Proposal for NC RFG Requirements of General Application

General

The compliance of 6 wind turbines with the proposed general requirements is checked according to their datasheets. Three wind turbine manufacturers were selected with the largest market share. The selected wind turbines are currently on the market and are known for their top technology. Two wind turbines are selected per wind turbine manufacturer, one larger than 3MW and one lower than 3MW.

We can conclude that some capabilities aren't met by the wind turbines, especially the wind turbines with an active power production which is lower than 3MW. This group of wind turbines is still valuable, due to the fact that some permits have a limitation in maximum allowed active power production. If a strict compliance is demanded, than projects with wind turbines with a smaller active power production can't be build.

Textual remarks on "Proposal for NC RFG Requirements Of General Application

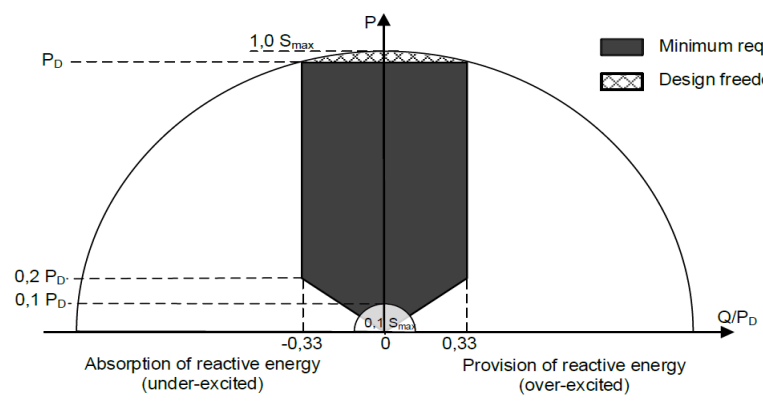
<table>
<tr><th></th><th>Proposed</th><th>Remark</th></tr>
<tr><td>3.1.1</td><td>
<table>
<tr><th>Frequency Range</th><th>Duration</th></tr>
<tr><td>47,5 Hz – 48,5 Hz</td><td>30 minutes</td></tr>
<tr><td>48,5 Hz – 49,0 Hz</td><td>30 minutes</td></tr>
<tr><td>49,0 Hz – 51,0 Hz</td><td>Unlimited</td></tr>
<tr><td>51,0 Hz – 51,5 Hz</td><td>30 minutes</td></tr>
</table>
</td><td>≥ or ≤ signs aren't used. For instance if the frequency is 49 Hz does the PGM needs to stay connected during 30 minutes or unlimited?</td></tr>
<tr><td>3.1.4</td><td>• The droop setting is 5 % and selectable within the range 2% and 12%;</td><td>Define formula for the droop, as described in and ENTSO-e grid code</td></tr>
<tr><td>4.3.1.</td><td>For public DSOs, the required reactive capabilities should be met at the Point of Connection with the public network.
 

Figure 7: Capability curve for SPGM type B</td><td>The reactive capabilities at point of connection of a public DSO are difficult to be met if a SPGM or PPM is connected in an industrial site. Due to the absorption or delivery of reactive power by the loads of the industrial site. Thus an exception should be made for this type of connected SPGM or PPM</td></tr>
<tr><td>5.6.2.</td><td>A PPM of type C shall be capable to deliver reactive power within the Q-P profile described in Figure 17.</td><td>A PPM of type C shall be capable to deliver reactive power within the Q-P profile described in Figure 18.</td></tr>
</table>

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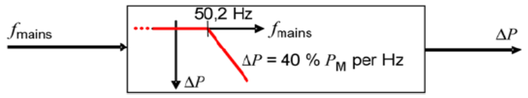
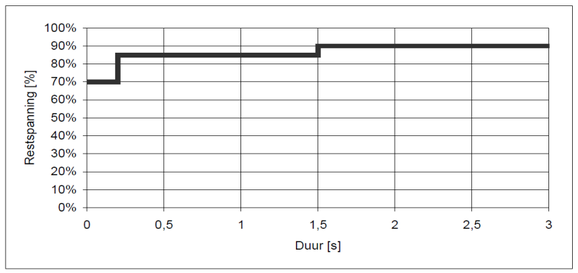
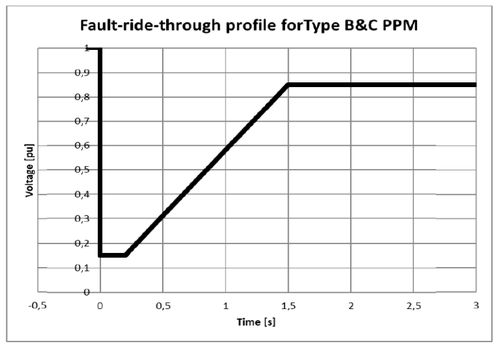
Art.	Demand	Current demand	Proposed demand	Should be met at	A	B	C	D	Comparison current and proposed	> 3 MW			< 3 MW		
										A1	B1	C1	A2	B2	C2
3.1.1	Frequency withstand capability	-Disconnect immediately in case fmains < 47,5 Hz OR fmains > 51,5 Hz - Produce power for at least 30 minutes in case 47,5 Hz ≤ fmains ≤ 49,0 Hz OR 51,0 Hz ≤ fmains ≤ 51,5 Hz	**Frequency Range** / **Duration** 47,5 Hz – 48,5 Hz: 30 minutes 48,5 Hz – 49,0 Hz: 30 minutes 49,0 Hz – 51,0 Hz: Unlimited 51,0 Hz – 51,5 Hz: 30 minutes	/	Y	Y	Y	Y	=	OK	?	OK	OK	NOK	OK
3.1.2.	ROCOF withstand capability	- df/dt: Ogenblikkelijke of vetraagde uitschakeling bij detectie van een frequentieverloop van 1Hz/s. Om ongewenste uitschakelingen ten gevolge van een oscillatie van de generator te vermijden mag een vertragingstijd ingesteld worden van 0,1s en mag bovendien deze functie uitgeschakeld worden voor frequentievariaties die kleiner zijn 0,2Hz.	The proposed RoCoF withstand capability is defined considering frequency against time profile as depicted in the Figure 3 with explicit measurement technique taking into consideration 2 Hz/s for a duration of 500 ms. For PGM connected to Transmission Network and relying on Loss Of Main	/	Y	Y	Y	Y	<>	?	?	?	?	?	?
3.1.4	Limited Frequency Sensitive Mode - Over frequency	 *figuur 1: beperking van het actie vermogen in geval van overfrequentie.* Bij 50,2 Hz ≤ f_{mains} ≤ 51,5Hz: • als P_{Amax} ≤ (P_M – ΔP) dan P = P_{Amax} • als P_{Amax} > (P_M – ΔP) dan P = P_M – ΔP met ΔP = 0,4.P_M.(f_{mains} – 50,2)	• The droop setting is 5 % and selectable within the range 2% and 12%; • Frequency activation threshold 50.2 Hz; **Parameters (PPM)** / **For power increase** / **For power decrease** **Step response time**: *For wind generation:* ≤ 5 seconds for an increase of active power of 20 % Pmax; ≤ 2 seconds for a decrease of active power of 50 % Pmax *For the rest:* ≤ 10 seconds for an increase of active power of 50 % Pmax **Settling time**: ≤ 30 seconds for an increase of active power / ≤ 20 seconds for a decrease of active power	/	Y	Y	Y	Y	<>	?	?	?	?	?	?
4.4.1	Fault Ride Through	• 85% restspanning gedurende 1,5s • 70% restspanning gedurende 0.2s  **Figuur 2-1 Tolerantieëis tegenover spanningsdips - grafische voorstelling**	 Figure 10: FRT requirement for PPM type B and C **Voltage parameters [pu]**: Uret=Uclear=Uret1= 0.15; Urec2 = 0.85 **Time parameters [seconds]**: tclear=trec1=trec2= 0.2; t_{rec3}=1.5	PoC	/	Y	Y	/	<>	?	OK	OK	?	OK	OK

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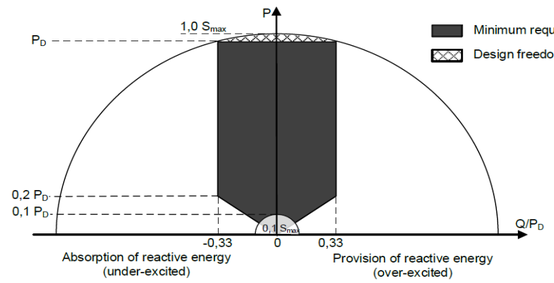
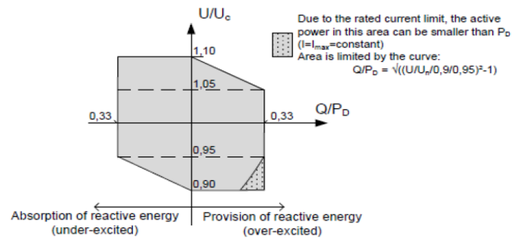
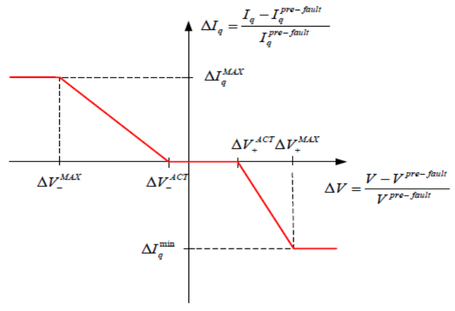
										A1	B1	C1	A2	B2	C2
4.4.2	Reactive capabilities - PPM	• Decentrale productie-installaties >1 MVA: De productie-installatie moet technisch in staat zijn om een reactief vermogen met een getalwaarde gelegen tussen –0,1 Pnom en 0,33 Pnom respectievelijk te absorberen of te leveren. De netbeheerder bepaalt het/de vereiste werkingspunt(en).	 Figure 11: Capability curve for PPM type B  Figure 12: U/U_c-Q/P_D profile for type B PPM in order to visualize reactive power requirements for voltages different from 1pu .	HV-side trafo	/	Y	/	/	<>	?	OK	OK	?	NOK	NOK
4.4.3.	Fault current support	/	 Figure 13: Injection of additional reactive current	/	/	/	Y	/	/	<>	?	?	?	?	?	?
4.4.4.	Post-fault active power recovery	/	For distribution connected PPMs of type B for which the public DSO is the relevant system operator, the proposed default post fault active power recovery requirement is 90% of pre-fault power within 1 seconds. Another site specific specification is to be agreed during the connection process with the DSO in coordination with the TSO.	/	/	Y	/	/	<>	?	?	OK	?	?	NOK

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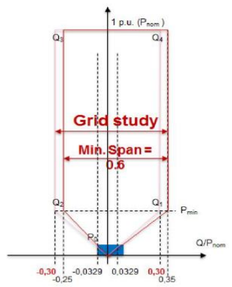
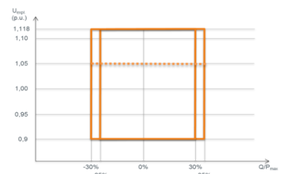
										A1	B1	C1	A2	B2	C2
5.6.2.	Reactive capabilities	• Decentrale productie-installaties >1 MVA: De productie-installatie moet technisch in staat zijn om een reactief vermogen met een getalwaarde gelegen tussen –0,1 Pnom en 0,33 Pnom respectievelijk te absorberen of te leveren. De netbeheerder bepaalt het/de vereiste werkingspunt(en).	 Figure 18: Reactive power capability for a Type C and D PPM.  Figure 19: U-Q/Pmax profile for a type C PPM (dashed for nominal voltages above 300kV).	PoC	/	/	Y	/		?	NOK	OK	NOK	NOK	NOK