European Network of
Transmission System Operators
for Electricity

NETWORK CODE FOR REQUIREMENTS FOR GRID CONNECTION APPLICABLE TO ALL GENERATORS

MOTIVATION AND APPROACH

24 JANUARY 2012

1 INTRODUCTION

1.1 BACKGROUND

ENTSO-E has drafted the Network Code “Requirements for Grid Connection Applicable to all Generators” (NC RfG) to set out clear and objective requirements for generators for network connection in order to contribute to non-discrimination, effective competition and the efficient functioning of the internal electricity market and to ensure system security. The NC RfG is based on ACER’s Framework Guidelines on Electricity Grid Connections (FWGL) [1]. The development of the FWGL and the NC RfG was pre-empted by a “Pilot Phase” in which ERGEG provided an Initial Impact Assessment associated with its consultation on its draft FWGL in July 2010 [2].

ENTSO-E drafted the NC RfG, based on the FWGL and the Initial Impact Assessment. The NC RfG states the technical requirements. Commercial aspects are not in the scope of the NC as they are not covered by the FWGL.

In the initial drafting phase ENTSO-E performed two workshops for stakeholders and an informal consultation. ENTSO-E received extensive stakeholder feedback (see list of stakeholders in Annex 7). Based on those discussions ENTSO-E provided an initial list of Frequently Asked Questions (FAQ) and gave specific feedback to stakeholders’ comments that were published in July 2011 [3]. As can be seen in the ENTSO-E feedback, the comments and requests were very valuable and many were taken into account in the code development process. In that process, ENTSO-E had to take several decisions that significantly influenced the NC RfG as it stands today.

Following the publication of the FWGL in July 2011, ENTSO-E developed the NC RfG further. ENTSO-E had intensive stakeholder interaction at both European and regional/national level.

This document provides an overview of the motivation and the technical approach of the NC RfG. More detailed explanations may be found in the updated and extended list of FAQ published together with this document and the NC RfG.

1.2 GUIDING PRINCIPLES

The guiding principle of the NC RfG has been to develop requirements for grid connection of generating units from the perspective of maintaining, preserving and restoring the security of the interconnected electricity transmission and distribution systems with a high level of reliability and quality in order to facilitate the functioning of the EU-internal electricity market now and in the future.

In this context existing grid codes as well as events from the past have been analysed. A weak technical framework bears the inherent risk of jeopardising system security, in some cases it may even lead to (partial) black-outs (see chapter 3.1). In addition, the increase of renewable generation (RES) will change the system characteristics and performance. Consequently the requirements are based on the experience to ensure secure operation in conjunction with the rapidly rise in renewable generation. The results of recent studies in this area (e.g. EWIS study [4]) have been considered.

The NC RfG has taken into account that future generation will be either synchronously connected (like for the vast majority of conventional thermal generating units or hydro power plants) or via a power converter installation (wind generators, PV installations, etc.). In addition generation will be connected to all voltage levels. Therefore ENTSO-E will ensure that the NC RfG will be compatible with the future Demand Connection Network Code[1] which will define the requirements for the connection of significant demand facilities and distribution networks.

Offshore wind generation will play a major role in Europe's future energy supply. Therefore requirements for offshore grid connection have been set forth in a separate chapter within the NC RfG.

A major objective of the NC RfG is to deliver a set of performance requirements for generators which are fit for purpose and applicable for their entire lifetime. In addition the requirements of the NC RfG have to be robust for a variety of generation scenarios at least up to 2030.

2 GENERAL APPROACH TO THE NC

2.1 STRUCTURE

The major goal of the NC RfG is to ensure secure system operation. This requires close cooperation of power generating facilities connected at all voltage levels with the network operators in an appropriate way. Therefore, power generating facilities have to be able to tolerate regularly occurring faults in the grid and have to be capable of providing services to the responsible network operators enabling them to discharge their system security obligations. From a system engineering approach, these capabilities are independent from generation technologies. Major differences in the capabilities of power generating facilities do not result from the primary energy source used for conversion into electricity (gas, coal, nuclear, hydro,

[1] The Demand Connection Network Code is planned to be submitted to ACER by the end of 2012 as requested in the EC mandate letter sent on 5 January 2012.

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etc.), but from the type of generator connected to the network, in particular whether the generator is synchronously or asynchronously connected to the grid or via a power converter.

To facilitate this, the choice was made to develop a single network code to ensure equitable treatment of all users by maintaining a consistent set of requirements for all power generating facilities. In the NC RfG it has been considered appropriate to distinguish between four categories of requirements:

- general requirements which shall apply regardless of the generator technology, as they are not influenced by it;
- specific requirements for synchronously connected generating units;
- specific requirements for non-synchronously connected generating units (so called power park modules);
- specific requirements applicable to offshore generation, defining the differences in treatment between onshore non-synchronous generators, taking into account the range of different configurations for the offshore network connections.

2.2 LEVEL OF DETAIL

A choice had to be made on the level of technical detail of requirements in the NC RfG. ENTSO-E consulted stakeholder opinions, which differed substantially over the appropriate level of detail.

Manufacturers have requested a considerably more detailed approach in order to achieve unambiguous and harmonized specifications for the generating units in order to drive down costs of product development and make efficient use of scarce engineering resources.

Noticeably the project developers / power generating facility owners have called for the opposite including raising concerns about cost increases. However, even this group welcomed harmonisation and specification, as a level playing field can be supported by a detailed network code. Furthermore, best use of resources can be made by adopting harmonized pan European designs.

In addition, harmonized rules facilitate the entry of new market players and allow experience from one market to be applied in another. ENTSO-E has followed an approach from the perspective of system security in order to facilitate a reliable platform for the EU-internal electricity market.

Therefore, the level of detail of the requirements varies and takes into consideration the principles of subsidiarity and proportionality. Consequently, some requirements have a rather prescriptive nature, when system security demands for not only common methods and principles, but common parameters and settings as well. Other requirements determine just the principles on an EU or synchronous area level and provide the necessary flexibility to be detailed at the most appropriate level (national or regional) in order to consider specific system conditions.

A guiding principle has been to specify the output (or performance) rather than the technical solution of achieving the required performance in order to maximise the freedom for innovation and development and hence achieving competition in the market.

Therefore, the required level of detail cannot be determined generally, but needs to be adjusted to each specific requirement. The necessary degree of detail can be determined by the extent of the system-wide impact. The relevant entity from the perspective of system security is predominantly the synchronous area and five of them are in the scope of the NC RfG, these being Continental Europe, Nordic States, Great Britain, Ireland and Baltic States.

Other requirements of NC RfG are most appropriately detailed in accordance with the subsidiarity principle at the national or single TSO level. In these cases, NC RfG only defines common methods and principles whereas national choices are made by explicit thresholds or parameter values in line with these methods and principles. Following the finalisation of NC RfG the

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provisions in the national codes or at the national regulation level, have to be adapted to fit the requirements of this network code.

2.3 FUTURE DEVELOPMENT OF RES GENERATION

In the development of the NC RfG extensive experience across Europe has been considered.

Many renewable energy sources (RES) (wind generators, PV installations, etc) are connected to the grid via power converters (fully or partially rated). These technologies behave differently from directly connected synchronous generators.

However, these technologies need to interact with the synchronous system and contribute to secure system operation. They offer different capabilities which should be fully utilized to stabilise the grid and therefore allow further increased penetration of RES. This is an important step to substantially increase renewable generation volumes and consequently to achieve the EU climate targets. Two examples of the use of these capabilities are explained below:

1. Fault-Ride-Through (FRT) capabilities and the supply of reactive power. The power electronic converters allow decoupling active and reactive power. They also allow a "choice" in the behaviour of the unit during a voltage dip, as priority can be given to deliver active and/or reactive power during a fault in order to support frequency or voltage. The NC RfG maximises the RES penetration by using these features.
2. Synchronous generation has the inherent capability to provide additional active power to the system in the event of a frequency drop because of the inertia of rotating machines. Conversely RES connected via power electronic converters are insensitive to frequency changes and do not contribute any additional active power to the system during a frequency fall. This lack of inertia already limits the RES integration in two synchronous areas in Europe. The NC RfG sets out that the RES shall be able to provide a synthetic inertia facility thus facilitating greater penetration of RES.

2.4 GRADED APPROACH TO REQUIREMENTS FOR SIGNIFICANT GRID USERS

The approach selected in respect of significant grid users is focused on graded significance. Requirements should only be introduced when necessary to deliver secure system operation, which in turn provides the stable platform for the energy market to function.

With regard to system security the individual behaviour of a certain type of generator in particular at domestic level may not be significant. However, when a large number of them respond similarly to a common stimulus they have the potential to become a threat to security of supply. Hence, the total installed capacity at presence and as anticipated in future needs to be considered as well in such cases. Therefore, NC RfG covers units starting from the smallest domestic level recognising that a small minority of requirements are essential to secure system operation regardless of individual capacity or location. These requirements, most notably the frequency range, relate to a common failure mode for all plants. For example if a million 5 kW plants (e.g. domestic solar PV roof units) in one synchronous area tripped simultaneously (as they all share the same frequency), this can have exactly the same impact as the simultaneous loss of 5000 MW of synchronous generation (ie the equivalent of losing five large thermal units. Such a loss is beyond what any of the systems (even the large Continental European system) is capable of coping with without causing loss of supply for consumers. Therefore the frequency range requirement must apply for all, large or small.

Given the types of service needed and their impact on the system recognising the associated costs of implementing the requirements, requirements have been developed to be progressive in nature. Four classes of generation units mainly dependent on their size are specified:

Type A covers all generators starting from the smallest domestic units and is designed to maintain security of supply for frequency related common mode failures.

Type B covers small to medium generation usually connected to the distribution system which is equipped with automated response, facilitating operator control and information exchange.

Type C covers larger generators providing more refined requirements including controllable dynamic frequency response.

Type D covers the largest generators and their specific requirements.

Given the different sizes of the synchronous systems and the varied geography of the networks, the NC RfG requires that specific capacity (MW) thresholds for the types B-D will be set at the national level, considered as the most appropriate level to define them.

The graded approach also applies to processes. For smaller units it is essential to reduce the per installation labour cost. Hence a simplified (not site based) compliance approach is allowed for Types A and B, which for the smallest units is expected to be achieved via European standards and associated type testing. For the largest units the controls are more complex and the system risks are greater. Therefore, a more rigorous compliance approach is required including some on-site activities.

The graded approach to significant grid users, together with avoiding application of NC RfG requirements to existing generating units unless well justified through a socio-economic cost benefit analysis and public consultation has allowed the ENTSO-E to respond positively to resolve the key cost concerns from industries like the solar PV industry.

Overall this graded approach of applying the requirements only where needed is the main tool in minimising the cost of implementation of the code, with potential for net cost reductions in some cases due to the greater level of harmonising allowing fewer versions of products.

2.5 APPLICATION OF NC RFG PROVISIONS TO EXISTING GENERATING UNITS

As requested by the FWGL, the NC RfG requirements will only apply to existing generating units based on a proposal from the relevant TSO, which has a demonstrable cost-benefit analysis and is subsequently approved by the National Regulatory Authority (NRA) (see FAQ 8).

Currently the European power systems are changing rapidly: the internal market is evolving, RES is increasing and new transmission technologies, like FACTS (Flexible AC Transmission Systems), HVDC (High Voltage Direct Current) circuits are being introduced. These factors result in some uncertainty in anticipating the needs for power system security for the next 20 years. The requirements of the NC RfG will become binding EU legislation, which mean that they will be applicable for a long time and changes/amendments to them can only be implemented in accordance with the relevant EU procedures. Hence, it is essential to have the possibility to apply network code requirements to existing plants. Such application will, however, only be pursued in well justified cases with the safeguards of the provision of the FWGL.

A network code requirement shall apply to an existing generating unit only if it is demonstrated by a quantitative cost-benefit analysis that the costs to fulfil this requirement are in an adequate relation to the benefits to the power system. Furthermore consultation at the national level is also required (see FAQ 10).

3 COST-BENEFIT EVALUATION FOR A EUROPEAN-WIDE HARMONIZED NC

The FWGL defines that *"The applicability of the standards and requirements to pre-existing significant users shall be decided on a national basis by NRA, based on a proposal from the relevant TSO, after a public consultation. The TSO proposal shall*

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be made on the basis of a sound and transparent quantitative cost-benefit analysis that shall demonstrate socio-economic benefit, in particular of retroactive application of the minimum standards and requirements".

Before any existing generating unit is required to comply with the NC RfG provisions, the relevant TSO will have carried out a public consultation and undertaken a sound and transparent quantitative cost-benefit analysis, and the NRA will have made the final decision based on information obtained from both the cost-benefit analysis and the consultation processes.

A sound and transparent quantitative cost-benefit analysis is an intensive process that requires resources from all market participants to collect the required data. To make best use of resources a filtering process is applied initially to identify the cases with best merit. This filtering consists of a high level analysis using a "traffic light" system. This method, applied by each TSO, evaluates if there is a reasonable prospect of justifying application to existing generating units with respect to each requirement defined in the NC RfG.

For requirements that do not justify their application to existing generating Units in the filtering process, no further action will be taken. As a result, these requirements will not be applicable to existing generating units. However, the FWGL allows for a review of this significance evaluation at a later date. This facility to review later is intended to, on the one hand, allow the TSO to avoid excessive applicability to existing generating units where this may prove unnecessary and, on the other hand, have a safety net for changes if required to maintain system security.

For requirements that may justify their application to existing generating units in the filtering process, then the TSO can proceed on to a more detailed assessment, being assisted by the power generating facility owners. If no clear indication from the filtering process emerges, more detailed analysis may be required (see FAQ 10).

The TSO will provide information of the outcomes of the above processes to stakeholders. A summary of the national decisions on the NC RfG requirements to existing significant grid users will also be shared with ENTSO-E, the relevant NRA and ACER.

3.1 BENEFITS ASSOCIATED WITH SECURE SYSTEM OPERATION

The major goal of a network code with harmonized grid connection requirements for power generating facilities is to enhance cross-border system security. Different events in previous years have led to a partial black out and/or a system split into several areas (see ENTSO-E Defence Plan [5]). Major events include:

- During the system split of 4th November 2006, a significant amount of wind generation (several 1000 MW) tripped at 49.5 Hz. They tripped correctly as required by local requirements, but as a consequence, the corresponding fall in system frequency resulted in automatic demand disconnection was that much greater, and many millions of customers lost supply as a result. If the NC RfG had been implemented this would not have happened. Additionally, implementation of the NC RfG requires automatic reduction of active power output at high frequencies. This would have resulted in faster system restoration as well as providing a safer margin to system shutdown of the overfrequency island.
- During 27th May 2008 unusually two large generation plants (including the largest twin nuclear unit) tripped simultaneously in Great Britain. This was beyond what the system was planned to be resilient for. Initially, in spite of the extreme challenge, the system frequency fell to at 49.2 Hz (avoiding automatic disconnection of generation). However, a modest yet critical amount of further loss of generation with narrow frequency range then tripped. As all response resources had already been exhausted, the system frequency then fell quickly to 48.8 Hz resulting in the first stage of nationwide demand disconnection. Application of frequency ranges and compliance for all generators is likely to have avoided this demand disconnection.
  These two events support more stringent frequency range requirements applied to all types of generation.
- In September 2003 Italy's 12 connections to other countries were all lost following initial flash-over to trees. Italy had been importing 25% of its electricity at this time during the night. When the Italian system was initially discon-

nected from the continental system, sufficient demand was disconnected such that the system should have survived. However, 15 of the largest generators then tripped making the supply deficit too large for rebalancing the system with demand disconnection. The frequency therefore dropped dramatically and the system shut down. It then took many hours to restore the system. If the complete robustness package of the NC RfG had been implemented the total system collapse may have been avoided.
This event supports improved robustness requirements.

These examples and related investigations have shown that some of the impacts could have been mitigated by a coherent behaviour of the generating units. One of the new features and main benefits from this network code is the approach of harmonizing grid connection requirements not only horizontally between countries or TSOs but in justified aspects also vertically between TSOs and DSOs.

The NC RfG is based on network operators' experience in their area of responsibility and allows for best practices taken from each other. Not only the requirements for the power generating facilities have been improved, but also the procedures for compliance testing and monitoring.

3.2 EVALUATION OF COST OF IMPLEMENTING THE REQUIREMENTS

To analytically compare the costs and benefits of implementing the NC RfG against not implementing them would require time and a huge effort. This process would necessitate the collection of large amounts of data from market players as well as a precise comparison with expected future developments. The data collection would require individual examination at each Member State level, as it would have to be compared against the cost of maintaining existing legislation and existing national grid codes which vary significantly. Other complex dimensions are the impact per technology type and the size of the installations. In addition, the national grid codes or equivalents have to evolve to cope with the changing environments. As a consequence, many of the requirements within the NC RfG would have been developed by the national bodies independently and the cost associated would have been at least the same. Due to harmonization by ENTSO-E in the NC RfG there are good prospects for significant savings, which has been supported by manufacturers.

On the cost side, this would in the first place, require a unitised cost difference to be established (before and after) for each element of the code – and the expected national code development. This would have to build on an overall change in cost caused by the NC RfG. This is not practical and therefore a qualitative comparison was considered to be more appropriate. A rough assessment of the changes of the NC RfG to existing grid codes relating to the costs for new and existing generators is:

1. For the number and strictness of requirements the changes are modest for most Member States, most commonly making the requirements more harmonized rather than more or fewer requirements,
2. The requirements are now applied further downstream in the system due to the growing impact of smaller units (see chapter 2.4),
3. Compliance testing is extended in order to improve reliability. Consequently the costs attached increase based on the requirements of the FWGL.
4. The NC RfG will require DSOs, in their capacity of system operators, to take a greater role in ensuring compliance of generators connected to their system. This will require greater resource within the DSOs than at present, but will lead to higher levels of network security.

The changes from existing standards are also modest as the standards always followed requirements given by the respective grid codes. As a consequence when there is relatively little change to existing grid codes there is also only a modest need for updating existing standards.

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To evaluate the costs ENTSO-E does not have access to detailed cost data and therefore asked the stakeholder groups representing the main generation technologies for more detailed information. The main results for the cost evaluation for **new plants** are:

- **EPIA** (solar PV) did respond positively to the request to provide cost information with hard data [6].
- The consulted **manufacturers** stated that there would be considerable savings from streamlining of projects through avoiding/ reducing the number of variants required to supply the European market:
    - The **wind industry** was particularly encouraged about the prospect of using less of its scarce specialist engineering resource on small, but time and resource consuming differences, in particular processes and documentation.
    - The **wind industry** believes that greater savings could be made if the code contained significantly more detail. EWEA had originally asked ENTSO-E to introduce 239 of their proposed requirements and ensure full standardisation of documentation including rationalising the vastly differently national codes in terms of presentation.
    - The impact on the **PV industry** is nearly entirely focused on their inverter systems. The cost to implement the NC RfG is expected to be zero in manufacturing cost. However, their contribution in terms of security of supply would be significant with only an insignificant software cost incurred during development. In addition, PV would have the advantage by being able to sell the same product in a much wider market. [6]

- The consulted **developers and plant owners** have not provided any evidence to answer this cost question.

The main feed-back for the cost evaluation for **existing plants** or **contractually committed** plants is:

- Manufacturers stated in bilateral consultation, that the full application of the NC RfG provisions to existing generating units seemed generally unworkable.
- The consulted plant owners stated that a significant amount of installed capacity may have to be withdrawn.
- Solar PV responded that software updates (e.g. to mitigate the tripping of PV units at 50,2 Hz) may be possible with relatively little costs, however changes in the hardware are unworkable.

3.3 CONCLUSIONS OF COST-BENEFIT EVALUATION

This evaluation has to be made for new plants and for existing/contractually committed plants separately. In general, a detailed cost-benefit analysis is not feasible due to the lack of information in a fast changing and competitive environment. The market development can only be estimated; the costs of innovative generation technology are not known and are subject to fierce competition.

It has been shown that a lack of requirements could lead to partial or system-wide blackouts. The risks and costs are difficult to calculate but large scale blackouts are known to result in costs estimated to be in the order of at least 1 billion € not to mention the risks for human safety and health (hospitals, traffic lights, etc.). As a consequence, activity which reduces the risk of black-outs should be credited as a benefit.

For **new plants**, the possible cost increases due to applying the requirements of NC RfG and the cost savings due to standardisation is roughly balanced. In view of the importance of maintaining system security for the European welfare in the context of:

- vastly increasing RES,
- implementing a level playing field,
- and facilitating the European market by supporting energy transfers over long distances,

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the NC RfG should be implemented. Considering the large amount of new generation to be built in the years to come this will significantly help to support the EU goals. As the NC RfG will become binding all over the EU and the synchronous systems mentioned within the code, this will ensure equitable treatment of all generators.

For existing/contractually committed plants the cost-benefit analysis is far more complex. As the existing generators were built based on different requirements and historic settings it will be extremely challenging to ensure equitable treatment for them in the future market, if full retroactive application were required. In addition, the units in operation today are known to function well in the system giving the required level of security of supply over many decades although it is known that some specific problems will have to be addressed. Application of specific requirements to mitigate the risk of existing PV tripping at 50,2 Hz in continental Europe found broad support from stakeholders due to the obvious threat to stable system operation. However, the improvement of single technical requirements does not justify the full application of the NC RfG to existing generating units. Hence ENTSO-E pursues the approach of requiring the applicability of NC RfG requirements to existing generating units, only if a positive cost-benefit analysis proves the socio-economic viability as discussed in chapter 2.5.

4 ASSESSMENT OF NC RFG IN RELATION TO EXISTING GRID CODES

Network codes are a prerequisite for non-discriminatory, cost effective and secure system operation. Therefore, in the past, all transmission systems in Europe have developed Grid Codes or comparable documents that have been the basis for the connections of generation units for many decades. Some requirements were harmonized on the level of a synchronous area, others were based on national or regional frameworks. Thereby a similar approach was pursued as stated in chapter 3.2.

In the following, an overview of the situation in the different synchronous areas is given (see FAQ 10 for more details):

The Continental European Region (formerly UCTE) includes more than 20 TSOs with many grid codes. In 2008 UCTE published a “Technical Paper – Definition of a Set of Requirements to Generating Units” [7] whose content was considered in the development of the NC RfG reflecting the needs of the existing UCTE system.

The Nordic states (Denmark, Finland, Norway and Sweden) have their own national generator codes, which do not fully cover all requirements for Generating Units which are considered necessary in future. There is also a consolidated Nordic grid code [8] for the Nordic states which does not cover all the details in the national generator codes. The existing Nordic grid code has similar requirements to NC RfG. However, the NC RfG brings new requirements to smaller units and extends compliance monitoring and testing for all units. In addition the NC RfG gives good specifications and clarifications for existing requirements.

The GB Grid Code [9] for Great Britain is similar to the NC RfG in respect of the number of requirements and in many respects of the strictness. One significant change is that the NC RfG introduces the extension of graded requirements to smaller units. Over the next 20 years this will avoid both a drop in level of system security from a larger proportion of smaller generation and from having to place a major restriction on the amount of RES which can be connected.

The Irish Grid Code [10] is similar to the requirements in the NC RfG and are within the system operator defined ranges where specified. The biggest area of change and benefit is focused on increasing the level of interaction and co-ordination between the generator and system operator, particularly for smaller distribution connected generators. This will enable the security and planning of the transmission and distribution systems in a more diverse environment assisting the realisation of European and national development targets (including RES) within Ireland.

For the Baltic countries (Estonia, Latvia and Lithuania) the NC RfG will provide a more complete set of requirements than in today’s national codes [11],[12],[13]. Consequently the new NC RfG will lead to harmonization between these countries, and to a certain extend to the other ENTSO-E members.

5 CONCLUSIONS

ENTSO-E has detailed the Network Code "Requirements for Grid Connection Applicable to all Generators" to set out clear and objective requirements for generators for network connection based on ACERs Framework Guidelines on Electricity Grid Connections.

The goal of the NC RfG is to ensure secure system operation and to support the integration of RES into the system now and in the years to come. As a consequence, not only has the historical background to each Member State been considered, but also the future developments required as described by European and national policy makers.

As a result, the requirements for generation facilities of all technologies have been described. Power generating facilities have to be capable of providing services to the responsible network operators to enable them to ensure system security. It has to be acknowledged that technologies offer different capabilities which should be utilised to contribute to grid stability and increase the potential RES integration. This is an important step to increase RES generation significantly and consequently achieve the EU climate targets.

Stakeholders have been consulted about the NC RfG in several public workshops and in many meetings with the main European associations. This pan-European consultation has recently been supplemented with regional/national consultations. It should be noted that the requirements of the stakeholders were not unanimous, but varied in many positions significantly.

In conclusion ENTSO-E believes that the NC RfG meets the needs for secure system operation for the European network for the foreseeable years and balances the wide diversity of views and opinions provided by stakeholders.

The approach taken by ENTSO-E is motivated in this document.

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6 ANNEXLITERATURE

[1] ACER July 2011
Framework Guidelines on Electricity Grid Connections (FWGL)), July 2011 - http://www.acer.europa.eu/portal/page/portal/ACER_HOME/Stakeholder_involvement/Public_consultatations/Closed_Public_Consultations/PC-01_FG_El_Grid_Connection/FINAL_FG

[2] ERGEG,Pilot Framework Guideline on Electricity Grid Connection - Initial Impact Assessment, July 2010 - http://www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_CONSULT/CLOSED%20PUBLIC%20CONSULTATIONS/ELECTRICITY/Pilot_Framework_Guideline_Electricity_Grid_Connection/CD/E09-ENM-18-03_FG-GridConnect-IIA_12-July-10.pdf

[3]ENTSO-E, Frequently Asked Questions on ENTSO-E's Informal Pilot Network Code for Requirements for Grid Connection Applicable to all Generators, July 2011 - https://www.entsoe.eu/fileadmin/user_upload/_library/SDC/Pilot_code/110711-Pilot_Code_FAQ.pdf

[4]EWIS Study 13.04.2010, European Wind Integration Study (Final Report), March 2010 - http://www.wind-integration.eu

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[6]Presentation EPIA, February 2011, EPIA's views on EU Pilot Network Code, February 2011

[7]UCTE, Technical Paper – Definition of a Set of Requirements to Generating Units, September 2008 - https://www.entsoe.eu/fileadmin/user_upload/_library/news/Technical_Paper-Requirements_to_generators.pdf

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[10] Irish Grid Code, http://www.eirgrid.com/media/2011%20Mar%2008%20EirGrid%20Grid%20Code%20Clean%20Version%203.5.pdf

[11] Estonian Grid Code, http://www.legaltext.ee/et/andmebaas/tekst.asp?loc=text&dok=XXXX010K1&keel=en&pg=1&ptyyp=RT&tyyp=X&query=grid

[12] Latvian Grid Codehttp://www.likumi.lv/doc.php?id=205904

[13] Lithuanian Grid Code http://www3.lrs.lt/pls/inter3/dokpaieska.showdoc_l?p_id=157875

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7 ANNEX STAKEHOLDER INTERACTIONS

Annex 7.1 lists all stakeholders that participated in discussions with the drafting team on NC RfG in the pilot process as well as in the formal process.

Annex 7.2 lists all stakeholders that responded in the consultation on the pilot code early 2011.

7.1 BILATERAL MEETINGS

- Alstom
- Andritz Hydro
- Areva
- CEDEC
- EPIA
- EUR
- Eurelectric DSO
- Eurelectric WG Thermal
- EU Turbines
- EWEA
- GE Energy
- GEODE
- IFIEC
- Siemens
- Wärtsilä

7.2 WRITTEN STAKEHOLDERS COMMENTS IN PILOT CODE CONSULTATION PROCESS

- Alstom
- Andritz hydro
- Areva
- CEDEC
- Clausthal University of Technology
- EDF Energy
- ENA
- EPIA
- ESN Networks DSO
- Eurelectric DSO
- Eurelectric Thermal
- EU Turbines
- EWEA
- Electricity Northwest-Distribution Code Review Panel
- GEODE
- IFIEC

- ODE Flanders
- RWE-UK
- SWE Confederation of Swedish Enterprise
- Vattenfall/Ringhals/Forsmark
- Wärtsilä
- Electricity Northwest-Distribution Code Review Panel

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