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Date:
2021-04-19

Our reference:
10270040-L-3-A

Your reference:
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Shadow flicker assessment for a changing at planned wind farm near Ellhöft, Germany

Introduction

Grenzstrom Bürgerwind GmbH & Co. KG (the "customer") is developing the Ellhöft Wind Farm in the region of North Frisia, Schleswig-Holstein, Germany. Regarding a changed planning for one Wind turbine (WTG 16) from the type Siemens SWT 3.2-113 to Siemens Gamesa SG 5.0-132, the customer has requested GL Garrad Hassan Deutschland GmbH (DNV) to carry out the shadow flicker assessment for this changed configuration. The results of this work are summarized in this technical letter.

Details of the methodology and procedures used for the shadow flicker calculation can be found within the report 10270040-A-2-A "Schattenwurfberechnung für die Umgebung des geplanten Windenergieparks Ellhöft" issued by DNV at 2020-12-15.

Wind turbines taken into account

The following turbine configuration given by the customer is considering 33 existing and additional planned wind turbine generator systems (WTGs) in total as well as six turbines planned by the customer. The additional windfarm project is planned/realized by a Danish operator and must be respected as preload. Table 1 shows detailed information of the turbines in question.

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Table 1: Planned and existing turbines and technical data

WTG No.	Manufacturer Type	Hub height (m)	Rotor diameter (m)	Ground reflection coefficient R_0
Existing WTGs (preload)				
S_01, S_02 and S_04 to S_08 to S_12	Siemens SWT 3.0-113	92,5	113,0	0
S_03	Siemens SWT 3.0-101	79,5	101,0	0
S_23, S_24, S_26, S_27	AN Bonus 1.3MW-62	68	62,0	0
S_28 to S_31	Siemens SWT 2.3-93	93	92,6	0
S_32 to S_34	REpower 6M	100	126,0	0
S_35	Enercon E-101	99	101,0	0
01 to 03	Vestas V112/3.3 MW	94	112,0	0
Additional planning Tønder Kommune, DK (preload)				
DK01 und K06	Vestas V126-3.45MW HTq	87	126,0	0
Planned WTGs (additional load)				
14, 15, 18, 19	Siemens SWT 3.2 MW-113	92,5	113,0	0
16	Siemens Gamesa SG 5.0-132	106,5	132,0	0
17	Siemens SWT-DD-130	115	130,0	0

In comparison with the primary authorized wind farm layout only the turbine type of the WTG 16 has changed from Siemens SWT 3.2-113 with a hub height of 115,5 m to Siemens Gamesa SG 5.0-132 with a hub height of 106,5 m. The reduced hub height of 9,0 m together with the increase of the rotor diameter by 19,0 m leads to a total height of 172,5 m which is 0,5 m above the former configuration.

Chosen points of impact and results

The points of shadow flicker impact chosen for the calculation are representative residences within the area of shadow flicker impact of the planned wind turbines.

For the area in question detailed information for these points of impact are given in report 10270040-A-2-A.

Table 2: Chosen relevant points of impact and results for preload additional shadow flicker and total impact

point of immission	Shadow flicker					
	Preload		additional impact		total impact	
	h/year	h/day	h/year	h/day	h/year	h/day
IO 003 Böglumer Straße 1	211:23	01:29	3:04	00:15	214:27	01:29
IO 004 Böglumer Str 2 u. 3	200:02	01:11	3:49	00:17	203:51	01:11
IO 005 Böglumer Straße 6	152:58	01:17	9:04	00:23	162:02	01:17
IO 006 Uhlenberg 1	42:41	00:33	13:26	00:24	56:07	00:33
IO 007 Dorfstraße 7	40:41	01:00	21:22	00:25	53:26	01:00
IO 008 Dorfstraße 8	42:54	00:35	11:41	00:25	54:35	00:35
IO 009 Dorfstraße 27	38:47	00:33	16:55	00:26	55:42	00:33
IO 010 Dorfstraße 2a	44:59	00:25	11:47	00:25	52:28	00:32
IO 011 Dorfstraße 9	23:51	00:29	7:44	00:21	28:01	00:35
IO 012 Grenzstraße 12, Osterhof (Schwarze Berge)	39:30	00:33	11:22	00:22	50:52	00:33
IO 014 Schwarze Berge 16	13:49	00:28	3:42	00:16	16:09	00:28
IO 015 Grenzstraße 1	46:13	00:46	13:05	00:25	52:18	00:46
IO 016 Schwarze Berge 18	15:17	00:28	0:00	00:00	15:17	00:28
IO 017 Beierskrovej 15 a-c	57:08	00:44	5:30	00:11	57:44	00:44
IO 019 Grenzstraße 2, Westre	5:45	00:16	0:00	00:00	5:45	00:16
IO 022 Engholm, Edlefsen	2:30	00:09	0:00	00:00	2:30	00:09
IO 039 Am Wald 1, Ellhöft	34:54	00:33	0:00	00:00	34:54	00:33
IO 041 Karlsminde (DK)	13:01	00:26	0:00	00:00	13:01	00:26
IO 042 Karlsmindevej 1 (DK)	2:22	00:14	3:19	00:12	5:41	00:14
IO 043 Lydersholmvej 13 (DK)	0:00	00:00	1:39	00:11	1:39	00:11
IO 044 Vindvedvej 3 (DK)	0:00	00:00	16:13	00:23	16:13	00:23
IO 095 Hovmosevej 15 (DK)	8:20	00:24	3:41	00:17	12:01	00:24
IO 096 Hovmosevej 17 (DK)	2:28	00:14	8:32	00:17	11:00	00:17
IO 110 Sændholm (1) (DK)	69:13	00:58	0:00	00:00	69:13	00:58

Assessment of results

In summary, the exceedance of the permitted shadow flicker limits is already affected by the existing turbines. The additional impact caused by the planned turbines is increasing this exceeding.

Overlooking the results for the points of impact at the danish territory (IO 41 to IO 044, IO 095, IO 96 and IO 110), the possibility of the surrounding residents being unduly affected, caused by the planned WTGs of the Grenzstrom Bürgerwind GmbH & Co. KG, can be excluded for the given configuration.

Independent from the planned turbine type, a suitable configured shadow flicker protection system can ensure that the surrounding residential areas are not unduly affected by the existing and/or planned turbines.



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Sincerely
for GL Garrad Hassan Deutschland GmbH

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