

Windturbine E70 Grote Sloot 158
Sint Maartensbrug
Onderzoek slagschaduw

Opdrachtgever
Usukara B.V.
Contactpersoon
de heer B.A. Schuijt
Kenmerk
R068224ag.00002.tdr
Versie
01_001
Datum
17 februari 2015
Auteur
T.E. (Thom) de Rijk MSc.
ir. M.T. (Mike) Dijkstra

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1 Inleiding

In opdracht van Usukara B.V. te Sint Maartensbrug, contactpersoon de heer B.A. Schuijt, is een onderzoek verricht naar de te verwachten slagschaduw van de nieuw te bouwen windturbine (ter vervanging van een reeds vergunde Enercon E66) op het perceel Grote Sloot 158 te Sint Maartensbrug.

Uit het onderzoek blijkt dat de norm voor slagschaduw uit het Activiteitenbesluit ter plaatse van enkele woningen wordt overschreden. De turbine zal hierom voorzien moeten worden van een stilstandvoorziening. In bijlage III is de slagschaduwkalender gegeven. De stilstandvoorziening kan indien gewenst met behulp van deze kalender worden ingesteld.

2 Uitgangspunten

2.1 Situatie

De windturbine is gesitueerd op het perceel aan de Grote Sloot 158. Figuur I.1 in bijlage I geeft een situatieschets. Ten westen van de turbine bevindt zich een bedrijfswoning. De dichtstbijzijnde woning van derden bevindt zich op circa 225 m ten zuidwesten van de turbine.

2.2 Wettelijk kader

De regels betreffende slagschaduw zijn opgenomen in artikel 3.12 lid 1 van de Activiteitenregeling Milieubeheer. Deze zijn als volgt.

Artikel 3.12

1. Ten behoeve van het voorkomen of beperken van slagschaduw en lichtschildering is de windturbine voorzien van een automatische stilstandvoorziening die de windturbine afschakelt indien slagschaduw optreedt ter plaatse van gevoelige objecten voorzover de afstand tussen de windturbine en de gevoelige objecten minder dan 12 maal de rotordiameter bedraagt en gemiddeld meer dan 17 dagen per jaar gedurende meer dan 20 minuten per dag slagschaduw kan optreden en voorzover zich in de door de slagschaduw getroffen uitwendige scheidingsconstructie van gevoelige gebouwen of woonwagens ramen bevinden. De afstand geldt van een punt op ashoogte van de windturbine tot de gevel van het gevoelige object.
2. Het bevoegd gezag kan met betrekking tot het in werking hebben van een windturbine aanvullend maatwerkvoorschriften stellen ten behoeve van het voorkomen of beperken van hinder door slagschaduw indien het eerste lid in een specifiek geval niet toereikend is.

2.3 De windturbine

De turbine is een Enercon E-70 met een variabel rotortoerental van circa 6 - 20 rpm. De rotordiameter van deze windturbine bedraagt 71 m, de ashoogte 57 m.

3 Berekening slagschaduw

3.1 Rekenmodel

De slagschaduwberekeningen zijn uitgevoerd met behulp van het softwarepakket WindPro, versie 2.9. Bij de berekeningen is gebruikgemaakt van de KNMI-gegevens van weerstation De Kooy (Den Helder) betreffende de gemiddelde zonuren per maand en de distributie van windrichtingen. Deze zijn als volgt.

Verdeling windrichting

Windrichting	N	NNO	ONO	O	OZO	ZZO	Z	ZZW	WZW	W	WNW	NNW
Uren per jaar	469	478	626	594	523	533	786	1001	1187	987	728	586

Gemiddelde zonuren per dag

maand	januari	februari	maart	april	mei	juni	juli	augustus	september	oktober	november	december
zonuren per dag	2,1	3,2	4,3	6,5	7,6	7,3	7,4	6,7	4,9	3,7	2,1	1,6

Opgemerkt wordt dat het hier gemiddelde verdelingen betreft. Per jaar kan de exacte verdeling van de windrichting en het aantal zonuren afwijken van de hier gebruikte gegevens. Conform de norm wordt dan ook het *gemiddeld* aantal slagschaduw dagen berekend.

Op basis van de windverdeling is rekening gehouden met een verwachte bedrijfsduur van de turbines van 97% gedurende het jaar. De overige tijd is de wind zodanig dat de turbine niet kan draaien (te weinig, te hard). Dit komt overeen met 3% stilstand gemiddeld gedurende het jaar¹. Hierin is de extra stilstand ten gevolge van mogelijk onderhoud niet in opgenomen. Het betreft dus een *worst case* aanname.

Per maand wordt op basis van de windrichting en de verwachte zonuren de kans berekend dat een mogelijke slagschaduw situatie (correcte zonstand) ook daadwerkelijk leidt tot slagschaduw. Hierbij wordt gecorrigeerd voor windrichting, zonuren, en de eerder genoemde operationele tijd. Per maand wordt het aantal dagen met potentieel meer dan 20 minuten slagschaduw berekend (worst case op basis van de zonnestand) en vermenigvuldigd met de eerder berekende kans. Hiermee wordt per maand het gemiddeld aantal dagen met meer dan 20 minuten slagschaduw berekend.

3.2 Resultaten

In figuur 3.1 is de contour weergegeven voor gemiddeld vijf uur en veertig minuten per jaar slagschaduw. Buiten deze contour kan de grenswaarde van gemiddeld 17 dagen meer dan 20 minuten niet worden overschreden. Uit de figuur blijkt dat meerdere woningen binnen deze contour liggen. Deze woningen zijn nader onderzocht. Het gemiddeld aantal dagen per jaar met meer dan 20 minuten slagschaduw is berekend. Hierbij is rekening gehouden met de operationele uren van de turbine, het aantal zonuren per maand en de verdeling van windrichtingen, zoals beschreven in paragraaf 3.1. Bij de beoordeling op de plek van deze woningen wordt uitgegaan van een gevel in de richting van de turbine die geheel uit ramen bestaat.

¹ Uit de langjarige windverdeling zou zelfs een stilstand van 5 à 10 % resulteren als gevolg van turbinestilstand bij wind op ashoogte van minder dan ca. 3 m/s.

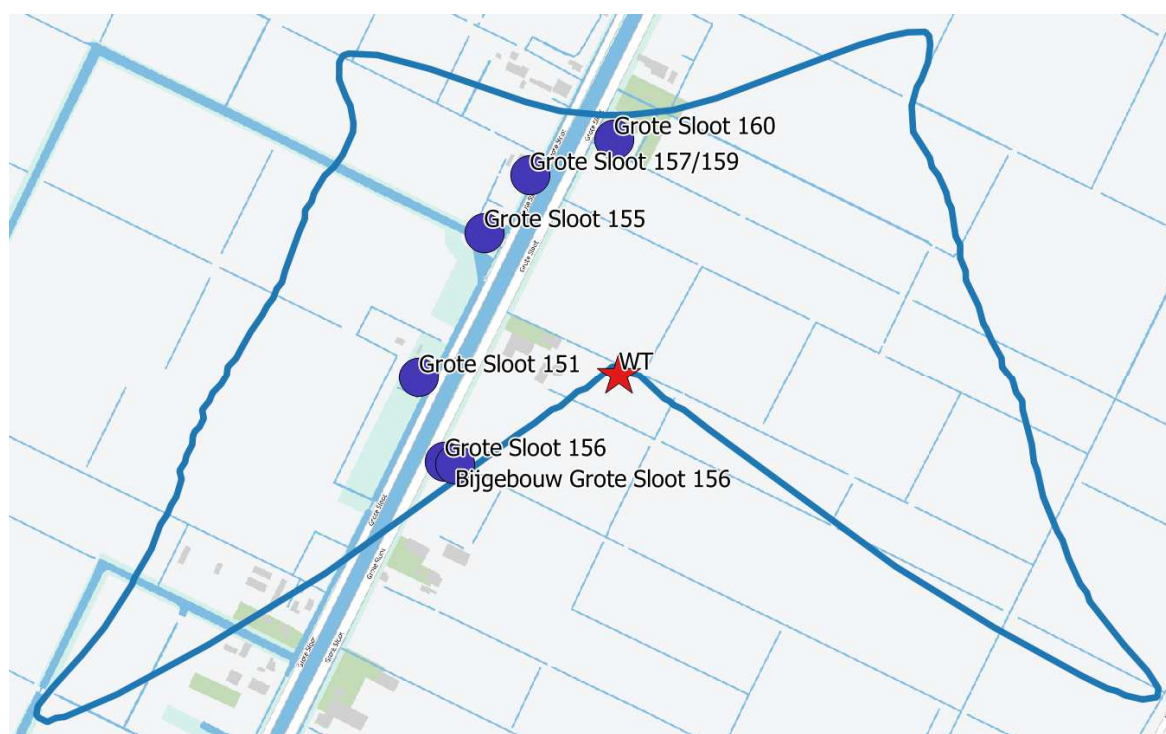
Vanwege de afmetingen van dat vlak duurt de schaduwpassage langs dit vlak langer dan de passage langs een punt (of enkel raam). Hierbij wordt rekening gehouden met de afmetingen van de gevel. Uitgegaan wordt van een gevel van 4 meter hoog. Er is gerekend vanaf een hoogte van 1 meter.

Tabel 3.1

Rekenresultaten slagschaduw

Beoordelingspunt	Max uren per jaar [u:m]	Verwacht uren per jaar [u:m]	Max dagen per jaar [#]	Verwacht dagen per jaar [#]	Maximale stilstand per jaar [%]
a. Grote Sloot 156	89:18	26:18	85	24	1,0
b. bijgebouw Grote Sloot 156	72:52	21:24	74	21	0,8
c. Grote Sloot 151	117:11	33:02	120	32	1,3
d. Grote Sloot 155	142:06	22:16	154	21	1,6
e. Grote Sloot 160	71:46	10:02	73	10	0,8
f. Grote Sloot 157/159	120:19	16:43	106	15	1,4

Uit tabel 3.1 blijkt dat ter plaatse van enkele beoordelingspunten de norm van 17 dagen met meer dan 20 minuten slagschaduw wordt overschreden. Daarom zal de turbine voorzien moeten worden van een stilstandvoorziening zoals voorgeschreven in het Activiteitenbesluit. In bijlage III is de slagschaduwkalender gegeven. De stilstandvoorziening kan, indien gewenst, met behulp van deze kalender worden ingesteld.



Figuur 3.1

Contour voor vijf uur en veertig minuten te verwachten slagschaduw. Bij woningen binnen deze contour wordt mogelijk de norm overschreden.

4 Conclusie

Uit het onderzoek blijkt dat de wettelijke normen betreffende slagschaduw wordt overschreden. Daarom zal de turbine voorzien moeten worden van een stilstandvoorziening zoals voorgeschreven in het Activiteitenbesluit. In bijlage III is de slagschaduwkalender gegeven. De stilstandvoorziening kan indien gewenst met behulp van deze kalender worden ingesteld.

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T.E. (Thom) de Rijk MSc.



ir. M.T. (Mike) Dijkstra

Bijlage I

Figuren

Figuren



Figuur I.1

Luchtfoto van de omgeving van de turbine (rode ster). Nabijgelegen woningen van derden zijn tevens gemarkeerd (paarse cirkel). De windturbine wordt geplaatst op de exacte coördinaten van de vergunde windturbine (binnen de aanduiding 'windturbine' zoals aangegeven op de verbeelding horende bij het vigerende bestemmingsplan). Deze locatie bevindt zich niet ver van de locatie van de huidige windturbine die zal worden verwijderd (zichtbaar op de foto).

Bijlage II

Details rekenmodel

Details rekenmodel

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+31 3023 11377
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SHADOW - Main Result

Calculation: receptoren

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
2,10	3,20	4,30	6,40	7,40	7,20	7,30	6,70	4,90	3,60	2,00	1,60

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
469	478	626	594	523	533	786	1.001	1.187	967	728	566	6.498

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

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:
Height contours used: Height Contours: CONTOURLINE_ONLINEDATA_1.wp
Obstacles used in calculation

Eye height: 1,5 m
Grid resolution: 10,0 m



WTGs

No	Dutch Stereo-RD/NAP 2000			Row data/Description	WTG type			Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Shadow data	
	East	North	Z		Valid	Manufact.	Type-generator				Calculation distance [m]	RPM [RPM]
1	110.267	531.891	0,0	Enercon E-70	Yes	ENERCON	E-70 E4 2,3 MW-2.300	2.300	71,0	57,0	1.645	20,0

Shadow receptor-Input

No.	Name	Dutch Stereo-RD/NAP 2000			Width [m]	Height [m]	Height a.g.l. [m]	Degrees from south cw [°]	Slope of window [°]	Direction mode
		East	North	Z						
A	Grote Sloot 156	110.087	531.790	0,0	5,0	4,0	1,0	0,0	90,0	"Green house mode"
B	bijgebouw Grote Sloot 156	110.079	531.787	0,0	5,0	4,0	1,0	0,0	90,0	"Green house mode"
C	Grote Sloot 151	110.038	531.888	0,0	8,0	4,0	1,0	0,0	90,0	"Green house mode"
D	Grote Sloot 155	110.113	532.054	0,0	8,0	4,0	1,0	0,0	90,0	"Green house mode"
E	Grote Sloot 160	110.262	532.181	0,0	8,0	4,0	1,0	0,0	90,0	"Green house mode"
F	Grote Sloot 157/159	110.165	532.120	0,0	8,0	4,0	1,0	0,0	90,0	"Green house mode"

Calculation Results

Shadow receptor

No.	Name	Shadow, worst case			Shadow, expected values	
		Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow hours per year [h/year]	Shadow hours per year [h/year]
A	Grote Sloot 156	89:18	85	1:18	26:18	
B	bijgebouw Grote Sloot 156	72:52	74	1:14	21:24	
C	Grote Sloot 151	117:11	120	1:19	33:02	
D	Grote Sloot 155	142:06	154	1:22	22:16	
E	Grote Sloot 160	71:46	73	1:10	10:02	
F	Grote Sloot 157/159	120:19	106	1:17	16:43	

WindPRO is developed by ENVI International A/S, Niels Jernissevej 10, DK-9220 Aalborg Ø, Tel: +45 96 36 44 44, Fax: +45 96 36 44 45, e-mail: windpro@envi.dk

Figuur II.1

Invoergegevens rekenmodel

Bijlage III

Gedetailleerde rekenresultaten

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SHADOW - Calendar

Calculation: receptorenShadow receptor: A - Grote Sloop 156

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
2,10 3,20 4,30 6,40 7,40 7,20 7,30 6,70 4,90 3,60 2,00 1,60

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum

469 478 626 594 523 533 786 1.001 1.187 987 728 586 8.498

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

	January	February	March	April	May	June	July	August	September	October	November	December			
1	08:54	08:26	07:31	07:18	06:11	05:24	06:07 (1)	05:21	06:11 (1)	05:59	06:40 (1)	06:50	07:41	07:37	08:30
2	08:54	08:24	07:28	07:16	06:09	05:23	06:07 (1)	05:21	06:10 (1)	06:00	06:44 (1)	06:52	07:43	07:39	08:31
3	08:54	08:22	07:26	07:13	06:07	05:23	06:06 (1)	05:22	06:11 (1)	06:02	06:54	07:45	07:41	08:33	08:33
4	08:53	08:21	07:24	07:11	06:05	05:22	06:07 (1)	05:23	06:12 (1)	06:04	06:55	07:46	07:43	08:34	08:34
5	08:53	08:19	07:22	07:09	06:03	05:21	06:06 (1)	05:24	06:11 (1)	06:05	06:57	07:48	07:44	08:35	08:35
6	08:53	08:17	07:19	07:06	06:02	05:20	06:06 (1)	05:25	06:12 (1)	06:07	06:59	07:50	07:46	08:37	08:37
7	08:52	08:16	07:17	07:04	06:00	05:20	06:06 (1)	05:26	06:12 (1)	06:08	07:01	07:52	07:48	08:38	08:38
8	08:52	08:14	07:15	07:02	05:58	05:19	06:06 (1)	05:27	06:13 (1)	06:10	07:02	07:53	07:50	08:39	08:39
9	08:51	08:12	07:12	06:59	05:56	05:19	06:06 (1)	05:28	06:14 (1)	06:12	07:04	07:55	07:52	08:40	08:40
10	08:51	08:10	07:10	06:57	05:54	05:18	06:06 (1)	05:29	06:14 (1)	06:13	07:06	07:57	07:54	08:42	08:42
11	08:50	08:08	07:08	06:55	05:53	05:18	06:05 (1)	05:30	06:15 (1)	06:15	07:07	07:59	07:56	08:43	08:43
12	08:50	08:06	07:05	06:52	05:51	05:17	06:06 (1)	05:31	06:15 (1)	06:17	07:09	08:01	07:57	08:44	08:44
13	08:49	08:04	07:03	06:50	05:49	05:17	06:06 (1)	05:32	06:16 (1)	06:18	07:11	08:02	07:59	08:45	08:45
14	08:48	08:02	07:01	06:48	05:48	05:17	06:06 (1)	05:33	06:16 (1)	06:20	07:12	08:04	08:01	08:46	08:46
15	08:47	08:00	06:58	06:46	05:46	05:17	06:07 (1)	05:34	06:17 (1)	06:22	07:14	08:06	08:03	08:47	08:47
16	08:46	07:58	06:56	06:43	05:44	05:16	06:07 (1)	05:36	06:18 (1)	06:23	07:16	08:08	08:05	08:48	08:48
17	08:45	07:56	06:54	06:41	05:43	05:16	06:07 (1)	05:37	06:19 (1)	06:25	07:17	08:09	08:06	08:48	08:48
18	08:44	07:54	06:51	06:39	05:41	05:16	06:07 (1)	05:38	06:20 (1)	06:27	07:19	08:11	08:08	08:49	08:49
19	08:43	07:52	06:49	06:37	05:40	05:16	06:07 (1)	05:40	06:20 (1)	06:28	07:21	08:13	08:10	08:50	08:50
20	08:42	07:50	06:46	06:34	05:38	05:16	06:07 (1)	05:41	06:22 (1)	06:30	07:22	08:15	08:12	08:51	08:51
21	08:41	07:48	06:44	06:32	05:37	05:17	06:07 (1)	05:42	06:23 (1)	06:32	07:24	08:17	08:13	08:51	08:51
22	08:40	07:46	06:42	06:30	05:36	05:17	06:07 (1)	05:44	06:23 (1)	06:34	07:26	08:19	08:15	08:52	08:52
23	08:39	07:44	06:39	06:28	05:34	05:17	06:08 (1)	05:45	06:24 (1)	06:35	07:28	08:20	08:17	08:52	08:52
24	08:37	07:42	06:37	06:26	05:33	05:17	06:08 (1)	05:47	06:26 (1)	06:37	07:29	08:22	08:19	08:53	08:53
25	08:36	07:39	06:35	06:24	05:32	05:18	06:08 (1)	05:48	06:27 (1)	06:39	07:31	08:24	08:20	08:53	08:53
26	08:35	07:37	06:32	06:22	05:30	05:18	06:09 (1)	05:49	06:29 (1)	06:40	07:33	08:26	08:22	08:53	08:53
27	08:33	07:35	06:30	06:19	05:29	05:18	06:09 (1)	05:51	06:30 (1)	06:42	07:34	08:28	08:24	08:54	08:54
28	08:32	07:33	06:27	06:17	05:28	05:19	06:09 (1)	05:52	06:31 (1)	06:44	07:36	08:30	08:25	08:54	08:54
29	08:30	07:31	06:25	06:15	05:27	05:20	06:09 (1)	05:54	06:33 (1)	06:45	07:38	08:31	08:27	08:54	08:54
30	08:29	07:29	06:23	06:13	05:26	05:20	06:10 (1)	05:56	06:35 (1)	06:47	07:40	08:33	08:28	08:54	08:54
31	08:27	07:27	06:21	06:11	05:24	05:20	06:10 (1)	05:57	06:38 (1)	06:49	07:42	08:35	08:30	08:54	08:54
Potential sun hours	255	276	367	418	489	504	506	456	381	330	263	239			
Total, worst case					1109	2290	1917	42							
Sun reduction					0,47	0,43	0,45	0,46							
Oper. time red.					0,97	0,97	0,97	0,97							
Wind dir. red.					0,68	0,68	0,68	0,68							
Total reduction					0,31	0,28	0,30	0,30							
Total, real					345	652	569	13							

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

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

Calculation: receptorenShadow receptor: B - bijgebouw Grote Sloot 156

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
2,10 3,20 4,30 6,40 7,40 7,20 7,30 6,70 4,90 3,60 2,00 1,60

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
469 478 626 594 523 533 786 1.001 1.187 987 728 586 8.498

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

Table with columns for months (January to December) and rows for each day of the month, showing sunrise and sunset times. Includes summary rows for 'Potential sun hours', 'Total, worst case', 'Sun reduction', 'Oper. time red.', 'Wind dir. red.', 'Total reduction', and 'Total, real'.

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

Matrix with 5 columns: Day in month, Sun rise (hh:mm), Sun set (hh:mm), Minutes with flicker, First time (hh:mm) with flicker, Last time (hh:mm) with flicker, (WTG causing flicker first time), (WTG causing flicker last time)

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SHADOW - Calendar

Calculation: receptorenShadow receptor: C - Grote Sloop 151

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
2,10 3,20 4,30 6,40 7,40 7,20 7,30 6,70 4,90 3,60 2,00 1,60

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
469 478 626 594 523 533 786 1.001 1.187 987 728 586 8.498

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

	January	February	March	April	May	June	July	August	September	October	November	December	
1	08:54 16:36	08:26 17:25	07:31 18:19	07:18 20:15	07:48 (1) 21:08	07:29 (1) 21:55	05:24 22:09	05:21 22:09	05:59 21:36	07:47 (1) 20:32	06:50 19:21	07:32 (1) 17:13	07:41 16:31
2	08:54 16:37	08:24 17:27	07:28 18:21	07:16 20:16	07:46 (1) 21:09	07:29 (1) 21:56	05:23 22:09	05:21 22:09	06:00 21:34	07:46 (1) 20:30	06:52 19:18	07:33 (1) 17:11	07:43 16:30
3	08:54 16:38	08:22 17:29	07:26 18:22	07:13 20:18	07:44 (1) 21:11	07:31 (1) 21:57	05:22 22:09	05:22 22:09	06:02 21:33	07:45 (1) 20:28	06:54 19:16	07:33 (1) 17:09	07:41 16:29
4	08:53 16:39	08:21 17:31	07:24 18:24	07:11 20:20	07:42 (1) 21:13	07:31 (1) 21:59	05:23 22:08	05:23 22:08	06:04 21:31	07:44 (1) 20:25	06:55 19:14	07:34 (1) 17:07	07:46 16:29
5	08:53 16:41	08:19 17:33	07:22 18:26	07:09 20:22	07:41 (1) 21:14	07:31 (1) 22:00	05:24 22:08	05:24 22:08	06:05 21:29	07:43 (1) 20:23	06:57 19:11	07:35 (1) 17:05	07:48 16:28
6	08:53 16:42	08:17 17:35	07:19 18:28	07:06 20:24	07:39 (1) 21:16	07:32 (1) 22:01	05:25 22:07	05:25 22:07	06:07 21:27	07:42 (1) 20:21	06:59 19:09	07:35 (1) 17:04	07:50 16:28
7	08:52 16:43	08:16 17:37	07:17 18:30	07:04 20:25	07:38 (1) 21:18	07:32 (1) 22:02	05:26 22:07	05:26 22:07	06:08 21:25	07:41 (1) 20:18	07:01 19:07	07:36 (1) 17:02	07:52 16:27
8	08:52 16:45	08:14 17:39	07:15 18:32	07:02 20:27	07:37 (1) 21:20	07:34 (1) 22:02	05:27 22:06	05:27 22:06	06:10 21:24	07:41 (1) 20:16	07:02 19:04	07:36 (1) 17:00	07:53 16:27
9	08:51 16:46	08:12 17:41	07:12 18:34	06:59 20:29	07:35 (1) 21:21	07:34 (1) 22:03	05:28 22:05	05:28 22:05	06:12 21:22	07:39 (1) 20:13	07:04 19:02	07:38 (1) 16:58	07:52 16:27
10	08:51 16:47	08:10 17:43	07:10 18:35	06:57 20:31	07:34 (1) 21:23	07:35 (1) 22:04	05:29 22:04	05:29 22:04	06:13 21:20	07:39 (1) 20:11	07:06 19:00	07:40 (1) 16:57	07:54 16:26
11	08:50 16:49	08:08 17:45	07:08 18:37	06:55 20:32	07:34 (1) 21:25	07:36 (1) 22:05	05:30 22:04	05:30 22:04	06:15 21:18	07:39 (1) 20:09	07:07 18:58	07:40 (1) 16:55	07:56 16:26
12	08:50 16:50	08:06 17:46	07:05 18:39	06:52 20:34	07:33 (1) 21:26	07:37 (1) 22:06	05:31 22:03	05:31 22:03	06:17 21:16	07:37 (1) 20:06	07:09 18:55	07:42 (1) 16:53	07:57 16:26
13	08:49 16:52	08:04 17:48	07:03 18:41	06:50 20:36	07:31 (1) 21:28	07:38 (1) 22:07	05:32 22:02	05:32 22:02	06:18 21:14	07:37 (1) 20:04	07:11 18:53	07:44 (1) 16:52	07:59 16:26
14	08:48 16:53	08:02 17:50	07:01 18:43	06:48 20:38	07:31 (1) 21:30	07:39 (1) 22:07	05:33 22:01	05:33 22:01	06:20 21:12	07:36 (1) 20:02	07:12 18:51	07:45 (1) 16:50	08:01 16:26
15	08:47 16:55	08:00 17:52	06:58 18:44	06:46 20:39	07:30 (1) 21:31	07:40 (1) 22:07	05:34 22:00	05:34 22:00	06:22 21:10	07:36 (1) 19:59	07:14 18:48	07:48 (1) 16:49	08:03 16:26
16	08:46 16:57	07:58 17:54	06:56 18:46	06:43 20:41	07:30 (1) 21:33	07:41 (1) 22:08	05:36 21:59	05:36 21:59	06:23 21:08	07:35 (1) 19:57	07:16 18:46	07:50 (1) 16:47	08:05 16:26
17	08:45 16:58	07:56 17:56	06:54 18:48	06:41 20:43	07:30 (1) 21:34	07:43 (1) 22:08	05:37 21:58	05:37 21:58	06:25 21:05	07:35 (1) 19:54	07:17 18:44	07:53 (1) 16:46	08:09 16:26
18	08:44 17:00	07:54 17:58	06:51 18:50	06:39 20:45	07:30 (1) 21:36	07:44 (1) 22:09	05:38 21:57	05:38 21:57	06:27 21:03	07:35 (1) 19:52	07:19 18:42	07:57 (1) 16:45	08:08 16:26
19	08:43 17:02	07:52 18:00	06:49 18:52	06:37 20:47	07:28 (1) 21:37	07:45 (1) 22:09	05:40 21:55	05:40 21:55	06:28 21:01	07:34 (1) 19:50	07:21 18:43	07:58 (1) 16:43	08:10 16:27
20	08:42 17:03	07:50 18:02	06:46 18:53	06:34 20:48	07:28 (1) 21:39	07:48 (1) 22:10	05:41 21:54	05:41 21:54	06:30 20:59	07:34 (1) 19:47	07:22 18:37	07:59 (1) 16:42	08:51 16:27
21	08:41 17:05	07:48 18:04	06:44 18:55	06:32 20:50	07:28 (1) 21:40	07:50 (1) 22:10	05:42 21:53	05:42 21:53	06:32 21:08	07:33 (1) 19:45	07:24 18:35	07:59 (1) 16:41	08:51 16:28
22	08:40 17:07	07:46 18:06	06:42 18:57	06:30 20:52	07:28 (1) 21:42	07:52 (1) 22:10	05:44 21:51	05:44 21:51	06:34 20:55	07:33 (1) 19:42	07:26 18:33	07:59 (1) 16:39	08:52 16:28
23	08:39 17:09	07:44 18:08	06:39 18:59	06:28 20:54	07:28 (1) 21:43	07:56 (1) 22:10	05:45 21:50	05:45 21:50	06:35 20:53	07:33 (1) 19:40	07:28 18:31	07:59 (1) 16:38	08:52 16:29
24	08:37 17:10	07:42 18:09	06:37 19:01	06:26 20:55	07:28 (1) 21:45	07:57 (1) 22:10	05:47 21:49	05:47 21:49	06:37 20:50	07:32 (1) 19:38	07:29 18:29	07:59 (1) 16:37	08:53 16:29
25	08:36 17:12	07:39 18:11	06:35 19:02	06:24 20:57	07:28 (1) 21:46	07:58 (1) 22:10	05:48 21:47	05:48 21:47	06:39 20:48	07:32 (1) 19:35	07:31 17:27	07:59 (1) 16:36	08:53 16:30
26	08:35 17:14	07:37 18:13	06:32 19:04	06:22 20:59	07:28 (1) 21:48	07:59 (1) 22:10	05:49 21:46	05:49 21:46	06:40 20:46	07:32 (1) 19:33	07:26 17:25	07:59 (1) 16:35	08:53 16:30
27	08:33 17:16	07:35 18:15	06:30 19:06	06:19 20:59	07:28 (1) 21:49	08:00 (1) 22:10	05:51 21:44	05:51 21:44	06:42 20:44	07:32 (1) 19:30	07:34 17:28	07:59 (1) 16:34	08:54 16:31
28	08:32 17:18	07:33 18:17	06:27 19:08	06:17 21:02	07:28 (1) 21:50	08:01 (1) 22:10	05:52 21:43	05:52 21:43	06:44 20:41	07:32 (1) 19:28	07:36 17:21	07:59 (1) 16:33	08:54 16:32
29	08:30 17:20	07:25 18:20	06:25 19:09	06:15 21:04	07:28 (1) 21:51	08:02 (1) 22:10	05:54 21:41	05:54 21:41	06:45 20:39	07:32 (1) 19:26	07:38 17:19	07:59 (1) 16:32	08:54 16:33
30	08:29 17:22	07:23 18:21	06:23 19:08	06:13 21:06	07:29 (1) 21:53	08:03 (1) 22:10	05:56 21:40	05:56 21:40	06:47 20:37	07:32 (1) 19:23	07:40 17:17	07:59 (1) 16:32	08:54 16:34
31	08:27 17:23	07:21 18:20	06:21 19:07	06:11 21:04	07:30 (1) 21:54	08:04 (1) 22:10	05:57 21:38	05:57 21:38	06:49 20:34	07:32 (1) 19:21	07:39 17:15	07:59 (1) 16:35	08:54 16:35
Potential sun hours	255	276	367	418	489	504	506	456	381	330	263	239	
Total, worst case			243	2174	1078	371	2190	975					
Sun reduction			0,36	0,46	0,47	0,45	0,46	0,39					
Oper. time red.			0,97	0,97	0,97	0,97	0,97	0,97					
Wind dir. red.			0,65	0,65	0,65	0,65	0,65	0,65					
Total reduction			0,23	0,29	0,30	0,28	0,29	0,24					
Total, real			56	633	320	105	631	238					

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

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

068224af windpro.2.9

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17-2-2015 14:17 / 4

Licensed user:

LBP SIGHT

Kelvinbaan 40, PO box 1475

NL-3430BL Nieuwegein

+31 3023 11377

TdR / tdr@lbp sight.nl

Calculated:

17-2-2015 14:11/2.9.269

SHADOW - Calendar

Calculation: receptorenShadow receptor: D - Grote Sloop 155

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2,10	3,20	4,30	6,40	7,40	7,20	7,30	6,70	4,90	3,60	2,00	1,60

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
469	478	626	594	523	533	786	1.001	1.187	987	728	586	8.498

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:54	09:39 (1) 08:26	09:20 (1) 07:31	09:26 (1) 07:18	10:01 (1) 06:11	10:24 (1) 05:24	10:51 (1) 05:21	11:18 (1) 05:59	11:45 (1) 06:50	12:12 (1) 07:41	12:39 (1) 08:32	13:06 (1) 09:23
2	08:54	09:38 (1) 08:24	09:19 (1) 07:28	09:27 (1) 07:16	10:00 (1) 06:09	10:23 (1) 05:23	10:50 (1) 05:21	11:17 (1) 06:00	11:44 (1) 06:52	12:11 (1) 07:43	12:38 (1) 08:34	13:05 (1) 09:25
3	08:54	09:38 (1) 08:22	09:19 (1) 07:26	09:29 (1) 07:13	10:02 (1) 06:07	10:25 (1) 05:22	10:52 (1) 05:22	11:19 (1) 06:02	11:46 (1) 06:54	12:13 (1) 07:45	12:40 (1) 08:36	13:07 (1) 09:27
4	08:53	09:38 (1) 08:21	09:19 (1) 07:24	09:30 (1) 07:11	10:03 (1) 06:05	10:26 (1) 05:22	10:53 (1) 05:23	11:20 (1) 06:04	11:47 (1) 06:55	12:14 (1) 07:46	12:41 (1) 08:37	13:08 (1) 09:28
5	08:53	09:37 (1) 08:19	09:18 (1) 07:22	09:31 (1) 07:09	10:04 (1) 06:03	10:27 (1) 05:21	10:54 (1) 05:24	11:21 (1) 06:05	11:48 (1) 06:57	12:15 (1) 07:48	12:42 (1) 08:39	13:09 (1) 09:29
6	08:53	09:36 (1) 08:17	09:18 (1) 07:19	09:34 (1) 07:06	10:05 (1) 06:02	10:28 (1) 05:20	10:55 (1) 05:25	11:22 (1) 06:07	11:49 (1) 06:59	12:16 (1) 07:50	12:43 (1) 08:41	13:10 (1) 09:30
7	08:52	09:35 (1) 08:16	09:19 (1) 07:17	09:37 (1) 07:04	10:06 (1) 06:00	10:29 (1) 05:20	10:56 (1) 05:26	11:23 (1) 06:08	11:50 (1) 07:01	12:17 (1) 07:52	12:44 (1) 08:42	13:11 (1) 09:31
8	08:52	09:34 (1) 08:14	09:19 (1) 07:15	09:40 (1) 07:02	10:07 (1) 05:58	10:30 (1) 05:19	10:57 (1) 05:27	11:24 (1) 06:10	11:51 (1) 07:02	12:18 (1) 07:53	12:45 (1) 08:43	13:12 (1) 09:32
9	08:51	09:34 (1) 08:12	09:18 (1) 07:12	09:49 (1) 06:59	10:08 (1) 05:56	10:31 (1) 05:19	10:58 (1) 05:28	11:25 (1) 06:12	11:52 (1) 07:04	12:19 (1) 07:55	12:46 (1) 08:44	13:13 (1) 09:33
10	08:51	09:33 (1) 08:10	09:18 (1) 07:10	09:52 (1) 06:57	10:09 (1) 05:54	10:32 (1) 05:18	10:59 (1) 05:29	11:26 (1) 06:13	11:53 (1) 07:06	12:20 (1) 07:57	12:47 (1) 08:45	13:14 (1) 09:34
11	08:50	09:32 (1) 08:08	09:18 (1) 07:08	09:55 (1) 06:55	10:10 (1) 05:53	10:33 (1) 05:18	11:00 (1) 05:30	11:27 (1) 06:15	11:54 (1) 07:07	12:21 (1) 07:59	12:48 (1) 08:46	13:15 (1) 09:35
12	08:50	09:31 (1) 08:06	09:18 (1) 07:05	09:58 (1) 06:52	10:11 (1) 05:51	10:34 (1) 05:17	11:01 (1) 05:31	11:28 (1) 06:17	11:55 (1) 07:09	12:22 (1) 08:01	12:49 (1) 08:47	13:16 (1) 09:36
13	08:49	09:30 (1) 08:04	09:19 (1) 07:03	10:01 (1) 06:50	10:12 (1) 05:49	10:35 (1) 05:17	11:02 (1) 05:32	11:29 (1) 06:18	11:56 (1) 07:11	12:23 (1) 08:02	12:50 (1) 08:48	13:17 (1) 09:37
14	08:48	09:29 (1) 08:02	09:19 (1) 07:01	10:02 (1) 06:48	10:13 (1) 05:48	10:36 (1) 05:17	11:03 (1) 05:33	11:30 (1) 06:20	11:57 (1) 07:12	12:24 (1) 08:04	12:51 (1) 08:49	13:18 (1) 09:38
15	08:47	09:28 (1) 08:00	09:18 (1) 06:58	10:03 (1) 06:46	10:14 (1) 05:46	10:37 (1) 05:16	11:04 (1) 05:34	11:31 (1) 06:22	11:58 (1) 07:14	12:25 (1) 08:05	12:52 (1) 08:49	13:19 (1) 09:39
16	08:46	09:28 (1) 07:58	09:18 (1) 06:56	10:04 (1) 06:43	10:15 (1) 05:44	10:38 (1) 05:15	11:05 (1) 05:36	11:32 (1) 06:23	12:00 (1) 07:16	12:26 (1) 08:06	12:53 (1) 08:49	13:20 (1) 09:39
17	08:45	09:27 (1) 07:56	09:19 (1) 06:54	10:05 (1) 06:41	10:16 (1) 05:43	10:39 (1) 05:16	11:06 (1) 05:37	11:33 (1) 06:25	12:01 (1) 07:17	12:27 (1) 08:09	12:54 (1) 08:49	13:21 (1) 09:39
18	08:44	09:27 (1) 07:54	09:19 (1) 06:51	10:06 (1) 06:39	10:17 (1) 05:41	10:40 (1) 05:16	11:07 (1) 05:38	11:34 (1) 06:27	12:02 (1) 07:19	12:28 (1) 08:11	12:55 (1) 08:49	13:22 (1) 09:39
19	08:43	09:25 (1) 07:52	09:20 (1) 06:49	10:07 (1) 06:37	10:18 (1) 05:40	10:41 (1) 05:16	11:08 (1) 05:39	11:35 (1) 06:28	12:03 (1) 07:21	12:29 (1) 08:13	12:56 (1) 08:49	13:23 (1) 09:39
20	08:42	09:25 (1) 07:50	09:20 (1) 06:46	10:08 (1) 06:34	10:19 (1) 05:38	10:42 (1) 05:16	11:09 (1) 05:38	11:36 (1) 06:27	12:04 (1) 07:22	12:30 (1) 08:15	12:57 (1) 08:49	13:24 (1) 09:39
21	08:41	09:25 (1) 07:48	09:21 (1) 06:44	10:09 (1) 06:32	10:20 (1) 05:37	10:43 (1) 05:17	11:10 (1) 05:39	11:37 (1) 06:28	12:05 (1) 07:23	12:31 (1) 08:16	12:58 (1) 08:49	13:25 (1) 09:39
22	08:40	09:23 (1) 07:46	09:21 (1) 06:42	10:10 (1) 06:30	10:21 (1) 05:36	10:44 (1) 05:17	11:11 (1) 05:40	11:38 (1) 06:29	12:06 (1) 07:24	12:32 (1) 08:17	12:59 (1) 08:49	13:26 (1) 09:39
23	08:39	09:23 (1) 07:44	09:21 (1) 06:39	10:11 (1) 06:28	10:22 (1) 05:34	10:45 (1) 05:17	11:12 (1) 05:41	11:39 (1) 06:30	12:07 (1) 07:25	12:33 (1) 08:18	13:00 (1) 08:49	13:27 (1) 09:39
24	08:37	09:23 (1) 07:42	09:22 (1) 06:37	10:12 (1) 06:26	10:23 (1) 05:33	10:46 (1) 05:17	11:13 (1) 05:42	11:40 (1) 06:31	12:08 (1) 07:26	12:34 (1) 08:19	13:01 (1) 08:49	13:28 (1) 09:39
25	08:36	09:22 (1) 07:39	09:23 (1) 06:35	10:13 (1) 06:24	10:24 (1) 05:32	10:47 (1) 05:18	11:14 (1) 05:43	11:41 (1) 06:32	12:09 (1) 07:27	12:35 (1) 08:20	13:02 (1) 08:49	13:29 (1) 09:39
26	08:35	09:22 (1) 07:37	09:23 (1) 06:32	10:14 (1) 06:21	10:25 (1) 05:30	10:48 (1) 05:18	11:15 (1) 05:44	11:42 (1) 06:33	12:10 (1) 07:28	12:36 (1) 08:21	13:03 (1) 08:49	13:30 (1) 09:39
27	08:33	09:21 (1) 07:35	09:24 (1) 06:30	10:15 (1) 06:19	10:26 (1) 05:29	10:49 (1) 05:18	11:16 (1) 05:45	11:43 (1) 06:34	12:11 (1) 07:29	12:37 (1) 08:22	13:04 (1) 08:49	13:31 (1) 09:39
28	08:32	09:21 (1) 07:33	09:25 (1) 06:27	10:16 (1) 06:17	10:27 (1) 05:28	10:50 (1) 05:19	11:17 (1) 05:46	11:44 (1) 06:35	12:12 (1) 07:30	12:38 (1) 08:23	13:05 (1) 08:49	13:32 (1) 09:39
29	08:30	09:21 (1) 07:31	09:27 (1) 06:25	10:17 (1) 06:15	10:28 (1) 05:27	10:51 (1) 05:20	11:18 (1) 05:47	11:45 (1) 06:36	12:13 (1) 07:31	12:39 (1) 08:24	13:06 (1) 08:49	13:33 (1) 09:39
30	08:29	09:20 (1) 07:29	09:28 (1) 06:23	10:18 (1) 06:13	10:29 (1) 05:26	10:52 (1) 05:21	11:19 (1) 05:48	11:46 (1) 06:37	12:14 (1) 07:32	12:40 (1) 08:25	13:07 (1) 08:49	13:34 (1) 09:39
31	08:27	09:19 (1) 07:27	09:29 (1) 06:21	10:19 (1) 06:11	10:30 (1) 05:25	10:53 (1) 05:22	11:20 (1) 05:49	11:47 (1) 06:38	12:15 (1) 07:33	12:41 (1) 08:26	13:08 (1) 08:49	13:35 (1) 09:39
Potential sun hours	255	276	367	418	489	504	506	456	381	330	263	239
Total, worst case	1635	2155	343	343						1743	2065	585
Sun reduction	0,26	0,33	0,36	0,36						0,34	0,23	0,21
Oper. time red.	0,97	0,97	0,97	0,97						0,97	0,97	0,97
Wind dir. red.	0,57	0,57	0,57	0,57						0,57	0,57	0,57
Total reduction	0,14	0,18	0,20	0,20						0,19	0,13	0,11
Total, real	230	386	69	69						325	260	67

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

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

Project:

068224af windpro2.9

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17-2-2015 14:17 / 5

Licensed user:

LBP SIGHT

Kelvinbaan 40, PO box 1475

NL-3430BL Nieuwegein

+31 3023 11377

TdR / tdr@lbp sight.nl

Calculated:

17-2-2015 14:11/2.9.269

SHADOW - Calendar

Calculation: receptorenShadow receptor: E - Grote Sloot 160

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
2,10 3,20 4,30 6,40 7,40 7,20 7,30 6,70 4,90 3,60 2,00 1,60

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
469 478 626 594 523 533 786 1.001 1.187 987 728 586 8.498
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December	
1	08:54 16:36	12:03 (1) 13:11 (1)	08:26 17:25	07:31 18:19	06:11 20:15	05:24 21:55	05:21 22:09	05:59 21:36	06:50 20:32	07:41 19:21	07:37 17:13	08:30 16:31	11:51 (1) 12:54 (1)
2	08:54 16:37	12:03 (1) 13:11 (1)	08:24 17:27	07:28 18:21	06:09 20:16	05:23 21:09	05:21 22:09	06:00 21:34	06:52 20:30	07:43 19:18	07:39 17:11	08:31 16:30	11:52 (1) 12:56 (1)
3	08:54 16:38	12:04 (1) 13:11 (1)	08:22 17:29	07:26 18:22	06:07 20:18	05:22 21:11	05:22 22:09	06:02 21:33	06:54 20:28	07:45 19:16	07:41 17:09	08:33 16:29	11:51 (1) 12:56 (1)
4	08:53 16:39	12:05 (1) 13:12 (1)	08:21 17:31	07:24 18:24	06:05 20:20	05:22 21:13	05:23 22:08	06:04 21:31	06:55 20:25	07:46 19:14	07:43 17:07	08:34 16:29	11:52 (1) 12:57 (1)
5	08:53 16:41	12:05 (1) 13:12 (1)	08:19 17:33	07:21 18:26	06:03 20:22	05:21 21:14	05:24 22:08	06:05 21:29	06:57 20:23	07:48 19:11	07:44 17:05	08:35 16:28	11:51 (1) 12:57 (1)
6	08:53 16:42	12:06 (1) 13:12 (1)	08:17 17:35	07:19 18:28	06:02 20:24	05:20 21:16	05:25 22:07	06:07 21:27	06:59 20:21	07:50 19:09	07:46 17:04	08:37 16:28	11:51 (1) 12:57 (1)
7	08:52 16:43	12:06 (1) 13:12 (1)	08:16 17:37	07:17 18:30	06:00 20:25	05:20 21:18	05:26 22:07	06:08 21:25	07:01 20:18	07:52 19:07	07:48 17:02	08:38 16:27	11:52 (1) 12:59 (1)
8	08:52 16:45	12:07 (1) 13:12 (1)	08:14 17:39	07:15 18:32	05:58 20:27	05:19 21:20	05:27 22:06	06:10 21:24	07:02 20:16	07:53 19:04	07:50 17:00	08:39 16:27	11:52 (1) 12:59 (1)
9	08:51 16:46	12:08 (1) 13:13 (1)	08:12 17:41	07:12 18:34	05:56 20:29	05:19 21:21	05:28 22:05	06:12 21:22	07:04 20:13	07:55 19:02	07:52 16:58	08:40 16:27	11:52 (1) 12:59 (1)
10	08:51 16:47	12:09 (1) 13:12 (1)	08:10 17:43	07:10 18:35	05:54 20:31	05:18 21:23	05:29 22:04	06:13 21:20	07:06 20:11	07:57 19:00	07:54 16:57	08:42 16:26	11:53 (1) 13:01 (1)
11	08:50 16:49	12:09 (1) 13:12 (1)	08:08 17:45	07:08 18:37	05:53 20:32	05:18 21:25	05:30 22:04	06:15 21:18	07:07 20:09	07:59 18:58	07:56 16:55	08:43 16:26	11:53 (1) 13:01 (1)
12	08:50 16:50	12:10 (1) 13:12 (1)	08:06 17:46	07:05 18:39	05:51 20:34	05:17 21:26	05:31 22:03	06:17 21:16	07:09 20:06	08:01 18:55	07:57 16:53	08:44 16:26	11:53 (1) 13:02 (1)
13	08:49 16:52	12:11 (1) 13:12 (1)	08:04 17:48	07:03 18:41	05:49 20:36	05:17 21:28	05:32 22:02	06:18 21:14	07:11 20:04	08:02 18:53	07:59 16:52	08:45 16:26	11:53 (1) 13:02 (1)
14	08:48 16:53	12:12 (1) 13:12 (1)	08:02 17:50	07:01 18:43	05:48 20:38	05:17 21:30	05:33 22:07	06:20 21:12	07:12 20:02	08:04 18:51	08:01 16:50	08:46 16:26	11:54 (1) 13:03 (1)
15	08:47 16:55	12:13 (1) 13:11 (1)	08:00 17:52	06:58 18:44	05:46 20:39	05:17 21:31	05:34 22:00	06:22 21:10	07:14 19:59	08:06 18:48	12:14 (1) 12:16 (1)	08:47 16:26	11:54 (1) 13:03 (1)
16	08:46 16:57	12:14 (1) 13:11 (1)	07:58 17:54	06:56 18:46	05:44 20:41	05:16 21:33	05:36 22:08	06:23 21:08	07:16 19:57	08:08 18:46	12:14 (1) 12:17 (1)	08:48 16:26	11:55 (1) 13:04 (1)
17	08:45 16:58	12:15 (1) 13:11 (1)	07:56 17:56	06:54 18:48	05:41 20:43	05:16 21:34	05:37 22:09	06:25 21:05	07:17 19:54	08:09 18:44	12:14 (1) 12:17 (1)	08:48 16:26	11:54 (1) 13:04 (1)
18	08:44 17:00	12:17 (1) 13:10 (1)	07:54 17:58	06:51 18:50	05:41 20:45	05:16 21:36	05:38 22:09	06:27 21:03	07:19 19:52	08:11 18:42	12:14 (1) 12:17 (1)	08:49 16:26	11:55 (1) 13:05 (1)
19	08:43 17:02	12:17 (1) 13:09 (1)	07:52 18:00	06:49 18:52	05:40 20:47	05:16 21:37	05:39 22:09	06:28 21:55	07:21 20:01	08:13 18:40	12:14 (1) 12:17 (1)	08:50 16:27	11:56 (1) 13:05 (1)
20	08:42 17:03	12:19 (1) 13:08 (1)	07:50 18:02	06:46 18:53	05:38 20:48	05:16 21:39	05:41 22:10	06:30 20:59	07:22 19:47	08:15 18:37	12:14 (1) 12:17 (1)	08:51 16:27	11:56 (1) 13:05 (1)
21	08:41 17:05	12:21 (1) 13:08 (1)	07:48 18:04	06:44 18:55	05:37 20:50	05:17 21:40	05:42 22:10	06:32 20:57	07:24 19:45	08:17 18:35	12:14 (1) 12:17 (1)	08:51 16:27	11:56 (1) 13:06 (1)
22	08:40 17:07	12:22 (1) 13:06 (1)	07:46 18:06	06:42 18:57	05:35 20:52	05:17 21:42	05:44 22:10	06:33 20:55	07:26 19:42	08:19 18:33	12:14 (1) 12:17 (1)	08:52 16:28	11:57 (1) 13:07 (1)
23	08:39 17:09	12:24 (1) 13:05 (1)	07:44 18:07	06:39 18:59	05:34 20:54	05:17 21:43	05:45 22:10	06:35 20:53	07:28 19:40	08:20 18:31	12:14 (1) 12:17 (1)	08:52 16:28	11:58 (1) 13:07 (1)
24	08:37 17:10	12:27 (1) 13:04 (1)	07:42 18:09	06:37 19:01	05:33 20:55	05:17 21:45	05:46 22:10	06:37 20:50	07:29 19:38	08:22 18:29	12:14 (1) 12:17 (1)	08:53 16:29	11:58 (1) 13:07 (1)
25	08:36 17:12	12:29 (1) 13:01 (1)	07:39 18:11	06:35 19:02	05:32 20:57	05:18 21:46	05:48 22:10	06:39 20:48	07:31 19:35	08:20 18:27	12:14 (1) 12:17 (1)	08:53 16:30	11:59 (1) 13:09 (1)
26	08:35 17:14	12:34 (1) 12:58 (1)	07:37 18:13	06:32 19:04	05:30 20:59	05:18 21:48	05:49 22:10	06:40 20:46	07:33 19:33	08:22 18:25	12:14 (1) 12:17 (1)	08:53 16:30	11:59 (1) 13:09 (1)
27	08:33 17:16	12:35 (1) 13:03 (1)	07:35 18:13	06:30 19:06	05:29 20:59	05:18 21:49	05:51 22:10	06:42 20:44	07:34 19:30	08:24 18:23	12:14 (1) 12:17 (1)	08:54 16:31	12:00 (1) 13:09 (1)
28	08:32 17:18	12:36 (1) 13:04 (1)	07:33 18:13	06:27 19:08	05:28 21:02	05:19 21:50	05:52 22:10	06:44 20:41	07:36 19:28	08:25 18:21	12:14 (1) 12:17 (1)	08:54 16:32	12:00 (1) 13:09 (1)
29	08:30 17:20	12:37 (1) 13:05 (1)	07:31 18:13	06:25 19:10	05:27 21:04	05:20 21:51	05:54 22:10	06:45 20:39	07:38 19:26	08:27 18:19	12:14 (1) 12:17 (1)	08:54 16:33	12:01 (1) 13:10 (1)
30	08:29 17:22	12:38 (1) 13:06 (1)	07:30 18:13	06:24 19:11	05:26 21:06	05:20 21:53	05:56 22:10	06:47 20:37	07:40 19:23	08:28 18:17	12:14 (1) 12:17 (1)	08:54 16:34	12:01 (1) 13:10 (1)
31	08:27 17:23	12:39 (1) 13:07 (1)	07:29 18:13	06:23 19:12	05:25 21:07	05:19 21:55	05:57 22:10	06:49 20:34	07:35 19:15	08:29 18:15	12:14 (1) 12:17 (1)	08:54 16:35	12:02 (1) 13:11 (1)
Potential sun hours	255	276	367	418	489	504	506	456	381	330	263	239	
Total, worst case	1458									736			2112
Sun reduction	0,26									0,23			0,21
Oper. time red.	0,97									0,97			0,97
Wind dir. red.	0,63									0,63			0,63
Total reduction	0,16									0,14			0,13
Total, real	229									103			270

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

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

Project:

068224af windpro2.9

Printed/Page

17-2-2015 14:17 / 6

Licensed user:

LBP SIGHT

Kelvinbaan 40, PO box 1475
NL-3430BL Nieuwegein
+31 3023 11377

TdR / tdr@lbp sight.nl

Calculated:

17-2-2015 14:11/2.9.269

SHADOW - Calendar

Calculation: receptorenShadow receptor: F - Grote Sloot 157/159

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
2,10 3,20 4,30 6,40 7,40 7,20 7,30 6,70 4,90 3,60 2,00 1,60

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
469 478 626 594 523 533 786 1.001 1.187 987 728 586 8.498

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:54	10:22 (1) 08:26	10:38 (1) 07:31	07:18	06:11	05:24	05:21	05:59	06:50	07:41	07:37	10:21 (1) 08:30
2	08:54	10:22 (1) 08:24	10:39 (1) 07:28	07:16	06:09	05:23	05:21	06:00	06:52	07:43	07:39	10:19 (1) 08:31
3	08:54	10:22 (1) 08:22	10:40 (1) 07:26	07:13	06:07	05:22	05:22	06:02	06:54	07:45	07:41	10:17 (1) 08:33
4	08:53	10:23 (1) 08:21	10:41 (1) 07:24	07:11	06:05	05:22	05:23	06:04	06:55	07:46	07:43	10:15 (1) 08:34
5	08:53	10:23 (1) 08:19	10:42 (1) 07:21	07:09	06:03	05:21	05:24	06:05	06:57	07:48	07:44	10:14 (1) 08:35
6	08:53	10:24 (1) 08:17	10:43 (1) 07:19	07:06	06:02	05:20	05:25	06:07	06:59	07:50	07:46	10:12 (1) 08:37
7	08:52	10:24 (1) 08:16	10:46 (1) 07:17	07:04	06:00	05:20	05:26	06:08	07:01	07:52	07:48	10:11 (1) 08:38
8	08:52	10:24 (1) 08:14	10:47 (1) 07:15	07:02	05:58	05:19	05:27	06:10	07:02	07:53	07:50	10:10 (1) 08:39
9	08:51	10:25 (1) 08:12	10:49 (1) 07:12	06:59	05:56	05:19	05:28	06:12	07:04	07:55	07:52	10:10 (1) 08:40
10	08:51	10:25 (1) 08:10	10:52 (1) 07:10	06:57	05:54	05:18	05:29	06:13	07:06	07:57	07:54	10:09 (1) 08:42
11	08:50	10:26 (1) 08:08	10:55 (1) 07:08	06:55	05:53	05:18	05:30	06:15	07:07	07:59	07:56	10:08 (1) 08:43
12	08:50	10:26 (1) 08:06	11:00 (1) 07:05	06:52	05:51	05:17	05:31	06:17	07:09	08:01	07:57	10:08 (1) 08:44
13	08:49	10:26 (1) 08:04	11:03 (1) 07:03	06:50	05:49	05:17	05:32	06:18	07:11	08:02	07:59	10:08 (1) 08:45
14	08:48	10:27 (1) 08:02	11:07 (1) 07:01	06:48	05:47	05:16	05:33	06:20	07:12	08:04	08:01	10:07 (1) 08:46
15	08:47	10:27 (1) 08:00	11:11 (1) 07:00	06:46	05:46	05:15	05:34	06:22	07:14	08:06	08:03	10:07 (1) 08:47
16	08:46	10:28 (1) 07:58	11:15 (1) 06:58	06:44	05:44	05:14	05:36	06:23	07:16	08:08	08:05	10:07 (1) 08:48
17	08:45	10:28 (1) 07:56	11:19 (1) 06:56	06:42	05:43	05:13	05:37	06:25	07:17	08:10	08:06	10:07 (1) 08:48
18	08:44	10:29 (1) 07:54	11:23 (1) 06:54	06:40	05:41	05:12	05:38	06:27	07:19	08:11	08:08	10:06 (1) 08:49
19	08:43	10:29 (1) 07:52	11:27 (1) 06:52	06:38	05:40	05:11	05:39	06:28	07:21	08:13	08:10	10:06 (1) 08:50
20	08:42	10:30 (1) 07:50	11:31 (1) 06:50	06:36	05:38	05:10	05:41	06:30	07:22	08:15	08:12	10:05 (1) 08:51
21	08:41	10:30 (1) 07:48	11:35 (1) 06:48	06:34	05:37	05:09	05:42	06:32	07:24	08:17	08:13	10:05 (1) 08:51
22	08:40	10:30 (1) 07:46	11:39 (1) 06:46	06:32	05:36	05:08	05:44	06:34	07:26	08:19	08:15	10:06 (1) 08:52
23	08:39	10:31 (1) 07:44	11:43 (1) 06:44	06:30	05:34	05:07	05:45	06:35	07:28	08:20	08:17	10:06 (1) 08:52
24	08:37	10:31 (1) 07:42	11:47 (1) 06:42	06:28	05:33	05:06	05:46	06:37	07:29	08:22	08:19	10:06 (1) 08:53
25	08:36	10:33 (1) 07:39	11:51 (1) 06:40	06:26	05:32	05:05	05:48	06:39	07:31	08:24	08:20	10:06 (1) 08:53
26	08:35	10:34 (1) 07:37	11:55 (1) 06:38	06:24	05:31	05:04	05:49	06:40	07:33	08:26	08:22	10:06 (1) 08:53
27	08:33	10:34 (1) 07:35	11:59 (1) 06:36	06:22	05:30	05:03	05:51	06:42	07:34	08:28	08:24	10:06 (1) 08:54
28	08:32	10:34 (1) 07:33	12:03 (1) 06:34	06:20	05:29	05:02	05:52	06:44	07:36	08:30	08:25	10:07 (1) 08:54
29	08:30	10:36 (1) 07:31	12:07 (1) 06:32	06:18	05:27	05:01	05:54	06:45	07:38	08:31	08:27	10:07 (1) 08:54
30	08:29	10:36 (1) 07:29	12:11 (1) 06:30	06:16	05:26	05:00	05:56	06:47	07:40	08:33	16	10:27 (1) 08:28
31	08:27	10:37 (1) 07:27	12:15 (1) 06:28	06:14	05:24	04:59	05:57	06:49	07:42	08:35	16	10:43 (1) 16:31
Potential sun hours	255	276	367	418	489	504	506	456	381	330	263	239
Total, worst case	2302	544								42	1972	2359
Sun reduction	0,26	0,33								0,34	0,23	0,21
Oper. time red.	0,97	0,97								0,97	0,97	0,97
Wind dir. red.	0,60	0,60								0,60	0,60	0,60
Total reduction	0,15	0,19								0,20	0,13	0,12
Total, real	343	103								8	263	286

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)