

Project:

Velinga RK20130618

Printed/Page

2013-09-24 13:56 / 1

Licensed user:

Vattenfall Vindkraft A/S

Oldenborggade 25-31

DK-7000 Fredericia

88275078

Rebecka Klintström / rebecka.klintstrom@vattenfall.com

Calculated:

2013-09-24 13:56/2.8.579

## SHADOW - Main Result

Calculation: alt 15 skuggberäkning

### 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) [GOTEBORG]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,32	2,16	3,42	6,08	9,24	8,56	7,23	5,77	4,73	3,30	1,75	1,23

Operational hours are calculated from WTGs in calculation and wind distribution:

Site data f.u.i. Wasp - vat03-pos2 - 8.44 at 125 m

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
406	372	470	532	533	476	714	906	1 511	1 346	743	546	8 558

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

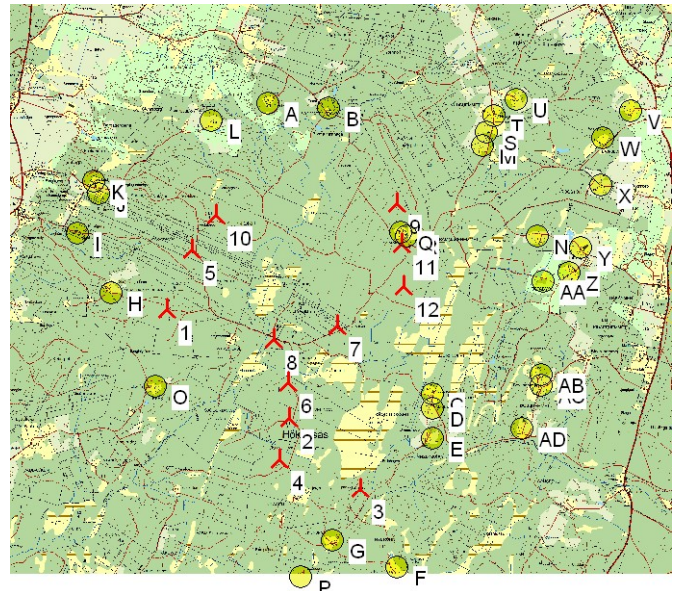
A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:

Height contours used: Height Contours: velinga height contours.map (8)

Obstacles used in calculation

Eye height: 1,5 m

Grid resolution: 10,0 m



New WTG

Scale 1:75 000  
Shadow receptor

### WTGs

RN	East	North	Z	Row data/Description	WTG type			Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Shadow data	
					Valid	Manufact.	Type-generator				Calculation distance [m]	RPM [RPM]
1	1 393 034	6 442 621	305,4	15F	Yes	Siemens	SWT-3.0 113m-3 000	3 000	113,0	122,5	1 357	0,0
2	1 394 246	6 441 546	308,8	15J	Yes	Siemens	SWT-3.0 113m-3 000	3 000	113,0	122,5	1 357	0,0
3	1 394 945	6 440 846	329,3	15L	Yes	Siemens	SWT-3.0 113m-3 000	3 000	113,0	122,5	1 357	0,0
4	1 394 149	6 441 135	309,2	15K	Yes	Siemens	SWT-3.0 113m-3 000	3 000	113,0	122,5	1 357	0,0
5	1 393 280	6 443 210	285,0	15D	Yes	Siemens	SWT-3.0 113m-3 000	3 000	113,0	122,5	1 357	0,0
6	1 394 238	6 441 903	300,2	15I	Yes	Siemens	SWT-3.0 113m-3 000	3 000	113,0	122,5	1 357	0,0
7	1 394 723	6 442 459	305,0	15G	Yes	Siemens	SWT-3.0 113m-3 000	3 000	113,0	122,5	1 357	0,0
8	1 394 088	6 442 326	290,0	15H	Yes	Siemens	SWT-3.0 113m-3 000	3 000	113,0	122,5	1 357	0,0
9	1 395 310	6 443 670	305,4	15A	Yes	Siemens	SWT-3.0 113m-3 000	3 000	113,0	122,5	1 357	0,0
10	1 393 518	6 443 553	268,8	15B	Yes	Siemens	SWT-3.0 113m-3 000	3 000	113,0	122,5	1 357	0,0
11	1 395 354	6 443 274	322,5	15C	Yes	Siemens	SWT-3.0 113m-3 000	3 000	113,0	122,5	1 357	0,0
12	1 395 376	6 442 854	317,2	15E	Yes	Siemens	SWT-3.0 113m-3 000	3 000	113,0	122,5	1 357	0,0

### Shadow receptor-Input

No.	RN			Width [m]	Height [m]	Height a.g.l. [m]	Degrees from south cw [°]	Slope of window [°]	Direction mode
	East	North	Z						
A	1 394 030	6 444 667	238,1	1,0	1,0	1,5	0,0	90,0	"Green house mode"
B	1 394 635	6 444 619	245,0	1,0	1,0	1,5	0,0	90,0	"Green house mode"
C	1 395 663	6 441 783	310,0	1,0	1,0	1,5	0,0	90,0	"Green house mode"
D	1 395 661	6 441 643	310,0	1,0	1,0	1,5	0,0	90,0	"Green house mode"
E	1 395 663	6 441 349	301,5	1,0	1,0	1,5	0,0	90,0	"Green house mode"
F	1 395 311	6 440 058	332,4	1,0	1,0	1,5	0,0	90,0	"Green house mode"
G	1 394 673	6 440 325	324,0	1,0	1,0	1,5	0,0	90,0	"Green house mode"
H	1 392 480	6 442 787	284,5	1,0	1,0	1,5	0,0	90,0	"Green house mode"
I	1 392 150	6 443 378	244,4	1,0	1,0	1,5	0,0	90,0	"Green house mode"
J	1 392 357	6 443 765	237,8	1,0	1,0	1,5	0,0	90,0	"Green house mode"

To be continued on next page...

Project:

Vellinga RK20130618

Printed/Page

2013-09-24 13:56 / 2

Licensed user:

**Vattenfall Vindkraft A/S**

Oldenborggade 25-31

DK-7000 Fredericia

88275078

Rebecka Klintström / rebecka.klintstrom@vattenfall.com

Calculated:

2013-09-24 13:56/2.8.579

**SHADOW - Main Result****Calculation:** alt 15 skuggberäkning

...continued from previous page

RN

No.	East	North	Z	Width	Height	Height a.g.l.	Degrees from south cw	Slope of window	Direction mode
			[m]	[m]	[m]	[m]	[°]	[°]	
K	1 392 306	6 443 893	233,4	1,0	1,0	1,5	0,0	90,0	"Green house mode"
L	1 393 472	6 444 491	235,0	1,0	1,0	1,5	0,0	90,0	"Green house mode"
M	1 396 154	6 444 239	320,0	1,0	1,0	1,5	0,0	90,0	"Green house mode"
N	1 396 704	6 443 349	323,6	1,0	1,0	1,5	0,0	90,0	"Green house mode"
O	1 392 924	6 441 859	302,3	1,0	1,0	1,5	0,0	90,0	"Green house mode"
P	1 394 354	6 439 964	310,5	1,0	1,0	1,5	0,0	90,0	"Green house mode"
Q	1 395 345	6 443 391	325,0	1,0	1,0	1,5	0,0	90,0	"Green house mode"
R	1 395 407	6 443 351	325,0	1,0	1,0	1,5	0,0	90,0	"Green house mode"
S	1 396 195	6 444 379	310,8	1,0	1,0	1,0	0,0	90,0	"Green house mode"
T	1 396 275	6 444 539	300,0	1,0	1,0	1,0	0,0	90,0	"Green house mode"
U	1 396 495	6 444 699	289,7	1,0	1,0	1,0	0,0	90,0	"Green house mode"
V	1 397 626	6 444 589	292,2	1,0	1,0	1,0	0,0	90,0	"Green house mode"
W	1 397 346	6 444 319	320,0	1,0	1,0	1,0	0,0	90,0	"Green house mode"
X	1 397 326	6 443 849	321,6	1,0	1,0	1,0	0,0	90,0	"Green house mode"
Y	1 397 126	6 443 229	319,9	1,0	1,0	1,0	0,0	90,0	"Green house mode"
Z	1 397 016	6 442 989	314,4	1,0	1,0	1,0	0,0	90,0	"Green house mode"
AA	1 396 755	6 442 899	311,0	1,0	1,0	1,0	0,0	90,0	"Green house mode"
AB	1 396 735	6 441 979	296,1	1,0	1,0	1,0	0,0	90,0	"Green house mode"
AC	1 396 735	6 441 869	295,0	1,0	1,0	1,0	0,0	90,0	"Green house mode"
AD	1 396 545	6 441 439	290,1	1,0	1,0	1,0	0,0	90,0	"Green house mode"

**Calculation Results**

Shadow receptor

No.	Shadow, worst case		Shadow, expected values	
	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow hours per year [h/year]
A	21:36	64	0:23	2:41
B	11:36	38	0:24	1:23
C	38:42	116	0:25	8:47
D	26:06	86	0:26	5:20
E	15:34	40	0:30	3:01
F	0:00	0	0:00	0:00
G	0:00	0	0:00	0:00
H	85:37	136	0:52	24:08
I	17:55	60	0:23	3:18
J	29:01	102	0:24	4:36
K	15:41	55	0:22	2:47
L	42:27	68	0:50	4:47
M	25:43	84	0:27	4:07
N	6:02	26	0:20	1:19
O	16:27	63	0:22	4:50
P	0:00	0	0:00	0:00
Q	576:48	310	2:42	131:36
R	508:19	273	3:02	135:10
S	11:08	36	0:24	1:52
T	9:20	35	0:21	1:24
U	0:00	0	0:00	0:00
V	0:00	0	0:00	0:00
W	0:00	0	0:00	0:00
X	0:00	0	0:00	0:00
Y	0:00	0	0:00	0:00
Z	0:00	0	0:00	0:00
AA	0:00	0	0:00	0:00
AB	0:00	0	0:00	0:00
AC	0:00	0	0:00	0:00
AD	0:00	0	0:00	0:00

Project:

Vellinga RK20130618

Printed/Page

2013-09-24 13:56 / 3

Licensed user:

**Vattenfall Vindkraft A/S**

Oldenborggade 25-31

DK-7000 Fredericia

88275078

Rebecka Klintström / rebecka.klintstrom@vattenfall.com

Calculated:

2013-09-24 13:56/2.8.579

**SHADOW - Main Result****Calculation:** alt 15 skuggberäkning

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

No.	Name	Worst case [h/year]	Expected [h/year]
1	15F	52:30	9:43
2	15J	0:00	0:00
3	15L	42:00	6:47
4	15K	0:00	0:00
5	15D	74:18	17:58
6	15I	6:39	1:44
7	15G	73:10	14:02
8	15H	9:48	3:06
9	15A	40:26	6:18
10	15B	83:45	14:36
11	15C	766:53	205:10
12	15E	128:55	15:48