

# **European DERlab Workshop on Interconnection Requirements for Distributed Generation**

## **Fault Ride Through (FRT)**

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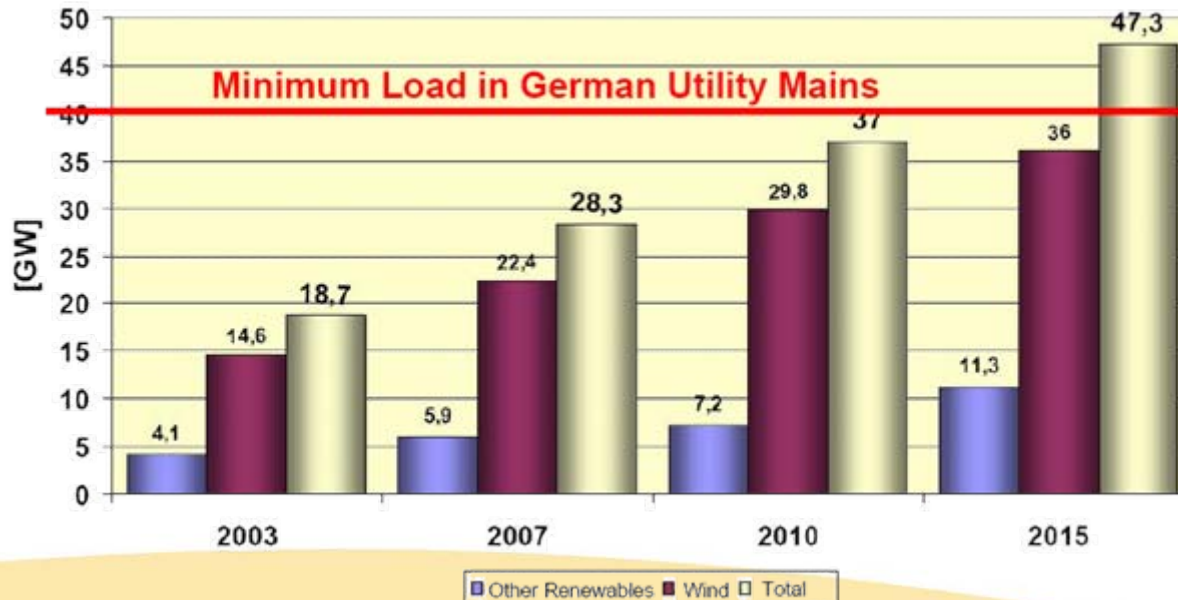
**Salzburg, 13.05.2009**

# Content

- Introduction
- Development of Grid Codes
- “Basics” on Fault-Ride-Through
- European Review on Fault-Ride-Through Requirements
- Suggestions for Discussion and Open questions

# Development of New Grid Codes

- Distributed Generators
  - Behaviour due to former Grid Codes: *...disconnect at the first sign of trouble ...*
    - Small frequency and voltage bands for operation
    - No grid support in case of faults and for voltage control
- Enormous growth of decentralised generation



Origin: Dena Grid Study, Germany 2005;  
Extracted from presentation:  
„PV-Inverters Supporting Electrical Grid Stability Through Active and Reactive Power Control“, Volker Wachenfeld, SMA Technology AG

# Development of New Grid Codes

- Faults in the UCTE Grid
  - Example: 04.11.2006
  - Loss of about 10 GW of distributed generation
- Consequences:
  - DER units in the distribution network should also contribute to grid stability
  - Development of new grid codes



Origin: Anforderungen an die Netzintegration erneuerbarer Energien aus Sicht eines Übertragungsnetzbetreibers, Präsentation, Stephan Schlucke, Vattenfall Transmission

## Development of New Grid Codes

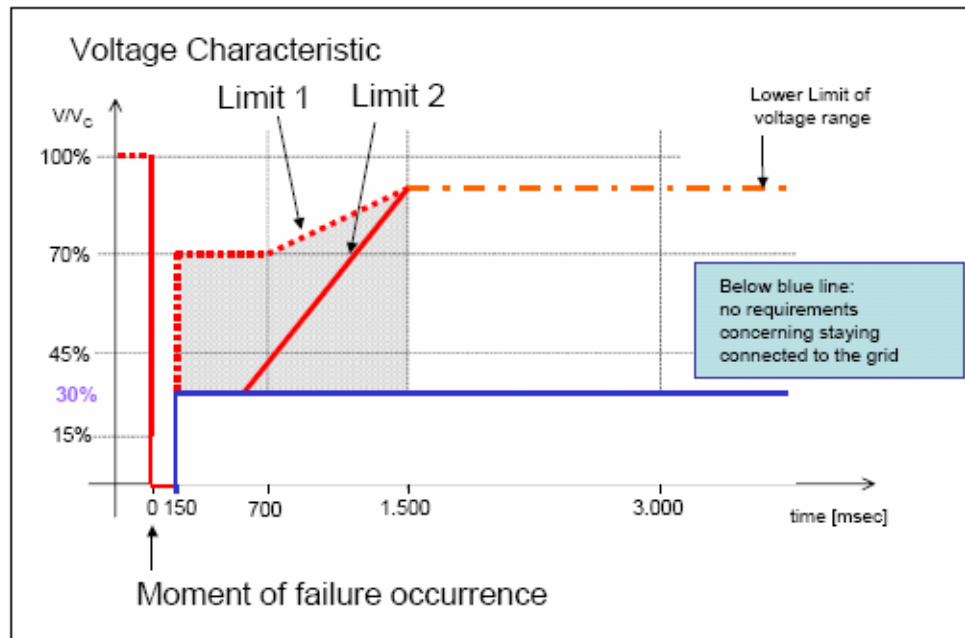
- France, Germany and Austria changed their Grid Codes
- Stability of Network Operation supported by
  - Fault-Ride-Through (FRT) capability
    - *Stay connected* during grid failures
    - *Supply short circuit current*
  - Keeping Voltage limits
    - Supply *reactive power* under normal operation conditions
  - Keeping Frequency limits
    - *Reduce active power* with over-frequency



New guideline for parallel operation with medium voltage grid feeding

## „Basics“ on Fault-Ride-Through

- Adaption of the Transmission Code for Distribution Networks
- All kind of faults: 1, 2 and 3 phase faults
- In case of unsymmetrical faults no increase of voltage above  $1.1 \cdot V_c$
- Fault Ride Through Requirements of German MV Grid Code
  - Above Limit 1:
    - Stable operation
  - Between Limit 1 and Limit 2
    - To be discussed with the DNO
  - Below Limit 2 and 30% of  $V_c$ 
    - Instant disconnection accepted

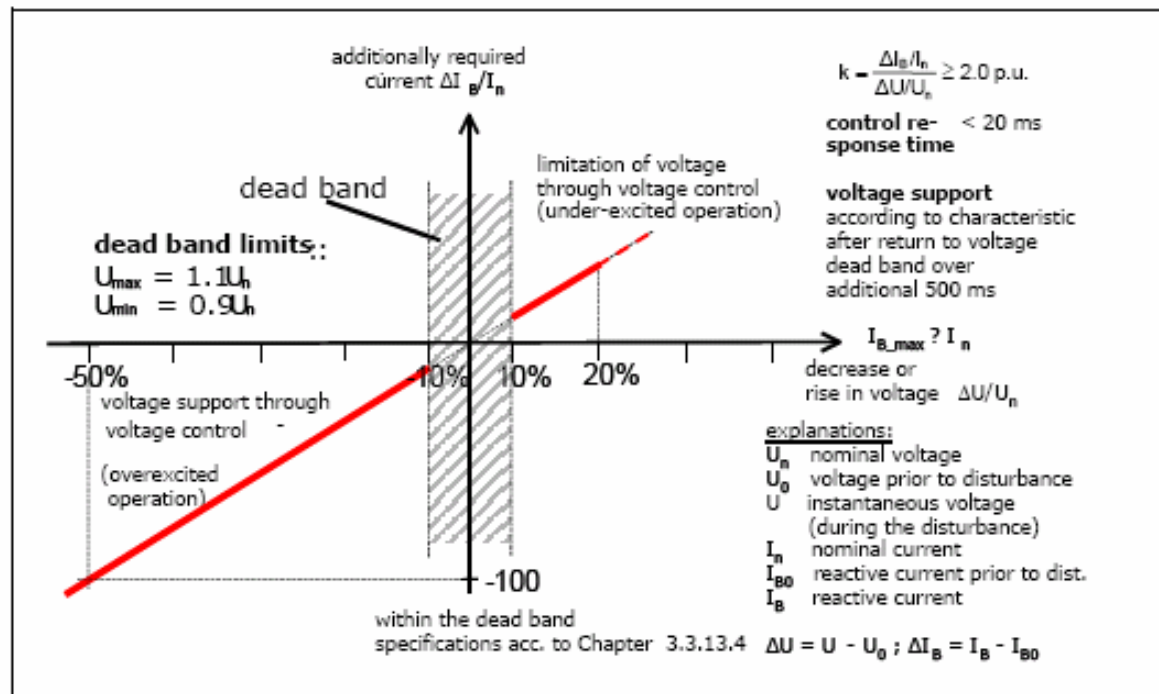


Origin: Erzeugungsanlagen am Mittelspannungsnetz, BDEW, Release 2008;  
 Extracted from presentation:

„PV-Inverters Supporting Electrical Grid Stability Through Active and Reactive Power Control“, Volker Wachenfeld, SMA Technology AG

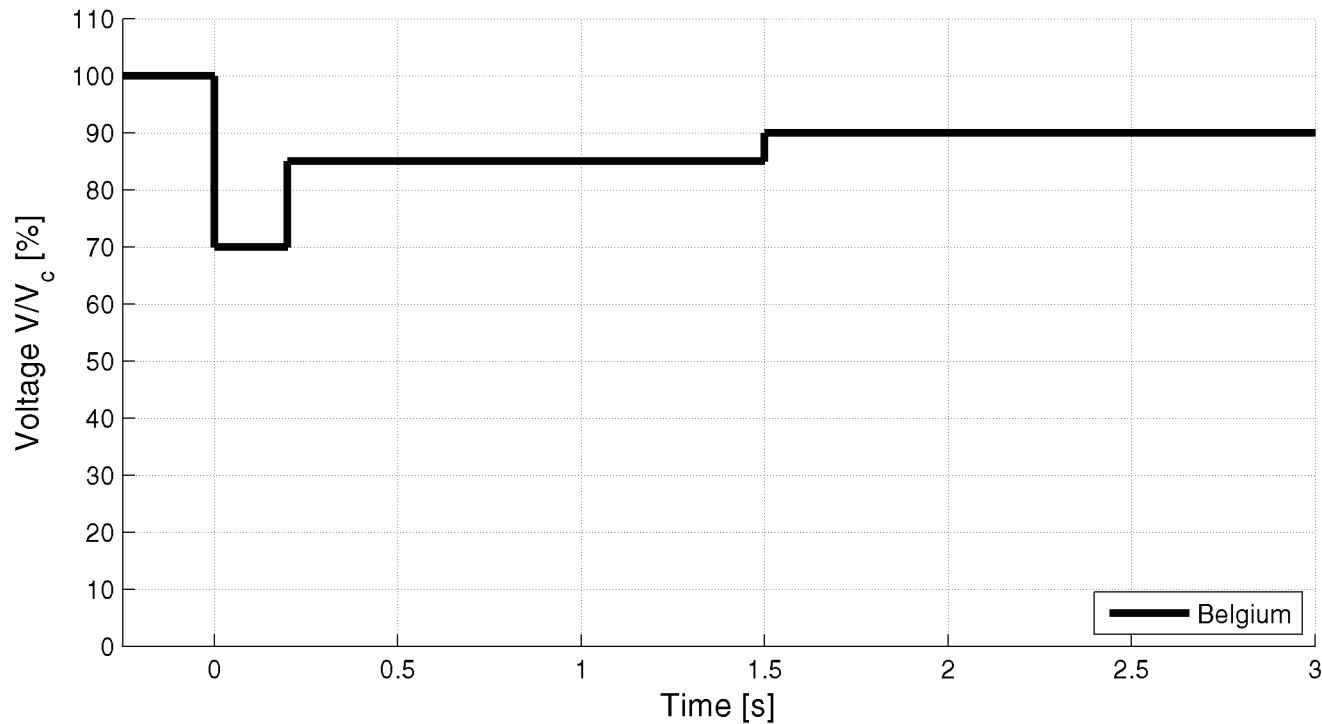
## „Basics“ on Fault-Ride-Through

- Behaviour of DER units during faults
  - Supply of reactive current during short circuit for dynamic voltage control
  - No change of active power generation before and after fault for frequency stabilisation



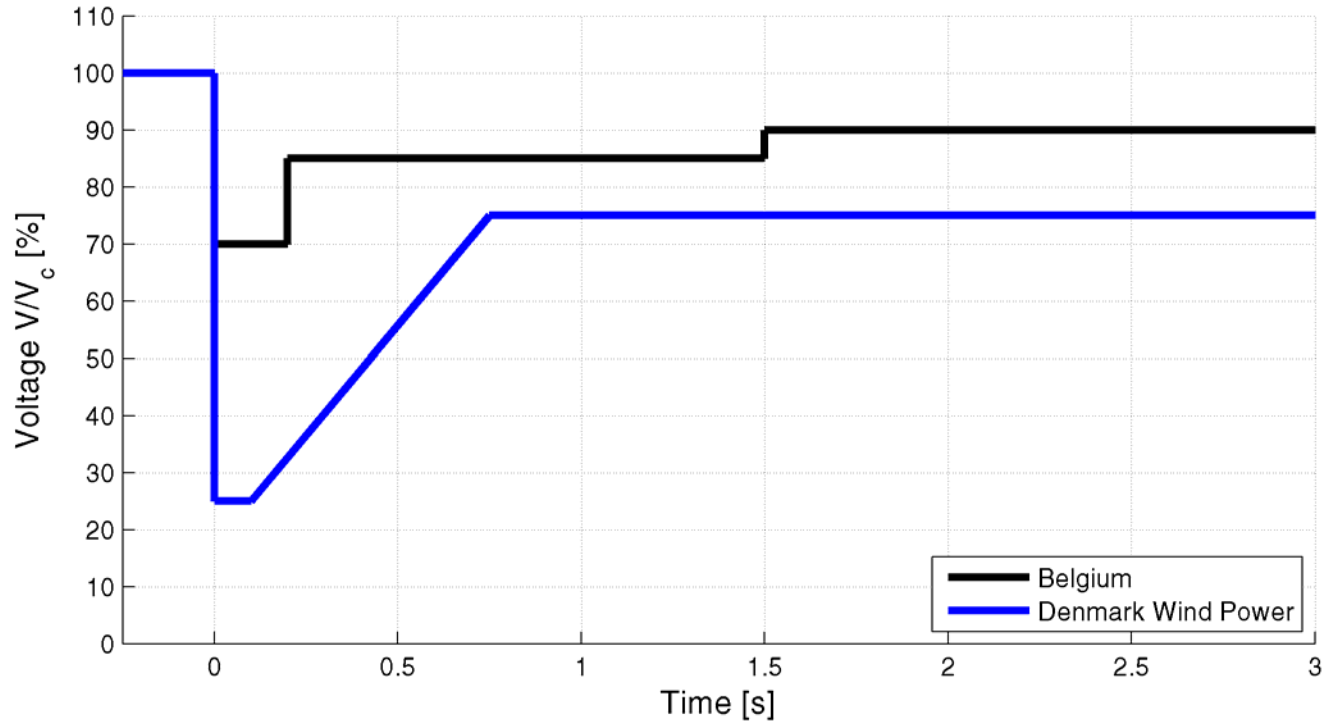
Origin: Transmission Code 2007, BDEW

# European Review on FRT Requirements

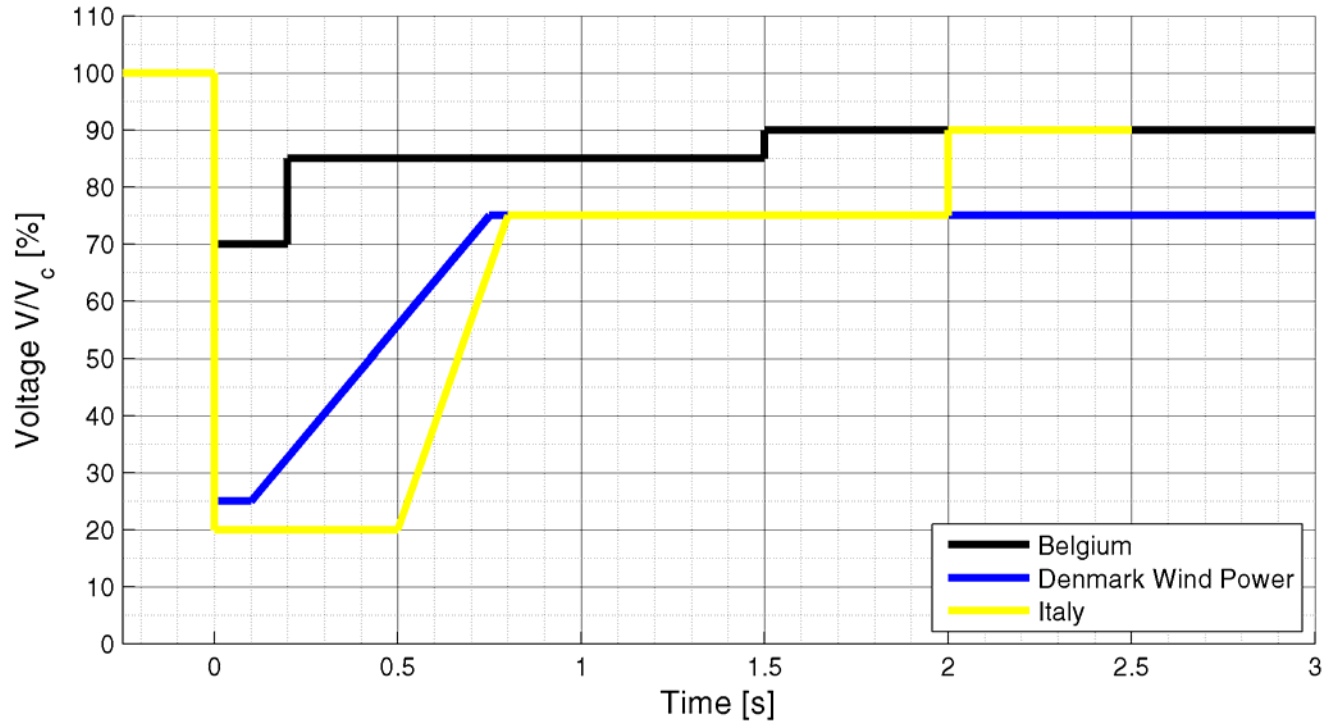




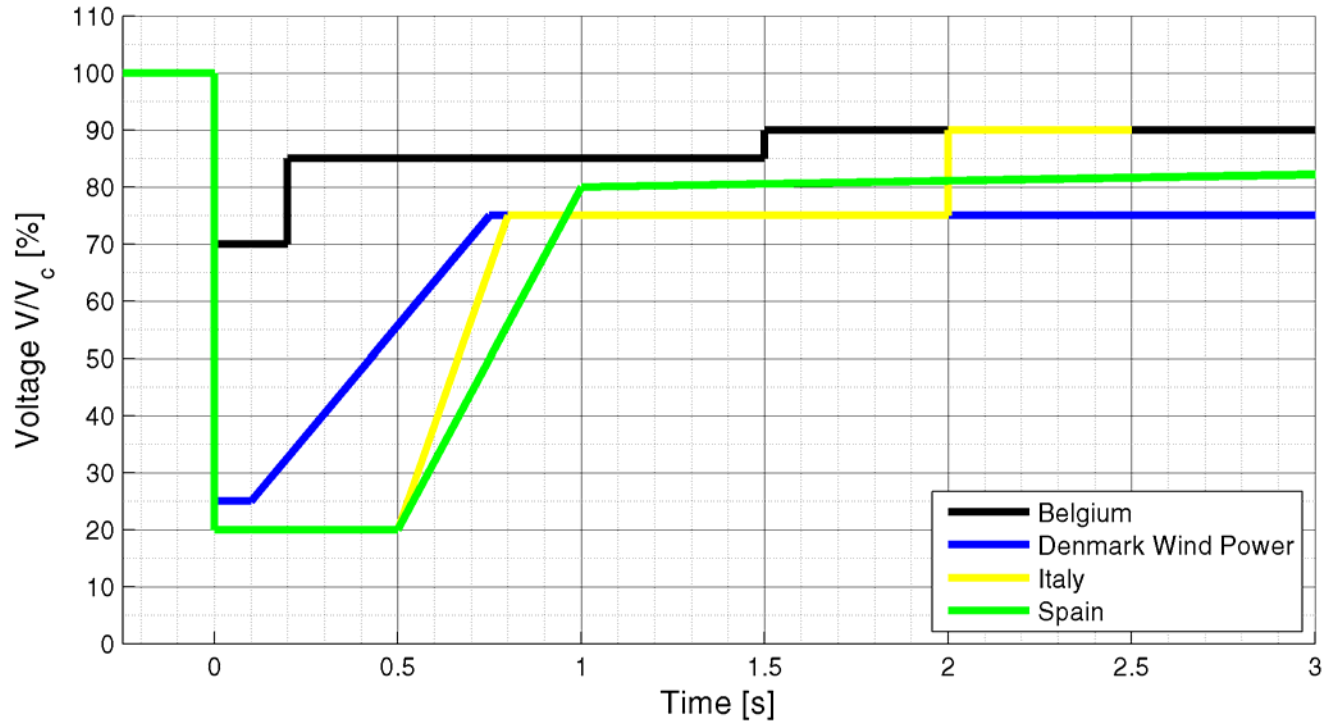
# European Review on FRT Requirements



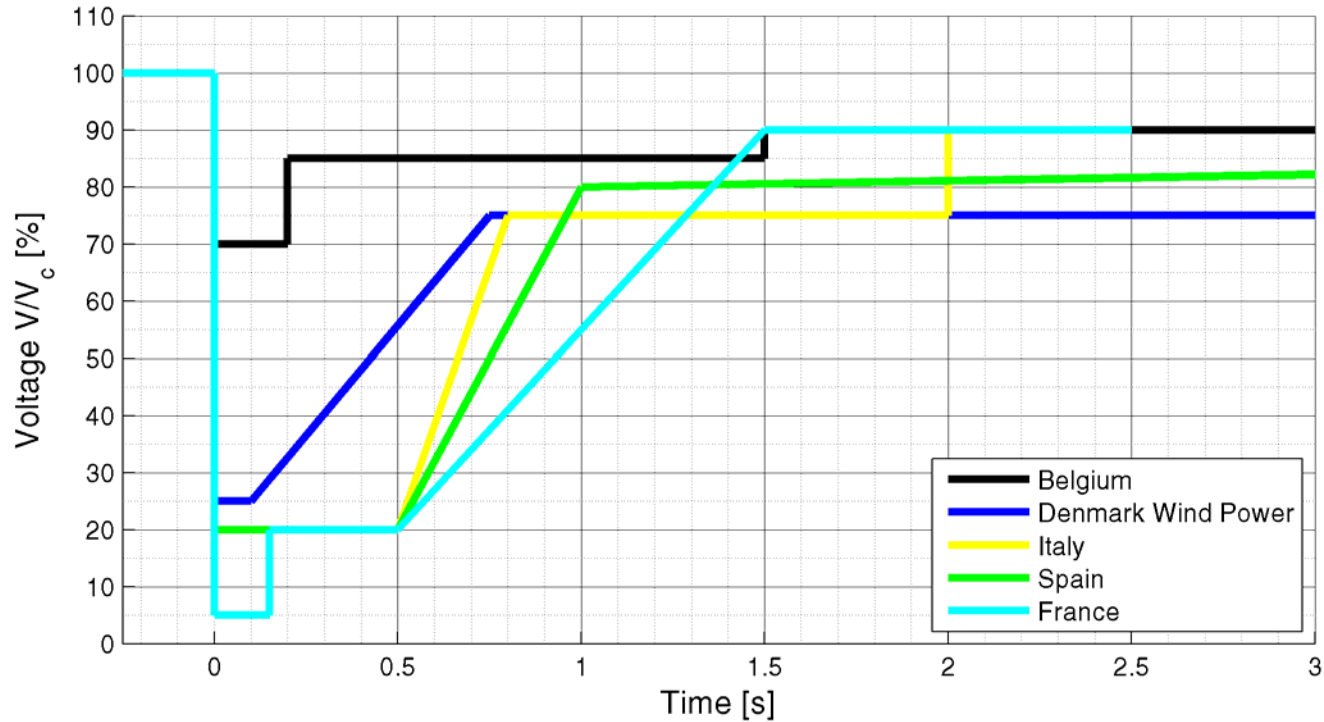
# European Review on FRT Requirements



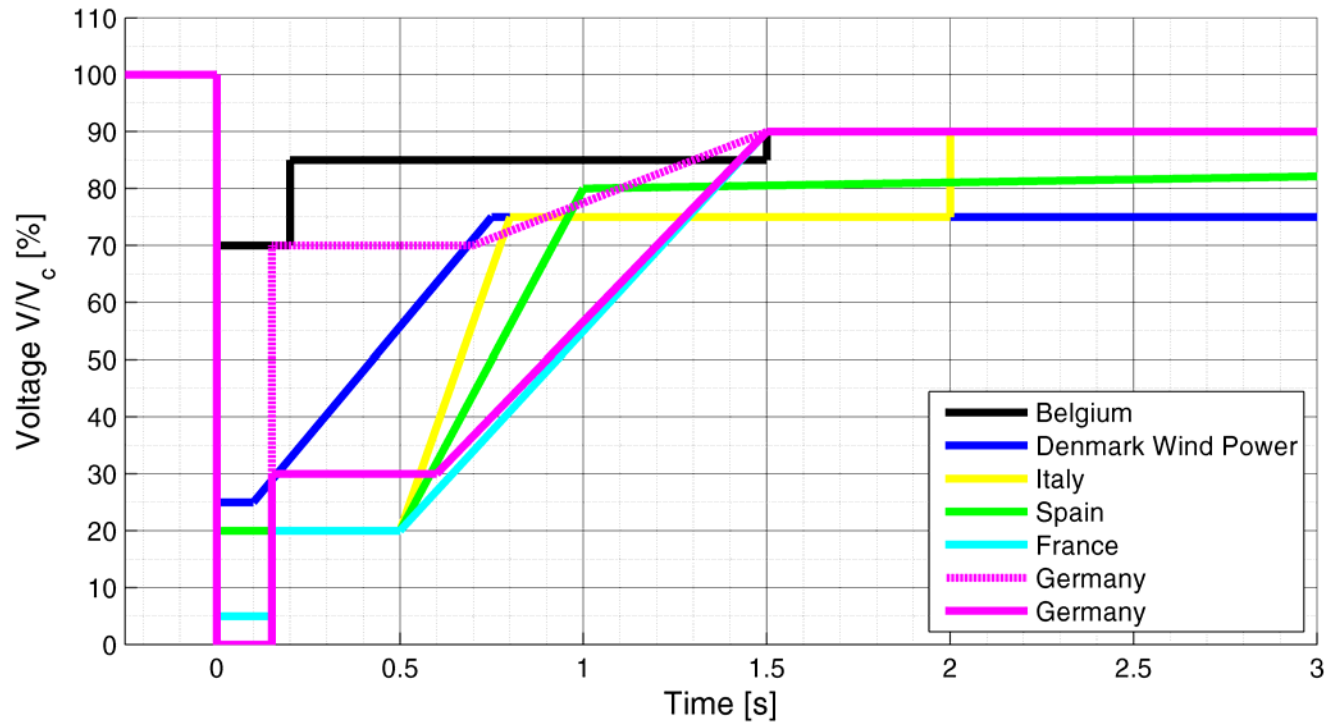
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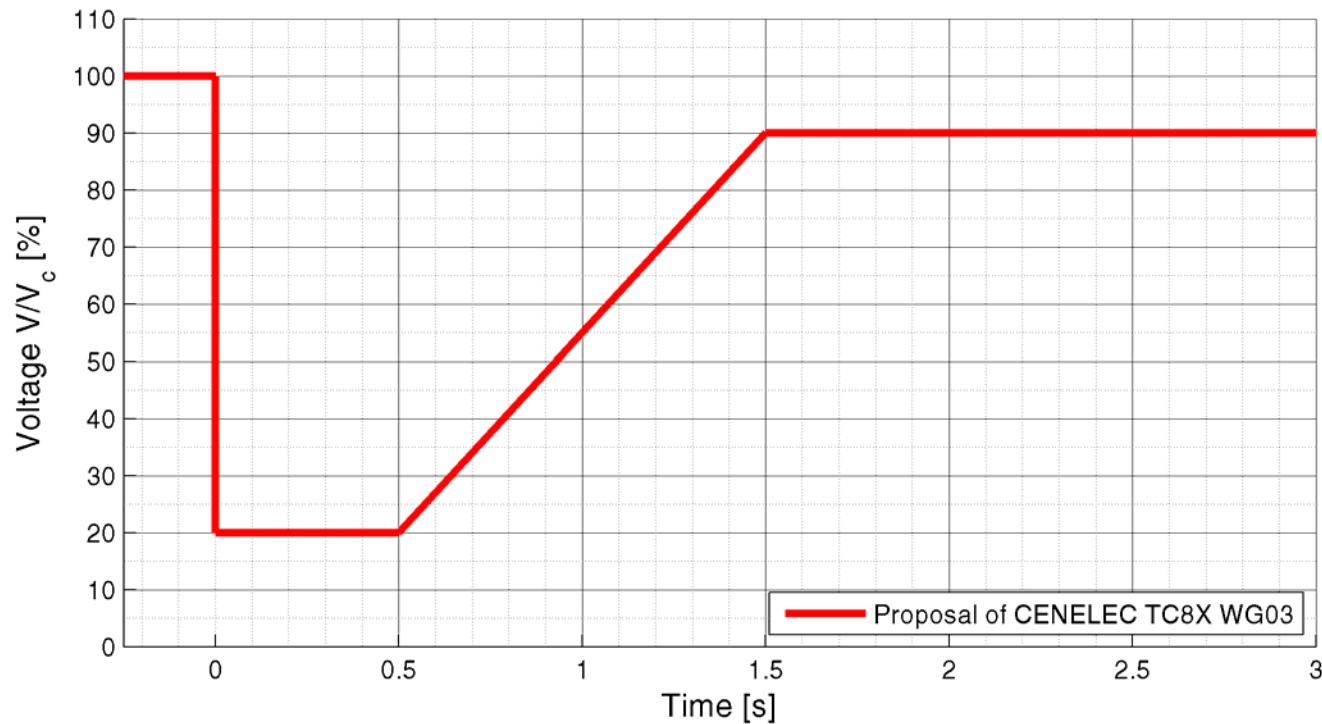


# European Review on FRT Requirements

- FRT-Curves differ from country to country
  - Manufacturer has to adopt FRT for every country
  - No similar behaviour of DER units within the UCTE grid
- European Harmonisation
  - CENELEC TC8X WG03:
    - Technical Specification: "Requirements for the connection of generators above 16 A per phase to the LV distribution system or to the MV distribution system."
    - Proposal of a common FRT curve
    - For all units, also connected to LV!

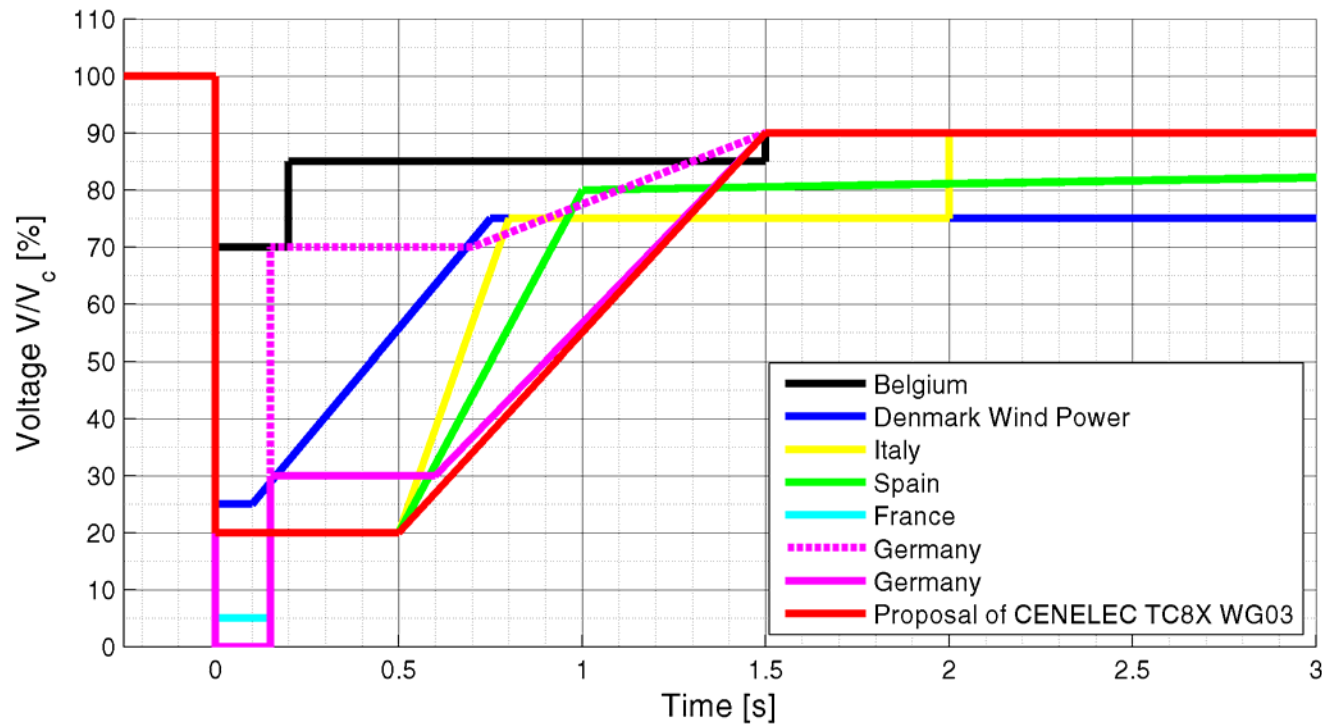
# European Review on FRT Requirements

- Proposal CENELEC TC8X WG03



# European Review on FRT Requirements

- Proposal CENELEC TC8X WG03 compared with existing FRT requirements





## Suggestions for Discussion

- Adaption also to the Low Voltage Level?
- Impact on different DER units
  - Inverters, induction generator, synchronous generator ...
- FRT Curve
  - How to find general limits for time and voltage until disconnection
- Behavior during fault
  - Injection of short circuit current / reactive current *or* just stay connected
- Impact on actual network protection