

# Requirements for Generators European Network Code High Level Implementation Issues



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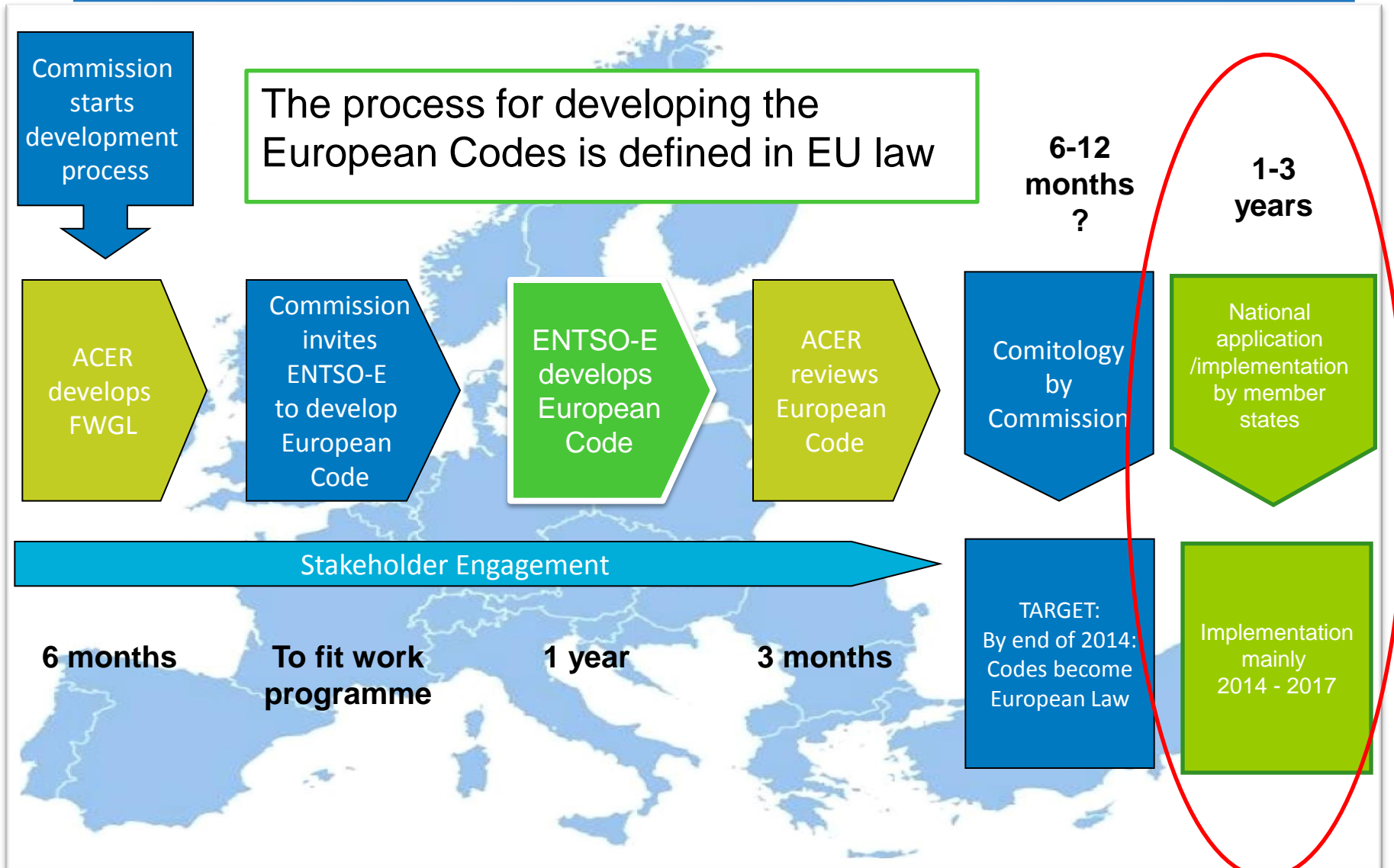
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# Overview

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- Timescales
- Pre Entry into Force – Issues
- Post Entry into Force – National parameter selection
- Implementation
- Key Issues
- Summary

# European Network Code (ENC) Development Process / Timescales



## Pre Entry into Force Considerations (1)

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- The RfG Code is not expected to be implemented until late 2016 / early 2017
- Largely limited to structural issues eg - in which document would the requirements reside (ie Type A – C ) in D Code (G59 / 83) and Type D in the Grid Code?
- Contractual Issues – NGET currently only has a contract with directly connected or Large Embedded Power Stations or those who are either Embedded and seeking to access the wholesale electricity market or wish to provide Ancillary Services.
- The definition of Large, Medium and Small Power Stations against the background of Type A – D Generators needs to be understood and its impact on the wider market
- Relationship / information exchange between NGET, TO's and DNO's needs to be considered
- Code structure in terms of requirements for Existing Generators and requirements for new Generators
- Transitional Arrangements and Bilateral Agreement Considerations

## Pre Entry into Force Considerations (2)

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- The drafting needs to recognise that the requirements on Type D Generators also includes the Type A – C requirements.
- The final codes must be easy to use by all parties
- Potential implications and changes to the Bilateral Agreements.
- Transitional Arrangements – eg for a Generator which seeks a connection in 2020 and applies in mid 2016 but would not be placing major plant contracts until mid 2017 (ie the existing code would still be in place) ahead of the final GB code being approved and updated in line with the RfG requirements.

## Post Entry into Force Considerations (1)






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- Tight timeframe – 2 years maximum
- Some form of project plan is likely to be required
- Full audit and consistency checking process required. Each clause of the RfG will need to be mapped to the GB Code before formal submission.
- National Parameter selection
- Justifications for National Parameter selection – Use existing requirements if already consistent with GB Code.
  - Some requirements are either new or specified in a different way and will require significant work / stakeholder engagement – eg Fault Ride Through
- Consultation and Governance
- Consideration to be given to Bilateral Agreements
- Changes to internal policies and procedures
- Major overhaul and assessment of GB Definitions required against RfG.

# Type A Requirements (800W – 1MW) and connected at less than 110kV







High Level Requirement	NGET Considerations (Large and Medium Power Stations)	Flag
Frequency Range	Already applies to Medium and Large Power Stations – Consistency checks required.	
Rate of Change of Frequency	Settings and parameters to be determined subject to Article 4(3) – Grid Code Rapid Frequency Changes Working Group	
Limited Frequency Oversensitive Mode (LFSM-O)	Already applies to Large and Medium Power Stations – Settings and parameters subject to Article 4(3) but current GB Grid Code settings - believed to be consistent with current RfG proposals.	
Installation of a logic interface in order to cease production within 5 seconds following an instruction from the Relevant Network Operator	For Large Power Stations instructions are issued to Generators directly through their Control Point. Remote operation would be required by the Relevant Network Operator subject to Article 4(3) although this is expected to be mainly an issue for the DNO's although some information provisions would be needed between the DNO / TO and TSO.	
Conditions for Automatic Network Reconnection	If required the TSO to define conditions and parameters (frequency range, ramp rates) for automatic reconnection to the network subject to Article 4(3)	

# Type B Requirements (1MW – 10MW) nationalgrid and connected at less than 110kV







High Level Requirement	NGET Considerations (Large and Medium Power Stations)	Flag
Power Generating Module to be equipped with an interface port in order to reduce Active Power as instructed by the RNO or TSO	For Large Power Stations instructions are issued to Generators directly through their Control Point. Remote operation would be required by the Relevant Network Operator although this is expected to be mainly an issue for the DNO's although some information provisions would be needed between the DNO / TO and TSO.	
Further requirements	Subject to Article 4(3) – would expect to pick up existing Grid Code provisions.	
Fault Ride Through	Already applies to Large and Medium Power Stations – Settings and parameters subject to Article 4(3). New voltage against time curves and associated parameters to be developed as requirements are quite different to existing GB requirements.- Developments underway for Synchronous plant through the GB Fault Ride Through Working Group. Further work required for Asynchronous Plant.	
Control Schemes, Protection and Settings	Subject to Article 4(3). Defines requirements for protection, schemes, settings and priority ranking order. Code amendments and consistency checks required.	
Information Exchange	Subject to Article 4(3). For Large and Medium Power Stations, Operational Metering requirements are contained in CC.6.5.6 of the Grid Code. Existing requirements assumed to apply.	





# Type C Requirements (10MW – 30MW) **nationalgrid** and connected at less than 110kV (1)

High Level Requirement	NGET Considerations (Large and Medium Power Stations)	Flag
Limited Frequency Sensitive Mode (LFSM-U)	New requirement. Would need to be implemented into GB Code including settings and parameters. D Code implementations also need to be understood	
Frequency Sensitive Mode	Believed to be broadly consistent with GB Code. Consistency checking and parameter selection required. D Code implementation also needs to be understood	
Ancillary Services Monitoring	Already applies to Large Power Stations and those with a Mandatory Services Agreement. Requirements currently specified in Bilateral Agreement. RfG Requires additional signals over than those currently specified. Additional signals required subject to Article 4(3). Implications on DNO's to be understood	
Conditions for Automatic disconnection	Specified by Network Operator in co-ordination with TSO subject to article 4(3)	
Robustness of Power Generating Modules	Maintenance of steady state stability, operation without power reduction within voltage / frequency limits and withstanding loading from single / three phase auto- reclosures. Linked to current fault ride through requirements. Implications for DNO's needs to be understood	
Black Start	Non Mandatory – Implications need to be understood in terms of current black start contracts.	





# Type C Requirements (10MW – 30MW) nationalgrid and connected at less than 110kV (2)

High Level Requirement	NGET Considerations (Large and Medium Power Stations)	Flag
Loss of Angular Stability	Pole Slipping Protection covered in Grid Code and specified in Bilateral Agreement. Current practice requires Pole Slipping protection to be fitted to Embedded Plant but not directly connected plant. DNO implications need to be understood	
Fault Recording, Dynamic System Monitoring and Quality of Supply Monitoring	Already covered in Grid Code/ Bilateral Agreement for Generators above a certain size. Settings and recording parameters to be agreed with the relevant Network Operator / TSO. National Grid Policy changes expected. DNO implications to be assessed.	
Simulation Models	Already covered in GB Grid Code through Planning Code although requirements for Electromagnetic Time Domain (EMT) analysis will need to be included. DNO implications need to be understood.	
Installation of devices for system operation / security of the System	Subject to Article 4(3) but already believed to be covered in Grid Code / D Code / Bilateral Agreements	
Ramp Rates	Grid Code only covers ramp rates in respect of BMU's not Generating Units. Implications need to be assessed in terms of Generating Units.	
Earthing Arrangements	Earthing Arrangements of the neutral point at the network side of step up transformers to be agreed with the Relevant Network Operator. Already covered in Grid Code.	



# Type C Requirements (10MW – 30MW) and connected at less than 110kV (3)

High Level Requirement	NGET Considerations (Large and Medium Power Stations)	Flag
Changes to Generating Plant and equipment	Changes to Generating Plant and equipment to be notified to the network operator. Already covered under Grid Code PC.A.1.2(b)).	
Modernisation / Replacement of Generating Plant	Changes to Generating Plant and equipment to be notified to the network operator. Already covered under Grid Code PC.A.1.2(b)). The use of existing spare components that do not meet the requirements will have to be agreed with the Relevant Network Operator in co-ordination with the TSO.	


# Type D Requirements (30MW plus) or connected at 110kV or above

High Level Requirement	NGET Considerations (Large and Medium Power Stations)	Flag
Voltage Range	Broadly consistent with GB Grid Code requirements however RfG requires a voltage range of 0.9 – 1.1p.u for voltages between 110kV – 300kV and in GB a voltage range of 0.9 – 1.1p.u is required at 275kV and 132kV but a voltage range of ±6% is required at voltages below 132kV. Wider voltage ranges and longer minimum operating times may be agreed between the TSO and Relevant Network Operator subject to Article 4(3) but there appears to be no scope for narrower operating ranges?	
Automatic Disconnection	Voltage range conditions for automatic disconnection to be specified by the Relevant Network Operator in co-ordination with the TSO.	
Fault Ride Through	Already applies to Large and Medium Power Stations – Settings and parameters subject to Article 4(3). New voltage against time curves and associated parameters to be developed as requirements are quite different to existing GB requirements.- Developments underway for Synchronous plant through the GB Fault Ride Through Working Group. Further work required for Asynchronous Plant.	
Synchronising	Specified in Bilateral Agreement which also refers to the Relevant Electrical Standards (RES). Internal policy changes may be required. DNO implications need to be understood	



# Type B Synchronous Power Generating Module Requirements (1MW – 10MW) and connected at less than 110kV

High Level Requirement	NGET Considerations (Large and Medium Power Stations)	Flag
Reactive Power and Voltage Control / Excitation System performance	Reactive Power capability specified by Relevant Network Operator subject to Article 4(3). Requirement to equipped with an automatic excitation control system. DNO implications need to be understood.	
Post fault active power recovery following fault ride through	Covered under CC.6.3.15 of the Grid Code. May require some reassessment but issue will also be picked up as part of GB Fault Ride Through working group. DNO assessment will also be required.	



# Type C Synchronous Power Generating Module Requirements (10MW – 30MW) and connected at less than 110kV

High Level Requirement	NGET Considerations (Large and Medium Power Stations)	Flag
Reactive Power Capability	Reactive power capability is covered under CC.6.3.2 of the Grid Code but it is specified in a very different way in RfG. Considerable discussion is likely to be required on this issue. Consideration and assessment also needs to be undertaken at a DNO level.	

# Type D Synchronous Power Generating Module Requirements (30MW plus) and connected at or above 110kV






High Level Requirement	NGET Considerations (Large and Medium Power Stations)	Flag
Voltage Control / Excitation performance parameters and settings	Subject to Article 4(3) but believed to be largely consistent with current GB Grid Code requirements under CC.6.3.8 and CC.A.6	
Requirements to aid angular stability under fault conditions	Subject to Article 4(3) but already believed to be covered under existing Grid Code and Bilateral Agreement requirements.	

# Type B Power Park Modules (1 - 10MW) and connected below 110kV





High Level Requirement	NGET Considerations (Large and Medium Power Stations)	Flag
Reactive Power Capability	Specified by Relevant Network Operator subject to Article 4(3).	
Fast fault current injection and active power recovery including performance during and after fault ride through	Reactive Current injection defined much more explicitly than in current GB Code. Issues such as active power recovery should map across more easily Further discussions and analysis required.	



# Type C Power Park Modules (10 - 30MW) and connected below 110kV

High Level Requirement	NGET Considerations (Large and Medium Power Stations)	Flag
Synthetic Inertia	Requirements to provide synthetic inertia specified by TSO subject to Article 4(3). Being addressed by GB frequency response working group.	
Reactive Capability	Reactive power capability is covered under CC.6.3.2 of the Grid Code but it is specified in a very different way in RfG. Considerable discussion is likely to be required on this issue. Consideration and assessment also needs to be undertaken at a DNO level.	
Reactive Power Control Modes	TSO to decide which control mode to use (voltage control, reactive power control or power factor control). GB requirements adopt voltage control which is broadly similar to RfG. Some limited additional drafting required to cover other control modes. There may be an issue for the DNO's in selecting which option they wish to adopt.	
Priority of Active or Reactive Power	TSO to define priority of Active or Reactive Power during faults. Loosely covered in GB Grid Code but will require some further analysis.	
Power Oscillation Damping	Specified by the TSO subject to the provisions of Article 4(3). Assessment by DNO's will also be required.	

# Other Requirements

High Level Requirement	NGET Considerations (Large and Medium Power Stations)	Flag
Offshore Connected AC Power Park Modules	Offshore only covers Configuration 1 (radial offshore connection) or Configuration 2 (meshed AC connections to shore). Under RfG the requirements for Offshore Power Park Modules are split between the RfG document and the HVDC code. The RfG code does not cover the GB Offshore Transmission regime so some assessment and discussion will be required with regard to Offshore Connections.	
Compliance	The compliance process is well established in GB however an assessment and thorough review will need to be undertaken to ensure the GB code is consistent with the RfG Code. The Compliance process will need to include new elements included under the connection requirements (eg LFSM-U) and additional tests / simulations identified in the RfG Compliance section	
Derogations	It is not clear if the derogation process will reside in the Grid Code or in an alternative vehicle	
Emerging Technologies	New section of code to be included in drafting. Consideration will also need to be given by the DNO's to new technology.	

# Key Issues

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- Pre Entry into Force
  - Timescales
  - Structure
  - Large / Medium / Small v Banding A, B, C and D
  - TSO / TO / DNO Interfaces
  - Transitional Arrangements
- Post Entry into Force
  - Parameter selection
    - Fault Ride Through
    - LFSM-U
    - Ancillary Services Monitoring
    - Voltage Range
    - Fault Ride Through
    - Reactive Power Capability
    - Fast fault current injection
    - Offshore AC Connected Networks
    - Compliance

## Useful links

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- ENTSO-E

- <https://www.entsoe.eu/resources/network-codes/>

- ACER

- [http://www.acer.europa.eu/portal/page/portal/ACER\\_HOME/Activities](http://www.acer.europa.eu/portal/page/portal/ACER_HOME/Activities)

- European Commission

- [http://ec.europa.eu/energy/index\\_en.htm](http://ec.europa.eu/energy/index_en.htm)

- JESG

- <http://www.nationalgrid.com/uk/Electricity/Codes/systemcode/workingstandinggroups/JointEuroSG/>

# Questions

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