:02
	16:37		17:15	33 16:52 (1)	18:48		19:22	19:54	20:19	20:21	19:50	19:02	18:11		16:29	7 16:05 (1)	16:16
13	07:11		06:45	16:20 (1)	07:02		06:10	05:29	05:11	05:23	05:52	06:23	06:55	17:08 (1)	06:31	16:01 (1)	07:03
	16:38		17:16	33 16:53 (1)	18:49		19:23	19:55	20:20	20:20	19:49	19:00	18:09	14 17:22 (1)	16:28	4 16:05 (1)	16:16
14	07:11		06:43	16:19 (1)	07:01		06:09	05:28	05:11	05:23	05:53	06:24	06:56	17:04 (1)	06:32		07:04
	16:39		17:17	35 16:54 (1)	18:50		19:24	19:56	20:20	20:20	19:48	18:58	18:07	21 17:25 (1)	16:27		16:16
15	07:10		06:42	16:19 (1)	06:59		06:07	05:27	05:11	05:24	05:54	06:25	06:57	17:01 (1)	06:34		07:05
	16:40		17:19	37 16:56 (1)	18:52		19:25	19:57	20:21	20:19	19:46	18:56	18:06	26 17:27 (1)	16:26		16:16
16	07:10		06:41	16:20 (1)	06:57		06:06	05:26	05:11	05:25	05:55	06:26	06:58	16:59 (1)	06:35		07:05
	16:41		17:20	37 16:57 (1)	18:53		19:27	19:58	20:21	20:19	19:45	18:55	18:04	29 17:28 (1)	16:26		16:17
17	07:09		06:39	16:20 (1)	06:56		06:04	05:25	05:11	05:26	05:56	06:27	06:59	16:58 (1)	06:36		07:06
	16:42		17:21	38 16:58 (1)	18:54		19:28	19:59	20:22	20:18	19:43	18:53	18:03	32 17:30 (1)	16:25		16:17
18	07:09		06:38	16:20 (1)	06:54		06:03	05:24	05:11	05:27	05:57	06:28	07:00	16:56 (1)	06:37		07:07
	16:44		17:22	40 17:00 (1)	18:55		19:29	20:00	20:22	20:17	19:42	18:51	18:01	35 17:31 (1)	16:24		16:17
19	07:08		06:37	16:20 (1)	06:52		06:01	05:24	05:11	05:28	05:58	06:29	07:01	16:54 (1)	06:38		07:07
	16:45		17:23	41 17:01 (1)	18:56		19:30	20:00	20:22	20:17	19:40	18:49	18:00	38 17:32 (1)	16:23		16:18
20	07:08		06:35	16:21 (1)	06:50		05:59	05:23	05:12	05:28	05:59	06:30	07:03	16:53 (1)	06:40		07:08
	16:46		17:25	41 17:02 (1)	18:57		19:31	20:01	20:23	20:16	19:39	18:48	17:58	40 17:33 (1)	16:23		16:18
21	07:07		06:34	16:21 (1)	06:49		05:58	05:22	05:12	05:29	06:00	06:31	07:04	16:52 (1)	06:41		07:09
	16:47		17:26	41 17:02 (1)	18:58		19:32	20:02	20:23	20:15	19:37	18:46	17:57	41 17:33 (1)	16:22		16:19
22	07:07		06:32	16:23 (1)	06:47		05:56	05:21	05:12	05:30	06:01	06:32	07:05	16:52 (1)	06:42		07:09
	16:48		17:27	39 17:02 (1)	18:59		19:33	20:03	20:23	20:14	19:36	18:44	17:55	41 17:33 (1)	16:21		16:19
23	07:06		06:31	16:23 (1)	06:45		05:55	05:20	05:12	05:31	06:02	06:33	07:06	16:51 (1)	06:43		07:10
	16:50		17:28	37 17:00 (1)	19:00		19:34	20:04	20:23	20:14	19:34	18:43	17:54	40 17:31 (1)	16:21		16:20
24	07:05		06:29	16:25 (1)	06:44		05:54	05:19	05:12	05:32	06:03	06:34	07:07	16:50 (1)	06:44		07:10
	16:51		17:30	34 16:59 (1)	19:02		19:35	20:05	20:23	20:13	19:33	18:41	17:52	39 17:29 (1)	16:20		16:20
25	07:04		06:28	16:26 (1)	06:42		05:52	05:19	05:13	05:33	06:04	06:35	07:08	16:49 (1)	06:45		07:10
	16:52		17:31	31 16:57 (1)	19:03		19:36	20:06	20:24	20:12	19:31	18:39	17:51	38 17:27 (1)	16:19		16:21
26	07:04		06:26	16:28 (1)	06:40		05:51	05:18	05:13	05:34	06:05	06:36	07:10	16:50 (1)	06:47		07:11
	16:53		17:32	28 16:56 (1)	19:04		19:37	20:07	20:24	20:11	19:30	18:37	17:50	37 17:27 (1)	16:19		16:21
27	07:03		06:25	16:29 (1)	06:39		05:49	05:17	05:13	05:35	06:06	06:38	07:11	16:49 (1)	06:48		07:11
	16:55		17:33	24 16:53 (1)	19:05		19:38	20:08	20:24	20:10	19:28	18:36	17:48	36 17:25 (1)	16:18		16:22
28	07:02		06:23	16:33 (1)	06:37		05:48	05:17	05:14	05:36	06:07	06:39	07:12	16:49 (1)	06:49		07:11
	16:56		17:34	18 16:51 (1)	19:06		19:40	20:09	20:24	20:09	19:27	18:34	17:47	34 17:23 (1)	16:18		16:23
29	07:01	16:29 (1)			06:35		05:46	05:16	05:14	05:37	06:08	06:40	07:13	16:48 (1)	06:50		07:12
	16:57	4 16:33 (1)			19:07		19:41	20:10	20:24	20:08	19:25	18:32	17:45	34 17:22 (1)	16:18		16:23
30	07:00	16:27 (1)			06:33		05:45	05:16	05:15	05:38	06:09	06:41	07:14	16:49 (1)	06:51		07:12
	16:58	7 16:34 (1)			19:08		19:42	20:10	20:24	20:07	19:23	18:31	17:44	32 17:21 (1)	16:17		16:24
31	06:59	16:26 (1)			06:32			05:15		05:39	06:10		07:15	16:49 (1)			07:12
	17:00	9 16:35 (1)			19:09			20:11		20:06	19:22		17:43	31 17:20 (1)			16:25
Potential sun hours	296		297		370		400	450	454	461	429	375	344		297		286
Total, worst case	20		830		9								638		228		
Sun reduction	0.56		0.58		0.58								0.61		0.50		
Oper. time red.	1.00		1.00		1.00								1.00		1.00		
Wind dir. red.	0.56		0.56		0.56								0.56		0.56		
Total reduction	0.31		0.32		0.32								0.34		0.28		
Total, real	6		267		3								216		63		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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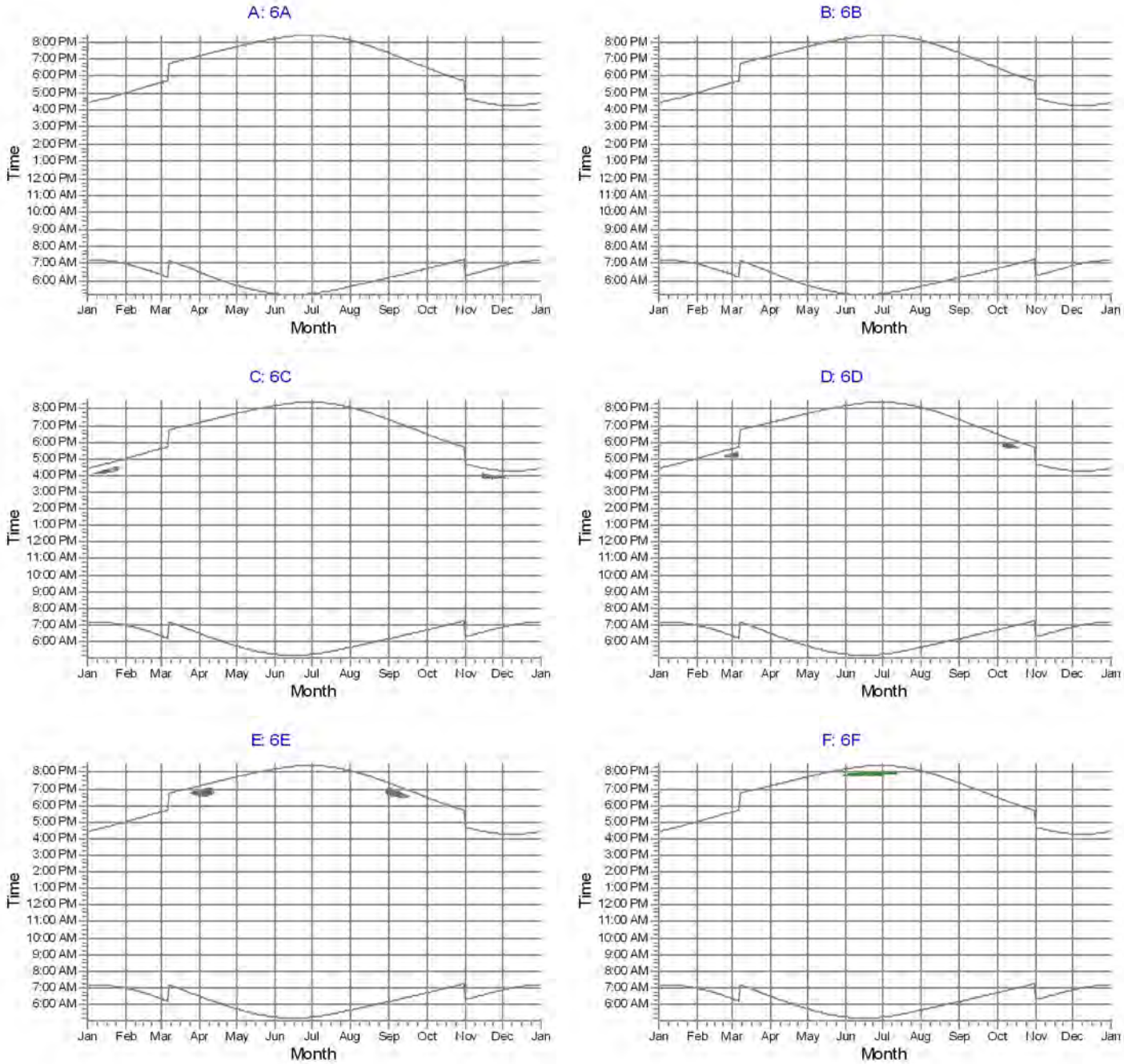
Calculated:
2/24/2011 12:26 PM/2.7.473

SHADOW - Calendar, graphical



WTGs

1: Bldg 6 DS

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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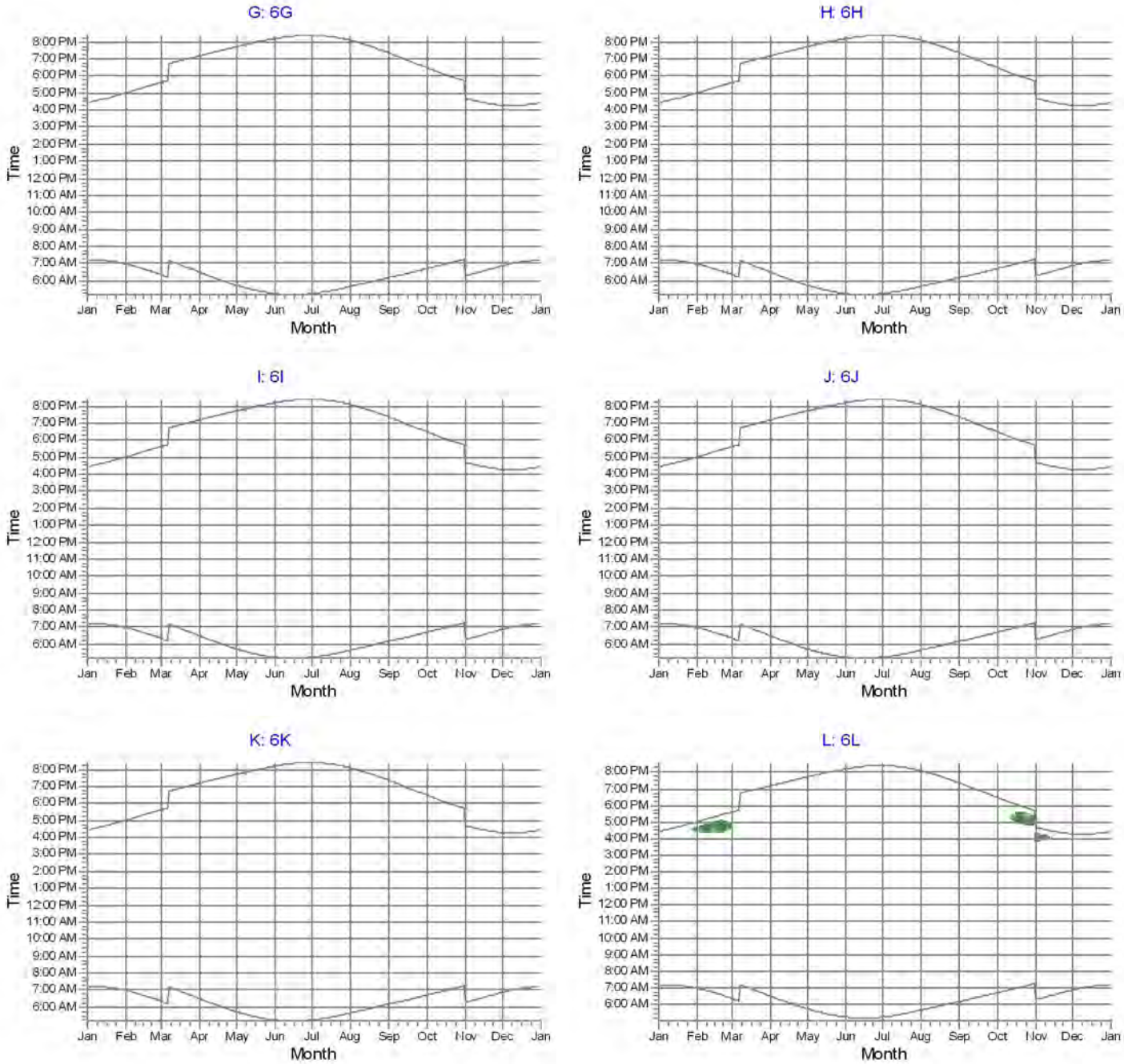
Calculated:
2/24/2011 12:26 PM/2.7.473

SHADOW - Calendar, graphical



WTGs

1: Bldg 6 DS

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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Calculated:
2/24/2011 12:26 PM/2.7.473

SHADOW - Calendar per WTG

WTG: 1 - Bldg 6 DS

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June
1	07:12 16:26	06:58 16:25-16:37/12 17:01	06:22 16:37-16:46/9 17:36 17:03-17:14/11	06:30 18:33-18:49/16 19:10	05:44 19:43	05:15 19:45-19:47/2 20:12
2	07:13 16:27	06:57 16:24-16:38/14 17:02	06:20 17:03-17:15/12 17:37	06:28 18:33-18:49/16 19:11	05:42 19:44	05:14 19:45-19:48/3 20:13
3	07:13 16:28	06:56 16:23-16:40/17 17:03	06:19 17:03-17:16/13 17:38	06:27 18:33-18:51/18 19:12	05:41 19:45	05:14 19:45-19:49/4 20:14
4	07:13 16:29	06:55 16:23-16:41/18 17:05	06:17 17:03-17:17/14 17:39	06:25 18:33-18:52/19 19:14	05:40 19:46	05:13 19:44-19:49/5 20:14
5	07:13 16:30	06:54 16:21-16:42/21 17:06	06:15 17:05-17:19/14 17:40	06:23 18:32-18:52/20 19:15	05:39 19:47	05:13 19:44-19:50/6 20:15
6	07:13 16:31	06:53 16:21-16:43/22 17:07	06:14 17:06-17:20/14 17:41	06:22 18:33-18:54/21 19:16	05:37 19:48	05:13 19:44-19:51/7 20:16
7	07:12 16:32	06:52 16:20-16:45/25 17:08	06:12 17:07-17:20/13 17:43	06:20 18:33-18:55/22 19:17	05:36 19:49	05:12 19:44-19:51/7 20:16
8	07:12 16:05-16:06/1 16:33	06:51 16:20-16:46/26 17:10	07:10 18:10-18:19/9 18:44	06:18 18:33-18:55/22 19:18	05:35 19:50	05:12 19:44-19:52/8 20:17
9	07:12 16:05-16:07/2 16:34	06:50 16:20-16:48/28 17:11	07:09 18:45	06:17 18:35-18:57/22 19:19	05:34 19:51	05:12 19:44-19:53/9 20:18
10	07:12 16:06-16:08/2 16:35	06:48 16:19-16:48/29 17:12	07:07 18:46	06:15 18:36-18:58/22 19:20	05:33 19:52	05:12 19:44-19:53/9 20:18
11	07:12 16:06-16:10/4 16:36	06:47 16:19-16:50/31 17:14	07:06 18:47	06:14 18:38-18:57/19 19:21	05:32 19:53	05:11 19:44-19:54/10 20:19
12	07:11 16:06-16:10/4 16:37	06:46 16:19-16:52/33 17:15	07:04 18:48	06:12 18:39-18:54/15 19:22	05:30 19:54	05:11 19:44-19:54/10 20:19
13	07:11 16:07-16:12/5 16:38	06:45 16:20-16:53/33 17:16	07:02 18:49	06:10 18:43-18:49/6 19:23	05:29 19:55	05:11 19:45-19:55/10 20:20
14	07:11 16:06-16:13/7 16:39	06:43 16:19-16:54/35 17:17	07:01 18:51	06:09 19:24	05:28 19:56	05:11 19:45-19:55/10 20:20
15	07:10 16:07-16:14/7 16:40	06:42 16:19-16:56/37 17:19	06:59 18:52	06:07 19:25	05:27 19:57	05:11 19:45-19:56/11 20:21
16	07:10 16:07-16:15/8 16:41	06:41 16:20-16:57/37 17:20	06:57 18:53	06:06 19:27	05:26 19:58	05:11 19:45-19:56/11 20:21
17	07:09 16:08-16:17/9 16:42	06:39 16:20-16:58/38 17:21	06:56 18:54	06:04 19:28	05:25 19:59	05:11 19:45-19:56/11 20:22
18	07:09 16:08-16:18/10 16:44	06:38 16:20-17:00/40 17:22	06:54 18:55	06:03 19:29	05:24 20:00	05:11 19:45-19:57/12 20:22
19	07:08 16:09-16:19/10 16:45	06:37 16:20-17:01/41 17:24	06:52 18:56	06:01 19:30	05:24 20:00	05:11 19:45-19:57/12 20:22
20	07:08 16:10-16:20/10 16:46	06:35 16:21-17:02/41 17:25	06:50 18:57	05:59 19:31	05:23 20:01	05:12 19:45-19:57/12 20:23
21	07:07 16:10-16:21/11 16:47	06:34 16:21-17:02/41 17:26	06:49 18:58	05:58 19:32	05:22 20:02	05:12 19:45-19:57/12 20:23
22	07:07 16:11-16:23/12 16:48	06:32 16:23-17:02/39 17:27	06:47 18:59	05:56 19:33	05:21 20:03	05:12 19:46-19:58/12 20:23
23	07:06 16:12-16:24/12 16:50	06:31 16:23-17:00/37 17:28	06:45 19:00	05:55 19:34	05:20 20:04	05:12 19:46-19:58/12 20:23
24	07:05 16:13-16:26/13 16:51	06:29 16:25-16:59/34 17:30 17:05-17:07/2	06:44 19:02	05:54 19:35	05:19 20:05	05:12 19:46-19:58/12 20:23
25	07:04 16:14-16:27/13 16:52	06:28 16:26-16:57/31 17:31 17:04-17:08/4	06:42 19:03	05:52 19:36	05:19 20:06	05:13 19:46-19:57/11 20:24
26	07:04 16:16-16:28/12 16:53	06:26 16:28-16:56/28 17:32 17:04-17:10/6	06:40 18:40-18:42/2 19:04	05:51 19:37	05:18 20:07	05:13 19:47-19:58/11 20:24
27	07:03 16:19-16:28/9 16:55	06:25 16:29-16:53/24 17:33 17:03-17:11/8	06:39 18:39-18:44/5 19:05	05:49 19:38	05:17 20:08	05:13 19:47-19:58/11 20:24
28	07:02 16:56	06:23 16:33-16:51/18 17:34 17:03-17:13/10	06:37 18:37-18:45/8 19:06	05:48 19:40	05:17 20:09	05:14 19:48-19:59/11 20:24
29	07:01 16:29-16:33/4 16:57		06:35 18:36-18:45/9 19:07	05:46 19:41	05:16 20:10	05:14 19:48-19:58/10 20:24
30	07:00 16:27-16:34/7 16:58		06:34 18:34-18:46/12 19:08	05:45 19:42	05:16 20:10	05:15 19:47-19:58/11 20:24
31	06:59 16:26-16:35/9 17:00		06:32 18:34-18:48/14 19:09		05:15 19:46-19:47/1 20:11	
Potential sun hours	296	297	370	400	450	454
Sum of minutes with flicker	181	860	159	238	1	282

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

Project:

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SHADOW - Calendar per WTG

WTG: 1 - Bldg 6 DS

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	July	August	September	October	November	December
1	05:15 19:48-19:58/10 20:24	05:40 20:05	06:11 18:37-18:56/19 19:20	06:42 18:29	06:17 15:49-16:18/29 16:42	06:52 15:49-15:52/3 16:17
2	05:16 19:48-19:57/9 20:24	05:41 20:04	06:12 18:35-18:57/22 19:18	06:43 18:27	06:18 15:49-16:16/27 16:40	06:53 15:49-15:52/3 16:17
3	05:16 19:49-19:58/9 20:23	05:42 20:03	06:13 18:33-18:55/22 19:17	06:44 18:25	06:19 15:50-16:16/26 16:39	06:54 15:50-15:51/1 16:16
4	05:17 19:49-19:57/8 20:23	05:43 20:02	06:14 18:31-18:53/22 19:15	06:45 18:24	06:20 15:50-16:14/24 16:38	06:55 15:50-15:51/1 16:16
5	05:17 19:50-19:57/7 20:23	05:44 20:01	06:15 18:30-18:52/22 19:13	06:46 17:50-17:52/2 18:22	06:22 15:51-16:13/22 16:37	06:56 16:16
6	05:18 19:50-19:58/8 20:23	05:45 19:58	06:16 18:29-18:50/21 19:12	06:47 17:45-17:57/12 18:20	06:23 15:52-16:12/20 16:36	06:57 16:16
7	05:19 19:50-19:57/7 20:23	05:46 19:57	06:17 18:28-18:49/21 19:10	06:48 17:42-17:56/14 18:19	06:24 15:53-16:11/18 16:34	06:58 16:16
8	05:19 19:51-19:57/6 20:22	05:47 19:56	06:18 18:28-18:47/19 19:08	06:49 17:40-17:54/14 18:17	06:25 15:53-16:09/16 16:33	06:59 16:16
9	05:20 19:52-19:57/5 20:22	05:48 19:54	06:19 18:27-18:45/18 19:07	06:50 17:39-17:52/13 18:15	06:26 15:55-16:09/14 16:32	07:00 16:16
10	05:21 19:52-19:56/4 20:22	05:49 19:53	06:20 18:26-18:43/17 19:05	06:51 17:37-17:51/14 18:14	06:28 15:56-16:08/12 16:31	07:01 16:16
11	05:21 19:53-19:56/3 20:21	05:50 19:52	06:21 18:26-18:41/15 19:03	06:52 17:37-17:50/13 18:12	06:29 15:57-16:06/9 16:30	07:02 16:16
12	05:22 19:54-19:56/2 20:21	05:51 19:50	06:22 18:25-18:39/14 19:02	06:54 17:37-17:48/11 18:11	06:30 15:58-16:05/7 16:29	07:02 16:16
13	05:23 20:20	05:52 19:49	06:23 18:26-18:37/11 19:00	06:55 17:08-17:22/14 18:09 17:36-17:46/10	06:31 16:01-16:05/4 16:28	07:03 16:16
14	05:23 20:20	05:53 19:48	06:24 18:26-18:36/10 18:58	06:56 17:04-17:25/21 18:07 17:36-17:45/9	06:32 16:27	07:04 16:16
15	05:24 20:19	05:54 19:46	06:25 18:26-18:34/8 18:56	06:57 17:01-17:27/26 18:06 17:35-17:43/8	06:34 15:51-16:00/9 16:27	07:05 16:16
16	05:25 20:19	05:55 19:45	06:26 18:27-18:32/5 18:55	06:58 16:59-17:28/29 18:04 17:35-17:41/6	06:35 15:50-16:02/12 16:26	07:05 16:17
17	05:26 20:18	05:56 19:43	06:27 18:28-18:31/3 18:53	06:59 16:58-17:30/32 18:03 17:36-17:40/4	06:36 15:48-16:01/13 16:25	07:06 16:17
18	05:27 20:17	05:57 19:42	06:28 18:51	07:00 16:56-17:31/35 18:01 17:37-17:39/2	06:37 15:47-15:59/12 16:24	07:07 16:17
19	05:28 20:17	05:58 19:41	06:29 18:49	07:01 16:54-17:32/38 18:00	06:38 15:46-15:58/12 16:23	07:07 16:18
20	05:28 20:16	05:59 19:39	06:30 18:48	07:03 16:53-17:33/40 17:58	06:40 15:47-15:58/11 16:23	07:08 16:18
21	05:29 20:15	06:00 19:38	06:31 18:46	07:04 16:52-17:33/41 17:57	06:41 15:46-15:57/11 16:22	07:09 16:19
22	05:30 20:14	06:01 19:36	06:32 18:44	07:05 16:52-17:33/41 17:55	06:42 15:46-15:56/10 16:21	07:09 16:19
23	05:31 20:14	06:02 19:34	06:33 18:43	07:06 16:51-17:31/40 17:54	06:43 15:45-15:55/10 16:21	07:10 16:20
24	05:32 20:13	06:03 19:33	06:34 18:41	07:07 16:50-17:29/39 17:52	06:44 15:46-15:56/10 16:20	07:10 16:20
25	05:33 20:12	06:04 19:31	06:35 18:39	07:08 16:49-17:27/38 17:51	06:45 15:46-15:55/9 16:19	07:10 16:21
26	05:34 20:11	06:05 19:30	06:36 18:37	07:10 16:50-17:27/37 17:50	06:47 15:46-15:54/8 16:19	07:11 16:21
27	05:35 20:10	06:06 19:28	06:38 18:36	07:11 16:49-17:25/36 17:48	06:48 15:46-15:53/7 16:18	07:11 16:22
28	05:36 20:09	06:07 19:27	06:39 18:34	07:12 16:49-17:23/34 17:47	06:49 15:46-15:53/7 16:18	07:11 16:23
29	05:37 20:08	06:08 19:25	06:40 18:32	07:13 16:48-17:22/34 17:45	06:50 15:47-15:52/5 16:18	07:12 16:23
30	05:38 20:07	06:09 18:43-18:50/7 19:23	06:41 18:31	07:14 16:49-17:21/32 17:44	06:51 15:48-15:53/5 16:17	07:12 16:24
31	05:39 20:06	06:10 18:39-18:54/15 19:22		07:15 16:49-17:20/31 17:43		07:12 16:25
Potential sun hours	461	429	375	344	297	286
Sum of minutes with flicker	78	22	269	770	379	8

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

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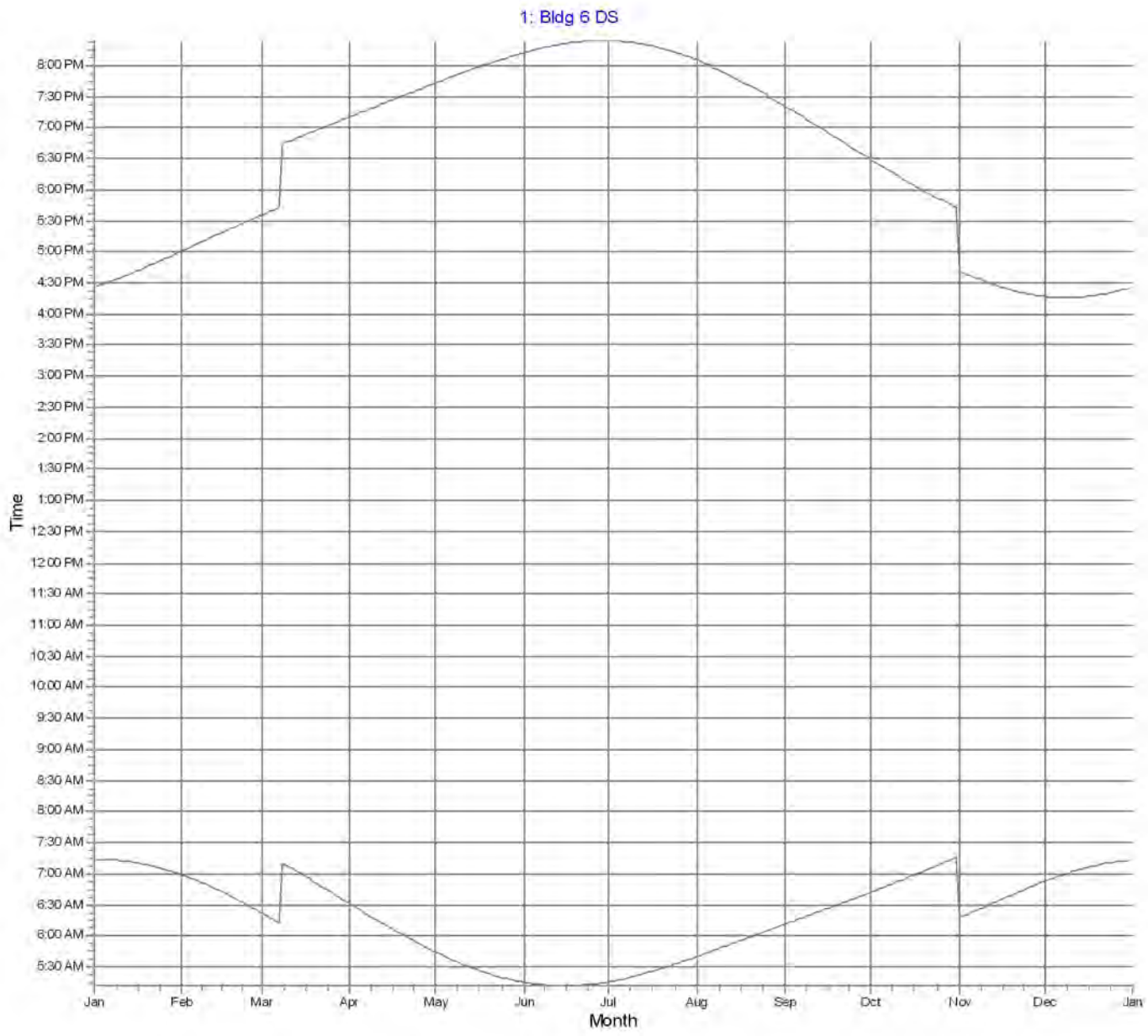
SHADOW - Calendar per WTG, graphical

WTG: 1 - Bldg 6 DS



WTGs

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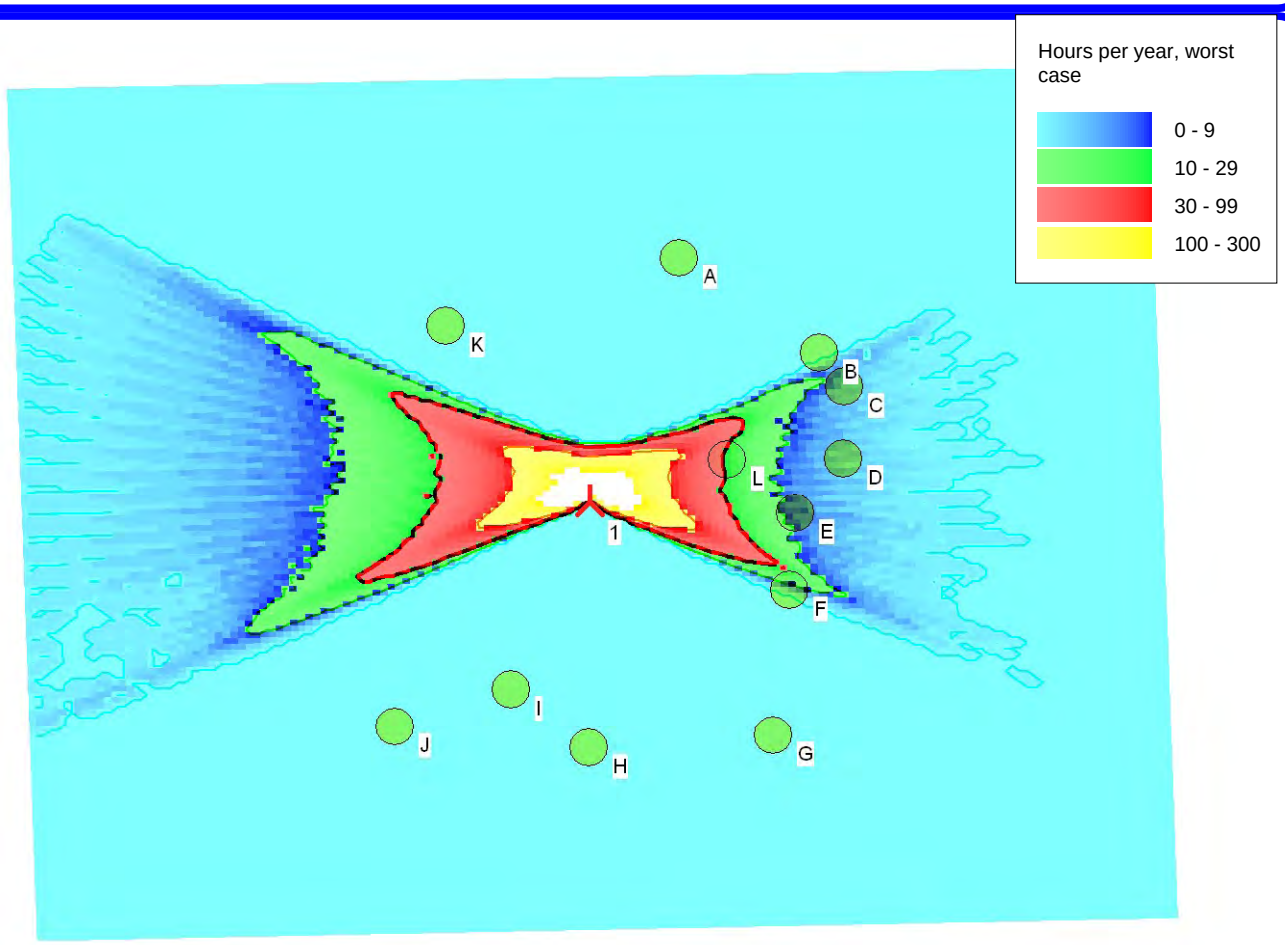
SHADOW - Map



0 250 500 750 1000m

Map: , Print scale 1:20,000, Map center Geo WGS 84 East: -71.311424° North: 41.524805°

New WTG Shadow receptor

Isolines showing shadow in Hours per year, worst case

0 10 30 100

APPENDIX 7

WIND TURBINE SITE 7 BUILDING 1112 (CODDINGTON POINT)

Figure A-7: Maximum predicted shadow flicker levels (hours per year) for a Vestas V112-3.0 MW Model at Wind Turbine Site 7 (Building 1112 – Coddington PointTank Farm 3).

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SHADOW - Main Result

Assumptions for shadow calculations

Maximum distance for influence
Calculate only when more than 20 % of sun is covered by the blade
Please look in WTG table

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

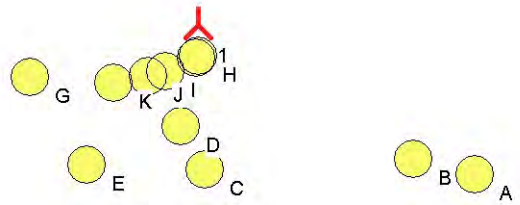
Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW
691	432	259	155	155	155	432	518	950	1,209	864	518

W	WNW	NW	NNW	Sum
432	604	691	691	8,756

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: Line object
Obstacles used in calculation
Eye height: 1.5 m
Grid resolution: 10 m



Scale 1:20,000
New WTG
Shadow receptor

WTGs

	Geo DD: WGS 84 Longitude	Latitude	Z [m]	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Shadow data Calculation distance [m]	RPM [RPM]
1	-71.323597° East	41.522978° North	3.1	Bldg 1112 CP	Yes	VESTAS	V112-3,000	3,000	112.0	84.0	2,000	12.8

Shadow receptor-Input

No.	Name	Geo DD: WGS 84 Longitude	Latitude	Z [m]	Width [m]	Height [m]	Height a.g.l. [m]	Degrees from south cw [°]	Slope of window [°]	Direction mode
A	7A	-71.314772° East	41.518253° North	14.1	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
B	7B	-71.316732° East	41.518731° North	7.5	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
C	7C	-71.323363° East	41.518396° North	20.4	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
D	7D	-71.324126° East	41.519764° North	16.6	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
E	7E	-71.327116° East	41.518557° North	1.9	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
F	7F	-71.323633° East	41.521957° North	16.3	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
G	7G	-71.328931° East	41.521321° North	0.0	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
H	7H	-71.323582° East	41.522007° North	15.9	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
I	7I	-71.324610° East	41.521512° North	16.9	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
J	7J	-71.325165° East	41.521349° North	21.3	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
K	7K	-71.326261° East	41.521149° North	15.2	1.0	1.0	1.0	-180.0	90.0	"Green house mode"

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SHADOW - Main Result

Calculation Results

Shadow receptor

		Shadow, worst case			Shadow, expected values
No.	Name	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	7A	0:00	0	0:00	0:00
B	7B	0:00	0	0:00	0:00
C	7C	0:00	0	0:00	0:00
D	7D	0:00	0	0:00	0:00
E	7E	0:00	0	0:00	0:00
F	7F	0:00	0	0:00	0:00
G	7G	75:09	91	0:58	25:28
H	7H	0:00	0	0:00	0:00
I	7I	0:00	0	0:00	0:00
J	7J	0:00	0	0:00	0:00
K	7K	0:00	0	0:00	0:00

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

No.	Name	Worst case [h/year]	Expected [h/year]
1	Bldg 1112 CP	75:09	25:28

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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Calculated:
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SHADOW - Calendar

Shadow receptor: A - 7A

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:23	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:39	05:13	05:17	05:44	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24	06:58
	16:32	17:09	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:35	16:16
8	07:12	06:51	07:11	06:19	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:32	05:12	05:21	05:50	06:21	06:52	06:29	07:02
	16:36	17:14	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:11	06:46	07:04	06:12	05:30	05:11	05:22	05:51	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:24	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:51	19:24	19:56	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:25	19:57	20:21	20:19	19:46	18:56	18:06	16:27	16:17
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:58	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:09	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	19:59	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:03	05:24	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:24	05:11	05:28	05:58	06:29	07:01	06:38	07:07
	16:45	17:24	18:56	19:30	20:00	20:22	20:17	19:41	18:50	18:00	16:23	16:18
20	07:08	06:35	06:50	06:00	05:23	05:12	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:13	05:35	06:06	06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:38	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:46	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:18	16:24
30	07:00		06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:15		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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4/5/2011 10:33 PM / 2

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
4/5/2011 10:33 PM/2.7.473

SHADOW - Calendar

Shadow receptor: B - 7B

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:23	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:39	05:13	05:17	05:44	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24	06:58
	16:32	17:09	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:35	16:16
8	07:12	06:51	07:11	06:19	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:32	05:12	05:21	05:50	06:21	06:52	06:29	07:02
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	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:24	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:51	19:24	19:56	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:26	19:57	20:21	20:19	19:46	18:56	18:06	16:27	16:17
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:58	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:10	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	19:59	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:03	05:24	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:24	05:11	05:28	05:58	06:29	07:01	06:38	07:07
	16:45	17:24	18:56	19:30	20:00	20:22	20:17	19:41	18:50	18:00	16:23	16:18
20	07:08	06:35	06:50	06:00	05:23	05:12	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:57	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54	05:20	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:13	05:35	06:06	06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:46	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:46	16:18	16:24
30	07:00		06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:15		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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4/5/2011 10:33 PM / 3

Licensed user:
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2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
4/5/2011 10:33 PM/2.7.473

SHADOW - Calendar

Shadow receptor: C - 7C

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:29	05:43	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:19	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:13	19:45	20:14	20:24	20:03	19:17	18:26	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:24	05:39	05:13	05:17	05:44	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:14	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24	06:58
	16:32	17:09	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:35	16:16
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	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
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	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
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26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:14	05:35	06:06	06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:19	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:47	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:46	16:18	16:24
30	07:00		06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:16		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
4/5/2011 10:33 PM/2.7.473

SHADOW - Calendar

Shadow receptor: D - 7D

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:29	05:43	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:19	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:13	19:45	20:14	20:24	20:03	19:17	18:26	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:24	05:39	05:13	05:17	05:44	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:14	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36	16:16
7	07:13	06:52	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24	06:58
	16:32	17:09	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:35	16:16
8	07:12	06:51	07:11	06:19	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:32	05:12	05:21	05:50	06:21	06:53	06:29	07:02
	16:36	17:14	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:11	06:46	07:04	06:12	05:31	05:11	05:22	05:51	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:56	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:24	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:51	19:24	19:57	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:26	19:58	20:21	20:19	19:46	18:56	18:06	16:27	16:17
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:10	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	20:00	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:03	05:25	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:24	05:11	05:28	05:58	06:29	07:01	06:38	07:07
	16:45	17:24	18:56	19:30	20:00	20:22	20:17	19:41	18:50	18:00	16:23	16:18
20	07:08	06:35	06:51	06:00	05:23	05:12	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:57	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:01	19:34	20:04	20:23	20:14	19:35	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54	05:20	05:13	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:36	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:14	05:35	06:06	06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:19	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:12
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:47	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:46	16:18	16:24
30	07:00		06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:16		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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4/5/2011 10:33 PM / 5

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
4/5/2011 10:33 PM/2.7.473

SHADOW - Calendar

Shadow receptor: E - 7E

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:29	05:43	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:19	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:13	19:45	20:14	20:24	20:03	19:17	18:26	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:24	05:39	05:13	05:17	05:44	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:14	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:21	16:36	16:16
7	07:13	06:52	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24	06:58
	16:32	17:09	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:35	16:16
8	07:12	06:51	07:11	06:19	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:32	05:12	05:21	05:50	06:21	06:53	06:29	07:02
	16:36	17:14	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:12	06:46	07:04	06:12	05:31	05:11	05:22	05:51	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:56	20:20	20:20	19:49	19:00	18:09	16:28	16:16
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	16:42	17:21	18:54	19:28	20:00	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:03	05:25	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:24	05:12	05:28	05:58	06:29	07:01	06:38	07:07
	16:45	17:24	18:56	19:30	20:01	20:22	20:17	19:41	18:50	18:00	16:23	16:18
20	07:08	06:35	06:51	06:00	05:23	05:12	05:29	05:59	06:30	07:03	06:40	07:08
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22	07:07	06:32	06:47	05:57	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
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	16:50	17:28	19:01	19:34	20:04	20:23	20:14	19:35	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54	05:20	05:13	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:05	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:36	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:20	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10	06:47	07:11
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Total, worst case												
Sun reduction												
Oper. time red.												
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Total reduction												
Total, real												

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Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
4/5/2011 10:33 PM/2.7.473

SHADOW - Calendar

Shadow receptor: F - 7F

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:29	05:43	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:19	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:13	19:45	20:14	20:24	20:03	19:17	18:26	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:24	05:39	05:13	05:17	05:44	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:14	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36	16:16
7	07:13	06:52	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24	06:58
	16:32	17:09	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:35	16:16
8	07:12	06:51	07:11	06:19	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:32	05:12	05:21	05:50	06:21	06:53	06:29	07:02
	16:36	17:14	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:12	06:46	07:04	06:12	05:31	05:11	05:22	05:51	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:56	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:24	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:51	19:24	19:57	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:26	19:58	20:21	20:19	19:46	18:56	18:06	16:27	16:17
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:10	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	20:00	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:03	05:25	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:24	05:11	05:28	05:58	06:29	07:01	06:38	07:07
	16:45	17:24	18:56	19:30	20:00	20:22	20:17	19:41	18:50	18:00	16:23	16:18
20	07:08	06:35	06:51	06:00	05:23	05:12	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:57	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:01	19:34	20:04	20:23	20:14	19:35	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54	05:20	05:13	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:05	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:36	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:13	05:35	06:06	06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:12
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:47	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:46	16:18	16:24
30	07:00		06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:16		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
4/5/2011 10:33 PM / 7

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
4/5/2011 10:33 PM/2.7.473

SHADOW - Calendar

Shadow receptor: G - 7G

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May			June			July			August			September	October	November	December
1	07:12	06:58	06:22	06:30	05:44			05:15		05:44 (1)	05:15		05:50 (1)	05:40		06:05 (1)	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43			20:12	56	06:40 (1)	20:24	57	06:47 (1)	20:05	33	06:38 (1)	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:29	05:43			05:14		05:44 (1)	05:16		05:49 (1)	05:41		06:07 (1)	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44			20:13	57	06:41 (1)	20:24	58	06:47 (1)	20:04	30	06:37 (1)	19:19	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41			05:14		05:45 (1)	05:16		05:50 (1)	05:42		06:09 (1)	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:13	19:45			20:14	56	06:41 (1)	20:24	57	06:47 (1)	20:03	26	06:35 (1)	19:17	18:26	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40			05:13		05:44 (1)	05:17		05:51 (1)	05:43		06:12 (1)	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46			20:14	57	06:41 (1)	20:23	57	06:48 (1)	20:02	20	06:32 (1)	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:24	05:39			05:13		05:45 (1)	05:17		05:51 (1)	05:44		06:15 (1)	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47			20:15	56	06:41 (1)	20:23	57	06:48 (1)	20:01	14	06:29 (1)	19:14	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37			05:13		05:45 (1)	05:18		05:51 (1)	05:45			06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48			20:16	57	06:42 (1)	20:23	57	06:48 (1)	19:58			19:12	18:21	16:36	16:16
7	07:13	06:52	06:12	06:20	05:36		06:09 (1)	05:12		05:44 (1)	05:19		05:51 (1)	05:46			06:17	06:48	06:24	06:58
	16:32	17:09	17:43	19:17	19:49	4	06:13 (1)	20:16	57	06:41 (1)	20:23	57	06:48 (1)	19:57			19:10	18:19	16:35	16:16
8	07:12	06:51	07:11	06:19	05:35		06:03 (1)	05:12		05:45 (1)	05:19		05:51 (1)	05:47			06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50	17	06:20 (1)	20:17	57	06:42 (1)	20:22	57	06:48 (1)	19:56			19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34		06:00 (1)	05:12		05:45 (1)	05:20		05:52 (1)	05:48			06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	23	06:23 (1)	20:18	57	06:42 (1)	20:22	57	06:49 (1)	19:54			19:07	18:16	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33		05:58 (1)	05:12		05:45 (1)	05:21		05:52 (1)	05:49			06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	27	06:25 (1)	20:18	58	06:43 (1)	20:22	56	06:48 (1)	19:53			19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:32		05:56 (1)	05:12		05:46 (1)	05:21		05:52 (1)	05:50			06:21	06:53	06:29	07:02
	16:36	17:14	18:47	19:21	19:53	31	06:27 (1)	20:19	57	06:43 (1)	20:21	56	06:48 (1)	19:52			19:03	18:12	16:30	16:16
12	07:12	06:46	07:04	06:12	05:31		05:54 (1)	05:11		05:46 (1)	05:22		05:53 (1)	05:51			06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:55	34	06:28 (1)	20:19	57	06:43 (1)	20:21	56	06:49 (1)	19:51			19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29		05:53 (1)	05:11		05:46 (1)	05:23		05:52 (1)	05:52			06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:56	37	06:30 (1)	20:20	57	06:43 (1)	20:20	56	06:48 (1)	19:49			19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28		05:52 (1)	05:11		05:46 (1)	05:24		05:53 (1)	05:53			06:24	06:56	06:32	07:04
	16:39	17:17	18:51	19:24	19:57	39	06:31 (1)	20:20	58	06:44 (1)	20:20	55	06:48 (1)	19:48			18:58	18:08	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27		05:51 (1)	05:11		05:47 (1)	05:24		05:53 (1)	05:54			06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:26	19:58	41	06:32 (1)	20:21	57	06:44 (1)	20:19	55	06:48 (1)	19:46			18:56	18:06	16:27	16:17
16	07:10	06:41	06:57	06:06	05:26		05:50 (1)	05:11		05:47 (1)	05:25		05:54 (1)	05:55			06:26	06:58	06:35	07:06
	16:41	17:20	18:53	19:27	19:59	43	06:33 (1)	20:21	57	06:44 (1)	20:19	54	06:48 (1)	19:45			18:55	18:04	16:26	16:17
17	07:10	06:39	06:56	06:04	05:25		05:49 (1)	05:11		05:47 (1)	05:26		05:54 (1)	05:56			06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	20:00	44	06:33 (1)	20:22	57	06:44 (1)	20:18	54	06:48 (1)	19:43			18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:03	05:25		05:48 (1)	05:11		05:47 (1)	05:27		05:54 (1)	05:57			06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00	46	06:34 (1)	20:22	57	06:44 (1)	20:17	54	06:48 (1)	19:42			18:51	18:01	16:24	16:17
19	07:09	06:37	06:52	06:01	05:24		05:48 (1)	05:11		05:47 (1)	05:28		05:55 (1)	05:58			06:29	07:01	06:39	07:07
	16:45	17:24	18:56	19:30	20:01	48	06:36 (1)	20:22	57	06:44 (1)	20:17	53	06:48 (1)	19:41			18:50	18:00	16:23	16:18
20	07:08	06:35	06:51	06:00	05:23		05:47 (1)	05:12		05:47 (1)	05:29		05:55 (1)	05:59			06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	49	06:36 (1)	20:23	57	06:44 (1)	20:16	52	06:47 (1)	19:39			18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58	05:22		05:47 (1)	05:12		05:47 (1)	05:29		05:56 (1)	06:00			06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	49	06:36 (1)	20:23	57	06:44 (1)	20:15	51	06:47 (1)	19:38			18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:57	05:21		05:46 (1)	05:12		05:48 (1)	05:30		05:57 (1)	06:01			06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	51	06:37 (1)	20:23	57	06:45 (1)	20:14	50	06:47 (1)	19:36			18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20		05:45 (1)	05:12		05:48 (1)	05:31		05:57 (1)	06:02			06:33	07:06	06:43	07:10
	16:50	17:28	19:01	19:34	20:04	52	06:37 (1)	20:23	57	06:45 (1)	20:14	50	06:47 (1)	19:35			18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54	05:20		05:46 (1)	05:13		05:48 (1)	05:32		05:57 (1)	06:03			06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	52	06:38 (1)	20:23	57	06:45 (1)	20:13	48	06:45 (1)	19:33			18:41	17:52	16:20	16:20
25	07:05	06:28	06:42	05:52	05:19		05:45 (1)	05:13		05:49 (1)	05:33		05:58 (1)	06:04			06:36	07:08	06:46	07:10
	16:52	17:31	19:03	19:36	20:06	53	06:38 (1)	20:24	57	06:46 (1)	20:12	47	06:45 (1)	19:31			18:39	17:51	16:20	16:21
26	07:04	06:26	06:40	05:51	05:18		05:45 (1)	05:13		05:49 (1)	05:34		05:59 (1)	06:05			06:37	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	54	06:39 (1)	20:24	57	06:46 (1)	20:11	45	06:44 (1)	19:30			18:37	17:50	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17		05:45 (1)	05:14		05:49 (1)	05:35		06:00 (1)	06:06			06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:39	20:08	54	06:39 (1)	20:24	57	06:46 (1)	20:10	44	06:44 (1)	19:28			18:36	17:48	16:19	16:22
28	07:02	06:23	06:37	05:48	05:17		05:44 (1)	05:14		05:49 (1)	05:36		06:01 (1)	06:07			06:39	07:12	06:49	07:12
	16:56	17:34	19:06	19:40	20:09	55	06:39 (1)	20:24	58	06:47 (1)	20:09	42	06:43 (1)	19:27			18:34	17:47	16:18	16:23
29	07:01		06:35	05:47	05:16		05:45 (1)	05:14		05:49 (1)	05:37		06:02 (1)	06:08			06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	55	06:40 (1)	20:24	58	06:47 (1)	20:08	40	06:42 (1)	19:25			18:32	17:46	16:18	16:24
30	07:00		06:34	05:45	05:16		05:44 (1)	05:15		05:49 (1)	05:38		06:03 (1)	06:09			06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	56	06:40 (1)	20:24	57	06:46 (1)	20:07	38	06:41 (1)	19:23			18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:45 (1)				05:39		06:04 (1)	06:10				07:16		07:12
	17:00		19:09		20:11	55	06:40 (1)				20:06	36	06:40 (1)	19:22				17:43		16:25
Potential sun hours	296	297	370	400	450			454			461			429			375	344	297	286
Total, worst case						1069			1711			1606			123					
Sun reduction						0.58			0.61			0.63			0.62					
Oper. time red.						1.00			1.00			1.00			1.00					
Wind dir. red.						0.56			0.56			0.56			0.56					
Total reduction						0.32			0.34			0.35			0.34					
Total, real						344			580			562			42					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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4/5/2011 10:33 PM / 8

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
4/5/2011 10:33 PM/2.7.473

SHADOW - Calendar

Shadow receptor: H - 7H

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:29	05:43	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:19	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:13	19:45	20:14	20:24	20:03	19:17	18:26	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:24	05:39	05:13	05:17	05:44	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:14	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36	16:16
7	07:13	06:52	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24	06:58
	16:32	17:09	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:35	16:16
8	07:12	06:51	07:11	06:19	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:32	05:12	05:21	05:50	06:21	06:53	06:29	07:02
	16:36	17:14	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:12	06:46	07:04	06:12	05:31	05:11	05:22	05:51	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:56	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:24	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:51	19:24	19:57	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:26	19:58	20:21	20:19	19:46	18:56	18:06	16:27	16:17
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:10	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	20:00	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:03	05:25	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:24	05:11	05:28	05:58	06:29	07:01	06:38	07:07
	16:45	17:24	18:56	19:30	20:00	20:22	20:17	19:41	18:50	18:00	16:23	16:18
20	07:08	06:35	06:51	06:00	05:23	05:12	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:57	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:01	19:34	20:04	20:23	20:14	19:35	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54	05:20	05:13	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:05	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:36	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:13	05:35	06:06	06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:12
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:47	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:46	16:18	16:24
30	07:00		06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:16		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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4/5/2011 10:33 PM / 9

Licensed user:
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2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
4/5/2011 10:33 PM/2.7.473

SHADOW - Calendar

Shadow receptor: I - 7I

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:29	05:43	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:19	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:13	19:45	20:14	20:24	20:03	19:17	18:26	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:24	05:39	05:13	05:17	05:44	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:14	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36	16:16
7	07:13	06:52	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24	06:58
	16:32	17:09	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:35	16:16
8	07:12	06:51	07:11	06:19	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:32	05:12	05:21	05:50	06:21	06:53	06:29	07:02
	16:36	17:14	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:12	06:46	07:04	06:12	05:31	05:11	05:22	05:51	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:56	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:24	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:51	19:24	19:57	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:26	19:58	20:21	20:19	19:46	18:56	18:06	16:27	16:17
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:10	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	20:00	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:03	05:25	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:24	05:11	05:28	05:58	06:29	07:01	06:38	07:07
	16:45	17:24	18:56	19:30	20:00	20:22	20:17	19:41	18:50	18:00	16:23	16:18
20	07:08	06:35	06:51	06:00	05:23	05:12	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:57	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:01	19:34	20:04	20:23	20:14	19:35	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54	05:20	05:13	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:05	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:36	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:13	05:35	06:06	06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:19	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:12
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:47	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:46	16:18	16:24
30	07:00		06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:16		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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4/5/2011 10:33 PM / 10

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
4/5/2011 10:33 PM/2.7.473

SHADOW - Calendar

Shadow receptor: J - 7J

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:29	05:43	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:19	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:13	19:45	20:14	20:24	20:03	19:17	18:26	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:24	05:39	05:13	05:17	05:44	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:14	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:21	16:36	16:16
7	07:13	06:52	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24	06:58
	16:32	17:09	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:35	16:16
8	07:12	06:51	07:11	06:19	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:32	05:12	05:21	05:50	06:21	06:53	06:29	07:02
	16:36	17:14	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
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	16:39	17:17	18:51	19:24	19:57	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:26	19:58	20:21	20:19	19:46	18:56	18:06	16:27	16:17
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	16:41	17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:26	16:17
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	16:44	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:24	05:11	05:28	05:58	06:29	07:01	06:38	07:07
	16:45	17:24	18:56	19:30	20:01	20:22	20:17	19:41	18:50	18:00	16:23	16:18
20	07:08	06:35	06:51	06:00	05:23	05:12	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:57	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:01	19:34	20:04	20:23	20:14	19:35	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54	05:20	05:13	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:05	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:36	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:14	05:35	06:06	06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:19	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:12
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29	07:01		06:35	05:47	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:46	16:18	16:24
30	07:00		06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
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31	06:59		06:32		05:15		05:39	06:10		07:16		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
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Project:

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Calculated:
4/5/2011 10:33 PM/2.7.473

SHADOW - Calendar

Shadow receptor: K - 7K

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
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	16:28	17:03	17:38	19:13	19:45	20:14	20:24	20:03	19:17	18:26	16:39	16:16
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	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
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Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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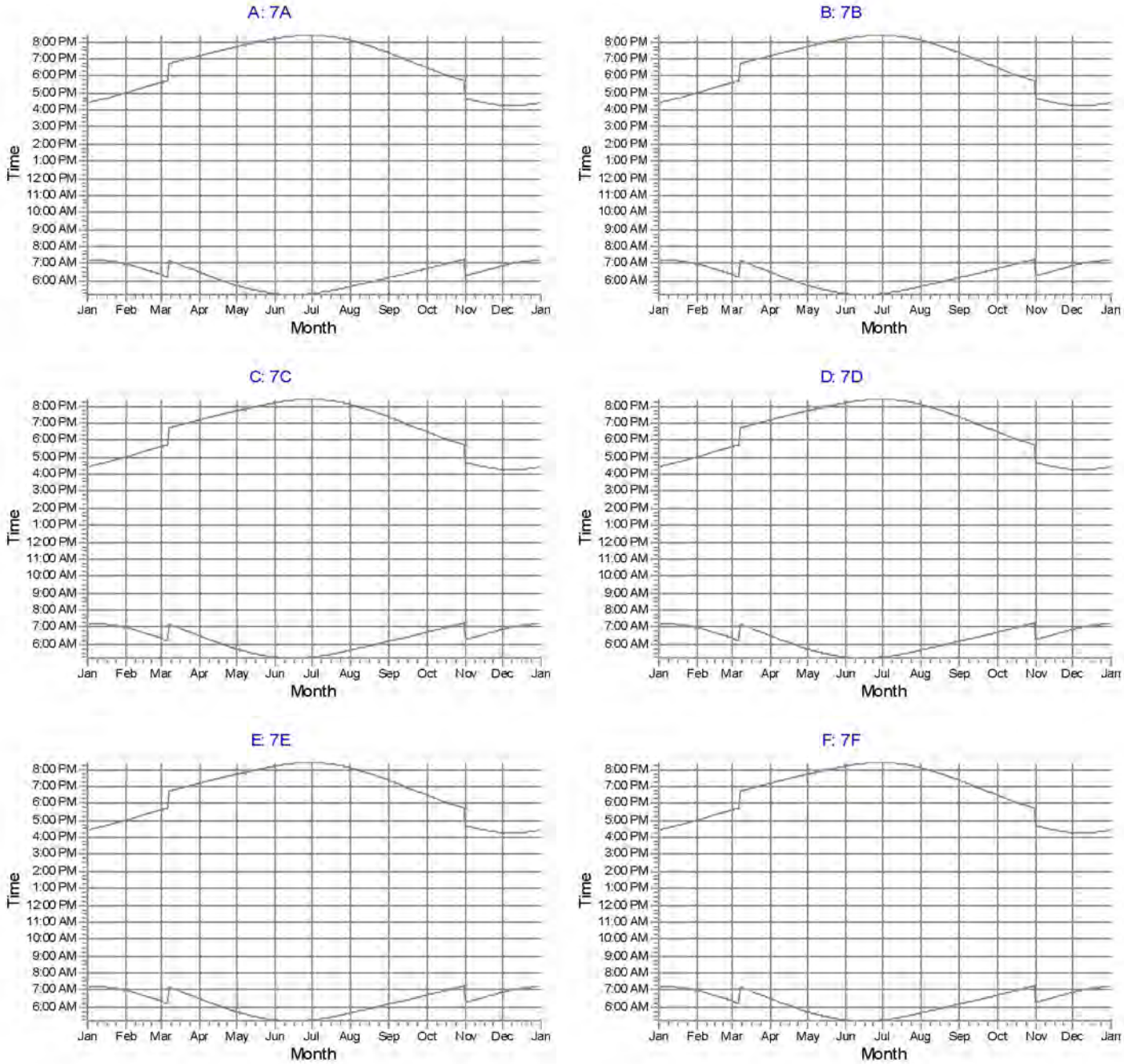
Calculated:
4/5/2011 10:33 PM/2.7.473

SHADOW - Calendar, graphical



WTGs

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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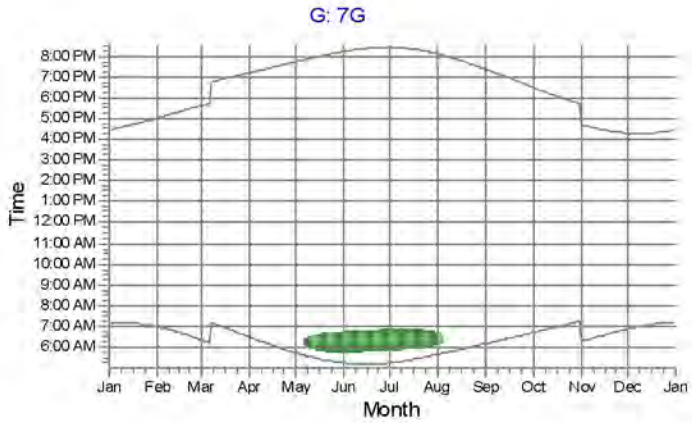
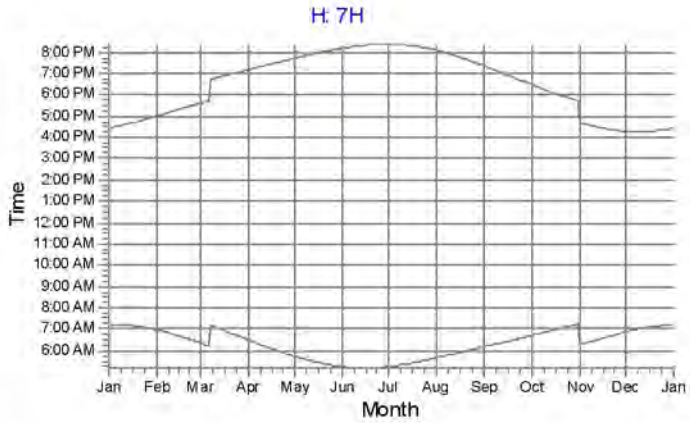
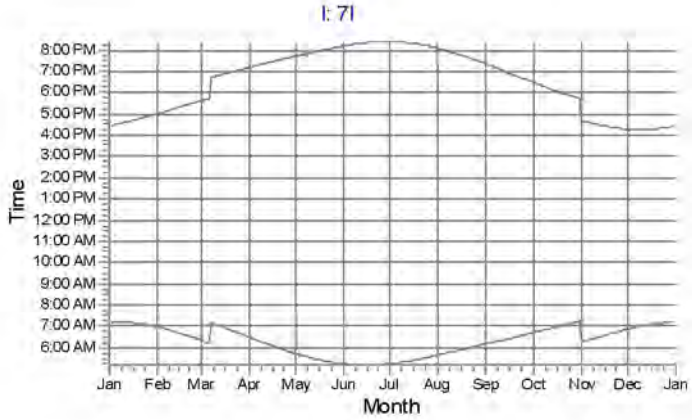
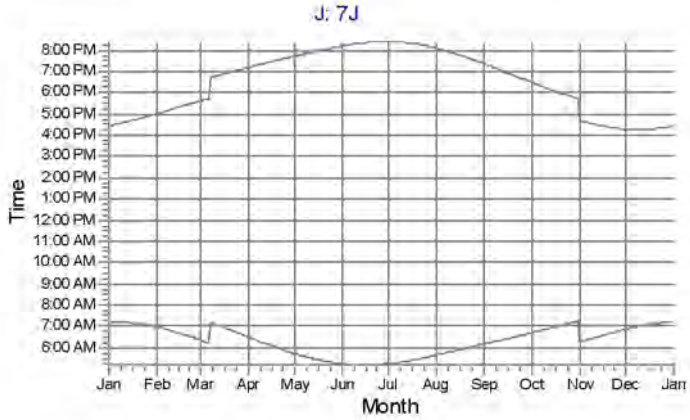
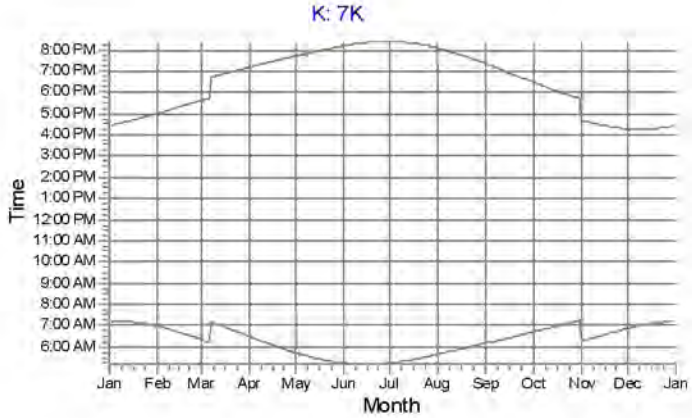
SHADOW - Calendar, graphical











WTGs

1: Bldg 1112 CP

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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4/5/2011 10:33 PM/2.7.473

SHADOW - Calendar per WTG

WTG: 1 - Bldg 1112 CP

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May		June		July		August		September	October	November	December
1	07:12	06:58	06:22	06:30	05:44		05:15	05:44-06:40/56	05:15	05:50-06:47/57	05:40	06:05-06:38/33	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43		20:12		20:24		20:05		19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:29	05:43		05:14	05:44-06:41/57	05:16	05:49-06:47/58	05:41	06:07-06:37/30	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44		20:13		20:24		20:04		19:19	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41		05:14	05:45-06:41/56	05:16	05:50-06:47/57	05:42	06:09-06:35/26	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:13	19:45		20:14		20:24		20:03		19:17	18:26	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40		05:13	05:44-06:41/57	05:17	05:51-06:48/57	05:43	06:12-06:32/20	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46		20:14		20:23		20:02		19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:24	05:39		05:13	05:45-06:41/56	05:17	05:51-06:48/57	05:44	06:15-06:29/14	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47		20:15		20:23		20:01		19:14	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37		05:13	05:45-06:42/57	05:18	05:51-06:48/57	05:45		06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48		20:16		20:23		19:58		19:12	18:20	16:36	16:16
7	07:13	06:52	06:12	06:20	05:36	06:09-06:13/4	05:12	05:44-06:41/57	05:19	05:51-06:48/57	05:46		06:17	06:48	06:24	06:58
	16:32	17:09	17:43	19:17	19:49		20:16		20:23		19:57		19:10	18:19	16:35	16:16
8	07:12	06:51	07:11	06:19	05:35	06:03-06:20/17	05:12	05:45-06:42/57	05:19	05:51-06:48/57	05:47		06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50		20:17		20:22		19:56		19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	06:00-06:23/23	05:12	05:45-06:42/57	05:20	05:52-06:49/57	05:48		06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51		20:18		20:22		19:54		19:07	18:16	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:58-06:25/27	05:12	05:45-06:43/58	05:21	05:52-06:48/56	05:49		06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52		20:18		20:22		19:53		19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:32	05:56-06:27/31	05:12	05:46-06:43/57	05:21	05:52-06:48/56	05:50		06:21	06:53	06:29	07:02
	16:36	17:14	18:47	19:21	19:53		20:19		20:21		19:52		19:03	18:12	16:30	16:16
12	07:12	06:46	07:04	06:12	05:31	05:54-06:28/34	05:11	05:46-06:43/57	05:22	05:53-06:49/56	05:51		06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54		20:19		20:21		19:50		19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:53-06:30/37	05:11	05:46-06:43/57	05:23	05:52-06:48/56	05:52		06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:56		20:20		20:20		19:49		19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:52-06:31/39	05:11	05:46-06:44/58	05:24	05:53-06:48/55	05:53		06:24	06:56	06:32	07:04
	16:39	17:17	18:51	19:24	19:57		20:20		20:20		19:48		18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:51-06:32/41	05:11	05:47-06:44/57	05:24	05:53-06:48/55	05:54		06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:26	19:58		20:21		20:19		19:46		18:56	18:06	16:27	16:17
16	07:10	06:41	06:57	06:06	05:26	05:50-06:33/43	05:11	05:47-06:44/57	05:25	05:54-06:48/54	05:55		06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:59		20:21		20:19		19:45		18:55	18:04	16:26	16:17
17	07:10	06:39	06:56	06:04	05:25	05:49-06:33/44	05:11	05:47-06:44/57	05:26	05:54-06:48/54	05:56		06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	20:00		20:22		20:18		19:43		18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:03	05:25	05:48-06:34/46	05:11	05:47-06:44/57	05:27	05:54-06:48/54	05:57		06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00		20:22		20:17		19:42		18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:24	05:48-06:36/48	05:11	05:47-06:44/57	05:28	05:55-06:48/53	05:58		06:29	07:01	06:38	07:07
	16:45	17:24	18:56	19:30	20:00		20:22		20:17		19:41		18:50	18:00	16:23	16:18
20	07:08	06:35	06:51	06:00	05:23	05:47-06:36/49	05:12	05:47-06:44/57	05:28	05:55-06:47/52	05:59		06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01		20:23		20:16		19:39		18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58	05:22	05:47-06:36/49	05:12	05:47-06:44/57	05:29	05:56-06:47/51	06:00		06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02		20:23		20:15		19:38		18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:57	05:21	05:46-06:37/51	05:12	05:48-06:45/57	05:30	05:57-06:47/50	06:01		06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03		20:23		20:14		19:36		18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:45-06:37/52	05:12	05:48-06:45/57	05:31	05:57-06:47/50	06:02		06:33	07:06	06:43	07:10
	16:50	17:28	19:01	19:34	20:04		20:23		20:14		19:35		18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54	05:20	05:46-06:38/52	05:13	05:48-06:45/57	05:32	05:57-06:45/48	06:03		06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05		20:23		20:13		19:33		18:41	17:52	16:20	16:20
25	07:05	06:28	06:42	05:52	05:19	05:45-06:38/53	05:13	05:49-06:46/57	05:33	05:58-06:45/47	06:04		06:36	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06		20:24		20:12		19:31		18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:45-06:39/54	05:13	05:49-06:46/57	05:34	05:59-06:44/45	06:05		06:37	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07		20:24		20:11		19:30		18:37	17:50	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:45-06:39/54	05:13	05:49-06:46/57	05:35	06:00-06:44/44	06:06		06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:39	20:08		20:24		20:10		19:28		18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:44-06:39/55	05:14	05:49-06:47/58	05:36	06:01-06:43/42	06:07		06:39	07:12	06:49	07:12
	16:56	17:34	19:06	19:40	20:09		20:24		20:09		19:27		18:34	17:47	16:18	16:23
29	07:01		06:35	05:47	05:16	05:45-06:40/55	05:14	05:49-06:47/58	05:37	06:02-06:42/40	06:08		06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10		20:24		20:08		19:25		18:32	17:46	16:18	16:24
30	07:00		06:34	05:45	05:16	05:44-06:40/56	05:15	05:49-06:46/57	05:38	06:03-06:41/38	06:09		06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10		20:24		20:07		19:23		18:31	17:44	16:17	16:24
31	06:59		06:32		05:15	05:45-06:40/55			05:39	06:04-06:40/36	06:10			07:16		07:12
	17:00		19:09		20:11				20:06		19:22			17:43		16:25
Potential sun hours	296	297	370	400	450		454		461		429		375	344	297	286
Sum of minutes with flicker	0	0	0	0	1069		1711		1606		123		0	0	0	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

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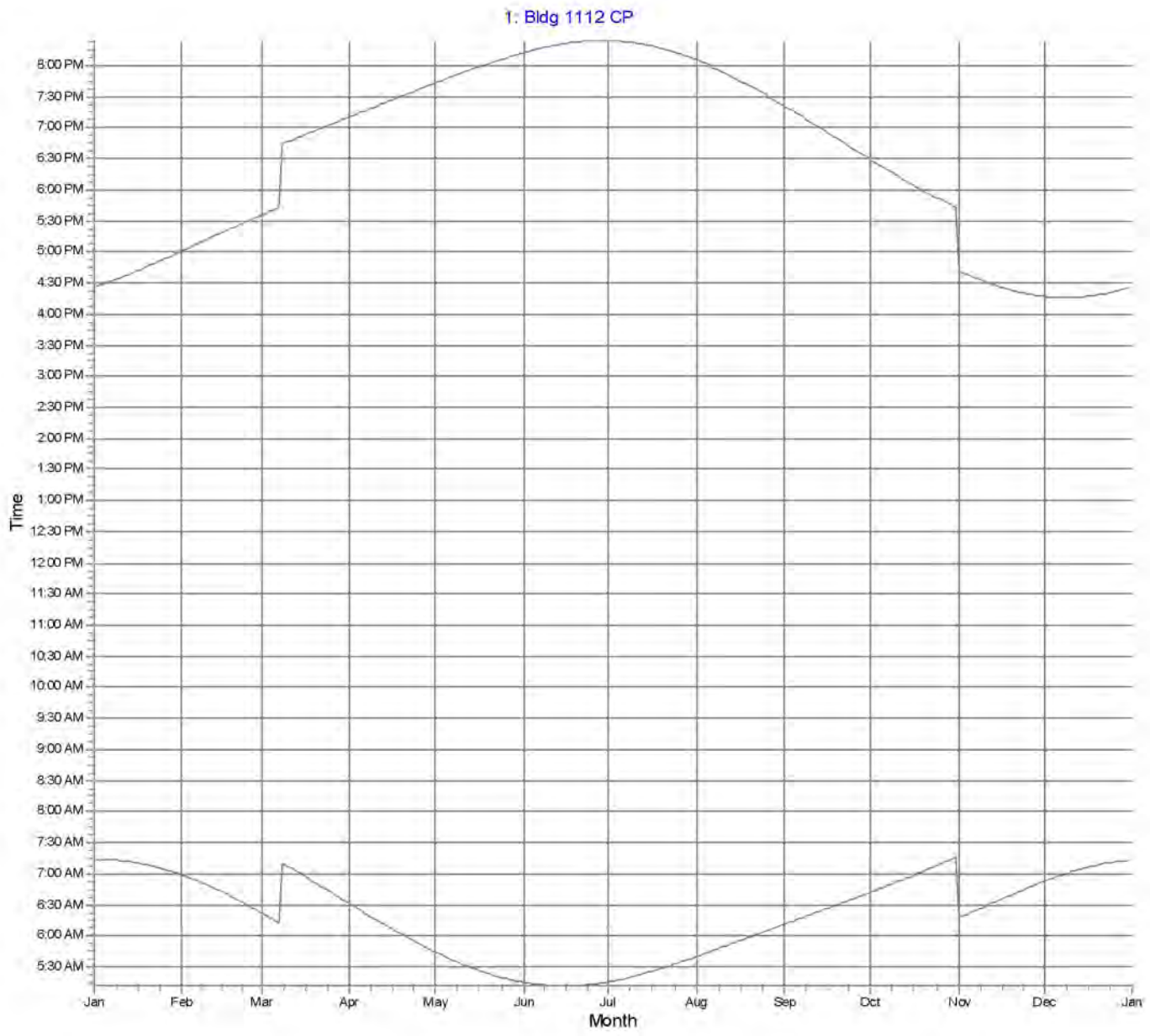
SHADOW - Calendar per WTG, graphical

WTG: 1 - Bldg 1112 CP



WTGs

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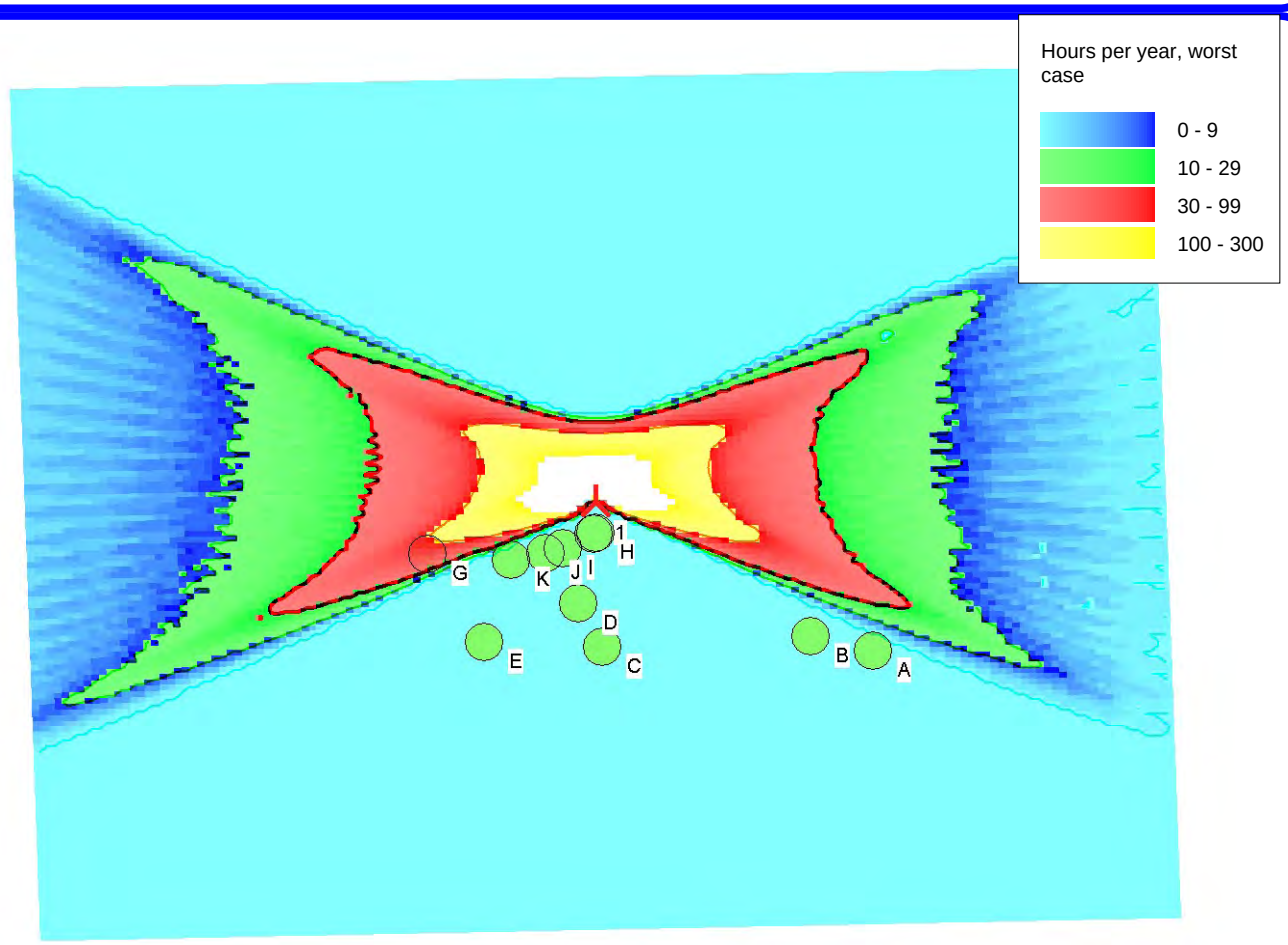
SHADOW - Map



0 250 500 750 1000m

Map: , Print scale 1:20,000, Map center Geo WGS 84 East: -71.323581° North: 41.522939°

New WTG Shadow receptor

Isolines showing shadow in Hours per year, worst case

0 10 30 100

APPENDIX 8

WIND TURBINE SITE 8 BUILDING 1285 (NAVY LODGE)

Figure A-8: Maximum predicted shadow flicker levels (hours per year) for a GE 1.5 MW sle Model at Wind Turbine Site 8 (Building 1285 – Navy Lodge).

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SHADOW - Main Result

Assumptions for shadow calculations

Maximum distance for influence
Calculate only when more than 20 % of sun is covered by the blade
Please look in WTG table

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

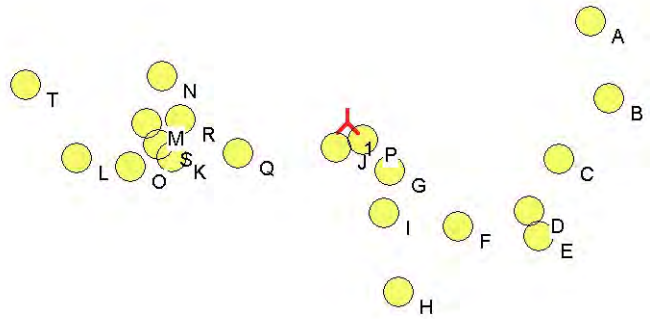
Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW
691	432	259	155	155	155	432	518	950	1,209	864	518

W	WNW	NW	NNW	Sum
432	604	691	691	8,756

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: Line object
Obstacles used in calculation
Eye height: 1.5 m
Grid resolution: 10 m



Scale 1:25,000
New WTG
Shadow receptor

WTGs

	Geo DD: WGS 84 Longitude	Latitude	Z [m]	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Shadow data Calculation distance [m]	RPM [RPM]
1	-71.316147° East	41.519826° North	2.6	Bldg 1285 NL	Yes	GE WIND ENERGY	GE 1.5sle-1,500	1,500	77.0	65.0	2,000	20.0

Shadow receptor-Input

No.	Name	Geo DD: WGS 84 Longitude	Latitude	Z [m]	Width [m]	Height [m]	Height a.g.l. [m]	Degrees from south cw [°]	Slope of window [°]	Direction mode
A	8A	-71.306477° East	41.523825° North	23.9	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
B	8B	-71.305764° East	41.520769° North	25.2	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
C	8C	-71.307755° East	41.518380° North	19.1	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
D	8D	-71.308924° East	41.516316° North	25.2	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
E	8E	-71.308536° East	41.515304° North	30.5	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
F	8F	-71.311767° East	41.515678° North	27.6	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
G	8G	-71.314460° East	41.517915° North	15.7	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
H	8H	-71.314131° East	41.513114° North	27.1	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
I	8I	-71.314685° East	41.516216° North	22.0	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
J	8J	-71.316609° East	41.518816° North	6.7	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
K	8K	-71.323145° East	41.518450° North	21.3	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
L	8L	-71.326908° East	41.518394° North	2.7	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
M	8M	-71.324129° East	41.519773° North	16.7	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
N	8N	-71.323522° East	41.521661° North	17.6	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
O	8O	-71.324783° East	41.518081° North	6.7	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
P	8P	-71.315516° East	41.519128° North	9.1	1.0	1.0	1.0	-180.0	90.0	"Green house mode"

To be continued on next page...

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Calculated:
4/5/2011 10:49 PM/2.7.473

SHADOW - Main Result

...continued from previous page

No.	Name	Geo DD: WGS 84 Longitude	Latitude	Z [m]	Width [m]	Height [m]	Height a.g.l. [m]	Degrees from south cw [°]	Slope of window [°]	Direction mode
Q	8Q	-71.320500° East	41.518613° North	16.5	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
R	8R	-71.322789° East	41.519944° North	16.8	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
S	8S	-71.323667° East	41.518945° North	11.0	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
T	8T	-71.328931° East	41.521321° North	0.0	1.0	1.0	1.0	-180.0	90.0	"Green house mode"

Calculation Results

Shadow receptor

No.	Name	Shadow, worst case: Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow, expected values: Shadow hours per year [h/year]
A	8A	3:50	30	0:12	1:08
B	8B	2:49	21	0:12	0:54
C	8C	7:58	34	0:21	2:38
D	8D	0:00	0	0:00	0:00
E	8E	0:00	0	0:00	0:00
F	8F	0:00	0	0:00	0:00
G	8G	0:00	0	0:00	0:00
H	8H	0:00	0	0:00	0:00
I	8I	0:00	0	0:00	0:00
J	8J	0:00	0	0:00	0:00
K	8K	13:37	46	0:27	4:19
L	8L	5:28	28	0:18	1:43
M	8M	8:57	34	0:24	2:54
N	8N	10:09	37	0:25	3:29
O	8O	10:17	38	0:23	3:16
P	8P	0:00	0	0:00	0:00
Q	8Q	71:26	108	0:49	23:54
R	8R	14:11	40	0:30	4:36
S	8S	12:28	40	0:28	3:57
T	8T	3:00	19	0:14	0:57

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

No.	Name	Worst case [h/year]	Expected [h/year]
1	Bldg 1285 NL	132:57	43:49

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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4/5/2011 10:50 PM / 1

Licensed user:
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Calculated:
4/5/2011 10:49 PM/2.7.473

SHADOW - Calendar

Shadow receptor: A - 8A

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January		February		March	April	May	June	July	August	September	October	November		December
1	07:12		06:58	16:26 (1)	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17		06:52
	16:26		17:01	9 16:35 (1)	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42		16:17
2	07:12		06:57		06:20	06:28	05:42	05:14	05:16	05:41	06:12	06:43	06:18		06:53
	16:27		17:02		17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40		16:17
3	07:13		06:56		06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19		06:54
	16:28		17:03		17:38	19:12	19:45	20:14	20:23	20:03	19:17	18:25	16:39		16:16
4	07:13		06:55		06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20		06:55
	16:29		17:05		17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38		16:16
5	07:13		06:54		06:15	06:23	05:39	05:13	05:17	05:44	06:15	06:46	06:21		06:56
	16:30		17:06		17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37		16:16
6	07:13		06:53		06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23		06:57
	16:31		17:07		17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36		16:16
7	07:12		06:52		06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24		06:58
	16:32		17:08		17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34		16:16
8	07:12		06:51		07:10	06:18	05:35	05:12	05:19	05:47	06:18	06:49	06:25		06:59
	16:33		17:10		18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33		16:16
9	07:12		06:50		07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26		07:00
	16:34		17:11		18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32		16:16
10	07:12		06:48		07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28	15:56 (1)	07:01
	16:35		17:12		18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	10 16:06 (1)	16:16
11	07:12		06:47		07:06	06:14	05:32	05:11	05:21	05:50	06:21	06:52	06:29	15:54 (1)	07:02
	16:36		17:14		18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	12 16:06 (1)	16:16
12	07:11		06:46		07:04	06:12	05:30	05:11	05:22	05:51	06:22	06:54	06:30	15:53 (1)	07:02
	16:37		17:15		18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	12 16:05 (1)	16:16
13	07:11		06:45		07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	15:53 (1)	07:03
	16:38		17:16		18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	12 16:05 (1)	16:16
14	07:11		06:43		07:01	06:09	05:28	05:11	05:23	05:53	06:24	06:56	06:32	15:52 (1)	07:04
	16:39		17:17		18:50	19:24	19:56	20:20	20:20	19:48	18:58	18:07	16:27	11 16:03 (1)	16:16
15	07:10		06:42		06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	15:52 (1)	07:05
	16:40		17:19		18:52	19:25	19:57	20:21	20:19	19:46	18:56	18:06	16:26	10 16:02 (1)	16:16
16	07:10		06:41		06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	15:52 (1)	07:05
	16:41		17:20		18:53	19:27	19:58	20:21	20:19	19:45	18:55	18:04	16:26	10 16:02 (1)	16:17
17	07:09		06:39		06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	15:52 (1)	07:06
	16:42		17:21		18:54	19:28	19:59	20:22	20:18	19:43	18:53	18:03	16:25	9 16:01 (1)	16:17
18	07:09		06:38	16:17 (1)	06:54	06:03	05:24	05:11	05:27	05:57	06:28	07:00	06:37	15:52 (1)	07:07
	16:44	2	17:22	16:18 (1)	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	8 16:00 (1)	16:17
19	07:08		06:37	16:18 (1)	06:52	06:01	05:24	05:11	05:28	05:58	06:29	07:01	06:38	15:52 (1)	07:07
	16:45	2	17:23	16:19 (1)	18:56	19:30	20:00	20:22	20:17	19:40	18:49	18:00	16:23	6 15:58 (1)	16:18
20	07:08		06:35	16:17 (1)	06:50	05:59	05:23	05:12	05:28	05:59	06:30	07:03	06:40	15:53 (1)	07:08
	16:46	3	17:25	16:20 (1)	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:23	5 15:58 (1)	16:18
21	07:07		06:34	16:17 (1)	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	15:53 (1)	07:09
	16:47	4	17:26	16:21 (1)	18:58	19:32	20:02	20:23	20:15	19:37	18:46	17:57	16:22	4 15:57 (1)	16:19
22	07:07		06:32	16:18 (1)	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	15:53 (1)	07:09
	16:48	5	17:27	16:23 (1)	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	3 15:56 (1)	16:19
23	07:06		06:31	16:18 (1)	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	15:54 (1)	07:10
	16:50	6	17:28	16:24 (1)	19:00	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:21	2 15:56 (1)	16:20
24	07:05		06:29	16:18 (1)	06:44	05:54	05:19	05:12	05:32	06:03	06:34	07:07	06:44	15:55 (1)	07:10
	16:51	8	17:30	16:26 (1)	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	2 15:56 (1)	16:20
25	07:04		06:28	16:18 (1)	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45		07:10
	16:52	9	17:31	16:27 (1)	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19		16:21
26	07:04		06:26	16:18 (1)	06:40	05:51	05:18	05:13	05:34	06:05	06:36	07:10	06:47		07:11
	16:53	10	17:32	16:28 (1)	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19		16:21
27	07:03		06:25	16:20 (1)	06:39	05:49	05:17	05:13	05:35	06:06	06:38	07:11	06:48		07:11
	16:55	10	17:33	16:30 (1)	19:05	19:38	20:08	20:24	20:10	19:28	18:36	17:48	16:18		16:22
28	07:02		06:23	16:20 (1)	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49		07:11
	16:56	11	17:34	16:31 (1)	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18		16:23
29	07:01			16:21 (1)	06:35	05:46	05:16	05:14	05:37	06:08	06:40	07:13	06:50		07:12
	16:57	12		16:33 (1)	19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:18		16:23
30	07:00			16:22 (1)	06:33	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51		07:12
	16:58	12		16:34 (1)	19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17		16:24
31	06:59			16:24 (1)	06:32		05:15		05:39	06:10		07:15			07:12
	17:00	11		16:35 (1)	19:09		20:11		20:06	19:22		17:43			16:25
Potential sun hours	296		297		370	400	450	454	461	429	375	344	297		286
Total, worst case		105		9										116	
Sun reduction		0.56		0.58										0.50	
Oper. time red.		1.00		1.00										1.00	
Wind dir. red.		0.57		0.57										0.57	
Total reduction		0.32		0.33										0.28	
Total, real		33		3										33	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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4/5/2011 10:50 PM / 2

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Calculated:
4/5/2011 10:49 PM/2.7.473

SHADOW - Calendar

Shadow receptor: B - 8B

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March			April	May	June	July	August	September			October			November	December
1	07:12	06:58	06:22			06:30	05:44	05:15	05:15	05:40	06:11			06:42		17:58 (1)	06:17	06:52
	16:26	17:01	17:36			19:10	19:43	20:12	20:24	20:05	19:20			18:29	9	18:07 (1)	16:42	16:17
2	07:12	06:57	06:20			06:28	05:42	05:14	05:16	05:41	06:12			06:43		17:58 (1)	06:18	06:53
	16:27	17:02	17:37			19:11	19:44	20:13	20:24	20:04	19:18			18:27	7	18:05 (1)	16:40	16:17
3	07:13	06:56	06:18			06:27	05:41	05:14	05:16	05:42	06:13			06:44		17:58 (1)	06:19	06:54
	16:28	17:03	17:38			19:12	19:45	20:13	20:23	20:03	19:17			18:25	5	18:03 (1)	16:39	16:16
4	07:13	06:55	06:17			06:25	05:40	05:13	05:17	05:43	06:14			06:45		17:58 (1)	06:20	06:55
	16:29	17:05	17:39			19:14	19:46	20:14	20:23	20:02	19:15			18:24	3	18:01 (1)	16:38	16:16
5	07:13	06:54	06:15			06:23	05:39	05:13	05:17	05:44	06:15			06:46		17:58 (1)	06:21	06:56
	16:30	17:06	17:40			19:15	19:47	20:15	20:23	20:01	19:13			18:22	2	18:00 (1)	16:37	16:16
6	07:13	06:53	06:14			06:22	05:37	05:13	05:18	05:45	06:16			06:47			06:23	06:57
	16:31	17:07	17:41			19:16	19:48	20:16	20:23	19:58	19:12			18:20			16:36	16:16
7	07:12	06:52	06:12			06:20	05:36	05:12	05:19	05:46	06:17			06:48			06:24	06:58
	16:32	17:08	17:43			19:17	19:49	20:16	20:23	19:57	19:10			18:19			16:34	16:16
8	07:12	06:51	07:10			06:18	05:35	05:12	05:19	05:47	06:18			06:49			06:25	06:59
	16:33	17:10	18:44			19:18	19:50	20:17	20:22	19:56	19:08			18:17			16:33	16:16
9	07:12	06:50	07:09		18:20 (1)	06:17	05:34	05:12	05:20	05:48	06:19			06:50			06:26	07:00
	16:34	17:11	18:45	3	18:23 (1)	19:19	19:51	20:18	20:22	19:54	19:07			18:15			16:32	16:16
10	07:12	06:48	07:07		18:19 (1)	06:15	05:33	05:12	05:21	05:49	06:20			06:51			06:28	07:01
	16:35	17:12	18:46	5	18:24 (1)	19:20	19:52	20:18	20:22	19:53	19:05			18:14			16:31	16:16
11	07:12	06:47	07:06		18:19 (1)	06:14	05:32	05:11	05:21	05:50	06:21			06:52			06:29	07:02
	16:36	17:14	18:47	7	18:26 (1)	19:21	19:53	20:19	20:21	19:52	19:03			18:12			16:30	16:16
12	07:11	06:46	07:04		18:18 (1)	06:12	05:30	05:11	05:22	05:51	06:22			06:54			06:30	07:02
	16:37	17:15	18:48	9	18:27 (1)	19:22	19:54	20:19	20:21	19:50	19:02			18:11			16:29	16:16
13	07:11	06:45	07:02		18:18 (1)	06:10	05:29	05:11	05:23	05:52	06:23			06:55			06:31	07:03
	16:38	17:16	18:49	9	18:27 (1)	19:23	19:55	20:20	20:20	19:49	19:00			18:09			16:28	16:16
14	07:11	06:43	07:01		18:19 (1)	06:09	05:28	05:11	05:23	05:53	06:24			06:56			06:32	07:04
	16:39	17:17	18:50	10	18:29 (1)	19:24	19:56	20:20	20:20	19:48	18:58			18:07			16:27	16:16
15	07:10	06:42	06:59		18:19 (1)	06:07	05:27	05:11	05:24	05:54	06:25			06:57			06:34	07:05
	16:40	17:19	18:52	11	18:30 (1)	19:25	19:57	20:21	20:19	19:46	18:56			18:06			16:26	16:16
16	07:10	06:41	06:57		18:19 (1)	06:06	05:26	05:11	05:25	05:55	06:26			06:58			06:35	07:05
	16:41	17:20	18:53	12	18:31 (1)	19:27	19:58	20:21	20:19	19:45	18:55			18:04			16:26	16:17
17	07:09	06:39	06:56		18:21 (1)	06:04	05:25	05:11	05:26	05:56	06:27			06:59			06:36	07:06
	16:42	17:21	18:54	12	18:33 (1)	19:28	19:59	20:22	20:18	19:43	18:53			18:03			16:25	16:17
18	07:09	06:38	06:54		18:24 (1)	06:03	05:24	05:11	05:27	05:57	06:28			07:00			06:37	07:07
	16:44	17:22	18:55	7	18:31 (1)	19:29	20:00	20:22	20:17	19:42	18:51			18:01			16:24	16:17
19	07:08	06:37	06:52			06:01	05:24	05:11	05:28	05:58	06:29			07:01			06:38	07:07
	16:45	17:23	18:56			19:30	20:00	20:22	20:17	19:40	18:49			18:00			16:23	16:18
20	07:08	06:35	06:50			05:59	05:23	05:12	05:28	05:59	06:30			07:03			06:40	07:08
	16:46	17:25	18:57			19:31	20:01	20:23	20:16	19:39	18:48			17:58			16:23	16:18
21	07:07	06:34	06:49			05:58	05:22	05:12	05:29	06:00	06:31			07:04			06:41	07:09
	16:47	17:26	18:58			19:32	20:02	20:23	20:15	19:37	18:46			17:57			16:22	16:19
22	07:07	06:32	06:47			05:56	05:21	05:12	05:30	06:01	06:32			07:05			06:42	07:09
	16:48	17:27	18:59			19:33	20:03	20:23	20:14	19:36	18:44			17:55			16:21	16:19
23	07:06	06:31	06:45			05:55	05:20	05:12	05:31	06:02	06:33			07:06			06:43	07:10
	16:50	17:28	19:00			19:34	20:04	20:23	20:14	19:34	18:43			17:54			16:21	16:20
24	07:05	06:29	06:44			05:54	05:19	05:12	05:32	06:03	06:34			07:07			06:44	07:10
	16:51	17:30	19:02			19:35	20:05	20:23	20:13	19:33	18:41			17:52			16:20	16:20
25	07:04	06:28	06:42			05:52	05:19	05:13	05:33	06:04	06:35		18:08 (1)	07:08			06:45	07:10
	16:52	17:31	19:03			19:36	20:06	20:24	20:12	19:31	18:39	4	18:12 (1)	17:51			16:19	16:21
26	07:04	06:26	06:40			05:51	05:18	05:13	05:34	06:05	06:36		18:04 (1)	07:09			06:47	07:11
	16:53	17:32	19:04			19:37	20:07	20:24	20:11	19:30	18:37	11	18:15 (1)	17:50			16:19	16:21
27	07:03	06:25	06:39			05:49	05:17	05:13	05:35	06:06	06:38		18:01 (1)	07:11			06:48	07:11
	16:55	17:33	19:05			19:38	20:08	20:24	20:10	19:28	18:36	12	18:13 (1)	17:48			16:18	16:22
28	07:02	06:23	06:37			05:48	05:17	05:14	05:36	06:07	06:39		18:01 (1)	07:12			06:49	07:11
	16:56	17:34	19:06			19:40	20:09	20:24	20:09	19:27	18:34	11	18:12 (1)	17:47			16:18	16:23
29	07:01		06:35			05:46	05:16	05:14	05:37	06:08	06:40		18:00 (1)	07:13			06:50	07:12
	16:57		19:07			19:41	20:10	20:24	20:08	19:25	18:32	10	18:10 (1)	17:45			16:18	16:23
30	07:00		06:33			05:45	05:16	05:15	05:38	06:09	06:41		17:59 (1)	07:14			06:51	07:12
	16:58		19:08			19:42	20:10	20:24	20:07	19:23	18:31	10	18:09 (1)	17:44			16:17	16:24
31	06:59		06:32				05:15		05:39	06:10				07:15				07:12
	17:00		19:09				20:11		20:06	19:22				17:43				16:25
Potential sun hours	296	297	370			400	450	454	461	429	375			344			297	286
Total, worst case				85								58			26			
Sun reduction				0.58								0.62			0.61			
Oper. time red.				1.00								1.00			1.00			
Wind dir. red.				0.54								0.54			0.54			
Total reduction				0.31								0.33			0.33			
Total, real				26								19			8			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
4/5/2011 10:50 PM / 3

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
4/5/2011 10:49 PM/2.7.473

SHADOW - Calendar

Shadow receptor: C - 8C

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April			May			June	July	August			September	October	November	December
1	07:12	06:58	06:22	06:30			05:44		19:01 (1)	05:15	05:15	05:40			06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10			19:43	9	19:10 (1)	20:12	20:24	20:05			19:20	18:29	16:42	16:17
2	07:12	06:57	06:20	06:28			05:42			05:14	05:16	05:41			06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11			19:44			20:13	20:24	20:04			19:18	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27			05:41			05:14	05:16	05:42			06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12			19:45			20:14	20:23	20:03			19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25			05:40			05:13	05:17	05:43			06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14			19:46			20:14	20:23	20:02			19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23			05:39			05:13	05:17	05:44			06:15	06:46	06:21	06:56
	16:30	17:06	17:40	19:15			19:47			20:15	20:23	20:01			19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22			05:37			05:13	05:18	05:45			06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16			19:48			20:16	20:23	19:58			19:12	18:20	16:36	16:16
7	07:12	06:52	06:12	06:20			05:36			05:12	05:19	05:46			06:17	06:48	06:24	06:58
	16:32	17:08	17:43	19:17			19:49			20:16	20:23	19:57			19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18			05:35			05:12	05:19	05:47			06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18			19:50			20:17	20:22	19:56			19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17			05:34			05:12	05:20	05:48			06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19			19:51			20:18	20:22	19:54			19:07	18:15	16:32	16:16
10	07:12	06:48	07:07	06:15			05:33			05:12	05:21	05:49			06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20			19:52			20:18	20:22	19:53			19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14			05:32			05:11	05:21	05:50			06:21	06:52	06:29	07:02
	16:36	17:14	18:47	19:21			19:53			20:19	20:21	19:52			19:03	18:12	16:30	16:16
12	07:11	06:46	07:04	06:12			05:30			05:11	05:22	05:51		19:08 (1)	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22			19:54			20:19	20:21	19:50	10	19:18 (1)	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10			05:29			05:11	05:23	05:52		19:06 (1)	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23			19:55			20:20	20:20	19:49	14	19:20 (1)	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09			05:28			05:11	05:23	05:53		19:04 (1)	06:24	06:56	06:32	07:04
	16:39	17:17	18:50	19:24			19:56			20:20	20:20	19:48	18	19:22 (1)	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07		19:00 (1)	05:27			05:11	05:24	05:54		19:03 (1)	06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:25	3	19:03 (1)	19:57			20:21	20:19	19:46	20	19:23 (1)	18:56	18:06	16:27	16:16
16	07:10	06:41	06:57	06:06		18:59 (1)	05:26			05:11	05:25	05:55		19:02 (1)	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	5	19:04 (1)	19:58			20:21	20:19	19:45	20	19:22 (1)	18:55	18:04	16:26	16:17
17	07:09	06:39	06:56	06:04		18:57 (1)	05:25			05:11	05:26	05:56		19:01 (1)	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	8	19:05 (1)	19:59			20:22	20:18	19:43	20	19:21 (1)	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:03		18:56 (1)	05:24			05:11	05:27	05:57		19:00 (1)	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	10	19:06 (1)	20:00			20:22	20:17	19:42	19	19:19 (1)	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01		18:55 (1)	05:24			05:11	05:28	05:58		19:00 (1)	06:29	07:01	06:38	07:07
	16:45	17:24	18:56	19:30	12	19:07 (1)	20:00			20:22	20:17	19:40	18	19:18 (1)	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59		18:55 (1)	05:23			05:12	05:28	05:59		18:59 (1)	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	14	19:09 (1)	20:01			20:23	20:16	19:39	18	19:17 (1)	18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58		18:54 (1)	05:22			05:12	05:29	06:00		18:59 (1)	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	15	19:09 (1)	20:02			20:23	20:15	19:37	16	19:15 (1)	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:56		18:54 (1)	05:21			05:12	05:30	06:01		18:59 (1)	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	16	19:10 (1)	20:03			20:23	20:14	19:36	15	19:14 (1)	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55		18:53 (1)	05:20			05:12	05:31	06:02		18:59 (1)	06:33	07:06	06:43	07:10
	16:50	17:28	19:00	19:34	18	19:11 (1)	20:04			20:23	20:14	19:34	13	19:12 (1)	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54		18:54 (1)	05:19			05:12	05:32	06:03		18:59 (1)	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	18	19:12 (1)	20:05			20:23	20:13	19:33	12	19:11 (1)	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52		18:54 (1)	05:19			05:13	05:33	06:04		18:59 (1)	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20	19:14 (1)	20:06			20:24	20:12	19:31	10	19:09 (1)	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51		18:54 (1)	05:18			05:13	05:34	06:05		19:00 (1)	06:36	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20	19:14 (1)	20:07			20:24	20:11	19:30	8	19:08 (1)	18:37	17:50	16:19	16:21
27	07:03	06:25	06:39	05:49		18:55 (1)	05:17			05:13	05:35	06:06		19:01 (1)	06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:38	21	19:16 (1)	20:08			20:24	20:10	19:28	5	19:06 (1)	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48		18:55 (1)	05:17			05:14	05:36	06:07		19:02 (1)	06:39	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20	19:15 (1)	20:09			20:24	20:09	19:27	3	19:05 (1)	18:34	17:47	16:18	16:23
29	07:01		06:35	05:46		18:57 (1)	05:16			05:14	05:37	06:08			06:40	07:13	06:50	07:12
	16:57		19:07	19:41	17	19:14 (1)	20:10			20:24	20:08	19:25			18:32	17:45	16:18	16:23
30	07:00		06:34	05:45		18:59 (1)	05:16			05:15	05:38	06:09			06:41	07:14	06:51	07:12
	16:58		19:08	19:42	13	19:12 (1)	20:10			20:24	20:07	19:23			18:31	17:44	16:17	16:24
31	06:59		06:32				05:15				05:39	06:10				07:15		07:12
	17:00		19:09				20:11				20:06	19:22				17:43		16:25
Potential sun hours	296	297	370	400			450			454	461	429			375	344	297	286
Total, worst case					230			9					239					
Sun reduction					0.57			0.58					0.62					
Oper. time red.					1.00			1.00					1.00					
Wind dir. red.					0.56			0.56					0.56					
Total reduction					0.32			0.32					0.35					
Total, real					73			3					82					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
4/5/2011 10:49 PM/2.7.473

SHADOW - Calendar

Shadow receptor: D - 8D

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:12	06:57	06:20	06:28	05:42	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:13	20:23	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:39	05:13	05:17	05:44	06:15	06:46	06:21	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24	06:58
	16:32	17:08	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:32	05:11	05:21	05:50	06:21	06:52	06:29	07:02
	16:36	17:14	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:11	06:46	07:04	06:12	05:30	05:11	05:22	05:51	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:24	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:51	19:24	19:56	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:25	19:57	20:21	20:19	19:46	18:56	18:06	16:27	16:16
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:58	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:09	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	19:59	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:03	05:24	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:24	05:11	05:28	05:58	06:29	07:01	06:38	07:07
	16:45	17:24	18:56	19:30	20:00	20:22	20:17	19:40	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:23	05:12	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:37	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:36	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:13	05:35	06:06	06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:38	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
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	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:18	16:23
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	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:15		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
4/5/2011 10:50 PM / 5

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
4/5/2011 10:49 PM/2.7.473

SHADOW - Calendar

Shadow receptor: E - 8E

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:12	06:57	06:20	06:28	05:42	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:13	20:23	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:39	05:13	05:17	05:44	06:15	06:46	06:21	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24	06:58
	16:32	17:08	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
8	07:12	06:51	07:10	06:18	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:15	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:32	05:11	05:21	05:50	06:21	06:52	06:29	07:02
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13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
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	16:39	17:17	18:50	19:24	19:56	20:20	20:20	19:48	18:58	18:07	16:27	16:16
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	16:40	17:19	18:52	19:25	19:57	20:21	20:19	19:46	18:56	18:06	16:27	16:16
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:58	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:09	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	19:59	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:03	05:24	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:24	05:11	05:28	05:58	06:29	07:01	06:38	07:07
	16:45	17:24	18:56	19:30	20:00	20:22	20:17	19:40	18:49	18:00	16:23	16:18
20	07:08	06:35	06:50	05:59	05:23	05:12	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:22	20:16	19:39	18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:37	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:36	07:09	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:13	05:35	06:06	06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:38	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:46	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:18	16:23
30	07:00		06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:15		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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4/5/2011 10:50 PM / 6

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
4/5/2011 10:49 PM/2.7.473

SHADOW - Calendar

Shadow receptor: F - 8F

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:12	06:57	06:20	06:28	05:42	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:23	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:39	05:13	05:17	05:44	06:15	06:46	06:21	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24	06:58
	16:32	17:09	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:34	16:16
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21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:37	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
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30	07:00		06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:15		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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4/5/2011 10:50 PM / 7

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
4/5/2011 10:49 PM/2.7.473

SHADOW - Calendar

Shadow receptor: G - 8G

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:23	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:39	05:13	05:17	05:44	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24	06:58
	16:32	17:09	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:35	16:16
8	07:12	06:51	07:11	06:19	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:32	05:12	05:21	05:50	06:21	06:52	06:29	07:02
	16:36	17:14	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:11	06:46	07:04	06:12	05:30	05:11	05:22	05:51	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:24	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:51	19:24	19:56	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:25	19:57	20:21	20:19	19:46	18:56	18:06	16:27	16:17
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:58	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:09	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	19:59	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:03	05:24	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:24	05:11	05:28	05:58	06:29	07:01	06:38	07:07
	16:45	17:24	18:56	19:30	20:00	20:22	20:17	19:41	18:50	18:00	16:23	16:18
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	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
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	16:50	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54	05:19	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
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	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:13	05:35	06:06	06:38	07:11	06:48	07:11
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	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

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	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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Calculated:
4/5/2011 10:49 PM/2.7.473

SHADOW - Calendar

Shadow receptor: H - 8H

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

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	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
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	16:32	17:09	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:35	16:16
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	16:33	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28	07:01
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Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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Calculated:
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SHADOW - Calendar

Shadow receptor: I - 8I

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	16:28	17:03	17:38	19:12	19:45	20:14	20:23	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
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7	07:12	06:52	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24	06:58
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	16:33	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
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	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16	16:32	16:16
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	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
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13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
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15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
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	16:42	17:21	18:54	19:28	19:59	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:03	05:24	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:24	05:11	05:28	05:58	06:29	07:01	06:38	07:07
	16:45	17:24	18:56	19:30	20:00	20:22	20:17	19:41	18:50	18:00	16:23	16:18
20	07:08	06:35	06:50	06:00	05:23	05:12	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:57	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54	05:20	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:13	05:35	06:06	06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:38	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:46	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:18	16:24
30	07:00		06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:15		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
4/5/2011 10:50 PM / 10

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
4/5/2011 10:49 PM/2.7.473

SHADOW - Calendar

Shadow receptor: J - 8J

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:23	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:39	05:13	05:17	05:44	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24	06:58
	16:32	17:09	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:35	16:16
8	07:12	06:51	07:11	06:19	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
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	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
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13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
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15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:26	19:57	20:21	20:19	19:46	18:56	18:06	16:27	16:17
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:58	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:10	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	19:59	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:03	05:24	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:24	05:11	05:28	05:58	06:29	07:01	06:38	07:07
	16:45	17:24	18:56	19:30	20:00	20:22	20:17	19:41	18:50	18:00	16:23	16:18
20	07:08	06:35	06:50	06:00	05:23	05:12	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:57	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54	05:20	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:13	05:35	06:06	06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:46	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:46	16:18	16:24
30	07:00		06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:15		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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4/5/2011 10:50 PM / 11

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
4/5/2011 10:49 PM/2.7.473

SHADOW - Calendar

Shadow receptor: K - 8K

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April			May			June	July	August			September	October	November	December
1	07:12	06:58	06:22	06:30			05:44		06:04 (1)	05:15	05:15	05:40			06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10			19:43	26	06:30 (1)	20:12	20:24	20:05			19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:29			05:43		06:02 (1)	05:14	05:16	05:41			06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11			19:44	27	06:29 (1)	20:13	20:24	20:04			19:19	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27			05:41		06:02 (1)	05:14	05:16	05:42			06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:13			19:45	26	06:28 (1)	20:14	20:24	20:03			19:17	18:26	16:39	16:16
4	07:13	06:55	06:17	06:25			05:40		06:03 (1)	05:13	05:17	05:43		06:20 (1)	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14			19:46	24	06:27 (1)	20:14	20:23	20:02	10	06:30 (1)	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:24			05:39		06:04 (1)	05:13	05:17	05:44		06:18 (1)	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15			19:47	22	06:26 (1)	20:15	20:23	20:01	14	06:32 (1)	19:14	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22			05:37		06:04 (1)	05:13	05:18	05:45		06:16 (1)	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16			19:48	20	06:24 (1)	20:16	20:23	19:58	18	06:34 (1)	19:12	18:20	16:36	16:16
7	07:12	06:52	06:12	06:20			05:36		06:06 (1)	05:12	05:19	05:46		06:13 (1)	06:17	06:48	06:24	06:58
	16:32	17:09	17:43	19:17			19:49	17	06:23 (1)	20:16	20:23	19:57	21	06:34 (1)	19:10	18:19	16:35	16:16
8	07:12	06:51	07:11	06:19			05:35		06:08 (1)	05:12	05:19	05:47		06:12 (1)	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18			19:50	13	06:21 (1)	20:17	20:22	19:56	23	06:35 (1)	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17			05:34		06:11 (1)	05:12	05:20	05:48		06:11 (1)	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19			19:51	7	06:18 (1)	20:18	20:22	19:54	25	06:36 (1)	19:07	18:16	16:32	16:16
10	07:12	06:48	07:07	06:15			05:33			05:12	05:21	05:49		06:10 (1)	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20			19:52			20:18	20:22	19:53	27	06:37 (1)	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14			05:32			05:12	05:21	05:50		06:11 (1)	06:21	06:53	06:29	07:02
	16:36	17:14	18:47	19:21			19:53			20:19	20:21	19:52	26	06:37 (1)	19:03	18:12	16:30	16:16
12	07:11	06:46	07:04	06:12			05:31			05:11	05:22	05:51		06:12 (1)	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22			19:54			20:19	20:21	19:50	26	06:38 (1)	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10			05:29			05:11	05:23	05:52		06:13 (1)	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23			19:55			20:20	20:20	19:49	25	06:38 (1)	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09			05:28			05:11	05:24	05:53		06:14 (1)	06:24	06:56	06:32	07:04
	16:39	17:17	18:51	19:24			19:57			20:20	20:20	19:48	24	06:38 (1)	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07			05:27			05:11	05:24	05:54		06:15 (1)	06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:26			19:58			20:21	20:19	19:46	23	06:38 (1)	18:56	18:06	16:27	16:17
16	07:10	06:41	06:57	06:06			05:26			05:11	05:25	05:55		06:16 (1)	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27			19:59			20:21	20:19	19:45	22	06:38 (1)	18:55	18:04	16:26	16:17
17	07:10	06:39	06:56	06:04		06:23 (1)	05:25			05:11	05:26	05:56		06:17 (1)	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	2	06:25 (1)	20:00			20:22	20:18	19:43	21	06:38 (1)	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:03		06:22 (1)	05:25			05:11	05:27	05:57		06:18 (1)	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	5	06:27 (1)	20:00			20:22	20:17	19:42	19	06:37 (1)	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01		06:20 (1)	05:24			05:11	05:28	05:58		06:19 (1)	06:29	07:01	06:38	07:07
	16:45	17:24	18:56	19:30	8	06:28 (1)	20:00			20:22	20:17	19:41	18	06:37 (1)	18:50	18:00	16:23	16:18
20	07:08	06:35	06:51	06:00		06:19 (1)	05:23			05:12	05:28	05:59		06:20 (1)	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	11	06:30 (1)	20:01			20:23	20:16	19:39	16	06:36 (1)	18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58		06:17 (1)	05:22			05:12	05:29	06:00		06:21 (1)	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	13	06:30 (1)	20:02			20:23	20:15	19:38	15	06:36 (1)	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:57		06:16 (1)	05:21			05:12	05:30	06:01		06:22 (1)	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	15	06:31 (1)	20:03			20:23	20:14	19:36	13	06:35 (1)	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55		06:14 (1)	05:20			05:12	05:31	06:02		06:23 (1)	06:33	07:06	06:43	07:10
	16:50	17:28	19:01	19:34	17	06:31 (1)	20:04			20:23	20:14	19:34	10	06:33 (1)	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54		06:13 (1)	05:20			05:13	05:32	06:03		06:24 (1)	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	18	06:31 (1)	20:05			20:23	20:13	19:33	8	06:32 (1)	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52		06:12 (1)	05:19			05:13	05:33	06:04		06:25 (1)	06:36	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20	06:32 (1)	20:06			20:24	20:12	19:31	5	06:30 (1)	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51		06:10 (1)	05:18			05:13	05:34	06:05		06:26 (1)	06:37	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	21	06:31 (1)	20:07			20:24	20:11	19:30	2	06:27 (1)	18:37	17:50	16:19	16:21
27	07:03	06:25	06:39	05:49		06:09 (1)	05:17			05:14	05:35	06:06			06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:39	22	06:31 (1)	20:08			20:24	20:10	19:28			18:36	17:48	16:19	16:22
28	07:02	06:23	06:37	05:48		06:08 (1)	05:17			05:14	05:36	06:07			06:39	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	23	06:31 (1)	20:09			20:24	20:09	19:27			18:34	17:47	16:18	16:23
29	07:01		06:35	05:47		06:06 (1)	05:16			05:14	05:37	06:08			06:40	07:13	06:50	07:12
	16:57		19:07	19:41	24	06:30 (1)	20:10			20:24	20:08	19:25			18:32	17:46	16:18	16:24
30	07:00		06:34	05:45		06:05 (1)	05:16			05:15	05:38	06:09			06:41	07:14	06:51	07:12
	16:58		19:08	19:42	25	06:30 (1)	20:10			20:24	20:07	19:23			18:31	17:44	16:17	16:24
31	06:59		06:32				05:15				05:39	06:10				07:16		07:12
	17:00		19:09				20:11				20:06	19:22				17:43		16:25
Potential sun hours	296	297	370	400			450			454	461	429			375	344	297	286
Total, worst case					224			182					411					
Sun reduction					0.57			0.58					0.62					
Oper. time red.					1.00			1.00					1.00					
Wind dir. red.					0.53			0.53					0.53					
Total reduction					0.30			0.31					0.33					
Total, real					68			56					135					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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4/5/2011 10:50 PM / 12

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
4/5/2011 10:49 PM/2.7.473

SHADOW - Calendar

Shadow receptor: L - 8L

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April		May	June	July	August		September		October	November	December
1	07:12	06:58	06:22	06:30		05:44	05:15	05:15	05:40		06:11	06:32 (1)	06:42	06:17	06:52
	16:26	17:01	17:36	19:10		19:43	20:12	20:24	20:05		19:20 5	06:37 (1)	18:29	16:42	16:17
2	07:13	06:57	06:20	06:29		05:43	05:14	05:16	05:41		06:12	06:33 (1)	06:43	06:18	06:53
	16:27	17:02	17:37	19:11		19:44	20:13	20:24	20:04		19:19 2	06:35 (1)	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27		05:41	05:14	05:16	05:42		06:13		06:44	06:19	06:54
	16:28	17:03	17:38	19:13		19:45	20:14	20:24	20:03		19:17		18:26	16:39	16:16
4	07:13	06:55	06:17	06:25		05:40	05:13	05:17	05:43		06:14		06:45	06:20	06:55
	16:29	17:05	17:39	19:14		19:46	20:14	20:23	20:02		19:15		18:24	16:38	16:16
5	07:13	06:54	06:15	06:24		05:39	05:13	05:17	05:44		06:15		06:46	06:22	06:56
	16:30	17:06	17:40	19:15		19:47	20:15	20:23	20:01		19:14		18:22	16:37	16:16
6	07:13	06:53	06:14	06:22		05:37	05:13	05:18	05:45		06:16		06:47	06:23	06:57
	16:31	17:07	17:41	19:16		19:48	20:16	20:23	19:58		19:12		18:21	16:36	16:16
7	07:13	06:52	06:12	06:20		05:36	05:12	05:19	05:46		06:17		06:48	06:24	06:58
	16:32	17:09	17:43	19:17		19:49	20:16	20:23	19:57		19:10		18:19	16:35	16:16
8	07:12	06:51	07:11	06:19		05:35	05:12	05:19	05:47		06:18		06:49	06:25	06:59
	16:33	17:10	18:44	19:18		19:50	20:17	20:22	19:56		19:08		18:17	16:33	16:16
9	07:12	06:50	07:09	06:17		05:34	05:12	05:20	05:48		06:19		06:50	06:26	07:00
	16:34	17:11	18:45	19:19		19:51	20:18	20:22	19:54		19:07		18:16	16:32	16:16
10	07:12	06:48	07:07	06:15		06:34 (1) 05:33	05:12	05:21	05:49		06:20		06:51	06:28	07:01
	16:35	17:12	18:46	19:20	2	06:36 (1) 19:52	20:18	20:22	19:53		19:05		18:14	16:31	16:16
11	07:12	06:47	07:06	06:14		06:33 (1) 05:32	05:12	05:21	05:50		06:21		06:53	06:29	07:02
	16:36	17:14	18:47	19:21	5	06:38 (1) 19:53	20:19	20:21	19:52		19:03		18:12	16:30	16:16
12	07:12	06:46	07:04	06:12		06:31 (1) 05:31	05:11	05:22	05:51		06:22		06:54	06:30	07:02
	16:37	17:15	18:48	19:22	8	06:39 (1) 19:54	20:19	20:21	19:50		19:02		18:11	16:29	16:16
13	07:11	06:45	07:02	06:10		06:30 (1) 05:29	05:11	05:23	05:52		06:23		06:55	06:31	07:03
	16:38	17:16	18:49	19:23	10	06:40 (1) 19:56	20:20	20:20	19:49		19:00		18:09	16:28	16:16
14	07:11	06:43	07:01	06:09		06:28 (1) 05:28	05:11	05:24	05:53		06:24		06:56	06:32	07:04
	16:39	17:17	18:51	19:24	12	06:40 (1) 19:57	20:20	20:20	19:48		18:58		18:08	16:27	16:16
15	07:10	06:42	06:59	06:07		06:26 (1) 05:27	05:11	05:24	05:54		06:25		06:57	06:34	07:05
	16:40	17:19	18:52	19:26	14	06:40 (1) 19:58	20:21	20:19	19:46		18:56		18:06	16:27	16:17
16	07:10	06:41	06:57	06:06		06:25 (1) 05:26	05:11	05:25	05:55		06:26		06:58	06:35	07:05
	16:41	17:20	18:53	19:27	15	06:40 (1) 19:59	20:21	20:19	19:45		18:55		18:04	16:26	16:17
17	07:10	06:39	06:56	06:04		06:23 (1) 05:25	05:11	05:26	05:56		06:27		06:59	06:36	07:06
	16:42	17:21	18:54	19:28	16	06:39 (1) 20:00	20:22	20:18	19:43		18:53		18:03	16:25	16:17
18	07:09	06:38	06:54	06:03		06:22 (1) 05:25	05:11	05:27	05:57		06:28		07:00	06:37	07:07
	16:44	17:22	18:55	19:29	17	06:39 (1) 20:00	20:22	20:17	19:42		18:51		18:01	16:24	16:17
19	07:08	06:37	06:52	06:01		06:20 (1) 05:24	05:12	05:28	05:58		06:29		07:01	06:38	07:07
	16:45	17:24	18:56	19:30	18	06:38 (1) 20:00	20:22	20:17	19:41		18:50		18:00	16:23	16:18
20	07:08	06:35	06:51	06:00		06:21 (1) 05:23	05:12	05:29	05:59	06:31 (1)	06:30		07:03	06:40	07:08
	16:46	17:25	18:57	19:31	16	06:37 (1) 20:01	20:23	20:16	19:39 6	06:37 (1)	18:48		17:58	16:23	16:18
21	07:07	06:34	06:49	05:58		06:21 (1) 05:22	05:12	05:29	06:00	06:28 (1)	06:31		07:04	06:41	07:09
	16:47	17:26	18:58	19:32	15	06:36 (1) 20:02	20:23	20:15	19:38 11	06:39 (1)	18:46		17:57	16:22	16:19
22	07:07	06:32	06:47	05:57		06:23 (1) 05:21	05:12	05:30	06:01	06:26 (1)	06:32		07:05	06:42	07:09
	16:48	17:27	18:59	19:33	11	06:34 (1) 20:03	20:23	20:14	19:36 15	06:41 (1)	18:44		17:55	16:21	16:19
23	07:06	06:31	06:45	05:55		06:26 (1) 05:20	05:12	05:31	06:02	06:25 (1)	06:33		07:06	06:43	07:10
	16:50	17:28	19:01	19:34	4	06:30 (1) 20:04	20:23	20:14	19:35 16	06:41 (1)	18:43		17:54	16:21	16:20
24	07:05	06:29	06:44	05:54		05:20	05:13	05:32	06:03	06:24 (1)	06:34		07:07	06:44	07:10
	16:51	17:30	19:02	19:35		20:05	20:23	20:13	19:33 18	06:42 (1)	18:41		17:52	16:20	16:20
25	07:05	06:28	06:42	05:52		05:19	05:13	05:33	06:04	06:25 (1)	06:36		07:08	06:45	07:10
	16:52	17:31	19:03	19:36		20:06	20:24	20:12	19:31 17	06:42 (1)	18:39		17:51	16:20	16:21
26	07:04	06:26	06:40	05:51		05:18	05:13	05:34	06:05	06:26 (1)	06:37		07:10	06:47	07:11
	16:53	17:32	19:04	19:37		20:07	20:24	20:11	19:30 16	06:42 (1)	18:37		17:50	16:19	16:21
27	07:03	06:25	06:39	05:49		05:17	05:14	05:35	06:06	06:27 (1)	06:38		07:11	06:48	07:11
	16:55	17:33	19:05	19:39		20:08	20:24	20:10	19:28 15	06:42 (1)	18:36		17:48	16:19	16:22
28	07:02	06:23	06:37	05:48		05:17	05:14	05:36	06:07	06:28 (1)	06:39		07:12	06:49	07:12
	16:56	17:34	19:06	19:40		20:09	20:24	20:09	19:27 14	06:42 (1)	18:34		17:47	16:18	16:23
29	07:01		06:35	05:47		05:16	05:14	05:37	06:08	06:29 (1)	06:40		07:13	06:50	07:12
	16:57		19:07	19:41		20:10	20:24	20:08	19:25 12	06:41 (1)	18:32		17:46	16:18	16:24
30	07:00		06:34	05:45		05:16	05:15	05:38	06:09	06:30 (1)	06:41		07:14	06:51	07:12
	16:58		19:08	19:42		20:10	20:24	20:07	19:23 10	06:40 (1)	18:31		17:44	16:17	16:24
31	06:59		06:32			05:15		05:39	06:10	06:31 (1)			07:16		07:12
	17:00		19:09			20:11		20:06	19:22 8	06:39 (1)			17:43		16:25
Potential sun hours	296	297	370	400		450	454	461	429		375		344	297	286
Total, worst case					163					158		7			
Sun reduction					0.57					0.62		0.62			
Oper. time red.					1.00					1.00		1.00			
Wind dir. red.					0.53					0.53		0.53			
Total reduction					0.30					0.33		0.33			
Total, real					49					52		2			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
4/5/2011 10:50 PM / 13

Licensed user:
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US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
4/5/2011 10:49 PM/2.7.473

SHADOW - Calendar

Shadow receptor: M - 8M

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March		April			May	June	July	August	September			October	November	December
1	07:12	06:58	06:22		06:30		06:49 (1)	05:44	05:15	05:15	05:40	06:11			06:42	06:17	06:52
	16:26	17:01	17:36		19:10	24	07:13 (1)	19:43	20:12	20:24	20:05	19:20			18:29	16:42	16:17
2	07:13	06:57	06:20		06:29		06:49 (1)	05:43	05:14	05:16	05:41	06:12			06:43	06:18	06:53
	16:27	17:02	17:37		19:11	23	07:12 (1)	19:44	20:13	20:24	20:04	19:19			18:27	16:40	16:17
3	07:13	06:56	06:19		06:27		06:50 (1)	05:41	05:14	05:16	05:42	06:13			06:44	06:19	06:54
	16:28	17:03	17:38		19:13	20	07:10 (1)	19:45	20:14	20:24	20:03	19:17			18:26	16:39	16:16
4	07:13	06:55	06:17		06:25		06:51 (1)	05:40	05:13	05:17	05:43	06:14			06:45	06:20	06:55
	16:29	17:05	17:39		19:14	17	07:08 (1)	19:46	20:14	20:23	20:02	19:15			18:24	16:38	16:16
5	07:13	06:54	06:15		06:24		06:53 (1)	05:39	05:13	05:17	05:44	06:15			06:46	06:22	06:56
	16:30	17:06	17:40		19:15	14	07:07 (1)	19:47	20:15	20:23	20:01	19:14			18:22	16:37	16:16
6	07:13	06:53	06:14		06:22		06:56 (1)	05:37	05:13	05:18	05:45	06:16		06:52 (1)	06:47	06:23	06:57
	16:31	17:07	17:41		19:16	6	07:02 (1)	19:48	20:16	20:23	19:58	19:12	6	06:58 (1)	18:20	16:36	16:16
7	07:13	06:52	06:12		06:20			05:36	05:12	05:19	05:46	06:17		06:48 (1)	06:48	06:24	06:58
	16:32	17:09	17:43		19:17			19:49	20:16	20:23	19:57	19:10	13	07:01 (1)	18:19	16:35	16:16
8	07:12	06:51	07:11		06:19			05:35	05:12	05:19	05:47	06:18		06:46 (1)	06:49	06:25	06:59
	16:33	17:10	18:44		19:18			19:50	20:17	20:22	19:56	19:08	17	07:03 (1)	18:17	16:33	16:16
9	07:12	06:50	07:09		06:17			05:34	05:12	05:20	05:48	06:19		06:44 (1)	06:50	06:26	07:00
	16:34	17:11	18:45		19:19			19:51	20:18	20:22	19:54	19:07	20	07:04 (1)	18:16	16:32	16:16
10	07:12	06:48	07:07		06:15			05:33	05:12	05:21	05:49	06:20		06:42 (1)	06:51	06:28	07:01
	16:35	17:12	18:46		19:20			19:52	20:18	20:22	19:53	19:05	23	07:05 (1)	18:14	16:31	16:16
11	07:12	06:47	07:06		06:14			05:32	05:12	05:21	05:50	06:21		06:42 (1)	06:53	06:29	07:02
	16:36	17:14	18:47		19:21			19:53	20:19	20:21	19:52	19:03	24	07:06 (1)	18:12	16:30	16:16
12	07:11	06:46	07:04		06:12			05:31	05:11	05:22	05:51	06:22		06:43 (1)	06:54	06:30	07:02
	16:37	17:15	18:48		19:22			19:54	20:19	20:21	19:50	19:02	23	07:06 (1)	18:11	16:29	16:16
13	07:11	06:45	07:02		06:10			05:29	05:11	05:23	05:52	06:23		06:44 (1)	06:55	06:31	07:03
	16:38	17:16	18:49		19:23			19:56	20:20	20:20	19:49	19:00	22	07:06 (1)	18:09	16:28	16:16
14	07:11	06:43	07:01		06:09			05:28	05:11	05:24	05:53	06:24		06:44 (1)	06:56	06:32	07:04
	16:39	17:17	18:51		19:24			19:57	20:20	20:20	19:48	18:58	21	07:05 (1)	18:07	16:27	16:16
15	07:10	06:42	06:59		06:07			05:27	05:11	05:24	05:54	06:25		06:45 (1)	06:57	06:34	07:05
	16:40	17:19	18:52		19:26			19:58	20:21	20:19	19:46	18:56	20	07:05 (1)	18:06	16:27	16:17
16	07:10	06:41	06:57		06:06			05:26	05:11	05:25	05:55	06:26		06:46 (1)	06:58	06:35	07:05
	16:41	17:20	18:53		19:27			19:59	20:21	20:19	19:45	18:55	18	07:04 (1)	18:04	16:26	16:17
17	07:10	06:39	06:56		06:04			05:25	05:11	05:26	05:56	06:27		06:47 (1)	06:59	06:36	07:06
	16:42	17:21	18:54		19:28			20:00	20:22	20:18	19:43	18:53	16	07:03 (1)	18:03	16:25	16:17
18	07:09	06:38	06:54		06:03			05:25	05:11	05:27	05:57	06:28		06:48 (1)	07:00	06:37	07:07
	16:44	17:22	18:55		19:29			20:00	20:22	20:17	19:42	18:51	14	07:02 (1)	18:01	16:24	16:17
19	07:08	06:37	06:52		06:01			05:24	05:11	05:28	05:58	06:29		06:49 (1)	07:01	06:38	07:07
	16:45	17:24	18:56		19:30			20:00	20:22	20:17	19:41	18:50	12	07:01 (1)	18:00	16:23	16:18
20	07:08	06:35	06:51		06:00			05:23	05:12	05:28	05:59	06:30		06:50 (1)	07:03	06:40	07:08
	16:46	17:25	18:57		19:31			20:01	20:23	20:16	19:39	18:48	10	07:00 (1)	17:58	16:23	16:18
21	07:07	06:34	06:49		07:08 (1)	58		05:22	05:12	05:29	06:00	06:31		06:51 (1)	07:04	06:41	07:09
	16:47	17:26	18:58	3	07:11 (1)	32		20:02	20:23	20:15	19:38	18:46	7	06:58 (1)	17:57	16:22	16:19
22	07:07	06:32	06:47		07:06 (1)	57		05:21	05:12	05:30	06:01	06:32		06:52 (1)	07:05	06:42	07:09
	16:48	17:27	18:59	6	07:12 (1)	33		20:03	20:23	20:14	19:36	18:44	4	06:56 (1)	17:55	16:21	16:19
23	07:06	06:31	06:45		07:04 (1)	55		05:20	05:12	05:31	06:02	06:33			07:06	06:43	07:10
	16:50	17:28	19:01	9	07:13 (1)	34		20:04	20:23	20:14	19:35	18:43			17:54	16:21	16:20
24	07:05	06:29	06:44		07:03 (1)	54		05:20	05:13	05:32	06:03	06:34			07:07	06:44	07:10
	16:51	17:30	19:02	12	07:15 (1)	35		20:05	20:23	20:13	19:33	18:41			17:52	16:20	16:20
25	07:05	06:28	06:42		07:01 (1)	52		05:19	05:13	05:33	06:04	06:36			07:08	06:45	07:10
	16:52	17:31	19:03	14	07:15 (1)	36		20:06	20:24	20:12	19:31	18:39			17:51	16:19	16:21
26	07:04	06:26	06:40		06:59 (1)	51		05:18	05:13	05:34	06:05	06:37			07:10	06:47	07:11
	16:53	17:32	19:04	16	07:15 (1)	37		20:07	20:24	20:11	19:30	18:37			17:50	16:19	16:21
27	07:03	06:25	06:39		06:58 (1)	49		05:17	05:14	05:35	06:06	06:38			07:11	06:48	07:11
	16:55	17:33	19:05	18	07:16 (1)	39		20:08	20:24	20:10	19:28	18:36			17:48	16:19	16:22
28	07:02	06:23	06:37		06:56 (1)	48		05:17	05:14	05:36	06:07	06:39			07:12	06:49	07:12
	16:56	17:34	19:06	19	07:15 (1)	40		20:09	20:24	20:09	19:27	18:34			17:47	16:18	16:23
29	07:01		06:35		06:54 (1)	47		05:16	05:14	05:37	06:08	06:40			07:13	06:50	07:12
	16:57		19:07	21	07:15 (1)	41		20:10	20:24	20:08	19:25	18:32			17:46	16:18	16:24
30	07:00		06:34		06:53 (1)	45		05:16	05:15	05:38	06:09	06:41			07:14	06:51	07:12
	16:58		19:08	22	07:15 (1)	42		20:10	20:24	20:07	19:23	18:31			17:44	16:17	16:24
31	06:59		06:32		06:51 (1)			05:15		05:39	06:10				07:16		07:12
	17:00		19:09	23	07:14 (1)			20:11		20:06	19:22				17:43		16:25
Potential sun hours	296	297	370			400		450	454	461	429	375			344	297	286
Total, worst case				163			104							270			
Sun reduction				0.58			0.57							0.62			
Oper. time red.				1.00			1.00							1.00			
Wind dir. red.				0.54			0.54							0.54			
Total reduction				0.31			0.31							0.34			
Total, real				51			32							91			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
4/5/2011 10:50 PM / 14

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
4/5/2011 10:49 PM/2.7.473

SHADOW - Calendar

Shadow receptor: N - 8N

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February		March		April	May	June	July	August	September	October		November	December
1	07:12	06:58		06:22	06:54 (1)	06:30	05:44	05:15	05:15	05:40	06:11	06:42		06:17	06:52
	16:26	17:01		17:36	12 07:06 (1)	19:10	19:43	20:12	20:24	20:05	19:20	18:29		16:42	16:17
2	07:13	06:57		06:20		06:29	05:43	05:14	05:16	05:41	06:12	06:43		06:18	06:53
	16:27	17:02		17:37		19:11	19:44	20:13	20:24	20:04	19:19	18:27		16:40	16:17
3	07:13	06:56		06:19		06:27	05:41	05:14	05:16	05:42	06:13	06:44		06:19	06:54
	16:28	17:03		17:38		19:13	19:45	20:14	20:24	20:03	19:17	18:26		16:39	16:16
4	07:13	06:55		06:17		06:25	05:40	05:13	05:17	05:43	06:14	06:45		06:20	06:55
	16:29	17:05		17:39		19:14	19:46	20:14	20:23	20:02	19:15	18:24		16:38	16:16
5	07:13	06:54		06:15		06:24	05:39	05:13	05:17	05:44	06:15	06:46		06:22	06:56
	16:30	17:06		17:40		19:15	19:47	20:15	20:23	20:01	19:14	18:22		16:37	16:16
6	07:13	06:53		06:14		06:22	05:37	05:13	05:18	05:45	06:16	06:47		06:23	06:57
	16:31	17:07		17:41		19:16	19:48	20:16	20:23	19:58	19:12	18:20		16:36	16:16
7	07:13	06:52		06:12		06:20	05:36	05:12	05:19	05:46	06:17	06:48		06:24	06:58
	16:32	17:09		17:43		19:17	19:49	20:16	20:23	19:57	19:10	18:19		16:35	16:16
8	07:12	06:51		07:11		06:19	05:35	05:12	05:19	05:47	06:18	06:49		06:25	06:59
	16:33	17:10		18:44		19:18	19:50	20:17	20:22	19:56	19:08	18:17		16:33	16:16
9	07:12	06:50		07:09		06:17	05:34	05:12	05:20	05:48	06:19	06:50		06:26	07:00
	16:34	17:11		18:45		19:19	19:51	20:18	20:22	19:54	19:07	18:16		16:32	16:16
10	07:12	06:48		07:07		06:15	05:33	05:12	05:21	05:49	06:20	06:51		06:28	07:01
	16:35	17:12		18:46		19:20	19:52	20:18	20:22	19:53	19:05	18:14		16:31	16:16
11	07:12	06:47		07:06		06:14	05:32	05:12	05:21	05:50	06:21	06:53		06:29	07:02
	16:36	17:14		18:47		19:21	19:53	20:19	20:21	19:52	19:03	18:12		16:30	16:16
12	07:12	06:46	07:06 (1)	07:04		06:12	05:31	05:11	05:22	05:51	06:22	06:54	07:30 (1)	06:30	07:02
	16:37	17:15	2 07:08 (1)	18:48		19:22	19:54	20:19	20:21	19:50	19:02	18:11	7 07:37 (1)	16:29	16:16
13	07:11	06:45	07:05 (1)	07:02		06:10	05:29	05:11	05:23	05:52	06:23	06:55	07:26 (1)	06:31	07:03
	16:38	17:16	6 07:11 (1)	18:49		19:23	19:56	20:20	20:20	19:49	19:00	18:09	14 07:40 (1)	16:28	16:16
14	07:11	06:43	07:03 (1)	07:01		06:09	05:28	05:11	05:24	05:53	06:24	06:56	07:23 (1)	06:32	07:04
	16:39	17:17	8 07:11 (1)	18:51		19:24	19:57	20:20	20:20	19:48	18:58	18:07	19 07:42 (1)	16:27	16:16
15	07:10	06:42	07:02 (1)	06:59		06:07	05:27	05:11	05:24	05:54	06:25	06:57	07:22 (1)	06:34	07:05
	16:40	17:19	11 07:13 (1)	18:52		19:26	19:58	20:21	20:19	19:46	18:56	18:06	21 07:43 (1)	16:27	16:17
16	07:10	06:41	07:01 (1)	06:57		06:06	05:26	05:11	05:25	05:55	06:26	06:58	07:20 (1)	06:35	07:05
	16:41	17:20	13 07:14 (1)	18:53		19:27	19:59	20:21	20:19	19:45	18:55	18:04	24 07:44 (1)	16:26	16:17
17	07:10	06:39	06:59 (1)	06:56		06:04	05:25	05:11	05:26	05:56	06:27	06:59	07:20 (1)	06:36	07:06
	16:42	17:21	15 07:14 (1)	18:54		19:28	20:00	20:22	20:18	19:43	18:53	18:03	25 07:45 (1)	16:25	16:17
18	07:09	06:38	06:58 (1)	06:54		06:03	05:25	05:11	05:27	05:57	06:28	07:00	07:21 (1)	06:37	07:07
	16:44	17:22	17 07:15 (1)	18:55		19:29	20:00	20:22	20:17	19:42	18:51	18:01	24 07:45 (1)	16:24	16:17
19	07:08	06:37	06:56 (1)	06:52		06:01	05:24	05:11	05:28	05:58	06:29	07:01	07:22 (1)	06:38	07:07
	16:45	17:24	19 07:15 (1)	18:56		19:30	20:00	20:22	20:17	19:41	18:50	18:00	24 07:46 (1)	16:23	16:18
20	07:08	06:35	06:55 (1)	06:51		06:00	05:23	05:12	05:28	05:59	06:30	07:03	07:23 (1)	06:40	07:08
	16:46	17:25	20 07:15 (1)	18:57		19:31	20:01	20:23	20:16	19:39	18:48	17:58	22 07:45 (1)	16:23	16:18
21	07:07	06:34	06:53 (1)	06:49		05:58	05:22	05:12	05:29	06:00	06:31	07:04	07:24 (1)	06:41	07:09
	16:47	17:26	22 07:15 (1)	18:58		19:32	20:02	20:23	20:15	19:38	18:46	17:57	21 07:45 (1)	16:22	16:19
22	07:07	06:32	06:52 (1)	06:47		05:57	05:21	05:12	05:30	06:01	06:32	07:05	07:26 (1)	06:42	07:09
	16:48	17:27	23 07:15 (1)	18:59		19:33	20:03	20:23	20:14	19:36	18:44	17:55	20 07:46 (1)	16:21	16:19
23	07:06	06:31	06:50 (1)	06:45		05:55	05:20	05:12	05:31	06:02	06:33	07:06	07:27 (1)	06:43	07:10
	16:50	17:28	24 07:14 (1)	19:01		19:34	20:04	20:23	20:14	19:35	18:43	17:54	18 07:45 (1)	16:21	16:20
24	07:05	06:29	06:49 (1)	06:44		05:54	05:20	05:13	05:32	06:03	06:34	07:07	07:28 (1)	06:44	07:10
	16:51	17:30	25 07:14 (1)	19:02		19:35	20:05	20:23	20:13	19:33	18:41	17:52	16 07:44 (1)	16:20	16:20
25	07:05	06:28	06:48 (1)	06:42		05:52	05:19	05:13	05:33	06:04	06:36	07:08	07:29 (1)	06:45	07:10
	16:52	17:31	24 07:12 (1)	19:03		19:36	20:06	20:24	20:12	19:31	18:39	17:51	15 07:44 (1)	16:19	16:21
26	07:04	06:26	06:49 (1)	06:40		05:51	05:18	05:13	05:34	06:05	06:37	07:10	07:31 (1)	06:47	07:11
	16:53	17:32	23 07:12 (1)	19:04		19:37	20:07	20:24	20:11	19:30	18:37	17:50	13 07:44 (1)	16:19	16:21
27	07:03	06:25	06:50 (1)	06:39		05:49	05:17	05:13	05:35	06:06	06:38	07:11	07:32 (1)	06:48	07:11
	16:55	17:33	20 07:10 (1)	19:05		19:39	20:08	20:24	20:10	19:28	18:36	17:48	10 07:42 (1)	16:18	16:22
28	07:02	06:23	06:52 (1)	06:37		05:48	05:17	05:14	05:36	06:07	06:39	07:12	07:33 (1)	06:49	07:12
	16:56	17:34	17 07:09 (1)	19:06		19:40	20:09	20:24	20:09	19:27	18:34	17:47	8 07:41 (1)	16:18	16:23
29	07:01			06:35		05:47	05:16	05:14	05:37	06:08	06:40	07:13	07:34 (1)	06:50	07:12
	16:57			19:07		19:41	20:10	20:24	20:08	19:25	18:32	17:46	5 07:39 (1)	16:18	16:24
30	07:00			06:34		05:45	05:16	05:15	05:38	06:09	06:41	07:14	07:36 (1)	06:51	07:12
	16:58			19:08		19:42	20:10	20:24	20:07	19:23	18:31	17:44	2 07:37 (1)	16:17	16:24
31	06:59			06:32			05:15		05:39	06:10		07:16			07:12
	17:00			19:09			20:11		20:06	19:22		17:43			16:25
Potential sun hours	296	297		370		400	450	454	461	429	375	344		297	286
Total, worst case			289		12								308		
Sun reduction			0.58		0.58								0.61		
Oper. time red.			1.00		1.00								1.00		
Wind dir. red.			0.58		0.58								0.58		
Total reduction			0.34		0.34								0.35		
Total, real			97		4								109		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
4/5/2011 10:50 PM / 15

Licensed user:
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Alec Richardson / arichardson@geo-marine.com

Calculated:
4/5/2011 10:49 PM/2.7.473

SHADOW - Calendar

Shadow receptor: O - 8O

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April			May			June	July	August			September	October	November	December
1	07:12	06:58	06:22	06:30			05:44		06:04 (1)	05:15	05:15	05:40			06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10			19:43	23	06:27 (1)	20:12	20:24	20:05			19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:29			05:43		06:03 (1)	05:14	05:16	05:41			06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11			19:44	23	06:26 (1)	20:13	20:24	20:04			19:19	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27			05:41		06:04 (1)	05:14	05:16	05:42			06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:13			19:45	22	06:26 (1)	20:14	20:24	20:03			19:17	18:26	16:39	16:16
4	07:13	06:55	06:17	06:25			05:40		06:05 (1)	05:13	05:17	05:43			06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14			19:46	20	06:25 (1)	20:14	20:23	20:02			19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:24			05:39		06:06 (1)	05:13	05:17	05:44		06:20 (1)	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15			19:47	18	06:24 (1)	20:15	20:23	20:01	10	06:30 (1)	19:14	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22			05:37		06:06 (1)	05:13	05:18	05:45		06:18 (1)	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16			19:48	16	06:22 (1)	20:16	20:23	19:58	14	06:32 (1)	19:12	18:21	16:36	16:16
7	07:13	06:52	06:12	06:20			05:36		06:08 (1)	05:12	05:19	05:46		06:15 (1)	06:17	06:48	06:24	06:58
	16:32	17:09	17:43	19:17			19:49	13	06:21 (1)	20:16	20:23	19:57	17	06:32 (1)	19:10	18:19	16:35	16:16
8	07:12	06:51	07:11	06:19			05:35		06:10 (1)	05:12	05:19	05:47		06:14 (1)	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18			19:50	8	06:18 (1)	20:17	20:22	19:56	19	06:33 (1)	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17			05:34			05:12	05:20	05:48		06:13 (1)	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19			19:51			20:18	20:22	19:54	21	06:34 (1)	19:07	18:16	16:32	16:16
10	07:12	06:48	07:07	06:15			05:33			05:12	05:21	05:49		06:12 (1)	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20			19:52			20:18	20:22	19:53	23	06:35 (1)	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14			05:32			05:12	05:21	05:50		06:12 (1)	06:21	06:53	06:29	07:02
	16:36	17:14	18:47	19:21			19:53			20:19	20:21	19:52	23	06:35 (1)	19:03	18:12	16:30	16:16
12	07:11	06:46	07:04	06:12			05:31			05:11	05:22	05:51		06:12 (1)	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22			19:54			20:19	20:21	19:50	23	06:35 (1)	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10			05:29			05:11	05:23	05:52		06:13 (1)	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23			19:56			20:20	20:20	19:49	22	06:35 (1)	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09			05:28			05:11	05:24	05:53		06:14 (1)	06:24	06:56	06:32	07:04
	16:39	17:17	18:51	19:24			19:57			20:20	20:20	19:48	21	06:35 (1)	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07			05:27			05:11	05:24	05:54		06:15 (1)	06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:26			19:58			20:21	20:19	19:46	20	06:35 (1)	18:56	18:06	16:27	16:17
16	07:10	06:41	06:57	06:06			05:26			05:11	05:25	05:55		06:16 (1)	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27			19:59			20:21	20:19	19:45	19	06:35 (1)	18:55	18:04	16:26	16:17
17	07:10	06:39	06:56	06:04			05:25			05:11	05:26	05:56		06:17 (1)	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28			20:00			20:22	20:18	19:43	17	06:34 (1)	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:03			05:25			05:11	05:27	05:57		06:18 (1)	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29			20:00			20:22	20:17	19:42	16	06:34 (1)	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01			05:24			05:11	05:28	05:58		06:19 (1)	06:29	07:01	06:38	07:07
	16:45	17:24	18:56	19:30			20:00			20:22	20:17	19:41	14	06:33 (1)	18:50	18:00	16:23	16:18
20	07:08	06:35	06:51	06:00		06:19 (1)	05:23			05:12	05:28	05:59		06:20 (1)	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	3	06:22 (1)	20:01			20:23	20:16	19:39	12	06:32 (1)	18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58		06:17 (1)	05:22			05:12	05:29	06:00		06:21 (1)	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	7	06:24 (1)	20:02			20:23	20:15	19:38	9	06:30 (1)	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:57		06:16 (1)	05:21			05:12	05:30	06:01		06:22 (1)	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	10	06:26 (1)	20:03			20:23	20:14	19:36	6	06:28 (1)	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55		06:14 (1)	05:20			05:12	05:31	06:02		06:23 (1)	06:33	07:06	06:43	07:10
	16:50	17:28	19:01	19:34	12	06:26 (1)	20:04			20:23	20:14	19:35	3	06:26 (1)	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54		06:13 (1)	05:20			05:13	05:32	06:03			06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	14	06:27 (1)	20:05			20:23	20:13	19:33			18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52		06:12 (1)	05:19			05:13	05:33	06:04			06:36	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	16	06:28 (1)	20:06			20:24	20:12	19:31			18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51		06:10 (1)	05:18			05:13	05:34	06:05			06:37	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	18	06:28 (1)	20:07			20:24	20:11	19:30			18:37	17:50	16:19	16:21
27	07:03	06:25	06:39	05:49		06:09 (1)	05:17			05:14	05:35	06:06			06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:39	19	06:28 (1)	20:08			20:24	20:10	19:28			18:36	17:48	16:19	16:22
28	07:02	06:23	06:37	05:48		06:08 (1)	05:17			05:14	05:36	06:07			06:39	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	21	06:29 (1)	20:09			20:24	20:09	19:27			18:34	17:47	16:18	16:23
29	07:01		06:35	05:47		06:06 (1)	05:16			05:14	05:37	06:08			06:40	07:13	06:50	07:12
	16:57		19:07	19:41	22	06:28 (1)	20:10			20:24	20:08	19:25			18:32	17:46	16:18	16:24
30	07:00		06:34	05:45		06:05 (1)	05:16			05:15	05:38	06:09			06:41	07:14	06:51	07:12
	16:58		19:08	19:42	23	06:28 (1)	20:10			20:24	20:07	19:23			18:31	17:44	16:17	16:24
31	06:59		06:32				05:15				05:39	06:10				07:16		07:12
	17:00		19:09				20:11				20:06	19:22				17:43		16:25
Potential sun hours	296	297	370	400			450			454	461	429			375	344	297	286
Total, worst case					165			143					309					
Sun reduction					0.57			0.58					0.62					
Oper. time red.					1.00			1.00					1.00					
Wind dir. red.					0.53			0.53					0.53					
Total reduction					0.30			0.31					0.33					
Total, real					50			44					102					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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4/5/2011 10:50 PM / 16

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
4/5/2011 10:49 PM/2.7.473

SHADOW - Calendar

Shadow receptor: P - 8P

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:28	05:42	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:23	20:03	19:17	18:25	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23	05:39	05:13	05:17	05:44	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24	06:58
	16:32	17:09	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:35	16:16
8	07:12	06:51	07:11	06:19	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:32	05:12	05:21	05:50	06:21	06:52	06:29	07:02
	16:36	17:14	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:11	06:46	07:04	06:12	05:30	05:11	05:22	05:51	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:24	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:51	19:24	19:56	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:26	19:57	20:21	20:19	19:46	18:56	18:06	16:27	16:17
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:58	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:09	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	19:59	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:03	05:24	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:24	05:11	05:28	05:58	06:29	07:01	06:38	07:07
	16:45	17:24	18:56	19:30	20:00	20:22	20:17	19:41	18:50	18:00	16:23	16:18
20	07:08	06:35	06:50	06:00	05:23	05:12	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:56	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:00	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54	05:20	05:12	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:13	05:35	06:06	06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:46	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:45	16:18	16:24
30	07:00		06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:15		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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4/5/2011 10:50 PM / 17

Licensed user:
Geo-Marine.Inc
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US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
4/5/2011 10:49 PM/2.7.473

SHADOW - Calendar

Shadow receptor: Q - 8Q

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April			May			June			July			August			September	October	November	December
1	07:12	06:58	06:22	06:30			05:44		06:04 (1)	05:15		05:46 (1)	05:15		05:55 (1)	05:40		06:02 (1)	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10			19:43	18	06:22 (1)	20:12	46	06:32 (1)	20:24	41	06:36 (1)	20:05	40	06:42 (1)	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:29			05:42		06:02 (1)	05:14		05:47 (1)	05:16		05:54 (1)	05:41		06:03 (1)	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11			19:44	21	06:23 (1)	20:13	45	06:32 (1)	20:24	42	06:36 (1)	20:04	38	06:41 (1)	19:18	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27			05:41		06:01 (1)	05:14		05:48 (1)	05:16		05:55 (1)	05:42		06:04 (1)	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12			19:45	24	06:25 (1)	20:14	44	06:32 (1)	20:23	41	06:36 (1)	20:03	37	06:41 (1)	19:17	18:26	16:39	16:16
4	07:13	06:55	06:17	06:25			05:40		06:00 (1)	05:13		05:47 (1)	05:17		05:55 (1)	05:43		06:05 (1)	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14			19:46	26	06:26 (1)	20:14	44	06:31 (1)	20:23	42	06:37 (1)	20:02	35	06:40 (1)	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:23			05:39		05:59 (1)	05:13		05:48 (1)	05:17		05:55 (1)	05:44		06:06 (1)	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15			19:47	28	06:27 (1)	20:15	44	06:32 (1)	20:23	42	06:37 (1)	20:01	33	06:39 (1)	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22			05:37		05:57 (1)	05:13		05:49 (1)	05:18		05:55 (1)	05:45		06:06 (1)	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16			19:48	30	06:27 (1)	20:16	43	06:32 (1)	20:23	43	06:38 (1)	19:58	32	06:38 (1)	19:12	18:20	16:36	16:16
7	07:12	06:52	06:12	06:20			05:36		05:56 (1)	05:12		05:48 (1)	05:19		05:54 (1)	05:46		06:07 (1)	06:17	06:48	06:24	06:58
	16:32	17:09	17:43	19:17			19:49	32	06:28 (1)	20:16	43	06:31 (1)	20:23	44	06:38 (1)	19:57	30	06:37 (1)	19:10	18:19	16:35	16:16
8	07:12	06:51	07:11	06:19			05:35		05:55 (1)	05:12		05:49 (1)	05:19		05:55 (1)	05:47		06:08 (1)	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18			19:50	34	06:29 (1)	20:17	42	06:31 (1)	20:22	44	06:39 (1)	19:56	28	06:36 (1)	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17			05:34		05:54 (1)	05:12		05:50 (1)	05:20		05:55 (1)	05:48		06:09 (1)	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19			19:51	36	06:30 (1)	20:18	41	06:31 (1)	20:22	44	06:39 (1)	19:54	25	06:34 (1)	19:07	18:16	16:32	16:16
10	07:12	06:48	07:07	06:15			05:33		05:53 (1)	05:12		05:50 (1)	05:21		05:54 (1)	05:49		06:10 (1)	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20			19:52	37	06:30 (1)	20:18	42	06:32 (1)	20:22	45	06:39 (1)	19:53	23	06:33 (1)	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14			05:32		05:52 (1)	05:12		05:51 (1)	05:21		05:54 (1)	05:50		06:11 (1)	06:21	06:53	06:29	07:02
	16:36	17:14	18:47	19:21			19:53	39	06:31 (1)	20:19	41	06:32 (1)	20:21	46	06:40 (1)	19:52	20	06:31 (1)	19:03	18:12	16:30	16:16
12	07:11	06:46	07:04	06:12			05:31		05:51 (1)	05:11		05:51 (1)	05:22		05:55 (1)	05:51		06:12 (1)	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22			19:54	40	06:31 (1)	20:19	41	06:32 (1)	20:21	45	06:40 (1)	19:50	17	06:29 (1)	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10			05:29		05:50 (1)	05:11		05:52 (1)	05:23		05:54 (1)	05:52		06:13 (1)	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23			19:55	42	06:32 (1)	20:20	40	06:32 (1)	20:20	46	06:40 (1)	19:49	13	06:26 (1)	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09			05:28		05:49 (1)	05:11		05:52 (1)	05:24		05:54 (1)	05:53		06:14 (1)	06:24	06:56	06:32	07:04
	16:39	17:17	18:51	19:24			19:57	43	06:32 (1)	20:20	40	06:32 (1)	20:20	47	06:41 (1)	19:48	8	06:22 (1)	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07			05:27		05:48 (1)	05:11		05:52 (1)	05:24		05:54 (1)	05:54			06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:26			19:58	44	06:32 (1)	20:21	40	06:32 (1)	20:19	47	06:41 (1)	19:46			18:56	18:06	16:27	16:17
16	07:10	06:41	06:57	06:06			05:26		05:47 (1)	05:11		05:53 (1)	05:25		05:54 (1)	05:55			06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27			19:59	45	06:32 (1)	20:21	39	06:32 (1)	20:19	48	06:42 (1)	19:45			18:55	18:04	16:26	16:17
17	07:10	06:39	06:56	06:04			05:25		05:46 (1)	05:11		05:53 (1)	05:26		05:54 (1)	05:56			06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28			19:59	46	06:32 (1)	20:22	39	06:32 (1)	20:18	47	06:41 (1)	19:43			18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:03			05:25		05:45 (1)	05:11		05:53 (1)	05:27		05:54 (1)	05:57			06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29			20:00	47	06:32 (1)	20:22	39	06:32 (1)	20:17	48	06:42 (1)	19:42			18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01			05:24		05:44 (1)	05:11		05:53 (1)	05:28		05:54 (1)	05:58			06:29	07:01	06:38	07:07
	16:45	17:24	18:56	19:30			20:00	48	06:32 (1)	20:22	39	06:32 (1)	20:17	48	06:42 (1)	19:41			18:50	18:00	16:23	16:18
20	07:08	06:35	06:51	06:00			05:23		05:44 (1)	05:12		05:53 (1)	05:28		05:54 (1)	05:59			06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31			20:01	49	06:33 (1)	20:23	39	06:32 (1)	20:16	49	06:43 (1)	19:39			18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58			05:22		05:44 (1)	05:12		05:53 (1)	05:29		05:54 (1)	06:00			06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32			20:02	49	06:33 (1)	20:23	39	06:32 (1)	20:15	49	06:43 (1)	19:38			18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:57			05:21		05:44 (1)	05:12		05:54 (1)	05:30		05:54 (1)	06:01			06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33			20:03	48	06:32 (1)	20:23	39	06:33 (1)	20:14	49	06:43 (1)	19:36			18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55			05:20		05:44 (1)	05:12		05:54 (1)	05:31		05:55 (1)	06:02			06:33	07:06	06:43	07:10
	16:50	17:28	19:01	19:34			20:04	48	06:32 (1)	20:23	39	06:33 (1)	20:14	48	06:43 (1)	19:34			18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54			05:20		05:45 (1)	05:13		05:54 (1)	05:32		05:54 (1)	06:03			06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35			20:05	48	06:33 (1)	20:23	39	06:33 (1)	20:13	48	06:42 (1)	19:33			18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52			05:19		05:44 (1)	05:13		05:54 (1)	05:33		05:55 (1)	06:04			06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36			20:06	48	06:32 (1)	20:24	39	06:33 (1)	20:12	48	06:43 (1)	19:31			18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51			05:18		05:44 (1)	05:13		05:55 (1)	05:34		05:56 (1)	06:05			06:37	07:10	06:47	07:11
	16:53	17:32	19:04	19:37			20:07	48	06:32 (1)	20:24	39	06:34 (1)	20:11	47	06:43 (1)	19:30			18:37	17:50	16:19	16:21
27	07:03	06:25	06:39	05:49			05:17		05:45 (1)	05:13		05:54 (1)	05:35		05:57 (1)	06:06			06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:39			20:08	48	06:33 (1)	20:24	40	06:34 (1)	20:10	46	06:43 (1)	19:28			18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48			05:17		05:45 (1)	05:14		05:55 (1)	05:36		05:58 (1)	06:07			06:39	07:12	06:49	07:11
	16:56	17:34	19:06	19:40			20:09	47	06:32 (1)	20:24	40	06:35 (1)	20:09	45	06:43 (1)	19:27			18:34	17:47	16:18	16:23
29	07:01		06:35	05:47		06:06 (1)	05:16		05:46 (1)	05:14		05:55 (1)	05:37		05:59 (1)	06:08			06:40	07:13	06:50	07:12
	16:57		19:07	19:41	10	06:16 (1)	20:10	46	06:32 (1)	20:24	40	06:35 (1)	20:08	44	06:43 (1)	19:25			18:32	17:46	16:18	16:24
30	07:00		06:34	05:45		06:05 (1)	05:16		05:46 (1)	05:15		05:54 (1)	05:38		06:00 (1)	06:09			06:41	07:14	06:51	07:12
	16:58		19:08	19:42	14	06:19 (1)	20:10	46	06:32 (1)	20:24	41	06:35 (1)	20:07	42	06:42 (1)	19:23			18:31	17:44	16:17	16:24
31	06:59		06:32				05:15		05:46 (1)				05:39		06:01 (1)	06:10				07:15		07:12
	17:00		19:09				20:11	46	06:32 (1)				20:06	41	06:42 (1)	19:22				17:43		16:25
Potential sun hours	296	297	370	400			450			454			461			429			375	344	297	286
Total, worst case					24			1251			1226			1406			379					
Sun reduction					0.57			0.58			0.61			0.63			0.62					
Oper. time red.					1.00			1.00			1.00			1.00			1.00					
Wind dir. red.					0.55			0.55			0.55			0.55			0.55					
Total reduction					0.31			0.32			0.34			0.35			0.34					
Total, real					8			399			412			487			129					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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4/5/2011 10:50 PM / 18

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Alec Richardson / arichardson@geo-marine.com

Calculated:
4/5/2011 10:49 PM/2.7.473

SHADOW - Calendar

Shadow receptor: R - 8R

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March		April		May	June	July	August	September		October	November	December
1	07:12	06:58	06:22		06:30	06:54 (1)	05:44	05:15	05:15	05:40	06:11		06:42	06:17	06:52
	16:26	17:01	17:36		19:10	27 07:21 (1)	19:43	20:12	20:24	20:05	19:20		18:29	16:42	16:17
2	07:13	06:57	06:20		06:29	06:56 (1)	05:43	05:14	05:16	05:41	06:12		06:43	06:18	06:53
	16:27	17:02	17:37		19:11	24 07:20 (1)	19:44	20:13	20:24	20:04	19:19		18:27	16:40	16:17
3	07:13	06:56	06:19		06:27	06:57 (1)	05:41	05:14	05:16	05:42	06:13		06:44	06:19	06:54
	16:28	17:03	17:38		19:13	21 07:18 (1)	19:45	20:14	20:24	20:03	19:17		18:26	16:39	16:16
4	07:13	06:55	06:17		06:25	06:58 (1)	05:40	05:13	05:17	05:43	06:14		06:45	06:20	06:55
	16:29	17:05	17:39		19:14	18 07:16 (1)	19:46	20:14	20:23	20:02	19:15		18:24	16:38	16:16
5	07:13	06:54	06:15		06:24	07:01 (1)	05:39	05:13	05:17	05:44	06:15		06:46	06:22	06:56
	16:30	17:06	17:40		19:15	12 07:13 (1)	19:47	20:15	20:23	20:01	19:14		18:22	16:37	16:16
6	07:13	06:53	06:14		06:22		05:37	05:13	05:18	05:45	06:16		06:47	06:23	06:57
	16:31	17:07	17:41		19:16		19:48	20:16	20:23	19:58	19:12		18:20	16:36	16:16
7	07:13	06:52	06:12		06:20		05:36	05:12	05:19	05:46	06:17		06:48	06:24	06:58
	16:32	17:09	17:43		19:17		19:49	20:16	20:23	19:57	19:10	12 07:08 (1)	18:19	16:35	16:16
8	07:12	06:51	07:11		06:19		05:35	05:12	05:19	05:47	06:18	06:53 (1)	06:49	06:25	06:59
	16:33	17:10	18:44		19:18		19:50	20:17	20:22	19:56	19:08	18 07:11 (1)	18:17	16:33	16:16
9	07:12	06:50	07:09		06:17		05:34	05:12	05:20	05:48	06:19	06:51 (1)	06:50	06:26	07:00
	16:34	17:11	18:45		19:19		19:51	20:18	20:22	19:54	19:07	21 07:12 (1)	18:16	16:32	16:16
10	07:12	06:48	07:07		06:15		05:33	05:12	05:21	05:49	06:20	06:49 (1)	06:51	06:28	07:01
	16:35	17:12	18:46		19:20		19:52	20:18	20:22	19:53	19:05	24 07:13 (1)	18:14	16:31	16:16
11	07:12	06:47	07:06		06:14		05:32	05:12	05:21	05:50	06:21	06:48 (1)	06:53	06:29	07:02
	16:36	17:14	18:47		19:21		19:53	20:19	20:21	19:52	19:03	26 07:14 (1)	18:12	16:30	16:16
12	07:11	06:46	07:04		06:12		05:31	05:11	05:22	05:51	06:22	06:46 (1)	06:54	06:30	07:02
	16:37	17:15	18:48		19:22		19:54	20:19	20:21	19:50	19:02	29 07:15 (1)	18:11	16:29	16:16
13	07:11	06:45	07:02		06:10		05:29	05:11	05:23	05:52	06:23	06:45 (1)	06:55	06:31	07:03
	16:38	17:16	18:49		19:23		19:55	20:20	20:20	19:49	19:00	30 07:15 (1)	18:09	16:28	16:16
14	07:11	06:43	07:01		06:09		05:28	05:11	05:24	05:53	06:24	06:44 (1)	06:56	06:32	07:04
	16:39	17:17	18:51		19:24		19:57	20:20	20:20	19:48	18:58	30 07:14 (1)	18:07	16:27	16:16
15	07:10	06:42	06:59		06:07		05:27	05:11	05:24	05:54	06:25	06:45 (1)	06:57	06:34	07:05
	16:40	17:19	18:52		19:26		19:58	20:21	20:19	19:46	18:56	29 07:14 (1)	18:06	16:27	16:17
16	07:10	06:41	06:57		06:06		05:26	05:11	05:25	05:55	06:26	06:46 (1)	06:58	06:35	07:05
	16:41	17:20	18:53		19:27		19:59	20:21	20:19	19:45	18:55	28 07:14 (1)	18:04	16:26	16:17
17	07:10	06:39	06:56	07:15 (1)	06:04		05:25	05:11	05:26	05:56	06:27	06:47 (1)	06:59	06:36	07:06
	16:42	17:21	18:54	4 07:19 (1)	19:28		20:00	20:22	20:18	19:43	18:53	27 07:14 (1)	18:03	16:25	16:17
18	07:09	06:38	06:54	07:13 (1)	06:03		05:25	05:11	05:27	05:57	06:28	06:48 (1)	07:00	06:37	07:07
	16:44	17:22	18:55	9 07:22 (1)	19:29		20:00	20:22	20:17	19:42	18:51	26 07:14 (1)	18:01	16:24	16:17
19	07:08	06:37	06:52	07:11 (1)	06:01		05:24	05:11	05:28	05:58	06:29	06:49 (1)	07:01	06:38	07:07
	16:45	17:24	18:56	12 07:23 (1)	19:30		20:00	20:22	20:17	19:41	18:50	24 07:13 (1)	18:00	16:23	16:18
20	07:08	06:35	06:51	07:10 (1)	06:00		05:23	05:12	05:28	05:59	06:30	06:50 (1)	07:03	06:40	07:08
	16:46	17:25	18:57	15 07:25 (1)	19:31		20:01	20:23	20:16	19:39	18:48	22 07:12 (1)	17:58	16:23	16:18
21	07:07	06:34	06:49	07:08 (1)	05:58		05:22	05:12	05:29	06:00	06:31	06:51 (1)	07:04	06:41	07:09
	16:47	17:26	18:58	17 07:25 (1)	19:32		20:02	20:23	20:15	19:38	18:46	20 07:11 (1)	17:57	16:22	16:19
22	07:07	06:32	06:47	07:06 (1)	05:57		05:21	05:12	05:30	06:01	06:32	06:52 (1)	07:05	06:42	07:09
	16:48	17:27	18:59	20 07:26 (1)	19:33		20:03	20:23	20:14	19:36	18:44	18 07:10 (1)	17:55	16:21	16:19
23	07:06	06:31	06:45	07:04 (1)	05:55		05:20	05:12	05:31	06:02	06:33	06:53 (1)	07:06	06:43	07:10
	16:50	17:28	19:01	22 07:26 (1)	19:34		20:04	20:23	20:14	19:34	18:43	16 07:09 (1)	17:54	16:21	16:20
24	07:05	06:29	06:44	07:03 (1)	05:54		05:20	05:13	05:32	06:03	06:34	06:54 (1)	07:07	06:44	07:10
	16:51	17:30	19:02	23 07:26 (1)	19:35		20:05	20:23	20:13	19:33	18:41	13 07:07 (1)	17:52	16:20	16:20
25	07:04	06:28	06:42	07:01 (1)	05:52		05:19	05:13	05:33	06:04	06:36	06:55 (1)	07:08	06:45	07:10
	16:52	17:31	19:03	25 07:26 (1)	19:36		20:06	20:24	20:12	19:31	18:39	10 07:05 (1)	17:51	16:19	16:21
26	07:04	06:26	06:40	06:59 (1)	05:51		05:18	05:13	05:34	06:05	06:37	06:57 (1)	07:10	06:47	07:11
	16:53	17:32	19:04	27 07:26 (1)	19:37		20:07	20:24	20:11	19:30	18:37	6 07:03 (1)	17:50	16:19	16:21
27	07:03	06:25	06:39	06:58 (1)	05:49		05:17	05:13	05:35	06:06	06:38		07:11	06:48	07:11
	16:55	17:33	19:05	28 07:26 (1)	19:39		20:08	20:24	20:10	19:28	18:36		17:48	16:18	16:22
28	07:02	06:23	06:37	06:56 (1)	05:48		05:17	05:14	05:36	06:07	06:39		07:12	06:49	07:11
	16:56	17:34	19:06	29 07:25 (1)	19:40		20:09	20:24	20:09	19:27	18:34		17:47	16:18	16:23
29	07:01		06:35	06:54 (1)	05:47		05:16	05:14	05:37	06:08	06:40		07:13	06:50	07:12
	16:57		19:07	30 07:24 (1)	19:41		20:10	20:24	20:08	19:25	18:32		17:46	16:18	16:24
30	07:00		06:34	06:54 (1)	05:45		05:16	05:15	05:38	06:09	06:41		07:14	06:51	07:12
	16:58		19:08	30 07:24 (1)	19:42		20:10	20:24	20:07	19:23	18:31		17:44	16:17	16:24
31	06:59		06:32	06:54 (1)			05:15		05:39	06:10			07:16		07:12
	17:00		19:09	29 07:23 (1)			20:11		20:06	19:22			17:43		16:25
Potential sun hours	296	297	370		400		450	454	461	429	375		344	297	286
Total, worst case				320		102						429			
Sun reduction				0.58		0.57						0.62			
Oper. time red.				1.00		1.00						1.00			
Wind dir. red.				0.54		0.54						0.54			
Total reduction				0.31		0.31						0.34			
Total, real				101		32						145			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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4/5/2011 10:50 PM / 19

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
4/5/2011 10:49 PM/2.7.473

SHADOW - Calendar

Shadow receptor: S - 8S

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April			May	June	July	August			September			October	November	December
1	07:12	06:58	06:22	06:30			05:44	05:15	05:15	05:40			06:11		06:32 (1)	06:42	06:17	06:52
	16:26	17:01	17:36	19:10			19:43	20:12	20:24	20:05			19:20	17	06:49 (1)	18:29	16:42	16:17
2	07:13	06:57	06:20	06:29			05:43	05:14	05:16	05:41			06:12		06:33 (1)	06:43	06:18	06:53
	16:27	17:02	17:37	19:11			19:44	20:13	20:24	20:04			19:19	15	06:48 (1)	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27			05:41	05:14	05:16	05:42			06:13		06:34 (1)	06:44	06:19	06:54
	16:28	17:03	17:38	19:13			19:45	20:14	20:24	20:03			19:17	13	06:47 (1)	18:26	16:39	16:16
4	07:13	06:55	06:17	06:25			05:40	05:13	05:17	05:43			06:14		06:35 (1)	06:45	06:20	06:55
	16:29	17:05	17:39	19:14			19:46	20:14	20:23	20:02			19:15	10	06:45 (1)	18:24	16:38	16:16
5	07:13	06:54	06:15	06:24			05:39	05:13	05:17	05:44			06:15		06:36 (1)	06:46	06:22	06:56
	16:30	17:06	17:40	19:15			19:47	20:15	20:23	20:01			19:14	6	06:42 (1)	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22		06:41 (1)	05:37	05:13	05:18	05:45			06:16		06:37 (1)	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	2	06:42 (1)	19:48	20:16	20:23	19:58			19:12	2	06:38 (1)	18:20	16:36	16:16
7	07:13	06:52	06:12	06:20		06:39 (1)	05:36	05:12	05:19	05:46			06:17			06:48	06:24	06:58
	16:32	17:09	17:43	19:17	6	06:45 (1)	19:49	20:16	20:23	19:57			19:10			18:19	16:35	16:16
8	07:12	06:51	07:11	06:19		06:38 (1)	05:35	05:12	05:19	05:47			06:18			06:49	06:25	06:59
	16:33	17:10	18:44	19:18	10	06:48 (1)	19:50	20:17	20:22	19:56			19:08			18:17	16:33	16:16
9	07:12	06:50	07:09	06:17		06:36 (1)	05:34	05:12	05:20	05:48			06:19			06:50	06:26	07:00
	16:34	17:11	18:45	19:19	13	06:49 (1)	19:51	20:18	20:22	19:54			19:07			18:16	16:32	16:16
10	07:12	06:48	07:07	06:15		06:34 (1)	05:33	05:12	05:21	05:49			06:20			06:51	06:28	07:01
	16:35	17:12	18:46	19:20	15	06:49 (1)	19:52	20:18	20:22	19:53			19:05			18:14	16:31	16:16
11	07:12	06:47	07:06	06:14		06:33 (1)	05:32	05:12	05:21	05:50			06:21			06:53	06:29	07:02
	16:36	17:14	18:47	19:21	18	06:51 (1)	19:53	20:19	20:21	19:52			19:03			18:12	16:30	16:16
12	07:11	06:46	07:04	06:12		06:31 (1)	05:31	05:11	05:22	05:51			06:22			06:54	06:30	07:02
	16:37	17:15	18:48	19:22	20	06:51 (1)	19:54	20:19	20:21	19:50			19:02			18:11	16:29	16:16
13	07:11	06:45	07:02	06:10		06:30 (1)	05:29	05:11	05:23	05:52			06:23			06:55	06:31	07:03
	16:38	17:16	18:49	19:23	21	06:51 (1)	19:55	20:20	20:20	19:49			19:00			18:09	16:28	16:16
14	07:11	06:43	07:01	06:09		06:28 (1)	05:28	05:11	05:24	05:53			06:24			06:56	06:32	07:04
	16:39	17:17	18:51	19:24	23	06:51 (1)	19:57	20:20	20:20	19:48			18:58			18:07	16:27	16:16
15	07:10	06:42	06:59	06:07		06:26 (1)	05:27	05:11	05:24	05:54			06:25			06:57	06:34	07:05
	16:40	17:19	18:52	19:26	24	06:50 (1)	19:58	20:21	20:19	19:46			18:56			18:06	16:27	16:17
16	07:10	06:41	06:57	06:06		06:25 (1)	05:26	05:11	05:25	05:55			06:26			06:58	06:35	07:05
	16:41	17:20	18:53	19:27	26	06:51 (1)	19:59	20:21	20:19	19:45			18:55			18:04	16:26	16:17
17	07:10	06:39	06:56	06:04		06:23 (1)	05:25	05:11	05:26	05:56			06:27			06:59	06:36	07:06
	16:42	17:21	18:54	19:28	27	06:50 (1)	20:00	20:22	20:18	19:43			18:53			18:03	16:25	16:17
18	07:09	06:38	06:54	06:03		06:22 (1)	05:25	05:11	05:27	05:57		06:34 (1)	06:28			07:00	06:37	07:07
	16:44	17:22	18:55	19:29	28	06:50 (1)	20:00	20:22	20:17	19:42	12	06:46 (1)	18:51			18:01	16:24	16:17
19	07:08	06:37	06:52	06:01		06:22 (1)	05:24	05:11	05:28	05:58		06:32 (1)	06:29			07:01	06:38	07:07
	16:45	17:24	18:56	19:30	26	06:48 (1)	20:00	20:22	20:17	19:41	16	06:48 (1)	18:50			18:00	16:23	16:18
20	07:08	06:35	06:51	06:00		06:23 (1)	05:23	05:12	05:28	05:59		06:30 (1)	06:30			07:03	06:40	07:08
	16:46	17:25	18:57	19:31	25	06:48 (1)	20:01	20:23	20:16	19:39	19	06:49 (1)	18:48			17:58	16:23	16:18
21	07:07	06:34	06:49	05:58		06:23 (1)	05:22	05:12	05:29	06:00		06:29 (1)	06:31			07:04	06:41	07:09
	16:47	17:26	18:58	19:32	23	06:46 (1)	20:02	20:23	20:15	19:38	22	06:51 (1)	18:46			17:57	16:22	16:19
22	07:07	06:32	06:47	05:57		06:24 (1)	05:21	05:12	05:30	06:01		06:27 (1)	06:32			07:05	06:42	07:09
	16:48	17:27	18:59	19:33	22	06:46 (1)	20:03	20:23	20:14	19:36	24	06:51 (1)	18:44			17:55	16:21	16:19
23	07:06	06:31	06:45	05:55		06:25 (1)	05:20	05:12	05:31	06:02		06:26 (1)	06:33			07:06	06:43	07:10
	16:50	17:28	19:01	19:34	18	06:43 (1)	20:04	20:23	20:14	19:35	26	06:52 (1)	18:43			17:54	16:21	16:20
24	07:05	06:29	06:44	05:54		06:27 (1)	05:20	05:13	05:32	06:03		06:26 (1)	06:34			07:07	06:44	07:10
	16:51	17:30	19:02	19:35	15	06:42 (1)	20:05	20:23	20:13	19:33	26	06:52 (1)	18:41			17:52	16:20	16:20
25	07:04	06:28	06:42	05:52		06:29 (1)	05:19	05:13	05:33	06:04		06:25 (1)	06:36			07:08	06:45	07:10
	16:52	17:31	19:03	19:36	11	06:40 (1)	20:06	20:24	20:12	19:31	28	06:53 (1)	18:39			17:51	16:19	16:21
26	07:04	06:26	06:40	05:51			05:18	05:13	05:34	06:05		06:26 (1)	06:37			07:10	06:47	07:11
	16:53	17:32	19:04	19:37			20:07	20:24	20:11	19:30	27	06:53 (1)	18:37			17:50	16:19	16:21
27	07:03	06:25	06:39	05:49			05:17	05:14	05:35	06:06		06:27 (1)	06:38			07:11	06:48	07:11
	16:55	17:33	19:05	19:39			20:08	20:24	20:10	19:28	25	06:52 (1)	18:36			17:48	16:19	16:22
28	07:02	06:23	06:37	05:48			05:17	05:14	05:36	06:07		06:28 (1)	06:39			07:12	06:49	07:11
	16:56	17:34	19:06	19:40			20:09	20:24	20:09	19:27	24	06:52 (1)	18:34			17:47	16:18	16:23
29	07:01		06:35	05:47			05:16	05:14	05:37	06:08		06:29 (1)	06:40			07:13	06:50	07:12
	16:57		19:07	19:41			20:10	20:24	20:08	19:25	23	06:52 (1)	18:32			17:46	16:18	16:24
30	07:00		06:34	05:45			05:16	05:15	05:38	06:09		06:30 (1)	06:41			07:14	06:51	07:12
	16:58		19:08	19:42			20:10	20:24	20:07	19:23	21	06:51 (1)	18:31			17:44	16:17	16:24
31	06:59		06:32				05:15		05:39	06:10		06:31 (1)				07:16		07:12
	17:00		19:09				20:11		20:06	19:22	19	06:50 (1)				17:43		16:25
Potential sun hours	296	297	370	400			450	454	461	429			375			344	297	286
Total, worst case					373						312				63			
Sun reduction					0.57						0.62				0.62			
Oper. time red.					1.00						1.00				1.00			
Wind dir. red.					0.53						0.53				0.53			
Total reduction					0.30						0.33				0.33			
Total, real					113						103				21			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
4/5/2011 10:50 PM / 20

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
4/5/2011 10:49 PM/2.7.473

SHADOW - Calendar

Shadow receptor: T - 8T

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March			April	May	June	July	August	September			October			November	December
1	07:12	06:58	06:22			06:30	05:44	05:15	05:15	05:40	06:11			06:42		07:02 (1)	06:17	06:52
	16:26	17:01	17:36			19:10	19:43	20:12	20:24	20:05	19:20			18:29	14	07:16 (1)	16:42	16:17
2	07:13	06:57	06:20			06:29	05:43	05:14	05:16	05:41	06:12			06:43		07:03 (1)	06:18	06:53
	16:27	17:02	17:37			19:11	19:44	20:13	20:24	20:04	19:19			18:27	13	07:16 (1)	16:40	16:17
3	07:13	06:56	06:19			06:27	05:41	05:14	05:16	05:42	06:13			06:44		07:04 (1)	06:19	06:54
	16:28	17:03	17:38			19:13	19:45	20:14	20:24	20:03	19:17			18:26	12	07:16 (1)	16:39	16:16
4	07:13	06:55	06:17			06:25	05:40	05:13	05:17	05:43	06:14			06:45		07:05 (1)	06:20	06:55
	16:29	17:05	17:39			19:14	19:46	20:14	20:23	20:02	19:15			18:24	11	07:16 (1)	16:38	16:16
5	07:13	06:54	06:15			06:24	05:39	05:13	05:17	05:44	06:15			06:46		07:06 (1)	06:22	06:56
	16:30	17:06	17:40			19:15	19:47	20:15	20:23	20:01	19:14			18:22	9	07:15 (1)	16:37	16:16
6	07:13	06:53	06:14		06:33 (1)	06:22	05:37	05:13	05:18	05:45	06:16			06:47		07:07 (1)	06:23	06:57
	16:31	17:07	17:41	4	06:37 (1)	19:16	19:48	20:16	20:23	19:58	19:12			18:21	7	07:14 (1)	16:36	16:16
7	07:13	06:52	06:12		06:32 (1)	06:20	05:36	05:12	05:19	05:46	06:17			06:48		07:08 (1)	06:24	06:58
	16:32	17:09	17:43	6	06:38 (1)	19:17	19:49	20:16	20:23	19:57	19:10			18:19	5	07:13 (1)	16:35	16:16
8	07:12	06:51	07:11		07:30 (1)	06:19	05:35	05:12	05:19	05:47	06:18			06:49		07:09 (1)	06:25	06:59
	16:33	17:10	18:44	8	07:38 (1)	19:18	19:50	20:17	20:22	19:56	19:08			18:17	2	07:11 (1)	16:33	16:16
9	07:12	06:50	07:09		07:28 (1)	06:17	05:34	05:12	05:20	05:48	06:19			06:50			06:26	07:00
	16:34	17:11	18:45	10	07:38 (1)	19:19	19:51	20:18	20:22	19:54	19:07			18:16			16:32	16:16
10	07:12	06:48	07:07		07:27 (1)	06:15	05:33	05:12	05:21	05:49	06:20			06:51			06:28	07:01
	16:35	17:12	18:46	12	07:39 (1)	19:20	19:52	20:18	20:22	19:53	19:05			18:14			16:31	16:16
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	16:36	17:14	18:47	13	07:38 (1)	19:21	19:53	20:19	20:21	19:52	19:03			18:12			16:30	16:16
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	16:38	17:16	18:49	13	07:36 (1)	19:23	19:56	20:20	20:20	19:49	19:00			18:09			16:28	16:16
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29	07:01		06:35			05:47	05:16	05:14	05:37	06:08	06:40		07:06 (1)	07:13			06:50	07:12
	16:57		19:07			19:41	20:10	20:24	20:08	19:25	18:32	7	07:13 (1)	17:46			16:18	16:24
30	07:00		06:34			05:45	05:16	05:15	05:38	06:09	06:41		07:03 (1)	07:14			06:51	07:12
	16:58		19:08			19:42	20:10	20:24	20:07	19:23	18:31	12	07:15 (1)	17:44			16:17	16:24
31	06:59		06:32				05:15		05:39	06:10				07:16				07:12
	17:00		19:09				20:11		20:06	19:22				17:43				16:25
Potential sun hours	296	297	370			400	450	454	461	429	375			344			297	286
Total, worst case				88								19			73			
Sun reduction				0.58								0.62			0.61			
Oper. time red.				1.00								1.00			1.00			
Wind dir. red.				0.54								0.54			0.54			
Total reduction				0.31								0.34			0.33			
Total, real				28								6			24			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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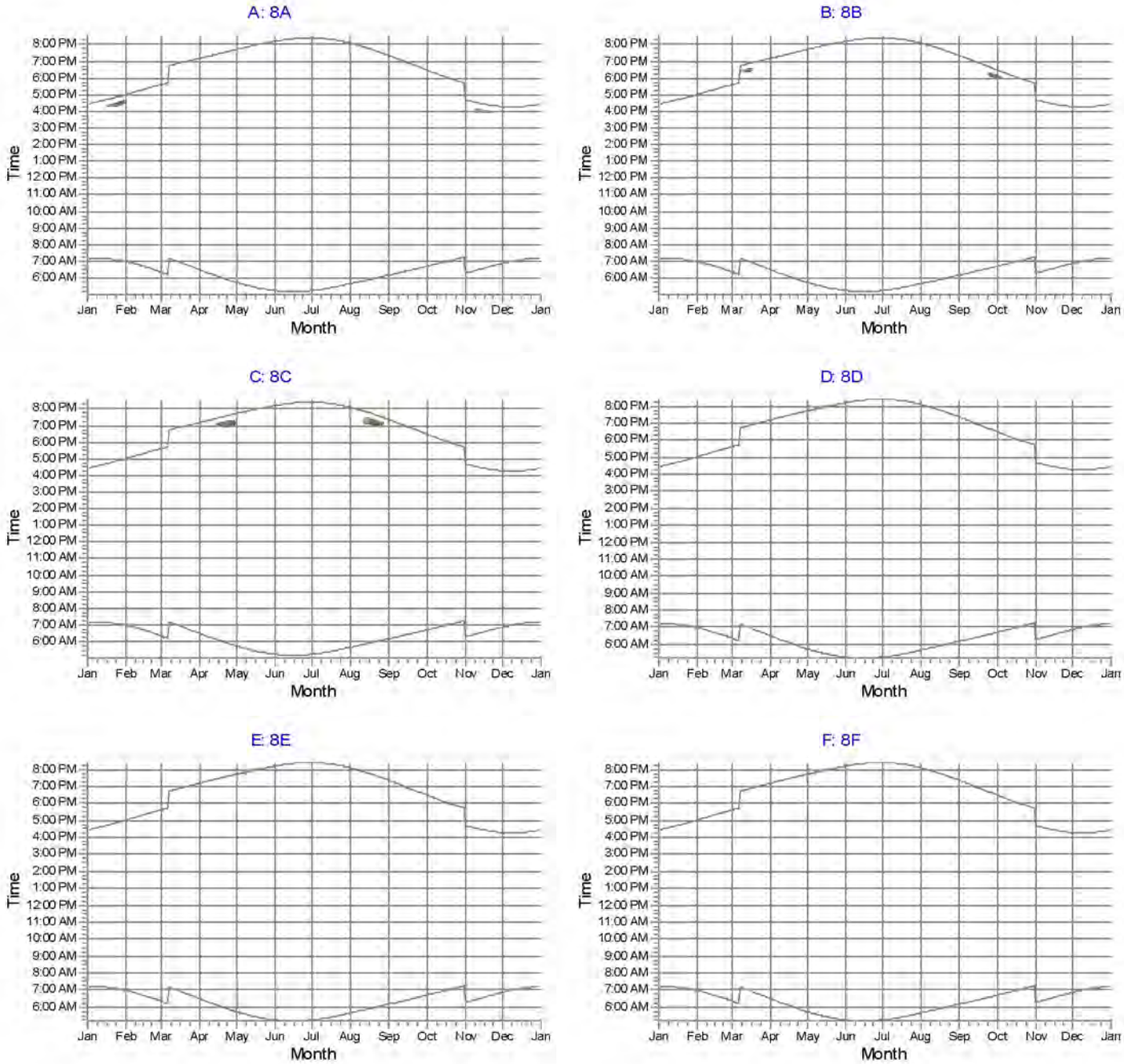
Calculated:
4/5/2011 10:49 PM/2.7.473

SHADOW - Calendar, graphical



WTGs

1: Bldg 1285 NL

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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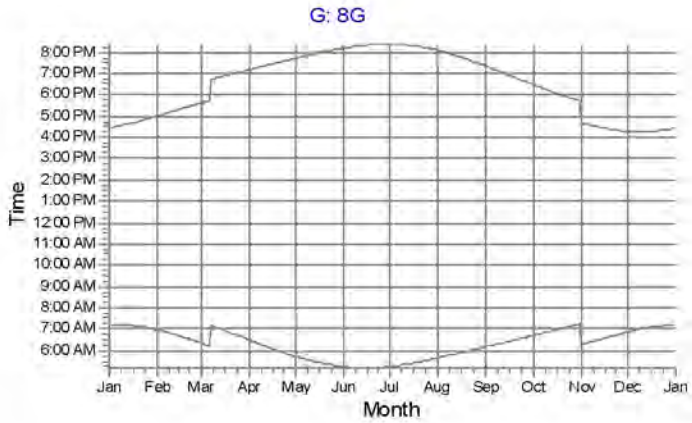
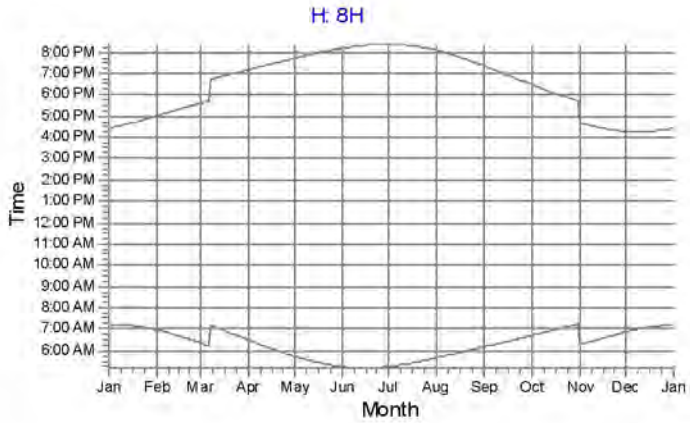
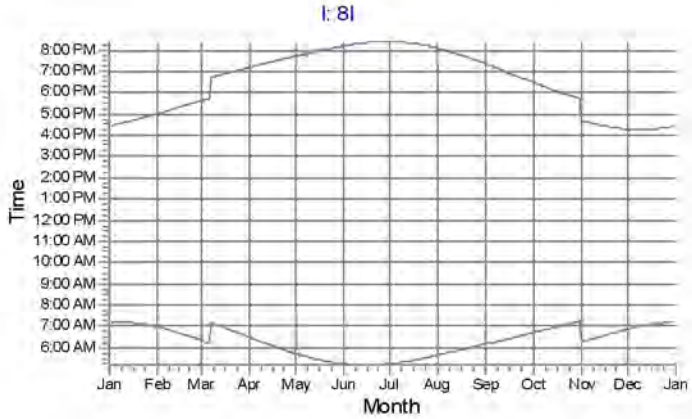
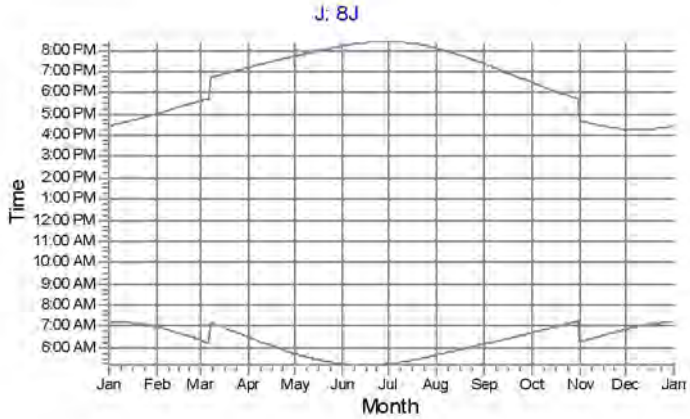
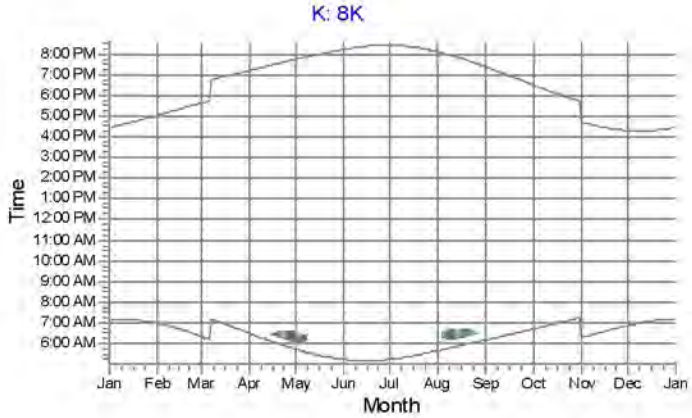
SHADOW - Calendar, graphical

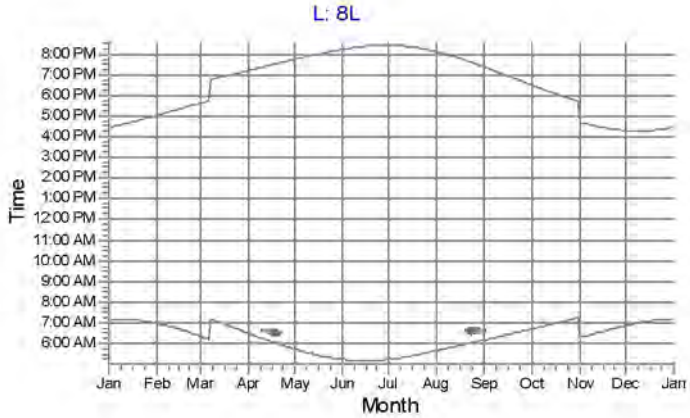












WTGs

1: Bldg 1285 NL

Project:

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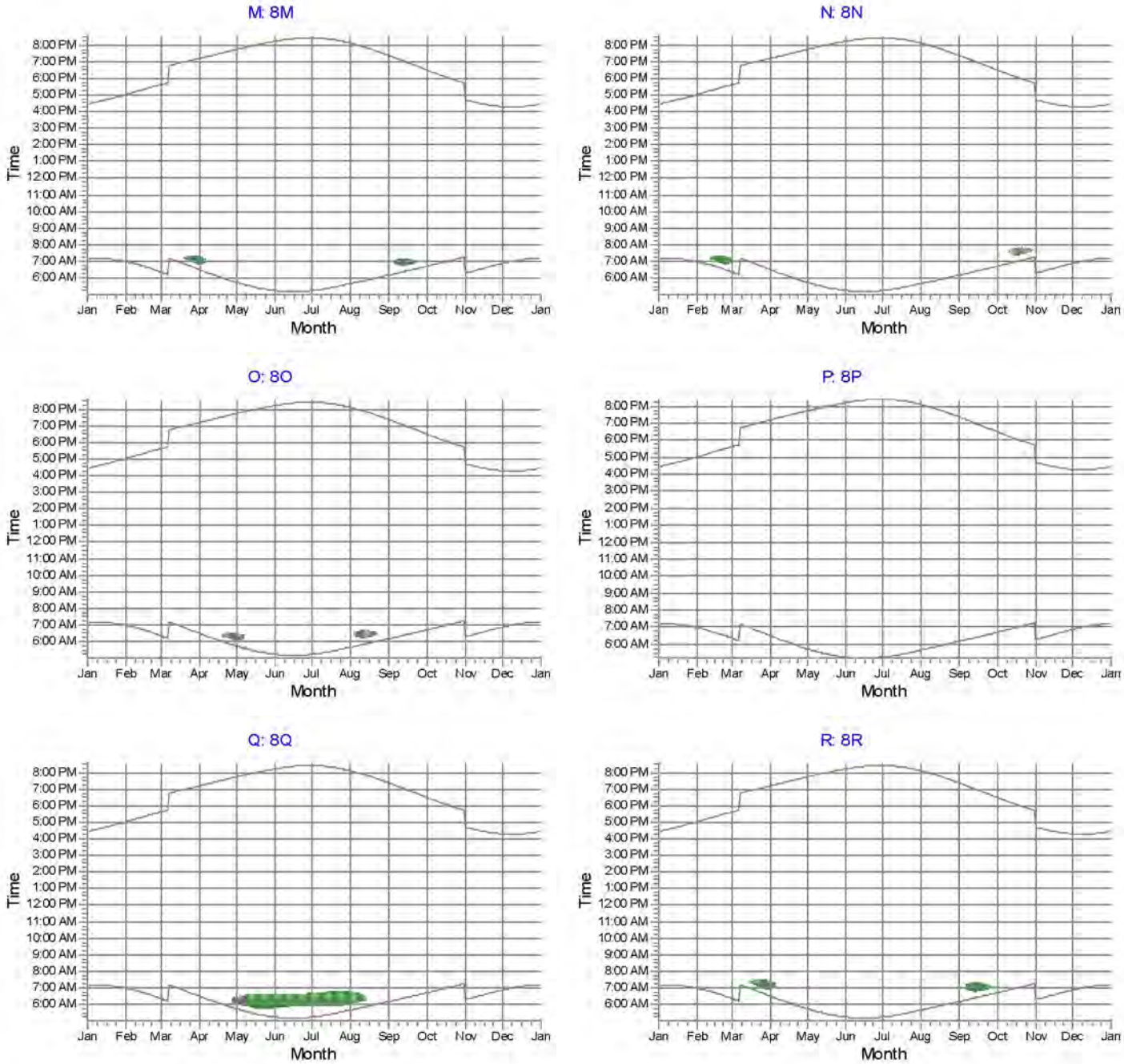
SHADOW - Calendar, graphical



WTGs

1: Bldg 1285 NL

Project:
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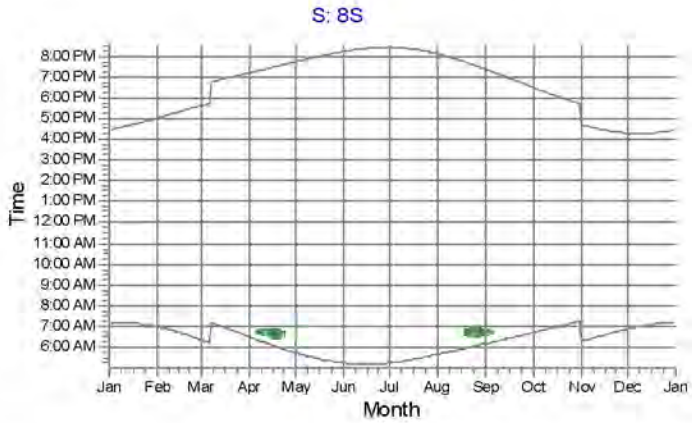
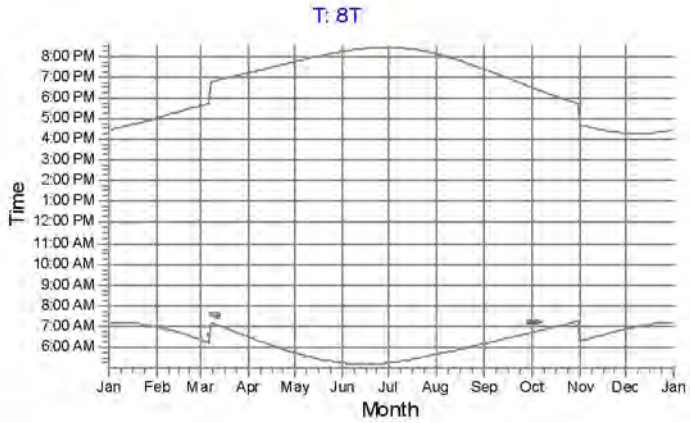
SHADOW - Calendar, graphical





WTGs

1: Bldg 1285 NL

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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SHADOW - Calendar per WTG

WTG: 1 - Bldg 1285 NL

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June
1	07:12 16:26	06:58 16:26-16:35/9 17:01	06:22 06:54-07:06/12 17:36	06:30 06:49-07:21/32 19:10	05:44 06:04-06:24/20 19:01-19:10/9 19:43 06:23-06:30/7	05:15 05:46-06:32/46 20:12
2	07:13 16:27	06:57 17:02	06:20 17:37	06:28 06:49-07:20/31 19:11	05:42 06:02-06:25/23 19:44 06:24-06:29/5	05:14 05:47-06:32/45 20:13
3	07:13 16:28	06:56 17:03	06:19 17:38	06:27 06:50-07:18/28 19:12	05:41 06:01-06:27/26 19:45 06:27-06:28/1	05:14 05:48-06:32/44 20:14
4	07:13 16:29	06:55 17:05	06:17 17:39	06:25 06:51-07:16/25 19:14	05:40 06:00-06:27/27 19:46	05:13 05:47-06:31/44 20:14
5	07:13 16:30	06:54 17:06	06:15 17:40	06:23 06:53-07:13/20 19:15	05:39 05:59-06:27/28 19:47	05:13 05:48-06:32/44 20:15
6	07:13 16:31	06:53 17:07	06:14 06:33-06:37/4 17:41	06:22 06:41-06:42/1 19:16 06:56-07:02/6	05:37 05:57-06:27/30 19:48	05:13 05:49-06:32/43 20:16
7	07:12 16:32	06:52 17:09	06:12 06:32-06:38/6 17:43	06:20 06:39-06:45/6 19:17	05:36 05:56-06:28/32 19:49	05:12 05:48-06:31/43 20:16
8	07:12 16:33	06:51 17:10	07:11 07:30-07:38/8 18:44	06:19 06:38-06:48/10 19:18	05:35 05:55-06:29/34 19:50	05:12 05:49-06:31/42 20:17
9	07:12 16:34	06:50 17:11	07:09 07:28-07:38/10 18:45 18:20-18:23/3	06:17 06:36-06:49/13 19:19	05:34 05:54-06:30/36 19:51	05:12 05:50-06:31/41 20:18
10	07:12 16:35	06:48 17:12	07:07 07:27-07:39/12 18:46 18:19-18:24/5	06:15 06:34-06:49/15 19:20	05:33 05:53-06:30/37 19:52	05:12 05:50-06:32/42 20:18
11	07:12 16:36	06:47 17:14	07:06 07:25-07:38/13 18:47 18:19-18:26/7	06:14 06:33-06:51/18 19:21	05:32 05:52-06:31/39 19:53	05:12 05:51-06:32/41 20:19
12	07:11 16:37	06:46 07:06-07:08/2 17:15	07:04 07:23-07:36/13 18:48 18:18-18:27/9	06:12 06:31-06:51/20 19:22	05:30 05:51-06:31/40 19:54	05:11 05:51-06:32/41 20:19
13	07:11 16:38	06:45 07:05-07:11/6 17:16	07:02 07:23-07:36/13 18:49 18:18-18:27/9	06:10 06:30-06:51/21 19:23	05:29 05:50-06:32/42 19:55	05:11 05:52-06:32/40 20:20
14	07:11 16:39	06:43 07:03-07:11/8 17:17	07:01 07:24-07:33/9 18:51 18:19-18:29/10	06:09 06:28-06:51/23 19:24	05:28 05:49-06:32/43 19:56	05:11 05:52-06:32/40 20:20
15	07:10 16:40	06:42 07:02-07:13/11 17:19	06:59 18:19-18:30/11 18:52	06:07 06:26-06:50/24 19:26 19:00-19:03/3	05:27 05:48-06:32/44 19:57	05:11 05:52-06:32/40 20:21
16	07:10 16:41	06:41 07:01-07:14/13 17:20	06:57 18:19-18:31/12 18:53	06:06 06:25-06:51/26 19:27 18:59-19:04/5	05:26 05:47-06:32/45 19:58	05:11 05:53-06:32/39 20:21
17	07:10 16:42	06:39 06:59-07:14/15 17:21	06:56 07:15-07:19/4 18:54 18:21-18:33/12	06:04 06:23-06:50/27 19:28 18:57-19:05/8	05:25 05:46-06:32/46 19:59	05:11 05:53-06:32/39 20:22
18	07:09 16:17-16:18/1 16:44	06:38 06:58-07:15/17 17:22	06:54 07:13-07:22/9 18:55 18:24-18:31/7	06:03 06:22-06:50/28 19:29 18:56-19:06/10	05:24 05:45-06:32/47 20:00	05:11 05:53-06:32/39 20:22
19	07:08 16:18-16:19/1 16:45	06:37 06:56-07:15/19 17:24	06:52 07:11-07:23/12 18:56	06:01 06:20-06:48/28 19:30 18:55-19:07/12	05:24 05:44-06:32/48 20:00	05:11 05:53-06:32/39 20:22
20	07:08 16:17-16:20/3 16:46	06:35 06:55-07:15/20 17:25	06:50 07:10-07:25/15 18:57	06:00 06:19-06:22/3 18:55-19:09/14 19:31 06:19-06:48/29	05:23 05:44-06:33/49 20:01	05:12 05:53-06:32/39 20:23
21	07:07 16:17-16:21/4 16:47	06:34 06:53-07:15/22 17:26	06:49 07:08-07:25/17 18:58	05:58 06:17-06:46/29 19:32 18:54-19:09/15	05:22 05:44-06:33/49 20:02	05:12 05:53-06:32/39 20:23
22	07:07 16:18-16:23/5 16:48	06:32 06:52-07:15/23 17:27	06:47 07:06-07:26/20 18:59	05:57 06:16-06:46/30 19:33 18:54-19:10/16	05:21 05:44-06:32/48 20:03	05:12 05:54-06:33/39 20:23
23	07:06 16:18-16:24/6 16:50	06:31 06:50-07:14/24 17:28	06:45 07:04-07:26/22 19:00	05:55 06:14-06:43/29 19:34 18:53-19:11/18	05:20 05:44-06:32/48 20:04	05:12 05:54-06:33/39 20:23
24	07:05 16:18-16:26/8 16:51	06:29 06:49-07:14/25 17:30	06:44 07:03-07:26/23 19:02	05:54 06:13-06:42/29 19:35 18:54-19:12/18	05:20 05:45-06:33/48 20:05	05:12 05:54-06:33/39 20:23
25	07:04 16:18-16:27/9 16:52	06:28 06:48-07:12/24 17:31	06:42 07:01-07:26/25 19:03	05:52 06:12-06:28/16 18:54-19:14/20 19:36 06:12-06:40/28	05:19 05:44-06:32/48 20:06	05:13 05:54-06:33/39 20:24
26	07:04 16:18-16:28/10 16:53	06:26 06:49-07:12/23 17:32	06:40 06:59-07:26/27 19:04	05:51 06:10-06:29/19 18:54-19:14/20 19:37 06:29-06:31/2	05:18 05:44-06:32/48 20:07	05:13 05:55-06:34/39 20:24
27	07:03 16:20-16:30/10 16:55	06:25 06:50-07:10/20 17:33	06:39 06:58-07:26/28 19:05	05:49 06:09-06:29/20 18:55-19:16/21 19:39 06:29-06:31/2	05:17 05:45-06:33/48 20:08	05:13 05:54-06:34/40 20:24
28	07:02 16:20-16:31/11 16:56	06:23 06:52-07:09/17 17:34	06:37 06:56-07:25/29 19:06	05:48 06:08-06:30/22 18:55-19:15/20 19:40 06:30-06:31/1	05:17 05:45-06:32/47 20:09	05:14 05:55-06:35/40 20:24
29	07:01 16:21-16:33/12 16:57		06:35 06:54-07:24/30 19:07	05:46 06:06-06:18/12 18:57-19:14/17 19:41 06:17-06:30/13	05:16 05:46-06:32/46 20:10	05:14 05:55-06:35/40 20:24
30	07:00 16:22-16:34/12 16:58		06:34 06:53-07:24/31 19:08	05:45 06:05-06:21/16 18:59-19:12/13 19:42 06:20-06:30/10	05:16 05:46-06:32/46 20:10	05:15 05:54-06:35/41 20:24
31	06:59 16:24-16:35/11 17:00		06:32 06:51-07:23/32 19:09		05:15 05:46-06:32/46 20:11	
Potential sun hours	296	297	370	400	450	454
Sum of minutes with flicker	103	298	509	937	1278	1226

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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4/5/2011 10:49 PM/2.7.473

SHADOW - Calendar per WTG

WTG: 1 - Bldg 1285 NL

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	July		August		September		October		November		December
1	05:15 20:24	05:55-06:36/41	05:40 20:05	06:02-06:42/40	06:11 19:20	06:32-06:49/17	06:42 18:29	07:02-07:16/14 17:58-18:07/9	06:17 16:42		06:52 16:17
2	05:16 20:24	05:54-06:36/42	05:41 20:04	06:03-06:41/38	06:12 19:18	06:33-06:48/15	06:43 18:27	07:03-07:16/13 17:58-18:05/7	06:18 16:40		06:53 16:17
3	05:16 20:23	05:55-06:36/41	05:42 20:03	06:04-06:41/37	06:13 19:17	06:34-06:47/13	06:44 18:25	07:04-07:16/12 17:58-18:03/5	06:19 16:39		06:54 16:16
4	05:17 20:23	05:55-06:37/42	05:43 20:02	06:05-06:40/35	06:14 19:15	06:35-06:45/10	06:45 18:24	07:05-07:16/11 17:58-18:01/3	06:20 16:38		06:55 16:16
5	05:17 20:23	05:55-06:37/42	05:44 20:01	06:06-06:39/33	06:15 19:13	06:36-06:42/6	06:46 18:22	07:06-07:15/9 17:58-18:00/2	06:22 16:37		06:56 16:16
6	05:18 20:23	05:55-06:38/43	05:45 19:58	06:06-06:38/32	06:16 19:12	06:37-06:38/1 06:52-06:58/6	06:47 18:20	07:07-07:14/7	06:23 16:36		06:57 16:16
7	05:19 20:23	05:54-06:38/44	05:46 19:57	06:07-06:37/30	06:17 19:10	06:48-07:08/20	06:48 18:19	07:08-07:13/5	06:24 16:35		06:58 16:16
8	05:19 20:22	05:55-06:39/44	05:47 19:56	06:08-06:36/28	06:18 19:08	06:46-07:11/25	06:49 18:17	07:09-07:11/2	06:25 16:33		06:59 16:16
9	05:20 20:22	05:55-06:39/44	05:48 19:54	06:09-06:35/26 06:35-06:36/1	06:19 19:07	06:44-07:12/28	06:50 18:16		06:26 16:32		07:00 16:16
10	05:21 20:22	05:54-06:39/45	05:49 19:53	06:10-06:35/25 06:34-06:37/3	06:20 19:05	06:42-07:13/31	06:51 18:14		06:28 16:31	15:56-16:06/10	07:01 16:16
11	05:21 20:21	05:54-06:40/46	05:50 19:52	06:11-06:33/22 06:32-06:37/5	06:21 19:03	06:42-07:14/32	06:52 18:12		06:29 16:30	15:54-16:06/12	07:02 16:16
12	05:22 20:21	05:55-06:40/45	05:51 19:50	06:12-06:31/19 19:08-19:18/10 06:30-06:38/8	06:22 19:02	06:43-07:15/32	06:54 18:11	07:30-07:37/7	06:30 16:29	15:53-16:05/12	07:02 16:16
13	05:23 20:20	05:54-06:40/46	05:52 19:49	06:13-06:28/15 19:06-19:20/14 06:27-06:38/11	06:23 19:00	06:44-07:15/31	06:55 18:09	07:26-07:40/14	06:31 16:28	15:53-16:05/12	07:03 16:16
14	05:24 20:20	05:54-06:41/47	05:53 19:48	06:14-06:24/10 19:04-19:22/18 06:23-06:38/15	06:24 18:58	06:44-07:14/30	06:56 18:07	07:23-07:42/19	06:32 16:27	15:52-16:03/11	07:04 16:16
15	05:24 20:19	05:54-06:41/47	05:54 19:46	06:15-06:36/21 19:03-19:23/20 06:36-06:38/2	06:25 18:56	06:45-07:14/29	06:57 18:06	07:22-07:43/21	06:34 16:27	15:52-16:02/10	07:05 16:17
16	05:25 20:19	05:54-06:42/48	05:55 19:45	06:16-06:36/20 19:02-19:22/20 06:36-06:38/2	06:26 18:55	06:46-07:14/28	06:58 18:04	07:20-07:44/24	06:35 16:26	15:52-16:02/10	07:05 16:17
17	05:26 20:18	05:54-06:41/47	05:56 19:43	06:17-06:35/18 19:01-19:21/20 06:35-06:38/3	06:27 18:53	06:47-07:14/27	06:59 18:03	07:20-07:45/25	06:36 16:25	15:52-16:01/9	07:06 16:17
18	05:27 20:17	05:54-06:42/48	05:57 19:42	06:18-06:46/28 19:00-19:19/19	06:28 18:51	06:48-07:14/26	07:00 18:01	07:21-07:45/24	06:37 16:24	15:52-16:00/8	07:07 16:17
19	05:28 20:17	05:54-06:42/48	05:58 19:41	06:19-06:48/29 19:00-19:18/18	06:29 18:50	06:49-07:13/24	07:01 18:00	07:22-07:46/24	06:38 16:23	15:52-15:58/6	07:07 16:18
20	05:28 20:16	05:54-06:43/49	05:59 19:39	06:20-06:49/29 18:59-19:17/18	06:30 18:48	06:50-07:12/22	07:03 17:58	07:23-07:45/22	06:40 16:23	15:53-15:58/5	07:08 16:18
21	05:29 20:15	05:54-06:43/49	06:00 19:38	06:21-06:51/30 18:59-19:15/16	06:31 18:46	06:51-07:11/20	07:04 17:57	07:24-07:45/21	06:41 16:22	15:53-15:57/4	07:09 16:19
22	05:30 20:14	05:54-06:43/49	06:01 19:36	06:22-06:51/29 18:59-19:14/15	06:32 18:44	06:52-07:10/18	07:05 17:55	07:26-07:46/20	06:42 16:21	15:53-15:56/3	07:09 16:19
23	05:31 20:14	05:55-06:43/48	06:02 19:34	06:23-06:52/29 18:59-19:12/13	06:33 18:43	06:53-07:09/16	07:06 17:54	07:27-07:45/18	06:43 16:21	15:54-15:56/2	07:10 16:20
24	05:32 20:13	05:54-06:42/48	06:03 19:33	06:24-06:52/28 18:59-19:11/12	06:34 18:41	06:54-07:07/13	07:07 17:52	07:28-07:44/16	06:44 16:20	15:55-15:56/1	07:10 16:20
25	05:33 20:12	05:55-06:43/48	06:04 19:31	06:25-06:53/28 18:59-19:09/10	06:35 18:39	06:55-07:05/10 18:08-18:12/4	07:08 17:51	07:29-07:44/15	06:45 16:19		07:10 16:21
26	05:34 20:11	05:56-06:43/47	06:05 19:30	06:26-06:53/27 19:00-19:08/8	06:37 18:37	06:57-07:03/6 18:04-18:15/11	07:10 17:50	07:31-07:44/13	06:47 16:19		07:11 16:21
27	05:35 20:10	05:57-06:43/46	06:06 19:28	06:27-06:52/25 19:01-19:06/5	06:38 18:36	18:01-18:13/12	07:11 17:48	07:32-07:42/10	06:48 16:18		07:11 16:22
28	05:36 20:09	05:58-06:43/45	06:07 19:27	06:28-06:52/24 19:02-19:05/3	06:39 18:34	18:01-18:12/11	07:12 17:47	07:33-07:41/8	06:49 16:18		07:11 16:23
29	05:37 20:08	05:59-06:43/44	06:08 19:25	06:29-06:52/23	06:40 18:32	07:06-07:13/7 18:00-18:10/10	07:13 17:45	07:34-07:39/5	06:50 16:18		07:12 16:24
30	05:38 20:07	06:00-06:42/42	06:09 19:23	06:30-06:51/21	06:41 18:31	07:03-07:15/12 17:59-18:09/10	07:14 17:44	07:36-07:37/1	06:51 16:17		07:12 16:24
31	05:39 20:06	06:01-06:42/41	06:10 19:22	06:31-06:50/19			07:15 17:43				07:12 16:25
Potential sun hours	461		429		375		344		297		286
Sum of minutes with flicker		1406		1102		613		406		115	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

Project:
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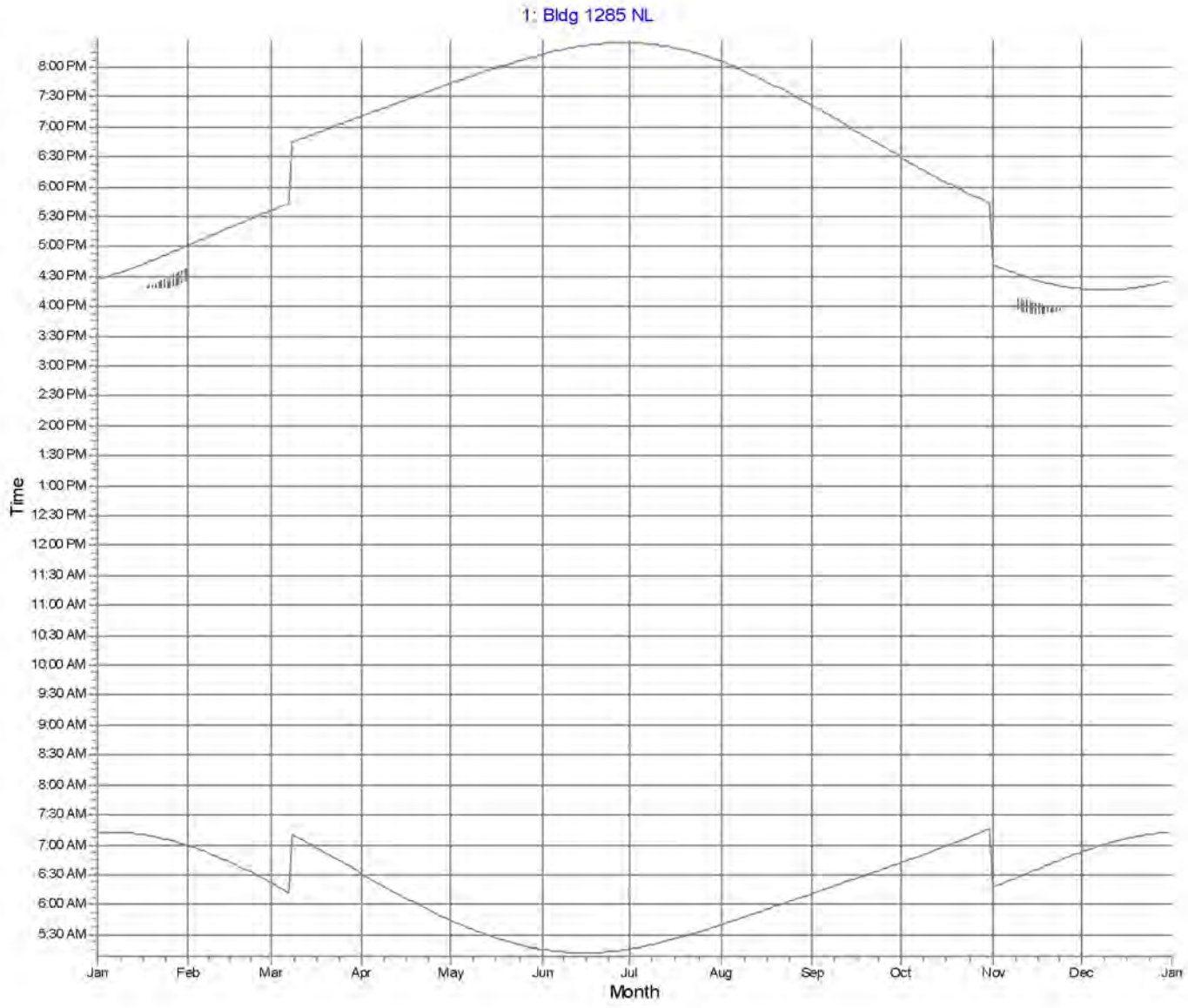
SHADOW - Calendar per WTG, graphical

WTG: 1 - Bldg 1285 NL



WTGs

A: 8A

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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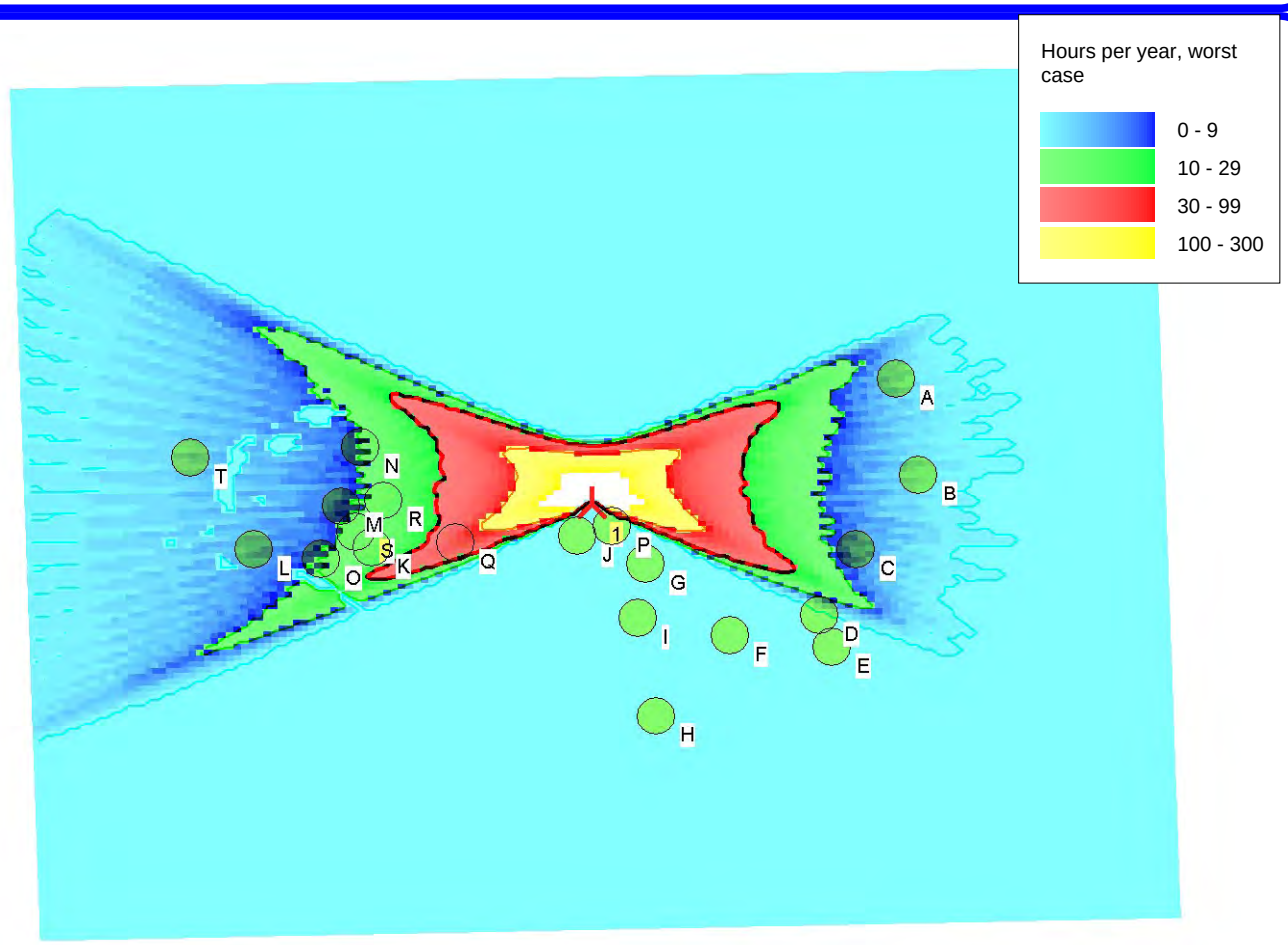
SHADOW - Map



0 250 500 750 1000m

Map: , Print scale 1:20,000, Map center Geo WGS 84 East: -71.316041° North: 41.519849°

New WTG Shadow receptor

Isolines showing shadow in Hours per year, worst case

0 10 30 100

APPENDIX 9

WIND TURBINE SITE 9 BISHOP ROCK

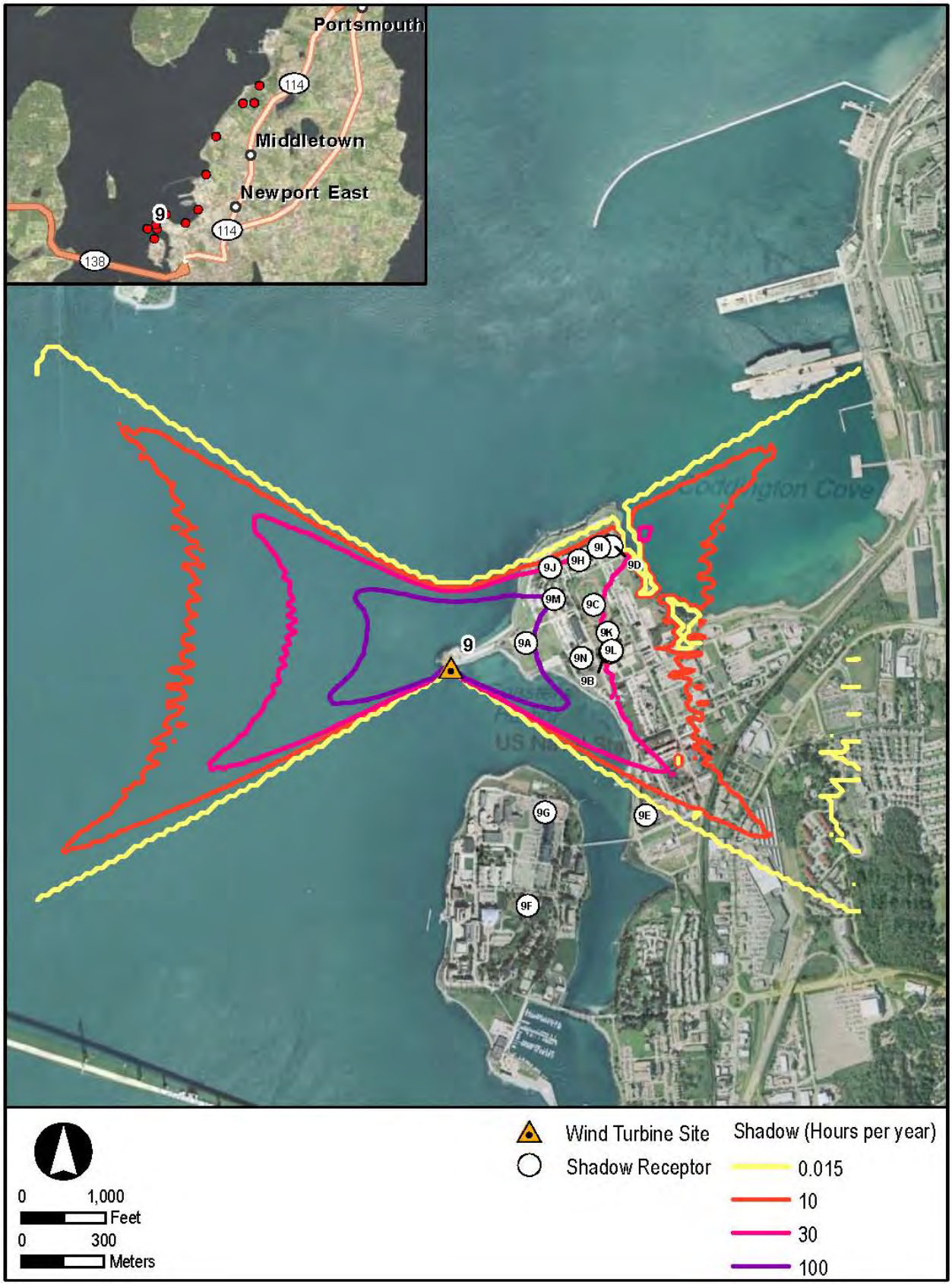


Figure A-9: Maximum predicted shadow flicker levels (hours per year) for a Vestas V112-3.0 MW Model at Wind Turbine Site 9 (Bishop Rock).

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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Calculated:
2/24/2011 1:04 PM/2.7.473

SHADOW - Main Result

Assumptions for shadow calculations

Maximum distance for influence
Calculate only when more than 20 % of sun is covered by the blade
Please look in WTG table

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

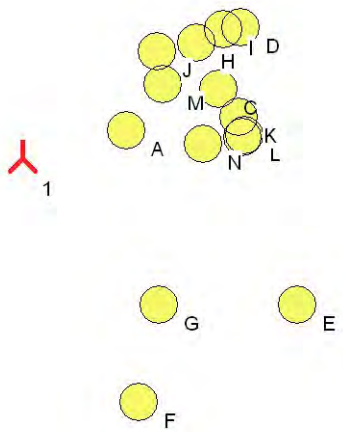
Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW
691	432	259	155	155	155	432	518	950	1,209	864	518

W	WNW	NW	NNW	Sum
432	604	691	691	8,756

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: Line object
Obstacles used in calculation
Eye height: 1.5 m
Grid resolution: 10 m



Scale 1:20,000
New WTG
Shadow receptor

WTGs

	Geo DD: WGS 84				WTG type						Shadow data	
	Longitude	Latitude	Z [m]	Row data/Description	Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Calculation distance [m]	RPM [RPM]
1	-71.330516° East	41.517654° North	1.3	Bishops Rock	Yes	VESTAS	V112-3,000	3,000	112.0	84.0	2,000	12.8

Shadow receptor-Input

No.	Name	Geo DD: WGS 84 Longitude	Latitude	Z [m]	Width [m]	Height [m]	Height a.g.l. [m]	Degrees from south cw [°]	Slope of window [°]	Direction mode
A	9A	-71.327214° East	41.518540° North	1.5	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
B	9B	-71.323522° East	41.518310° North	19.6	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
C	9C	-71.324297° East	41.519854° North	17.3	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
D	9D	-71.323598° East	41.521791° North	18.1	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
E	9E	-71.321775° East	41.512991° North	4.0	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
F	9F	-71.326836° East	41.509920° North	7.4	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
G	9G	-71.326194° East	41.512999° North	4.6	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
H	9H	-71.324997° East	41.521309° North	20.6	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
I	9I	-71.324132° East	41.521743° North	19.8	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
J	9J	-71.326244° East	41.521039° North	15.2	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
K	9K	-71.323662° East	41.518954° North	11.0	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
L	9L	-71.323458° East	41.518372° North	19.8	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
M	9M	-71.326053° East	41.520003° North	18.3	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
N	9N	-71.324781° East	41.518098° North	6.7	1.0	1.0	1.0	-180.0	90.0	"Green house mode"

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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Calculated:
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SHADOW - Main Result

Calculation Results

Shadow receptor

		Shadow, worst case			Shadow, expected values
No.	Name	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	9A	121:50	111	1:25	39:46
B	9B	27:01	56	0:43	8:39
C	9C	36:17	72	0:46	11:34
D	9D	33:29	64	0:37	10:22
E	9E	0:00	0	0:00	0:00
F	9F	0:00	0	0:00	0:00
G	9G	0:00	0	0:00	0:00
H	9H	36:21	62	0:44	11:29
I	9I	29:05	56	0:38	9:07
J	9J	32:19	54	0:45	10:30
K	9K	29:45	57	0:44	9:22
L	9L	26:12	55	0:41	8:23
M	9M	88:49	114	1:00	27:06
N	9N	46:31	68	0:53	14:57

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

No.	Name	Worst case [h/year]	Expected [h/year]
1	Bishops Rock	297:10	95:01

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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Calculated:
2/24/2011 1:04 PM/2.7.473

SHADOW - Calendar

Shadow receptor: A - 9A

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February		March		April		May	June	July	August	September		October		November	December
1	07:12	06:58		06:22		15:39 (1)	06:30	16:49 (1)	05:44	05:15	05:15	05:40	06:11		06:42		16:15 (1)	06:17	06:52
	16:26	17:01		17:36	80	16:59 (1)	19:10	17:38 (1)	19:43	20:12	20:24	20:05	19:20		18:29	84	17:39 (1)	16:42	16:17
2	07:13	06:57		06:20		15:39 (1)	06:29	16:51 (1)	05:43	05:14	05:16	05:41	06:12		06:43		16:14 (1)	06:18	06:53
	16:27	17:02		17:37	81	17:00 (1)	19:11	17:36 (1)	19:44	20:13	20:24	20:04	19:19		18:27	84	17:38 (1)	16:40	16:17
3	07:13	06:56		06:19		15:38 (1)	06:27	16:53 (1)	05:41	05:14	05:16	05:42	06:13		06:44		16:13 (1)	06:19	06:54
	16:28	17:03		17:38	81	16:59 (1)	19:13	17:34 (1)	19:45	20:14	20:24	20:03	19:17		18:26	85	17:38 (1)	16:39	16:16
4	07:13	06:55		06:17		15:37 (1)	06:25	16:55 (1)	05:40	05:13	05:17	05:43	06:14		06:45		16:13 (1)	06:20	06:55
	16:29	17:05		17:39	82	16:59 (1)	19:14	17:30 (1)	19:46	20:14	20:23	20:02	19:15		18:24	84	17:37 (1)	16:38	16:16
5	07:13	06:54		06:15		15:37 (1)	06:24	16:59 (1)	05:39	05:13	05:17	05:44	06:15		06:46		16:12 (1)	06:22	06:56
	16:30	17:06		17:40	83	17:00 (1)	19:15	17:28 (1)	19:47	20:15	20:23	20:01	19:14		18:22	85	17:37 (1)	16:37	16:16
6	07:13	06:53		06:14		15:36 (1)	06:22	17:03 (1)	05:37	05:13	05:18	05:45	06:16	16:59 (1)	06:47		16:12 (1)	06:23	06:57
	16:31	17:07		17:41	84	17:00 (1)	19:16	17:23 (1)	19:48	20:16	20:23	19:58	19:12	17:18 (1)	18:21	84	17:36 (1)	16:36	16:16
7	07:13	06:52		06:12		15:36 (1)	06:20		05:36	05:12	05:19	05:46	06:17	16:55 (1)	06:48		16:12 (1)	06:24	06:58
	16:32	17:09		17:43	84	17:00 (1)	19:17		19:49	20:16	20:23	19:57	19:10	17:22 (1)	18:19	84	17:36 (1)	16:35	16:16
8	07:12	06:51		07:11		16:36 (1)	06:19		05:35	05:12	05:19	05:47	06:18	16:51 (1)	06:49		16:12 (1)	06:25	06:59
	16:33	17:10		18:44	84	18:00 (1)	19:18		19:50	20:17	20:22	19:56	19:08	17:25 (1)	18:17	83	17:35 (1)	16:33	16:16
9	07:12	06:50		07:09		16:35 (1)	06:17		05:34	05:12	05:20	05:48	06:19	16:48 (1)	06:50		16:11 (1)	06:26	07:00
	16:34	17:11		18:45	85	18:00 (1)	19:19		19:51	20:18	20:22	19:54	19:07	17:27 (1)	18:16	83	17:34 (1)	16:32	16:16
10	07:12	06:48		07:07		16:36 (1)	06:15		05:33	05:12	05:21	05:49	06:20	16:45 (1)	06:51		16:12 (1)	06:28	07:01
	16:35	17:12		18:46	84	18:00 (1)	19:20		19:52	20:18	20:22	19:53	19:05	17:29 (1)	18:14	82	17:34 (1)	16:31	16:16
11	07:12	06:47		07:06		16:35 (1)	06:14		05:32	05:12	05:21	05:50	06:21	16:42 (1)	06:53		16:12 (1)	06:29	07:02
	16:36	17:14	20	16:10 (1)	18:47	85	18:00 (1)	19:21	19:53	20:19	20:21	19:52	19:03	17:31 (1)	18:12	82	17:34 (1)	16:30	16:16
12	07:12	06:46		16:06 (1)	07:04		16:35 (1)	06:12	05:31	05:11	05:22	05:51	06:22	16:40 (1)	06:54		16:12 (1)	06:30	07:02
	16:37	17:15	29	16:35 (1)	18:48	84	17:59 (1)	19:22	19:54	20:19	20:21	19:50	19:02	17:32 (1)	18:11	81	17:33 (1)	16:29	16:16
13	07:11	06:45		16:03 (1)	07:02		16:36 (1)	06:10	05:29	05:11	05:23	05:52	06:23	16:38 (1)	06:55		16:12 (1)	06:31	07:03
	16:38	17:16	35	16:38 (1)	18:49	83	17:59 (1)	19:23	19:56	20:20	20:20	19:49	19:00	17:33 (1)	18:09	80	17:32 (1)	16:28	16:16
14	07:11	06:43		15:59 (1)	07:01		16:35 (1)	06:09	05:28	05:11	05:24	05:53	06:24	16:36 (1)	06:56		16:13 (1)	06:32	07:04
	16:39	17:17	41	16:40 (1)	18:51	84	17:59 (1)	19:24	19:57	20:20	20:20	19:48	18:58	17:35 (1)	18:08	78	17:31 (1)	16:27	16:16
15	07:10	06:42		15:57 (1)	06:59		16:35 (1)	06:07	05:27	05:11	05:24	05:54	06:25	16:33 (1)	06:57		16:13 (1)	06:34	07:05
	16:40	17:19	46	16:43 (1)	18:52	83	17:58 (1)	19:26	19:58	20:21	20:19	19:46	18:56	17:34 (1)	18:06	77	17:30 (1)	16:27	16:17
16	07:10	06:41		15:55 (1)	06:57		16:35 (1)	06:06	05:26	05:11	05:25	05:55	06:26	16:31 (1)	06:58		16:13 (1)	06:35	07:05
	16:41	17:20	51	16:46 (1)	18:53	82	17:57 (1)	19:27	19:59	20:21	20:19	19:45	18:55	17:35 (1)	18:04	75	17:28 (1)	16:26	16:17
17	07:10	06:39		15:53 (1)	06:56		16:36 (1)	06:04	05:25	05:11	05:26	05:56	06:27	16:29 (1)	06:59		16:15 (1)	06:36	07:06
	16:42	17:21	54	16:47 (1)	18:54	81	17:57 (1)	19:28	20:00	20:22	20:18	19:43	18:53	17:36 (1)	18:03	73	17:28 (1)	16:25	16:17
18	07:09	06:38		15:52 (1)	06:54		16:36 (1)	06:03	05:25	05:11	05:27	05:57	06:28	16:28 (1)	07:00		16:15 (1)	06:37	07:07
	16:44	17:22	57	16:49 (1)	18:55	80	17:56 (1)	19:29	20:00	20:22	20:17	19:42	18:51	17:37 (1)	18:01	72	17:27 (1)	16:24	16:17
19	07:08	06:37		15:49 (1)	06:52		16:36 (1)	06:01	05:24	05:12	05:28	05:58	06:29	16:26 (1)	07:01		16:16 (1)	06:38	07:07
	16:45	17:24	61	16:50 (1)	18:56	79	17:55 (1)	19:30	20:01	20:22	20:17	19:41	18:50	17:37 (1)	18:00	69	17:25 (1)	16:23	16:18
20	07:08	06:35		15:48 (1)	06:51		16:37 (1)	06:00	05:23	05:12	05:29	05:59	06:30	16:25 (1)	07:03		16:17 (1)	06:40	07:08
	16:46	17:25	63	16:51 (1)	18:57	78	17:55 (1)	19:31	20:01	20:23	20:16	19:39	18:48	17:37 (1)	17:58	67	17:24 (1)	16:23	16:18
21	07:07	06:34		15:47 (1)	06:49		16:37 (1)	05:58	05:22	05:12	05:29	06:00	06:31	16:23 (1)	07:04		16:18 (1)	06:41	07:09
	16:47	17:26	65	16:52 (1)	18:58	77	17:54 (1)	19:32	20:02	20:23	20:15	19:38	18:46	17:38 (1)	17:57	64	17:22 (1)	16:22	16:19
22	07:07	06:32		15:46 (1)	06:47		16:38 (1)	05:57	05:21	05:12	05:30	06:01	06:32	16:22 (1)	07:05		16:19 (1)	06:42	07:09
	16:48	17:27	68	16:54 (1)	18:59	75	17:53 (1)	19:33	20:03	20:23	20:14	19:36	18:44	17:38 (1)	17:55	63	17:22 (1)	16:21	16:19
23	07:06	06:31		15:44 (1)	06:45		16:39 (1)	05:55	05:20	05:12	05:31	06:02	06:33	16:21 (1)	07:06		16:20 (1)	06:43	07:10
	16:50	17:28	70	16:54 (1)	19:01	73	17:52 (1)	19:34	20:04	20:23	20:14	19:35	18:43	17:38 (1)	17:54	60	17:20 (1)	16:21	16:20
24	07:05	06:29		15:43 (1)	06:44		16:40 (1)	05:54	05:20	05:13	05:32	06:03	06:34	16:20 (1)	07:07		16:22 (1)	06:44	07:10
	16:51	17:30	73	16:56 (1)	19:02	71	17:51 (1)	19:35	20:05	20:23	20:13	19:33	18:41	17:38 (1)	17:52	56	17:18 (1)	16:20	16:20
25	07:05	06:28		15:42 (1)	06:42		16:40 (1)	05:52	05:19	05:13	05:33	06:04	06:36	16:20 (1)	07:08		16:23 (1)	06:45	07:10
	16:52	17:31	74	16:56 (1)	19:03	69	17:49 (1)	19:36	20:06	20:24	20:12	19:31	18:39	17:39 (1)	17:51	53	17:16 (1)	16:20	16:21
26	07:04	06:26		15:42 (1)	06:40		16:41 (1)	05:51	05:18	05:13	05:34	06:05	06:37	16:19 (1)	07:10		16:26 (1)	06:47	07:11
	16:53	17:32	75	16:57 (1)	19:04	67	17:48 (1)	19:37	20:07	20:24	20:11	19:30	18:37	17:39 (1)	17:50	49	17:15 (1)	16:19	16:21
27	07:03	06:25		15:40 (1)	06:39		16:42 (1)	05:49	05:17	05:14	05:35	06:06	06:38	16:18 (1)	07:11		16:27 (1)	06:48	07:11
	16:55	17:33	77	16:57 (1)	19:05	65	17:47 (1)	19:39	20:08	20:24	20:10	19:28	18:36	17:39 (1)	17:48	45	17:12 (1)	16:19	16:22
28	07:02	06:23		15:40 (1)	06:37		16:43 (1)	05:48	05:17	05:14	05:36	06:07	06:39	16:17 (1)	07:12		16:29 (1)	06:49	07:12
	16:56	17:34	78	16:58 (1)	19:06	62	17:45 (1)	19:40	20:09	20:24	20:09	19:27	18:34	17:39 (1)	17:47	41	17:10 (1)	16:18	16:23
29	07:01				06:35		16:44 (1)	05:47	05:16	05:14	05:37	06:08	06:40	16:16 (1)	07:13		16:32 (1)	06:50	07:12
	16:57				19:07	60	17:44 (1)	19:41	20:10	20:24	20:08	19:25	18:32	17:39 (1)	17:46	34	17:06 (1)	16:18	16:24
30	07:00				06:34		16:46 (1)	05:45	05:16	05:15	05:38	06:09	06:41	16:15 (1)	07:14		16:36 (1)	06:51	07:12
	16:58				19:08	56	17:42 (1)	19:42	20:10	20:24	20:07	19:23	18:31	17:39 (1)	17:44	28	17:04 (1)	16:17	16:24
31	06:59				06:32		16:47 (1)		05:15		05:39	06:10			07:16		16:41 (1)		07:12
	17:00				19:09	53	17:40 (1)		20:11		20:06	19:22			17:43	17	16:58 (1)		16:25
Potential sun hours	296	297			370			400	450	454	461	429	375		344			297	286
Total, worst case			1037			2375		219						1577		2102			
Sun reduction			0.58			0.58		0.57						0.62		0.61			
Oper. time red.			1.00			1.00		1.00						1.00		1.00			
Wind dir. red.			0.55			0.55		0.55						0.55		0.55			
Total reduction			0.32			0.32		0.31						0.34		0.33			
Total, real			328			753		68						536		701			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
2/24/2011 1:05 PM / 2

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 1:04 PM/2.7.473

SHADOW - Calendar

Shadow receptor: B - 9B

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March			April	May	June	July	August	September			October			November	December
1	07:12	06:58	06:22			06:30	05:44	05:15	05:15	05:40	06:11			06:42		17:37 (1)	06:17	06:52
	16:26	17:01	17:36			19:10	19:43	20:12	20:24	20:05	19:20			18:29	30	18:07 (1)	16:42	16:17
2	07:13	06:57	06:20			06:29	05:43	05:14	05:16	05:41	06:12			06:43		17:37 (1)	06:18	06:53
	16:27	17:02	17:37			19:11	19:44	20:13	20:24	20:04	19:19			18:27	28	18:05 (1)	16:40	16:17
3	07:13	06:56	06:19			06:27	05:41	05:14	05:16	05:42	06:13			06:44		17:37 (1)	06:19	06:54
	16:28	17:03	17:38			19:13	19:45	20:14	20:24	20:03	19:17			18:26	26	18:03 (1)	16:39	16:16
4	07:13	06:55	06:17		17:13 (1)	06:25	05:40	05:13	05:17	05:43	06:14			06:45		17:38 (1)	06:20	06:55
	16:29	17:05	17:39	4	17:17 (1)	19:14	19:46	20:14	20:23	20:02	19:15			18:24	23	18:01 (1)	16:38	16:16
5	07:13	06:54	06:15		17:10 (1)	06:24	05:39	05:13	05:17	05:44	06:15			06:46		17:39 (1)	06:22	06:56
	16:30	17:06	17:40	9	17:19 (1)	19:15	19:47	20:15	20:23	20:01	19:14			18:22	21	18:00 (1)	16:37	16:16
6	07:13	06:53	06:14		17:07 (1)	06:22	05:37	05:13	05:18	05:45	06:16			06:47		17:40 (1)	06:23	06:57
	16:31	17:07	17:41	13	17:20 (1)	19:16	19:48	20:16	20:23	19:58	19:12			18:20	18	17:58 (1)	16:36	16:16
7	07:13	06:52	06:12		17:05 (1)	06:20	05:36	05:12	05:19	05:46	06:17			06:48		17:41 (1)	06:24	06:58
	16:32	17:09	17:43	16	17:21 (1)	19:17	19:49	20:16	20:23	19:57	19:10			18:19	15	17:56 (1)	16:35	16:16
8	07:12	06:51	07:11		18:03 (1)	06:19	05:35	05:12	05:19	05:47	06:18			06:49		17:43 (1)	06:25	06:59
	16:33	17:10	18:44	19	18:22 (1)	19:18	19:50	20:17	20:22	19:56	19:08			18:17	11	17:54 (1)	16:33	16:16
9	07:12	06:50	07:09		18:01 (1)	06:17	05:34	05:12	05:20	05:48	06:19			06:50		17:46 (1)	06:26	07:00
	16:34	17:11	18:45	22	18:23 (1)	19:19	19:51	20:18	20:22	19:54	19:07			18:16	6	17:52 (1)	16:32	16:16
10	07:12	06:48	07:07		18:00 (1)	06:15	05:33	05:12	05:21	05:49	06:20			06:51			06:28	07:01
	16:35	17:12	18:46	25	18:25 (1)	19:20	19:52	20:18	20:22	19:53	19:05			18:14			16:31	16:16
11	07:12	06:47	07:06		17:59 (1)	06:14	05:32	05:12	05:21	05:50	06:21			06:53			06:29	07:02
	16:36	17:14	18:47	27	18:26 (1)	19:21	19:53	20:19	20:21	19:52	19:03			18:12			16:30	16:16
12	07:11	06:46	07:04		17:57 (1)	06:12	05:31	05:11	05:22	05:51	06:22		18:01 (1)	06:54			06:30	07:02
	16:37	17:15	18:48	30	18:27 (1)	19:22	19:54	20:19	20:21	19:50	19:02	8	18:09 (1)	18:11			16:29	16:16
13	07:11	06:45	07:02		17:57 (1)	06:10	05:29	05:11	05:23	05:52	06:23		17:55 (1)	06:55			06:31	07:03
	16:38	17:16	18:49	31	18:28 (1)	19:23	19:55	20:20	20:20	19:49	19:00	18	18:13 (1)	18:09			16:28	16:16
14	07:11	06:43	07:01		17:56 (1)	06:09	05:28	05:11	05:24	05:53	06:24		17:51 (1)	06:56			06:32	07:04
	16:39	17:17	18:51	33	18:29 (1)	19:24	19:57	20:20	20:20	19:48	18:58	24	18:15 (1)	18:07			16:27	16:16
15	07:10	06:42	06:59		17:55 (1)	06:07	05:27	05:11	05:24	05:54	06:25		17:49 (1)	06:57			06:34	07:05
	16:40	17:19	18:52	35	18:30 (1)	19:26	19:58	20:21	20:19	19:46	18:56	27	18:16 (1)	18:06			16:27	16:17
16	07:10	06:41	06:57		17:54 (1)	06:06	05:26	05:11	05:25	05:55	06:26		17:47 (1)	06:58			06:35	07:05
	16:41	17:20	18:53	37	18:31 (1)	19:27	19:59	20:21	20:19	19:45	18:55	31	18:18 (1)	18:04			16:26	16:17
17	07:10	06:39	06:56		17:55 (1)	06:04	05:25	05:11	05:26	05:56	06:27		17:45 (1)	06:59			06:36	07:06
	16:42	17:21	18:54	38	18:33 (1)	19:28	20:00	20:22	20:18	19:43	18:53	34	18:19 (1)	18:03			16:25	16:17
18	07:09	06:38	06:54		17:54 (1)	06:03	05:25	05:11	05:27	05:57	06:28		17:43 (1)	07:00			06:37	07:07
	16:44	17:22	18:55	40	18:34 (1)	19:29	20:00	20:22	20:17	19:42	18:51	36	18:19 (1)	18:01			16:24	16:17
19	07:08	06:37	06:52		17:54 (1)	06:01	05:24	05:11	05:28	05:58	06:29		17:42 (1)	07:01			06:38	07:07
	16:45	17:24	18:56	40	18:34 (1)	19:30	20:00	20:22	20:17	19:41	18:50	38	18:20 (1)	18:00			16:23	16:18
20	07:08	06:35	06:51		17:55 (1)	06:00	05:23	05:12	05:28	05:59	06:30		17:41 (1)	07:03			06:40	07:08
	16:46	17:25	18:57	41	18:36 (1)	19:31	20:01	20:23	20:16	19:39	18:48	39	18:20 (1)	17:58			16:23	16:18
21	07:07	06:34	06:49		17:54 (1)	05:58	05:22	05:12	05:29	06:00	06:31		17:40 (1)	07:04			06:41	07:09
	16:47	17:26	18:58	43	18:37 (1)	19:32	20:02	20:23	20:15	19:38	18:46	41	18:21 (1)	17:57			16:22	16:19
22	07:07	06:32	06:47		17:54 (1)	05:57	05:21	05:12	05:30	06:01	06:32		17:39 (1)	07:05			06:42	07:09
	16:48	17:27	18:59	41	18:35 (1)	19:33	20:03	20:23	20:14	19:36	18:44	42	18:21 (1)	17:55			16:21	16:19
23	07:06	06:31	06:45		17:54 (1)	05:55	05:20	05:12	05:31	06:02	06:33		17:38 (1)	07:06			06:43	07:10
	16:50	17:28	19:01	40	18:34 (1)	19:34	20:04	20:23	20:14	19:34	18:43	42	18:20 (1)	17:54			16:21	16:20
24	07:05	06:29	06:44		17:56 (1)	05:54	05:20	05:13	05:32	06:03	06:34		17:37 (1)	07:07			06:44	07:10
	16:51	17:30	19:02	38	18:34 (1)	19:35	20:05	20:23	20:13	19:33	18:41	41	18:18 (1)	17:52			16:20	16:20
25	07:04	06:28	06:42		17:56 (1)	05:52	05:19	05:13	05:33	06:04	06:36		17:37 (1)	07:08			06:45	07:10
	16:52	17:31	19:03	36	18:32 (1)	19:36	20:06	20:24	20:12	19:31	18:39	40	18:17 (1)	17:51			16:19	16:21
26	07:04	06:26	06:40		17:56 (1)	05:51	05:18	05:13	05:34	06:05	06:37		17:37 (1)	07:10			06:47	07:11
	16:53	17:32	19:04	35	18:31 (1)	19:37	20:07	20:24	20:11	19:30	18:37	39	18:16 (1)	17:50			16:19	16:21
27	07:03	06:25	06:39		17:58 (1)	05:49	05:17	05:14	05:35	06:06	06:38		17:37 (1)	07:11			06:48	07:11
	16:55	17:33	19:05	32	18:30 (1)	19:39	20:08	20:24	20:10	19:28	18:36	37	18:14 (1)	17:48			16:19	16:22
28	07:02	06:23	06:37		17:59 (1)	05:48	05:17	05:14	05:36	06:07	06:39		17:37 (1)	07:12			06:49	07:11
	16:56	17:34	19:06	28	18:27 (1)	19:40	20:09	20:24	20:09	19:27	18:34	35	18:12 (1)	17:47			16:18	16:23
29	07:01		06:35		18:01 (1)	05:47	05:16	05:14	05:37	06:08	06:40		17:37 (1)	07:13			06:50	07:12
	16:57		19:07	24	18:25 (1)	19:41	20:10	20:24	20:08	19:25	18:32	33	18:10 (1)	17:46			16:18	16:24
30	07:00		06:34		18:04 (1)	05:45	05:16	05:15	05:38	06:09	06:41		17:37 (1)	07:14			06:51	07:12
	16:58		19:08	18	18:22 (1)	19:42	20:10	20:24	20:07	19:23	18:31	32	18:09 (1)	17:44			16:17	16:24
31	06:59		06:32		18:07 (1)		05:15		05:39	06:10				07:16				07:12
	17:00		19:09	11	18:18 (1)		20:11		20:06	19:22				17:43				16:25
Potential sun hours	296	297	370			400	450	454	461	429	375			344			297	286
Total, worst case				806								637			178			
Sun reduction				0.58								0.62			0.61			
Oper. time red.				1.00								1.00			1.00			
Wind dir. red.				0.54								0.54			0.54			
Total reduction				0.31								0.33			0.33			
Total, real				250								212			58			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
2/24/2011 1:05 PM / 3

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 1:04 PM/2.7.473

SHADOW - Calendar

Shadow receptor: C - 9C

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January			February			March	April	May	June	July	August	September	October			November			December
1	07:12			06:58		16:10 (1)	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42			06:17		15:36 (1)	06:52
	16:26			17:01	27	16:37 (1)	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29			16:42	42	16:18 (1)	16:17
2	07:13			06:57		16:10 (1)	06:20	06:29	05:43	05:14	05:16	05:41	06:12	06:43			06:18		15:36 (1)	06:53
	16:27			17:02	28	16:38 (1)	17:37	19:11	19:44	20:13	20:24	20:04	19:19	18:27			16:40	40	16:16 (1)	16:17
3	07:13			06:56		16:09 (1)	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44			06:19		15:37 (1)	06:54
	16:28			17:03	31	16:40 (1)	17:38	19:13	19:45	20:14	20:24	20:03	19:17	18:26			16:39	39	16:16 (1)	16:16
4	07:13			06:55		16:09 (1)	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45			06:20		15:37 (1)	06:55
	16:29			17:05	32	16:41 (1)	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24			16:38	37	16:14 (1)	16:16
5	07:13			06:54		16:08 (1)	06:15	06:24	05:39	05:13	05:17	05:44	06:15	06:46			06:22		15:37 (1)	06:56
	16:30			17:06	34	16:42 (1)	17:40	19:15	19:47	20:15	20:23	20:01	19:14	18:22			16:37	36	16:13 (1)	16:16
6	07:13			06:53		16:07 (1)	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47			06:23		15:38 (1)	06:57
	16:31			17:07	36	16:43 (1)	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20			16:36	34	16:12 (1)	16:16
7	07:13			06:52		16:07 (1)	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48			06:24		15:39 (1)	06:58
	16:32			17:09	38	16:45 (1)	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19			16:35	32	16:11 (1)	16:16
8	07:12			06:51		16:07 (1)	07:11	06:19	05:35	05:12	05:19	05:47	06:18	06:49			06:25		15:39 (1)	06:59
	16:33			17:10	39	16:46 (1)	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17			16:33	30	16:09 (1)	16:16
9	07:12			06:50		16:07 (1)	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50			06:26		15:41 (1)	07:00
	16:34			17:11	41	16:48 (1)	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16			16:32	28	16:09 (1)	16:16
10	07:12			06:48		16:07 (1)	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51			06:28		15:41 (1)	07:01
	16:35			17:12	41	16:48 (1)	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14			16:31	27	16:08 (1)	16:16
11	07:12			06:47		16:07 (1)	07:06	06:14	05:32	05:12	05:21	05:50	06:21	06:53			06:29		15:42 (1)	07:02
	16:36			17:14	43	16:50 (1)	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12			16:30	24	16:06 (1)	16:16
12	07:11			06:46		16:07 (1)	07:04	06:12	05:31	05:11	05:22	05:51	06:22	06:54			06:30		15:43 (1)	07:02
	16:37			17:15	45	16:52 (1)	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11			16:29	22	16:05 (1)	16:16
13	07:11			06:45		16:08 (1)	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55			06:31		15:44 (1)	07:03
	16:38			17:16	45	16:53 (1)	18:49	19:23	19:56	20:20	20:20	19:49	19:00	18:09			16:28	21	16:05 (1)	16:16
14	07:11			06:43		16:07 (1)	07:01	06:09	05:28	05:11	05:24	05:53	06:24	06:56			06:32		15:46 (1)	07:04
	16:39			17:17	46	16:53 (1)	18:51	19:24	19:57	20:20	20:20	19:48	18:58	18:07			16:27	17	16:03 (1)	16:16
15	07:10			06:42		16:08 (1)	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57		16:56 (1)	06:34		15:47 (1)	07:05
	16:40			17:19	45	16:53 (1)	18:52	19:26	19:58	20:21	20:19	19:46	18:56	18:06	11	17:07 (1)	16:27	15	16:02 (1)	16:17
16	07:10			06:41		16:09 (1)	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58		16:52 (1)	06:35		15:49 (1)	07:05
	16:41			17:20	44	16:53 (1)	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	19	17:11 (1)	16:26	13	16:02 (1)	16:17
17	07:10			06:39		16:09 (1)	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59		16:50 (1)	06:36		15:51 (1)	07:06
	16:42			17:21	43	16:52 (1)	18:54	19:28	20:00	20:22	20:18	19:43	18:53	18:03	24	17:14 (1)	16:25	10	16:01 (1)	16:17
18	07:09			06:38		16:10 (1)	06:54	06:03	05:25	05:11	05:27	05:57	06:28	07:00		16:47 (1)	06:37		15:53 (1)	07:07
	16:44			17:22	42	16:52 (1)	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	29	17:16 (1)	16:24	7	16:00 (1)	16:17
19	07:08			06:37		16:10 (1)	06:52	06:01	05:24	05:11	05:28	05:58	06:29	07:01		16:45 (1)	06:38		15:57 (1)	07:07
	16:45			17:24	40	16:50 (1)	18:56	19:30	20:00	20:22	20:17	19:41	18:50	18:00	32	17:17 (1)	16:23	2	15:58 (1)	16:18
20	07:08			06:35		16:11 (1)	06:51	06:00	05:23	05:12	05:28	05:59	06:30	07:03		16:44 (1)	06:40			07:08
	16:46			17:25	39	16:50 (1)	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	34	17:18 (1)	16:23			16:18
21	07:07			06:34		16:12 (1)	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04		16:42 (1)	06:41			07:09
	16:47			17:26	36	16:48 (1)	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	37	17:19 (1)	16:22			16:19
22	07:07			06:32		16:13 (1)	06:47	05:57	05:21	05:12	05:30	06:01	06:32	07:05		16:42 (1)	06:42			07:09
	16:48			17:27	34	16:47 (1)	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	39	17:21 (1)	16:21			16:19
23	07:06		16:23 (1)	06:31		16:14 (1)	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06		16:40 (1)	06:43			07:10
	16:50	2	16:24 (1)	17:28	31	16:45 (1)	19:01	19:34	20:04	20:23	20:14	19:35	18:43	17:54	41	17:21 (1)	16:21			16:20
24	07:05		16:19 (1)	06:29		16:17 (1)	06:44	05:54	05:20	05:13	05:32	06:03	06:34	07:07		16:39 (1)	06:44			07:10
	16:51	7	16:26 (1)	17:30	27	16:44 (1)	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	42	17:21 (1)	16:20			16:20
25	07:05		16:17 (1)	06:28		16:18 (1)	06:42	05:52	05:19	05:13	05:33	06:04	06:36	07:08		16:38 (1)	06:45			07:10
	16:52	10	16:27 (1)	17:31	23	16:41 (1)	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	44	17:22 (1)	16:19			16:21
26	07:04		16:16 (1)	06:26		16:22 (1)	06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10		16:38 (1)	06:47			07:11
	16:53	13	16:29 (1)	17:32	16	16:38 (1)	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	45	17:23 (1)	16:19			16:21
27	07:03		16:15 (1)	06:25		16:28 (1)	06:39	05:49	05:17	05:14	05:35	06:06	06:38	07:11		16:38 (1)	06:48			07:11
	16:55	15	16:30 (1)	17:33	3	16:31 (1)	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	45	17:23 (1)	16:19			16:22
28	07:02		16:14 (1)	06:23			06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12		16:37 (1)	06:49			07:12
	16:56	17	16:31 (1)	17:34			19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	46	17:23 (1)	16:18			16:23
29	07:01		16:12 (1)				06:35	05:47	05:16	05:14	05:37	06:08	06:40	07:13		16:36 (1)	06:50			07:12
	16:57	21	16:33 (1)				19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:46	46	17:22 (1)	16:18			16:24
30	07:00		16:12 (1)				06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14		16:37 (1)	06:51			07:12
	16:58	22	16:34 (1)				19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	44	17:21 (1)	16:17			16:24
31	06:59		16:11 (1)				06:32		05:15		05:39	06:10		07:16		16:37 (1)				07:12
	17:00	24	16:35 (1)				19:09		20:11		20:06	19:22		17:43	43	17:20 (1)				16:25
Potential sun hours	296			297			370	400	450	454	461	429	375	344			297			286
Total, worst case		131			949										621			476		
Sun reduction		0.56			0.58										0.61			0.50		
Oper. time red.		1.00			1.00										1.00			1.00		
Wind dir. red.		0.56			0.56										0.56			0.56		
Total reduction		0.31			0.32										0.34			0.28		
Total, real		41			308										212			133		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
2/24/2011 1:05 PM / 4

Licensed user:
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2201 K Avenue Suite A2
US-75074-5977 Plano TX
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Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 1:04 PM/2.7.473

SHADOW - Calendar

Shadow receptor: D - 9D

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January			February	March	April	May	June	July	August	September	October	November			December		
1	07:12		15:23 (1)	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17			06:52		15:12 (1)
	16:26	37	16:00 (1)	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42			16:17	33	15:45 (1)
2	07:13		15:23 (1)	06:57	06:20	06:29	05:43	05:14	05:16	05:41	06:12	06:43	06:18			06:53		15:12 (1)
	16:27	37	16:00 (1)	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:19	18:27	16:40			16:17	34	15:46 (1)
3	07:13		15:24 (1)	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19			06:54		15:12 (1)
	16:28	37	16:01 (1)	17:03	17:38	19:13	19:45	20:14	20:24	20:03	19:17	18:26	16:39			16:16	34	15:46 (1)
4	07:13		15:25 (1)	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20			06:55		15:12 (1)
	16:29	36	16:01 (1)	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38			16:16	35	15:47 (1)
5	07:13		15:25 (1)	06:54	06:15	06:24	05:39	05:13	05:17	05:44	06:15	06:46	06:22			06:56		15:12 (1)
	16:30	37	16:02 (1)	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:14	18:22	16:37			16:16	35	15:47 (1)
6	07:13		15:26 (1)	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23			06:57		15:12 (1)
	16:31	36	16:02 (1)	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36			16:16	36	15:48 (1)
7	07:13		15:27 (1)	06:52	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24			06:58		15:12 (1)
	16:32	35	16:02 (1)	17:09	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:35			16:16	37	15:49 (1)
8	07:12		15:28 (1)	06:51	07:11	06:19	05:35	05:12	05:19	05:47	06:18	06:49	06:25			06:59		15:13 (1)
	16:33	35	16:03 (1)	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33			16:16	36	15:49 (1)
9	07:12		15:28 (1)	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26			07:00		15:13 (1)
	16:34	34	16:02 (1)	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16	16:32			16:16	37	15:50 (1)
10	07:12		15:29 (1)	06:48	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28			07:01		15:14 (1)
	16:35	34	16:03 (1)	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31			16:16	37	15:51 (1)
11	07:12		15:30 (1)	06:47	07:06	06:14	05:32	05:12	05:21	05:50	06:21	06:53	06:29			07:02		15:13 (1)
	16:36	33	16:03 (1)	17:14	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30			16:16	37	15:50 (1)
12	07:12		15:30 (1)	06:46	07:04	06:12	05:31	05:11	05:22	05:51	06:22	06:54	06:30			07:02		15:14 (1)
	16:37	32	16:02 (1)	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29			16:16	36	15:50 (1)
13	07:11		15:31 (1)	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31			07:03		15:14 (1)
	16:38	32	16:03 (1)	17:16	18:49	19:23	19:56	20:20	20:20	19:49	19:00	18:09	16:28			16:16	36	15:50 (1)
14	07:11		15:32 (1)	06:43	07:01	06:09	05:28	05:11	05:24	05:53	06:24	06:56	06:32			07:04		15:15 (1)
	16:39	30	16:02 (1)	17:17	18:51	19:24	19:57	20:20	20:20	19:48	18:58	18:07	16:27			16:16	36	15:51 (1)
15	07:10		15:33 (1)	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34			07:05		15:14 (1)
	16:40	29	16:02 (1)	17:19	18:52	19:26	19:58	20:21	20:19	19:46	18:56	18:06	16:27			16:17	36	15:50 (1)
16	07:10		15:35 (1)	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35			07:05		15:15 (1)
	16:41	27	16:02 (1)	17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:26			16:17	36	15:51 (1)
17	07:10		15:36 (1)	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36			07:06		15:16 (1)
	16:42	25	16:01 (1)	17:21	18:54	19:28	20:00	20:22	20:18	19:43	18:53	18:03	16:25			16:17	35	15:51 (1)
18	07:09		15:36 (1)	06:38	06:54	06:03	05:25	05:11	05:27	05:57	06:28	07:00	06:37			07:07		15:16 (1)
	16:44	24	16:00 (1)	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24			16:17	35	15:51 (1)
19	07:08		15:39 (1)	06:37	06:52	06:01	05:24	05:11	05:28	05:58	06:29	07:01	06:38			07:07		15:17 (1)
	16:45	21	16:00 (1)	17:24	18:56	19:30	20:00	20:22	20:17	19:41	18:50	18:00	16:23			16:18	35	15:52 (1)
20	07:08		15:40 (1)	06:35	06:51	06:00	05:23	05:12	05:28	05:59	06:30	07:03	06:40		15:21 (1)	07:08		15:18 (1)
	16:46	18	15:58 (1)	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:23	9	15:30 (1)	16:18	34	15:52 (1)
21	07:07		15:42 (1)	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41		15:18 (1)	07:09		15:18 (1)
	16:47	14	15:56 (1)	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	14	15:32 (1)	16:19	34	15:52 (1)
22	07:07		15:46 (1)	06:32	06:47	05:57	05:21	05:12	05:30	06:01	06:32	07:05	06:42		15:16 (1)	07:09		15:18 (1)
	16:48	9	15:55 (1)	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	18	15:34 (1)	16:19	35	15:53 (1)
23	07:06			06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43		15:15 (1)	07:10		15:19 (1)
	16:50			17:28	19:01	19:34	20:04	20:23	20:14	19:35	18:43	17:54	16:21	21	15:36 (1)	16:20	34	15:53 (1)
24	07:05			06:29	06:44	05:54	05:20	05:13	05:32	06:03	06:34	07:07	06:44		15:15 (1)	07:10		15:19 (1)
	16:51			17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	23	15:38 (1)	16:20	35	15:54 (1)
25	07:05			06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:36	07:08	06:45		15:14 (1)	07:10		15:20 (1)
	16:52			17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	25	15:39 (1)	16:21	35	15:55 (1)
26	07:04			06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10	06:47		15:13 (1)	07:11		15:20 (1)
	16:53			17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	27	15:40 (1)	16:21	35	15:55 (1)
27	07:03			06:25	06:39	05:49	05:17	05:13	05:35	06:06	06:38	07:11	06:48		15:12 (1)	07:11		15:20 (1)
	16:55			17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:18	29	15:41 (1)	16:22	35	15:55 (1)
28	07:02			06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49		15:12 (1)	07:12		15:21 (1)
	16:56			17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	30	15:42 (1)	16:23	36	15:57 (1)
29	07:01				06:35	05:47	05:16	05:14	05:37	06:08	06:40	07:13	06:50		15:11 (1)	07:12		15:22 (1)
	16:57				19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:46	16:18	32	15:43 (1)	16:24	35	15:57 (1)
30	07:00				06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51		15:12 (1)	07:12		15:22 (1)
	16:58				19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	32	15:44 (1)	16:24	36	15:58 (1)
31	06:59				06:32		05:15		05:39	06:10		07:16				07:12		15:22 (1)
	17:00				19:09		20:11		20:06	19:22		17:43				16:25	37	15:59 (1)
Potential sun hours	296			297	370	400	450	454	461	429	375	344	297			286		
Total, worst case		652												260			1097	
Sun reduction		0.56												0.50			0.52	
Oper. time red.		1.00												1.00			1.00	
Wind dir. red.		0.59												0.59			0.59	
Total reduction		0.33												0.29			0.30	
Total, real		213												76			333	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
2/24/2011 1:05 PM / 5

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 1:04 PM/2.7.473

SHADOW - Calendar

Shadow receptor: E - 9E

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:29	05:43	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:13	19:45	20:14	20:23	20:03	19:17	18:26	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:24	05:39	05:13	05:17	05:44	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24	06:58
	16:32	17:09	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:35	16:16
8	07:12	06:51	07:11	06:19	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:32	05:12	05:21	05:50	06:21	06:53	06:29	07:02
	16:36	17:14	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:11	06:46	07:04	06:12	05:31	05:11	05:22	05:51	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:24	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:51	19:24	19:56	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:26	19:57	20:21	20:19	19:46	18:56	18:06	16:27	16:17
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:58	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:10	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	19:59	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:03	05:25	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:24	05:12	05:28	05:58	06:29	07:01	06:38	07:07
	16:45	17:24	18:56	19:30	20:00	20:22	20:17	19:41	18:50	18:00	16:23	16:18
20	07:08	06:35	06:51	06:00	05:23	05:12	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:57	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:01	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54	05:20	05:13	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:20	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:14	05:35	06:06	06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:19	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:47	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:46	16:18	16:24
30	07:00		06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:15		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 1:05 PM / 6

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 1:04 PM/2.7.473

SHADOW - Calendar

Shadow receptor: F - 9F

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:29	05:43	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:19	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:13	19:45	20:14	20:23	20:03	19:17	18:26	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:24	05:39	05:13	05:17	05:44	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:14	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:21	16:36	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24	06:58
	16:32	17:09	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:35	16:16
8	07:12	06:51	07:11	06:19	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:32	05:12	05:21	05:50	06:21	06:53	06:29	07:02
	16:36	17:14	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:11	06:46	07:04	06:12	05:31	05:11	05:22	05:51	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:24	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:51	19:24	19:57	20:20	20:20	19:48	18:58	18:08	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:26	19:58	20:21	20:19	19:46	18:56	18:06	16:27	16:17
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:10	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:43	17:21	18:54	19:28	19:59	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:03	05:25	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:24	05:12	05:28	05:58	06:29	07:01	06:38	07:07
	16:45	17:24	18:56	19:30	20:00	20:22	20:17	19:41	18:50	18:00	16:23	16:18
20	07:08	06:35	06:51	06:00	05:23	05:12	05:29	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:57	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:01	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54	05:20	05:13	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:36	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:20	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	16:22
27	07:03	06:25	06:39	05:49	05:17	05:14	05:35	06:06	06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:19	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:47	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:46	16:18	16:24
30	07:00		06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:16		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
2/24/2011 1:05 PM / 7

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 1:04 PM/2.7.473

SHADOW - Calendar

Shadow receptor: G - 9G

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:29	05:43	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:19	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:13	19:45	20:14	20:24	20:03	19:17	18:26	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:24	05:39	05:13	05:17	05:44	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:14	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:21	16:36	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24	06:58
	16:32	17:09	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:35	16:16
8	07:12	06:51	07:11	06:19	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:32	05:12	05:21	05:50	06:21	06:53	06:29	07:02
	16:36	17:14	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:11	06:46	07:04	06:12	05:31	05:11	05:22	05:51	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:24	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:51	19:24	19:57	20:20	20:20	19:48	18:58	18:08	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:26	19:58	20:21	20:19	19:46	18:56	18:06	16:27	16:17
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:10	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:43	17:21	18:54	19:28	20:00	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:03	05:25	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:24	05:12	05:28	05:58	06:29	07:01	06:38	07:07
	16:45	17:24	18:56	19:30	20:00	20:22	20:17	19:41	18:50	18:00	16:23	16:18
20	07:08	06:35	06:51	06:00	05:23	05:12	05:29	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:57	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:01	19:34	20:04	20:23	20:14	19:35	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54	05:20	05:13	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:36	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:20	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:14	05:35	06:06	06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:19	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:47	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:46	16:18	16:24
30	07:00		06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:16		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 1:05 PM / 8

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 1:04 PM/2.7.473

SHADOW - Calendar

Shadow receptor: H - 9H

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January			February	March	April	May	June	July	August	September	October	November			December		
1	07:12		15:09 (1)	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17			06:52		14:59 (1)
	16:26	42	15:51 (1)	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42			16:17	35	15:34 (1)
2	07:13		15:09 (1)	06:57	06:20	06:29	05:43	05:14	05:16	05:41	06:12	06:43	06:18			06:53		14:59 (1)
	16:27	42	15:51 (1)	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:19	18:27	16:40			16:17	36	15:35 (1)
3	07:13		15:10 (1)	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19			06:54		14:59 (1)
	16:28	41	15:51 (1)	17:03	17:38	19:13	19:45	20:14	20:24	20:03	19:17	18:26	16:39			16:16	37	15:36 (1)
4	07:13		15:11 (1)	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20			06:55		14:59 (1)
	16:29	40	15:51 (1)	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38			16:16	37	15:36 (1)
5	07:13		15:12 (1)	06:54	06:15	06:24	05:39	05:13	05:17	05:44	06:15	06:46	06:22			06:56		14:58 (1)
	16:30	40	15:52 (1)	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:14	18:22	16:37			16:16	39	15:37 (1)
6	07:13		15:12 (1)	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23			06:57		14:59 (1)
	16:31	40	15:52 (1)	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36			16:16	39	15:38 (1)
7	07:13		15:13 (1)	06:52	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24			06:58		14:59 (1)
	16:32	39	15:52 (1)	17:09	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:35			16:16	40	15:39 (1)
8	07:12		15:14 (1)	06:51	07:11	06:19	05:35	05:12	05:19	05:47	06:18	06:49	06:25			06:59		14:59 (1)
	16:33	38	15:52 (1)	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33			16:16	40	15:39 (1)
9	07:12		15:15 (1)	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26			07:00		14:59 (1)
	16:34	37	15:52 (1)	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16	16:32			16:16	41	15:40 (1)
10	07:12		15:16 (1)	06:48	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28			07:01		14:59 (1)
	16:35	36	15:52 (1)	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31			16:16	42	15:41 (1)
11	07:12		15:17 (1)	06:47	07:06	06:14	05:32	05:12	05:21	05:50	06:21	06:53	06:29			07:02		14:59 (1)
	16:36	35	15:52 (1)	17:14	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30			16:16	42	15:41 (1)
12	07:12		15:17 (1)	06:46	07:04	06:12	05:31	05:11	05:22	05:51	06:22	06:54	06:30			07:02		14:59 (1)
	16:37	34	15:51 (1)	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29			16:16	42	15:41 (1)
13	07:11		15:19 (1)	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31			07:03		15:00 (1)
	16:38	32	15:51 (1)	17:16	18:49	19:23	19:56	20:20	20:20	19:49	19:00	18:09	16:28			16:16	42	15:42 (1)
14	07:11		15:20 (1)	06:43	07:01	06:09	05:28	05:11	05:24	05:53	06:24	06:56	06:32			07:04		15:00 (1)
	16:39	31	15:51 (1)	17:17	18:51	19:24	19:57	20:20	20:20	19:48	18:58	18:07	16:27			16:16	43	15:43 (1)
15	07:10		15:21 (1)	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34			07:05		15:00 (1)
	16:40	29	15:50 (1)	17:19	18:52	19:26	19:58	20:21	20:19	19:46	18:56	18:06	16:27			16:17	43	15:43 (1)
16	07:10		15:23 (1)	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35			07:05		15:01 (1)
	16:41	27	15:50 (1)	17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:26			16:17	43	15:44 (1)
17	07:10		15:24 (1)	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36			07:06		15:01 (1)
	16:42	25	15:49 (1)	17:21	18:54	19:28	20:00	20:22	20:18	19:43	18:53	18:03	16:25			16:17	44	15:45 (1)
18	07:09		15:26 (1)	06:38	06:54	06:03	05:25	05:11	05:27	05:57	06:28	07:00	06:37			07:07		15:01 (1)
	16:44	21	15:47 (1)	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24			16:17	44	15:45 (1)
19	07:08		15:28 (1)	06:37	06:52	06:01	05:24	05:11	05:28	05:58	06:29	07:01	06:38			07:07		15:02 (1)
	16:45	18	15:46 (1)	17:24	18:56	19:30	20:00	20:22	20:17	19:41	18:50	18:00	16:23			16:18	43	15:45 (1)
20	07:08		15:31 (1)	06:35	06:51	06:00	05:23	05:12	05:28	05:59	06:30	07:03	06:40			07:08		15:03 (1)
	16:46	13	15:44 (1)	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:23			16:18	43	15:46 (1)
21	07:07		15:36 (1)	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41		15:13 (1)	07:09		15:03 (1)
	16:47	3	15:39 (1)	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	2	15:14 (1)	16:19	43	15:46 (1)
22	07:07			06:32	06:47	05:57	05:21	05:12	05:30	06:01	06:32	07:05	06:42		15:07 (1)	07:09		15:04 (1)
	16:48			17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	13	15:20 (1)	16:19	43	15:47 (1)
23	07:06			06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43		15:05 (1)	07:10		15:04 (1)
	16:50			17:28	19:01	19:34	20:04	20:23	20:14	19:35	18:43	17:54	16:21	17	15:22 (1)	16:20	43	15:47 (1)
24	07:05			06:29	06:44	05:54	05:20	05:13	05:32	06:03	06:34	07:07	06:44		15:04 (1)	07:10		15:04 (1)
	16:51			17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	21	15:25 (1)	16:20	43	15:47 (1)
25	07:05			06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:36	07:08	06:45		15:02 (1)	07:10		15:05 (1)
	16:52			17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	25	15:27 (1)	16:21	44	15:49 (1)
26	07:04			06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10	06:47		15:01 (1)	07:11		15:05 (1)
	16:53			17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	27	15:28 (1)	16:21	44	15:49 (1)
27	07:03			06:25	06:39	05:49	05:17	05:14	05:35	06:06	06:38	07:11	06:48		15:00 (1)	07:11		15:06 (1)
	16:55			17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:19	29	15:29 (1)	16:22	43	15:49 (1)
28	07:02			06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49		15:00 (1)	07:12		15:07 (1)
	16:56			17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	30	15:30 (1)	16:23	43	15:50 (1)
29	07:01				06:35	05:47	05:16	05:14	05:37	06:08	06:40	07:13	06:50		14:59 (1)	07:12		15:07 (1)
	16:57				19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:46	16:18	32	15:31 (1)	16:24	43	15:50 (1)
30	07:00				06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51		14:59 (1)	07:12		15:08 (1)
	16:58				19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	34	15:33 (1)	16:24	42	15:50 (1)
31	06:59				06:32		05:15		05:39	06:10		07:16				07:12		15:08 (1)
	17:00				19:09		20:11		20:06	19:22		17:43				16:25	42	15:50 (1)
Potential sun hours	296			297	370	400	450	454	461	429	375	344	297			286		
Total, worst case		663												230			1288	
Sun reduction		0.56												0.50			0.52	
Oper. time red.		1.00												1.00			1.00	
Wind dir. red.		0.60												0.60			0.60	
Total reduction		0.33												0.30			0.31	
Total, real		221												69			399	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
2/24/2011 1:05 PM / 9

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 1:04 PM/2.7.473

SHADOW - Calendar

Shadow receptor: I - 9I

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January			February	March	April	May	June	July	August	September	October	November			December		
1	07:12		15:17 (1)	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17			06:52		15:08 (1)
	16:26	36	15:53 (1)	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42			16:17	28	15:36 (1)
2	07:13		15:17 (1)	06:57	06:20	06:29	05:43	05:14	05:16	05:41	06:12	06:43	06:18			06:53		15:07 (1)
	16:27	36	15:53 (1)	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:19	18:27	16:40			16:17	30	15:37 (1)
3	07:13		15:18 (1)	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19			06:54		15:07 (1)
	16:28	35	15:53 (1)	17:03	17:38	19:13	19:45	20:14	20:24	20:03	19:17	18:26	16:39			16:16	31	15:38 (1)
4	07:13		15:19 (1)	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20			06:55		15:07 (1)
	16:29	35	15:54 (1)	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38			16:16	31	15:38 (1)
5	07:13		15:20 (1)	06:54	06:15	06:24	05:39	05:13	05:17	05:44	06:15	06:46	06:22			06:56		15:07 (1)
	16:30	34	15:54 (1)	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:14	18:22	16:37			16:16	32	15:39 (1)
6	07:13		15:21 (1)	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23			06:57		15:07 (1)
	16:31	33	15:54 (1)	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36			16:16	33	15:40 (1)
7	07:13		15:22 (1)	06:52	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24			06:58		15:07 (1)
	16:32	32	15:54 (1)	17:09	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:35			16:16	34	15:41 (1)
8	07:12		15:23 (1)	06:51	07:11	06:19	05:35	05:12	05:19	05:47	06:18	06:49	06:25			06:59		15:07 (1)
	16:33	31	15:54 (1)	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33			16:16	35	15:42 (1)
9	07:12		15:23 (1)	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26			07:00		15:07 (1)
	16:34	31	15:54 (1)	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16	16:32			16:16	35	15:42 (1)
10	07:12		15:24 (1)	06:48	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28			07:01		15:07 (1)
	16:35	30	15:54 (1)	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31			16:16	36	15:43 (1)
11	07:12		15:25 (1)	06:47	07:06	06:14	05:32	05:12	05:21	05:50	06:21	06:53	06:29			07:02		15:07 (1)
	16:36	29	15:54 (1)	17:14	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30			16:16	36	15:43 (1)
12	07:12		15:26 (1)	06:46	07:04	06:12	05:31	05:11	05:22	05:51	06:22	06:54	06:30			07:02		15:07 (1)
	16:37	27	15:53 (1)	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29			16:16	37	15:44 (1)
13	07:11		15:28 (1)	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31			07:03		15:08 (1)
	16:38	25	15:53 (1)	17:16	18:49	19:23	19:56	20:20	20:20	19:49	19:00	18:09	16:28			16:16	36	15:44 (1)
14	07:11		15:29 (1)	06:43	07:01	06:09	05:28	05:11	05:24	05:53	06:24	06:56	06:32			07:04		15:08 (1)
	16:39	24	15:53 (1)	17:17	18:51	19:24	19:57	20:20	20:20	19:48	18:58	18:07	16:27			16:16	37	15:45 (1)
15	07:10		15:30 (1)	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34			07:05		15:08 (1)
	16:40	21	15:51 (1)	17:19	18:52	19:26	19:58	20:21	20:19	19:46	18:56	18:06	16:27			16:17	37	15:45 (1)
16	07:10		15:33 (1)	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35			07:05		15:09 (1)
	16:41	18	15:51 (1)	17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:26			16:17	37	15:46 (1)
17	07:10		15:35 (1)	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36			07:06		15:09 (1)
	16:42	14	15:49 (1)	17:21	18:54	19:28	20:00	20:22	20:18	19:43	18:53	18:03	16:25			16:17	38	15:47 (1)
18	07:09		15:37 (1)	06:38	06:54	06:03	05:25	05:11	05:27	05:57	06:28	07:00	06:37			07:07		15:09 (1)
	16:44	9	15:46 (1)	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24			16:17	38	15:47 (1)
19	07:08			06:37	06:52	06:01	05:24	05:11	05:28	05:58	06:29	07:01	06:38			07:07		15:10 (1)
	16:45			17:24	18:56	19:30	20:00	20:22	20:17	19:41	18:50	18:00	16:23			16:18	38	15:48 (1)
20	07:08			06:35	06:51	06:00	05:23	05:12	05:28	05:59	06:30	07:03	06:40			07:08		15:11 (1)
	16:46			17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:23			16:18	38	15:49 (1)
21	07:07			06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41			07:09		15:11 (1)
	16:47			17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22			16:19	38	15:49 (1)
22	07:07			06:32	06:47	05:57	05:21	05:12	05:30	06:01	06:32	07:05	06:42			07:09		15:12 (1)
	16:48			17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21			16:19	38	15:50 (1)
23	07:06			06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43			07:10		15:12 (1)
	16:50			17:28	19:01	19:34	20:04	20:23	20:14	19:35	18:43	17:54	16:21			16:20	38	15:50 (1)
24	07:05			06:29	06:44	05:54	05:20	05:13	05:32	06:03	06:34	07:07	06:44		15:16 (1)	07:10		15:12 (1)
	16:51			17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	8	15:24 (1)	16:20	38	15:50 (1)
25	07:05			06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:36	07:08	06:45		15:13 (1)	07:10		15:13 (1)
	16:52			17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	14	15:27 (1)	16:21	38	15:51 (1)
26	07:04			06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10	06:47		15:11 (1)	07:11		15:13 (1)
	16:53			17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	18	15:29 (1)	16:21	38	15:51 (1)
27	07:03			06:25	06:39	05:49	05:17	05:13	05:35	06:06	06:38	07:11	06:48		15:10 (1)	07:11		15:13 (1)
	16:55			17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:18	20	15:30 (1)	16:22	38	15:51 (1)
28	07:02			06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49		15:09 (1)	07:12		15:15 (1)
	16:56			17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	23	15:32 (1)	16:23	37	15:52 (1)
29	07:01				06:35	05:47	05:16	05:14	05:37	06:08	06:40	07:13	06:50		15:08 (1)	07:12		15:15 (1)
	16:57				19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:46	16:18	25	15:33 (1)	16:24	37	15:52 (1)
30	07:00				06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51		15:08 (1)	07:12		15:16 (1)
	16:58				19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	27	15:35 (1)	16:24	36	15:52 (1)
31	06:59				06:32		05:15		05:39	06:10		07:16				07:12		15:16 (1)
	17:00				19:09		20:11		20:06	19:22		17:43				16:25	37	15:53 (1)
Potential sun hours	296			297	370	400	450	454	461	429	375	344	297			286		
Total, worst case		500												135			1110	
Sun reduction		0.56												0.50			0.52	
Oper. time red.		1.00												1.00			1.00	
Wind dir. red.		0.60												0.60			0.60	
Total reduction		0.33												0.30			0.31	
Total, real		166												40			342	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
2/24/2011 1:05 PM / 10

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 1:04 PM/2.7.473

SHADOW - Calendar

Shadow receptor: J - 9J

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January			February	March	April	May	June	July	August	September	October	November			December		
1	07:12		14:46 (1)	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17			06:52		14:39 (1)
	16:26	43	15:29 (1)	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42			16:17	31	15:10 (1)
2	07:13		14:47 (1)	06:57	06:20	06:29	05:43	05:14	05:16	05:41	06:12	06:43	06:18			06:53		14:39 (1)
	16:27	42	15:29 (1)	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:19	18:27	16:40			16:17	32	15:11 (1)
3	07:13		14:48 (1)	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19			06:54		14:38 (1)
	16:28	41	15:29 (1)	17:03	17:38	19:13	19:45	20:14	20:24	20:03	19:17	18:26	16:39			16:16	34	15:12 (1)
4	07:13		14:49 (1)	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20			06:55		14:38 (1)
	16:29	40	15:29 (1)	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38			16:16	35	15:13 (1)
5	07:13		14:50 (1)	06:54	06:15	06:24	05:39	05:13	05:17	05:44	06:15	06:46	06:22			06:56		14:37 (1)
	16:30	39	15:29 (1)	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:14	18:22	16:37			16:16	37	15:14 (1)
6	07:13		14:51 (1)	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23			06:57		14:37 (1)
	16:31	38	15:29 (1)	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:21	16:36			16:16	38	15:15 (1)
7	07:13		14:52 (1)	06:52	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24			06:58		14:37 (1)
	16:32	37	15:29 (1)	17:09	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:35			16:16	39	15:16 (1)
8	07:12		14:53 (1)	06:51	07:11	06:19	05:35	05:12	05:19	05:47	06:18	06:49	06:25			06:59		14:37 (1)
	16:33	36	15:29 (1)	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33			16:16	40	15:17 (1)
9	07:12		14:54 (1)	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26			07:00		14:37 (1)
	16:34	34	15:28 (1)	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16	16:32			16:16	41	15:18 (1)
10	07:12		14:55 (1)	06:48	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28			07:01		14:37 (1)
	16:35	33	15:28 (1)	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31			16:16	42	15:19 (1)
11	07:12		14:57 (1)	06:47	07:06	06:14	05:32	05:12	05:21	05:50	06:21	06:53	06:29			07:02		14:36 (1)
	16:36	31	15:28 (1)	17:14	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30			16:16	43	15:19 (1)
12	07:12		14:58 (1)	06:46	07:04	06:12	05:31	05:11	05:22	05:51	06:22	06:54	06:30			07:02		14:37 (1)
	16:37	28	15:26 (1)	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29			16:16	42	15:19 (1)
13	07:11		15:00 (1)	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31			07:03		14:37 (1)
	16:38	26	15:26 (1)	17:16	18:49	19:23	19:56	20:20	20:20	19:49	19:00	18:09	16:28			16:16	43	15:20 (1)
14	07:11		15:02 (1)	06:43	07:01	06:09	05:28	05:11	05:24	05:53	06:24	06:56	06:32			07:04		14:38 (1)
	16:39	23	15:25 (1)	17:17	18:51	19:24	19:57	20:20	20:20	19:48	18:58	18:08	16:27			16:16	43	15:21 (1)
15	07:10		15:04 (1)	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34			07:05		14:37 (1)
	16:40	19	15:23 (1)	17:19	18:52	19:26	19:58	20:21	20:19	19:46	18:56	18:06	16:27			16:17	44	15:21 (1)
16	07:10		15:07 (1)	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35			07:05		14:38 (1)
	16:41	15	15:22 (1)	17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:26			16:17	44	15:22 (1)
17	07:10		15:12 (1)	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36			07:06		14:38 (1)
	16:42	5	15:17 (1)	17:21	18:54	19:28	20:00	20:22	20:18	19:43	18:53	18:03	16:25			16:17	45	15:23 (1)
18	07:09			06:38	06:54	06:03	05:25	05:11	05:27	05:57	06:28	07:00	06:37			07:07		14:38 (1)
	16:44			17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24			16:17	45	15:23 (1)
19	07:08			06:37	06:52	06:01	05:24	05:11	05:28	05:58	06:29	07:01	06:38			07:07		14:39 (1)
	16:45			17:24	18:56	19:30	20:01	20:22	20:17	19:41	18:50	18:00	16:23			16:18	45	15:24 (1)
20	07:08			06:35	06:51	06:00	05:23	05:12	05:28	05:59	06:30	07:03	06:40			07:08		14:40 (1)
	16:46			17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:23			16:18	45	15:25 (1)
21	07:07			06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41			07:09		14:40 (1)
	16:47			17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22			16:19	45	15:25 (1)
22	07:07			06:32	06:47	05:57	05:21	05:12	05:30	06:01	06:32	07:05	06:42			07:09		14:41 (1)
	16:48			17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21			16:19	45	15:26 (1)
23	07:06			06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43			07:10		14:41 (1)
	16:50			17:28	19:01	19:34	20:04	20:23	20:14	19:35	18:43	17:54	16:21			16:20	45	15:26 (1)
24	07:05			06:29	06:44	05:54	05:20	05:13	05:32	06:03	06:34	07:07	06:44			07:10		14:41 (1)
	16:51			17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20			16:20	45	15:26 (1)
25	07:05			06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:36	07:08	06:45		14:50 (1)	07:10		14:42 (1)
	16:52			17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	5	14:55 (1)	16:21	45	15:27 (1)
26	07:04			06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10	06:47		14:46 (1)	07:11		14:42 (1)
	16:53			17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	14	15:00 (1)	16:21	45	15:27 (1)
27	07:03			06:25	06:39	05:49	05:17	05:14	05:35	06:06	06:38	07:11	06:48		14:43 (1)	07:11		14:43 (1)
	16:55			17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:19	19	15:02 (1)	16:22	44	15:27 (1)
28	07:02			06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49		14:42 (1)	07:12		14:44 (1)
	16:56			17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	22	15:04 (1)	16:23	44	15:28 (1)
29	07:01				06:35	05:47	05:16	05:14	05:37	06:08	06:40	07:13	06:50		14:40 (1)	07:12		14:44 (1)
	16:57				19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:46	16:18	26	15:06 (1)	16:24	44	15:28 (1)
30	07:00				06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51		14:40 (1)	07:12		14:45 (1)
	16:58				19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	28	15:08 (1)	16:24	43	15:28 (1)
31	06:59				06:32		05:15		05:39	06:10		07:16				07:12		14:46 (1)
	17:00				19:09		20:11		20:06	19:22		17:43				16:25	42	15:28 (1)
Potential sun hours	296			297	370	400	450	454	461	429	375	344	297			286		
Total, worst case		530												114			1295	
Sun reduction		0.56												0.50			0.52	
Oper. time red.		1.00												1.00			1.00	
Wind dir. red.		0.62												0.62			0.62	
Total reduction		0.34												0.31			0.32	
Total, real		182												35			413	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
2/24/2011 1:05 PM / 11

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 1:04 PM/2.7.473

SHADOW - Calendar

Shadow receptor: K - 9K

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February			March			April	May	June	July	August	September			October			November	December
1	07:12	06:58			06:22		16:38 (1)	06:30	05:44	05:15	05:15	05:40	06:11			06:42		17:17 (1)	06:17	06:52
	16:26	17:01			17:36	36	17:14 (1)	19:10	19:43	20:12	20:24	20:05	19:20			18:29	38	17:55 (1)	16:42	16:17
2	07:13	06:57			06:20		16:38 (1)	06:29	05:43	05:14	05:16	05:41	06:12			06:43		17:16 (1)	06:18	06:53
	16:27	17:02			17:37	37	17:15 (1)	19:11	19:44	20:13	20:24	20:04	19:19			18:27	39	17:55 (1)	16:40	16:17
3	07:13	06:56			06:19		16:37 (1)	06:27	05:41	05:14	05:16	05:42	06:13			06:44		17:15 (1)	06:19	06:54
	16:28	17:03			17:38	39	17:16 (1)	19:13	19:45	20:14	20:24	20:03	19:17			18:26	41	17:56 (1)	16:39	16:16
4	07:13	06:55			06:17		16:36 (1)	06:25	05:40	05:13	05:17	05:43	06:14			06:45		17:14 (1)	06:20	06:55
	16:29	17:05			17:39	41	17:17 (1)	19:14	19:46	20:14	20:23	20:02	19:15			18:24	42	17:56 (1)	16:38	16:16
5	07:13	06:54			06:15		16:37 (1)	06:24	05:39	05:13	05:17	05:44	06:15			06:46		17:13 (1)	06:22	06:56
	16:30	17:06			17:40	42	17:19 (1)	19:15	19:47	20:15	20:23	20:01	19:14			18:22	43	17:56 (1)	16:37	16:16
6	07:13	06:53			06:14		16:36 (1)	06:22	05:37	05:13	05:18	05:45	06:16			06:47		17:12 (1)	06:23	06:57
	16:31	17:07			17:41	44	17:20 (1)	19:16	19:48	20:16	20:23	19:58	19:12			18:20	44	17:56 (1)	16:36	16:16
7	07:13	06:52			06:12		16:37 (1)	06:20	05:36	05:12	05:19	05:46	06:17			06:48		17:12 (1)	06:24	06:58
	16:32	17:09			17:43	43	17:20 (1)	19:17	19:49	20:16	20:23	19:57	19:10			18:19	43	17:55 (1)	16:35	16:16
8	07:12	06:51			07:11		17:36 (1)	06:19	05:35	05:12	05:19	05:47	06:18			06:49		17:11 (1)	06:25	06:59
	16:33	17:10			18:44	43	18:19 (1)	19:18	19:50	20:17	20:22	19:56	19:08			18:17	43	17:54 (1)	16:33	16:16
9	07:12	06:50			07:09		17:36 (1)	06:17	05:34	05:12	05:20	05:48	06:19			06:50		17:11 (1)	06:26	07:00
	16:34	17:11			18:45	42	18:18 (1)	19:19	19:51	20:18	20:22	19:54	19:07			18:16	41	17:52 (1)	16:32	16:16
10	07:12	06:48			07:07		17:37 (1)	06:15	05:33	05:12	05:21	05:49	06:20			06:51		17:12 (1)	06:28	07:01
	16:35	17:12			18:46	41	18:18 (1)	19:20	19:52	20:18	20:22	19:53	19:05			18:14	40	17:52 (1)	16:31	16:16
11	07:12	06:47			07:06		17:37 (1)	06:14	05:32	05:12	05:21	05:50	06:21			06:53		17:11 (1)	06:29	07:02
	16:36	17:14			18:47	40	18:17 (1)	19:21	19:53	20:19	20:21	19:52	19:03			18:12	39	17:50 (1)	16:30	16:16
12	07:11	06:46			07:04		17:37 (1)	06:12	05:31	05:11	05:22	05:51	06:22			06:54		17:11 (1)	06:30	07:02
	16:37	17:15			18:48	39	18:16 (1)	19:22	19:54	20:19	20:21	19:50	19:02			18:11	37	17:48 (1)	16:29	16:16
13	07:11	06:45			07:02		17:39 (1)	06:10	05:29	05:11	05:23	05:52	06:23			06:55		17:12 (1)	06:31	07:03
	16:38	17:16			18:49	36	18:15 (1)	19:23	19:55	20:20	20:20	19:49	19:00			18:09	34	17:46 (1)	16:28	16:16
14	07:11	06:43			07:01		17:39 (1)	06:09	05:28	05:11	05:24	05:53	06:24			06:56		17:12 (1)	06:32	07:04
	16:39	17:17			18:51	35	18:14 (1)	19:24	19:57	20:20	20:20	19:48	18:58			18:07	33	17:45 (1)	16:27	16:16
15	07:10	06:42			06:59		17:40 (1)	06:07	05:27	05:11	05:24	05:54	06:25			06:57		17:12 (1)	06:34	07:05
	16:40	17:19			18:52	32	18:12 (1)	19:26	19:58	20:21	20:19	19:46	18:56			18:06	31	17:43 (1)	16:27	16:17
16	07:10	06:41			06:57		17:41 (1)	06:06	05:26	05:11	05:25	05:55	06:26			06:58		17:13 (1)	06:35	07:05
	16:41	17:20			18:53	29	18:10 (1)	19:27	19:59	20:21	20:19	19:45	18:55			18:04	28	17:41 (1)	16:26	16:17
17	07:10	06:39			06:56		17:43 (1)	06:04	05:25	05:11	05:26	05:56	06:27			06:59		17:14 (1)	06:36	07:06
	16:42	17:21			18:54	25	18:08 (1)	19:28	20:00	20:22	20:18	19:43	18:53			18:03	26	17:40 (1)	16:25	16:17
18	07:09	06:38			06:54		17:45 (1)	06:03	05:25	05:11	05:27	05:57	06:28			07:00		17:15 (1)	06:37	07:07
	16:44	17:22			18:55	20	18:05 (1)	19:29	20:00	20:22	20:17	19:42	18:51			18:01	24	17:39 (1)	16:24	16:17
19	07:08	06:37			06:52		17:49 (1)	06:01	05:24	05:11	05:28	05:58	06:29			07:01		17:17 (1)	06:38	07:07
	16:45	17:24			18:56	12	18:01 (1)	19:30	20:00	20:22	20:17	19:41	18:50			18:00	20	17:37 (1)	16:23	16:18
20	07:08	06:35		16:53 (1)	06:51			06:00	05:23	05:12	05:28	05:59	06:30			07:03		17:18 (1)	06:40	07:08
	16:46	17:25	9	17:02 (1)	18:57			19:31	20:01	20:23	20:16	19:39	18:48			17:58	17	17:35 (1)	16:23	16:18
21	07:07	06:34		16:49 (1)	06:49			05:58	05:22	05:12	05:29	06:00	06:31			07:04		17:20 (1)	06:41	07:09
	16:47	17:26	14	17:03 (1)	18:58			19:32	20:02	20:23	20:15	19:38	18:46			17:57	13	17:33 (1)	16:22	16:19
22	07:07	06:32		16:47 (1)	06:47			05:57	05:21	05:12	05:30	06:01	06:32			07:05		17:25 (1)	06:42	07:09
	16:48	17:27	18	17:05 (1)	18:59			19:33	20:03	20:23	20:14	19:36	18:44			17:55	8	17:33 (1)	16:21	16:19
23	07:06	06:31		16:45 (1)	06:45			05:55	05:20	05:12	05:31	06:02	06:33			07:06			06:43	07:10
	16:50	17:28	21	17:06 (1)	19:01			19:34	20:04	20:23	20:14	19:35	18:43			17:54			16:21	16:20
24	07:05	06:29		16:43 (1)	06:44			05:54	05:20	05:13	05:32	06:03	06:34		17:34 (1)	07:07			06:44	07:10
	16:51	17:30	25	17:08 (1)	19:02			19:35	20:05	20:23	20:13	19:33	18:41	8	17:42 (1)	17:52			16:20	16:20
25	07:04	06:28		16:42 (1)	06:42			05:52	05:19	05:13	05:33	06:04	06:36		17:29 (1)	07:08			06:45	07:10
	16:52	17:31	26	17:08 (1)	19:03			19:36	20:06	20:24	20:12	19:31	18:39	17	17:46 (1)	17:51			16:19	16:21
26	07:04	06:26		16:41 (1)	06:40			05:51	05:18	05:13	05:34	06:05	06:37		17:27 (1)	07:10			06:47	07:11
	16:53	17:32	29	17:10 (1)	19:04			19:37	20:07	20:24	20:11	19:30	18:37	23	17:50 (1)	17:50			16:19	16:21
27	07:03	06:25		16:39 (1)	06:39			05:49	05:17	05:14	05:35	06:06	06:38		17:24 (1)	07:11			06:48	07:11
	16:55	17:33	32	17:11 (1)	19:05			19:39	20:08	20:24	20:10	19:28	18:36	27	17:51 (1)	17:48			16:19	16:22
28	07:02	06:23		16:39 (1)	06:37			05:48	05:17	05:14	05:36	06:07	06:39		17:22 (1)	07:12			06:49	07:11
	16:56	17:34	34	17:13 (1)	19:06			19:40	20:09	20:24	20:09	19:27	18:34	31	17:53 (1)	17:47			16:18	16:23
29	07:01				06:35			05:47	05:16	05:14	05:37	06:08	06:40		17:20 (1)	07:13			06:50	07:12
	16:57				19:07			19:41	20:10	20:24	20:08	19:25	18:32	34	17:54 (1)	17:46			16:18	16:24
30	07:00				06:34			05:45	05:16	05:15	05:38	06:09	06:41		17:18 (1)	07:14			06:51	07:12
	16:58				19:08			19:42	20:10	20:24	20:07	19:23	18:31	37	17:55 (1)	17:44			16:17	16:24
31	06:59				06:32				05:15		05:39	06:10				07:16				07:12
	17:00				19:09				20:11		20:06	19:22				17:43				16:25
Potential sun hours	296	297			370			400	450	454	461	429	375			344			297	286
Total, worst case			208			676								177			724			
Sun reduction			0.58			0.58								0.62			0.61			
Oper. time red.			1.00			1.00								1.00			1.00			
Wind dir. red.			0.53			0.53								0.53			0.53			
Total reduction			0.31			0.31								0.33			0.32			
Total, real			64			207								58			233			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
2/24/2011 1:05 PM / 12

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 1:04 PM/2.7.473

SHADOW - Calendar

Shadow receptor: L - 9L

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March			April	May	June	July	August	September			October			November	December
1	07:12	06:58	06:22			06:30	05:44	05:15	05:15	05:40	06:11			06:42		17:35 (1)	06:17	06:52
	16:26	17:01	17:36			19:10	19:43	20:12	20:24	20:05	19:20			18:29	32	18:07 (1)	16:42	16:17
2	07:13	06:57	06:20			06:29	05:43	05:14	05:16	05:41	06:12			06:43		17:35 (1)	06:18	06:53
	16:27	17:02	17:37			19:11	19:44	20:13	20:24	20:04	19:19			18:27	30	18:05 (1)	16:40	16:17
3	07:13	06:56	06:19		17:12 (1)	06:27	05:41	05:14	05:16	05:42	06:13			06:44		17:35 (1)	06:19	06:54
	16:28	17:03	17:38	4	17:16 (1)	19:13	19:45	20:14	20:24	20:03	19:17			18:26	28	18:03 (1)	16:39	16:16
4	07:13	06:55	06:17		17:08 (1)	06:25	05:40	05:13	05:17	05:43	06:14			06:45		17:36 (1)	06:20	06:55
	16:29	17:05	17:39	9	17:17 (1)	19:14	19:46	20:14	20:23	20:02	19:15			18:24	25	18:01 (1)	16:38	16:16
5	07:13	06:54	06:15		17:06 (1)	06:24	05:39	05:13	05:17	05:44	06:15			06:46		17:36 (1)	06:22	06:56
	16:30	17:06	17:40	13	17:19 (1)	19:15	19:47	20:15	20:23	20:01	19:14			18:22	24	18:00 (1)	16:37	16:16
6	07:13	06:53	06:14		17:03 (1)	06:22	05:37	05:13	05:18	05:45	06:16			06:47		17:37 (1)	06:23	06:57
	16:31	17:07	17:41	17	17:20 (1)	19:16	19:48	20:16	20:23	19:58	19:12			18:20	21	17:58 (1)	16:36	16:16
7	07:13	06:52	06:12		17:02 (1)	06:20	05:36	05:12	05:19	05:46	06:17			06:48		17:38 (1)	06:24	06:58
	16:32	17:09	17:43	19	17:21 (1)	19:17	19:49	20:16	20:23	19:57	19:10			18:19	18	17:56 (1)	16:35	16:16
8	07:12	06:51	07:11		18:00 (1)	06:19	05:35	05:12	05:19	05:47	06:18			06:49		17:39 (1)	06:25	06:59
	16:33	17:10	18:44	22	18:22 (1)	19:18	19:50	20:17	20:22	19:56	19:08			18:17	15	17:54 (1)	16:33	16:16
9	07:12	06:50	07:09		17:58 (1)	06:17	05:34	05:12	05:20	05:48	06:19			06:50		17:41 (1)	06:26	07:00
	16:34	17:11	18:45	25	18:23 (1)	19:19	19:51	20:18	20:22	19:54	19:07			18:16	11	17:52 (1)	16:32	16:16
10	07:12	06:48	07:07		17:58 (1)	06:15	05:33	05:12	05:21	05:49	06:20			06:51		17:44 (1)	06:28	07:01
	16:35	17:12	18:46	27	18:25 (1)	19:20	19:52	20:18	20:22	19:53	19:05			18:14	8	17:52 (1)	16:31	16:16
11	07:12	06:47	07:06		17:57 (1)	06:14	05:32	05:12	05:21	05:50	06:21			06:53		17:49 (1)	06:29	07:02
	16:36	17:14	18:47	29	18:26 (1)	19:21	19:53	20:19	20:21	19:52	19:03			18:12	2	17:50 (1)	16:30	16:16
12	07:11	06:46	07:04		17:56 (1)	06:12	05:31	05:11	05:22	05:51	06:22			06:54			06:30	07:02
	16:37	17:15	18:48	31	18:27 (1)	19:22	19:54	20:19	20:21	19:50	19:02			18:11			16:29	16:16
13	07:11	06:45	07:02		17:56 (1)	06:10	05:29	05:11	05:23	05:52	06:23			06:55			06:31	07:03
	16:38	17:16	18:49	32	18:28 (1)	19:23	19:55	20:20	20:20	19:49	19:00			18:09			16:28	16:16
14	07:11	06:43	07:01		17:55 (1)	06:09	05:28	05:11	05:24	05:53	06:24		17:54 (1)	06:56			06:32	07:04
	16:39	17:17	18:51	34	18:29 (1)	19:24	19:57	20:20	20:20	19:48	18:58	15	18:09 (1)	18:07			16:27	16:16
15	07:10	06:42	06:59		17:54 (1)	06:07	05:27	05:11	05:24	05:54	06:25		17:51 (1)	06:57			06:34	07:05
	16:40	17:19	18:52	36	18:30 (1)	19:26	19:58	20:21	20:19	19:46	18:56	21	18:12 (1)	18:06			16:27	16:17
16	07:10	06:41	06:57		17:53 (1)	06:06	05:26	05:11	05:25	05:55	06:26		17:48 (1)	06:58			06:35	07:05
	16:41	17:20	18:53	38	18:31 (1)	19:27	19:59	20:21	20:19	19:45	18:55	26	18:14 (1)	18:04			16:26	16:17
17	07:10	06:39	06:56		17:54 (1)	06:04	05:25	05:11	05:26	05:56	06:27		17:46 (1)	06:59			06:36	07:06
	16:42	17:21	18:54	39	18:33 (1)	19:28	20:00	20:22	20:18	19:43	18:53	29	18:15 (1)	18:03			16:25	16:17
18	07:09	06:38	06:54		17:53 (1)	06:03	05:25	05:11	05:27	05:57	06:28		17:44 (1)	07:00			06:37	07:07
	16:44	17:22	18:55	41	18:34 (1)	19:29	20:00	20:22	20:17	19:42	18:51	32	18:16 (1)	18:01			16:24	16:17
19	07:08	06:37	06:52		17:53 (1)	06:01	05:24	05:11	05:28	05:58	06:29		17:42 (1)	07:01			06:38	07:07
	16:45	17:24	18:56	41	18:34 (1)	19:30	20:00	20:22	20:17	19:41	18:50	35	18:17 (1)	18:00			16:23	16:18
20	07:08	06:35	06:51		17:54 (1)	06:00	05:23	05:12	05:28	05:59	06:30		17:41 (1)	07:03			06:40	07:08
	16:46	17:25	18:57	41	18:35 (1)	19:31	20:01	20:23	20:16	19:39	18:48	37	18:18 (1)	17:58			16:23	16:18
21	07:07	06:34	06:49		17:54 (1)	05:58	05:22	05:12	05:29	06:00	06:31		17:40 (1)	07:04			06:41	07:09
	16:47	17:26	18:58	40	18:34 (1)	19:32	20:02	20:23	20:15	19:38	18:46	38	18:18 (1)	17:57			16:22	16:19
22	07:07	06:32	06:47		17:54 (1)	05:57	05:21	05:12	05:30	06:01	06:32		17:38 (1)	07:05			06:42	07:09
	16:48	17:27	18:59	39	18:33 (1)	19:33	20:03	20:23	20:14	19:36	18:44	41	18:19 (1)	17:55			16:21	16:19
23	07:06	06:31	06:45		17:54 (1)	05:55	05:20	05:12	05:31	06:02	06:33		17:38 (1)	07:06			06:43	07:10
	16:50	17:28	19:01	38	18:32 (1)	19:34	20:04	20:23	20:14	19:34	18:43	41	18:19 (1)	17:54			16:21	16:20
24	07:05	06:29	06:44		17:56 (1)	05:54	05:20	05:13	05:32	06:03	06:34		17:37 (1)	07:07			06:44	07:10
	16:51	17:30	19:02	35	18:31 (1)	19:35	20:05	20:23	20:13	19:33	18:41	41	18:18 (1)	17:52			16:20	16:20
25	07:04	06:28	06:42		17:56 (1)	05:52	05:19	05:13	05:33	06:04	06:36		17:36 (1)	07:08			06:45	07:10
	16:52	17:31	19:03	33	18:29 (1)	19:36	20:06	20:24	20:12	19:31	18:39	41	18:17 (1)	17:51			16:19	16:21
26	07:04	06:26	06:40		17:57 (1)	05:51	05:18	05:13	05:34	06:05	06:37		17:36 (1)	07:10			06:47	07:11
	16:53	17:32	19:04	30	18:27 (1)	19:37	20:07	20:24	20:11	19:30	18:37	40	18:16 (1)	17:50			16:19	16:21
27	07:03	06:25	06:39		17:59 (1)	05:49	05:17	05:14	05:35	06:06	06:38		17:36 (1)	07:11			06:48	07:11
	16:55	17:33	19:05	27	18:26 (1)	19:39	20:08	20:24	20:10	19:28	18:36	38	18:14 (1)	17:48			16:19	16:22
28	07:02	06:23	06:37		18:01 (1)	05:48	05:17	05:14	05:36	06:07	06:39		17:35 (1)	07:12			06:49	07:11
	16:56	17:34	19:06	22	18:23 (1)	19:40	20:09	20:24	20:09	19:27	18:34	37	18:12 (1)	17:47			16:18	16:23
29	07:01		06:35		18:04 (1)	05:47	05:16	05:14	05:37	06:08	06:40		17:35 (1)	07:13			06:50	07:12
	16:57		19:07	15	18:19 (1)	19:41	20:10	20:24	20:08	19:25	18:32	35	18:10 (1)	17:46			16:18	16:24
30	07:00		06:34			05:45	05:16	05:15	05:38	06:09	06:41		17:35 (1)	07:14			06:51	07:12
	16:58		19:08			19:42	20:10	20:24	20:07	19:23	18:31	34	18:09 (1)	17:44			16:17	16:24
31	06:59		06:32				05:15		05:39	06:10				07:16				07:12
	17:00		19:09				20:11		20:06	19:22				17:43				16:25
Potential sun hours	296	297	370			400	450	454	461	429	375			344			297	286
Total, worst case				777								581			214			
Sun reduction				0.58								0.62			0.61			
Oper. time red.				1.00								1.00			1.00			
Wind dir. red.				0.53								0.53			0.53			
Total reduction				0.31								0.33			0.33			
Total, real				241								193			70			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
2/24/2011 1:05 PM / 13

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 1:04 PM/2.7.473

SHADOW - Calendar

Shadow receptor: M - 9M

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January			February			March	April	May	June	July	August	September	October			November			December		
1	07:12		15:19 (1)	06:58		15:27 (1)	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42			06:17		15:05 (1)	06:52		15:03 (1)
	16:26	41	16:00 (1)	17:01	56	16:23 (1)	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29			16:42	41	15:46 (1)	16:17	49	15:52 (1)
2	07:13		15:19 (1)	06:57		15:28 (1)	06:20	06:29	05:43	05:14	05:16	05:41	06:12	06:43			06:18		15:04 (1)	06:53		15:03 (1)
	16:27	41	16:00 (1)	17:02	55	16:23 (1)	17:37	19:11	19:44	20:13	20:24	20:04	19:19	18:27			16:40	43	15:47 (1)	16:17	49	15:52 (1)
3	07:13		15:19 (1)	06:56		15:29 (1)	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44			06:19		15:03 (1)	06:54		15:04 (1)
	16:28	42	16:01 (1)	17:03	54	16:23 (1)	17:38	19:13	19:45	20:14	20:24	20:03	19:17	18:26			16:39	46	15:49 (1)	16:16	47	15:51 (1)
4	07:13		15:19 (1)	06:55		15:30 (1)	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45			06:20		15:02 (1)	06:55		15:05 (1)
	16:29	43	16:02 (1)	17:05	52	16:22 (1)	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24			16:38	48	15:50 (1)	16:16	46	15:51 (1)
5	07:13		15:20 (1)	06:54		15:31 (1)	06:15	06:24	05:39	05:13	05:17	05:44	06:15	06:46			06:22		15:01 (1)	06:56		15:05 (1)
	16:30	43	16:03 (1)	17:06	51	16:22 (1)	17:40	19:15	19:47	20:15	20:23	20:01	19:14	18:22			16:37	49	15:50 (1)	16:16	46	15:51 (1)
6	07:13		15:20 (1)	06:53		15:31 (1)	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47			06:23		15:00 (1)	06:57		15:06 (1)
	16:31	44	16:04 (1)	17:07	49	16:20 (1)	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:21			16:36	52	15:52 (1)	16:16	45	15:51 (1)
7	07:13		15:20 (1)	06:52		15:32 (1)	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48			06:24		14:59 (1)	06:58		15:07 (1)
	16:32	46	16:06 (1)	17:09	48	16:20 (1)	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19			16:35	53	15:52 (1)	16:16	43	15:50 (1)
8	07:12		15:21 (1)	06:51		15:33 (1)	07:11	06:19	05:35	05:12	05:19	05:47	06:18	06:49			06:25		14:59 (1)	06:59		15:07 (1)
	16:33	46	16:07 (1)	17:10	46	16:19 (1)	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17			16:33	54	15:53 (1)	16:16	43	15:50 (1)
9	07:12		15:20 (1)	06:50		15:35 (1)	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50			06:26		14:59 (1)	07:00		15:08 (1)
	16:34	47	16:07 (1)	17:11	43	16:18 (1)	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16			16:32	55	15:54 (1)	16:16	42	15:50 (1)
10	07:12		15:20 (1)	06:48		15:37 (1)	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51			06:28		14:58 (1)	07:01		15:09 (1)
	16:35	49	16:09 (1)	17:12	40	16:17 (1)	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14			16:31	56	15:54 (1)	16:16	42	15:51 (1)
11	07:12		15:21 (1)	06:47		15:38 (1)	07:06	06:14	05:32	05:12	05:21	05:50	06:21	06:53			06:29		14:58 (1)	07:02		15:09 (1)
	16:36	49	16:10 (1)	17:14	37	16:15 (1)	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12			16:30	56	15:54 (1)	16:16	41	15:50 (1)
12	07:12		15:20 (1)	06:46		15:40 (1)	07:04	06:12	05:31	05:11	05:22	05:51	06:22	06:54			06:30		14:57 (1)	07:02		15:09 (1)
	16:37	50	16:10 (1)	17:15	34	16:14 (1)	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11			16:29	58	15:55 (1)	16:16	41	15:50 (1)
13	07:11		15:21 (1)	06:45		15:42 (1)	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55			06:31		14:57 (1)	07:03		15:10 (1)
	16:38	51	16:12 (1)	17:16	30	16:12 (1)	18:49	19:23	19:56	20:20	20:20	19:49	19:00	18:09			16:28	59	15:56 (1)	16:16	40	15:50 (1)
14	07:11		15:22 (1)	06:43		15:44 (1)	07:01	06:09	05:28	05:11	05:24	05:53	06:24	06:56			06:32		14:57 (1)	07:04		15:11 (1)
	16:39	52	16:14 (1)	17:17	25	16:09 (1)	18:51	19:24	19:57	20:20	20:20	19:48	18:58	18:08			16:27	59	15:56 (1)	16:16	40	15:51 (1)
15	07:10		15:21 (1)	06:42		15:48 (1)	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57			06:34		14:57 (1)	07:05		15:11 (1)
	16:40	53	16:14 (1)	17:19	18	16:06 (1)	18:52	19:26	19:58	20:21	20:19	19:46	18:56	18:06			16:27	59	15:56 (1)	16:17	39	15:50 (1)
16	07:10		15:22 (1)	06:41		15:55 (1)	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58			06:35		14:57 (1)	07:05		15:12 (1)
	16:41	54	16:16 (1)	17:20	4	15:59 (1)	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04			16:26	60	15:57 (1)	16:17	39	15:51 (1)
17	07:10		15:22 (1)	06:39			06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59			06:36		14:57 (1)	07:06		15:13 (1)
	16:42	55	16:17 (1)	17:21			18:54	19:28	20:00	20:22	20:18	19:43	18:53	18:03			16:25	60	15:57 (1)	16:17	38	15:51 (1)
18	07:09		15:21 (1)	06:38			06:54	06:03	05:25	05:11	05:27	05:57	06:28	07:00			06:37		14:57 (1)	07:07		15:13 (1)
	16:44	57	16:18 (1)	17:22			18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01			16:24	60	15:57 (1)	16:17	38	15:51 (1)
19	07:08		15:22 (1)	06:37			06:52	06:01	05:24	05:11	05:28	05:58	06:29	07:01			06:38		14:57 (1)	07:07		15:14 (1)
	16:45	57	16:19 (1)	17:24			18:56	19:30	20:01	20:22	20:17	19:41	18:50	18:00			16:23	60	15:57 (1)	16:18	38	15:52 (1)
20	07:08		15:22 (1)	06:35			06:51	06:00	05:23	05:12	05:28	05:59	06:30	07:03			06:40		14:58 (1)	07:08		15:15 (1)
	16:46	58	16:20 (1)	17:25			18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58			16:23	60	15:58 (1)	16:18	37	15:52 (1)
21	07:07		15:22 (1)	06:34			06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04			06:41		14:58 (1)	07:09		15:15 (1)
	16:47	59	16:21 (1)	17:26			18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57			16:22	59	15:57 (1)	16:19	37	15:52 (1)
22	07:07		15:23 (1)	06:32			06:47	05:57	05:21	05:12	05:30	06:01	06:32	07:05			06:42		14:58 (1)	07:09		15:16 (1)
	16:48	60	16:23 (1)	17:27			18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55			16:21	58	15:56 (1)	16:19	37	15:53 (1)
23	07:06		15:23 (1)	06:31			06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06			06:43		14:58 (1)	07:10		15:16 (1)
	16:50	60	16:23 (1)	17:28			19:01	19:34	20:04	20:23	20:14	19:35	18:43	17:54			16:21	58	15:56 (1)	16:20	37	15:53 (1)
24	07:05		15:23 (1)	06:29			06:44	05:54	05:20	05:13	05:32	06:03	06:34	07:07			06:44		14:59 (1)	07:10		15:16 (1)
	16:51	60	16:23 (1)	17:30			19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52			16:20	57	15:56 (1)	16:20	38	15:54 (1)
25	07:05		15:23 (1)	06:28			06:42	05:52	05:19	05:13	05:33	06:04	06:36	07:08			06:45		15:00 (1)	07:10		15:17 (1)
	16:52	60	16:23 (1)	17:31			19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51			16:19	55	15:55 (1)	16:21	38	15:55 (1)
26	07:04		15:25 (1)	06:26			06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10		16:22 (1)	06:47		15:00 (1)	07:11		15:17 (1)
	16:53	59	16:24 (1)	17:32			19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	10	16:32 (1)	16:19	54	15:54 (1)	16:21	38	15:55 (1)
27	07:03		15:25 (1)	06:25			06:39	05:49	05:17	05:14	05:35	06:06	06:38	07:11		16:17 (1)	06:48		15:00 (1)	07:11		15:17 (1)
	16:55	59	16:24 (1)	17:33			19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	20	16:37 (1)	16:19	53	15:53 (1)	16:22	38	15:55 (1)
28	07:02		15:25 (1)	06:23			06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12		16:13 (1)	06:49		15:01 (1)	07:12		15:18 (1)
	16:56	59	16:24 (1)	17:34			19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	26	16:39 (1)	16:18	52	15:53 (1)	16:23	39	15:57 (1)
29	07:01		15:26 (1)				06:35	05:47	05:16	05:14	05:37	06:08	06:40	07:13		16:10 (1)	06:50		15:01 (1)	07:12		15:18 (1)
	16:57	58	16:24 (1)				19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:46	31	16:41 (1)	16:18	51	15:52 (1)	16:24	39	15:57 (1)
30	07:00		15:26 (1)				06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14		16:09 (1)	06:51		15:02 (1)	07:12		15:18 (1)
	16:58	58	16:24 (1)				19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	35	16:44 (1)	16:17	51	15:53 (1)	16:24	40	15:58 (1)
31	06:59		15:27 (1)				06:32		05:15		05:39	06:10		07:16		16:07 (1)				07:12		15:18 (1)
	17:00	56	16:23 (1)				19:09		20:11		20:06	19:22		17:43	38	16:45 (1)				16:25	41	15:59 (1)
Potential sun hours	296			297			370	400	450	454	461	429	375	344			297			286		
Total, worst case		1626			642										160			1636			1265	
Sun reduction		0.56			0.58										0.61			0.50			0.52	
Oper. time red.		1.00			1.00										1.00			1.00			1.00	
Wind dir. red.		0.57			0.57										0.57			0.57			0.57	
Total reduction		0.32			0.33										0.35			0.29			0.30	
Total, real		518			212										56			466			374	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
2/24/2011 1:05 PM / 14

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 1:04 PM/2.7.473

SHADOW - Calendar

Shadow receptor: N - 9N

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March			April			May	June	July	August	September			October			November	December
1	07:12	06:58	06:22			06:30		17:43 (1)	05:44	05:15	05:15	05:40	06:11			06:42		17:34 (1)	06:17	06:52
	16:26	17:01	17:36			19:10	47	18:30 (1)	19:43	20:12	20:24	20:05	19:20			18:29	33	18:07 (1)	16:42	16:17
2	07:13	06:57	06:20			06:29		17:44 (1)	05:43	05:14	05:16	05:41	06:12		17:55 (1)	06:43		17:35 (1)	06:18	06:53
	16:27	17:02	17:37			19:11	46	18:30 (1)	19:44	20:13	20:24	20:04	19:19	16	18:11 (1)	18:27	30	18:05 (1)	16:40	16:17
3	07:13	06:56	06:19			06:27		17:45 (1)	05:41	05:14	05:16	05:42	06:13		17:51 (1)	06:44		17:37 (1)	06:19	06:54
	16:28	17:03	17:38			19:13	43	18:28 (1)	19:45	20:14	20:24	20:03	19:17	23	18:14 (1)	18:26	26	18:03 (1)	16:39	16:16
4	07:13	06:55	06:17			06:25		17:45 (1)	05:40	05:13	05:17	05:43	06:14		17:48 (1)	06:45		17:39 (1)	06:20	06:55
	16:29	17:05	17:39			19:14	42	18:27 (1)	19:46	20:14	20:23	20:02	19:15	29	18:17 (1)	18:24	22	18:01 (1)	16:38	16:16
5	07:13	06:54	06:15			06:24		17:47 (1)	05:39	05:13	05:17	05:44	06:15		17:46 (1)	06:46		17:43 (1)	06:22	06:56
	16:30	17:06	17:40			19:15	39	18:26 (1)	19:47	20:15	20:23	20:01	19:14	32	18:18 (1)	18:22	15	17:58 (1)	16:37	16:16
6	07:13	06:53	06:14			06:22		17:48 (1)	05:37	05:13	05:18	05:45	06:16		17:44 (1)	06:47			06:23	06:57
	16:31	17:07	17:41			19:16	36	18:24 (1)	19:48	20:16	20:23	19:58	19:12	36	18:20 (1)	18:21			16:36	16:16
7	07:13	06:52	06:12			06:20		17:49 (1)	05:36	05:12	05:19	05:46	06:17		17:42 (1)	06:48			06:24	06:58
	16:32	17:09	17:43			19:17	32	18:21 (1)	19:49	20:16	20:23	19:57	19:10	39	18:21 (1)	18:19			16:35	16:16
8	07:12	06:51	07:11		18:09 (1)	06:19		17:51 (1)	05:35	05:12	05:19	05:47	06:18		17:40 (1)	06:49			06:25	06:59
	16:33	17:10	18:44	9	18:18 (1)	19:18	29	18:20 (1)	19:50	20:17	20:22	19:56	19:08	42	18:22 (1)	18:17			16:33	16:16
9	07:12	06:50	07:09		18:03 (1)	06:17		17:53 (1)	05:34	05:12	05:20	05:48	06:19		17:39 (1)	06:50			06:26	07:00
	16:34	17:11	18:45	20	18:23 (1)	19:19	24	18:17 (1)	19:51	20:18	20:22	19:54	19:07	43	18:22 (1)	18:16			16:32	16:16
10	07:12	06:48	07:07		18:00 (1)	06:15		17:56 (1)	05:33	05:12	05:21	05:49	06:20		17:38 (1)	06:51			06:28	07:01
	16:35	17:12	18:46	25	18:25 (1)	19:20	16	18:12 (1)	19:52	20:18	20:22	19:53	19:05	45	18:23 (1)	18:14			16:31	16:16
11	07:12	06:47	07:06		17:57 (1)	06:14			05:32	05:12	05:21	05:50	06:21		17:36 (1)	06:53			06:29	07:02
	16:36	17:14	18:47	29	18:26 (1)	19:21			19:53	20:19	20:21	19:52	19:03	47	18:23 (1)	18:12			16:30	16:16
12	07:11	06:46	07:04		17:55 (1)	06:12			05:31	05:11	05:22	05:51	06:22		17:35 (1)	06:54			06:30	07:02
	16:37	17:15	18:48	32	18:27 (1)	19:22			19:54	20:19	20:21	19:50	19:02	49	18:24 (1)	18:11			16:29	16:16
13	07:11	06:45	07:02		17:54 (1)	06:10			05:29	05:11	05:23	05:52	06:23		17:34 (1)	06:55			06:31	07:03
	16:38	17:16	18:49	34	18:28 (1)	19:23			19:56	20:20	20:20	19:49	19:00	50	18:24 (1)	18:09			16:28	16:16
14	07:11	06:43	07:01		17:52 (1)	06:09			05:28	05:11	05:24	05:53	06:24		17:32 (1)	06:56			06:32	07:04
	16:39	17:17	18:51	37	18:29 (1)	19:24			19:57	20:20	20:20	19:48	18:58	51	18:23 (1)	18:07			16:27	16:16
15	07:10	06:42	06:59		17:50 (1)	06:07			05:27	05:11	05:24	05:54	06:25		17:32 (1)	06:57			06:34	07:05
	16:40	17:19	18:52	40	18:30 (1)	19:26			19:58	20:21	20:19	19:46	18:56	51	18:23 (1)	18:06			16:27	16:17
16	07:10	06:41	06:57		17:48 (1)	06:06			05:26	05:11	05:25	05:55	06:26		17:31 (1)	06:58			06:35	07:05
	16:41	17:20	18:53	43	18:31 (1)	19:27			19:59	20:21	20:19	19:45	18:55	52	18:23 (1)	18:04			16:26	16:17
17	07:10	06:39	06:56		17:48 (1)	06:04			05:25	05:11	05:26	05:56	06:27		17:30 (1)	06:59			06:36	07:06
	16:42	17:21	18:54	45	18:33 (1)	19:28			20:00	20:22	20:18	19:43	18:53	53	18:23 (1)	18:03			16:25	16:17
18	07:09	06:38	06:54		17:46 (1)	06:03			05:25	05:11	05:27	05:57	06:28		17:30 (1)	07:00			06:37	07:07
	16:44	17:22	18:55	48	18:34 (1)	19:29			20:00	20:22	20:17	19:42	18:51	53	18:23 (1)	18:01			16:24	16:17
19	07:08	06:37	06:52		17:45 (1)	06:01			05:24	05:11	05:28	05:58	06:29		17:29 (1)	07:01			06:38	07:07
	16:45	17:24	18:56	49	18:34 (1)	19:30			20:00	20:22	20:17	19:41	18:50	53	18:22 (1)	18:00			16:23	16:18
20	07:08	06:35	06:51		17:45 (1)	06:00			05:23	05:12	05:28	05:59	06:30		17:29 (1)	07:03			06:40	07:08
	16:46	17:25	18:57	51	18:36 (1)	19:31			20:01	20:23	20:16	19:39	18:48	53	18:22 (1)	17:58			16:23	16:18
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25	07:04	06:28	06:42		17:42 (1)	05:52			05:19	05:13	05:33	06:04	06:36		17:29 (1)	07:08			06:45	07:10
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26	07:04	06:26	06:40		17:42 (1)	05:51			05:18	05:13	05:34	06:05	06:37		17:30 (1)	07:10			06:47	07:11
	16:53	17:32	19:04	53	18:35 (1)	19:37			20:07	20:24	20:11	19:30	18:37	46	18:16 (1)	17:50			16:19	16:21
27	07:03	06:25	06:39		17:42 (1)	05:49			05:17	05:14	05:35	06:06	06:38		17:30 (1)	07:11			06:48	07:11
	16:55	17:33	19:05	53	18:35 (1)	19:39			20:08	20:24	20:10	19:28	18:36	44	18:14 (1)	17:48			16:19	16:22
28	07:02	06:23	06:37		17:42 (1)	05:48			05:17	05:14	05:36	06:07	06:39		17:31 (1)	07:12			06:49	07:12
	16:56	17:34	19:06	52	18:34 (1)	19:40			20:09	20:24	20:09	19:27	18:34	41	18:12 (1)	17:47			16:18	16:23
29	07:01		06:35		17:42 (1)	05:47			05:16	05:14	05:37	06:08	06:40		17:32 (1)	07:13			06:50	07:12
	16:57		19:07	51	18:33 (1)	19:41			20:10	20:24	20:08	19:25	18:32	38	18:10 (1)	17:46			16:18	16:24
30	07:00		06:34		17:43 (1)	05:45			05:16	05:15	05:38	06:09	06:41		17:32 (1)	07:14			06:51	07:12
	16:58		19:08	50	18:33 (1)	19:42			20:10	20:24	20:07	19:23	18:31	37	18:09 (1)	17:44			16:17	16:24
31	06:59		06:32		17:43 (1)				05:15		05:39	06:10				07:16				07:12
	17:00		19:09	49	18:32 (1)				20:11		20:06	19:22				17:43				16:25
Potential sun hours	296	297	370			400			450	454	461	429	375			344			297	286
Total, worst case				1033			354							1278			126			
Sun reduction				0.58			0.57							0.62			0.61			
Oper. time red.				1.00			1.00							1.00			1.00			
Wind dir. red.				0.54			0.54							0.54			0.54			
Total reduction				0.31			0.31							0.33			0.33			
Total, real				322			108							426			41			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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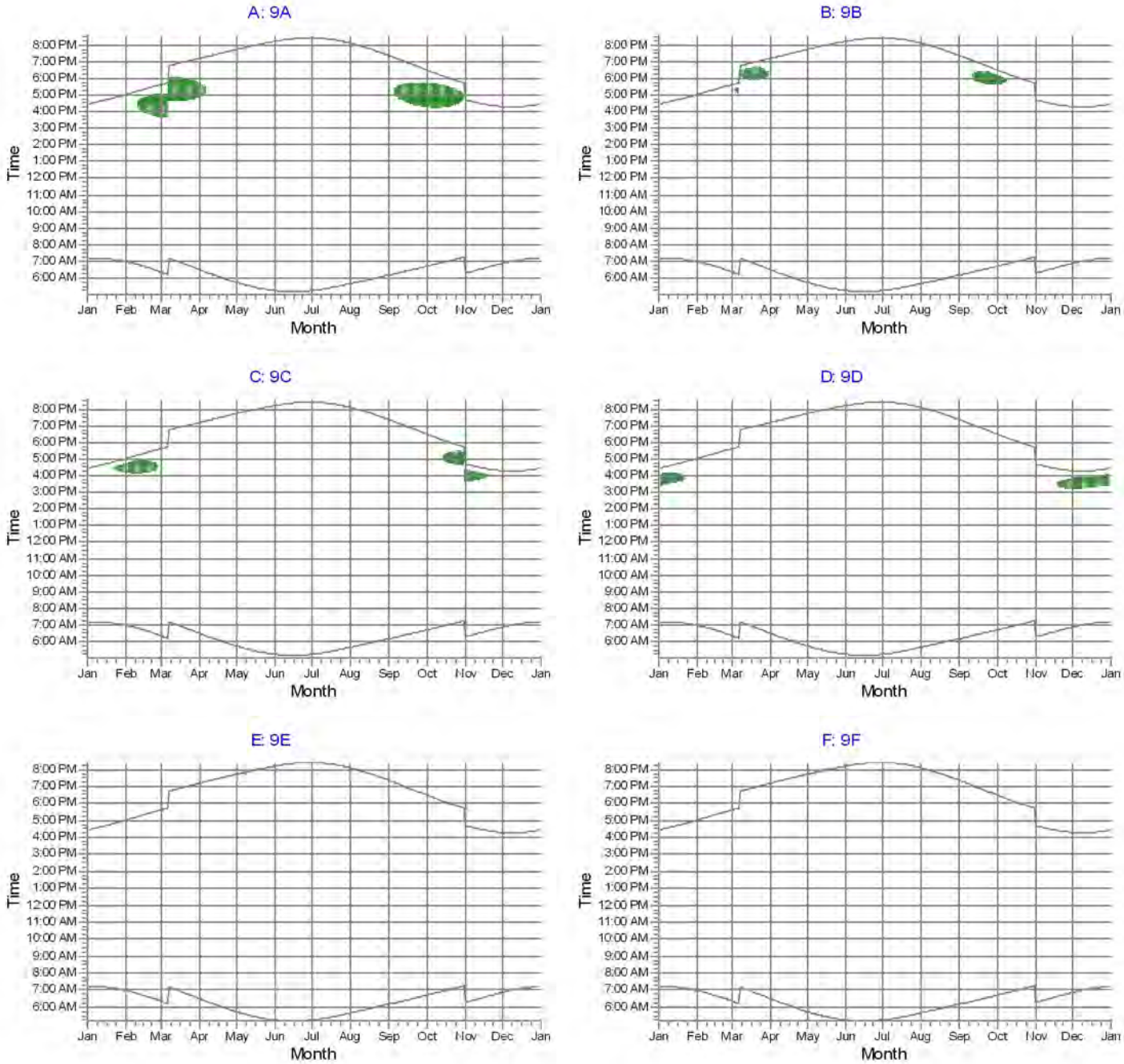
2/24/2011 1:04 PM/2.7.473

SHADOW - Calendar, graphical



WTGs

1: Bishops Rock

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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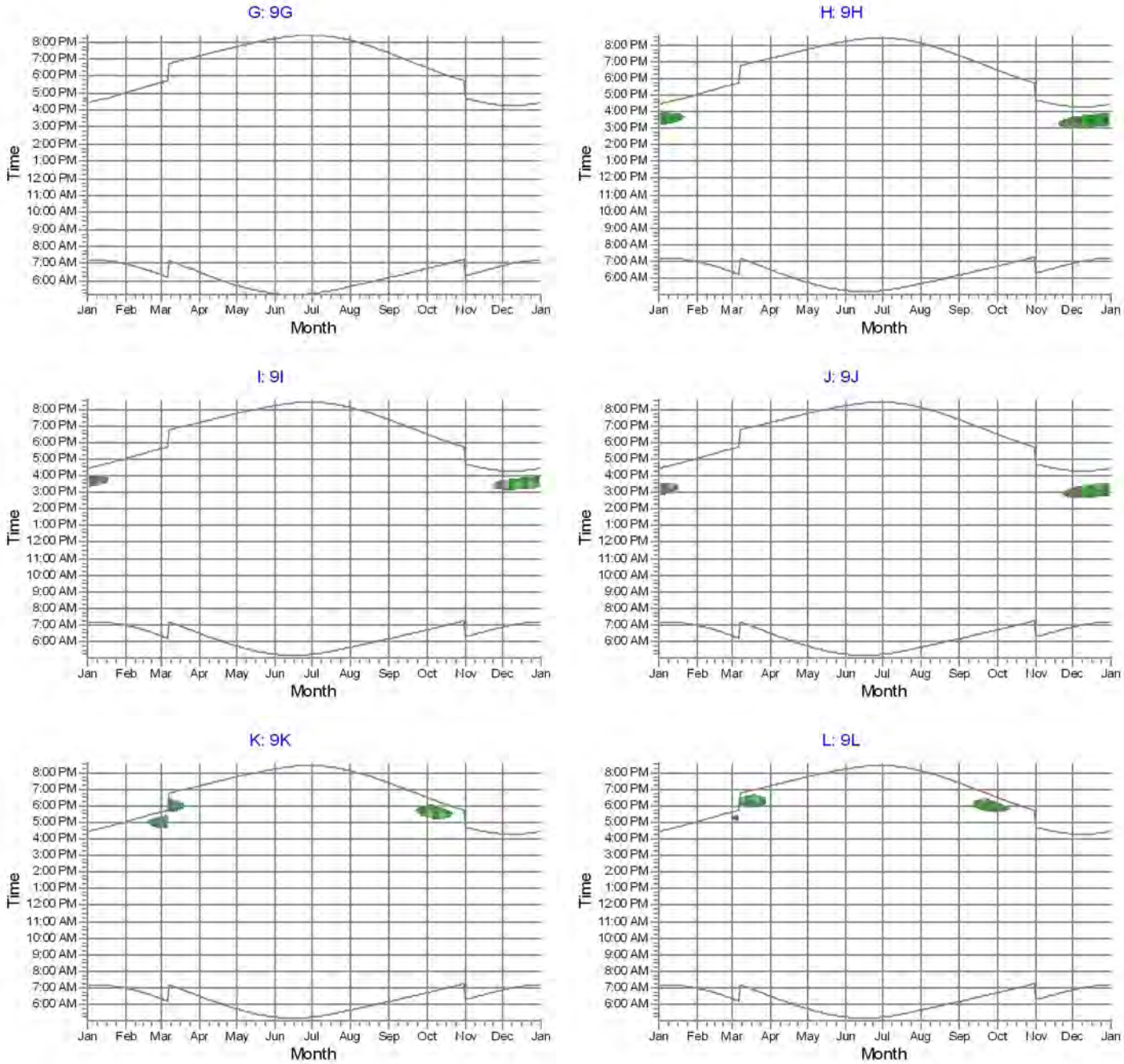
SHADOW - Calendar, graphical



WTGs

1: Bishops Rock

Project:
Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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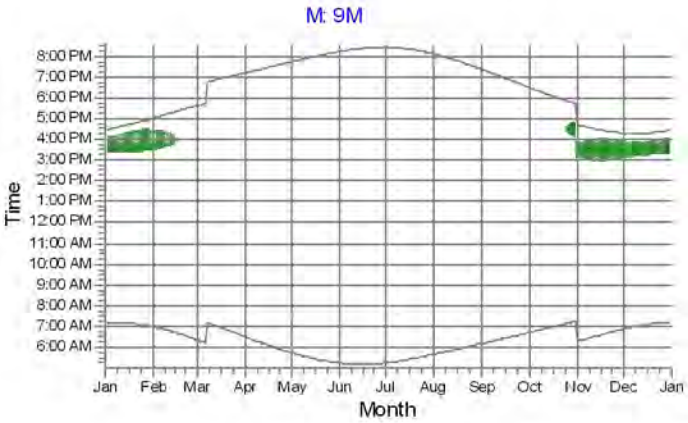
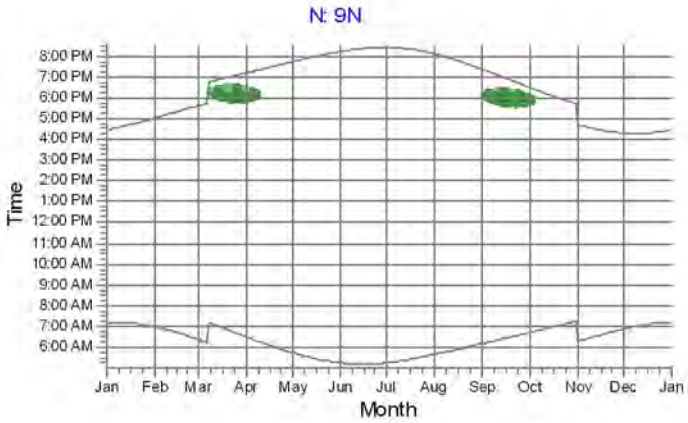
SHADOW - Calendar, graphical





WTGs

1: Bishops Rock

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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Calculated:
2/24/2011 1:04 PM/2.7.473

SHADOW - Calendar per WTG

WTG: 1 - Bishops Rock

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June
1	07:12 14:46-16:00/74 16:26	06:58 15:27-16:24/57 17:01 16:24-16:37/13	06:22 15:39-17:14/95 17:36	06:30 16:49-17:38/49 19:10 17:43-18:30/47	05:44 19:43	05:15 20:12
2	07:13 14:47-16:00/73 16:27	06:57 15:28-16:24/56 17:02 16:24-16:38/14	06:20 15:39-17:15/96 17:37	06:29 16:51-17:36/45 19:11 17:44-18:30/46	05:43 19:44	05:14 20:13
3	07:13 14:48-16:01/73 16:28	06:56 15:29-16:24/55 17:03 16:24-16:40/16	06:19 15:38-17:16/98 17:38	06:27 16:53-17:34/41 19:13 17:45-18:28/43	05:41 19:45	05:14 20:14
4	07:13 14:49-16:02/73 16:29	06:55 15:30-16:23/53 17:05 16:23-16:41/18	06:17 15:37-17:17/100 17:39	06:25 16:55-17:30/35 19:14 17:45-18:27/42	05:40 19:46	05:13 20:14
5	07:13 14:50-16:03/73 16:30	06:54 15:31-16:23/52 17:06 16:23-16:42/19	06:15 15:37-17:19/102 17:40	06:24 16:59-17:28/29 19:15 17:47-18:26/39	05:39 19:47	05:13 20:15
6	07:13 14:51-16:04/73 16:31	06:53 15:31-16:21/50 17:07 16:21-16:43/22	06:14 15:36-17:20/104 17:41	06:22 17:03-17:23/20 19:16 17:48-18:24/36	05:37 19:48	05:13 20:16
7	07:13 14:52-16:06/74 16:32	06:52 15:32-16:21/49 17:09 16:21-16:45/24	06:12 15:36-17:21/105 17:43	06:20 17:49-18:21/32 19:17	05:36 19:49	05:12 20:16
8	07:12 14:53-16:07/74 16:33	06:51 15:33-16:20/47 17:10 16:20-16:46/26	07:11 16:36-18:20/104 18:44 18:19-18:22/3	06:19 17:51-18:20/29 19:18	05:35 19:50	05:12 20:17
9	07:12 14:54-16:07/73 16:34	06:50 15:35-16:19/44 17:11 16:19-16:48/29	07:09 16:35-18:23/108 18:45	06:17 17:53-18:17/24 19:19	05:34 19:51	05:12 20:18
10	07:12 14:55-16:09/74 16:35	06:48 15:37-16:18/41 17:12 16:18-16:48/30	07:07 16:36-18:25/109 18:46	06:15 17:56-18:12/16 19:20	05:33 19:52	05:12 20:18
11	07:12 14:57-16:10/73 16:36	06:47 15:38-16:17/39 17:14 16:16-16:50/34	07:06 16:35-18:26/111 18:47	06:14 19:21	05:32 19:53	05:12 20:19
12	07:12 14:58-16:10/72 16:37	06:46 15:40-16:16/36 17:15 16:15-16:52/37	07:04 16:35-18:27/112 18:48	06:12 19:22	05:31 19:55	05:11 20:19
13	07:11 15:00-16:12/72 16:38	06:45 15:42-16:14/32 17:16 16:13-16:53/40	07:02 16:36-18:28/112 18:49	06:10 19:23	05:29 19:56	05:11 20:20
14	07:11 15:02-16:14/72 16:39	06:43 15:44-16:11/27 17:17 16:10-16:53/43	07:01 16:35-18:29/114 18:51	06:09 19:24	05:28 19:57	05:11 20:20
15	07:10 15:04-16:14/70 16:40	06:42 15:48-16:07/19 17:19 16:07-16:53/46	06:59 16:35-18:30/115 18:52	06:07 19:26	05:27 19:58	05:11 20:21
16	07:10 15:07-16:16/69 16:41	06:41 15:55-16:00/5 17:20 16:00-16:53/53	06:57 16:35-18:31/116 18:53	06:06 19:27	05:26 19:59	05:11 20:21
17	07:10 15:12-15:17/5 16:43 15:22-16:17/55	06:39 15:53-16:52/59 17:21	06:56 16:36-18:33/117 18:54	06:04 19:28	05:25 20:00	05:11 20:22
18	07:09 15:21-16:18/57 16:44	06:38 15:52-16:52/60 17:22	06:54 16:36-18:34/118 18:55	06:03 19:29	05:25 20:00	05:11 20:22
19	07:09 15:22-16:19/57 16:45	06:37 15:49-16:50/61 17:24	06:52 16:36-18:34/118 18:56	06:01 19:30	05:24 20:01	05:12 20:22
20	07:08 15:22-16:20/58 16:46	06:35 15:48-16:51/63 17:25 16:53-17:02/9	06:51 16:37-18:36/119 18:57	06:00 19:31	05:23 20:01	05:12 20:23
21	07:07 15:22-16:21/59 16:47	06:34 15:47-17:03/76 17:26 16:12-16:48/36	06:49 16:37-18:37/120 18:58	05:58 19:32	05:22 20:02	05:12 20:23
22	07:07 15:23-16:23/60 16:48	06:32 15:46-17:05/79 17:27	06:47 16:38-18:36/118 18:59	05:57 19:33	05:21 20:03	05:12 20:23
23	07:06 15:23-16:24/61 16:50	06:31 15:44-17:06/82 17:28	06:45 16:39-18:36/117 19:01	05:55 19:34	05:20 20:04	05:12 20:23
24	07:05 15:23-16:24/61 16:51 16:24-16:26/2	06:29 15:43-17:08/85 17:30	06:44 16:40-18:36/116 19:02	05:54 19:35	05:20 20:05	05:13 20:23
25	07:05 15:23-16:24/61 16:52 16:24-16:27/3	06:28 15:42-17:08/86 17:31 16:18-16:41/23	06:42 16:40-18:35/115 19:03	05:52 19:36	05:19 20:06	05:13 20:24
26	07:04 15:25-16:25/60 16:53 16:25-16:29/4	06:26 15:42-17:10/88 17:32 16:22-16:38/16	06:40 16:41-18:35/114 19:04	05:51 19:37	05:18 20:07	05:13 20:24
27	07:03 15:25-16:25/60 16:55 16:25-16:30/5	06:25 15:40-17:11/91 17:33 16:28-16:31/3	06:39 16:42-18:35/113 19:05	05:49 19:39	05:17 20:08	05:14 20:24
28	07:02 15:25-16:25/60 16:56 16:25-16:31/6	06:23 15:40-17:13/93 17:34	06:37 16:43-18:34/111 19:06	05:48 19:40	05:17 20:09	05:14 20:24
29	07:01 15:26-16:25/59 16:57 16:25-16:33/8		06:35 16:44-18:33/109 19:07	05:47 19:41	05:16 20:10	05:14 20:24
30	07:00 15:26-16:25/59 16:58 16:25-16:34/9		06:34 16:46-17:42/56 19:08 17:43-18:33/50	05:45 19:42	05:16 20:10	05:15 20:24
31	06:59 15:27-16:24/57 17:00 16:24-16:35/11		06:32 16:47-17:40/53 19:09 17:43-18:32/49		05:15 20:11	
Potential sun hours	296	297	370	400	450	454
Sum of minutes with flicker	2099	2054	3416	573	0	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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Calculated:
2/24/2011 1:04 PM/2.7.473

SHADOW - Calendar per WTG

WTG: 1 - Bishops Rock

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	July	August	September	October	November	December
1	05:15 20:24	05:40 20:05	06:11 19:20	06:42 16:15-18:07/112 18:29	06:17 15:05-15:47/42 16:42 15:47-16:18/31	06:52 14:39-15:52/73 16:17
2	05:16 20:24	05:41 20:04	06:12 17:55-18:11/16 19:19	06:43 16:14-18:05/111 18:27	06:18 15:04-15:48/44 16:40 15:48-16:16/28	06:53 14:39-15:52/73 16:17
3	05:16 20:24	05:42 20:03	06:13 17:51-18:14/23 19:17	06:44 16:13-18:03/110 18:26	06:19 15:03-15:50/47 16:39 15:50-16:16/26	06:54 14:38-15:51/73 16:16
4	05:17 20:23	05:43 20:02	06:14 17:48-18:17/29 19:15	06:45 16:13-18:01/108 18:24	06:20 15:02-15:51/49 16:38 15:51-16:14/23	06:55 14:38-15:51/73 16:16
5	05:17 20:23	05:44 20:01	06:15 17:46-18:18/32 19:14	06:46 16:12-18:00/108 18:22 17:59-18:00/1	06:22 15:01-15:51/50 16:37 15:51-16:13/22	06:56 14:37-15:51/74 16:16
6	05:18 20:23	05:45 19:58	06:16 16:59-17:18/19 19:12 17:44-18:20/36	06:47 16:12-17:58/106 18:21	06:23 15:00-15:53/53 16:36 15:53-16:12/19	06:57 14:37-15:51/74 16:16
7	05:19 20:23	05:46 19:57	06:17 16:55-17:22/27 19:10 17:42-18:21/39	06:48 16:12-17:56/104 18:19	06:24 14:59-15:53/54 16:35 15:53-16:11/18	06:58 14:37-15:50/73 16:16
8	05:19 20:22	05:47 19:56	06:18 16:51-17:25/34 19:08 17:40-18:22/42	06:49 16:12-17:54/102 18:17	06:25 14:59-15:54/55 16:33 15:54-16:09/15	06:59 14:37-15:50/73 16:16
9	05:20 20:22	05:48 19:54	06:19 16:48-17:27/39 19:07 17:39-18:22/43	06:50 16:11-17:52/101 18:16	06:26 14:59-15:55/56 16:32 15:55-16:09/14	07:00 14:37-15:50/73 16:16
10	05:21 20:22	05:49 19:53	06:20 16:45-17:29/44 19:05 17:38-18:23/45	06:51 16:12-17:52/100 18:14	06:28 14:58-15:55/57 16:31 15:55-16:08/13	07:01 14:37-15:51/74 16:16
11	05:21 20:21	05:50 19:52	06:21 16:42-17:31/49 19:03 17:36-18:23/47	06:53 16:12-17:50/98 18:12	06:29 14:58-15:55/57 16:30 15:55-16:06/11	07:02 14:36-15:50/74 16:16
12	05:22 20:21	05:51 19:50	06:22 16:40-17:32/52 19:02 17:35-18:24/49	06:54 16:12-17:48/96 18:11	06:30 14:57-15:56/59 16:29 15:56-16:05/9	07:02 14:37-15:50/73 16:16
13	05:23 20:20	05:52 19:49	06:23 16:38-17:33/55 19:00 17:34-18:24/50	06:55 16:12-17:46/94 18:09	06:31 14:57-15:57/60 16:28 15:57-16:05/8	07:03 14:37-15:50/73 16:16
14	05:24 20:20	05:53 19:48	06:24 16:36-18:23/107 18:58	06:56 16:13-17:45/92 18:08	06:32 14:57-15:57/60 16:27 15:57-16:03/6	07:04 14:38-15:51/73 16:16
15	05:24 20:19	05:54 19:46	06:25 16:33-18:23/110 18:56	06:57 16:13-17:43/90 18:06 16:56-17:07/11	06:34 14:57-15:57/60 16:27 15:57-16:02/5	07:05 14:37-15:50/73 16:17
16	05:25 20:19	05:55 19:45	06:26 16:31-18:23/112 18:55	06:58 16:13-17:41/88 18:04 16:52-17:11/19	06:35 14:57-15:58/61 16:26 15:58-16:02/4	07:06 14:38-15:51/73 16:17
17	05:26 20:18	05:56 19:43	06:27 16:29-18:23/114 18:53	06:59 16:15-17:40/85 18:03	06:36 14:57-15:58/61 16:25 15:58-16:01/3	07:06 14:38-15:51/73 16:17
18	05:27 20:17	05:57 19:42	06:28 16:28-18:23/115 18:51	07:00 16:15-17:39/84 18:01	06:37 14:57-15:58/61 16:24 15:58-16:00/2	07:07 14:38-15:51/73 16:17
19	05:28 20:17	05:58 19:41	06:29 16:26-18:22/116 18:50	07:01 16:16-17:37/81 18:00	06:38 14:57-15:58/61 16:23	07:07 14:39-15:52/73 16:18
20	05:29 20:16	05:59 19:39	06:30 16:25-18:22/117 18:48	07:03 16:17-17:35/78 17:58	06:40 14:58-15:58/60 16:23	07:08 14:40-15:52/72 16:18
21	05:29 20:15	06:00 19:38	06:31 16:23-18:21/118 18:46	07:04 16:18-17:33/75 17:57 16:42-17:19/37	06:41 14:58-15:57/59 16:22	07:09 14:40-15:52/72 16:19
22	05:30 20:14	06:01 19:36	06:32 16:22-18:21/119 18:44	07:05 16:19-17:22/63 17:55 17:25-17:33/8	06:42 14:58-15:56/58 16:21	07:09 14:41-15:53/72 16:19
23	05:31 20:14	06:02 19:35	06:33 16:21-18:20/119 18:43	07:06 16:20-17:21/61 17:54	06:43 14:58-15:56/58 16:21	07:10 14:41-15:53/72 16:20
24	05:32 20:13	06:03 19:33	06:35 16:20-18:18/118 18:41	07:07 16:22-17:21/59 17:52	06:44 14:59-15:56/57 16:20	07:10 14:41-15:54/73 16:20
25	05:33 20:12	06:04 19:31	06:36 16:20-18:17/117 18:39	07:08 16:23-17:22/59 17:51	06:46 14:50-14:55/5 16:20 15:00-15:55/55	07:10 14:42-15:55/73 16:21
26	05:34 20:11	06:05 19:30	06:37 16:19-18:16/117 18:37	07:10 16:22-16:33/11 17:50 16:33-17:23/50	06:47 14:46-15:54/68 16:19	07:11 14:42-15:55/73 16:22
27	05:35 20:10	06:06 19:28	06:38 16:18-18:14/116 18:36	07:11 16:17-16:38/21 17:48 16:38-17:23/45	06:48 14:43-15:53/70 16:19	07:11 14:43-15:55/72 16:22
28	05:36 20:09	06:07 19:27	06:39 16:17-18:12/115 18:34	07:12 16:13-16:41/28 17:47 16:40-17:23/43	06:49 14:42-15:53/71 16:18	07:12 14:44-15:57/73 16:23
29	05:37 20:08	06:08 19:25	06:40 16:16-18:10/114 18:32	07:13 16:10-16:43/33 17:46 16:42-17:22/40	06:50 14:40-15:52/72 16:18	07:12 14:44-15:57/73 16:24
30	05:38 20:07	06:09 19:23	06:41 16:15-18:09/114 18:31	07:14 16:09-16:46/37 17:44 16:45-17:21/36	06:51 14:40-15:53/73 16:17	07:12 14:45-15:58/73 16:24
31	05:39 20:06	06:10 19:22		07:16 16:07-16:47/40 17:43 16:46-17:20/34		07:12 14:46-15:59/73 16:25
Potential sun hours	461	429	375	344	297	286
Sum of minutes with flicker	0	0	2728	2688	2010	2262

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

Project:
Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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Calculated:
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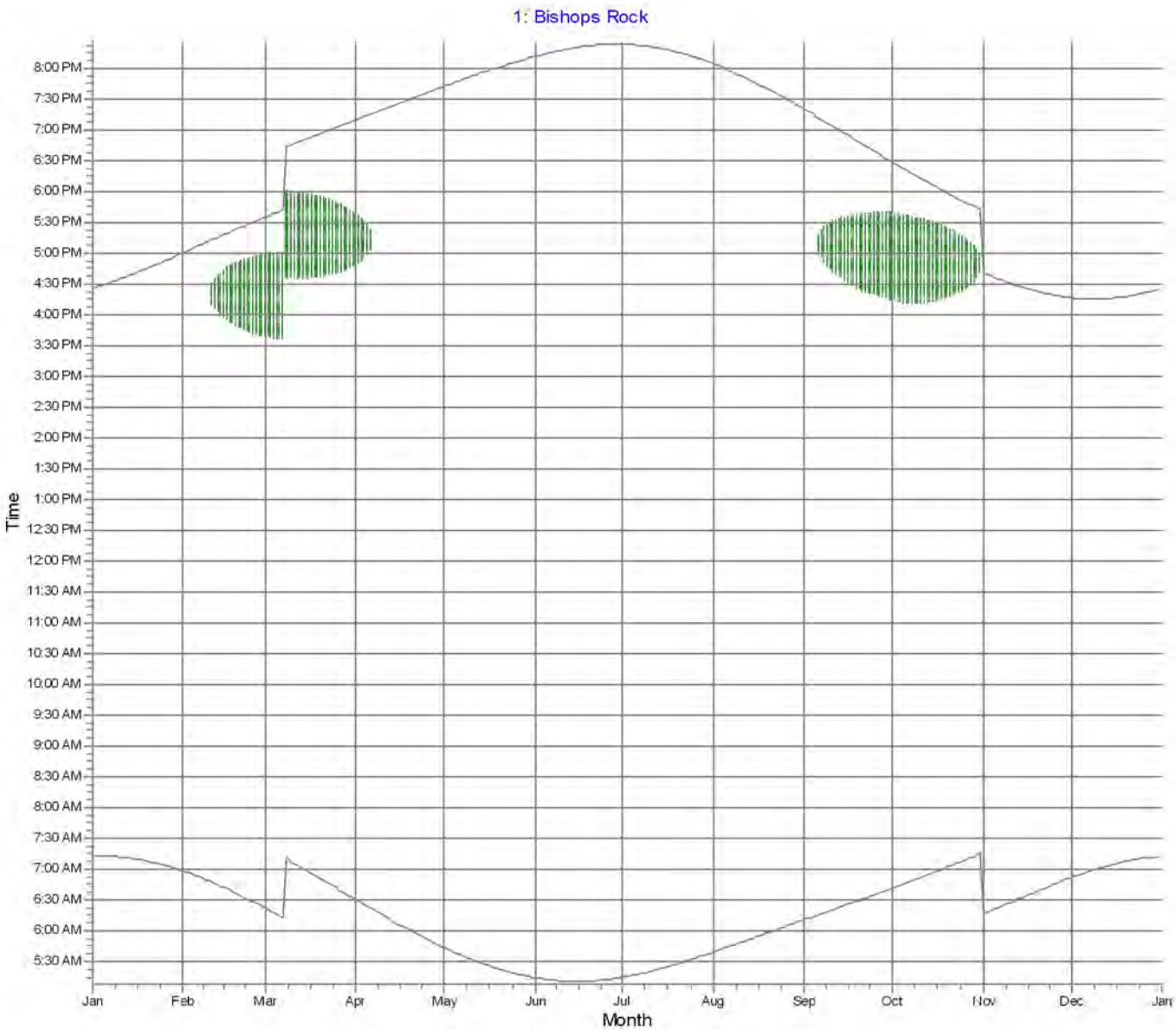
SHADOW - Calendar per WTG, graphical

WTG: 1 - Bishops Rock



WTGs

A: 9A

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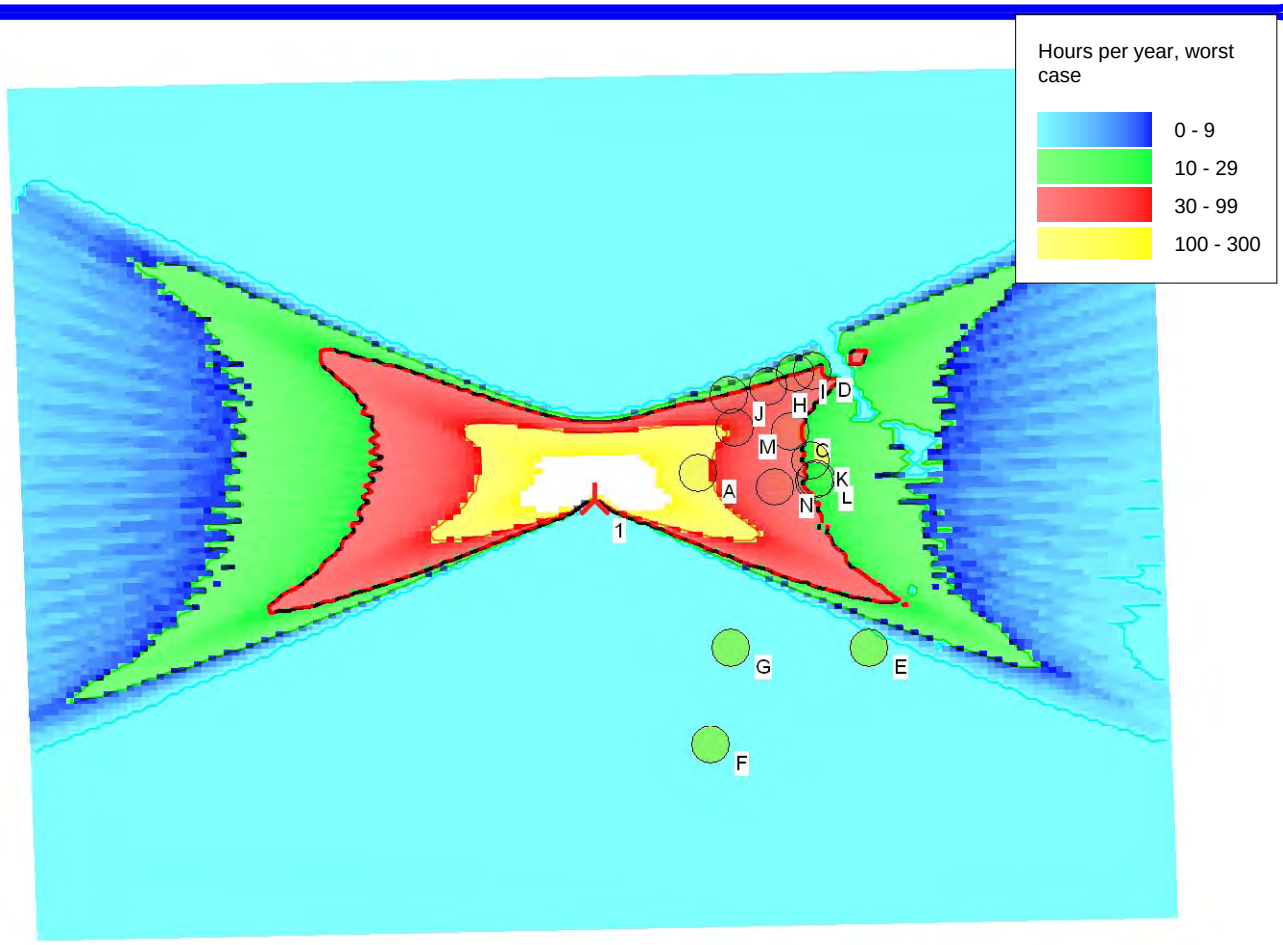
SHADOW - Map



0 250 500 750 1000m

Map: , Print scale 1:20,000, Map center Geo WGS 84 East: -71.330579° North: 41.517574°

New WTG
Shadow receptor

Isolines showing shadow in Hours per year, worst case

0 10 30 100

APPENDIX 10A

WIND TURBINE SITE 10A PRICHARD FIELD NORTH

Figure A-10a: Maximum predicted shadow flicker levels (hours per year) for a Vestas V112-3.0 MW Model at Wind Turbine Site 10a (Prichard Field North).

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SHADOW - Main Result

Assumptions for shadow calculations

Maximum distance for influence
Calculate only when more than 20 % of sun is covered by the blade
Please look in WTG table

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

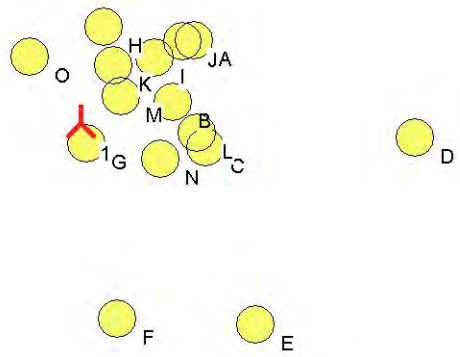
Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW
691	432	259	155	155	155	432	518	950	1,209	864	518

W	WNW	NW	NNW	Sum
432	604	691	691	8,756

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: Line object
Obstacles used in calculation
Eye height: 1.5 m
Grid resolution: 10 m



Scale 1:20,000
New WTG
Shadow receptor

WTGs

	Geo DD: WGS 84 Longitude	Latitude	Z [m]	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Shadow data Calculation distance [m]	RPM [RPM]
1	-71.327303° East	41.519213° North	6.6	Prichard Field North	Yes	VESTAS	V112-3,000	3,000	112.0	84.0	2,000	12.8

Shadow receptor-Input

No.	Name	Geo DD: WGS 84 Longitude	Latitude	Z [m]	Width [m]	Height [m]	Height a.g.l. [m]	Degrees from south cw [°]	Slope of window [°]	Direction mode
A	10aA	-71.323707° East	41.521833° North	18.3	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
B	10aB	-71.324394° East	41.519882° North	17.6	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
C	10aC	-71.323329° East	41.518445° North	20.6	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
D	10aD	-71.316681° East	41.518732° North	7.9	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
E	10aE	-71.321741° East	41.512816° North	4.3	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
F	10aF	-71.326164° East	41.513002° North	4.6	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
G	10aG	-71.327139° East	41.518566° North	2.0	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
H	10aH	-71.326586° East	41.522263° North	0.0	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
I	10aI	-71.324959° East	41.521267° North	19.8	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
J	10aJ	-71.324062° East	41.521799° North	19.8	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
K	10aK	-71.326263° East	41.521025° North	15.1	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
L	10aL	-71.323604° East	41.518912° North	11.5	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
M	10aM	-71.326035° East	41.520060° North	18.3	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
N	10aN	-71.324769° East	41.518087° North	6.8	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
O	10aO	-71.328931° East	41.521321° North	0.0	1.0	1.0	1.0	-180.0	90.0	"Green house mode"

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SHADOW - Main Result

Calculation Results

Shadow receptor

		Shadow, worst case			Shadow, expected values
No.	Name	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	10aA	83:48	89	1:07	26:57
B	10aB	162:08	131	1:38	52:09
C	10aC	152:30	140	1:18	52:02
D	10aD	12:40	38	0:29	4:06
E	10aE	0:00	0	0:00	0:00
F	10aF	0:00	0	0:00	0:00
G	10aG	0:00	0	0:00	0:00
H	10aH	0:00	0	0:00	0:00
I	10aI	134:24	104	1:32	44:27
J	10aJ	80:03	84	1:10	26:05
K	10aK	178:41	106	2:02	64:08
L	10aL	162:21	168	1:22	53:00
M	10aM	518:19	233	2:47	175:57
N	10aN	23:02	36	0:49	8:41
O	10aO	147:14	106	1:39	55:51

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

No.	Name	Worst case [h/year]	Expected [h/year]
1	Prichard Field North	1123:31	388:43

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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SHADOW - Calendar

Shadow receptor: A - 10aA

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January			February			March	April	May	June	July	August	September	October	November			December		
1	07:12		14:37 (1)	06:58		15:08 (1)	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17			06:52		14:26 (1)
	16:26	67	15:44 (1)	17:01	29	15:37 (1)	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42			16:17	63	15:29 (1)
2	07:13		14:38 (1)	06:57		15:11 (1)	06:20	06:29	05:43	05:14	05:16	05:41	06:12	06:43	06:18			06:53		14:26 (1)
	16:27	66	15:44 (1)	17:02	24	15:35 (1)	17:37	19:11	19:44	20:13	20:24	20:04	19:19	18:27	16:40			16:17	64	15:30 (1)
3	07:13		14:38 (1)	06:56		15:15 (1)	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19			06:54		14:26 (1)
	16:28	66	15:44 (1)	17:03	16	15:31 (1)	17:38	19:13	19:45	20:14	20:24	20:03	19:17	18:26	16:39			16:16	64	15:30 (1)
4	07:13		14:39 (1)	06:55			06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20			06:55		14:26 (1)
	16:29	66	15:45 (1)	17:05			17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38			16:16	65	15:31 (1)
5	07:13		14:40 (1)	06:54			06:15	06:24	05:39	05:13	05:17	05:44	06:15	06:46	06:22			06:56		14:26 (1)
	16:30	65	15:45 (1)	17:06			17:40	19:15	19:47	20:15	20:23	20:01	19:14	18:22	16:37			16:16	65	15:31 (1)
6	07:13		14:40 (1)	06:53			06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23			06:57		14:26 (1)
	16:31	66	15:46 (1)	17:07			17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36			16:16	66	15:32 (1)
7	07:13		14:41 (1)	06:52			06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24		14:52 (1)	06:58		14:27 (1)
	16:32	65	15:46 (1)	17:09			17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:35	2	14:54 (1)	16:16	65	15:32 (1)
8	07:12		14:42 (1)	06:51			07:11	06:19	05:35	05:12	05:19	05:47	06:18	06:49	06:25		14:44 (1)	06:59		14:27 (1)
	16:33	65	15:47 (1)	17:10			18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	18	15:02 (1)	16:16	66	15:33 (1)
9	07:12		14:42 (1)	06:50			07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26		14:41 (1)	07:00		14:27 (1)
	16:34	64	15:46 (1)	17:11			18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16	16:32	25	15:06 (1)	16:16	66	15:33 (1)
10	07:12		14:42 (1)	06:48			07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28		14:38 (1)	07:01		14:28 (1)
	16:35	65	15:47 (1)	17:12			18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	30	15:08 (1)	16:16	66	15:34 (1)
11	07:12		14:43 (1)	06:47			07:06	06:14	05:32	05:12	05:21	05:50	06:21	06:53	06:29		14:36 (1)	07:02		14:27 (1)
	16:36	64	15:47 (1)	17:14			18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	34	15:10 (1)	16:16	67	15:34 (1)
12	07:12		14:43 (1)	06:46			07:04	06:12	05:31	05:11	05:22	05:51	06:22	06:54	06:30		14:34 (1)	07:02		14:28 (1)
	16:37	64	15:47 (1)	17:15			18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	37	15:11 (1)	16:16	66	15:34 (1)
13	07:11		14:44 (1)	06:45			07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31		14:33 (1)	07:03		14:29 (1)
	16:38	63	15:47 (1)	17:16			18:49	19:23	19:56	20:20	20:20	19:49	19:00	18:09	16:28	41	15:14 (1)	16:16	66	15:35 (1)
14	07:11		14:45 (1)	06:43			07:01	06:09	05:28	05:11	05:24	05:53	06:24	06:56	06:32		14:32 (1)	07:04		14:29 (1)
	16:39	62	15:47 (1)	17:17			18:51	19:24	19:57	20:20	20:20	19:48	18:58	18:07	16:27	43	15:15 (1)	16:16	67	15:36 (1)
15	07:10		14:46 (1)	06:42			06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34		14:30 (1)	07:05		14:29 (1)
	16:40	61	15:47 (1)	17:19			18:52	19:26	19:58	20:21	20:19	19:46	18:56	18:06	16:27	46	15:16 (1)	16:17	66	15:35 (1)
16	07:10		14:47 (1)	06:41			06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35		14:30 (1)	07:05		14:30 (1)
	16:41	61	15:48 (1)	17:20			18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:26	48	15:18 (1)	16:17	66	15:36 (1)
17	07:10		14:47 (1)	06:39			06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36		14:29 (1)	07:06		14:30 (1)
	16:42	60	15:47 (1)	17:21			18:54	19:28	20:00	20:22	20:18	19:43	18:53	18:03	16:25	49	15:18 (1)	16:17	67	15:37 (1)
18	07:09		14:48 (1)	06:38			06:54	06:03	05:25	05:11	05:27	05:57	06:28	07:00	06:37		14:28 (1)	07:07		14:30 (1)
	16:44	59	15:47 (1)	17:22			18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	51	15:19 (1)	16:17	67	15:37 (1)
19	07:08		14:49 (1)	06:37			06:52	06:01	05:24	05:11	05:28	05:58	06:29	07:01	06:38		14:27 (1)	07:07		14:31 (1)
	16:45	58	15:47 (1)	17:24			18:56	19:30	20:00	20:22	20:17	19:41	18:50	18:00	16:23	53	15:20 (1)	16:18	67	15:38 (1)
20	07:08		14:50 (1)	06:35			06:51	06:00	05:23	05:12	05:28	05:59	06:30	07:03	06:40		14:27 (1)	07:08		14:32 (1)
	16:46	57	15:47 (1)	17:25			18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:23	55	15:22 (1)	16:18	67	15:39 (1)
21	07:07		14:50 (1)	06:34			06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41		14:26 (1)	07:09		14:32 (1)
	16:47	56	15:46 (1)	17:26			18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	56	15:22 (1)	16:19	67	15:39 (1)
22	07:07		14:52 (1)	06:32			06:47	05:57	05:21	05:12	05:30	06:01	06:32	07:05	06:42		14:26 (1)	07:09		14:33 (1)
	16:48	55	15:47 (1)	17:27			18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	57	15:23 (1)	16:19	67	15:40 (1)
23	07:06		14:53 (1)	06:31			06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43		14:25 (1)	07:10		14:33 (1)
	16:50	53	15:46 (1)	17:28			19:01	19:34	20:04	20:23	20:14	19:35	18:43	17:54	16:21	58	15:23 (1)	16:20	67	15:40 (1)
24	07:05		14:54 (1)	06:29			06:44	05:54	05:20	05:13	05:32	06:03	06:34	07:07	06:44		14:26 (1)	07:10		14:33 (1)
	16:51	51	15:45 (1)	17:30			19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	59	15:25 (1)	16:20	67	15:40 (1)
25	07:05		14:55 (1)	06:28			06:42	05:52	05:19	05:13	05:33	06:04	06:36	07:08	06:45		14:25 (1)	07:10		14:34 (1)
	16:52	49	15:44 (1)	17:31			19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	60	15:25 (1)	16:21	67	15:41 (1)
26	07:04		14:57 (1)	06:26			06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10	06:47		14:25 (1)	07:11		14:34 (1)
	16:53	48	15:45 (1)	17:32			19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	61	15:26 (1)	16:21	67	15:41 (1)
27	07:03		14:58 (1)	06:25			06:39	05:49	05:17	05:13	05:35	06:06	06:38	07:11	06:48		14:25 (1)	07:11		14:35 (1)
	16:55	46	15:44 (1)	17:33			19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:18	61	15:26 (1)	16:22	66	15:41 (1)
28	07:02		15:00 (1)	06:23			06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49		14:25 (1)	07:12		14:36 (1)
	16:56	43	15:43 (1)	17:34			19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	62	15:27 (1)	16:23	66	15:42 (1)
29	07:01		15:01 (1)				06:35	05:47	05:16	05:14	05:37	06:08	06:40	07:13	06:50		14:25 (1)	07:12		14:36 (1)
	16:57	41	15:42 (1)				19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:46	16:18	62	15:27 (1)	16:24	67	15:43 (1)
30	07:00		15:03 (1)				06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51		14:25 (1)	07:12		14:36 (1)
	16:58	37	15:40 (1)				19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	64	15:29 (1)	16:24	67	15:43 (1)
31	06:59		15:05 (1)				06:32		05:15		05:39	06:10		07:16				07:12		14:37 (1)
	17:00	34	15:39 (1)				19:09		20:11		20:06	19:22		17:43				16:25	66	15:43 (1)
Potential sun hours	296			297			370	400	450	454	461	429	375	344	297			286		
Total, worst case		1777			69											1132			2050	
Sun reduction		0.56			0.58											0.50			0.52	
Oper. time red.		1.00			1.00											1.00			1.00	
Wind dir. red.		0.61			0.61											0.61			0.61	
Total reduction		0.34			0.35											0.30			0.32	
Total, real		604			24											344			646	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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Calculated:
4/5/2011 11:01 PM/2.7.473

SHADOW - Calendar

Shadow receptor: B - 10aB

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February			March			April			May	June
1	07:12	06:58			06:22		15:42 (1)	06:30		16:41 (1)	05:44	05:15
	16:26	17:01			17:36	88	17:10 (1)	19:10	79	18:00 (1)	19:43	20:12
2	07:13	06:57			06:20		15:42 (1)	06:29		16:42 (1)	05:43	05:14
	16:27	17:02			17:37	89	17:11 (1)	19:11	77	17:59 (1)	19:44	20:13
3	07:13	06:56			06:19		15:41 (1)	06:27		16:43 (1)	05:41	05:14
	16:28	17:03			17:38	90	17:11 (1)	19:13	75	17:58 (1)	19:45	20:14
4	07:13	06:55			06:17		15:39 (1)	06:25		16:44 (1)	05:40	05:13
	16:29	17:05			17:39	92	17:11 (1)	19:14	72	17:56 (1)	19:46	20:14
5	07:13	06:54			06:15		15:39 (1)	06:24		16:46 (1)	05:39	05:13
	16:30	17:06			17:40	93	17:12 (1)	19:15	69	17:55 (1)	19:47	20:15
6	07:13	06:53			06:14		15:38 (1)	06:22		16:47 (1)	05:37	05:13
	16:31	17:07			17:41	94	17:12 (1)	19:16	66	17:53 (1)	19:48	20:16
7	07:13	06:52			06:12		15:38 (1)	06:20		16:48 (1)	05:36	05:12
	16:32	17:09			17:43	95	17:13 (1)	19:17	63	17:51 (1)	19:49	20:16
8	07:12	06:51			07:11		16:37 (1)	06:19		16:50 (1)	05:35	05:12
	16:33	17:10			18:44	96	18:13 (1)	19:18	60	17:50 (1)	19:50	20:17
9	07:12	06:50			07:09		16:37 (1)	06:17		16:51 (1)	05:34	05:12
	16:34	17:11			18:45	95	18:12 (1)	19:19	56	17:47 (1)	19:51	20:18
10	07:12	06:48			07:07		16:37 (1)	06:15		16:52 (1)	05:33	05:12
	16:35	17:12			18:46	96	18:13 (1)	19:20	53	17:45 (1)	19:52	20:18
11	07:12	06:47		16:20 (1)	07:06		16:36 (1)	06:14		16:55 (1)	05:32	05:12
	16:36	17:14	14	16:34 (1)	18:47	97	18:13 (1)	19:21	48	17:43 (1)	19:53	20:19
12	07:12	06:46		16:14 (1)	07:04		16:35 (1)	06:12		16:57 (1)	05:31	05:11
	16:37	17:15	27	16:41 (1)	18:48	97	18:12 (1)	19:22	43	17:40 (1)	19:54	20:19
13	07:11	06:45		16:10 (1)	07:02		16:36 (1)	06:10		17:00 (1)	05:29	05:11
	16:38	17:16	35	16:45 (1)	18:49	97	18:13 (1)	19:23	38	17:38 (1)	19:56	20:20
14	07:11	06:43		16:06 (1)	07:01		16:35 (1)	06:09		17:02 (1)	05:28	05:11
	16:39	17:17	42	16:48 (1)	18:51	98	18:13 (1)	19:24	32	17:34 (1)	19:57	20:20
15	07:10	06:42		16:04 (1)	06:59		16:35 (1)	06:07		17:06 (1)	05:27	05:11
	16:40	17:19	47	16:51 (1)	18:52	97	18:12 (1)	19:26	24	17:30 (1)	19:58	20:21
16	07:10	06:41		16:02 (1)	06:57		16:34 (1)	06:06		17:13 (1)	05:26	05:11
	16:41	17:20	52	16:54 (1)	18:53	97	18:11 (1)	19:27	11	17:24 (1)	19:59	20:21
17	07:10	06:39		15:59 (1)	06:56		16:35 (1)	06:04			05:25	05:11
	16:42	17:21	56	16:55 (1)	18:54	97	18:12 (1)	19:28			20:00	20:22
18	07:09	06:38		15:57 (1)	06:54		16:35 (1)	06:03			05:25	05:11
	16:44	17:22	61	16:58 (1)	18:55	96	18:11 (1)	19:29			20:00	20:22
19	07:08	06:37		15:55 (1)	06:52		16:35 (1)	06:01			05:24	05:11
	16:45	17:24	64	16:59 (1)	18:56	95	18:10 (1)	19:30			20:00	20:22
20	07:08	06:35		15:54 (1)	06:51		16:35 (1)	06:00			05:23	05:12
	16:46	17:25	67	17:01 (1)	18:57	96	18:11 (1)	19:31			20:01	20:23
21	07:07	06:34		15:52 (1)	06:49		16:35 (1)	05:58			05:22	05:12
	16:47	17:26	70	17:02 (1)	18:58	95	18:10 (1)	19:32			20:02	20:23
22	07:07	06:32		15:51 (1)	06:47		16:35 (1)	05:57			05:21	05:12
	16:48	17:27	72	17:03 (1)	18:59	94	18:09 (1)	19:33			20:03	20:23
23	07:06	06:31		15:49 (1)	06:45		16:36 (1)	05:55			05:20	05:12
	16:50	17:28	75	17:04 (1)	19:01	93	18:09 (1)	19:34			20:04	20:23
24	07:05	06:29		15:48 (1)	06:44		16:36 (1)	05:54			05:20	05:13
	16:51	17:30	78	17:06 (1)	19:02	92	18:08 (1)	19:35			20:05	20:23
25	07:05	06:28		15:46 (1)	06:42		16:36 (1)	05:52			05:19	05:13
	16:52	17:31	80	17:06 (1)	19:03	91	18:07 (1)	19:36			20:06	20:24
26	07:04	06:26		15:45 (1)	06:40		16:37 (1)	05:51			05:18	05:13
	16:53	17:32	83	17:08 (1)	19:04	89	18:06 (1)	19:37			20:07	20:24
27	07:03	06:25		15:44 (1)	06:39		16:38 (1)	05:49			05:17	05:14
	16:55	17:33	84	17:08 (1)	19:05	88	18:06 (1)	19:39			20:08	20:24
28	07:02	06:23		15:43 (1)	06:37		16:38 (1)	05:48			05:17	05:14
	16:56	17:34	86	17:09 (1)	19:06	86	18:04 (1)	19:40			20:09	20:24
29	07:01				06:35		16:38 (1)	05:47			05:16	05:14
	16:57				19:07	85	18:03 (1)	19:41			20:10	20:24
30	07:00				06:34		16:40 (1)	05:45			05:16	05:15
	16:58				19:08	83	18:03 (1)	19:42			20:10	20:24
31	06:59				06:32		16:40 (1)				05:15	
	17:00				19:09	81	18:01 (1)				20:11	
Potential sun hours	296	297			370			400			450	454
Total, worst case			1093			2872			866			
Sun reduction			0.58			0.58			0.57			
Oper. time red.			1.00			1.00			1.00			
Wind dir. red.			0.54			0.54			0.54			
Total reduction			0.31			0.31			0.31			
Total, real			341			897			266			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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SHADOW - Calendar

Shadow receptor: B - 10aB

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	July	August		September		October		November	December
1	05:15	05:40		06:11		16:54 (1)	06:42	16:15 (1)	06:17	06:52
	20:24	20:05		19:20	48	17:42 (1)	18:29	97	17:52 (1)	16:42	16:17
2	05:16	05:41		06:12		16:51 (1)	06:43	16:15 (1)	06:18	06:53
	20:24	20:04		19:19	53	17:44 (1)	18:27	97	17:52 (1)	16:40	16:17
3	05:16	05:42		06:13		16:49 (1)	06:44	16:14 (1)	06:19	06:54
	20:24	20:03		19:17	56	17:45 (1)	18:26	97	17:51 (1)	16:39	16:16
4	05:17	05:43		06:14		16:47 (1)	06:45	16:14 (1)	06:20	06:55
	20:23	20:02		19:15	60	17:47 (1)	18:24	96	17:50 (1)	16:38	16:16
5	05:17	05:44		06:15		16:45 (1)	06:46	16:14 (1)	06:22	06:56
	20:23	20:01		19:14	63	17:48 (1)	18:22	95	17:49 (1)	16:37	16:16
6	05:18	05:45		06:16		16:43 (1)	06:47	16:14 (1)	06:23	06:57
	20:23	19:58		19:12	66	17:49 (1)	18:20	95	17:49 (1)	16:36	16:16
7	05:19	05:46		06:17		16:41 (1)	06:48	16:14 (1)	06:24	06:58
	20:23	19:57		19:10	69	17:50 (1)	18:19	94	17:48 (1)	16:35	16:16
8	05:19	05:47		06:18		16:39 (1)	06:49	16:14 (1)	06:25	06:59
	20:22	19:56		19:08	72	17:51 (1)	18:17	93	17:47 (1)	16:33	16:16
9	05:20	05:48		06:19		16:37 (1)	06:50	16:14 (1)	06:26	07:00
	20:22	19:54		19:07	75	17:52 (1)	18:16	92	17:46 (1)	16:32	16:16
10	05:21	05:49		06:20		16:36 (1)	06:51	16:15 (1)	06:28	07:01
	20:22	19:53		19:05	76	17:52 (1)	18:14	91	17:46 (1)	16:31	16:16
11	05:21	05:50		06:21		16:34 (1)	06:53	16:15 (1)	06:29	07:02
	20:21	19:52		19:03	79	17:53 (1)	18:12	90	17:45 (1)	16:30	16:16
12	05:22	05:51		06:22		16:33 (1)	06:54	16:15 (1)	06:30	07:02
	20:21	19:50		19:02	80	17:53 (1)	18:11	89	17:44 (1)	16:29	16:16
13	05:23	05:52		06:23		16:31 (1)	06:55	16:16 (1)	06:31	07:03
	20:20	19:49		19:00	83	17:54 (1)	18:09	87	17:43 (1)	16:28	16:16
14	05:24	05:53		06:24		16:29 (1)	06:56	16:16 (1)	06:32	07:04
	20:20	19:48		18:58	84	17:53 (1)	18:07	85	17:41 (1)	16:27	16:16
15	05:24	05:54		06:25		16:27 (1)	06:57	16:17 (1)	06:34	07:05
	20:19	19:46		18:56	87	17:54 (1)	18:06	83	17:40 (1)	16:27	16:17
16	05:25	05:55		06:26		16:26 (1)	06:58	16:17 (1)	06:35	07:05
	20:19	19:45		18:55	88	17:54 (1)	18:04	82	17:39 (1)	16:26	16:17
17	05:26	05:56		06:27		16:25 (1)	06:59	16:19 (1)	06:36	07:06
	20:18	19:43		18:53	89	17:54 (1)	18:03	79	17:38 (1)	16:25	16:17
18	05:27	05:57		06:28		16:24 (1)	07:00	16:20 (1)	06:37	07:07
	20:17	19:42		18:51	90	17:54 (1)	18:01	77	17:37 (1)	16:24	16:17
19	05:28	05:58		06:29		16:23 (1)	07:01	16:21 (1)	06:38	07:07
	20:17	19:41		18:50	91	17:54 (1)	18:00	74	17:35 (1)	16:23	16:18
20	05:28	05:59		06:30		16:22 (1)	07:03	16:21 (1)	06:40	07:08
	20:16	19:39		18:48	92	17:54 (1)	17:58	72	17:33 (1)	16:23	16:18
21	05:29	06:00		06:31		16:21 (1)	07:04	16:23 (1)	06:41	07:09
	20:15	19:38		18:46	93	17:54 (1)	17:57	69	17:32 (1)	16:22	16:19
22	05:30	06:01		06:32		16:20 (1)	07:05	16:25 (1)	06:42	07:09
	20:14	19:36		18:44	94	17:54 (1)	17:55	66	17:31 (1)	16:21	16:19
23	05:31	06:02		06:33		16:19 (1)	07:06	16:26 (1)	06:43	07:10
	20:14	19:35		18:43	95	17:54 (1)	17:54	63	17:29 (1)	16:21	16:20
24	05:32	06:03		06:34		16:18 (1)	07:07	16:27 (1)	06:44	07:10
	20:13	19:33		18:41	96	17:54 (1)	17:52	60	17:27 (1)	16:20	16:20
25	05:33	06:04		06:36		16:17 (1)	07:08	16:29 (1)	06:45	07:10
	20:12	19:31		18:39	97	17:54 (1)	17:51	55	17:24 (1)	16:19	16:21
26	05:34	06:05		06:37		16:18 (1)	07:10	16:32 (1)	06:47	07:11
	20:11	19:30		18:37	96	17:54 (1)	17:50	51	17:23 (1)	16:19	16:21
27	05:35	06:06	17:14 (1)	06:38		16:17 (1)	07:11	16:34 (1)	06:48	07:11
	20:10	19:28	12	17:26 (1)	18:36	97	17:54 (1)	17:48	46	17:20 (1)	16:19	16:22
28	05:36	06:07	17:07 (1)	06:39		16:16 (1)	07:12	16:37 (1)	06:49	07:12
	20:09	19:27	25	17:32 (1)	18:34	98	17:54 (1)	17:47	40	17:17 (1)	16:18	16:23
29	05:37	06:08	17:03 (1)	06:40		16:16 (1)	07:13	16:40 (1)	06:50	07:12
	20:08	19:25	33	17:36 (1)	18:32	97	17:53 (1)	17:46	33	17:13 (1)	16:18	16:24
30	05:38	06:09	17:00 (1)	06:41		16:15 (1)	07:14	16:45 (1)	06:51	07:12
	20:07	19:23	38	17:38 (1)	18:31	98	17:53 (1)	17:44	25	17:10 (1)	16:17	16:24
31	05:39	06:10	16:56 (1)			07:16	16:52 (1)		07:12
	20:06	19:22	44	17:40 (1)			17:43	10	17:02 (1)		16:25
Potential sun hours	461	429		375		344		297	286
Total, worst case		152		2462		2283			
Sun reduction		0.62		0.62		0.61			
Oper. time red.		1.00		1.00		1.00			
Wind dir. red.		0.54		0.54		0.54			
Total reduction		0.33		0.33		0.33			
Total, real		51		824		750			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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Licensed user:
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Calculated:
4/5/2011 11:01 PM/2.7.473

SHADOW - Calendar

Shadow receptor: C - 10aC

Assumptions for shadow calculations

Maximum distance for influence	2,000	m
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Day step for calculation	1	days
Time step for calculation	1	minutes

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April			May			June			July			August			September	October	November	December
1	07:12	06:58	06:22	06:30			05:44		18:10 (1)	05:15		18:12 (1)	05:15		18:21 (1)	05:40		18:17 (1)	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10			19:43	70	19:20 (1)	20:12	70	19:22 (1)	20:24	65	19:26 (1)	20:05	77	19:34 (1)	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:29			05:43		18:08 (1)	05:14		18:13 (1)	05:16		18:20 (1)	05:41		18:17 (1)	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11			19:44	72	19:20 (1)	20:13	69	19:22 (1)	20:24	66	19:26 (1)	20:04	77	19:34 (1)	19:19	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27			05:41		18:08 (1)	05:14		18:13 (1)	05:16		18:21 (1)	05:42		18:17 (1)	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:13			19:45	73	19:21 (1)	20:14	69	19:22 (1)	20:24	66	19:27 (1)	20:03	77	19:34 (1)	19:17	18:26	16:39	16:16
4	07:13	06:55	06:17	06:25			05:40		18:08 (1)	05:13		18:13 (1)	05:17		18:21 (1)	05:43		18:17 (1)	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14			19:46	75	19:23 (1)	20:14	68	19:21 (1)	20:23	66	19:27 (1)	20:02	77	19:34 (1)	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:24			05:39		18:08 (1)	05:13		18:14 (1)	05:17		18:21 (1)	05:44		18:17 (1)	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15			19:47	75	19:23 (1)	20:15	68	19:22 (1)	20:23	66	19:27 (1)	20:01	77	19:34 (1)	19:14	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22			05:37		18:07 (1)	05:13		18:15 (1)	05:18		18:21 (1)	05:45		18:17 (1)	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16			19:48	76	19:23 (1)	20:16	67	19:22 (1)	20:23	67	19:28 (1)	19:58	77	19:34 (1)	19:12	18:20	16:36	16:16
7	07:12	06:52	06:12	06:20			05:36		18:07 (1)	05:12		18:14 (1)	05:19		18:20 (1)	05:46		18:16 (1)	06:17	06:48	06:24	06:58
	16:32	17:09	17:43	19:17			19:49	76	19:23 (1)	20:16	67	19:21 (1)	20:23	68	19:28 (1)	19:57	76	19:32 (1)	19:10	18:19	16:35	16:16
8	07:12	06:51	07:11	06:19			05:35		18:06 (1)	05:12		18:15 (1)	05:19		18:20 (1)	05:47		18:16 (1)	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18			19:50	77	19:23 (1)	20:17	66	19:21 (1)	20:22	69	19:29 (1)	19:56	76	19:32 (1)	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17			05:34		18:06 (1)	05:12		18:16 (1)	05:20		18:21 (1)	05:48		18:17 (1)	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19			19:51	78	19:24 (1)	20:18	65	19:21 (1)	20:22	68	19:29 (1)	19:54	74	19:31 (1)	19:07	18:16	16:32	16:16
10	07:12	06:48	07:07	06:15			05:33		18:06 (1)	05:12		18:16 (1)	05:21		18:20 (1)	05:49		18:17 (1)	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20			19:52	78	19:24 (1)	20:18	66	19:22 (1)	20:22	69	19:29 (1)	19:53	73	19:30 (1)	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14			05:32		18:06 (1)	05:12		18:17 (1)	05:21		18:20 (1)	05:50		18:17 (1)	06:21	06:53	06:29	07:02
	16:36	17:14	18:47	19:21			19:53	78	19:24 (1)	20:19	65	19:22 (1)	20:21	70	19:30 (1)	19:52	72	19:29 (1)	19:03	18:12	16:30	16:16
12	07:11	06:46	07:04	06:12			05:31		18:06 (1)	05:11		18:17 (1)	05:22		18:20 (1)	05:51		18:17 (1)	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22			19:54	78	19:24 (1)	20:19	65	19:22 (1)	20:21	70	19:30 (1)	19:50	70	19:27 (1)	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10		18:43 (1)	05:29		18:06 (1)	05:11		18:18 (1)	05:23		18:19 (1)	05:52		18:18 (1)	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	13	18:56 (1)	19:55	78	19:24 (1)	20:20	64	19:22 (1)	20:20	71	19:30 (1)	19:49	68	19:26 (1)	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09		18:37 (1)	05:28		18:06 (1)	05:11		18:18 (1)	05:24		18:19 (1)	05:53		18:18 (1)	06:24	06:56	06:32	07:04
	16:39	17:17	18:51	19:24	24	19:01 (1)	19:57	78	19:24 (1)	20:20	64	19:22 (1)	20:20	72	19:31 (1)	19:48	67	19:25 (1)	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07		18:32 (1)	05:27		18:07 (1)	05:11		18:18 (1)	05:24		18:19 (1)	05:54		18:18 (1)	06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:26	31	19:03 (1)	19:58	77	19:24 (1)	20:21	64	19:22 (1)	20:19	72	19:31 (1)	19:46	65	19:23 (1)	18:56	18:06	16:27	16:17
16	07:10	06:41	06:57	06:06		18:30 (1)	05:26		18:07 (1)	05:11		18:19 (1)	05:25		18:20 (1)	05:55		18:19 (1)	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	34	19:04 (1)	19:59	77	19:24 (1)	20:21	63	19:22 (1)	20:19	72	19:32 (1)	19:45	63	19:22 (1)	18:55	18:04	16:26	16:17
17	07:10	06:39	06:56	06:04		18:26 (1)	05:25		18:07 (1)	05:11		18:19 (1)	05:26		18:19 (1)	05:56		18:20 (1)	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	39	19:05 (1)	20:00	76	19:23 (1)	20:22	63	19:22 (1)	20:18	72	19:31 (1)	19:43	61	19:21 (1)	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:03		18:25 (1)	05:25		18:07 (1)	05:11		18:19 (1)	05:27		18:19 (1)	05:57		18:20 (1)	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	41	19:06 (1)	20:00	76	19:23 (1)	20:22	63	19:22 (1)	20:17	73	19:32 (1)	19:42	59	19:19 (1)	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01		18:22 (1)	05:24		18:08 (1)	05:11		18:19 (1)	05:28		18:19 (1)	05:58		18:21 (1)	06:29	07:01	06:38	07:07
	16:45	17:24	18:56	19:30	45	19:07 (1)	20:00	76	19:24 (1)	20:22	63	19:22 (1)	20:17	73	19:32 (1)	19:41	57	19:18 (1)	18:50	18:00	16:23	16:18
20	07:08	06:35	06:51	06:00		18:21 (1)	05:23		18:08 (1)	05:12		18:19 (1)	05:28		18:19 (1)	05:59		18:22 (1)	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	48	19:09 (1)	20:01	76	19:24 (1)	20:23	63	19:22 (1)	20:16	74	19:33 (1)	19:39	55	19:17 (1)	18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58		18:19 (1)	05:22		18:08 (1)	05:12		18:19 (1)	05:29		18:18 (1)	06:00		18:23 (1)	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	50	19:09 (1)	20:02	75	19:23 (1)	20:23	63	19:22 (1)	20:15	75	19:33 (1)	19:38	52	19:15 (1)	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:57		18:18 (1)	05:21		18:08 (1)	05:12		18:20 (1)	05:30		18:18 (1)	06:01		18:24 (1)	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	52	19:10 (1)	20:03	75	19:23 (1)	20:23	63	19:23 (1)	20:14	76	19:34 (1)	19:36	50	19:14 (1)	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55		18:16 (1)	05:20		18:08 (1)	05:12		18:20 (1)	05:31		18:18 (1)	06:02		18:25 (1)	06:33	07:06	06:43	07:10
	16:50	17:28	19:01	19:34	55	19:11 (1)	20:04	75	19:23 (1)	20:23	63	19:23 (1)	20:14	76	19:34 (1)	19:34	47	19:12 (1)	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54		18:15 (1)	05:20		18:09 (1)	05:13		18:20 (1)	05:32		18:17 (1)	06:03		18:26 (1)	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	57	19:12 (1)	20:05	74	19:23 (1)	20:23	63	19:23 (1)	20:13	76	19:33 (1)	19:33	45	19:11 (1)	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52		18:14 (1)	05:19		18:09 (1)	05:13		18:21 (1)	05:33		18:17 (1)	06:04		18:28 (1)	06:36	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	60	19:14 (1)	20:06	74	19:23 (1)	20:24	63	19:24 (1)	20:12	77	19:34 (1)	19:31	41	19:09 (1)	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51		18:13 (1)	05:18		18:09 (1)	05:13		18:21 (1)	05:34		18:17 (1)	06:05		18:30 (1)	06:37	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	61	19:14 (1)	20:07	73	19:22 (1)	20:24	63	19:24 (1)	20:11	77	19:34 (1)	19:30	38	19:08 (1)	18:37	17:50	16:19	16:21
27	07:03	06:25	06:39	05:49		18:12 (1)	05:17		18:10 (1)	05:14		18:20 (1)	05:35		18:17 (1)	06:06		18:32 (1)	06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:39	64	19:16 (1)	20:08	73	19:23 (1)	20:24	64	19:24 (1)	20:10	77	19:34 (1)	19:28	34	19:06 (1)	18:36	17:48	16:19	16:22
28	07:02	06:23	06:37	05:48		18:12 (1)	05:17		18:10 (1)	05:14		18:21 (1)	05:36		18:17 (1)	06:07		18:34 (1)	06:39	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	65	19:17 (1)	20:09	72	19:22 (1)	20:24	64	19:25 (1)	20:09	77	19:34 (1)	19:27	31	19:05 (1)	18:34	17:47	16:18	16:23
29	07:01		06:35	05:47		18:10 (1)	05:16		18:11 (1)	05:14		18:21 (1)	05:37		18:17 (1)	06:08		18:38 (1)	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	67	19:17 (1)	20:10	72	19:23 (1)	20:24	64	19:25 (1)	20:08	77	19:34 (1)	19:25	24	19:02 (1)	18:32	17:46	16:18	16:24
30	07:00		06:34	05:45		18:10 (1)	05:16		18:11 (1)	05:15		18:20 (1)	05:38		18:17 (1)	06:09		18:43 (1)	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	69	19:19 (1)	20:10	71	19:22 (1)	20:24	65	19:25 (1)	20:07	77	19:34 (1)	19:23	13	18:56 (1)	18:31	17:44	16:17	16:24
31	06:59		06:32				05:15		18:12 (1)				05:39		18:17 (1)	06:10				07:16		07:12
	17:00		19:09				20:11	70	19:22 (1)				20:06	77	19:34 (1)	19:22				17:43		16:25
Potential sun hours	296	297	370	400			450			454			461			429			375	344	297	286
Total, worst case					875			2324			1947			2231			1773					
Sun reduction					0.57			0.58			0.61			0.63			0.62					
Oper. time red.					1.00			1.00			1.00			1.00			1.00					
Wind dir. red.					0.56			0.56			0.56			0.56			0.56					
Total reduction					0.32			0.33			0.34			0.36			0.35					
Total, real					281			760			670			792			620					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
4/5/2011 11:06 PM / 5

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
4/5/2011 11:01 PM/2.7.473

SHADOW - Calendar

Shadow receptor: D - 10aD

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March		April			May	June	July	August			September			October	November	December
1	07:12	06:58	06:22		06:30		18:29 (1)	05:44	05:15	05:15	05:40			06:11		18:28 (1)	06:42	06:17	06:52
	16:26	17:01	17:36		19:10	19	18:48 (1)	19:43	20:12	20:24	20:05			19:20	22	18:50 (1)	18:29	16:42	16:17
2	07:13	06:57	06:20		06:28		18:28 (1)	05:42	05:14	05:16	05:41			06:12		18:26 (1)	06:43	06:18	06:53
	16:27	17:02	17:37		19:11	21	18:49 (1)	19:44	20:13	20:24	20:04			19:18	25	18:51 (1)	18:27	16:40	16:17
3	07:13	06:56	06:19		06:27		18:28 (1)	05:41	05:14	05:16	05:42			06:13		18:25 (1)	06:44	06:19	06:54
	16:28	17:03	17:38		19:12	23	18:51 (1)	19:45	20:14	20:23	20:03			19:17	27	18:52 (1)	18:25	16:39	16:16
4	07:13	06:55	06:17		06:25		18:27 (1)	05:40	05:13	05:17	05:43			06:14		18:24 (1)	06:45	06:20	06:55
	16:29	17:05	17:39		19:14	25	18:52 (1)	19:46	20:14	20:23	20:02			19:15	28	18:52 (1)	18:24	16:38	16:16
5	07:13	06:54	06:15		06:23		18:26 (1)	05:39	05:13	05:17	05:44			06:15		18:23 (1)	06:46	06:22	06:56
	16:30	17:06	17:40		19:15	26	18:52 (1)	19:47	20:15	20:23	20:01			19:13	29	18:52 (1)	18:22	16:37	16:16
6	07:13	06:53	06:14		06:22		18:27 (1)	05:37	05:13	05:18	05:45			06:16		18:23 (1)	06:47	06:23	06:57
	16:31	17:07	17:41		19:16	27	18:54 (1)	19:48	20:16	20:23	19:58			19:12	27	18:50 (1)	18:20	16:36	16:16
7	07:12	06:52	06:12		06:20		18:26 (1)	05:36	05:12	05:19	05:46			06:17		18:22 (1)	06:48	06:24	06:58
	16:32	17:09	17:43		19:17	29	18:55 (1)	19:49	20:16	20:23	19:57			19:10	27	18:49 (1)	18:19	16:35	16:16
8	07:12	06:51	07:11		06:19		18:27 (1)	05:35	05:12	05:19	05:47			06:18		18:22 (1)	06:49	06:25	06:59
	16:33	17:10	18:44		19:18	28	18:55 (1)	19:50	20:17	20:22	19:56			19:08	25	18:47 (1)	18:17	16:33	16:16
9	07:12	06:50	07:09		06:17		18:27 (1)	05:34	05:12	05:20	05:48			06:19		18:22 (1)	06:50	06:26	07:00
	16:34	17:11	18:45		19:19	27	18:54 (1)	19:51	20:18	20:22	19:54			19:07	23	18:45 (1)	18:16	16:32	16:16
10	07:12	06:48	07:07		06:15		18:27 (1)	05:33	05:12	05:21	05:49			06:20		18:22 (1)	06:51	06:28	07:01
	16:35	17:12	18:46		19:20	25	18:52 (1)	19:52	20:18	20:22	19:53			19:05	22	18:44 (1)	18:14	16:31	16:16
11	07:12	06:47	07:06		06:14		18:29 (1)	05:32	05:12	05:21	05:50			06:21		18:22 (1)	06:52	06:29	07:02
	16:36	17:14	18:47		19:21	22	18:51 (1)	19:53	20:19	20:21	19:52			19:03	20	18:42 (1)	18:12	16:30	16:16
12	07:11	06:46	07:04		06:12		18:29 (1)	05:30	05:11	05:22	05:51			06:22		18:22 (1)	06:54	06:30	07:02
	16:37	17:15	18:48		19:22	20	18:49 (1)	19:54	20:19	20:21	19:50			19:02	17	18:39 (1)	18:11	16:29	16:16
13	07:11	06:45	07:02		06:10		18:31 (1)	05:29	05:11	05:23	05:52			06:23		18:22 (1)	06:55	06:31	07:03
	16:38	17:16	18:49		19:23	17	18:48 (1)	19:55	20:20	20:20	19:49			19:00	15	18:37 (1)	18:09	16:28	16:16
14	07:11	06:43	07:01		06:09		18:33 (1)	05:28	05:11	05:24	05:53			06:24		18:23 (1)	06:56	06:32	07:04
	16:39	17:17	18:51		19:24	11	18:44 (1)	19:56	20:20	20:20	19:48			18:58	13	18:36 (1)	18:07	16:27	16:16
15	07:10	06:42	06:59		06:07			05:27	05:11	05:24	05:54			06:25		18:25 (1)	06:57	06:34	07:05
	16:40	17:19	18:52		19:26			19:57	20:21	20:19	19:46			18:56	9	18:34 (1)	18:06	16:27	16:17
16	07:10	06:41	06:57		06:06			05:26	05:11	05:25	05:55			06:26		18:27 (1)	06:58	06:35	07:05
	16:41	17:20	18:53		19:27			19:58	20:21	20:19	19:45			18:55	5	18:32 (1)	18:04	16:26	16:17
17	07:10	06:39	06:56		06:04			05:25	05:11	05:26	05:56			06:27			06:59	06:36	07:06
	16:42	17:21	18:54		19:28			19:59	20:22	20:18	19:43			18:53			18:03	16:25	16:17
18	07:09	06:38	06:54		06:03			05:24	05:11	05:27	05:57			06:28			07:00	06:37	07:07
	16:44	17:22	18:55		19:29			20:00	20:22	20:17	19:42			18:51			18:01	16:24	16:17
19	07:08	06:37	06:52		06:01			05:24	05:11	05:28	05:58			06:29			07:01	06:38	07:07
	16:45	17:24	18:56		19:30			20:00	20:22	20:17	19:41			18:50			18:00	16:23	16:18
20	07:08	06:35	06:50		06:00			05:23	05:12	05:28	05:59			06:30			07:03	06:40	07:08
	16:46	17:25	18:57		19:31			20:01	20:23	20:16	19:39			18:48			17:58	16:23	16:18
21	07:07	06:34	06:49		05:58			05:22	05:12	05:29	06:00			06:31			07:04	06:41	07:09
	16:47	17:26	18:58		19:32			20:02	20:23	20:15	19:38			18:46			17:57	16:22	16:19
22	07:07	06:32	06:47		05:57			05:21	05:12	05:30	06:01			06:32			07:05	06:42	07:09
	16:48	17:27	18:59		19:33			20:03	20:23	20:14	19:36			18:44			17:55	16:21	16:19
23	07:06	06:31	06:45		05:55			05:20	05:12	05:31	06:02			06:33			07:06	06:43	07:10
	16:50	17:28	19:00		19:34			20:04	20:23	20:14	19:34			18:43			17:54	16:21	16:20
24	07:05	06:29	06:44		05:54			05:20	05:12	05:32	06:03			06:34			07:07	06:44	07:10
	16:51	17:30	19:02		19:35			20:05	20:23	20:13	19:33			18:41			17:52	16:20	16:20
25	07:04	06:28	06:42		05:52			05:19	05:13	05:33	06:04			06:35			07:08	06:45	07:10
	16:52	17:31	19:03		19:36			20:06	20:24	20:12	19:31			18:39			17:51	16:19	16:21
26	07:04	06:26	06:40		05:51			05:18	05:13	05:34	06:05			06:37			07:10	06:47	07:11
	16:53	17:32	19:04		19:37			20:07	20:24	20:11	19:30			18:37			17:50	16:19	16:21
27	07:03	06:25	06:39		18:40 (1)	5:49		05:17	05:13	05:35	06:06			06:38			07:11	06:48	07:11
	16:55	17:33	19:05	4	18:44 (1)	19:39		20:08	20:24	20:10	19:28			18:36			17:48	16:18	16:22
28	07:02	06:23	06:37		18:36 (1)	5:48		05:17	05:14	05:36	06:07			06:39			07:12	06:49	07:11
	16:56	17:34	19:06	9	18:45 (1)	19:40		20:09	20:24	20:09	19:27			18:34			17:47	16:18	16:23
29	07:01		06:35		18:33 (1)	5:46		05:16	05:14	05:37	06:08		18:34 (1)	06:40			07:13	06:50	07:12
	16:57		19:07	12	18:45 (1)	19:41		20:10	20:24	20:08	19:25	12	18:46 (1)	18:32			17:46	16:18	16:24
30	07:00		06:34		18:32 (1)	5:45		05:16	05:15	05:38	06:09		18:31 (1)	06:41			07:14	06:51	07:12
	16:58		19:08	15	18:47 (1)	19:42		20:10	20:24	20:07	19:23	17	18:48 (1)	18:31			17:44	16:17	16:24
31	06:59		06:32		18:31 (1)			05:15		05:39	06:10		18:29 (1)				07:15		07:12
	17:00		19:09	17	18:48 (1)			20:11		20:06	19:22	20	18:49 (1)				17:43		16:25
Potential sun hours	296	297	370			400		450	454	461	429			375			344	297	286
Total, worst case				57			320					49			334				
Sun reduction				0.58			0.57					0.62			0.62				
Oper. time red.				1.00			1.00					1.00			1.00				
Wind dir. red.				0.54			0.54					0.54			0.54				
Total reduction				0.31			0.31					0.34			0.34				
Total, real				18			99					17			113				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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4/5/2011 11:06 PM / 6

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
4/5/2011 11:01 PM/2.7.473

SHADOW - Calendar

Shadow receptor: E - 10aE

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:29	05:43	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:13	19:45	20:14	20:23	20:03	19:17	18:26	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:24	05:39	05:13	05:17	05:44	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24	06:58
	16:32	17:09	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:35	16:16
8	07:12	06:51	07:11	06:19	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:32	05:12	05:21	05:50	06:21	06:53	06:29	07:02
	16:36	17:14	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:11	06:46	07:04	06:12	05:31	05:11	05:22	05:51	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:24	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:51	19:24	19:56	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:26	19:57	20:21	20:19	19:46	18:56	18:06	16:27	16:17
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:58	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:10	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	19:59	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:03	05:25	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:24	05:12	05:28	05:58	06:29	07:01	06:38	07:07
	16:45	17:24	18:56	19:30	20:00	20:22	20:17	19:41	18:50	18:00	16:23	16:18
20	07:08	06:35	06:51	06:00	05:23	05:12	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:57	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:01	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54	05:20	05:13	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:20	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:14	05:35	06:06	06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:19	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:47	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:46	16:18	16:24
30	07:00		06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:15		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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4/5/2011 11:06 PM / 7

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
4/5/2011 11:01 PM/2.7.473

SHADOW - Calendar

Shadow receptor: F - 10aF

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12 16:26	06:58 17:01	06:22 17:36	06:30 19:10	05:44 19:43	05:15 20:12	05:15 20:24	05:40 20:05	06:11 19:20	06:42 18:29	06:17 16:42	06:52 16:17
2	07:13 16:27	06:57 17:02	06:20 17:37	06:29 19:11	05:43 19:44	05:14 20:13	05:16 20:24	05:41 20:04	06:12 19:19	06:43 18:27	06:18 16:40	06:53 16:17
3	07:13 16:28	06:56 17:03	06:19 17:38	06:27 19:13	05:41 19:45	05:14 20:14	05:16 20:24	05:42 20:03	06:13 19:17	06:44 18:26	06:19 16:39	06:54 16:16
4	07:13 16:29	06:55 17:05	06:17 17:39	06:25 19:14	05:40 19:46	05:13 20:14	05:17 20:23	05:43 20:02	06:14 19:15	06:45 18:24	06:20 16:38	06:55 16:16
5	07:13 16:30	06:54 17:06	06:15 17:40	06:24 19:15	05:39 19:47	05:13 20:15	05:17 20:23	05:44 20:01	06:15 19:14	06:46 18:22	06:22 16:37	06:56 16:16
6	07:13 16:31	06:53 17:07	06:14 17:41	06:22 19:16	05:37 19:48	05:13 20:16	05:18 20:23	05:45 19:58	06:16 19:12	06:47 18:21	06:23 16:36	06:57 16:16
7	07:12 16:32	06:52 17:09	06:12 17:43	06:20 19:17	05:36 19:49	05:12 20:16	05:19 20:23	05:46 19:57	06:17 19:10	06:48 18:19	06:24 16:35	06:58 16:16
8	07:12 16:33	06:51 17:10	07:11 18:44	06:19 19:18	05:35 19:50	05:12 20:17	05:19 20:22	05:47 19:56	06:18 19:08	06:49 18:17	06:25 16:33	06:59 16:16
9	07:12 16:34	06:50 17:11	07:09 18:45	06:17 19:19	05:34 19:51	05:12 20:18	05:20 20:22	05:48 19:54	06:19 19:07	06:50 18:16	06:26 16:32	07:00 16:16
10	07:12 16:35	06:48 17:12	07:07 18:46	06:15 19:20	05:33 19:52	05:12 20:18	05:21 20:22	05:49 19:53	06:20 19:05	06:51 18:14	06:28 16:31	07:01 16:16
11	07:12 16:36	06:47 17:14	07:06 18:47	06:14 19:21	05:32 19:53	05:12 20:19	05:21 20:21	05:50 19:52	06:21 19:03	06:53 18:12	06:29 16:30	07:02 16:16
12	07:11 16:37	06:46 17:15	07:04 18:48	06:12 19:22	05:31 19:54	05:11 20:19	05:22 20:21	05:51 19:50	06:22 19:02	06:54 18:11	06:30 16:29	07:02 16:16
13	07:11 16:38	06:45 17:16	07:02 18:49	06:10 19:23	05:29 19:55	05:11 20:20	05:23 20:20	05:52 19:49	06:23 19:00	06:55 18:09	06:31 16:28	07:03 16:16
14	07:11 16:39	06:43 17:17	07:01 18:51	06:09 19:24	05:28 19:57	05:11 20:20	05:24 20:20	05:53 19:48	06:24 18:58	06:56 18:08	06:32 16:27	07:04 16:16
15	07:10 16:40	06:42 17:19	06:59 18:52	06:07 19:26	05:27 19:58	05:11 20:21	05:24 20:19	05:54 19:46	06:25 18:56	06:57 18:06	06:34 16:27	07:05 16:17
16	07:10 16:41	06:41 17:20	06:57 18:53	06:06 19:27	05:26 19:59	05:11 20:21	05:25 20:19	05:55 19:45	06:26 18:55	06:58 18:04	06:35 16:26	07:05 16:17
17	07:10 16:43	06:39 17:21	06:56 18:54	06:04 19:28	05:25 20:00	05:11 20:22	05:26 20:18	05:56 19:43	06:27 18:53	06:59 18:03	06:36 16:25	07:06 16:17
18	07:09 16:44	06:38 17:22	06:54 18:55	06:03 19:29	05:25 20:00	05:11 20:22	05:27 20:17	05:57 19:42	06:28 18:51	07:00 18:01	06:37 16:24	07:07 16:17
19	07:08 16:45	06:37 17:24	06:52 18:56	06:01 19:30	05:24 20:00	05:12 20:22	05:28 20:17	05:58 19:41	06:29 18:50	07:01 18:00	06:38 16:23	07:07 16:18
20	07:08 16:46	06:35 17:25	06:51 18:57	06:00 19:31	05:23 20:01	05:12 20:23	05:29 20:16	05:59 19:39	06:30 18:48	07:03 17:58	06:40 16:23	07:08 16:18
21	07:07 16:47	06:34 17:26	06:49 18:58	05:58 19:32	05:22 20:02	05:12 20:23	05:29 20:15	06:00 19:38	06:31 18:46	07:04 17:57	06:41 16:22	07:09 16:19
22	07:07 16:48	06:32 17:27	06:47 18:59	05:57 19:33	05:21 20:03	05:12 20:23	05:30 20:14	06:01 19:36	06:32 18:44	07:05 17:55	06:42 16:21	07:09 16:19
23	07:06 16:50	06:31 17:28	06:45 19:01	05:55 19:34	05:20 20:04	05:12 20:23	05:31 20:14	06:02 19:35	06:33 18:43	07:06 17:54	06:43 16:21	07:10 16:20
24	07:05 16:51	06:29 17:30	06:44 19:02	05:54 19:35	05:20 20:05	05:13 20:23	05:32 20:13	06:03 19:33	06:34 18:41	07:07 17:52	06:44 16:20	07:10 16:20
25	07:04 16:52	06:28 17:31	06:42 19:03	05:52 19:36	05:19 20:06	05:13 20:24	05:33 20:12	06:04 19:31	06:36 18:39	07:08 17:51	06:45 16:20	07:10 16:21
26	07:04 16:53	06:26 17:32	06:40 19:04	05:51 19:37	05:18 20:07	05:13 20:24	05:34 20:11	06:05 19:30	06:37 18:37	07:10 17:50	06:47 16:19	07:11 16:21
27	07:03 16:55	06:25 17:33	06:39 19:05	05:49 19:39	05:17 20:08	05:14 20:24	05:35 20:10	06:06 19:28	06:38 18:36	07:11 17:48	06:48 16:19	07:11 16:22
28	07:02 16:56	06:23 17:34	06:37 19:06	05:48 19:40	05:17 20:09	05:14 20:24	05:36 20:09	06:07 19:27	06:39 18:34	07:12 17:47	06:49 16:18	07:11 16:23
29	07:01 16:57		06:35 19:07	05:47 19:41	05:16 20:10	05:14 20:24	05:37 20:08	06:08 19:25	06:40 18:32	07:13 17:46	06:50 16:18	07:12 16:24
30	07:00 16:58		06:34 19:08	05:45 19:42	05:16 20:10	05:15 20:24	05:38 20:07	06:09 19:23	06:41 18:31	07:14 17:44	06:51 16:17	07:12 16:24
31	06:59 17:00		06:32 19:09		05:15 20:11		05:39 20:06	06:10 19:22		07:16 17:43		07:12 16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
4/5/2011 11:01 PM/2.7.473

SHADOW - Calendar

Shadow receptor: G - 10aG

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:29	05:43	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:19	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:13	19:45	20:14	20:24	20:03	19:17	18:26	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:24	05:39	05:13	05:17	05:44	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:14	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:21	16:36	16:16
7	07:13	06:52	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24	06:58
	16:32	17:09	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:35	16:16
8	07:12	06:51	07:11	06:19	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:32	05:12	05:21	05:50	06:21	06:53	06:29	07:02
	16:36	17:14	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:12	06:46	07:04	06:12	05:31	05:11	05:22	05:51	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:56	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:24	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:51	19:24	19:57	20:20	20:20	19:48	18:58	18:08	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:26	19:58	20:21	20:19	19:46	18:56	18:06	16:27	16:17
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:10	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	20:00	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:03	05:25	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:24	05:12	05:28	05:58	06:29	07:01	06:38	07:07
	16:45	17:24	18:56	19:30	20:01	20:22	20:17	19:41	18:50	18:00	16:23	16:18
20	07:08	06:35	06:51	06:00	05:23	05:12	05:29	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:57	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:01	19:34	20:04	20:23	20:14	19:35	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54	05:20	05:13	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:05	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:36	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:20	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:14	05:35	06:06	06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:19	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:12
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:47	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:46	16:18	16:24
30	07:00		06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:16		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
4/5/2011 11:01 PM/2.7.473

SHADOW - Calendar

Shadow receptor: H - 10aH

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:29	05:43	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:19	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:13	19:45	20:14	20:24	20:03	19:17	18:26	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:24	05:39	05:13	05:17	05:44	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:14	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:21	16:36	16:16
7	07:13	06:52	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24	06:58
	16:32	17:09	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:35	16:16
8	07:12	06:51	07:11	06:19	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:32	05:12	05:21	05:50	06:21	06:53	06:29	07:02
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19	07:09	06:37	06:52	06:01	05:24	05:11	05:28	05:58	06:29	07:01	06:38	07:07
	16:45	17:24	18:56	19:30	20:01	20:22	20:17	19:41	18:50	18:00	16:23	16:18
20	07:08	06:35	06:51	06:00	05:23	05:12	05:28	05:59	06:30	07:03	06:40	07:08
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	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:05	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:36	07:08	06:45	07:10
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Table layout: For each day in each month the following matrix apply

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Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
4/5/2011 11:01 PM/2.7.473

SHADOW - Calendar

Shadow receptor: I - 10al

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

	January			February			March	April	May	June	July	August	September	October			November			December		
1	07:12		13:58 (1)	06:58		14:24 (1)	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42			06:17		14:13 (1)	06:52		13:46 (1)
	16:26	91	15:29 (1)	17:01	64	15:28 (1)	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29			16:42	30	14:43 (1)	16:17	89	15:15 (1)
2	07:13		13:59 (1)	06:57		14:25 (1)	06:20	06:29	05:43	05:14	05:16	05:41	06:12	06:43			06:18		14:09 (1)	06:53		13:46 (1)
	16:27	91	15:30 (1)	17:02	63	15:28 (1)	17:37	19:11	19:44	20:13	20:24	20:04	19:19	18:27			16:40	36	14:45 (1)	16:17	89	15:15 (1)
3	07:13		13:59 (1)	06:56		14:27 (1)	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44			06:19		14:07 (1)	06:54		13:46 (1)
	16:28	91	15:30 (1)	17:03	60	15:27 (1)	17:38	19:13	19:45	20:14	20:24	20:03	19:17	18:26			16:39	42	14:49 (1)	16:16	90	15:16 (1)
4	07:13		14:00 (1)	06:55		14:29 (1)	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45			06:20		14:04 (1)	06:55		13:47 (1)
	16:29	90	15:30 (1)	17:05	56	15:25 (1)	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24			16:38	46	14:50 (1)	16:16	89	15:16 (1)
5	07:13		14:00 (1)	06:54		14:31 (1)	06:15	06:24	05:39	05:13	05:17	05:44	06:15	06:46			06:22		14:02 (1)	06:56		13:47 (1)
	16:30	91	15:31 (1)	17:06	53	15:24 (1)	17:40	19:15	19:47	20:15	20:23	20:01	19:14	18:22			16:37	50	14:52 (1)	16:16	90	15:17 (1)
6	07:13		14:01 (1)	06:53		14:32 (1)	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47			06:23		14:01 (1)	06:57		13:47 (1)
	16:31	90	15:31 (1)	17:07	50	15:22 (1)	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20			16:36	53	14:54 (1)	16:16	90	15:17 (1)
7	07:13		14:02 (1)	06:52		14:35 (1)	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48			06:24		13:58 (1)	06:58		13:47 (1)
	16:32	90	15:32 (1)	17:09	45	15:20 (1)	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19			16:35	58	14:56 (1)	16:16	91	15:18 (1)
8	07:12		14:02 (1)	06:51		14:38 (1)	07:11	06:19	05:35	05:12	05:19	05:47	06:18	06:49			06:25		13:57 (1)	06:59		13:48 (1)
	16:33	90	15:32 (1)	17:10	40	15:18 (1)	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17			16:33	60	14:57 (1)	16:16	90	15:18 (1)
9	07:12		14:02 (1)	06:50		14:41 (1)	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50			06:26		13:56 (1)	07:00		13:48 (1)
	16:34	90	15:32 (1)	17:11	35	15:16 (1)	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16			16:32	63	14:59 (1)	16:16	91	15:19 (1)
10	07:12		14:03 (1)	06:48		14:45 (1)	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51			06:28		13:54 (1)	07:01		13:49 (1)
	16:35	89	15:32 (1)	17:12	28	15:13 (1)	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14			16:31	65	14:59 (1)	16:16	91	15:20 (1)
11	07:12		14:04 (1)	06:47		14:49 (1)	07:06	06:14	05:32	05:12	05:21	05:50	06:21	06:53			06:29		13:53 (1)	07:02		13:48 (1)
	16:36	89	15:33 (1)	17:14	19	15:08 (1)	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12			16:30	67	15:00 (1)	16:16	91	15:19 (1)
12	07:12		14:04 (1)	06:46			07:04	06:12	05:31	05:11	05:22	05:51	06:22	06:54			06:30		13:52 (1)	07:02		13:49 (1)
	16:37	89	15:33 (1)	17:15			18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11			16:29	69	15:01 (1)	16:16	91	15:20 (1)
13	07:11		14:05 (1)	06:45			07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55			06:31		13:51 (1)	07:03		13:49 (1)
	16:38	88	15:33 (1)	17:16			18:49	19:23	19:56	20:20	20:20	19:49	19:00	18:09			16:28	72	15:03 (1)	16:16	92	15:21 (1)
14	07:11		14:06 (1)	06:43			07:01	06:09	05:28	05:11	05:24	05:53	06:24	06:56			06:32		13:50 (1)	07:04		13:50 (1)
	16:39	88	15:34 (1)	17:17			18:51	19:24	19:57	20:20	20:20	19:48	18:58	18:07			16:27	73	15:03 (1)	16:16	91	15:21 (1)
15	07:10		14:06 (1)	06:42			06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57			06:34		13:49 (1)	07:05		13:50 (1)
	16:40	87	15:33 (1)	17:19			18:52	19:26	19:58	20:21	20:19	19:46	18:56	18:06			16:27	75	15:04 (1)	16:17	91	15:21 (1)
16	07:10		14:08 (1)	06:41			06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58			06:35		13:49 (1)	07:05		13:50 (1)
	16:41	86	15:34 (1)	17:20			18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04			16:26	76	15:05 (1)	16:17	92	15:22 (1)
17	07:10		14:08 (1)	06:39			06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59			06:36		13:48 (1)	07:06		13:51 (1)
	16:42	86	15:34 (1)	17:21			18:54	19:28	20:00	20:22	20:18	19:43	18:53	18:03			16:25	78	15:06 (1)	16:17	92	15:23 (1)
18	07:09		14:08 (1)	06:38			06:54	06:03	05:25	05:11	05:27	05:57	06:28	07:00			06:37		13:47 (1)	07:07		13:51 (1)
	16:44	85	15:33 (1)	17:22			18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01			16:24	80	15:07 (1)	16:17	92	15:23 (1)
19	07:08		14:10 (1)	06:37			06:52	06:01	05:24	05:11	05:28	05:58	06:29	07:01			06:38		13:47 (1)	07:07		13:52 (1)
	16:45	84	15:34 (1)	17:24			18:56	19:30	20:00	20:22	20:17	19:41	18:50	18:00			16:23	80	15:07 (1)	16:18	91	15:23 (1)
20	07:08		14:10 (1)	06:35			06:51	06:00	05:23	05:12	05:28	05:59	06:30	07:03			06:40		13:47 (1)	07:08		13:53 (1)
	16:46	83	15:33 (1)	17:25			18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58			16:23	81	15:08 (1)	16:18	91	15:24 (1)
21	07:07		14:11 (1)	06:34			06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04			06:41		13:47 (1)	07:09		13:53 (1)
	16:47	82	15:33 (1)	17:26			18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57			16:22	82	15:09 (1)	16:19	91	15:24 (1)
22	07:07		14:12 (1)	06:32			06:47	05:57	05:21	05:12	05:30	06:01	06:32	07:05			06:42		13:46 (1)	07:09		13:54 (1)
	16:48	81	15:33 (1)	17:27			18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55			16:21	83	15:09 (1)	16:19	91	15:25 (1)
23	07:06		14:13 (1)	06:31			06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06			06:43		13:46 (1)	07:10		13:54 (1)
	16:50	80	15:33 (1)	17:28			19:01	19:34	20:04	20:23	20:14	19:35	18:43	17:54			16:21	84	15:10 (1)	16:20	91	15:25 (1)
24	07:05		14:14 (1)	06:29			06:44	05:54	05:20	05:13	05:32	06:03	06:34	07:07			06:44		13:46 (1)	07:10		13:54 (1)
	16:51	79	15:33 (1)	17:30			19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52			16:20	85	15:11 (1)	16:20	91	15:25 (1)
25	07:05		14:14 (1)	06:28			06:42	05:52	05:19	05:13	05:33	06:04	06:36	07:08			06:45		13:46 (1)	07:10		13:55 (1)
	16:52	78	15:32 (1)	17:31			19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51			16:19	86	15:12 (1)	16:21	91	15:26 (1)
26	07:04		14:16 (1)	06:26			06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10			06:47		13:46 (1)	07:11		13:55 (1)
	16:53	76	15:32 (1)	17:32			19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50			16:19	86	15:12 (1)	16:21	92	15:27 (1)
27	07:03		14:17 (1)	06:25			06:39	05:49	05:17	05:14	05:35	06:06	06:38	07:11			06:48		13:45 (1)	07:11		13:55 (1)
	16:55	75	15:32 (1)	17:33			19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48			16:19	87	15:12 (1)	16:22	92	15:27 (1)
28	07:02		14:18 (1)	06:23			06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12			06:49		13:45 (1)	07:12		13:56 (1)
	16:56	73	15:31 (1)	17:34			19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47			16:18	88	15:13 (1)	16:23	92	15:28 (1)
29	07:01		14:19 (1)				06:35	05:47	05:16	05:14	05:37	06:08	06:40	07:13			06:50		13:45 (1)	07:12		13:57 (1)
	16:57	72	15:31 (1)				19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:46			16:18	88	15:13 (1)	16:24	91	15:28 (1)
30	07:00		14:21 (1)				06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14			06:51		13:46 (1)	07:12		13:57 (1)
	16:58	69	15:30 (1)				19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44			16:17	89	15:15 (1)	16:24	91	15:28 (1)
31	06:59		14:22 (1)				06:32		05:15		05:39	06:10		07:16		15:18 (1)				07:12		13:58 (1)
	17:00	67	15:29 (1)				19:09		20:11		20:06	19:22		17:43	21	15:39 (1)				16:25	91	15:29 (1)
Potential sun hours	296			297			370	400	450	454	461	429	375	344			297			286		
Total, worst case		2600			513										21			2112			2818	
Sun reduction		0.56			0.58										0.61			0.50			0.52	
Oper. time red.		1.00			1.00										1.00			1.00			1.00	
Wind dir. red.		0.62			0.62										0.62			0.62			0.62	
Total reduction		0.35			0.36										0.38			0.31			0.32	
Total, real		905			185										8			658			911	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
4/5/2011 11:06 PM / 11

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
4/5/2011 11:01 PM/2.7.473

SHADOW - Calendar

Shadow receptor: J - 10aJ

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January			February			March	April	May	June	July	August	September	October	November			December		
1	07:12		14:26 (1)	06:58		15:09 (1)	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17			06:52		14:15 (1)
	16:26	69	15:35 (1)	17:01	7	15:16 (1)	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42			16:17	64	15:19 (1)
2	07:13		14:27 (1)	06:57			06:20	06:29	05:43	05:14	05:16	05:41	06:12	06:43	06:18			06:53		14:15 (1)
	16:27	68	15:35 (1)	17:02			17:37	19:11	19:44	20:13	20:24	20:04	19:19	18:27	16:40			16:17	65	15:20 (1)
3	07:13		14:27 (1)	06:56			06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19			06:54		14:15 (1)
	16:28	68	15:35 (1)	17:03			17:38	19:13	19:45	20:14	20:24	20:03	19:17	18:26	16:39			16:16	66	15:21 (1)
4	07:13		14:28 (1)	06:55			06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20			06:55		14:15 (1)
	16:29	68	15:36 (1)	17:05			17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38			16:16	66	15:21 (1)
5	07:13		14:29 (1)	06:54			06:15	06:24	05:39	05:13	05:17	05:44	06:15	06:46	06:22			06:56		14:16 (1)
	16:30	67	15:36 (1)	17:06			17:40	19:15	19:47	20:15	20:23	20:01	19:14	18:22	16:37			16:16	66	15:22 (1)
6	07:13		14:30 (1)	06:53			06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23			06:57		14:16 (1)
	16:31	66	15:36 (1)	17:07			17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36			16:16	66	15:22 (1)
7	07:13		14:30 (1)	06:52			06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24			06:58		14:16 (1)
	16:32	67	15:37 (1)	17:09			17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:35			16:16	67	15:23 (1)
8	07:12		14:31 (1)	06:51			07:11	06:19	05:35	05:12	05:19	05:47	06:18	06:49	06:25			06:59		14:16 (1)
	16:33	66	15:37 (1)	17:10			18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33			16:16	68	15:24 (1)
9	07:12		14:31 (1)	06:50			07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26			07:00		14:17 (1)
	16:34	66	15:37 (1)	17:11			18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16	16:32			16:16	67	15:24 (1)
10	07:12		14:32 (1)	06:48			07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28		14:39 (1)	07:01		14:17 (1)
	16:35	65	15:37 (1)	17:12			18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	9	14:48 (1)	16:16	68	15:25 (1)
11	07:12		14:33 (1)	06:47			07:06	06:14	05:32	05:12	05:21	05:50	06:21	06:53	06:29		14:33 (1)	07:02		14:16 (1)
	16:36	64	15:37 (1)	17:14			18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	20	14:53 (1)	16:16	69	15:25 (1)
12	07:12		14:33 (1)	06:46			07:04	06:12	05:31	05:11	05:22	05:51	06:22	06:54	06:30		14:30 (1)	07:02		14:17 (1)
	16:37	64	15:37 (1)	17:15			18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	26	14:56 (1)	16:16	68	15:25 (1)
13	07:11		14:35 (1)	06:45			07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31		14:28 (1)	07:03		14:17 (1)
	16:38	62	15:37 (1)	17:16			18:49	19:23	19:56	20:20	20:20	19:49	19:00	18:09	16:28	31	14:59 (1)	16:16	69	15:26 (1)
14	07:11		14:36 (1)	06:43			07:01	06:09	05:28	05:11	05:24	05:53	06:24	06:56	06:32		14:26 (1)	07:04		14:18 (1)
	16:39	62	15:38 (1)	17:17			18:51	19:24	19:57	20:20	20:20	19:48	18:58	18:07	16:27	35	15:01 (1)	16:16	69	15:27 (1)
15	07:10		14:36 (1)	06:42			06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34		14:24 (1)	07:05		14:18 (1)
	16:40	61	15:37 (1)	17:19			18:52	19:26	19:58	20:21	20:19	19:46	18:56	18:06	16:27	39	15:03 (1)	16:17	69	15:27 (1)
16	07:10		14:38 (1)	06:41			06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35		14:23 (1)	07:05		14:18 (1)
	16:41	59	15:37 (1)	17:20			18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:26	42	15:05 (1)	16:17	70	15:28 (1)
17	07:10		14:38 (1)	06:39			06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36		14:22 (1)	07:06		14:19 (1)
	16:42	59	15:37 (1)	17:21			18:54	19:28	20:00	20:22	20:18	19:43	18:53	18:03	16:25	44	15:06 (1)	16:17	69	15:28 (1)
18	07:09		14:39 (1)	06:38			06:54	06:03	05:25	05:11	05:27	05:57	06:28	07:00	06:37		14:20 (1)	07:07		14:19 (1)
	16:44	57	15:36 (1)	17:22			18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	47	15:07 (1)	16:17	69	15:28 (1)
19	07:08		14:40 (1)	06:37			06:52	06:01	05:24	05:11	05:28	05:58	06:29	07:01	06:38		14:19 (1)	07:07		14:20 (1)
	16:45	56	15:36 (1)	17:24			18:56	19:30	20:00	20:22	20:17	19:41	18:50	18:00	16:23	49	15:08 (1)	16:18	69	15:29 (1)
20	07:08		14:41 (1)	06:35			06:51	06:00	05:23	05:12	05:28	05:59	06:30	07:03	06:40		14:19 (1)	07:08		14:21 (1)
	16:46	55	15:36 (1)	17:25			18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:23	51	15:10 (1)	16:18	69	15:30 (1)
21	07:07		14:42 (1)	06:34			06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41		14:18 (1)	07:09		14:21 (1)
	16:47	53	15:35 (1)	17:26			18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	53	15:11 (1)	16:19	69	15:30 (1)
22	07:07		14:44 (1)	06:32			06:47	05:57	05:21	05:12	05:30	06:01	06:32	07:05	06:42		14:17 (1)	07:09		14:22 (1)
	16:48	51	15:35 (1)	17:27			18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	55	15:12 (1)	16:19	69	15:31 (1)
23	07:06		14:45 (1)	06:31			06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43		14:16 (1)	07:10		14:22 (1)
	16:50	49	15:34 (1)	17:28			19:01	19:34	20:04	20:23	20:14	19:35	18:43	17:54	16:21	56	15:12 (1)	16:20	69	15:31 (1)
24	07:05		14:46 (1)	06:29			06:44	05:54	05:20	05:13	05:32	06:03	06:34	07:07	06:44		14:17 (1)	07:10		14:22 (1)
	16:51	47	15:33 (1)	17:30			19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	57	15:14 (1)	16:20	69	15:31 (1)
25	07:05		14:48 (1)	06:28			06:42	05:52	05:19	05:13	05:33	06:04	06:36	07:08	06:45		14:16 (1)	07:10		14:23 (1)
	16:52	44	15:32 (1)	17:31			19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	59	15:15 (1)	16:21	69	15:32 (1)
26	07:04		14:50 (1)	06:26			06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10	06:47		14:16 (1)	07:11		14:23 (1)
	16:53	42	15:32 (1)	17:32			19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	59	15:15 (1)	16:21	69	15:32 (1)
27	07:03		14:52 (1)	06:25			06:39	05:49	05:17	05:13	05:35	06:06	06:38	07:11	06:48		14:15 (1)	07:11		14:23 (1)
	16:55	39	15:31 (1)	17:33			19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:18	61	15:16 (1)	16:22	69	15:32 (1)
28	07:02		14:54 (1)	06:23			06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49		14:15 (1)	07:12		14:25 (1)
	16:56	35	15:29 (1)	17:34			19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	62	15:17 (1)	16:23	69	15:34 (1)
29	07:01		14:56 (1)				06:35	05:47	05:16	05:14	05:37	06:08	06:40	07:13	06:50		14:15 (1)	07:12		14:25 (1)
	16:57	31	15:27 (1)				19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:46	16:18	62	15:17 (1)	16:24	69	15:34 (1)
30	07:00		14:59 (1)				06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51		14:16 (1)	07:12		14:25 (1)
	16:58	26	15:25 (1)				19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	63	15:19 (1)	16:24	69	15:34 (1)
31	06:59		15:03 (1)				06:32		05:15		05:39	06:10		07:16				07:12		14:26 (1)
	17:00	19	15:22 (1)				19:09		20:11		20:06	19:22		17:43				16:25	68	15:34 (1)
Potential sun hours	296			297			370	400	450	454	461	429	375	344	297			286		
Total, worst case		1705			7											980			2111	
Sun reduction		0.56			0.58											0.50			0.52	
Oper. time red.		1.00			1.00											1.00			1.00	
Wind dir. red.		0.62			0.62											0.62			0.62	
Total reduction		0.34			0.36											0.31			0.32	
Total, real		587			2											302			675	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
4/5/2011 11:06 PM / 12

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
4/5/2011 11:01 PM/2.7.473

SHADOW - Calendar

Shadow receptor: K - 10aK

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January			February			March	April	May	June	July	August	September	October			November			December		
1	07:12		12:27 (1)	06:58		12:58 (1)	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42			06:17		12:53 (1)	06:52		12:16 (1)
	16:26	120	14:27 (1)	17:01	86	14:24 (1)	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29			16:42	45	13:38 (1)	16:17	116	14:12 (1)
2	07:13		12:27 (1)	06:57		13:00 (1)	06:20	06:29	05:43	05:14	05:16	05:41	06:12	06:43			06:18		12:48 (1)	06:53		12:16 (1)
	16:27	120	14:27 (1)	17:02	83	14:23 (1)	17:37	19:11	19:44	20:13	20:24	20:04	19:19	18:27			16:40	52	13:40 (1)	16:17	117	14:13 (1)
3	07:13		12:28 (1)	06:56		13:02 (1)	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44			06:19		12:45 (1)	06:54		12:16 (1)
	16:28	120	14:28 (1)	17:03	80	14:22 (1)	17:38	19:13	19:45	20:14	20:24	20:03	19:17	18:26			16:39	58	13:43 (1)	16:16	117	14:13 (1)
4	07:13		12:28 (1)	06:55		13:05 (1)	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45			06:20		12:42 (1)	06:55		12:16 (1)
	16:29	120	14:28 (1)	17:05	76	14:21 (1)	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24			16:38	63	13:45 (1)	16:16	118	14:14 (1)
5	07:13		12:29 (1)	06:54		13:07 (1)	06:15	06:24	05:39	05:13	05:17	05:44	06:15	06:46			06:22		12:39 (1)	06:56		12:16 (1)
	16:30	119	14:28 (1)	17:06	72	14:19 (1)	17:40	19:15	19:47	20:15	20:23	20:01	19:14	18:22			16:37	68	13:47 (1)	16:16	118	14:14 (1)
6	07:13		12:30 (1)	06:53		13:09 (1)	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47			06:23		12:37 (1)	06:57		12:16 (1)
	16:31	119	14:29 (1)	17:07	68	14:17 (1)	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:21			16:36	72	13:49 (1)	16:16	119	14:15 (1)
7	07:13		12:31 (1)	06:52		13:13 (1)	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48			06:24		12:34 (1)	06:58		12:16 (1)
	16:32	118	14:29 (1)	17:09	62	14:15 (1)	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19			16:35	77	13:51 (1)	16:16	119	14:15 (1)
8	07:12		12:32 (1)	06:51		13:16 (1)	07:11	06:19	05:35	05:12	05:19	05:47	06:18	06:49			06:25		12:32 (1)	06:59		12:16 (1)
	16:33	118	14:30 (1)	17:10	57	14:13 (1)	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17			16:33	80	13:52 (1)	16:16	120	14:16 (1)
9	07:12		12:32 (1)	06:50		13:20 (1)	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50			06:26		12:31 (1)	07:00		12:17 (1)
	16:34	117	14:29 (1)	17:11	51	14:11 (1)	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16			16:32	83	13:54 (1)	16:16	120	14:17 (1)
10	07:12		12:33 (1)	06:48		13:25 (1)	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51			06:28		12:29 (1)	07:01		12:17 (1)
	16:35	117	14:30 (1)	17:12	43	14:08 (1)	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14			16:31	86	13:55 (1)	16:16	120	14:17 (1)
11	07:12		12:34 (1)	06:47		13:29 (1)	07:06	06:14	05:32	05:12	05:21	05:50	06:21	06:53			06:29		12:27 (1)	07:02		12:17 (1)
	16:36	116	14:30 (1)	17:14	35	14:04 (1)	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12			16:30	89	13:56 (1)	16:16	120	14:17 (1)
12	07:12		12:34 (1)	06:46		13:36 (1)	07:04	06:12	05:31	05:11	05:22	05:51	06:22	06:54			06:30		12:25 (1)	07:02		12:17 (1)
	16:37	116	14:30 (1)	17:15	22	13:58 (1)	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11			16:29	92	13:57 (1)	16:16	121	14:18 (1)
13	07:11		12:35 (1)	06:45			07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55			06:31		12:25 (1)	07:03		12:18 (1)
	16:38	115	14:30 (1)	17:16			18:49	19:23	19:56	20:20	20:20	19:49	19:00	18:09			16:28	93	13:58 (1)	16:16	121	14:19 (1)
14	07:11		12:36 (1)	06:43			07:01	06:09	05:28	05:11	05:24	05:53	06:24	06:56			06:32		12:23 (1)	07:04		12:18 (1)
	16:39	115	14:31 (1)	17:17			18:51	19:24	19:57	20:20	20:20	19:48	18:58	18:08			16:27	96	13:59 (1)	16:16	121	14:19 (1)
15	07:10		12:36 (1)	06:42			06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57			06:34		12:22 (1)	07:05		12:18 (1)
	16:40	114	14:30 (1)	17:19			18:52	19:26	19:58	20:21	20:19	19:46	18:56	18:06			16:27	98	14:00 (1)	16:17	121	14:19 (1)
16	07:10		12:38 (1)	06:41			06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58			06:35		12:22 (1)	07:05		12:19 (1)
	16:41	113	14:31 (1)	17:20			18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04			16:26	99	14:01 (1)	16:17	121	14:20 (1)
17	07:10		12:38 (1)	06:39			06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59			06:36		12:20 (1)	07:06		12:19 (1)
	16:42	112	14:30 (1)	17:21			18:54	19:28	20:00	20:22	20:18	19:43	18:53	18:03			16:25	102	14:02 (1)	16:17	122	14:21 (1)
18	07:09		12:39 (1)	06:38			06:54	06:03	05:25	05:11	05:27	05:57	06:28	07:00			06:37		12:19 (1)	07:07		12:19 (1)
	16:44	111	14:30 (1)	17:22			18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01			16:24	103	14:02 (1)	16:17	122	14:21 (1)
19	07:08		12:40 (1)	06:37			06:52	06:01	05:24	05:11	05:28	05:58	06:29	07:01			06:38		12:18 (1)	07:07		12:20 (1)
	16:45	110	14:30 (1)	17:24			18:56	19:30	20:01	20:22	20:17	19:41	18:50	18:00			16:23	105	14:03 (1)	16:18	121	14:21 (1)
20	07:08		12:41 (1)	06:35			06:51	06:00	05:23	05:12	05:28	05:59	06:30	07:03			06:40		12:19 (1)	07:08		12:21 (1)
	16:46	109	14:30 (1)	17:25			18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58			16:23	106	14:05 (1)	16:18	121	14:22 (1)
21	07:07		12:42 (1)	06:34			06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04			06:41		12:18 (1)	07:09		12:21 (1)
	16:47	107	14:29 (1)	17:26			18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57			16:22	107	14:05 (1)	16:19	121	14:22 (1)
22	07:07		12:44 (1)	06:32			06:47	05:57	05:21	05:12	05:30	06:01	06:32	07:05			06:42		12:17 (1)	07:09		12:22 (1)
	16:48	106	14:30 (1)	17:27			18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55			16:21	109	14:06 (1)	16:19	121	14:23 (1)
23	07:06		12:44 (1)	06:31			06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06			06:43		12:16 (1)	07:10		12:22 (1)
	16:50	105	14:29 (1)	17:28			19:01	19:34	20:04	20:23	20:14	19:35	18:43	17:54			16:21	110	14:06 (1)	16:20	121	14:23 (1)
24	07:05		12:45 (1)	06:29			06:44	05:54	05:20	05:13	05:32	06:03	06:34	07:07			06:44		12:17 (1)	07:10		12:22 (1)
	16:51	103	14:28 (1)	17:30			19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52			16:20	111	14:08 (1)	16:20	121	14:23 (1)
25	07:05		12:47 (1)	06:28			06:42	05:52	05:19	05:13	05:33	06:04	06:36	07:08			06:45		12:16 (1)	07:10		12:23 (1)
	16:52	101	14:28 (1)	17:31			19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51			16:19	112	14:08 (1)	16:21	122	14:25 (1)
26	07:04		12:49 (1)	06:26			06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10			06:47		12:16 (1)	07:11		12:23 (1)
	16:53	99	14:28 (1)	17:32			19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50			16:19	113	14:09 (1)	16:21	122	14:25 (1)
27	07:03		12:50 (1)	06:25			06:39	05:49	05:17	05:14	05:35	06:06	06:38	07:11			06:48		12:16 (1)	07:11		12:23 (1)
	16:55	98	14:28 (1)	17:33			19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48			16:19	113	14:09 (1)	16:22	122	14:25 (1)
28	07:02		12:51 (1)	06:23			06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12			06:49		12:15 (1)	07:12		12:25 (1)
	16:56	96	14:27 (1)	17:34			19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47			16:18	115	14:10 (1)	16:23	121	14:26 (1)
29	07:01		12:53 (1)				06:35	05:47	05:16	05:14	05:37	06:08	06:40	07:13			06:50		12:15 (1)	07:12		12:25 (1)
	16:57	93	14:26 (1)				19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:46			16:18	115	14:10 (1)	16:24	121	14:26 (1)
30	07:00		12:54 (1)				06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14		14:04 (1)	06:51		12:16 (1)	07:12		12:25 (1)
	16:58	92	14:26 (1)				19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	25	14:29 (1)	16:17	116	14:12 (1)	16:24	121	14:26 (1)
31	06:59		12:56 (1)				06:32		05:15		05:39	06:10		07:16		13:58 (1)				07:12		12:26 (1)
	17:00	89	14:25 (1)				19:09		20:11		20:06	19:22		17:43	36	14:34 (1)				16:25	121	14:27 (1)
Potential sun hours	296			297			370	400	450	454	461	429	375	344			297			286		
Total, worst case		3408			735										61			2788			3729	
Sun reduction		0.56			0.58										0.61			0.50			0.52	
Oper. time red.		1.00			1.00										1.00			1.00			1.00	
Wind dir. red.		0.68			0.68										0.68			0.68			0.68	
Total reduction		0.38			0.39										0.41			0.34			0.35	
Total, real		1287			288										25			941			1307	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
4/5/2011 11:06 PM / 13

Licensed user:
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9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
4/5/2011 11:01 PM/2.7.473

SHADOW - Calendar

Shadow receptor: L - 10aL

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March			April			May			June		
1	07:12	06:58	06:22			06:30		18:06 (1)	05:44		17:36 (1)	05:15		17:56 (1)
	16:26	17:01	17:36			19:10	33	18:39 (1)	19:43	81	18:57 (1)	20:12	44	18:40 (1)
2	07:13	06:57	06:20			06:29		18:03 (1)	05:43		17:36 (1)	05:14		17:57 (1)
	16:27	17:02	17:37			19:11	40	18:43 (1)	19:44	80	18:56 (1)	20:13	43	18:40 (1)
3	07:13	06:56	06:19			06:27		18:00 (1)	05:41		17:36 (1)	05:14		17:58 (1)
	16:28	17:03	17:38			19:13	45	18:45 (1)	19:45	80	18:56 (1)	20:14	42	18:40 (1)
4	07:13	06:55	06:17			06:25		17:57 (1)	05:40		17:37 (1)	05:13		17:59 (1)
	16:29	17:05	17:39			19:14	49	18:46 (1)	19:46	79	18:56 (1)	20:14	40	18:39 (1)
5	07:13	06:54	06:15			06:24		17:55 (1)	05:39		17:37 (1)	05:13		18:00 (1)
	16:30	17:06	17:40			19:15	54	18:49 (1)	19:47	79	18:56 (1)	20:15	38	18:38 (1)
6	07:13	06:53	06:14			06:22		17:53 (1)	05:37		17:37 (1)	05:13		18:01 (1)
	16:31	17:07	17:41			19:16	57	18:50 (1)	19:48	78	18:55 (1)	20:16	37	18:38 (1)
7	07:13	06:52	06:12			06:20		17:51 (1)	05:36		17:37 (1)	05:12		18:01 (1)
	16:32	17:09	17:43			19:17	59	18:50 (1)	19:49	78	18:55 (1)	20:16	36	18:37 (1)
8	07:12	06:51	07:11			06:19		17:50 (1)	05:35		17:38 (1)	05:12		18:03 (1)
	16:33	17:10	18:44			19:18	62	18:52 (1)	19:50	76	18:54 (1)	20:17	33	18:36 (1)
9	07:12	06:50	07:09			06:17		17:48 (1)	05:34		17:38 (1)	05:12		18:04 (1)
	16:34	17:11	18:45			19:19	65	18:53 (1)	19:51	76	18:54 (1)	20:18	32	18:36 (1)
10	07:12	06:48	07:07			06:15		17:46 (1)	05:33		17:39 (1)	05:12		18:05 (1)
	16:35	17:12	18:46			19:20	67	18:53 (1)	19:52	75	18:54 (1)	20:18	31	18:36 (1)
11	07:12	06:47	07:06			06:14		17:45 (1)	05:32		17:39 (1)	05:12		18:06 (1)
	16:36	17:14	18:47			19:21	70	18:55 (1)	19:53	74	18:53 (1)	20:19	29	18:35 (1)
12	07:11	06:46	07:04			06:12		17:44 (1)	05:31		17:40 (1)	05:11		18:07 (1)
	16:37	17:15	18:48			19:22	71	18:55 (1)	19:54	73	18:53 (1)	20:19	28	18:35 (1)
13	07:11	06:45	07:02			06:10		17:43 (1)	05:29		17:40 (1)	05:11		18:08 (1)
	16:38	17:16	18:49			19:23	73	18:56 (1)	19:55	72	18:52 (1)	20:20	26	18:34 (1)
14	07:11	06:43	07:01			06:09		17:42 (1)	05:28		17:41 (1)	05:11		18:09 (1)
	16:39	17:17	18:51			19:24	74	18:56 (1)	19:57	71	18:52 (1)	20:20	25	18:34 (1)
15	07:10	06:42	06:59			06:07		17:40 (1)	05:27		17:42 (1)	05:11		18:09 (1)
	16:40	17:19	18:52			19:26	76	18:56 (1)	19:58	69	18:51 (1)	20:21	25	18:34 (1)
16	07:10	06:41	06:57			06:06		17:40 (1)	05:26		17:42 (1)	05:11		18:10 (1)
	16:41	17:20	18:53			19:27	77	18:57 (1)	19:59	69	18:51 (1)	20:21	23	18:33 (1)
17	07:10	06:39	06:56			06:04		17:39 (1)	05:25		17:43 (1)	05:11		18:11 (1)
	16:42	17:21	18:54			19:28	78	18:57 (1)	20:00	67	18:50 (1)	20:22	22	18:33 (1)
18	07:09	06:38	06:54			06:03		17:39 (1)	05:25		17:43 (1)	05:11		18:11 (1)
	16:44	17:22	18:55			19:29	79	18:58 (1)	20:00	66	18:49 (1)	20:22	22	18:33 (1)
19	07:08	06:37	06:52			06:01		17:38 (1)	05:24		17:45 (1)	05:11		18:11 (1)
	16:45	17:24	18:56			19:30	79	18:57 (1)	20:00	64	18:49 (1)	20:22	22	18:33 (1)
20	07:08	06:35	06:51			06:00		17:38 (1)	05:23		17:45 (1)	05:12		18:12 (1)
	16:46	17:25	18:57			19:31	80	18:58 (1)	20:01	64	18:49 (1)	20:23	21	18:33 (1)
21	07:07	06:34	06:49			05:58		17:37 (1)	05:22		17:46 (1)	05:12		18:12 (1)
	16:47	17:26	18:58			19:32	81	18:58 (1)	20:02	62	18:48 (1)	20:23	20	18:32 (1)
22	07:07	06:32	06:47			05:57		17:37 (1)	05:21		17:47 (1)	05:12		18:13 (1)
	16:48	17:27	18:59			19:33	81	18:58 (1)	20:03	60	18:47 (1)	20:23	20	18:33 (1)
23	07:06	06:31	06:45			05:55		17:36 (1)	05:20		17:47 (1)	05:12		18:13 (1)
	16:50	17:28	19:01			19:34	82	18:58 (1)	20:04	59	18:46 (1)	20:23	21	18:34 (1)
24	07:05	06:29	06:44			05:54		17:36 (1)	05:20		17:49 (1)	05:13		18:12 (1)
	16:51	17:30	19:02			19:35	82	18:58 (1)	20:05	57	18:46 (1)	20:23	22	18:34 (1)
25	07:04	06:28	06:42			05:52		17:36 (1)	05:19		17:49 (1)	05:13		18:13 (1)
	16:52	17:31	19:03			19:36	82	18:58 (1)	20:06	56	18:45 (1)	20:24	22	18:35 (1)
26	07:04	06:26	06:40			05:51		17:36 (1)	05:18		17:50 (1)	05:13		18:12 (1)
	16:53	17:32	19:04			19:37	82	18:58 (1)	20:07	54	18:44 (1)	20:24	23	18:35 (1)
27	07:03	06:25	06:39			05:49		17:36 (1)	05:17		17:51 (1)	05:14		18:12 (1)
	16:55	17:33	19:05			19:39	82	18:58 (1)	20:08	53	18:44 (1)	20:24	24	18:36 (1)
28	07:02	06:23	06:37			05:48		17:36 (1)	05:17		17:52 (1)	05:14		18:12 (1)
	16:56	17:34	19:06			19:40	82	18:58 (1)	20:09	51	18:43 (1)	20:24	25	18:37 (1)
29	07:01		06:35			05:47		17:35 (1)	05:16		17:53 (1)	05:14		18:11 (1)
	16:57		19:07			19:41	82	18:57 (1)	20:10	50	18:43 (1)	20:24	26	18:37 (1)
30	07:00		06:34		18:18 (1)	05:45		17:36 (1)	05:16		17:54 (1)	05:15		18:10 (1)
	16:58		19:08	12	18:30 (1)	19:42	81	18:57 (1)	20:10	48	18:42 (1)	20:24	28	18:38 (1)
31	06:59		06:32		18:10 (1)				05:15		17:55 (1)			
	17:00		19:09	26	18:36 (1)				20:11	47	18:42 (1)			
Potential sun hours	296	297	370			400			450			454		
Total, worst case				38			2105			2068			850	
Sun reduction				0.58			0.57			0.58			0.61	
Oper. time red.				1.00			1.00			1.00			1.00	
Wind dir. red.				0.54			0.54			0.54			0.54	
Total reduction				0.31			0.31			0.32			0.33	
Total, real				12			651			652			282	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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4/5/2011 11:06 PM / 14

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Calculated:
4/5/2011 11:01 PM/2.7.473

SHADOW - Calendar

Shadow receptor: L - 10aL

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	July			August			September			October	November	December
1	05:15		18:10 (1)	05:40		17:50 (1)	06:11		17:44 (1)	06:42	06:17	06:52
	20:24	29	18:39 (1)	20:05	74	19:04 (1)	19:20	70	18:54 (1)	18:29	16:42	16:17
2	05:16		18:09 (1)	05:41		17:50 (1)	06:12		17:45 (1)	06:43	06:18	06:53
	20:24	30	18:39 (1)	20:04	74	19:04 (1)	19:19	67	18:52 (1)	18:27	16:40	16:17
3	05:16		18:09 (1)	05:42		17:49 (1)	06:13		17:46 (1)	06:44	06:19	06:54
	20:24	32	18:41 (1)	20:03	75	19:04 (1)	19:17	65	18:51 (1)	18:26	16:39	16:16
4	05:17		18:09 (1)	05:43		17:49 (1)	06:14		17:47 (1)	06:45	06:20	06:55
	20:23	33	18:42 (1)	20:02	76	19:05 (1)	19:15	62	18:49 (1)	18:24	16:38	16:16
5	05:17		18:08 (1)	05:44		17:48 (1)	06:15		17:48 (1)	06:46	06:22	06:56
	20:23	35	18:43 (1)	20:01	77	19:05 (1)	19:14	60	18:48 (1)	18:22	16:37	16:16
6	05:18		18:08 (1)	05:45		17:48 (1)	06:16		17:49 (1)	06:47	06:23	06:57
	20:23	36	18:44 (1)	19:58	77	19:05 (1)	19:12	57	18:46 (1)	18:20	16:36	16:16
7	05:19		18:06 (1)	05:46		17:46 (1)	06:17		17:50 (1)	06:48	06:24	06:58
	20:23	38	18:44 (1)	19:57	79	19:05 (1)	19:10	54	18:44 (1)	18:19	16:35	16:16
8	05:19		18:06 (1)	05:47		17:46 (1)	06:18		17:52 (1)	06:49	06:25	06:59
	20:22	39	18:45 (1)	19:56	79	19:05 (1)	19:08	50	18:42 (1)	18:17	16:33	16:16
9	05:20		18:06 (1)	05:48		17:45 (1)	06:19		17:54 (1)	06:50	06:26	07:00
	20:22	41	18:47 (1)	19:54	80	19:05 (1)	19:07	45	18:39 (1)	18:16	16:32	16:16
10	05:21		18:05 (1)	05:49		17:45 (1)	06:20		17:56 (1)	06:51	06:28	07:01
	20:22	42	18:47 (1)	19:53	80	19:05 (1)	19:05	40	18:36 (1)	18:14	16:31	16:16
11	05:21		18:04 (1)	05:50		17:44 (1)	06:21		17:58 (1)	06:53	06:29	07:02
	20:21	44	18:48 (1)	19:52	81	19:05 (1)	19:03	35	18:33 (1)	18:12	16:30	16:16
12	05:22		18:04 (1)	05:51		17:44 (1)	06:22		18:02 (1)	06:54	06:30	07:02
	20:21	45	18:49 (1)	19:50	81	19:05 (1)	19:02	27	18:29 (1)	18:11	16:29	16:16
13	05:23		18:02 (1)	05:52		17:43 (1)	06:23		18:08 (1)	06:55	06:31	07:03
	20:20	48	18:50 (1)	19:49	82	19:05 (1)	19:00	14	18:22 (1)	18:09	16:28	16:16
14	05:24		18:02 (1)	05:53		17:43 (1)	06:24			06:56	06:32	07:04
	20:20	49	18:51 (1)	19:48	82	19:05 (1)	18:58			18:07	16:27	16:16
15	05:24		18:01 (1)	05:54		17:43 (1)	06:25			06:57	06:34	07:05
	20:19	51	18:52 (1)	19:46	82	19:05 (1)	18:56			18:06	16:27	16:17
16	05:25		18:01 (1)	05:55		17:43 (1)	06:26			06:58	06:35	07:05
	20:19	52	18:53 (1)	19:45	82	19:05 (1)	18:55			18:04	16:26	16:17
17	05:26		17:59 (1)	05:56		17:42 (1)	06:27			06:59	06:36	07:06
	20:18	54	18:53 (1)	19:43	82	19:04 (1)	18:53			18:03	16:25	16:17
18	05:27		17:59 (1)	05:57		17:42 (1)	06:28			07:00	06:37	07:07
	20:17	55	18:54 (1)	19:42	82	19:04 (1)	18:51			18:01	16:24	16:17
19	05:28		17:58 (1)	05:58		17:42 (1)	06:29			07:01	06:38	07:07
	20:17	57	18:55 (1)	19:41	82	19:04 (1)	18:50			18:00	16:23	16:18
20	05:28		17:58 (1)	05:59		17:42 (1)	06:30			07:03	06:40	07:08
	20:16	58	18:56 (1)	19:39	81	19:03 (1)	18:48			17:58	16:23	16:18
21	05:29		17:57 (1)	06:00		17:42 (1)	06:31			07:04	06:41	07:09
	20:15	60	18:57 (1)	19:38	81	19:03 (1)	18:46			17:57	16:22	16:19
22	05:30		17:57 (1)	06:01		17:42 (1)	06:32			07:05	06:42	07:09
	20:14	61	18:58 (1)	19:36	80	19:02 (1)	18:44			17:55	16:21	16:19
23	05:31		17:56 (1)	06:02		17:42 (1)	06:33			07:06	06:43	07:10
	20:14	63	18:59 (1)	19:35	80	19:02 (1)	18:43			17:54	16:21	16:20
24	05:32		17:55 (1)	06:03		17:42 (1)	06:34			07:07	06:44	07:10
	20:13	64	18:59 (1)	19:33	79	19:01 (1)	18:41			17:52	16:20	16:20
25	05:33		17:54 (1)	06:04		17:42 (1)	06:36			07:08	06:45	07:10
	20:12	65	18:59 (1)	19:31	79	19:01 (1)	18:39			17:51	16:19	16:21
26	05:34		17:54 (1)	06:05		17:42 (1)	06:37			07:10	06:47	07:11
	20:11	66	19:00 (1)	19:30	78	19:00 (1)	18:37			17:50	16:19	16:21
27	05:35		17:53 (1)	06:06		17:42 (1)	06:38			07:11	06:48	07:11
	20:10	68	19:01 (1)	19:28	77	18:59 (1)	18:36			17:48	16:19	16:22
28	05:36		17:52 (1)	06:07		17:42 (1)	06:39			07:12	06:49	07:11
	20:09	69	19:01 (1)	19:27	76	18:58 (1)	18:34			17:47	16:18	16:23
29	05:37		17:52 (1)	06:08		17:43 (1)	06:40			07:13	06:50	07:12
	20:08	70	19:02 (1)	19:25	74	18:57 (1)	18:32			17:46	16:18	16:24
30	05:38		17:51 (1)	06:09		17:43 (1)	06:41			07:14	06:51	07:12
	20:07	72	19:03 (1)	19:23	73	18:56 (1)	18:31			17:44	16:17	16:24
31	05:39		17:51 (1)	06:10		17:44 (1)				07:16		07:12
	20:06	72	19:03 (1)	19:22	71	18:55 (1)				17:43		16:25
Potential sun hours	461			429			375			344	297	286
Total, worst case		1598			2436			646				
Sun reduction		0.63			0.62			0.62				
Oper. time red.		1.00			1.00			1.00				
Wind dir. red.		0.54			0.54			0.54				
Total reduction		0.34			0.34			0.34				
Total, real		547			820			217				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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4/5/2011 11:06 PM / 15

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Alec Richardson / arichardson@geo-marine.com

Calculated:
4/5/2011 11:01 PM/2.7.473

SHADOW - Calendar

Shadow receptor: M - 10aM

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January		February		March		April		May	June
1	07:12		13:36 (1)	06:58	13:30 (1)	06:22	13:27 (1)	06:30	15:07 (1)	05:44	05:15
	16:26	124	15:40 (1)	17:01	156	16:06 (1)	17:36	164	16:11 (1)	19:10	98	16:45 (1)	19:43	20:12
2	07:13		13:36 (1)	06:57	13:30 (1)	06:20	13:28 (1)	06:29	15:09 (1)	05:43	05:14
	16:27	125	15:41 (1)	17:02	157	16:07 (1)	17:37	164	16:12 (1)	19:11	95	16:44 (1)	19:44	20:13
3	07:13		13:36 (1)	06:56	13:30 (1)	06:19	13:28 (1)	06:27	15:11 (1)	05:41	05:14
	16:28	126	15:42 (1)	17:03	158	16:08 (1)	17:38	163	16:11 (1)	19:13	91	16:42 (1)	19:45	20:14
4	07:13		13:36 (1)	06:55	13:29 (1)	06:17	13:29 (1)	06:25	15:13 (1)	05:40	05:13
	16:29	127	15:43 (1)	17:05	159	16:08 (1)	17:39	161	16:10 (1)	19:14	87	16:40 (1)	19:46	20:14
5	07:13		13:36 (1)	06:54	13:29 (1)	06:15	13:30 (1)	06:24	15:16 (1)	05:39	05:13
	16:30	128	15:44 (1)	17:06	160	16:09 (1)	17:40	160	16:10 (1)	19:15	83	16:39 (1)	19:47	20:15
6	07:13		13:36 (1)	06:53	13:28 (1)	06:14	13:30 (1)	06:22	15:17 (1)	05:37	05:13
	16:31	128	15:44 (1)	17:07	161	16:09 (1)	17:41	159	16:09 (1)	19:16	79	16:36 (1)	19:48	20:16
7	07:13		13:36 (1)	06:52	13:28 (1)	06:12	13:31 (1)	06:20	15:19 (1)	05:36	05:12
	16:32	130	15:46 (1)	17:09	161	16:09 (1)	17:43	159	16:10 (1)	19:17	75	16:34 (1)	19:49	20:16
8	07:12		13:36 (1)	06:51	13:28 (1)	07:11	14:32 (1)	06:19	15:22 (1)	05:35	05:12
	16:33	131	15:47 (1)	17:10	162	16:10 (1)	18:44	157	17:09 (1)	19:18	71	16:33 (1)	19:50	20:17
9	07:12		13:36 (1)	06:50	13:28 (1)	07:09	14:32 (1)	06:17	15:24 (1)	05:34	05:12
	16:34	131	15:47 (1)	17:11	162	16:10 (1)	18:45	156	17:08 (1)	19:19	66	16:30 (1)	19:51	20:18
10	07:12		13:36 (1)	06:48	13:28 (1)	07:07	14:34 (1)	06:15	15:27 (1)	05:33	05:12
	16:35	132	15:48 (1)	17:12	163	16:11 (1)	18:46	154	17:08 (1)	19:20	61	16:28 (1)	19:52	20:18
11	07:12		13:36 (1)	06:47	13:27 (1)	07:06	14:34 (1)	06:14	15:30 (1)	05:32	05:12
	16:36	133	15:49 (1)	17:14	164	16:11 (1)	18:47	153	17:07 (1)	19:21	56	16:26 (1)	19:53	20:19
12	07:12		13:35 (1)	06:46	13:27 (1)	07:04	14:35 (1)	06:12	15:33 (1)	05:31	05:11
	16:37	134	15:49 (1)	17:15	164	16:11 (1)	18:48	151	17:06 (1)	19:22	50	16:23 (1)	19:54	20:19
13	07:11		13:35 (1)	06:45	13:27 (1)	07:02	14:37 (1)	06:10	15:36 (1)	05:29	05:11
	16:38	136	15:51 (1)	17:16	165	16:12 (1)	18:49	149	17:06 (1)	19:23	44	16:20 (1)	19:56	20:20
14	07:11		13:36 (1)	06:43	13:26 (1)	07:01	14:38 (1)	06:09	15:40 (1)	05:28	05:11
	16:39	136	15:52 (1)	17:17	166	16:12 (1)	18:51	147	17:05 (1)	19:24	37	16:17 (1)	19:57	20:20
15	07:10		13:35 (1)	06:42	13:26 (1)	06:59	14:38 (1)	06:07	15:44 (1)	05:27	05:11
	16:40	137	15:52 (1)	17:19	166	16:12 (1)	18:52	146	17:04 (1)	19:26	28	16:12 (1)	19:58	20:21
16	07:10		13:35 (1)	06:41	13:27 (1)	06:57	14:39 (1)	06:06	15:51 (1)	05:26	05:11
	16:41	139	15:54 (1)	17:20	166	16:13 (1)	18:53	144	17:03 (1)	19:27	15	16:06 (1)	19:59	20:21
17	07:10		13:34 (1)	06:39	13:26 (1)	06:56	14:41 (1)	06:04	05:25	05:11
	16:42	140	15:54 (1)	17:21	166	16:12 (1)	18:54	142	17:03 (1)	19:28	20:00	20:22
18	07:09		13:34 (1)	06:38	13:26 (1)	06:54	14:42 (1)	06:03	05:25	05:11
	16:44	141	15:55 (1)	17:22	167	16:13 (1)	18:55	139	17:01 (1)	19:29	20:00	20:22
19	07:08		13:34 (1)	06:37	13:26 (1)	06:52	14:44 (1)	06:01	05:24	05:11
	16:45	142	15:56 (1)	17:24	166	16:12 (1)	18:56	136	17:00 (1)	19:30	20:01	20:22
20	07:08		13:34 (1)	06:35	13:26 (1)	06:51	14:46 (1)	06:00	05:23	05:12
	16:46	143	15:57 (1)	17:25	167	16:13 (1)	18:57	134	17:00 (1)	19:31	20:01	20:23
21	07:07		13:33 (1)	06:34	13:26 (1)	06:49	14:47 (1)	05:58	05:22	05:12
	16:47	144	15:57 (1)	17:26	166	16:12 (1)	18:58	132	16:59 (1)	19:32	20:02	20:23
22	07:07		13:33 (1)	06:32	13:26 (1)	06:47	14:48 (1)	05:57	05:21	05:12
	16:48	146	15:59 (1)	17:27	167	16:13 (1)	18:59	129	16:57 (1)	19:33	20:03	20:23
23	07:06		13:33 (1)	06:31	13:26 (1)	06:45	14:51 (1)	05:55	05:20	05:12
	16:50	146	15:59 (1)	17:28	166	16:12 (1)	19:01	126	16:57 (1)	19:34	20:04	20:23
24	07:05		13:32 (1)	06:29	13:26 (1)	06:44	14:52 (1)	05:54	05:20	05:13
	16:51	148	16:00 (1)	17:30	167	16:13 (1)	19:02	124	16:56 (1)	19:35	20:05	20:23
25	07:05		13:32 (1)	06:28	13:26 (1)	06:42	14:54 (1)	05:52	05:19	05:13
	16:52	149	16:01 (1)	17:31	166	16:12 (1)	19:03	120	16:54 (1)	19:36	20:06	20:24
26	07:04		13:32 (1)	06:26	13:27 (1)	06:40	14:55 (1)	05:51	05:18	05:13
	16:53	150	16:02 (1)	17:32	165	16:12 (1)	19:04	118	16:53 (1)	19:37	20:07	20:24
27	07:03		13:32 (1)	06:25	13:27 (1)	06:39	14:57 (1)	05:49	05:17	05:14
	16:55	151	16:03 (1)	17:33	165	16:12 (1)	19:05	115	16:52 (1)	19:39	20:08	20:24
28	07:02		13:31 (1)	06:23	13:27 (1)	06:37	14:59 (1)	05:48	05:17	05:14
	16:56	153	16:04 (1)	17:34	165	16:12 (1)	19:06	111	16:50 (1)	19:40	20:09	20:24
29	07:01		13:31 (1)		06:35	15:01 (1)	05:47	05:16	05:14
	16:57	153	16:04 (1)		19:07	108	16:49 (1)	19:41	20:10	20:24
30	07:00		13:31 (1)		06:34	15:03 (1)	05:45	05:16	05:15
	16:58	154	16:05 (1)		19:08	105	16:48 (1)	19:42	20:10	20:24
31	06:59		13:30 (1)		06:32	15:05 (1)	05:15
	17:00	156	16:06 (1)		19:09	101	16:46 (1)	20:11
Potential sun hours	296		297		370		400		450	454
Total, worst case	4313		4583		4327		1036
Sun reduction	0.56		0.58		0.58		0.57
Oper. time red.	1.00		1.00		1.00		1.00
Wind dir. red.	0.60		0.60		0.60		0.60
Total reduction	0.33		0.35		0.35		0.34
Total, real	1443		1590		1504		354

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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4/5/2011 11:06 PM / 16

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
4/5/2011 11:01 PM/2.7.473

SHADOW - Calendar

Shadow receptor: M - 10aM

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	July	August		September			October			November			December		
1	05:15	05:40		06:11		15:29 (1)	06:42		14:15 (1)	06:17		12:57 (1)	06:52		13:18 (1)
	20:24	20:05		19:20	56	16:25 (1)	18:29	150	16:45 (1)	16:42	163	15:40 (1)	16:17	133	15:31 (1)
2	05:16	05:41		06:12		15:26 (1)	06:43		14:13 (1)	06:18		12:57 (1)	06:53		13:19 (1)
	20:24	20:04		19:19	61	16:27 (1)	18:27	152	16:45 (1)	16:40	162	15:39 (1)	16:17	132	15:31 (1)
3	05:16	05:42		06:13		15:22 (1)	06:44		14:12 (1)	06:19		12:58 (1)	06:54		13:20 (1)
	20:24	20:03		19:17	66	16:28 (1)	18:26	153	16:45 (1)	16:39	162	15:40 (1)	16:16	131	15:31 (1)
4	05:17	05:43		06:14		15:19 (1)	06:45		14:10 (1)	06:20		12:58 (1)	06:55		13:20 (1)
	20:23	20:02		19:15	71	16:30 (1)	18:24	155	16:45 (1)	16:38	161	15:39 (1)	16:16	131	15:31 (1)
5	05:17	05:44		06:15		15:16 (1)	06:46		14:09 (1)	06:22		12:58 (1)	06:56		13:21 (1)
	20:23	20:01		19:14	75	16:31 (1)	18:22	156	16:45 (1)	16:37	160	15:38 (1)	16:16	130	15:31 (1)
6	05:18	05:45		06:16		15:14 (1)	06:47		14:07 (1)	06:23		12:59 (1)	06:57		13:22 (1)
	20:23	19:58		19:12	78	16:32 (1)	18:21	158	16:45 (1)	16:36	160	15:39 (1)	16:16	129	15:31 (1)
7	05:19	05:46		06:17		15:11 (1)	06:48		14:06 (1)	06:24		12:59 (1)	06:58		13:23 (1)
	20:23	19:57		19:10	83	16:34 (1)	18:19	159	16:45 (1)	16:35	159	15:38 (1)	16:16	128	15:31 (1)
8	05:19	05:47		06:18		15:08 (1)	06:49		14:05 (1)	06:25		13:00 (1)	06:59		13:24 (1)
	20:22	19:56		19:08	87	16:35 (1)	18:17	160	16:45 (1)	16:33	157	15:37 (1)	16:16	127	15:31 (1)
9	05:20	05:48		06:19		15:05 (1)	06:50		14:04 (1)	06:26		13:01 (1)	07:00		13:25 (1)
	20:22	19:54		19:07	91	16:36 (1)	18:16	161	16:45 (1)	16:32	157	15:38 (1)	16:16	126	15:31 (1)
10	05:21	05:49		06:20		15:03 (1)	06:51		14:04 (1)	06:28		13:01 (1)	07:01		13:26 (1)
	20:22	19:53		19:05	94	16:37 (1)	18:14	162	16:46 (1)	16:31	156	15:37 (1)	16:16	125	15:31 (1)
11	05:21	05:50		06:21		15:00 (1)	06:53		14:02 (1)	06:29		13:01 (1)	07:02		13:26 (1)
	20:21	19:52		19:03	98	16:38 (1)	18:12	163	16:45 (1)	16:30	155	15:36 (1)	16:16	124	15:30 (1)
12	05:22	05:51		06:22		14:57 (1)	06:54		14:01 (1)	06:30		13:02 (1)	07:02		13:27 (1)
	20:21	19:50		19:02	101	16:38 (1)	18:11	164	16:45 (1)	16:29	154	15:36 (1)	16:16	124	15:31 (1)
13	05:23	05:52		06:23		14:55 (1)	06:55		14:01 (1)	06:31		13:03 (1)	07:03		13:28 (1)
	20:20	19:49		19:00	104	16:39 (1)	18:09	164	16:45 (1)	16:28	153	15:36 (1)	16:16	123	15:31 (1)
14	05:24	05:53		06:24		14:51 (1)	06:56		14:00 (1)	06:32		13:03 (1)	07:04		13:29 (1)
	20:20	19:48		18:58	108	16:39 (1)	18:08	164	16:44 (1)	16:27	152	15:35 (1)	16:16	122	15:31 (1)
15	05:24	05:54		06:25		14:49 (1)	06:57		13:59 (1)	06:34		13:04 (1)	07:05		13:28 (1)
	20:19	19:46		18:56	111	16:40 (1)	18:06	165	16:44 (1)	16:27	151	15:35 (1)	16:17	123	15:31 (1)
16	05:25	05:55		06:26		14:46 (1)	06:58		13:58 (1)	06:35		13:05 (1)	07:05		13:29 (1)
	20:19	19:45		18:55	114	16:40 (1)	18:04	166	16:44 (1)	16:26	150	15:35 (1)	16:17	122	15:31 (1)
17	05:26	05:56		06:27		14:44 (1)	06:59		13:58 (1)	06:36		13:06 (1)	07:06		13:30 (1)
	20:18	19:43		18:53	117	16:41 (1)	18:03	166	16:44 (1)	16:25	149	15:35 (1)	16:17	122	15:32 (1)
18	05:27	05:57		06:28		14:41 (1)	07:00		13:58 (1)	06:37		13:06 (1)	07:07		13:30 (1)
	20:17	19:42		18:51	120	16:41 (1)	18:01	166	16:44 (1)	16:24	148	15:34 (1)	16:17	122	15:32 (1)
19	05:28	05:58		06:29		14:39 (1)	07:01		13:57 (1)	06:38		13:07 (1)	07:07		13:31 (1)
	20:17	19:41		18:50	123	16:42 (1)	18:00	167	16:44 (1)	16:23	146	15:33 (1)	16:18	122	15:33 (1)
20	05:28	05:59		06:30		14:37 (1)	07:03		13:57 (1)	06:40		13:08 (1)	07:08		13:32 (1)
	20:16	19:39		18:48	125	16:42 (1)	17:58	166	16:43 (1)	16:23	146	15:34 (1)	16:18	121	15:33 (1)
21	05:29	06:00		06:31		14:34 (1)	07:04		13:56 (1)	06:41		13:09 (1)	07:09		13:32 (1)
	20:15	19:38		18:46	128	16:42 (1)	17:57	167	16:43 (1)	16:22	144	15:33 (1)	16:19	121	15:33 (1)
22	05:30	06:01		06:32		14:32 (1)	07:05		13:57 (1)	06:42		13:10 (1)	07:09		13:33 (1)
	20:14	19:36		18:44	131	16:43 (1)	17:55	166	16:43 (1)	16:21	143	15:33 (1)	16:19	121	15:34 (1)
23	05:31	06:02		06:33		14:30 (1)	07:06		13:56 (1)	06:43		13:10 (1)	07:10		13:33 (1)
	20:14	19:35		18:43	133	16:43 (1)	17:54	167	16:43 (1)	16:21	142	15:32 (1)	16:20	121	15:34 (1)
24	05:32	06:03		06:34		14:28 (1)	07:07		13:56 (1)	06:44		13:12 (1)	07:10		13:33 (1)
	20:13	19:33		18:41	135	16:43 (1)	17:52	166	16:42 (1)	16:20	141	15:33 (1)	16:20	122	15:35 (1)
25	05:33	06:04		06:36		14:26 (1)	07:08		13:56 (1)	06:45		13:12 (1)	07:10		13:34 (1)
	20:12	19:31		18:39	138	16:44 (1)	17:51	166	16:42 (1)	16:19	140	15:32 (1)	16:21	122	15:36 (1)
26	05:34	06:05		06:37		14:24 (1)	07:10		13:56 (1)	06:47		13:13 (1)	07:11		13:34 (1)
	20:11	19:30		18:37	141	16:45 (1)	17:50	166	16:42 (1)	16:19	139	15:32 (1)	16:21	122	15:36 (1)
27	05:35	06:06	15:52 (1)	06:38		14:22 (1)	07:11		13:56 (1)	06:48		13:14 (1)	07:11		13:34 (1)
	20:10	19:28	17 16:09 (1)	18:36	143	16:45 (1)	17:48	166	16:42 (1)	16:19	137	15:31 (1)	16:22	122	15:36 (1)
28	05:36	06:07	15:45 (1)	06:39		14:21 (1)	07:12		13:56 (1)	06:49		13:15 (1)	07:12		13:35 (1)
	20:09	19:27	29 16:14 (1)	18:34	144	16:45 (1)	17:47	165	16:41 (1)	16:18	136	15:31 (1)	16:23	123	15:38 (1)
29	05:37	06:08	15:40 (1)	06:40		14:19 (1)	07:13		13:56 (1)	06:50		13:15 (1)	07:12		13:36 (1)
	20:08	19:25	38 16:18 (1)	18:32	146	16:45 (1)	17:46	165	16:41 (1)	16:18	136	15:31 (1)	16:24	122	15:38 (1)
30	05:38	06:09	15:36 (1)	06:41		14:17 (1)	07:14		13:57 (1)	06:51		13:17 (1)	07:12		13:36 (1)
	20:07	19:23	45 16:21 (1)	18:31	148	16:45 (1)	17:44	164	16:41 (1)	16:17	134	15:31 (1)	16:24	123	15:39 (1)
31	05:39	06:10	15:32 (1)				07:16		13:57 (1)				07:12		13:36 (1)
	20:06	19:22	51 16:23 (1)				17:43	163	16:40 (1)				16:25	123	15:39 (1)
Potential sun hours	461	429		375			344			297			286		
Total, worst case		180			3270			5038			4493			3859	
Sun reduction		0.62			0.62			0.61			0.50			0.52	
Oper. time red.		1.00			1.00			1.00			1.00			1.00	
Wind dir. red.		0.60			0.60			0.60			0.60			0.60	
Total reduction		0.37			0.37			0.37			0.30			0.31	
Total, real		67			1217			1841			1344			1198	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
4/5/2011 11:01 PM/2.7.473

SHADOW - Calendar

Shadow receptor: N - 10aN

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June			July			August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15			05:15		18:51 (1)	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12			20:24	40	19:31 (1)	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:29	05:43	05:14			05:16		18:51 (1)	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13			20:24	39	19:30 (1)	20:04	19:19	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14			05:16		18:53 (1)	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:13	19:45	20:14			20:24	37	19:30 (1)	20:03	19:17	18:26	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13		18:57 (1)	05:17		18:55 (1)	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	16	19:13 (1)	20:23	34	19:29 (1)	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:24	05:39	05:13		18:55 (1)	05:17		18:56 (1)	05:44	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	22	19:17 (1)	20:23	32	19:28 (1)	20:01	19:14	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13		18:53 (1)	05:18		18:58 (1)	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	26	19:19 (1)	20:23	28	19:26 (1)	19:58	19:12	18:21	16:36	16:16
7	07:13	06:52	06:12	06:20	05:36	05:12		18:50 (1)	05:19		19:00 (1)	05:46	06:17	06:48	06:24	06:58
	16:32	17:09	17:43	19:17	19:49	20:16	31	19:21 (1)	20:23	24	19:24 (1)	19:57	19:10	18:19	16:35	16:16
8	07:12	06:51	07:11	06:19	05:35	05:12		18:49 (1)	05:19		19:03 (1)	05:47	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50	20:17	34	19:23 (1)	20:22	19	19:22 (1)	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12		18:48 (1)	05:20		19:08 (1)	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	36	19:24 (1)	20:22	10	19:18 (1)	19:54	19:07	18:16	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12		18:47 (1)	05:21			05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	39	19:26 (1)	20:22			19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:32	05:12		18:47 (1)	05:21			05:50	06:21	06:53	06:29	07:02
	16:36	17:14	18:47	19:21	19:53	20:19	40	19:27 (1)	20:21			19:52	19:03	18:12	16:30	16:16
12	07:11	06:46	07:04	06:12	05:31	05:11		18:46 (1)	05:22			05:51	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	20:19	42	19:28 (1)	20:21			19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11		18:46 (1)	05:23			05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:56	20:20	43	19:29 (1)	20:20			19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11		18:45 (1)	05:24			05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:51	19:24	19:57	20:20	45	19:30 (1)	20:20			19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11		18:45 (1)	05:24			05:54	06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:26	19:58	20:21	46	19:31 (1)	20:19			19:46	18:56	18:06	16:27	16:17
16	07:10	06:41	06:57	06:06	05:26	05:11		18:45 (1)	05:25			05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:59	20:21	46	19:31 (1)	20:19			19:45	18:55	18:04	16:26	16:17
17	07:10	06:39	06:56	06:04	05:25	05:11		18:45 (1)	05:26			05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	20:00	20:22	47	19:32 (1)	20:18			19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:03	05:25	05:11		18:44 (1)	05:27			05:57	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00	20:22	48	19:32 (1)	20:17			19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:24	05:11		18:44 (1)	05:28			05:58	06:29	07:01	06:38	07:07
	16:45	17:24	18:56	19:30	20:00	20:22	48	19:32 (1)	20:17			19:41	18:50	18:00	16:23	16:18
20	07:08	06:35	06:51	06:00	05:23	05:12		18:44 (1)	05:28			05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	48	19:32 (1)	20:16			19:39	18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12		18:44 (1)	05:29			06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	49	19:33 (1)	20:15			19:38	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:57	05:21	05:12		18:45 (1)	05:30			06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	48	19:33 (1)	20:14			19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12		18:45 (1)	05:31			06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:01	19:34	20:04	20:23	48	19:33 (1)	20:14			19:35	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54	05:20	05:13		18:45 (1)	05:32			06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	48	19:33 (1)	20:13			19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13		18:47 (1)	05:33			06:04	06:36	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	47	19:34 (1)	20:12			19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13		18:47 (1)	05:34			06:05	06:37	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	46	19:33 (1)	20:11			19:30	18:37	17:50	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:14		18:47 (1)	05:35			06:06	06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:39	20:08	20:24	46	19:33 (1)	20:10			19:28	18:36	17:48	16:19	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14		18:48 (1)	05:36			06:07	06:39	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20:09	20:24	45	19:33 (1)	20:09			19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:47	05:16	05:14		18:49 (1)	05:37			06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	43	19:32 (1)	20:08			19:25	18:32	17:46	16:18	16:24
30	07:00		06:34	05:45	05:16	05:15		18:49 (1)	05:38			06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	42	19:31 (1)	20:07			19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15				05:39			06:10		07:16		07:12
	17:00		19:09		20:11				20:06			19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454			461			429	375	344	297	286
Total, worst case							1119			263						
Sun reduction							0.61			0.63						
Oper. time red.							1.00			1.00						
Wind dir. red.							0.61			0.61						
Total reduction							0.38			0.39						
Total, real							420			102						

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
4/5/2011 11:06 PM / 18

Licensed user:
Geo-Marine.Inc
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US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
4/5/2011 11:01 PM/2.7.473

SHADOW - Calendar

Shadow receptor: O - 10aO

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January			February			March	April	May	June	July	August	September	October			November			December		
1	07:12		08:52 (1)	06:58		09:13 (1)	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42			06:17		08:58 (1)	06:52		08:40 (1)
	16:26	99	10:31 (1)	17:01	72	10:25 (1)	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29			16:42	37	09:35 (1)	16:17	96	10:16 (1)
2	07:13		08:53 (1)	06:57		09:15 (1)	06:20	06:29	05:43	05:14	05:16	05:41	06:12	06:43			06:18		08:55 (1)	06:53		08:40 (1)
	16:27	98	10:31 (1)	17:02	69	10:24 (1)	17:37	19:11	19:44	20:13	20:24	20:04	19:19	18:27			16:40	43	09:38 (1)	16:17	96	10:16 (1)
3	07:13		08:53 (1)	06:56		09:16 (1)	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44			06:19		08:54 (1)	06:54		08:40 (1)
	16:28	98	10:31 (1)	17:03	66	10:22 (1)	17:38	19:13	19:45	20:14	20:24	20:03	19:17	18:26			16:39	48	09:42 (1)	16:16	97	10:17 (1)
4	07:13		08:54 (1)	06:55		09:18 (1)	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45			06:20		08:52 (1)	06:55		08:40 (1)
	16:29	98	10:32 (1)	17:05	63	10:21 (1)	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24			16:38	52	09:44 (1)	16:16	98	10:18 (1)
5	07:13		08:54 (1)	06:54		09:19 (1)	06:15	06:24	05:39	05:13	05:17	05:44	06:15	06:46			06:22		08:50 (1)	06:56		08:41 (1)
	16:30	98	10:32 (1)	17:06	60	10:19 (1)	17:40	19:15	19:47	20:15	20:23	20:01	19:14	18:22			16:37	56	09:46 (1)	16:16	97	10:18 (1)
6	07:13		08:55 (1)	06:53		09:20 (1)	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47			06:23		08:49 (1)	06:57		08:41 (1)
	16:31	98	10:33 (1)	17:07	56	10:16 (1)	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:21			16:36	60	09:49 (1)	16:16	98	10:19 (1)
7	07:13		08:55 (1)	06:52		09:22 (1)	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48			06:24		08:47 (1)	06:58		08:41 (1)
	16:32	98	10:33 (1)	17:09	52	10:14 (1)	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19			16:35	64	09:51 (1)	16:16	98	10:19 (1)
8	07:12		08:56 (1)	06:51		09:24 (1)	07:11	06:19	05:35	05:12	05:19	05:47	06:18	06:49			06:25		08:46 (1)	06:59		08:42 (1)
	16:33	98	10:34 (1)	17:10	47	10:11 (1)	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17			16:33	66	09:52 (1)	16:16	98	10:20 (1)
9	07:12		08:56 (1)	06:50		09:27 (1)	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50			06:26		08:45 (1)	07:00		08:42 (1)
	16:34	97	10:33 (1)	17:11	42	10:09 (1)	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16			16:32	70	09:55 (1)	16:16	98	10:20 (1)
10	07:12		08:57 (1)	06:48		09:30 (1)	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51			06:28		08:44 (1)	07:01		08:43 (1)
	16:35	96	10:33 (1)	17:12	35	10:05 (1)	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14			16:31	72	09:56 (1)	16:16	98	10:21 (1)
11	07:12		08:58 (1)	06:47		09:33 (1)	07:06	06:14	05:32	05:12	05:21	05:50	06:21	06:53			06:29		08:43 (1)	07:02		08:42 (1)
	16:36	96	10:34 (1)	17:14	27	10:00 (1)	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12			16:30	74	09:57 (1)	16:16	99	10:21 (1)
12	07:12		08:58 (1)	06:46		09:40 (1)	07:04	06:12	05:31	05:11	05:22	05:51	06:22	06:54			06:30		08:42 (1)	07:02		08:43 (1)
	16:37	95	10:33 (1)	17:15	13	09:53 (1)	18:48	19:22	19:55	20:19	20:21	19:51	19:02	18:11			16:29	76	09:58 (1)	16:16	98	10:21 (1)
13	07:11		08:59 (1)	06:45			07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55			06:31		08:42 (1)	07:03		08:43 (1)
	16:38	95	10:34 (1)	17:16			18:49	19:23	19:56	20:20	20:20	19:49	19:00	18:09			16:28	78	10:00 (1)	16:16	99	10:22 (1)
14	07:11		09:00 (1)	06:43			07:01	06:09	05:28	05:11	05:24	05:53	06:24	06:56			06:32		08:41 (1)	07:04		08:44 (1)
	16:39	94	10:34 (1)	17:17			18:51	19:24	19:57	20:20	20:20	19:48	18:58	18:08			16:27	80	10:01 (1)	16:16	99	10:23 (1)
15	07:10		09:00 (1)	06:42			06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57			06:34		08:41 (1)	07:05		08:44 (1)
	16:40	94	10:34 (1)	17:19			18:52	19:26	19:58	20:21	20:19	19:46	18:56	18:06			16:27	81	10:02 (1)	16:17	99	10:23 (1)
16	07:10		09:01 (1)	06:41			06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58			06:35		08:41 (1)	07:06		08:44 (1)
	16:41	93	10:34 (1)	17:20			18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04			16:26	83	10:04 (1)	16:17	99	10:23 (1)
17	07:10		09:01 (1)	06:39			06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59			06:36		08:40 (1)	07:06		08:45 (1)
	16:42	93	10:34 (1)	17:21			18:54	19:28	20:00	20:22	20:18	19:43	18:53	18:03			16:25	85	10:05 (1)	16:17	99	10:24 (1)
18	07:09		09:01 (1)	06:38			06:54	06:03	05:25	05:11	05:27	05:57	06:28	07:00			06:37		08:40 (1)	07:07		08:45 (1)
	16:44	92	10:33 (1)	17:22			18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01			16:24	86	10:06 (1)	16:17	99	10:24 (1)
19	07:09		09:02 (1)	06:37			06:52	06:01	05:24	05:11	05:28	05:58	06:29	07:01			06:39		08:39 (1)	07:07		08:46 (1)
	16:45	92	10:34 (1)	17:24			18:56	19:30	20:01	20:22	20:17	19:41	18:50	18:00			16:23	87	10:06 (1)	16:18	99	10:25 (1)
20	07:08		09:03 (1)	06:35			06:51	06:00	05:23	05:12	05:29	05:59	06:30	07:03			06:40		08:40 (1)	07:08		08:47 (1)
	16:46	90	10:33 (1)	17:25			18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58			16:23	88	10:08 (1)	16:18	99	10:26 (1)
21	07:07		09:03 (1)	06:34			06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04			06:41		08:39 (1)	07:09		08:47 (1)
	16:47	90	10:33 (1)	17:26			18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57			16:22	90	10:09 (1)	16:19	99	10:26 (1)
22	07:07		09:04 (1)	06:32			06:47	05:57	05:21	05:12	05:30	06:01	06:32	07:05			06:42		08:39 (1)	07:09		08:48 (1)
	16:48	89	10:33 (1)	17:27			18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55			16:21	90	10:09 (1)	16:19	99	10:27 (1)
23	07:06		09:05 (1)	06:31			06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06			06:43		08:38 (1)	07:10		08:48 (1)
	16:50	87	10:32 (1)	17:28			19:01	19:34	20:04	20:23	20:14	19:35	18:43	17:54			16:21	92	10:10 (1)	16:20	99	10:27 (1)
24	07:05		09:06 (1)	06:29			06:44	05:54	05:20	05:13	05:32	06:03	06:34	07:07			06:44		08:39 (1)	07:10		08:48 (1)
	16:51	86	10:32 (1)	17:30			19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52			16:20	92	10:11 (1)	16:20	99	10:27 (1)
25	07:05		09:06 (1)	06:28			06:42	05:52	05:19	05:13	05:33	06:04	06:36	07:08			06:46		08:39 (1)	07:10		08:49 (1)
	16:52	85	10:31 (1)	17:31			19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51			16:20	93	10:12 (1)	16:21	99	10:28 (1)
26	07:04		09:08 (1)	06:26			06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10			06:47		08:39 (1)	07:11		08:49 (1)
	16:53	83	10:31 (1)	17:32			19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50			16:19	93	10:12 (1)	16:21	99	10:28 (1)
27	07:03		09:09 (1)	06:25			06:39	05:49	05:17	05:14	05:35	06:06	06:38	07:11			06:48		08:39 (1)	07:11		08:49 (1)
	16:55	81	10:30 (1)	17:33			19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48			16:19	94	10:13 (1)	16:22	99	10:28 (1)
28	07:02		09:09 (1)	06:23			06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12			06:49		08:39 (1)	07:12		08:51 (1)
	16:56	80	10:29 (1)	17:34			19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47			16:18	94	10:13 (1)	16:23	99	10:30 (1)
29	07:01		09:10 (1)				06:35	05:47	05:16	05:14	05:37	06:08	06:40	07:13			06:50		08:40 (1)	07:12		08:51 (1)
	16:57	78	10:28 (1)				19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:46			16:18	95	10:15 (1)	16:24	99	10:30 (1)
30	07:00		09:11 (1)				06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14		10:08 (1)	06:51		08:40 (1)	07:12		08:51 (1)
	16:58	76	10:27 (1)				19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	17	10:25 (1)	16:17	95	10:15 (1)	16:24	99	10:30 (1)
31	06:59		09:12 (1)				06:32		05:15		05:39	06:10		07:16		10:02 (1)				07:12		08:52 (1)
	17:00	74	10:26 (1)				19:09		20:11		20:06	19:22		17:43	29	10:31 (1)				16:25	98	10:30 (1)
Potential sun hours	296			297			370	400	450	454	461	429	375	344			297			286		
Total, worst case		2821			602										46			2314			3051	
Sun reduction		0.56			0.58										0.61			0.50			0.52	
Oper. time red.		1.00			1.00										1.00			1.00			1.00	
Wind dir. red.		0.72			0.72										0.72			0.72			0.72	
Total reduction		0.40			0.41										0.44			0.36			0.37	
Total, real		1126			249										20			826			1130	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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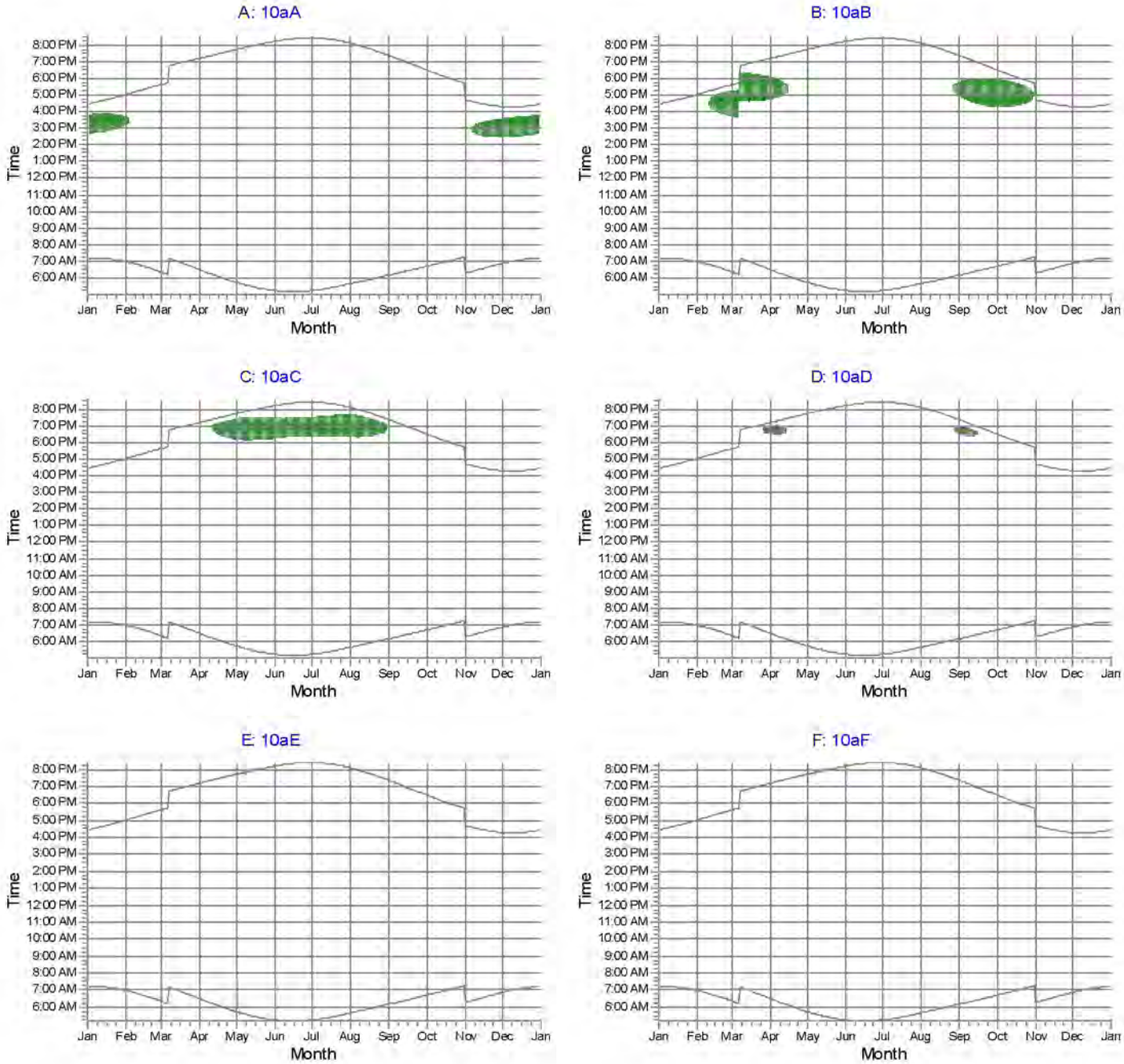
4/5/2011 11:07 PM / 1

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
4/5/2011 11:01 PM/2.7.473

SHADOW - Calendar, graphical



WTGs

1: Prichard Field North

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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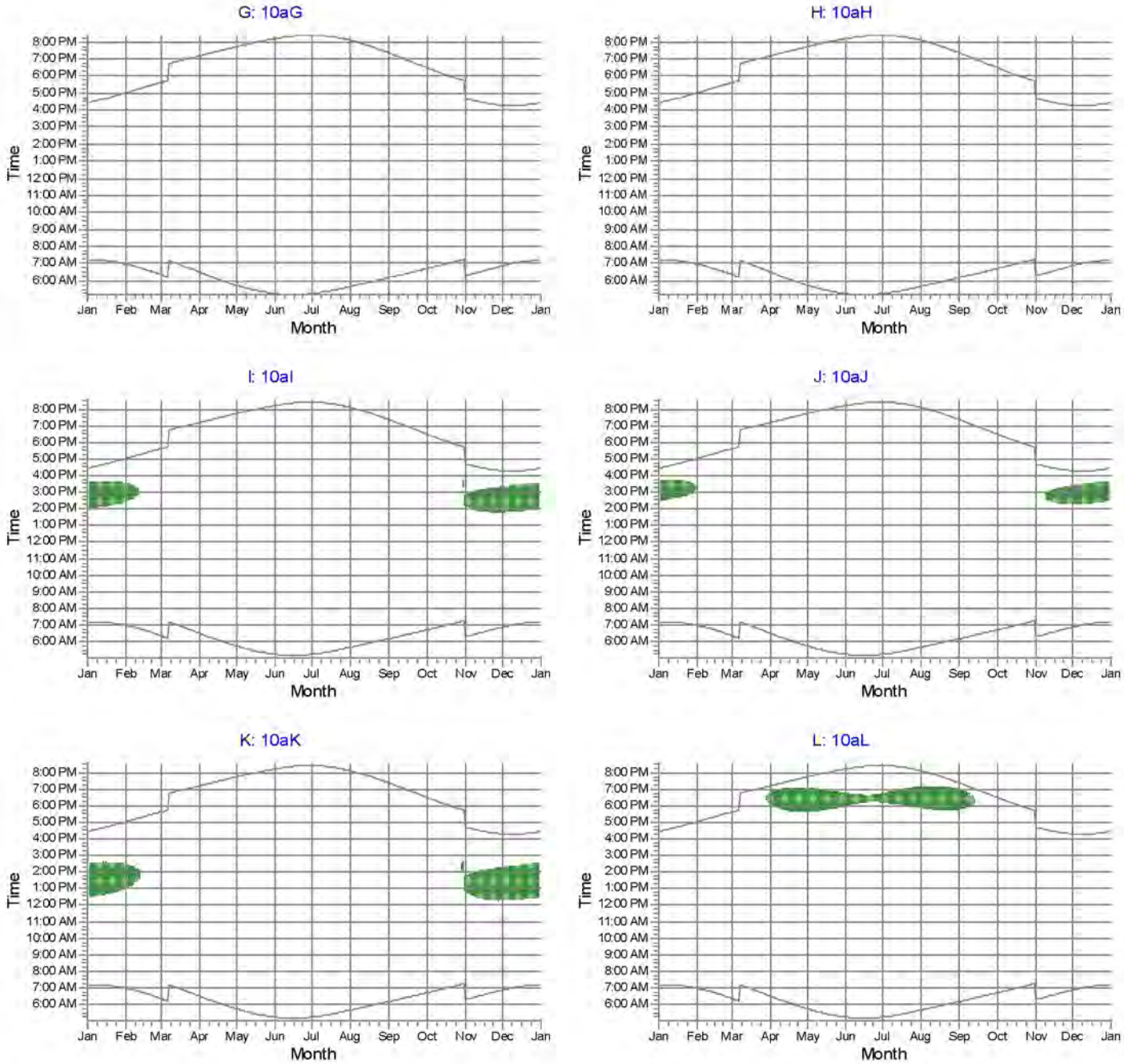
Calculated:
4/5/2011 11:01 PM/2.7.473

SHADOW - Calendar, graphical



WTGs

1: Prichard Field North

Project:
Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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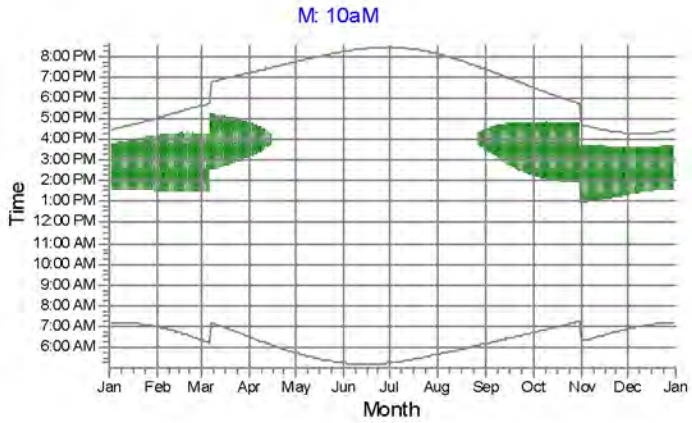
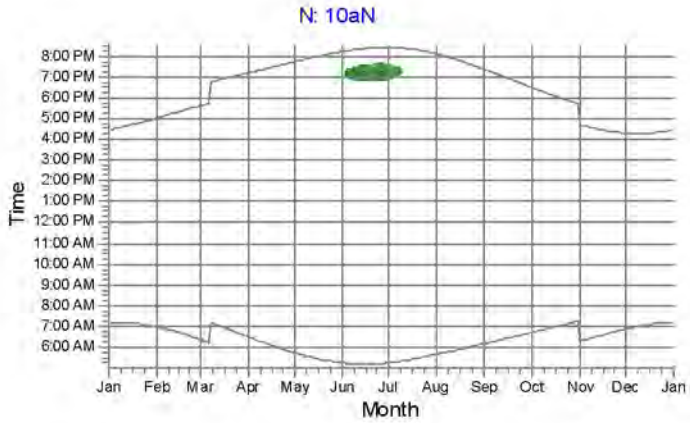
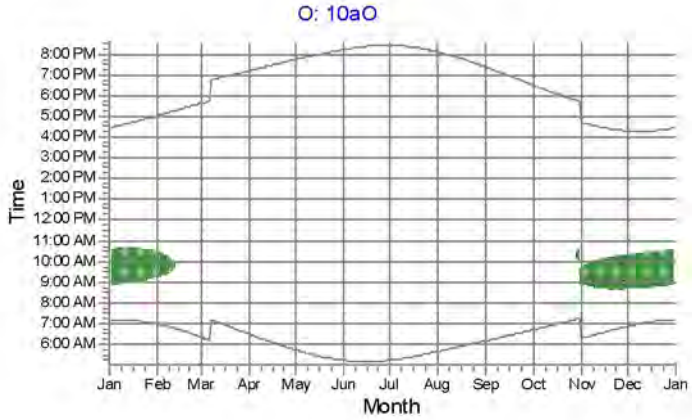
Calculated:
4/5/2011 11:01 PM/2.7.473

SHADOW - Calendar, graphical







WTGs

1: Prichard Field North

Project:

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Calculated:
4/5/2011 11:01 PM/2.7.473

SHADOW - Calendar per WTG

WTG: 1 - Prichard Field North

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June
1	07:12 08:52-10:31/99	06:58 09:13-10:25/72	06:22 13:27-16:12/165	06:30 15:07-16:46/99 18:06-18:48/42	05:44 17:36-18:58/82	05:15 17:56-18:41/45
	16:26 12:27-15:44/197	17:01 12:58-16:06/188	17:36 16:12-17:10/58	19:10 16:46-18:00/74	19:43 18:58-19:20/22	20:12 18:41-19:22/41
2	07:13 08:53-10:31/98	06:57 09:15-10:24/69	06:20 13:28-16:13/165	06:29 15:09-16:45/96 18:03-18:49/46	05:43 17:36-18:57/81	05:14 17:57-18:41/44
	16:27 12:27-15:44/197	17:02 13:00-16:07/187	17:37 16:13-17:11/58	19:11 16:45-17:59/74	19:44 18:57-19:20/23	20:13 18:41-19:22/41
3	07:13 08:53-10:31/98	06:56 09:16-10:22/66	06:19 13:28-16:12/164	06:27 15:11-16:42/91 18:00-18:51/51	05:41 17:36-18:57/81	05:14 17:58-18:41/43
	16:28 12:28-15:44/196	17:03 13:02-16:08/186	17:38 16:12-17:11/59	19:13 16:43-17:58/75	19:45 18:57-19:21/24	20:14 18:41-19:22/41
4	07:13 08:54-10:32/98	06:55 09:18-10:21/63	06:17 13:29-16:11/162	06:25 15:13-16:40/87 17:57-18:52/55	05:40 17:37-18:57/80	05:13 17:59-18:39/40 19:14-19:21/7
	16:29 12:28-15:45/197	17:05 13:05-16:08/183	17:39 16:11-17:11/60	19:14 16:44-17:56/72	19:46 18:57-19:23/26	20:14 18:13-19:14/61
5	07:13 08:54-10:32/98	06:54 09:19-10:19/60	06:15 13:30-16:11/161	06:24 15:16-16:39/83	05:39 17:37-18:57/80	05:13 18:00-18:38/38 19:18-19:22/4
	16:30 12:29-15:45/196	17:06 13:07-16:09/182	17:40 16:11-17:12/61	19:15 16:46-18:52/126	19:47 18:57-19:23/26	20:15 18:14-19:18/64
6	07:13 08:55-10:33/98	06:53 09:20-10:16/56	06:14 13:30-16:10/160	06:22 15:17-16:36/79	05:37 17:37-18:56/79	05:13 18:01-18:38/37 19:20-19:22/2
	16:31 12:30-15:46/196	17:07 13:09-16:09/180	17:41 16:10-17:12/62	19:16 16:47-18:54/127	19:48 18:56-19:23/27	20:16 18:15-19:20/65
7	07:13 08:55-10:33/98	06:52 09:22-10:14/52	06:12 13:31-16:11/160	06:20 15:19-16:34/75	05:36 17:37-18:56/79	05:12 18:01-18:37/36
	16:32 12:31-15:46/195	17:09 13:13-16:09/176	17:43 16:11-17:13/62	19:17 16:48-18:55/127	19:49 18:56-19:23/27	20:16 18:14-19:21/67
8	07:12 08:56-10:34/98	06:51 09:24-10:11/47	07:11 14:32-17:10/158	06:19 15:22-16:33/71	05:35 17:38-18:55/77	05:12 18:03-18:36/33
	16:33 12:32-15:47/195	17:10 13:16-16:10/174	18:44 17:10-18:13/63	19:18 16:50-18:55/125	19:50 18:55-19:23/28	20:17 18:15-19:23/68
9	07:12 08:56-10:33/97	06:50 09:27-10:09/42	07:09 14:32-17:09/157	06:17 15:24-16:30/66 17:48-18:54/66	05:34 17:38-18:55/77	05:12 18:04-18:36/32
	16:34 12:32-15:47/195	17:11 13:20-16:10/170	18:45 17:09-18:12/63	19:19 16:51-17:47/56	19:51 18:55-19:24/29	20:18 18:16-19:24/68
10	07:12 08:57-10:33/96	06:48 09:30-10:05/35	07:07 14:34-17:09/155	06:15 15:27-16:28/61 17:46-18:53/67	05:33 17:39-18:55/76	05:12 18:05-18:36/31
	16:35 12:33-15:48/195	17:12 13:25-16:11/166	18:46 17:09-18:13/64	19:20 16:52-17:45/53	19:52 18:55-19:24/29	20:18 18:16-19:26/70
11	07:12 08:58-10:34/96	06:47 09:33-10:00/27 16:20-16:34/14	07:06 14:34-17:08/154	06:14 15:30-16:26/56 17:45-18:55/70	05:32 17:39-18:54/75	05:12 18:06-18:35/29
	16:36 12:34-15:49/195	17:14 13:27-16:11/164	18:47 17:08-18:13/65	19:21 16:55-17:43/48	19:53 18:54-19:24/30	20:19 18:17-19:27/70
12	07:12 08:58-10:33/95	06:46 09:40-09:53/13 16:14-16:41/27	07:04 14:35-17:07/152	06:12 15:33-16:23/50 17:44-18:55/71	05:31 17:40-18:54/74	05:11 18:07-18:35/28
	16:37 12:34-15:49/195	17:15 13:27-16:11/164	18:48 17:07-18:12/65	19:22 16:57-17:40/43	19:54 18:54-19:24/30	20:19 18:17-19:28/71
13	07:11 08:59-10:34/95	06:45 13:27-16:13/166	07:02 14:37-17:07/150	06:10 15:36-16:20/44 17:43-18:56/73	05:29 17:40-18:53/73	05:11 18:08-18:34/26
	16:38 12:35-15:51/196	17:16 16:13-16:45/32	18:49 17:07-18:13/66	19:23 17:00-17:38/38	19:56 18:53-19:24/31	20:20 18:18-19:29/71
14	07:11 09:00-10:34/94	06:43 13:26-16:13/167	07:01 14:38-17:06/148	06:09 15:40-16:17/37 17:42-19:01/79	05:28 17:41-18:53/72	05:11 18:09-18:34/25
	16:39 12:36-15:52/196	17:17 16:13-16:48/35	18:51 17:06-18:13/67	19:24 17:02-17:34/32	19:57 18:53-19:24/31	20:20 18:18-19:30/72
15	07:10 09:00-10:34/94	06:42 13:26-16:13/167	06:59 14:38-17:05/147	06:07 15:44-16:12/28 17:40-19:03/83	05:27 17:42-18:52/70	05:11 18:09-18:34/25
	16:40 12:36-15:52/196	17:19 16:13-16:51/38	18:52 17:05-18:12/67	19:26 17:06-17:30/24	19:58 18:52-19:24/32	20:21 18:18-19:31/73
16	07:10 09:01-10:34/93	06:41 13:27-16:14/167	06:57 14:39-17:04/145	06:06 15:51-16:06/15 17:40-19:04/84	05:26 17:42-18:52/70	05:11 18:10-18:33/23
	16:41 12:38-15:54/196	17:20 16:14-16:54/40	18:53 17:04-18:11/67	19:27 17:13-17:24/11	19:59 18:52-19:24/32	20:21 18:19-19:31/72
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	16:42 12:38-15:54/196	17:21 16:13-16:55/42	18:54 17:04-18:12/68	19:28 18:58-19:05/7	20:00 18:51-19:23/32	20:22 18:19-19:32/73
18	07:09 09:01-10:33/92	06:38 13:26-16:14/168	06:54 14:42-17:02/140	06:03 17:39-18:59/80	05:25 17:43-18:50/67	05:11 18:11-18:33/22
	16:44 12:39-15:55/196	17:22 16:14-16:58/44	18:55 17:02-18:11/69	19:29 18:59-19:06/7	20:00 18:50-19:23/33	20:22 18:19-19:32/73
19	07:08 09:02-10:34/92	06:37 13:26-16:13/167	06:52 14:44-17:01/137	06:01 17:38-18:58/80	05:24 17:45-18:50/65	05:12 18:11-18:33/22
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21	07:07 09:03-10:33/90	06:34 13:26-16:13/167	06:49 14:47-17:00/133	05:58 17:37-18:59/82	05:22 17:46-18:49/63	05:12 18:12-18:32/20
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22	07:07 09:04-10:33/89	06:32 13:26-16:14/168	06:47 14:48-16:58/130	05:57 17:37-18:59/82	05:21 17:47-18:48/61	05:12 18:13-18:33/20
	16:48 12:44-15:59/195	17:27 16:14-17:03/49	18:59 16:58-18:09/71	19:33 18:59-19:10/11	20:03 18:48-19:23/35	20:23 18:20-19:33/73
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26	07:04 09:08-10:31/83	06:26 13:27-16:13/166	06:40 14:55-16:54/119	05:51 17:36-18:59/83	05:18 17:50-18:45/55	05:13 18:12-18:35/23
	16:53 12:49-16:02/193	17:32 16:13-17:08/55	19:04 16:54-18:06/72	19:37 18:59-19:14/15	20:07 18:45-19:22/37	20:24 18:21-19:33/72
27	07:03 09:09-10:30/81	06:25 13:27-16:13/166	06:39 14:57-16:53/116 18:40-18:44/4	05:49 17:36-18:59/83	05:17 17:51-18:45/54	05:14 18:12-18:36/24
	16:55 12:50-16:03/193	17:33 16:13-17:08/55	19:05 16:53-18:06/73	19:39 18:59-19:16/17	20:08 18:45-19:23/38	20:24 18:20-19:33/73
28	07:02 09:09-10:29/80	06:23 13:27-16:13/166	06:37 14:59-16:51/112 18:36-18:45/9	05:48 17:36-18:59/83	05:17 17:52-18:44/52	05:14 18:12-18:37/25
	16:56 12:51-16:04/193	17:34 16:13-17:09/56	19:06 16:51-18:04/73	19:40 18:59-19:17/18	20:09 18:44-19:22/38	20:24 18:21-19:33/72
29	07:01 09:10-10:28/78		06:35 15:01-16:50/109 18:33-18:45/12	05:47 17:35-18:58/83	05:16 17:53-18:44/51	05:14 18:11-18:37/26
	16:57 12:53-16:04/191		19:07 16:50-18:03/73	19:41 18:58-19:17/19	20:10 18:44-19:23/39	20:24 18:21-19:32/71
30	07:00 09:11-10:27/76		06:34 15:03-16:49/106 18:18-18:30/12	05:45 17:36-18:58/82	05:16 17:54-18:43/49	05:15 18:10-18:38/28
	16:58 12:54-16:05/191		19:08 16:49-18:03/74 18:32-18:47/15	19:42 18:58-19:19/21	20:10 18:43-19:22/39	20:24 18:20-19:31/71
31	06:59 09:12-10:26/74		06:32 15:05-16:47/102 18:10-18:48/38		05:15 17:55-18:43/48	
	17:00 12:56-16:06/190		19:09 16:47-18:01/74		20:11 18:43-19:22/39	
Potential sun hours	296	297	370	400	450	454
Sum of minutes with flicker	8863	6179	6525	4261	3087	2457

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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Calculated:
4/5/2011 11:01 PM/2.7.473

SHADOW - Calendar per WTG

WTG: 1 - Prichard Field North

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	July	August	September	October	November	December
1	05:15 18:10-18:39/29	05:40 17:50-19:05/75	06:11 15:29-16:25/56 17:44-18:54/70	06:42 14:15-16:46/151	06:17 08:58-09:35/37	06:52 08:40-10:16/96
	20:24 18:21-19:31/70	20:05 19:05-19:34/29	19:20 16:54-17:42/48	18:29 16:46-17:52/66	16:42 12:53-15:40/167	16:17 12:16-15:31/195
2	05:16 18:09-18:39/30	05:41 17:50-19:05/75	06:12 15:26-16:27/61 17:45-18:52/67	06:43 14:13-16:46/153	06:18 08:55-09:38/43	06:53 08:40-10:16/96
	20:24 18:20-19:30/70	20:04 19:05-19:34/29	19:19 16:51-17:44/53	18:27 16:46-17:52/66	16:40 12:48-15:39/171	16:17 12:16-15:31/195
3	05:16 18:09-18:41/32	05:42 17:49-19:05/76	06:13 15:22-16:28/66 17:46-18:52/66	06:44 14:12-16:46/154	06:19 08:54-09:42/48	06:54 08:40-10:17/97
	20:24 18:21-19:30/69	20:03 19:05-19:34/29	19:17 16:49-17:45/56	18:26 16:46-17:51/65	16:39 12:45-15:40/175	16:16 12:16-15:31/195
4	05:17 18:09-18:42/33	05:43 17:49-19:06/77	06:14 15:19-16:30/71	06:45 14:10-16:46/156	06:20 08:52-09:44/52	06:55 08:40-10:18/98
	20:23 18:21-19:29/68	20:02 19:06-19:34/28	19:15 16:47-18:52/125	18:24 16:46-17:50/64	16:38 12:42-15:39/177	16:16 12:16-15:31/195
5	05:17 18:08-18:43/35	05:44 17:48-19:06/78	06:15 15:16-16:31/75	06:46 14:09-16:46/157	06:22 08:50-09:46/56	06:56 08:41-10:18/97
	20:23 18:21-19:28/67	20:01 19:06-19:34/28	19:14 16:45-18:52/127	18:22 16:46-17:49/63	16:37 12:39-15:38/179	16:16 12:16-15:31/195
6	05:18 18:08-18:44/36 19:27-19:28/1	05:45 17:48-19:06/78	06:16 15:14-16:32/78	06:47 14:07-16:46/159	06:23 08:49-09:49/60	06:57 08:41-10:19/98
	20:23 18:21-19:27/66	19:58 19:06-19:34/28	19:12 16:43-18:50/127	18:21 16:46-17:49/63	16:36 12:37-15:39/182	16:16 12:16-15:32/196
7	05:19 18:06-18:44/38 19:25-19:28/3	05:46 17:46-19:06/80	06:17 15:11-16:34/83	06:48 14:06-16:46/160	06:24 08:47-09:51/64	06:58 08:41-10:19/98
	20:23 18:20-19:25/65	19:57 19:06-19:32/26	19:10 16:41-18:49/128	18:19 16:46-17:48/62	16:35 12:34-15:38/184	16:16 12:16-15:32/196
8	05:19 18:06-18:45/39 19:23-19:29/6	05:47 17:46-19:06/80	06:18 15:08-16:35/87 17:52-18:47/55	06:49 14:05-16:46/161	06:25 08:46-09:52/66	06:59 08:42-10:20/98
	20:22 18:20-19:23/63	19:56 19:06-19:32/26	19:08 16:39-17:51/72	18:17 16:46-17:47/61	16:33 12:32-15:37/185	16:16 12:16-15:33/197
9	05:20 18:06-18:47/41 19:19-19:29/10	05:48 17:45-19:06/81	06:19 15:05-16:36/91 17:54-18:45/51	06:50 14:04-16:46/162	06:26 08:45-09:55/70	07:00 08:42-10:20/98
	20:22 18:21-19:19/58	19:54 19:06-19:31/25	19:07 16:37-17:52/75	18:16 16:46-17:46/60	16:32 12:31-15:38/187	16:16 12:17-15:33/196
10	05:21 18:05-18:48/43	05:49 17:45-19:06/81	06:20 15:03-16:38/95 17:56-18:44/48	06:51 14:04-16:47/163	06:28 08:44-09:56/72	07:01 08:43-10:21/98
	20:22 18:48-19:29/41	19:53 19:06-19:30/24	19:05 16:38-17:52/74	18:14 16:47-17:46/59	16:31 12:29-15:37/188	16:16 12:17-15:34/197
11	05:21 18:04-18:49/45	05:50 17:44-19:06/82	06:21 15:00-16:39/99 17:58-18:42/44	06:53 14:02-16:46/164	06:29 08:43-09:57/74	07:02 08:42-10:21/99
	20:21 18:49-19:30/41	19:52 19:06-19:29/23	19:03 16:39-17:53/74	18:12 16:46-17:45/59	16:30 12:27-15:36/189	16:16 12:17-15:34/197
12	05:22 18:04-18:50/46	05:51 17:44-19:06/82	06:22 14:57-16:39/102 18:02-18:39/37	06:54 14:01-16:46/165	06:30 08:42-09:58/76	07:02 08:43-10:21/98
	20:21 18:50-19:30/40	19:50 19:06-19:27/21	19:02 16:39-17:53/74	18:11 16:46-17:44/58	16:29 12:25-15:36/191	16:16 12:17-15:34/197
13	05:23 18:02-18:51/49	05:52 17:43-19:06/83	06:23 14:55-16:40/105 18:08-18:37/29	06:55 14:01-16:46/165	06:31 08:42-10:00/78	07:03 08:43-10:22/99
	20:20 18:51-19:30/39	19:49 19:06-19:26/20	19:00 16:40-17:54/74	18:09 16:46-17:43/57	16:28 12:25-15:36/191	16:16 12:18-15:35/197
14	05:24 18:02-18:52/50	05:53 17:43-19:06/83	06:24 14:51-16:40/109 18:23-18:36/13	06:56 14:00-16:45/165	06:32 08:41-10:01/80	07:04 08:44-10:23/99
	20:20 18:52-19:31/39	19:48 19:06-19:25/19	18:58 16:40-17:53/73	18:08 16:45-17:41/56	16:27 12:23-15:35/192	16:16 12:18-15:36/198
15	05:24 18:01-18:53/52	05:54 17:43-19:06/83	06:25 14:49-16:41/112 18:25-18:34/9	06:57 13:59-16:45/166	06:34 08:41-10:02/81	07:05 08:44-10:23/99
	20:19 18:53-19:31/38	19:46 19:06-19:23/17	18:56 16:41-17:54/73	18:06 16:45-17:40/55	16:27 12:22-15:35/193	16:17 12:18-15:35/197
16	05:25 18:01-18:54/53	05:55 17:43-19:06/83	06:26 14:46-16:41/115 18:27-18:32/5	06:58 13:58-16:45/167	06:35 08:41-10:04/83	07:05 08:44-10:23/99
	20:19 18:54-19:32/38	19:45 19:06-19:22/16	18:55 16:41-17:54/73	18:04 16:45-17:39/54	16:26 12:22-15:35/193	16:17 12:19-15:36/197
17	05:26 17:59-18:54/55	05:56 17:42-19:05/83	06:27 14:44-16:42/118	06:59 13:58-16:45/167	06:36 08:40-10:05/85	07:06 08:45-10:24/99
	20:18 18:54-19:31/37	19:43 19:05-19:21/16	18:53 16:42-17:54/72	18:03 16:45-17:38/53	16:25 12:20-15:35/195	16:17 12:19-15:37/198
18	05:27 17:59-18:55/56	05:57 17:42-19:05/83	06:28 14:41-16:42/121	07:00 13:58-16:45/167	06:37 08:40-10:06/86	07:07 08:45-10:24/99
	20:17 18:55-19:32/37	19:42 19:05-19:19/14	18:51 16:42-17:54/72	18:01 16:45-17:37/52	16:24 12:19-15:34/195	16:17 12:19-15:37/198
19	05:28 17:58-18:56/58	05:58 17:42-19:05/83	06:29 14:39-16:43/124	07:01 13:57-16:45/168	06:38 08:39-10:06/87	07:07 08:46-10:25/99
	20:17 18:56-19:32/36	19:41 19:05-19:18/13	18:50 16:43-17:54/71	18:00 16:45-17:35/50	16:23 12:18-15:33/195	16:18 12:20-15:38/198
20	05:29 17:58-18:57/59	05:59 17:42-19:04/82	06:30 14:37-16:43/126	07:03 13:57-16:44/167	06:40 08:40-10:08/88	07:08 08:47-10:26/99
	20:16 18:57-19:33/36	19:39 19:04-19:17/13	18:48 16:43-17:54/71	17:58 16:44-17:33/49	16:23 12:19-15:34/195	16:18 12:21-15:39/198
21	05:29 17:57-18:58/61	06:00 17:42-19:04/82	06:31 14:34-16:43/129	07:04 13:56-16:44/168	06:41 08:39-10:09/90	07:09 08:47-10:26/99
	20:15 18:58-19:33/35	19:38 19:04-19:15/11	18:46 16:43-17:54/71	17:57 16:44-17:32/48	16:22 12:18-15:33/195	16:19 12:21-15:39/198
22	05:30 17:57-18:59/62	06:01 17:42-19:03/81	06:32 14:32-16:44/132	07:05 13:57-16:44/167	06:42 08:39-10:09/90	07:09 08:48-10:27/99
	20:14 18:59-19:34/35	19:36 19:03-19:14/11	18:44 16:44-17:54/70	17:55 16:44-17:31/47	16:21 12:17-15:33/196	16:19 12:22-15:40/198
23	05:31 17:56-19:00/64	06:02 17:42-19:03/81	06:33 14:30-16:44/134	07:06 13:56-16:44/168	06:43 08:38-10:10/92	07:10 08:48-10:27/99
	20:14 19:00-19:34/34	19:35 19:03-19:12/9	18:43 16:44-17:54/70	17:54 16:44-17:29/45	16:21 12:16-15:32/196	16:20 12:22-15:40/198
24	05:32 17:55-19:00/65	06:03 17:42-19:02/80	06:34 14:28-16:44/136	07:07 13:56-16:43/167	06:44 08:39-10:11/92	07:10 08:48-10:27/99
	20:13 19:00-19:33/33	19:33 19:02-19:11/9	18:41 16:44-17:54/70	17:52 16:43-17:27/44	16:20 12:17-15:33/196	16:20 12:22-15:40/198
25	05:33 17:54-19:00/66	06:04 17:42-19:02/80	06:36 14:26-16:45/139	07:08 13:56-16:43/167	06:45 08:39-10:12/93	07:10 08:49-10:28/99
	20:12 19:00-19:34/34	19:31 19:02-19:09/7	18:39 16:45-17:54/69	17:51 16:43-17:24/41	16:20 12:16-15:32/196	16:21 12:23-15:41/198
26	05:34 17:54-19:01/67	06:05 17:42-19:01/79	06:37 14:24-16:46/142	07:10 13:56-16:43/167	06:47 08:39-10:12/93	07:11 08:49-10:28/99
	20:11 19:01-19:34/33	19:30 19:01-19:08/7	18:37 16:46-17:54/68	17:50 16:43-17:23/40	16:19 12:16-15:32/196	16:21 12:23-15:41/198
27	05:35 17:53-19:02/69	06:06 15:52-16:09/17 17:42-19:06/84	06:38 14:22-16:46/144	07:11 13:56-16:43/167	06:48 08:39-10:13/94	07:11 08:49-10:28/99
	20:10 19:02-19:34/32	19:28 17:14-17:26/12	18:36 16:46-17:54/68	17:48 16:43-17:20/37	16:19 12:16-15:31/195	16:22 12:23-15:41/198
28	05:36 17:52-19:02/70	06:07 15:45-16:14/29 17:42-19:05/83	06:39 14:21-16:46/145	07:12 13:56-16:42/166	06:49 08:39-10:13/94	07:12 08:51-10:30/99
	20:09 19:02-19:34/32	19:27 17:07-17:32/25	18:34 16:46-17:54/68	17:47 16:42-17:17/35	16:18 12:15-15:31/196	16:23 12:25-15:42/197
29	05:37 17:52-19:03/71	06:08 15:40-16:18/38 17:43-19:02/79	06:40 14:19-16:46/147	07:13 13:56-16:42/166	06:50 08:40-10:15/95	07:12 08:51-10:30/99
	20:08 19:03-19:34/31	19:25 17:03-17:36/33	18:32 16:46-17:53/67	17:46 16:42-17:13/31	16:18 12:15-15:31/196	16:24 12:25-15:43/198
30	05:38 17:51-19:04/73	06:09 15:36-16:21/45 17:43-18:56/73	06:41 14:17-16:46/149	07:14 10:08-10:25/17 16:45-17:10/25	06:51 08:40-10:15/95	07:12 08:51-10:30/99
	20:07 19:04-19:34/30	19:23 17:00-17:38/38	18:31 16:46-17:53/67	17:44 13:57-16:41/164	16:17 12:16-15:31/195	16:24 12:25-15:43/198
31	05:39 17:51-19:04/73	06:10 15:32-16:23/51 17:44-18:55/71		07:16 10:02-10:31/29 16:52-17:02/10		07:12 08:52-10:30/98
	20:06 19:04-19:34/30	19:22 16:56-17:40/44		17:43 13:57-16:40/163		16:25 12:26-15:43/197
Potential sun hours	461	429	375	344	297	286
Sum of minutes with flicker	2845	3311	6085	6688	7995	9159

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

Project:
Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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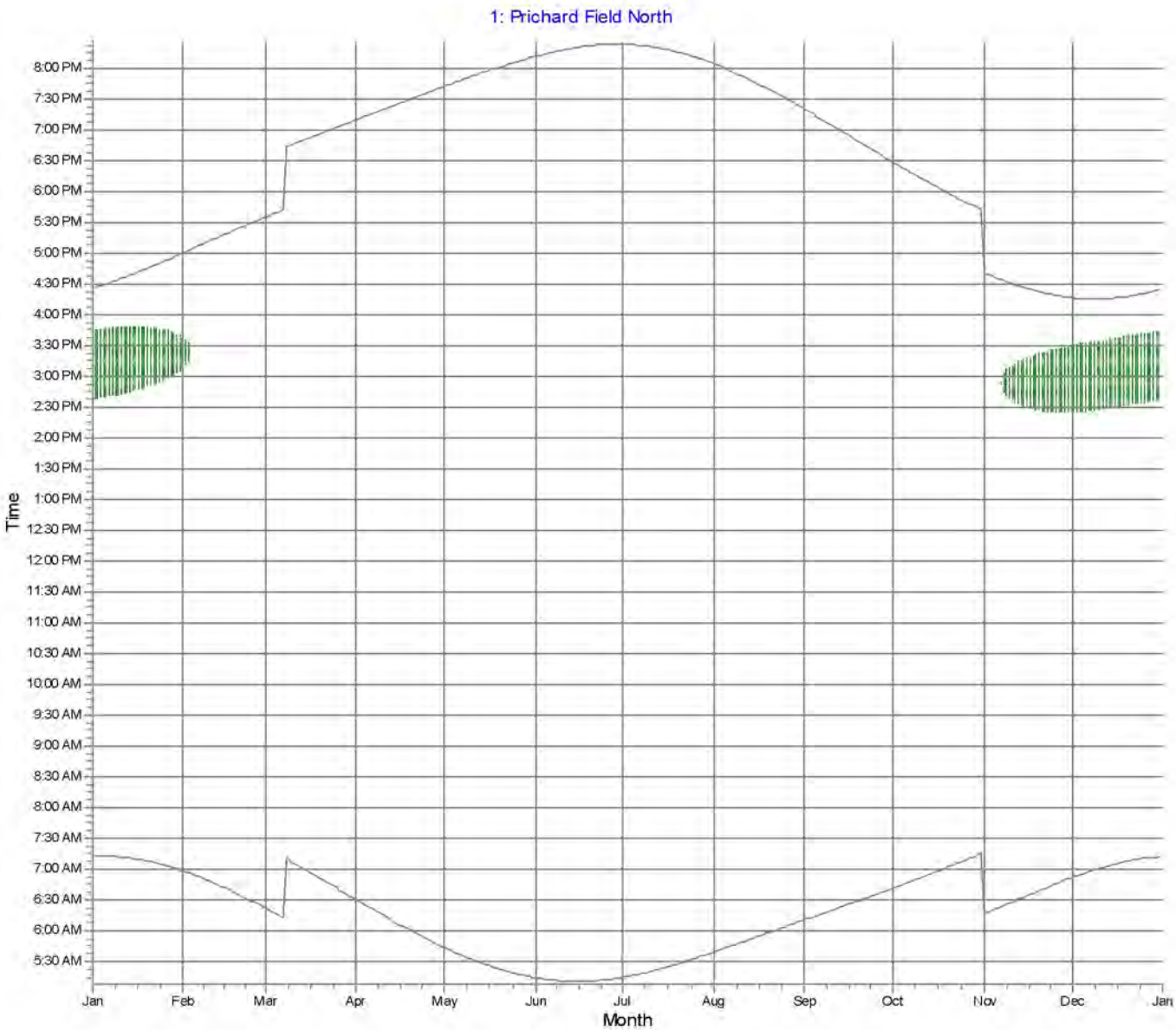
Calculated:
4/5/2011 11:01 PM/2.7.473

SHADOW - Calendar per WTG, graphical

WTG: 1 - Prichard Field North



WTGs

A: 10aA

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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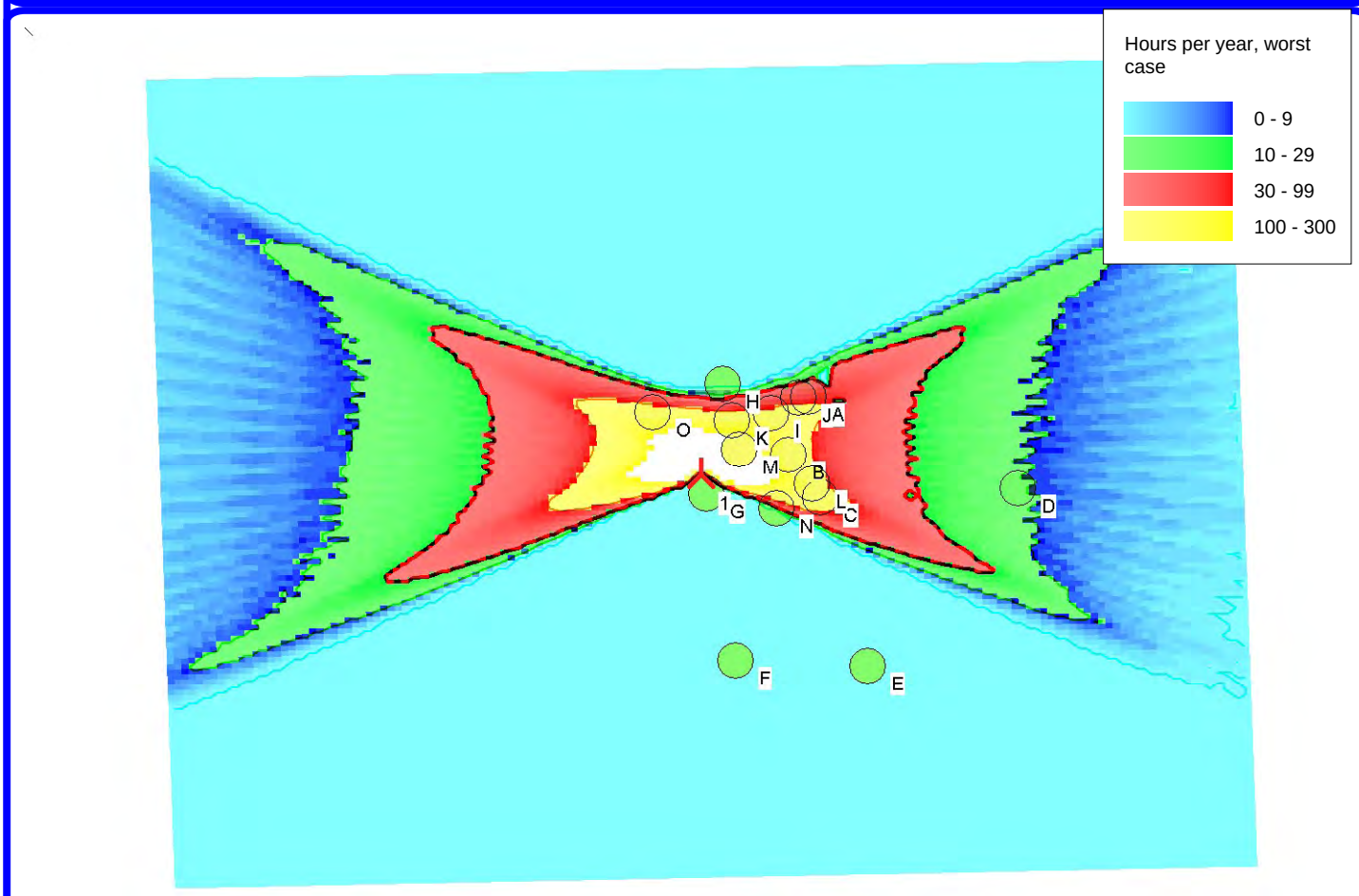
4/5/2011 11:01 PM/2.7.473

SHADOW - Map



0 250 500 750 1000m

Map: , Print scale 1:20,000, Map center Geo WGS 84 East: -71.327284° North: 41.519261°

New WTG
Shadow receptor

Isolines showing shadow in Hours per year, worst case

0 10 30 100

APPENDIX 10B

WIND TURBINE SITE 10B PRICHARD FIELD SOUTH

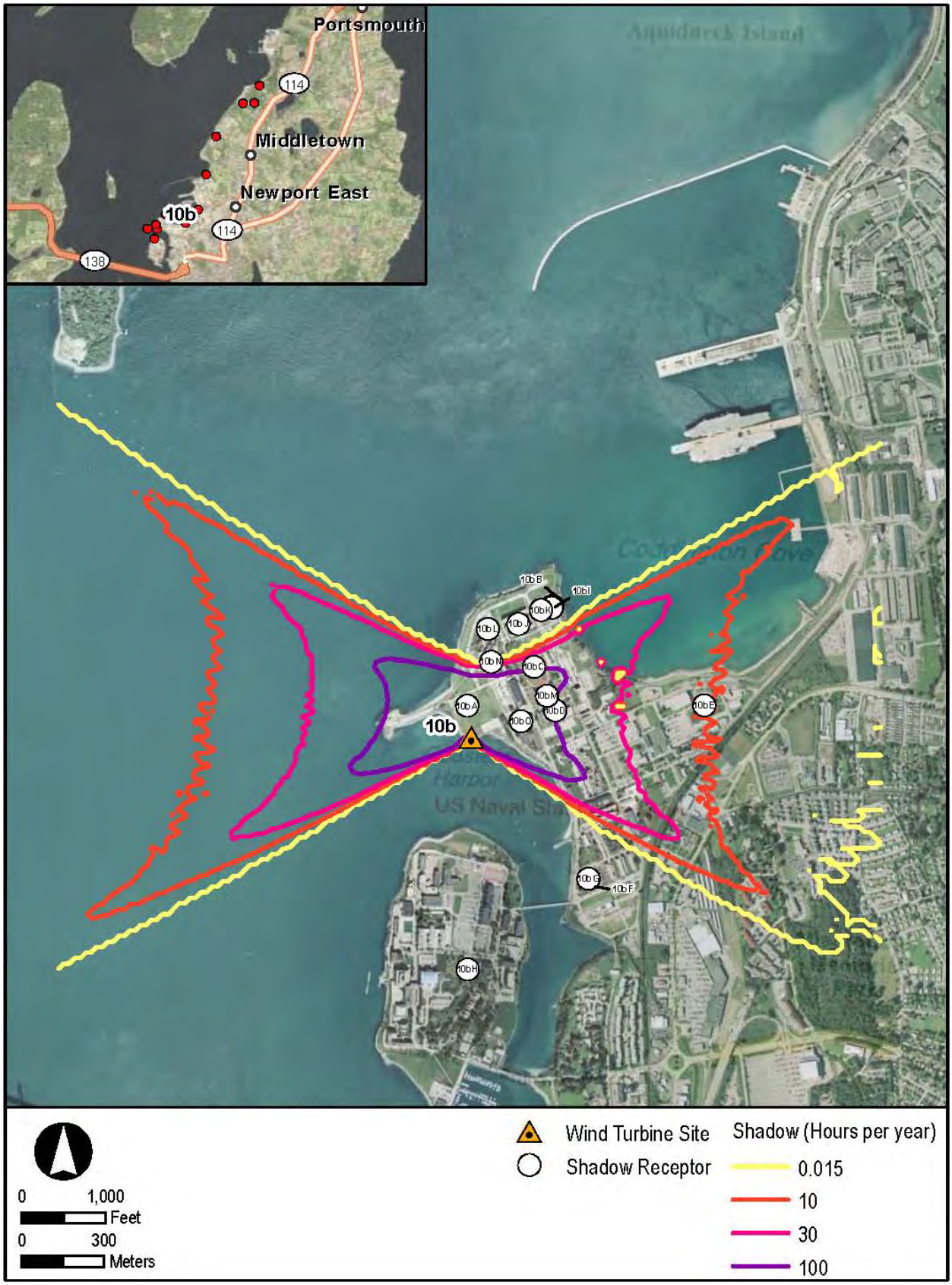


Figure A-10b: Maximum predicted shadow flicker levels (hours per year) for a Vestas V112-3.0 MW Model at Wind Turbine Site 10b (Prichard Field South).

Project:
Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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Calculated:
2/24/2011 1:45 PM/2.7.473

SHADOW - Main Result

Assumptions for shadow calculations

Maximum distance for influence
Calculate only when more than 20 % of sun is covered by the blade
Please look in WTG table

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

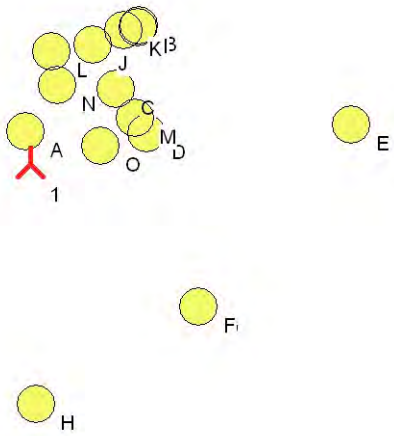
Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW
691	432	259	155	155	155	432	518	950	1,209	864	518

W	WNW	NW	NNW	Sum
432	604	691	691	8,756

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: Line object
Obstacles used in calculation
Eye height: 1.5 m
Grid resolution: 10 m



Scale 1:20,000
New WTG
Shadow receptor

WTGs

	Geo DD: WGS 84 Longitude	Latitude	Z [m]	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Shadow data Calculation distance [m]	RPM [RPM]
1	-71.326975° East	41.517510° North	0.0	Prichard Field South	Yes	VESTAS	V112-3,000	3,000	112.0	84.0	2,000	12.8

Shadow receptor-Input

No.	Name	Geo DD: WGS 84 Longitude	Latitude	Z [m]	Width [m]	Height [m]	Height a.g.l. [m]	Degrees from south cw [°]	Slope of window [°]	Direction mode
A	10bA	-71.327132° East	41.518552° North	1.7	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
B	10bB	-71.323519° East	41.521900° North	16.3	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
C	10bC	-71.324252° East	41.519888° North	17.8	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
D	10bD	-71.323282° East	41.518476° North	21.3	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
E	10bE	-71.316772° East	41.518768° North	6.5	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
F	10bF	-71.321628° East	41.512976° North	4.6	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
G	10bG	-71.321628° East	41.512976° North	4.6	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
H	10bH	-71.326800° East	41.509898° North	7.2	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
I	10bI	-71.323560° East	41.521844° North	17.2	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
J	10bJ	-71.324996° East	41.521281° North	20.2	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
K	10bK	-71.324016° East	41.521757° North	19.8	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
L	10bL	-71.326322° East	41.521084° North	14.8	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
M	10bM	-71.323662° East	41.518954° North	11.0	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
N	10bN	-71.326131° East	41.520018° North	18.3	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
O	10bO	-71.324753° East	41.518087° North	6.9	1.0	1.0	1.0	-180.0	90.0	"Green house mode"

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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Geo-Marine.Inc
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Calculated:
2/24/2011 1:45 PM/2.7.473

SHADOW - Main Result

Calculation Results

Shadow receptor

		Shadow, worst case			Shadow, expected values
No.	Name	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	10bA	553:09	191	3:11	227:34
B	10bB	0:00	0	0:00	0:00
C	10bC	88:13	84	1:17	29:04
D	10bD	99:47	107	1:19	32:14
E	10bE	12:11	38	0:28	3:52
F	10bF	0:00	0	0:00	0:00
G	10bG	0:00	0	0:00	0:00
H	10bH	0:00	0	0:00	0:00
I	10bI	0:00	0	0:00	0:00
J	10bJ	0:00	0	0:00	0:00
K	10bK	0:00	0	0:00	0:00
L	10bL	0:00	0	0:00	0:00
M	10bM	135:08	137	1:21	43:11
N	10bN	0:00	0	0:00	0:00
O	10bO	254:26	167	2:01	82:45

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

No.	Name	Worst case [h/year]	Expected [h/year]
1	Prichard Field South	993:07	369:58

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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Calculated:
2/24/2011 1:45 PM/2.7.473

SHADOW - Calendar

Shadow receptor: A - 10bA

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January		February		March		April		May	June
1	07:12		09:58 (1)	06:58		10:02 (1)	06:22	10:04 (1)	06:30	05:44	05:15
	16:26	175	12:53 (1)	17:01	189	13:11 (1)	17:36	184	13:08 (1)	19:10	19:43	20:12
2	07:13		09:59 (1)	06:57		10:03 (1)	06:20		10:05 (1)	06:29	05:43	05:14
	16:27	175	12:54 (1)	17:02	188	13:11 (1)	17:37	183	13:08 (1)	19:11	19:44	20:13
3	07:13		09:59 (1)	06:56		10:03 (1)	06:19		10:04 (1)	06:27	05:41	05:14
	16:28	176	12:55 (1)	17:03	189	13:12 (1)	17:38	183	13:07 (1)	19:13	19:45	20:14
4	07:13		09:59 (1)	06:55		10:03 (1)	06:17		10:04 (1)	06:25	05:40	05:13
	16:29	176	12:55 (1)	17:05	189	13:12 (1)	17:39	182	13:06 (1)	19:14	19:46	20:14
5	07:13		09:59 (1)	06:54		10:03 (1)	06:15		10:05 (1)	06:24	05:39	05:13
	16:30	177	12:56 (1)	17:06	189	13:12 (1)	17:40	181	13:06 (1)	19:15	19:47	20:15
6	07:13		10:00 (1)	06:53		10:02 (1)	06:14		10:05 (1)	06:22	05:37	05:13
	16:31	177	12:57 (1)	17:07	190	13:12 (1)	17:41	179	13:04 (1)	19:16	19:48	20:16
7	07:13		10:00 (1)	06:52		10:02 (1)	06:12		10:06 (1)	06:20	05:36	05:12
	16:32	178	12:58 (1)	17:09	190	13:12 (1)	17:43	178	13:04 (1)	19:17	19:49	20:16
8	07:12		10:01 (1)	06:51		10:02 (1)	07:11		11:06 (1)	06:19	05:35	05:12
	16:33	177	12:58 (1)	17:10	191	13:13 (1)	18:44	177	14:03 (1)	19:18	19:50	20:17
9	07:12		10:00 (1)	06:50		10:03 (1)	07:09		11:06 (1)	06:17	05:34	05:12
	16:34	178	12:58 (1)	17:11	190	13:13 (1)	18:45	175	14:01 (1)	19:19	19:51	20:18
10	07:12		10:01 (1)	06:48		10:03 (1)	07:07		11:07 (1)	06:15	05:33	05:12
	16:35	178	12:59 (1)	17:12	190	13:13 (1)	18:46	173	14:00 (1)	19:20	19:52	20:18
11	07:12		10:01 (1)	06:47		10:02 (1)	07:06		11:08 (1)	06:14	05:32	05:12
	16:36	179	13:00 (1)	17:14	191	13:13 (1)	18:47	171	13:59 (1)	19:21	19:53	20:19
12	07:12		10:01 (1)	06:46		10:02 (1)	07:04		11:08 (1)	06:12	05:31	05:11
	16:37	179	13:00 (1)	17:15	191	13:13 (1)	18:48	169	13:57 (1)	19:22	19:54	20:19
13	07:11		10:01 (1)	06:45		10:03 (1)	07:02		11:09 (1)	06:10	05:29	05:11
	16:38	180	13:01 (1)	17:16	190	13:13 (1)	18:49	167	13:56 (1)	19:23	19:56	20:20
14	07:11		10:02 (1)	06:43		10:02 (1)	07:01		11:09 (1)	06:09	05:28	05:11
	16:39	180	13:02 (1)	17:17	191	13:13 (1)	18:51	165	13:54 (1)	19:24	19:57	20:20
15	07:10		10:01 (1)	06:42		10:03 (1)	06:59		11:10 (1)	06:07	05:27	05:11
	16:40	181	13:02 (1)	17:19	190	13:13 (1)	18:52	162	13:52 (1)	19:26	19:58	20:21
16	07:10		10:02 (1)	06:41		10:03 (1)	06:57		11:10 (1)	06:06	05:26	05:11
	16:41	181	13:03 (1)	17:20	190	13:13 (1)	18:53	159	13:49 (1)	19:27	19:59	20:21
17	07:10		10:02 (1)	06:39		10:02 (1)	06:56		11:12 (1)	06:04	05:25	05:11
	16:42	181	13:03 (1)	17:21	191	13:13 (1)	18:54	155	13:47 (1)	19:28	20:00	20:22
18	07:09		10:01 (1)	06:38		10:03 (1)	06:54		11:13 (1)	06:03	05:25	05:11
	16:44	183	13:04 (1)	17:22	190	13:13 (1)	18:55	150	13:43 (1)	19:29	20:00	20:22
19	07:08		10:02 (1)	06:37		10:02 (1)	06:52		11:13 (1)	06:01	05:24	05:12
	16:45	183	13:05 (1)	17:24	190	13:12 (1)	18:56	146	13:39 (1)	19:30	20:01	20:22
20	07:08		10:02 (1)	06:35		10:03 (1)	06:51		11:16 (1)	06:00	05:23	05:12
	16:46	183	13:05 (1)	17:25	189	13:12 (1)	18:57	139	13:35 (1)	19:31	20:01	20:23
21	07:07		10:01 (1)	06:34		10:02 (1)	06:49		11:17 (1)	05:58	05:22	05:12
	16:47	184	13:05 (1)	17:26	189	13:11 (1)	18:58	130	13:27 (1)	19:32	20:02	20:23
22	07:07		10:02 (1)	06:32		10:03 (1)	06:47		11:18 (1)	05:57	05:21	05:12
	16:48	185	13:07 (1)	17:27	189	13:12 (1)	18:59	117	13:15 (1)	19:33	20:03	20:23
23	07:06		10:02 (1)	06:31		10:03 (1)	06:45		11:21 (1)	05:55	05:20	05:12
	16:50	185	13:07 (1)	17:28	188	13:11 (1)	19:01	94	12:55 (1)	19:34	20:04	20:23
24	07:05		10:02 (1)	06:29		10:03 (1)	06:44		11:24 (1)	05:54	05:20	05:13
	16:51	185	13:07 (1)	17:30	188	13:11 (1)	19:02	69	12:33 (1)	19:35	20:05	20:23
25	07:05		10:02 (1)	06:28		10:03 (1)	06:42		11:27 (1)	05:52	05:19	05:13
	16:52	185	13:07 (1)	17:31	187	13:10 (1)	19:03	49	12:16 (1)	19:36	20:06	20:24
26	07:04		10:03 (1)	06:26		10:04 (1)	06:40		11:34 (1)	05:51	05:18	05:13
	16:53	186	13:09 (1)	17:32	186	13:10 (1)	19:04	26	12:00 (1)	19:37	20:07	20:24
27	07:03		10:03 (1)	06:25		10:03 (1)	06:39			05:49	05:17	05:14
	16:55	186	13:09 (1)	17:33	186	13:09 (1)	19:05			19:39	20:08	20:24
28	07:02		10:02 (1)	06:23		10:04 (1)	06:37			05:48	05:17	05:14
	16:56	187	13:09 (1)	17:34	185	13:09 (1)	19:06			19:40	20:09	20:24
29	07:01		10:02 (1)				06:35			05:47	05:16	05:14
	16:57	188	13:10 (1)				19:07			19:41	20:10	20:24
30	07:00		10:02 (1)				06:34			05:45	05:16	05:15
	16:58	188	13:10 (1)				19:08			19:42	20:10	20:24
31	06:59		10:02 (1)				06:32				05:15	
	17:00	188	13:10 (1)				19:09				20:11	
Potential sun hours	296			297			370			400	450	454
Total, worst case		5624			5296			3863				
Sun reduction		0.56			0.58			0.58				
Oper. time red.		1.00			1.00			1.00				
Wind dir. red.		0.74			0.74			0.74				
Total reduction		0.41			0.43			0.43				
Total, real		2308			2254			1647				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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Calculated:
2/24/2011 1:45 PM/2.7.473

SHADOW - Calendar

Shadow receptor: A - 10bA

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	July	August	September			October			November			December		
1	05:15	05:40	06:11			06:42		10:48 (1)	06:17		09:32 (1)	06:52		09:43 (1)
	20:24	20:05	19:20			18:29	168	13:36 (1)	16:42	190	12:42 (1)	16:17	179	12:42 (1)
2	05:16	05:41	06:12			06:43		10:47 (1)	06:18		09:31 (1)	06:53		09:44 (1)
	20:24	20:04	19:19			18:27	170	13:37 (1)	16:40	191	12:42 (1)	16:17	178	12:42 (1)
3	05:16	05:42	06:13			06:44		10:45 (1)	06:19		09:32 (1)	06:54		09:44 (1)
	20:24	20:03	19:17			18:26	173	13:38 (1)	16:39	190	12:42 (1)	16:16	178	12:42 (1)
4	05:17	05:43	06:14			06:45		10:44 (1)	06:20		09:32 (1)	06:55		09:45 (1)
	20:23	20:02	19:15			18:24	174	13:38 (1)	16:38	190	12:42 (1)	16:16	177	12:42 (1)
5	05:17	05:44	06:15			06:46		10:43 (1)	06:22		09:32 (1)	06:56		09:45 (1)
	20:23	20:01	19:14			18:22	176	13:39 (1)	16:37	190	12:42 (1)	16:16	178	12:43 (1)
6	05:18	05:45	06:16			06:47		10:42 (1)	06:23		09:33 (1)	06:57		09:46 (1)
	20:23	19:58	19:12			18:21	177	13:39 (1)	16:36	189	12:42 (1)	16:16	177	12:43 (1)
7	05:19	05:46	06:17			06:48		10:41 (1)	06:24		09:33 (1)	06:58		09:47 (1)
	20:23	19:57	19:10			18:19	179	13:40 (1)	16:35	189	12:42 (1)	16:16	176	12:43 (1)
8	05:19	05:47	06:18			06:49		10:40 (1)	06:25		09:32 (1)	06:59		09:47 (1)
	20:22	19:56	19:08			18:17	180	13:40 (1)	16:33	189	12:41 (1)	16:16	176	12:43 (1)
9	05:20	05:48	06:19			06:50		10:39 (1)	06:26		09:33 (1)	07:00		09:48 (1)
	20:22	19:54	19:07			18:16	181	13:40 (1)	16:32	189	12:42 (1)	16:16	176	12:44 (1)
10	05:21	05:49	06:20			06:51		10:39 (1)	06:28		09:33 (1)	07:01		09:49 (1)
	20:22	19:53	19:05			18:14	182	13:41 (1)	16:31	189	12:42 (1)	16:16	175	12:44 (1)
11	05:21	05:50	06:21			06:53		10:39 (1)	06:29		09:33 (1)	07:02		09:48 (1)
	20:21	19:52	19:03			18:12	183	13:42 (1)	16:30	188	12:41 (1)	16:16	176	12:44 (1)
12	05:22	05:51	06:22			06:54		10:38 (1)	06:30		09:33 (1)	07:02		09:49 (1)
	20:21	19:50	19:02			18:11	184	13:42 (1)	16:29	188	12:41 (1)	16:16	175	12:44 (1)
13	05:23	05:52	06:23			06:55		10:37 (1)	06:31		09:34 (1)	07:03		09:50 (1)
	20:20	19:49	19:00			18:09	185	13:42 (1)	16:28	188	12:42 (1)	16:16	175	12:45 (1)
14	05:24	05:53	06:24			06:56		10:36 (1)	06:32		09:34 (1)	07:04		09:51 (1)
	20:20	19:48	18:58			18:08	186	13:42 (1)	16:27	187	12:41 (1)	16:16	174	12:45 (1)
15	05:24	05:54	06:25			06:57		10:36 (1)	06:34		09:35 (1)	07:05		09:50 (1)
	20:19	19:46	18:56			18:06	186	13:42 (1)	16:27	186	12:41 (1)	16:17	175	12:45 (1)
16	05:25	05:55	06:26			06:58		10:35 (1)	06:35		09:36 (1)	07:05		09:51 (1)
	20:19	19:45	18:55			18:04	187	13:42 (1)	16:26	186	12:42 (1)	16:17	174	12:45 (1)
17	05:26	05:56	06:27		11:25 (1)	06:59		10:35 (1)	06:36		09:36 (1)	07:06		09:52 (1)
	20:18	19:43	18:53	19	11:44 (1)	18:03	188	13:43 (1)	16:25	185	12:41 (1)	16:17	174	12:46 (1)
18	05:27	05:57	06:28		11:16 (1)	07:00		10:35 (1)	06:37		09:36 (1)	07:07		09:52 (1)
	20:17	19:42	18:51	44	12:00 (1)	18:01	188	13:43 (1)	16:24	185	12:41 (1)	16:17	174	12:46 (1)
19	05:28	05:58	06:29		11:11 (1)	07:01		10:34 (1)	06:38		09:36 (1)	07:07		09:53 (1)
	20:17	19:41	18:50	65	12:16 (1)	18:00	188	13:42 (1)	16:23	185	12:41 (1)	16:18	174	12:47 (1)
20	05:29	05:59	06:30		11:07 (1)	07:03		10:33 (1)	06:40		09:37 (1)	07:08		09:54 (1)
	20:16	19:39	18:48	88	12:35 (1)	17:58	189	13:42 (1)	16:23	185	12:42 (1)	16:18	174	12:48 (1)
21	05:29	06:00	06:31		11:04 (1)	07:04		10:33 (1)	06:41		09:38 (1)	07:09		09:54 (1)
	20:15	19:38	18:46	112	12:56 (1)	17:57	189	13:42 (1)	16:22	183	12:41 (1)	16:19	174	12:48 (1)
22	05:30	06:01	06:32		11:02 (1)	07:05		10:33 (1)	06:42		09:38 (1)	07:09		09:55 (1)
	20:14	19:36	18:44	127	13:09 (1)	17:55	190	13:43 (1)	16:21	183	12:41 (1)	16:19	174	12:49 (1)
23	05:31	06:02	06:33		10:59 (1)	07:06		10:33 (1)	06:43		09:38 (1)	07:10		09:55 (1)
	20:14	19:35	18:43	137	13:16 (1)	17:54	190	13:43 (1)	16:21	183	12:41 (1)	16:20	174	12:49 (1)
24	05:32	06:03	06:34		10:57 (1)	07:07		10:32 (1)	06:44		09:39 (1)	07:10		09:55 (1)
	20:13	19:33	18:41	144	13:21 (1)	17:52	190	13:42 (1)	16:20	183	12:42 (1)	16:20	174	12:49 (1)
25	05:33	06:04	06:36		10:57 (1)	07:08		10:32 (1)	06:45		09:40 (1)	07:10		09:56 (1)
	20:12	19:31	18:39	149	13:26 (1)	17:51	190	13:42 (1)	16:20	182	12:42 (1)	16:21	174	12:50 (1)
26	05:34	06:05	06:37		10:55 (1)	07:10		10:33 (1)	06:47		09:40 (1)	07:11		09:56 (1)
	20:11	19:30	18:37	153	13:28 (1)	17:50	190	13:43 (1)	16:19	181	12:41 (1)	16:21	174	12:50 (1)
27	05:35	06:06	06:38		10:53 (1)	07:11		10:32 (1)	06:48		09:40 (1)	07:11		09:56 (1)
	20:10	19:28	18:36	158	13:31 (1)	17:48	191	13:43 (1)	16:19	181	12:41 (1)	16:22	174	12:50 (1)
28	05:36	06:07	06:39		10:52 (1)	07:12		10:32 (1)	06:49		09:41 (1)	07:12		09:57 (1)
	20:09	19:27	18:34	160	13:32 (1)	17:47	190	13:42 (1)	16:18	180	12:41 (1)	16:23	175	12:52 (1)
29	05:37	06:08	06:40		10:50 (1)	07:13		10:32 (1)	06:50		09:41 (1)	07:12		09:58 (1)
	20:08	19:25	18:32	164	13:34 (1)	17:46	190	13:42 (1)	16:18	180	12:41 (1)	16:24	174	12:52 (1)
30	05:38	06:09	06:41		10:49 (1)	07:14		10:32 (1)	06:51		09:43 (1)	07:12		09:58 (1)
	20:07	19:23	18:31	166	13:35 (1)	17:44	191	13:43 (1)	16:17	179	12:42 (1)	16:24	174	12:52 (1)
31	05:39	06:10				07:16		10:32 (1)				07:12		09:58 (1)
	20:06	19:22				17:43	190	13:42 (1)				16:25	175	12:53 (1)
Potential sun hours	461	429	375			344			297			286		
Total, worst case				1686			5715			5574			5431	
Sun reduction				0.62			0.61			0.50			0.52	
Oper. time red.				1.00			1.00			1.00			1.00	
Wind dir. red.				0.74			0.74			0.74			0.74	
Total reduction				0.46			0.45			0.37			0.38	
Total, real				769			2562			2045			2069	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 1:47 PM / 3

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 1:45 PM/2.7.473

SHADOW - Calendar

Shadow receptor: B - 10bB

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:29	05:43	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:19	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:13	19:45	20:14	20:24	20:03	19:17	18:26	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:24	05:39	05:13	05:17	05:44	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:14	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36	16:16
7	07:13	06:52	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24	06:58
	16:32	17:09	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:35	16:16
8	07:12	06:51	07:11	06:19	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:32	05:12	05:21	05:50	06:21	06:53	06:29	07:02
	16:36	17:14	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:12	06:46	07:04	06:12	05:31	05:11	05:22	05:51	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:56	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:24	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:51	19:24	19:57	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:26	19:58	20:21	20:19	19:46	18:56	18:06	16:27	16:17
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:10	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	20:00	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:03	05:25	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:24	05:11	05:28	05:58	06:29	07:01	06:38	07:07
	16:45	17:24	18:56	19:30	20:00	20:22	20:17	19:41	18:50	18:00	16:23	16:18
20	07:08	06:35	06:51	06:00	05:23	05:12	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:57	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:01	19:34	20:04	20:23	20:14	19:35	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54	05:20	05:13	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:05	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:36	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:13	05:35	06:06	06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:12
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:47	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:46	16:18	16:24
30	07:00		06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:16		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 1:47 PM / 4

Licensed user:
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US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 1:45 PM/2.7.473

SHADOW - Calendar

Shadow receptor: C - 10bC

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January			February			March	April	May	June	July	August	September	October	November			December		
1	07:12		14:12 (1)	06:58		14:57 (1)	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17			06:52		14:02 (1)
	16:26	76	15:28 (1)	17:01	11	15:08 (1)	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42			16:17	70	15:12 (1)
2	07:13		14:13 (1)	06:57			06:20	06:29	05:43	05:14	05:16	05:41	06:12	06:43	06:18			06:53		14:02 (1)
	16:27	75	15:28 (1)	17:02			17:37	19:11	19:44	20:13	20:24	20:04	19:19	18:27	16:40			16:17	71	15:13 (1)
3	07:13		14:13 (1)	06:56			06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19			06:54		14:02 (1)
	16:28	75	15:28 (1)	17:03			17:38	19:13	19:45	20:14	20:24	20:03	19:17	18:26	16:39			16:16	71	15:13 (1)
4	07:13		14:14 (1)	06:55			06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20			06:55		14:02 (1)
	16:29	75	15:29 (1)	17:05			17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38			16:16	72	15:14 (1)
5	07:13		14:15 (1)	06:54			06:15	06:24	05:39	05:13	05:17	05:44	06:15	06:46	06:22			06:56		14:02 (1)
	16:30	74	15:29 (1)	17:06			17:40	19:15	19:47	20:15	20:23	20:01	19:14	18:22	16:37			16:16	73	15:15 (1)
6	07:13		14:16 (1)	06:53			06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23			06:57		14:02 (1)
	16:31	73	15:29 (1)	17:07			17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36			16:16	73	15:15 (1)
7	07:13		14:17 (1)	06:52			06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24			06:58		14:02 (1)
	16:32	73	15:30 (1)	17:09			17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:35			16:16	74	15:16 (1)
8	07:12		14:18 (1)	06:51			07:11	06:19	05:35	05:12	05:19	05:47	06:18	06:49	06:25			06:59		14:02 (1)
	16:33	72	15:30 (1)	17:10			18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33			16:16	75	15:17 (1)
9	07:12		14:18 (1)	06:50			07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26			07:00		14:02 (1)
	16:34	71	15:29 (1)	17:11			18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16	16:32			16:16	75	15:17 (1)
10	07:12		14:19 (1)	06:48			07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28		14:27 (1)	07:01		14:03 (1)
	16:35	71	15:30 (1)	17:12			18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	13	14:40 (1)	16:16	75	15:18 (1)
11	07:12		14:20 (1)	06:47			07:06	06:14	05:32	05:12	05:21	05:50	06:21	06:53	06:29		14:22 (1)	07:02		14:02 (1)
	16:36	70	15:30 (1)	17:14			18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	23	14:45 (1)	16:16	76	15:18 (1)
12	07:11		14:20 (1)	06:46			07:04	06:12	05:31	05:11	05:22	05:51	06:22	06:54	06:30		14:18 (1)	07:02		14:03 (1)
	16:37	69	15:29 (1)	17:15			18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	30	14:48 (1)	16:16	76	15:19 (1)
13	07:11		14:21 (1)	06:45			07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31		14:16 (1)	07:03		14:03 (1)
	16:38	69	15:30 (1)	17:16			18:49	19:23	19:56	20:20	20:20	19:49	19:00	18:09	16:28	35	14:51 (1)	16:16	76	15:19 (1)
14	07:11		14:22 (1)	06:43			07:01	06:09	05:28	05:11	05:24	05:53	06:24	06:56	06:32		14:14 (1)	07:04		14:04 (1)
	16:39	67	15:29 (1)	17:17			18:51	19:24	19:57	20:20	20:20	19:48	18:58	18:07	16:27	39	14:53 (1)	16:16	76	15:20 (1)
15	07:10		14:23 (1)	06:42			06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34		14:12 (1)	07:05		14:03 (1)
	16:40	67	15:30 (1)	17:19			18:52	19:26	19:58	20:21	20:19	19:46	18:56	18:06	16:27	42	14:54 (1)	16:17	77	15:20 (1)
16	07:10		14:24 (1)	06:41			06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35		14:11 (1)	07:05		14:04 (1)
	16:41	66	15:30 (1)	17:20			18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:26	46	14:57 (1)	16:17	77	15:21 (1)
17	07:10		14:25 (1)	06:39			06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36		14:09 (1)	07:06		14:05 (1)
	16:42	64	15:29 (1)	17:21			18:54	19:28	20:00	20:22	20:18	19:43	18:53	18:03	16:25	49	14:58 (1)	16:17	77	15:22 (1)
18	07:09		14:26 (1)	06:38			06:54	06:03	05:25	05:11	05:27	05:57	06:28	07:00	06:37		14:08 (1)	07:07		14:05 (1)
	16:44	62	15:28 (1)	17:22			18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	51	14:59 (1)	16:17	76	15:21 (1)
19	07:08		14:28 (1)	06:37			06:52	06:01	05:24	05:11	05:28	05:58	06:29	07:01	06:38		14:07 (1)	07:07		14:05 (1)
	16:45	61	15:29 (1)	17:24			18:56	19:30	20:00	20:22	20:17	19:41	18:50	18:00	16:23	53	15:00 (1)	16:18	77	15:22 (1)
20	07:08		14:28 (1)	06:35			06:51	06:00	05:23	05:12	05:28	05:59	06:30	07:03	06:40		14:06 (1)	07:08		14:06 (1)
	16:46	60	15:28 (1)	17:25			18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:23	56	15:02 (1)	16:18	77	15:23 (1)
21	07:07		14:29 (1)	06:34			06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41		14:05 (1)	07:09		14:06 (1)
	16:47	58	15:27 (1)	17:26			18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	58	15:03 (1)	16:19	77	15:23 (1)
22	07:07		14:31 (1)	06:32			06:47	05:57	05:21	05:12	05:30	06:01	06:32	07:05	06:42		14:04 (1)	07:09		14:07 (1)
	16:48	56	15:27 (1)	17:27			18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	60	15:04 (1)	16:19	77	15:24 (1)
23	07:06		14:33 (1)	06:31			06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43		14:04 (1)	07:10		14:07 (1)
	16:50	53	15:26 (1)	17:28			19:01	19:34	20:04	20:23	20:14	19:35	18:43	17:54	16:21	61	15:05 (1)	16:20	77	15:24 (1)
24	07:05		14:34 (1)	06:29			06:44	05:54	05:20	05:13	05:32	06:03	06:34	07:07	06:44		14:04 (1)	07:10		14:07 (1)
	16:51	51	15:25 (1)	17:30			19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	62	15:06 (1)	16:20	77	15:24 (1)
25	07:05		14:36 (1)	06:28			06:42	05:52	05:19	05:13	05:33	06:04	06:36	07:08	06:45		14:03 (1)	07:10		14:09 (1)
	16:52	48	15:24 (1)	17:31			19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	64	15:07 (1)	16:21	76	15:25 (1)
26	07:04		14:38 (1)	06:26			06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10	06:47		14:03 (1)	07:11		14:09 (1)
	16:53	46	15:24 (1)	17:32			19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	65	15:08 (1)	16:21	77	15:26 (1)
27	07:03		14:40 (1)	06:25			06:39	05:49	05:17	05:14	05:35	06:06	06:38	07:11	06:48		14:02 (1)	07:11		14:09 (1)
	16:55	42	15:22 (1)	17:33			19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:19	67	15:09 (1)	16:22	77	15:26 (1)
28	07:02		14:42 (1)	06:23			06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49		14:02 (1)	07:12		14:10 (1)
	16:56	39	15:21 (1)	17:34			19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	67	15:09 (1)	16:23	77	15:27 (1)
29	07:01		14:45 (1)				06:35	05:47	05:16	05:14	05:37	06:08	06:40	07:13	06:50		14:01 (1)	07:12		14:11 (1)
	16:57	34	15:19 (1)				19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:46	16:18	69	15:10 (1)	16:24	76	15:27 (1)
30	07:00		14:48 (1)				06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51		14:02 (1)	07:12		14:11 (1)
	16:58	28	15:16 (1)				19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	69	15:11 (1)	16:24	76	15:27 (1)
31	06:59		14:51 (1)				06:32		05:15		05:39	06:10		07:16				07:12		14:12 (1)
	17:00	22	15:13 (1)				19:09		20:11		20:06	19:22		17:43				16:25	75	15:27 (1)
Potential sun hours	296			297			370	400	450	454	461	429	375	344	297			286		
Total, worst case		1867			11											1079			2336	
Sun reduction		0.56			0.58											0.50			0.52	
Oper. time red.		1.00			1.00											1.00			1.00	
Wind dir. red.		0.62			0.62											0.62			0.62	
Total reduction		0.35			0.36											0.31			0.32	
Total, real		650			4											336			755	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
2/24/2011 1:47 PM / 5

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 1:45 PM/2.7.473

SHADOW - Calendar

Shadow receptor: D - 10bD

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February		March		April	May	June	July	August	September		October		November		December
1	07:12	06:58		06:22		15:56 (1)	06:30	05:44	05:15	05:15	05:40	06:11		06:42		16:37 (1)	06:17		15:40 (1)	06:52
	16:26	17:01		17:36	78	17:14 (1)	19:10	19:43	20:12	20:24	20:05	19:20		18:29	71	17:48 (1)	16:42	38	16:18 (1)	16:17
2	07:13	06:57		06:20		15:56 (1)	06:29	05:43	05:14	05:16	05:41	06:12		06:43		16:36 (1)	06:18		15:41 (1)	06:53
	16:27	17:02		17:37	78	17:14 (1)	19:11	19:44	20:13	20:24	20:04	19:19		18:27	72	17:48 (1)	16:40	35	16:16 (1)	16:17
3	07:13	06:56		16:28 (1)	06:19	15:56 (1)	06:27	05:41	05:14	05:16	05:42	06:13		06:44		16:35 (1)	06:19		15:43 (1)	06:54
	16:28	17:03	12	16:40 (1)	17:38	78	17:14 (1)	19:13	19:45	20:14	20:24	20:03	19:17		18:26	73	17:48 (1)	16:39	33	16:16 (1)	16:16
4	07:13	06:55		16:23 (1)	06:17	15:55 (1)	06:25	05:40	05:13	05:17	05:43	06:14		06:45		16:34 (1)	06:20		15:45 (1)	06:55
	16:29	17:05	18	16:41 (1)	17:39	78	17:13 (1)	19:14	19:46	20:14	20:23	20:02	19:15		18:24	74	17:48 (1)	16:38	29	16:14 (1)	16:16
5	07:13	06:54		16:19 (1)	06:15	15:56 (1)	06:24	05:39	05:13	05:17	05:44	06:15		06:46		16:33 (1)	06:22		15:47 (1)	06:56
	16:30	17:06	23	16:42 (1)	17:40	77	17:13 (1)	19:15	19:47	20:15	20:23	20:01	19:14		18:22	75	17:48 (1)	16:37	26	16:13 (1)	16:16
6	07:13	06:53		16:17 (1)	06:14	15:55 (1)	06:22	05:37	05:13	05:18	05:45	06:16		06:47		16:32 (1)	06:23		15:51 (1)	06:57
	16:31	17:07	26	16:43 (1)	17:41	78	17:13 (1)	19:16	19:48	20:16	20:23	19:58	19:12		18:20	76	17:48 (1)	16:36	21	16:12 (1)	16:16
7	07:12	06:52		16:15 (1)	06:12	15:56 (1)	06:20	05:36	05:12	05:19	05:46	06:17		06:48		16:31 (1)	06:24		15:54 (1)	06:58
	16:32	17:09	30	16:45 (1)	17:43	77	17:13 (1)	19:17	19:49	20:16	20:23	19:57	19:10		18:19	77	17:48 (1)	16:35	17	16:11 (1)	16:16
8	07:12	06:51		16:13 (1)	07:11	16:56 (1)	06:19	05:35	05:12	05:19	05:47	06:18		06:49		16:31 (1)	06:25		15:59 (1)	06:59
	16:33	17:10	33	16:46 (1)	18:44	76	18:12 (1)	19:18	19:50	20:17	20:22	19:56	19:08		18:17	77	17:48 (1)	16:33	10	16:09 (1)	16:16
9	07:12	06:50		16:12 (1)	07:09	16:56 (1)	06:17	05:34	05:12	05:20	05:48	06:19		06:50		16:30 (1)	06:26			07:00
	16:34	17:11	36	16:48 (1)	18:45	75	18:11 (1)	19:19	19:51	20:18	20:22	19:54	19:07		18:16	78	17:48 (1)	16:32		16:16
10	07:12	06:48		16:10 (1)	07:07	16:57 (1)	06:15	05:33	05:12	05:21	05:49	06:20		06:51		16:30 (1)	06:28			07:01
	16:35	17:12	38	16:48 (1)	18:46	74	18:11 (1)	19:20	19:52	20:18	20:22	19:53	19:05		18:14	79	17:49 (1)	16:31		16:16
11	07:12	06:47		16:08 (1)	07:06	16:57 (1)	06:14	05:32	05:12	05:21	05:50	06:21		06:53		16:30 (1)	06:29			07:02
	16:36	17:14	42	16:50 (1)	18:47	73	18:10 (1)	19:21	19:53	20:19	20:21	19:52	19:03		18:12	78	17:48 (1)	16:30		16:16
12	07:11	06:46		16:07 (1)	07:04	16:57 (1)	06:12	05:31	05:11	05:22	05:51	06:22		06:54		16:29 (1)	06:30			07:02
	16:37	17:15	45	16:52 (1)	18:48	72	18:09 (1)	19:22	19:54	20:19	20:21	19:50	19:02		18:11	79	17:48 (1)	16:29		16:16
13	07:11	06:45		16:06 (1)	07:02	16:58 (1)	06:10	05:29	05:11	05:23	05:52	06:23		06:55		16:29 (1)	06:31			07:03
	16:38	17:16	47	16:53 (1)	18:49	70	18:08 (1)	19:23	19:55	20:20	20:20	19:49	19:00		18:09	77	17:46 (1)	16:28		16:16
14	07:11	06:43		16:05 (1)	07:01	16:59 (1)	06:09	05:28	05:11	05:24	05:53	06:24		06:56		16:29 (1)	06:32			07:04
	16:39	17:17	49	16:54 (1)	18:51	68	18:07 (1)	19:24	19:57	20:20	20:20	19:48	18:58		18:07	76	17:45 (1)	16:27		16:16
15	07:10	06:42		16:04 (1)	06:59	16:59 (1)	06:07	05:27	05:11	05:24	05:54	06:25		06:57		16:28 (1)	06:34			07:05
	16:40	17:19	52	16:56 (1)	18:52	67	18:06 (1)	19:26	19:58	20:21	20:19	19:46	18:56		18:06	75	17:43 (1)	16:27		16:17
16	07:10	06:41		16:03 (1)	06:57	17:00 (1)	06:06	05:26	05:11	05:25	05:55	06:26		17:14 (1)	06:58		16:28 (1)	06:35		07:05
	16:41	17:20	54	16:57 (1)	18:53	64	18:04 (1)	19:27	19:59	20:21	20:19	19:45	18:55	9	17:23 (1)	18:04	73	17:41 (1)	16:26		16:17
17	07:10	06:39		16:02 (1)	06:56	17:01 (1)	06:04	05:25	05:11	05:26	05:56	06:27		17:07 (1)	06:59		16:29 (1)	06:36		07:06
	16:42	17:21	56	16:58 (1)	18:54	62	18:03 (1)	19:28	20:00	20:22	20:18	19:43	18:53	23	17:30 (1)	18:03	71	17:40 (1)	16:25		16:17
18	07:09	06:38		16:01 (1)	06:54	17:02 (1)	06:03	05:25	05:11	05:27	05:57	06:28		17:02 (1)	07:00		16:29 (1)	06:37		07:07
	16:44	17:22	59	17:00 (1)	18:55	60	18:02 (1)	19:29	20:00	20:22	20:17	19:42	18:51	31	17:33 (1)	18:01	70	17:39 (1)	16:24		16:17
19	07:08	06:37		16:00 (1)	06:52	17:03 (1)	06:01	05:24	05:11	05:28	05:58	06:29		16:59 (1)	07:01		16:29 (1)	06:38		07:07
	16:45	17:24	61	17:01 (1)	18:56	57	18:00 (1)	19:30	20:00	20:22	20:17	19:41	18:50	36	17:35 (1)	18:00	68	17:37 (1)	16:23		16:18
20	07:08	06:35		16:00 (1)	06:51	17:05 (1)	06:00	05:23	05:12	05:28	05:59	06:30		16:56 (1)	07:03		16:29 (1)	06:40		07:08
	16:46	17:25	62	17:02 (1)	18:57	54	17:59 (1)	19:31	20:01	20:23	20:16	19:39	18:48	41	17:37 (1)	17:58	66	17:35 (1)	16:23		16:18
21	07:07	06:34		15:59 (1)	06:49	17:06 (1)	05:58	05:22	05:12	05:29	06:00	06:31		16:53 (1)	07:04		16:29 (1)	06:41		07:09
	16:47	17:26	64	17:03 (1)	18:58	51	17:57 (1)	19:32	20:02	20:23	20:15	19:38	18:46	46	17:39 (1)	17:57	64	17:33 (1)	16:22		16:19
22	07:07	06:32		15:58 (1)	06:47	17:07 (1)	05:57	05:21	05:12	05:30	06:01	06:32		16:51 (1)	07:05		16:31 (1)	06:42		07:09
	16:48	17:27	67	17:05 (1)	18:59	47	17:54 (1)	19:33	20:03	20:23	20:14	19:36	18:44	50	17:41 (1)	17:55	62	17:33 (1)	16:21		16:19
23	07:06	06:31		15:57 (1)	06:45	17:09 (1)	05:55	05:20	05:12	05:31	06:02	06:33		16:49 (1)	07:06		16:31 (1)	06:43		07:10
	16:50	17:28	69	17:06 (1)	19:01	43	17:52 (1)	19:34	20:04	20:23	20:14	19:34	18:43	53	17:42 (1)	17:54	60	17:31 (1)	16:21		16:20
24	07:05	06:29		15:57 (1)	06:44	17:12 (1)	05:54	05:20	05:13	05:32	06:03	06:34		16:47 (1)	07:07		16:31 (1)	06:44		07:10
	16:51	17:30	71	17:08 (1)	19:02	38	17:50 (1)	19:35	20:05	20:23	20:13	19:33	18:41	56	17:43 (1)	17:52	58	17:29 (1)	16:20		16:20
25	07:04	06:28		15:56 (1)	06:42	17:14 (1)	05:52	05:19	05:13	05:33	06:04	06:36		16:45 (1)	07:08		16:32 (1)	06:45		07:10
	16:52	17:31	72	17:08 (1)	19:03	32	17:46 (1)	19:36	20:06	20:24	20:12	19:31	18:39	59	17:44 (1)	17:51	55	17:27 (1)	16:19		16:21
26	07:04	06:26		15:57 (1)	06:40	17:17 (1)	05:51	05:18	05:13	05:34	06:05	06:37		16:44 (1)	07:10		16:33 (1)	06:47		07:11
	16:53	17:32	73	17:10 (1)	19:04	25	17:42 (1)	19:37	20:07	20:24	20:11	19:30	18:37	62	17:46 (1)	17:50	54	17:27 (1)	16:19		16:21
27	07:03	06:25		15:56 (1)	06:39	17:24 (1)	05:49	05:17	05:14	05:35	06:06	06:38		16:43 (1)	07:11		16:34 (1)	06:48		07:11
	16:55	17:33	75	17:11 (1)	19:05	13	17:37 (1)	19:39	20:08	20:24	20:10	19:28	18:36	63	17:46 (1)	17:48	51	17:25 (1)	16:19		16:22
28	07:02	06:23		15:56 (1)	06:37			05:48	05:17	05:14	05:36	06:07	06:39		16:41 (1)	07:12		16:35 (1)	06:49		07:11
	16:56	17:34	77	17:13 (1)	19:06			19:40	20:09	20:24	20:09	19:27	18:34	66	17:47 (1)	17:47	48	17:23 (1)	16:18		16:23
29	07:01				06:35			05:47	05:16	05:14	05:37	06:08	06:40		16:40 (1)	07:13		16:35 (1)	06:50		07:12
	16:57				19:07			19:41	20:10	20:24	20:08	19:25	18:32	67	17:47 (1)	17:46	47	17:22 (1)	16:18		16:24
30	07:00				06:34			05:45	05:16	05:15	05:38	06:09	06:41		16:38 (1)	07:14		16:37 (1)	06:51		07:12
	16:58				19:08			19:42	20:10	20:24	20:07	19:23	18:31	70	17:48 (1)	17:44	44	17:21 (1)	16:17		16:24
31	06:59				06:32				05:15		05:39	06:10				07:16		16:38 (1)			07:12
	17:00				19:09				20:11		20:06	19:22				17:43	42	17:20 (1)			16:25
Potential sun hours	296	297			370			400	450	454	461	429	375			344			297		286
Total, worst case			1311			1665								732			2070			209	
Sun reduction			0.58			0.58								0.62			0.61			0.50	
Oper. time red.			1.00			1.00								1.00			1.00			1.00	
Wind dir. red.			0.55			0.55								0.55			0.55			0.55	
Total reduction			0.32			0.32								0.34			0.33			0.27	
Total, real			414			527								248			689			57	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
2/24/2011 1:47 PM / 6

Licensed user:
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US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 1:45 PM/2.7.473

SHADOW - Calendar

Shadow receptor: E - 10bE

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March			April	May	June	July	August	September			October			November	December
1	07:12	06:58	06:22			06:30	05:44	05:15	05:15	05:40	06:11			06:42		17:40 (1)	06:17	06:52
	16:26	17:01	17:36			19:10	19:43	20:12	20:24	20:05	19:20			18:29	27	18:07 (1)	16:42	16:17
2	07:13	06:57	06:20		17:14 (1)	06:28	05:42	05:14	05:16	05:41	06:12			06:43		17:39 (1)	06:18	06:53
	16:27	17:02	17:37	2	17:15 (1)	19:11	19:44	20:13	20:24	20:04	19:18			18:27	26	18:05 (1)	16:40	16:17
3	07:13	06:56	06:19		17:10 (1)	06:27	05:41	05:14	05:16	05:42	06:13			06:44		17:39 (1)	06:19	06:54
	16:28	17:03	17:38	6	17:16 (1)	19:12	19:45	20:14	20:23	20:03	19:17			18:25	24	18:03 (1)	16:39	16:16
4	07:13	06:55	06:17		17:07 (1)	06:25	05:40	05:13	05:17	05:43	06:14			06:45		17:39 (1)	06:20	06:55
	16:29	17:05	17:39	10	17:17 (1)	19:14	19:46	20:14	20:23	20:02	19:15			18:24	22	18:01 (1)	16:38	16:16
5	07:13	06:54	06:15		17:06 (1)	06:23	05:39	05:13	05:17	05:44	06:15			06:46		17:39 (1)	06:22	06:56
	16:30	17:06	17:40	13	17:19 (1)	19:15	19:47	20:15	20:23	20:01	19:13			18:22	21	18:00 (1)	16:37	16:16
6	07:13	06:53	06:14		17:04 (1)	06:22	05:37	05:13	05:18	05:45	06:16			06:47		17:39 (1)	06:23	06:57
	16:31	17:07	17:41	16	17:20 (1)	19:16	19:48	20:16	20:23	19:58	19:12			18:20	19	17:58 (1)	16:36	16:16
7	07:12	06:52	06:12		17:03 (1)	06:20	05:36	05:12	05:19	05:46	06:17			06:48		17:40 (1)	06:24	06:58
	16:32	17:09	17:43	17	17:20 (1)	19:17	19:49	20:16	20:23	19:57	19:10			18:19	16	17:56 (1)	16:35	16:16
8	07:12	06:51	07:11		18:03 (1)	06:19	05:35	05:12	05:19	05:47	06:18			06:49		17:40 (1)	06:25	06:59
	16:33	17:10	18:44	19	18:22 (1)	19:18	19:50	20:17	20:22	19:56	19:08			18:17	14	17:54 (1)	16:33	16:16
9	07:12	06:50	07:09		18:01 (1)	06:17	05:34	05:12	05:20	05:48	06:19			06:50		17:41 (1)	06:26	07:00
	16:34	17:11	18:45	22	18:23 (1)	19:19	19:51	20:18	20:22	19:54	19:07			18:16	11	17:52 (1)	16:32	16:16
10	07:12	06:48	07:07		18:02 (1)	06:15	05:33	05:12	05:21	05:49	06:20			06:51		17:44 (1)	06:28	07:01
	16:35	17:12	18:46	23	18:25 (1)	19:20	19:52	20:18	20:22	19:53	19:05			18:14	8	17:52 (1)	16:31	16:16
11	07:12	06:47	07:06		18:01 (1)	06:14	05:32	05:12	05:21	05:50	06:21			06:52		17:46 (1)	06:29	07:02
	16:36	17:14	18:47	25	18:26 (1)	19:21	19:53	20:19	20:21	19:52	19:03			18:12	4	17:50 (1)	16:30	16:16
12	07:11	06:46	07:04		18:00 (1)	06:12	05:30	05:11	05:22	05:51	06:22			06:54			06:30	07:02
	16:37	17:15	18:48	27	18:27 (1)	19:22	19:54	20:19	20:21	19:50	19:02			18:11			16:29	16:16
13	07:11	06:45	07:02		18:00 (1)	06:10	05:29	05:11	05:23	05:52	06:23			06:55			06:31	07:03
	16:38	17:16	18:49	27	18:27 (1)	19:23	19:55	20:20	20:20	19:49	19:00			18:09			16:28	16:16
14	07:11	06:43	07:01		18:01 (1)	06:09	05:28	05:11	05:24	05:53	06:24			06:56			06:32	07:04
	16:39	17:17	18:51	28	18:29 (1)	19:24	19:56	20:20	20:20	19:48	18:58			18:07			16:27	16:16
15	07:10	06:42	06:59		18:01 (1)	06:07	05:27	05:11	05:24	05:54	06:25			06:57			06:34	07:05
	16:40	17:19	18:52	27	18:28 (1)	19:26	19:57	20:21	20:19	19:46	18:56			18:06			16:27	16:17
16	07:10	06:41	06:57		18:01 (1)	06:06	05:26	05:11	05:25	05:55	06:26			06:58			06:35	07:05
	16:41	17:20	18:53	26	18:27 (1)	19:27	19:58	20:21	20:19	19:45	18:55			18:04			16:26	16:17
17	07:10	06:39	06:56		18:02 (1)	06:04	05:25	05:11	05:26	05:56	06:27			06:59			06:36	07:06
	16:42	17:21	18:54	24	18:26 (1)	19:28	19:59	20:22	20:18	19:43	18:53			18:03			16:25	16:17
18	07:09	06:38	06:54		18:03 (1)	06:03	05:24	05:11	05:27	05:57	06:28			07:00			06:37	07:07
	16:44	17:22	18:55	21	18:24 (1)	19:29	20:00	20:22	20:17	19:42	18:51			18:01			16:24	16:17
19	07:08	06:37	06:52		18:05 (1)	06:01	05:24	05:11	05:28	05:58	06:29			07:01			06:38	07:07
	16:45	17:24	18:56	17	18:22 (1)	19:30	20:00	20:22	20:17	19:41	18:50			18:00			16:23	16:18
20	07:08	06:35	06:50		18:08 (1)	06:00	05:23	05:12	05:28	05:59	06:30			07:03			06:40	07:08
	16:46	17:25	18:57	12	18:20 (1)	19:31	20:01	20:23	20:16	19:39	18:48			17:58			16:23	16:18
21	07:07	06:34	06:49			05:58	05:22	05:12	05:29	06:00	06:31			07:04			06:41	07:09
	16:47	17:26	18:58			19:32	20:02	20:23	20:15	19:38	18:46			17:57			16:22	16:19
22	07:07	06:32	06:47			05:57	05:21	05:12	05:30	06:01	06:32			07:05			06:42	07:09
	16:48	17:27	18:59			19:33	20:03	20:23	20:14	19:36	18:44			17:55			16:21	16:19
23	07:06	06:31	06:45			05:55	05:20	05:12	05:31	06:02	06:33		17:52 (1)	07:06			06:43	07:10
	16:50	17:28	19:00			19:34	20:04	20:23	20:14	19:34	18:43	10	18:02 (1)	17:54			16:21	16:20
24	07:05	06:29	06:44			05:54	05:20	05:12	05:32	06:03	06:34		17:49 (1)	07:07			06:44	07:10
	16:51	17:30	19:02			19:35	20:05	20:23	20:13	19:33	18:41	16	18:05 (1)	17:52			16:20	16:20
25	07:04	06:28	06:42			05:52	05:19	05:13	05:33	06:04	06:35		17:46 (1)	07:08			06:45	07:10
	16:52	17:31	19:03			19:36	20:06	20:24	20:12	19:31	18:39	20	18:06 (1)	17:51			16:19	16:21
26	07:04	06:26	06:40			05:51	05:18	05:13	05:34	06:05	06:37		17:44 (1)	07:10			06:47	07:11
	16:53	17:32	19:04			19:37	20:07	20:24	20:11	19:30	18:37	23	18:07 (1)	17:50			16:19	16:21
27	07:03	06:25	06:39			05:49	05:17	05:13	05:35	06:06	06:38		17:44 (1)	07:11			06:48	07:11
	16:55	17:33	19:05			19:39	20:08	20:24	20:10	19:28	18:36	25	18:09 (1)	17:48			16:18	16:22
28	07:02	06:23	06:37			05:48	05:17	05:14	05:36	06:07	06:39		17:43 (1)	07:12			06:49	07:11
	16:56	17:34	19:06			19:40	20:09	20:24	20:09	19:27	18:34	27	18:10 (1)	17:47			16:18	16:23
29	07:01		06:35			05:46	05:16	05:14	05:37	06:08	06:40		17:42 (1)	07:13			06:50	07:12
	16:57		19:07			19:41	20:10	20:24	20:08	19:25	18:32	28	18:10 (1)	17:46			16:18	16:24
30	07:00		06:34			05:45	05:16	05:15	05:38	06:09	06:41		17:41 (1)	07:14			06:51	07:12
	16:58		19:08			19:42	20:10	20:24	20:07	19:23	18:31	28	18:09 (1)	17:44			16:17	16:24
31	06:59		06:32				05:15		05:39	06:10				07:15				07:12
	17:00		19:09				20:11		20:06	19:22				17:43				16:25
Potential sun hours	296	297	370			400	450	454	461	429	375			344			297	286
Total, worst case				362								177			192			
Sun reduction				0.58								0.62			0.61			
Oper. time red.				1.00								1.00			1.00			
Wind dir. red.				0.53								0.53			0.53			
Total reduction				0.31								0.33			0.32			
Total, real				112								58			62			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
2/24/2011 1:47 PM / 7

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 1:45 PM/2.7.473

SHADOW - Calendar

Shadow receptor: F - 10bF

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:29	05:43	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:23	20:03	19:17	18:26	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:24	05:39	05:13	05:17	05:44	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24	06:58
	16:32	17:09	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:35	16:16
8	07:12	06:51	07:11	06:19	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:32	05:12	05:21	05:50	06:21	06:53	06:29	07:02
	16:36	17:14	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:11	06:46	07:04	06:12	05:31	05:11	05:22	05:51	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:24	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:51	19:24	19:56	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:26	19:57	20:21	20:19	19:46	18:56	18:06	16:27	16:17
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:58	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:10	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	19:59	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:03	05:25	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:24	05:11	05:28	05:58	06:29	07:01	06:38	07:07
	16:45	17:24	18:56	19:30	20:00	20:22	20:17	19:41	18:50	18:00	16:23	16:18
20	07:08	06:35	06:51	06:00	05:23	05:12	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:57	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:01	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54	05:20	05:13	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:20	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:14	05:35	06:06	06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:19	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:47	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:46	16:18	16:24
30	07:00		06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:15		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
2/24/2011 1:47 PM / 8

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 1:45 PM/2.7.473

SHADOW - Calendar

Shadow receptor: G - 10bG

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:29	05:43	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:12	19:45	20:14	20:23	20:03	19:17	18:26	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:24	05:39	05:13	05:17	05:44	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:13	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24	06:58
	16:32	17:09	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:35	16:16
8	07:12	06:51	07:11	06:19	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:32	05:12	05:21	05:50	06:21	06:53	06:29	07:02
	16:36	17:14	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:11	06:46	07:04	06:12	05:31	05:11	05:22	05:51	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:24	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:51	19:24	19:56	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:26	19:57	20:21	20:19	19:46	18:56	18:06	16:27	16:17
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:58	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:10	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	19:59	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:03	05:25	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:24	05:11	05:28	05:58	06:29	07:01	06:38	07:07
	16:45	17:24	18:56	19:30	20:00	20:22	20:17	19:41	18:50	18:00	16:23	16:18
20	07:08	06:35	06:51	06:00	05:23	05:12	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:57	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:01	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54	05:20	05:13	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:35	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:20	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:14	05:35	06:06	06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:19	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:47	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:46	16:18	16:24
30	07:00		06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:15		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
2/24/2011 1:47 PM / 9

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 1:45 PM/2.7.473

SHADOW - Calendar

Shadow receptor: H - 10bH

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:29	05:43	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:19	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:13	19:45	20:14	20:23	20:03	19:17	18:26	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:24	05:39	05:13	05:17	05:44	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:14	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:21	16:36	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24	06:58
	16:32	17:09	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:35	16:16
8	07:12	06:51	07:11	06:19	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:32	05:12	05:21	05:50	06:21	06:53	06:29	07:02
	16:36	17:14	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:11	06:46	07:04	06:12	05:31	05:11	05:22	05:51	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
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	16:39	17:17	18:51	19:24	19:57	20:20	20:20	19:48	18:58	18:08	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:26	19:58	20:21	20:19	19:46	18:56	18:06	16:27	16:17
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:10	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:43	17:21	18:54	19:28	19:59	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:03	05:25	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:24	05:12	05:28	05:58	06:29	07:01	06:38	07:07
	16:45	17:24	18:56	19:30	20:00	20:22	20:17	19:41	18:50	18:00	16:23	16:18
20	07:08	06:35	06:51	06:00	05:23	05:12	05:29	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:57	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:01	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54	05:20	05:13	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:36	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:20	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	16:22
27	07:03	06:25	06:39	05:49	05:17	05:14	05:35	06:06	06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:19	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:47	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:46	16:18	16:24
30	07:00		06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:16		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
2/24/2011 1:47 PM / 10

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 1:45 PM/2.7.473

SHADOW - Calendar

Shadow receptor: I - 10bI

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:29	05:43	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:19	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:13	19:45	20:14	20:24	20:03	19:17	18:26	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:24	05:39	05:13	05:17	05:44	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:14	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36	16:16
7	07:13	06:52	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24	06:58
	16:32	17:09	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:35	16:16
8	07:12	06:51	07:11	06:19	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16	16:32	16:16
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	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
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	16:42	17:21	18:54	19:28	20:00	20:22	20:18	19:43	18:53	18:03	16:25	16:17
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	16:44	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
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	16:45	17:24	18:56	19:30	20:00	20:22	20:17	19:41	18:50	18:00	16:23	16:18
20	07:08	06:35	06:51	06:00	05:23	05:12	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:23	16:18
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	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:01	19:34	20:04	20:23	20:14	19:35	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54	05:20	05:13	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
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	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	16:21
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	16:55	17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:12
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
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	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:16		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
2/24/2011 1:47 PM / 11

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 1:45 PM/2.7.473

SHADOW - Calendar

Shadow receptor: J - 10bJ

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:29	05:43	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:19	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:13	19:45	20:14	20:24	20:03	19:17	18:26	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:24	05:39	05:13	05:17	05:44	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:14	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36	16:16
7	07:13	06:52	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24	06:58
	16:32	17:09	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:35	16:16
8	07:12	06:51	07:11	06:19	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
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	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28	07:01
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13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:56	20:20	20:20	19:49	19:00	18:09	16:28	16:16
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	16:39	17:17	18:51	19:24	19:57	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:26	19:58	20:21	20:19	19:46	18:56	18:06	16:27	16:17
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:10	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
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18	07:09	06:38	06:54	06:03	05:25	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:24	05:11	05:28	05:58	06:29	07:01	06:38	07:07
	16:45	17:24	18:56	19:30	20:00	20:22	20:17	19:41	18:50	18:00	16:23	16:18
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	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:19
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23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:01	19:34	20:04	20:23	20:14	19:35	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54	05:20	05:13	05:32	06:03	06:34	07:07	06:44	07:10
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25	07:05	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:36	07:08	06:45	07:10
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26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:14	05:35	06:06	06:38	07:11	06:48	07:11
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28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:12
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:47	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:46	16:18	16:24
30	07:00		06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:16		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 1:47 PM / 12

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 1:45 PM/2.7.473

SHADOW - Calendar

Shadow receptor: K - 10bK

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:29	05:43	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:19	18:27	16:40	16:17
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	16:28	17:03	17:38	19:13	19:45	20:14	20:24	20:03	19:17	18:26	16:39	16:16
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	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
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	16:39	17:17	18:51	19:24	19:57	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:26	19:58	20:21	20:19	19:46	18:56	18:06	16:27	16:17
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:10	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	20:00	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:03	05:25	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:24	05:11	05:28	05:58	06:29	07:01	06:38	07:07
	16:45	17:24	18:56	19:30	20:00	20:22	20:17	19:41	18:50	18:00	16:23	16:18
20	07:08	06:35	06:51	06:00	05:23	05:12	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:57	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:01	19:34	20:04	20:23	20:14	19:35	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54	05:20	05:13	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:05	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:36	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:13	05:35	06:06	06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:12
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:47	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:46	16:18	16:24
30	07:00		06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:16		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 1:47 PM / 13

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 1:45 PM/2.7.473

SHADOW - Calendar

Shadow receptor: L - 10bL

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:29	05:43	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:19	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:13	19:45	20:14	20:24	20:03	19:17	18:26	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:24	05:39	05:13	05:17	05:44	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:14	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:21	16:36	16:16
7	07:13	06:52	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24	06:58
	16:32	17:09	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:35	16:16
8	07:12	06:51	07:11	06:19	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:32	05:12	05:21	05:50	06:21	06:53	06:29	07:02
	16:36	17:14	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:12	06:46	07:04	06:12	05:31	05:11	05:22	05:51	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:56	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:24	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:51	19:24	19:57	20:20	20:20	19:48	18:58	18:08	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:26	19:58	20:21	20:19	19:46	18:56	18:06	16:27	16:17
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:06
	16:41	17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:10	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	20:00	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:03	05:25	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:24	05:11	05:28	05:58	06:29	07:01	06:38	07:07
	16:45	17:24	18:56	19:30	20:01	20:22	20:17	19:41	18:50	18:00	16:23	16:18
20	07:08	06:35	06:51	06:00	05:23	05:12	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:57	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:01	19:34	20:04	20:23	20:14	19:35	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54	05:20	05:13	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:05	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:36	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:14	05:35	06:06	06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:19	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:12
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:47	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:46	16:18	16:24
30	07:00		06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:16		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 1:47 PM / 14

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 1:45 PM/2.7.473

SHADOW - Calendar

Shadow receptor: M - 10bM

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January			February			March			April			May	June
1	07:12			06:58		15:21 (1)	06:22		15:26 (1)	06:30			05:44	05:15
	16:26			17:01	74	16:35 (1)	17:36	66	16:32 (1)	19:10			19:43	20:12
2	07:13			06:57		15:21 (1)	06:20		15:28 (1)	06:29			05:43	05:14
	16:27			17:02	75	16:36 (1)	17:37	63	16:31 (1)	19:11			19:44	20:13
3	07:13			06:56		15:20 (1)	06:19		15:29 (1)	06:27			05:41	05:14
	16:28			17:03	77	16:37 (1)	17:38	60	16:29 (1)	19:13			19:45	20:14
4	07:13		15:44 (1)	06:55		15:20 (1)	06:17		15:30 (1)	06:25			05:40	05:13
	16:29	9	15:53 (1)	17:05	77	16:37 (1)	17:39	57	16:27 (1)	19:14			19:46	20:14
5	07:13		15:42 (1)	06:54		15:19 (1)	06:15		15:32 (1)	06:24			05:39	05:13
	16:30	15	15:57 (1)	17:06	78	16:37 (1)	17:40	54	16:26 (1)	19:15			19:47	20:15
6	07:13		15:40 (1)	06:53		15:19 (1)	06:14		15:33 (1)	06:22			05:37	05:13
	16:31	20	16:00 (1)	17:07	79	16:38 (1)	17:41	51	16:24 (1)	19:16			19:48	20:16
7	07:13		15:39 (1)	06:52		15:19 (1)	06:12		15:35 (1)	06:20			05:36	05:12
	16:32	23	16:02 (1)	17:09	79	16:38 (1)	17:43	48	16:23 (1)	19:17			19:49	20:16
8	07:12		15:38 (1)	06:51		15:19 (1)	07:11		16:37 (1)	06:19			05:35	05:12
	16:33	27	16:05 (1)	17:10	80	16:39 (1)	18:44	43	17:20 (1)	19:18			19:50	20:17
9	07:12		15:36 (1)	06:50		15:19 (1)	07:09		16:39 (1)	06:17			05:34	05:12
	16:34	30	16:06 (1)	17:11	80	16:39 (1)	18:45	39	17:18 (1)	19:19			19:51	20:18
10	07:12		15:35 (1)	06:48		15:18 (1)	07:07		16:42 (1)	06:15			05:33	05:12
	16:35	33	16:08 (1)	17:12	81	16:39 (1)	18:46	33	17:15 (1)	19:20			19:52	20:18
11	07:12		15:34 (1)	06:47		15:19 (1)	07:06		16:46 (1)	06:14			05:32	05:12
	16:36	36	16:10 (1)	17:14	80	16:39 (1)	18:47	25	17:11 (1)	19:21			19:53	20:19
12	07:11		15:33 (1)	06:46		15:19 (1)	07:04		16:51 (1)	06:12			05:31	05:11
	16:37	37	16:10 (1)	17:15	81	16:40 (1)	18:48	14	17:05 (1)	19:22			19:54	20:19
13	07:11		15:32 (1)	06:45		15:19 (1)	07:02			06:10			05:29	05:11
	16:38	40	16:12 (1)	17:16	81	16:40 (1)	18:49			19:23			19:55	20:20
14	07:11		15:31 (1)	06:43		15:19 (1)	07:01			06:09			05:28	05:11
	16:39	42	16:13 (1)	17:17	80	16:39 (1)	18:51			19:24			19:57	20:20
15	07:10		15:30 (1)	06:42		15:19 (1)	06:59			06:07			05:27	05:11
	16:40	44	16:14 (1)	17:19	81	16:40 (1)	18:52			19:26			19:58	20:21
16	07:10		15:30 (1)	06:41		15:20 (1)	06:57			06:06			05:26	05:11
	16:41	46	16:16 (1)	17:20	80	16:40 (1)	18:53			19:27			19:59	20:21
17	07:10		15:29 (1)	06:39		15:19 (1)	06:56			06:04			05:25	05:11
	16:42	48	16:17 (1)	17:21	80	16:39 (1)	18:54			19:28			20:00	20:22
18	07:09		15:28 (1)	06:38		15:20 (1)	06:54			06:03			05:25	05:11
	16:44	50	16:18 (1)	17:22	79	16:39 (1)	18:55			19:29			20:00	20:22
19	07:08		15:28 (1)	06:37		15:20 (1)	06:52			06:01			05:24	05:11
	16:45	52	16:20 (1)	17:24	79	16:39 (1)	18:56			19:30			20:00	20:22
20	07:08		15:27 (1)	06:35		15:20 (1)	06:51			06:00			05:23	05:12
	16:46	53	16:20 (1)	17:25	79	16:39 (1)	18:57			19:31			20:01	20:23
21	07:07		15:26 (1)	06:34		15:20 (1)	06:49			05:58			05:22	05:12
	16:47	55	16:21 (1)	17:26	78	16:38 (1)	18:58			19:32			20:02	20:23
22	07:07		15:26 (1)	06:32		15:21 (1)	06:47			05:57			05:21	05:12
	16:48	57	16:23 (1)	17:27	77	16:38 (1)	18:59			19:33			20:03	20:23
23	07:06		15:25 (1)	06:31		15:21 (1)	06:45			05:55			05:20	05:12
	16:50	59	16:24 (1)	17:28	76	16:37 (1)	19:01			19:34			20:04	20:23
24	07:05		15:24 (1)	06:29		15:22 (1)	06:44			05:54			05:20	05:13
	16:51	62	16:26 (1)	17:30	74	16:36 (1)	19:02			19:35			20:05	20:23
25	07:04		15:23 (1)	06:28		15:23 (1)	06:42			05:52			05:19	05:13
	16:52	64	16:27 (1)	17:31	72	16:35 (1)	19:03			19:36			20:06	20:24
26	07:04		15:24 (1)	06:26		15:24 (1)	06:40			05:51			05:18	05:13
	16:53	65	16:29 (1)	17:32	71	16:35 (1)	19:04			19:37			20:07	20:24
27	07:03		15:23 (1)	06:25		15:24 (1)	06:39			05:49			05:17	05:14
	16:55	67	16:30 (1)	17:33	70	16:34 (1)	19:05			19:39			20:08	20:24
28	07:02		15:23 (1)	06:23		15:26 (1)	06:37			05:48			05:17	05:14
	16:56	68	16:31 (1)	17:34	67	16:33 (1)	19:06			19:40			20:09	20:24
29	07:01		15:22 (1)				06:35			05:47			05:16	05:14
	16:57	71	16:33 (1)				19:07			19:41			20:10	20:24
30	07:00		15:22 (1)				06:34			05:45			05:16	05:15
	16:58	72	16:34 (1)				19:08			19:42			20:10	20:24
31	06:59		15:21 (1)				06:32						05:15	
	17:00	73	16:34 (1)				19:09						20:11	
Potential sun hours	296			297			370			400			450	454
Total, worst case		1318			2165			553						
Sun reduction		0.56			0.58			0.58						
Oper. time red.		1.00			1.00			1.00						
Wind dir. red.		0.57			0.57			0.57						
Total reduction		0.32			0.33			0.33						
Total, real		418			712			182						

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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Licensed user:
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2201 K Avenue Suite A2
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9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 1:45 PM/2.7.473

SHADOW - Calendar

Shadow receptor: M - 10bM

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	July	August	September	October			November			December		
1	05:15	05:40	06:11	06:42		16:36 (1)	06:17		14:48 (1)	06:52		15:16 (1)
	20:24	20:05	19:20	18:29	3	16:39 (1)	16:42	80	16:08 (1)	16:17	36	15:52 (1)
2	05:16	05:41	06:12	06:43		16:26 (1)	06:18		14:48 (1)	06:53		15:18 (1)
	20:24	20:04	19:19	18:27	22	16:48 (1)	16:40	80	16:08 (1)	16:17	33	15:51 (1)
3	05:16	05:42	06:13	06:44		16:22 (1)	06:19		14:49 (1)	06:54		15:20 (1)
	20:24	20:03	19:17	18:26	29	16:51 (1)	16:39	79	16:08 (1)	16:16	30	15:50 (1)
4	05:17	05:43	06:14	06:45		16:18 (1)	06:20		14:49 (1)	06:55		15:21 (1)
	20:23	20:02	19:15	18:24	36	16:54 (1)	16:38	79	16:08 (1)	16:16	28	15:49 (1)
5	05:17	05:44	06:15	06:46		16:15 (1)	06:22		14:49 (1)	06:56		15:24 (1)
	20:23	20:01	19:14	18:22	41	16:56 (1)	16:37	78	16:07 (1)	16:16	23	15:47 (1)
6	05:18	05:45	06:16	06:47		16:12 (1)	06:23		14:50 (1)	06:57		15:26 (1)
	20:23	19:58	19:12	18:20	46	16:58 (1)	16:36	78	16:08 (1)	16:16	20	15:46 (1)
7	05:19	05:46	06:17	06:48		16:10 (1)	06:24		14:50 (1)	06:58		15:29 (1)
	20:23	19:57	19:10	18:19	49	16:59 (1)	16:35	77	16:07 (1)	16:16	15	15:44 (1)
8	05:19	05:47	06:18	06:49		16:07 (1)	06:25		14:50 (1)	06:59		15:32 (1)
	20:22	19:56	19:08	18:17	53	17:00 (1)	16:33	76	16:06 (1)	16:16	10	15:42 (1)
9	05:20	05:48	06:19	06:50		16:05 (1)	06:26		14:51 (1)	07:00		
	20:22	19:54	19:07	18:16	57	17:02 (1)	16:32	76	16:07 (1)	16:16		
10	05:21	05:49	06:20	06:51		16:04 (1)	06:28		14:52 (1)	07:01		
	20:22	19:53	19:05	18:14	59	17:03 (1)	16:31	74	16:06 (1)	16:16		
11	05:21	05:50	06:21	06:53		16:02 (1)	06:29		14:52 (1)	07:02		
	20:21	19:52	19:03	18:12	62	17:04 (1)	16:30	73	16:05 (1)	16:16		
12	05:22	05:51	06:22	06:54		16:01 (1)	06:30		14:53 (1)	07:02		
	20:21	19:50	19:02	18:11	64	17:05 (1)	16:29	72	16:05 (1)	16:16		
13	05:23	05:52	06:23	06:55		15:59 (1)	06:31		14:54 (1)	07:03		
	20:20	19:49	19:00	18:09	67	17:06 (1)	16:28	71	16:05 (1)	16:16		
14	05:24	05:53	06:24	06:56		15:58 (1)	06:32		14:55 (1)	07:04		
	20:20	19:48	18:58	18:07	68	17:06 (1)	16:27	68	16:03 (1)	16:16		
15	05:24	05:54	06:25	06:57		15:56 (1)	06:34		14:55 (1)	07:05		
	20:19	19:46	18:56	18:06	70	17:06 (1)	16:27	67	16:02 (1)	16:17		
16	05:25	05:55	06:26	06:58		15:55 (1)	06:35		14:57 (1)	07:05		
	20:19	19:45	18:55	18:04	72	17:07 (1)	16:26	65	16:02 (1)	16:17		
17	05:26	05:56	06:27	06:59		15:55 (1)	06:36		14:57 (1)	07:06		
	20:18	19:43	18:53	18:03	73	17:08 (1)	16:25	64	16:01 (1)	16:17		
18	05:27	05:57	06:28	07:00		15:54 (1)	06:37		14:58 (1)	07:07		
	20:17	19:42	18:51	18:01	74	17:08 (1)	16:24	62	16:00 (1)	16:17		
19	05:28	05:58	06:29	07:01		15:53 (1)	06:38		14:59 (1)	07:07		
	20:17	19:41	18:50	18:00	75	17:08 (1)	16:23	59	15:58 (1)	16:18		
20	05:28	05:59	06:30	07:03		15:52 (1)	06:40		15:01 (1)	07:08		
	20:16	19:39	18:48	17:58	76	17:08 (1)	16:23	57	15:58 (1)	16:18		
21	05:29	06:00	06:31	07:04		15:51 (1)	06:41		15:02 (1)	07:09		
	20:15	19:38	18:46	17:57	77	17:08 (1)	16:22	55	15:57 (1)	16:19		
22	05:30	06:01	06:32	07:05		15:51 (1)	06:42		15:03 (1)	07:09		
	20:14	19:36	18:44	17:55	78	17:09 (1)	16:21	53	15:56 (1)	16:19		
23	05:31	06:02	06:33	07:06		15:50 (1)	06:43		15:04 (1)	07:10		
	20:14	19:35	18:43	17:54	79	17:09 (1)	16:21	52	15:56 (1)	16:20		
24	05:32	06:03	06:34	07:07		15:49 (1)	06:44		15:06 (1)	07:10		
	20:13	19:33	18:41	17:52	80	17:09 (1)	16:20	50	15:56 (1)	16:20		
25	05:33	06:04	06:36	07:08		15:49 (1)	06:45		15:07 (1)	07:10		
	20:12	19:31	18:39	17:51	80	17:09 (1)	16:19	48	15:55 (1)	16:21		
26	05:34	06:05	06:37	07:10		15:49 (1)	06:47		15:08 (1)	07:11		
	20:11	19:30	18:37	17:50	81	17:10 (1)	16:19	46	15:54 (1)	16:21		
27	05:35	06:06	06:38	07:11		15:49 (1)	06:48		15:09 (1)	07:11		
	20:10	19:28	18:36	17:48	80	17:09 (1)	16:19	44	15:53 (1)	16:22		
28	05:36	06:07	06:39	07:12		15:48 (1)	06:49		15:11 (1)	07:11		
	20:09	19:27	18:34	17:47	81	17:09 (1)	16:18	42	15:53 (1)	16:23		
29	05:37	06:08	06:40	07:13		15:48 (1)	06:50		15:12 (1)	07:12		
	20:08	19:25	18:32	17:46	81	17:09 (1)	16:18	40	15:52 (1)	16:24		
30	05:38	06:09	06:41	07:14		15:49 (1)	06:51		15:15 (1)	07:12		
	20:07	19:23	18:31	17:44	80	17:09 (1)	16:17	38	15:53 (1)	16:24		
31	05:39	06:10		07:16		15:48 (1)				07:12		
	20:06	19:22		17:43	81	17:09 (1)				16:25		
Potential sun hours	461	429	375	344			297			286		
Total, worst case					1974			1903			195	
Sun reduction					0.61			0.50			0.52	
Oper. time red.					1.00			1.00			1.00	
Wind dir. red.					0.57			0.57			0.57	
Total reduction					0.35			0.28			0.29	
Total, real					684			539			57	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 1:45 PM/2.7.473

SHADOW - Calendar

Shadow receptor: N - 10bN

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:29	05:43	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:19	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:13	19:45	20:14	20:24	20:03	19:17	18:26	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:24	05:39	05:13	05:17	05:44	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:14	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:21	16:36	16:16
7	07:13	06:52	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24	06:58
	16:32	17:09	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:35	16:16
8	07:12	06:51	07:11	06:19	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:32	05:12	05:21	05:50	06:21	06:53	06:29	07:02
	16:36	17:14	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:12	06:46	07:04	06:12	05:31	05:11	05:22	05:51	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:56	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:24	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:51	19:24	19:57	20:20	20:20	19:48	18:58	18:08	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:26	19:58	20:21	20:19	19:46	18:56	18:06	16:27	16:17
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:10	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	20:00	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:03	05:25	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:24	05:11	05:28	05:58	06:29	07:01	06:38	07:07
	16:45	17:24	18:56	19:30	20:01	20:22	20:17	19:41	18:50	18:00	16:23	16:18
20	07:08	06:35	06:51	06:00	05:23	05:12	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:57	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:01	19:34	20:04	20:23	20:14	19:35	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54	05:20	05:13	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:05	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:36	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:14	05:35	06:06	06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:19	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:12
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:47	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:46	16:18	16:24
30	07:00		06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:16		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 1:45 PM/2.7.473

SHADOW - Calendar

Shadow receptor: O - 10bO

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February			March			April			May			June
1	07:12	06:58			06:22		15:12 (1)	06:30		16:04 (1)	05:44		16:49 (1)	05:15
	16:26	17:01			17:36	106	16:58 (1)	19:10	113	17:57 (1)	19:43	21	17:10 (1)	20:12
2	07:13	06:57			06:20		15:11 (1)	06:29		16:06 (1)	05:43		16:56 (1)	05:14
	16:27	17:02			17:37	108	16:59 (1)	19:11	111	17:57 (1)	19:44	6	17:02 (1)	20:13
3	07:13	06:56			06:19		15:10 (1)	06:27		16:06 (1)	05:41			05:14
	16:28	17:03			17:38	110	17:00 (1)	19:13	109	17:55 (1)	19:45			20:14
4	07:13	06:55			06:17		15:09 (1)	06:25		16:06 (1)	05:40			05:13
	16:29	17:05			17:39	111	17:00 (1)	19:14	108	17:54 (1)	19:46			20:14
5	07:13	06:54			06:15		15:08 (1)	06:24		16:07 (1)	05:39			05:13
	16:30	17:06			17:40	113	17:01 (1)	19:15	107	17:54 (1)	19:47			20:15
6	07:13	06:53			06:14		15:07 (1)	06:22		16:08 (1)	05:37			05:13
	16:31	17:07			17:41	114	17:01 (1)	19:16	105	17:53 (1)	19:48			20:16
7	07:13	06:52			06:12		15:07 (1)	06:20		16:08 (1)	05:36			05:12
	16:32	17:09			17:43	115	17:02 (1)	19:17	104	17:52 (1)	19:49			20:16
8	07:12	06:51			07:11		16:06 (1)	06:19		16:10 (1)	05:35			05:12
	16:33	17:10			18:44	116	18:02 (1)	19:18	101	17:51 (1)	19:50			20:17
9	07:12	06:50		15:55 (1)	07:09		16:05 (1)	06:17		16:10 (1)	05:34			05:12
	16:34	17:11	24	16:19 (1)	18:45	117	18:02 (1)	19:19	100	17:50 (1)	19:51			20:18
10	07:12	06:48		15:49 (1)	07:07		16:05 (1)	06:15		16:11 (1)	05:33			05:12
	16:35	17:12	35	16:24 (1)	18:46	118	18:03 (1)	19:20	98	17:49 (1)	19:52			20:18
11	07:12	06:47		15:45 (1)	07:06		16:04 (1)	06:14		16:12 (1)	05:32			05:12
	16:36	17:14	43	16:28 (1)	18:47	119	18:03 (1)	19:21	96	17:48 (1)	19:53			20:19
12	07:11	06:46		15:42 (1)	07:04		16:04 (1)	06:12		16:13 (1)	05:31			05:11
	16:37	17:15	50	16:32 (1)	18:48	119	18:03 (1)	19:22	94	17:47 (1)	19:54			20:19
13	07:11	06:45		15:39 (1)	07:02		16:04 (1)	06:10		16:15 (1)	05:29			05:11
	16:38	17:16	56	16:35 (1)	18:49	120	18:04 (1)	19:23	91	17:46 (1)	19:56			20:20
14	07:11	06:43		15:36 (1)	07:01		16:03 (1)	06:09		16:15 (1)	05:28			05:11
	16:39	17:17	61	16:37 (1)	18:51	120	18:03 (1)	19:24	89	17:44 (1)	19:57			20:20
15	07:10	06:42		15:34 (1)	06:59		16:02 (1)	06:07		16:16 (1)	05:27			05:11
	16:40	17:19	65	16:39 (1)	18:52	121	18:03 (1)	19:26	87	17:43 (1)	19:58			20:21
16	07:10	06:41		15:32 (1)	06:57		16:02 (1)	06:06		16:18 (1)	05:26			05:11
	16:41	17:20	70	16:42 (1)	18:53	121	18:03 (1)	19:27	84	17:42 (1)	19:59			20:21
17	07:10	06:39		15:29 (1)	06:56		16:02 (1)	06:04		16:18 (1)	05:25			05:11
	16:42	17:21	74	16:43 (1)	18:54	121	18:03 (1)	19:28	82	17:40 (1)	20:00			20:22
18	07:09	06:38		15:28 (1)	06:54		16:02 (1)	06:03		16:20 (1)	05:25			05:11
	16:44	17:22	77	16:45 (1)	18:55	121	18:03 (1)	19:29	79	17:39 (1)	20:00			20:22
19	07:08	06:37		15:25 (1)	06:52		16:01 (1)	06:01		16:21 (1)	05:24			05:11
	16:45	17:24	81	16:46 (1)	18:56	121	18:02 (1)	19:30	76	17:37 (1)	20:00			20:22
20	07:08	06:35		15:24 (1)	06:51		16:02 (1)	06:00		16:23 (1)	05:23			05:12
	16:46	17:25	84	16:48 (1)	18:57	121	18:03 (1)	19:31	73	17:36 (1)	20:01			20:23
21	07:07	06:34		15:22 (1)	06:49		16:02 (1)	05:58		16:24 (1)	05:22			05:12
	16:47	17:26	87	16:49 (1)	18:58	120	18:02 (1)	19:32	70	17:34 (1)	20:02			20:23
22	07:07	06:32		15:21 (1)	06:47		16:01 (1)	05:57		16:26 (1)	05:21			05:12
	16:48	17:27	90	16:51 (1)	18:59	121	18:02 (1)	19:33	67	17:33 (1)	20:03			20:23
23	07:06	06:31		15:19 (1)	06:45		16:02 (1)	05:55		16:27 (1)	05:20			05:12
	16:50	17:28	93	16:52 (1)	19:01	120	18:02 (1)	19:34	63	17:30 (1)	20:04			20:23
24	07:05	06:29		15:18 (1)	06:44		16:02 (1)	05:54		16:29 (1)	05:20			05:13
	16:51	17:30	96	16:54 (1)	19:02	119	18:01 (1)	19:35	60	17:29 (1)	20:05			20:23
25	07:04	06:28		15:16 (1)	06:42		16:02 (1)	05:52		16:32 (1)	05:19			05:13
	16:52	17:31	98	16:54 (1)	19:03	119	18:01 (1)	19:36	56	17:28 (1)	20:06			20:24
26	07:04	06:26		15:16 (1)	06:40		16:02 (1)	05:51		16:33 (1)	05:18			05:13
	16:53	17:32	100	16:56 (1)	19:04	118	18:00 (1)	19:37	52	17:25 (1)	20:07			20:24
27	07:03	06:25		15:14 (1)	06:39		16:03 (1)	05:49		16:36 (1)	05:17			05:14
	16:55	17:33	102	16:56 (1)	19:05	117	18:00 (1)	19:39	47	17:23 (1)	20:08			20:24
28	07:02	06:23		15:13 (1)	06:37		16:03 (1)	05:48		16:38 (1)	05:17			05:14
	16:56	17:34	105	16:58 (1)	19:06	116	17:59 (1)	19:40	43	17:21 (1)	20:09			20:24
29	07:01				06:35		16:03 (1)	05:47		16:41 (1)	05:16			05:14
	16:57				19:07	115	17:58 (1)	19:41	36	17:17 (1)	20:10			20:24
30	07:00				06:34		16:04 (1)	05:45		16:44 (1)	05:16			05:15
	16:58				19:08	115	17:59 (1)	19:42	30	17:14 (1)	20:10			20:24
31	06:59				06:32		16:04 (1)				05:15			
	17:00				19:09	114	17:58 (1)				20:11			
Potential sun hours	296	297			370			400			450			454
Total, worst case			1491			3626			2431			27		
Sun reduction			0.58			0.58			0.57			0.58		
Oper. time red.			1.00			1.00			1.00			1.00		
Wind dir. red.			0.55			0.55			0.55			0.55		
Total reduction			0.32			0.32			0.31			0.32		
Total, real			471			1147			756			9		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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Calculated:
2/24/2011 1:45 PM/2.7.473

SHADOW - Calendar

Shadow receptor: O - 10bO

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	July	August			September			October			November			December
1	05:15	05:40			06:11		16:11 (1)	06:42		15:43 (1)	06:17		15:19 (1)	06:52
	20:24	20:05			19:20	96	17:47 (1)	18:29	119	17:42 (1)	16:42	34	15:53 (1)	16:17
2	05:16	05:41			06:12		16:10 (1)	06:43		15:43 (1)	06:18		15:25 (1)	06:53
	20:24	20:04			19:19	98	17:48 (1)	18:27	119	17:42 (1)	16:40	21	15:46 (1)	16:17
3	05:16	05:42			06:13		16:08 (1)	06:44		15:43 (1)	06:19			06:54
	20:24	20:03			19:17	100	17:48 (1)	18:26	118	17:41 (1)	16:39			16:16
4	05:17	05:43			06:14		16:07 (1)	06:45		15:43 (1)	06:20			06:55
	20:23	20:02			19:15	101	17:48 (1)	18:24	117	17:40 (1)	16:38			16:16
5	05:17	05:44			06:15		16:05 (1)	06:46		15:43 (1)	06:22			06:56
	20:23	20:01			19:14	104	17:49 (1)	18:22	116	17:39 (1)	16:37			16:16
6	05:18	05:45			06:16		16:04 (1)	06:47		15:43 (1)	06:23			06:57
	20:23	19:58			19:12	105	17:49 (1)	18:21	115	17:38 (1)	16:36			16:16
7	05:19	05:46			06:17		16:03 (1)	06:48		15:43 (1)	06:24			06:58
	20:23	19:57			19:10	106	17:49 (1)	18:19	114	17:37 (1)	16:35			16:16
8	05:19	05:47			06:18		16:01 (1)	06:49		15:43 (1)	06:25			06:59
	20:22	19:56			19:08	108	17:49 (1)	18:17	113	17:36 (1)	16:33			16:16
9	05:20	05:48			06:19		16:00 (1)	06:50		15:43 (1)	06:26			07:00
	20:22	19:54			19:07	110	17:50 (1)	18:16	112	17:35 (1)	16:32			16:16
10	05:21	05:49			06:20		15:59 (1)	06:51		15:44 (1)	06:28			07:01
	20:22	19:53			19:05	111	17:50 (1)	18:14	111	17:35 (1)	16:31			16:16
11	05:21	05:50		17:01 (1)	06:21		15:58 (1)	06:53		15:45 (1)	06:29			07:02
	20:21	19:52	13	17:14 (1)	19:03	112	17:50 (1)	18:12	109	17:34 (1)	16:30			16:16
12	05:22	05:51		16:55 (1)	06:22		15:56 (1)	06:54		15:45 (1)	06:30			07:02
	20:21	19:50	24	17:19 (1)	19:02	114	17:50 (1)	18:11	107	17:32 (1)	16:29			16:16
13	05:23	05:52		16:51 (1)	06:23		15:55 (1)	06:55		15:46 (1)	06:31			07:03
	20:20	19:49	32	17:23 (1)	19:00	115	17:50 (1)	18:09	105	17:31 (1)	16:28			16:16
14	05:24	05:53		16:47 (1)	06:24		15:53 (1)	06:56		15:46 (1)	06:32			07:04
	20:20	19:48	39	17:26 (1)	18:58	116	17:49 (1)	18:07	104	17:30 (1)	16:27			16:16
15	05:24	05:54		16:44 (1)	06:25		15:52 (1)	06:57		15:47 (1)	06:34			07:05
	20:19	19:46	44	17:28 (1)	18:56	117	17:49 (1)	18:06	101	17:28 (1)	16:27			16:17
16	05:25	05:55		16:42 (1)	06:26		15:51 (1)	06:58		15:47 (1)	06:35			07:05
	20:19	19:45	48	17:30 (1)	18:55	117	17:48 (1)	18:04	100	17:27 (1)	16:26			16:17
17	05:26	05:56		16:39 (1)	06:27		15:50 (1)	06:59		15:49 (1)	06:36			07:06
	20:18	19:43	53	17:32 (1)	18:53	118	17:48 (1)	18:03	97	17:26 (1)	16:25			16:17
18	05:27	05:57		16:37 (1)	06:28		15:49 (1)	07:00		15:50 (1)	06:37			07:07
	20:17	19:42	57	17:34 (1)	18:51	119	17:48 (1)	18:01	95	17:25 (1)	16:24			16:17
19	05:28	05:58		16:35 (1)	06:29		15:48 (1)	07:01		15:51 (1)	06:38			07:07
	20:17	19:41	60	17:35 (1)	18:50	120	17:48 (1)	18:00	92	17:23 (1)	16:23			16:18
20	05:28	05:59		16:33 (1)	06:30		15:48 (1)	07:03		15:52 (1)	06:40			07:08
	20:16	19:39	64	17:37 (1)	18:48	119	17:47 (1)	17:58	89	17:21 (1)	16:23			16:18
21	05:29	06:00		16:30 (1)	06:31		15:47 (1)	07:04		15:53 (1)	06:41			07:09
	20:15	19:38	68	17:38 (1)	18:46	120	17:47 (1)	17:57	86	17:19 (1)	16:22			16:19
22	05:30	06:01		16:28 (1)	06:32		15:46 (1)	07:05		15:55 (1)	06:42			07:09
	20:14	19:36	71	17:39 (1)	18:44	121	17:47 (1)	17:55	84	17:19 (1)	16:21			16:19
23	05:31	06:02		16:27 (1)	06:33		15:46 (1)	07:06		15:56 (1)	06:43			07:10
	20:14	19:35	73	17:40 (1)	18:43	120	17:46 (1)	17:54	81	17:17 (1)	16:21			16:20
24	05:32	06:03		16:25 (1)	06:34		15:45 (1)	07:07		15:58 (1)	06:44			07:10
	20:13	19:33	76	17:41 (1)	18:41	121	17:46 (1)	17:52	77	17:15 (1)	16:20			16:20
25	05:33	06:04		16:23 (1)	06:36		15:44 (1)	07:08		15:59 (1)	06:45			07:10
	20:12	19:31	79	17:42 (1)	18:39	121	17:45 (1)	17:51	73	17:12 (1)	16:19			16:21
26	05:34	06:05		16:21 (1)	06:37		15:45 (1)	07:10		16:02 (1)	06:47			07:11
	20:11	19:30	82	17:43 (1)	18:37	121	17:46 (1)	17:50	69	17:11 (1)	16:19			16:21
27	05:35	06:06		16:19 (1)	06:38		15:44 (1)	07:11		16:04 (1)	06:48			07:11
	20:10	19:28	85	17:44 (1)	18:36	121	17:45 (1)	17:48	65	17:09 (1)	16:19			16:22
28	05:36	06:07		16:18 (1)	06:39		15:44 (1)	07:12		16:06 (1)	06:49			07:11
	20:09	19:27	87	17:45 (1)	18:34	121	17:45 (1)	17:47	60	17:06 (1)	16:18			16:23
29	05:37	06:08		16:16 (1)	06:40		15:44 (1)	07:13		16:08 (1)	06:50			07:12
	20:08	19:25	89	17:45 (1)	18:32	120	17:44 (1)	17:46	55	17:03 (1)	16:18			16:24
30	05:38	06:09		16:14 (1)	06:41		15:43 (1)	07:14		16:12 (1)	06:51			07:12
	20:07	19:23	92	17:46 (1)	18:31	120	17:43 (1)	17:44	49	17:01 (1)	16:17			16:24
31	05:39	06:10		16:13 (1)				07:16		16:15 (1)				07:12
	20:06	19:22	94	17:47 (1)				17:43	42	16:57 (1)				16:25
Potential sun hours	461	429			375			344			297			286
Total, worst case			1330			3412			2894			55		
Sun reduction			0.62			0.62			0.61			0.50		
Oper. time red.			1.00			1.00			1.00			1.00		
Wind dir. red.			0.55			0.55			0.55			0.55		
Total reduction			0.34			0.34			0.33			0.27		
Total, real			451			1155			963			15		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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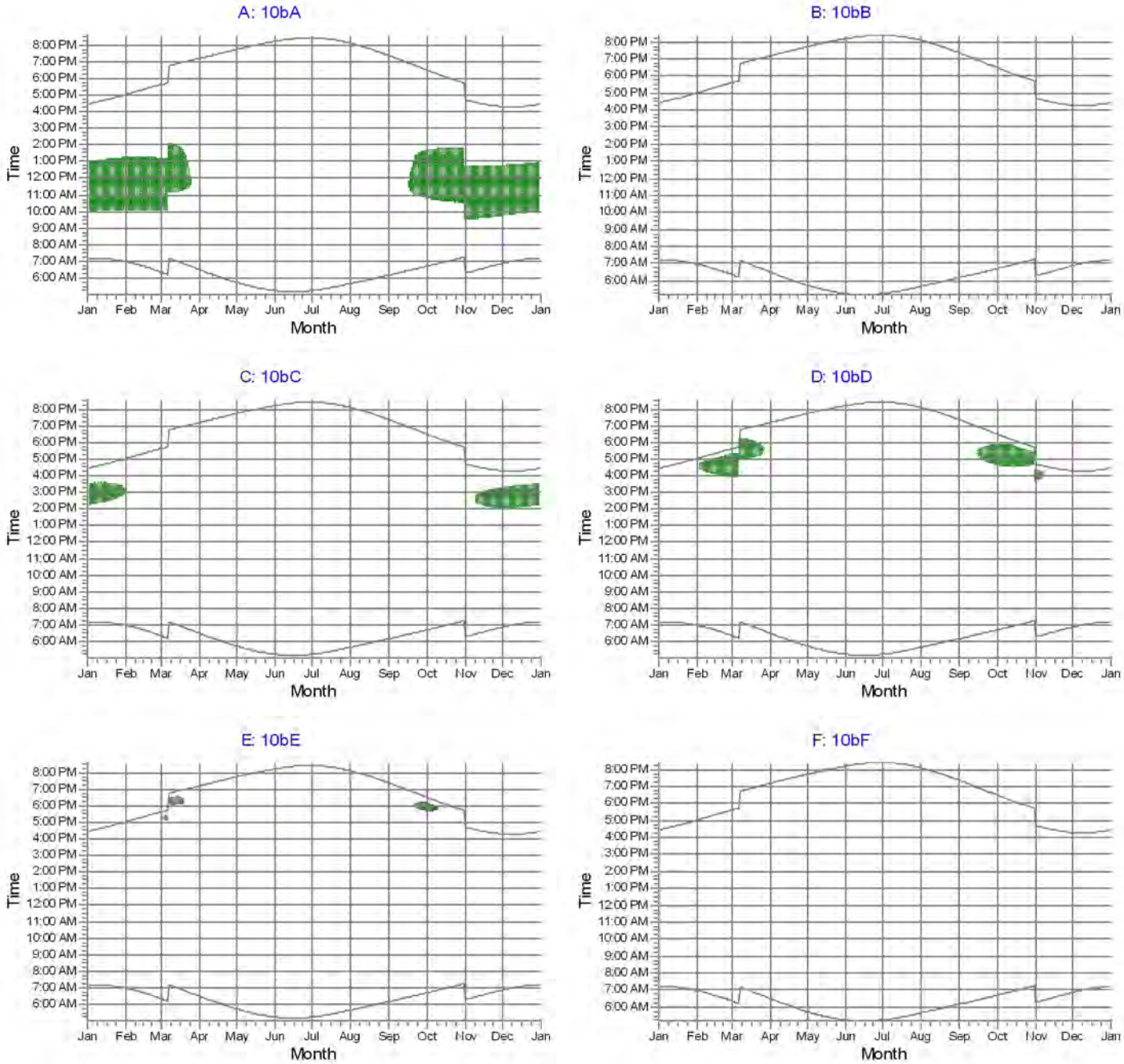
Calculated:
2/24/2011 1:45 PM/2.7.473

SHADOW - Calendar, graphical



WTGs

1: Prichard Field South

Project:

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9724235480
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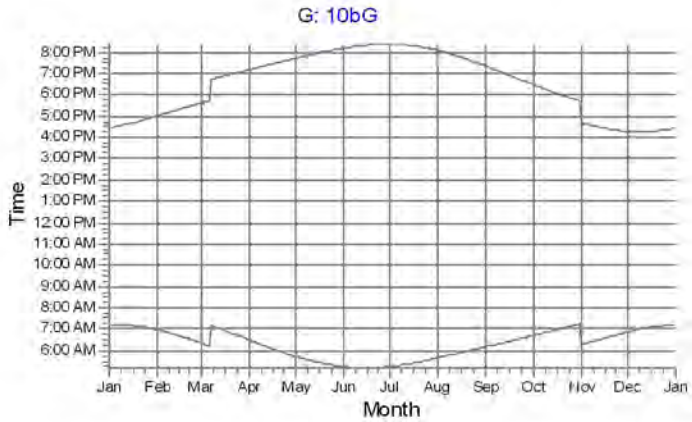
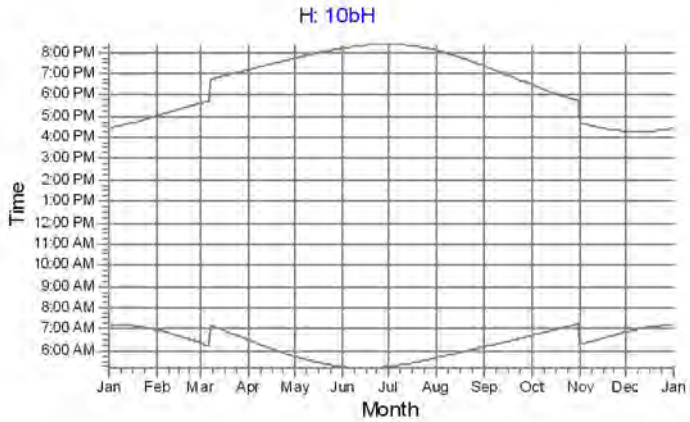
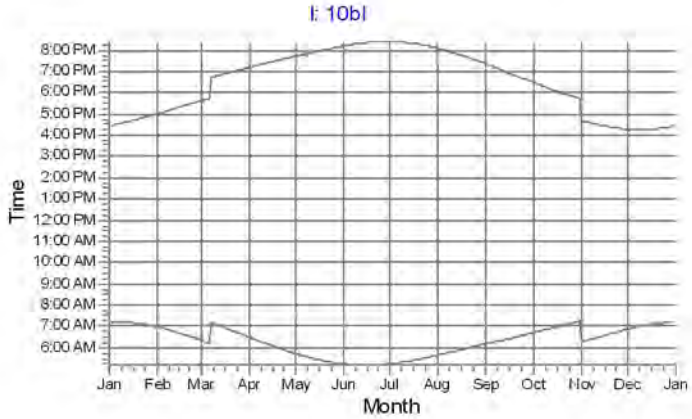
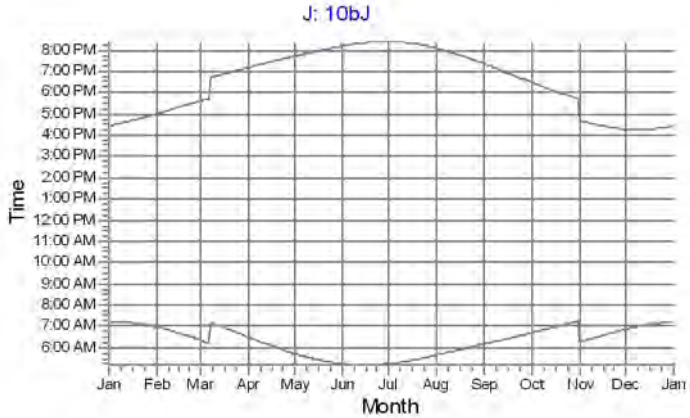
Calculated:
2/24/2011 1:45 PM/2.7.473

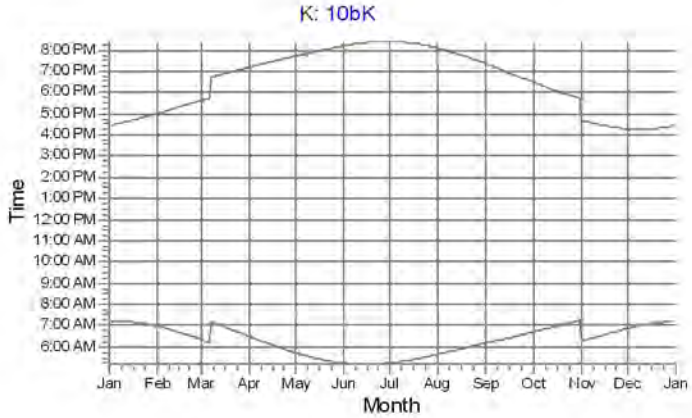
SHADOW - Calendar, graphical

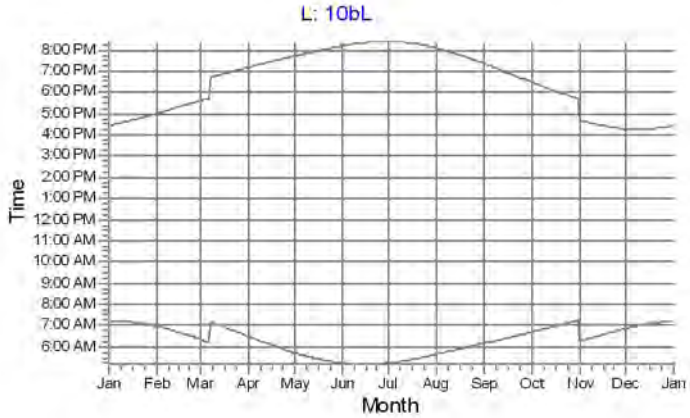












WTGs

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 1:48 PM / 3

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Geo-Marine.Inc
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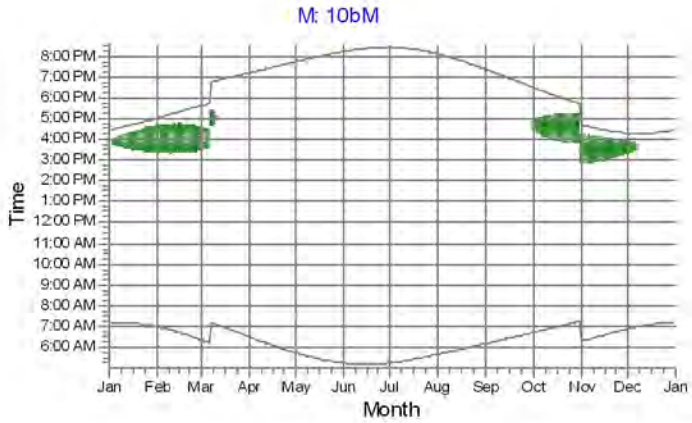
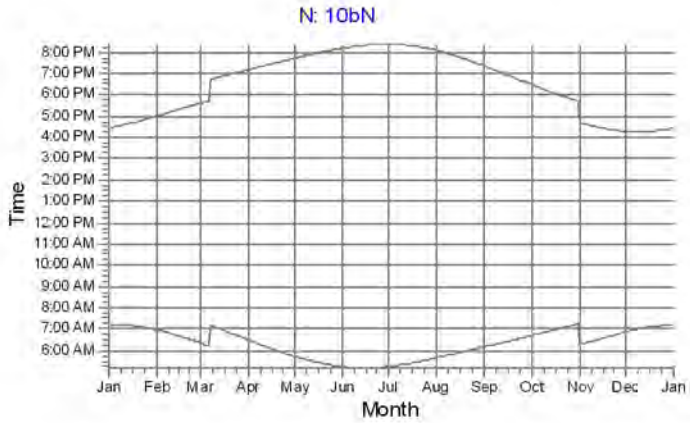
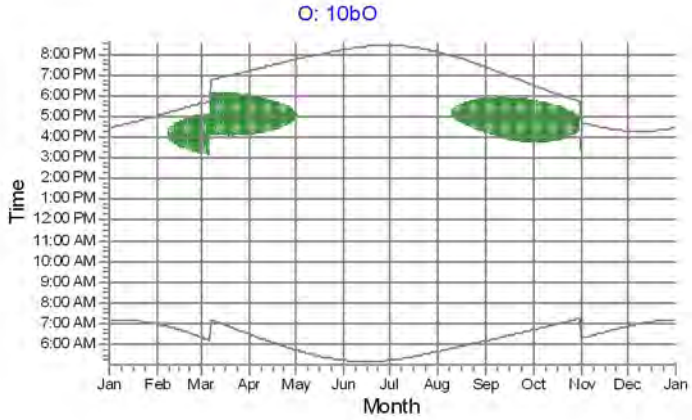
Calculated:
2/24/2011 1:45 PM/2.7.473

SHADOW - Calendar, graphical







WTGs

1: Prichard Field South

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 1:49 PM / 1

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Calculated:
2/24/2011 1:45 PM/2.7.473

SHADOW - Calendar per WTG

WTG: 1 - Prichard Field South

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June
1	07:12 09:58-12:53/175 16:26 14:12-15:28/76	06:58 10:02-13:11/189 15:21-16:35/74 17:01 14:57-15:08/11	06:22 10:04-13:08/184 16:59-17:14/15 17:36 15:12-16:59/107	06:30 16:04-17:57/113 19:10	05:44 16:49-17:10/21 19:43	05:15 20:12
2	07:13 09:59-12:54/175 16:27 14:13-15:28/75	06:57 10:03-13:11/188 17:02 15:21-16:36/75	06:20 10:05-13:08/183 17:00-17:15/15 17:37 15:11-17:00/109	06:29 16:06-17:57/111 19:11	05:43 16:56-17:02/6 19:44	05:14 20:13
3	07:13 09:59-12:55/176 16:28 14:13-15:28/75	06:56 10:03-13:12/189 16:38-16:40/2 17:03 15:20-16:38/78	06:19 10:04-13:07/183 17:01-17:16/15 17:38 15:10-17:01/111	06:27 16:06-17:55/109 19:13	05:41 19:45	05:14 20:14
4	07:13 09:59-12:55/176 15:44-15:53/9 16:29 14:14-15:29/75	06:55 10:03-13:12/189 16:38-16:41/3 17:05 15:20-16:38/78	06:17 10:04-13:06/182 17:01-17:17/16 17:39 15:09-17:01/112	06:25 16:06-17:54/108 19:14	05:40 19:46	05:13 20:14
5	07:13 09:59-12:56/177 15:42-15:57/15 16:30 14:15-15:29/74	06:54 10:03-13:12/189 16:38-16:42/4 17:06 15:19-16:38/79	06:15 10:05-13:06/181 17:02-17:19/17 17:40 15:08-17:02/114	06:24 16:07-17:54/107 19:15	05:39 19:47	05:13 20:15
6	07:13 10:00-12:57/177 15:40-16:00/20 16:31 14:16-15:29/73	06:53 10:02-13:12/190 16:39-16:43/4 17:07 15:19-16:39/80	06:14 10:05-13:04/179 17:02-17:20/18 17:41 15:07-17:02/115	06:22 16:08-17:53/105 19:16	05:37 19:48	05:13 20:16
7	07:13 10:00-12:58/178 15:39-16:02/23 16:32 14:17-15:30/73	06:52 10:02-13:12/190 16:39-16:45/6 17:09 15:19-16:39/80	06:12 10:06-13:04/178 17:03-17:20/17 17:43 15:07-17:03/116	06:20 16:08-17:52/104 19:17	05:36 19:49	05:12 20:16
8	07:12 10:01-12:58/177 15:38-16:05/27 16:33 14:18-15:30/72	06:51 10:02-13:13/191 16:40-16:46/6 17:10 15:19-16:40/81	07:11 11:06-14:03/177 18:03-18:22/19 18:44 16:06-18:03/117	06:19 16:10-17:51/101 19:18	05:35 19:50	05:12 20:17
9	07:12 10:00-12:58/178 15:36-16:06/30 16:34 14:18-15:29/71	06:50 10:03-13:13/190 16:20-16:48/28 17:11 15:19-16:21/62	07:09 11:06-14:01/175 18:03-18:23/20 18:45 16:05-18:04/119	06:17 16:10-17:50/100 19:19	05:34 19:51	05:12 20:18
10	07:12 10:01-12:59/178 15:35-16:08/33 16:35 14:19-15:30/71	06:48 10:03-13:13/190 16:25-16:48/23 17:12 15:18-16:26/68	07:07 11:07-14:00/173 18:04-18:25/21 18:46 16:05-18:05/120	06:15 16:11-17:49/98 19:20	05:33 19:52	05:12 20:18
11	07:12 10:01-13:00/179 15:34-16:10/36 16:36 14:20-15:30/70	06:47 10:02-13:13/191 16:29-16:50/21 17:14 15:19-16:30/71	07:06 11:08-13:59/171 18:04-18:26/22 18:47 16:04-18:05/121	06:14 16:12-17:48/96 19:21	05:32 19:53	05:12 20:19
12	07:12 10:01-13:00/179 15:33-16:10/37 16:37 14:20-15:29/69	06:46 10:02-13:13/191 16:33-16:52/19 17:15 15:19-16:34/75	07:04 11:08-13:57/169 18:04-18:27/23 18:48 16:04-18:05/121	06:12 16:13-17:47/94 19:22	05:31 19:54	05:11 20:19
13	07:11 10:01-13:01/180 15:32-16:12/40 16:38 14:21-15:30/69	06:45 10:03-13:13/190 16:36-16:53/17 17:16 15:19-16:37/78	07:02 11:09-13:56/167 18:05-18:27/22 18:49 16:04-18:06/122	06:10 16:15-17:46/91 19:23	05:29 19:56	05:11 20:20
14	07:11 10:02-13:02/180 15:31-16:13/42 16:39 14:22-15:29/67	06:43 10:02-13:13/191 16:38-16:54/16 17:17 15:19-16:39/80	07:01 11:09-13:54/165 18:04-18:29/25 18:51 16:03-18:05/122	06:09 16:15-17:44/89 19:24	05:28 19:57	05:11 20:20
15	07:10 10:01-13:02/181 16:40 14:23-16:14/111	06:42 10:03-13:13/190 16:41-16:56/15 17:19 15:19-16:41/82	06:59 11:10-13:52/162 18:04-18:28/24 18:52 16:02-18:05/123	06:07 16:16-17:43/87 19:26	05:27 19:58	05:11 20:21
16	07:10 10:02-13:03/181 16:41 14:24-16:16/112	06:41 10:03-13:13/190 16:43-16:57/14 17:20 15:20-16:43/83	06:57 11:10-13:49/159 18:04-18:27/23 18:53 16:02-18:04/122	06:06 16:18-17:42/84 19:27	05:26 19:59	05:11 20:21
17	07:10 10:02-13:03/181 16:43 14:25-16:17/112	06:39 10:02-13:13/191 16:44-16:58/14 17:21 15:19-16:44/85	06:56 11:12-13:47/155 18:04-18:26/22 18:54 16:02-18:04/122	06:04 16:18-17:40/82 19:28	05:25 20:00	05:11 20:22
18	07:09 10:01-13:04/183 16:44 14:26-16:18/112	06:38 10:03-13:13/190 16:46-17:00/14 17:22 15:20-16:46/86	06:54 11:13-13:43/150 18:04-18:24/20 18:55 16:02-18:04/122	06:03 16:20-17:39/79 19:29	05:25 20:00	05:11 20:22
19	07:08 10:02-13:05/183 16:45 14:28-16:20/112	06:37 10:02-13:12/190 16:47-17:01/14 17:24 15:20-16:47/87	06:52 11:13-13:39/146 18:05-18:22/17 18:56 16:01-18:02/121	06:01 16:21-17:37/76 19:30	05:24 20:00	05:12 20:22
20	07:08 10:02-13:05/183 16:46 14:28-16:20/112	06:35 10:03-13:12/189 16:49-17:02/13 17:25 15:20-16:49/89	06:51 11:16-13:35/139 18:08-18:20/12 18:57 16:02-18:03/121	06:00 16:23-17:36/73 19:31	05:23 20:01	05:12 20:23
21	07:07 10:01-13:05/184 16:47 14:29-16:21/112	06:34 10:02-13:11/189 16:50-17:03/13 17:26 15:20-16:50/90	06:49 11:17-13:27/130 18:58 16:02-18:02/120	05:58 16:24-17:34/70 19:32	05:22 20:02	05:12 20:23
22	07:07 10:02-13:07/185 16:48 14:31-16:23/112	06:32 10:03-13:12/189 16:52-17:05/13 17:27 15:21-16:52/91	06:47 11:18-13:15/117 18:59 16:01-18:02/121	05:57 16:26-17:33/67 19:33	05:21 20:03	05:12 20:23
23	07:06 10:02-13:07/185 16:50 14:33-16:24/111	06:31 10:03-13:11/188 16:53-17:06/13 17:28 15:19-16:53/94	06:45 11:21-12:55/94 19:01 16:02-18:02/120	05:55 16:27-17:30/63 19:34	05:20 20:04	05:12 20:23
24	07:05 10:02-13:07/185 16:51 14:34-16:26/112	06:29 10:03-13:11/188 16:55-17:08/13 17:30 15:18-16:55/97	06:44 11:24-12:33/69 19:02 16:02-18:01/119	05:54 16:29-17:29/60 19:35	05:20 20:05	05:13 20:23
25	07:05 10:02-13:07/185 16:52 14:36-16:27/111	06:28 10:03-13:10/187 16:55-17:08/13 17:31 15:16-16:55/99	06:42 11:27-12:16/49 19:03 16:02-18:01/119	05:52 16:32-17:28/56 19:36	05:19 20:06	05:13 20:24
26	07:04 10:03-13:09/186 16:53 14:38-16:29/111	06:26 10:04-13:10/186 16:57-17:10/13 17:32 15:16-16:57/101	06:40 11:34-12:00/26 19:04 16:02-18:00/118	05:51 16:33-17:25/52 19:37	05:18 20:07	05:13 20:24
27	07:03 10:03-13:09/186 15:23-16:30/67 16:55 14:40-15:22/42	06:25 10:03-13:09/186 16:57-17:11/14 17:33 15:14-16:57/103	06:39 16:03-18:00/117 19:05	05:49 16:36-17:23/47 19:39	05:17 20:08	05:14 20:24
28	07:02 10:02-13:09/187 15:23-16:31/68 16:56 14:42-15:21/39	06:23 10:04-13:09/185 16:59-17:13/14 17:34 15:13-16:59/106	06:37 16:03-17:59/116 19:06	05:48 16:38-17:21/43 19:40	05:17 20:09	05:14 20:24
29	07:01 10:02-13:10/188 15:22-16:33/71 16:57 14:45-15:19/34		06:35 16:03-17:58/115 19:07	05:47 16:41-17:17/36 19:41	05:16 20:10	05:14 20:24
30	07:00 10:02-13:10/188 15:22-16:34/72 16:58 14:48-15:16/28		06:34 16:04-17:59/115 19:08	05:45 16:44-17:14/30 19:42	05:16 20:10	05:15 20:24
31	06:59 10:02-13:10/188 15:21-16:34/73 17:00 14:51-15:13/22		06:32 16:04-17:58/114 19:09		05:15 20:11	
Potential sun hours	296	297	370	400	450	454
Sum of minutes with flicker	8802	7992	7890	2431	27	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 1:45 PM/2.7.473

SHADOW - Calendar per WTG

WTG: 1 - Prichard Field South

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	July	August	September	October	November	December
1	05:15 20:24	05:40 20:05	06:11 16:11-17:47/96 19:20	06:42 10:48-13:36/168 17:43-18:07/24 18:29 15:43-17:44/121	06:17 09:32-12:42/190 15:54-16:18/24 16:42 14:48-15:55/67	06:52 09:43-12:42/179 15:16-15:52/36 16:17 14:02-15:12/70
2	05:16 20:24	05:41 20:04	06:12 16:10-17:48/98 19:19	06:43 10:47-13:37/170 17:43-18:05/22 18:27 15:43-17:44/121	06:18 09:31-12:42/191 15:47-16:16/29 16:40 14:48-15:48/60	06:53 09:44-12:42/178 15:18-15:51/33 16:17 14:02-15:13/71
3	05:16 20:24	05:42 20:03	06:13 16:08-17:48/100 19:17	06:44 10:45-13:38/173 17:42-18:03/21 18:26 15:43-17:43/120	06:19 09:32-12:42/190 16:09-16:16/7 16:39 14:49-16:09/80	06:54 09:44-12:42/178 15:20-15:50/30 16:16 14:02-15:13/71
4	05:17 20:23	05:43 20:02	06:14 16:07-17:48/101 19:15	06:45 10:44-13:38/174 17:41-18:01/20 18:24 15:43-17:42/119	06:20 09:32-12:42/190 16:09-16:14/5 16:38 14:49-16:09/80	06:55 09:45-12:42/177 15:21-15:49/28 16:16 14:02-15:14/72
5	05:17 20:23	05:44 20:01	06:15 16:05-17:49/104 19:14	06:46 10:43-13:39/176 17:40-18:00/20 18:22 15:43-17:41/118	06:22 09:32-12:42/190 16:08-16:13/5 16:37 14:49-16:08/79	06:56 09:45-12:43/178 15:24-15:47/23 16:16 14:02-15:15/73
6	05:18 20:23	05:45 19:58	06:16 16:04-17:49/105 19:12	06:47 10:42-13:39/177 17:39-17:58/19 18:21 15:43-17:39/116	06:23 09:33-12:42/189 16:09-16:12/3 16:36 14:50-16:09/79	06:57 09:46-12:43/177 15:26-15:46/20 16:16 14:02-15:15/73
7	05:19 20:23	05:46 19:57	06:17 16:03-17:49/106 19:10	06:48 10:41-13:40/179 17:38-17:56/18 18:19 15:43-17:38/115	06:24 09:33-12:42/189 16:08-16:11/3 16:35 14:50-16:08/78	06:58 09:47-12:43/176 15:29-15:44/15 16:16 14:02-15:16/74
8	05:19 20:22	05:47 19:56	06:18 16:01-17:49/108 19:08	06:49 10:40-13:40/180 17:37-17:54/17 18:17 15:43-17:37/114	06:25 09:32-12:41/189 16:07-16:09/2 16:33 14:50-16:07/77	06:59 09:47-12:43/176 15:32-15:42/10 16:16 14:02-15:17/75
9	05:20 20:22	05:48 19:54	06:19 16:00-17:50/110 19:07	06:50 10:39-13:40/181 17:36-17:52/16 18:16 15:43-17:36/113	06:26 09:33-12:42/189 16:32 14:51-16:07/76	07:00 09:48-12:44/176 16:16 14:02-15:17/75
10	05:21 20:22	05:49 19:53	06:20 15:59-17:50/111 19:05	06:51 10:39-13:41/182 17:36-17:52/16 18:14 15:44-17:36/112	06:28 09:33-12:42/189 14:52-16:06/74 16:31 14:27-14:40/13	07:01 09:49-12:44/175 16:16 14:03-15:18/75
11	05:21 20:21	05:50 17:01-17:14/13 19:52	06:21 15:58-17:50/112 19:03	06:53 10:39-13:42/183 17:35-17:50/15 18:12 15:45-17:35/110	06:29 09:33-12:41/188 14:52-16:05/73 16:30 14:22-14:45/23	07:02 09:48-12:44/176 16:16 14:02-15:18/76
12	05:22 20:21	05:51 16:55-17:19/24 19:50	06:22 15:56-17:50/114 19:02	06:54 10:38-13:42/184 17:33-17:48/15 18:11 15:45-17:33/108	06:30 09:33-12:41/188 14:53-16:05/72 16:29 14:18-14:48/30	07:02 09:49-12:44/175 16:16 14:03-15:19/76
13	05:23 20:20	05:52 16:51-17:23/32 19:49	06:23 15:55-17:50/115 19:00	06:55 10:37-13:42/185 17:32-17:46/14 18:09 15:46-17:32/106	06:31 09:34-12:42/188 14:54-16:05/71 16:28 14:16-14:51/35	07:03 09:50-12:45/175 16:16 14:03-15:19/76
14	05:24 20:20	05:53 16:47-17:26/39 19:48	06:24 15:53-17:49/116 18:58	06:56 10:36-13:42/186 17:31-17:45/14 18:08 15:46-17:31/105	06:32 09:34-12:41/187 14:55-16:03/68 16:27 14:14-14:53/39	07:04 09:51-12:45/174 16:16 14:04-15:20/76
15	05:24 20:19	05:54 16:44-17:28/44 19:46	06:25 15:52-17:49/117 18:56	06:57 10:36-13:42/186 17:29-17:43/14 18:06 15:47-17:29/102	06:34 09:35-12:41/186 14:55-16:02/67 16:27 14:12-14:54/42	07:05 09:50-12:45/175 16:17 14:03-15:20/77
16	05:25 20:19	05:55 16:42-17:30/48 19:45	06:26 15:51-17:48/117 18:55	06:58 10:35-13:42/187 17:28-17:41/13 18:04 15:47-17:28/101	06:35 09:36-12:42/186 16:26 14:11-16:02/111	07:05 09:51-12:45/174 16:17 14:04-15:21/77
17	05:26 20:18	05:56 16:39-17:32/53 19:43	06:27 11:25-11:44/19 18:53 15:50-17:48/118	06:59 10:35-13:43/188 17:27-17:40/13 18:03 15:49-17:27/98	06:36 09:36-12:41/185 16:25 14:09-16:01/112	07:06 09:52-12:46/174 16:17 14:05-15:22/77
18	05:27 20:17	05:57 16:37-17:34/57 19:42	06:28 11:16-12:00/44 18:51 15:49-17:48/119	07:00 10:35-13:43/188 17:26-17:39/13 18:01 15:50-17:26/96	06:37 09:36-12:41/185 16:24 14:08-16:00/112	07:07 09:52-12:46/174 16:17 14:05-15:21/76
19	05:28 20:17	05:58 16:35-17:35/60 19:41	06:29 11:11-12:16/65 18:50 15:48-17:48/120	07:01 10:34-13:42/188 17:24-17:37/13 18:00 15:51-17:24/93	06:38 09:36-12:41/185 16:23 14:07-15:58/111	07:07 09:53-12:47/174 16:18 14:05-15:22/77
20	05:29 20:16	05:59 16:33-17:37/64 19:39	06:30 11:07-12:35/88 18:48 15:48-17:47/119	07:03 10:33-13:42/189 17:22-17:35/13 17:58 15:52-17:22/90	06:40 09:37-12:42/185 16:23 14:06-15:58/112	07:08 09:54-12:48/174 16:18 14:06-15:23/77
21	05:29 20:15	06:00 16:30-17:38/68 19:38	06:31 11:04-12:56/112 18:46 15:47-17:47/120	07:04 10:33-13:42/189 17:20-17:33/13 17:57 15:51-17:20/89	06:41 09:38-12:41/183 16:22 14:05-15:57/112	07:09 09:54-12:48/174 16:19 14:06-15:23/77
22	05:30 20:14	06:01 16:28-17:39/71 19:36	06:32 11:02-13:09/127 18:44 15:46-17:47/121	07:05 10:33-13:43/190 17:20-17:33/13 17:55 15:51-17:20/89	06:42 09:38-12:41/183 16:21 14:04-15:56/112	07:09 09:55-12:49/174 16:19 14:07-15:24/77
23	05:31 20:14	06:02 16:27-17:40/73 19:35	06:33 10:59-13:16/137 17:52-18:02/10 18:43 15:46-17:46/120	07:06 10:33-13:43/190 17:18-17:31/13 17:54 15:50-17:18/88	06:43 09:38-12:41/183 16:21 14:04-15:56/112	07:10 09:55-12:49/174 16:20 14:07-15:24/77
24	05:32 20:13	06:03 16:25-17:41/76 19:33	06:34 10:57-13:21/144 17:49-18:05/16 18:41 15:45-17:46/121	07:07 10:32-13:42/190 17:16-17:29/13 17:52 15:49-17:16/87	06:44 09:39-12:42/183 16:20 14:04-15:56/112	07:10 09:55-12:49/174 16:20 14:07-15:24/77
25	05:33 20:12	06:04 16:23-17:42/79 19:31	06:36 10:57-13:26/149 17:46-18:06/20 18:39 15:44-17:45/121	07:08 10:32-13:42/190 17:13-17:27/14 17:51 15:49-17:13/84	06:45 09:40-12:42/182 16:20 14:03-15:55/112	07:10 09:56-12:50/174 16:21 14:09-15:25/76
26	05:34 20:11	06:05 16:21-17:43/82 19:30	06:37 10:55-13:28/153 17:47-18:07/20 18:37 15:45-17:47/122	07:10 10:33-13:43/190 17:12-17:27/15 17:50 15:49-17:12/83	06:47 09:40-12:41/181 16:19 14:03-15:54/111	07:11 09:56-12:50/174 16:21 14:09-15:26/77
27	05:35 20:10	06:06 16:19-17:44/85 19:28	06:38 10:53-13:31/158 17:46-18:09/23 18:36 15:44-17:46/122	07:11 10:32-13:43/191 17:10-17:25/15 17:48 15:49-17:10/81	06:48 09:40-12:41/181 16:19 14:02-15:53/111	07:11 09:56-12:50/174 16:22 14:09-15:26/77
28	05:36 20:09	06:07 16:18-17:45/87 19:27	06:39 10:52-13:32/160 17:46-18:10/24 18:34 15:44-17:47/123	07:12 10:32-13:42/190 17:07-17:23/16 17:47 15:48-17:08/80	06:49 09:41-12:41/180 15:11-15:53/42 16:18 14:02-15:09/67	07:12 09:57-12:52/175 16:23 14:10-15:27/77
29	05:37 20:08	06:08 16:16-17:45/89 19:25	06:40 10:50-13:34/164 17:45-18:10/25 18:32 15:44-17:46/122	07:13 10:32-13:42/190 17:04-17:22/18 17:46 15:48-17:05/77	06:50 09:41-12:41/180 15:12-15:52/40 16:18 14:01-15:10/69	07:12 09:58-12:52/174 16:24 14:11-15:27/76
30	05:38 20:07	06:09 16:14-17:46/92 19:23	06:41 10:49-13:35/166 17:44-18:09/25 18:31 15:43-17:45/122	07:14 10:32-13:43/191 17:02-17:21/19 17:44 15:49-17:03/74	06:51 09:43-12:42/179 15:15-15:53/38 16:17 14:02-15:11/69	07:12 09:58-12:52/174 16:24 14:11-15:27/76
31	05:39 20:06	06:10 16:13-17:47/94 19:22		07:16 10:32-13:42/190 16:58-17:20/22 17:43 15:48-16:59/71		07:12 09:58-12:53/175 16:25 14:12-15:27/75
Potential sun hours	461	429	375	344	297	286
Sum of minutes with flicker	0	1330	5267	9289	8599	7962

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

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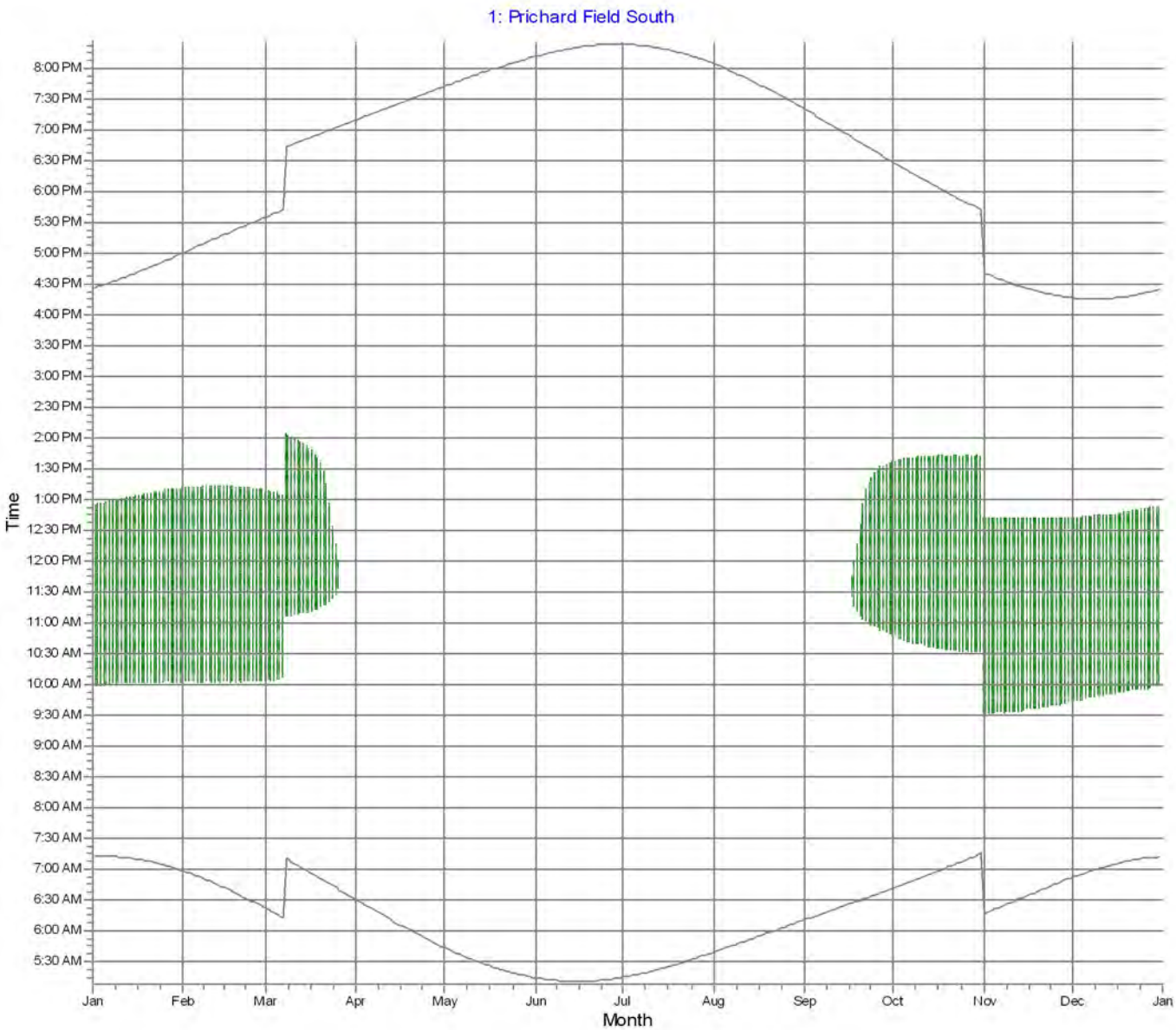
SHADOW - Calendar per WTG, graphical

WTG: 1 - Prichard Field South



WTGs

A: 10bA

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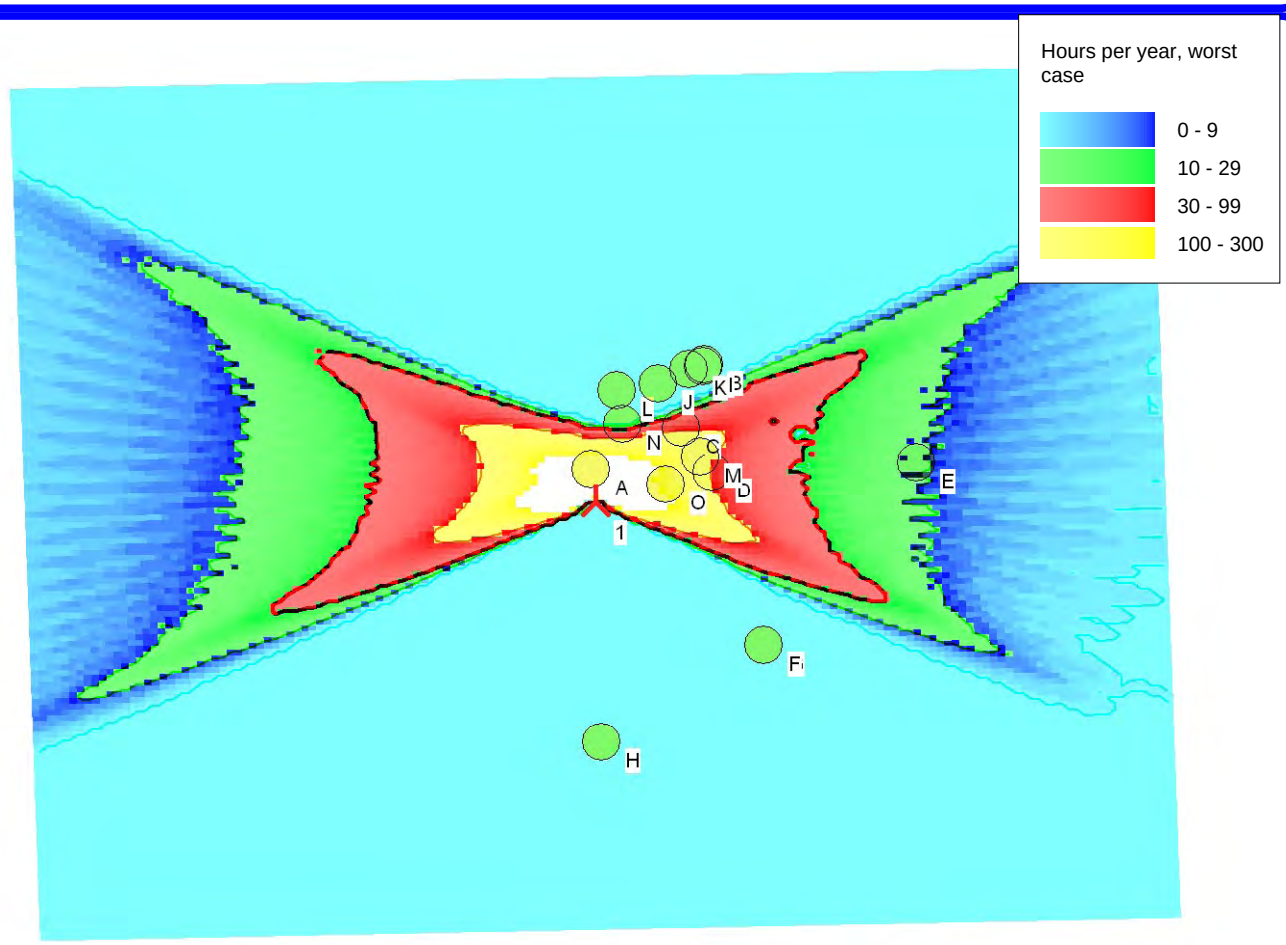
SHADOW - Map



0 250 500 750 1000m

Map: , Print scale 1:20,000, Map center Geo WGS 84 East: -71.326980° North: 41.517466°

New WTG Shadow receptor

Isolines showing shadow in Hours per year, worst case

0 10 30 100

APPENDIX 11

WIND TURBINE SITE 11 KATY FIELD

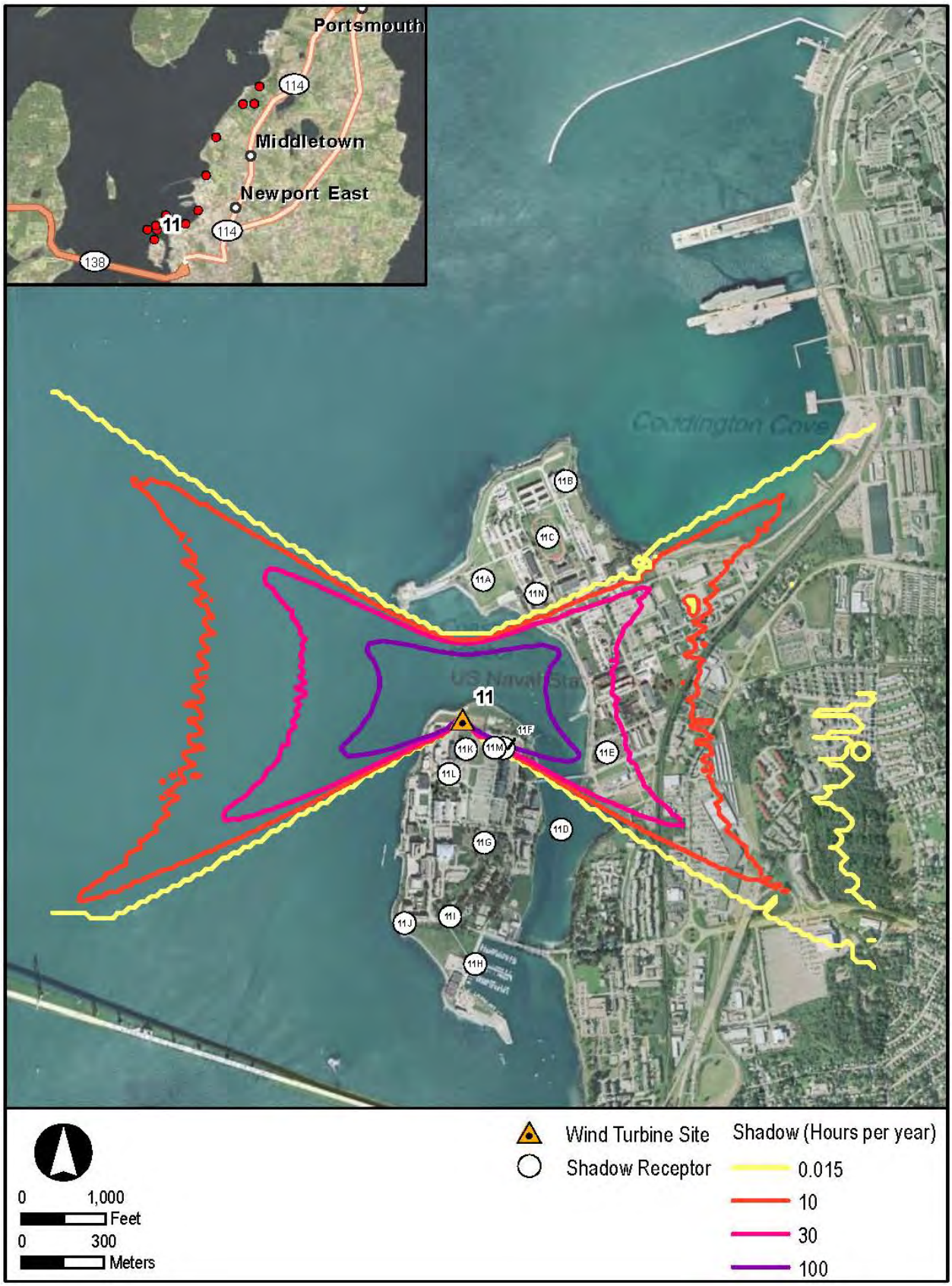


Figure A-11: Maximum predicted shadow flicker levels (hours per year) for a Vestas V112-3.0 MW Model at Wind Turbine Site 11 (Katy Field).

Project:

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SHADOW - Main Result

Assumptions for shadow calculations

Maximum distance for influence
Calculate only when more than 20 % of sun is covered by the blade
Please look in WTG table

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

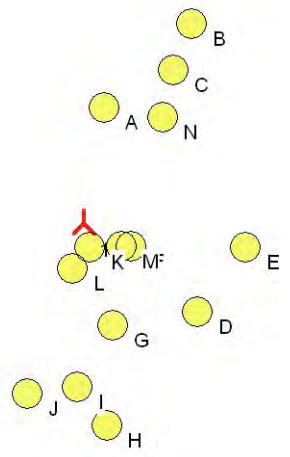
Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW
691	432	259	155	155	155	432	518	950	1,209	864	518

W	WNW	NW	NNW	Sum
432	604	691	691	8,756

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: Line object
Obstacles used in calculation
Eye height: 1.5 m
Grid resolution: 10 m



Scale 1:25,000
New WTG
Shadow receptor

WTGs

	Geo DD: WGS 84				WTG type						Shadow data	
	Longitude	Latitude	Z [m]	Row data/Description	Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Calculation distance [m]	RPM [RPM]
1	-71.327905° East	41.513888° North	0.3	Katy Field	Yes	VESTAS	V112-3,000	3,000	112.0	84.0	2,000	12.8

Shadow receptor-Input

No.	Name	Geo DD: WGS 84 Longitude	Latitude	Z [m]	Width [m]	Height [m]	Height a.g.l. [m]	Degrees from south cw [°]	Slope of window [°]	Direction mode
A	11A	-71.327118° East	41.518498° North	1.5	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
B	11B	-71.323621° East	41.521821° North	18.0	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
C	11C	-71.324352° East	41.519961° North	19.1	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
D	11D	-71.323413° East	41.510381° North	0.0	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
E	11E	-71.321504° East	41.512942° North	4.6	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
F	11F	-71.326030° East	41.512994° North	4.6	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
G	11G	-71.326762° East	41.509869° North	6.7	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
H	11H	-71.327012° East	41.505884° North	0.4	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
I	11I	-71.328166° East	41.507421° North	10.7	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
J	11J	-71.330157° East	41.507159° North	7.9	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
K	11K	-71.327680° East	41.512931° North	2.3	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
L	11L	-71.328382° East	41.512098° North	4.6	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
M	11M	-71.326429° East	41.513004° North	4.6	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
N	11N	-71.324780° East	41.518090° North	6.7	1.0	1.0	1.0	-180.0	90.0	"Green house mode"

Project:

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SHADOW - Main Result

Calculation Results

Shadow receptor

		Shadow, worst case			Shadow, expected values
No.	Name	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	11A	0:00	0	0:00	0:00
B	11B	0:00	0	0:00	0:00
C	11C	0:00	0	0:00	0:00
D	11D	0:00	0	0:00	0:00
E	11E	46:56	78	0:49	15:21
F	11F	19:35	31	0:48	7:25
G	11G	0:00	0	0:00	0:00
H	11H	0:00	0	0:00	0:00
I	11I	0:00	0	0:00	0:00
J	11J	0:00	0	0:00	0:00
K	11K	0:00	0	0:00	0:00
L	11L	0:00	0	0:00	0:00
M	11M	0:00	0	0:00	0:00
N	11N	0:00	0	0:00	0:00

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

No.	Name	Worst case [h/year]	Expected [h/year]
1	Katy Field	66:31	22:46

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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SHADOW - Calendar

Shadow receptor: A - 11A

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:29	05:43	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:19	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:13	19:45	20:14	20:24	20:03	19:17	18:26	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:24	05:39	05:13	05:17	05:44	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:14	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:21	16:36	16:16
7	07:13	06:52	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24	06:58
	16:32	17:09	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:35	16:16
8	07:12	06:51	07:11	06:19	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:32	05:12	05:21	05:50	06:21	06:53	06:29	07:02
	16:36	17:14	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:12	06:46	07:04	06:12	05:31	05:11	05:22	05:51	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:56	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:24	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:51	19:24	19:57	20:20	20:20	19:48	18:58	18:08	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:26	19:58	20:21	20:19	19:46	18:56	18:06	16:27	16:17
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:10	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	20:00	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:03	05:25	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:24	05:12	05:28	05:58	06:29	07:01	06:38	07:07
	16:45	17:24	18:56	19:30	20:01	20:22	20:17	19:41	18:50	18:00	16:23	16:18
20	07:08	06:35	06:51	06:00	05:23	05:12	05:29	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:57	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:01	19:34	20:04	20:23	20:14	19:35	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54	05:20	05:13	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:05	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:36	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:20	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	16:21
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	16:55	17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:19	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:12
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
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30	07:00		06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
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31	06:59		06:32		05:15		05:39	06:10		07:16		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
2/24/2011 2:01 PM / 2

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 2:00 PM/2.7.473

SHADOW - Calendar

Shadow receptor: B - 11B

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:29	05:43	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:19	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:13	19:45	20:14	20:24	20:03	19:17	18:26	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:24	05:39	05:13	05:17	05:44	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:14	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36	16:16
7	07:13	06:52	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24	06:58
	16:32	17:09	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:35	16:16
8	07:12	06:51	07:11	06:19	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:32	05:12	05:21	05:50	06:21	06:53	06:29	07:02
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13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:56	20:20	20:20	19:49	19:00	18:09	16:28	16:16
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	16:39	17:17	18:51	19:24	19:57	20:20	20:20	19:48	18:58	18:07	16:27	16:16
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	16:40	17:19	18:52	19:26	19:58	20:21	20:19	19:46	18:56	18:06	16:27	16:17
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:10	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	20:00	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:03	05:25	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:24	05:11	05:28	05:58	06:29	07:01	06:38	07:07
	16:45	17:24	18:56	19:30	20:00	20:22	20:17	19:41	18:50	18:00	16:23	16:18
20	07:08	06:35	06:51	06:00	05:23	05:12	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:57	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:01	19:34	20:04	20:23	20:14	19:35	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54	05:20	05:13	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:05	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:36	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:13	05:35	06:06	06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:18	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:12
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:47	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:46	16:18	16:24
30	07:00		06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:16		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
2/24/2011 2:01 PM / 3

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 2:00 PM/2.7.473

SHADOW - Calendar

Shadow receptor: C - 11C

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:29	05:43	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:19	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:13	19:45	20:14	20:24	20:03	19:17	18:26	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:24	05:39	05:13	05:17	05:44	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:14	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36	16:16
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	16:32	17:09	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:35	16:16
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21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
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22	07:07	06:32	06:47	05:57	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
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	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:16		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
2/24/2011 2:01 PM / 4

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 2:00 PM/2.7.473

SHADOW - Calendar

Shadow receptor: D - 11D

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:29	05:43	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:18	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:13	19:45	20:14	20:23	20:03	19:17	18:26	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:24	05:39	05:13	05:17	05:44	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:14	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:20	16:36	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24	06:58
	16:32	17:09	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:35	16:16
8	07:12	06:51	07:11	06:19	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:32	05:12	05:21	05:50	06:21	06:53	06:29	07:02
	16:36	17:14	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:11	06:46	07:04	06:12	05:31	05:11	05:22	05:51	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:24	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:51	19:24	19:56	20:20	20:20	19:48	18:58	18:07	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:26	19:57	20:21	20:19	19:46	18:56	18:06	16:27	16:17
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:58	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:10	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:43	17:21	18:54	19:28	19:59	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:03	05:25	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:24	05:12	05:28	05:58	06:29	07:01	06:38	07:07
	16:45	17:24	18:56	19:30	20:00	20:22	20:17	19:41	18:50	18:00	16:23	16:18
20	07:08	06:35	06:51	06:00	05:23	05:12	05:29	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:57	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:01	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54	05:20	05:13	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:36	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:20	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:14	05:35	06:06	06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:19	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:47	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:46	16:18	16:24
30	07:00		06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:15		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
2/24/2011 2:01 PM / 5

Licensed user:
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9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 2:00 PM/2.7.473

SHADOW - Calendar

Shadow receptor: E - 11E

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April		May		June	July		August		September		October	November	December
1	07:12	06:58	06:22	06:30		05:44	18:24 (1)	05:15	05:15		05:40	18:41 (1)	06:11	18:41 (1)	06:42	06:17	06:52
	16:26	17:01	17:36	19:10		19:43	47 19:11 (1)	20:12	20:24		20:05	32 19:13 (1)	19:20	17 18:58 (1)	18:29	16:42	16:17
2	07:13	06:57	06:20	06:29		05:43	18:23 (1)	05:14	05:16		05:41	18:39 (1)	06:12	18:45 (1)	06:43	06:18	06:53
	16:27	17:02	17:37	19:11		19:44	46 19:09 (1)	20:13	20:24		20:04	35 19:14 (1)	19:18	10 18:55 (1)	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27		05:41	18:24 (1)	05:14	05:16		05:42	18:39 (1)	06:13		06:44	06:19	06:54
	16:28	17:03	17:38	19:12		19:45	45 19:09 (1)	20:14	20:23		20:03	36 19:15 (1)	19:17		18:26	16:39	16:16
4	07:13	06:55	06:17	06:25		05:40	18:24 (1)	05:13	05:17		05:43	18:38 (1)	06:14		06:45	06:20	06:55
	16:29	17:05	17:39	19:14		19:46	45 19:09 (1)	20:14	20:23		20:02	38 19:16 (1)	19:15		18:24	16:38	16:16
5	07:13	06:54	06:15	06:24		05:39	18:25 (1)	05:13	05:17		05:44	18:37 (1)	06:15		06:46	06:22	06:56
	16:30	17:06	17:40	19:15		19:47	43 19:08 (1)	20:15	20:23		20:01	40 19:17 (1)	19:13		18:22	16:37	16:16
6	07:13	06:53	06:14	06:22		05:37	18:25 (1)	05:13	05:18		05:45	18:36 (1)	06:16		06:47	06:23	06:57
	16:31	17:07	17:41	19:16		19:48	42 19:07 (1)	20:16	20:23		19:58	41 19:17 (1)	19:12		18:20	16:36	16:16
7	07:12	06:52	06:12	06:20		05:36	18:26 (1)	05:12	05:19		05:46	18:34 (1)	06:17		06:48	06:24	06:58
	16:32	17:09	17:43	19:17		19:49	40 19:06 (1)	20:16	20:23		19:57	43 19:17 (1)	19:10		18:19	16:35	16:16
8	07:12	06:51	07:11	06:19		05:35	18:26 (1)	05:12	05:19		05:47	18:33 (1)	06:18		06:49	06:25	06:59
	16:33	17:10	18:44	19:18		19:50	40 19:06 (1)	20:17	20:22		19:56	44 19:17 (1)	19:08		18:17	16:33	16:16
9	07:12	06:50	07:09	06:17		05:34	18:27 (1)	05:12	05:20		05:48	18:33 (1)	06:19		06:50	06:26	07:00
	16:34	17:11	18:45	19:19		19:51	38 19:05 (1)	20:18	20:22		19:54	45 19:18 (1)	19:07		18:16	16:32	16:16
10	07:12	06:48	07:07	06:15		18:46 (1) 05:33	18:28 (1)	05:12	05:21		05:49	18:32 (1)	06:20		06:51	06:28	07:01
	16:35	17:12	18:46	19:20	10	18:56 (1) 19:52	36 19:04 (1)	20:18	20:22		19:53	46 19:18 (1)	19:05		18:14	16:31	16:16
11	07:12	06:47	07:06	06:14		18:42 (1) 05:32	18:29 (1)	05:12	05:21		05:50	18:32 (1)	06:21		06:53	06:29	07:02
	16:36	17:14	18:47	19:21	17	18:59 (1) 19:53	34 19:03 (1)	20:19	20:21		19:52	46 19:18 (1)	19:03		18:12	16:30	16:16
12	07:11	06:46	07:04	06:12		18:38 (1) 05:31	18:30 (1)	05:11	05:22		05:51	18:31 (1)	06:22		06:54	06:30	07:02
	16:37	17:15	18:48	19:22	22	19:00 (1) 19:54	32 19:02 (1)	20:19	20:21		19:50	47 19:18 (1)	19:02		18:11	16:29	16:16
13	07:11	06:45	07:02	06:10		18:36 (1) 05:29	18:32 (1)	05:11	05:23		05:52	18:31 (1)	06:23		06:55	06:31	07:03
	16:38	17:16	18:49	19:23	26	19:02 (1) 19:55	29 19:01 (1)	20:20	20:20		19:49	48 19:19 (1)	19:00		18:09	16:28	16:16
14	07:11	06:43	07:01	06:09		18:34 (1) 05:28	18:33 (1)	05:11	05:24		05:53	18:31 (1)	06:24		06:56	06:32	07:04
	16:39	17:17	18:51	19:24	28	19:02 (1) 19:56	26 18:59 (1)	20:20	20:20		19:48	48 19:19 (1)	18:58		18:07	16:27	16:16
15	07:10	06:42	06:59	06:07		18:32 (1) 05:27	18:35 (1)	05:11	05:24		05:54	18:30 (1)	06:25		06:57	06:34	07:05
	16:40	17:19	18:52	19:26	31	19:03 (1) 19:57	23 18:58 (1)	20:21	20:19		19:46	48 19:18 (1)	18:56		18:06	16:27	16:17
16	07:10	06:41	06:57	06:06		18:31 (1) 05:26	18:37 (1)	05:11	05:25		05:55	18:30 (1)	06:26		06:58	06:35	07:05
	16:41	17:20	18:53	19:27	33	19:04 (1) 19:58	19 18:56 (1)	20:21	20:19		19:45	48 19:18 (1)	18:55		18:04	16:26	16:17
17	07:10	06:39	06:56	06:04		18:29 (1) 05:25	18:39 (1)	05:11	05:26		05:56	18:30 (1)	06:27		06:59	06:36	07:06
	16:42	17:21	18:54	19:28	36	19:05 (1) 19:59	14 18:53 (1)	20:22	20:18		19:43	48 19:18 (1)	18:53		18:03	16:25	16:17
18	07:09	06:38	06:54	06:03		18:28 (1) 05:25	18:43 (1)	05:11	05:27		05:57	18:30 (1)	06:28		07:00	06:37	07:07
	16:44	17:22	18:55	19:29	38	19:06 (1) 20:00	6 18:49 (1)	20:22	20:17		19:42	48 19:18 (1)	18:51		18:01	16:24	16:17
19	07:08	06:37	06:52	06:01		18:27 (1) 05:24		05:11	05:28		05:58	18:30 (1)	06:29		07:01	06:38	07:07
	16:45	17:24	18:56	19:30	40	19:07 (1) 20:00		20:22	20:17		19:41	47 19:17 (1)	18:50		18:00	16:23	16:18
20	07:08	06:35	06:51	06:00		18:26 (1) 05:23		05:12	05:28		05:59	18:30 (1)	06:30		07:03	06:40	07:08
	16:46	17:25	18:57	19:31	42	19:08 (1) 20:01		20:23	20:16		19:39	46 19:16 (1)	18:48		17:58	16:23	16:18
21	07:07	06:34	06:49	05:58		18:25 (1) 05:22		05:12	05:29		06:00	18:30 (1)	06:31		07:04	06:41	07:09
	16:47	17:26	18:58	19:32	44	19:09 (1) 20:02		20:23	20:15		19:38	45 19:15 (1)	18:46		17:57	16:22	16:19
22	07:07	06:32	06:47	05:57		18:25 (1) 05:21		05:12	05:30		06:01	18:30 (1)	06:32		07:05	06:42	07:09
	16:48	17:27	18:59	19:33	45	19:10 (1) 20:03		20:23	20:14		19:36	44 19:14 (1)	18:44		17:55	16:21	16:19
23	07:06	06:31	06:45	05:55		18:24 (1) 05:20		05:12	05:31		06:02	18:30 (1)	06:33		07:06	06:43	07:10
	16:50	17:28	19:01	19:34	47	19:11 (1) 20:04		20:23	20:14		19:34	42 19:12 (1)	18:43		17:54	16:21	16:20
24	07:05	06:29	06:44	05:54		18:24 (1) 05:20		05:13	05:32		06:03	18:31 (1)	06:34		07:07	06:44	07:10
	16:51	17:30	19:02	19:35	48	19:12 (1) 20:05		20:23	20:13		19:33	40 19:11 (1)	18:41		17:52	16:20	16:20
25	07:04	06:28	06:42	05:52		18:24 (1) 05:19		05:13	05:33		06:04	18:31 (1)	06:35		07:08	06:45	07:10
	16:52	17:31	19:03	19:36	48	19:12 (1) 20:06		20:24	20:12		19:31	38 19:09 (1)	18:39		17:51	16:20	16:21
26	07:04	06:26	06:40	05:51		18:23 (1) 05:18		05:13	05:34	18:51 (1)	06:05	18:32 (1)	06:37		07:10	06:47	07:11
	16:53	17:32	19:04	19:37	48	19:11 (1) 20:07		20:24	20:11	11 19:02 (1)	19:30	36 19:08 (1)	18:37		17:50	16:19	16:21
27	07:03	06:25	06:39	05:49		18:23 (1) 05:17		05:14	05:35	18:48 (1)	06:06	18:33 (1)	06:38		07:11	06:48	07:11
	16:55	17:33	19:05	19:39	49	19:12 (1) 20:08		20:24	20:10	17 19:05 (1)	19:28	33 19:06 (1)	18:36		17:48	16:19	16:22
28	07:02	06:23	06:37	05:48		18:24 (1) 05:17		05:14	05:36	18:46 (1)	06:07	18:34 (1)	06:39		07:12	06:49	07:11
	16:56	17:34	19:06	19:40	48	19:12 (1) 20:09		20:24	20:09	21 19:07 (1)	19:27	31 19:05 (1)	18:34		17:47	16:18	16:23
29	07:01		06:35	05:47		18:23 (1) 05:16		05:14	05:37	18:45 (1)	06:08	18:35 (1)	06:40		07:13	06:50	07:12
	16:57		19:07	19:41	48	19:11 (1) 20:10		20:24	20:08	24 19:09 (1)	19:25	28 19:03 (1)	18:32		17:46	16:18	16:24
30	07:00		06:34	05:45		18:23 (1) 05:16		05:15	05:38	18:43 (1)	06:09	18:36 (1)	06:41		07:14	06:51	07:12
	16:58		19:08	19:42	48	19:11 (1) 20:10		20:24	20:07	27 19:10 (1)	19:23	25 19:01 (1)	18:31		17:44	16:17	16:24
31	06:59		06:32			05:15			05:39	18:42 (1)	06:10	18:38 (1)			07:15		07:12
	17:00		19:09			20:11			20:06	30 19:12 (1)	19:22	22 19:00 (1)			17:43		16:25
Potential sun hours	296	297	370	400		450		454	461		429		375		344	297	286
Total, worst case				796		605			130		1258		27				
Sun reduction				0.57		0.58			0.63		0.62		0.62				
Oper. time red.				1.00		1.00			1.00		1.00		1.00				
Wind dir. red.				0.55		0.55			0.55		0.55		0.55				
Total reduction				0.31		0.32			0.34		0.34		0.34				
Total, real				248		192			45		427		9				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 2:01 PM / 6

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 2:00 PM/2.7.473

SHADOW - Calendar

Shadow receptor: F - 11F

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June			July			August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15			05:15		18:40 (1)	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12			20:24	37	19:17 (1)	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:29	05:43	05:14			05:16		18:41 (1)	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13			20:24	35	19:16 (1)	20:04	19:19	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14			05:16		18:43 (1)	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:13	19:45	20:14			20:24	31	19:14 (1)	20:03	19:17	18:26	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13			05:17		18:46 (1)	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14			20:23	27	19:13 (1)	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:24	05:39	05:13			05:17		18:48 (1)	05:44	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15			20:23	22	19:10 (1)	20:01	19:14	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13		18:50 (1)	05:18		18:53 (1)	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	7	18:57 (1)	20:23	13	19:06 (1)	19:58	19:12	18:21	16:36	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12		18:44 (1)	05:19			05:46	06:17	06:48	06:24	06:58
	16:32	17:09	17:43	19:17	19:49	20:16	18	19:02 (1)	20:23			19:57	19:10	18:19	16:35	16:16
8	07:12	06:51	07:11	06:19	05:35	05:12		18:41 (1)	05:19			05:47	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50	20:17	25	19:06 (1)	20:22			19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12		18:39 (1)	05:20			05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	30	19:09 (1)	20:22			19:54	19:07	18:16	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12		18:37 (1)	05:21			05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	34	19:11 (1)	20:22			19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:32	05:12		18:36 (1)	05:21			05:50	06:21	06:53	06:29	07:02
	16:36	17:14	18:47	19:21	19:53	20:19	37	19:13 (1)	20:21			19:52	19:03	18:12	16:30	16:16
12	07:11	06:46	07:04	06:12	05:31	05:11		18:35 (1)	05:22			05:51	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	20:19	39	19:14 (1)	20:21			19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11		18:34 (1)	05:23			05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:55	20:20	41	19:15 (1)	20:20			19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11		18:34 (1)	05:24			05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:51	19:24	19:57	20:20	43	19:17 (1)	20:20			19:48	18:58	18:08	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11		18:33 (1)	05:24			05:54	06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:26	19:58	20:21	44	19:17 (1)	20:19			19:46	18:56	18:06	16:27	16:17
16	07:10	06:41	06:57	06:06	05:26	05:11		18:33 (1)	05:25			05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:59	20:21	45	19:18 (1)	20:19			19:45	18:55	18:04	16:26	16:17
17	07:10	06:39	06:56	06:04	05:25	05:11		18:32 (1)	05:26			05:56	06:27	06:59	06:36	07:06
	16:43	17:21	18:54	19:28	20:00	20:22	47	19:19 (1)	20:18			19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:03	05:25	05:11		18:32 (1)	05:27			05:57	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00	20:22	47	19:19 (1)	20:17			19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:24	05:12		18:32 (1)	05:28			05:58	06:29	07:01	06:38	07:07
	16:45	17:24	18:56	19:30	20:00	20:22	48	19:20 (1)	20:17			19:41	18:50	18:00	16:23	16:18
20	07:08	06:35	06:51	06:00	05:23	05:12		18:32 (1)	05:29			05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	48	19:20 (1)	20:16			19:39	18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12		18:32 (1)	05:29			06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	48	19:20 (1)	20:15			19:38	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:57	05:21	05:12		18:33 (1)	05:30			06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	48	19:21 (1)	20:14			19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12		18:33 (1)	05:31			06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:01	19:34	20:04	20:23	48	19:21 (1)	20:14			19:35	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54	05:20	05:13		18:33 (1)	05:32			06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	48	19:21 (1)	20:13			19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13		18:34 (1)	05:33			06:04	06:36	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	47	19:21 (1)	20:12			19:31	18:39	17:51	16:20	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13		18:34 (1)	05:34			06:05	06:37	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	47	19:21 (1)	20:11			19:30	18:37	17:50	16:19	16:21
27	07:03	06:25	06:39	05:49	05:17	05:14		18:35 (1)	05:35			06:06	06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:39	20:08	20:24	45	19:20 (1)	20:10			19:28	18:36	17:48	16:19	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14		18:36 (1)	05:36			06:07	06:39	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20:09	20:24	44	19:20 (1)	20:09			19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:47	05:16	05:14		18:37 (1)	05:37			06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	42	19:19 (1)	20:08			19:25	18:32	17:46	16:18	16:24
30	07:00		06:34	05:45	05:16	05:15		18:39 (1)	05:38			06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	40	19:19 (1)	20:07			19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15				05:39			06:10		07:16		07:12
	17:00		19:09		20:11				20:06			19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454			461			429	375	344	297	286
Total, worst case							1010			165						
Sun reduction							0.61			0.63						
Oper. time red.							1.00			1.00						
Wind dir. red.							0.62			0.62						
Total reduction							0.38			0.39						
Total, real							381			64						

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
2/24/2011 2:01 PM / 7

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 2:00 PM/2.7.473

SHADOW - Calendar

Shadow receptor: G - 11G

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:29	05:43	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:19	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:03	17:38	19:13	19:45	20:14	20:23	20:03	19:17	18:26	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:24	05:39	05:13	05:17	05:44	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:14	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:21	16:36	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24	06:58
	16:32	17:09	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:35	16:16
8	07:12	06:51	07:11	06:19	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:32	05:12	05:21	05:50	06:21	06:53	06:29	07:02
	16:36	17:14	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:11	06:46	07:04	06:12	05:31	05:11	05:22	05:51	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:29	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:24	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:51	19:24	19:57	20:20	20:20	19:48	18:58	18:08	16:27	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:26	19:58	20:21	20:19	19:46	18:56	18:06	16:27	16:17
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:59	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:10	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:43	17:21	18:54	19:28	19:59	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:03	05:25	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:24	05:12	05:28	05:58	06:29	07:01	06:38	07:07
	16:45	17:24	18:56	19:30	20:00	20:22	20:17	19:41	18:50	18:00	16:23	16:18
20	07:08	06:35	06:51	06:00	05:23	05:12	05:29	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:57	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:01	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54	05:20	05:13	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:36	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:20	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	16:22
27	07:03	06:25	06:39	05:49	05:17	05:14	05:35	06:06	06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:19	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:47	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:46	16:18	16:24
30	07:00		06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:16		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 2:01 PM / 8

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 2:00 PM/2.7.473

SHADOW - Calendar

Shadow receptor: H - 11H

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:29	05:43	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:19	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:04	17:38	19:13	19:45	20:14	20:23	20:03	19:17	18:26	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:24	05:39	05:13	05:17	05:44	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:14	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:21	16:36	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24	06:58
	16:32	17:09	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:35	16:16
8	07:12	06:51	07:11	06:19	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:32	05:12	05:21	05:50	06:21	06:53	06:29	07:02
	16:36	17:14	18:47	19:21	19:53	20:19	20:21	19:52	19:03	18:12	16:30	16:16
12	07:11	06:46	07:04	06:12	05:31	05:11	05:22	05:51	06:22	06:54	06:30	07:02
	16:37	17:15	18:48	19:22	19:54	20:19	20:21	19:50	19:02	18:11	16:29	16:16
13	07:11	06:45	07:02	06:10	05:30	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
14	07:11	06:43	07:01	06:09	05:28	05:11	05:24	05:53	06:24	06:56	06:32	07:04
	16:39	17:17	18:51	19:24	19:56	20:20	20:20	19:48	18:58	18:08	16:28	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:26	19:58	20:21	20:19	19:46	18:56	18:06	16:27	16:17
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
	16:41	17:20	18:53	19:27	19:58	20:21	20:19	19:45	18:55	18:04	16:26	16:17
17	07:10	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:43	17:21	18:54	19:28	19:59	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:03	05:25	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:24	05:12	05:28	05:58	06:29	07:01	06:38	07:07
	16:45	17:24	18:56	19:30	20:00	20:22	20:17	19:41	18:50	18:00	16:23	16:18
20	07:08	06:35	06:51	06:00	05:23	05:12	05:29	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:57	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:01	19:34	20:04	20:23	20:14	19:34	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54	05:20	05:13	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:36	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:20	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	16:22
27	07:03	06:25	06:39	05:49	05:18	05:14	05:35	06:06	06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:19	16:22
28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:11
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:47	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:46	16:18	16:24
30	07:00		06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:16		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 2:01 PM / 9

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 2:00 PM/2.7.473

SHADOW - Calendar

Shadow receptor: I - 11I

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:29	05:43	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:19	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:04	17:38	19:13	19:45	20:14	20:23	20:03	19:17	18:26	16:39	16:16
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:24	05:39	05:13	05:17	05:44	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:14	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:21	16:36	16:16
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	16:32	17:09	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:35	16:16
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	16:33	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
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	16:44	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:24	05:12	05:28	05:58	06:29	07:01	06:38	07:07
	16:45	17:24	18:56	19:30	20:00	20:22	20:17	19:41	18:50	18:00	16:23	16:18
20	07:08	06:35	06:51	06:00	05:23	05:12	05:29	05:59	06:30	07:03	06:40	07:08
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22	07:07	06:32	06:47	05:57	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
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23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:01	19:34	20:04	20:23	20:14	19:35	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54	05:20	05:13	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:36	07:08	06:45	07:10
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27	07:03	06:25	06:39	05:49	05:18	05:14	05:35	06:06	06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:19	16:22
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Oper. time red.												
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Table layout: For each day in each month the following matrix apply

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	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 2:00 PM/2.7.473

SHADOW - Calendar

Shadow receptor: J - 11J

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
2	07:13	06:57	06:20	06:29	05:43	05:14	05:16	05:41	06:12	06:43	06:18	06:53
	16:27	17:02	17:37	19:11	19:44	20:13	20:24	20:04	19:19	18:27	16:40	16:17
3	07:13	06:56	06:19	06:27	05:41	05:14	05:16	05:42	06:13	06:44	06:19	06:54
	16:28	17:04	17:38	19:13	19:45	20:14	20:23	20:03	19:17	18:26	16:39	16:17
4	07:13	06:55	06:17	06:25	05:40	05:13	05:17	05:43	06:14	06:45	06:20	06:55
	16:29	17:05	17:39	19:14	19:46	20:14	20:23	20:02	19:15	18:24	16:38	16:16
5	07:13	06:54	06:15	06:24	05:39	05:13	05:17	05:44	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:14	18:22	16:37	16:16
6	07:13	06:53	06:14	06:22	05:37	05:13	05:18	05:45	06:16	06:47	06:23	06:57
	16:31	17:07	17:41	19:16	19:48	20:16	20:23	19:58	19:12	18:21	16:36	16:16
7	07:12	06:52	06:12	06:20	05:36	05:12	05:19	05:46	06:17	06:48	06:24	06:58
	16:32	17:09	17:43	19:17	19:49	20:16	20:23	19:57	19:10	18:19	16:35	16:16
8	07:12	06:51	07:11	06:19	05:35	05:12	05:19	05:47	06:18	06:49	06:25	06:59
	16:33	17:10	18:44	19:18	19:50	20:17	20:22	19:56	19:08	18:17	16:33	16:16
9	07:12	06:50	07:09	06:17	05:34	05:12	05:20	05:48	06:19	06:50	06:26	07:00
	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16	16:32	16:16
10	07:12	06:48	07:07	06:15	05:33	05:12	05:21	05:49	06:20	06:51	06:28	07:01
	16:35	17:12	18:46	19:20	19:52	20:18	20:22	19:53	19:05	18:14	16:31	16:16
11	07:12	06:47	07:06	06:14	05:32	05:12	05:21	05:50	06:21	06:53	06:29	07:02
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12	07:11	06:46	07:04	06:12	05:31	05:11	05:22	05:51	06:22	06:54	06:30	07:02
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13	07:11	06:45	07:02	06:10	05:30	05:11	05:23	05:52	06:23	06:55	06:31	07:03
	16:38	17:16	18:49	19:23	19:55	20:20	20:20	19:49	19:00	18:09	16:28	16:16
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	16:39	17:17	18:51	19:24	19:57	20:20	20:20	19:48	18:58	18:08	16:28	16:16
15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
	16:40	17:19	18:52	19:26	19:58	20:21	20:19	19:46	18:56	18:06	16:27	16:17
16	07:10	06:41	06:57	06:06	05:26	05:11	05:25	05:55	06:26	06:58	06:35	07:05
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	16:43	17:21	18:54	19:28	20:00	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:03	05:25	05:11	05:27	05:57	06:28	07:00	06:37	07:07
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19	07:08	06:37	06:52	06:01	05:24	05:12	05:28	05:58	06:29	07:01	06:38	07:07
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	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:57	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:01	19:34	20:04	20:23	20:14	19:35	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54	05:20	05:13	05:32	06:03	06:35	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:36	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:20	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	16:22
27	07:03	06:25	06:39	05:49	05:18	05:14	05:35	06:06	06:38	07:11	06:48	07:11
	16:55	17:33	19:05	19:39	20:08	20:24	20:10	19:28	18:36	17:48	16:19	16:22
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31	06:59		06:32		05:15		05:39	06:10		07:16		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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2/24/2011 2:01 PM / 11

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 2:00 PM/2.7.473

SHADOW - Calendar

Shadow receptor: K - 11K

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
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	16:28	17:03	17:38	19:13	19:45	20:14	20:24	20:03	19:17	18:26	16:39	16:16
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5	07:13	06:54	06:15	06:24	05:39	05:13	05:17	05:44	06:15	06:46	06:22	06:56
	16:30	17:06	17:40	19:15	19:47	20:15	20:23	20:01	19:14	18:22	16:37	16:16
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15	07:10	06:42	06:59	06:07	05:27	05:11	05:24	05:54	06:25	06:57	06:34	07:05
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Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
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Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
2/24/2011 2:01 PM / 12

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 2:00 PM/2.7.473

SHADOW - Calendar

Shadow receptor: L - 11L

Assumptions for shadow calculations

Maximum distance for influence	2,000	m
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Day step for calculation	1	days
Time step for calculation	1	minutes

Sunshine probability S (Average daily sunshine hours) []

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5	07:13	06:54	06:15	06:24	05:39	05:13	05:17	05:44	06:15	06:46	06:22	06:56
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	16:34	17:11	18:45	19:19	19:51	20:18	20:22	19:54	19:07	18:16	16:32	16:16
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30	07:00		06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:16		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
2/24/2011 2:01 PM / 13

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 2:00 PM/2.7.473

SHADOW - Calendar

Shadow receptor: M - 11M

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12 16:26	06:58 17:01	06:22 17:36	06:30 19:10	05:44 19:43	05:15 20:12	05:15 20:24	05:40 20:05	06:11 19:20	06:42 18:29	06:17 16:42	06:52 16:17
2	07:13 16:27	06:57 17:02	06:20 17:37	06:29 19:11	05:43 19:44	05:14 20:13	05:16 20:24	05:41 20:04	06:12 19:19	06:43 18:27	06:18 16:40	06:53 16:17
3	07:13 16:28	06:56 17:03	06:19 17:38	06:27 19:13	05:41 19:45	05:14 20:14	05:16 20:24	05:42 20:03	06:13 19:17	06:44 18:26	06:19 16:39	06:54 16:16
4	07:13 16:29	06:55 17:05	06:17 17:39	06:25 19:14	05:40 19:46	05:13 20:14	05:17 20:23	05:43 20:02	06:14 19:15	06:45 18:24	06:20 16:38	06:55 16:16
5	07:13 16:30	06:54 17:06	06:15 17:40	06:24 19:15	05:39 19:47	05:13 20:15	05:17 20:23	05:44 20:01	06:15 19:14	06:46 18:22	06:22 16:37	06:56 16:16
6	07:13 16:31	06:53 17:07	06:14 17:41	06:22 19:16	05:37 19:48	05:13 20:16	05:18 20:23	05:45 19:58	06:16 19:12	06:47 18:21	06:23 16:36	06:57 16:16
7	07:12 16:32	06:52 17:09	06:12 17:43	06:20 19:17	05:36 19:49	05:12 20:16	05:19 20:23	05:46 19:57	06:17 19:10	06:48 18:19	06:24 16:35	06:58 16:16
8	07:12 16:33	06:51 17:10	07:11 18:44	06:19 19:18	05:35 19:50	05:12 20:17	05:19 20:22	05:47 19:56	06:18 19:08	06:49 18:17	06:25 16:33	06:59 16:16
9	07:12 16:34	06:50 17:11	07:09 18:45	06:17 19:19	05:34 19:51	05:12 20:18	05:20 20:22	05:48 19:54	06:19 19:07	06:50 18:16	06:26 16:32	07:00 16:16
10	07:12 16:35	06:48 17:12	07:07 18:46	06:15 19:20	05:33 19:52	05:12 20:18	05:21 20:22	05:49 19:53	06:20 19:05	06:51 18:14	06:28 16:31	07:01 16:16
11	07:12 16:36	06:47 17:14	07:06 18:47	06:14 19:21	05:32 19:53	05:12 20:19	05:21 20:21	05:50 19:52	06:21 19:03	06:53 18:12	06:29 16:30	07:02 16:16
12	07:11 16:37	06:46 17:15	07:04 18:48	06:12 19:22	05:31 19:54	05:11 20:19	05:22 20:21	05:51 19:50	06:22 19:02	06:54 18:11	06:30 16:29	07:02 16:16
13	07:11 16:38	06:45 17:16	07:02 18:49	06:10 19:23	05:29 19:55	05:11 20:20	05:23 20:20	05:52 19:49	06:23 19:00	06:55 18:09	06:31 16:28	07:03 16:16
14	07:11 16:39	06:43 17:17	07:01 18:51	06:09 19:24	05:28 19:57	05:11 20:20	05:24 20:20	05:53 19:48	06:24 18:58	06:56 18:08	06:32 16:27	07:04 16:16
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17	07:10 16:43	06:39 17:21	06:56 18:54	06:04 19:28	05:25 20:00	05:11 20:22	05:26 20:18	05:56 19:43	06:27 18:53	06:59 18:03	06:36 16:25	07:06 16:17
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21	07:07 16:47	06:34 17:26	06:49 18:58	05:58 19:32	05:22 20:02	05:12 20:23	05:29 20:15	06:00 19:38	06:31 18:46	07:04 17:57	06:41 16:22	07:09 16:19
22	07:07 16:48	06:32 17:27	06:47 18:59	05:57 19:33	05:21 20:03	05:12 20:23	05:30 20:14	06:01 19:36	06:32 18:44	07:05 17:55	06:42 16:21	07:09 16:19
23	07:06 16:50	06:31 17:28	06:45 19:01	05:55 19:34	05:20 20:04	05:12 20:23	05:31 20:14	06:02 19:35	06:33 18:43	07:06 17:54	06:43 16:21	07:10 16:20
24	07:05 16:51	06:29 17:30	06:44 19:02	05:54 19:35	05:20 20:05	05:13 20:23	05:32 20:13	06:03 19:33	06:34 18:41	07:07 17:52	06:44 16:20	07:10 16:20
25	07:04 16:52	06:28 17:31	06:42 19:03	05:52 19:36	05:19 20:06	05:13 20:24	05:33 20:12	06:04 19:31	06:36 18:39	07:08 17:51	06:45 16:20	07:10 16:21
26	07:04 16:53	06:26 17:32	06:40 19:04	05:51 19:37	05:18 20:07	05:13 20:24	05:34 20:11	06:05 19:30	06:37 18:37	07:10 17:50	06:47 16:19	07:11 16:21
27	07:03 16:55	06:25 17:33	06:39 19:05	05:49 19:39	05:17 20:08	05:14 20:24	05:35 20:10	06:06 19:28	06:38 18:36	07:11 17:48	06:48 16:19	07:11 16:22
28	07:02 16:56	06:23 17:34	06:37 19:06	05:48 19:40	05:17 20:09	05:14 20:24	05:36 20:09	06:07 19:27	06:39 18:34	07:12 17:47	06:49 16:18	07:11 16:23
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30	07:00 16:58		06:34 19:08	05:45 19:42	05:16 20:10	05:15 20:24	05:38 20:07	06:09 19:23	06:41 18:31	07:14 17:44	06:51 16:17	07:12 16:24
31	06:59 17:00		06:32 19:09		05:15 20:11		05:39 20:06	06:10 19:22		07:16 17:43		07:12 16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

Printed/Page
2/24/2011 2:01 PM / 14

Licensed user:
Geo-Marine.Inc
2201 K Avenue Suite A2
US-75074-5977 Plano TX
9724235480
Alec Richardson / arichardson@geo-marine.com

Calculated:
2/24/2011 2:00 PM/2.7.473

SHADOW - Calendar

Shadow receptor: N - 11N

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12	06:58	06:22	06:30	05:44	05:15	05:15	05:40	06:11	06:42	06:17	06:52
	16:26	17:01	17:36	19:10	19:43	20:12	20:24	20:05	19:20	18:29	16:42	16:17
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17	07:10	06:39	06:56	06:04	05:25	05:11	05:26	05:56	06:27	06:59	06:36	07:06
	16:42	17:21	18:54	19:28	20:00	20:22	20:18	19:43	18:53	18:03	16:25	16:17
18	07:09	06:38	06:54	06:03	05:25	05:11	05:27	05:57	06:28	07:00	06:37	07:07
	16:44	17:22	18:55	19:29	20:00	20:22	20:17	19:42	18:51	18:01	16:24	16:17
19	07:08	06:37	06:52	06:01	05:24	05:11	05:28	05:58	06:29	07:01	06:38	07:07
	16:45	17:24	18:56	19:30	20:00	20:22	20:17	19:41	18:50	18:00	16:23	16:18
20	07:08	06:35	06:51	06:00	05:23	05:12	05:28	05:59	06:30	07:03	06:40	07:08
	16:46	17:25	18:57	19:31	20:01	20:23	20:16	19:39	18:48	17:58	16:23	16:18
21	07:07	06:34	06:49	05:58	05:22	05:12	05:29	06:00	06:31	07:04	06:41	07:09
	16:47	17:26	18:58	19:32	20:02	20:23	20:15	19:38	18:46	17:57	16:22	16:19
22	07:07	06:32	06:47	05:57	05:21	05:12	05:30	06:01	06:32	07:05	06:42	07:09
	16:48	17:27	18:59	19:33	20:03	20:23	20:14	19:36	18:44	17:55	16:21	16:19
23	07:06	06:31	06:45	05:55	05:20	05:12	05:31	06:02	06:33	07:06	06:43	07:10
	16:50	17:28	19:01	19:34	20:04	20:23	20:14	19:35	18:43	17:54	16:21	16:20
24	07:05	06:29	06:44	05:54	05:20	05:13	05:32	06:03	06:34	07:07	06:44	07:10
	16:51	17:30	19:02	19:35	20:05	20:23	20:13	19:33	18:41	17:52	16:20	16:20
25	07:04	06:28	06:42	05:52	05:19	05:13	05:33	06:04	06:36	07:08	06:45	07:10
	16:52	17:31	19:03	19:36	20:06	20:24	20:12	19:31	18:39	17:51	16:19	16:21
26	07:04	06:26	06:40	05:51	05:18	05:13	05:34	06:05	06:37	07:10	06:47	07:11
	16:53	17:32	19:04	19:37	20:07	20:24	20:11	19:30	18:37	17:50	16:19	16:21
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28	07:02	06:23	06:37	05:48	05:17	05:14	05:36	06:07	06:39	07:12	06:49	07:12
	16:56	17:34	19:06	19:40	20:09	20:24	20:09	19:27	18:34	17:47	16:18	16:23
29	07:01		06:35	05:47	05:16	05:14	05:37	06:08	06:40	07:13	06:50	07:12
	16:57		19:07	19:41	20:10	20:24	20:08	19:25	18:32	17:46	16:18	16:24
30	07:00		06:34	05:45	05:16	05:15	05:38	06:09	06:41	07:14	06:51	07:12
	16:58		19:08	19:42	20:10	20:24	20:07	19:23	18:31	17:44	16:17	16:24
31	06:59		06:32		05:15		05:39	06:10		07:16		07:12
	17:00		19:09		20:11		20:06	19:22		17:43		16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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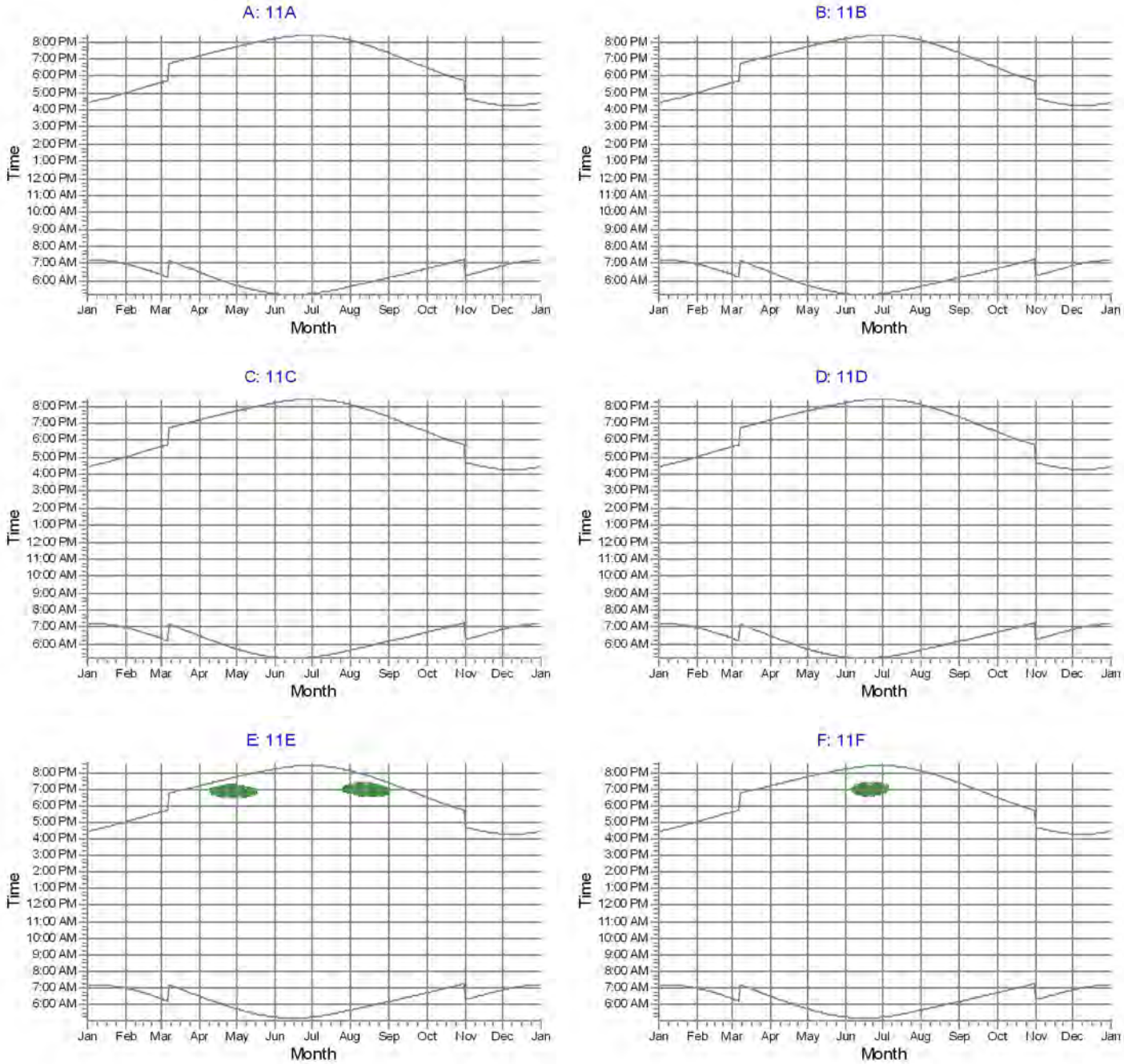
SHADOW - Calendar, graphical



WTGs

1: Katy Field

Project:

Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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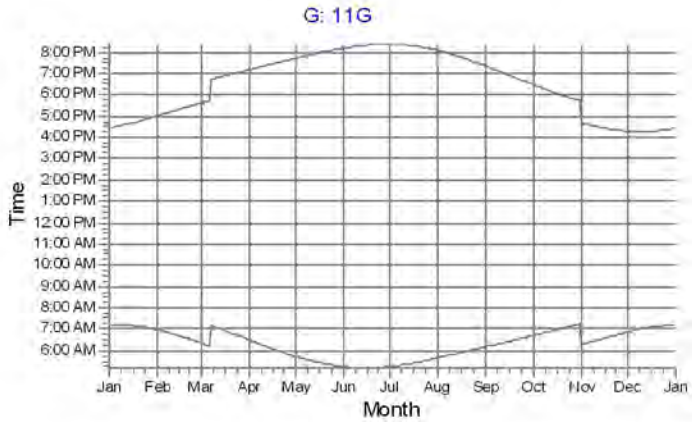
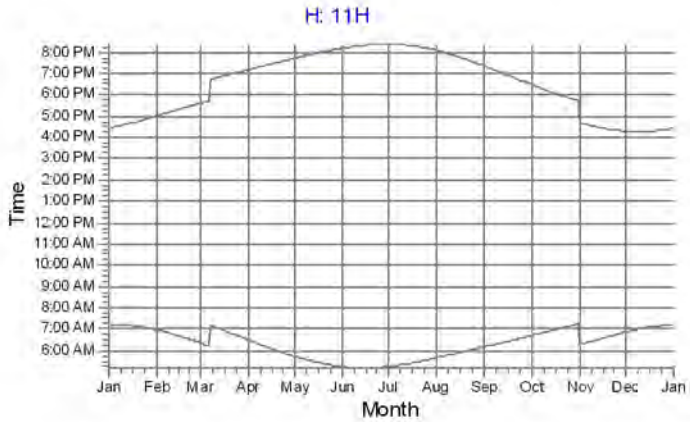
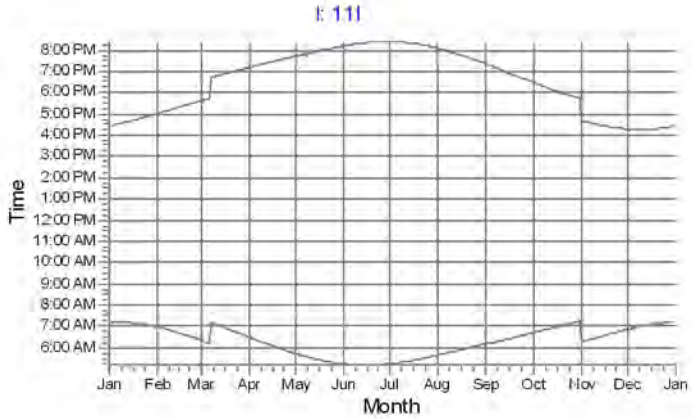
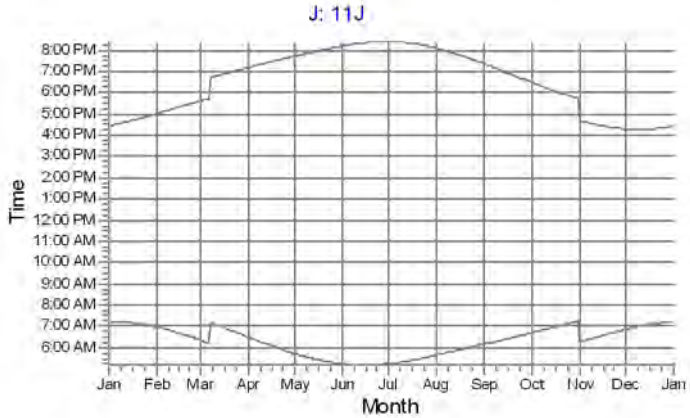
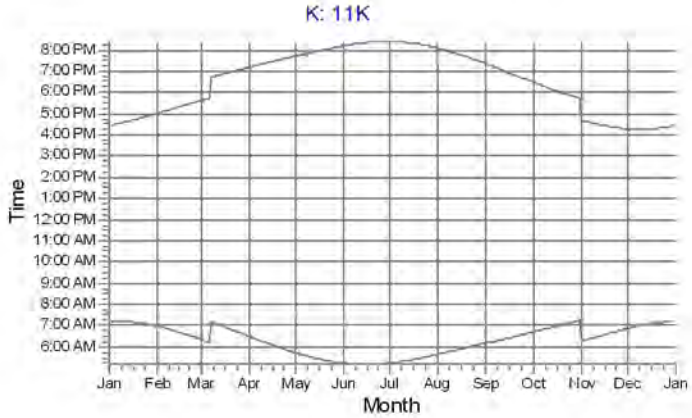
SHADOW - Calendar, graphical

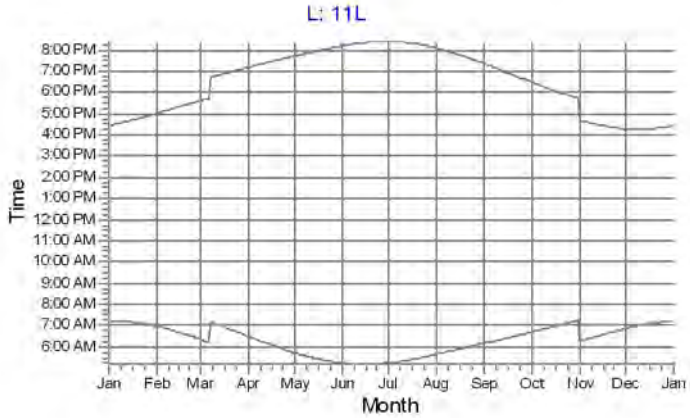












WTGs

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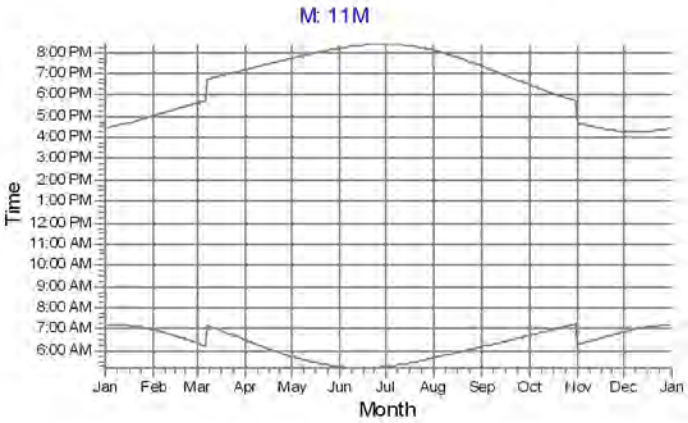
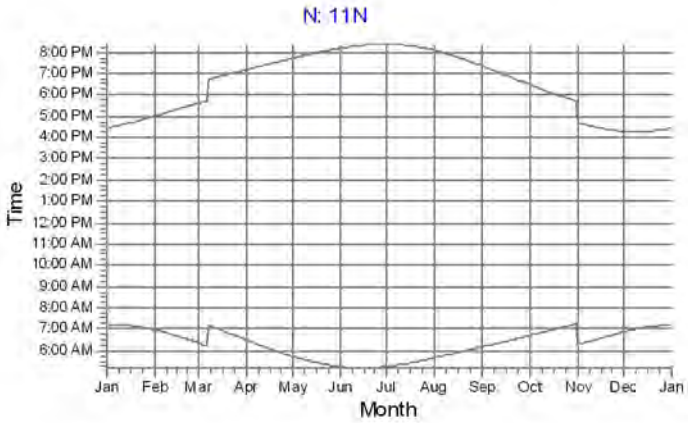
SHADOW - Calendar, graphical





WTGs

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Shadow Flicker: Wind Energy Facility Development, NAVSTA Newport, RI

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SHADOW - Calendar per WTG

WTG: 1 - Katy Field

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) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.33	6.13	6.91	7.59	8.42	9.24	9.37	8.58	7.75	6.77	4.93	4.78

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
691	432	259	155	155	155	432	518	950	1,209	864	518	432	604	691	691	8,756

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:12 16:26	06:58 17:01	06:22 17:36	06:30 19:10	05:44 18:24-19:11/47 19:43	05:15 20:12	05:15 18:40-19:17/37 20:24	05:40 18:41-19:13/32 20:05	06:11 18:41-18:58/17 19:20	06:42 18:29	06:17 16:42	06:52 16:17
2	07:13 16:27	06:57 17:02	06:20 17:37	06:29 19:11	05:43 18:23-19:09/46 19:44	05:14 20:13	05:16 18:41-19:16/35 20:24	05:41 18:39-19:14/35 20:04	06:12 18:45-18:55/10 19:19	06:43 18:27	06:18 16:40	06:53 16:17
3	07:13 16:28	06:56 17:03	06:19 17:38	06:27 19:13	05:41 18:24-19:09/45 19:45	05:14 20:14	05:16 18:43-19:14/31 20:24	05:42 18:39-19:15/36 20:03	06:13 19:17	06:44 18:26	06:19 16:39	06:54 16:16
4	07:13 16:29	06:55 17:05	06:17 17:39	06:25 19:14	05:40 18:24-19:09/45 19:46	05:13 20:14	05:17 18:46-19:13/27 20:23	05:43 18:38-19:16/38 20:02	06:14 19:15	06:45 18:24	06:20 16:38	06:55 16:16
5	07:13 16:30	06:54 17:06	06:15 17:40	06:24 19:15	05:39 18:25-19:08/43 19:47	05:13 20:15	05:17 18:48-19:10/22 20:23	05:44 18:37-19:17/40 20:01	06:15 19:14	06:46 18:22	06:22 16:37	06:56 16:16
6	07:13 16:31	06:53 17:07	06:14 17:41	06:22 19:16	05:37 18:25-19:07/42 19:48	05:13 18:50-18:57/7 20:16	05:18 18:53-19:06/13 20:23	05:45 18:36-19:17/41 19:58	06:16 19:12	06:47 18:21	06:23 16:36	06:57 16:16
7	07:13 16:32	06:52 17:09	06:12 17:43	06:20 19:17	05:36 18:26-19:06/40 19:49	05:12 18:44-19:02/18 20:16	05:19 20:23	05:46 18:34-19:17/43 19:57	06:17 19:10	06:48 18:19	06:24 16:35	06:58 16:16
8	07:12 16:33	06:51 17:10	07:11 18:44	06:19 19:18	05:35 18:26-19:06/40 19:50	05:12 18:41-19:06/25 20:17	05:19 20:22	05:47 18:33-19:17/44 19:56	06:18 19:08	06:49 18:17	06:25 16:33	06:59 16:16
9	07:12 16:34	06:50 17:11	07:09 18:45	06:17 19:19	05:34 18:27-19:05/38 19:51	05:12 18:39-19:09/30 20:18	05:20 20:22	05:48 18:33-19:18/45 19:54	06:19 19:07	06:50 18:16	06:26 16:32	07:00 16:16
10	07:12 16:35	06:48 17:12	07:07 18:46	06:15 18:46-18:56/10 19:20	05:33 18:28-19:04/36 19:52	05:12 18:37-19:11/34 20:18	05:21 20:22	05:49 18:32-19:18/46 19:53	06:20 19:05	06:51 18:14	06:28 16:31	07:01 16:16
11	07:12 16:36	06:47 17:14	07:06 18:47	06:14 18:42-18:59/17 19:21	05:32 18:29-19:03/34 19:53	05:12 18:36-19:13/37 20:19	05:21 20:21	05:50 18:32-19:18/46 19:52	06:21 19:03	06:53 18:12	06:29 16:30	07:02 16:16
12	07:11 16:37	06:46 17:15	07:04 18:48	06:12 18:38-19:00/22 19:22	05:31 18:30-19:02/32 19:54	05:11 18:35-19:14/39 20:19	05:22 20:21	05:51 18:31-19:18/47 19:50	06:22 19:02	06:54 18:11	06:30 16:29	07:02 16:16
13	07:11 16:38	06:45 17:16	07:02 18:49	06:10 18:36-19:02/26 19:23	05:29 18:32-19:01/29 19:56	05:11 18:34-19:15/41 20:20	05:23 20:20	05:52 18:31-19:19/48 19:49	06:23 19:00	06:55 18:09	06:31 16:28	07:03 16:16
14	07:11 16:39	06:43 17:17	07:01 18:51	06:09 18:34-19:02/28 19:24	05:28 18:33-18:59/26 19:57	05:11 18:34-19:17/43 20:20	05:24 20:20	05:53 18:31-19:19/48 19:48	06:24 18:58	06:56 18:08	06:32 16:27	07:04 16:16
15	07:10 16:40	06:42 17:19	06:59 18:52	06:07 18:32-19:03/31 19:26	05:27 18:35-18:58/23 19:58	05:11 18:33-19:17/44 20:21	05:24 20:19	05:54 18:30-19:18/48 19:46	06:25 18:56	06:57 18:06	06:34 16:27	07:05 16:17
16	07:10 16:41	06:41 17:20	06:57 18:53	06:06 18:31-19:04/33 19:27	05:26 18:37-18:56/19 19:59	05:11 18:33-19:18/45 20:21	05:25 20:19	05:55 18:30-19:18/48 19:45	06:26 18:55	06:58 18:04	06:35 16:26	07:05 16:17
17	07:10 16:43	06:39 17:21	06:56 18:54	06:04 18:29-19:05/36 19:28	05:25 18:39-18:53/14 20:00	05:11 18:32-19:19/47 20:22	05:26 20:18	05:56 18:30-19:18/48 19:43	06:27 18:53	06:59 18:03	06:36 16:25	07:06 16:17
18	07:09 16:44	06:38 17:22	06:54 18:55	06:03 18:28-19:06/38 19:29	05:25 18:43-18:49/6 20:00	05:11 18:32-19:19/47 20:22	05:27 20:17	05:57 18:30-19:18/48 19:42	06:28 18:51	07:00 18:01	06:37 16:24	07:07 16:17
19	07:08 16:45	06:37 17:24	06:52 18:56	06:01 18:27-19:07/40 19:30	05:24 20:00	05:12 18:32-19:20/48 20:22	05:28 20:17	05:58 18:30-19:17/47 19:41	06:29 18:50	07:01 18:00	06:38 16:23	07:07 16:18
20	07:08 16:46	06:35 17:25	06:51 18:57	06:00 18:26-19:08/42 19:31	05:23 20:01	05:12 18:32-19:20/48 20:23	05:29 20:16	05:59 18:30-19:16/46 19:39	06:30 18:48	07:03 17:58	06:40 16:23	07:08 16:18
21	07:07 16:47	06:34 17:26	06:49 18:58	05:58 18:25-19:09/44 19:32	05:22 20:02	05:12 18:32-19:20/48 20:23	05:29 20:15	06:00 18:30-19:15/45 19:38	06:31 18:46	07:04 17:57	06:41 16:22	07:09 16:19
22	07:07 16:48	06:32 17:27	06:47 18:59	05:57 18:25-19:10/45 19:33	05:21 20:03	05:12 18:33-19:21/48 20:23	05:30 20:14	06:01 18:30-19:14/44 19:36	06:32 18:44	07:05 17:55	06:42 16:21	07:09 16:19
23	07:06 16:50	06:31 17:28	06:45 19:01	05:55 18:24-19:11/47 19:34	05:20 20:04	05:12 18:33-19:21/48 20:23	05:31 20:14	06:02 18:30-19:12/42 19:35	06:33 18:43	07:06 17:54	06:43 16:21	07:10 16:20
24	07:05 16:51	06:29 17:30	06:44 19:02	05:54 18:24-19:12/48 19:35	05:20 20:05	05:13 18:33-19:21/48 20:23	05:32 20:13	06:03 18:31-19:11/40 19:33	06:34 18:41	07:07 17:52	06:44 16:20	07:10 16:20
25	07:05 16:52	06:28 17:31	06:42 19:03	05:52 18:24-19:12/48 19:36	05:19 20:06	05:13 18:34-19:21/47 20:24	05:33 20:12	06:04 18:31-19:09/38 19:31	06:36 18:39	07:08 17:51	06:45 16:20	07:10 16:21
26	07:04 16:53	06:26 17:32	06:40 19:04	05:51 18:23-19:11/48 19:37	05:18 20:07	05:13 18:34-19:21/47 20:24	05:34 18:51-19:02/11 20:11	06:05 18:32-19:08/36 19:30	06:37 18:37	07:10 17:50	06:47 16:19	07:11 16:22
27	07:03 16:55	06:25 17:33	06:39 19:05	05:49 18:23-19:12/49 19:39	05:17 20:08	05:14 18:35-19:20/45 20:24	05:35 18:48-19:05/17 20:10	06:06 18:33-19:06/33 19:28	06:38 18:36	07:11 17:48	06:48 16:19	07:11 16:22
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31	06:59 17:00		06:32 19:09		05:15 20:11		05:39 18:42-19:12/30 20:06	06:10 18:38-19:00/22 19:22		07:16 17:43		07:12 16:25
Potential sun hours	296	297	370	400	450	454	461	429	375	344	297	286
Sum of minutes with flicker	0	0	0	796	605	1010	295	1258	27	0	0	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

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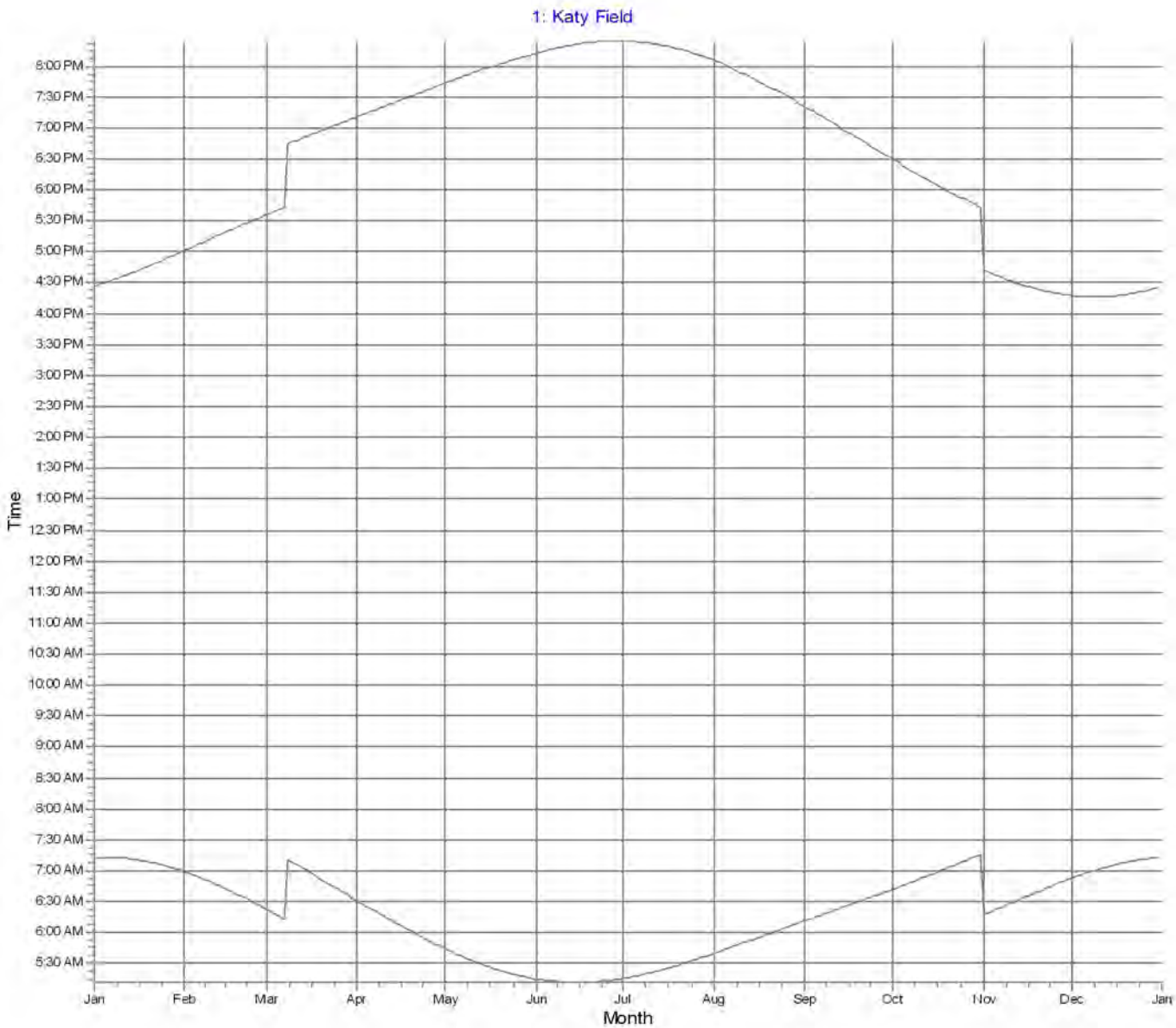
2/24/2011 2:00 PM/2.7.473

SHADOW - Calendar per WTG, graphical

WTG: 1 - Katy Field



WTGs

Project:

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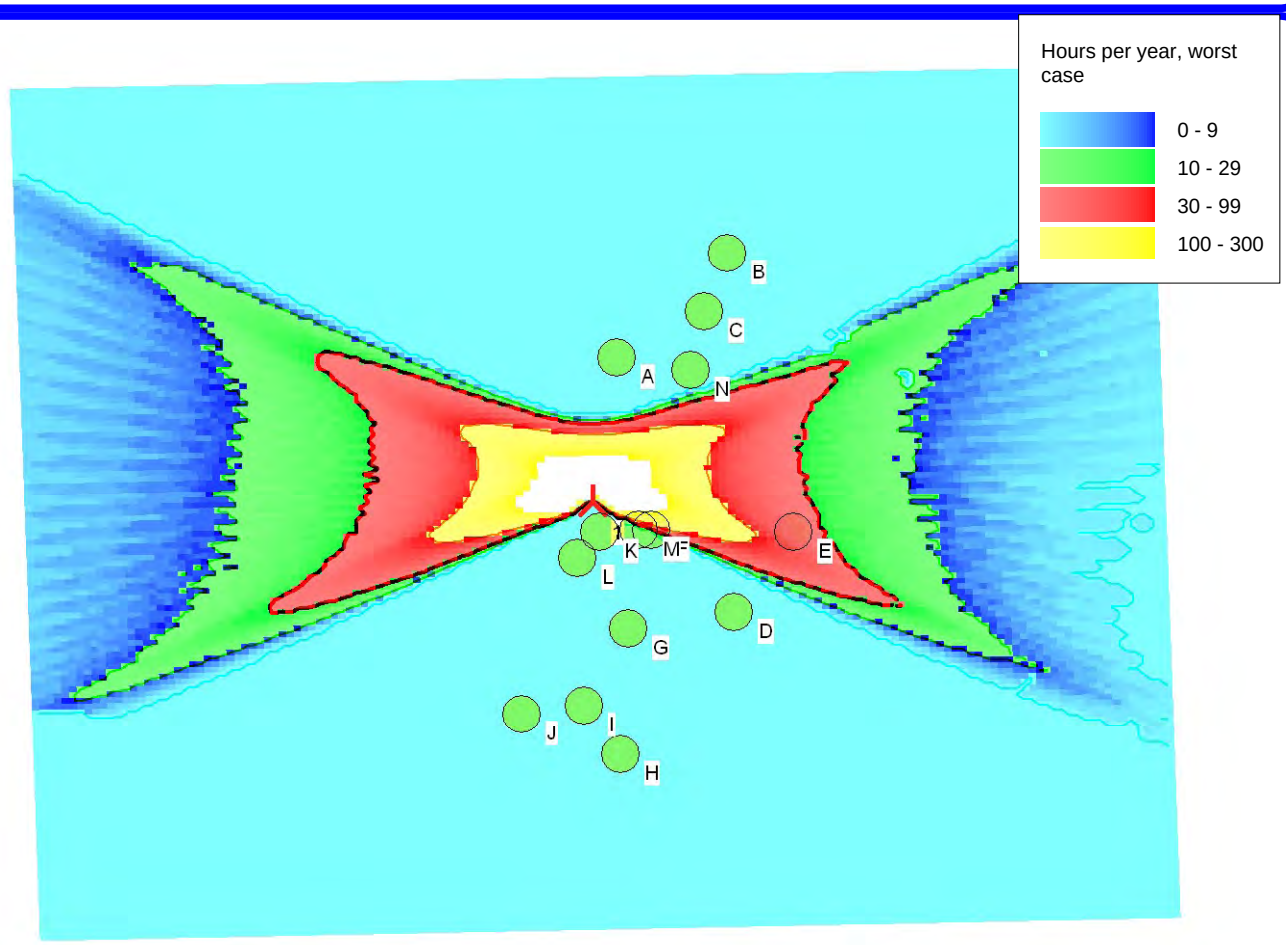
SHADOW - Map



0 250 500 750 1000m

Map: , Print scale 1:20,000, Map center Geo WGS 84 East: -71.327809° North: 41.513847°

New WTG Shadow receptor

Isolines showing shadow in Hours per year, worst case

0 10 30 100