



Proposal for categorization of Significant Users

First step of the iterative process

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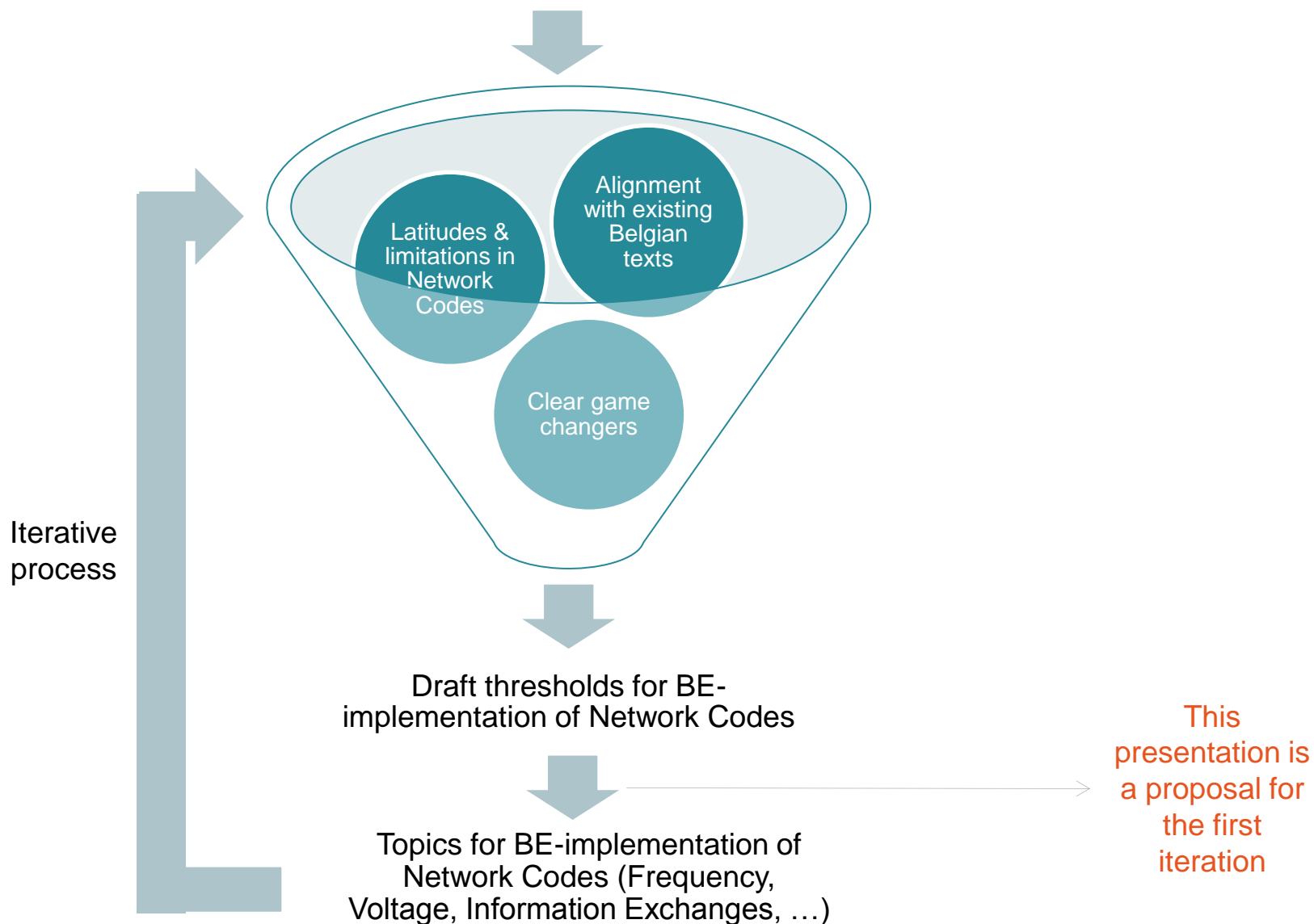
Network Security Assessment/Power System Operation and Security, Elia

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- **Overview of proposed methodology**
- **Categorization of users in European Network Codes**
 - Categories in Network Codes
 - Threshold for categories
- **Thresholds for categories of users in existing Belgian texts**
- **Assessment of thresholds between type A & B generating units**
 - What should a type B generating units do (in addition to A generating units)?
 - Proposed threshold and motivation
- **Assessment of thresholds between type B & C generating units**
 - What should a type C generating units do (in addition to B generating units)?
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 - What should a type D generating units do (in addition to C generating units)?
 - Proposed threshold and motivation
- **Conclusions**

Overview of proposed methodology



Categories of grid users in Network Codes



Network Codes	Existing / New	Generator type (A, B, C, D)	Connection Point above 110kV	DS-/TS-connected	Affected parties or Specific Users	User providing System Services
NC RfG	X	X (each)	X			
NC DCC	X			X		X
NC HVDC				X		
NC OS		X (A vs others)		X		
NC OPS		X (A vs others)		X	X	
NC LFC&R		X (A vs others)		X		
NC E&R		X (A vs others)		X	X	
NC CACM						
NC FCA						
NC EB						

- The following categories do not need further definition:
 - Distribution System Connected vs Transmission System connected (i.e. Elia Grid)
 - Voltage at connection point above 110kV
 - User provided System Services
 - Affected party or specific users
- Application of NC to new users but modernization, de-commissioning, future context evolutions and related CBAs should allow the NCs to apply to all units in the future.
- Therefore, only thresholds for categories of generating units of type A, B, C & D should be defined.

Threshold for categories of generating units



Types	Conditions in Continental Europe (NC RfG)	Feasibility check of thresholds - Conditions in Ireland (NC RfG)
Type A	Maximum Capacity \geq 800 W & PoC $<$ 110 kV	Maximum Capacity \geq 800 W & PoC $<$ 110 kV
Type B	Maximum Capacity \geq XX but max 1MW & PoC $<$ 110 kV	Maximum Capacity \geq XX but max 100kW & PoC $<$ 110 kV
Type C	Maximum Capacity \geq XX but max 50MW & PoC $<$ 110 kV	Maximum Capacity \geq XX but max 5 MW & PoC $<$ 110 kV
Type D	Maximum Capacity \geq XX but max 75MW OR PoC \geq 110 kV	Maximum Capacity \geq XX but max 10MW OR PoC \geq 110 kV

Example of issue, a 5kW PV installation within a client facility (not being a CDS) and with connection point in 150kV should be type D unit. It doesn't seem realistic!

=> Proposal to deviate from the Network Code for conditions of type D (derogation to be asked by the Elia to the regulator) – see proposal in later slides.

Categories in existing Belgian texts



Belgian Texts	Stirling below 30kVA	User above 5kVA	Generator above 10kVA	User above 25kVA	User above 56kVA	User above 250kVA	Generator above 400kVA	User above 630kVA	Generator above 1 MVA	Cogen above 1MW	User above 2MVA	Generator above 2.5MW	Generator above 4MW	User above 5MW	User above 10MW	User above 15MW	Cogen below 20MW	Generator above 25MW	Generator above 75MW	Generator above 100MW	Nuclear / Not Nuclear	DS / Local TS/ TS	Above 70kV	Cogen	RES	Local Generation	DSO	CDS	Mobile Load	
Electricity Law 1999																		X		X	X	X	X	X	X					
Federal Grid Code																	X	X	X					X	X	X	X			
Walloon Grid Code		X			X	X		X			X			X				X				X		X	X	X		X		
Flemish Grid Code			X	X		X	X		X	X				X		X			X										X	
Brussels Grid Code																		X						X	X	X				
MD Afshakel Plan																							X					X		
Connection Contract																							X							
Access Contract																X			X										X	
ARP Contract																X			X										X	
CIPU Contract																			X				X							
Tariff methodology																							X							X
Synergrid C10-11	X	X	X						X			X	X		X															

Categories in existing Belgian texts – Connection to Local Transmission Grid or Distribution Grid



Walloon Grid Code (Art. 46-5 and 46-6)

- Between 5MVA & 25MVA => If possible Distribution Grid at the MV bus bar of the MV/HV substation.
- Above 25MVA => Local transmission Grid (HV)

Flemish Grid Code (III.2.1.1 § 1 & 2)

- Between 15MVA & 25MVA => If possible Distribution Grid
- Above 25MVA => Local transmission Grid (HV)

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What should a type B generating units do (in addition to A generating units)? 1/3



Network Codes		Belgium	
What?	Which doc?	Threshold in BE	Which doc?
Remote control of active power	NC RfG – PGM – Art. 11.2	250kVA 1MVA or lower	Walloon Grid Code Flemish Grid Code
Low Voltage Ride Through	NC RfG – PGM – Art. 11.3	1MVA	Synergrid C10/11
Conditions for reconnection after tripping	NC RfG – PGM – Art. 11.4	10kVA	Synergrid C10/11
Authorization for reconnection during restoration	NC RfG – PGM – Art. 11.4	Connection in Local Transmission or Transmission (ie. 5MVA, 15MVA or 25MVA)	SOK (within clearing of Feeders) Walloon Grid Code Flemish Grid Code
Details of control schemes and settings	NC RfG – PGM – Art. 11.5	Connection in Local Transmission or Transmission (ie. 5MVA, 15MVA or 25MVA)	Annex of Orientation Study for Federal and Regional Grid Codes
Details of electrical protection schemes and settings	NC RfG – PGM – Art. 11.5	0kV	RGIE Synergrid C10/11
Operational notification procedure for connection & compliance verification – equipment certificate & detailed data	NC RfG – PGM – Art. 28.1, 29.1, 29.2, 29.3, 29.4, 29.5	0kV with equipment certificate Connection to MV (no simulation) (i.e. 56kV or 250kVA)	Synergrid C10/26 Federal Grid Code Walloon Grid Code Flemish Grid Code
System state monitoring, frequency, voltage, Scc, stability, congestion management, protection, SA, Notification in case of non-compliance and modification.	NC OS & NC OP&S		

What should a type B generating units do (in addition to A generating units) 2/3



Network Codes		Belgium	
What?	Which doc?	Threshold in BE	Which doc?
Data exchange for DS-connected users directly between user and TSO if economically and efficient	NC OS	Not Existing	/
Reactive Power Capability to be defined by RNO	NC RfG – PPM– Art. 17.2	1MVA	Synergrid C10/11
Can request Fast current injection	NC RfG – PPM– Art. 17.2	Belgian Offshore Grid (i.e. above 75MW)	Annex for wind generation of Federal Grid Code
Low Voltage Ride Through – Post fault active power recovery	NC RfG – PPM– Art. 17.3	- 1MVA for LVRT - Belgian Offshore Grid (i.e. above 75MW) for post fault active power recovery	- Synergrid C10/11 - Annex for wind generation of Federal Grid Code
Limited Frequency Sensitive Mode – Over-Frequency – Test or Equipment Certificate	NC RfG – PPM– Art. 43.1, 43.2, 43.3	0kVA with Equipment certificate	Synergrid C10/26
Limited Frequency Sensitive Mode – Over-Frequency – Simulation or Equipment Certificate	NC RfG – PPM– Art. 50.1, 50.2	0kVA with Equipment certificate	Synergrid C10/26
Fast current injection – Simulation or Equipment Certificate – if requested	NC RfG – PPM– Art. 50.1, 50.3	Belgian Offshore Grid (i.e. above 75MW)	Annex for wind generation of Federal Grid Code
Low Voltage Ride Through – Post fault active power recovery – Simulation or Equipment Certificate	NC RfG – PPM– Art. 50.1, 50.4, 50.5	Belgian Offshore Grid (i.e. above 75MW)	Annex for wind generation of Federal Grid Code

What should a type B generating units do (in addition to A generating units)? 3/3



Network Codes		Belgium	
What?	Which doc?	Threshold in BE	Which doc?
Reactive Power Capability to be defined by RNO	NC RfG – SPGM– Art. 14.2	1MVA	Synergrid C10/11
AVR controlling alternator terminal at constant value	NC RfG – SPGM– Art. 14.2	Not Existing. More advanced voltage control from 25MW	/
Low Voltage Ride Through – Post fault active power recovery	NC RfG – SPGM – Art. 14.3	- 1MVA for LVRT - Not Existing for post fault active power recovery	Synergrid C10/11
Limited Frequency Sensitive Mode – Over-Frequency – Test or Equipment Certificate	NC RfG – SPGM – Art. 40.1, 40.2	0kVA with Equipment certificate	??
Limited Frequency Sensitive Mode – Over-Frequency – Simulation or Equipment Certificate	NC RfG – SPGM – Art. 47.1, 47.2	0kVA with Equipment certificate	??
Low Voltage Ride Through – Post fault active power recovery – Simulation or Equipment Certificate	NC RfG – SPGM – Art. 47.1, 47.3, 47.4	Not Existing	/

Proposed threshold and motivation : Type B from 250kVA

- System Services FCR, FRR (automatic & Manual), RR (Balancing and Congestion management) + MVAR contracts (Voltage control) are at the moment mainly provided by units of type C and D.
- Depending on the circumstances: large imports, low load, lot of RES, number of units of those units (C & D) may not be sufficient.
- Number of units of type C & D is decreasing
- Units of type B are also technically capable to offer those services.

Therefore, reducing the threshold for type B increases

- the number of Generating units capable of providing System Services and
- the number of units compatible with Fault Ride Through requirement (Stability)

Proposed threshold and motivation : Type B from 250kVA



Specific needs for the TSO

- Ensure volume of reserves
- Ensure volume of MVar to manage voltage in HV and MV
- Ensure volume of Gflex to manage congestion in HV
- Ensure adequate volume of units which are FRT compatible (stability of the grid).

Specific needs for the DSO:

- Ensure volume MVar to manage voltage MV;
- Ensure volume Gflex to manage congestion in MV;
- Better knowledge of RES in their grid (actual generation in shorter time-frames).

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What should a type C generating units do (in addition to B generating units)? 1/5



Network Codes		Belgium	
What?	Which doc?	Threshold in BE	Which doc?
Capability of participating to frequency restoration reserve and restoration reserve	NC RfG – PGM – Art. 12.2	CIPU (Connection in Local Transmission or Transmission (i.e. 5MVA, 15MVA or 25MVA) & Local Generation (with simulations) except Nuclear, WKK & Wind)	CIPU, Federal Grid Code Walloon Grid Code Flemish Grid Code
Limited Frequency Sensitive Mode – under-frequency	NC RfG – PGM – Art. 12.2	Not Existing	/
Voltage deviation protection devices	NC RfG – PGM – Art. 12.3	0 kVA	Synergrid C10/11
Frequency, Voltage and Power quality withstand capability	NC RfG – PGM – Art. 12.4	0 kVA	Synergrid C10/11
Can be requested to provide black start offer inline with black start tender	NC RfG – PGM – Art. 12.5	CIPU (Connection in Local Transmission or Transmission (ie. 5MVA, 15MVA or 25MVA) & Local Generation (with simulations))	CIPU, Federal Grid Code Walloon Grid Code Flemish Grid Code
Instability protection, fault recording & dynamic models	NC RfG – PGM – Art. 12.6	Connection in Local Transmission or Transmission (ie. 5MVA, 15MVA or 25MVA) & Local Generation (with simulations)	Federal Grid Code Walloon Grid Code Flemish Grid Code

What should a type C generating units do (in addition to B generating units)? 2/5



Network Codes		Belgium	
What?	Which doc?	Threshold in BE	Which doc?
Reactive Power Capability to be defined by RNO inline with limits defined in NC	NC RfG – SPGM – Art. 15.2	Connection in Local Transmission or Transmission (i.e. 5MVA, 15MVA or 25MVA) & Local Generation (with simulations)	Federal Grid Code Walloon Grid Code Flemish Grid Code
Can be requested to provide synthetic inertia	NC RfG – PPM – Art. 18.2	Not Existing	/
Reactive Power Capability to be defined by RNO inline with limits defined in NC	NC RfG – PPM – Art. 18.3	Connection in Local Transmission or Transmission (i.e. 5MVA, 15MVA or 25MVA) & Local Generation (with simulations)	Annex for wind generation of Federal Grid Code and Regional Grid Codes
Operational notification procedure for connection & compliance verification – simulations and test	NC RfG – PGM – Art. 28.1, 29.1, 29.2, 29.3, 29.4, 29.5	Connection in Local Transmission or Transmission (i.e. 5MVA, 15MVA or 25MVA) & Local Generation (with simulations)	Federal Grid Code Walloon Grid Code Flemish Grid Code
Tests – modulation of active power	NC RfG – SPGM – Art. 41.1, 41.2	Not Existing except for R3 contracts	AS production contracts
Tests – Frequency Sensitive Mode	NC RfG – SPGM – Art. 41.1, 41.3	Not Existing except for R1 contracts	AS production contracts
Tests – Frequency Restoration Control	NC RfG – SPGM – Art. 41.1, 41.4	Not Existing except for R2 contracts	AS production contracts

What should a type C generating units do (in addition to B generating units)? 3/5



Network Codes		Belgium	
What?	Which doc?	Threshold in BE	Which doc?
Test - Black-start, if requested	NC RfG – SPGM – Art. 41.1, 41.5	All black-start units	AS production contracts
Test - Tripping to houseload	NC RfG – SPGM – Art. 41.1, 41.6	Not Existing	/
Tests - Reactive Power Capability	NC RfG – SPGM – Art. 41.1, 41.7	Not Existing (only ex-post verification in MVAr Contract)	/
Simulation – Limited Frequency Sensitive Mode – Under-frequency	NC RfG – SPGM – Art. 48.1, 48.2	Not Existing	/
Simulation – Frequency Sensitive Mode	NC RfG – SPGM – Art. 48.1, 48.3	Not Existing	/
Simulation – Tripping to houseload	NC RfG – SPGM – Art. 48.1, 48.4	Not Existing	/
Simulation - Reactive Power Capability	NC RfG – SPGM – Art. 48.1, 48.5	Connection in Local Transmission or Transmission (i.e. 5MVA, 15MVA or 25MVA) & Local Generation (with simulations)	Federal Grid Code Walloon Grid Code Flemish Grid Code
Operational notification procedure for connection & compliance verification – simulations and test	NC RfG – PGM – Art. 28.1, 29.1, 29.2, 29.3, 29.4, 29.5	Connection in Local Transmission or Transmission (i.e. 5MVA, 15MVA or 25MVA) & Local Generation (with simulations)	Federal Grid Code Walloon Grid Code Flemish Grid Code

What should a type C generating units do (in addition to B generating units)? 4/5



Network Codes		Belgium	
What?	Which doc?	Threshold in BE	Which doc?
Tests – modulation of active power	NC RfG – PPM – Art. 44.1, 44.2	Not Existing except for R3 contracts	AS production contracts
Tests – Limited Frequency Sensitive Mode – Under-frequency	NC RfG – PPM – Art. 44.1, 44.3	Not Existing	/
Tests – Frequency Sensitive Mode	NC RfG – PPM – Art. 44.1, 44.4	Not Existing except for R1 contracts (if any for PPM)	AS production contracts
Tests – Frequency Restoration Control	NC RfG – PPM – Art. 44.1, 44.5	Not Existing except for R2 contracts (if any for PPM)	AS production contracts
Tests - Reactive Power Capability	NC RfG – PPM – Art. 44.1, 44.6	Not Existing (only ex-post verification in MVar Contract)	/
Test - Voltage control, if selected	NC RfG – PPM – Art. 44.1, 44.7, 44.10	Not Existing (only ex-post verification in MVar Contract) except pilot test for 1 Wind Farm in BE	/
Test - Reactive power control, if selected	NC RfG – PPM – Art. 44.1, 44.8, 44.10	Not Existing (only ex-post verification in MVar Contract)	/
Test - Power factor control test, if selected	NC RfG – PPM – Art. 44.1, 44.9, 44.10	Not Existing	/

What should a type C generating units do (in addition to B generating units)? 5/5



Network Codes		Belgium	
What?	Which doc?	Threshold in BE	Which doc?
Simulation – Limited Frequency Sensitive Mode – Under-frequency	NC RfG – PPM – Art. 51.1, 51.2	Not Existing	/
Simulation – Frequency Sensitive Mode	NC RfG – PPM – Art. 51.1, 51.3	Not Existing	/
Simulation – Tripping to houseload	NC RfG – PPM – Art. 51.1, 51.4	Not Existing	/
Simulation - Synthetic Inertia, , if requested	NC RfG – PPM – Art. 51.1, 51.5	Not Existing	/
Simulation - Reactive Power Capability	NC RfG – PPM – Art. 51.1, 51.6	Connection in Local Transmission or Transmission (i.e. 5MVA, 15MVA or 25MVA) & Local Generation (with simulations)	Federal Grid Code Walloon Grid Code Flemish Grid Code
Simulation – Power Oscillation Damper	NC RfG – PPM – Art. 51.1, 51.7, 44.10	Belgian Offshore Grid (i.e. above 75MW)	Annex for wind generation of Federal Grid Code, Walloon Grid Code, Flemish Grid Code

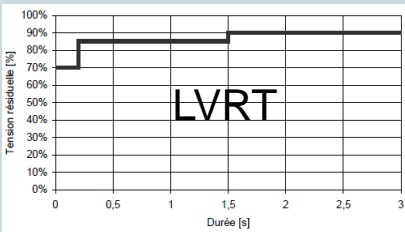
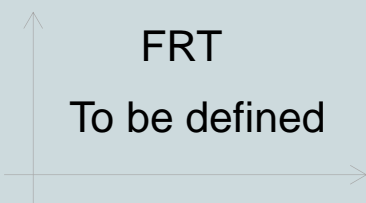
Proposed threshold and motivation :

Type C from 25MW



- Proposal of threshold (25MW) is less stringent than current practices in BE. This could be acceptable only if
 - Sub-thresholds are defined for B when **connected in (Local) Transmission**
 - Equipment Certificate could be replaced by simulations of compliance
 - Values for Low Voltage Ride Through profiles may differ (DSO vs Local Transmission)
 - Additional simulations and test of compliance for Users of type B wishing to provide MVar, FCR, FRR or RR services. This should be specified in Ancillary services tenders.
 - All units of type C should follow requirements for AVR, UEL, OEL & PSS of type D units (inline with current practices in BE)
 - Note that needs for minimum technical requirements for synchronization shall be identified dedicated working groups.
- However, all units delivering **Black Start services** should follow all requirements of type D units. This should be specified in Black Start tenders.
- All units connected above 110kV and greater than 25MW should be of type D as FRT should be inline with the one defined in type D units.

Therefore - Note on type B

	Type B		Type C
	DSO grid	Local Transmission	
Compliance for LVRT & LFSM	equipment certificate	Simulations or equipment certificate	Simulations & tests
LVRT profile	 <p>The graph shows the LVRT profile with 'Tension résiduelle [%]' on the y-axis (0% to 100%) and 'Durée [s]' on the x-axis (0 to 3). The curve starts at 70% at 0s, rises to 80% at 0.5s, and then to 90% at 1.5s, remaining constant thereafter.</p>	<p>FRT To be defined</p> 	

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What should a type D generating units do (in addition to C generating units)? 1/2



Network Codes		Belgium	
What?	Which doc?	Threshold in BE	Which doc?
Voltage withstand capability	NC RfG – PGM – Art. 13.2	Connection in Local Transmission or Transmission (i.e. 5MVA, 15MVA or 25MVA) & Local Generation	Federal Grid Code Walloon Grid Code Flemish Grid Code
Fault-Ride Through capability	NC RfG – PGM – Art. 13.3	Connection in Local Transmission or Transmission (i.e. 5MVA, 15MVA or 25MVA) & Local Generation	Federal Grid Code Walloon Grid Code Flemish Grid Code
Synchrocheck / Synchrocoupler	NC RfG – PGM – Art. 13.4	Connection in Local Transmission or Transmission (i.e. 5MVA, 15MVA or 25MVA) & Local Generation	Federal Grid Code Walloon Grid Code Flemish Grid Code
AVR, UEL, OEL, PSS	NC RfG – SPGM – Art. 16.2	Connection in Local Transmission or Transmission (i.e. 5MVA, 15MVA or 25MVA) & Local Generation	Federal Grid Code Walloon Grid Code Flemish Grid Code

What should a type D generating units do (in addition to C generating units)? 2/2



Network Codes		Belgium	
What?	Which doc?	Threshold in BE	Which doc?
Energization Operational Notification	NC RfG – PGM – Art. 30.1, 31.1, 31.2	Not explicit	/
Interim Operational Notification	NC RfG – PGM – Art. 30.1, 32.1, 32.2, 32.3, 32.4, 32.5	Connection in Local Transmission or Transmission Simplified below 25MVA 5years/15years in local transmissions	Federal Grid Code Walloon Grid Code Flemish Grid Code
Final Operational Notification	NC RfG – PGM – Art. 30.1, 33.1, 33.2, 33.3, 33.4, 33.5, 33.6	Connection in Local Transmission or Transmission Simplified below 25MVA	Federal Grid Code Walloon Grid Code Flemish Grid Code
Simulation – POD & PSS	NC RfG – SPGM – Art. 49.2	Connection in Local Transmission or Transmission (i.e. 5MVA, 15MVA or 25MVA) & Local Generation	Federal Grid Code Walloon Grid Code Flemish Grid Code
Simulation – Fault Ride Through	NC RfG – SPGM – Art. 49.3	Connection in Local Transmission or Transmission (i.e. 5MVA, 15MVA or 25MVA) & Local Generation	Federal Grid Code Walloon Grid Code Flemish Grid Code
Simulation – Fault Ride Through	NC RfG – PPM – Art. 52.3	Connection in Local Transmission or Transmission (i.e. 5MVA, 15MVA or 25MVA) & Local Generation	Federal Grid Code Walloon Grid Code Flemish Grid Code

Proposed threshold and motivation : Type D from 75MW



- Nowadays several peak units or co-generation power plants have difficulties to fulfill fault-ride-through capabilities of the federal and regional grid codes.
- All units delivering Black Start services should follow all requirements of type D units (see comment above)
- About voltage conditions for Type D units
 - Need to impose the same fault ride through profile for all large units connected in 380kV, 220kV and 150kV (i.e. PoC \geq 110 kV) as the grid is highly meshed and grid impedance is low.
 - Need to avoid unjustified discrimination between CDS-connected and local generation for small units.
 - Therefore, proposal to modify conditions from (PoC \geq 110 kV) to (Pinst \geq 25MW & PoC \geq 110 kV)

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Proposal for categorization of Significant Users – Generating Units First Iteration



Types	ENTSO-e Latitude	Draft Proposal	Main Arguments
Type A	Maximum Capacity $\geq 800 \text{ W}$ & PoC $< 110 \text{ kV}$	$800\text{W} \leq P_{\text{inst}} < 250\text{kVA}$	
Type B	Maximum Capacity $\geq \text{XX}$ but $\text{max } 1\text{MW}$ & PoC $< 110 \text{ kV}$	$250\text{kVA} \leq P_{\text{inst}} < 25\text{MW}$ Equipment certificate for DSO grids & LVRT	Increase capabilities to provide congestion management, voltage control and balancing reserve
		Equipment certificate Or simulation of compliance for Local Transmission grid & FRT	Avoid compliance physical test below 25MW
Type C	Maximum Capacity $\geq \text{XX}$ but $\text{max } 50\text{MW}$ & PoC $< 110 \text{ kV}$	$25\text{MW} \leq P_{\text{inst}} < 75\text{MW}$ Or FCR, FRR, RR services	With AVR, OEL, UEL & PSS of Type D Need for tests for units providing services
Type D	Maximum Capacity $\geq \text{XX}$ but $\text{max } 75\text{MW}$ Or PoC $\geq 110 \text{ kV}$	$P_{\text{inst}} \geq 75\text{MW}$ Or Blackstart Or $P_{\text{inst}} \geq 25\text{MW}$ & PoC $\geq 110 \text{ kV}$	Avoid 0V-FRT for co- generation and peak units