ESTIMATION OF POWER QUALITY

According to IEC 61400-21: Wind turbine generator system, of 12.2001

Report:	**NR 08 028**	**Sheet:**	**NR 08 028.001**	**page 1 of 3**
Wind turbine type designation:	**WTN 250**	Serial number	-	
Name of test organisation:	DEWI-GmbH Deutsches Windenergie- Institut Ebertstr. 96, D-26382 Wilhelmshaven, Germany			
Wind turbine manufacture:	Windtechnik-Nord Enger Strasse 13 D-25917 Enge-Sande			

Description of the tested wind turbine, including settings of control parameters:	Document name and date/ Manufacturer specification of: WTN 250
Description of the test side and grid connection:	-
Description of the test equipment:	-
Description of test conditions:	-
Measurement period:	-

Note of exceptions to IEC 61400-21:

The given values of this data sheet are not based on power quality measurements at the WTN 250 as it is required by IEC 61400-21. They are based on an estimation, which is performed on the basis of the experience of power quality measurements at similar wind turbines and of the theoretical investigations of the main specifications of the WTN 250.

Remarks:

1) Due to the type of wind turbine (directly coupled asynchronous generator) it is not required by the IEC61400-21 to give harmonic currents.

General Data:

Number of blades:	3	**Generator type and rating(s):**	asynchronous 250 kW
Rotor diameter [m]:	30 m	**Frequency converter** type rating**:**	---
Hub height [m]:	50 m	Special features:	
Blade control (pitch/stall):	stall		
Speed control(fixed/2speed/variable):	2 speed		

Rated Data:

Rated power, P_n:	250 kW	**Rated apparent power, S_n:**	261 kVA
Rated wind speed, v_n:	14 m/s	**Rated reactive power, Q_n:**	75 kvar, inductive
Rated voltage, U_n:	400 V	**Rated current, I_n:**	377 A

ESTIMATION

Maximum power and assessed reactive power:

Max. permitted power, P_{mc}:		**Max. 60 sec. average**		**Max. 0.2 sec. average**	
P_{mc}	$p_{mc}=P_{mc}/P_n$	P_{60}	$p_{60}=P_{60}/P_n$	$P_{0.2}$	$p_{0.2}=P_{0.2}/P_n$
275 kW	1.10	300 kW	1.20	375 kW	1.50
Q_{mc} at P_{mc}	Q_{mc}/P_n [kvar/kW]	Q_{60} at P_{60}	Q_{60}/P_n [kvar/kW]	$Q_{0.2}$ at $P_{0.2}$	$Q_{0.2}/P_n$ [kvar/kW]
85 kvar inductive	0.34 inductive	100 kvar inductive	0.40 inductive	160 kvar inductive	0.64 inductive

Reactive power:

Output power bin P/P_n		**Active power bin-mean-value [kW]**	**Reactive power bin-mean-value [kvar]**
from	to		
-0.05	**<0.05**	0	9 inductive
0.05	**<0.15**	25	12 inductive
0.15	**<0.25**	50	18 inductive
0.25	**<0.35**	75	23 inductive
0.35	**<0.45**	100	29 inductive
0.45	**<0.55**	125	32 inductive
0.55	**<0.65**	150	38 inductive
0.65	**<0.75**	175	45 inductive
0.75	**<0.85**	200	55 inductive
0.85	**<0.95**	225	65 inductive
0.95	**<1.05**	250	75 inductive

Harmonics: [1)]

Order	**Harmonic current: [% of I_n]**	**Output power [kW]**	**Order**	**Harmonic current: [% of I_n]**	**Output power [kW]**	**Order**	**Harmonic current: [% of I_n]**	**Output power [kW]**
2			**3**			**4**		
5			**6**			**7**		
8			**9**			**10**		
11			**12**			**13**		
14			**15**			**16**		
17			**18**			**19**		
20			**21**			**22**		
23			**24**			**25**		
26			**27**			**28**		
29			**30**			**31**		
32			**33**			**34**		
35			**36**			**37**		
38			**39**			**40**		
41			**42**			**43**		
44			**45**			**46**		
47			**48**			**49**		
50								

Maximum total harmonic current distortion:[% of I_n]		**Output power at maximum total harmonic current distortion [kW]:**	

PRELIMINARY

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Flicker:

Network impedance phase angle, ψ_k:	30°	50°	70°	85°
Annual average wind speed, v_a(m/s):	Flicker coefficient, $c(\psi_k, v_a)$:			
6.0 m/s	10	11	12	12
7.5 m/s	10	11	12	12
8.5 m/s	10	11	12	12
10.0 m/s	10	11	12	12

Switching operations:

Case of switching operation:	Start-up at cut in wind speed			
Maximum number of switching operations, N_{10}:	12			
Maximum number of switching operations, N_{120}:	120			
Network impedance phase angle, ψ_k:	30°	50°	70°	85°
Flicker step factor, $k_f(\psi_k)$:	0.7	0.8	1.0	1.0
Voltage change factor, $k_U(\psi_k)$:	0.5	0.6	0.6	0.7

Case of switching operation:	Start up at rated wind speed			
Maximum number of switching operations, N_{10}:	1			
Maximum number of switching operations, N_{120}:	12			
Network impedance phase angle, ψ_k:	30°	50°	70°	85°
Flicker step factor, $k_f(\psi_k)$:	1.1	1.3	1.4	1.5
Voltage change factor, $k_U(\psi_k)$:	2.0	1.7	1.9	2.1

Worst case switching between generators:

Case of switching operation:	From small to large generator stage			
Maximum number of switching operations, N_{10}:	12			
Maximum number of switching operations, N_{120}:	120			
Network impedance phase angle, ψ_k:	30°	50°	70°	85°
Flicker step factor, $k_f(\psi_k)$:	1.0	1.1	1.2	1.3
Voltage change factor, $k_U(\psi_k)$:	1.8	1.6	1.7	1.9

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