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Load-Frequency Control and Reserves Network Code



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JESG – 19 March 2013

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Agenda

- Overview and Timescales
- Stakeholder Engagement
- Overview of the Code
- More detailed discussion on Frequency Quality reporting & Normal Distribution methods

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Background and purpose

- One of the **Network Codes** being developed under the **System Operation Framework Guidelines**
- Overview:
  - The LFC&R Network Code considers the containment and restoration system frequency and appropriate dimensioning of reserves to achieve and maintain satisfactory frequency quality in terms of the frequency deviations from the nominal value and how often these deviations occur within a defined time period.
  - The code seeks harmonisation where practical and achievable and standardisation of terminology.
- Where necessary parameters are defined on a per synchronous area basis

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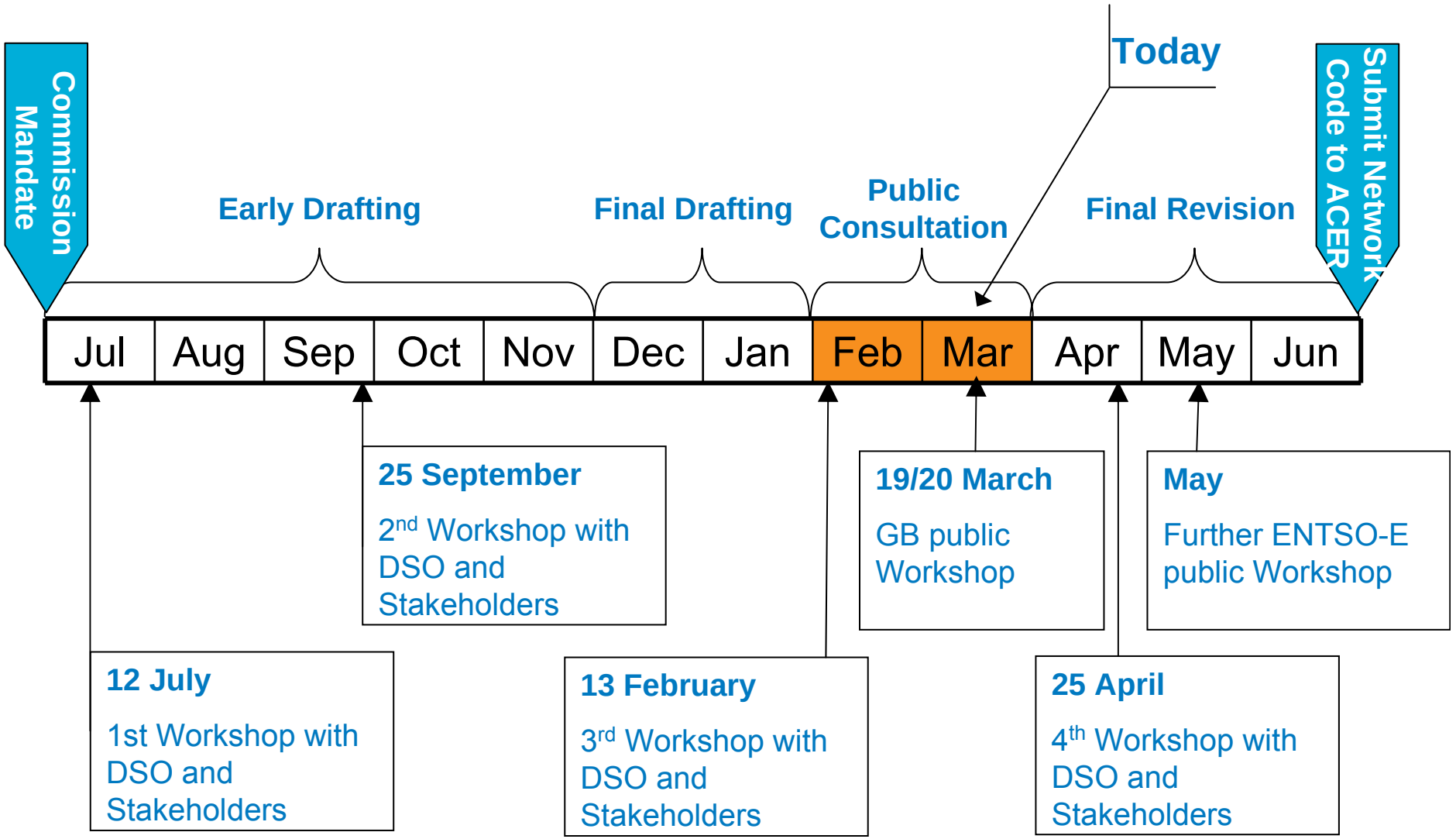
ENTSO-E LFC&R Timescale



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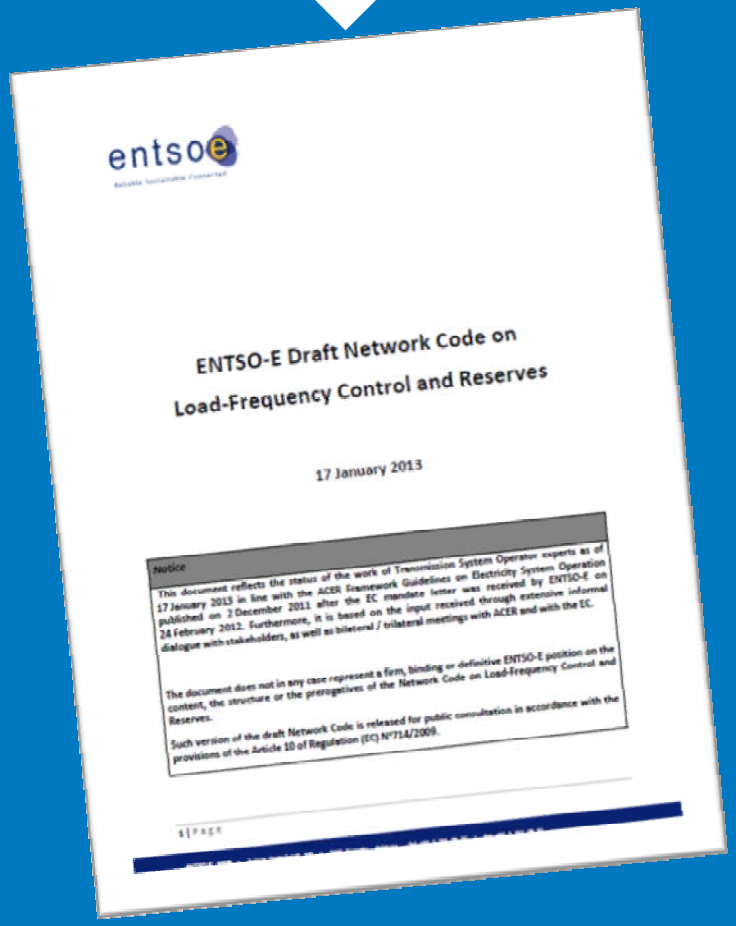
Stakeholder Engagement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ENTSO-E Draft Network Code on

Load-Frequency Control and Reserves

17 January 2013

Notice

This document reflects the status of the work of Transmission System Operator experts as of 17 January 2013 in line with the ACER Framework Guidelines on Electricity System Operation published on 3 December 2011 after the EC mandate letter was received by ENTSO-E on 24 February 2012. Furthermore, it is based on the input received through extensive informal dialogue with stakeholders, as well as bilateral / trilateral meetings with ACER and with the EC.

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Key dates and opportunities to engage in the process

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ENTSO-E Stakeholder Engagement

- **ENTSO-E Public Stakeholder Workshop**
  - **12/03/2013 took place in Brussels**
  - **A further Public Workshop will be arranged towards the end of the drafting process**
- All Responses to ENTSO-E by electronic comment via the consultation website.
  - https://www.entsoe.eu/news-events/entso-e-consultations/
  - https://www.entsoe.eu/major-projects/network-code-development/load-frequency-control-reserves/

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GB Stakeholder Engagement

- (Today) 19th & 20th March – 2 day event (ELEXON Building)
  - Presentation and discussion on the LFCR code and its impact on GB operations and industry.
  - *Please this does not replace the ENTSO-E consultation. Formal stakeholder comments are to be submitted directly to ENTSO-E.*

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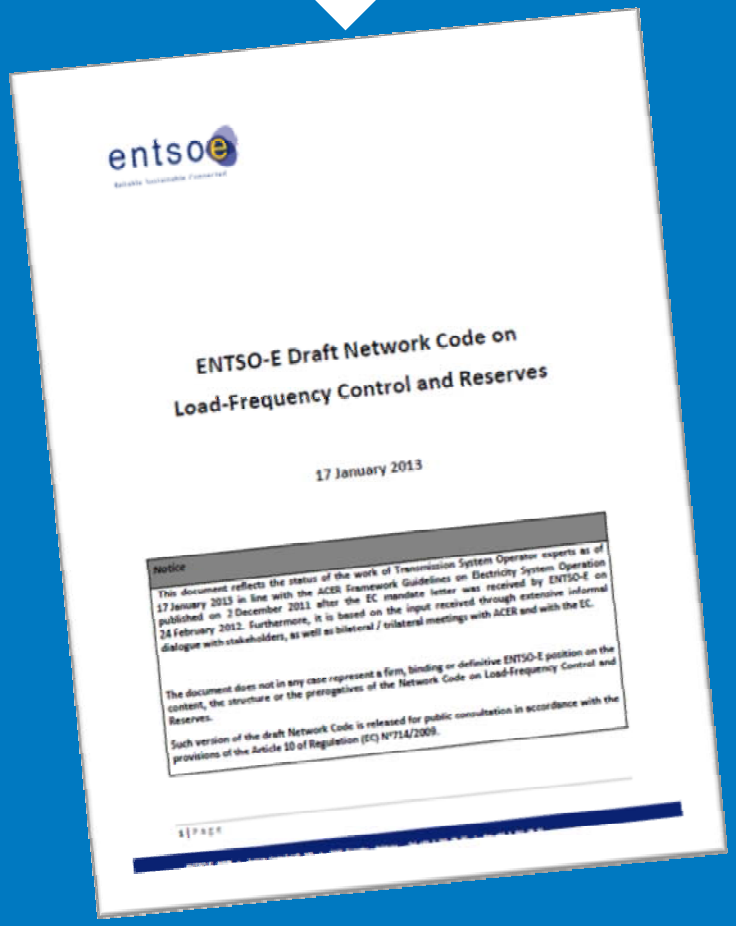
Provisions of the Network Code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Overview of the Code:
Structure and
Key concepts

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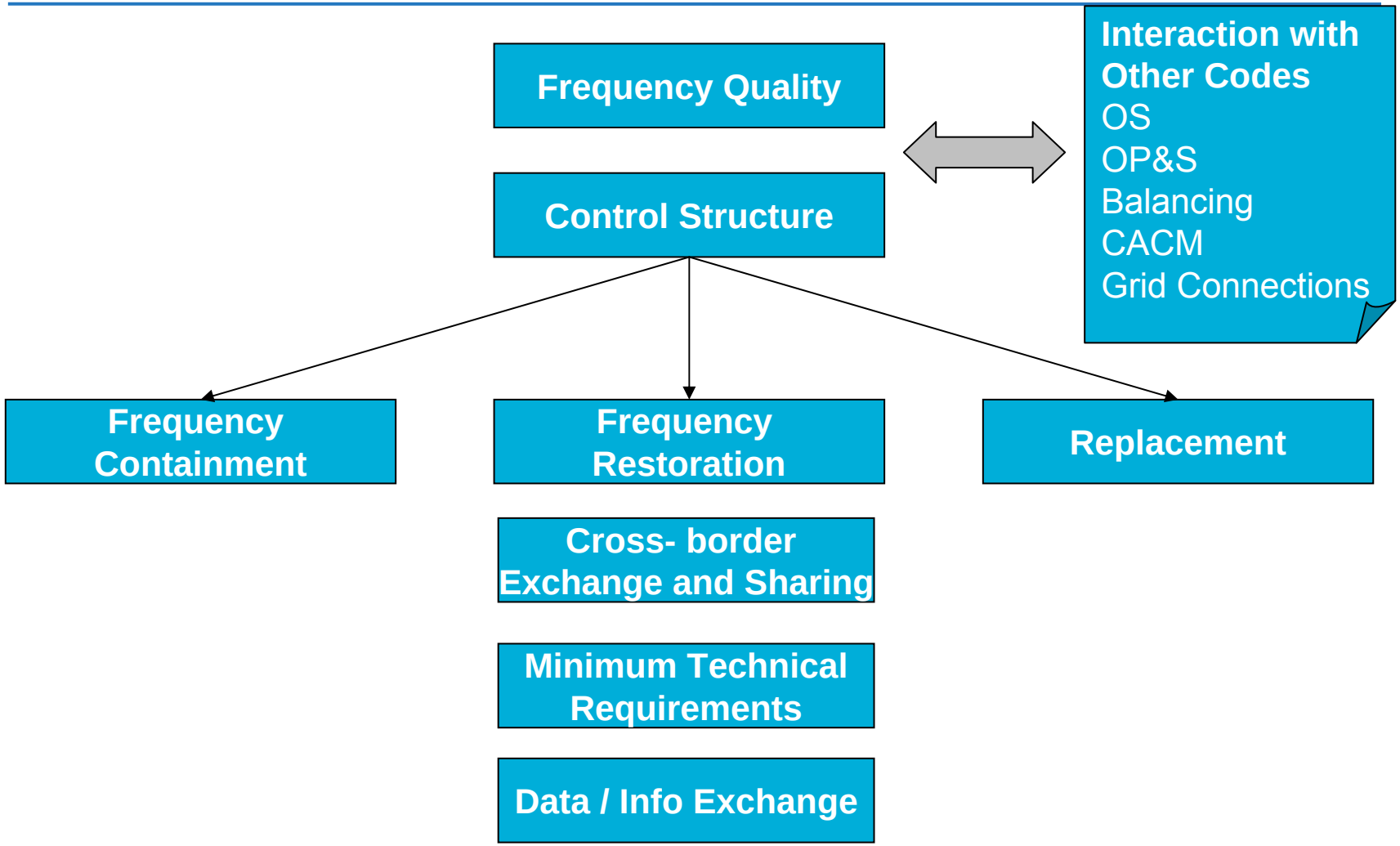
LFC&R Framework



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Chapter 2: Frequency Quality

- This section defines the specific operating criteria of each Synchronous Area with specific values (Table 1);
- Specific interaction between frequency quality, dimensioning incident and 3-categories of reserve are introduced;

Frequency Quality Parameters

	GB Synchronous Area
Nominal Frequency	50 Hz
Standard Frequency Range	±200 mHz
Maximum Instantaneous Frequency Deviation	800 mHz
Maximum Steady-state Frequency Deviation	500 mHz
Time to Recover Frequency	1 minute
Frequency Range Within Time To Recover Frequency	±500 mHz
Time To Restore Frequency	10 minutes
Frequency Range Within Time To Restore Frequency	±200 mHz

Table 1: Frequency Quality Criteria

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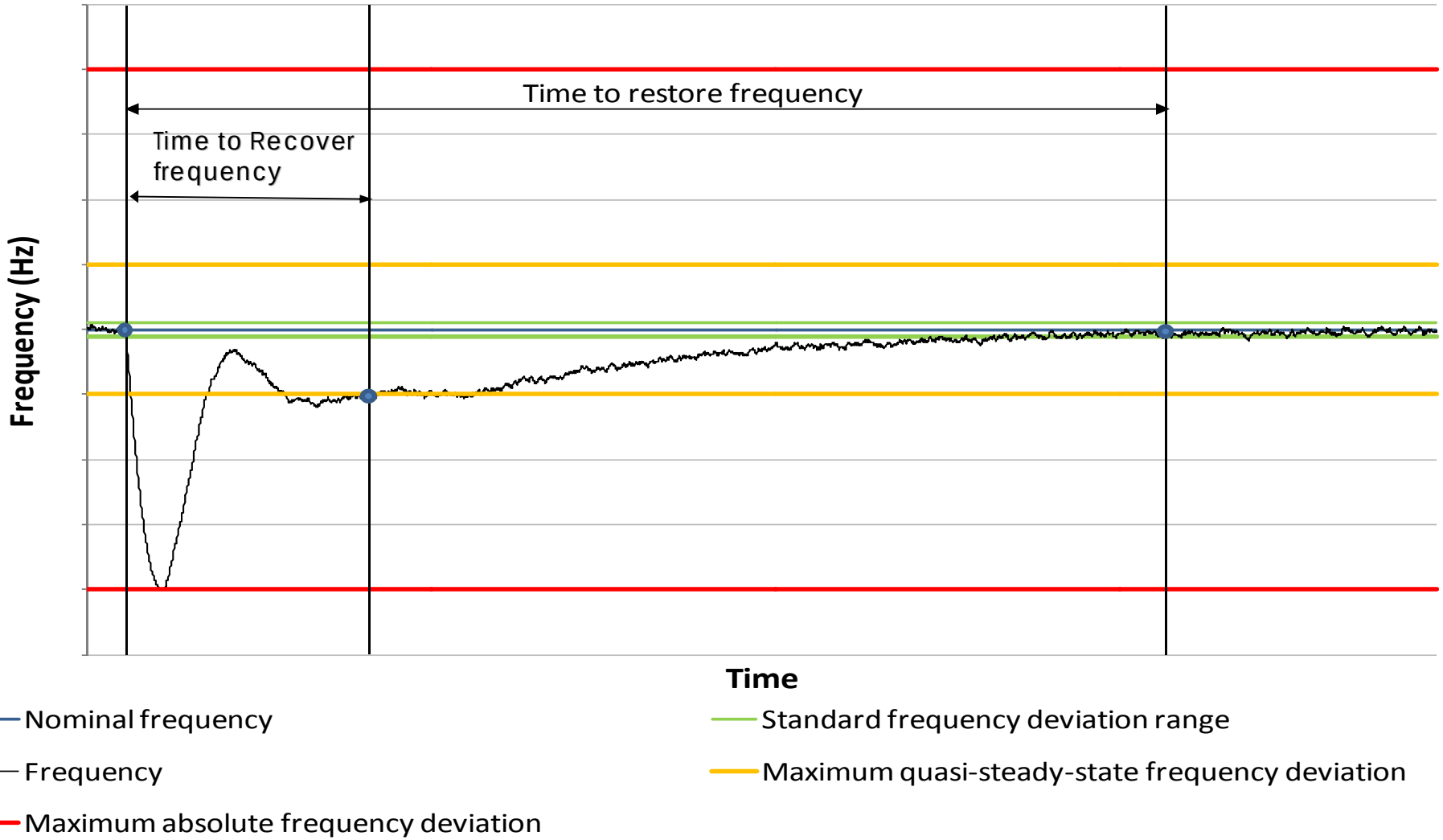
Frequency Quality – General Terms



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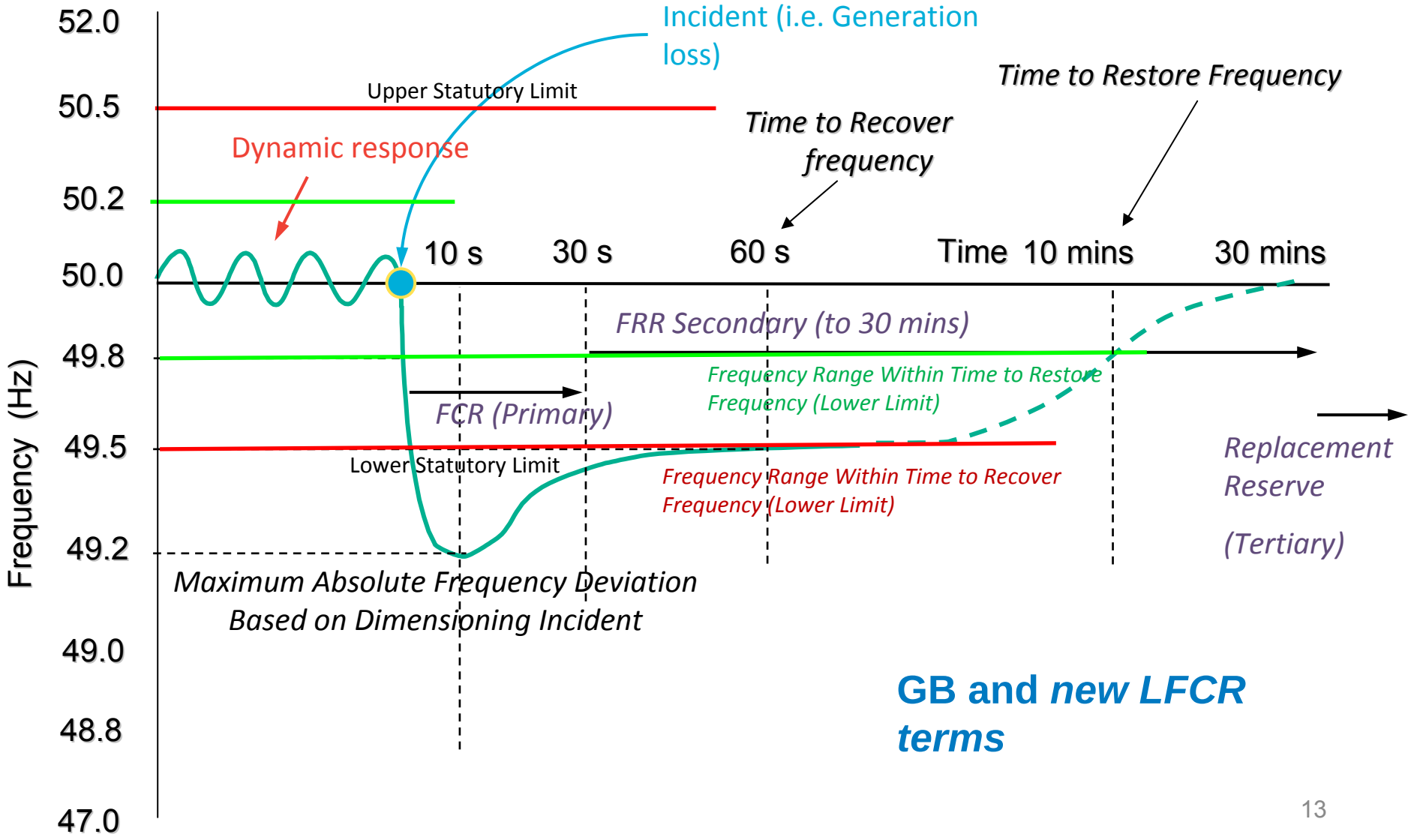
Response and reserve – current and new terms



GB and *new LFCR terms*

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Control Structure

The classification of reserve category is determined according to activation time and the delivery time of the reserve.

- General principle of Reserve Activation
  1. Frequency Containment Reserves (FCR),
  2. Frequency Restoration Reserves (FRR),
  3. Replacement Reserves (RR)

- The terminology is different to that presently in GB

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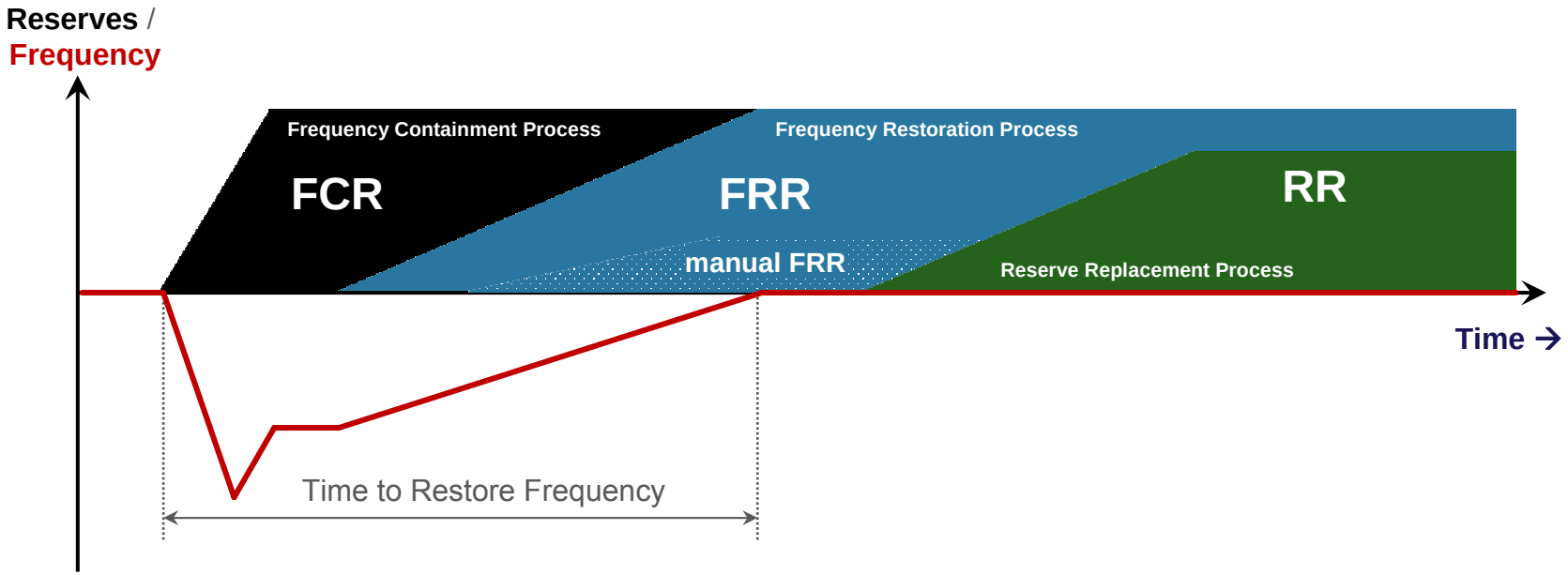
Process Activation Structure



- Frequency Containment Process→ Stabilization
- Frequency Restoration Process→ Regulate to Set-Point Value
- Reserve Replacement Process → Restore FRR

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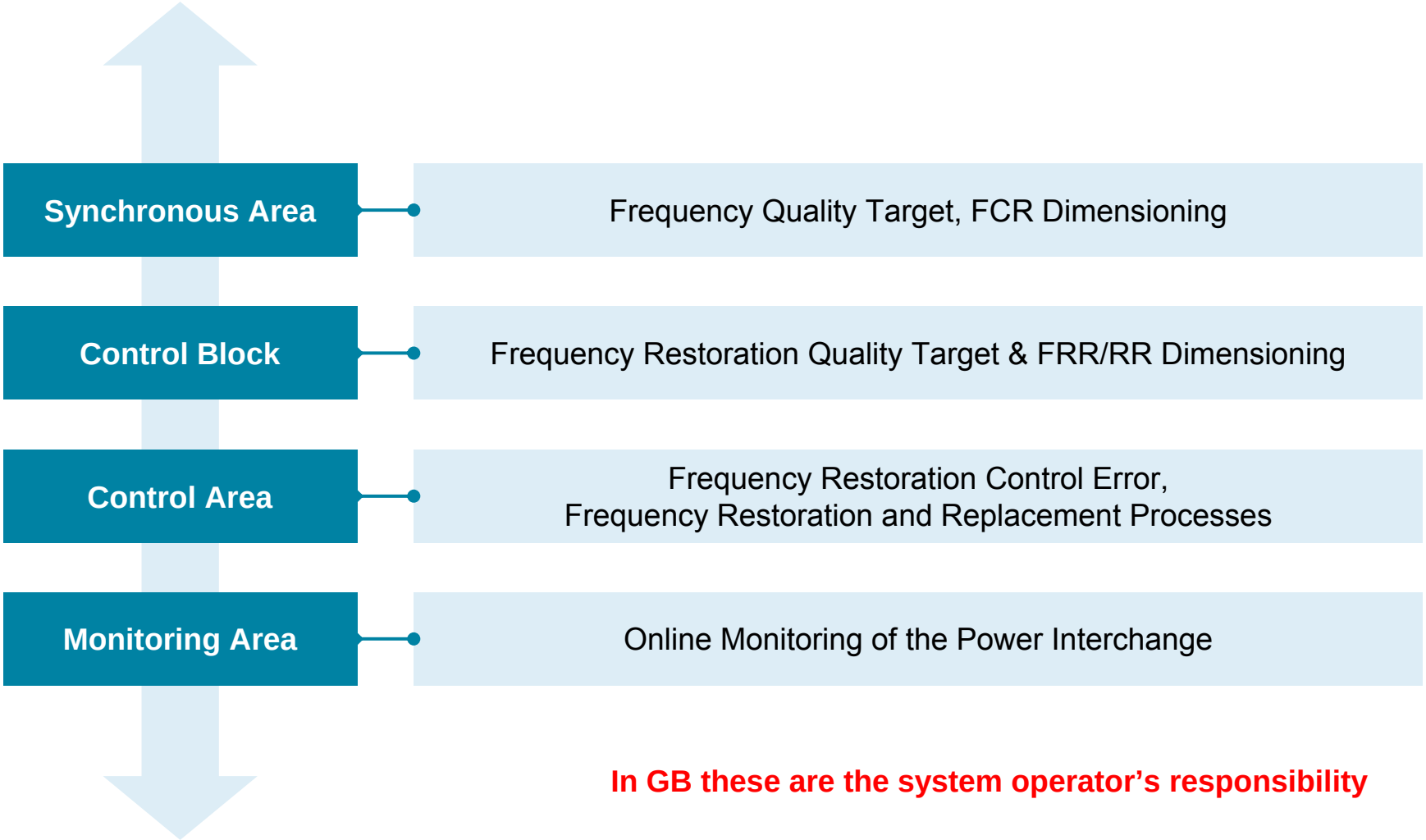
Process Responsibility Structure - 1

- Requirements are specified on a Synchronous Area basis e.g. GB, Continental Europe, Nordic
- Control hierarchy is present:
  - Synchronous Area
    - → 1 or more Load Frequency Control Blocks
      - → 1 or more Load Frequency Control Areas
        - → 1 or more Monitoring Areas…
- *For GB there will be only be one responsible entity for all elements within the Control Hierarchy – i.e. the NETSO = NGET*

Process Responsibility Structure - 2



In GB these are the system operator's responsibility

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Reserves Categories - FCR

- Dimensioning (reserve holding) obligations on TSO remain largely unchanged;
- NG has sought to retain Minimum technical requirements unchanged – e.g. full activation in 10s and sustainable for a further 20s;
- Geographic limitations to avoid concentrations of reserve providers in one part of the network. Within GB this is part of the normal TSO competency and hence no change.
- Pooling of providers permitted where the TSO considers it to have no security of supply implications
- Provision is subject to a prequalification process.
- Code applicable to all FCR providing units of any size(??);
- GB may exchange or share this service across HVDC links – see later slide

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FCR minimum technical parameters

FCR Parameter	FCR Value
Minimum accuracy of frequency measurement	1 mHz
Maximum insensitivity of the governor of the FCR Providing Units	15 mHz
Full Activation Time of FCR	10s
FCR Full Activation Deviation.	±500 mHz

- **TSOs may set more onerous criteria within there synchronous areas;**
- **FCR is a broad category of reserve for 'containment' and there may be a requirement for faster and more sensitive products;**

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Reserve Category - FRR

- TSO obligations are to ensure enough FRR is held to restore frequency for credible risk events (ie dimensioning incident)
- Those current GB reserve products whose full activation time is outside normal FRR full activation time may be considered to be in this category of reserve (specific product structure is for Balancing Code)
- The code sets out minimal technical requirements but permits TSOs to set requirements specific to their system.
- Full activation within 30seconds;
- TSOs have right to set per SA requirements;
- Code applicable to Reserve Providing Units of 1MW of bigger
- The code seeks to cover all synchronous areas with definitions for Automatic Generation Control as well as Manual activation.
- Prequalification Process is required
- Provisions exist for Sharing and Exchange of this service – see later slides

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Reserve Category - RR

- Termed “Replacement Reserves” these relate to all despatched instructions which may be used to maintain margins or replace depleted FCR/FRR.
- There is a prequalification process
- Provisions for GB to Exchange and/or Share this product exist – see later slide

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Reserve Exchange, Sharing and Netting

- Mechanisms exist within the code that will allow GB to share or exchange products with neighbouring systems
  - Imbalance Netting – permits TSOs to reduce unnecessary simultaneous activation of reserves in opposite directions
  - Sharing – common dimensioning and holding of reserves for use in more than one area – already in place for GB-Ireland
  - Exchange – SO-SO / SO-BRP models of exchange are permitted – these services exist e.g. GB – FR
- There are provisions to allow an ‘Affected TSO or Block’ to prevent exchanges/sharing occurring;
- There are provisions to limit exchanges/sharing by TSOs for security reasons;

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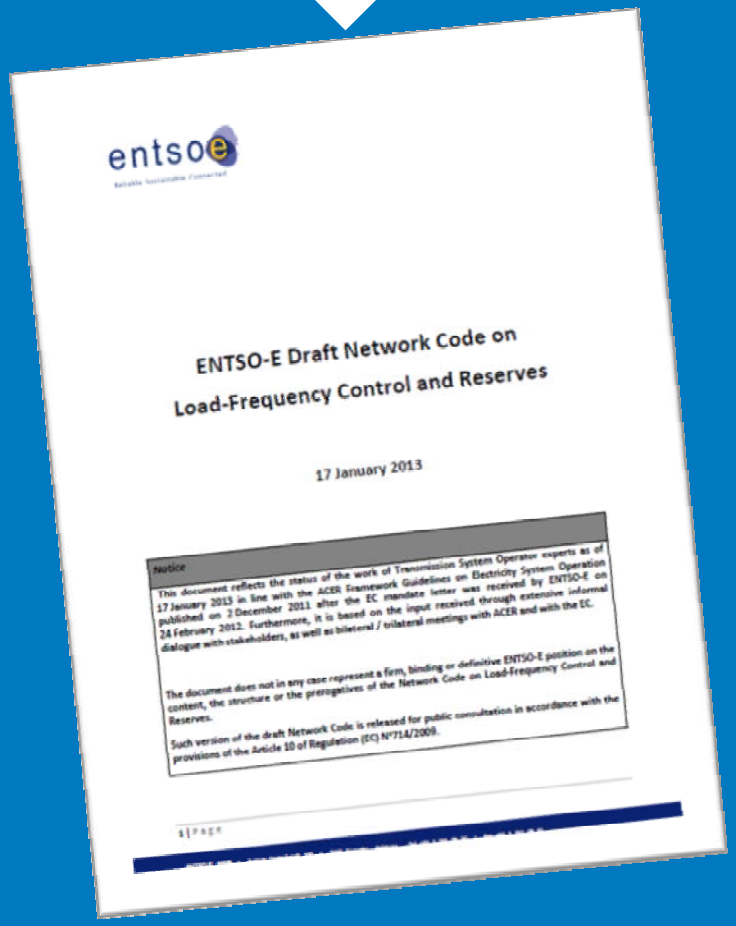
LFCR supporting slides for JESG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Concepts of frequency quality in LFCR network code

Evaluation of the application of methods within the code

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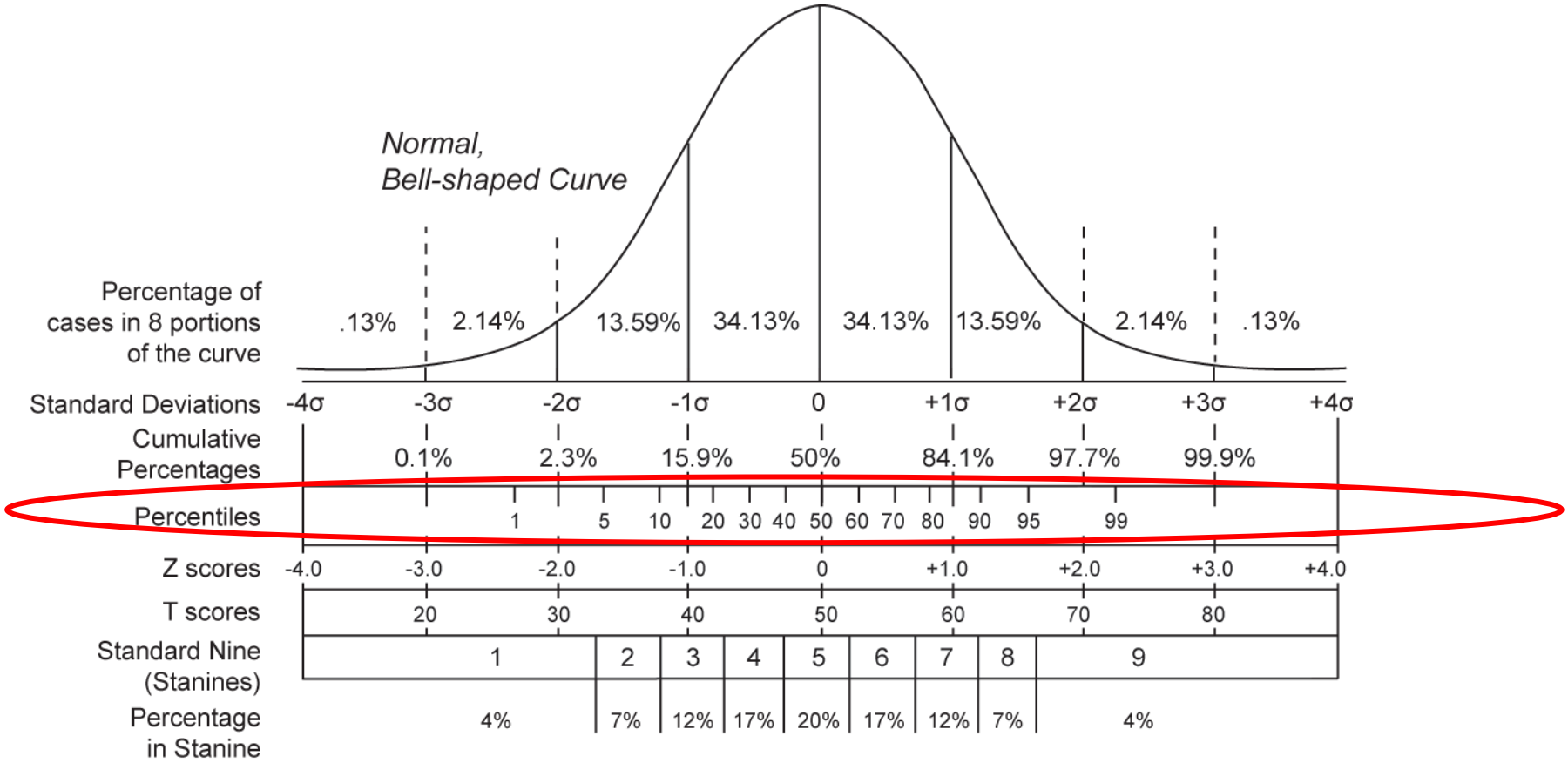
Common representation a Normal Distribution



http://commons.wikimedia.org/wiki/File:Normal_distribution_and_scales.gif/

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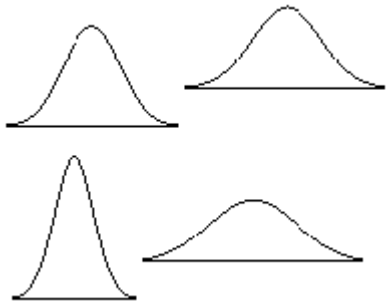
The affect of averaging frequency values

- 1 sec / 1mHz measurements taken
- 1 minute average used to show up the fast moving errors in frequency around FCR utilisation;
- 10 minute (time to restore frequency duration) averaging used to show slower errors in FRR and RR



	Europe	**GB**
1 second	Little of error in this category	A good measure of system dynamic stability and shows-up all range of details;
1 minute	Begins to show errors in FCR	A reasonable measure for highlighting GB excursions whilst filtering continuous dynamic frequency movement;
10 minute	Shows inter-block errors and FCR/FRR issues	Frequency Deviations not permitted to continue this long (different measurement approach required);

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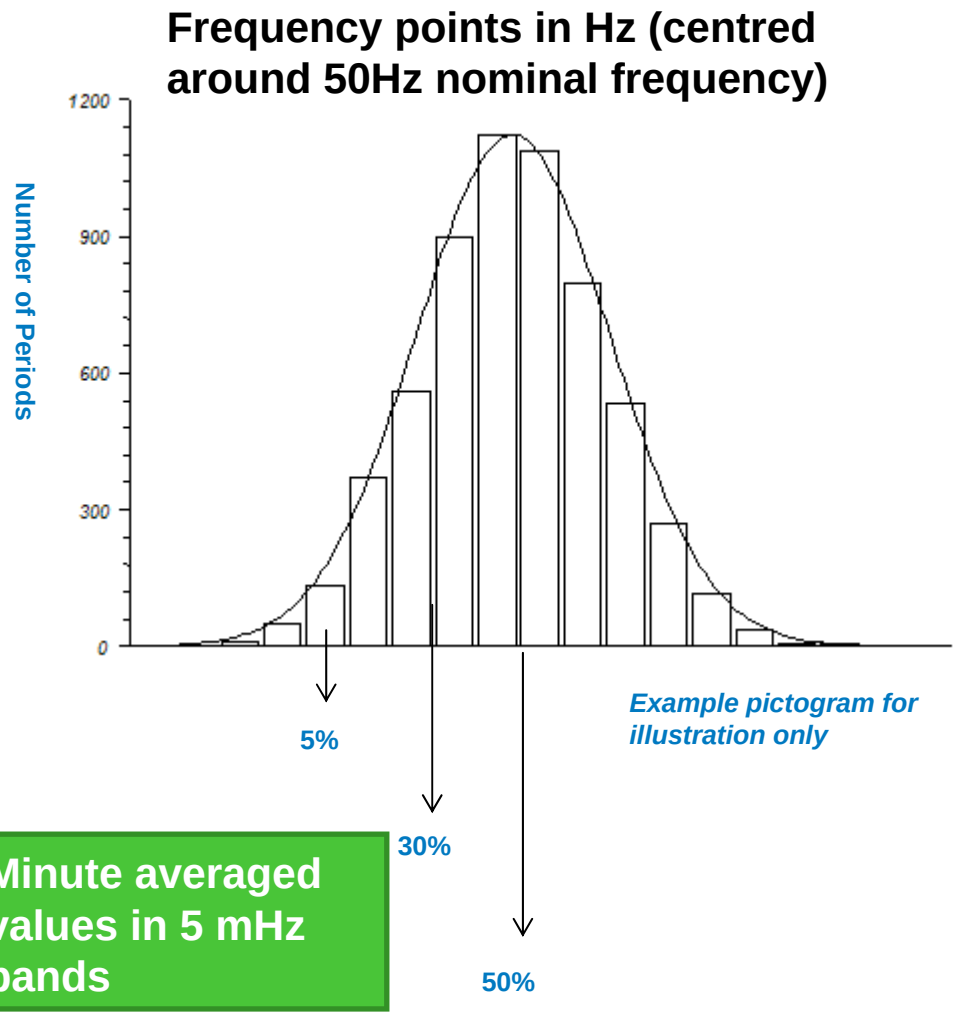
Overview of Articles 10 & 12

- Overview of Frequency Quality Target Parameters
- Within the code Article 10(3)
    1. Consider the number of minutes outside of the target error ranges determined ranges to be applied based on the 30% and 5% of historical frequency plot;
        1. The “Frequency Restoration Control Error Ranges” values in Hz now used as the basis to report minutes outside these ranges;
- Within Article 12
    1. Report on the Quarterly standard deviation of frequency information
    2. Report on the 95% distribution based on the 10 minute averaged frequency data

Method explained for article 10 & 12



Minute averaged values in 5 mHz bands

Current text in Article 10 asks for

- Level 1 Frequency Restoration Control Error Range = 30% of minutes. The value read from the horizontal axis being a value in Hz
- Level 2 Frequency Restoration Control Error Range = 5% of minutes. The value read from the horizontal axis being a value in Hz

It must be explained that the further these values are from Nominal Frequency the worse the average frequency control was for that period.

It is important to note that these values in Hz do not relate to specific operational thresholds but are rather specific error reporting boundaries

Illustration of an alternative method under consideration for GB & Ireland

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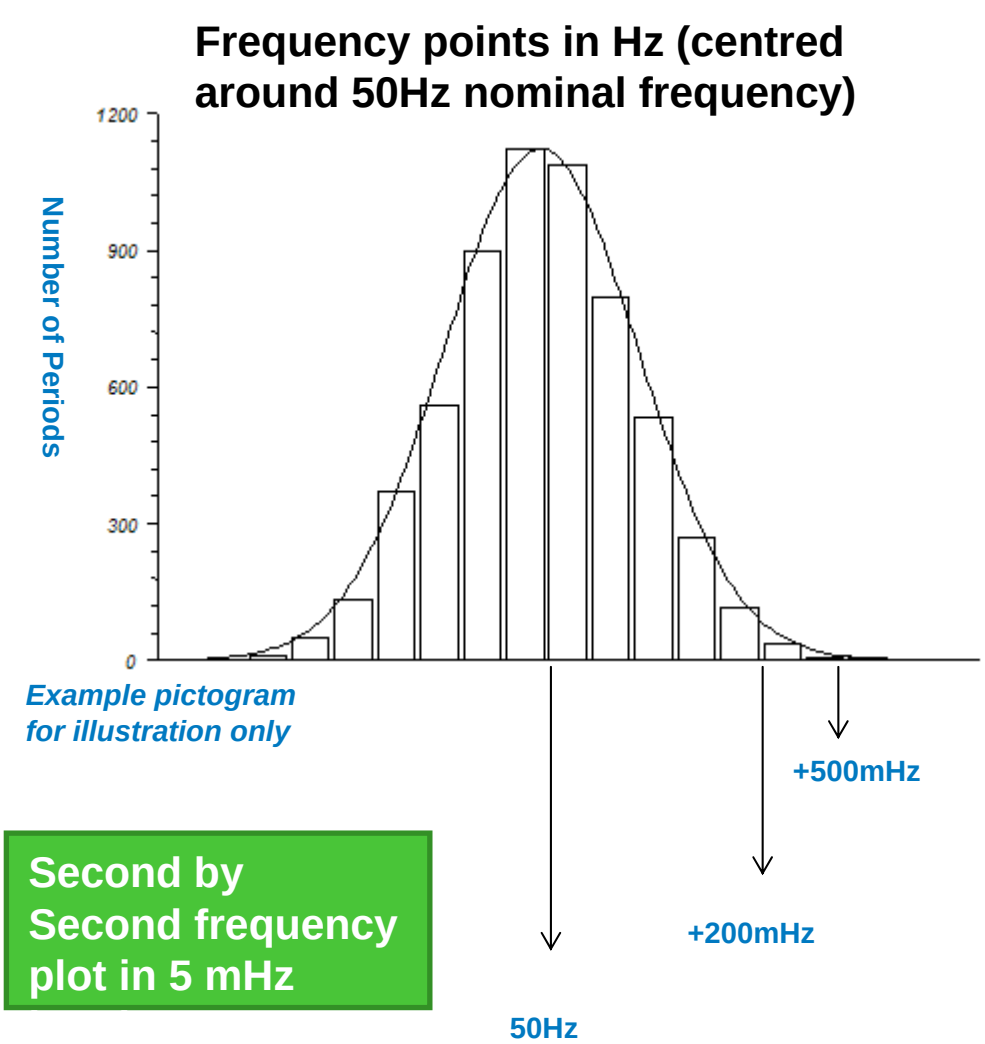

Second by Second frequency plot in 5 mHz

Proposed approach is to plot the number of seconds in each frequency band that occur in a period and then look at the % of minutes that lie outside the two given ranges.

- Standard Frequency Range (±200mHz)
- Frequency Range Within Time To Recover Frequency (±500mHz)

This method explicitly shows the time spent outside of operational and statutory limits (in current GB speak).

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Article 12 : LFC Block Error Calculations

- The current text has an issue in Article 12, Clause 2(b) where for GB the 10 minute averaged data would always be zero.
  - This is because the GB NETSO always takes action to both preserve the dimensioned requirement of FCR/FRR/RR and lastly will take emergency measures to restore frequency within the time to restore frequency.
  - Only one exceptional event has within recent records lasted for more than 10 minutes – loss of 2 generators in seconds in May 2008.

The regulation of values between blocks is not required for GB and two options exist:
1.Propose a exemption or
2.Alternative quality parameters which work for smaller systems with dynamic redimensioning

Once again GB is considering alternate methods. One possible alternative being a threshold based on reporting the number of minutes outside the ±500mHz threshold based on second-by-second data