EWEA
THE EUROPEAN WIND ENERGY ASSOCIATION

Towards European grid connection requirements
Challenges and opportunities for wind power

Executive Summary

The drafting of a European Network Code for the connection of generators (NC) launched within the Third Liberalisation Package is an opportunity for ENTSO-E to deliver a guiding document with a pan-European approach that ultimately will lead to a harmonised set of grid connection requirements in all member states. This would serve, in a cost-effective way, the needs of the system and make the best out of capabilities for system support from wind power plants. As a directly affected stakeholder, EWEA was in dialogue with ENTSO-E during the development of the draft NC. From this position EWEA has identified several shortcomings related both to the contents and structure of the draft NC as to the further deployment of the legislative process in which this NC is embedded.

Therefore, with the present paper, EWEA puts forward recommendations both on the NC and the surrounding regulatory processes at EU and national level which – when taken up by the relevant stakeholders - should facilitate an effective harmonisation of grid code requirements for wind power in all Member States. This harmonisation can be regarded as one of the essential preconditions to achieving the foreseen high penetration levels of wind power in a cost-effective way with due regard to power system stability.

The principal recommendations for necessary improvements to the contents of the draft NC are related to several issues:

- As a matter of principle, technical requirements should make a better distinction between variable (supply driven) primary energy sources (wind, solar) and constant (demand driven) primary energy sources (biomass, gas, coal) for optimum use of their inherent characteristics.
- In order to maximise social welfare, the NC should strike an appropriate balance between the minimum level of compulsory technical requirements (which are not remunerated) and generator performances for delivering system support which would better be solicited through an ancillary services market. The minimum level of technical requirements should be based on transparent cost-benefit analyses. Also, the requirements in the NC should not be applicable to existing wind plants unless there is an adequate remuneration through ancillary service markets or a clearly demonstrated macro-economic benefit.
- Connection requirements must be flexible enough to allow new generation concepts to get grid access and sufficient transition periods should be foreseen for the development of products that shall meet any new requirements.
- Protection of intellectual property must be fully taken into account for example by provisions of non-disclosure agreements when exchanging data between wind industry and TSOs.
- Finally, as an overall principle the NC should try to be comprehensive, transparent and as detailed and explicit as possible as well as include clear, commonly shared definitions of the terms used for electrical characteristics, wind power plants and other equipment. To the maximum extent possible, it should make use of the opportunity of serving as a model for the formulation of requirements in national codes – which ultimately are going to be applied in practice.

Regarding the process to develop and implement the NC, EWEA recommends that sufficient time and resources be given to develop and draft the network code with an adequate level of accuracy and detail, so that it can be effectively and efficiently applied and used. In this respect, the NC should undergo a more extensive consultation process than has been the case in its preliminary stage. After its entry into force, adequate possibilities should be foreseen for all stakeholders to participate in the review process and to submit proposals for modifications in the NC. Future changes should be performed in a transparent way considering technical and economic aspects and adequate transition periods should be envisaged. Overall, the actual process of implementation of the provisions in the NC into national codes requires thorough deliberation in order to ensure that an effective harmonisation of connection requirements for wind power will take place throughout the European power system.

1. Introduction

This EWEA position paper serves two main purposes:

- To follow up on the ENTSO-E development process on the upcoming Network Code on electricity grid connection for generators (NC) and provide views on both the development process and the content on this NC.
- To put the NC in the context of the challenge to develop a harmonised set of grid code requirements for wind power scrutinising the impact of the NC compared to a structural harmonisation of grid code requirements for wind power as proposed by EWEA[1].

In order to facilitate ever-increasing shares of variable RES like wind power in the most cost effective way, an improved electrical power system and better integrated electricity markets are needed across the EU. In this context grid connection requirements are of highest importance to the European wind industry in view of the way in which these requirements have developed, and in the envisaged increase of wind power generation across the EU.

This urgent topic was taken up formally by ENTSO-E and ERGEG, with support from the European Commission and the Florence Forum, as the very first step for a Pilot Framework Guidelines and subsequent Pilot Network Code. EWEA welcomed this decision as wind energy is set to be the largest contributor to meet the EU's 2020 targets following the adoption of the 2009 EU Renewable Energy Directive (2009/28/EC).

The envisaged deliverables in the Third Liberalisation Package in terms of EU-wide rules for network management through a binding set of Network Codes provide an unprecedented window of opportunity to provide the legal framework for a more thorough structural and technical harmonisation of connection requirements for wind power.

To this end EWEA proposes in this position paper improvements to the ENTSO-E NC development process as well as to the actual content of the NC drafts published so far. For further clarification EWEA also reiterates here its disagreement with specific provisions of the draft NC documents published by ENTSO-E, especially the ENTSO-E Informal Pilot Network Code for Requirements for Grid Connection Applicable to all Generators (Pilot Code) and the Summary document of Stakeholder Comments and the Frequently Asked Questions on this.

2. Challenges for a Pan-European sustainable power system

The integration of large amounts of renewable generation in European networks is one of the major drivers for improving and upgrading the European electricity system. Present expectations show a RES penetration level of 34% in 2020 and wind energy meeting 15.7% of EU electricity demand by this time. By 2030, wind power in the EU alone could meet up to 28.5% of EU electricity demand, according to EWEA's scenarios, depending on the level of demand. Thus, wind power presently is and will be one of the main RES power sources.

Another major driver towards an improved European grid is a more cost effective power supply for all European citizens and industries to be achieved by improved trade which involves increased power exchange capabilities between the member states and a more open and well regulated European electricity market. Last but not least, a major driver is maintaining an adequate level of security of supply across the interconnected transmission systems in Europe. These drivers call for coherent actions at the European level with regard to onshore and offshore grid infrastructure deployment, further

[1] Please also refer to Chapter 4.

development of power system design and operational practices, and development and implementation of adequate power market rules.

They also call for appropriate standards and practices for connecting grid users - i.e. generators and consumers - which appropriately reflect the capabilities and responsibilities of maintaining an adequate level of security of supply in a cost efficient way. The development of the NC containing minimum requirements for grid connection of generators should be considered in the above perspective.

3. Enabling European legislative framework

EWEA considers the implementation of the legislative measures at European level under the 3rd Liberalisation Package as an appropriate vehicle to arrive at an improved power system at European level as outlined above. The cooperation of European TSOs under the umbrella of ENTSO-E and the creation of the ACER agency where national energy regulators cooperate at the European level should lead to a better handling of cross-border issues for example the removal of bottlenecks to power exchange and the enlargement of balancing areas - aspects which lead to lower power prices and favour the cost-effective integration of renewable energy.

The development of adequate network and market codes at European level in consultation with the stakeholders is a critical step in this legislative process. In EWEA's view, the process of network code development should be carried out carefully, taking sufficient account of the interests of the stakeholders in renewable energy and with a timeframe that enables the drafting of adequate rules and standards leading to a balanced market deployment and technology development.

4. Benefits and opportunities of harmonised grid connection requirements

The way in which grid code requirements for wind power in Europe have developed has resulted in gross inefficiencies and additional costs for consumers, manufacturers and wind farm developers. Currently the European wind industry has to contend with a high degree of diversity in technical requirements in more than 30 differing National Grid Codes from a variety of countries. These requirements are often not sufficiently clear and are not always technically justified nor economically sound from the point of view of the power system. This results in unnecessary extra costs and efforts from the wind power industry and other system users, including consumers. Such a diverse range of requirements makes wind power unnecessarily expensive. The lack of harmonised grid code requirements leads to the necessity of maintaining locally adapted products and maintaining staff to interpret grid codes.

With the growing penetration of wind energy, there is an increasing need to develop a harmonised set of grid code requirements to overcome these deficiencies. Between 2010 and 2020 Grid Codes in the EU will affect the connection of thousands of new wind power projects, not to mention other RES. The connection of projects is strongly site specific (rated power, local network conditions etc.). The large number of projects requires standardisation as far as possible to reduce the time and costs for preparing connection agreements. In the absence of a thorough standardisation, processes will go slowly, connections will not be cost-effective and system security will not be as desired. Thus, harmonised technical requirements for connecting wind power will bring benefits for all parties and should be employed wherever possible and appropriate.

The EWEA Working Group on Grid Code Regulations proposes a two-step harmonisation process for the network connection requirements of wind power. The first step, structural harmonisation, consists of agreeing at European level on a template Grid Code for wind power, with a well-defined structure of

chapters, and a rational common system of designations, definitions, parameterisations, and associated verification. A concrete proposal was published by EWEA in December 2009, namely the first Generic Grid Code Format (GGCF),[2] putting flesh on the bones on the harmonisation of grid code requirements for wind power. Proposing such a template implicitly means that the wind power industry is strongly favouring a specific harmonised grid code document for wind power generation, and that the requirements are not embedded or spread out in a code for all types of generation. The second step, technical harmonisation, is seen as a longer term process, enabled only if the first step is properly made. In this respect, it should be noted that a complete European harmonisation is not practical in the short term. If such a process is pursued it could, in an extreme case, lead to the implementation of the most stringent requirements from each TSO in his respective country. This would be neither desirable and efficient nor economically beneficial.

The long term outcome should be that the connection requirements for wind power in the EU are crafted according to a common structure template. Drafting of connection requirements should be coordinated in the long run at EU level with the participation by ENTSO-E and relevant stakeholders, including the wind energy industry and the regulators.

5. Essential improvements for further NC development

EWEA has had, as a directly affected stakeholder, the opportunity to join ENTSO-E in regular dialogue during the development process of the Pilot Code. EWEA identified several shortcomings which in our view should be consequently tackled by the concerned stakeholders. To this end the following section outlines our main concerns as well as proposes solutions in terms of amendments or changes to be included in the upcoming NC draft and in the overall process to arrive at an agreed NC at EU level down to its implementation in national Grid Codes. The main concerns include:

- Adequate formulation of requirements in the NC
- Cost-effectiveness: Ancillary services versus compulsory requirements
- Adequate stakeholder involvement in the NC development process
- Maintenance and further development of the NC
- Facilitating harmonisation of European grid connection requirements
- Acknowledging the characteristics of supply driven RES
- Enabling technology development
- Data exchange and adequate protection of intellectual property
- Applicability of new requirements to existing generators (Retroactivity)

5.1 Adequate formulation of requirements in the NC

Deficits in grid codes (like with any other applicable standard, rules, law, directive, etc.) caused by a lack of completeness, details, explicitness and clear definitions lead to additional time and costs for wind power projects. Unfinished topics and unclear provisions need then to be clarified on a project-by-project basis. Such case-by-case clarification is much less efficient than developing and drafting codes that do not trigger such a need. These costs make wind energy unnecessarily expensive and hinder the fast increase in the installation of renewable energies to meet the climate and renewable energy targets. The clarification process often leads to different interpretations by developers and TSOs and results in either expensive retrospective plant modifications, or costly and time-consuming disputes.

In recent years wind farm developers, investors and banks have learnt their lessons regarding the importance of getting access to the grid and meeting grid codes requirements. If requirements cannot be met just because of insufficient explicitness or lack of clarity, additional risk is added to the project

[2] http://www.ewea.org/fileadmin/ewea_documents/documents/publications/091127_GGCF_Final_Draft.pdf

or even the overall business. Risks are converted into additional costs – costs that could be avoided by properly drafted codes. Also these additional risk-based costs make wind energy unnecessarily more expensive and hinder a fast increase in the installation of renewable energies to meet the climate and renewable energy targets.

The preconditions to developing grid code requirements that achieve an adequate level of quality are to provide the necessary resources by network operators and to give this process sufficient time. During recent years the European wind energy industry unfortunately faced the fact that many codes were drafted with too few resources and in too narrow a time frame. The development of the ENTSO-E Informal Pilot Network Code for Requirements for Grid Connection Applicable to all Generators reconfirmed this and leads to concerns regarding the future development of the NC.

Recommendations:

- Grid Code requirements for wind power plants and other power generating technologies should be comprehensive and transparent to avoid misinterpretation.
- Requirements should be as explicit as possible, and include clear, commonly shared definitions of the terms used for wind turbines, wind farms and other equipment;
- It is essential that sufficient time and resources and increased stakeholder involvement is given to develop and draft the NC with a sufficient level of quality, so that it can be effectively and efficiently applied and used.

5.2 Cost-effectiveness: Ancillary services versus compulsory requirements

The power plant portfolio in a power system must provide a minimum technical performance to maintain power system security and reliability. EWEA is concerned that network operators keep on increasing the compulsory minimum technical connection requirements for wind power plants without clearly explaining the need to do so and without providing cost-benefit analyses in a transparent way. Examples are fault-ride-through and reactive power requirements for wind power plants.

Obviously some minimum technical requirements must be fulfilled by all individual generators (e. g. the capability to operate over a frequency range of around 50Hz) to ensure power system security. At power system level however, there are necessary performances which do not need to be provided by all operating generating facilities but only by some. Primary and secondary reserves are well-known examples of this and ancillary service markets are a common way to identify the most cost-effective plants to provide such performances and to remunerate them specifically for the service.

Generation technologies differ in their cost-effectiveness in delivering electrical energy, providing ancillary services and fulfilling compulsory minimum technical requirements. The costs for producing, transmitting, and distributing electrical energy have to be paid by the electricity users. Therefore, appropriate market design and rules should secure maximum cost-effectiveness. Furthermore, the compulsory minimum technical requirements for the connection of generators form a part of these market conditions.

By increasing compulsory requirements, TSOs could avoid the need for ancillary services (e. g. requesting a large reactive power capability and requiring this service to be free). As a consequence the payments for ancillary services to generators would be avoided and TSOs might minimise their own costs. As generators would not get paid directly for fulfilling compulsory requirements, they would need to include these compliance costs into the calculation of their energy prices.

If all generating facilities fulfilled minimum technical requirements and/or provided ancillary services at the same costs this would not impact the consumer. But this is not the case. Inherent capabilities lead to differences in costs between the various types of generation. E. g. primary reserves (positive in dealing with falling frequency and negative in dealing with rising frequency) can be provided more

cost-effectively by some generating facilities than others. For wind power plants as supply driven generating facilities it is very costly to provide such a positive reserve service as they do not have dispatchable primary energy and currently no intrinsic energy storage. .
This example shows that ancillary service schemes and markets can reduce the operational cost of power generation. In other words, consumers will have to pay more when TSOs avoid paying for ancillary services by increasing the level of minimum requirements for the generators.

As mentioned before, reactive power requirements can already be very onerous and often up to a level where the capability would hardly ever be used. A more cost effective way would be to set the rules at a much lower level and when more reactive power is locally needed, generators under ancillary service contracts could provide the extra at lower costs. Of course more stringent requirements than the fixed minimum can be agreed voluntarily and bilaterally.

An inappropriate unbalance between compulsory requirements and ancillary services also impacts the achievement of RES targets in Europe. If costs for producing electrical energy by RES are driven too high by compulsory, not specifically remunerated requirements, investors may get discouraged from building wind power plants. Either the energy prices determined by market prices are not competitive or the margin between costs and feed-in tariffs are too low.

As a consequence the concept of ancillary services should be utilised as much as possible because it leads to higher cost-effectiveness and hence to an overall reduction of the electricity costs for the users.

With the increase of RES, the power plant portfolio is changing in Europe. Intrinsic performances of conventional plants are not necessarily part of new types of generation; new capabilities become evident with new technologies. This development can also affect the concepts for ancillary services. The known ancillary services[3] are based on the capabilities of conventional plants that have played an exclusive role in the system for many decades. As new technologies with different capabilities participate in the power system, there is potential to further develop a cost-effective integration of renewables.

A focus on market based ancillary services and less on onerous code requirements will also result in a reduced request for derogations – especially for existing plants. As derogations distort the market by exempting some players from requirements, they should be minimised. Furthermore the workload (and cost to the consumer) in applying, approving and policing derogations should not be underestimated. Also unnecessary and costly retrospective modifications to existing plants to meet onerous code requirements can be avoided. However where such modifications are cost effective, owners will make these modifications in order to benefit from ancillary services revenues.

Recommendations:

- Technical requirements for generating facilities should balance the costs and benefits of technical performances, and generally be specified in order to meet a defined security-of-supply level at minimum overall system costs.
- Grid codes in Europe should firstly consider ancillary services market options instead of compulsory requirements to be fulfilled without specific remuneration. The compulsory technical requirements for all generators must therefore focus on the essential aspects of technical performances, leaving an opening for ancillary services.
- The development of new types of remunerated ancillary services should be accelerated to achieve the transition to a cost-effective and secure supply of electrical energy with a maximised share from wind and other renewables. This is a task for the TSOs and the entire power sector where the wind industry will provide its contribution.

[3] E. g. primary reserve, secondary reserve, tertiary reserve, reactive power, black start capability

5.3 Adequate stakeholder involvement in the NC development process

EWEA started a constructive dialogue with ENTSO-E in 2009 on the scope and technical contents of the so called ENTSO-E Pilot Code. This informal process was regarded and understood as a "test run" for the following formal consultation for Network Codes. This enables the European power sector now to begin the coming formal consultation at a better starting point.

The Pilot Code process showed that drafting minimum requirements in a well-defined, unambiguous and non-discriminatory way is a very time and resource consuming task. On the other hand this was not a new experience but reconfirmed the previous ones the European wind energy industry gained from dealing with more than 30 national codes up to today.

EWEA is highly concerned that the process as implemented today will not support the set goals but will rather counteract them. The envisaged timeline of 12 months[4] is extremely short for drafting a robust Pan-European network code which will ultimately serve as a binding regulation with due involvement of all affected stakeholders and should be adapted to the fact that drafting such a complex NC needs sufficient time.

Stakeholder involvement in the drafting and consultation process of the Pilot Code has been far from sufficient and needs strong improvements in the future. There was an inadequate number of meetings workshops held by ENTSO-E and time allocated to provide comments to ENTSO-E. EWEA also noticed the poor response by ENTSO-E to comments from industry stakeholder.

Drafting teams for technical requirements in many Member States are composed of representatives from network operators and stakeholders (plant owners, market participants, manufacturers, operators, consultants, research and university institutes, etc.) in a well-balanced way[5]. In contrast, the ENTSO-E drafting team on the Pilot Code comprised TSOs exclusively and stakeholder meetings took place on an ad-hoc basis. However, during the NC development process on capacity allocation and congestion management, informal stakeholder advisory groups were established by ENTSO-E well in advance with meetings on a regular basis. This can be seen as a practical means to a more effective cooperation between the relevant parties and to ensure adequate stakeholder involvement when developing future NCs.

Recommendations:

- Generally, stronger stakeholder involvement is needed for the next phase of the NC: Public workshops should reserve at least 50 % of the time for questions and comments from attendees. As stakeholders are typically requested to provide a detailed justification of their comments and/or proposals, the TSOs themselves musts meet such requirements and provide comprehensive explanation and cost-benefit analysis of the requirements.
- Informal stakeholder advisory groups as set up during the NC development process on capacity allocation and congestion management should be considered for all future NCs to ensure adequate stakeholder involvement.
- As stakeholder consultations do not guarantee consensus, a process for arbitration could be set up by the regulators (ACER).
- For future NC development procedures, the option for a voluntary consultation process with ENTSO-E and all concerned stakeholders before the start of the official 12 month period and also an optional prolongation of 6 months on top of the 12 months period in case ENTSO-E together with other involved stakeholders see this need, should be considered. This could provide for a

[4] According to article 6(6) of Regulation (EC) No 714/2009
[5] Examples: Forum network technology / network operation in the VDE (FNN) in Germany; Grid Code Review Panels in Ireland and UK

timeframe of approximately 24 months in total which should be seen as a minimum to establish a comprehensive NC.

5.4 Maintenance and further development of the NC

A process to maintain the NC has not been covered so far in the draft NC or in the corresponding ACER framework guideline. The ENTSO-E rules of procedure however do state that the maintenance of network codes should be carried out at least every five years by the relevant ENTSO-E committee[6]. Yet, these rules of procedure do not describe which, if not all, possible changes have to go through comitology. In view of the rapid technical developments in both power system and generation technologies, EWEA believes that a more regular and flexible process of maintenance of network codes is needed in order to adequately deal with (or take into account) technical and regulatory progress in all aspects of the power system.

A more institutionalised review cycle of the NC for Network Connection should be established through a dedicated feed-back loop between ENTSO-E and relevant stakeholders on a regular basis. This maintenance process should impose a consultation with the involved stakeholders every two to three years, or more frequently upon request from a number of stakeholders on a specific topic. Such a regular consultation would improve the whole process in both directions. On the one hand it will help the NC to be optimised by tracking and benefiting from the latest technology advancements. On the other hand it will allow manufacturers to adapt their products in the mentioned mid-term perspective of two to three years ahead.

A way of polling the stakeholders should also be set up and its results officially published to find out which topics are pressing and meet the need to involve stakeholders.

Finally, because a change that is regarded as necessary by one stakeholder is sometimes viewed as unnecessary by the others, an independent group of experts has to weight the different stakeholder interests. This independent group or review panel would also embrace the whole maintenance process.
However, it remains an open question whether a fast-track option to change or amend network codes to reflect changes for technical requirements in a more practical way is needed rather than the mere possibility of changes only through a protracted comitology process.

Recommendations:

- A maintenance process for the NC needs to be defined with ACER as a main facilitator.
- When requesting a change in the NC, this independent group must take technical, economic and market aspects into consideration and any changes made by ENTSO-E must undergo a drafting and commenting phase and must include a timeframe for implementation.

5.5 Facilitating harmonisation of European grid connection requirements

A cost-effective large scale deployment of wind power and connection to the network necessitates a system of harmonised technical standards and network connection requirements (as explained in earlier section of this paper).

Essential conditions to achieving an adequate set of harmonised requirements in Europe are:

[6] As consulted by ACER in April 2011, see:
http://www.acer.europa.eu/portal/page/portal/ACER_HOME/Public_Docs/Acts%20of%20the%20Agency/Opinions/2011/Opinion%201

– *A well thought-through and complete formulation of requirements: including nomenclature, definition specifications, will lead to a complete and unambiguous interpretation of the requirements*. In this respect, the draft NC should be improved substantially, notably with respect to the formulations of requirements for FRT and reactive power. Detailed proposals for improvements are presently being developed by the EWEA WG GCR and will be proposed to ENTSO-E for inclusion in the NC. An adequate formulation of the NC should not be hampered by formal limitations such as the limitation of number of pages imposed by the formal process.

– *Uniform implementation of the formulations and specifications in the national (regional) grid codes*. In order for national and regional grid codes to effectively implement the NC it is essential that they use the same structure and nomenclature. Furthermore, a structural harmonisation is essential to make requirements transparent and comparable to the wind industry. Because the wind industry builds mass products, it cannot – as opposed to manufacturers of large conventional power plants - economically analyse, discuss and negotiate non-transparent requirements with local grid operators. The development process of the NC is an excellent opportunity to create an exemplary model of Grid Code to which national Grid Codes could be restructured. Therefore, it is recommended that the NC, where appropriate, makes reference to proposals for specific methods of formulation of requirements developed by stakeholders, such as the Generic Grid Code Format (GGCF) of EWEA. However, there is no incentive at present for national and regional institutions to restructure their grid code. There is a need for a (legal) mechanism at the European level to require national and regional Grid Codes to apply the same structure and formulations.

– *Establishing clear, well-founded methods for implementing local and regional parameter values depending on the local network characteristics and requirements.* Presently, with the latest status of the NC, there is a lot of freedom left for local TSOs to apply local values of technical parameters and for derogation of requirements in the NC. On the other hand, neither the NC nor any other formal document or process gives guidance to local TSOs in setting local parameter values and requirements deviating from the NC. As a consequence, and in absence of proper methods and implementation measures, a consistent implementation of the NC by National TSOs will not be possible and the wind industry will continue to face an unnecessary high diversity of requirements throughout Europe, preventing proper standardisation and cost reduction. A common methodology for implementing suitable and consistent local parameter values and requirements in national Grid Codes should be established.

Recommendations:

- In formulating its requirements, the NC should strive at being a model for harmonising the structure in national Grid Codes. Reference should be made in the NC to EWEA's proposal for a harmonised structure of grid connection requirements for wind power.
- A mechanism should be developed at European level to require national and regional Grid Codes to apply the same structure and formulations.
- A common methodology for implementing suitable and consistent local parameter values and requirements in national and regional Grid Codes should be established.

5.6 Acknowledging the characteristics of supply driven RES

Currently, the NC only distinguishes between different generator technologies, but not primary energy sources. This is sensible as the various generator technologies (synchronous and converter based) have different strengths regarding their electrical properties.

However, the draft NC implicitly assumes that all generators can operate at maximum output at will, which is not the case for renewables with a variable primary energy source. Consequently some re-

quirements like frequency control cannot be applied to wind generation without interpretation. This interpretation will be different with each manufacturer unless the distinction is made in the grid code.

For example, National Grid and other grid code authors who do not distinguish between variable and constant primary energy sources had to spend significant resources on releasing separate explanations on how to apply the grid code to wind power plants as well as to determine whether wind turbine manufacturers correctly interpreted the grid code.

Recommendations:

- Where technically applicable, the NC and national Grid Codes should explicitly write specific requirements for wind generation reflecting inherent performances driven by primary energies and generating technologies.
- Requirements for wind power plants should be neither excessive nor discriminatory, and should not be stricter than grid connection requirements for other generation technologies unless there is a specific technical justification. This applies in particular to active power and frequency control methods.

5.7 Enabling technological development

The European wind industry has always been highly innovative and constantly adapting to changing requirements and improving cost, yield and reliability. While increasing wind penetration calls for well-defined connection requirements, these should not prevent manufacturers from bringing novel concepts to markets. Grid Codes are always written based for a certain state of technology. If novel concepts for power generation arise they may achieve the same level of ancillary service quality, but possibly in a way that fulfils only the intentions of the grid code – not the wording. Equally, when there is a need from a power system perspective to put forward new requirements, there should be left sufficient time for technology to adapt.

Hence, development and testing of novel generator concepts should be possible without proven grid code compliance. Grid connection requirements should subsequently be adjusted to take full advantage of their capabilities. Moreover, grid connection requirements and corresponding implementation procedures should contain adequate provisions to enable technology to adapt to new requirements.

Recommendation:

- The NC should contain provisions enabling manufacturers to test prototypes of new wind turbine generators for a period of at least three years during which the NC requirements should not fully apply. This will give manufacturers enough time to achieve and prove NC compliance and, if necessary, to request changes to the NC to accommodate for the technical particularities of new concepts and performances.

5.8 Data exchange and adequate protection of intellectual property

Provision and exchange of data for study and planning purposes is key to system planning, system development and integrating generating plants into the system. Today providing data and mathematical models for the simulation and analysis of steady-state conditions, long term dynamics and short term dynamics (time domain from some 10 minutes to some 10 milliseconds) is standard practice with most European TSOs and DSOs. The data may be commercially sensitive but is currently not critical with regard to the technical details of wind turbine technology and intellectual property.

The drafts published by ENTSO-E also contain a provision to request models for simulating so called electro-magnetic transients (time domain: a few milliseconds and faster) including a large amount of documentation for these models. There's a fundamental difference in the amount of information included in such models compared to the less critical data described above. Being forced to provide such very detailed models without a clear and stringent set of rules to keep these confidential means all major manufactures face the major threat of losing intellectual property. Therefore, this part of the draft NC is not acceptable. Such rules can lead to situations where manufacturers will decide against delivering advanced cost-effective products and solutions to the EU. This endangers the EU's ability to meet their renewable energy targets in a cost effective way. In some special situations the wind industry has already faced request for such very complex models in Europe. However, concerns regarding confidentially could be resolved.

Unfortunately the published ENTSO-E drafts do not contain any provisions on how and what power system data should be made available to the planners of generating facilities. As TSOs and DSOs rely on correct generating facility data for their system, planners of generating facilities rely on accurate power system data to check the feasibility of new plants and to plan their facility in a cost-effective way to meet the connection requirements. There is an imbalance between the interests of TSOs and DSOs on one side and the generators (developers and manufacturers) on the other side. Of course such data about the power system shall be - for security reasons - kept confidential. Further careful consideration must be given to the liability of the provided information. Inaccurate data may lead to costly disinvestments either in the network and/or in a wind power plant. In extreme cases it may lead to black-outs causing huge costs for the affected consumers.

Recommendations:

- Clauses to provide very detailed numerical models (e.g. to study electro-magnetic transients) may be acceptable if these models are safely black-boxed and kept strictly confidential. Such clauses should be requested if specifically justified and not on a general basis for each project.
- Only limited model documentation should be disclosed to protect IP.
- Due to the complexity of detailed models, TSOs should be obliged to share results with the vendors to prevent misuse and misinterpretation of results.
- Project developers and manufacturers must get access to accurate information and data on the power system which is necessary to check the feasibility and planning of wind power plants in accordance with the specific technical requirements of the NC. This provision of data shall be within a practical framework securing confidentiality.
- Depending on the liability clauses applied to wind power plant operators for the provision of incorrect data, well-balanced, adequate liability rules should also be applied to the TSOs regarding the provided power system data.

5.9 Applicability of new requirements to existing generators (Retroactivity)

The electricity grid evolves and grid codes need to be adapted to this evolution. In some cases, it makes sense to investigate upgrade possibilities in existing generators. However, retrofits imply costs and consequently the need to be financially compensated. These costs are not only material costs but include administration and certification costs. The current approach reflected in the ENTSO-E Pilot Network Code draft makes these upgrades mandatory and grants exceptions - these are not acceptable. If retrofit costs have to be borne by generator owners, retrofits would appear in cost risk analyses, which in turn would create additional regulatory uncertainty for investments in power generation assets. Furthermore, an excessively easy inclusion of retroactive requirements would discourage ENTSO-E and TSOs from planning ahead and running studies to determine well thought-through requirements and making best use of resources to avoid unnecessary retrofits.

Recommendations:

- Take into account the provision of the ACER Framework Guidelines on Electricity Grid Connections promoting the exclusion of unmodified existing plants from the application of the NC unless necessity is proven on the basis of a sound and transparent quantitative cost-benefit analysis demonstrating the socio-economic benefit of the retro-fit.
- Furthermore a process should also be detailed on how the generator owner is compensated for his expenses in case retroactivity is applied.

6. Conclusions

In this paper, EWEA assessed the ongoing development of a European Network Code for Connection of Generators by ENTSO-E, against the backdrop of the European wind industry's strategy for more harmonised grid code requirements in Europe. The main observations can be summarised as follows:

1. The European wind industry (as well as TSOs) have recognised for several years the need for developing a consistent set of grid code requirements for wind power in order to achieve a secure and cost-effective power system at European level with a large amount of wind power. The present diversity of connection requirements for wind power plants in national grid codes is a significant obstacle for wind power integration in several ways: it leads to unnecessary costs and time for wind plant operators and manufacturers, at the same time it hampers the optimisation of system security. Thus, the wind industry is asking for a harmonisation of requirements for wind power that optimally takes into account both the needs of the power system and the techical capabilities of wind power plants – which is essential to enable the foreseen high penetration levels. Also there is a need from an economic point of view to develop a more transparent division principle between minimum connection requirements and the performance of system support in the form of ancillary services.

2. The NC for Connection of Generators presently being drafted by ENTSO-E potentially constitutes a major step in the harmonisation process leading to a consistent set of requirements in the national grid codes Europe wide. However necessary, a European Network Code for Connection of Generators is not sufficient alone without adequate guidance to make the appropriate changes in a consistent way in the national codes. The overall impression from the wind industry from the drafting process of the NC until now is a document with many inadequacies both in contents and structuring of requirements applicable to wind power plants. Moreover, it is not making use of the opportunity of serving as a model for the formulation of requirements in national codes – which ultimately are going to be applied in practice. Also there is insufficient time and flexibility foreseen in the present NC development process both for an adequate dialogue with the stakeholders and for continuous improvement of the NC in the future.

The wind energy industry is concerned that if the present shortcomings in the draft NC and the absence of essential elements in the harmonisation process are not solved, the goal of achieving a timely and consistent set of requirements for wind power connection in Europe will not be reached. This will hamper cost reduction of wind power, and prevent making the best use of wind power capabilities for power system support. EWEA calls therefore in this paper for the implementation of the above recommendations for improvements.

This position paper was prepared by the EWEA working group on grid code requirements. Since 2007 this working group has been active on the harmonisation of grid code requirements for wind turbine generators and wind power plants in Europe. The following manufacturers, developers, operators, consultants, national associations and test & research institutes are members of this EWEA working group (in alphabetical order):

ABB, Acciona, AEE - Asociación Empresarial Eólica, Alstom, BWE – Bundesverband Windenergie, DONG, Ecofys, EDP, EON Climate&Renewables, Enercon, ENR - Syndicat des énergies renouvelables, FGH - Forschungsgemeinschaft für Elektrische Anlagen und Stromwirtschaft, Gamesa, GE, GL/GarradHassan, Iberdrola, Ingeteam, Nordex, Renewable UK, Repower, RES, RWE Innogy, Siemens, Sintef, SSE, Suzlon, Vestas

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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 650 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.