European Network of
Transmission System Operators
for Electricity

Special issues associated with type ‘A’ generators

ENTSO-E guidance document for national implementation for network codes on grid connection

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DESCRIPTION

Code(s) & Article(s)	Network Code (NC) Requirement for Generators (RfG) Article 13, Special Requirements for Type A generators Article 30, Operational notification of type A power generating modules Article 40 Responsibility of the power generating facility owner Article 62 Paragraph 12, Request for a derogation by a power generating facility owner TITLE VI Transitional arrangements for emerging technologies
Introducti on	The categorisation of type A generators is set at the European level as generators above 800W up to a maximum level of from which a Power Generating Module (PGM) is of type B (where a type A generator becomes a type B generator) varies from one synchronous network to another. The limit for maximum capacity threshold where this occurs in the requirement for generators network code is reflective of the collective impact that type A generation may have on a synchronous network. Accordingly, the 100kW limit for maximum capacity threshold for Ireland as the smallest synchronous network rises to 1MW for Continental Europe. These limits for maximum capacity thresholds largely relate to the percentage of the generation portfolio that might be type A. Higher percentage Type A with the maximum limit in a country, tends to justify choosing a lower boundary between A and B to ensure the further capabilities associated with Type B are available in sufficient volume under all operating conditions.. Type A due to their size and application operating from the domestic level require special consideration in their application. Typically a large number of these generating units are expected to be mass produced and installed predominantly as a standard package with little or no electrical performance related site specific activity. Given the potential scale of the domestic generation industry and the limited impact of individual generating units of this scale on a network, a rigorous on-site installation compliance process and test is not appropriate. However together the potential of these units to contribute to security of supply cannot be overlooked, as they increasingly become a sizable percentage of power generation. Simple equipment certification as a part of the proof of compliances permitted and is seen to be adequate when combined with simple user site specific data to meet compliance requirements. Site specific data in this context is very simple for example, name of applicant, address, basic generator type (Photovoltaic (PV), wind, etc), installation date, etc.
NC frame	The non-exhaustive requirements for Type A generators are limited. Given that mass produced generating units are typically built to standards, the European industry has responded to the impending introduction of the network code requirements for generators by updating some of its standards to reflect the codes. CENELEC standards CLC TS50549 Requirements for generating plants to be connected in parallel with distribution networks - Part 1: Connection to a LV distribution network above 16 A and Part 2: Connection to a MV distribution network. Both of these standards set the frequency range that a generator unit shall be capable of

	withstanding and maintaining operation at the worst case values that may be selected from Table 2 in the requirements for generators for any synchronous system and the Rate Of Change of Frequency to 2.5Hz/sec withstand capability. ENTSO-E supports the selected range and consequently and expect that any generating plants and associated equipment complying with these standards by default would provide evidence of compliance for the requirement[s] and therefore be adequate for any European synchronous network in this regard. It should be noted that system operator’s requirements for site specific data as part of an installation document and any outstanding requirements for which a equipment certificate is not used would still need to be provided by the PGM owner. What is required to comply with the installation document would be specified by the relevant system operator. Also although these standards provide the necessary ranges of both the over-frequency Limited Frequency Sensitivity Mode (LFSM) and admissible active power reduction from maximum output, no standards exist for their settings. These are the responsibility of each Transmission System Operator. These settings will need to be co-ordinated within each synchronous area to ensure that they operate in sympathy across a synchronous network. As part of consultation for the codes, manufacturers have indicated their intention to make great use equipment certificates to ease compliance requirements. TSOs will then make their best effort in trying to timely involve stakeholder about provision of non-exhaustive requirements, for example settings, in order to help manufacturers to request the certification of their equipment by independent authorised certifiers, and standards to be developed to assist this activity. The TSO can allow disconnection of generation at various staged frequencies instead to deal with over-frequency situations in place of LFSM functionality. However given the standardisation of LFSM within European standards for the mass market which is the focus of this specialised issues guide, no further guidance is given in this document on the best practice approach for TSOs to follow.
Further info	[1] Frequently asked questions [Notably No 7], Network code on Requirement for Generators, June 2012 Link: [2] Justification Outlines, Network code on Requirement for Generators, June 2012 Link:

INTERDEPENDENCIES

Between the CNCs	The requirement for Type A generators with regard to frequency management is directly related to the national implementation of other connection codes. For example, the capabilities of a generator to fulfil the LFSM requirements for frequency response is dictated by the ability of the network and all the users (including demand with or without demand response, and High Voltage Direct Current (HVDC) circuits) to remain stably connected withstanding changes in frequency. Therefore the appropriate frequency range and Rate Of Change Of Frequency (ROCOF) withstand capability for all type A units must account for the

	same capabilities being required of the network (i.e. HVDC circuits) and other users (i.e. demand facilities and distribution networks). In short the generators must remain connected at least in line with demand users. The network is expected to have a higher capability than its users to avoid network instability. The total frequency response and utilization from all devices in both the transmission and distribution system must be considered in aggregate to meet local, region and national needs. Therefore all devices responding to frequency variations i.e. generators, HVDC systems, and DSR, in general must be collectively considered to ensure adequacy and optimum balance of the necessary frequency response requirements. Therefore NCs RfG, Demand Connection Code (DCC) and HVDC in this regard all have interdependencies on the capabilities required of each user for frequency response.
With other NCs	In addition to the capability to respond to frequency changes and maintain active power as this frequency varies, the expected operational philosophy and actions across the lifetime of the equipment must be considered to ensure an adequate capability. Failure to recognize and account for operational challenges, for example the maximum level of penetration of wind on a system, may result in a shortage of capability of connected PGMs in a network to provide frequency response. Indirectly the Guideline for System Operation need to be aligned as does NC Electricity Balancing to manage frequency well.
System characteristics	The availability of frequency response from all sources has to be considered when determining what settings needs to be applied to type A generators for over-frequency LFSM and maximum power capability reduction as frequency reduces. As an increasingly wider area is examined, the loss of RES output for frequency response in a localised region is mitigated by the overall capability of a synchronous system to provide frequency response. Therefore both active power reduction with frequency and the LFSM response for over-frequency should in the first instance be examined on a synchronous system level at high RES outputs over a number of seasons, typically with load-flow followed by dynamic simulations. These studies should examine the security standards applied to the network to determine the worst case deviations in system frequency. Dynamic modelling of these with expected generation portfolios will show the rate of change in output required from Type A generators as part of an overall portfolio to arrest further frequency rises or drops post FSM action in the worst cases. This will provide the generic settings (LFSM over-frequency - Article 13.2(a) and (f), and active power reduction with reduced frequency - Article 13.4) that should be applied to type A generators by the relevant TSO for its control area in collaboration with the TSOs of the same synchronous areas to ensure minimal impacts on neighbouring areas in the synchronous area. Another non-exhaustive requirement on the possibility to and required process for re-connection (Article 13.7) that the

	Transmission System Operator (TSO) must specify can be informed by these studies. Re-connection of generation is generally supportive at sub 50Hz frequencies and permissible at elevated frequencies below 50.2Hz, at which point over-frequency LFSM operates. The maximum permissible ramp rate that may be applied in these circumstances should be determined from the studies using the assumed maximum reconnection rate based on the portfolio of type A and other generation that retains dynamic stability. However the studies to define generic settings will not take account of localised network topography impacts, notably the impact of system separation. The need (if any) for these additional studies should be based on whether these generic settings will function in a particular region where there is a credible risk of isolation from the rest of the synchronous network (driving higher changes in frequency than would be experienced in the wider synchronous network). Similar to LFSM over-frequency response and maximum power capability reduction at reduced frequency, wider frequency ranges and a higher ROCOF setting could be required of type A generators in a local region of a wider synchronous system due to the risk of system separation. However this is not expected, given that type A generators that have adhered to European standards (see above) will have already applied the widest permissible range. Finally when considering what non-exhaustive parameters to be applied the existing protection strategy must be considered to ensure no unexpected interaction. In the event that interaction is perceived, the system wide implications of adapting either or both existing protection strategies and the non-exhaustive parameters must be considered. When adaption of protection is favoured, then consideration must also be given to how to identify the need and timing for protection adaption will operate. This is very important as many type A generators are expected to be installed with limited notice.
Technology characteristics	Type A generators are technologically expected to be able to comply with both the limited range of Requirements for Generators network code settings and the updated European standards. It is expected that small synchronous generators with very limited inertia and control facilities may be most challenged to meet the LFSM capability. It should be noted that title VI of the network code permits an exception to be made for emerging technologies, provided that the conditions listed in title VI of the NC are satisfied, to give them time to adapt to the requirements for type A generation. Type A generators are expected to be mass produced and have a simple installation process, with minimal compliance requirements. The equipment certification is expected to be used to make this a reality, with certification of compliance with updated European standards a corner stone of a simplified connection and compliance requirements. Whilst TSO national choice under the principal of subsidiarity and necessity to maintain security of supply should not be prohibited, collective TSO action to determine universal range of settings for each synchronous system will greatly enhance technological development of type A generation.

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Whilst technological application is a matter for product developers, the use of universal settings would permit the use of a range of pre-set settings suitable for each synchronous area and a very simplified retail and installation process across the EU.

Also the application of equipment certificates is expected to be very flexible with both certifications for packaged components and/or individual components possible (the last is useful where presumably this certification is able to guarantee the compliance of the package). For example the inclusion of a step up transformer to a suitable voltage for connection could be constructed with the generator and transformer as one packaged component or as two separate components with the one or two equipment certificates respectively to provide compliance with one or more requirements of the code.

These can be assessed as part of issuing an Equipment Certificate by an Authorised Certifier, permitted as proof of compliance in the code. An ‘authorised certifier’ means an entity that issues equipment certificates and power generating module documents and whose accreditation is given by the national affiliate of the European cooperation for Accreditation ('EA'), established in accordance with Regulation (EC) No 765/2008.

COLLABORATION

TSO – TSO	There should be a need for co-ordination between TSOs with regard to the setting of the droop for the over-frequency LFSM to ensure an equitable and technical acceptable spread of reduced generation output across a synchronous zone. Similarly at higher penetrations of type A generation, the change in active power across the synchronous zone will need to be modelled and accounted for by all TSOs to ensure security of supply.
TSO – DSO	Given the combined impact of changes in embedded generation good communication of generation portfolios should be required between system operators to ensure security of supply for both networks.
RSO – Grid User	Good communication between RSOs with Type A generation owners should be required to ensure a full understanding of generation portfolios that exist (or planned) and expectations placed upon users to remain compliant with the regulations.

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