Justification and Implementation of Increased Voltage Ranges as per EU Regulation 2016/631 and 2016/1447

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Voltage range requirements in Grid Codes

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EU Regulation 2016/631 / 2016/1447

- With regards to voltage range (Article 16, 2(a), Article 25) – clearly defined for type D PPM's and AC connected PPM's
- Relevant voltage range from 110kV to 300 kV for type D and below 300 kV for AC connected PPM's
- No further details for type B and C PPM's
- Requirements for DC connected PPM's specified in Annex VII, Table 9, 10 (reference to Article 40)

Table 6.1

Synchronous area	Voltage range	Time period for operation
Continental Europe	0,85 pu-0,90 pu	60 minutes
	0,90 pu-1,118 pu	Unlimited
	1,118 pu-1,15 pu	To be specified by each TSO, but not less than 20 minutes and not more than 60 minutes
Nordic	0,90 pu-1,05 pu	Unlimited
	1,05 pu-1,10 pu	60 minutes
Great Britain	0,90 pu-1,10 pu	Unlimited
Ireland and Northern Ireland	0,90 pu-1,118 pu	Unlimited
Baltic	0,85 pu-0,90 pu	30 minutes
	0,90 pu-1,118 pu	Unlimited
	1,118 pu-1,15 pu	20 minutes

The table shows the minimum time periods during which a power-generating module must be capable of operating for voltages deviating from the reference 1 pu value at the connection point without disconnecting from the network, where the voltage base for pu values is from 110 kV to 300 kV.

National requirements

- Example 1: German TenneT's Offshore Netzanschlussregeln (O-NAR) – Chapter 4.1.1 for PPM's connected to 66 kV

Tabelle 1 Mindestzeiträume für den Betrieb von EZA bei 66 kV Netznennspannung

Netznennspannung U_n in kV	Spannungsbereich in kV	Mindestzeitraum für den Betrieb
66	56,1 bis 59,4	60 min
	59,4 bis 72,5	Unbegrenzt
	72,5 bis 75,9	30 min

- Example 2: Netherland's Netcode electriciteit – Article 3.33 for AC connected offshore PPM's

Artikel 3.33 NLE RfG 25.1

1. De offshore-power park module, aangesloten op een spanningsniveau lager dan 300 kV is in staat aan het net gekoppeld en in bedrijf te blijven gedurende de volgende tijdsperioden, als bedoeld in artikel 25, eerste lid, van de Verordening (EU) 2016/631 (NC RfG):
   a. onbeperkt bij een netspanning kleiner 1,118 pu en groter dan of gelijk aan 0,9 pu;
   b. 60 minuten bij een netspanning kleiner dan 0,9 pu en groter dan of gelijk aan 0,85 pu;
   c. 60 minuten bij een netspanning kleiner dan 1,15 pu en groter dan of gelijk aan 1,118 pu.

Challenges with extended voltage range requirements

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Challenges and consequences with extended voltage ranges

Challenges:

- EC Regulation 2016/631 as well as 2016/1447 and respectively national grid codes are requiring continuous- and long-term operation at voltages which are higher than the standard of +10% for HV systems.
- Present HV equipment standards such as the EN 60076-3 (insulation coordination for power transformers), EN 62271-1, 62271-205 (high voltage switchgear and controlgear) are only covering design and testing of equipment up to +10%.
- This is seen as a power system industry challenge and not a “Wind” specific challenge as HV equipment is highly used in all power system applications.

Consequences:

- Present HV equipment is tested and verified to work according to the prevailing standard voltage ranges (up to +10%) and would therefore not comply to the extended voltage range requirements outlined above.
- Uncertainty of cost impact on HV equipment (it is not known whether actual products, such as switchgear, transformer, connectors and cables will have to be upgraded (completely new technologies) or if it is just a matter of updating the test specification.

Note:

- Similar issues have already been raised during the public consultation of ENTSO-E NC RfG several years ago (see old consultation material) as well as during some national implementation activities (e.g. German VDE FNN work).

Questions and way forward

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Questions and way forward

Questions:

- Currently, no standardization activities to align relevant HV equipment standards are ongoing? Are there any plans to initiate this and is there a time plan for such updates?
- Has an alignment with standardization activities been considered and coordinated with the roll-out of the requirements?
- How can it be guaranteed that requirements (extended voltage range) will only apply to newly installed HV equipment?
- How are the DSO's / TSO's handling the updated requirements with regards to onshore and offshore substations? How are system operators specifying HV equipment which complies with the present requirements?
- Has there been an assessment of the cost impact (CBA), associated with potential needs to update products and test facilities to cover the extended voltage range? Has this been assessed against the potential benefits of the extended voltage range?
- Have HV equipment manufacturers been consulted regarding product impact of increased voltage ranges?

What next?

- How to address the challenges? Should an expert group be initiated and work on the problem? Potential impact to developments for RfG 2.0?

Questions?

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