

ACER draft amendments to the Network Code on HVDC

Fields marked with * are mandatory.

Introduction

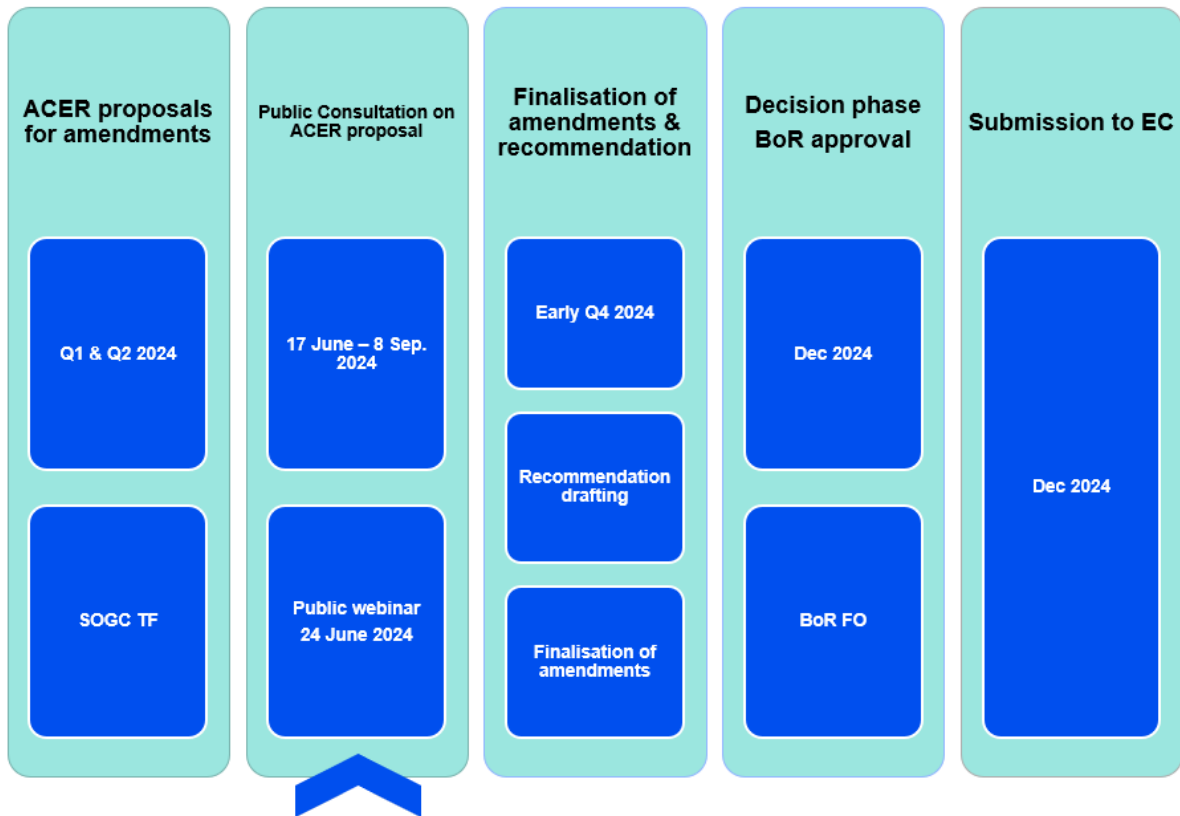
This consultation aims at presenting ACER's draft amendments to the **Commission Regulation (EU) 2016 /1447 of 26 August 2016 establishing a network code on requirements for grid connection of high voltage direct current systems and direct current-connected power park modules ('NC HVDC')**.

Responses to this consultation should be submitted by 8 September 2024.

Background

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 to the NC HVDC, as presented to the GC ESC is outlined in the Figure below:



In the context of [the ongoing revisions of the European grid connection network codes](#), ACER will consult with stakeholders to collect views on ACER's concrete amendment proposals to the network code on grid connection requirements for high voltage direct current systems and related power park modules ([NC HVDC](#)).

The revisions to the NC HVDC aim to:

- Enhance the existing grid connection regulatory framework.
- Align the code with the [ACER Recommendation](#) on reasoned proposals for amendments to the network codes on requirements for grid connection of generators and on demand connection.
- Ensure the interconnected system is adapted to emerging trends, such as the increasing generation capacity of offshore networks (AC hubs) and the connection of new system users (storage, demand facilities, including power-to-gas demand units).

Stakeholder's details

ACER is highly committed in processing personal data in a lawful way.

Find out more how we process your data: <https://www.acer.europa.eu/the-agency/about-acer/data-protection>

* Name of the stakeholder:

Siemens Energy Global GmbH & Co. KG

* Contact person:

* Contact person's email address:

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

* 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)

Instructions

Stakeholders are invited to submit their comments to the **NC HVDC articles** amended by ACER in three mandatory steps:

1. download the ACER draft amendments in the Word file provided below. The file could also be accessed on the right panel of the consultation form under the Background Documents;
2. comment on the ACER's draft amendments through this online consultation form and adding your alternative text proposals to the table, if any; and
3. uploading the alternative amendment proposals to the **entire NC HVDC** document using the Track Changes mode in the ACER draft amendments file downloaded from Step 1.

Where the stakeholder does not have any comments regarding the amendments, the relevant cells in the consultation form can be left blank.

The mandatory steps for submitting the comments are listed below.

Step 1

Please see ACER's draft amendments in the Word file provided below. The file could also be accessed on the right panel of the consultation form under the Background Documents.


[Download ACER draft amendments to the NC HVDC here](#)

Step 2

Kindly note that this consultation form follows the structure of the NC HVDC amended legal text provided by ACER in Step 1.

The paragraph numbering in the form reflects paragraph numbers in the amended legal text. Nevertheless, stakeholders can comment on the deleted paragraphs/articles/titles, which are marked as [deleted]. New articles and titles are marked as [new].

Please use this form to comment on ACER draft amendments and/or to provide an alternative text proposal. The instructions are the following:


Please write your comments on the ACER draft amendments and your alternative text proposals, if any, in the table below 

Includes new articles

	Comment on the ACER draft amendments	Alternative text amendment proposal (if applicable)
Article 1	1	2
Article 3		
Article 4		
Article 5		
Article 6		
Article 7		
Article 8		
Article 9		
Article 10		

Please write your amendment proposals, if any, in the table below

	Text amendment proposal (if applicable)	3
New article		

Please upload figures or tables if necessary 

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Select file(s) to upload

4

1. Leave comments on the ACER draft amendment proposals.
2. Propose (if any) alternative wording of the relevant provision, as you provided in the Word file.
3. Provide (if any) your proposals for adding new provisions to the relevant section of the NC HVDC, as you provided in the Word file.
4. Upload figures or tables if necessary; text inputs should be provided directly in the consultation form.

Step 3

Where the stakeholder would like to propose an alternative amendment to the entire **NC HVDC**, please upload the Word file (**downloaded from Step 1**) containing all your alternative amendment proposals in the Track Changes mode to the next **FILE UPLOAD** section and rename it with your stakeholder's name ("ACER_draft_HVDC_stakeholder_name"). You can also upload your justification documents, where applicable.

In case the file size exceeds the 1MB limit, which is a consultation tool limit, kindly send the document to the functional mailbox shown on the right panel of the consultation form. Please rename the file with your stakeholder's name as indicated above and send it with the subject "ACER draft HVDC legal text [stakeholder name]". Note that only submissions sent within the consultation deadline will be considered.

To facilitate the process, please, make sure that the **alternative text proposals provided in this consultation form are consistent**, to the extent possible, **with those in the Word file** you are uploading, taking into account the character limitations of each cell (max 5000 characters).

File upload

Please upload your file here

The maximum file size is 1 MB

Only files of the type pdf,doc,docx,odt,txt,rtf are allowed

0adf96a1-2704-4618-9e1b-ae530874393c/ACER_draft_HVDC_SiemensEnergy.docx

Kindly note that in case the file size exceeds 1MB, the file can be sent to the functional mailbox shown on the right panel of the consultation form under Contact. Please ensure that the file name and email subject are consistent with the instructions in Step 3.

Please also upload any other document (i.e. **justifications**) below, if relevant.

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Due to the significant length of this survey:

- you have the possibility to edit your answer after submission. When clicking on "Submit" button, you will be given a Contribution ID which you can then use to access your answers and edit them, if necessary.
- 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 comments on the ACER draft amendments and your alternative text proposals, if any, in the table below

Numbers in the first column correspond to the recitals of the amended version of NC HVDC Whereas section, including new recitals

	Comment on the ACER draft amendments	Alternative text amendment proposal (if applicable)
(1)		
(2)		
(3)		
(4)		
(5)		
(6)		
(7)		
(8)		
(9)		
(10)		
(11)		
(12)		
(13)		
(14)		
(15)		
(16)		
(17)		
(18)		
(19)		

Please write your amendment proposals, if any, in the table below

	Text amendment proposal (if applicable)
New recital	

Definitions (Article 2)

Please write your comments on the ACER draft amendments and your alternative text proposals, if any, in the table below

Includes new definitions

	Comment on the ACER draft amendments	Alternative text amendment proposal (if applicable)
Article 2(1)		
Article 2(2)[deleted]		
Article 2(2)		
Article 2(3)		
Article 2(5)[deleted]		
Article 2(6)[deleted]		
Article 2(4)		
Article 2(5)		
Article 2(6)		
Article 2(7)		
Article 2(8)[NEW]		
Article 2(9)[NEW]		
Article 2(10)[NEW]		
Article 2(11)[NEW]		
Article 2(12)[NEW]		
Article 2(13)[NEW]		
Article 2(14)[NEW]		
Article 2(15)[NEW]		
Article 2(16)[NEW]		
Article 2(17)[NEW]		
Article 2(18)[NEW]		

Please write your amendment proposals, if any, in the table below

	Text amendment proposal (if applicable)
New definition	<p>'relevant isolated AC network operator' means the isolated AC network operator to whose system a HVDC system, asynchronously connected power park modules, asynchronously connected demand facilities, asynchronously connected power-to-gas demand units or asynchronously connected electricity storage modules are or will be connected;</p> <p>Comment/Explanation for the new definition: The NC HVDC is based on the terms Relevant System Operators and Relevant Transmission System Operations defined in NC RfG. It is not clear, whether these entities also cover the coordination/operation/ownership of islanded AC networks (requirements, etc.). It is proposed to introduce the neutral term "Relevant Isolated AC Network Operator" for this field of responsibility. Similar approach was already taken for HVDC Systems and the HVDC System Owner.</p>

Please upload figures or tables if necessary

The maximum file size is 1 MB

TITLE I - GENERAL PROVISIONS

Please write your comments on the ACER draft amendments and your alternative text proposals, if any, in the table below

Includes new articles

	Comment on the ACER draft amendments	Alternative text amendment proposal (if applicable)
Article 1		
Article 3		
Article 4		
Article 5		
Article 6		
Article 7		
Article 8		
Article 9		
Article 10		

Please write your amendment proposals, if any, in the table below

	Text amendment proposal (if applicable)
New article	

Please upload figures or tables if necessary

The maximum file size is 1 MB

TITLE II - GENERAL REQUIREMENTS FOR HVDC CONNECTIONS

Please write your comments on the ACER draft amendments and your alternative text proposals, if any, in the table below

	Comment on the ACER draft amendments	Alternative text amendment proposal (if applicable)
Article 11		
Article 12		
Article 13		
	<p>Comment 1:</p> <p>1. a) The term adjustable, could lead to misunderstanding or it could be understood as an adjustment by the operator. E.g. the internal impedance cannot be adjusted during operation, due to its impact on current limiting and stability.</p> <p>Changing voltage amplitude, voltage phase angle, frequency, and internal impedance are subject to the design of the converter and its controls as well as protection. A vendor will design its system according to the functional requirements specified.</p> <p>Comment 2:</p> <p>1(b) i.</p> <p>With focus on a designated/prioritized contribution to amplitude and phase of the voltage regarding the</p>	

<p>Article 14</p>	<p>internal virtual impedance of the GFM-control the reaction happens "inherently".</p> <p>Comment 3: 1 (b), iv: The provision of grid forming functionalities depends on capabilities of the converter and the primary energy source behind the converter, if any. E.g., The maximum amount of inertia depends on the system design (converter and energy source) and the value selected would have an impact on the controller stability. Therefore, the value of synthetic inertia should be selectable by the system operator in a defined range only. Such range needs to be agreed between HVDC system owner and relevant system operator.</p> <p>Comment 5: 5. Requirements for cases where grid forming behaviour is not required should be stated in Article 15. Move Article 14, 5. to Article 15.</p>	<p>To Comment 1: 1, a) Within the HVDC system voltage, current and energy limits, the HVDC converter station shall be capable of behaving as a controllable voltage source behind an internal impedance (i.e. a Thevenin source) during both the normal operation and immediately after a grid disturbance. The Thevenin source is characterized by its voltage amplitude, voltage phase angle, frequency, and internal impedance. All of these characteristics are a result of a control and/or protection response which shall ensure stability in the connected electrical power networks;</p> <p>To Comment 2: ...The positive and the negative sequence current exchanged between the HVDC converter station (converter unit side), and AC grid shall flow inherently according to grid and converter impedances;</p> <p>To Comment 3: 1 (b) (iv) the relevant TSOs, in agreement with the HVDC system owner where so relevant, shall specify the relevant dynamic performance of the HVDC system and its associated performance parameters, including the change of control parameters via remote signals according to Article 51 (3);</p> <p>To Comment 5: 5. deleted</p>
		<p>Requirements relating to frequency sensitive mode,</p>

Article 15

Requirements for cases where grid forming behaviour is not required should be stated in Article 15, Please refer to comment Article 14. 5

limited frequency sensitive mode overfrequency, limited frequency sensitive mode underfrequency and rate-of-change-of-frequency

1. Requirements applying to frequency sensitive mode, limited frequency sensitive mode overfrequency and limited frequency sensitive mode underfrequency shall be as set out in Annex II.

2. If grid forming capability as prescribed in paragraphs 1-4 of Article 14 is not requested, an HVDC system shall be capable of contributing to limiting the transient frequency deviation by adjusting its active power as a function of the measured rate of change of frequency both in low and/or high frequency regimes, if specified by the relevant system operator, in coordination with the relevant TSOs. The following shall apply:

(a) the HVDC system shall be capable without intentional delay of adjusting the active power injected to or withdrawn from AC grid within its rated power;

(b) this active power adjustment shall be performed based on the measured rate of change of frequency. The measurement method shall be agreed between the relevant TSOs and the HVDC system owner;

(c) when the frequency has recovered, the operating point of the HVDC system shall return to its pre-disturbance active power value or an operating point according to the power available for transmission through the HVDC system;

(d) the requirements regarding rate-of-change-of-

		frequency measurement as well as the dynamic performance parameters of rapidly adjusted active power injected to or withdrawn from AC grid shall be agreed between the relevant TSOs and the HVDC system owner.
Article 16		
Article 17		
	<p>Comment 1</p> <p>If the HVDC system is requested to operate at maximum current within the ranges of the network voltage, this would mean that the HVDC system power exchange would vary accordingly, resulting in overload operation at increased AC voltages. Thus the operational definition based on power is preferred.</p> <p>Replace actual wording based on currents by power.</p> <p>Comment 2:</p> <p>Establish compatibility of Annex III, Table 4 and Table 5 with insulation levels and U_m as defined IEC 60071-1.</p> <p>The AC system voltage at the HVDC connection point is controlled by the HVDC system which allows limiting steady state and temporary voltage excursions (transient voltage excursions are not addressed here).</p>	

Article 18	<p>Overdimensioning by choosing equipment from the next higher set of standard insulation levels as defined in IEC 60071-1 shall be avoided by following approach:</p> <p>i) Considering the inherent HVDC system voltage control capability, the TSO or relevant system operator is asked to define at the HVDC connection point a voltage in terms of voltage amplitude and duration which is compatible with IEC 60071-1 insulation levels.</p> <p>ii) Furthermore, it is considered that AC substation equipment is selected according to the closest IEC 60071-1 insulation levels and it is fit for purpose. This accordingly shall apply for HVDC AC feeder equipment. The remaining HVDC equipment will comply with the specified voltage band under i).</p> <p>iii) Furthermore, Article 18(2) foresees the possibility to agree on wider voltage ranges anyway, if economically and technically feasible.</p> <p>The phrase "established technical standards" is proposed to comply with typical wording for network code regulations.</p>	<p>To Comment 1:</p> <p>1. Without prejudice to Article 25, an HVDC converter station shall be capable of staying connected to the network and capable of operating at HVDC system maximum power, within the ranges of the network voltage at the connection point, expressed by the voltage at the connection point related to reference 1 pu voltage, and the time periods specified in Tables 4 and 5, Annex III.</p> <p>To Comment 2:</p> <p>1. Without prejudice to Article 25, an HVDC converter station shall be capable of staying connected to the network and capable of operating at HVDC system maximum power, within the ranges of the network voltage at the connection point, expressed by the voltage at the connection point related to reference 1 pu voltage, and the time periods specified in Tables 4 and 5, Annex III. The establishment of the reference 1 pu voltage and the resulting ranges of the network voltage shall comply with the highest voltage values for equipment as defined in established technical standards, unless the standardized voltages prove to be not technically or economically feasible for the specific HVDC connection point.</p>
Article 19		
Article 20		
Article 21		

Article 22	<p>Comment 1: 2. This function requires coordination with the HVDC system owner as well, since additional control modes can have significant impact on the HVDC system design.</p> <p>Comment 2: The selected reactive power control mode needs to be coordinated with the grid forming mode, as specified in Article 14, in a way that the initial system response is not inhibited.</p>	<p>2. An HVDC converter station shall be capable of operating in additional control modes specified by the relevant system operator in coordination with the relevant TSO and the HVDC system owner.</p> <p>To Comment 2: [New] 7. The selected reactive power control mode shall not interfere with the initial grid forming response when grid forming capability according to Article 14 is required</p>
Article 23	<p>Prioritization of active or reactive power contradicts the initial behaviour of grid forming mode (as long as current, voltage or energy limits are not reached).</p>	<p>Taking into account the capabilities of the HVDC system specified in accordance with this Regulation, the relevant TSO shall determine whether active power contribution or reactive power contribution shall have priority during low or high voltage operation and during faults for which fault-ride-through capability is required. If priority is given to active power contribution, its provision shall be established within a time from the fault inception as specified by relevant TSO.</p> <p>In case of grid forming capability according to Article 14 is required, prioritization of active or reactive power contribution shall only be applied if voltage, current or energy limit controls are active.</p>
Article 24		
Article 25	<p>6. The specification of fault-ride-through capabilities in case of asymmetrical faults by individual TSOs could potentially lead to customized solutions. The details should be agreed between TSO and HVDC owner.</p>	<p>6. The relevant TSO shall specify fault-ride-through capabilities in case of asymmetrical faults in coordination with the. HVDC system owner.</p>

Article 26		
Article 27		
Article 28		
Article 29	<p>Comment 1: 5. It is uncertain, whether a HVDC system owner is allowed to distribute models from external sources. In such case, the system owner shall inform details about the external models being used during the interaction study and about the setup of such models in the full AC system representation. "all relevant" is a duplication of the requirement, "relevant" suffice.</p> <p>Comment 2: 6. In case of detrimental interactions, it is possible, that a single plant cannot mitigate the resulting interaction alone. For the enhancement of system stability similar mitigating actions shall be taken by the other plants.</p>	<p>To Comment 1: 5. The relevant TSO may review or replicate some or all of the studies. The HVDC system owner, the owners of the A-PPM, A-PtG-DU, A-ESM and/or A-DF, and the isolated-AC-network operators, if any, shall provide the relevant TSO relevant data and models that are adequate to perform the studies.</p> <p>To Comment 2: 6. Any necessary mitigating actions attributed to the new HVDC system owner as identified by the studies carried out in accordance with paragraphs 2 to 5 and reviewed by the relevant TSO shall be undertaken by the HVDC system owner as part of the connection of the new HVDC converter station. If mitigation measures cannot be realized within the new HVDC system, the new HVDC system owner shall propose potential mitigating actions.</p>
Article 30		
Article 31		
Article 32		
Article 33		
Article 34		
Article 35		
Article 36		
Article 37		

Please write your amendment proposals, if any, in the table below

	Text amendment proposal (if applicable)
New article	

Please upload figures or tables if necessary

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TITLE III - REQUIREMENTS FOR ASYNCHRONOUSLY CONNECTED
POWER PARK MODULES, ASYNCHRONOUSLY CONNECTED
DEMAND FACILITIES, ASYNCHRONOUSLY CONNECTED POWER-TO-
GAS DEMAND UNITS, ASYNCHRONOUSLY CONNECTED
ELECTRICITY STORAGE MODULES AND REMOTE-END HVDC
CONVERTER STATIONS

Please write your comments on the ACER draft amendments and your alternative text proposals, if any, in the table below

	Comment on the ACER draft amendments	Alternative text amendment proposal (if applicable)
Article 38		

<p>Article 39</p>	<p>Comment 1:</p> <p>1. The specified time of 0,1 second can be interpreted to include the processing time at the A-PPM, A-PTG-U, A-ESM and remote-end HVDC converter stations as well as the singal transmission from the sending point. The Text allows different interpretations, whether or not the signal transmission time is part of the 0,1 seconds. The transmission time should not be part of the 0,1 seconds, because it is not under control of the asynchronously connected system.</p> <p>Requirements for remote end converter stations are addressed in Article 47.2. Please refer to comment to Article 47.2.</p> <p>Comment 2:</p> <p>3 The wording "at any point in time as an average of the rate of change of frequency for the previous 1 second" is not in line with the requirements as described in Article 12. The requirements should be phrased identically. Use "measured over a period of 1 second" instead.</p>	<p>To Comment 1:</p> <p>1. (a) an asynchronously connected power park module, asynchronously connected power-to-gas demand unit, and asynchronously connected electricity storage module shall be capable of receiving at its interface point a fast signal of the frequency in the synchronous area to which frequency response is being provided An asynchronously connected power park module, asynchronously connected power-to-gas demand unit, asynchronously connected electricity storage module shall be able to process this signal within 0,1 second from receiving to completion of processing the signal for activation of the response. Frequency shall be measured at the connection point of the HVDC system or a predefined connection point in a synchronous area to which frequency response is being provided;</p> <p>To Comment 2:</p> <p>3. With regards to rate-of-change-of-frequency withstand capability, an asynchronously connected power park module, an asynchronously connected demand facility, an asynchronously connected power-to-gas demand unit and an asynchronously connected electricity storage module shall be capable of staying connected to the remote-end HVDC converter station isolated AC network and operable if the system frequency changes at a rate up to ± 2 Hz/s (measured over a period of 1 second) at the HVDC interface point of the asynchronously connected power park module, the asynchronously connected demand facility, the asynchronously connected power-to-gas demand unit and the asynchronously connected electricity storage module for the 50 Hz nominal system.</p>
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Comment 1:
Establish compatibility of Annex VII, Table 9 and Table 10 with insulation levels and U_m as defined IEC 60071-1.

The AC system voltage at the HVDC interface point is controlled by the HVDC system which allows limiting steady state and temporary voltage excursions. This applies to an asynchronously connected power park module, an asynchronously connected power-to-gas demand unit, an asynchronously connected demand facility and an asynchronously connected electricity storage module DC-connected power park module as well.

Overdimensioning by choosing equipment from the next higher set of standard insulation levels as defined in IEC 60071-1 shall be avoided by following approach:

- i) Considering the inherent HVDC system voltage control capability, the TSO or relevant system operator is asked to define at the HVDC interface point a voltage in terms of voltage amplitude and duration which is compatible with IEC 60071-1 insulation levels.
- ii) Furthermore, it is considered that AC substation equipment is selected according to the closest IEC 60071-1 insulation levels and it is fit for purpose. This accordingly shall apply for HVDC AC feeder equipment.

To Comment 1:

1. (a) an asynchronously connected power park module, an asynchronously connected power-to-gas demand unit, an asynchronously connected demand facility and an asynchronously connected electricity storage module DC-connected power park module shall be capable of staying connected to the remote-end HVDC converter station isolated AC network and operating within the voltage ranges (per unit), for the time periods specified in Tables 9 and 10, Annex VII. The applicable voltage range and time periods specified are selected based on the reference 1 pu voltage. The establishment of the reference 1 pu voltage and the resulting ranges of the network voltage shall comply with the highest voltage values for equipment as defined in established technical standards, unless the standardized voltages prove to be not technically or economically feasible for the connection point of the asynchronously connected power park module, an asynchronously connected power-to-gas demand unit, an asynchronously connected demand facility and an asynchronously connected electricity storage module DC-connected power park module;

To Comment 2:

2.b.i. ... If the Ten-Year Network Development Plan developed in accordance with Article 308 of Regulation (EUC) 2019No 714/9432009 or a national plan developed and approved in accordance with Article 5122 of Directive (EU) 20109/94472/EC specifies that an asynchronously connected power park module and an asynchronously connected electricity storage module DC-connected power park module will become AC-connected to the synchronous area, the requirements of Article 39 apply without transmission of a frequency

	<p>The remaining HVDC equipment will comply with the specified voltage band under i).</p> <p>iii) Furthermore, Article 40, 1. (b) foresees the possibility to agree on wider voltage ranges or longer times anyway, if economically and technically feasible. The phrase "The establishment of the reference 1 pu voltage" was added in consistency with Article 18(1).</p> <p>Comment 2:</p> <p>2.b) If an asynchronous area gets connected to a synchronous zone via AC, the requirements of Article 39 apply without transmission of a frequency signal. The frequency will automatically be coupled with the frequency of the synchronous area.</p>	<p>signal and the relevant TSO may specify that either:</p> <ul style="list-style-type: none"> — the asynchronously connected power park module and the asynchronously connected electricity storage moduleDC-connected power park module shall have the capabilities prescribed in Article 25(4) of RfG 2.0 Regulation (EU) 2016/631 for that synchronous area installed at the time of initial connection and commissioning of the asynchronously connected power park module and the asynchronously connected electricity storage module DC-connected power park module to the AC-network; or — the asynchronously connected power park module owner and the asynchronously connected electricity storage moduleDC-connected power park module owner shall demonstrate to, and then reach agreement with, the relevant system operator and the relevant TSO on how the reactive power capability prescribed in Article 25(4) of RfG 2.0 Regulation (EU) 2016/631 for that synchronous area will be provided in the event that the asynchronously connected power park module and the asynchronously connected electricity storage moduleDC-connected power park module becomes AC-connected to the synchronous area.
Article 40a[NEW]		
Article 40b[NEW]		
Article 41		
Article 42		
Article 43		
Article 44		
Article 45		
Article 46		
	Comment 1:	

Article 47

2. The present draft regulation should be clear as to how the frequency signal is provided to the A-PPMs, A-DF-Us, A-PtG-Us, A-ESMs. This signal could be provided in a cost-effective manner via the HVDC system with the frequency measured at the HVDC system's connection point.

The signal transmission from the interface point to the A-PPMs, A-DF-Us, A-PtG-Us, A-ESMs should be in the responsibility of the relevant isolated AC network operator.

There can be more than one remote-end HVDC converter stations, A-PPMs, A-DF-Us, A-PtG-Us, A-ESMs. Thus, the text should use the word owners instead of owner.

The following sentence does not seem to be clear. It does not appear to be related to the technical modalities of the fast signal communication. The sentence should be deleted:

"For an HVDC system connecting an asynchronously connected power park module, an asynchronously connected demand facility, an asynchronously connected power-to-gas demand unit and an asynchronously connected electricity storage module the adjustment of active power frequency response shall be limited by the capability of the DC-asynchronously connected power park modules. "

Comment 2:

5. Grid forming capability in this context is still under development.

The modality of the coordination between the HVDC system and the asynchronously connected PPM should be coordinated by the relevant TSO with the HVDC system owner and the owner of the asynchronously

To Comment 1:

2. With regards to frequency response, the relevant isolated AC network operator, the remote-end HVDC converter station owners, the asynchronously connected power park module owners, the asynchronously connected demand facility owners, the asynchronously connected power-to-gas demand unit owners and the asynchronously connected electricity storage module owners connecting with their assets to the relevant isolated AC network operator's isolated AC network shall agree on the technical modalities of the fast signal communication in accordance with Article 39(1). The HVDC system shall be capable of providing the network frequency from its connection points as a signal to the remote-end HVDC converter station's interface point. The relevant isolated AC network operator shall further relay this fast signal to the interface points of asynchronously connected power park module, asynchronously connected power-to-gas demand unit and asynchronously connected electricity storage modules.

To comment 2:

5. Grid forming capability in this context is still under development.

The modality of the coordination between the HVDC system and the asynchronously connected PPM should be coordinated by the relevant TSO with the HVDC system owner and the owner of the asynchronously connected PPM.

	connected PPM.	
Article 48	<p>Establish compatibility of Annex VIII, Table 12 and Table 13 with insulation levels and U_m as defined IEC 60071-1.</p> <p>The AC system voltage at the HVDC interface point is controlled by the HVDC system which allows limiting steady state and temporary voltage excursions (transient voltage excursions are not addressed here).</p> <p>Overdimensioning by choosing equipment from the next higher set of standard insulation levels as defined in IEC 60071-1 shall be avoided by following approach:</p> <p>i) Considering the inherent HVDC system voltage control capability, the isolated AC network operator is asked to define at the HVDC interface point a voltage in terms of voltage amplitude and duration which is compatible with IEC 60071-1 insulation levels.</p> <p>ii) Furthermore, it is considered that AC substation equipment is selected according to the closest IEC 60071-1 insulation levels and it is fit for purpose. This accordingly shall apply for HVDC AC feeder equipment. The remaining HVDC equipment will comply with the specified voltage band under i).</p> <p>iii) Furthermore, Article 48(1)(b) foresees the possibility to agree on wider voltage ranges anyway, if economically and technically feasible.</p> <p>The phrase "established technical standards" is proposed to comply with typical wording for network code regulations.</p>	<p>1. With respect to voltage ranges:</p> <p>(a) a remote-end HVDC converter station shall be capable of staying connected to the remote-end HVDC converter station isolated AC network and operating within the voltage ranges (per unit) and time periods specified in Tables 12 and 13, Annex VIII, or for voltage level below 110kV as specified by the relevant system operator. The applicable voltage range and time periods specified are selected based on the reference 1 pu voltage and the resulting ranges of the network voltage shall comply with the highest voltage values for equipment as defined in established technical standards, unless the standardized voltages prove to be not technically or economically feasible for the specific HVDC interface point;</p>
Article 49		
Article 50		

Please write your amendment proposals, if any, in the table below

	Text amendment proposal (if applicable)
New article	

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TITLE IV - INFORMATION EXCHANGE AND COORDINATION

Please write your comments on the ACER draft amendments and your alternative text proposals, if any, in the table below

	Comment on the ACER draft amendments	Alternative text amendment proposal (if applicable)
Article 51		
Article 52	<p>Grid forming capability is an internal control function and its modification shall only be done in coordination with the HVDC system owner.</p> <p>All the defined functions require a suitable coordination and therefore modifications in the settings and the hierarchy can jeopardize the system stability and should be agreed between HVDC system owner and relevant TSO.</p>	<p>The hierarchy, parameters and settings of the main control functions of an HVDC system and the possible modifications of the parameters determining the grid forming capability shall be agreed between the HVDC system owner and the relevant system operator, in coordination with the relevant TSO. Those main control functions are at least:</p>
Article 53		
	<p>Comment 1: 2. (d) Encrypted models are typically more detailed and representative of a solution than open-source models. For example, generic models for grid forming are not yet fully developed. Therefore, encrypted models should be preferred and only in case that appropriate sharing agreements are not in place, generic models can be used.</p> <p>Comment 2: 3. It seems that the requirements are for HVDC models. Therefore, this should be specified.</p> <p>Comment 3: 3. (d) The word "accurate" is not clear and should be deleted.</p>	<p>To Comment 1: 2. (d) be an open model for RMS simulations delivered for cross-border network stability studies, in case that agreements between the relevant TSO and the system owners do not allow the encrypted model sharing between parties;</p> <p>To Comment 2: 3. Without prejudice to the Member State's rights to introduce additional requirements, the HVDC system models shall:</p> <p>To Comment 3: 3-(d) include a representation of the submodule level, the frequency dependency of the HVDC system lines and sufficient representation of communication systems instruments, where deemed necessary for the respective HVDC system</p>

Article 54

The representation should allow to address module balancing dynamics and related protection. The representation detail and acceptable simplifications should be agreed between HVDC system owner and relevant TSO according to the scope of the studies where the model is used.

Comment 4:

4.a) The upper limit of the frequency range is limited by the classical representation of passive components in EMT-Tools, e.g. transformers and reactors. The character of the model may have to change in the frequency range above 2500 Hz. Therefore, details of the model in this frequency range shall be coordinated.

Comment 5:

7. The model requirements for this purpose are already defined in Article 54, 4.

model and study purpose. The representation and acceptable simplifications shall be agreed between HVDC system owner and relevant TSO according to the scope of the studies where the representation is used;

To Comment 4:

4. (a) the impedance model of the HVDC converter station shall be requested in the frequency range 5 Hz till 2500 Hz. Higher frequency range requirements for this model up to 9000 Hz shall be coordinated between the relevant TSO and the system owners;

To Comment 5:

7. The frequency dependent impedance model as defined in Article 54, 4. can be used when adverse control interactions may result with HVDC converter stations and other connections in close electrical proximity if requested by the relevant system operator or relevant TSO.

Please write your amendment proposals, if any, in the table below

	Text amendment proposal (if applicable)
New article	

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TITLE V - OPERATIONAL NOTIFICATION PROCEDURE FOR
CONNECTION

Please write your comments on the ACER draft amendments and your alternative text proposals, if any, in the table below

	Comment on the ACER draft amendments	Alternative text amendment proposal (if applicable)
Article 55		
Article 56		
Article 57		
Article 58		
Article 59		
Article 60		
Article 61		
Article 62		
Article 63		
Article 64		
Article 65		
Article 66		

Please write your amendment proposals, if any, in the table below

	Text amendment proposal (if applicable)
New article	

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TITLE VI - COMPLIANCE

Please write your comments on the ACER draft amendments and your alternative text proposals, if any, in the table below

	Comment on the ACER draft amendments	Alternative text amendment proposal (if applicable)
Article 67		
Article 68		
Article 69		
Article 70		
Article 71	6. (a) The modalities to modulate active power by the HVDC system should be limited to the capabilities of the surrounding AC systems.	(6)-(a) the HVDC system shall demonstrate its technical capability to continuously modulate active power over the full operating range between maximum HVDC active power transmission capacity and minimum HVDC active power transmission capacity to contribute to frequency control limited up to the active power exchange capability of the AC systems and shall verify the steady-state parameters of regulations, such as droop and deadband and dynamic parameters, including robustness during frequency step change response and large, fast frequency changes;
Article 72		
Article 73		
Article 74		
Article 75		
Article 76		

Please write your amendment proposals, if any, in the table below

	Text amendment proposal (if applicable)
New article	

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TITLE VII - DEROGATIONS

Please write your comments on the ACER draft amendments and your alternative text proposals, if any, in the table below

	Comment on the ACER draft amendments	Alternative text amendment proposal (if applicable)
Article 77		
Article 78		
Article 79		
Article 80		
Article 81		
Article 82		
Article 83		

Please write your amendment proposals, if any, in the table below

	Text amendment proposal (if applicable)
New article	

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TITLE VIII - FINAL PROVISIONS

Please write your comments on the ACER draft amendments and your alternative text proposals, if any, in the table below

	Comment on the ACER draft amendments	Alternative text amendment proposal (if applicable)
Article 84		
Article 85		
Article 85a[NEW]		
Article 86		

Please write your amendment proposals, if any, in the table below

	Text amendment proposal (if applicable)
New article	

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Annex I - Frequency ranges referred to in Article 11

Please write your comments on the ACER draft amendments and your alternative text proposals, if any, in the table below

	Comment on the ACER draft amendments	Alternative text amendment proposal (if applicable)
Annex I		

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Annex II - Requirements applying to frequency sensitive mode, limited frequency sensitive mode overfrequency and limited frequency sensitive mode underfrequency

Please write your comments on the ACER draft amendments and your alternative text proposals, if any, in the table below

	Comment on the ACER draft amendments	Alternative text amendment proposal (if applicable)
Annex II		

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Annex III - Voltage ranges referred to in Article 18

Please write your comments on the ACER draft amendments and your alternative text proposals, if any, in the table below

	Comment on the ACER draft amendments	Alternative text amendment proposal (if applicable)
Annex III	<p>Comment 1: Tables 4 and 5: In IEC standards, the term "rated voltage" is used for voltages that are assigned by a manufacturer or other entity to a component, device, equipment, or system to state the maximum value for defined operating conditions. The meaning of the term in tables 4 and 5 appears to be different. The term "nominal voltage" should be used instead. In IEC 601-01-21 "nominal voltage of a system" is defined as "a suitable approximate value of voltage used to designate or identify a system"</p> <p>Comment 2: Table 4: Without definition of the reference voltage value in kV, the table can be interpreted in different ways leading to different voltage ranges. Deviations from established standards should be justified in the cost benefit analysis as proposed in the comment to Article 18(1).</p> <p>Comment 3: Table 5: Without definition of the reference voltage value in kV, the table can be interpreted in different ways leading to different voltage ranges. Deviations from established standards should be justified in the cost benefit analysis as proposed in the comment to Article 18(1).</p>	<p>To Comment 1: change "rated voltage" to "nominal voltage" in the table header</p> <p>To Comment 2: Table 4: Minimum time periods an HVDC system shall be capable of operating for voltages deviating from the reference 1 pu value at the connection points without disconnecting from the network. In case of deviation from the corresponding highest voltage values for equipment as defined in established technical standards, this shall be justified as specified in Article 18(1). This table applies in case of pu voltage base values at or above 110 kV and up to (not including) 300 kV.</p> <p>To Comment 3: Table 5: Minimum time periods an HVDC system shall be capable of operating for voltages deviating from the reference 1 pu value at the connection points without disconnecting from the network. In case of deviation from the corresponding highest voltage values for equipment as defined in established technical standards, this shall be justified as specified in Article 18(1). This table applies in case of pu voltage base values from 300 kV to 400 kV (included).</p>

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Annex IV - Requirements for U-Q/Pmax-profile referred to in Article 20

Please write your comments on the ACER draft amendments and your alternative text proposals, if any, in the table below

	Comment on the ACER draft amendments	Alternative text amendment proposal (if applicable)
Annex IV		

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Annex V - Voltage-against-time-profile referred to in Article 25

Please write your comments on the ACER draft amendments and your alternative text proposals, if any, in the table below

	Comment on the ACER draft amendments	Alternative text amendment proposal (if applicable)
Annex V	New text related to Urec2 and Urec3 and the times proposed for having a correct reference to the changes proposed on Annexe III and VII.	Please refer to attachment with revised Annex V Table 7.1 and Table 7.2

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/ACER_draft_HVDC_SiemensEnergy_ANNEX_V_Tables_7_1and7_2.docx

Annex VI - Frequency ranges and time periods referred to in Article 39(2)

(a)

Please write your comments on the ACER draft amendments and your alternative text proposals, if any, in the table below

	Comment on the ACER draft amendments	Alternative text amendment proposal (if applicable)
Annex VI		

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Annex VII - Voltage ranges and time periods referred to in Article 40

Please write your comments on the ACER draft amendments and your alternative text proposals, if any, in the table below

	Comment on the ACER draft amendments	Alternative text amendment proposal (if applicable)
Annex VII	<p>Comment 1: Tables 9 and 10: In IEC standards, the term "rated voltage" is used for voltages that are assigned by a manufacturer or other entity to a component, device, equipment, or system to state the maximum value for defined operating conditions. The meaning of the term in tables 4 and 5 appears to be different. The term "nominal voltage" should be used instead. In IEC 601-01-21 "nominal voltage of a system" is defined as "a suitable approximate value of voltage used to designate or identify a system"</p> <p>Comment 2: Table 9: Without definition of the reference voltage value in kV, the table can be interpreted in different ways leading to different voltage ranges. Deviations from established standards should be justified in the cost benefit analysis as proposed in the comment to Article 40(1). The word "different" appears to be obsolete.</p> <p>Comment 3: Table 10: Without definition of the reference voltage value in kV, the table can be interpreted in different ways leading to different voltage ranges. Deviations from established standards should be justified in the cost benefit analysis as proposed in the comment to Article 40(1). The word "different" appears to be obsolete.</p> <p>Comment 4:</p>	<p>To Comment 1: change "rated voltage" to "nominal voltage" in the table header</p> <p>To Comment 2: Table 9: Minimum time periods for which an asynchronously connected power park module, an asynchronously connected electricity storage module, an asynchronously connected power-to-gas demand unit and an asynchronously connected demand facility shall be capable of operating for voltages deviating from a reference 1 pu value without disconnecting from the network. In case of deviation from the highest voltage values for equipment as defined in established technical standards this shall be justified as specified in Article 40(1).</p> <p>To Comment 3: Table 10: Minimum time periods for which an DC-asynchronously connected power park module, an asynchronously connected electricity storage module, an asynchronously connected power-to-gas demand unit and an asynchronously connected demand facility shall be capable of operating for voltages deviating from a reference 1 pu value without disconnecting from the network. In case of deviation from the highest voltage values for equipment as defined in established technical</p>

	<p>For future cost-effective isolated AC networks, 275 kV equipment / nominal voltage is expected to play an important role (larger power transfer as with 220 kV but less needs for reactive power compensation than for 400 kV). That's why adding this nominal voltage level is proposed here.</p> <p>Comment 5: it should be the isolated AC network owner who shall make the choices for their system design. This could be the relevant TSO, but it is not necessarily the relevant TSO. That's why here again neutral language is proposed.</p>	<p>standards this shall be justified as specified in Article 40(1).</p> <p>To comment 4: Voltage levels and time to operate added to table 9 for 275 kV nominal voltage.</p> <p>To comment 5: Please replace "TSO" by "isolated AC network operator" in tables 9 and 10</p>
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Annex VIII - Reactive power and voltage requirements referred to in Article 48

Please write your comments on the ACER draft amendments and your alternative text proposals, if any, in the table below

	Comment on the ACER draft amendments	Alternative text amendment proposal (if applicable)
	<p>Comment 1:</p> <p>Tables 12 and 13: In IEC standards, the term "rated voltage" is used for voltages that are assigned by a manufacturer or other entity to a component, device, equipment, or system to state the maximum value for defined operating conditions. The meaning of the term in tables 4 and 5 appears to be different. The term "nominal voltage" should be used instead.</p> <p>In IEC 601-01-21 "nominal voltage of a system" is defined as "a suitable approximate value of voltage used to designate or identify a system"</p> <p>Comment 2:</p> <p>Table 12: Without definition of the reference voltage value in kV, the table can be interpreted in different ways leading to different voltage ranges. Deviations from established standards should be justified in the cost benefit analysis as proposed in the comment to Article 48(1)(a).</p> <p>Comment 3:</p>	

Table 13: Without definition of the reference voltage value in kV, the table can be interpreted in different ways leading to different voltage ranges. Deviations from established standards should be justified in the cost benefit analysis as proposed in the comment to Article 48(1)(a).

Comment 4:
For future cost-effective isolated AC networks, 275 kV equipment / nominal voltage is expected to play an important role (larger power transfer as with 220 kV but less needs for reactive power compensation than for 400 kV). That's why adding this nominal voltage level is proposed here.

Comment 5:
it should be the isolated AC network owner how shall make the choices for their system design. This could be the relevant TSO, but it is not necessarily the relevant TSO. That's why here again neutral language is proposed.

To Comment 1:
change "rated voltage" to "nominal voltage" in the table header

To Comment 2:
Table 12: Minimum time periods for which a remote-end HVDC converter station shall be capable of operating for different voltages deviating from a reference 1 pu value without disconnecting from the network. In case of deviation from the corresponding highest voltage values for equipment as defined in established technical standards, this shall be justified as specified in Article 48(1)(a)).

To Comment 3:
Table 13: Minimum time periods for which a remote-end HVDC converter station shall be capable of operating for different voltages deviating from a reference 1 pu value without disconnecting from the network. In case of deviation from the corresponding highest voltage values for equipment as defined in established technical standards, this shall be justified as specified in Article 48(1)(a).

To Comment 4:
Voltage bands and time for operation at 275 kV nominal voltage added to table 12

To Comment 5:
Please replace "TSO" by "isolated AC network operator" in tables 12 and 13

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Other additional provisions

Please write your amendment proposals, if any, in the table below

	Text amendment proposal (if applicable)
Other new provisions	

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Useful links

[more info on ACERs HVDC public consultation \(https://www.acer.europa.eu/documents/public-consultations/pc2024e05-public-consultation-amendments-electricity-grid-connection-network-code\)](https://www.acer.europa.eu/documents/public-consultations/pc2024e05-public-consultation-amendments-electricity-grid-connection-network-code)

Background Documents

[ACER_draft_amendment_proposal_NC_HVDC_for_PC_2024_E_05.docx](#)

Contact

ACER-ELE-2022-015@acer.europa.eu

