

Proposals for amendments to the Requirements for Generators

Fields marked with * are mandatory.

Introduction

Important developments in the policies of decarbonisation of the European Union (EU) energy and transport sectors have taken place since the inception of the development of the first European Grid Connection Network Codes (GC NCs) in 2012.

In the framework of the Grid Connection European Stakeholder Committee (GC ESC), the European Commission proposed for ACER to initiate the process towards the amendment of the existing GC NCs in September 2022. The amendment process, as presented to the GC ESC is outlined in the Figure below:



Following the scoping phase, ACER published the Policy Paper on the revision of the network code on requirements for grid connection of generators and the network code on demand connection in September 2022. The Policy Paper aims to transparently indicate to stakeholders the key policy areas in which amendments are to be expected. Moreover, the Paper draws on the alternative policy options and provides recommendations and proposed actions for the amendment process.

[Access the ACER Policy Paper on the revision of the NC RfG and NC DC](#)

This consultation aims at gathering, from all interested stakeholders, concrete proposals for amendments to the Commission Regulation (EU) 2016/631 of 14 April 2016 establishing a **Network Code on Requirements for Grid Connection of Generators** ('NC RfG').

For amendment proposals concerning Network Code on Demand Connection, please go to the form: [NC DC](#).

Responses to this consultation should be submitted by 28 November 2022 23:59 CET.

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* Name of the stakeholder:

Vestas Wind Systems A/S

* Contact person:

[REDACTED]

* Contact person's email address:

[REDACTED]

* Country of the stakeholder's headquarters or main country of operation:

Denmark

* Type of the stakeholder:

- ☐ Generator (including association)
- ☐ Consumer (including association)
- ☐ Transmission system operator (including association)
- ☐ Distribution system operator (including association)
- ☒ Manufacturers (including association)
- ☐ Academia/research institution
- ☐ Regulatory authority
- ☐ Other (please, elaborate)

Please, elaborate on your answer above, if necessary:

* Do you consent to the publication of the stakeholder's name?

- ☒ Yes

☐ No

* Do you consent to the publication of provided answers?

☒ Yes

☐ No (please, note that your answer, without your name and organization, may be shared with the EU institutions and national authorities, drafting team members, and other persons or entities involved in the European Grid Connection Network Codes amendment process)

Instructions

Stakeholders are invited to submit their amendment proposals to the RfG articles that they consider should be revised in a two-step process:

1. by inserting the proposed amendments in the provided Word file
2. by motivating/reasoning the proposed amendments through this online consultation form.

Both steps are mandatory for all amendment proposals.

(Where no amendment is proposed, the article text in the word file can be left unaltered and the cells in the consultation form can be left blank.)

The mandatory steps for submitting amendment proposals are detailed below. At the end of this section, you can find an example showing how to submit your proposals.

Step 1

Please include all your amendment proposals in the **Word file provided below using the Track Changes mode**. Once you edit the file and rename it with your stakeholder's name ("NC_RfG_stakeholder_name"), please upload it in the last section of this form (FILE UPLOAD)

[Download the Word file \(NC RfG\)](#)

Step 2

In addition, please use this form to motivate/reason your proposals, following the instructions:

General requirements for type B power-generating modules

Please write your amendment proposal and the reasoning in the table below.

| | Amendment proposal | Reasoning | Relation to other provisions |
|---------------|--------------------|-----------|------------------------------|
| Article 14(1) | 1 | 2 | 3 |
| Article 14(2) | | | |
| Article 14(3) | | | |
| Article 14(4) | | | |
| Article 14(5) | | | |

Please write your amendment proposal and the reasoning in the table below.

| | Proposal for new provisions in this section | Reasoning | Relation to other provisions |
|---|---------------------------------------------|-----------|------------------------------|
| 4 | New provisions | | |

Please upload your file if necessary

The maximum file size is 1 MB

5 Select file to upload

1. Propose an amended wording of the relevant provision, as you provided in the Word file.
2. Provide the motivation/reasoning behind your proposal.
3. Indicate (if any) which other provisions of the NC RfG are impacted and may need to be amended following your proposal.
4. Provide (if any) your proposals for adding new provisions to the relevant section of the Regulation, as you provided in the Word file.
5. Upload figures or tables if necessary; text inputs should be provided directly in the consultation form.

Example

Stakeholder XYZ would like to propose an amendment to Article 27 of NC RfG. In their view, the meaning of the word "respectively" in this article is not clear. Following a two-step process, the stakeholder downloads the Word file from the **Instruction** section, turns on the Track Changes mode and edits the text (first step).



Article 27

System restoration requirements applicable to AC-connected offshore power park modules

The system restoration requirements laid down respectively in Article 14(4) and Article 15(5) shall apply to AC-connected offshore power park modules types B and C, respectively.

Article 28

General system management requirements applicable to AC-connected offshore power park modules

The general system management requirements laid down in Article 14(5), Article 15(6) and Article 16(4) shall apply to AC-connected offshore power park modules.

After saving the edited file on their device under the name "*NC_RfG_Stakeholder_XYZ*", the stakeholder uploads it in the **FILE UPLOAD** section.

Pages

| | | | | | | |
|--------------|-------------|---------|-------------|-----------|----------------|--------------------|
| Introduction | Instruction | Whereas | Definitions | TITLE I | TITLE II CH. 1 | TITLE II |
| TITLE III | TITLE IV | TITLE V | TITLE VI | TITLE VII | Other | FILE UPLOAD |

FILE UPLOAD

Please upload the Word file (downloaded from the *Instruction* section) containing all your amendments

The maximum file size is 1 MB

NC_RfG_Stakeholder_XYZ.docx

Select file to upload

Previous

Submit

The stakeholder proceeds to motivate/reason their proposal. As they would like to propose an amendment to Article 27 of NC RfG, they enter **TITLE II CHAPTER 4** Section and insert the proposed amended wording and the reasoning (second step). As the proposed amendment of Article 27 does not affect other provisions, they leave the last column blank.

Pages

[Introduction](#)[Instruction](#)[Whereas](#)[Definitions](#)[TITLE I](#)[TITLE II CH. 1](#)[TITLE II CH. 2](#)[TITLE II CH. 3](#)[TITLE II CH. 4](#)[TITLE III](#)[TITLE IV](#)[TITLE V](#)[TITLE VI](#)[TITLE VII](#)[Other](#)[FILE UPLOAD](#)

TITLE II CHAPTER 4 - Requirements for offshore power park modules

Please write your amendment proposal and the reasoning in the table below.

| | Amendment proposal | Reasoning | Relation to other provisions |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| Article 23 | // | // | // |
| Article 24 | // | // | // |
| Article 25 | // | // | // |
| Article 26 | // | // | // |
| Article 27 | The system restoration requirements laid down in Article 14(4) and Article 15(5) shall apply to AC-connected offshore power park modules types B and C, respectively. | The current wording of Article 27 refers to the provisions of Articles 14(4) and 15(5). However, it is unclear from the legal text how the respective application should be understood. Indicating that the requirements of Article 14(4) shall apply to offshore PPMs type B and requirements of Article 15(5) shall apply to offshore PPMs type C follows the internal logic of the NC RfG and corresponds with the capabilities of the units in question. | - // |
| Article 28 | // | // | // |

As the survey is long,

1. you have the possibility to edit your answer after submission. When clicking on "submit", you will be given a contribution ID, which you can then use to access your contribution here. This allows you to proceed in steps.
2. we kindly suggest that you download the entire survey as .pdf (link on the right), prepare your answers and then upload them at once in the EU Survey Tool, to avoid a session timeout on submission.

The maximum length of each cell is 5000 characters. This is the maximum technical limit set by the EUsurvey tool, which cannot be increased.

Whereas Section

Please write your amendment proposal and the reasoning in the table below.

Numbers in the first column correspond with the recitals of the NC RfG Whereas section

| | Amendment proposal | Reasoning | Relation to other provisions |
|------|--------------------|-----------|------------------------------|
| (1) | | | |
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Please write your amendment proposal and the reasoning in the table below.

| | Proposal for new recitals | Reasoning | Relation to other provisions |
|--------------|---------------------------|-----------|------------------------------|
| New recitals | | | |

Please write your amendment proposal and the reasoning in the table below.

| | Amendment proposal | Reasoning | Relation to other provisions |
|---------------|--------------------|-----------|------------------------------|
| Article 2(1) | | | |
| Article 2(2) | | | |
| Article 2(3) | | | |
| Article 2(4) | | | |
| Article 2(5) | | | |
| Article 2(6) | | | |
| Article 2(7) | | | |
| Article 2(8) | | | |
| Article 2(9) | | | |
| Article 2(10) | | | |
| Article 2(11) | | | |
| Article 2(12) | | | |
| Article 2(13) | | | |
| Article 2(14) | | | |
| Article 2(15) | | | |
| Article 2(16) | | | |
| Article 2(17) | | | |
| Article 2(18) | | | |
| Article 2(19) | | | |
| Article 2(20) | | | |
| Article 2(21) | | | |
| Article 2(22) | | | |
| Article 2(23) | | | |
| Article 2(24) | | | |
| Article 2(25) | | | |
| Article 2(26) | | | |

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| Article 2(27) | | | |
| Article 2(28) | | | |
| Article 2(29) | | | |
| Article 2(30) | | | |
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| Article 2(32) | | | |
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| Article 2(56) | | | |
| Article 2(57) | | | |
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| Article 2(59) | | | |
| Article 2(60) | | | |
| Article 2(61) | | | |
| Article 2(62) | | | |
| Article 2(63) | | | |
| Article 2(64) | | | |
| Article 2(65) | | | |

Please write your amendment proposal and the reasoning in the table below.

| | Proposal for new definitions | Reasoning | Relation to other provisions |
|-----------------|------------------------------|-----------|------------------------------|
| New definitions | | | |

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TITLE I - General provisions

Please write your amendment proposal and the reasoning in the table below.

| | Amendment proposal | Reasoning | Relation to other provisions |
|------------|--------------------|-----------|------------------------------|
| Article 1 | | | |
| Article 3 | | | |
| Article 4 | | | |
| Article 5 | | | |
| Article 6 | | | |
| Article 7 | | | |
| Article 8 | | | |
| Article 9 | | | |
| Article 10 | | | |
| Article 11 | | | |
| Article 12 | | | |

Please write your amendment proposal and the reasoning in the table below.

| | Proposal for new articles in this section | Reasoning | Relation to other provisions |
|--------------|-------------------------------------------|-----------|------------------------------|
| New articles | | | |

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TITLE II CHAPTER 1 - General Requirements

General requirements for type A power-generating modules

Please write your amendment proposal and the reasoning in the table below.

| | Amendment proposal | Reasoning | Relation to other provisions |
|---------------|--------------------|-----------|------------------------------|
| Article 13(1) | | | |
| Article 13(2) | | | |
| Article 13(3) | | | |
| Article 13(4) | | | |
| Article 13(5) | | | |
| Article 13(6) | | | |
| Article 13(7) | | | |

Please write your amendment proposal and the reasoning in the table below.

| | Proposal for new provisions in this section | Reasoning | Relation to other provisions |
|----------------|---------------------------------------------|-----------|------------------------------|
| New provisions | | | |

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General requirements for type B power-generating modules

Please write your amendment proposal and the reasoning in the table below.

| | Amendment proposal | Reasoning | Relation to other provisions |
|---------------|--------------------|-----------|------------------------------|
| Article 14(1) | | | |
| Article 14(2) | | | |
| Article 14(3) | | | |
| Article 14(4) | | | |
| Article 14(5) | | | |

Please write your amendment proposal and the reasoning in the table below.

| | Proposal for new provisions in this section | Reasoning | Relation to other provisions |
|----------------|---------------------------------------------|-----------|------------------------------|
| New provisions | | | |

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General requirements for type C power-generating modules

Please write your amendment proposal and the reasoning in the table below.

| | Amendment proposal | Reasoning | Relation to other provisions |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|------------------------------|
| Article 15(1) | | | |
| Article 15(2) | | | |
| Article 15(3) | | | |
| Article 15(4) | | | |
| Article 15(5) | | | |
| | <p>(c) with regard to the simulation models:</p> <p>(i) at the request of the relevant system operator or the relevant TSO, the power-generating facility owner shall provide simulation models which properly reflect the behaviour of the power-generating module for the relevant study purpose in both steady-state and dynamic simulations (root mean square) or in electromagnetic transient simulations. The simulation model requirements and data provided shall not violate manufacturers intellectual property; The power-generating facility owner shall ensure that the models provided have been verified against the results of compliance tests referred to in Chapters 2, 3 and 4 of Title IV, and shall notify the results of the verification to the relevant system operator or</p> | | |

relevant TSO. Member States may require that such verification be carried out by an authorised certifier;

(ii) the synchronous power-generating module simulation models provided by the power-generating facility owner shall contain the following sub-models, depending on the existence of the individual components:

- alternator and prime mover,
- speed and power control,
- voltage control, including, if applicable, power system stabiliser ('PSS') function and excitation control system, and
- power-generating module protection models, as agreed between the relevant system operator and the power-generating facility owner;

(iii) for the purpose of electromechanical dynamic simulations (RMS simulation studies) of power park modules, the relevant system operator or the relevant TSO shall have the right to specify the power park modules simulation model requirements, either encrypted RMS model (with accurate representation) or generic

model (with limitations). Without prejudice to the Member State's rights to introduce additional requirements, the simulation models of the power park modules provided by the power generation facility owner shall:

- a) in the case that encrypted detailed RMS models are accepted by the relevant TSO, manufacturer specific models (e.g., DLL based models) should be also acceptable and models shall be valid for the specified operating range and all control modes of the power-generating facility. The RSO shall specify necessary information to ensure that both the provided model and the interface will be applicable by the RSO in the relevant national regulatory framework, while preserving the confidentiality surrounding manufacturers intellectual property. The RSO together with the plant owner (and PGM technology manufacturer) shall specify requirements of the model encryption (for example use of source code, the model structure and the signal interfaces). The agreement may be made on project specific basis;
- b) encrypted detailed RMS models

should be include a proper representation of the converter modules and its control systems (including the synchronization module) that influence the dynamic behaviour of the power-generating module in the specified time frame;

c) as alternative, be open source generic model for cross border network stability studies (limitations of generic model shall be acknowledged);

d) in the case that encrypted detailed RMS models are accepted by the relevant TSO, the relevant TSO shall specify the requirements of the model encryption according to national regulations (for example use of source code, the model structure and the signal interfaces to be observable in the network studies);

e) include the relevant protection function models;

(iv) For the purpose of time domain electromagnetic transient (EMT) simulations of power park modules, the relevant system operator or the relevant TSO shall have the right to specify the power park module model requirements. Without prejudice to the Member State's rights to introduce

Article 15(6)

additional requirements, the models shall contain the following:

- a) be valid in the frequency range 0.2 Hz – 2500 Hz for relevant interaction studies. The validity of the PPM model shall be ensured for the given frequency range at the connection point;
- b) be valid for specified operating range and control modes of the PPM in both the positive and in the negative phase sequence;
- c) reproduce the detailed response of the power-generating module and its control blocks during balanced and unbalanced AC network faults in the valid frequency range;
- d) include the power plant level control and the power plant relevant functionalities if applicable;
- e) include the frequency dependence of the lines and/or cables in the power-generating facility;
- f) represent the Power Plant Module transformers model including saturation, resistors, filter, breaker and AC arrester in the valid frequency;
- g) include all the relevant protection function models for the relevant interaction studies;
- h) be capable to be used for the

The provided amendment proposal is in line with the report of ENTSO-E expert group Interaction Studies and Simulation Models for PGM /HVDC (EG ISSM).

We need scalable solutions and more harmonization in the area of compliance verification, even though we are convinced that encrypted manufacturer specific models (e.g., DLL based models) are the way forward to cope with increasing requirements on model accuracy.

Provision of documentation on a model's structure and block diagrams does not preserve the confidentiality surrounding manufacturers intellectual property.

numerical calculation of the frequency dependent impedance of PPM at the connection point (impedance amplitude and impedance phase angle) in the frequency range that the model is valid);

i) Be open source or be encrypted.

The RSO together with the plant owner (and PGM technology manufacturer) shall specify necessary information to ensure that both the provided model and the interface will be applicable by the RSO in the relevant national regulatory framework, while preserving the confidentiality surrounding manufacturers intellectual property.

(v) For the purpose of frequency domain simulations for the risk assessment of the resonance stability of the power park module, the relevant system operator or the relevant TSO shall have the right to request from the power-generating facility owner the frequency dependent impedance model of the power generating facility at the point of interconnection to the grid. Without prejudice to the Member State's rights to introduce additional

requirements, the following requirements shall apply:

- a) The impedance model of the power-generating facility shall be requested at least in the range 5.0 Hz - 2500Hz; As an additional requirement, the relevant system operator or the relevant TSO can extend the required applicability of the model to up to 9 000 Hz.
- b) The relevant system operator or the relevant TSO together with the plant owner (and PGM technology manufacturer) shall agree on the requested calculation of the impedance model of the power-generating facility to be either preferably numerically (using the EMT model) or optional analytically (using transfer function) or both;
- c) The relevant system operator or the relevant TSO shall have the right to request the impedance profile of the power-generating facility at the connection point through the whole operating range and control modes of operation;
- d) The impedance model of the power-generating facility shall be provided for both the positive and for the negative phase sequence;
- e) The power-generating facility owner shall take into account the influence of the power-generating

module control and measurement system as other parts of the power-generating module which influences the output impedance in the specified frequency range;

f) The power-generating facility owner shall specify and justify simplifications made in the calculation of the impedance model.

(vi) the request by the relevant system operator referred to in point (i) and (ii) shall be coordinated with the relevant TSO. The RSO shall specify necessary information to ensure that both the provided model and the interface will be applicable by the RSO in the relevant national regulatory framework, while preserving the confidentiality surrounding manufacturers intellectual property. It shall include:

- the format in which models are to be provided,
- an estimate of the minimum and maximum short circuit capacity at the connection point, expressed in MVA, as an equivalent of the network;

Please write your amendment proposal and the reasoning in the table below.

| | Proposal for new provisions in this section | Reasoning | Relation to other provisions |
|----------------|---------------------------------------------|-----------|------------------------------|
| New provisions | | | |

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General requirements for type D power-generating modules

Please write your amendment proposal and the reasoning in the table below.

| | Amendment proposal | Reasoning | Relation to other provisions |
|---------------|--------------------|-----------|------------------------------|
| Article 16(1) | | | |
| Article 16(2) | | | |
| Article 16(3) | | | |
| Article 16(4) | | | |

Please write your amendment proposal and the reasoning in the table below.

| | Proposal for new provisions in this section | Reasoning | Relation to other provisions |
|----------------|---------------------------------------------|-----------|------------------------------|
| New provisions | | | |

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TITLE II CHAPTER 2 - Requirements for synchronous power-generating modules

Requirements for type B synchronous power-generating modules

Please write your amendment proposal and the reasoning in the table below.

| | Amendment proposal | Reasoning | Relation to other provisions |
|---------------|--------------------|-----------|------------------------------|
| Article 17(1) | | | |
| Article 17(2) | | | |
| Article 17(3) | | | |

Please write your amendment proposal and the reasoning in the table below.

| | Proposal for new provisions in this section | Reasoning | Relation to other provisions |
|----------------|---------------------------------------------|-----------|------------------------------|
| New provisions | | | |

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Requirements for type C synchronous power-generating modules

Please write your amendment proposal and the reasoning in the table below.

| | Amendment proposal | Reasoning | Relation to other provisions |
|---------------|--------------------|-----------|------------------------------|
| Article 18(1) | | | |
| Article 18(2) | | | |

Please write your amendment proposal and the reasoning in the table below.

| | Proposal for new provisions in this section | Reasoning | Relation to other provisions |
|----------------|---------------------------------------------|-----------|------------------------------|
| New provisions | | | |

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Requirements for type D synchronous power-generating modules

Please write your amendment proposal and the reasoning in the table below.

| | Amendment proposal | Reasoning | Relation to other provisions |
|---------------|--------------------|-----------|------------------------------|
| Article 19(1) | | | |
| Article 19(2) | | | |
| Article 19(3) | | | |

Please write your amendment proposal and the reasoning in the table below.

| | Proposal for new provisions in this section | Reasoning | Relation to other provisions |
|----------------|---------------------------------------------|-----------|------------------------------|
| New provisions | | | |

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TITLE II CHAPTER 3 - Requirements for power park modules

Requirements for type B power park modules

Please write your amendment proposal and the reasoning in the table below.

| | Amendment proposal | Reasoning | Relation to other provisions |
|---------------|--------------------|-----------|------------------------------|
| Article 20(1) | | | |
| Article 20(2) | | | |
| Article 20(3) | | | |

Please write your amendment proposal and the reasoning in the table below.

| | Proposal for new provisions in this section | Reasoning | Relation to other provisions |
|----------------|---------------------------------------------|-----------|------------------------------|
| New provisions | | | |

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Requirements for type C power park modules

Please write your amendment proposal and the reasoning in the table below.

| | Amendment proposal | Reasoning | Relation to other provisions |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|------------------------------|
| Article 21(1) | | | |
| Article 21(2) | | | |
| | <p>(f) with regard to power oscillations damping control, if specified by the relevant system operator or the relevant TSO a power park module shall be capable of activating contribution to damping of low frequency electromechanical oscillations in a frequency range specified by the relevant system operator in coordination with the relevant TSO.</p> <p>(i) The voltage and reactive power control characteristics of power park modules must not adversely affect the damping of power oscillations. For cases where the</p> | | |

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|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Article 21(3) | <p>required damping performance cannot be obtained simultaneously with fulfilling the requirements for voltage and reactive power control laid down in point (d) of Article 21 (3), the relevant system operator or the relevant TSO shall specify whether voltage and reactive power control or power oscillation damping shall be prioritized;</p> <p>(ii) the power park module shall be capable of either continuously contribute to damping or activate the damping contribution by detection of a relevant oscillation event (discontinuous operation);</p> <p>(iii) the frequency range specified by the relevant system operator or the relevant TSO shall be between 0.1 Hz and 2.0 Hz inclusive;</p> | <p>Since the requirement laid down in point (f) of Article 21(3) is non-exhaustive and needs further national specification for its entire application, we as power-generating unit (PGU) / power park module manufacturer, experienced a wide variety of national implementations of this requirement. This leads to uncertainties regarding the requirement interpretation on national level and has the potential to negatively influence project execution timelines.</p> <p>Hence further clarification and guidance is needed. We also propose to provide an Implementation Guidance Document (IGD) on Power Oscillation Damping (POD) control, since this capability is still considered as emerging technology and standardization in terms of both capability and performance is not practical (see also IEEE 2800-2022). We as Vestas are happy to share our experience with Power Oscillation Damping (POD) provided by wind power park modules in order to draft jointly such an IGD.</p> | |
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Please write your amendment proposal and the reasoning in the table below.

| | Proposal for new provisions in this section | Reasoning | Relation to other provisions |
|----------------|---------------------------------------------|-----------|------------------------------|
| New provisions | | | |

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Requirements for type D power park modules

Please write your amendment proposal and the reasoning in the table below.

| | Amendment proposal | Reasoning | Relation to other provisions |
|------------|--------------------|-----------|------------------------------|
| Article 22 | | | |

Please write your amendment proposal and the reasoning in the table below.

| | Proposal for new provisions in this section | Reasoning | Relation to other provisions |
|----------------|---------------------------------------------|-----------|------------------------------|
| New provisions | | | |

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TITLE II CHAPTER 4 - Requirements for offshore power park modules

Please write your amendment proposal and the reasoning in the table below.

| | Amendment proposal | Reasoning | Relation to other provisions |
|------------|--------------------|-----------|------------------------------|
| Article 23 | | | |
| Article 24 | | | |
| Article 25 | | | |
| Article 26 | | | |
| Article 27 | | | |
| Article 28 | | | |

Please write your amendment proposal and the reasoning in the table below.

| | Proposal for new articles in this section | Reasoning | Relation to other provisions |
|--|-------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| | | <p>Network Code and grid code requirements around the topic of "forced oscillations of active power" generated by offshore power park modules is raising more and more attention and concerns within the power system industry (especially system operators with growing share of offshore power park modules). Concerns are that existing oscillation modes being present in the power system (e.g., inter- and intra-area oscillations) are amplified by "forced oscillations of active power" generated by offshore power park modules.</p> <p>"Forced oscillations of active power" needs are a result of the fact that the mechanical system of the wind turbine is not 100% stiff where wave and wind misalignments (as a natural</p> | |

New articles

Article 25

Voltage stability requirements applicable to AC-connected offshore power park modules

6. With regard to forced oscillations of active power generated by offshore power park modules:

(a) Active power oscillations measured and averaged over 1 minute with frequencies of 0.1 Hz - 2.0 Hz shall not exceed the least restrictive of:

- $\pm 2\%$ of the actual active power,
- $\pm 1\%$ of the maximum capacity, and
- ± 1 MW;

(b) Active power oscillations that exceed the limits defined above shall be damped to be within the limits within 180 seconds;

(c) Requirement applies within the voltage ranges and time periods for operation laid down in Article 25 (table 10);

(d) The requirement is demonstrated in normal, stable conditions in the transmission grid and after an event outside the offshore power park modules. In case of repeated events the acceptable levels shall be reached within 180 seconds after the last event.

behavior) results in certain movements.

Active damping of tower movements has been best practice for the last decades to save cost and tower steel. Active tower damping can reduce the amount of needed steel in the range of 100 – 300 tons. Together with increasing steel prices this has the potential to negatively influence the European energy transition significantly.

Reducing the amplitude of allowed damping active power will significantly increase the costs of hardware of power-generating units and even asking for “No” active power oscillation will technically be very complex or almost impossible without additional equipment at power park module / plant level. Providing tolerances will allow the industry to develop technical solutions to limit their forced active power oscillations.

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TITLE III - Operational notification procedure for connection

Please write your amendment proposal and the reasoning in the table below.

| | Amendment proposal | Reasoning | Relation to other provisions |
|------------|--------------------|-----------|------------------------------|
| Article 29 | | | |
| Article 30 | | | |
| Article 31 | | | |
| Article 32 | | | |
| Article 33 | | | |
| Article 34 | | | |
| Article 35 | | | |
| Article 36 | | | |
| Article 37 | | | |
| Article 38 | | | |
| Article 39 | | | |

Please write your amendment proposal and the reasoning in the table below.

| | Proposal for new articles in this section | Reasoning | Relation to other provisions |
|--------------|-------------------------------------------|-----------|------------------------------|
| New articles | | | |

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TITLE IV - Compliance

Please write your amendment proposal and the reasoning in the table below.

| | Amendment proposal | Reasoning | Relation to other provisions |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|------------------------------|
| Article 40 | | | |
| Article 41 | | | |
| Article 42 | | | |
| Article 43 | | | |
| Article 44 | | | |
| Article 45 | | | |
| Article 46 | | | |
| Article 47 | | | |
| Article 48 | | | |
| Article 49 | | | |
| Article 50 | | | |
| Article 51 | | | |
| | <p>Article 52(2)</p> <p>With regard to the LFSM-U response simulation the following requirements shall apply:</p> <p>a) the power-generating module's capability to modulate active power at low frequencies in accordance with point (c) of Article 15(2) shall be demonstrated by RMS simulation;</p> <p>Article 52(3)</p> <p>With regard to the FSM response simulation the following requirements shall apply:</p> <p>(a) the power-generating module's</p> | | |

Article 52

capability to modulate active power over the full frequency range in accordance with point (d) of Article 15(2) shall be demonstrated by RMS simulation;

Article 52(4)

With regard to the island operation simulation the following requirements shall apply:

(a) the power-generating module's performance during island operation referred to in the conditions set out in point (b) of Article 15(5) shall be demonstrated by RMS simulation;

Article 52(5)

With regard to the reactive power capability simulation the following requirements shall apply:

(a) the power-generating module's capability to provide leading and lagging reactive power capability in accordance with the conditions set out in points (b) and (c) of Article 18 (2) shall be demonstrated by simulation in the outer corners of the U-Q/Pmax diagram. In addition two simulations of the executed tests shall be performed with the real grid voltage and load points during the tests;

(b) the simulation shall be deemed

The provided amendment proposal is in line with the report of ENTSO-E expert group Interaction Studies and Simulation Models for PGM /HVDC (EG ISSM).

The proposed amendments are reflecting as of today best practice compliance verification via compliance simulations.

| | | | |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|
| | <p>successful if the following conditions are fulfilled:</p> <p>(i) the simulation model of the power-generating module is validated against the compliance tests for reactive power capability as far as these tests were accommodated (grid voltage deviations) and allowed by the RSO described in Article 45(7); and</p> <p>(ii) compliance with the requirements of points (b) and (c) of Article 18(2) is demonstrated.</p> | | |
| Article 53 | | | |
| Article 54 | | | |
| | <p>7. With regard to the power oscillations damping control simulation, the following requirements shall apply:</p> <p>(a) the model of the power park module shall demonstrate that it can contribute to provide active power oscillations damping of low frequency electromechanical oscillations capability in accordance with point (f) of Article</p> | | |

| | | | |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Article 55 | <p>21(3);</p> <p>(b) the simulation shall be deemed successful in the event that if the following conditions are cumulatively fulfilled:</p> <p>(i) the power park module is capable to contribute to damping of low frequency electromechanical oscillations within a frequency range specified by the relevant system operator or the relevant TSO;</p> <p>(ii) the damping is greater with the Power Oscillation Damping (POD) function enabled than with the Power Oscillation Damping (POD) function disabled and shall be verified by compliance simulations either based on a relevant test network or by analysis of phase shift between input and output quantities; and</p> <p>(iii) the model demonstrates compliance laid down with the conditions described in point (f) of Article 21(3) is demonstrated.</p> | <p>Since the requirement laid down in point (f) of Article 21(3) is non-exhaustive and needs further national specification for its entire application, we as power-generating unit (PGU) / power park module manufacturer, experienced a wide variety of national implementations of this requirement. This leads to uncertainties regarding the requirement interpretation on national level and has the potential to negatively influence project execution timelines.</p> <p>Hence further clarification and guidance is needed. We also propose to provide an Implementation Guidance Document (IGD) on Power Oscillation Damping (POD) control, since this capability is still considered as emerging technology and standardization in terms of both capability and performance is not practical (see also IEEE 2800-2022). We as Vestas are happy to share our experience with Power Oscillation Damping (POD) provided by wind power park modules in order to draft jointly such an IGD.</p> | |
| Article 56 | | | |

| | | | |
|------------|--|--|--|
| Article 57 | | | |
| Article 58 | | | |
| Article 59 | | | |

Please write your amendment proposal and the reasoning in the table below.

| | Proposal for new articles in this section | Reasoning | Relation to other provisions |
|--------------|-------------------------------------------|-----------|------------------------------|
| New articles | | | |

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TITLE V - Derogations

Please write your amendment proposal and the reasoning in the table below.

| | Amendment proposal | Reasoning | Relation to other provisions |
|------------|--------------------|-----------|------------------------------|
| Article 60 | | | |
| Article 61 | | | |
| Article 62 | | | |
| Article 63 | | | |
| Article 64 | | | |
| Article 65 | | | |

Please write your amendment proposal and the reasoning in the table below.

| | Proposal for new articles in this section | Reasoning | Relation to other provisions |
|--------------|-------------------------------------------|-----------|------------------------------|
| New articles | | | |

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TITLE VI - Transitional arrangements for emerging technologies

Please write your amendment proposal and the reasoning in the table below.

| | Amendment proposal | Reasoning | Relation to other provisions |
|------------|--------------------|-----------|------------------------------|
| Article 66 | | | |
| Article 67 | | | |
| Article 68 | | | |
| Article 69 | | | |
| Article 70 | | | |

Please write your amendment proposal and the reasoning in the table below.

| | Proposal for new articles in this section | Reasoning | Relation to other provisions |
|--------------|-------------------------------------------|-----------|------------------------------|
| New articles | | | |

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TITLE VII - Final provisions

Please write your amendment proposal and the reasoning in the table below.

| | Amendment proposal | Reasoning | Relation to other provisions |
|------------|--------------------|-----------|------------------------------|
| Article 71 | | | |
| Article 72 | | | |

Please write your amendment proposal and the reasoning in the table below.

| | Proposal for new articles in this section | Reasoning | Relation to other provisions |
|--------------|-------------------------------------------|-----------|------------------------------|
| New articles | | | |

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Other additional provisions

Please write your amendment proposal and the reasoning in the table below.

| | Proposal for new provisions | Reasoning | Relation to other provisions |
|----------------------|-----------------------------|-----------|------------------------------|
| Other new provisions | | | |

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Please upload the Word file (downloaded from the **Instruction** section) containing all your amendment proposals in the Track Changes mode.

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