# PUBLIC CONSULTATION: MAXIMUM CAPACITY THRESHOLDS FOR TYPES B, C AND D POWER-GENERATING MODULES

**Elia – TSO Proposal following the NC RfG Art. 5(3)**

**Consultation period: from 19th May to 20th June 2017**

May 2017

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# 1. Introduction

This public consultation is about the proposal for maximum capacity thresholds for types B, C, D of power-generating modules as defined in Network Code Requirements for Generators (NC RfG)[1] art. 5 and is meant to fulfill the requirement laid upon the relevant transmission system operator, Elia, to hold a public consultation on this topic, as defined in NC RfG art. 5(3).

Via this public consultation Elia wishes to provide all interested stakeholders the opportunity to react on Elia's proposal. As described in section 2.1 stakeholders have been able to share their views and react on earlier related proposals via different meetings and written inputs in the context of the Elia Users' Group.

Stakeholders can freely react on the content of this document, but Elia also raised a number of specific questions for which any stakeholder feedback would be appreciated. These questions are formulated in section 6.

All reactions received in the context of this public consultation will be made public at the end of the public consultation, except in those cases where the respondent explicitly indicated the confidential character of its reaction. In such case respondents are asked to specify whether only the content of their reaction is considered confidential and/or whether the name of the respondent is confidential (i.e. anonymous). Nevertheless, Elia will transparently communicate to the competent authorities all reactions, including any confidential (and/or anonymous) reactions.

The consultation period is one month, which is in line with NC RfG art. 10(1). The period starts on 19$^{th}$ May and ends on 20$^{th}$ June 2017, 18h.

Reactions can be communicated to Elia via the form on the website, accessible through the following link: http://www.elia.be/en/about-elia/publications/Public-Consultation.

After the consultation period Elia will consolidate all reactions received and a consultation report containing an Elia view on the reactions received will be prepared and published. Any reactions related to aspects going beyond the scope of this public consultation will not be taken into account. As stipulated in NC RfG art. 10(2) Elia shall duly take into account the views of stakeholders resulting from this public consultation.

The remainder of this document is structured as follows. Section 2 describes the context of this publication, including the background, the scope, coordination aspects and next steps. Section 3 discusses the link between the technical solution and a legal solution. Whereas section 4 describes the proposal for maximum capacity thresholds for power generating modules type B, C and D, in section 5 an argumentation for this proposal is given. Finally, section 6 provides a number of concrete questions for which Elia seeks feedback via this public consultation.

[1] Commission Regulation (EU) 2016/631 of 14 April 2016 establishing a network code on requirements for grid connection of generators, http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016R0631&from=EN

# 2. Context

## 2.1. Background

With the support of the Federal Administration (FOD/SPF Energy) Elia launched in the second half of 2015 via the Elia Users' Group a process to discuss the implementation of the European Network Codes in Belgium.

Although particularly oriented at the implementation at federal level, Elia always envisaged an approach that also covers those aspects that are in Belgium of regional competence. Elia also put forward the goal of working towards a coherent and consistent framework across all levels and regions.

The Task Force Implementation Network Codes was created at the end of 2015 by the Users' Group as sub-group of the Working Group Belgian Grid, to act as a platform to analyze and exchange ideas on the implementation of the European Network Codes in the Belgian context. The focus of the discussions in this task force was 'content'-driven and not on how the technical analyses should be taken into account in legislative, contractual and/or regulatory documents.

Participation to the task force meetings was open to all interested parties. The members of the Task Force Implementation Network Codes were representatives of:

- BGA ('Belgian Generator Associations': grouping BOP, COGEN Vlaanderen, EDORA, FEBEG and ODE)
- Febeliec (energy consumers and CDS)
- Federal Administration Energy (FOD/SPF)
- Federal Regulator (CREG)
- Regional Regulators (Brugel, CWaPE, VREG)
- Synergrid
- Equipement manufacturers
- Elia.

The agenda and topics of this Task Force have been set by the WG Belgian Grid and the status of this task force was reported by the Chairman of the Task Force Implementation NC in every WG Belgian Grid meeting since the creation of the Task Force.

| Topics | Task Force Implementation NC sessions |
|---|---|
| 1st SGU Iteration | 26/11/2015; 25/01/2016; 25/02/2016; |
| Special Workshop Genval | 06/09/2016 |
| 2nd SGU Iteration | 01/02/2017; 21/02/2017; 27/03/2017 |
| Connection and Compliance processes | 25/01/2016; 25/02/2016 |
| Voltage Control & Reactive Power Management | 25/02/2016; 26/04/2016; 30/05/2016; 14/12/2016; 1/02/2017 |
| Robustness & Fault Ride Through | 26/04/2016; 30/05/2016; 14/09/2016 |
| Frequency Stability & Management | 07/06/2016; 17/10/2016 |
| Short-Circuit Power | 07/06/2016; 14/09/2016 |
| Operational Information Exchange | 17/10/2016; 21/11/2016; 20/12/2016 |
| Protection and Control | 21/11/2016 |

Table 1: Topics discussed and dates of the sessions in the Task Force Implementation Network Codes

Tabel 1 gives an overview of the topics discussed and the dates of the sessions in the Task Force Implementation Network Codes. This Task Force started at the end of 2015 and continued till the end of March 2017 consisting of a first iteration SGU[2], multiple sessions on various technical topics and ended with a second iteration SGU. The minutes and presentations of all meetings can be consulted in the Users' Group section of the Elia website.[3] The history of the Task Force is briefly described below:

### 2.1.1. First iteration SGU (end 2015 – early 2016)

The Task Force started with a first iteration on 'Significant Grid Users', that took place at the end of 2015 and early 2016, and led to a draft proposal on the maximum capacity thresholds for types B, C and D power-generating modules (PGM).

### 2.1.2. Technical discussions per topic (early 2016 – early 2017)

The proposal on maximum capacity thresholds for types B, C and D PGM developed during the first iteration was used as a fixed assumption in the technical discussions on various network code topics, as listed in table 1, during 2016 and early 2017.

Technical experts of Elia and members of the Task Force presented during these meetings their vision and proposals on how to implement the exhaustive, but especially the non-

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[2] Significant Grid User, as defined by the European Network Codes

[3] Website of the Task Force Implementation Network Codes: http://www.elia.be/en/users-group/Working-Group-Belgian-Grid/Task-Force-Implementation-nc

exhaustive requirements, per topic. The number of sessions per topic depended on the complexity of the topic and the importance of the stakeholder debate.

The aim of each topic was to deliver a proposal on a set of requirements that was understood and where possible supported by all members of the Task Force. For all topics Elia has come up with an initial proposal and this was reviewed and adapted, where deemed valid and applicable, after consideration of the stakeholder comments. Next to the presentations in the Task Force sessions, Elia provided several technical annexes to the members of the Task Force to clarify or to answer specific questions of Task Force members.

A one-day 'special' workshop took place on 6th September 2016 to intermediately wrap-up the technical discussions.

### 2.1.3. Second iteration SGU (early 2017)

Having in mind the outcomes of the technical discussions, the proposal on the ABCD limits has been reanalyzed during a 2nd iteration SGU in the first quarter of 2017. As input for this 2nd iteration, Elia prepared a 'Technical Summary', presenting the existing proposal of maximum capacity thresholds and including the link with many requirements to coherently and transparently presenting the main impact of the maximum capacity thresholds. All members of the Task Force had the opportunity to present their comments and to raise their concerns on this Technical Summary and other aspects discussed until that moment.

The final output of this 2nd iteration was an amended proposal, after thorough assessment of all comments made in this Task Force and considering the concerns raised by BGA, Febeliec and Synergrid and the concerns raised on issues related to closed distribution systems (CDS) discussed between Elia and Febeliec in March 2017.

During the whole Task Force Implementation process, Elia has closely coordinated its proposals on technical topics, particularly the maximum capacity thresholds for type B, C and D PGM, with the DSOs within Synergrid and has adapted these proposals, where needed, in function of the needs and expectations of the DSOs.

It is to be noted that the above approach clearly goes beyond the minimum stakeholder involvement requirements put forward by the NC RfG.

## 2.2. Scope of the public consultation

This public consultation aims to fulfill the requirement laid out in NC RfG art. 5(3) stipulating that in forming the proposals for the limits between the different types of power-generating modules the TSO shall conduct a public consultation.

The scope of the public consultation meant by NC RfG art. 5(3) is the proposal of maximum capacity thresholds for type B, C and D power-generating modules as described NC RfG art. 5(2). Section 4 of this consultation document describes such proposal.

A proposal for these thresholds cannot be isolated from the technical requirements that will be required from the installations affected by these limits. In addition the preceding interactions with all stakeholders (cf. section 2.1) have made clear which aspects of the technical requirements are particularly relevant for proposing a reasonable set of limits. During the different stakeholder interactions Elia has provided a sufficient insight in the contours and for several aspects also the details of these technical requirements.

As such Elia refers to the technical requirements for PGMs in this consultation and proposes a package, i.e. a technical solution covering both thresholds and aspects linked to technical requirements.

The proposal put forward in this public consultation and the feedback received on this proposal will be taken into account when further specifying the details of the technical requirements and the preparation for applying for derogations.

## 2.3. Coordination with adjacent TSOs and DSOs

Art. 5(3) of the NC RfG mentions that next to a public consultation, the proposal for maximum capacity thresholds for types B, C, D of power-generating modules should be coordinated with adjacent TSOs and DSOs.

It is not further defined how such coordination should take place neither what the concrete result of the coordination should be. Elia has interpreted the need for coordination as a need to understand the other parties' (TSOs as well as DSOs) context and proposals and as a means to discuss a possible alignment in positions.

Having a mutual understanding of the context and constraints in each country and of the DSOs connected to the transmission network is important for proposing a reasonable set of maximum capacity thresholds.

The need for coordination with adjacent TSOs does, however, not imply a need for full harmonization of the maximum capacity thresholds. As the NC RfG has explicitly assigned the determination of the maximum capacity thresholds to the national level within a range of possible values, this implies that no full harmonization is deemed necessary.

By having defined the degree of freedom and ranges in which national implementation must take place, also the level of minimum harmonization has been implicitly determined by the NC RfG. Notwithstanding this interpretation, Elia believes that harmonization would be beneficial for fostering a level playing field throughout Europe, but only to the extent that this takes into account the (potentially different) national contexts and technical boundaries of national transmission networks. Section 5.6 further discusses the currently consulted proposal in the wider context of adjacent TSOs.

The need for coordination with adjacent DSOs was especially important and since the start of the process, Elia coordinated within Synergrid with the DSOs[4] connected to the Elia-grid. During previous interactions with stakeholders (cf. section 2.1), results of the alignment within Synergrid had been put forward. The proposal for the limits currently consulted upon was discussed already within Synergrid and their feedback was also taken into account. Moreover, the proposal for the limits made in section 4 has the support from all grid operators member of the Synergrid organisation. Next to the formal obligation to coordinate with the DSOs, Elia and the DSOs believe that such coordination is crucial for obtaining a coherent and consistent overall solution.

In addition Elia interpreted NC RfG art. 5(3) in a broad way and decided to also coordinate with the CDSOs (Closed Distribution System Operators). The concerns of the CDSOs have been heard during several stakeholder interactions (cf. section 2.1) and the proposal made in section 4 also aims to accommodate their concerns to a maximal extent.

Elia understands that from a technical perspective the context of CDS is different from the context of a "public" distribution grid. A closed distribution system deals with industrial grid

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[4] Throughout this document DSOs refers to "public" DSOs. Whenever also Closed Distribution System Operators are meant, this is explicitly stated. However, whenever "relevant system operator" is used as a term, this may – depending on the technical context – refer to the transmission, distribution and/or closed distribution system operator(s).

users and is from a technical perspective in principle not different from an industrial demand facility connected to the transmission grid. As already expressed on previous occasions, Elia commits to make a best effort – within the boundaries provided by the legal framework – for finding pragmatic solutions accommodating the industrial reality of CDS.

## 2.4. Further process on determining the maximum capacity thresholds for types B, C and D power-generating modules

Section 2.1 describes the timing and positioning of the 1st and 2nd SGU iteration that were organised in the Task Force Implementation Network Codes prior to this public consultation.

As mentioned above, the requirement for the relevant TSO to propose maximum capacity thresholds for types B, C and D power-generating modules is described in NC RfG art. 5(3). The timing to submit to the competent authorities these maximum capacity thresholds is not specified in the NC RfG. Therefore it is proposed to use the same deadline as specified in NC RfG art. 7(4) for the proposal on requirements of general application. i.e. 2 years after the entry into force of the NC RfG.

The Belgian Federal Administration (FOD/SPF Energy) presented on the 7th of March 2017 in the WG Belgian Grid[5] its vision on the further implementation process of the European Network Codes and communicated that the final proposal on the maximum capacity thresholds for types B, C and D power-generating modules has to be submitted to the competent authority, together with the proposal on the requirements of general application (and together with the track change version of an amended Federal Grid Code), 2 years after the entry into force of the NC RfG, i.e. by May 2018. A formal public consultation needs to be organised by Elia for all deliverables before the final submission. As a result, after the closing of the consultation period on the maximum capacity thresholds for types B, C and D power-generating modules, the feedback received will be reviewed and taken into account but the formal submission to the competent authorities of the final proposal of the maximum capacity thresholds will only take place on 17 May 2018. Meanwhile, the outcome of the public consultation will be taken into account in the determination of the proposal for requirements of general application.

After the final submission to the competent authorities at regional and federal level, currently foreseen in May 2018, the competent authorities will decide on maximum capacity thresholds. At federal level, FOD/SPF Energy currently foresees December 2018 as target date for their decision on these aspects.

[5] Presentation FOD/SPF Energy in WG Belgian Grid (in Dutch): http://www.elia.be/~/media/files/Elia/users-group/WG%20Belgian%20Grid/20170307%20WG%20Belgian%20Grid/FOD_Vision-for_FederalGridCode.pdf

Minutes of Meeting WG Belgian Grid 7th March 2017 (in French): http://www.elia.be/~/media/files/Elia/users-group/WG%20Belgian%20Grid/20170421_WG%20BG/20170307_PV_WGBG_FR_FINAL_WRITTEN-APPROVED.pdf

# 3. Technical and legal solution

As outlined in section 2.2 the maximum capacity thresholds for types B, C and D power-generating modules cannot be considered independently from the technical requirements laid upon these installations. Therefore, section 4 describes a proposal for limits and the link to several technical requirements is made. Also in the section 5 the justification for the proposal refers to aspects of the technical requirements.

Proposing the maximum capacity thresholds together with the requirements to be imposed as part of the technical solution should however also take into account the legal feasibility. A same technical solution might for instance be achieved by different sets of maximum capacity thresholds combined with different accompanying technical requirements which are either directly described in the NC or which should be fostered via different legal ways (such as derogations or the imposition of additional requirements through national grid codes or contracts,...). Different approaches could be envisaged, such as (i) proposing a higher limit in terms of maximum capacity thresholds and complement this with more stringent technical requirements via national grid codes or contracts for (some) units falling under this limit; or (ii) put a lower limit in terms of maximum capacity thresholds and then seek derogations for (some) units above this limit via the procedure described in the NC RfG.

The proposal described in section 4 already takes into account a trade-off between lower or higher maximum capacity thresholds and consequent needs for different legal ways for implementing technical requirements. In particular, it is believed to be legally more indicated to put a lower limit in terms of maximum capacity thresholds and then seek derogations for (some) units above this limit than to go for the first approach described in the paragraph above consisting of proposing a higher limit in terms of maximum capacity thresholds and complement this with more stringent technical requirements. Of course, the same technical solution is aimed for in both approaches and this proposal to go for the second approach should rather be interpreted as a legal implementation choice.

The legal reasoning behind this proposal is as follows: By foreseeing requirements for a certain type of grid users, the NC RfG harmonizes what is considered necessary at the EU level for the application of the said requirement. It can thus be considered it is not deemed necessary to apply the requirements to other types of grid users. In general, in cases where NC RfG has foreseen specific requirements, for instance for type B, this inherently implies that demanding the same requirement from a type A PGM is not in line with the NC RfG. Foreseeing connection requirements from a higher type on a lower type of PGMs (e.g. type B requirements on type A PGMs) could indeed only be considered valid if (1) it is fully compatible with the objectives of the requirements applicable for the concerned type of PGMs pursuant to the NC RfG, (2) it is allowed by the aims linked to the technical requirement as formulated in the whereas of the NC RfG and the specific requirements and (3) it is demonstrated that it does not affect cross-border trade, unless it is demonstrated that the measure at national level merely details the requirement of the NC RfG. Elia considers meeting these legal conditions – in case of the first approach described above – as very difficult if not impossible for the aspects considered in the proposal described in section 4, in particular because it goes further than merely detailing already existing requirements for the lower type of PGMs (i.e. type A in the example). The fact that several requirements as such do not exist in the NC RfG for the lower type makes it difficult to claim that it does not impact cross-border trade as this impact has been one of the driving principles for the NC RfG to determine the requirements for each type.

As a consequence, Elia considers the approach of seeking derogations via the mechanism built-in in the NC RfG as legally more indicated. Obviously, the derogation process also requires several justifications to be presented and finally accepted and approved by the concerned regulatory authority.

Therefore, and as described in section 4, the maximum capacity thresholds are proposed to be accompanied by derogations for several requirements thereby ensuring that the technical solution aimed for can be implemented. The context of these derogations is described in NC RfG art. 63. Of course, Elia has not the power to grant derogations, neither can Elia decide on regulated contracts (e.g. the connection contract) or other regulated requirements (e.g. Grid Codes, C10/11 requirements). Nevertheless, Elia and the DSOs make the commitment to take the necessary actions to file and advocate for the derogations and other necessary legal implementation acts put forward in the proposal. Anyone evaluating the proposal in this public consultation should be aware of this package-approach aiming at a technical solution and not merely looking at the maximum capacity thresholds defined in NC RfG art. 5.

Finally, it is important to bear in mind the scope and objectives of the EU network codes for connection. By determining the connection requirements for PGMs that are needed to contribute to solving the cross-border issues[6], the NC RfG ensures the availability of the needed means and technical capabilities to operate the European electrical system in a secure manner. It is clear that the NC RfG requirements also apply on installations connected to the distribution grids, which will host a very significant part of the new generation capacity (especially type A and type B PGMs). This implies that for the implementation of these requirements coordination with the distribution systems is needed.

Furthermore, connection requirements define the minimum capabilities needed to comply with the connection rules. While proving compliance with the connection rules, it is considered of major importance for the relevant system operators to identify the availability of any capabilities going beyond these minimum requirements. Indeed, the knowledge of these capabilities would allow the system operators to take the optimal decisions trough the most appropriate framework to benefit general interest.

[6] EC Regulation 714/2009 Article 8 (7) states that “the network codes shall be developed for cross-border network issues and market integration issues and shall be without prejudice to the Member States’ right to establish national network codes which do not affect cross-border trade”.

Furthermore, the preamble (2) of the NC RfG states that “Those requirements that contribute to maintaining, preserving and restoring system security in order to facilitate proper functioning of the internal electricity market within and between synchronous areas, and to achieve cost efficiencies, should be regarded as cross-border network issues and market integration issues.“

# 4. Proposed maximum capacity thresholds for the determination of significance

In line with the NC RfG art. 5, Elia is consulting on the following choice of maximum capacity thresholds for the determination of type:

- Type A
  - $0.8kW \leq P_{MAX}^{Capacity} < 0.25\ MW\ and\ V_{cp} < 110kV$
- Type B
  - $0.25\ MW \leq P_{MAX}^{Capacity} < 25MW\ and\ V_{cp} < 110kV$
- Type C
  - $25MW \leq P_{MAX}^{Capacity} < 75MW\ and\ V_{cp} < 110kV$
- Type D
  - $75MW \leq P_{MAX}^{Capacity}$ or
  - $0.8kW \leq P_{MAX}^{Capacity}$ and $V_{cp} \geq 110kV$

Where $P_{MAX}^{Capacity}$ is the maximum (installed) capacity of the power-generating modules and $V_{cp}$ is the voltage level at the connection point.

The parameters for the determination of significance are graphically illustrated in Figure 1 below.

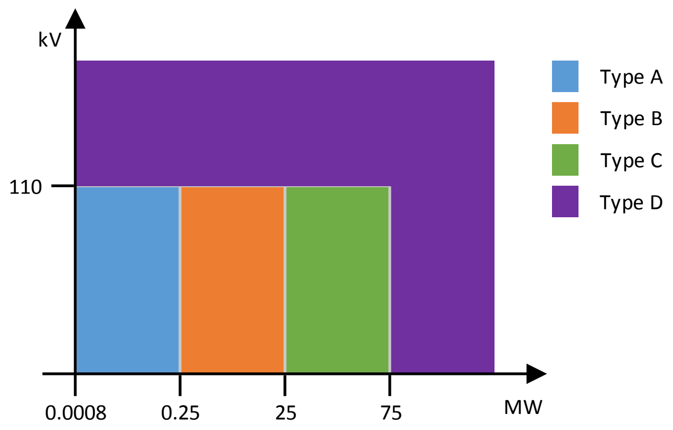


Figure 1 : Graphical representation of the proposed maximum capacity thresholds.

However, Elia is proposing to adapt the requirements for power-generating modules (PGM) with a maximum installed capacity lower than 25MW and with a voltage at the connection point higher or equal to 110kV to reflect the specification of the PGM of the same size with a voltage at the connection point lower or equal to 110kV. The justification to this choice is presented in Section 5.5.1. The requirements will be adapted via a derogation.

More specifically the following requirements are proposed:

- Type D PGM having a $0.8kW \leq P_{MAX}^{Capacity} < 0.25\,MW$ will follow the same requirements as type A PGM
- Type D PGM having a $0.25\,MW \leq P_{MAX}^{Capacity} < 25MW$ will follow the same requirements as type B PGM.

A graphical representation of the expected resulting requirements is presented in Figure 2 below.

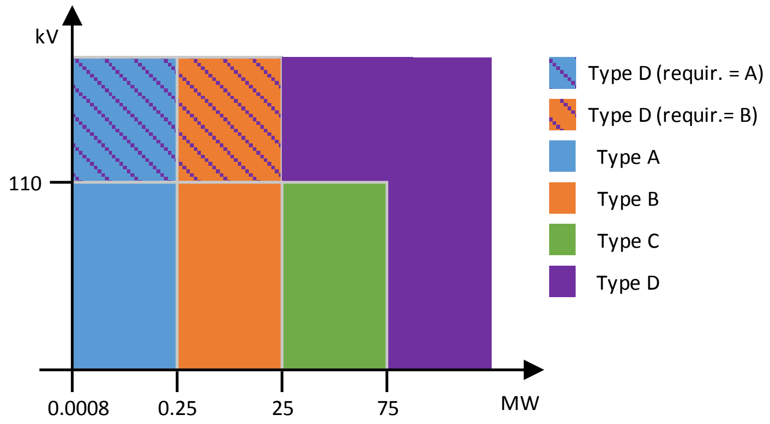


Figure 2 : Graphical representation of the requirements to be followed by PGM depending on the proposed maximum capacity thresholds considering the results of the intended derogation process.

## 4.1. Conditions for the choice of the maximum capacity thresholds

The proposed thresholds are the result of several rounds of workshops and discussions with the stakeholders and are proposed under the conditions explained in this section.

### 4.1.1. PGM with $250kW \leq P_{MAX}^{Capacity} < 1MW$

For PGM with $250kW \leq P_{MAX}^{Capacity} < 1MW$, there is a considerable uncertainty on the expected growth rate on the medium and long term horizon. These PGMs are considered of type B in the proposal but will not be required to respect the full set of requirement for this type. Therefore, the proposal made below for derogations for this group of PGMs should be considered in the context of further evolutions of the generation mix and system needs. If the context changes and the evolutions go in directions that system needs would no longer be adequately covered, more stringent requirements could be required or derogations be repealed (or not prolonged) or even the maximum capacity thresholds be revised. Only if such a flexible approach is considered acceptable, Elia and the DSOs can agree to seek derogations for some specific requirements and can consider not using, in the future, the option to retroactively request new investments on existing installations to meet the system needs.

More specifically it is proposed that for the following requirements a request for derogation is submitted by the relevant system operator or the relevant TSO (in line with NC RfG art. 63). The initial duration of the derogation is intended to be fixed to five years. After this period a reassessment of the need for the derogation will be performed.

- Robustness
    - 14(3)a&b - Fault Ride Through (FRT).
    - 17(3) - Providing post-fault active power recovery (SPGM)
    - 20(2)b&c. - Providing fast fault current (PPM)
    - 20(3)a&b. - Providing post-fault active power recovery (PPM)

Elia expects support from all the stakeholders for defining and defending the process of derogation.

### 4.1.2. Other conditions

For type C Synchronous Power Generating Modules (SPGM), stricter requirements than foreseen by the NC RfG for which regards voltage regulations will be necessary. Elia will request Automatic Voltage Regulation (AVR), Over Excitation Limiter (OEL), Under Excitation Limiter (UEL) and Power System Stabilizer (PSS) functions. The activation and tuning of the PSS function will be required depending on the connection point, size and the characteristic of the SPGM. This approach is in line with the Implementation Guidance Document, proposed and submitted by ENTSO-e, for national implementation of the network codes on grid connection (IGD) on “Parameters of Non-exhaustive requirements“ which recommends site specific implementation of the requirement 19(2)b.(v)

Closed Distribution Systems (CDS) requirements will be aligned, to the greatest possible extent, to the ones of Demand Facilities and DSO.

# 5. Justifications of the choice of the maximum capacity thresholds

The choice of the maximum capacity thresholds for types B, C and D power-generating modules has been obtained by the combination of analysis of the existing legislative framework, of the expected energy mix development in the future years, of cross-border effect considerations and of coordination with the neighbouring countries. In this chapter the essential reasoning and justifications of the choice of the maximum capacity thresholds are presented. The reasoning takes already into account the stakeholders feedbacks received during discussions.

## 5.1. Existing legislative framework

Existing federal and regional regulations have been analysed and compared with the threshold ranges proposed within the NC RfG. The analysis is synthetically presented in Table 2.

The proposed thresholds have been chosen to be in line with the existing legislative framework where possible. This choice is driven by the will not to overthrow the system entirely and to – where possible and reasonable – rather aim for an evolution than a revolution. Nevertheless as some requirements are intrinsically new as related to the development of specific technologies and availability on the market of functionalities (e.g. Fault Ride Through), a perfect match would not only be impossible but also insufficient for covering the system evolving needs.

The link between the specific Belgian requirements prior to the entry into force of the NC RfG and the one related to the different types are detailed in the remainder of the document where relevant for each threshold value.

## 5.2. Expected energy mix evolution

The current generation mix in Belgium is shown in Figure 3 (a). It consists of mainly (with regards to aggregated MW values) large (equivalent to type D) synchronous generators (SPGM) connected to the TSO network, followed by a relatively large MW volume of type A and B DSO connected PGM. The expected tendency of having more renewable generation, shows on the one hand a shift towards an increase of type D PPM generation, mostly offshore parks and, on the other hand, a considerable increase of type B PPM generation connected to the DSO as shown in Figure 3 (b).

For 2030 and beyond, in all of the European scenarios of the Ten-Year-Network Development Plans (TYNDP), the tendency towards large offshore parks and a larger number of smaller PGM connected to DSO network is confirmed for Belgium. The increase in volume of PGM in the types A, B and C confirms the need of more stringent requirements than in the prevailing Belgian framework for these types of PGM to allow maintaining the current level of quality of service (safe system operation, quality of supply (including security of supply)), facilitate grid access, support of national and regional objectives and overall economic efficiency.

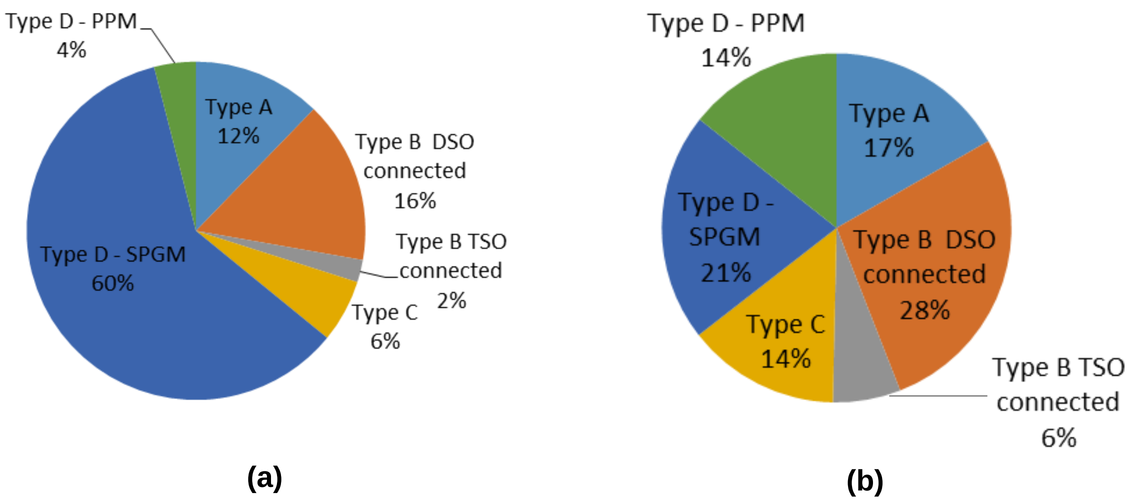


Figure 3: Current - 2016 (a) and expected (b) evolution for the 2025 horizon with constrained progress hypothesis of the energy mix in Belgium per type of generator with the proposed categorization.

| Belgian Texts | Stirling below 30kVA | User above 5kVA | Generator above 10kVA | User above 25kVA | User above 56kVA | User above 250kVA | Generator above 400kVA | Users above 630kVA | Generator above 1 MVA | Cogen above 1MW | User above 2MVA | Generator above 2.5MVA | Generator above 4MVA | User above 5MW | User above 10MVA | User above 15MW | Cogen below 20MW | Generator above 25MW | Generator above 75MW | Generator above 100MW | Nuclear / Not Nuclear | DS / Local TS / TS | Above 70kV | Cogen | RES | Local Generation | DSO | CDS | Mobile Load |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Electricity Law 1999 | | | | | | | | | | | | | | | | | | X | | X | X | X | X | X | X | | | | |
| Federal Grid Code | | | | | | | | | | | | | | | | | X | X | X | | | | | X | X | X | X | | |
| Walloon Grid Code | | X | | | X | X | | X | | | X | | | X | | | | X | | | | X | | X | X | X | | X | |
| Flemish Grid Code | | | X | X | | X | X | | X | X | | | | X | | X | | X | | | | | | | | | | X | |
| Brussels Grid Code | | | | | | | | | | | | | | | | | | X | | | | | | X | X | X | | | |
| MD Afschakel Plan | | | | | | | | | | | | | | | | | | | | | | X | | | | | X | | |
| Connection Contract | | | | | | | | | | | | | | | | | | | | | | X | | | | | | | |
| Access Contract | | | | | | | | | | | | | | | | X | | X | | | | | | | | | | X | |
| ARP Contract | | | | | | | | | | | | | | | | X | | X | | | | | | | | | | X | |
| CIPU Contract | | | | | | | | | | | | | | | | | | X | | | | X | | | | | | | |
| Tariff methodology | | | | | | | | | | | | | | | | | | | | | | X | | | | | | | X |
| Synergrid C10-11 | X | X | X | | | | | | X | | | X | X | | X | | | | | | | | | | | | | | |

Table 2: Comparison of the existing thresholds thoughout the existing belgian framework.

## 5.3. Threshold for type B PGM = 0.25MW (max admissible value = 1MW)

The current and expected evolution of energy mix in Belgium shows that, typically, large thermal controllable synchronous generators will be replaced by smaller size renewable-based power electronic connected units, many of which of type B.

Their power injection is inherently much more variable than the one of classical thermal generators. This variability makes on the one hand the control of power flows more challenging and dynamic, and on the other hand the need for more reactive power capability and controllability of theses PGM to maintain correct voltages throughout the system while facing these variability. Remote controllability of active and reactive power as well as reactive capability are thus necessary to operate the system with the same quality of service in the future as it is nowadays and to allow distribution system (including closed distribution systems) to meet the NC DCC[7] requirements at the Transmission-Distribution interface.

The current proposed requirements[8] for controllability are in line with what is already available on the market and are under many aspects chosen among the less stringent within the ranges allowed by the NC RfG.

In particular for PGM type A and B, an evolution is expected in international standards making them fully compliant with the European implementations of the NC RfG. Once this evolution is achieved, and provided that those standards sufficiently cover the Belgian system needs, they will be adopted through the most appropriate framework as the conformity of a PGM with these international standards will allow to achieve compliance with the Belgian implementation of the NC RfG, without the need to undergo heavy procedures.

In terms of reactive capability and voltage control requirements, Elia and the distribution system operators within Synergrid have taken into account the comments from the Belgian Generators Association (BGA) communicated in their position paper of 20/10/2016 on reactive power capabilities for type B PGMs between 250kW and 1MW. Based on their arguments, an enhanced proposal has been made for type B PGMs. The proposal is presented in Annex II.

A sufficient knowledge of the units' characteristics and of their operational state is necessary to be able to correctly forecast and observe in real-time their behaviour. For this reason the information on the characteristic of the installation and operational information exchange is needed and will be required for new PGMs, while this is not required retroactively for the existing PGMs unless this can be achieved by existing installation at limited or no additional costs.

In case of event resulting in severe voltage dips, if no or insufficiently robust LVRT functionality is implemented, a large number of these PGMs may disconnect and

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[7] Commission Regulation (EU) 2016/1388 of 17 August 2016 establishing a Network Code on Demand Connection, http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016R1388&from=EN

[8] The last information on the proposed non-exhaustive requirements for each type is available online at http://www.elia.be/nl/users-group/belgian-grid/Task-Force-Implementation-nc/Sujets. The work is still ongoing to define exhaustively the requirements but no major change of the current state of the discussion is expected.

subsequently cause power unbalance, possible overloads with cascade tripping or even worst consequences such as local and regional load shedding.

The requirements regarding LVRT functionality for this type, as presented in various Task Force sessions, represent the less stringent choice according to the ranges in the NC RfG, set as degrees of freedom for national implementation, for the remaining voltage. It is expected that this choice facilitates the compliance and limits the impact on the asset cost.

Many of the PGM of this class are and will in the future be connected through power electronics (PPM). This technology does not naturally support the system voltage by injecting fault current during voltage dips, making the overall voltage profile worse. Considering that these PPM will increasingly replace voltage support –friendly SPGM enforcing this effect. This weakening of voltage support increases the size of the system impacted by a voltage dip and as consequence the amount of PGM being at risk of disconnection.

For this reason, for PPM, it is requested to include a capability to actively support the voltage by injecting reactive fault current during voltage dips and to recover the active power after it. Such functionality will not be requested to all the PPMs as it is related to the characteristics of the network at the point of connection. Its characteristics and activation will be agreed with the relevant TSO during the connection procedure and are expected to be in line with what is available on the market and inline the European Implementation Guiding Document (IGD) on Fast Fault Current injection.

During large disturbances or during network reconstruction, an automatic, uncontrolled reconnection of PGM may endanger and jeopardize the already delicate process of system operation in not normal situations. The automatic reconnection of these PGM should be agreed with the relevant TSO and is not expected to have an impact on the cost of the installations.

Some of the above mentioned requirements, such as voltage control for PGM having a maximum capacity lower than 25MW, were not present in the current legal framework. The reason to include such requirements are justified by the current and future evolution of the Belgian energy mix, by the experience of other TSOs with similar issues that have experienced a high risk of cross-border impact, e.g. in case of sudden voltage dips.

To simplify the compliance process, Elia is ready to accept for FRT characteristic of Type B PPM and possibly other requirements, manufacturer’s certificates or simulations instead of specific tests. This choice will considerably facilitate the process.

### 5.3.1. Type B PGM with $250kW \leq P_{MAX}^{Capacity} < 1MW$

The decision to derogate for a number of the requirements for the PGM having a maximum capacity between 250kW and 1MW is motivated by the relative high impact of the requirements on the cost of the asset, the availability of the required functions and the limited beneficial system-wide effect of the requirement.

As presented in Section 4.1.1, the requirements on robustness will be derogated.

Due the expected energy mix evolution (from mostly type D towards 50% type B PGMs), type B PGMs become more important for ensuring voltage stability in the system. Therefore, broad reactive power capabilities should ideally be requested, within the framework of the EU NCs, for the future challenges in reactive power management and voltage control.

Power quality and voltage management is strongly related to the capacity of the TSO and DSO to manage reactive power flows.

When the Renewable Energy Sources (RES) connected to the distribution grid are at their full generation capacity and, at the very same moment, consumption is low, the voltage profile within the distribution grid and within the transmission grid cannot be managed without proper balance of reactive power.

That is the reason why, in NC DCC art. 15, it is required that, in such a case, the reactive power balance of each DSO must be managed locally to avoid cascading effect of the management of reactive power in the TSO grid.

Considering the embedded characteristics of the RES connected to the distribution grid, the use of these capabilities should be preferred over dedicated and concentrated assets to provide reactive power balance. This approach is inline with the ENTSO-E Guidance document for national implementation for network codes on grid connection (IGD) on “Reactive Power Management at the T-D interface”.

The requested capabilities should, of course, be reasonable, and are therefore aligned with the proposal of the Belgian Generators Association (BGA) (cfr. previous paragraph and Annex II). For this reason, derogation is considered not needed.

Regarding robustness, studies have shown that the difference in volume of production at risk in case of voltage dip, considering the current generation development scenarios, is limited if the type B PGM smaller than 1MW do not comply with the FRT curve of type B PGM. Imposing such requirement for these PGMs can possibly, at the current state of technology, have a non-negligible impact on the asset costs and may preclude some specific technologies such as small cogeneration plants or asynchronous generators the access to the Belgian market. As mentioned above, if PGMs have a capability of going beyond the minimum requirements (e.g. broader LVRT profile) the relevant system operator has to be informed (and the protection scheme will have to be set up accordingly).

Because of these impacts a derogation is proposed for these FRT requirements described in article 15(3)a&b of the NC RfG. Further, as described in Section 4.1.1. it is proposed to seek derogations for NC RfG articles 17(3), 20(2)b&c and 20(3)a&b. The remaining requirements for this type of PGM will not be derogated: the motivations are presented here below.

#### 5.3.1.1. System Restoration - Art 14(4)

During system restoration, the DSOs have to increase the offtake in a substation with an agreed amount of power (as asked by the TSO), when reconnecting feeders. The DSOs have to make sure that the amount of power remains within the margin as agreed with the TSO, even when reconnecting feeders on which decentralized PGM are connected. In the time in between the reconnection of new feeders, the DSO should guarantee that the offtake in a substation does not change significantly; this can be the case when renewable decentralized production is present on the feeder. This requirement is thus necessary to allow system restoration on a system with high level of integration of distributed generation integration such as is already the case in the Belgian network.

#### 5.3.1.2. Art 14(5)d - communication and information exchange

Due to the intermittent nature of distributed Renewable Energy Sources (RES), voltage fluctuations on the MV network may become larger (amplitude) and more frequent than those observed in the past.

Figures 4 and 5 below illustrate the phenomena.

"Classic" situation (without distributed generation): The HV/MV regulator enables the MV to be kept at + or - 3% of the setpoint voltage.

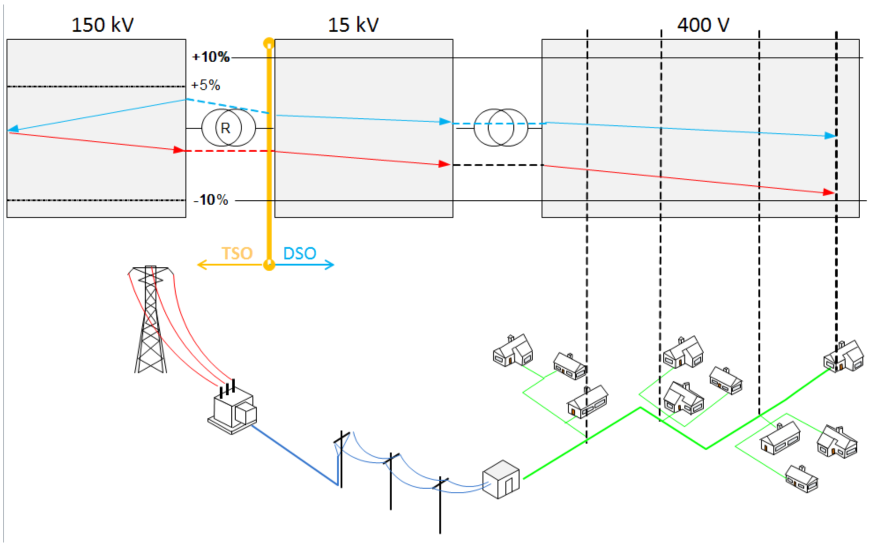


Figure 4: Graphical representation and voltage profile of a 'classic' situation (without distributed generation)

With the arrival of distributed generation: RES connected to the MV network increase the risk of having LV problems because, in the vicinity of a PGM, the voltage increases.

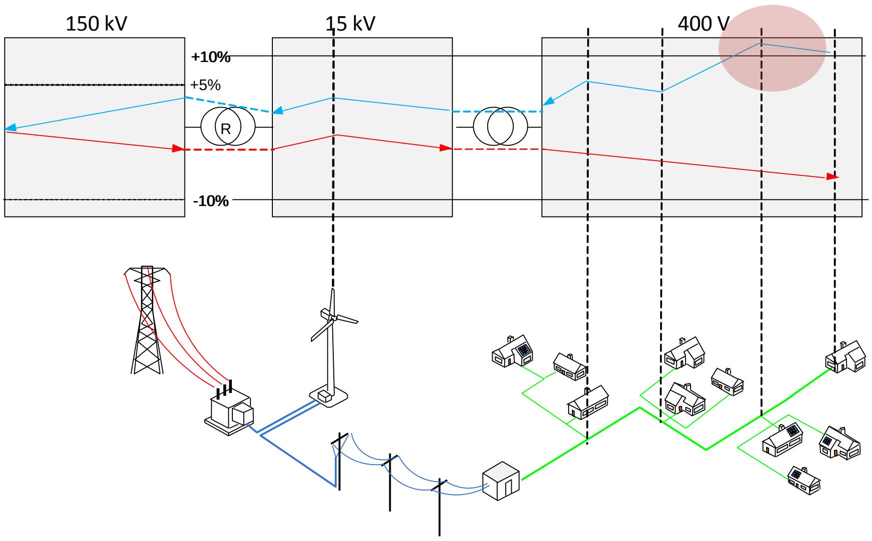


Figure 5: Graphical representation and voltage profile of a situation with distributed generation

It is obvious that the grid users (in MV but also in LV because the voltage level in the latter is influenced by the variations of the MV) cannot suffer a disadvantage and that the quality of the product (for which voltage is one of the indicators) must remain at an acceptable level (as defined in the standard EN50160).

For these reasons, it is therefore essential that DSOs have a better knowledge of the power flows in the MV network and that they can predict them, which implies:

- having the information about how much kWs and kVAR are generated;
- need for more sensors and measuring devices on the MV network;
- implementation of tools to predict these power flows (via a state estimator).

Only then, DSOs will be able to anticipate and prepare the network to accommodate these power flows, and thus facilitate active management of the network structure, e.g. by facilitating the transfer of charges from one transformer station to another, better computation of the available injection capacity, …

Furthermore, as required by the COMMISSION REGULATION (EU) No 543/2013 of 14 June 2013 on submission and publication of data in electricity markets and amending Annex I to Regulation (EC) No 714/2009 of the European Parliament and of the Council, for their control areas, TSOs calculate and provide the following information to ENTSO-E: art 16(b) aggregated generation output per market time unit and per production type. The information shall be published no later than one hour after the operational period.

For the time being, TSO receives from the DSOs already these data for the important generation (as from 1MW) and make assumptions for smaller units. Having the information of the generated power for units between 250 kW and 1 MW will increase the quality of this publication and also help the TSO, and therefore the market as a whole, to better estimate and forecast the RES part of the generation. This is will become more important considering the potential growth of this category of generation.

#### 5.3.1.3. Other system management requirements (Art 14(5)a, b and c), operational notifications (Art 31, Art 32) and compliance (Art 44, Art 47, Art 50 and Art 54)

These last requirements are considered limitedly cost-impacting as no additional asset investments are needed to be compliant but only cost for processing already existing information.

Regarding especially the electrical protection schemes and settings, DSOs are already since many years, during the connection process, asking for electrical protection schemes and are setting values for protection of the local grids. It is one of the elements to comply with in the package of deliverables for granting a connection to the distribution grid and not only for generators between 250kW and 1 MW, but even for generators as from 10kW.

Regarding the compliance verification (NC RfG art. 41) for units of type B, the relevant system operator shall have the right to request that the power-generating facility owner carries out compliance tests and simulations. It is obvious that this right will only be exercised by using the least cost impacting solution, including as far as reasonably possible equipment certificates and general (factory) testing procedures.

## 5.4. Threshold for type C PGM = 25MW (max admissible value = 50MW)

PGM of maximum capacity higher than 25MW are expected to contribute to the power system stability not only during exceptional situations (e.g. voltage support during voltage dips) but also during normal operation to the control and support the system with a larger involvement than for type B PGM.

Considering the expected evolution of the energy mix, an increasingly large volume of controllable conventional PGM will be displaced towards RES that are inherently more difficult or limitedly controllable. Such evolution may cause difficulties in certain situations or times during which the remaining conventional PGM have to compensate for this lack of controllability, specifically for frequency and voltage control.

Reliability of voltage control is of major importance when largely used. For this reason type C SPGM will also have to comply with the type D SPGM requirements related to voltage control functionality including AVR, OEL and UEL. In addition the tendency to have more and more power-electronic connected generators (PPM) and load (such as high efficiency domestic or industrial rotating machines) will drastically decrease the total system inertia and affect its repartition. As a consequence, this trend also causesa reduction of the available means to naturally damp oscillations (such as AC connected rotating loads and large synchronous generators). For this reason additional means to actively damp oscillations is requested, depending on the connection site, via the presence of a PSS function in the SPGM voltage control system.

This is in line with requirements for PGM of this size as requested by the current Belgian legal framework.

The non-mandatory requirement for synthetic inertia for PPM of this type will not yet be required as it is not considered necessary. Such choice eases the compliance process and reduces the impact on the installation cost but may evolve in the future. Elia will follow the recommendation proposed by ENTSO-E in the Implementation Guiding Document (IGD) on synthetic inertia and high penetration of non-synchronous generation.

The FRT profile of Type C is identical to the FRT profile of Type B. The proposed FRT requirement for type C PGM is less stringent than what requested the FRT requirement imposed by the current Belgian legal framework.

Taking into account the fact that for SPGM the aggregated installed capacities per site will not be considered to categorize PGM (except in the case of indivisible set of installations), the proposed threshold for type C lead to less stringent requirement than requested in the current Belgian legal framework.

The compliance verification of the regulating functionalities via simulation and eventually tests are of major importance to the securely operation of the power system and to avoid having to use a lower threshold than 25MW.

The main driver for the choice of this threshold at 25MW is the alignment with the current legislations, both at federal level as at regional level. As an illustrative example PGM larger than 25MW are considered “regulating” both in the Federal Grid Code art. 68 and the Flemish Regional Grid Code (Technisch Reglement Plaatselijk Vervoersnet) Art III.3.2.6. The current requirements for this class of PGM are in line with the ones of the NC RfG.

## 5.5. Threshold for type D PGM = 75MW (max admissible value = 75MW)

In addition to the above mentioned key rationales, the choice of the threshold for type D PGM is based on the fact that, being the latter large PGM usually connected to the highest voltage levels; it is considered that they shall strongly contribute to maintaining the stability of the system by controlling the voltage and the system frequency.

For these PGM the Fault Ride Through is also of fundamental importance as they are connected to the highest voltage levels and are “electrically close” to neighbouring grids with the consequence of having a large cross-border impact. The requirements for Fault

Ride Through are more stringent than for PGM of type B and C. Nevertheless the proposed requirements for this type of PGM for Fault Ride Through are in line with the one existing in the current Belgian legal framework (cfr Art. 64 of Federal Grid Code) for which regard the remaining voltage and duration of the first voltage dip.

In addition, the voltage ranges on which these PGM should be able to operate, the voltage control system and the capabilities are the most stringent than to PGM of type A, B and C.

The threshold for the PGM of type D has been aligned with the maximum admissible value following the NC RfG as it is considered sufficient for the current and future needs of the Belgian system.

### 5.5.1. PGM of type D smaller than 25MW

Small PGM, i.e. with capacity lower than 25MW connected to voltage levels higher than 110kV will incur in relative high additional costs to comply with the specifications of type D when considering their relative low cost compared to larger PGM of the same category.

Taking into account the expected aggregated volume of such installations, Elia considers limited system benefits to apply type D requirements to these PGM.

Elia is proposing to adapt the requirement for this class of PGM to reflect the same ones as the PGM of the same size connected to voltage levels lower than 110kV. This means that PGM of type D of size between 0.25 MW and 25MW would follow the same requirement as type B and PGM with size lower than 0.25 MW same as type A.

The PGM of type D with size between 25MW and 75MW connected to voltage levels higher than 110kV will however remain of type D. This choice is justified by the fact that these PGM represent a high volume already now and is expected to further increase in the future Furthermore due to the proximity of their connection point with the highest voltage levels, the cross-border impact is larger. Finally, the compliance is more simplified as it is to be validated for a connection a stronger network, i.e. a voltage level higher than 110kV. For some requirements such as FRT, a higher voltage level at the connection point, with often higher short circuit power can strongly facilitate the compliance.

Elia asks support from the stakeholders for defining and arguing the derogation needed to adapt the requirements for this class of PGM (Type D with capacity smaller than 25MW, just like PGM type A and B).

## 5.6. Benchmark with neighbouring TSOs

A process of discussion and benchmarking of the proposed thresholds has been held within ENTSO-e through bilateral and multilateral meetings with neighbouring TSOs.

More specifically Elia has held discussions with RTE, TENNET BV, CREOS, TENNET GmbH, AMPRION and TransnetBW GmbH, respectively the French, Dutch, Luxemburgish and (a representation of) the German TSOs.

The objective of the meetings is the coordination on maximum capacity thresholds for types B, C and D power-generating modules as described in NC RfG art. 5(3).

The currently proposed maximum capacity thresholds considered by the different TSOs are shown in Table 3 below.

At the moment of the redaction of this consultation document some of the TSOs (i.e. the German and French ones) are still in discussion, for this reason these are presented for information only. CREOS, being electrically strongly connected to Germany, is considering applying the same threshold values as in Germany.

The discussions focussed on the background of the selection of threshold values. The difference in generation portfolio is often the reason why the threshold values are different as well as the coherence with existing national legal frameworks. The intentions to fulfil a secure and stable operation of the network are the same in the different countries through empowerment for example of Fault Ride Through requirements to a sufficient large volume of installed power.

The choice of the limit is also impacted by the network structure, current and future expected development of the generation fleet.

This is particularly evident when comparing the Belgian proposal with the French one. These two sets of maximum capacity thresholds are practically in line when considering the evolution of the threshold B. In this case the only limited difference is the threshold C. Elia and RTE consider the difference of volume of generation of type B and C due to this non-alignment to be very limited.

The discussions and the choice of the threshold for type B PGM show that a key factor in the choice of this limit is the penetration level of small renewable PGM. This explains the low value of the B threshold in Germany, lower than the other ones and partly in line with the Belgian one. In the Netherlands however the amount of small PGM is not considered to be or become critical when compared to the total installed power for a near future.

| | **Belgium (Elia)** | **France (RTE)** | **The Netherland (TENNET BV)[9]** | **German TSOs[10]** |
|---|---|---|---|---|
| **Threshold B** | 0.25 MW | (0.25MW[11]) 1MW | 1MW | 0.135 MW |
| **Threshold C** | 25MW | 18MW | 50MW | 36MW |
| **Threshold D** | 75MW | 75MW | 60MW | 45MW |

Table 3: Comparison of the proposed thresholds with neighbouring TSOs

Therefore, bearing in mind the above benchmark of the values for the thresholds with neighbouring countries and notwithstanding the fact that not only the thresholds but also general requirements can be determining, Elia believes that the proposed thresholds for

[9] Reference to the consultation document of TENNET BV: http://www.netbeheernederland.nl/Content/Files/file/20161031%20voorstel%20BR-16-1249%20maximumcapaciteitsdrempelwaarden%20RfG.pdf

[10] These values are the outcome of their public consultation but have not yet been approved by the German competent authority and the information is therefore for information only. Reference: https://www.vde.com/de/fnn/themen/europaeische-network-codes/umsetzung-im-fnn/leistungsklassen

[11] The French competent authority has not yet approved this choice and the information is presented for information only (values are based on information retrieved from RTE). RTE plans to review the Threshold B to a value of 0.25 MW as soon as the cost of communication decreases.

Belgium neither jeopardize a level playing field nor puts Belgium in an isolated position on the market of PGMs.

As both the French and the German market can be considered due to their size as weighing significantly on the European PGMs development efforts by manufacturers, it can be expected that the Belgian market will be implicitly "served" as well. In this respect, also the more stringent limits for one or more thresholds defined in NC RfG art. 5 or chosen by other European regions (notably the Nordic and Baltic regions, Ireland, Northern Ireland) add to the likely availability of PGM corresponding to the different thresholds proposed for Belgium.

# 6. Explicit questions to stakeholders in the context of this public consultation

All interested stakeholders can freely react on the proposal put forward in this public consultation document.

Elia also invites stakeholders to provide an answer to the following specific questions:

1. About the maximum capacity thresholds:
    a. Do you support the proposal for maximum capacity thresholds for types B, C, D of power-generating modules taking into account the link with the currently presented technical requirements, i.e. the “package-approach”?
    b. If you do not support the proposal, which aspects are considered blocking and why?
    c. If you do not support the proposal, with which arguments put forward by Elia do you disagree?
2. About the possible future evolution of the maximum capacity thresholds and technical requirements:

    Can you accept the proposed approach where in a first stage specific technical requirements (e.g. fault ride through for PGM type B between 250 kW and 1 MW) are not required (and a derogation is applied for), but depending on the further evolution of the energy mix and system needs can nevertheless be requested at a later stage (via a change of the maximum capacity thresholds and/or changing the technical requirements, depending which will be the optimal solution)?
3. About the proposed threshold of 250 kW distinguishing PGM types A and B and the proposed linked set of derogations
    a. Do you share the view that the legal approach based on a lower threshold (i.e. 250kW) accompanied with a set of derogations is the most indicated way to obtain the technical solution put forward? If not, which legal approach would you propose and on which legal basis can it be justified?
    b. Do you consider the proposed list of derogations as acceptable? In particular, do you share the view that, ceteris paribus, the requirements of NC (art. 14(4), 14(5)a,b&c, 31, 32, 44, 47, 51 and 54), for which no derogation is proposed are not critically determining an investment decision?

| | Description in English | Description en français | Beschrijving in het Nederlands |
|---|---|---|---|
| **AVR** | Automatic Voltage Regulator | Régulateur automatique de tension | Automatische spanningsregeling |
| **CDS** | Closed Distribution System | Réseau fermé de distribution | Gesloten Distributiesysteem |
| **CDSO** | Closed Distribution System Operator | gestionnaire de réseau fermé de distribution | beheerder van gesloten distributiesysteem |
| **DCC** | Demand Connection Code | Demand Connection Code | Demand Connection Code |
| **DSO** | Distribution System Operator | Gestionnaire de réseau de distribution (GRD) | Distributienetbeheerder (DNB) |
| **FRT** | Fault Ride Through | tenue aux creux de tension | Fault-ride-through |
| **HV** | High Voltage | Haute tension (HT) | Hoogspanning (HS) |
| **IGD** | Implementation Guidance Document | Document d’orientations non contraignantes sur la mise en œuvre nationale des codes de réseaux (Implementation Guidance Document) | Begeleidend niet-bindend document over de implementatie van de netwerkcodes (Implementation Guidance Document) |
| **LV** | Low Voltage | Basse tension (BT) | Laagspanning (LS) |
| **LVRT** | Low Voltage Ride Through | Low Voltage Ride Through | Low Voltage Ride Through |
| **MV** | Medium Voltage | Moyenne tension (MT) | Middenspanning (MS) |
| **NC** | Network Code | Code de Réseau | Netwerkcode |
| **OEL** | Over Excitation Limiter | imiteur de surexcitation | Overbekrachtingsbegrenzer |
| **PGM** | Power Generating Module | Unité de production d'électricité | elektriciteitsproductie-eenheid |
| **PPM** | Power Park Module | parc non synchrone de générateurs | power park module |
| **PSS** | Power System Stabilizer | stabilisateur de puissance | power system stabiliser |
| **RES** | Renewable Energy Sources | Sources d'énergie renouvelables (SER) | Hernieuwbare energiebronnen (HEB) |
| **RfG** | Requirements for Generators | Requirements for Generators | Requirements for Generators |
| **SGU** | Significant Grid User | Utilisateur significatif du réseau | Significante netgebruiker |

| | | | |
|---|---|---|---|
| **SPGM** | Synchronous Power Generating Module | Unité de production d’électricité synchrone | Synchrone elektriciteitsproductie-eenheid |
| **TSO** | Transmission System Operator | Gestionnaire de réseau de transport (GRT) | Transmissienetbeheerder (TNB) |
| **UEL** | Under Excitation Limiter | Limiteur de sous-excitation | Onderbekrachtingsbegrenzer |

# ANNEX I - NC RFG REQUIREMENTS REGARDING GENERATORS OF TYPE A, B, C, D[12]

Table 4: General Requirements

| Title | Requirement type | Type A | Type B | Type C | Type D |
|---|---|---|---|---|---|
| FREQUENCY RANGES | Frequency stability | X | X | X | X |
| LIMITED FREQUENCY SENSITIVE MODE (OVERFREQUENCY) | Frequency stability | X | X | X | X |
| RATE OF CHANGE OF FREQUENCY WITHSTAND CAPABILITY | Frequency stability | X | X | X | X |
| CONSTANT OUTPUT AT TARGET ACTIVE POWER | Frequency stability | X | X | X | X |
| MAXIMUM POWER REDUCTION AT UNDERFREQUENCY | Frequency stability | X | X | X | X |
| AUTOMATIC CONNECTION | Frequency stability | X | X | X | X |
| REMOTE SWITCH ON/OFF | Frequency stability | X | X | | |
| ACTIVE POWER REDUCTION | Frequency stability | | X | | |
| ACTIVE POWER CONTROLLABILITY AND CONTROL RANGE | Frequency stability | | | X | X |
| DISCONNECTION OF LOAD DUE TO UNDERFREQUENCY | Frequency stability | | | X | X |
| FREQUENCY RESTORATION CONTROL | Frequency stability | | | X | X |
| FREQUENCY SENSITIVE MODE | Frequency stability | | | X | X |
| LIMITED FREQUENCY SENSITIVE MODE (UNDERFREQUENCY) | Frequency stability | | | X | X |
| MONITORING OF FREQUENCY RESPONSE | Frequency stability | | | X | X |
| CONTROL SCHEMES AND SETTINGS | General system management | | X | X | X |
| INFORMATION EXCHANGE | General system management | | X | X | X |
| PRIORITY RANKING OF PROTECTION AND CONTROL | General system management | | X | X | X |
| TRANSFORMER NEUTRL-POINT TREATMENT | General system management | | | X | X |
| ELECTRICAL PROTECTION SCHEMES AND SETTINGS | General system management | | X | X | X |
| INSTALLATION OF DEVICES FOR SYSTEM OPERATION AND/ OR SECURITY | General system management | | | X | X |
| INSTRUMENTATION FOR FAULT AND DYNAMIC BEHAVIOUR RECORDING | General system management | | | X | X |
| LOSS OF STABILITY | General system management | | | X | X |
| RATE OF CHANGE OF ACTIVE POWER | General system management | | | X | X |
| SIMULATION MODELS | General system management | | | X | X |
| SYNCHRONISATION | General system management | | | | X |
| AUTO RECLOSURES | Robustness of Generating Units | | | X | X |
| STEADY-STATE STABILITY | Robustness of Generating Units | | | X | X |
| RECONNECTION AFTER AN INCIDENTAL DISCONNECTION DUE TO A NETWORK DISTURBANCE | System restoration | | X | X | X |

[12] From Annex 3 of “Selecting national MW boundaries” ENTSO-E guidance document for national implementation for network codes on grid connection, 16 November 2016.

| | | | | | |
|---|---|---|---|---|---|
| **BLACK START** | System restoration | | | X | X |
| **CAPABILITY TO TAKE PART IN ISOLATED NETWORK OPERATION** | System restoration | | | X | X |
| **QUICK RE-SYNCHRONISATION** | System restoration | | | X | X |
| **HIGH/LOW VOLTAGE DISCONNECTION** | Voltage stability | | | X | |
| **VOLTAGE RANGES** | Voltage stability | | | | X |

Table 5: Synchronous power generating modules requirements:

| Title | Requirement type | Type A | Type B | Type | Type D |
|---|---|---|---|---|---|
| **POST FAULT ACTIVE POWER RECOVERY** | Robustness of Generating Units | | X | X | X |
| **FAULT RIDE THROUGH CAPABILITY OF SYNCHRONOUS GENERATORS CONNECTED BELOW 110 kV** | Robustness of Generating Units | | X | X | |
| **FAULT RIDE THROUGH CAPABILITY OF SYNCHRONOUS GENERATORS CONNECTED AT 110 kV OR ABOVE** | Robustness of Generating Units | | | | X |
| **CAPABILITIES TO AID ANGULAR STABILITY** | Robustness of Generating Units | | | | X |
| **VOLTAGE CONTROL SYSTEM (SIMPLE)** | Voltage stability | | X | X | |
| **REACTIVE POWER CAPABILITY (SIMPLE)** | Voltage stability | | X | | |
| **REACTIVE POWER CAPABILITY AT MAXIMUM ACTIVE POWER** | Voltage stability | | | X | X |
| **REACTIVE POWER CAPABILITY BELOW MAXIMUM ACTIVE POWER** | Voltage stability | | | X | X |
| **VOLTAGE CONTROL SYSTEM** | Voltage stability | | | | X |

Table 6: PPMs requirements:

| Title | Requirement type | Type A | Type B | Type | Type D |
|---|---|---|---|---|---|
| **SYNTHETIC INERTIA CAPABILITY** | Frequency stability | | | X | X |
| **POST FAULT ACTIVE POWER RECOVERY** | Robustness of Generating Units | | X | X | X |
| **FAULT RIDE THROUGH CAPABILITY OF POWER PARK MODULES CONNECTED BELOW 110 kV** | Robustness of Generating Units | | X | X | |
| **FAULT RIDE THROUGH CAPABILITY OF POWER PARK MODULES CONNECTED AT 110kV OR ABOVE** | Robustness of Generating Units | | | | X |
| **REACTIVE CURRENT INJECTION** | Voltage stability | | X | X | X |
| **REACTIVE POWER CAPABILITY(SIMPLE)** | Voltage stability | | X | | |
| **PRIORITY TO ACTIVE OR REACTIVE POWER CONTRIBUTION** | Voltage stability | | | X | X |
| **REACTIVE POWER CAPABILITY AT MAXIMUM ACTIVE POWER** | Voltage stability | | | X | X |
| **REACTIVE POWER CAPABILITY BELOW MAXIMUM ACTIVE POWER** | Voltage stability | | | X | X |
| **REACTIVE POWER CONTROL MODES** | Voltage stability | | | X | X |
| **POWER OSCILLATIONS DAMPING CONTROL** | Voltage stability | | | X | X |

# ANNEX II – UPDATED PROPOSAL FOR REACTIVE CAPABILITY AND VOLTAGE CONTROL FOR TYPE B PGM

In terms of reactive capability and voltage control, Elia has identified a big game changer, i.e. the nuclear phase out. This event will introduce the loss of a huge amount of reactive power and voltage control capabilities. Therefore (during the task forces on Reactive Power Management and Voltage Control), compared to the actual requirements (cfr."federal technical regulation"), Elia proposed to maintain similar requirements as currently of application in Belgium on type C and D PGMs and more stringent capability requirements on type B generators (since a lot of those generators will take over the role of the nuclear units). However, the proposed requirements have been commented[13] by the Belgian Generators Association (BGA) communicated in their position paper of 20/10/2016 on reactive power capabilities for type B PGMs between 250kW and 1MW. Elia and the distribution system operators within Synergrid have taken into account those comments, and based on their arguments, an enhanced proposal has been made for type B PGMs, the proposal is presented here below.

For SPGMs of type B, the requirement at the connection point for the reactive power provision capability is determined by the Q-P profile represented in Figure 6 where the limitations are based on nominal current at high active power output and by a reactive power (Q) limited to -25% and +48% of $P_D$, where $P_D$ is the maximum active power that can be produced in case of the maximum requested reactive power output (hence equal to $0.9*S_{nom}$). This figure should be respected at nominal voltage. Note that, at type of connection, the available capability of the SPGM (which could be wider than the minimum requirement) should be communicated, demonstrated and considered as the Q-P profile of the SPGM.

As requested by the NC, the SPGM shall furthermore be equipped with a permanent excitation control system that can provide constant alternator voltage at a selectable set point without instability over the entire operating range.

[13] Position BGA position on Reactive Power and Voltage Control (20/10/2016): http://www.elia.be/~/media/files/Elia/users-group/2016_TF%20Implementation%20NCs/17102016_TFNCs/20161020_BGA_Position%20_ReactivePower.pdf

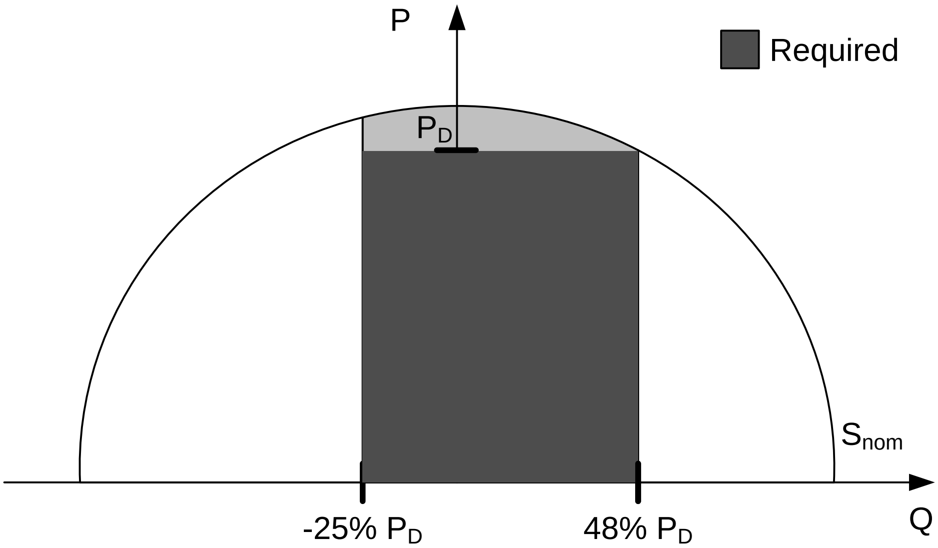


Figure 6: Reactive power capabilities for type B SPGMs

For PPMs of type B, the requirement at the connection point for the reactive power provision capability is determined by the Q-P profile represented in Figure 7 where the limitations are based on nominal current at high active power output and by a power factor (cos(phi)) defined by the 2 points at Q= -30% and +33% of $P_D$, where $P_D$ is the maximum active power that can be produced in case of the maximum requested reactive power output (hence equal to $0.95*S_{nom}$). This figure should be respected at nominal voltage. Note that, at type of connection, the available capability of the PPM (which could be wider than the minimum requirement) should be communicated, demonstrated and considered as the Q-P profile of the PPM

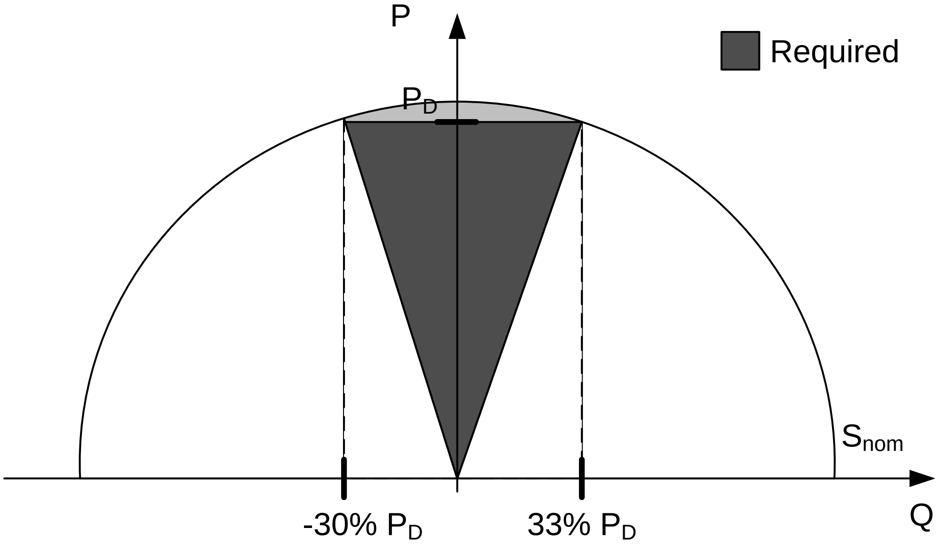


Figure 7: Reactive power capabilities for type B PPMs