Network Code on Requirements for Generators stakeholder discussion

EUTurbines

Eurelectric WG Thermal / VGB

20 December 2011

Stuttgart

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Agenda

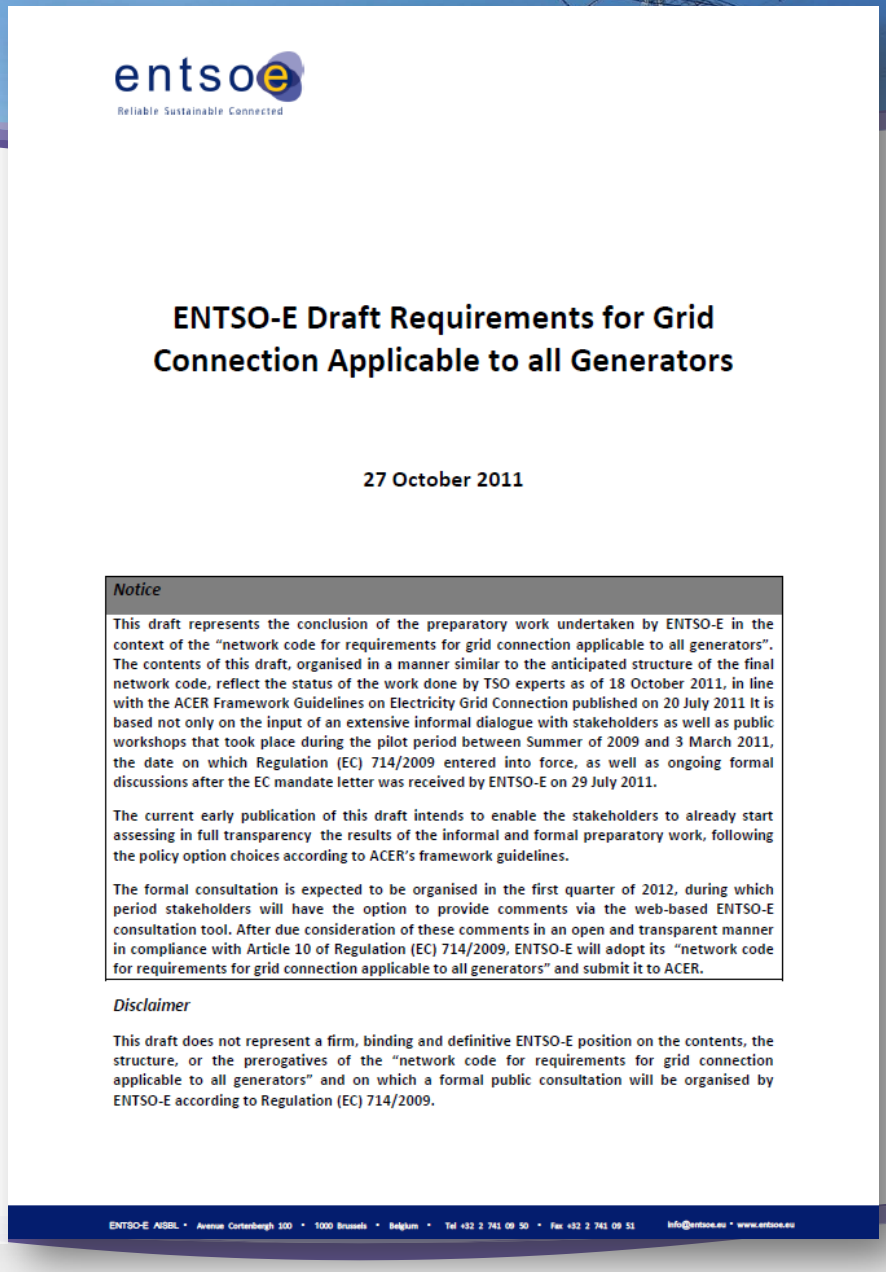
11:00-11:15hrs:	Welcome, Attendance, Approval of Agenda
11:15-11:30hrs:	Network code development – Status and schedule
11:30-12:15hrs:	Review of the network code update based on ACER's final framework guideline
12:15-13:00hrs:	Cost-Benefit Analysis – methods and criteria
13:00-14:00hrs:	*Lunch break*
14:00-15:30hrs:	Discussion of EUTurbines comments
15:30-16:30hrs:	Discussion of Eurelectric WG Thermal & VGB PowerTech comments
16:30-17:00hrs:	AOB

Meeting objectives

- Communication on status and next steps in the NC development
- Stakeholder position on crucial NC RfG elements
  - *Process for retro-active application & methodology for CBA (two stages)*
  - *Process for derogation*
  - *Graded approach in requirements (Types)*
  - *Significant deviations with existing standards / grid codes*
- Review of main stakeholder comments on 27/10/2011 working draft document: argumentation, ENTSO-E clarification, possible proposals for adaptation of the draft code

Note: meeting documents are to be made public in line with Regulation (EC) 714/2009

- Pilot process
- Redrafting based on ACER's final framework guidelines
- Working draft publication
- Continued stakeholder interaction
- Public consultation



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ENTSO-E Draft Requirements for Grid Connection Applicable to all Generators

27 October 2011

Notice

This draft represents the conclusion of the preparatory work undertaken by ENTSO-E in the context of the "network code for requirements for grid connection applicable to all generators". The contents of this draft, organised in a manner similar to the anticipated structure of the final network code, reflect the status of the work done by TSO experts as of 18 October 2011, in line with the ACER Framework Guidelines on Electricity Grid Connection published on 20 July 2011 It is based not only on the input of an extensive informal dialogue with stakeholders as well as public workshops that took place during the pilot period between Summer of 2009 and 3 March 2011, the date on which Regulation (EC) 714/2009 entered into force, as well as ongoing formal discussions after the EC mandate letter was received by ENTSO-E on 29 July 2011.

The current early publication of this draft intends to enable the stakeholders to already start assessing in full transparency the results of the informal and formal preparatory work, following the policy option choices according to ACER's framework guidelines.

The formal consultation is expected to be organised in the first quarter of 2012, during which period stakeholders will have the option to provide comments via the web-based ENTSO-E consultation tool. After due consideration of these comments in an open and transparent manner in compliance with Article 10 of Regulation (EC) 714/2009, ENTSO-E will adopt its "network code for requirements for grid connection applicable to all generators" and submit it to ACER.

Disclaimer

This draft does not represent a firm, binding and definitive ENTSO-E position on the contents, the structure, or the prerogatives of the "network code for requirements for grid connection applicable to all generators" and on which a formal public consultation will be organised by ENTSO-E according to Regulation (EC) 714/2009.

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Working draft available at
http://www.entsoe.eu

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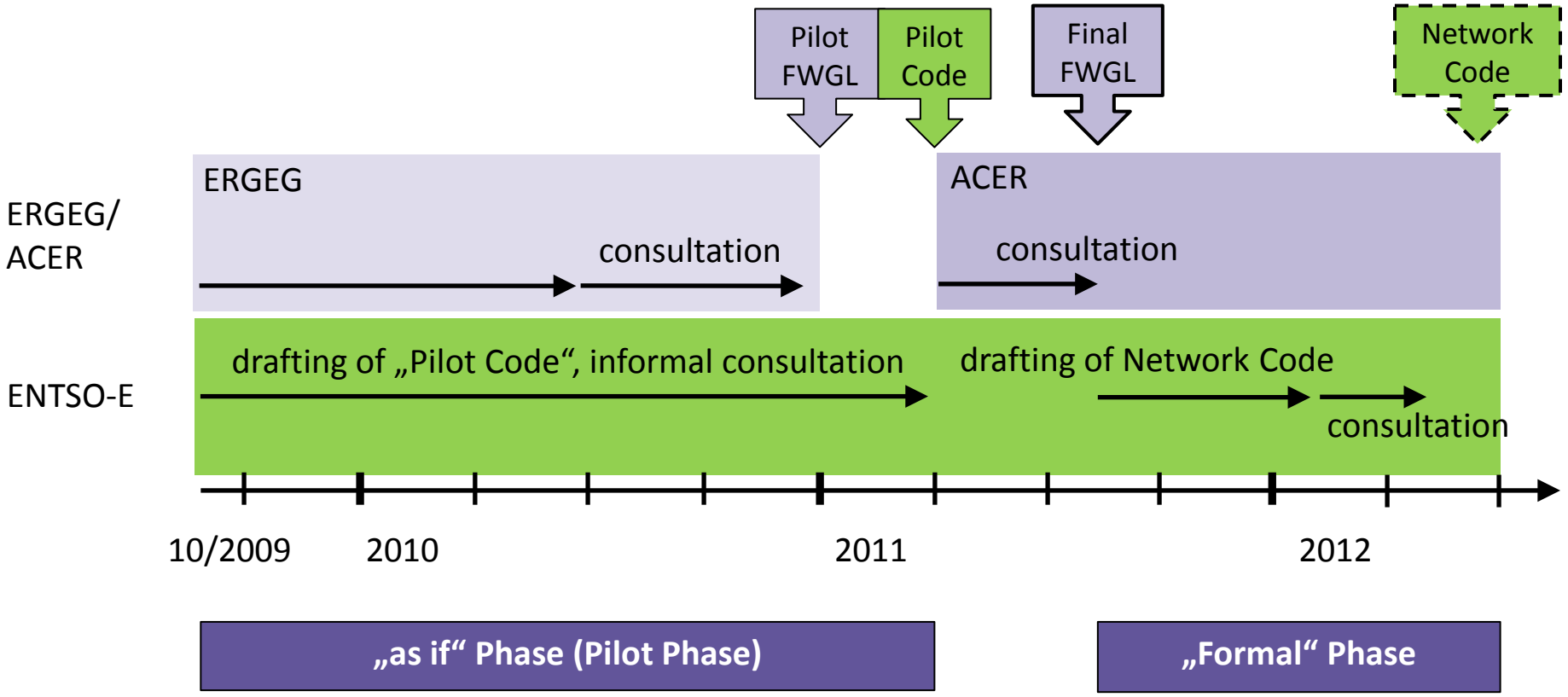
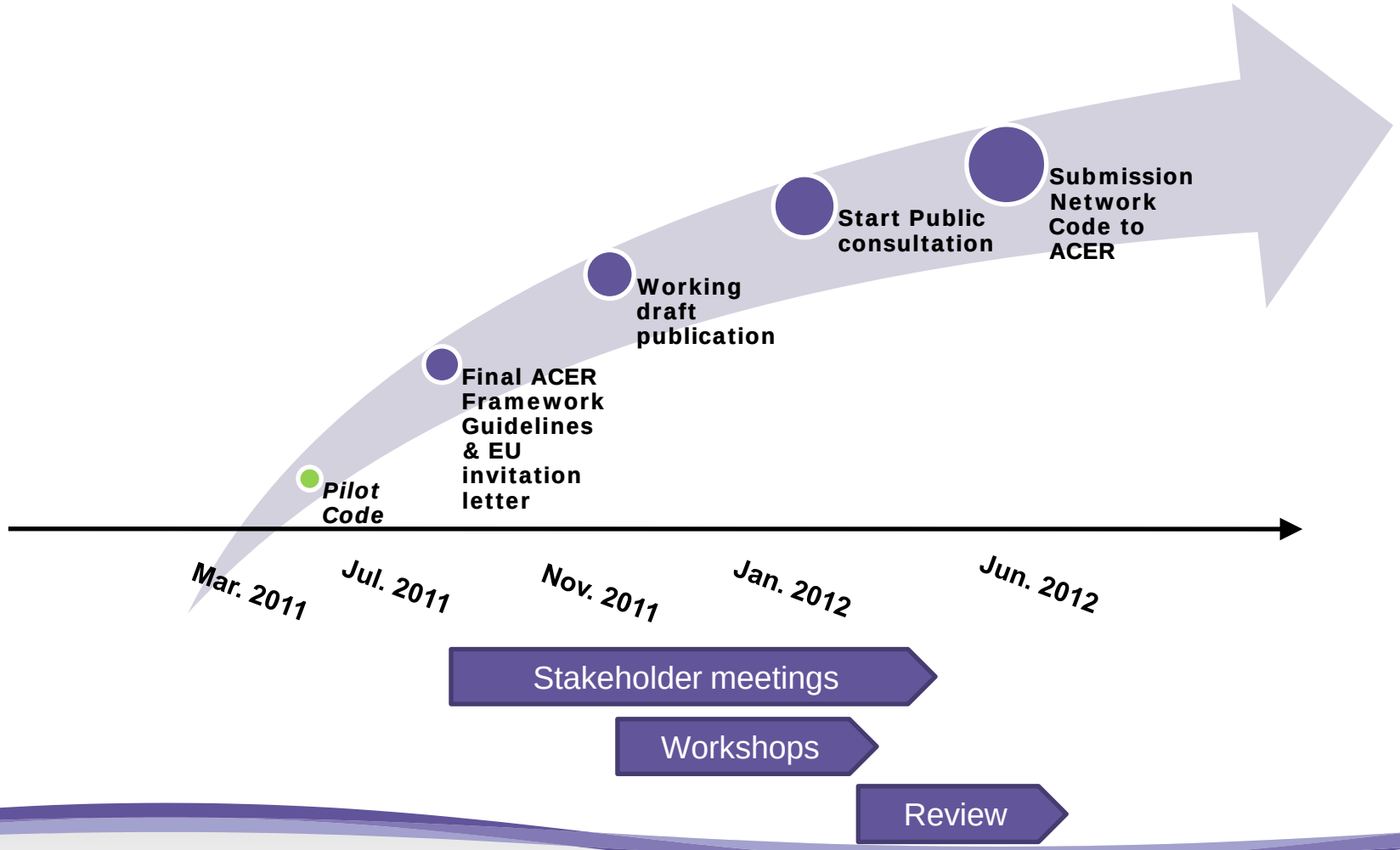
Pilot process versus formal process



Formal Network Code process



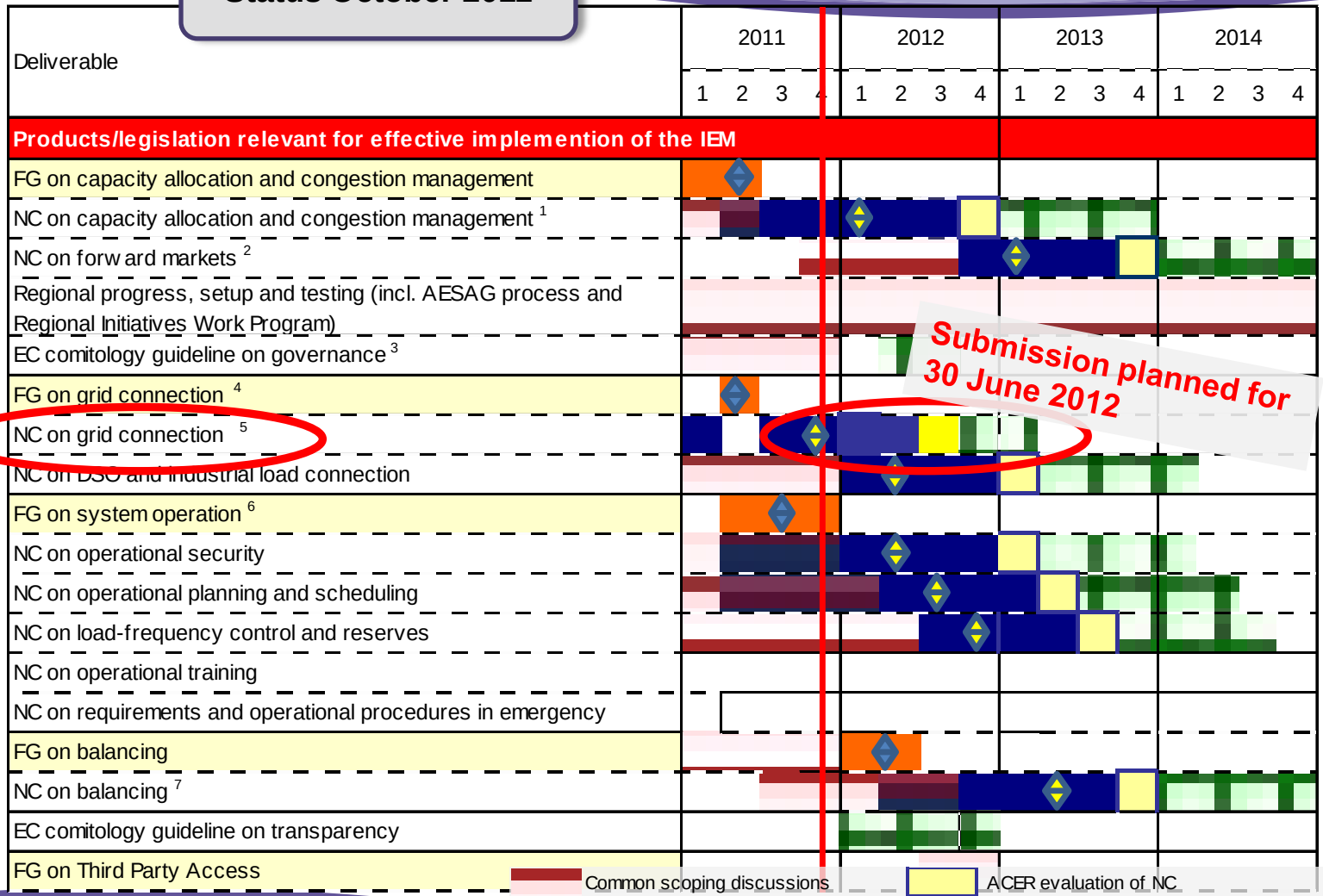
Status and next steps

- Working document published on 2 November 2011
- Ongoing bilateral meetings with stakeholders to further develop the draft code

- **Next steps**
  - **Public consultation (two months) starts end of January 2012**
    - ***Publication of updated draft code***
    - ***Publication of FAQs with technical motivation of the code requirements***
    - ***Publication of an explanatory note on the approach taken***
  - **Public workshop on 15 February 2012 in Brussels**
  - **ENTSO-E review of all comments, response and adaptation fo the code where needed in Q2/2012**
  - **Submission to ACER by 30 June 2012**

EC / ACER / ENTSO-E high priority list

Status October 2011



Topics

- Definition of “cross-border issue”
- Significant users
- Level of detail
- Derogations
- Compatibility with existing standards
- Allocation/reimbursement of costs

What is a cross-border issue?

ACER Framework Guideline on Electricity Grid Connection

A.o. in definition of Significant Grid Users – *"Pre-existing grid users and new grid users which are deemed significant on the basis of their impact on the cross border system performance via influence on the control area's security of supply, including provision of ancillary services."*

Cross-border issues

(EC) 714/2009 – Art. 8 (7)

- *"The network codes shall be developed for **cross-border network issues and market integration issues** and shall be without prejudice to the Member States' right to establish national network codes which do not affect cross-border trade"*

Context 3rd Energy Package

- supporting the completion and functioning of the internal market in electricity and cross-border trade
- facilitating the targets for penetration of renewable generation
- maintaining security of supply

ENTSO-E definition

- All requirements that **contribute to maintaining, preserving and restoring system security** in order to **facilitate proper functioning of the internal electricity market** within and between synchronous areas, and to **achieving cost efficiencies through technical standardization** shall be regarded as "**cross-border network issues and market integration issues**".

Cross-border issues

Why are even small domestic units considered?

- One 5kW PV panel his negligible impact on a synchronous area level.
- What if all units respond similarly to a given stimulus? E.g. disconnection on a sunny day of 200.000 units of 5kW at a frequency rise of 50.2Hz results in a sudden production loss of 1000MW

How can a voltage problem be a cross-border issue?

- A frequency deviation is measured system wide.
- A voltage dip/rise could be a local issue, which can be locally resolved.
- A voltage dip/rise could occur system wide, resulting in a voltage collapse if no **coherent action** is taken. Note: a local measurement cannot identify a starting voltage collapse.

Cross-border issues

Automatic disconnection due to frequency deviations prohibited within the following ranges:

Frequency Range	Time period for operation				
	Continental Europe	Nordic	Great Britain	Ireland	Baltic
47.0 Hz – 47.5 Hz			20 seconds		
47.5 Hz – 48.5 Hz	To be determined* by each TSO, but not less than 30 minutes	30 minutes	90 minutes	90 minutes	90 minutes
48.5 Hz – 49.0 Hz	To be determined* by each TSO, but not less than the period for 47.5 Hz – 48.5 Hz	To be determined* by each TSO, but not less than 30 minutes	To be determined* by each TSO, but not less than 90 minutes	To be determined* by each TSO but not less than 90 minutes	To be determined* by each TSO, but not less than 90 minutes
49.0 Hz – 51.0 Hz	Unlimited	Unlimited	Unlimited	Unlimited	Unlimited
51.0 Hz – 51.5 Hz	30 minutes	30 minutes	90 minutes	90 minutes	90 minutes
51.5 Hz – 52.0 Hz			15 minutes		

** under the conditions off the existing national framework, and respecting the principles of transparency, publicity and non-discrimination*

What is a Significant Grid User?

ACER Framework Guideline on Electricity Grid Connection

- *"The network code(s) developed according to these Framework Guidelines shall define appropriate minimum standards and requirements applicable to all significant grid users."*
- *"The minimum standards and requirements shall be defined for each type of significant grid user and shall take into account the voltage level at the grid user's connection point. The network code(s) shall specify the criteria and methodology for the definition of significant grid users. These shall be based on a predefined set of parameters which measure the degree of their impact on cross-border system performance via influence on control area`s security of supply, including provision of ancillary services ("significance test")…"*

Significant users

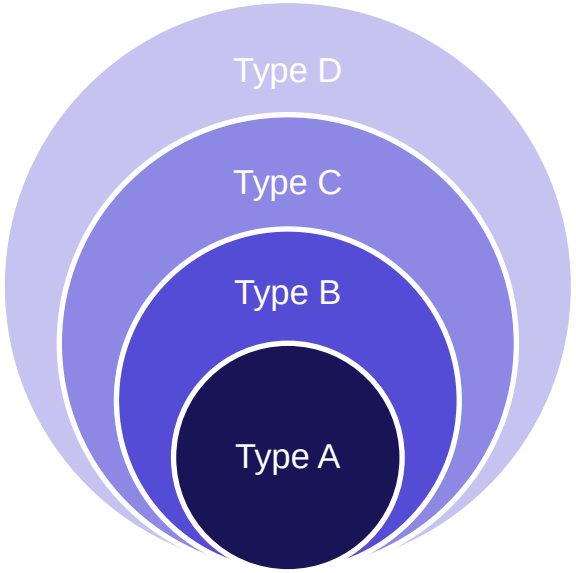
- **Generator capabilities are formulated from a system performance perspective, independent from technology**
- **Need to be able to cope with evolutions in generation mix**
- **Significance is regarded per requirement**

Wide-scale network operation and stability including European-wide balancing services

Stable and controllable dynamic response capabilities covering all operational network states

Automated dynamic response and resilience to operational events including system operator control

Basic capabilities to withstand wide-scale critical events; limited automated response/operator control



Significant users

Network Code gives max. thresholds at synchronous system level

- Criteria based on voltage level (> 110kV → Type D) and MW capacity (table)
- Decision at national level by National Regulatory Authority

Synchronous Area	maximum capacity threshold from which on a Generating Unit is of Type B	maximum capacity threshold from which on a Generating Unit is of Type C
Continental Europe	0.1 MW	10 MW
Nordic	1.5 MW	10 MW
Great Britain	1 MW	10 MW
Ireland	0.1 MW	5 MW
Baltic	0.1 MW	5 MW

What is the appropriate level of detail for Network Code requirements?

ACER Framework Guideline on Electricity Grid Connection

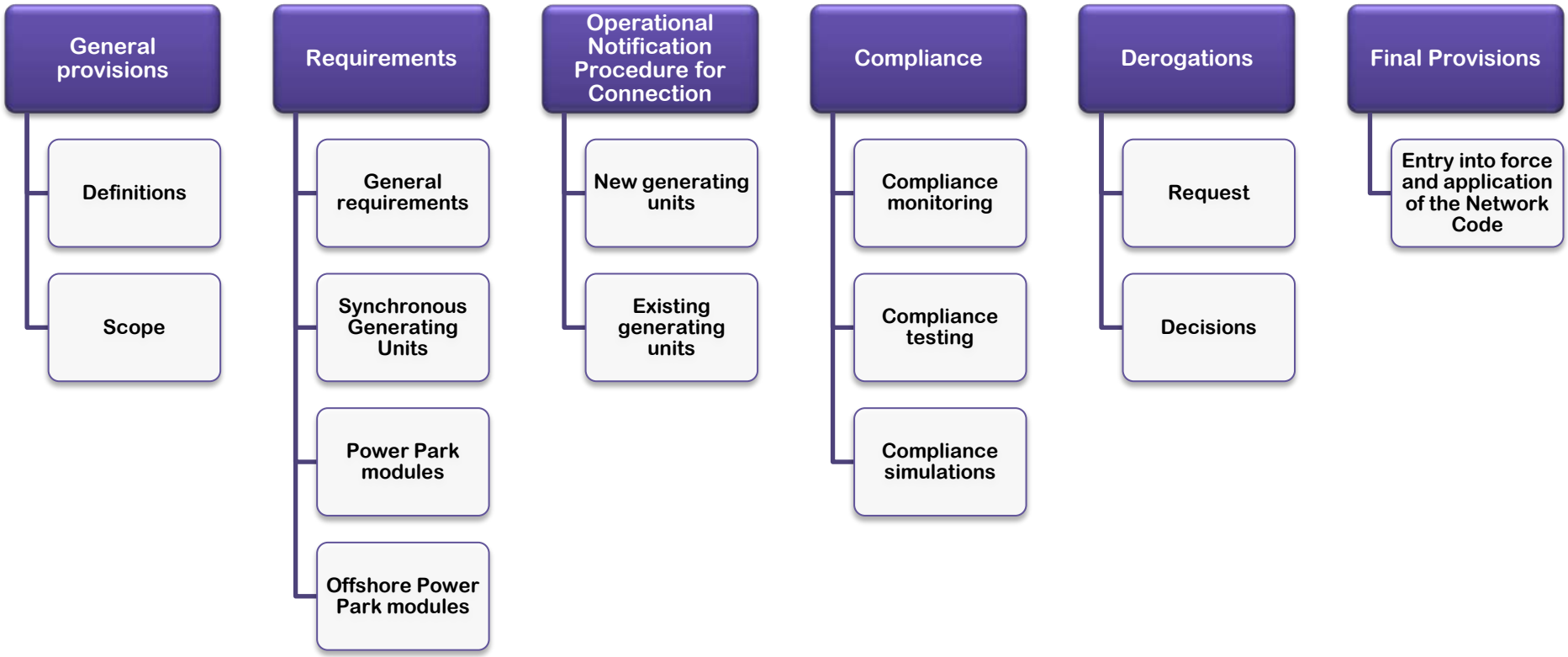
"Furthermore, the network code(s) shall define the requirements on significant grid users in relation to the relevant system parameters contributing to secure system operation, including:

- *Frequency and voltage parameters;*
- *Requirements for reactive power;*
- *Load-frequency control related issues;*
- *Short-circuit current;*
- *Requirements for protection devices and settings;*
- *Fault-ride-through capability; and*
- *Provision of ancillary services.*

…

The network code(s) shall set out how the TSO defines the technical requirements related to frequency and active power control and to voltage and reactive power management."

Network Code structure



Network Code requirements

Prescriptive requirements

- The Network Code lays down requirements and specific parameters
- ***E.g. frequency disconnection***

Framework requirements

- The Network Code gives a coherent approach to formulate requirements
- Avoids divergence of requirements throughout Europe
- Specific setting of parameters based on a given legal framework, e.g. NRA approval, consultation, in mutual agreement, other Network Codes, …
- ***E.g. reactive power provision***

Principle requirements

- High level requirement on functionality
- Specific implementation prescribed by other agreements, national legislation, Network Codes, …
- ***E.g. information exchange***

Level of detail

Harmonization

- Favored by manufacturers: larger market for same product
- Favored by project developers: less resources to engineering
- Concern by project developers: excuse for increased prices
- Note: Harmonisation is no objective in itself (3rd Energy Package)

Viewpoint of system security

- Different needs in each synchronous zone
- Different need of details in all requirements

Conclusion

- Level of detail differs per requirement
- General principles as well parameter settings exist in the Network Code

Are derogations possible and how are they approved?

ACER Framework Guideline on Electricity Grid Connection

- *"The network code(s) developed according to these Framework Guidelines shall describe the process and criteria for applying for derogation. This process is applicable to pre-existing (and in exceptional cases new) significant grid users."*
- *"The derogation process shall be transparent, non-discriminatory, non-biased, well documented and based on the cost-benefit analysis performed by the TSO."*
- *"The network code(s) may provide that derogation from all or some of the minimum standards and requirements may be granted to classes of pre-existing (and, in exceptional cases, new) significant grid users, non-discriminatorily, without the cost-benefit analysis being performed, if the TSO submits to the NRA a reasoned request and the exemption from the cost-benefit analysis is authorised by the NRA."*

Procedure for derogations

Application to the Relevant Network Operator

Assessment of the request and submission to the NRA

Decision by the NRA

Assessment of the decision by ACER and recommendations to the NRA

Register of derogations maintained by the NRA

Is the Network Code compatible with existing standards?

Compatibility with existing standards

The European Network Code will evidently show deviations from existing grid codes

Deviation	Impact
Number of requirements	Modest for most countries
Strictness and range of requirements	Modest for most countries
Units affected by the requirements	Harmonization of requirements to smaller units (also distribution level)
Compliance procedures and tests	Intensity increases

Compatibility with existing standards

ENTSO-E network code is drafted, based on best practices and existing grid codes throughout Europe

Earlier versions of the network code have been challenged in a public consultation (pilot process) and various bilateral discussions

All comments have been thoroughly assessed and if needed integrated in the code

ENTSO-E states that the Network Code does not impose significant variations from existing standards and grid codes

Stakeholders are invited to comment on this if needed in the public consultation (Q1/2012)

How are costs related to implementing Network Code requirements allocated and reimbursed?

ACER Framework Guideline on Electricity Grid Connection

- *"The network code(s) shall always require the system operators to optimise between the highest overall efficiency and lowest total cost for all involved stakeholders. In that respect, NRAs shall ensure, that, whatever the cost-sharing scheme is, the cost split follows the principles of non-discrimination, maximum transparency and assignment to the real originator of the costs."*

Provision of ancillary services driven by markets

Connection requirements need to provide forward looking capabilities

- What will the system situation be like in 10, 20, 30,… years time? Shift of providing grid services by smaller units is likely to continue further.
- Technical capabilities have impact on the basic design of generating units
- Manufacturers consider the requirements technically feasible, but R&D is needed to deliver adequate products.
- Short term market decisions can be detrimental for system security.

The actual provision of a number of ancillary services needs to be market based

- Based on adequate remuneration
- Based on market-related Network Codes to be developed (e. g. Balancing)

Retroactive application?

ACER Framework Guideline on Electricity Grid Connection

"The applicability of the standards and requirements to pre-existing significant grid users shall be decided on a national basis by the NRA, based on a proposal from the relevant TSO, after a public consultation. The TSO proposal shall be made on the basis of a sound and transparent quantitative cost-benefit analysis that shall demonstrate the socio-economic benefit, in particular of retroactive application of the minimum standards and requirements ... The format and methodology or principles of the cost-benefit analysis shall be prescribed by the network code(s)."

Retroactive application

Generation Units not yet under construction are considered to be existing, if

- Legally binding contract for main plant is in force
- Evidence is provided within 6 months after entry into force of the code
- Network Operator can request confirmation by Third Party auditor

Decision on retroactive application

- On a national basis
- Cost Benefit Analysis process initiated by TSO and supported by stakeholders
- Final approval of retroactive application (based on TSO proposal) by the National Regulatory Authority

Retroactive application

A full quantitive CBA is a resource intensive process

➲ A <u>filtering</u> (CBA stage 1) is performed based on engineering review

Cost of modification
Insignificant
Significant

Benefit in reduced demand loss / balancing costs
No/low impact
Significant impact

COST	BENEFIT	ACTION
		1
		2
		2
		3

- 1: Analyse retrofit via Stage 2 CBA
- 2: Make further judgment; check against ENTSO-E library
- No further action

Retroactive application

Examples	Cost	Benefit	Action
Reactive capability for large old generators different to new code, but not dramatically less Q range than code.			No further action
Generator narrow frequency range. Plant ok for full range, but require frequency trip settings change.			Quantitative CBA
Solar PV: Trip at modest system frequency deviation. Implement frequency range change and LFSM (at 50.2-50.5Hz).		Cont. Eur.	Quantitative CBA
		Other area	Further review
Limited frequency range of domestic CHP, volume modest			Further review
Early wind farms with inadequate reactive capability and reactive control facilities, as well as inadequate FRT capability		Great Britain	No further action
		Spain	Further review

Retroactive application

Green light: reasonable prospect of justifying retroactive application ⇨ quantitative CBA (stage 2)

CBA techniques

- Net Present Value / Return On Investment / Rate of Return / Time to Break Even.
- Discount rate at TSO's discretion

Cost components

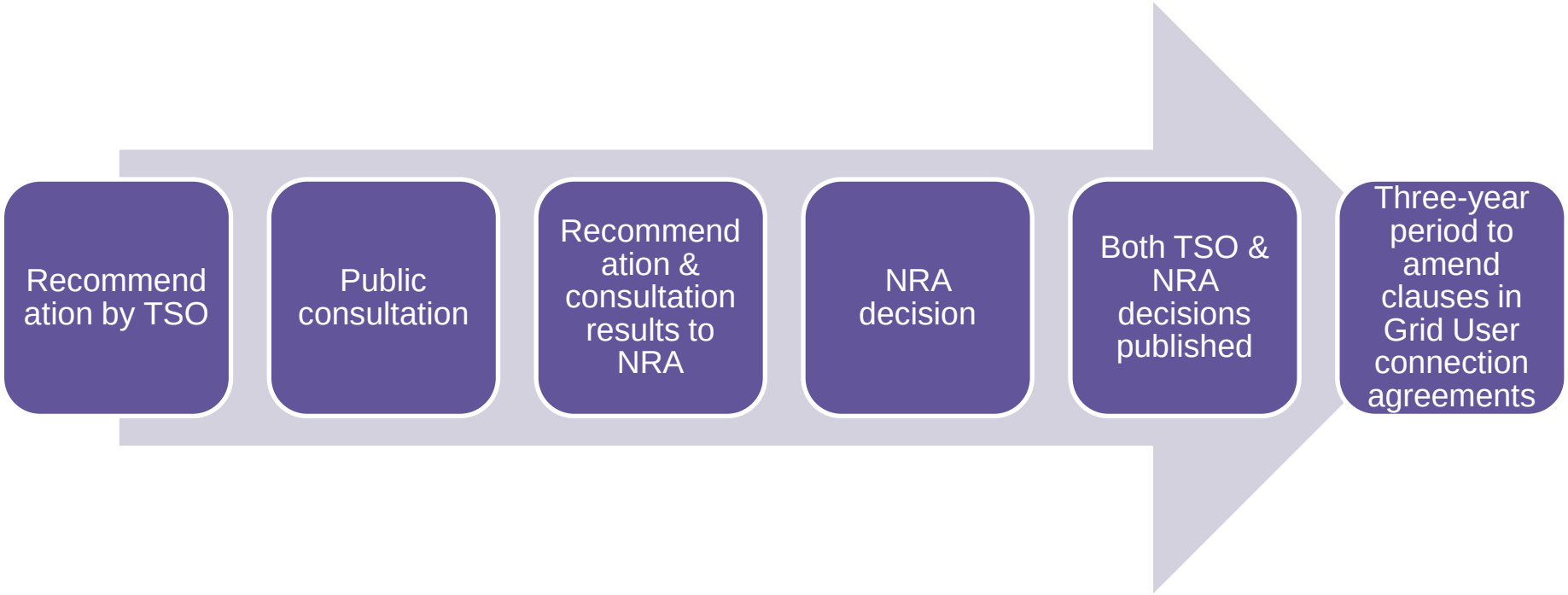
- Costs for implementing the requirement
- Any attributable loss of opportunity
- Change in maintenance costs

Societal Benefits

- Improvement of security of supply (black out probability)
- Improvement to the internal market in electricity and cross-border trade (reactive power provision, freq. response, reserves, …)

Retroactive application

If CBA justifies retroactive application for a user or a class of users



Retroactive application

- **If retroactive application for a requirement is not enforced**
  - → Existing Generating Unit remains bound by technical requirements pursuant to national legislation or by contractual agreements.
- **National legislation**
  - → may remain in force, in case it refers to requirements not covered by the Network Code
- **If national legislation is repealed**
  - → Existing Generating Unit remains bound by technical requirements pursuant to national legislation such as it was the day before it ceased to be in force.
- **Former derogations to national legislation**
  - → are not valid as derogation for the European Network Code, but provide evidently useful information

Backup

Why is there no Network Code per type of generation technology?

ACER Framework Guideline on Electricity Grid Connection

"Where additional requirements beyond those defined in the minimum standards and requirements are mandated for a particular class, technology, size or location of significant grid user, the network code(s) shall set out and justify these additional requirements."

Types of generation

Examples

- *« Why not differentiate between variable and constant primary sources? »*
- *« Why not differentiate between technologies with inherently different inertia? »*

Network Code built from a system perspective

- Voltage/frequency/angular stability
- Balancing
- Information exchange
- …
- are all independent from prime mover

Connection interface is of importance

- Synchronous generator
- Power electronic interface (Power Park Module)

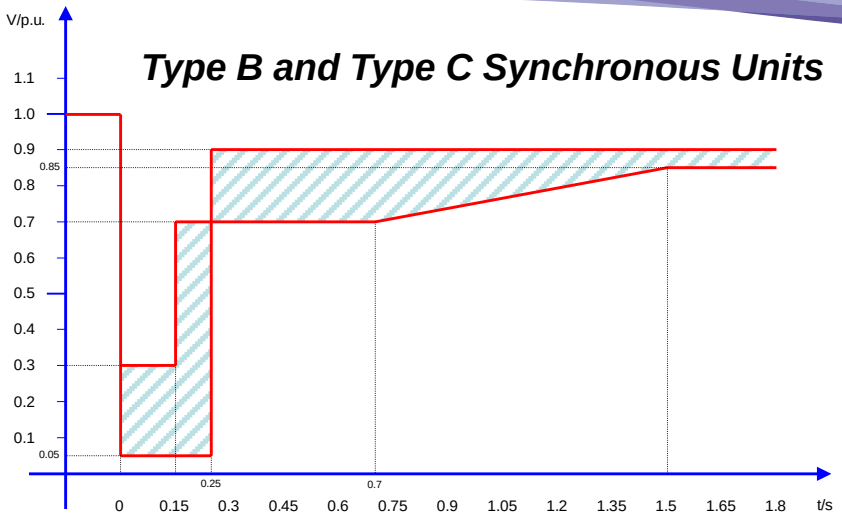
Additional requirements for offshore wind

Consistent set of requirements aids in equitable treatment of all Grid Users

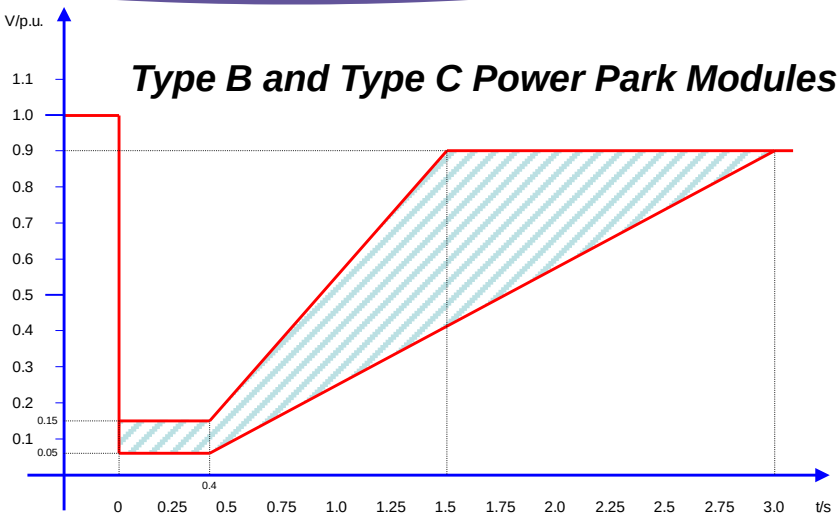
How to understand Fault-Ride-Through capability?

Fault-Ride-Through Capability

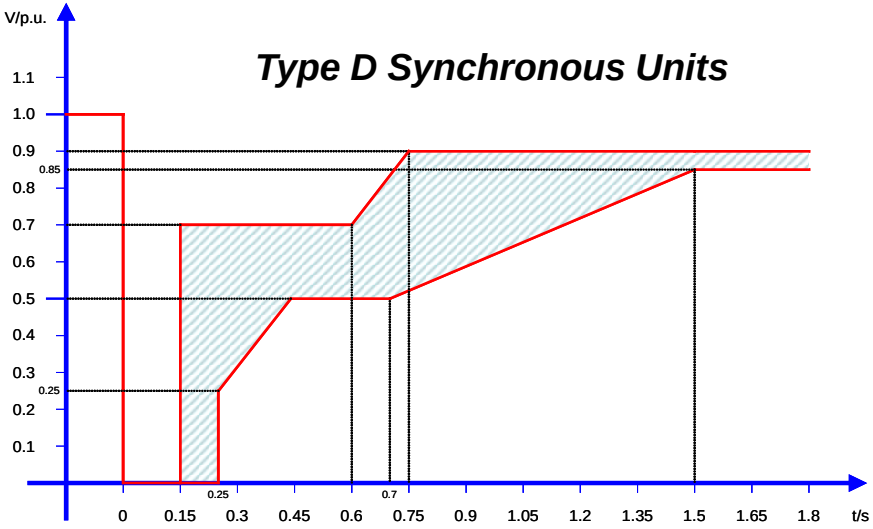
Type B and Type C Synchronous Units



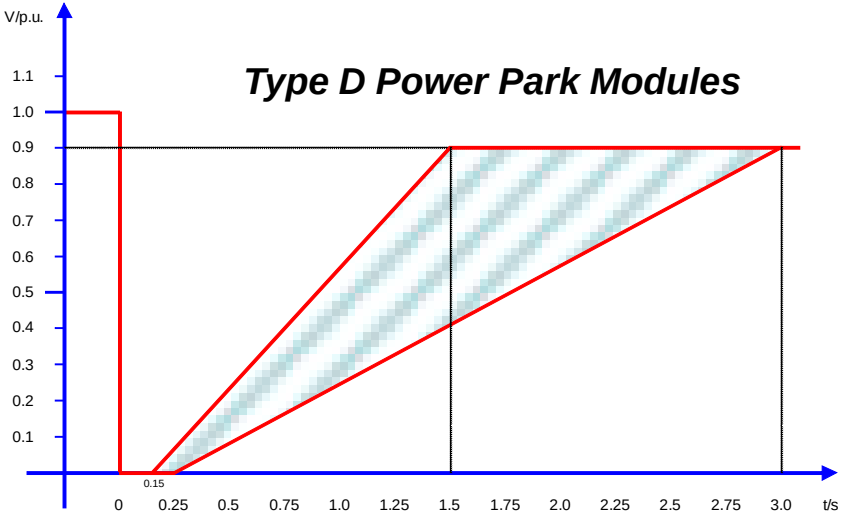
Type B and Type C Power Park Modules



Type D Synchronous Units



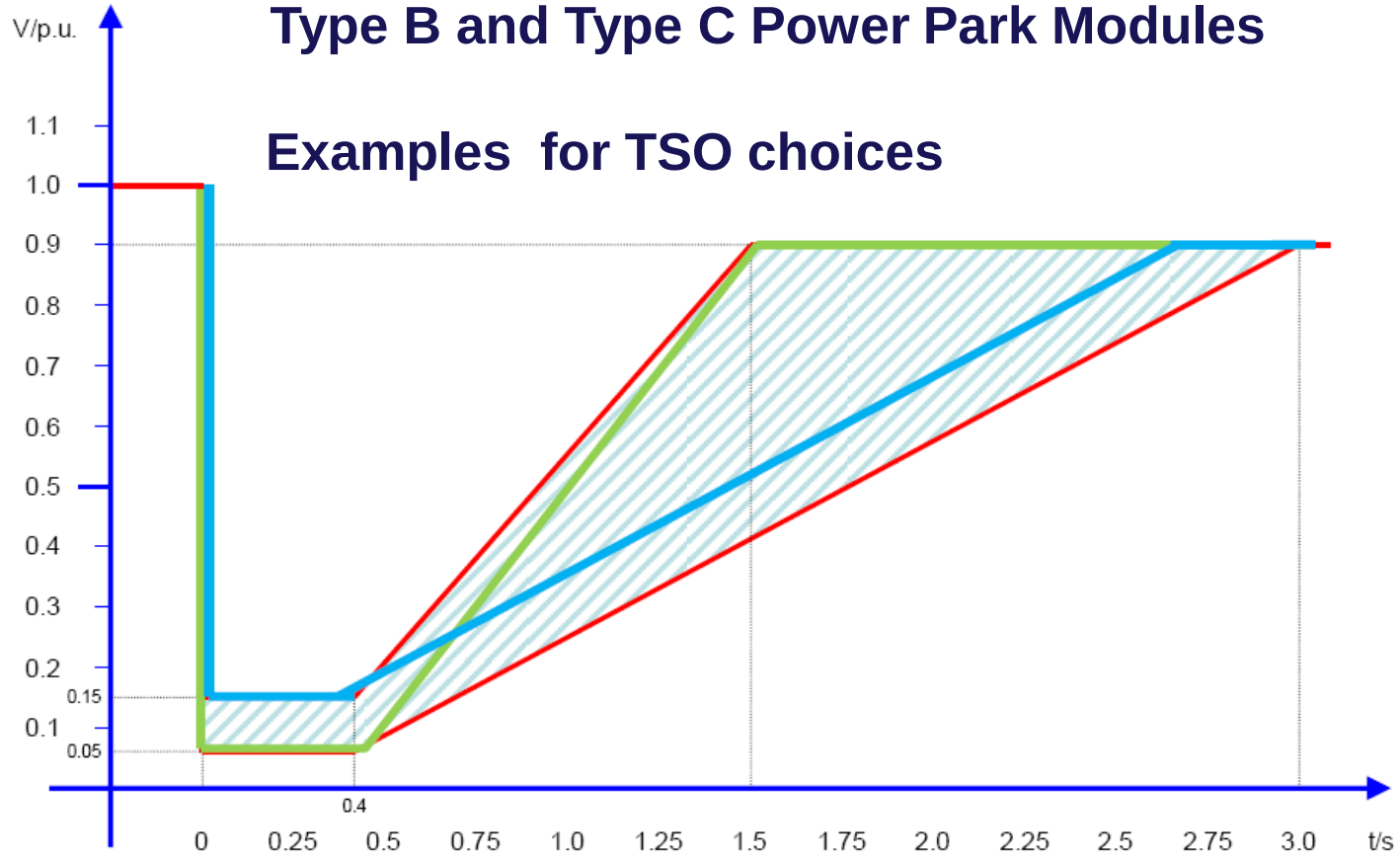
Type D Power Park Modules



Fault-Ride-Through Capability

Type B and Type C Power Park Modules

Examples for TSO choices



Fault-Ride-Through Capability

Successful Fault-Ride-Through depends on actual voltage recovery profile

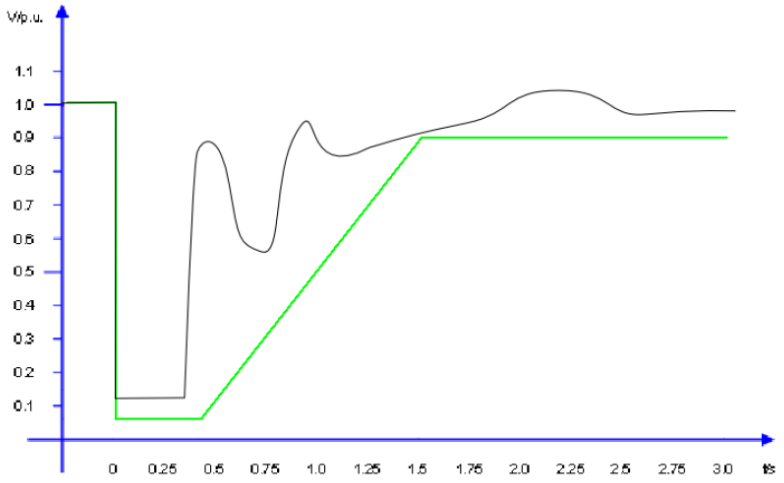


Figure 1: Fault-Ride-Through required

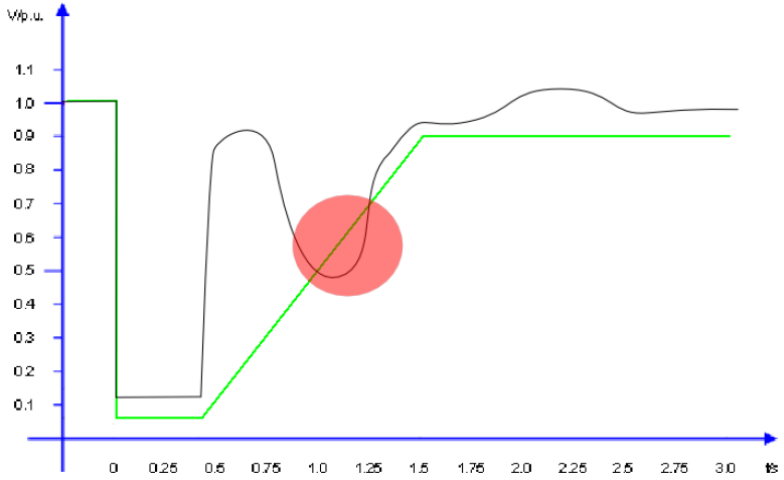


Figure 2: Disconnection admissible

Why is the reactive power capability so wide?

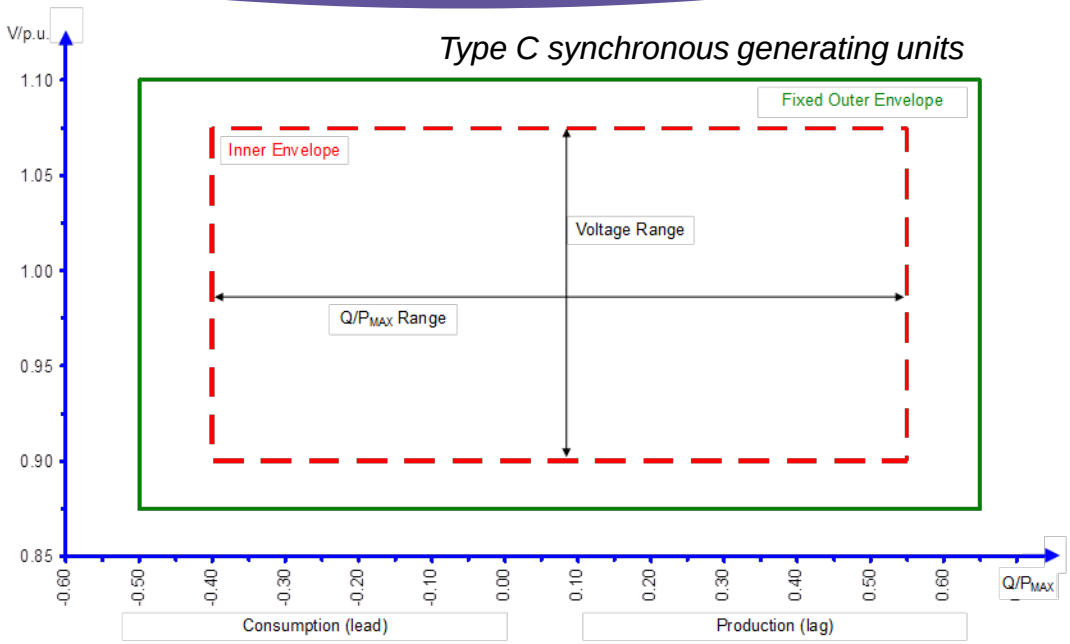
Reactive power capability

Need for reactive power depends strongly on the type of network (length, cable/overhead, loading, …)

- Network Operator defines U-Q/Pmax shape within red envelope
- Red envelope can be moved within boundaries
- Dimensions red envelope depend on synchronous area
- Green outer boundary is based on all relevant grid codes in Europe. Note: the green boundary is not the requested range.

Provides a basis for efficient voltage regulation in constantly evolving networks

Type C synchronous generating units



Synchronous Area	Range of Q/P_{max}	Range of steady state voltage level in PU
Continental Europe	0.95	0.225
Nordic	0.95	0.150
Great Britain	0.95	0.100
Ireland	1.08	0.218
Baltic States	1.0	0.220