

Network Code on Connection Requirements applicable to all Generators

Main content

Workshop RTE November, 25th 2011

NC on RfG

entsoe

Reliable Sustainable Connected



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."

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: Harmonization 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

Network Code requirements



The network code shows three levels of 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***



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

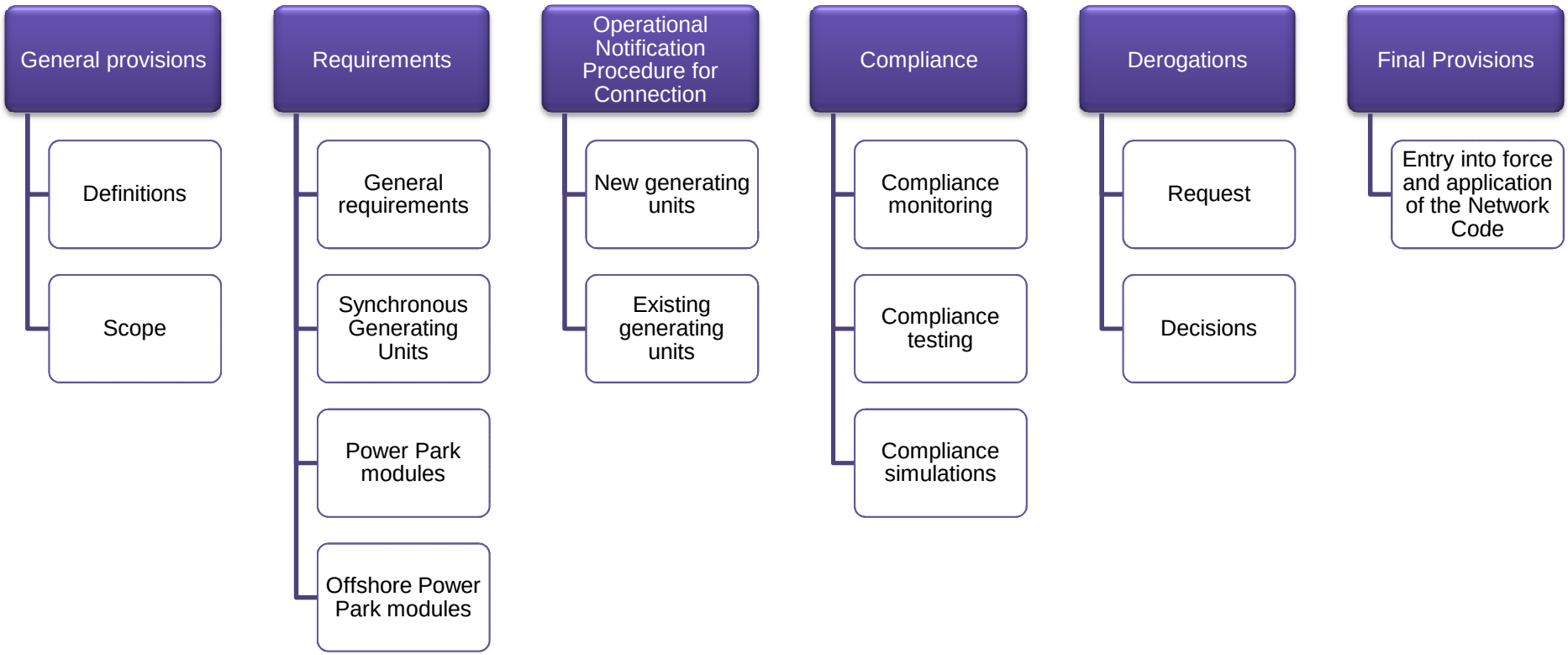
Connection interface is of importance

- 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

Network Code structure



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

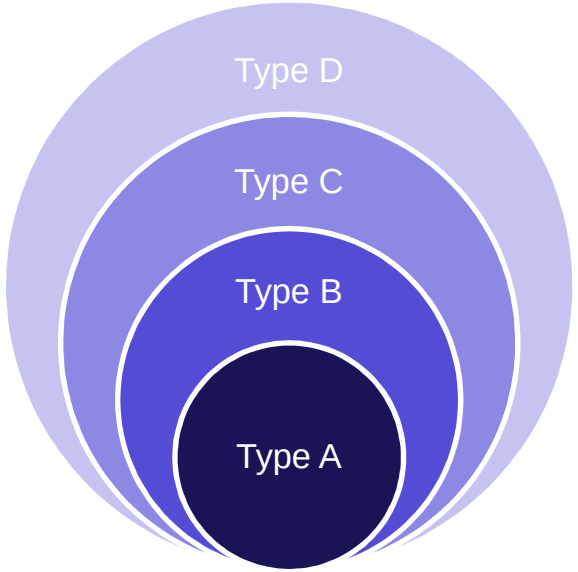
- **Generator capabilities are formulated from a system performance perspective, independent from technology**
- **Need to be able to cope with evolutions in generation mix**
- **Significance is regarded per requirement**

Europe wide balancing services

Refined and controllable dynamic response

Automated response, operator control, information

Common failure mode for all plants (frequency)



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

- Continental Europe:
  - Type A: U< 110 kV, P > 400 W
  - Type B: U< 110 kV, P > 0,1 MW
  - Type C: U< 110 kV, P> 10 MW
  - Type D: U> 110 kV

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.

Retro-active 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)."

Retro-active application



Considered as an Existing Generation Unit if

- Physically connected to the network, or
- Legally binding contract for main part of the generator is provided within 6 months after entry into force of the code
- Can be audited by the Relevant Network Operator

Decision on retro-active fitting

- On a national basis
- Cost Benefit Analysis (two-stage ‘traffic light’) process initiated by TSO
- Final decision to approve retro-active fitting (based on TSO proposal) by the National Regulatory Authority

Retro-active 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

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

COST	BENEFIT	ACTION
		1
		2
		2
		3

Retro-active application



Green light: reasonable prospect of justifying retro-active fitting

⇨ 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

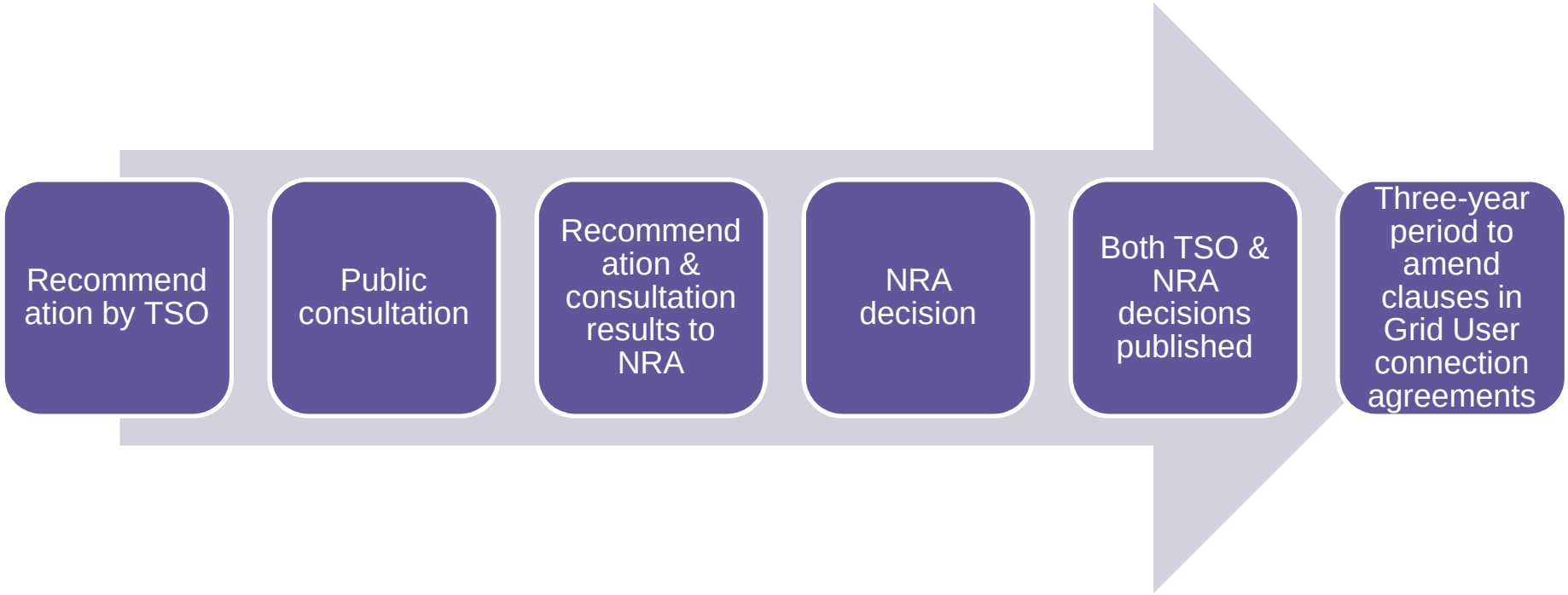
- Costs for implementing the requirement
- Any attributable loss of opportunity
- Change in maintenance costs

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, …)

Retro-active application

If CBA justifies retro-active application for a user or a class of users



Retro-active application



- **If retro-activity for a requirement is not enforced**

  → Existing Generating Unit remains bound by technical requirements pursuant to national legislation or by contractual agreements.

- **If national legislation is repealed**

  → Existing Generating Unit (in case of no retrofitting) remains bound by technical requirements pursuant to national legislation such as it was the day before it ceased to be in force.

- **National legislation**

  → may remain in force, in case it refers to requirements not covered by the Network Code

- **Former derogations to national legislation**

  → are not valid as derogation for the European Network Code, but provide evidently useful information



Le système de dérogations

Dérogations



- **Demande de dérogation par le Producteur**

  → Sur le respect d'une ou plusieurs exigences du code

  → Adressée au GRT ou GRD, avec le détail de la demande , les arguments et le groupe concerné.

- **Dans les 6 mois, soumission de la demande par le gestionnaire de réseau au Régulateur National**

  → Position du gestionnaire

  → Analyse coûts/bénéfices ou demande d'exemption (le Régulateur doit répondre à cette demande sous un mois)

Dérogations



- **Sous 3 mois, réponse argumentée du Régulateur National et durée de la dérogation** (pendant la phase de traitement, le Producteur est considéré comme conforme aux exigences)

  → Information de la réponse au Producteur, GRT ou GRD, ACER

  → Tenue d'un registre des dérogations acceptées et rejetées, communiqué tous les 6 mois à l'ACER, copie ENTSOE

- **Rôle de l'ACER**

→ Suit l'ensemble des procédures de dérogation

→ Peut faire des recommandations au Régulateur National

→ Peut révoquer une dérogation



Procédure d’accès au réseau

Procédure d’accès au réseau



- **Procédure d’accès au réseau en 3 étapes, proche de celle existant actuellement pour l’accès au RPT:**
  - Mise sous tension du réseau interne, avant couplage
  - Phase d’essais, d’une durée maximum de 24 mois
  - Accès au réseau définitif, après levée des éventuelles non-conformités

- **Existence d’une autorisation limitée d’accès au réseau:**
  - en cas de modification ou perte temporaire d’une capacité due à une modification de l’installation

  ou

  - en cas de défaut d’un équipement conduisant à la non-conformité par rapport à une exigence (pour une durée >3 mois).

  - Durée maximum de 12 mois avec calendrier de remise en conformité.

Does the Network Code deviate significantly from existing standards?

Deviations from existing requirements



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

Deviations from existing requirements

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)

Deviations from existing requirements

- **Les nouvelles exigences :**

- **L’injection de courant réactif pendant les défauts (ou les baisses de tension)**

- **L’émulation d’inertie**

- **Les variations des exigences existantes :**

- **Les plages de variation de fréquence**

- **Les plages de variation de tension**

- **Les gabarits de creux de tension**

- **Le réglage de fréquence étendu**

•Exigence pour les PPM:

P>0,1 MW (type B)

–Injecter du courant réactif lorsque la tension baisse.

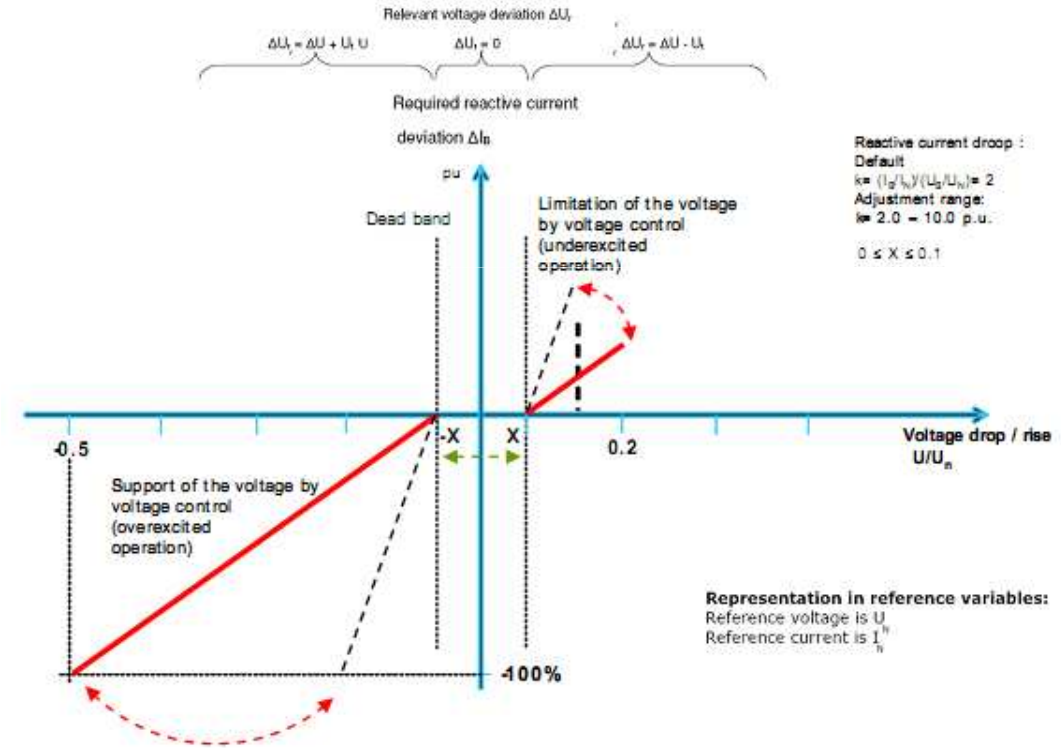
–Le but de cette exigence est de limiter la propagation des creux de tension et d'en limiter l'impact en terme de volume déconnecté.

Exigence :

–2 % I réactif / 1 % de chute de tension

–Dynamique : 40 ms

–I réactif max >= I effectivement fourni avant défaut



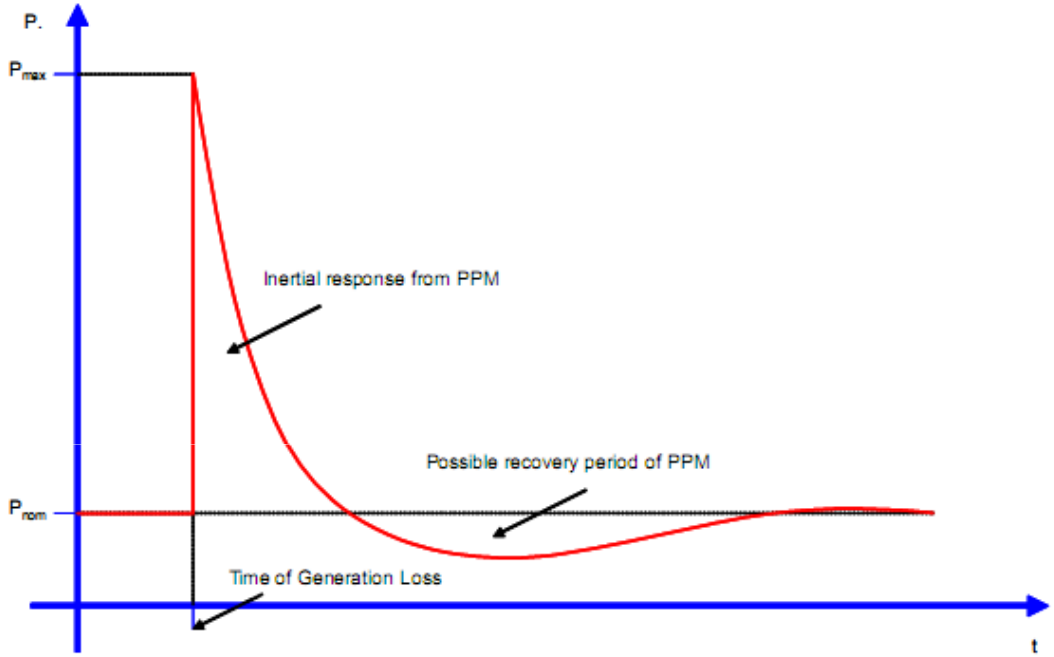
Inertie équivalente simulée

P>10 MW (type C)

- **Si le GRT l'exige**
  le moyen de production doit :

–Fournir une inertie équivalente à un groupe de production classique (génératrice synchrone) en réponse à une variation de fréquence

–Les modalités de réponse et de retour à Pnom sont définies par le TSO



Plage de variation en fréquence

Exigence française

Plage de fréquence	Durée minimale de fonctionnement
47 => 47,5	1 min
47,5 => 49	3 min
49 => 49,5	5 H
49,5 => 50,5	Sans limite
50,5 => 51	60 min
51 => 52	15 min

Exigence ENTSOE

Applicable à tous

Synchronous Area	Frequency Range	Time period for operation
Continental Europe	47.5 Hz – 48.5 Hz	To be determined by each TSO, but not less than 30 minutes
	48.5 Hz – 49.0 Hz	To be determined by each TSObut 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

Plage de variation en tension



Exigence française

Tension de référence	Plage de tension basse	Plage de tension haute	Plage basse (pu)	Plage Haute (pu)
225 kV	180kV / 200 kV	245 kV / 250 kV	0.8 / 0.89 (90 min à 0.85)	1.09 / 1.11 (5 min à 1.1)
400kV	320 kV / 380 kV	420 kV / 440 kV	0.8 / 0.85 (90 min à 0.85)	1.05 / 1.1 (5 min à 1.1)

Exigence ENTSOE

Uniquement pour les groupes raccordés au-dessus de 110 kV

225 kV Continental	0.80 pu – 0.85 pu	30 minutes
	0.85 pu – 0.90 pu	60 minutes
	0.90 pu – 1.115 pu	Unlimited
	1.115 pu – 1.15 pu	60 minutes

400 kV Continental	0.80 pu – 0.85 pu	30 minutes
	0.85 pu – 0.90 pu	60 minutes
	0.90 pu – 1.05 pu	Unlimited
	1.05 pu – 1.0875 pu	To be determined by each TSO but not less than 60 minutes
	1.0875 pu – 1.10 pu	60 minutes

Creux de tension :

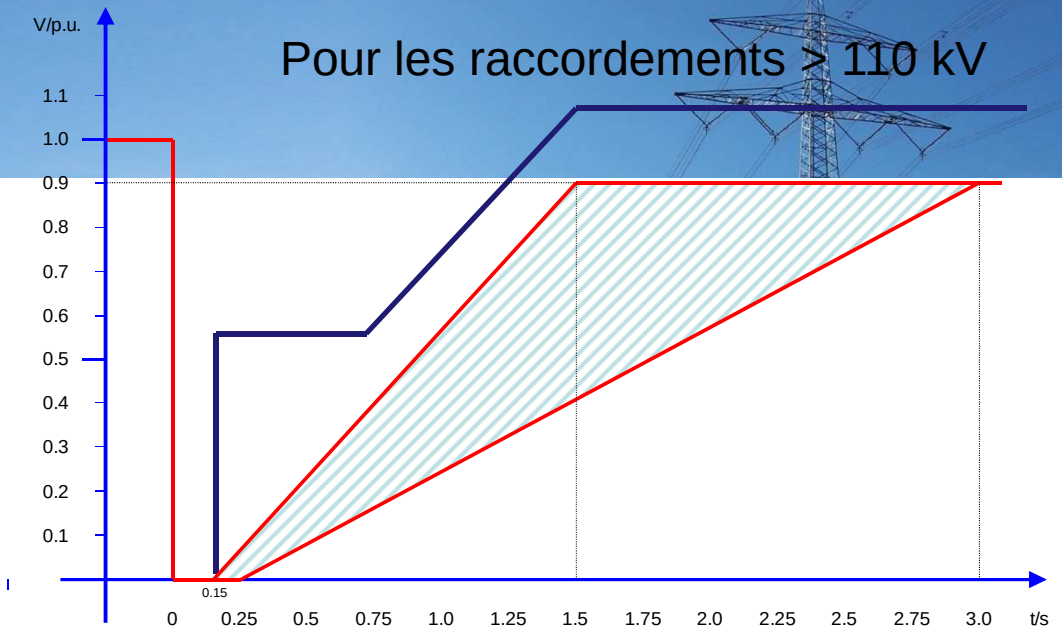
PPM

- **Code RfG**

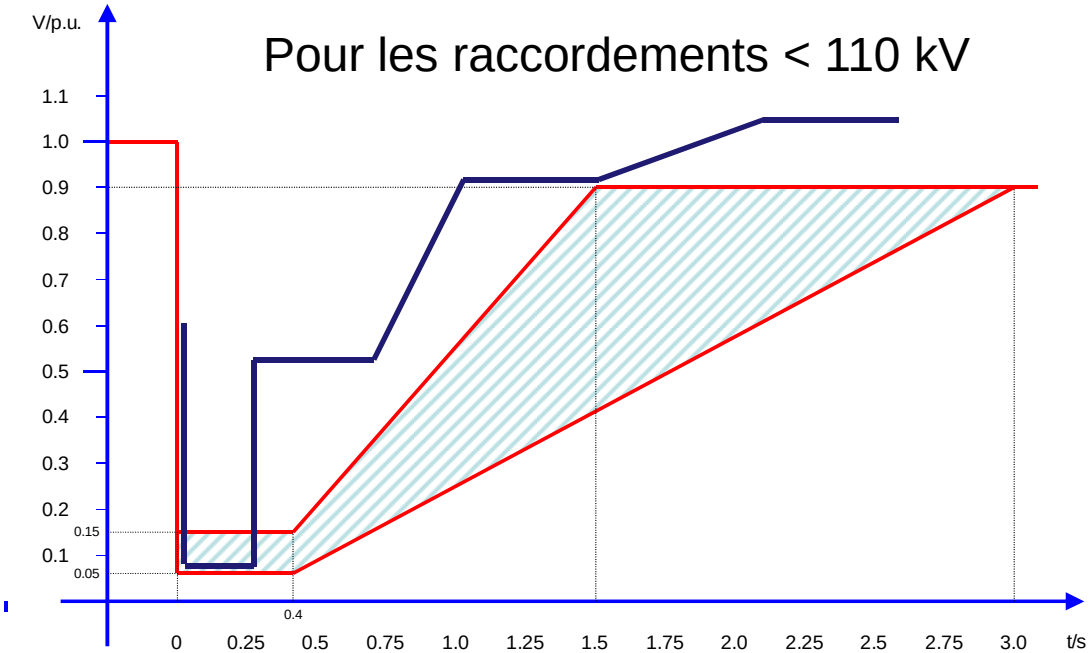
P>0,1 MW (type B)

- **Exigences françaises**

Pour les raccordements > 110 kV



Pour les raccordements < 110 kV

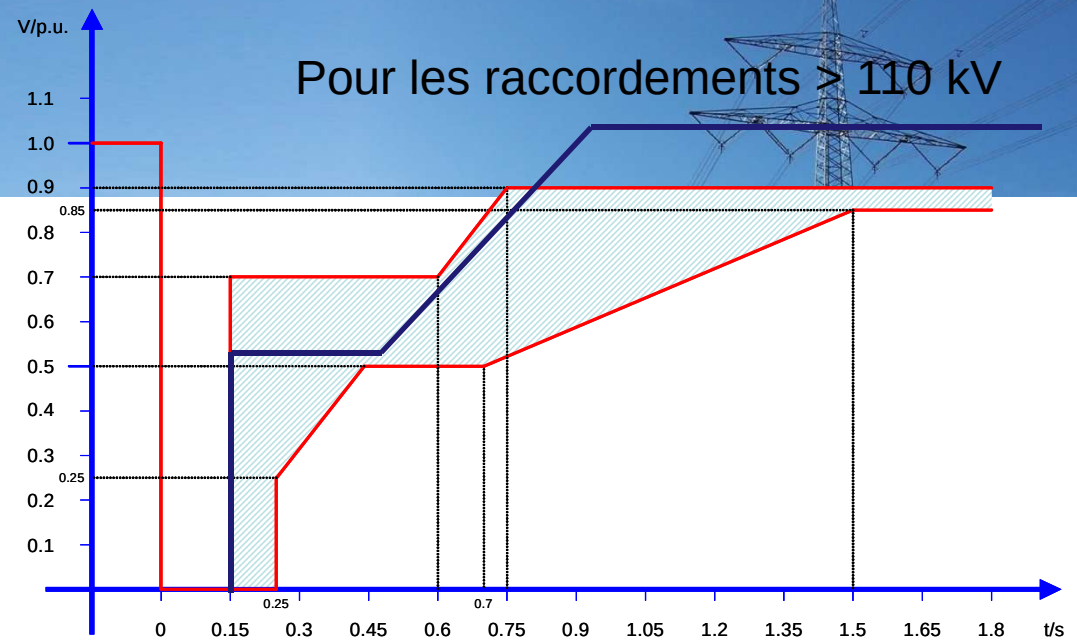


Creux de tension :

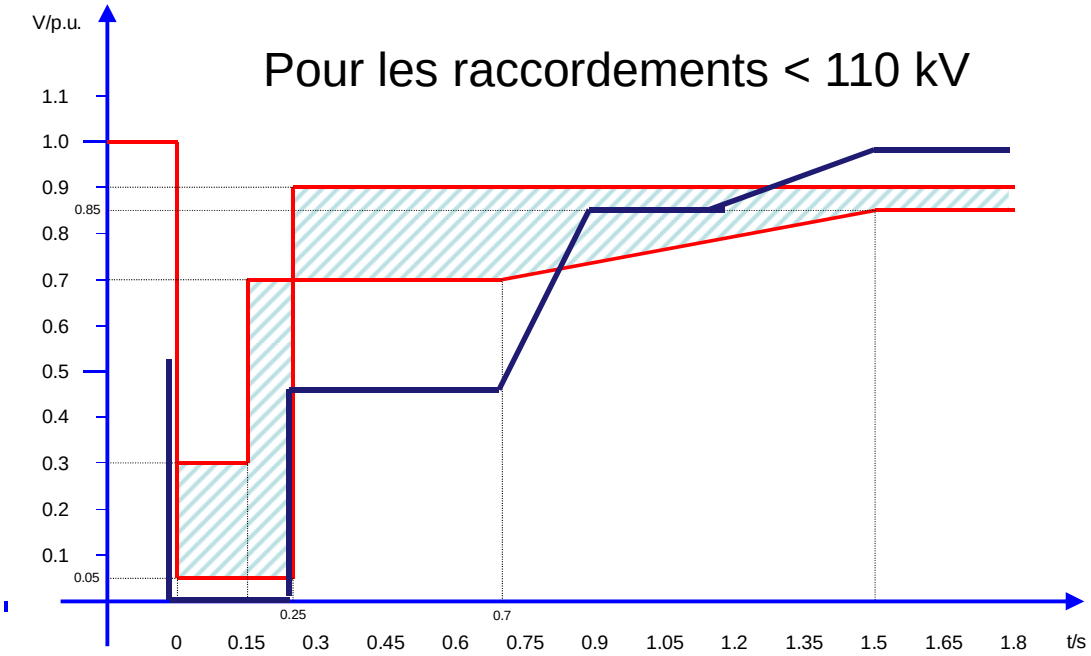
Machine synchrone

Code RfG

P>0,1 MW (type B)



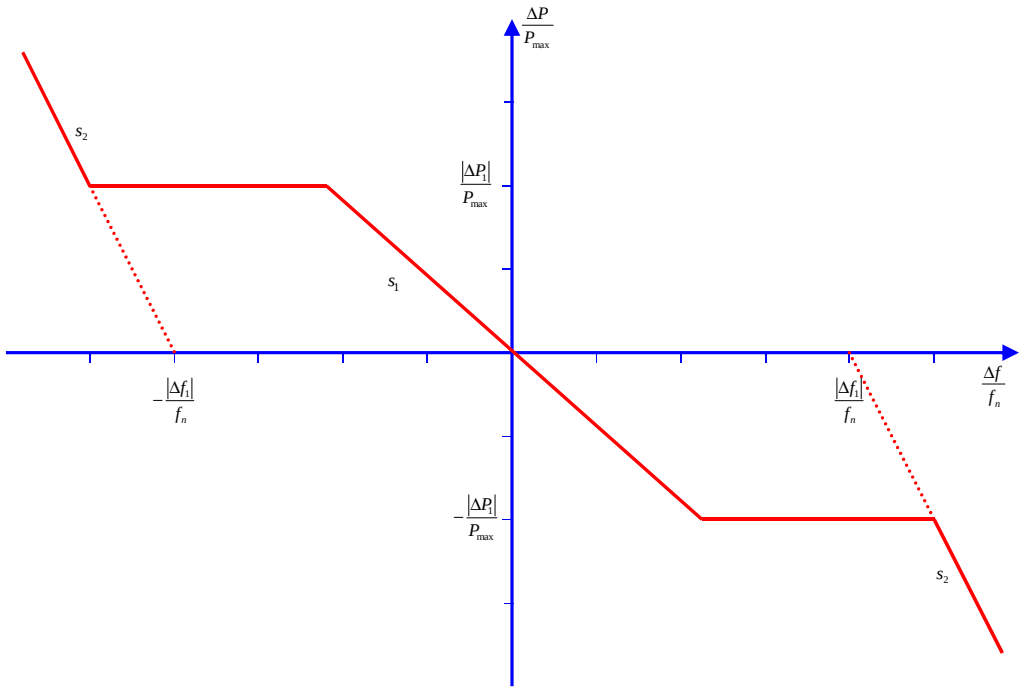
•Exigences françaises



Réglage de fréquence

–Pour tous les raccordement d'une puissance **supérieure à 10 MW**. La capacité de réglage de fréquence est obligatoire.

–Exigence technique de capacité : le mode d'utilisation n'est pas prescrit dans le code.





Questions?

- **Working draft of the Network Code**
  - http://www.entsoe.eu
- **Documents to be published during public consultation**
  - Frequently Asked Questions (update)
  - Position paper on the Network Code approach