ENTSO-E amendments to the Network Code for Requirements for Grid Connection Applicable to all Generators

Response to ACER's Opinion No. 08/2012

8 March 2013

1. Background

This note captures the motivation for ENTSO-E's amendments of 8 March 2013 to its Network Code for Requirements for Grid Connection Applicable to all Generators (NC RfG) of 26 June 2012[1]. The amendments in a select number of key aspects are driven by ACER's Opinion on the NC RfG (dated 13 October 2012). The Opinion acknowledges that the code of 26 June 2012 is broadly in line with the framework guidelines on electricity grid connections and the objectives stated therein. On a limited number of clearly described areas the Opinion calls for either increased flexibility of the provisions of the code or additional argumentations. This notes serves as response to all four requests in the Opinion. As acknowledged by the Agency, ENTSO-E stresses the importance of a timely adoption of the Network Code as European Regulation for security of supply, the completion and well-functioning of the internal market in electricity and the facilitation of Europe's targets for penetration of renewable energy sources.

In preparation of these amendments, ENTSO-E requested feedback of relevant stakeholders on possible ways forward in each of the four areas outlined in ACER's Opinion. For this purpose several meetings were initiated with the RfG User Group (22 November 2012 and 16 January 2013) and the DSO Technical Expert Group (22 November 2012). All relevant material is accessible on the ENTSO-E website[2]. ENTSO-E's first draft proposals on how to amend the NC RfG were sent to the User Group on 17 December 2012. The constructive feedback on the four areas of ACER's Opinion was appreciated, guided the amendments to the code and has been reflected in this note where relevant. ENTSO-E notes that several concerns still persist within some sectors on other items than the ones considered for improvement in this phase of amending the code. These are mostly based on how non-exhaustive requirements of the NC RfG will be implemented at national level (which specification? which approval process? which coordination across Member States? which kind of stakeholder involvement?). ENTSO-E is convinced that a further implementation of the Directive 2009/72/EC, a continued interaction with network operators at ENTSO-E and national level before the code enters into force, and finalization of other ENTSO-E network codes with related requirements will provide more clarity and confidence on these aspects already before the NC RfG enters in to force.

2. Response to the individual items of ACER's Opinion

a. Significance Test to identify „significant grid users"

ACER's Opinion acknowledges the technology-neutral approach adopted in the code as well as the importance of a uniform application of the requirements regardless of the generation technology. Nevertheless, more justification is asked on the lower limit of 800W of the category of type A generators.

[1]https://www.entsoe.eu/fileadmin/user_upload/_library/consultations/Network_Code_RfG/120626_final_Network_Code_on_Requirements_for_Grid_Connection_applicable_to_all_Generators.pdf

[2]https://www.entsoe.eu/major-projects/network-code-development/requirements-for-generators/

More importantly the aggregated impact, or in other terms the significance, of type A generators with small-scale penetration of installed capacity each is questioned. Explicitly concerns are raised that market entry barriers for emerging technologies may be introduced. At least two potential approaches are mentioned in the Opinion to mitigate these concerns:

a. An enhancement of the significance test by introducing principles to take the aggregated volume of installed capacity per synchronous area into account, as an additional criterium to the 800W threshold; or
b. An enhancement of the derogation process, which may be open to manufacturers at a coordinated pan-European level.

ENTSO-E wishes to stress that requirements for type A generators are clearly limited to frequency stability issues and cover:

- Frequency withstand capability
- Rate of Change of Frequency Withstand Capability
- Limited Frequency Sensitive Mode – Overfrequency
- Constant Output at Target Active Power
- Maximum Active Power Reduction at Low Frequencies
- Remote Switch On/Off
- Automatic Connection

All these requirements are justified based on the aggregated impact that even small scale generators may have due to a common response to a triggering event (e. g. a frequency deviation from is nominal value), irrespective of its individual size or technology. The need for these requirements has been discussed and justified extensively already in recent national cases, e.g. in Continental Europe, where urgent retro-fitting of PV units was deemed a necessity to ensure system security[3]. These cases underline that the aggregated impact of existing type A generators is already significant with regard to frequency stability requirements introduced to them by the RfG network code. A general straightforward exemption from type A requirements below a specific kW unit-size would not be proportional as the vast majority of present technologies can easily meet the type A requirements, which has been demonstrated by the PV case of Continental Europe. An unlimited exemption of new connections of a specific, well-targeted class of users or even technologies in the code would inevitably result in a discriminatory approach across all users. Furthermore such general exemptions may deter manufacturers from endeavouring technology developments which are compliant to the applicable network code requirements.

ENTSO-E also wishes to stress that for every MW of generation exempted from the respective requirements, frequency stability support needs to be covered by the Transmission System Operators through their allocated active power reserves. Any exemption would consequently result in additional provision of these reserves. This results inevitably in a cost sharing/shift across all users, based on the exemption of a limited number of users.

From recent discussions with stakeholders on difficulties of few type A generation technologies to comply with the requirements of the NC RfG, ENTSO-E draws the conclusion that these are focused on narrowly defined classes of users, in which specific details are often rather manufacturer-specific. No overall criterium could be given of which a single class of users should be justifiably considered for an exemption. The CHP sector has demonstrated the technical constraints of the presently existing free piston linear stirling engine based micro CHP and has asked for a 'window of opportunity' to adapt a technology that is at present commercially viable and for which R&D and production process investments have been made. In addition the CHP sector has asked for a manufacturer-oriented pan-European derogation process to initiate a class derogation on other technologies (fuel cell, ICE) for specific type A requirements.

For the option of a pan European class derogation initiated by manufacturers, ENTSO-E stresses its earlier arguments that a manufacturer is not immediately addressed by a connection code which entails

[3] ENTSO-E Report Assessment of the system security with respect to disconnection rules of photovoltaic panels (25 April 2012)

responsibilities on the connecting party (the Power Generating Facility Owner), the Network Operator, and relevant entities in the applicable regulatory regime (e.g. the National Regulatory Authority). To allow for class derogations still, the code provides for a derogation process initiated by a Network Operator which could cover an exemption on imposing requirements on a specific class of technology. Also a derogation application necessitates an in-depth analysis (most likely including a CBA) in which national specifics are to be considered, in particular if it refers to non-exhaustive requirements. As such a pan-European derogation cannot be a 'one-stop-shop', but would in any case be a collation of many national analyses where regulatory coherence needs to be ensured.

Based on these considerations, ENTSO-E considers that an enhanced significance test by simply increasing the de minimis threshold for type A technologies or introducing an additional threshold based on aggregated capacity, or alternatively a more flexible derogation process is neither the most suitable means to address the consideration raised in ACER's Opinion or by specific manufacturers in the RfG consultation, nor can it be supported by ENTSO-E to reach the objectives of this code. A conclusion from the recent stakeholder interaction, on which manufacturers of type A technologies, regulators, the EC and ENTSO-E agreed was that specific considerations for emerging technologies can only be seen as a temporary measure in case a technology has made its R&D and production investments already (and as such is an 'existing technology'), but its limited penetration is negligible compared to other type A units at present.

To cover this specific situation in a technology-neutral manner, an additional title is added to the NC RfG covering emerging technologies (Art 57-61). This process covers broadly the following steps:

- All TSOs specify a fixed level of penetration (MWs) per synchronous area which can cover the situation of existing emerging technologies. TSOs propose an allocation per Member State based on relevant frequency containment reserves sharing practices.
- Manufacturers can apply for a specific product to be labelled an emerging technology when a set of criteria are met:
    - The size of units falls in the type A category;
    - The product is commercially viable already; and
    - Sales at the synchronous area level fall below a given threshold at the day of application.
- NRAs coordinate and decide whether the technology is qualified as an emerging technology.
- Grid users connecting a Power Generating Module of which the technology is labelled as emerging technology at the date of connection are not obliged to comply with the NC RfG requirements for this specific module, except for the operational notification step by means of an Installation Document.
- NRAs monitor the aggregated penetration of all emerging technologies in a Member State on a monthly basis.
- When the threshold for a Member State is reached, the transitory regime terminates and from that point in time on all new connections shall comply with the Network Code requirements. The label of emerging technology is considered revoked for all earlier qualified technologies in this Member State. Note that already connected Power Generating Modules are still in a similar regime as that of Existing Power Generating Modules and are not by default required to be retrofitted.

When there are multiple technologies qualified as emerging technology in a Member State, this process avoids that one technology is favoured over the other. All have equal chances to make use of the transitory regime. The transitory regime offers manufacturers the possibility to have a direct role in the process and obliges manufacturers of a qualified emerging technology to provide updated sales figures on a quarterly basis. The process is deemed transparent and does create a window of opportunity for existing emerging technologies to adapt to the code, while it provides a safeguard for system security against a sudden 'boom' of the technology due to changed market conditions or policy incentives.

ENTSO-E is confident this approach offers a technology-objective and transparent process as a transitory regime for emerging technologies without adverse impact on the overall objectives of this code.

b. Justification of the significant deviations from existing standards and practices

ACER noted in its Opinion, and underlined in the User Group meeting of 22 November, that further analysis on this topic is restricted to two specific items:

- The mandatory nature of Article 9(3)(a); and
- The application of the principles of Article 3(6)(h).

a. Fault-Ride-Through capability for type B generators (Article 9(3) (a))

ACER notes in its Opinion that "… the first step is to establish a baseline of current requirements". The wide variety by which Fault-Ride-Through (FRT) requirements are implemented nowadays has been underlined in the RfG supporting document "Requirements in the context of present practices" (published 13 July 2012). It elaborates how some present practices can

- ask for a voltage-against-time profile or only cover a fault clearance time;
- give specific pre/post fault conditions or not; or
- are technology-specific.

Initially FRT requirements were not broadly applied to smaller (embedded) generators. This notwithstanding, the wider industry has already acknowledged the importance of FRT requirements as such on all generators. ENTSO-E in principle welcomes the intention of CENELEC to introduce an FRT requirement on generators connected at medium and low voltage (>16A/phase) by prTS50549-1 and -2, which would essentially stretch down to type A generators. Also in the context of the RfG User Group, manufacturers of smaller generators have not contested the necessity and technical feasibility of FRT requirements in general or even questioned a leap one would take in mandating it for type B units. The industry is ready for this requirement and many technologies already inherently have this capability. Concerns do exist on the eventual specific settings that will be applied at national level, e.g. on the fault clearance time, the retained voltage, active power recovery or reactive current injections. All relate to fault behaviour; all are crucial to be adequately addressed for all units down to type B size in order to avoid adverse impacts of mass tripping on frequency stability; but all are also strongly dependent on local system conditions. Consequently, the FRT requirements in the Network Code are of non-exhaustive nature and specific implementations are to be covered in the national processes referred to by the principles of Article 4(3). This does however not question the mandatory nature of the general FRT requirement as referred to in Article 9(3)a).

ACER notes secondly in its Opinion that "… justification should be provided confirming the cross border character of this requirement at this voltage level ". The FRT requirement's main purpose is to support frequency stability by avoiding mass tripping of distributed generation units. The case studies discussed cover both simulations as well as analyses of real events in GB, France, Germany and Spain. A summary of these case studies is given in Annex I.

These cases emphasize the importance of FRT for small scale generation by means of

- simulation studies in the GB and French system;
- analyses of real events in the German and Spanish system; and
- references to the EU funded EWIS study results.

ENTSO-E considers that these analyses demonstrate the detrimental cross-border impact that non-application of FRT requirements may have on the wider system. It also demonstrates the need to impose a FRT requirement with a given retained voltage during fault clearance on embedded generation. An in-depth discussion was conducted with the DSO Technical Expert Group on 22 November 2012 in which these conclusions were confirmed (See Annex II).

ACER notes thirdly in its Opinion "… justification should be provided … demonstrating that addressing this issue at power generating module's connection points (i.e. with grid users) is more cost effective than at network level (i.e. through the transmission/distribution interface, leaving the distribution system operator to balance the means by which stable operation is achieved)." ENTSO-E and the DSO Technical Expert Group came to the joint conclusion that there is no viable technical means to reach the same capability at the transmission/distribution interface level. As there is no alternative to compare the FRT requirement with, this makes by default a cost based comparison for the mandatory nature of a clear FRT requirement on type B units not feasible.

In conclusion, based on various feedback of what the wider industry can already offer today as FRT capabilities and what the industry is aiming for in the future, as well as based on the extensive case studies discussed in which ENTSO-E and the DSO Technical Expert Group reached a joint conclusion, ENTSO-E expects this covers ACER's request for further argumentation on this requirement.

b. Combined Heat Power units on industrial sites (Article 3(6) (h))

In its Opinion, ACER questions the potential discrimination and lack of proportionality Article 3(6)h) may impose on industrial processes whose output is tightly coupled to the production of heat. ACER does acknowledge ENTSO-E's initial argument that some processes may require a lower quality of heat (e.g. district/building heating), based on which an overall exemption of CHPs cannot be justified. In this context and as a follow-up of the User Group meeting of 22 November, ENTSO-E welcomes the additional clarification that the industry has provided on this topic (See Annex III). Steam is only one form of heat carrier used in cogeneration processes in industry today. The specific heat carrier chosen will vary according to the needs of the manufacturing or production process and the design of the plant. In some cases more than one carrier may be used in different stages of a process. The industrial processes all share the characteristic of being heat-demand led, and the electricity generated is therefore tightly coupled to the process in question. Based on these arguments, ENTSO-E acknowledges that potential undue discrimination is avoided, without extending the exemption of Article 3(6)(h) to cases where there is no a priori justifiable merit, by rephrasing Article 3(6)h as

"Without prejudice to the general applicability of the requirements set forth in this Network Code, a requirement of this Network Code shall not apply to Power Generating Modules of facilities for combined heat and power production (CHP) embedded in the Networks of industrial sites in the following cumulative circumstances:

- *the primary purpose of these facilities is to produce **heat** for production processes of this industrial site;*
- *the generation of **heat** and power are rigidly coupled to each other, i. e. any change of **heat** generation results inadvertently in a change of Active Power generation and vice versa;*
- *the Power Generating Modules are of Type A, B or C according to Article 3(6) (a) to (c); and*
- *the requirement is related to the capability maintain constant Active Power output or to modulate Active Power output other than Article 8(1) (c) and (e)."*

c. National scrutiny of the NC's requirements to be implemented at national level

As the NC RfG strikes a balance between specifications that are mandatorily enshrined in the code and non-exhaustive requirements which are to be implemented based on local system needs, ENTSO-E underlines the importance of describing clearly the principles on how this national implementation will take place, without prejudice to the actual national framework itself. ENTSO-E notes that many stakeholders have urged for more clarity on the process of Article 4(3), e.g. on ensuring adequate consultation and including possibilities for appeal against decisions taken. In its Opinion ACER raises three concerns on the wording and application of Article 4(3) in the code.

1. Wording of Article 4(3)

Firstly, ACER questions the wording of the first paragraph of Article 4(3) on the ground of possible interpretations of both Article 5 and 37 of Directive 2009/72/EC. In its Opinion, ACER requests to clarify the way in which the rules of national law implementing Article 37(6)(a), (7) and (10) are to be understood. ACER proposes to delete also the second paragraph of Article 4(3), leaving the task of establishing the referred rules to the Member States.

In order to assess these concerns, ENTSO-E amends the code by making a clear distinction between different purposes of the original provision, i.e.:

- to describe the NRAs' involvement in the process of determining various requirements under the NC RfG; and
- to specify the general TSO/DSO decision making framework.

With regard to the NRAs' involvement, ENTSO-E's objective of the initial Article 4(3) was to reflect the powers of NRAs as described in Directive 2009/72/EC without prejudging on possible interpretations of those powers by the Member States (in particular of Articles 5 and 37 of the Directive). Therefore, ENTSO-E amends the code by rephrasing the former Article 4(3) in a more generalized way, without limiting the focus on specific parts of the Directive 2009/72/EC.

With regard to the initial second paragraph, it is important to note that various provisions of the NC RfG provide for the general TSO/DSO decision making framework. This means that the code specifies which entity, i.e. either TSO or DSO, will be in charge of determining a particular requirement and in which form this will be done (decisions or agreements). This general decision making framework constitutes a crucial element of the network code structure. In exceptional cases, this general decision making framework interferes with present practices in Member States embedded in their national legislation.

In order to lift the confusion or ambiguity coming from the attempt to deal with these two issues in one paragraph, ENTSO-E restructures Article 4 and clarifies its wording:

- Article 4(3) is restricted in scope, dealing solely with the powers of the NRAs according to Directive 2009/72/EC (former Article 4(3) first paragraph);
- Article 4(5) is added and confirms the TSO/DSO decision making framework provided in the Code. The peculiarities of some Member States are addressed in the recitals of the network code, as well as in the second sentence of this clause.
- Article 4(4) was not questioned in the Opinion and remains unchanged. The corresponding recital is revised in light of the new Article 4(5) and its recital.

The amended Article 4(3) and 4(5) thus reads as follows:

"3. Where reference is made to this paragraph, the terms and conditions for connection and access to networks or their methodologies shall be established by the National Regulatory Authorities, or by the Member States in accordance with the rules of national law implementing Directive 2009/72/EC, and with the principles of transparency, proportionality and non-discrimination."

"5. The allocation of tasks between the Relevant Network Operators, as well as the legal framework under which they determine the grid connections requirements under this Network Code, are established pursuant to this Network Code. TSOs granted public authority or competence according to national law can adopt decisions when defining requirements under this Network Code while respecting Directive 2009/72/EC."

The network code is also amended with two recitals being the interpretative sentences of Article 4:

"(4) The Network Code provides for various requirements to be defined by the Relevant Network Operators. In those countries where the Transmission System Operators are entitled to define – read here to propose to the relevant bodies for its approval – the technical and instrumental operational procedures for the proper technical management of the power system or to give the necessary instructions to other entities, which need to be taken into account to ensure the necessary coordination of the system and maintain the overall system security, the Network Code does not affect the Transmission System Operators' competences and responsibilities.

(5) The Network Code provides for agreements by Relevant Network Operators on various technical requirements. In those countries where the Transmission System Operators are granted public authority or

competence to adopt decisions when defining requirements for connecting Power Generating Modules which have to be taken into account for, and cannot be changed by, any subsequent Connection Agreement with the Relevant Network Operator, this Network Code does not affect the Transmission System Operators' decision making powers in those countries.“

2. *Application of Article 4(3) throughout the code*

Secondly, ACER's Opinion suggests an overall application of the principles of Article 4(3) to the entire network code, questioning the few cases of TSOs specifications in the code where no explicit reference to that provision is made and arguing a possible lack of NRA involvement in the process.

After a throughout review of all the cases where reference to Article 4(3) was not made previously, the following amendments are made in the code:

- In cases where the requirement impacts the plant design, an explicit reference to Article 4(3) is added;
- In case of decisions on parameters within the same design or on site-specific decisions NRA involvement can be ensured by means of a notification, the conditions of which (ex-ante or ex-post) are to be decided in accordance with the national regulatory framework. Therefore, the expression "*…subject to notification to the National Regulatory Authority. The modalities of that notification shall be determined in accordance with the applicable national regulatory framework.*" is added in these cases.

The following table lists all Network Operator specifications in the code, that are highlighted in ACER's Opinion, and the ENTSO-E amendments in the code to address ACER's concerns.

Art.	***Article amendment***	***Nature of the specification***		
		Impact on plant design	***Parameters within the same design***	***Site-specific decision***
8(1)(b)	With regard to the rate of change of Frequency withstand capability, a Power Generating Module shall be capable of staying connected to the Network and operating at rates of change of Frequency up to a value defined by the Relevant TSO while respecting the provisions of Article 4(3) other than triggered by rate-of-change-of-Frequency-type of loss of mains protection. This rate-of-change-of-Frequency-type of loss of mains protection will be defined by the Relevant Network Operator in coordination with the Relevant TSO **and subject to notification to the National Regulatory Authority. The modalities of that notification shall be determined in accordance with the applicable national regulatory framework.**		✓	(✓)

Art.	Article amendment	Nature of the specification		
		Impact on plant design	*Parameters within the same design*	*Site-specific decision*
8(1)(c)(1)	The Power Generating Module shall be capable of activating the provision of Active Power Frequency Response according to figure 1 at a Frequency threshold between and including 50.2 Hz and 50.5 Hz with a Droop in a range of 2 – 12 %. The actual Frequency threshold and Droop settings shall be determined by the Relevant TSO **subject to notification to the National Regulatory Authority. The modalities of that notification shall be determined in accordance with the applicable national regulatory framework**. The Power Generating Module shall be capable of activating Active Power Frequency Response as fast as technically feasible with an initial delay that shall be as short as possible and reasonably justified by the Power Generating Facility Owner to the Relevant TSO if greater than 2 seconds. The Power Generating Module shall be capable of either continuing operation at Minimum Regulating Level when reaching it or further decreasing Active Power output in this case, as defined by the Relevant TSO while respecting the provisions of Article 4(3).		✓	
8(1)(e)	a) The Relevant TSO shall define **while respecting the provisions of Article 4(3)** admissible Active Power reduction from maximum output with falling Frequency within the boundaries, given by the full lines in Figure 2: - Below 49 Hz falling by a reduction rate of 2 % of the Maximum Capacity at 50 Hz per 1 Hz Frequency drop; - Below 49.5 Hz by a reduction rate of 10 % of the Maximum Capacity at 50 Hz per 1 Hz Frequency drop. Applicability of this reduction is limited to a selection of affected generation technologies and may be subject to further conditions defined by the Relevant TSO while respecting the provisions of Article 4(3).	✓		

Art.	Article amendment	Nature of the specification		
		Impact on plant design	***Parameters within the same design***	***Site-specific decision***
9(3)(a)(2)	This voltage-against-time-profile shall be expressed by a lower limit of the course of the phase-to-phase Voltages on the Network Voltage level at the Connection Point during a symmetrical fault, as a function of time before, during and after the fault. This lower limit is defined by the TSO **<u>while respecting the provisions of Article 4(3)</u>** using parameters in figure 3 according to tables 3.1 and 3.2.	✓		
10(2)(a)	With regard to Active Power controllability and control range, the Power Generating Module control system shall be capable of adjusting an Active Power Setpoint as instructed by the Relevant Network Operator or the Relevant TSO to the Power Generating Facility Owner. It shall be capable of implementing the Setpoint within a period specified in the above Instruction and within a tolerance defined by the Relevant Network Operator or the Relevant TSO (subject to the availability of the prime mover resource), **<u>subject to notification to the National Regulatory Authority. The modalities of that notification shall be determined in accordance with the applicable national regulatory framework.</u>** Manual, local measures shall be possible in the case that any automatic remote control devices are out of service.	(✓)	✓	✓

Art.	Article amendment	Nature of the specification		
		Impact on plant design	*Parameters within the same design*	*Site-specific decision*
10(2)(b)(1)	The Power Generating Module shall be capable of activating the provision of Active Power Frequency Response according to figure 4 at a Frequency threshold between and including 49.8 Hz and 49.5 Hz with a Droop in a range of 2 – 12 %. In the LFSM-U mode the Power Generating Module shall be capable of providing a power increase up to its Maximum Capacity. The actual delivery of Active Power Frequency Response in LFSM-U mode depends on the operating and ambient conditions of the Power Generating Module when this response is triggered, in particular limitations on operation near Maximum Capacity at low frequencies according to Article 8(1) (e) and available primary energy sources. The actual Frequency threshold and Droop settings shall be determined by the Relevant TSO**, subject to notification to the National Regulatory Authority. The modalities of that notification shall be determined in accordance with the applicable national regulatory framework**. The Active Power Frequency Response shall be activated as fast as technically feasible with an initial delay that shall be as short as possible and reasonably justified by the Power Generating Facility Owner to the Relevant TSO if greater than 2 seconds.		✓	
10(2)(c)(1)	The Power Generating Module shall be capable of providing Active Power Frequency Response with respect to figure 5 and in accordance with the parameters specified by each TSO within the ranges shown in table 4. **This specification shall be subject to notification to the National Regulatory Authority. The modalities of that notification shall be determined in accordance with the applicable national regulatory framework.**		✓	
10(2)(c)(4)	The Frequency Response Deadband of Frequency deviation and Droop are selected by the TSO and must be able to be reselected subsequently (without requiring to be online or remote) within the given frames in the table 4, **subject to notification to the National Regulatory Authority. The modalities of that notification shall be determined in accordance with the applicable national regulatory framework.**		✓	

Art.	Article amendment	Nature of the specification		
		Impact on plant design	*Parameters within the same design*	*Site-specific decision*
10(2)(c)(5)	As a result of a frequency step change, the Power Generating Module shall be capable of activating full Active Power Frequency Response, at or above the full line according to figure 6 in accordance with the parameters specified by each TSO (aiming at avoiding Active Power oscillations for the Power Generating Module) within the ranges according to table 5. **This specification shall be subject to notification to the National Regulatory Authority. The modalities of that notification shall be determined in accordance with the applicable national regulatory framework.** The combination of choice of the parameters according to table 5 shall take into account possible technology dependent limitations. The initial delay of activation shall be as short as possible and reasonably justified by the Power Generating Facility Owner to the Relevant TSO, by providing technical evidence for why a longer time is needed, if greater than 2 seconds or a shorter time if specified by the Relevant TSO while respecting the provisions of Article 4(3) for generation technologies without Inertia.		✓	
11(3)(a)(1)	The voltage-against-time-profile shall be defined by the TSO **while respecting the provisions of Article 4(3)** using parameters in figure 3 according to tables 7.1 and 7.2.	✓		
15(2)(b)(1)(a)	ensuring the supply of the additional reactive Current at the Connection Point according to further specifications by the Relevant Network Operator in coordination with the Relevant TSO **while respecting the provisions of Article 4(3)** of the magnitude of this Current, depending on the deviation of the Voltage at the Connection point from its nominal value; or	✓		(✓)*
15(2)(b)(1)(b)	alternatively, measuring Voltage deviations at the terminals of the individual units of the Power Park Module and providing an additional reactive Current at the terminals of these units according to further specifications by the Relevant Network Operator in coordination with the Relevant TSO **while respecting the provisions of Article 4(3)** of the magnitude of this Current, depending on the deviation of the Voltage at units' terminals from its nominal value.	✓		(✓)*

Art.	Article amendment	Nature of the specification		
		Impact on plant design	Parameters within the same design	Site-specific decision
15(2)(b)(2)	The Power Park Module (Article 15(2) (b) point 1) option a.) or the individual units of the Power Park Module (Article 15(2) (b) point 1) option b.) shall be capable of providing at least 2/3 of the additional reactive Current within a time period specified by the Relevant TSO **while respecting the provisions of Article 4(3)**, which shall not be less than 10 milliseconds. The target value of this additional reactive Current defined by Article 15(2) (b) point 1) shall be reached with an accuracy of 10% within 60 milliseconds from the moment the Voltage deviation has occurred as further specified according to Article 15(2) (b) point 1).	✓		(✓)*
30(4)	The maximum period for the Power Generating Facility Owner to remain in the Interim Operational Notification (ION) status shall not exceed twenty-four months. The Relevant Network Operator is entitled to specify a shorter ION validity period while respecting the provisions of Article 4(2)**. The ION validity period shall be subject to notification to the National Regulatory Authority. The modalities of that notification shall be determined in accordance** with **the applicable national regulatory framework**. ION extensions **shall be** granted only if the Power Generating Facility Owner has made substantial progress towards full compliance. At the time of ION extension, the outstanding issues should be explicitly identified.	(✓)	(✓)	✓
Title 4	**COMPLIANCE**	(✓)	(✓)	✓**

*   *Rather technology-specific than site-specific*
** *Verification of Compliance is not a single decision according to Article 4(3). The various provisions of Title 4 that do refer to a Network Operator specification for e.g. documents to be delivered or testing schedules, are covered with regulatory oversight by means of an Article 4(3) reference.*

3. *Implementation monitoring of the code*

Thirdly, ACER asks in its Opinion for clarification on the monitoring of the exact requirements and criteria at national level, either in the Network Code or elsewhere. ENTSO-E notes the monitoring task of ACER and ENTSO-E prescribed by the 3rd Package, and proposes this is not covered in each Network Code in itself but is to be clarified in an overarching methodology across all relevant areas. ENTSO-E underlines the relevance of the monitoring tasks as prescribed by Regulation (EC) 713/2009 and Regulation (EC) 714/2009, and notes that work on this is still ongoing.

d. Recovery of Costs incurred by TSOs and DSOs

In its reasoned opinion, ACER requested the removal of Article 5 in the NC RfG considering it is going beyond the scope of the framework guidelines and the subsidiarity principle.

ENTSO-E notes that the inclusion of a clause on cost recovery for regulated Network Operators is a transversal policy issue which ENTSO-E has been applying in all network codes being developed in a consistent manner. ENTSO-E deems the inclusion of this clause to be necessary to ensure the functioning of the Internal Energy Market, a level playing field among all regulated Network Operators when implementing the provisions of this code and the economic viability of all regulated Network Operators.

Even if Article 5 may go be beyond the explicit scope of the framework guidelines, it is not considered to be in breach of its objectives. In addition, ENTSO-E considers the wording not to put any prejudice on the regulatory scheme applicable in a given Member State, respecting the principle of subsidiarity in this matter. With its inclusion in the NC RfG, it matches Europe-wide obligations with Europe-wide rights.

In order to provide a more confined frame on which cost categories can be qualified for recovery by regulated Network Operators and as not to impose stronger obligations on NRAs than as what national regulatory frameworks prescribe, ENTSO-E amends the wording of Article 5(2) as follows:

*“Costs assessed as **efficient**, reasonable and proportionate shall be recovered ~~in a timely manner via network tariffs or appropriate mechanisms~~ as determined by National Regulatory Authorities.”*

3. Demand Connection Code

Shortly after publication of ACER’s Opinion on the NC RfG, ENTSO-E finalized its Demand Connection Code (DCC) and submitted it to ACER on 4 January 2013. Being drafted in line with the same framework guidelines, both codes are strongly interrelated.

The final DCC’s Article 9(3) on the national implementation of non-exhaustive requirements was not identical to the NC RfG’s Article 4(3) in the version of 26 June 2012, but reflected the latest state of ongoing informal discussions with ACER at the time of submission. With the amendments of the NC RfG regarding Article 4(3), ENTSO-E supports a consistent approach for the DCC.

The final DCC’s Article 10 covered a cost recovery process aligned with that of the NC RfG version of 26 June 2012. With the amendments of the NC RfG regarding Article 5, ENTSO-E supports a consistent approach for the DCC.

ANNEX I

Slides from DSO TEG meeting on 22/11/2012, as presented by ENTSO-E.

ANNEX II

Minutes of DSO TEG meeting on 22/11/2012, as agreed between ENTSO-E and the DSO TEG

ANNEX III

Paper on industrial CHPs, as provided by COGEN Europe.

Justification of the FRT- Requirement for Type B Units in the RfG Network Code

Meeting with DSO Technical Expert Group
22/11/2012
Brussels

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Content

- Aim and Justification of the Requirement for Type B Units
- Concern by ACER
- Examples in order to verify the need of the Requirement
  - by Investigations
    - GB focus on frequency with studies
    - in France
  - by Incidents
    - in Germany
    - in Spain
  - by European Studies
    - EWIS
- Proposal by the DT RfG
- Summary

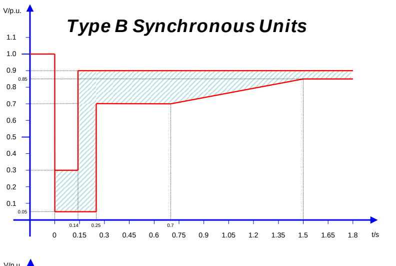
Fault Ride Through Capability

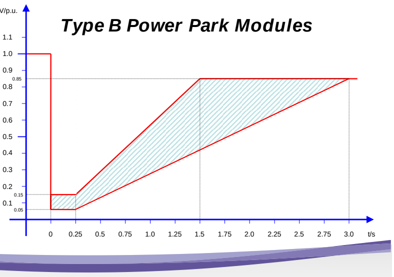
Generating Units should remain stable and connected to the network when faults occur on the ***TRANSMISSION NETWORK***, in particular in order to avoid frequency instability.

It is an emerging requirement, in particular for TSOs with a high penetration of distributed generation

Aim and Justification of the FRT-Requirement for Type B Units

- The *FRT-Requirement is based on a V(t)- profile at the CP*, which reflects the worst voltage variation during a fault and after its clearance which is to be withstood.
- PGM have to *stay connected to the grid for voltages above these worst-case conditions* and shall continue stable operation after a secured fault on the network.
- Due to the *limited impact of failures at the distribution levels on power system security*, both Synchronous PGM and PPMs have to fulfil *less stringent requirements* during the voltage drop. They have to withstand a voltage drop that results from a fault at the Transmission voltage level.
- *Different V(t)-profiles* for Synchronous PGM and PPMs are applied in order to make best use of the *different technical capabilities of the generation technologies*.
- The power system is *designed to withstand a maximum sudden loss of generation* after system faults. If PGM connected to healthy circuits do not remain connected and stable during and after a fault, a considerable amount of generation may be lost even after a secured fault. This results in the *potential* loss of generation connected to healthy circuits with the consequence of losing the maximum designed infeed loss, the impact being the *collapse of system frequency and blackout*.





ACER Opinion regarding FRT

Regarding non-exhaustive requirements, whilst the Agency accepts that it is not straightforward to undertake a cost-benefit analysis to justify such requirements, it is still reasonable to expect a justification where a non-exhaustive requirement is applied to a grid user for the first time. For example, for type B power generating modules that currently have no obligation for fault ride through capability, a justification that these users should be mandated to have this new capability should be provided, in line with the respective Framework Guidelines text and regardless of the final set point that is assigned to the requirement at national level.

- The relevance of FRT capability for frequency stability could be better highlighted
- Frequency stability criteria and related requirements are acknowledged
- Need for justification by means of system studies

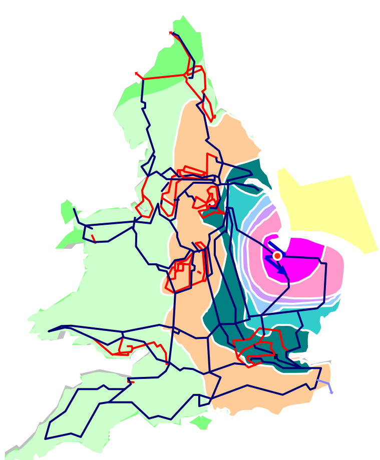
GB focus on frequency stability

Analysis in 2004 leading to FRT requirements

Summary

- The GB process to introduce FRT to the Grid Code process was based on frequency stability.
- A credible fault on the Transmission system could directly disconnect 1320MW generation connected at the fault location. Loss already equal to largest loss.
- No margin for further embedded generation losses
- Next 6 slides are extract from joint presentations made to stakeholders in 2004 by the three GB TSO at OFGEM's forum (the GB NRA).
- In GB faults in the network below 400/275kV were explicitly excluded, but generation connected at lower voltages required to ride through 400/275kV faults.
- Process of proving the LV generation FRT capability became complicated and resource intensive.
- Calculating retained voltage at lower voltage level is challenging as it is dependent upon output from other LV generators. Slide 13 shows the expected range of retained voltages at 33kV and 690Volt.
- Simplified method in RfG (avoiding the complex calculations) is still based on the same principle – it brings stakeholder benefits in terms of simplicity.
- FRT now needs to be extended to cover smaller embedded generators, but still limited to HV faults, although defined in a simpler way at Connection Point.

Aligned Proposals, Justification & Manufacturer Capabilities
Fault Ride Through Capability
Justification: Voltage Dip Propagation - The Wash

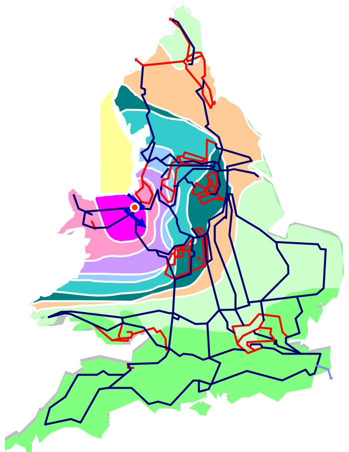


3 phase fault applied at Walpole 400 kV substation

- **Fault Location 0 %**
- **0 - 15 %**
- **15 - 30 %**
- **30 - 40 %**
- **40 - 50 %**
- **50 - 60 %**
- **60 - 70 %**
- **70 - 80 %**
- **80 - 90 %**

Legend: The retained voltage in relation to the pre-fault voltage on Transmission Level

Aligned Proposals, Justification & Manufacturer Capabilities
Fault Ride Through Capability
Justification: Voltage Dip Propagation - North West

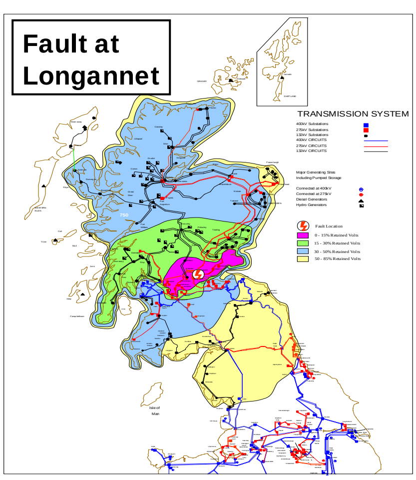


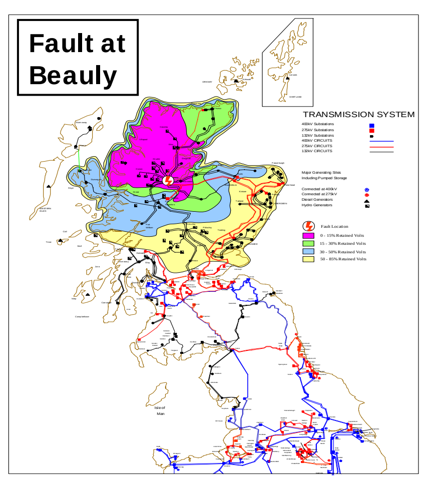
3 phase fault applied at Deeside 400 kV substation

- Fault Location 0 %
- 0 - 15 %
- 15 - 30 %
- 30 - 40 %
- 40 - 50 %
- 50 - 60 %
- 60 - 70 %
- 70 - 80 %
- 80 - 90 %

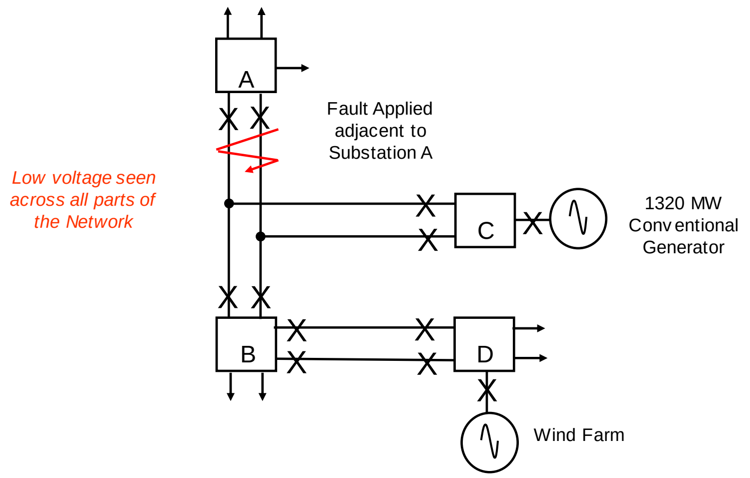
<u>Legend:</u> The retained voltage in relation to the pre-fault voltage on Transmission Level

Aligned Proposals, Justification & Manufacturer Capabilities
Fault Ride Through Capability
Justification: Voltage Dip Propagation - Scotland

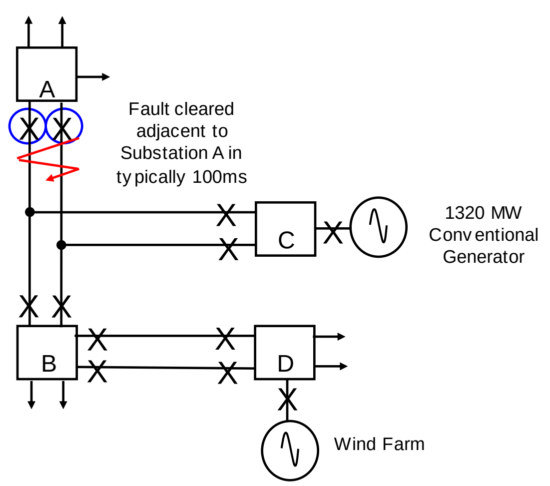




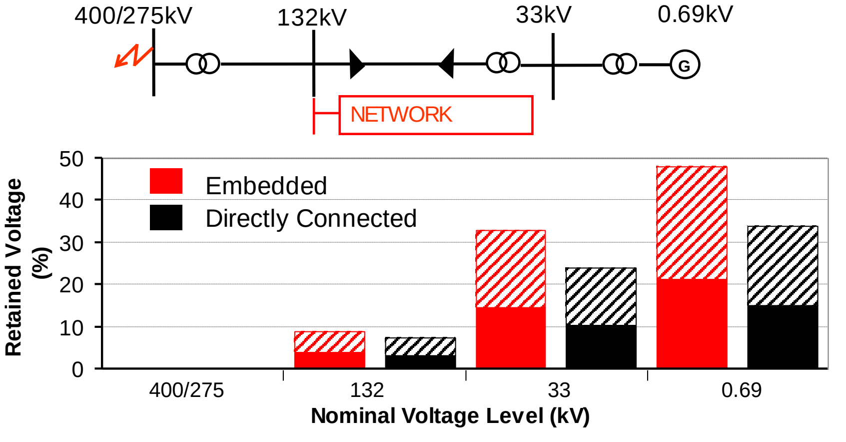
FRT – Protection Operation under Fault Conditions (1)



FRT – Protection Operation under Fault Conditions (2)



Aligned Proposals, Justification & Manufacturer Capabilities
Fault Ride Through Capability Justification:
Retained Voltage in a Windfarm during a Transmission System Fault



Examples by Investigations in France

Former situation

- **Before 2008**, there was no requirement for fault ride through capability for distribution connected generation. **The settings of the protection installed disconnected the wind farms for voltage below 0.85 Un (15% voltage dip).**

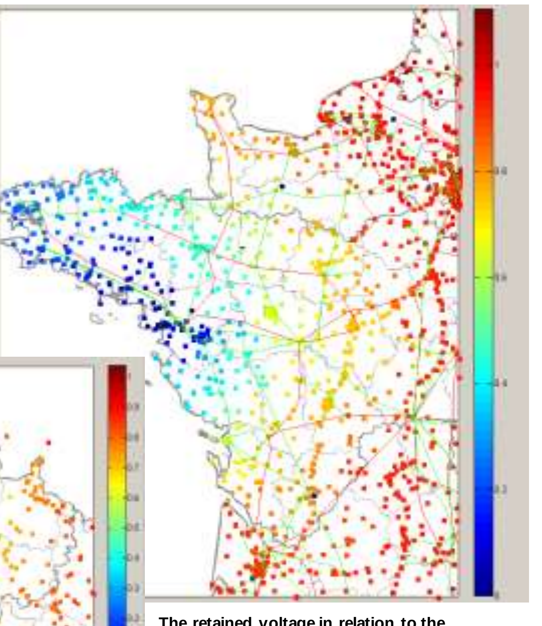
- At that time, the wind power installed capacity in France was below 2GW.

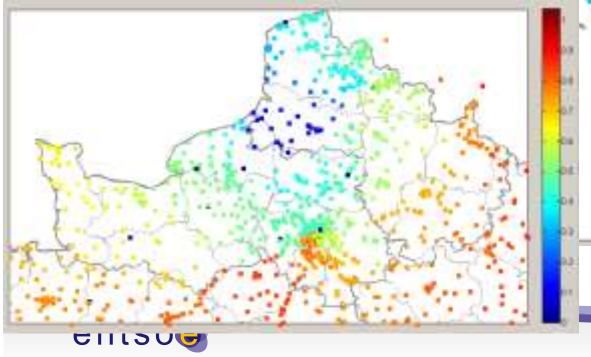
- In 2008, the law changed to require the distribution connected generation to withstand a voltage of 0.05 Un during 150ms.

- **Why was this change necessary?**

Example of voltage profile

This pictures represent the voltage profile on the grid down to 63kV for fault happening on the 400kV grid.





The retained voltage in relation to the pre-fault voltage in p.u. is shown

Evolution of disconnected power

In 2008, these faults would have lead to disconnection of a few 100 MW.

With the actual installed capacity without FRT requirement, more than 1 GW would disconnect, in addition to the potential loss of a big thermal power plant. It could result in loss of more than 2.5 GW of generation.

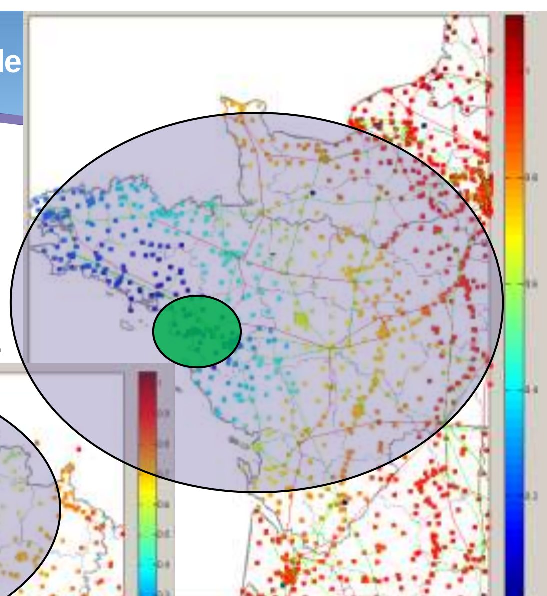
With the new requirement, the disconnection of distributed generation is locally limited.

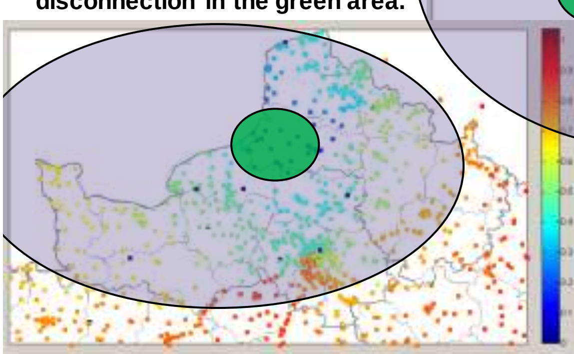
Example of voltage profile

This pictures represent the voltage profile on the grid down to 63kV.

No FRT => disconnection in the shaded area.

FRT requirement => disconnection in the green area.

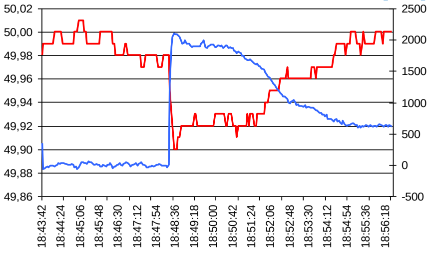


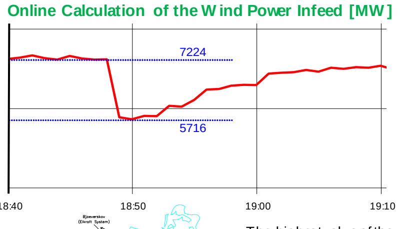


The retained voltage in relation to the pre-fault voltage in p.u. is shown

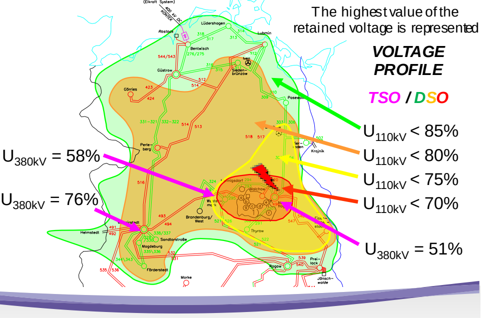
Examples by Incidents in Germany

Fault in Germany nearby 50Hertz-substation Neuenhagen in 2007



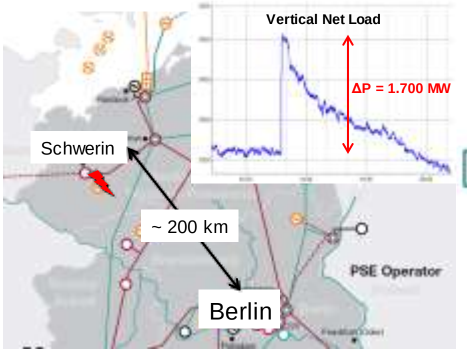


- **Frequency deviation of -100mHz** was triggered by a 2-phase-fault in the transmission network nearby 380-kV-substation Neuenhagen (Berlin Area)
- Fast Fault clearing time approx. 80ms
- Temporary increase of the power import from neighbouring TSOs of approx. 2.000 MW
- The online calculation prediction tool of the wind power infeed refers to an disconnection of approx. 1.500 MW of wind power generation



Fault in Germany nearby 50Hertz-substation Wessin in 2012

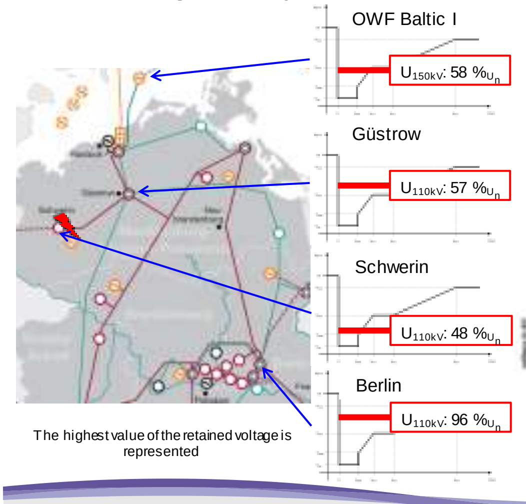
1. The "Frequency Stability" Problem



- **Frequency deviation of -100mHz** was triggered by a 2-phase-fault in the transmission network nearby 380-kV-substation Wessin (Schwerin Area)
- Fast Fault clearing time approx. 70ms
- Temporary increase of the vertical net load (Power Export to all DSOs) from 1.300 MW up to 3.000 MW due to disconnection of distributed generation
- 1.430 MW of WTG are connected to the medium-voltage grid in the Northern Part of 50Hertz
- Thereof only 204 MW of WTG are certified in order to comply with the FRT-Requirement according to German SDLWindV

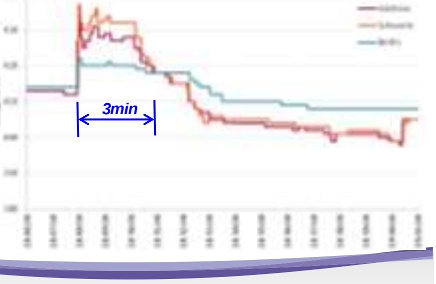
Fault in Germany nearby 50Hertz-substation Wessin in 2012

2. The "Voltage Stability" Problem



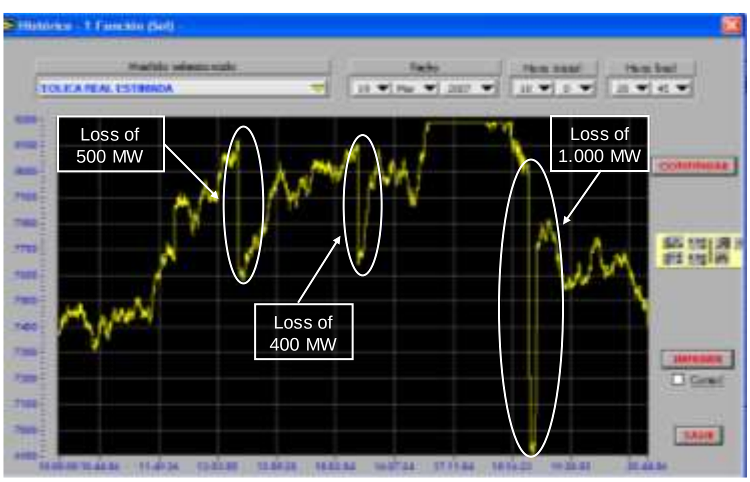
The highest value of the retained voltage is represented

- Due to the disconnection of WTG in the DSO-networks and the thereupon occurrence of network deloading the voltage in the transmission network increases considerably above 420 kV (up to 435 kV) for approx. 3 min
- Because of the high voltage in the DSO-level further WTGs were disconnected → they had no High Voltage Ride Through Capability
- Voltage decrease was carried out by switching of several reactors; unfortunately the 550 MW Power Plant Rostock was not in operation

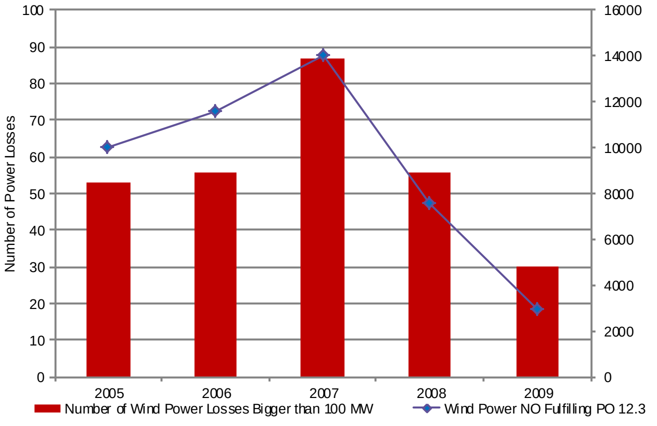


Examples by Incidents and Investigations in Spain

Loss of Wind Power Generation due to several Voltage dips on 19/March/2007



Number of Loss of Wind Power vs. Evolution of Wind Power without FRT

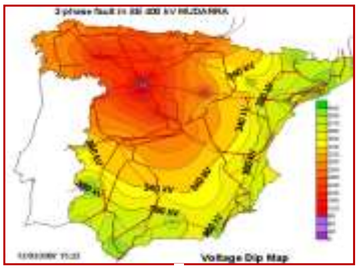


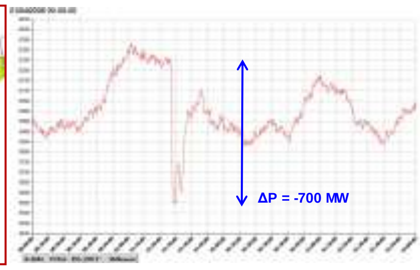
Number of losses of more than 100 MW of wind power per year (red columns) versus evolution of wind power without FRT (blue line).

Examples by Investigations and Incidents from the EWIS Study

EWIS Study – Technical Analysis (1)

Spain, Disturbance in 2008

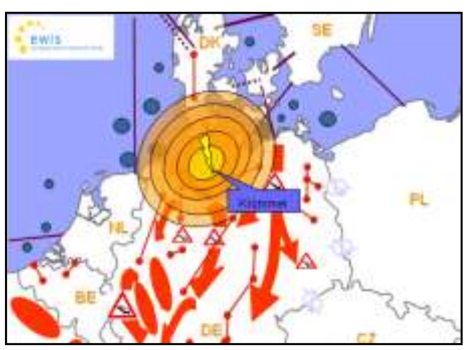




- Both figures (left and right) correspond to a real disturbance: 3ph short circuit in a main 400 kV bus in the central part of Spain.
- Left figure shows the propagation of the voltage dip and right figure shows the sudden wind power loss (700 MW) due to this voltage dip.
- This is a past situation, currently overcome, in which a huge amount (>1 GW) of wind power could be lost due to voltage dips.
- Since 2008 it is mandatory for all WTGs to comply with the current FRT Spanish grid code.
- In the year 2012 almost all wind farms will fulfil the current grid code, except for a remainder of approximately 800 MW .

EWIS Study – Technical Analysis (2)

Germany, Calculation for 2015

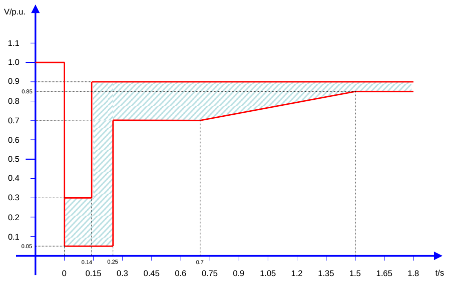


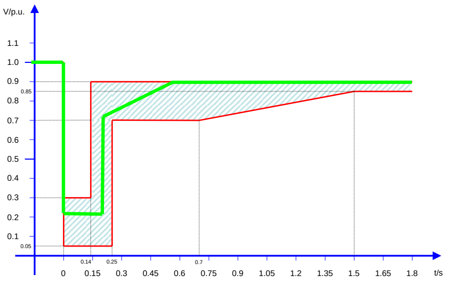
- The figure shows the impact in the North German Transmission network triggered by a solid 3-phase-fault nearby 380-kV-substation Krümmel (Hamburg Area).
- The calculated loss of wind power is approx. 2.600 MW.
- System Security is achieved with FRT-Performance of the WTGs.

Proposal by DT RfG

Example – RfG requirement for Type B synch. generators

- **Range of** voltage-against-time profile as of NC RfG
- Green Line: Example of a Voltage-against-time profile for TSO Choice





- Profile determined by the standard (Green Line) is fully compliant with the RfG code.

Summary

- The aim and the justification of the FRT-Requirement for Type B Units has been explicitly explained.
- ACER's concern has been considered and dealt with.
  - No need to cover LV faults in NC RfG.
  - FRT requirement is justified based on expected voltage dip propagation
- The coherency between faults in the Transmission network and a considerable amount of loss of wind power generation in the distribution networks has been demonstrated by means of
  - Incidents in Germany and Spain as well as
  - Investigations in the EWIS Study & studies for GB and France.
- This presentation proves, that the FRT-Requirement for Type B unit is justified in order to maintain frequency stability and system security.
- ENTSO-E recommends to maintain the FRT-Requirement in the Network Code as mandatory for all type B units, with settings to be defined at national level.

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Minutes of Meeting
ENTSO-E Drafting Team on RfG
DSO Technical Expert Group

Date: 22 November 2012
Time: 14h00 – 16h30
Place: ENTSO-E premises, Brussels

Participants

Name	Affiliation	present	excused
DT RfG			
Hans Abele	Transnet		X
Ines Barreda	REE	X	
Dimitrios Chaniotis	ENTSO-E	X	
Luis Coronado	REE	X	
Anders Danell	SVK		X
Torsten Haase	50Hz	X	
Edwin Haesen	ENTSO-E	X	
Jako Kilter	Elering		X
Sergio Martinez Villanueva	REE	X	
Mark Norton	EirGrid		X
Ramūnas Ponelis	Litgrid	X	
Ralph Pfeiffer	Amprion	X	
Thibault Prevost	RTE	X	
Jerzy Rychlak	PSE		X
Rosen Ulinski	ESO		X
Helge Urdal	National Grid	X	
Mario Valente	Terna		X
Wilhelm Winter	Tennet		X
DSO TEG			
Pierre Andersson	E.ON Energihandel Nordic (Eurelectric DSO)		X
Pilar Barrera	Bewag Netz (Eurelectric DSO)		X
Alberto Cerretti	Enel Distribuzione (Eurelectric DSO / EDSO-SG)		X
Florian Chapalain	EDSO-SG	X	
Ivan Codd	ESB (Eurelectric DSO)		
Falk Engelmann	VKU (CEDEC)		X
Bruno Gouverneur	Synergrid (Eurelectric DSO)		X
Tony Hearne	ESB (Eurelectric DSO)	X	
Mike Kay	ENWL (Geode)		X
Riccardo Lama	Enel Distribuzione (Eurelectric DSO)		X
Mika Loukkalahti	Helen Sahköverkko Oy (Eurelectric DSO)		X
Johan Lundqvist	Svenskenergi (Geode)	X	
Marc Malbrancke	Inter-Regies (CEDEC)		X
Pavla Mandatova	Eurelectric DSO		X
Javier Meco	Endesa (EDSO-SG)		X
Jacques Merley	ERDF (Eurelectric DSO)	X	
Viktoria Neimane	Vattenfall R&D (Eurelectric DSO)		X
Joachim Nilges	RWE (Eurelectric DSO)	X	
Piotr Ordyna	Tauron (EDSO-SG)		X
Allan Norsk Jensen	DEA (Eurelectric DSO)		X
Jesus Peco	Iberdrola (EDSO-SG)		X
Herman Poelman	Alliander (CEDEC / EDSO-SG)	X	
Graeme Vincent	Scottish Power (Eurelectric DSO)		X
Jarmo Saarinen	Fortum Oyj (Eurelectric DSO)		X
Walter Schaffer	Salzburgnetz (CEDEC)		X
Bilal Simsek	TEDAS (Eurelectric DSO)		X
Joris Soens	Eandis (EDSO-SG)	X	
Siegfried Wanzek	E.ON-Energie (Eurelectric DSO)	X	

The meeting is also attended by Matti Supponen (EC – DG ENER).

1. **Welcome, agenda**

	Coffee	
14:00	**Agenda & objectives of meeting**	**ENTSO-E**
14:10	**Summary of RfG User Group outcome and impact on network operators**	**ENTSO-E** **DSO TEG**
14:30	**The need for mandatory FRT capabilities on embedded generation ;** **DSO impact of FRT by embedded generation**	**ENTSO-E ;** **DSO TEG**
16:30	**Summary and next steps**	**ENTSO-E**
17:00	*End of meeting*	

2. **Summary of RfG User Group outcome**

3. **The need for mandatory FRT capabilities on embedded generation**

ENTSO-E presents an overview of system studies that demonstrate the system need for FRT capabilities on embedded generation. A shorter overview has also been discussed in the RfG User Group. The studies cover :

- Investigations
    - GB focus on frequency with studies
    - in France
- Incidents
    - in Germany
    - in Spain
- European Studies
    - EWIS

The DSO TEG asks whether the case studies considered the same thresholds as in the NC RfG and what the impact of lowering a threshold at national level would be. ENTSO-E notes that the studies did not focus on type B units, but address the need for FRT capability from embedded generation in general.

The DSO TEG asks whether the requirements would apply at the connection point or at the module. ENTSO-E confirms it is at the connection points as clearly stated in the code and the FAQs.

The DSO TEG agrees that an FRT need is not a voltage related issue, but a frequency stability issue.

The DSO TEG confirms that there is no viable alternative of covering the same system need at the transmission/distribution interface, leaving the DSO to balance the means by which stable operation is achieved.

Discussion on the specific cases presented :

- GB cases
  - ENTSO-E clarifies that the cases show the worst case 400kV fault impact during the fault itself.
  - The study demonstrates the reasonable range of retained voltage on which the parameter ranges of the type B FRT requirements were based. The range also covers the support by embedded generation on keeping the retained voltage higher during the fault.
  - ENTSO-E notes that as the penetration of embedded generation increases the system need will rise as well. The non-mandatory requirement of fast reactive current injection can bring support as well.
- French cases
  - The DSO TEG agrees that the comparison of situations with/without FRT justify the need for this requirement.
  - The DSO TEG notes that at present the French grid code asks for FRT profile with slower rise time (i.e. more stringent than the NC RfG ranges allow for).

The DSO TEG notes that FRT for low-voltage connected generation is likely more needed as well, but not from the perspective of a European Network Code covering cross-border issues. The DSO TEG considers that some type A units may easily deliver FRT capability as well, which may be relevant for faults at distribution level. ENTSO-E agrees that only faults at transmission level have the clear potential to propagate as a frequency stability problem, and are as such in scope of the NC RfG.

The DSO TEG notes that the studies focus strongly on wind generation. FRT may be relevant for PV as well.

The DSO TEG considers that prescribing the FRT requirements as a non-exhaustive requirement helps to lower implementation costs as present practices can be used when possible.

ENTSO-E is open to accept additional argumentation from DSO TEG that support the conclusions reached in the meeting.

End of meeting

COGEN Europe Briefing Note

The use of heat and steam in cogeneration processes in industry

03/12/2012

Introduction
Cogeneration is used in a range of industrial and production processes. While the core prime mover often a gas turbine or a gas engine is standardized the total design of the cogeneration installation is adapted to meet the exact needs of the process that the industrial producer requires. Energy intensive process industries typically use steam for their heat processes but many industries including ceramics, distilling and cement use heat in direct drying processes or indirect drying processes (some food processes for instance). In these processes the hot exhaust gases from an engine or turbine are channelled for use directly into the primary process of the industry. High temperature hot water is also used as a carrier in parts or all of the food industry such as dairies and breweries because the heat is easier to use and there is less chance of overheating and spoiling.

Comprehensive statistics on cogeneration in industry and manufacturing are not available. It is possible to find details on a limited sectoral basis and within specific member states however information remains patchy and is drawn from a range of sources. An indication can be taken from the IEE project D-PLOY which looked at four industry sectors food, paper, chemicals and refineries. The average penetration of cogeneration across these sectors was 27%.

The Use of heat in industry
Many industrial processes do not use steam from their CHP plants. The ceramic industry need direct exhaust gas heating for drying purposes, the pulp and paper and petrochemical industries need besides steam also a lot of hot water and direct exhaust gas heating, the food industry and breweries need mostly hot water and chilled water, the mechanical and electronic industry need very accurate space heating and cooling from their CHP plant, etc. There are many installations which directly utilise the exhaust gases in a dryer and when producing hot water utilise an exhaust gas hot water boiler together with the engine cooling water's heat.

In reality industry based power plants may try to avoid steam production and produce the heat by hot water or something else. The reason is simple. When a steam system is used in a process the operator needs trained and certified personnel at site all the time the steam production is running. The regulations for pressure vessels are demanding. If you need only hot water up to 120 C the plant can be remotely controlled and does not need certified personnel. This is a significant cost

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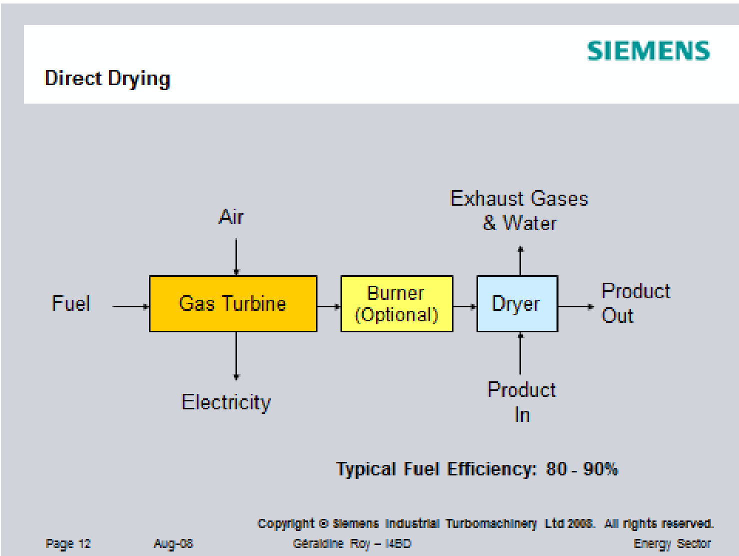
consideration for many industries. Thermal oil systems are sometimes also used in order to avoid rigid steam systems.
On an industrial site there can be many generators and big electrical consumers in a, sometimes very big, internal network before the network is connected to the grid. These generators are many times, but not always in CHP production and also many times rigidly coupled to the heat production. If the process does not need heat, which could be supplied as either steam or heat, electricity is not produced

<u>Typical applications using heat in a tightly coupled industrial process.</u>

a)Direct Dry cycling typical applications
Direct drying can be used in the early stages of raw material processing and product finishing. The gas turbine exhaust may be used directly for drying processes or via a gas/air exchanger in contaminant sensitive environment (i.e. indirect drying for the food industry). Exhaust gas temperature can be increased by auxiliary firing and the total exhaust stream divided in the required proportion between direct drying and another application like Process Steam.



Direct dry cycling typical applications are:
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The gas turbine exhaust may be used directly for drying processes or via a gas/air exchanger in contaminant sensitive environment (i.e. indirect drying for the food industry).
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Sectors that can benefit from direct drying:

- Food (crop drying, animal feedstock)
- Ceramic (brick, china, tiles)
- Distilling
- Cement

b) Indirect drying
Indirect drying is used in sensitive environment
Sectors that can benefit from Indirect Drying:

- Sludges
- Food
- Thermal oil

c) High temperature hot water

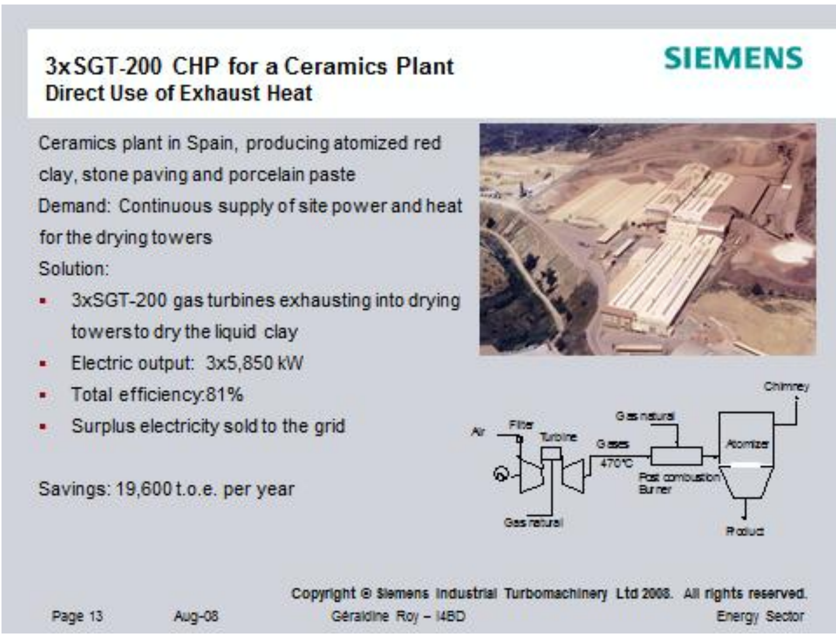
- Dairy
- Brewing

Case study from the ceramic industry

The European ceramic industry is a world leader of high quality ceramic products:

- **1100 Mm2** in 2010 (Italy, Spain, Poland, Portugal, France, Germany).
- **9,8 bn €** total sales
- 395 Mm2 exports
- **49.700 jobs** throughout EU

Cogeneration is widely used throughout the ceramics sector and is popular for example within the Spanish tile production industry, supplying 80% of their required electricity. It is a major operating trend in the industry.



- This plant is an example of a CHP-scheme, where a gas turbine exhausts into a process, using the exhaust heat for drying and heating.
- Three gas turbines SGT-200 in total producing 17,500 kW of electricity for the electric needs of a ceramics plant, while producing hot gas to dry the clay and reaching in excess of 80% total efficiency.
- The plant saves the equivalent of 19,600 tonnes of oil a year on this installation.

Conclusion

Steam is only one form of heat carrier used in cogeneration processes in industry today. The specific heat carrier chosen will vary according to the needs of the manufacturing or production process and the design of the plant. In some cases more than one carrier may be used in different stages of a process. The industrial processes all share the characteristic of being heat-demand led, and the electricity generated is therefore tightly coupled to the process in question.

COGEN Europe believe that Article 3(6)(h) of ENTSO-E network code for requirements for grid connection applicable to all generators should use the term “heat” rather than “steam”. This avoids specifying a particular heat carrier but rather recognise that it is the tightly coupled nature of the heat and electricity in industrial processes which merits special provisions. This will avoid any potential for undue discrimination as referred to in the ACER opinion 08/2012 of 13th October 2012.

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