EWEA and EPIA main concerns and proposals for solutions

ENTSO-E Network Code for Requirements for Grid Connection applicable to all Generators

January 2013

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1. Introduction to principal concerns of EWEA and EPIA with the NC RfG

The European wind industry represented by EWEA has together with EPIA assessed the ENTSO-E Network Code for Requirements for Grid Connection applicable to all Generators (NC RfG) and the ACER reasoned opinion and has prepared this joint association paper as constructive input in view of the currently on-going revision process of the NC RfG.

This document summarises significant technical concerns that EWEA and EPIA want to highlight concerning the NC RfG published in June 2012, and subsequently amended in light of the ACER reasoned opinion published on 13 October 2012. These concerns are:

- FRT requirements: “Fast reactive current injection” and “Post fault active power recovery”
- Voltage/reactive power ranges for capability requirements for MV connected PPM.

The first item on FRT requirements is directly linked to the deficit in the NC identified by ACER in its reasoned opinion (missing justification in particular of the FRT specifications for type B units).

EWEA and EPIA reject the present concept of FRT specification in the NC RfG that includes inadequate requirements for fast reactive current injection and post-fault active power recovery.

The second item of concern on voltage and reactive power ranges is related in a broader way to the concern of ACER regarding deviations from present practices and leading to unjustified cost increases. We believe that if the ENTSO-E NC RfG is not amended on these items, it will hinder rather than facilitate security of supply and further wind power integration in the European network for the following reasons:

- Trade of wind power technology will be hampered because in some markets grid code requirements will go beyond state-of-the-art technology. Locally imposed minimum values in requirements may put certain manufacturers and their sub-suppliers at risk, because they can only be fulfilled by certain types of conversion systems due to physical restrictions of different technologies.

- The above mentioned requirements are estimated to result in additional investments in wind power generation technology of more than €1.5 billion by 2020. The technical and economic justification for these requirements is entirely absent; hence the resulting overall increased cost of power generation is totally unnecessary.

Thus, overall, the implementation of the NC RfG as it stands now forms a major economic threat for the renewable energy industry, and will most likely seriously affect the achievement of the European Renewable Energy targets by 2020. Moreover, as a secondary effect, National

Regulatory Authorities will have to cope with a multitude of derogation applications which may take years to solve and are likely to result in numerous legal challenges at national level.

The two mentioned issues (FRT and reactive capability for MV) are of huge concern for the wind and solar PV industries as they have a direct and severe impact on many key design aspects of the respective technologies. The current proposal in the NC RfG – both what is specified and not specified – is unacceptable to both industries.

In order to facilitate the on-going review process, EWEA and EPIA have proposed solutions in part 2 and part 3 of this paper, for the above mentioned key technical concerns on the subsequent pages.

2. FRT Requirements for Type B PPM

With respect of the FRT requirements for Type B PPMs, EWEA and EPIA have two major points of concern, namely:

- Specification of fast reactive current injection during FRT
- Active power recovery after the fault

In the following section, the concerns are explained, and proposed solutions are provided for the related paragraphs in Article 15.

Reactive Current Injection during FRT - Article 15.2.b)2)

In the process of drafting the June version of the NC text, the formulation of Article 15, 2b,2 was introduced by ENTSO-E at the very last minute, without transparent and sufficient interaction with the wind industry. Instead, ENTSO-E stated it had contacted some manufacturers, and proposes this interaction as principal justification for the formulation. We quote the e-mail from ENTSO-E to EWEA (30th of July 2012):

….ENTSO-E has checked its sources among leading wind turbine manufacturers which has confirmed that the change between the consulted version of a single requirement with narrow tolerance (40ms with 5% tolerance) to a split requirement including a fast component (at least 2/3rds in a TSO specified time, not faster than 10ms) along with a slower requirement with wider tolerance (60ms with 10% tolerance) makes good sense in terms of:

- *System needs: Deliver a component of fast current contribution for secure clearance of transmission system faults during high RES production when synchronous generators, normally relied upon, are displaced.*
- *Capability of wind turbine technologies (particularly the power converters): Less tight tolerances on the requirements. Note that the 10 ms is a lower limit ("shall not be less than 10 milliseconds") taking into account inherent differences in technologies.*

EWEA strongly contests that there has been a proper and sufficient interaction with the wind industry on this particular point and strongly objects to this narrow approach by ENTSO-E in assessing technology capabilities. The wind and solar PV industry cannot accept that an arbitrary requirement which is not underpinned by any calculation is imposed all over the EU through European law. Instead, this requirement appears to be introduced in the NC perhaps from a regionally biased perspective supported by informal contacts with a single wind turbine manufacturer.

EWEA and EPIA therefore propose the following solution for amending Article 15.2.b)2), page 40, which closely follows the formulation in the NC RfG.

Text of NC RfG (version 6/06/2012)

The Power Park Module [...] shall be capable of providing

at least ~~2/3~~ **90%** -of the additional reactive Current **(positive sequence of the fundamental)**

within a time period specified by the Relevant TSO, which shall

not be less than ~~10~~ **60** milliseconds.

The target value of this additional reactive Current [...] shall be reached

with an accuracy of ~~10%~~ **-10%/+20% (of Irated)**

within ~~60~~ **100** milliseconds

from the moment the Voltage deviation has occurred as further specified [...].

Below 40 % retained voltage reactive current shall be supplied as far as technically feasible.

A FEW ADDITIONAL COMMENTS HAVE TO BE MADE:

The 10 ms requirement introduced by ENTSO-E is unprecedented and beyond any current or typical best industry practice (state-of the art). The rise time aspect is only one of approximately 10-15 aspects needed for a full FRT specification. It is not acceptable for the wind and solar industry that such a crucial design impacting requirement can be introduced only at the last minute on a non-existing foundation or without an opportunity for discussion. No justification has been made publicly available, on the contrary:

- The arguments, assumptions and methodologies used to assess the supposed need for the 10 ms requirement are unknown to the industry because documentation is absent and/or inaccessible. According to ENTSO-E statements no calculations have been performed to justify the need;

- Potential non-intended technical disadvantages of implementing the requirement are unknown e.g. the risk of high TOV voltages (50 Hz temporary overvoltages);
- The supposed need currently seems to be related to only one national system but the NC will apply to all of Europe,
- Many TSO´s seem to disagree that there is a need for this requirement in this moment;
- The potential existence of technical alternatives is unknown and so are the associated cost comparison for these alternatives;
- There is no general consensus in the industry (manufacturers, TSO´s etc.) regarding the need or how it is to be specified properly.

The actual requirement in the German Grid Codes in relation to this rise time aspect specifies 30 ms plus a further 20 ms for detection, i.e. 50 ms in total. Apart from the fact that this 50 ms value is not directly comparable to the 10 ms specified by ENTSO-E because of differences in detailed definitions, it should be remarked that the values in the German Grid Code are debatable and lacking properly documented calculations of the need.

In general, it bears a huge risk for the manufacturers when one parameter is moved excessively but the full specification can not be seen at the same time. This applies to the current NC RfG – but it becomes even more challenging during later national implementation where TSO´s may start to combine many different sets of parameter values in an uncontrolled way. This will create a huge uncertainty and risk for all stakeholders involved in grid integration and compliance.

Beside the rise time value, the accuracy requirement in the NC RfG is excessive. The most demanding requirement in present grid codes would be the German one which requires -10%/+20% accuracy. The accuracy should be in relation to the rated current (not the target value). Contrarily to ENTSO-E statements, the accuracy during the fault does not have an impact on possible post-fault overvoltages.

The requirement for current injection for retained voltages below 10% should be excluded from the FRT requirements in Art 15, 2b, 2, and the requirement should be relaxed to a level of 40%. Problems may arise with phase angle detection during very low voltages. Moreover, the impact of reactive current contribution on the grid voltage for a retained voltage below 10% is negligible.

Active power recovery (Article 15,3)

EWEA and EPIA have significant concerns about the vague formulation of the requirement, mainly because it will cause the actual specifications for active power recovery behaviour to be determined in a scattered way all over Europe by local grid operators. This will most likely lead to discrimination against certain generator types and will cause a lot of consultation work for each national TSO. Therefore it would be very helpful if the NC RfG provides clear guidance. Requirements as to the wind turbine behaviour during active power recovery may have a significant effect on the wind turbine mechanical loads – and therefore affect its structural design. For example, careless choice of recovery time parameters may negatively interfere with wind turbine drive train dynamics and result in excessive wind turbine drive train loads. As a consequence, non-uniform grid code requirements throughout the EU will lead to different design requirements and hence to obstacles in the free movement of RES technologies.

Text of NC RfG (version 26/06/2012) and amended text proposal:

Type B Power Park Modules shall fulfil the following requirements referring to robustness of Power Generating Modules:

a) With regard to post fault Active Power recovery after fault-ride-through, the Relevant TSO shall specify while respecting the provisions of Article 4(3) ~~magnitude and time for Active Power recovery the Power Park Module shall be capable of providing.~~ a maximum recovery time for the Active Power to reach at least the level of 90 % of the pre-fault power, measured from the time the local voltage has recovered above 90 % of the pre-fault nominal voltage value. The maximum recovery time shall be specified to a value chosen within the range of 0.5 seconds and 10 seconds for faults that are cleared within 140 ms ($t_{clear} \leq 140$ ms) and within a range of 1 second and 10 seconds for faults that are cleared in a longer time than 140 ms (140 ms $> t_{clear} \leq 250$ ms).

3. Reactive power capability requirements for MV connected PPM Type C and Type D (Articles 16 and 17)

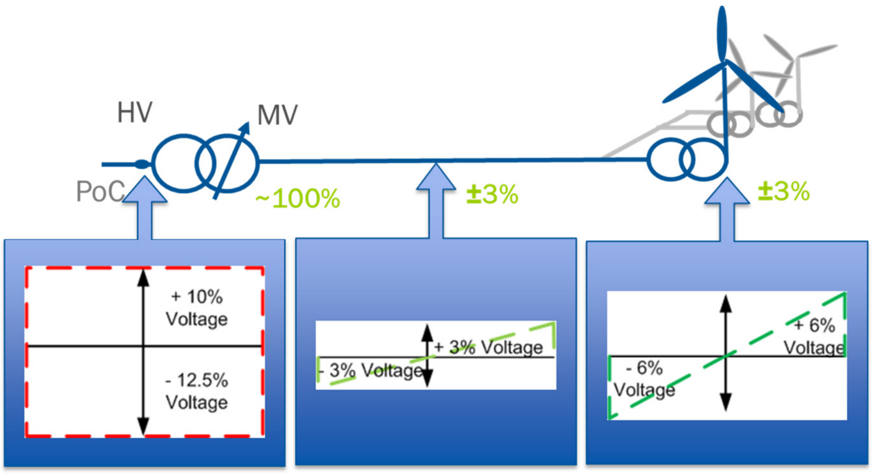
A major concern of EWEA and EPIA with respect to voltage and reactive power requirements is related specifically to the voltage range for reactive power capability requirement for Type C and Type D wind farms connected to MV, as specified in the NC RfG Article 16 and 17.

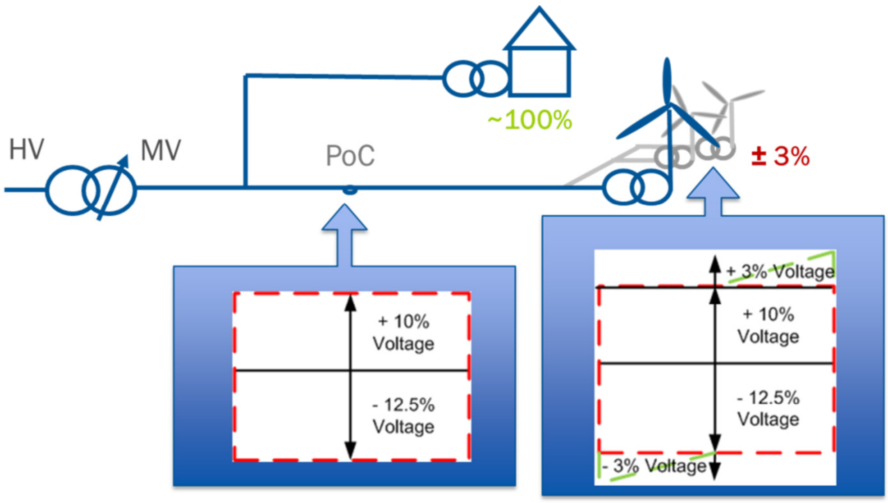
The NC RfG does not account for the difference in steady state voltage fluctuations between HV and MV voltage level when specifying the reactive capability requirements. In the case of plant connected below 100 kV (medium voltage) the stated reactive power over voltage range results in onerous requirements which cannot be met by even state-of-the-art wind turbines. In the absence of a proper justification for the presence of this reactive capability at MV level, Europe-wide implementation of this requirement will result in a huge amount of unnecessary investments and increased costs of power generation.

Moreover, the requirements in Articles 16 and 17 for MV connected plant conflict with the ACER reasoned opinion (page 8): " [...] *However, the case is less clear for voltage related issues occurring at lower voltages in the distribution networks. In particular because: a) the impact is less likely to be propagated directly up to transmission level/cross border, unless many small power generating modules of the same type are affected by the regional voltage profile significantly, and b) economic and efficient actions to correct voltage related issues are likely to vary significantly between distribution system operator areas, reflecting differences in topology, local generation and demand, and approaches to network management. Given this, justification should be provided for mandating particular solutions with relation to voltage imposed directly on grid users, versus the alternative approach of mandating voltage related requirements at the transmission/distribution boundary."*

The following explains why these requirements are excessive:

Figure 8 of Article 16 specifies that reactive capability shall be present over a voltage range from +10 to -12.5%. In high voltage grids, a tap changer reduces the large voltage fluctuations. However, for medium voltage connected plant there is no such voltage range reduction. As a consequence, requiring the same voltage operating range for reactive power capability for PPM in medium voltage networks will result in effectively wider voltage ranges than the equipment would be designed for, and thus will lead to increased investment costs for the PPM. Because there is no technical necessity for such a requirement, there will be hardly any use for this extended capability. If this NC requirement is universally applied in Europe, a large amount of investment in reactive capability will become stranded.





In this context, one should bear in mind the wording from the ACER framework guideline: "*The minimum standards and requirements shall be defined for each type of significant grid user and shall take into account the voltage level at the grid user's connection point.*" The requirements in Article 16 in the NC RfG do not fully take into account the possible situations with respect to voltage level of the grid users, and thus do not respect the FGL. The requirements will in many cases negatively affect the business case of Type C and D wind plants connected at MV level.

Amended text proposal:

During the public consultation of the draft NC in March 2012, EWEA has proposed to ENTSO-E an amendment of the NC to take the above considerations into account. The proposal was not accepted, and no sufficient justification has been provided by ENTSO-E for its rejection. The proposal of March 2012 is therefore re-introduced here.

The proposed changes concern:

- Reactive power capability at maximum capacity: paragraph Article 16.3 b)2), to add the graph Figure 8bis and table 9bis, and to modify the text of the paragraph to include proper references to this figure and table.
- Reactive power capability below maximum capacity: paragraph Article 16.3 c)2, to add Figure 9bis, and to modify the text of the paragraph to include proper reference to the figure.

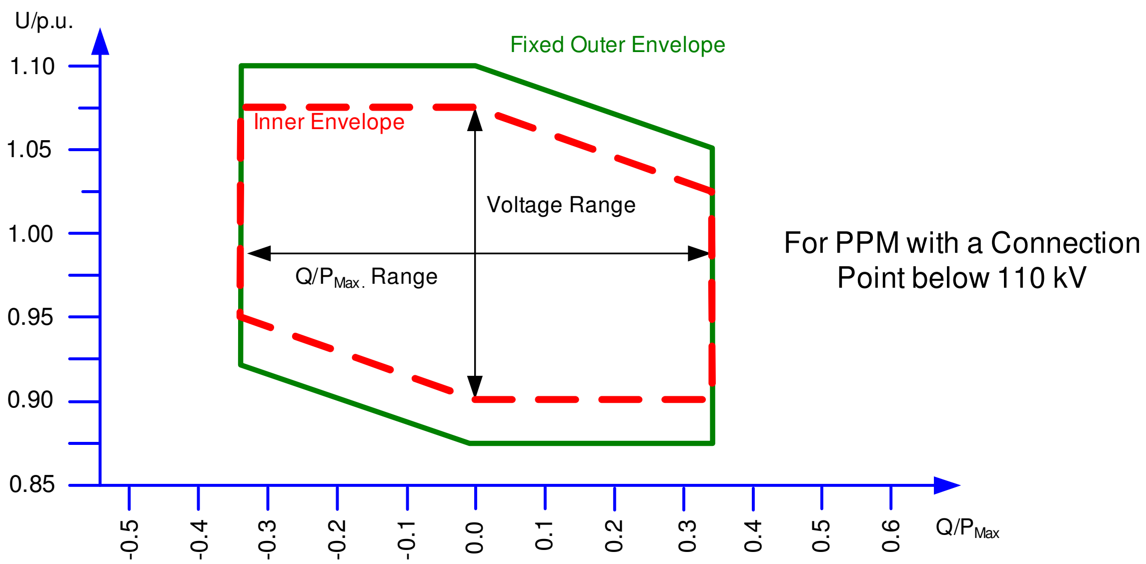


Figure 8 bis U-Q/PMax-profile for Power Park Modules with a Connection Point below 110 kV by the Voltage at Connection Point, expressed by the ratio of its actual voltage value U and its nominal value of U in per unit, against the ratio of the Reactive Power capability (Q) and the Maximum Capacity (PMax) of a Power Park Module.

Synchronous Area	Maximum range of Q/P_{max}	Maximum range of steady state voltage level in PU
Continental Europe	0.66	0.175
Nordic	0.66	0.150
Great Britain	0.66	0.100
Ireland	0.66	0. 175
Baltic States	0.66	0. 175

Table 9bis: Parameters for the inner envelope in figure 8bis for PPM with a Connection Point below 110 kV

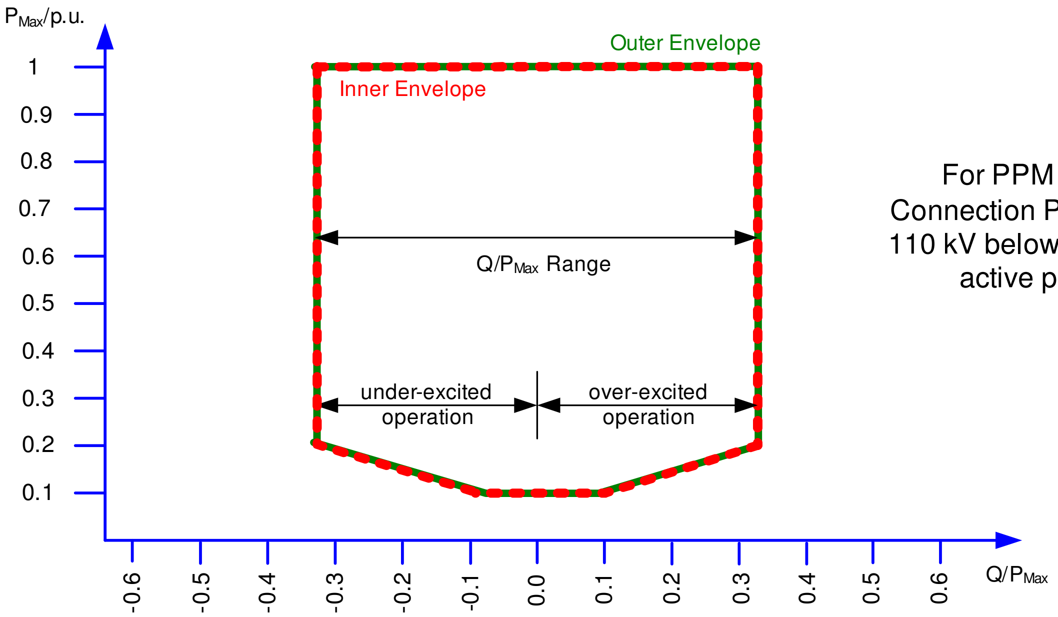


Figure 9bis - P-Q/Pmax-profile of a Power Park Module with a Connection Point below 110 kV. The diagram represents a P-Q/Pmax-profile by the Active Power, expressed by the ratio of its actual value and the Maximum Capacity in per unit, against the ratio of the Reactive Power capability (Q) and the Maximum Capacity (Pmax) of a PPM.

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EPIA - the European Photovoltaic Industry Association – is the voice of the photovoltaic industry in the world's largest PV market, with Members active along the whole solar PV value chain: from silicon, cells and module production to systems development and PV electricity generation as well as marketing and sales. EPIA's mission is to give its global membership a distinct and effective voice in the European market, especially in the EU.

The European Wind Energy Association (EWEA) is the voice of the wind industry, actively promoting the utilisation of wind power in Europe and worldwide. Over 700 members from nearly 60 countries, including manufacturers, developers, research institutes, associations, electricity providers, finance organisations and consultants, make EWEA the world's largest wind energy network.