

Voltage and Frequency requirements

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Reliable Sustainable Connected

Voltage Withstand Capabilities – Introduction



Fundamental

- Voltage stability is a **key issue** for system performance and **security**.
- Most of the **large-scale disturbances** in recent years caused by **voltage instability (low voltage)**
- **High voltage** situations increasing due to underground cables and lack of generation support in specific areas.
- Any additional losses of demand due to narrow voltage withstand capabilities makes the situation worse.

Today

- Generator units used to contribute most to voltage stability.

Future

- In future all kinds of network users need to contribute to support voltage stability (accounting for their technical capabilities and connection voltage)
- Distribution Networks provide a pathway for embedded generation and DSR to contribute to voltage stability

Voltage Withstand Capabilities – Introduction



Future

- Intermittency of RES, and a less controllable, wider and more dispersed generation portfolio increases the needs for stability and certainty in response from other elements in the network.
- Withstand capabilities in case of high voltage situations would be particularly valuable support for all demand users.
- NC DCC relates to **cross border issues** and therefore the NC only looks to place requirements on **transmission connected demand users**.
- ENTSO-E recognises the right of the demand user to alter their demand for their own reasons seeking only to increase the stability of demand by avoiding equipment limitations.

Voltage Withstand Capabilities – Requirements



Ranges for 300kV to 400kV connections

For equipment at the connection point only

Automatic disconnection at specified voltages if RNO required

Synchronous Area		Time period for operation
Continental Europe	0.90 pu – 1.05 pu	Unlimited
	1.05 pu – 1.0875 pu	To be defined by each TSO while respecting the provisions of Article 4 (3) with required co-ordination at interconnection points with adjacent TSOs under the conditions, but not less than 60 minutes
	1.0875 pu – 1.10 pu	60 minutes
Nordic	0.90 pu – 1.05 pu	Unlimited
	1.05 pu – 1.10 pu	60 minutes
	0.90 pu – 1.05 pu	Unlimited
	1.05 pu – 1.10 pu	15 minutes
Ireland	0.90 pu – 1.05 pu	Unlimited
Baltic	0.88 pu – 0.90 pu	20 minutes
	0.90 pu – 1.10 pu	Unlimited
	1.10 pu – 1.15 pu	20 minutes

Voltage Withstand Capabilities – Requirements



Ranges for 110kV at and to 300kV connections

For equipment at the connection point only

Automatic disconnection at specified voltages if RNO required

Synchronous Area		Time period for operation
Continental Europe	0.90 pu – 1.118 pu	Unlimited
	1.118 pu – 1.15 pu	To be defined by each TSO while respecting the provisions of Article 4 (3) with required co-ordination at interconnection points with adjacent TSOs under the conditions, but not less than 20 minutes
Nordic	0.90 pu – 1.05 pu	Unlimited
	1.05 pu – 1.10 pu	60 minutes
Great Britain	0.90pu–1.10pu	Unlimited
Ireland	0.90 pu – 1.118 pu	Unlimited
Baltic	0.80 pu – 0.90 pu	30 minutes
	0.90 pu – 1.12 pu	Unlimited
	1.12 pu – 1.15 pu	20 minutes

Frequency Withstand Capabilities – Introduction

- System frequency is around 50 Hz
- However, an imbalance between generation and demand causes the frequency to deviate from this target value
- Predictable reaction of generation and demand contributes significantly to the level of certainty in responsive actions necessary the return of the system to its frequency target
- In future generation is more likely from volatile energy sources, mainly non-synchronously connected and with reduced inertia. **This will increase the frequency sensitivity of the power system to power imbalance**
- To respond to this increased predictability in the reaction of generation and demand during a frequency deviation is required

As a consequence ENTSO-E considers requirements to withstand frequency deviations should be required in the NC DCC

Frequency Withstand Capabilities – Requirements

- All Demand users and Distribution Networks with expectations of frequency ranges in code (next slide)
- Demand Facilities and Closed Distribution Networks with DSR be designed to stay connected during these frequency ranges
- Wider ranges can be specified and capability not to unreasonably withheld
- RNO can specify automatic frequency disconnection – terms and settings to be agreed

Frequency Withstand Capabilities – Requirements

Synchronous Area	Frequency Range	Time period for operation
Continental Europe	47.5 Hz – 48.5 Hz	To be defined by each TSO, while respecting the provisions of Article 4 (3), but not less than 30 minutes
	48.5 Hz – 49.0 Hz	To be defined by each TSO, while respecting the provisions of Article 4 (3), but not less than the period for 47.5 Hz – 48.5 Hz
	49.0 Hz – 51.0 Hz	Unlimited
	51.0 Hz – 51.5 Hz	30 minutes
Nordic	47.5 Hz – 48.5 Hz	30 minutes
	48.5 Hz – 49.0 Hz	To be defined by each TSO, while respecting the provisions of Article 4 (3), but not less than 30 minutes
	49.0 Hz – 51.0 Hz	Unlimited
	51.0 Hz – 51.5 Hz	30 minutes
Great Britain	47.0 Hz – 47.5 Hz	20 seconds
	47.5 Hz – 48.5 Hz	90 minutes
	48.5 Hz – 49.0 Hz	To be defined by each TSO, while respecting the provisions of Article 4 (3), but not less than 90 minutes
	49.0 Hz – 51.0 Hz	Unlimited
	51.0 Hz – 51.5 Hz	90 minutes
	51.5 Hz – 52.0 Hz	15 minutes
Ireland	47.5 Hz – 48.5 Hz	90 minutes
	48.5 Hz – 49.0 Hz	To be defined by each TSO, while respecting the provisions of Article 4 (3), but not less than 90 minutes
	49.0 Hz – 51.0 Hz	Unlimited
	51.0 Hz – 51.5 Hz	90 minutes
Baltic	47.5 Hz – 48.5 Hz	90 minutes
	48.5 Hz – 49.0 Hz	To be defined by each TSO, while respecting the provisions of Article 4 (3), but not less than 90 minutes
	49.0 Hz – 51.0 Hz	Unlimited
	51.0 Hz – 51.5 Hz	90 minutes



Thanks for your attention

Any questions