

# ENTSO-E Draft Network Code on Load-Frequency Control and Reserves

30 April 2013

## **Notice**

This document reflects the status of the work of Transmission System Operator experts as of 30 January 2013 in line with the ACER Framework Guidelines on Electricity System Operation published on 2 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.

The document does not in any case represent a firm, binding or definitive ENTSO-E position on the content, the structure or the prerogatives of the Network Code on Load-Frequency Control and Reserves.

Such version of the draft Network Code is released for public consultation in accordance with the provisions of the Article 10 of Regulation (EC) N°714/2009.

THE EUROPEAN COMMISSION,

Having regard to the Treaty on the Functioning of the European Union,

Having regard to Directive 2009/72/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC,

Having regard to Regulation (EC) No 713/2009 of the European Parliament and of the Council of 13 July 2009 establishing an Agency for the Cooperation of Energy Regulators (ACER),

Having regard to Regulation (EC) 714/2009 of the European Parliament and of the Council of 13 July 2009 on conditions for access to the network for cross-border exchanges in electricity and repealing Regulation (EC) No 1228/2003 and especially Article 6,

Having regard to the priority list issued by the European Commission on 22 December 2010,

Having regard to the Framework Guidelines on Electricity System Operation issued by the Agency for the Cooperation of Energy Regulators on 2 December 2011,

Whereas:

- (1) Directive 2009/72/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC and Regulation (EC) N° 714/2009 of the European parliament and of the Council of 13 July 2009 underline the need for an increased cooperation and coordination among Transmission System Operators within a European Network of Transmission System Operators for Electricity (ENTSO-E) to create Network Codes for providing and managing effective and transparent access to the Transmission Systems across borders, and to ensure coordinated and sufficiently forward-looking planning and sound technical evolution of the Transmission System in the European Union, including the creation of Interconnection capacities, with due regard to the environment;
- (2) Directive 2009/72/EC stresses that a secure supply of electricity is of vital importance for the development of European society, the implementation of a sustainable climate change policy, and the fostering of competitiveness within the internal market;
- (3) Transmission System Operators (TSOs) are according to Article 12 of Directive 2009/72/EC responsible for providing and operating high and extra-high voltage networks for long-distance transmission of electricity. Besides this transmission and supply task it is also the TSOs' responsibility to ensure the Operational Security of their LFC Areas and together in the whole Synchronous Areas and the European Union, with a high level of reliability and quality;
- (4) One of the most critical processes to ensure the Transmission System Operational Security with a high level of reliability and quality is the Load-Frequency Control (LFC). Effective Load-Frequency Control can be made possible only if there is an obligation for the TSOs, Reserve Connecting Distribution Network Operators (DNOs), Providers' Power Generating Facilities and Demand Facilities to cooperate and to meet the relevant minimum technical requirements for the operation of the interconnected Transmission Systems as one entity;
- (5) ENTSO-E has drafted this Network Code for Load-Frequency Control and Reserves aiming at setting out clear, objective and harmonised requirements for TSOs, Reserve Connecting DNOs, Providers' Power Generating Facilities and Demand Facilities in order to ensure system security and to contribute to non-discrimination effective competition and the efficient functioning of the internal electricity market;

- (6) To ensure the Operational Security of the interconnected Transmission Systems and to provide a common frequency quality level it is essential that a common set of minimum requirements for European-Union-wide load-frequency control and reserves principles are defined as a basis for both the cross-border cooperation between the TSOs and, where relevant, for utilising characteristics of the connected generation, consumption and distribution systems. The requirements address following aspects of LFC process: LFC structure and operational rules, quality criteria and targets, reserve dimensioning, reserve exchange, sharing and distribution and monitoring;
- (7) The Network Code should respect the competences of national authorities raising out of Regulation (EC) N° 714/2009 and Directive 72/2009/EC in combination with its implementation in national legislation.
- (8) This Network Code should not hinder National Regulatory Authorities competence to monitor compliance with Network security and reliability rules and to set or approve standards and requirements for quality of service and supply.
- (9) This Network Code should not be detrimental to the right of any party having a complaint against a transmission or distribution system operator in relation to that operator's obligations under this Network Code to direct its complaint to the regulatory authority.
- (10) Close cooperation between TSOs should take place in due compliance with the principle of confidentiality as established in Article 16(1) of Directive 2009/72/EC;
- (11) In terms of LFC structure and operational rules, this Network Code introduces rules regarding FCR, FRR and RR control processes that shall set a basis for an efficient and effective Load-Frequency Control in the European Union. FCR shall aim at containing the frequency drop after an incident within a pre-defined range. FRR shall aim at restoring the frequency to its Nominal Frequency of 50 Hz. RR replace the activated reserves to restore the available reserves in the system or for economic optimisation;
- (12) The establishment of Load-Frequency Control Structure shall allow the efficient and effective load-frequency control in each Synchronous Area. The frequency quality target is defined at the level of the Synchronous Area, as the frequency is common parameter for a whole Synchronous Area. The Synchronous Area comprises of one or, in case of large Synchronous Area, more LFC Blocks. The frequency restoration quality is defined at the level of the LFC Block. In order to achieve maximum efficiency each LFC Block comprises of one or more LFC Areas. This control structure design allows to establish clear rules for TSO responsibilities and to create incentives for cooperation at LFC Block or Synchronous Area level. The choice of Load-Frequency Control Structure per Synchronous Area should be based on the number of TSOs involved and on the level of complexity congestion management on the transmission system;
- (13) The common frequency quality target defined at the Synchronous Area level shall contain Frequency Quality Target Parameters and Frequency Quality Evaluation Criteria. The FCP shall be established at Synchronous Area level as a common process. A list of the total amount of reserves needed per Synchronous Area and the share of reserves that each TSO of the Synchronous Area shall be able to provide should be defined on Synchronous Area level;
- (14) The FRP and the RRP shall be established at LFC Block level and shall contain the amount of reserves needed per LFC Block. The quality target values per TSO for the frequency restoration shall be defined per LFC Block and derived from the common frequency quality target established per Synchronous Area;

- (15) The operation of load-frequency control, as a core TSO responsibility, shall be defined at the level of the LFC Area in form of automatic and manual control;
- (16) This Network Code delivers the basis to determine the amount of reserves needed per FCP, FRP and RRP with respect to the required quality;
- (17) The efficiency of load-frequency control shall be enhanced by cross-border exchange, sharing and activation of reserves and imbalance netting. This exchange relates to the FCP, the FRP, and the RRP as well as to the Imbalance Netting Process. The cross-border exchange shall be treated within a Synchronous Area or between Synchronous Areas. The Network Code shall establish restrictions to the cross-border exchanges where needed from a technical point of view.
- (18) This Network Code has been drafted in accordance with the Article 8(7) of Regulation (EC) No 714/2009 according to which 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.

HAS ADOPTED THIS NETWORK CODE:

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# CHAPTER 1

## GENERAL PROVISIONS

### Article 1

#### SUBJECT MATTER AND SCOPE

1. This Network Code defines the minimal requirements and principles for load-frequency control and reserves applicable to all TSOs, Reserve Connecting DNOs and Reserve Providers.
2. This Network Code aims at:
  - a) achieving and maintaining a satisfactory level of frequency quality and efficient utilisation of the power system and resources;
  - b) ensuring coherent and coordinated behaviour of the transmission systems and power systems in real-time operation;
  - c) determining common requirements and principles for FCR, FRR and RR; determining common requirements for cross-border exchange, sharing and activation and sizing of reserves
3. The provisions of this Network Code shall not apply to power systems operating in a synchronous area whose frequency is influenced in a predominant way by systems that are not bound by the EU legislation and to Sardinia.
4. The provisions of the NC are without prejudice to the relevant provisions for human and nuclear safety.
5. No action in fulfilment of this Network Code shall hinder the implementation of new applications.
6. The technical and other requirements set in this Network Code shall mean standards and measures used when applying good industry practice.

## Article 2 DEFINITIONS

1. For the purpose of this Network Code, the definitions contained in Article 2 of Directive 2009/72/EC and in Article 2 of Regulation (EC) N°714/2009 apply. The definitions contained in the Article [2] of the [NC RfG], [NC CACM], [NC DCC], [NC OS] and [NC OPS] shall also apply.
2. The following definitions shall apply in addition:

**1-minute Average Frequency Data** means the set of data consisting of the average values of the recorded Instantaneous Frequency Data over a period of 1 minute each;

**1-minute Average Frequency Deviation Data** means the set of data consisting of the average values of the difference between the Nominal Frequency and the recorded Instantaneous Frequency Data over a period of 1 minute each;

**1-minute Average Frequency Restoration Control Error Data** means the set of data consisting of the average values of the recorded Instantaneous Frequency Restoration Control Error Data over a period of 1 minute each;

**Adjacent LFC Areas** means LFC Areas having a common electrical border;

**Adjacent LFC Blocks** means LFC Blocks having a common electrical border;

**Affected TSO** means a TSO for which the Exchange of Reserves and/or Sharing of Reserves and/or Imbalance Netting Process and/or Cross-Border Activation Process has an impact on Operational Security according to [NC OS];

**Alert State Trigger Time** means the time until Alert State becomes active.

**Anti-Windup Logic** means a control algorithm which prevents the integral term of a proportional-integral controller from accumulating the control error and overshooting;

**Area Control Error (ACE)** means the sum of the instantaneous difference between the actual and the set-point value (measured total power value and Control Program including Virtual Tie-Lines) for the power interchange of a LFC Area or a LFC Block and the frequency bias given by the product of the K-Factor of the LFC Area or the LFC Block and the Frequency Deviation;

**Automatic FRR** means FRR that can be activated by an automatic control device;

**Automatic FRR Activation Delay** means the period of time between the set point change and the commencement of Automatic FRR delivery;

**Automatic FRR Full Activation Time** means the time period between the set point change and the corresponding activation or deactivation of Automatic FRR;

**Average Frequency Restoration Control Error Data** means the Set of data consisting of the average value of the recorded instantaneous Frequency Restoration Control Error of a LFC Area or a LFC Block within a given measurement period time;

**Control Capability Providing TSO** means the TSO which shall trigger the activation of his Reserve Capacity for a Control Capability Receiving TSO under conditions of a sharing agreement.

**Control Capability Receiving TSO** means the TSO calculating Reserve Capacity by taking into account Reserve Capacity which is accessible through a Control Capability Providing TSO under conditions of a sharing agreement.

**Criteria Application Process** means the process of calculation of the target parameters for the Synchronous Area, the LFC Block and the LFC Area based on the data obtained in the Data Collection and Delivery Process;

**Cross-Border FRR Activation Process** means a process agreed between the TSOs participating in the process that allows for activation of FRR connected in a different LFC Area by correcting the input of the involved FRPs accordingly;

**Cross-Border RR Activation Process** means a process agreed between the TSOs participating in the process that allows for activation of RR connected in a different LFC Area by correcting the input of the involved RRP accordingly;

**Data Collection and Delivery Process** means the Process of collection of the set of data necessary in order to perform the Frequency Quality Evaluation Criteria;

**Dimensioning Incident** means the highest expected instantaneously occurring imbalance within a LFC Block in both positive and negative direction;

**Electrical Time Deviation** means the time discrepancy between synchronous time and Universal Time Coordinated (UTC);

**Exchange of Reserves** means a concept for a TSO to hold Reserve Capacity connected to another LFC Area, LFC Block, or Synchronous Area to comply with the amount of required reserves resulting from its own reserve dimensioning process of either FCR, FRR or RR. These reserves are held exclusively by this TSO, meaning that they are not taken into account by any other TSO to comply with the amount of required reserves resulting from their respective reserve dimensioning processes;

**FCR Full Activation Frequency Deviation** means the rated value of Frequency Deviation at which the FCR in a Synchronous Area is fully activated;

**FCR Full Activation Time** means the time period between the occurrence of the Reference Incident and the corresponding full activation of the FCR;

**FCR Obligation** means the part of all of the FCR that falls under the responsibility of a TSO;

**Frequency Containment Process (FCP)** means a process that aims at stabilizing the frequency by compensating imbalances by means of appropriate reserves;

**Frequency Containment Reserves (FCR)** means the Active Power Reserves activated to contain System Frequency after the occurrence of an imbalance;

**Frequency Deviation** means the difference between the actual System Frequency and the Nominal Frequency of the Synchronous Area which can be negative or positive;

**Frequency Quality Defining Parameters** means the main System Frequency variables that define the principles of Frequency Quality. These parameters reflect the system behaviour in normal operation by design;

**Frequency Quality Evaluation Criteria** means the criteria set determined in order to evaluate the Frequency Quality with reference to the Frequency Quality Target Parameters;

**Frequency Quality Evaluation Data** means the set of data used to evaluate the Frequency Quality Evaluation Criteria;

**Frequency Quality Target Parameter** means the main System Frequency target variables on basis of which the behaviour of the FRR and RR of the LFC Block is evaluated in Normal State;

**Frequency Range within Time to Recover Frequency** means the System Frequency range to which the System Frequency is expected to return after the occurrence of an imbalance equal to or less than the Reference Incident within the Time To Recover Frequency

**Frequency Range within Time to Restore Frequency** means the System Frequency range to which the System Frequency is expected to return after the occurrence of an imbalance equal to or less than the Reference Incident within the Time To Restore Frequency;

**Frequency Restoration Control Error** means the control error for the FRP which is equal to the ACE of a LFC Area or is equal to the Frequency Deviation where the LFC Area geographically corresponds to the Synchronous Area

**Frequency Restoration Control Error Target Parameters** means the main LFC Block variables on basis of which the state and dimensioning criteria for FRR and RR of the LFC Block are determined and evaluated. These parameters reflect the LFC Block behaviour in normal operation.

**Frequency Restoration Power Interchange** means the Power which is interchanged between one or more LFC Areas within the Cross-Border FRR Activation Process;

**Frequency Restoration Process (FRP)** means a process that aims at restoring frequency to the Nominal Frequency and for Synchronous Area consisting of more than one LFC Area power balance to the scheduled value;

**Frequency Restoration Reserves (FRR)** means the Active Power Reserves activated to restore System Frequency to the Nominal Frequency and for Synchronous Area consisting of more than one LFC Area power balance to the scheduled value;

**Frequency Set-Point** means the Frequency target value for FRR. In general the sum of the Nominal System Frequency and an offset value needed to reduce an Electrical Time Deviation;

**FRR Availability Requirements** means a set of requirements defined by the TSOs of a LFC Block regarding the availability of FRR;

**FRR Dimensioning Rules** means the specifications of the FRR dimensioning process of a LFC Block;

**Imbalance Netting Power Interchange** means the power which is interchanged between one or more LFC Areas within the Imbalance Netting Process;

**Imbalance Netting Process** means a process agreed between TSOs of two or more LFC Areas within one or more than one Synchronous Areas that allows for avoidance of simultaneous FRR activation in opposite directions by taking into account the respective Frequency Restoration Control Errors as well as activated FRR and correcting the input of the involved FRPs accordingly;

**Initial FCR Obligation** means the amount of FCR allocated to a TSO on the basis of a general sharing key;

**Instantaneous Frequency Data** means a set of data measurements of the overall System Frequency for the Synchronous Area with a very small measurement period used for System Frequency quality evaluation purposes;

**Instantaneous Frequency Deviation** means a set of data measurements of the **Frequency Deviation** with a very small measurement period;

**Instantaneous Frequency Restoration Control Error Data** means a set of data of the Frequency Restoration Control Error for a LFC Block with a very small measurement period used for System Frequency quality evaluation purposes;

**Level 1 Frequency Restoration Control Error Range** means a Frequency Restoration Control Error Defining Parameter used for System Frequency quality evaluation purposes;

**Level 2 Frequency Restoration Control Error Range** means a Frequency Restoration Control Error Defining Parameter used for System Frequency quality evaluation purposes;

**LFC Block Operational Agreement** means a multi-party agreement between all TSO of a LFC Block if the LFC Block consists of more than one TSO; if a LFC Block consists only of one TSO it means a formal declaration of obligations;

**LFC Block Imbalances** means the sum of the Frequency Restoration Control Error, FRR Activation and RR Activation of a LFC Block;

**LFC Block Monitor** means a TSO responsible for collecting the Frequency Quality Evaluation Criteria Data and applying the Frequency Quality Evaluation Criteria for the LFC Block;

**Load-Frequency Control Structure** means the basic structure considering all relevant aspects of Load-Frequency Control in particular concerning respective responsibilities and obligations (Process Responsibility Structure) as well as types and purposes of Active Power Reserves (Process Activation Structure);

**Load-Frequency Control Area (LFC Area)** means a part of a Synchronous Area or an entire Synchronous Area, physically demarcated by points of measurement of Tie-Lines to other LFC Areas, operated by one or more TSOs fulfilling the obligations of a LFC Area;

**Load-Frequency Control Block (LFC Block)** means a part of a Synchronous Area or an entire Synchronous Area, physically demarcated by points of measurement of Tie-Lines to other LFC Blocks, consisting of one or more LFC Areas, operated by one or more TSOs fulfilling the obligations of a LFC Block;

**Manual FRR Full Activation Time** means the time period between the set point change and the corresponding activation or deactivation of Manual FRR;

**Maximum Instantaneous Frequency Deviation** means the maximum expected absolute instantaneous Frequency Deviation after the occurrence of an imbalance equal or less than the Reference Incident, beyond which emergency measures are activated.

**Maximum Steady-State Frequency Deviation** means the maximum expected Frequency Deviation after the occurrence of an imbalance equal or less than the Reference Incident at which the System Frequency is designed to be stabilized;

**Monitoring Area** means a part of the Synchronous Area or the entire Synchronous Area, physically demarcated by points of measurement of Tie-Lines to other LFC Areas, operated by one or more TSOs fulfilling the obligations of a Monitoring Area;

**Nominal Frequency** means the rated value of the System Frequency in a power system, namely 50 Hertz;

**Notification Process** means the process in which a TSO notifies an Exchange and/or Sharing of Reserves agreement with another TSO to the other TSOs;

**Prequalification** means the Process to verify the compliance of a Reserve Providing Unit or a Reserve Providing Group of kind FCR, FRR or RR with the requirements set by the TSO according to principles stipulated in this code;

**Process Activation Structure** means the structure to categorize the processes concerning the different types of Active Power Reserves in terms of purpose and activation;

**Process Responsibility Structure** means the structure to determine responsibilities and obligations with respect to Active Power Reserves based on Area Types;

**Provider** means a legal entity with a legal or contractual obligation to supply FCR, FRR or RR from at least one Reserve Providing Unit or Reserve Providing Group;

**Reference Incident** means the maximum instantaneously occurring power deviation between generation and demand in a Synchronous Area in both positive and negative direction considered in the FCR dimensioning;

**Reserve Instructing TSO** means the TSO responsible for the instruction of the Reserve Providing Unit or the Reserve Providing Group to activate FRR and/or RR.

**Replacement Power Interchange** means the power which is interchanged between one or more LFC Areas within the Cross-Border RR Activation Process;

**Replacement Reserves (RR)** means the reserves used to restore/support the required level of FRR to be prepared for further system imbalances. This category includes operating reserves with activation time from Time to Restore Frequency up to hours;

**Reserve Capacity** means the amount of FCR, FRR or RR that needs to be available to the TSO;

**Reserve Connecting DNO** means the DNO or CDNO responsible for the Distribution Network to which a Reserve Providing Unit or Reserve Providing Group, providing reserves to a TSO, is connected.

**Reserve Connecting TSO** means the TSO responsible for the Monitoring Area to which a Reserve Providing Unit or Reserve Providing Group is connected to;

**Reserve Providing Group** means an aggregation of Reserve Providing Units connected to more than one Connection Point fulfilling the respective requirements for FCR, FRR or RR;

**Reserve Providing Unit** means a single Generating Unit or Demand Unit or an aggregation of Generating Units or Demand Units connected to a common Connection Point fulfilling the respective requirements for FCR, FRR or RR;

**Reserve Receiving TSO** means the TSO involved in an exchange with a Reserve Connecting TSO and/or a Reserve Providing Unit or a Reserve Providing Group connected to another Monitoring or LFC Area;

**Reserve Replacement Process (RRP)** means a process to restore activated FRR and additionally for GB and Ireland to restore the activated FCR.

**RR Availability Requirements** means a set of requirements defined the TSOs of an LFC Area or LFC Block regarding the availability of RR;

**Set-Point** means a target value for a physical variable;

**Sharing of Reserves:** mechanism in which more than one TSO take the same Reserve Capacity, being FCR, FRR or RR, into account to fulfil their respective reserve requirements resulting for their reserve dimensioning processes;

**Standard Frequency Deviation** means the absolute value of the Frequency Deviation that limits the Standard Frequency Range;

**Standard Frequency Range** means a defined interval symmetrically around the Nominal Frequency within which the System Frequency of a Synchronous Area is supposed to be operated;

**Synchronous Area** means an area covered by interconnected TSOs with a common System Frequency in a steady operational state such as the Synchronous Areas Continental Europe (CE), Great Britain (GB), Ireland (IRE) and Northern Europe (NE);

**Synchronous Area Operational Agreement** means a multi-party agreement between all TSO of a Synchronous Area if the Synchronous Area consists of more than one TSO; if a Synchronous Area consists only of one TSO it means a formal declaration of obligations;

**Synchronous Area Monitor** means a TSO responsible for collecting the Frequency Quality Evaluation Criteria Data and applying the Frequency Quality Evaluation Criteria for the LFC Block;

**System Frequency** is the electric frequency of the system that can be measured in all network areas of the synchronous system under the assumption of a coherent value for the system in the time frame of seconds (with minor differences between different measurement locations only).

**Tie-Line** means a transmission line that connects different areas excluding HVDC Interconnectors;

**Time Control Process** means a process for time control, where time control is a control action carried out to return the Electrical Time Deviation between synchronous time and UTC time to zero.

**Time To Restore Frequency** means the maximum expected time after the occurrence of an imbalance smaller than or equal to the Reference Incident in which the System Frequency returns to the Frequency Range Within Time To Restore Frequency for Synchronous Areas with only one LFC Area or for Synchronous Areas with more than one LFC Area the maximum expected time after the occurrence of an imbalance of an LFC Area within which the imbalance is compensated;

**Time To Recover Frequency** means the maximum expected time after the occurrence of an imbalance smaller than or equal to the Reference Incident in which the System Frequency returns to the Maximum steady state Frequency Deviation;

**Virtual Tie-Line** means an additional input of the controllers of the involved areas that has the same effect as a measuring value of a physical Tie-Line and allows exchange of electric energy between the respective areas

### **Article 3**

#### **REGULATORY ASPECTS**

1. The requirements established in this Network Code and their applications are based on the principle of non-discrimination and transparency as well as the principle of optimisation between the highest overall efficiency and lowest total cost for all involved parties.
2. Notwithstanding the above, the application of the principle of non-discrimination and the principle of optimisation between the highest overall efficiency and lowest total costs while maintaining Operational Security as the highest priority for all involved parties shall be balanced with the aim of achieving the maximum transparency in issues of interest for the market and the assignment to the real originator of the costs.
3. The terms and conditions or actions necessary to ensure Operational Security or the methodologies to establish them shall be established by TSOs in accordance with the principles of transparency, proportionality and non-discrimination. The definition of these terms and conditions or actions necessary to ensure Operational Security shall be performed in compliance with and respecting the TSO's responsibility to ensure system security according to national legislation.

### **Article 4**

#### **REGULATORY APPROVALS**

1. National Regulatory Authority or, when explicitly foreseen in national law, other relevant national authority shall be responsible for approving the methodologies and conditions establishing the framework for the adoption by TSOs of terms and conditions or actions necessary to ensure Operational Security as referred to in the Article 4(2) to Article 4(4).
2. Each TSO shall submit the following methodologies and conditions established by the TSO to the National Regulatory Authority or, when explicitly foreseen in national law, other relevant national authority for approval:
  - a. The additional requirements for FCR Providing Groups pursuant to Article 36(3)
  - b. FRR technical requirements defined by the TSO pursuant to Article 39(3)
  - c. RR technical requirements defined by the TSO pursuant to Article 41(3))
3. Each TSO of a LFC Block shall submit the following methodologies and conditions established by the TSOs of a LFC Block to its National Regulatory Authority or, when explicitly foreseen in national law, other relevant national authorities for approval:
  - a. The measures to reduce the Frequency Restoration Control Error by requiring changes in the Active Power production or consumption of generating and demand facilities pursuant to Article 11(15)
  - b. Definition of FRR availability requirements and control quality pursuant to Article 39(2)
  - c. Definition of FRR dimensioning rules pursuant to Article 38(1)
  - d. Escalation procedure pursuant to Article 38(4)
  - e. Requirements of RR dimensioning rules pursuant to Article 40(3)
  - f. Escalation procedure pursuant to Article 40(7)
  - g. Definition of RR availability requirements pursuant to Article 41(2)
  - h. Definition of the Process Responsibility Structure pursuant to Article 24
  - i. Definition of mitigation measures pursuant to Article 21
  - j. The definition of the methodology to limit the amount of FRR Capacity that can be made available for the Cross-Border RR Activation Process pursuant to Article 29(7)

- k. The definition of the methodology to limit the amount of RR Capacity that can be made available for the Cross-Border RR Activation Process pursuant to Article 30(7)
  - l. Limits for the Exchange of FCR within a LFC Block for SA CE pursuant to Article 42(2)
  - m. Limits for the Exchange of FRR within a LFC Block Article 46(1)
  - n. Limits for the Exchange of RR within a LFC Block Article 48(2)
4. Each TSO of a Synchronous Area shall submit the following methodologies and conditions established by the TSOs of a Synchronous Area to its National Regulatory Authority or, when explicitly foreseen in national law, other relevant national authorities for approval:
- a. The modification of the Frequency Quality Defining Parameters or the Frequency Quality Target Parameter pursuant to Article 11(6)
  - b. Common methodology to assess the risk of FCR Exhaustion pursuant to Article 13(3)
  - c. Determination of additional properties of the FCR pursuant to Article 36(2)
  - d. methods to ensure recovery of energy reservoirs for FCR in GB and IRE pursuant to Article 37(6)b)i
  - e. Definition of mitigation measures pursuant to Article 21
  - f. Limits for the Exchange of FCR within the Synchronous Areas IRE, GB and NE pursuant to Article 42(2)
  - g. Limits for the cross Synchronous Area Exchange of FCR pursuant to Article 51(1)
  - h. Limits for the cross Synchronous Area Sharing of FCR for GB and IRE pursuant to Article 52(2)
  - i. Limits for the cross Synchronous Area Exchange of FRR pursuant to Article 54(1)
  - j. Limits for the cross Synchronous Area Sharing of FRR pursuant to Article 55(1)
  - k. Limits for the cross Synchronous Area Exchange of RR pursuant to Article 56(1)
  - l. Limits for the cross Synchronous Area Sharing of RR pursuant to Article 57(1)
5. National Regulatory Authorities shall, no later than six months after having received the methodologies or conditions establishing the framework for the adoption by TSOs of terms and conditions or actions necessary to ensure Operational Security, provide TSOs with an approval or a request to amend the proposed methodology or condition.
6. Where the concerned National Regulatory Authorities have not been able to reach an agreement within a period of six months from when the case was referred to the last of those National Regulatory Authorities, or upon a joint request from the competent National Regulatory Authorities, the Agency shall decide upon those regulatory issues that fall within the competence of National Regulatory Authorities as specified under Article 8 of Regulation (EC) N° 713/2009.

## **Article 5**

### **RECOVERY OF COSTS**

1. The costs related to the obligations referred to in this Network Code which have to be borne by regulated Network Operators shall be assessed by National Regulatory Authorities.
2. Costs assessed as efficient, reasonable and proportionate shall be recovered as determined by National Regulatory Authorities.
3. If requested to do so by National Regulatory Authorities, regulated Network Operators shall, within three months of such a request, use best endeavours to provide such additional information as reasonably requested by National Regulatory Authorities to facilitate the assessment of the costs incurred.

## **Article 6**

### **CONFIDENTIALITY OBLIGATIONS**

1. Each TSO, Reserve Connecting DNO or Provider shall preserve the confidentiality of the information and data submitted to them in connection with this Network Code and shall use them exclusively for the purpose they have been submitted in compliance with this Network Code.
2. Without prejudice to the obligation to preserve the confidentiality of commercially sensitive information obtained in the course of carrying out its activities, each TSO shall in compliance with the provisions of this Network Code, provide to the other TSOs, or where required DNOs, sufficient information to ensure the secure and efficient operation, coordinated development and interoperability of the interconnected system.
3. In case of disclosure for other purposes than those described in Article 6(2) above, a TSO or a Reserve Connecting DNO shall seek the consent of the owner of such information and data based on reasoned request. This consent cannot be unreasonably withheld.

## **Article 7**

### **AGREEMENT WITH TSOS NOT BOUND BY THIS NETWORK CODE**

1. No later than 12 months after entering into force of this Network Code all TSOs shall endeavour to implement a Synchronous Area agreement within a Synchronous Area to ensure that TSOs with no legal obligation to respect this Network Code, belonging to the Synchronous Area, also cooperate to fulfil the requirements.
2. If an agreement according to Article 7(1) cannot be implemented, the respective TSOs shall implement, no later than by [*date – 14 months after entry into force*], processes to ensure compliance with the requirements of this Network Code within its LFC Area.

## **Article 8**

### **TSO COOPERATION**

1. Where the TSOs of a Synchronous Area are required to adopt a decision in accordance with this Network Code, all TSOs of a Synchronous Area shall cooperate loyally to adopt the decision.
2. Where the TSOs of a Synchronous Area are required to adopt a decision in accordance with this Network Code, ENTSO-E shall facilitate the adoption of decisions.

## **CHAPTER 2**

### **OPERATIONAL AGREEMENTS**

#### **Article 9**

##### **SYNCHRONOUS AREA OPERATIONAL AGREEMENT**

1. All TSOs of each Synchronous Area shall establish a Synchronous Area Operational Agreement that shall at least include:
  - a. the list of Frequency Quality Evaluation Data defined in accordance with Article 14(2), and the measurement, calculation and information exchange parameters for the Frequency Quality Evaluation Data defined in accordance with Article 14(3);
  - b. the methodology to assess the risk and the evolution of the risk of FCR Exhaustion of the Synchronous Area established in accordance with Article 13(3);
  - c. the appointment or delegation of a Synchronous Area Monitor in accordance with Article 15(1);
  - d. the Load-Frequency Control Structure defined in accordance with Article 22;
  - e. the implementation of the requirements of Article 23(6);
  - f. the roles and responsibilities of different groups of TSOs defined in accordance with Article 31;
  - g. the parameters defined in accordance with Article 33(2);
  - h. the requirements for FRR defined in accordance with Article 39;
  - i. the common rules for the operation in Normal State and Alert State in accordance with Article 34(6) and the actions defined in accordance with Article 34(14);
  - j. limits for the Exchange of FCR between the TSOs of the LFC Areas of an LFC Block for Synchronous Area CE and limits for the Exchange of FCR between the TSOs of other Synchronous Areas in accordance with Article 42;
  - k. the roles and responsibilities of the Reserve Connecting TSO, the Reserve Receiving TSO and the Affected TSO for the exchange and sharing of FRR and RR defined in accordance with Article 44(1) and Article 45(1); and
  - l. the roles and responsibilities of the Reserve Connecting TSO, the Reserve Receiving TSO and the Affected TSO for the Exchange or Sharing Of Reserves between Synchronous Areas defined in accordance with Article 50(1);
  - m. the methodology to determine limits on the amount of Exchange Of FCR between Synchronous Areas defined in accordance with Article 51(1);
  - n. the methodology to determine limits on the amount of Exchange Of FRR between Synchronous Areas defined in accordance with Article 54(1);
  - o. the methodology to determine limits on the amount of Sharing Of FRR between Synchronous Areas defined in accordance with Article 55(1);

- p. the methodology to determine limits on the amount of Exchange Of RR between Synchronous Areas defined in accordance with Article 56(1); and
- q. the methodology to determine limits on the amount of Sharing Of RR between Synchronous Areas defined in accordance with Article 57(1).

## **Article 10      LFC BLOCK OPERATIONAL AGREEMENT**

1. All TSOs of each LFC Block shall establish an LFC Block Operational Agreement that shall at least include:
  - a) the Frequency Restoration Control Error Defining Parameters and Frequency Restoration Control Error Target Parameters for each LFC Area within the LFC Block defined in accordance with Article 11 and Article 12 whenever the LFC Block contains more than one LFC Area;
  - b) the appointment of an LFC Block Monitor in accordance with Article 16;
  - c) the implementation of the requirements of Article 24(5);
  - d) if applicable, the appointment of the TSO responsible for the tasks in Article 26(6);
  - e) the FRR Dimensioning Rules defined in accordance with Article 38(1);
  - f) the specific allocation of responsibilities defined in accordance with Article 38(3), and when applicable the specific allocation of responsibilities defined in accordance with Article 40(6);
  - g) the FRR Availability Requirements and the requirements to the control quality defined in accordance with Article 39(2), and when applicable, the RR Technical Minimum Requirements defined in accordance with Article 41(1);
  - h) any limits on the Exchange Of FCR, FRR or RR between the LFC Areas of the LFC Block defined in accordance with Article 42(2), Article 46(1) and Article 48(1);
  - i) the roles and the responsibilities of the Reserve Connecting TSO, the Reserve Receiving TSO and the Affected TSO for the Exchange Of FRR and/or RR with TSOs of other LFC Blocks defined in accordance with Article 44(6).

## **CHAPTER 3**

### **FREQUENCY QUALITY**

#### **Article 11**

#### **FREQUENCY QUALITY DEFINING AND TARGET PARAMETERS**

1. The Frequency Quality Defining Parameters shall be:
  - a) the Nominal Frequency for all Synchronous Areas;
  - b) the Standard Frequency Range for all Synchronous Areas;
  - c) the Maximum Instantaneous Frequency Deviation for all Synchronous Areas;
  - d) the Maximum Steady-State Frequency Deviation for all Synchronous Areas;
  - e) the Time to Restore Frequency for all Synchronous Areas;
  - f) the Time to Recover Frequency for the Synchronous Areas GB and IRE;
  - g) the Frequency Range within Time to Restore Frequency for the Synchronous Areas GB, IRE and NE; and
  - h) the Frequency Range within Time to Recover Frequency for the Synchronous Areas GB and IRE.
2. The Nominal Frequency shall be 50Hz for all Synchronous Areas.
3. The default values of the Frequency Quality Defining Parameters listed in Article 11(1) shall be the values given in Table 1.

	CE	GB	IRE	NE
<b>Standard Frequency Range</b>	±50 mHz	±200 mHz	±200 mHz	±100 mHz
<b>Maximum Instantaneous Frequency Deviation</b>	800 mHz	800 mHz	1000 mHz	to be filled in
<b>Maximum Steady-state Frequency Deviation</b>	200 mHz	500 mHz	500 mHz	500 mHz
<b>Time to Recover Frequency</b>	not used	1 minute	1 minute	not used
<b>Frequency Range Within Time To Recover Frequency</b>	not used	±500 mHz	±500 mHz	not used
<b>Time To Restore Frequency</b>	15 minutes	10 minutes	20 minutes	15 minutes
<b>Frequency Range Within Time To Restore Frequency</b>	not used	±200 mHz	±200 mHz	±100 mHz
<b>Alert State Trigger Time</b>	5 minutes	10 minutes	10 minutes	5 minutes

Table 1 : Frequency Quality Defining Parameters of the Synchronous Areas

4. The Frequency Quality Target Parameter shall be the target maximum number of minutes outside the Standard Frequency Range per year per Synchronous Area, and its default value per Synchronous Area shall be the value given in Table 2.

	CE	GB	IRE	NE
<b>Maximum number of minutes outside the Standard Frequency Range</b>	15000	15000	10500	To be filled in.

Table 2 : Frequency Quality Target Parameters of the Synchronous Area

5. The Frequency Quality Defining Parameters (3) and the Frequency Quality Target Parameter (4) shall have the default values unless all TSOs of a Synchronous Area agree on a modified value in accordance with (6).

6. All TSOs of a Synchronous Area shall have the right to agree on a modified value of the Frequency Quality Defining Parameters (3) or the Frequency Quality Target Parameter (4) in case the following conditions are met:
  - a. the proposed modification of the Frequency Quality Defining Parameter (3) or the Frequency Quality Target Parameter (4) takes into account:
    - i. system size based on consumption and generation of the Synchronous Area and Inertia of the Synchronous Area;
    - ii. the Reference Incident;
    - iii. grid structure and/or network topology;
    - iv. load and generation behaviour;
    - v. Number and response of Power Generating Modules with Limited Frequency Sensitive Mode - Overfrequency and Limited Frequency Sensitive Mode - Underfrequency as defined in [NC RfG Article 8 (1) (c) and NC RfG Article 10 (2) (b)] and of Demand Facilities operating with activated Demand Side Response System Frequency Control or Demand Side Response Very Fast Active Power Control as defined in [NC DCC Article 23 and NC DCC Article 24]; and
    - vi. The capabilities for Power Generating Units and Demand Facilities described in [NC RfG Article 10 (2) (c)] and [NC DCC Article 21 and 22]; and
  - b. the impact on stakeholders is investigated;

## **Article 12**

### **FREQUENCY RESTORATION CONTROL ERROR TARGET PARAMETERS**

1. The TSOs of the Synchronous Areas CE and NE shall define and use the following Frequency Restoration Control Error Target Parameters for each LFC Block of the Synchronous Area with the goal of respecting the provisions of Article 11:
  - a) Level 1 Frequency Restoration Control Error Range and
  - b) Level 2 Frequency Restoration Control Error Range ;

The TSOs of a Synchronous Area with more than one LFC Block shall ensure that the Level 1 Frequency Restoration Control Error Ranges and the Level 2 Frequency Restoration Control Error Ranges of the LFC Blocks of this Synchronous Area are proportional to the square root of the sum of the Initial FCR Obligations according to Article 31 of the TSOs constituting the LFC Blocks.

The TSOs of Synchronous Areas GB and IRE shall define and use the following Frequency Restoration Control Error Defining Parameters:

- a) Level 1 Frequency Restoration Control Error Range shall be  $\pm 200\text{mHz}$ ;
- b) Level 2 Frequency Restoration Control Error Range shall be  $\pm 500\text{mHz}$ ;

2. The TSOs of the Synchronous Areas CE, NE shall agree on setting the value of the Frequency Restoration Control Error Defining Parameters for each LFC Block of the Synchronous Area at least every year.
3. The TSOs of a Synchronous Area shall use the following Frequency Restoration Control Error Target Parameters for each LFC Block of the Synchronous Area:
  - a) the maximum number of time intervals per year outside the Level 1 Frequency Restoration Control Error Range within a time interval equal to the Time to Restore Frequency shall be equal to 30% of the time intervals in the year; and
  - b) the maximum number of time intervals per year outside the Level 2 Frequency Restoration Control Error Range within a time interval equal to resolution the Time to Restore Frequency shall be equal to 5% or the time intervals in the year.
4. Where a LFC Block consists of more than one LFC Area, all TSOs of the LFC Block shall define in a TSO multi-party agreement the Frequency Restoration Control Error Defining Parameters and Frequency Restoration Control Error Target Parameters for each LFC Area complying with Article 12(1) and Article 12(2).
5. The TSOs of Synchronous Area GB and IRE shall use the following Frequency Restoration Control Error Target Parameters of a Synchronous Area:
  - a) maximum number of time intervals outside the Level 1 Frequency Restoration Control Error Range as defined in Table 3, per year shall be less than or equal to the value below as a % of the time intervals per year;
  - b) maximum number of time intervals outside the Level 2 Frequency Restoration Control Error Range as defined in Table 3, per year shall be less than or equal to the value below as a % of the time intervals per year;

For the Synchronous Area GB and IRE the fulfilment of these targets shall be monitored by the TSOs of the LFC Block on at least an annual basis.

	<b>GB</b>	<b>IRE</b>
Level 1	3%	2%
Level 2	1%	1%

Table 3 : Frequency Restoration Control Error Target Parameters for GB and IRE

### **Article 13**

#### **CRITERIA APPLICATION PROCESS AND FREQUENCY QUALITY EVALUATION CRITERIA**

1. The Criteria Application Process shall comprise:
  - a) the collection of Frequency Quality Evaluation Data; and
  - b) the calculation of Frequency Quality Evaluation Criteria.
2. The Frequency Quality Evaluation Criteria shall comprise:

a) for the Synchronous Area for operation in Normal State or Alert State as defined by [NC OS Article 8]) for a 3-month period for the Instantaneous Frequency Data:

- i. the mean value;
- ii. the standard deviation;
- iii. the 5-percentile and the 95-percentile;
- iv. total time in which the Instantaneous Frequency Deviation was larger than the Standard Frequency Deviation, separate for negative and positive Frequency Deviations;
- v. total time in which the Instantaneous Frequency Deviation was larger than the Maximum Instantaneous Frequency Deviation, separate for negative and positive Frequency Deviations);
- vi. the number of events for which the Instantaneous Frequency Deviation of the Synchronous Area exceeded 200% of the Standard Frequency Deviation and the Instantaneous Frequency Deviation was not returned to
  1. For CE: 50% of the Standard Frequency Deviation
  2. For GB, IRE and NE: the Frequency Range Within Time to Restore Frequencywithin the Time to Restore Frequency (separate for negative and positive Frequency Deviations).
- vii. For GB and IRE: the number of events for which the Instantaneous Frequency Deviation exceeded the Frequency Range Within Time To Recover Frequency and the Instantaneous Frequency Deviation was not returned to the Frequency Range Within Time To Recover Frequency within the Time to Recover Frequency (separate for negative and positive Frequency Deviations);

b) for the LFC Blocks of the Synchronous Area CE or NE for operation in Normal State or Alert State as defined by [NC OS Article 8]) for a 3-month period:

For a data-set containing the average values of the Frequency Restoration Control Error of the LFC Block for time intervals with a length equal to Time To Restore Frequency:

- i. mean value;
- ii. standard deviation;
- iii. the 5-percentile and the 95-percentile;
- iv. number of time intervals for which the Frequency Restoration Control Error is outside the Level 1 Frequency Restoration Control Error Range (separate for negative and positive FRCE);
- v. number of time intervals for which the Frequency Restoration Control Error is outside the Level 2 Frequency Restoration Control Error Range (separate for negative and positive FRCE);

For a data-set containing the average values of the Frequency Restoration Control Error of the LFC Block for time intervals with a length of one minute:

- vi. The number of events for which Frequency Restoration Control Error exceeds 60 % of the Minimum FRR Capacity and is not returned to 15 % of the Minimum FRR Capacity within the Time to Restore Frequency (separate for negative and positive FRCE)
- c) for the LFC Blocks of the Synchronous Area GB or IRE for operation in Normal State or Alert State as defined by [NC OS Article 8]) for a 3-month period:
  - i. the number of events for which the Frequency Deviation exceeds the Maximum Steady-state Frequency Deviation and the Frequency Deviation is not returned Frequency Range Within Time To Recover Frequency within the Time to Restore Frequency, separate for negative and positive Frequency Deviations);
- 3. The TSOs of a Synchronous Area shall define in a Synchronous Area agreement a common methodology to assess the risk and the evolution of the risk of FCR Exhaustion of the Synchronous Area. This methodology shall be performed at least on an annual basis and shall be based at least on historical System Frequency data. The TSOs of a Synchronous Area shall provide the required input data for this analysis.

#### **Article 14** **DATA COLLECTION AND DELIVERY PROCESS**

1. The Data Collection and Delivery Process shall comprise the following:
  - a) measurements of the System Frequency;
  - b) calculation of the Frequency Quality Evaluation Data; and
  - c) delivery of the Frequency Quality Evaluation Data for the Criteria Application Process.
2. All TSOs of a Synchronous Area shall define in a Synchronous Area agreement the list of Frequency Quality Evaluation Data, which shall include:
  - a) for the Synchronous Area:
    - i. Instantaneous Frequency Data;
    - ii. Instantaneous Frequency Deviation Data;
    - iii. 1-minute Average Frequency Data; and
    - iv. 1-minute Average Frequency Deviation Data.
  - b) for each LFC Block of the Synchronous Area:
    - ii. Instantaneous Frequency Restoration Control Error Data;
    - iii. 1-minute Average Frequency Restoration Control Error Data; and
    - v. Average Frequency Restoration Control Error Data within a time interval equal to the Time to Restore Frequency.

3. All TSOs of a Synchronous Area shall define in a Synchronous Area agreement measurement, calculation and information exchange parameters for the Frequency Quality Evaluation Data including but not limited to:

- a) measurement resolution;  
The measurement resolution of the Instantaneous Frequency Data shall be shorter than or equal to one second and of the Instantaneous Frequency Restoration Control Error shall be shorter than or equal to 10 seconds.
- b) measurement accuracy;  
The measurement accuracy of the Instantaneous Frequency Data shall be 1 mHz or better and of the Instantaneous Frequency Restoration Control Error (if not measured in Hz) shall be 1% or better.
- c) calculation method;  
The calculation of the 1-minute average data mentioned in (2) shall be performed by obtaining the sum of the instantaneous values of each measurement within the corresponding minute and dividing by the number of samples used in the minute.  
  
The calculation of the Average Frequency Restoration Control Error Data within a time interval equal to the Time to Restore Frequency mentioned in (2) shall be performed by obtaining the sum of the instantaneous values of each measurement within the corresponding time interval equal to the Time to Restore Frequency and dividing by the number of samples used in the time interval equal to the Time to Restore Frequency.
- d) file format and means of exchange.

## **Article 15**

### **SYNCHRONOUS AREA MONITOR**

- 1. All TSOs of a Synchronous Area shall appoint in a Synchronous Area agreement one TSO of this Synchronous Area as the Synchronous Area Monitor.
- 2. The Synchronous Area Monitor shall implement the Data Collection and Delivery Process of the Synchronous Area as defined in accordance with Article 14.
- 3. The Synchronous Area Monitor shall implement the Criteria Application Process as defined in accordance with Article 13.

The Synchronous Area Monitor shall collect the Frequency Quality Evaluation Data regarding the Synchronous Area and perform the Criteria Application Process including the calculation of Frequency Quality Evaluation Criteria, during a 3-month period within 3 months from the time stamp of the last value of the Frequency Quality Evaluation Data.

**Article 16**  
**LFC BLOCK MONITOR**

1. All TSOs of a LFC Block shall appoint in a multi-party agreement a TSO of this LFC Block as LFC Block Monitor for the LFC Block.
2. The LFC Block Monitor shall collect the Frequency Quality Evaluation Data for the LFC Block in accordance with the Criteria Application Process defined in accordance with 0.
3. Each TSO of a LFC Area shall provide the LFC Block Monitor with the necessary real-time LFC Area measurements needed for collecting Frequency Quality Evaluation Data for the LFC Block.
4. The LFC Block Monitor shall deliver the Frequency Quality Evaluation Data regarding the LFC Block and its LFC Areas during a 3-month period to the Synchronous Area Monitor within 3 months from the time stamp of the last value of the Frequency Quality Evaluation Data.

**Article 17**  
**INFORMATION ON LOAD AND GENERATION BEHAVIOUR**

1. In accordance with Article 16(3) of [NC OS], each Connecting TSO shall have the right to request the information necessary from Power Generating Modules, Demand Units, HVDC Interconnectors and Significant Grid Users as defined in NC OS Article 1(3) to monitor the load and generation behaviour related to imbalances. This information may include:
  - a) the time-stamped Active Power Set-Point for real-time and future operation; and
  - the time-stamped total Active Power output

**Article 18**  
**RAMPING PERIOD FOR THE SYNCHRONOUS AREA**

1. All TSOs of each Synchronous Area with more than one LFC Area shall define rules for the calculation of the Control Program from the Netted Area AC Position with a common Ramping Period for ACE calculation.

**Article 19**  
**RAMPING RESTRICTIONS FOR ACTIVE POWER OUTPUT ON SYNCHRONOUS AREA LEVEL**

1. In accordance with Article 9(14) of NC OS, all TSOs of each Synchronous Area shall have the right to define restrictions for the Active Power output of HVDC Interconnectors between Synchronous Areas to limit their influence on the fulfilment the Frequency Quality Target of the Synchronous Area by agreeing on:
  - a) a unique Maximum Ramp Rate and/or a unique Ramping Period applicable to all individual HVDC Interconnectors; and/or
  - b) a combined Maximum Ramp Rate for all HVDC Interconnectors of the Synchronous Area.

## **Article 20**

### **RAMPING RESTRICTIONS FOR ACTIVE POWER OUTPUT ON LFC BLOCK LEVEL**

1. In accordance with Article 9(14) of NC OS, all Connecting TSOs of an HVDC Interconnector in the same or in different Synchronous Areas shall have the right to define common restrictions for the Active Power output of this HVDC Interconnector to limit their influence on the fulfilment of the Frequency Restoration Control Error Target Parameter of the connected LFC Blocks by agreeing on Ramping Periods and/or Maximum Ramp Rates for this HVDC Interconnector while respecting the provisions of Article 19.
2. In accordance with Article 9(14) of NC OS, all TSOs of an LFC Block shall have the right to apply the following measures to support the fulfilment of the Frequency Restoration Control Error Target Parameter of the LFC Block:
  - a) Definition of Ramping Periods and/or Maximum Ramp Rates on Power Generating Modules and/or Demand Units;
  - b) individual ramping starting times for Power Generating Modules and/or Demand Units within the LFC Block; and
  - c) coordination of the ramping between Power Generation Modules, Demand Units and Active Power consumption within the LFC Block

## **Article 21**

### **MITIGATION**

1. If the values calculated for the measurement period of the Frequency Quality Target Parameters or the Frequency Restoration Control Error Target Parameters are outside the set targets for the Synchronous Area or for the LFC Block or in case of a justified expected risk for it, all TSOs of the relevant Synchronous Area or of the relevant LFC Block shall decide on mitigation measures to ensure that the targets for the Synchronous Area or for the LFC Block can be met in the future.

## **CHAPTER 4**

### **LOAD-FREQUENCY-CONTROL STRUCTURE**

#### **Article 22**

##### **BASIC STRUCTURE**

1. All TSOs of a Synchronous Area shall define, in a Synchronous Area agreement a Load-Frequency-Control Structure for the Synchronous Area. Each TSO shall be responsible for implementing and operating according to the Load-Frequency-Control Structure of its Synchronous Area.
2. The Load-Frequency Control Structure of each Synchronous Area shall include:
  - a) a Process Activation Structure according to Article 23; and
  - b) a Process Responsibility Structure according to Article 24.

#### **Article 23**

##### **PROCESS ACTIVATION STRUCTURE**

1. The Process Activation Structure shall include:
  - a) a FCP according to Article 25; and
  - b) a FRP according to Article 26.
2. The Process Activation Structure may include:
  - a) a RRP according to Article 27;
  - b) an Imbalance Netting Process according to Article 28;
  - c) a Cross-Border FRR Activation Process according to Article 29; and
  - d) a Cross-Border RR Activation Process according to Article 30.
3. The Process Activation Structure of CE shall include a Time Control Process according to Article 59.

#### **Article 24**

##### **PROCESS RESPONSIBILITY STRUCTURE**

1. When defining the Process Responsibility Structure, all TSOs of a Synchronous Area shall take into account at least the following criteria:
  - a) size and the total Inertia and Synthetic Inertia of the Synchronous Area;
  - b) grid structure and/or network topology; and
  - c) load, generation and HVDC behaviour.
2. In addition the TSOs of a Synchronous Area shall ensure that:
  - a) the Synchronous Area consists of at least one Monitoring Area, one LFC Area and one LFC Block;

- b) the set union of all Monitoring Areas is congruent to the Synchronous Area;
  - c) the set union of all LFC Areas is congruent to the Synchronous Area;
  - d) the set union of all LFC Block is congruent to the Synchronous Area;
  - e) a Monitoring Area is part of one and only one LFC Area;
  - f) a LFC Area is part of one and only one LFC Block;
  - g) a LFC Block is part of one and only one Synchronous Area;
  - h) a LFC Area is congruent to one or more Monitoring Areas;
  - i) a LFC Block is congruent to one or more LFC Areas; and
  - j) a Synchronous Area is congruent to one or more LFC Blocks.
3. All TSOs of a Monitoring Area shall continuously calculate and monitor the real-time Active Power interchange of the Monitoring Area.
4. All TSOs of a LFC Area shall:
- a) continuously monitor the Frequency Restoration Control Error of the LFC Area;
  - b) implement and operate a FRP for the LFC Area;
  - c) make best endeavours to fulfil the Frequency Restoration Control Error Target Parameters of the LFC Area as defined in Article 12; and
  - d) have the right to implement one or several of the processes referred to in Article 23(2)
5. All TSOs of a LFC Block shall:
- a) make best endeavours to fulfil the Frequency Restoration Control Error Target Parameters of the LFC Block as defined in Article 12; and
  - b) comply with FRR Dimensioning Rules established in Article 38 and RR Dimensioning Rules established in Article 40.
6. All TSOs of a Synchronous Area shall:
- a) implement and operate a FCP for the Synchronous Area;
  - b) comply with FCR Dimensioning Rules established in Article 35; and
  - c) make best endeavours to fulfil the Frequency Quality Target Parameters as established in Article 9.
7. Each TSO shall comply with the obligations established in Article 24(2) to Article 24(6) for its Monitoring Area, LFC Area, LFC Block and Synchronous Area.
8. All TSOs of a Monitoring Area shall agree in a TSO multi-party agreement on the specific allocation of responsibilities between TSOs within the Monitoring Area for the implementation of the obligations established in Article 24(3).

9. All TSOs of a LFC Area, LFC Block and Synchronous Area shall agree on similar multi-party agreement for the implementation of the obligations established in Article 24 (4) to Article 24(6).

#### **Article 25**

##### **FREQUENCY CONTAINMENT PROCESS (FCP)**

1. The control target of FCP shall be to stabilize the System Frequency by activation of FCR.
2. The overall characteristic for FCR activation in a Synchronous Area shall reflect a monotonically decrease of the FCR activation as a function of the Frequency Deviation.

#### **Article 26**

##### **FREQUENCY RESTORATION PROCESS (FRP)**

1. The control target of the FRP shall be to
  - a) regulate the Frequency Restoration Control Error to zero within the Time To Restore Frequency; and
  - b) for CE and NE to progressively replace the activated FCR by activation of FRR;
2. The Frequency Restoration Control Error shall be
  - a) the Area Control Error (ACE) of a LFC Area where there are more than one LFC Area in a Synchronous Area; or
  - b) the Frequency Deviation where one LFC Area corresponds to the LFC Block and the Synchronous Area.
3. The ACE of a LFC Area shall be calculated as the sum of the product of the K-Factor of the LFC Area with the Frequency Deviation plus the subtraction of:
  - a) the total Tie-Line and Virtual Tie-Line Active Power flow; and
  - b) the Control Program according to Article 18
4. The Set-Point value for automated FRR activation shall be calculated by a single frequency restoration controller operated by a TSO within its LFC Area. The frequency restoration controller shall:
  - a) be an automatic control device designed to reduce the Frequency Restoration Control Error to zero;
  - b) be operated in a closed-loop manner with Frequency Restoration Control Error as input and Set-Point value for FRR activation as output;
  - c) have proportional-integral behaviour; and
  - d) have a control algorithm which prevents the integral term of a proportional-integral controller from accumulating the control error and overshooting.
5. The Set-Point value for manual FRR activation shall be left to the discretion of the TSO for its LFC Area.

6. Without prejudice to Article 24(4) and Article 26, when a LFC Block consists of more than one LFC Areas all TSOs of the LFC Block shall have the right to appoint in the LFC Block Operational Agreement one TSO of the LFC Block to:
  - a) calculate and monitor the Frequency Restoration Control Error of the whole LFC Block; and
  - b) take the Frequency Restoration Control Error of the whole LFC Block into account for the calculation of the Set-Point value for FRR activation according to Article 26(4) and Article 26(5) in addition to the Frequency Restoration Control Error of the LFC Area.
7. Where a LFC Area consists of more than one Monitoring Areas, all TSOs of the LFC Area shall appoint one TSO who shall be responsible for the implementation and operation of the Frequency Restoration Process according to Article 26 in the LFC Block Operational Agreement.
8. Without prejudice to Article 24(4), where a LFC Area consists of more than one Monitoring Areas, the Frequency Restoration Process of this LFC Area shall enable the control of the Active Power interchange of each Monitoring Area to a value determined as secure based on a real-time Operational Security Analysis.

#### **Article 27**

#### **RESERVE REPLACEMENT PROCESS (RRP)**

1. The control target of the RRP shall be to fulfil one or several of the following goals:
  - a) progressively restore the activated FRR; and
  - b) support FRR activation;
  - c) for for the Synchronous Areas of GB and IRE to progressively restore the activated FCR and FRR.
2. The Set-Point value for RR activation shall be determined by a TSO for its LFC Area where the RRP is implemented.

#### **Article 28**

#### **IMBALANCE NETTING PROCESS**

1. The control target of the Imbalance Netting Process shall be to reduce the amount of simultaneous counteracting FRR activation of different participating Adjacent LFC Areas by Imbalance Netting Power Interchange. Each TSO shall have the right to implement the Imbalance Netting Process for LFC Areas within the same LFC Block, between different LFC Blocks or between different Synchronous Areas.
2. The Imbalance Netting Process shall not affect
  - a) the stability of the FCP of the Synchronous Area or Synchronous Areas involved in the Imbalance Netting Process;
  - b) the stability of the FRP and the RRP of each LFC Area operated by participating or Affected TSOs; and
  - c) the Operational Security.

3. The Imbalance Netting Power Interchange between LFC Areas of the same Synchronous Area shall be implemented by one or several of the following actions:
  - a) defining an Active Power flow over a Virtual Tie-Line which shall be part of the Frequency Restoration Control Error calculation; and/or
  - b) adjusting the Active Power flows over HVDC Interconnectors.
4. The Imbalance Netting Power Interchange between LFC Areas of different Synchronous Areas shall be implemented by adjusting the Active Power flows over HVDC Interconnectors.
5. The Imbalance Netting Power Interchange of a LFC Area shall not exceed the actual amount of FRR activation which is necessary to regulate the Frequency Restoration Control Error of this LFC Area to zero without Imbalance Netting Power Interchange.
6. The Imbalance Netting Power Interchange between LFC Areas shall not result in power flows which exceed Operational Security Limits according to [OS NC].
7. All TSOs participating in the same Imbalance Netting Process shall ensure that the sum of all Imbalance Netting Power Interchanges is equal to zero.
8. The Imbalance Netting Process shall include a fall-back mechanism which shall:
  - a) ensure that the Imbalance Netting Power Interchange of each LFC Area is zero or limited to a value for which Operational Security according to the [OS NC] can be guaranteed; and
  - b) comply with the requirements established in Article 28(2).
9. Where a LFC Block consists of more than one LFC Area and the FRR Capacity as well as RR Capacity is calculated based on the LFC Block Imbalances, all TSOs of the same LFC Block shall implement an Imbalance Netting Process and interchange the maximum amount of Imbalance Netting Power as defined in Article 28(3) with other LFC Areas of the same LFC Block while complying with Article 28(1).
10. Where an Imbalance Netting Process is implemented for LFC Areas of different Synchronous Areas, all TSOs shall interchange the maximum amount of Imbalance Netting Power as defined in Article 28(5) with other TSOs of the same Synchronous Area participating in this Imbalance Netting Process while complying with Article 28(9).
11. Where an Imbalance Netting Process is implemented for LFC Areas which are not part of the same LFC Block, all TSOs of the LFC Blocks shall be able fulfil the obligations established in Article 24(5) regardless of Imbalance Netting Power Interchange.

## **Article 29**

### **CROSS-BORDER FRR ACTIVATION PROCESS**

1. The control target of the Cross-Border FRR Activation Process shall be to enable a TSO to perform the FRP by Frequency Restoration Power Interchange between LFC Areas. Each TSO shall have the right to implement the Cross-Border FRR Activation Process for LFC Areas within the same LFC Block, between different LFC Blocks or between different Synchronous Areas.
2. The Cross-Border FRR Activation Process shall not affect

- a) the stability of the FCP of the Synchronous Area or Synchronous Areas involved in the Cross-Border FRR Activation Process;
  - b) the stability of the FRP and the RRP of each LFC Area operated by participating or Affected TSOs; and
  - c) Operational Security.
3. The Frequency Restoration Power Interchange between LFC Areas of the same Synchronous Area shall be implemented by one or several of the following actions:
    - a) defining an Active Power flow over a Virtual Tie-Line which shall be part of the Frequency Restoration Control Error calculation where FRR activation is automated;
    - b) adjusting a Control Program or defining an Active Power flow over a Virtual Tie-Line between LFC Areas where FRR activation is manual; or
    - c) adjusting the Active Power flows over HVDC Interconnectors.
  4. The Frequency Restoration Power Interchange between LFC Areas of different Synchronous Areas shall be implemented by adjustment of Active Power flows over HVDC Interconnectors.
  5. The Frequency Restoration Power Interchange between LFC Areas shall not result in power flows which exceed Operational Security Limits according to [OS NC].
  6. All TSOs participating in the same Cross-Border FRR Activation Process shall ensure that the sum of all Frequency Restoration Power Interchanges is equal to zero.
  7. All TSOs of an LFC Block shall have the right to define a methodology to limit the amount of FRR Capacity that can be made available for the Cross-Border FRR Activation Process to ensure
    - a) the ability of the Synchronous Area to reach the Frequency Quality Targets or the ability of its LFC Block to reach the Frequency Restoration Control Error Quality Target in accordance with Article 11 and Article 12;
    - b) the ability of the TSOs of the LFC Block to have continuously access to the amount of FRR resulting from the FRR Dimensioning Processes in accordance with Article 38; and
    - c) the Operational Security.
  8. The Cross-Border FRR Activation Process shall include a fall-back mechanism which shall:
    - a) ensure that the Frequency Restoration Power Interchange of each LFC Area is zero or limited to a value for which Operational Security according to the [OS NC] can be guaranteed; and
    - b) comply with the requirements established in Article 29(2).

### **Article 30**

#### **CROSS-BORDER RR ACTIVATION PROCESS**

1. The control target Cross-Border RR Activation Process shall be to enable a TSO to perform the RRP through Replacement Power Interchange between LFC Areas. Each TSO shall have the right to implement the Cross-Border RR Activation Process for LFC Areas within the same LFC Block, between different LFC Blocks or between different Synchronous Areas.

2. The Cross-Border RR Activation Process shall not affect
  - a) the stability of the FCP of the Synchronous Area or Synchronous Areas involved in the Cross-Border RR Activation Process;
  - b) the stability of the FRP and the RRP of each LFC Area operated by participating or Affected TSOs; and
  - c) Operational Security.
3. The Replacement Power Interchange between LFC Areas of the same Synchronous Area shall be implemented by one or several of the following actions:
  - a) defining an Active Power flow over a Virtual Tie-Line which shall be part of the Frequency Restoration Control Error calculation;
  - b) adjusting of a Control Program; or
  - c) adjusting of Active Power flows over HVDC Interconnectors.
4. The Replacement Power Interchange between LFC Areas of different Synchronous Areas shall be implemented by adjustment of Active Power flows over HVDC Interconnectors.
5. The Replacement Power Interchange between LFC Areas shall not result in power flows which exceed Operational Security Limits according to [OS NC].
6. All TSOs participating in the same Cross-Border RR Activation Process shall ensure that the sum of all Replacement Power Interchanges is equal to zero.
7. All TSOs of an LFC Block shall have the right to define a methodology to limit the amount of RR Capacity that can be made available for the Cross-Border RR Activation Process to ensure
  - a) the ability of the Synchronous Area to reach the Frequency Quality Targets or the ability of its LFC Block to reach the Frequency Restoration Control Error Quality Target in accordance with Article 11 and Article 12;
  - b) the ability of the TSOs of the LFC Block to have continuously access to the amount of FRR resulting from the RR Dimensioning Processes in accordance with Article 40; and
  - c) the Operational Security.
8. The Cross-Border RR Activation Process shall include a fall-back mechanism which shall:
  - a) ensure that the Replacement Power Interchange of each LFC Area is zero or limited to a value for which Operational Security according to the [OS NC] can be guaranteed;
  - b) comply with the requirements established in Article 30(2).

**Article 31**  
**GENERAL REQUIREMENTS FOR CROSS-BORDER CONTROL PROCESSES**

1. All TSOs participating in an Exchange or Sharing of FRR shall implement a Cross-Border FRR Activation Process. All TSOs participating in an Exchange or Sharing of RR shall implement a Cross-Border RR Activation Process.
2. All TSOs of a Synchronous Area shall determine in a Synchronous Area agreement the roles and the responsibilities of the TSOs implementing an Imbalance Netting Process, a Cross-Border FRR Activation Process or a Cross-Border RR Activation Process between LFC Areas of different LFC Blocks or of different Synchronous Areas.
3. All TSOs participating in the same Imbalance Netting Process, Cross-Border FRR Activation Process or Cross-Border RR Activation Process shall define in a multi-party agreement roles and responsibilities of the TSOs including but not limited to:
  - a) the provision of all input data necessary for
    - i. calculation of power interchange with respect to the Operational Security Limits;
    - ii. real-time Operational Security Analysis by participating and Affected TSOs;
  - b) the responsibility to calculate the power interchange according to a defined algorithm; and
  - c) implementation of coordinated and uncoordinated operational procedures to ensure Operational Security.
4. Without prejudice to Article 28(9), Article 28(10) and Article 28(11) and as part of the multi-party agreement referred to in Article 31(3), all TSOs participating in the same Imbalance Netting Process, Cross-Border FRR Activation Process or Cross-Border RR Activation Process shall have the right to define a sequential approach for calculation of the power interchange allowing any group of TSOs operating Adjacent LFC Areas or LFC Blocks to interchange Imbalance Netting, Frequency Restoration or Reserve Replacement Power among themselves ahead of interchange with other TSOs.
5. A TSO shall have the right to participate in more than one Imbalance Netting Process, Cross-Border FRR Activation Process or Cross-Border RR Activation Process only if
  - a) there are no contradictions between the multi-party agreements signed by the TSO for each process;
  - b) the amounts for possible Imbalance Netting, Frequency Restoration and Reserve Replacement Power Interchange are clearly divided between the single processes; and

the overall Imbalance Netting, Frequency Restoration and Reserve Replacement Power Interchange of this TSO do not result in power flows violating Operational Security Limits.

**Article 32**  
**TSO NOTIFICATION**

1. All TSOs willing to implement an Imbalance Netting Process, a Cross-Border FRR Activation, a Cross-Border RR Activation Process, Exchange of Reserves or Sharing of Reserves shall send a notification to all TSOs of the Synchronous Area three months in advance. The notification shall include:

- a) involved TSOs;
  - b) expected amount of power interchange due to the Imbalance Netting Process, Cross-Border FRR Activation Process or Cross-Border RR Activation Process;
  - c) reserve type and amount of Exchange or Sharing of Reserves; and
  - d) time frame of Exchange or Sharing of Reserves.
2. Where an Imbalance Netting Process, a Cross-Border FRR Activation Process or a Cross-Border RR Activation Process is implemented for LFC Areas which are not parts of the same LFC Block, each TSO of a LFC Area adjacent to the LFC Areas participating in the Imbalance Netting Process shall have the right to declare himself as an Affected TSO based on Operational Security Analysis within one month after notification.
3. The Affected TSO shall have the right to:
- a) require the provision of real-time values for Imbalance Netting Power Interchange, Frequency Restoration Power Interchange and Replacement Power Interchange necessary for real-time Operational Security Analysis; and
  - b) require an implementation of an operational procedure enabling the Affected TSO to set limits for the Imbalance Netting Power Interchange, Frequency Restoration Power Interchange and Replacement Power Interchange between the respective LFC Areas based on Operational Security Analysis.

### **Article 33 INFRASTRUCTURE**

1. All TSOs shall consider the technical infrastructure necessary to implement and operate one or more processes listed in Article 23 as critical according to [OS NC].
2. All TSOs of a Synchronous Area shall define in a Synchronous Area agreement and in accordance minimum requirements for availability, reliability and redundancy of the technical infrastructure referred to in Article 33(1) including but not limited to:
  - a) precision, resolution, availability and redundancy of Active Power flow and Virtual Tie-Line measurements;
  - b) availability and redundancy of digital control systems;
  - c) availability and redundancy of communication infrastructure; and
  - d) communication protocols.
3. All TSOs of a LFC Block shall define in a LFC Block Agreement additional requirements for availability, reliability and redundancy of the technical infrastructure while complying with Article 33(2).
4. Each TSO of a LFC Area shall:
  - a) ensure a sufficient quality and availability of the Frequency Restoration Control Error calculation;

- b) perform real-time quality monitoring of the Frequency Restoration Control Error calculation;
- c) take action in case of Frequency Restoration Control Error miscalculation; and,
- d) where the Frequency Restoration Control Error is defined by the ACE, perform an ex-post quality monitoring of the Frequency Restoration Control Error calculation by comparing Frequency Restoration Control Error to reference values at least on an annual basis.

## **CHAPTER 5**

### **OPERATION OF LOAD-FREQUENCY CONTROL**

#### **Article 34**

#### **SYSTEM STATES RELATED TO THE SYSTEM FREQUENCY**

1. All TSOs of a Synchronous Area shall establish a real-time data exchange inter alia and in accordance with [OS NC Article 18] of
  - a) the System State of the Transmission System in reference to the [OS NC]; and
  - b) the real-time measurement data of the Frequency Restoration Control Error of the LFC Blocks and LFC Areas of the Synchronous Area.
2. The Synchronous Area Monitor shall determine the System State with regard to the System Frequency in reference to the [OS NC] according to the System Frequency limits.
3. The System Frequency limits for Normal State are fulfilled when:
  - a) the steady state System Frequency Deviation is within the Standard Frequency Range; or
  - b) the steady state System Frequency Deviation is not bigger than 50 % of the Maximum steady state Frequency Deviation for a time period not longer than the Time to Restore Frequency; or
  - c) the steady state System Frequency Deviation is not larger than the Maximum steady state Frequency Deviation for a time period not longer than the Alert State Trigger Time.
4. The System Frequency limits for Alert State are fulfilled when:
  - a) the absolute value of the steady state System Frequency Deviation is not larger than the Maximum steady state Frequency Deviation; and
  - b) the System Frequency limits for Normal State are not fulfilled
5. The Synchronous Area Monitor shall inform the TSOs of the Synchronous Area in case the System Frequency Deviation fulfils one of the criteria for the Alert State .
6. The TSOs of a Synchronous Area shall define common rules for the operation of Load-Frequency Control in Normal State and Alert State in a Synchronous Area agreement.
7. The TSOs of a LFC Block shall reduce the Frequency Restoration Control Error of the LFC Block by activation of Active Power Reserves.
8. The TSOs of a LFC Block shall make reasonable endeavours to avoid Frequency Restoration Control Errors persisting for more than the Time to Restore Frequency.

9. For the case of an Alert State due a violation of System Frequency limits the TSOs of a Synchronous Area shall define actions to reduce the System Frequency Deviation to restore the System State to Normal State and to limit the risk to enter into Emergency State. For these actions the TSOs of the Synchronous Areas shall have the right to deviate from the obligation set in Article 26(1) after common agreement.
10. In case of an Alert State due to there being insufficient Active Power Reserves to meet the requirements of the TSOs of those LFC Blocks, the TSOs shall in close cooperation with the other TSOs of the Synchronous Area and TSOs of other Synchronous Areas act to restore and replace necessary levels of Active Power reserves. For this purpose the TSOs of a LFC Block shall have the right to require changes in the Active Power production or consumption of generating or demand facilities within its area with the aim to reduce or to eliminate the violation of Active Power Reserve requirements.
11. For the case the 1-minute average of the Frequency Restoration Control Error of a LFC Block is above the Level 2 Frequency Restoration Control Error Range for at least the Time To Restore Frequency:
  - a) the TSOs of the concerned LFC Block shall cooperate with the other TSOs of the Synchronous Area to reduce the Frequency Restoration Control Error; and
  - b) in case the Frequency Restoration Control Error is not expected to be reduced sufficiently by the actions related to a) the TSOs of a LFC Block shall have the right to require changes in the Active Power production or consumption of generating and demand facilities within its area with the aim to reduce the Frequency Restoration Control Error.
12. For the Synchronous Areas CE and NE, for the case the Frequency Restoration Control Error of a LFC Block exceeds 25 % of the Reference Incident of the Synchronous Area for more than 30 consecutive minutes or the Frequency Restoration Control Error exceeds the inactive FRR in the respective direction for at least the Time to Restore Frequency;
  - a) the TSOs of the concerned LFC Block shall cooperate with the other TSOs of the Synchronous Area in the closest manner to reduce the Frequency Restoration Control Error; and
  - b) in case the Frequency Restoration Control Error is not expected to be reduced sufficiently by the actions related to a) the TSOs of a LFC Block shall require changes in the Active Power production or consumption of generating and demand facilities within its area with the aim to reduce the Frequency Restoration Control Error as defined in (15).
13. The LFC Block Monitor shall determine any violation of the limits referred to in (11) and (12) in the case that these referenced clauses apply in their LFC Block. In these cases the LFC Block Monitor shall inform the other TSOs of the LFC Block and coordinate the actions to reduce the Frequency Restoration Control Error.
14. For the cases as specified in (9) to (12) in the case that these referenced clauses apply in their LFC Block the TSOs of a Synchronous Area shall define actions to enable the TSOs of a LFC Block to actively reduce the Frequency Deviation by cross-border activation of reserves. In case of an occurrence of these cases the TSOs of Synchronous Area shall make reasonable endeavours to enable the TSOs of the concerned LFC Block to reduce its Frequency Restoration Control Error.
15. The TSOs of a LFC Block shall define measures to reduce the Frequency Restoration Control Error by requiring changes in the Active Power production or consumption of generating and demand facilities within its area.

## **CHAPTER 6**

### **FREQUENCY CONTAINMENT RESERVES (FCR)**

#### **Article 35**

#### **FCR DIMENSIONING**

1. All TSOs of a Synchronous Area shall determine the FCR Capacity required for the Synchronous Area and the shares of FCR required for each TSO as the Initial FCR Obligation according to Article 35(5) and Article 35(7).
2. All TSOs of a Synchronous Area shall apply a dimensioning approach in accordance with Article 35(5) for FCR based on a risk assessment criterion taking into account the pattern of load, generation and inertia.
3. All TSOs of a Synchronous Area shall recalculate the FCR Capacity required for the Synchronous Area and the Initial FCR Obligation for each TSO at least on an annual basis in accordance with Article 35(5) and Article 35(7) .
4. All TSOs of the Synchronous Area shall have the right to recalculate the FCR Capacity required for the Synchronous Area and the Initial FCR Obligation for each TSO more frequently than on an annual basis All TSOs of a Synchronous Area shall define dimensioning rules respecting the following criteria:
  - a) the FCR Capacity required for the Synchronous Area shall at least cover the Reference Incident of the Synchronous Area, based on a deterministic analysis and respecting the Frequency Quality Defining Parameters; and
  - b) for CE and NE all TSOs of a Synchronous Area shall define a dimensioning approach for FCR on the basis of the principle of covering remaining imbalances in the Synchronous Area that are likely to happen according to a probability of once in 20 years.
5. The TSOs of a Synchronous Area shall determine the size of the Reference Incident respecting the following conditions:
  - c) For CE: the Reference Incident shall be the largest imbalance that may result from an instantaneous change of Active Power of two generating units, two demand facilities or two HVDC Interconnectors connected to the same electrical node.
  - d) For GB, IRE, and NE: the Reference Incident shall be the largest imbalance that may result from an instantaneous change of Active Power of a single generating unit, single demand facility, single HVDC Interconnector or from a tripping of an AC-Line.
6. The shares of the FCR Capacity required for each TSO as Initial FCR Obligation shall be based on the sum of the net generation and consumption of its area divided by the sum of net generation and consumption of the Synchronous Area over a period of one year.

**Article 36**  
**FCR TECHNICAL MINIMUM REQUIREMENTS**

1. Each Reserve Connecting TSO shall ensure that the FCR corresponds to the following properties listed according to its Synchronous Area in accordance with [NC RfG Article 10 (2) (c)] in table 3:

Minimum accuracy of frequency measurement	CE, GB, IRE and NE	10 mHz or the current industrial standard or better
Maximum combined effect of inherent insensitivity and possible intentional dead band of the governor of the FCR Providing Units or FCR Providing Groups.	CE	10 mHz
	GB	15 mHz
	IRE	15 mHz
	NE	10 mHz
Full Activation Time of FCR	CE	30 s
	GB	30 s
	IRE	15 s
	NE	30 s if System Frequency is outside Standard Frequency Range
FCR Full Activation Deviation.	CE	± 200 mHz
	GB	±500 mHz
	IRE	Dynamic FCR ±500 mHz Static FCR ±1000 mHz
	NE	± 500 mHz

Table 3: FCR Properties in the different Synchronous Area

2. All TSOs of a Synchronous Area shall have the right to determine common additional properties of the FCR required to ensure operational security in the Synchronous Area by means of a set of technical parameters and within the capabilities described in [NC RfG Article 10 (2) (c)] and [NC DCC Article 21 and 22].]. These properties of FCR shall reflect the installed capacity, structure and pattern of consumption and generation of the Synchronous Area. For the introduction of additional properties a transition period upon consultation with affected FCR Providers shall be foreseen.
3. The Reserve Connecting TSO shall have the right to define additional requirements for FCR Providing Groups within the capabilities described with [NC RfG Article 10 (2) (c)] and [NC DCC

Article 21 and 22] based on technical arguments to ensure operational security. The FCR Provider shall ensure that monitoring of the FCR activation of the FCR Providing Units within a Reserve Providing Group is possible.

4. Each FCR Providing Unit and each FCR Providing Group shall only have one Reserve Connecting TSO.
5. Each Reserve Connecting TSO shall implement a FCR Prequalification process to assess the fulfilment of the technical and availability requirements by possible FCR Providing Units or Reserve Providing Groups. This process shall include at least a reassessment in case requirements or equipment change and a periodical reassessment within the time frame of at least five years. A potential FCR Provider shall have the right to apply for a prequalification of potential FCR Providing Units or Reserve Providing Groups at a relevant Reserve Connecting TSO. In case compliance with certain requirements of this code has already been verified against the Reserve Connecting TSO it will be recognised in the prequalification.

The Prequalification shall consist of the submission of the formal application of the potential FCR Provider including all required information to the Reserve Connecting TSO, the evaluation of the provided information by the Reserve Connecting TSO, the announcement of the respective findings including the possibility for the FCR Provider to amend the provided information within a defined period of time and the acceptance or refusal of the application by the Reserve Connecting TSO.

The Reserve Connecting TSO shall process the application within 3 months after provision of all the required information by the FCR Provider to the Reserve Connecting TSO and shall prequalify FCR Providing Units or FCR Providing Groups which successfully passed a FCR Prequalification.

6. Each FCR Providing Unit and each FCR Providing Group shall comply with the required properties for FCR according to Article 36(1) and Article 36(2) and shall activate the agreed FCR in accordance to Article 36(1) and Article 36(2) by means of a proportional governor reacting to frequency deviations or alternatively based on a monotonic piecewise linear power-frequency characteristic in the case of relay activated FCR.
7. Each Reserve Connecting TSO shall ensure that the activation of its FCR Providing Units or Reserve Providing Groups is in line with the requirements of the Synchronous Area according to Article 36(1) and Article 36(2).
8. Each Reserve Connecting TSO shall monitor all FCR Providing Units and FCR Providing Groups connected to its grid. Each FCR Provider shall make available to the Reserve Connecting TSO for each of its FCR Providing Units and Reserve Providing Groups at least the following information taking into account the provisions defined in [NC RfG Article 10 (2) (c)]:
  - a) time-stamped status indicating if FCR is on or off;
  - b) time-stamped Active Power data needed to verify FCR activation. This data shall include, but is not limited to time-stamped instantaneous power
  - c) droop of the governor for Type C and Type D Power Generating Modules as defined in [NC RfG Article 3] acting as FCR Providing Units or its equivalent parameter for FCR Providing Groups consisting on Type A and/or Type B Power Generating Modules as defined in [NC RfG Article 3] and/or Demand Facilities with Demand Side Response Active Power Control as defined in [NC DCC Article 22];

Each FCR Provider has the right to aggregate the respective data for its FCR Providing Units under the condition that the maximum power of the aggregated units is below 1 MW and clear verification of activation of FCR is possible.

At the request of the Reserve Connecting TSO, a FCR Provider has to make this information available in real time with a time resolution of at least 10 seconds taking into account the provisions defined in [NC RfG Article 10 (2) (c)]]].

At the request of the Reserve Connecting TSO, a FCR Provider has to make available data below the level of units in case it is necessary for clear verification of activation of FCR.

### **Article 37 FCR PROVISION**

1. Each TSO shall ensure the availability of at least its Initial FCR Obligation agreed upon in accordance with Article 35(7), Article 42, Article 51 and Article 52.
2. The TSOs of a Synchronous Area shall determine at least on an annual basis the size of the K-Factor of the Synchronous Area taking into account factors including, but not limited to:
  - a) The FCR Capacity divided by the Maximum Steady-State Frequency Deviation;
  - b) the auto-control of generation; and
  - c) the self-regulation of load taking into account the contribution according to the [DCC NC].
3. The shares of the K-Factor for each TSO shall be based on its Initial FCR Obligation according to (1) of its area divided by the FCR Capacity.
4. A FCR Provider shall guarantee the continuous availability of FCR with the exception of a forced outage of a FCR Providing Unit during the time period in which it is obliged to provide FCR .

Each FCR Provider shall inform its Reserve Connecting TSO about any changes in actual availability of its FCR Providing Unit or its FCR Providing Group or a part of its FCR Providing Group that is considered to be relevant according to the results of Prequalification without undue delay.

5. Each TSO shall ensure, or shall require from its FCR Providers to ensure that:
  - a) The loss of a FCR Providing Unit does not endanger the System Security by:
    - i. limiting the share of the FCR provided per Reserve Providing Unit to 5 % of the FCR Capacity required for the SA for CE; and
    - ii. taking the loss of the largest FCR Providing Unit into account in the dimensioning process for GB, IRE and NE.
    - iii. the FCR which is made unavailable due to an forced outage or an unavailability of an FCR Providing Unit or FCR Providing Group is replaced as soon as technically possible and according to the conditions that shall be defined by the Reserve Connecting TSO.
6. A FCR Providing Unit or FCR Providing Group:
  - a) With an energy reservoir that does not limit the FCR providing capability shall activate its FCR as long as the Frequency Deviation persists.

- b) With an energy reservoir that limits the FCR providing capability shall activate its FCR as long as the Frequency Deviation persists unless its energy reservoir is exhausted in either direction

For the Synchronous Area CE and NE, a FCR Providing Unit or FCR Providing Group with an energy reservoir that limits the FCR providing capability shall be able to fully activate its FCR continuously for a time period of not less than 30 minutes and for an equivalent longer time period in case of Frequency Deviations smaller than the FCR Full Activation Frequency Deviation and shall specify the limitations of the energy reservoir in the Prequalification process.

An FCR Provider using FCR Providing Units or FCR Providing Group with an energy reservoir that limits the FCR providing capability has to take appropriate measures to ensure recovery of energy reservoirs in any of the two directions

- i. for GB and IRE: according to the methods that shall be defined by the TSOs of the Synchronous Area
- ii. for all other Synchronous Areas: as soon as possible but at least within 2 hours,

## **CHAPTER 7**

### **FREQUENCY RESTORATION RESERVES (FRR)**

#### **Article 38** **FRR DIMENSIONING**

1. All TSOs of a LFC Block shall define FRR Dimensioning Rules .
2. The FRR Dimensioning Rules shall comprise at least the following requirements:
  - a) All TSOs of a LFC Block shall determine the required FRR Capacity of the LFC Block based on consecutive historical records at least comprising historical LFC Block Imbalance values. The sampling of these historical records shall be at least the Time To Restore Frequency. The considered time period of these records shall be representative and include at least one full year period ending not earlier than 6 months prior to the calculation;
  - b) All TSOs of a LFC Block in the Synchronous Areas CE, NE shall determine the FRR Capacity of the LFC Block such that it is sufficient to respect the current Frequency Restoration Control Error Target Parameters in accordance with Article 12 for the considered historical period of time based at least on a probabilistic methodology. In this methodology possible restrictions agreements for the Sharing or Exchange of Reserves due to possible violations of Operational Security and the FRR Availability Requirements shall be taken into account. All TSOs of a LFC Block shall take expected significant changes to the distribution of LFC Block Imbalances or other relevant influencing factors relative to the considered time period into account for this determination;
  - c) All TSOs of a LFC Block shall determine the ratio of Automatic FRR Capacity and Manual FRR Capacity and the Automatic FRR Full Activation Time and Manual FRR Full Activation Time such that requirement (b) can be fulfilled. For this the Automatic FRR Full Activation Time of a LFC Block and the Manual FRR Full Activation Time of the LFC Block shall at most be the Time to Restore Frequency.
  - d) The TSOs of a LFC Block shall determine the size of the Dimensioning Incident. The Dimensioning Incident shall be the largest imbalance that may result from an instantaneous

change of active power of a single generating unit, single demand facility, single HVDC interconnector or from a tripping of an AC-Line within the LFC Block.

- e) All TSOs of a LFC Block shall determine the positive FRR Capacity such that it is not smaller than the positive Dimensioning Incident of the LFC Block;
- f) All TSOs of a LFC Block shall determine the negative FRR Capacity such that it is not smaller than the negative Dimensioning Incident of the LFC Block;
- g) All TSOs of a LFC Block shall determine the FRR Capacity of a LFC Block and possible geographical limitations for its distribution within the LFC Block and possible geographical limitations for any Exchange of Reserves or Sharing of Reserves with other LFC Blocks to respect the Operational Security according to the [OS NC];
- h) All TSOs of a LFC Block shall ensure that the positive FRR Capacity or a combination of FRR and RR Capacity if an RRP according to Article 27 is implemented is sufficient to cover the positive LFC Block Imbalances in at least 99 % of the time based on the historical record as defined in (a) ;
- i) All TSOs of a LFC Block shall ensure that the negative FRR Capacity or a combination of FRR and RR Capacity if an RRP according to 27 is implemented is sufficient to cover the negative LFC Block Imbalances in at least 99 % of the time based on the historical record as defined in (a);
- j) All TSOs of a LFC Block are allowed to reduce the positive FRR Capacity of the LFC Block, resulting from the FRR Dimensioning Process, by concluding an agreement for the Sharing of FRR with other LFC Blocks in accordance with the provisions of Chapter 9. The reduction of the positive FRR Capacity of a LFC Block is:
  - i. For CE and Nordic: limited to the difference, if positive, between the size of the positive Dimensioning Incident and the FRR Capacity required to cover the positive LFC Block imbalances in 99 % of time based on historical records as defined in (a); and
  - ii. For CE and Nordic: shall never exceed 30 % of the size of the positive Dimensioning Incident.
  - iii. For GB and Ireland the positive FRR capacity and risk of non-delivery due to sharing shall be continually assessed by the TSOs of the LFC Block.
- k) All TSOs of a LFC Block are allowed to reduce the negative FRR Capacity of the LFC Block, resulting from the FRR Dimensioning Process, by concluding an agreement for the Sharing of FRR with other LFC Blocks in accordance with the provisions of Chapter 9. The reduction of the negative FRR Capacity of a LFC Block is:
  - i. For CE and Nordic: limited to the difference, if positive, between the size of the negative Dimensioning Incident and the FRR Capacity required to cover the Negative LFC Block imbalances in 99 % of time based on historical records as defined in (a); and
  - ii. For CE and Nordic : shall never exceed 30 % of the size of the Negative Dimensioning Incident.

- iii. For GB and Ireland the positive FRR capacity and risk of non-delivery due to sharing shall be continually assessed by the TSOs of the LFC Block
- 3. All TSOs of a LFC Block where the LFC Block comprises more than one TSO, shall agree in a TSO multi-party agreement on the specific allocation of responsibilities between shall agree in a TSO multi-party agreement on the specific allocation of responsibilities between TSOs of different LFC Areas for the implementation of the obligations established in Article 38.
- 4. All TSOs of a LFC Block shall have sufficient FRR Capacity according to the FRR Dimensioning Rules at any time. For the case of a severe risk of insufficient FRR Capacity of a LFC Block an escalation procedure shall be agreed by all TSOs of a LFC.

### **Article 39**

#### **FRR TECHNICAL MINIMUM REQUIREMENTS**

1. The FRR Technical Minimum Requirements shall be:
  - a) a FRR Providing Unit or FRR Providing Group shall be connected to only one Reserve Connecting TSO;
  - b) a FRR Providing Unit or FRR Providing Group shall activate FRR according to the Set-Point received from only one Reserve Instructing TSO;
  - c) the Reserve Instructing TSO shall be the Reserve Connecting TSO or a TSO appointed by the Reserve Connecting TSO in a multi-party agreement on exchange of FRR referred to in Article 44;
  - d) a FRR Providing Unit or FRR Providing Group for Automatic FRR shall have an Automatic FRR Activation Delay of at most 30 seconds;
  - e) a FRR Provider shall ensure that monitoring of the FRR activation of the FRR Providing Units within a Reserve Providing Group is possible. For this the FRR Provider shall be able to supply real-time measurements of the activated FRR and the relevant reference power production or consumption at the Connection Point to the Reserve Connecting TSO and the Reserve Instructing TSO for
    - i. each FRR Providing Unit;
    - ii. each FRR Providing Group; and
    - iii. each Power Generating Module or Demand Unit of a FRR Providing Group with a maximum Active Power output larger than or equal to 1 MW;
  - f) a FRR Providing Unit or FRR Providing Group for Automatic FRR shall be able to activate its complete FRR Capacity within the Automatic FRR Full Activation Time;
  - g) a FRR Providing Unit or FRR Providing Group for Manual FRR shall be able to activate its complete Manual FRR Capacity within the Manual FRR Full Activation Time;
  - h) a FRR Provider shall fulfil the FRR Availability Requirements;
  - i) a FRR Providing Unit or FRR Providing Group shall fulfil the ramp rate requirements of the LFC Block.

2. All TSOs of a LFC Block shall define FRR Availability Requirements and requirements to the control quality of FRR Providing Units and FRR Providing Groups for their LFC Block in the LFC Block Operational Agreement and Article 38.
3. The Reserve Connecting TSO shall define technical requirements for the connection of FRR Providing Units and FRR Providing Groups to ensure that the delivery of FRR is possible in a safe and secure way.
4. The Reserve Connecting TSO shall have the right to exclude FRR Providing Groups from the provision of FRR based on technical arguments to ensure Operational Security according to the [OS NC].
5. Each TSO shall implement a FRR Prequalification Process to assess the fulfilment the FRR Technical Minimum Requirements according to (1), the FRR Availability Requirements and the ramp rate requirements according to (2) and the connection requirements according to (3) by potential FRR Providing Units and FRR Providing Groups. This process shall include at least a reassessment in case requirements or equipment change and a periodical reassessment within the time frame of at least five years.
6. A potential FRR Provider shall have the right to apply for a prequalification of potential FRR Providing Units and FRR Providing Groups at a relevant Reserve Connecting TSO or at a TSO appointed by the Reserve Connecting TSO in a multi-party agreement on exchange of FRR referred to in Article 44;.

A TSO shall process an application for prequalification within 3 months and shall prequalify FRR Providing Units or FRR Providing Groups which fulfil the FRR Technical Minimum Requirements according to (1), the FRR Availability Requirements and the ramp rate requirements according to (2) and the connection requirements according to (3).

7. Each FRR Provider shall
  - a) ensure that its FRR Providing Units and FRR Providing Groups fulfil the FRR Technical Minimum Requirements, the FRR Availability Requirements and the ramp rate requirements according to (1) to (3);
  - b) inform its Reserve Instructing TSO about a reduction of the actual availability of its FRR Providing Unit or its FRR Providing Group or a part of its FRR Providing Group without undue delay.
8. Each Reserve Instructing TSO shall ensure that for its FRR Providing Units and FRR Providing Groups the fulfilment of the FRR Technical Minimum Requirements according to (1), the FRR Availability Requirements and the ramp rate requirements according to (2) and the connection requirements according to (3) are monitored.

## **CHAPTER 8**

### **REPLACEMENT RESERVES (RR)**

#### **Article 40**

##### **RR DIMENSIONING**

1. All TSOs of a LFC Block shall have the right to implement a Reserve Replacement Process
2. All TSOs of a LFC Block with a RRP according to Article 23(2), performing a combined Dimensioning Process of FRR and RR to fulfil the requirements of Article 38 (2), shall define the RR Dimensioning Rules in order to respect the Frequency Restoration Control Error Target Parameters in accordance with Article 12.
3. The RR Dimensioning Rules shall comprise at least the following requirements:
  - a) sufficient positive RR Capacity to restore the required amount of positive FRR and for GB and IRE: sufficient positive RR Capacity to restore the required amount of positive FCR and positive FRR;
  - b) sufficient negative RR Capacity to restore the required amount of negative FRR and for GB and IRE: sufficient negative RR Capacity to restore the required amount of negative FCR and negative FRR
  - c) sufficient RR Capacity, if taken into account to dimension the FRR Capacity to respect the Frequency Restoration Error Quality Target for the considered period of time, based on theoretical considerations; and
  - d) respect the operational security according to the [OS NC] within a LFC Block to determine RR Capacity.
4. All TSOs of a LFC Block are allowed to reduce the positive RR Capacity of the LFC Block, resulting from the RR Dimensioning Process, by concluding an agreement for the Sharing of RR for this positive RR Capacity with other LFC Blocks in accordance with the provisions of Chapter 9. The Control Capability Receiving TSO shall limit the reduction of its positive RR Capacity:
  - a) in order to guarantee that it can still meet its FRCE Quality Targets as set forth in Article 12;
  - b) in order to ensure that Operational Security according to [NC OS] is not endangered; and
  - c) in order to ensure that the reduction of the positive RR Capacity shall never exceed the remaining positive RR Capacity of the LFC Block.
5. All TSOs of a LFC Block are allowed to reduce the negative RR Capacity of the LFC Block, resulting from the RR Dimensioning Process, by concluding an agreement for the Sharing of RR for this negative RR Capacity with other LFC Blocks in accordance with the provisions of Article 49 and Article 57. The Control Capability Receiving TSO shall limit the reduction of its negative RR Capacity:
  - a) in order to guarantee that it can still meet its FRCE Quality Targets as set forth in Article 12;

- b) in order to ensure that Operational Security according to [NC OS] is not endangered; and
  - c) in order to ensure that the reduction of the negative RR Capacity shall never exceed the remaining negative RR Capacity of the LFC Block
- 6. Where a LFC Block is operated by more than one TSO, all TSOs of that LFC Block shall agree in a TSO multi-party agreement on the specific allocation of responsibilities between TSOs of different LFC Areas for the implementation of the obligations if the process is needed by a LFC Block.
- 7. A TSO shall have sufficient RR Capacity according to the RR Dimensioning Rules at any time. For the case of a severe risk of insufficient RR Capacity of a LFC Block an escalation procedure shall be agreed by all TSOs of a LFC Block.

#### **Article 41**

#### **RR TECHNICAL MINIMUM REQUIREMENTS**

1. The RR Technical Minimum Requirements for RR Providing Units and RR Providing Groups shall be:
    - a) a RR Providing Unit or RR Providing Group shall be connected to only one Reserve Connecting TSO;
    - b) a RR Providing Unit or RR Providing Group shall activate RR according to the Set Point received from only one Reserve Instructing TSO ;
    - c) a RR Providing Unit or RR Providing Group shall activate its complete RR Capacity within the activation time defined by the Instructing TSO;
    - d) a RR Providing Unit or RR Providing Group shall de-activate RR according to the Set Point received from the Reserve Instructing TSO;
    - e) a RR Provider shall ensure that monitoring of the RR activation of the RR Providing Units within a Reserve Providing Group is possible. For this, the RR Provider shall be able to supply real-time measurements at the Connection Point to the Reserve Connecting TSO and the Reserve Instructing TSO of :
      - i. time-stamped scheduled Active Power output;
      - ii. time-stamped instantaneous Active Power

for

    - i. each FRR Providing Unit;
    - ii. each FRR Providing Group; and
    - iii. each Power Generating Module or Demand Unit of a FRR Providing Group with a maximum Active Power output larger than or equal to 1 MW;  - f) a RR Providing Unit or RR Providing Group shall fulfil the RR Availability Requirements;
2. All TSOs of a LFC Block shall define RR Availability Requirements of RR Providing Units and RR Providing Groups for their LFC Block in the LFC Block Operational Agreement while respecting the provisions of Article 3(3) and Article 38

3. The Reserve Connecting TSO shall define technical requirements for the connection of RR Providing Units and RR Providing Groups to ensure that the delivery of RR is possible in a safe and secure way.
4. The Reserve Connecting TSO shall have the right to exclude RR Providing Groups from the provision of RR based on technical arguments to ensure operational security according to the [OS NC].
5. Each TSO shall implement a RR Prequalification Process to assess the fulfilment of the technical and availability requirements by possible RR Providing Units and RR Providing Groups according to (1) to (3). This process shall include at least a reassessment in case requirements or equipment change and a periodical reassessment within the time frame of at least five years.
6. A potential RR Provider shall have the right to apply for a prequalification of potential RR Providing Units and RR Providing Groups at a relevant Reserve Connecting TSO or at a TSO appointed by the Reserve Connecting TSO in a multi-party agreement on exchange of RR referred to in Article 44.

A TSO shall process an application for prequalification within 3 months and shall prequalify RR Providing Units or RR Providing Groups which fulfil the RR Technical Minimum Requirements according to (1), the RR Availability Requirements according to (2) and the connection requirements according to (3).

7. Each RR Provider shall
  - a) ensure that its RR Providing Units and RR Providing Groups fulfil the RR technical minimum requirements and the RR Availability Requirements according to (1) to (3);
  - b) inform its Reserve Instructing TSO about a reduction of the actual availability or a forced outage of its RR Providing Unit or its FRR Providing Group or a part of its RR Providing Group without undue delay.
8. Each Reserve Instructing TSO shall ensure that for its RR Providing Units and RR Providing Groups the fulfilment of the RR Technical Requirements according to (1) and the RR Availability Requirements according to (2) are monitored

# CHAPTER 9

## EXCHANGE AND SHARING OF RESERVES

### Section 1

#### EXCHANGE AND SHARING OF RESERVES WITHIN A SYNCHRONOUS AREA

##### Article 42

##### EXCHANGE OF FCR WITHIN A SYNCHRONOUS AREA

1. The Exchange of FCR within a Synchronous Area is allowed in accordance with the provisions and limits of this article. The Exchange of FCR invokes a transfer of FCR Obligation from the Reserve Receiving TSO to the Reserve Connecting TSO for the considered FCR Capacity.
2. All TSOs involved in the Exchange of FCR within a Synchronous Area shall ensure to respect the limits and requirements for the Exchange of FCR within the Synchronous Area as defined in Table 4:

Synchronous Area	Exchange of FCR allowed between:	Limits for the Exchange of FCR
Synchronous Area CE	TSOs of LFC Blocks	- the TSOs of a LFC Block shall secure that at least 30% of their total combined Initial FCR Obligations, according to Article 35(1), is physically provided inside their LFC Block.
	TSOs of Adjacent LFC Blocks	- the amount of FCR Capacity, physically located in an LFC Block as a result of the Exchange of FCR with other LFC Blocks, shall be limited to the maximum of: <ul style="list-style-type: none"> <li>o 30% of the total combined Initial FCR Obligations, according to Article 35(1), of the TSOs of the LFC Block to which the FCR Capacity is physically connected;</li> <li>o 100 MW of FCR Capacity.</li> </ul>
	TSOs of the LFC Areas of the same LFC Block	- The TSOs of the LFC Areas constituting a LFC Block shall have the right to set internal limits for the Exchange of FCR between the LFC Areas of the same LFC Block in a TSO multi-party agreement, , in order to: <ul style="list-style-type: none"> <li>o avoid internal congestions in case of the activation of FCR;</li> <li>o ensure an even distribution of FCR for the case of network splitting; and</li> <li>o avoid that the stability of the FCP or the Operational Security is affected.</li> </ul>
Other Synchronous Areas	TSOs of the Synchronous Area	- The TSOs of the Synchronous Area shall have the right to set limits for the exchange of FCR within a Synchronous Area agreement, , in order to: <ul style="list-style-type: none"> <li>o avoid internal congestions in case of the activation of FCR;</li> <li>o ensure an even distribution of FCR for the case of network splitting; and</li> <li>o avoid that the stability of the FCP or the Operational Security is affected.</li> </ul>

Table 4: Limits and requirements for the Exchange of FCR Obligation

3. In case of the Exchange of FCR, the Reserve Connecting TSO and Reserve Receiving TSO shall perform a Notification Process according to Article 32 .

4. Any Reserve Connecting TSO, Reserve Receiving TSO or Affected TSO involved in the Exchange of FCR has the right to refuse the Exchange of FCR in case the Exchange of FCR would lead to power flows in violation of the Operational Security Limits when activating the FCR Capacity subject to the Exchange of FCR.
5. Each Affected TSO shall verify that its Reliability Margin, defined according to [Article 26 of the NC CACM] is sufficient to accommodate the flows resulting from the activation of the FCR Capacity subject to the Exchange of FCR.
6. All TSOs of a LFC Area shall adjust the parameters of their Frequency Restoration Control Error calculation to account for the Exchange of FCR.
7. The Reserve Connecting TSO shall be responsible for the requirements according to Article 36 and Article 37 with regards to the FCR Capacity subject to the Exchange of FCR.
8. The FCR Providing Unit or Group shall only have a responsibility for FCR activation towards its Reserve Connecting TSO.

#### **Article 43**

#### **SHARING OF FCR WITHIN A SYNCHRONOUS AREA**

1. It is prohibited for a TSO to perform Sharing of FCR with other TSOs of its Synchronous Area in order to fulfil its FCR Obligation and to reduce the total amount of FCR of the Synchronous Area as defined in accordance with Article 35(1).

#### **Article 44**

#### **GENERAL REQUIREMENTS FOR THE EXCHANGE OF FRR AND RR WITHIN A SYNCHRONOUS AREA**

1. All TSOs of a Synchronous Area shall define in a Synchronous Area agreement the roles and the responsibilities of the Reserve Connecting TSO, the Reserve Receiving TSO and the Affected TSO for the Exchange of FRR and/or RR. The roles and responsibilities shall cover at least:
  - a) scheduling and accounting of the activated FRR/RR subject to the Exchange of FRR/RR; and
  - b) data delivery and transparency.
2. In case of the Exchange of FRR/RR, the Reserve Connecting TSO and Reserve Receiving TSO shall perform a Notification Process according to Article 32.
3. The Reserve Connecting and Reserve Receiving TSOs involved in the Exchange of FRR/RR shall define, in a multi-party agreement, their roles and responsibilities including but not limited to:
  - a) the responsibility of the Reserve Instructing TSO for the FRR/RR Capacity subject to the Exchange of FRR/RR;
  - b) the amount of the FRR/RR Capacity subject to the Exchange of FRR/RR;
  - c) the implementation of the Cross-Border FRR/RR Activation Process according to Article 29 and Article 30;
  - d) FRR/RR Technical Minimum Requirements related to the Cross-Border FRR/RR Activation Process where the Reserve Connecting TSO is not the Reserve Instructing TSO

- e) the implementation of the FRR/RR Prequalification Process for the FRR/RR Capacity subject to the Exchange of FRR/RR according to Article 39(5) and Article 41(5);
  - f) the responsibility to monitor the fulfilment of the FRR/RR Technical Requirements and FRR/RR Availability Requirements for the FRR/RR Capacity subject to the Exchange of FRR/RR according to Article 39(8) and Article 41(8) ; and
  - g) procedures to ensure that the Exchange of FRR/RR does not lead to power flows in violation with the Operational Security Limits according to [OS NC].
4. Any Reserve Connecting TSO, Reserve Receiving TSO or Affected TSO involved in the Exchange of FRR/RR has the right to refuse the Exchange of FRR/RR in case the Exchange of FRR/RR would lead to power flows in violation of the Operational Security Limits when activating the FRR/RR Capacity subject to the Exchange of FRR/RR.
  5. The involved TSOs shall ensure that Exchange of FRR/RR does not hinder any TSO to fulfil the reserve requirements according to the Reserve Dimensioning Process.
  6. All TSOs of a LFC Block shall define in a multi-party agreement their roles and the responsibilities as the Reserve Connecting TSO, the Reserve Receiving TSO and the Affected TSO for the Exchange of FRR and/or RR with TSOs of other LFC Blocks.

#### **Article 45**

#### **GENERAL REQUIREMENTS FOR THE SHARING OF FRR AND RR WITHIN A SYNCHRONOUS AREA**

1. All TSOs of a Synchronous Area shall define, in a Synchronous Area agreement the roles and responsibilities of the Control Capability Providing TSO, the Control Capability Receiving TSO and the Affected TSO for the Sharing of FRR/RR. The roles and responsibilities shall cover at least:
  - a. scheduling and accounting of the activated shared FRR/RR; and
  - b. data delivery and transparency.
2. In case of the Sharing of FRR/RR, the Control Capability Providing TSO and Control Capability Receiving TSO shall perform a Notification Process according to Article 32.
3. The Control Capability Receiving TSO and the Control Capability Providing TSO participating in the Sharing of FRR/RR shall define in a multi-party TSO agreement their roles and responsibilities including but not limited to:
  - a. the amount of FRR/RR Capacity subject to the Sharing of FRR/RR;
  - b. the implementation of the Cross-Border FRR/RR Activation Process; and
  - c. procedures to ensure that the activation of the FRR/RR Capacity subject to the Sharing of FRR/RR does not lead to power flows in violation with the Operational Security Limits according to [OS NC].
4. Any Control Capability Providing TSO, Control Capability Receiving TSO or Affected TSO involved in the Sharing of FRR/RR has the right to refuse the Sharing of FRR/RR in case the Sharing of FRR/RR would lead to power flows in violation of the Operational Security Limits when activating the FRR/RR Capacity subject to the Sharing of FRR/RR.

5. In case of the Sharing of FRR/RR, the Control Capability Providing TSO shall make available part of its own FRR/RR Capacity required to fulfil its reserve requirements for FRR and/or RR resulting from the FRR/RR dimensioning process of Article 38 and Article 40 to the Control Capability Receiving TSO. The Control Capability Providing TSO can be either:
  - a. the Reserve Instructing TSO for the FRR/RR Capacity subject to the Sharing of FRR/RR;
  - b. the TSO having access to its FRR/RR Capacity subject to the Sharing of FRR/RR through an implemented Cross-Border FRR/RR Activation Process as part of an agreement for the Exchange of FRR/RR referred to in Article 44.
6. Each Control Capability Receiving TSO shall remain responsible to cope with incidents and imbalances in case the FRR/RR Capacity subject to the Sharing of FRR/RR are unavailable due to:
  - a) constraints for Frequency Restoration or Replacement Power Interchange related to Operation Security according to the [OS NC];
  - b) partial or full usage of the FRR/RR Capacity by the Control Capability Providing TSO.
7. All TSOs of a LFC Block shall define in a multi-party agreement their roles and the responsibilities as the Control Capability Providing TSO, the Control Capability Receiving TSO and the Affected TSO for the Sharing of FRR and RR with TSOs of other LFC Blocks.

#### **Article 46**

#### **EXCHANGE OF FRR WITHIN A SYNCHRONOUS AREA**

1. The Exchange of FRR within a Synchronous Area is allowed in accordance with the provisions of this article and Article 44. All TSOs in a Synchronous Area consisting of more than one LFC Block involved in the Exchange of FRR within the Synchronous Area shall ensure to respect the requirements and limits as defined in Table 5:

<b>Synchronous Area</b>	<b>Exchange of FRR allowed between</b>	<b>Limits for the Exchange of FRR</b>
All Synchronous Areas consisting of more than one LFC Block	TSOs of different LFC Blocks	- The TSOs of a LFC Block shall ensure that at least 50 % of their total combined FRR Capacity resulting from the FRR Dimensioning Process according to Article 38(1) and before any reduction due to the Sharing of FRR according to Article 38(2) remains located within their LFC Block.
	TSOs of the LFC Areas of the same LFC Block	- The TSOs of the LFC Areas constituting a LFC Block shall have the right, if required, to set internal limits, for the Exchange of FRR between the LFC Areas of the LFC Block in a TSO multi-party agreement as to: <ul style="list-style-type: none"> <li>○ avoid internal congestions due to the activation of the FRR Capacity subject to the Exchange of FRR</li> <li>○ ensure an even distribution of FRR throughout the Synchronous Areas and LFC Blocks in case of network splitting; and</li> <li>○ avoid that the stability of the FRP or the Operational Security is affected.</li> </ul>

Table 5: Requirements and limits for the Exchange of FRR within the Synchronous Area

#### Article 47

##### SHARING OF FRR WITHIN A SYNCHRONOUS AREA

1. Each TSO of a LFC Block shall have the right to perform Sharing of FRR with other LFC Blocks of its Synchronous Area within the limits set by the FRR Dimensioning Process in Article 38(1) while respecting the general rules of Article 45 and Article 46.

#### Article 48

##### EXCHANGE OF RR WITHIN A SYNCHRONOUS AREA

1. The Exchange of RR within the Synchronous Area is allowed in accordance with the provisions of this Article and Article 44.
2. All TSOs in a Synchronous Area consisting of more than one LFC Block involved in the Exchange of RR within the Synchronous Area shall ensure to respect the requirements and limits for the Exchange of RR as defined in Table 6:

Synchronous Area	Exchange of RR allowed between	Limits for the Exchange of RR
All Synchronous Areas consisting of more than one LFC Block	TSOs of different LFC Blocks	- The TSOs of the LFC Areas constituting a LFC Block shall ensure that at least 50 % of their total combined RR Capacity resulting from the RR Dimensioning Process according to Article 40 and before any reduction of RR Capacity as a result of the Sharing of RR remains located within their LFC Block.
	TSOs of the LFC Areas of the same LFC Block	- The TSOs of the LFC Areas constituting a LFC Block shall have the right, if required, to set internal limits, for the Exchange of RR between LFC Areas of the LFC Block in a TSO multi-party agreement as to: <ul style="list-style-type: none"><li>○ avoid internal congestions due to the activation of RR Capacity subject to the Exchange of RR;</li><li>○ ensure an even distribution of RR throughout the Synchronous Area in case of network splitting; and</li><li>○ avoid that the stability of the RRP or the Operational Security is affected.</li></ul>

Table 6: Requirements and limits for the Exchange of RR within the Synchronous Area

#### Article 49

##### SHARING OF RR WITHIN A SYNCHRONOUS AREA

1. Each TSO of a LFC Block shall have the right to perform Sharing of RR with other LFC Blocks of the same Synchronous Area within the limits set by the RR Dimensioning Process in accordance with Article 40(4) and Article 40 (5) while respecting the provisions of Article 45 and Article 48

## **Section 2**

### **EXCHANGE AND SHARING OF RESERVES BETWEEN SYNCHRONOUS AREAS**

#### **Article 50**

#### **GENERAL REQUIREMENTS**

1. Each HVDC Operator and HVDC Owner of an HVDC Interconnector interconnecting Synchronous Areas shall provide the capability where the technology allows permitting the Connecting TSOs of the HVDC Interconnector to perform Exchange and Sharing of FCR, FRR and RR on HVDC Interconnectors.
2. All TSOs of the Synchronous Area CE, GB, IRE and NE shall define in a Cross-Synchronous Area Agreement the roles and the responsibilities of the Reserve Connecting TSO, the Reserve Receiving TSO and the Affected TSO for the Exchange of Reserves and the Control Capability Providing TSO, Control Capability Receiving TSO and Affected TSO for the Sharing of FCR between Synchronous Areas. The roles and responsibilities shall cover at least:
  - a) scheduling and accounting of the activated Reserve Capacity subject to the Exchange or Sharing of Reserves; and
  - b) data delivery and transparency.
3. In case of the Exchange or Sharing of FCR/FRR/RR, respectively the Reserve Connecting TSO and Reserve Receiving TSO or the Control Capability Providing TSO and the Control Capability Receiving TSO shall perform a Notification Process according to Article 32.
4. The Reserve Connecting and Reserve Receiving TSOs involved in the Exchange or Sharing of Reserve shall define, in a multi-party agreement, their roles and responsibilities including but not limited to:
  - a) the responsibility of the Reserve Instructing TSO for the Reserve Capacity subject to the Exchange or Sharing of Reserve;
  - b) the amount of the Reserve Capacity subject to the Exchange or Sharing of Reserve;
  - c) the implementation of the Cross-Border FRR/RR Activation Process according to Article 29 and Article 30;
  - d) the implementation of the Prequalification Process for the Reserve Capacity subject to the Exchange or Sharing of Reserve according Article 39(5) and Article 41(5);
  - e) the responsibility to monitor the fulfilment of the Technical Requirements and Availability Requirements for the Reserve Capacity subject to the Exchange or Sharing of Reserve according to Article 39(8) and Article 41(8); and
  - f) procedures to ensure that the Exchange or Sharing of Reserve does not lead to power flows in violation with the Operational Security Limits according to [OS NC].
5. The Reserve Connecting and Reserve Receiving TSOs involved in the Exchange or Sharing of Reserve shall agree with the Interconnector Owners, Interconnector Operators or various legal groupings of these a HVDC operating and coordination agreement including but not limited to:
  - a) consider interactions across all timescales including planning and activation;

- b) the MW/Hz sensitivity factor, linearity/dynamic or static/step response function of each link connecting any two or more given Synchronous Areas; and
  - c) the share/interaction of these functions across multiple HVDC paths between the Synchronous Areas.
5. Any Reserve Connecting TSO, Reserve Receiving TSO or Affected TSO involved in the Exchange or Sharing of Reserve has the right to refuse the Exchange or Sharing of Reserve in case the Exchange or Sharing of Reserve would lead to power flows in violation of the Operational Security Limits when activating the Reserve Capacity subject to the Exchange or Sharing of Reserve.
  6. Facilitation of Exchange or Sharing of Reserves between Synchronous Areas shall be organised based on TSO to TSO arrangements to ensure Operational Security.
  7. The involved TSOs shall ensure that Exchange of Reserve Capacity between Synchronous Area does not hinder any TSO to fulfil the reserve requirements according to Article 35, Article 38 and Article 40.
  8. Should the HVDC operator or the Reserve Provider fail in real-time to deliver the Reserve Capacity relating to FCR, FRR and RR, then the Reserve Receiving TSO has an obligation to act to ensure Operational Security is maintained within its Synchronous Area.

#### **Article 51**

#### **EXCHANGE OF FCR BETWEEN SYNCHRONOUS AREAS**

1. All TSOs of the Synchronous Area CE, GB, IRE and NE shall define in a cross - Synchronous Area agreement a methodology to determine limits on the amount of Exchange FCR between Synchronous Areas. The methodology shall take into account:
  - a) the operational impact between the Synchronous Areas;
  - b) the stability of the FCP of the Synchronous Area;
  - c) the ability of the Synchronous Area to reach the Frequency Quality Targets in accordance with Article 11; and
  - d) the Operational Security according to [OS NC].
2. Each HVDC operator of a HVDC Interconnector shall control the Active Power Flow over the HVDC Interconnector in accordance with instructions defined by the TSOs of the receiving LFC Area in accordance with the FCR requirements established in 22(1).
3. All TSOs participating to an Exchange of FCR shall organise the cross-border exchange in such a way that the TSOs of a first Synchronous Area may receive part of the total FCR Capacity required for their Synchronous Area as defined in accordance with the Article 35(1) within a second Synchronous Area.

The part of the total FCR required Capacity for the first Synchronous Area which is exchanged shall be provided within the second Synchronous Area in addition to the total FCR Capacity required for this second Synchronous Area in accordance with Article 35(1).

4. All TSOs of the Synchronous Areas involved shall agree in a TSO multi-party agreement upon the Exchange of FCR Obligation.
5. In case the Exchange of FCR fails, the TSOs of the receiving Synchronous Area remain responsible to stabilize the System Frequency in their Synchronous Area.
6. For the Exchange of FCR between Synchronous Areas, the Reserve Receiving TSOs shall ensure that the contribution from each bi-pole of a HVDC Interconnector and the total contribution from a HVDC Interconnector shall not exceed the limits established in Article 37(5).
7. All parties involved in Exchange of FCR will ensure that they comply with their obligations as set out in Article 29(5).

## **Article 52**

### **SHARING OF FCR BETWEEN SYNCHRONOUS AREAS**

1. A TSO shall not share part of its FCR with other TSOs of another Synchronous Area, unless the TSO is sharing FCR between the Synchronous Areas GB and IRE.
2. The TSOs of the Synchronous Area GB and IRE shall define in a multilateral agreement a methodology to determine limits on the amount of Sharing of FCR between their Synchronous Areas. The methodology shall take into account:
  - a) provisions for calculation and adaptation across operational timescales according to system conditions;
  - b) the operational impact between the Synchronous Areas;
  - c) the stability of the FCP of the Synchronous Area;
  - d) the ability of the Synchronous Area to reach the Frequency Quality Article 11; and
  - e) the Operational Security according to [OS NC].
3. Each HVDC operator of a HVDC Interconnector shall control the Active Power Flow over the HVDC Interconnector in accordance with instructions defined by the TSOs of the receiving LFC Area in accordance with the FCR requirements established in 22(1).
4. All TSOs participating in the Sharing of FCR shall organise the cross-border Sharing in such a way that the TSOs of a first Synchronous Area may receive part of the total FCR Capacity required for their Synchronous Area as defined in accordance with the Article 35(1) within a second Synchronous Area.
5. All TSOs of the Synchronous Areas involved shall agree in a TSO multi-party agreement upon the exchange of FCR Obligation.
6. In case the Sharing of FCR fails, the TSOs of the receiving Synchronous Area remain responsible to stabilize the System Frequency in their Synchronous Area.
7. For the Sharing of FCR between Synchronous Areas, the Reserve Receiving TSO shall ensure that the contribution from each bi-pole of a HVDC Interconnector and the total contribution from a HVDC Interconnector shall not exceed the limits established in Article 33(5a).

8. All parties involved in Sharing of FCR will ensure that they comply with their obligations as set out in Article 29(5).

### **Article 53            GENERAL REQUIREMENTS FOR THE SHARING OF FRR AND RR BETWEEN SYNCHRONOUS AREAS**

1. In case of the Sharing of FRR/RR, the Control Capability Providing TSO shall make available part of its own FRR/RR Capacity required to fulfil its reserve requirements for FRR and/or RR resulting from the FRR/RR dimensioning process of Article 38 and Article 40 to the Control Capability Receiving TSO. The Control Capability Providing TSO can be either:
  - a) the Reserve Instructing TSO for the FRR/RR Capacity subject to the Sharing of FRR/RR; or
  - b) the TSO having access to its FRR/RR Capacity subject to the Sharing of FRR/RR through an implemented Cross-Border FRR/RR Activation Process as part of an agreement for the Exchange of FRR/RR referred to in Article 44.
2. Each Control Capability Receiving TSO shall remain responsible to cope with incidents and imbalances in case the FRR/RR Capacity subject to the Sharing of FRR/RR are unavailable due to:
  - a) constraints for Frequency Restoration or Replacement Power Interchange related to Operation Security according to the [OS NC]; or
  - b) partial or full usage of the FRR/RR Capacity by the Control Capability Providing TSO.
3. All TSOs of a LFC Block shall define in a HVDC agreement their roles and the responsibilities as the Control Capability Providing TSO, the Control Capability Receiving TSO and the Affected TSO for the Sharing of FRR and RR with TSOs of other LFC Blocks.

### **Article 54 EXCHANGE OF FRR BETWEEN SYNCHRONOUS AREAS**

1. All TSOs of the Synchronous Area CE, GB, IRE and NE shall define in a cross - Synchronous Area agreement a methodology to determine limits on the amount of Exchange of FRR between Synchronous Areas. The methodology shall take into account:
  - a) the operational impact between the Synchronous Areas;
  - b) the stability of the FRP of the Synchronous Area;
  - c) the ability of the Synchronous Area to reach the Frequency Quality Targets in accordance with Article 11 and and the Frequency Restoration Control Quality Targets in accordance with Article 12; and
  - d) the Operational Security according to [OS NC].
2. All TSOs of LFC Blocks participating in the Exchange of FRR between Synchronous Areas shall organise the Exchange of FRR in such a way that the TSOs of a LFC Block in the first Synchronous Area may receive part of the total FRR Capacity required for their LFC Block as defined in accordance with the Article 30(1) from a LFC Block in the second Synchronous Area.

The part of the total FRR Capacity required for the LFC Block in the Synchronous Area which is exchanged shall be provided from the LFC Block in the second Synchronous Area in addition to the total FRR Capacity required for this second LFC Block in accordance with 30(1).

3. Each HVDC operator of a HVDC Interconnector shall control the Active Power Flow over the HVDC Interconnector in accordance with instructions defined by the TSOs of the receiving LFC Block in accordance with the FRR Technical Minimum Requirements established in 30(1).
4. All TSOs of the Reserve Providing LFC Block and the Reserve Receiving LFC Block shall agree in a multi-party agreement upon the Exchange of FRR.
5. In case the Exchange of FRR fails, the TSOs of the receiving Synchronous Area remain responsible to correct the Frequency Restoration Control Error in their Synchronous Area.

## **Article 55**

### **SHARING OF FRR BETWEEN SYNCHRONOUS AREAS**

1. All TSOs of the Synchronous Area CE, GB, IRE and NE shall define in a cross - Synchronous Area agreement a methodology to determine limits on the amount of Sharing of FRR between Synchronous Areas. The methodology shall take into account:
  - a) the operational impact between the Synchronous Areas;
  - b) the stability of the FRP of the Synchronous Area;
  - c) the maximum reduction of FRR that can be taken into account in the FRR Dimensioning according to Article 38 as a result from the FRR sharing agreements;
  - d) the ability of the Synchronous Area to reach the Frequency Quality Targets in accordance with Article 11 and the Frequency Restoration Control Quality Targets in accordance with Article 12; and
  - e) the Operational Security according to [OS NC].
2. All TSOs of LFC Blocks participating in the Sharing of FRR between Synchronous Areas shall organise the Sharing of FRR in such a way that the TSOs of a LFC Block in the first Synchronous Area may receive part of the total FRR Capacity required for their LFC Block as defined in accordance with the Article 30(1) from a LFC Block in the second Synchronous Area.
3. Each HVDC operator of a HVDC Interconnector shall control the Active Power Flow over the HVDC Interconnector in accordance with instructions defined by the TSOs of the receiving LFC Block in accordance with the FRR Technical Minimum Requirements established in 30(1).
4. All TSOs of the Reserve Providing LFC Block and the Reserve Receiving LFC Block shall agree in a multi-party agreement upon the Sharing of FRR.
5. In case the Sharing of FRR fails, the TSOs of the receiving Synchronous Area remain responsible to correct the Frequency Restoration Control Error in their Synchronous Area.

**Article 56**  
**EXCHANGE OF RR BETWEEN SYNCHRONOUS AREAS.**

1. All TSOs of the Synchronous Area CE, GB, IRE and NE shall define in a cross - Synchronous Area agreement a methodology to determine limits on the amount of Exchange of RR between Synchronous Areas. The methodology shall take into account:
  - a) the operational impact between the Synchronous Areas;
  - b) the stability of the RP of the Synchronous Area;
  - c) the ability of the Synchronous Area to reach the Frequency Quality Targets in accordance with Article 11 and and the Frequency Restoration Control Quality Targets in accordance with Article 12; and
  - d) the Operational Security according to [OS NC].
2. All TSOs of LFC Blocks participating in the Exchange of RR between Synchronous Areas shall organise the Exchange of RR in such a way that the TSOs of a LFC Block in the first Synchronous Area may receive part of the total RR Capacity required for their LFC Block as defined in accordance with the Article 33(1) from a LFC Block in the second Synchronous Area.

The part of the total RR Capacity required for the LFC Block in the Synchronous Area which is exchanged shall be provided from the LFC Block in the second Synchronous Area in addition to the total RR Capacity required for this second LFC Block in accordance with Article 33(1).
3. Each HVDC operator of a HVDC Interconnector shall control the Active Power Flow over the HVDC Interconnector in accordance with instructions defined by the TSOs of the receiving LFC Block in accordance with the RR Technical Minimum Requirements established in Article 33(1).
4. All TSOs of the Reserve Providing LFC Block and the Reserve Receiving LFC Block shall agree in a multi-party agreement upon the Exchange of RR.
5. In case the Exchange of RR fails, the TSOs of the receiving Synchronous Area remain responsible to correct the Frequency Restoration Control Error in their Synchronous Area.

**Article 57**  
**SHARING OF RR BETWEEN SYNCHRONOUS AREAS**

1. All TSOs of the Synchronous Area CE, GB, IRE and NE shall define in a cross - Synchronous Area agreement a methodology to determine limits on the amount of Sharing of RR between Synchronous Areas. The methodology shall take into account:
  - a) the operational impact between the Synchronous Areas;
  - b) the stability of the FRP of the Synchronous Area;
  - c) the maximum reduction of RR that can be taken into account in the RR Dimensioning process as a result from the RR sharing agreements;
  - d) the ability of the Synchronous Area to reach the Frequency Quality Targets in accordance with Article 11 and and the Frequency Restoration Control Quality Targets in accordance with Article 12; and

- e) the Operational Security according to [OS NC].
- 2. All TSOs of LFC Blocks participating in the Sharing of RR between Synchronous Areas shall organise the Sharing of RR in such a way that the TSOs of a LFC Block in the first Synchronous Area may receive part of the total RR Capacity required for their LFC Block as defined in accordance with the Article 33(1) from a LFC Block in the second Synchronous Area.
- 3. Each HVDC operator of a HVDC Interconnector shall control the Active Power Flow over the HVDC Interconnector in accordance with instructions defined by the TSOs of the receiving LFC Block in accordance with the RR Technical Minimum Requirements established in Article 33(1).
- 4. All TSOs of the Reserve Providing LFC Block and the Reserve Receiving LFC Block shall agree in a multi-party agreement upon the Sharing of RR.
- 5. In case the Sharing of RR fails, the TSOs of the receiving Synchronous Area remain responsible to correct the Frequency Restoration Control Error in their Synchronous Area.

### **Section 3**

#### **CROSS-BORDER ACTIVATION PROCESS FOR FRR/RR**

##### **Article 58 CROSS-BORDER ACTIVATION PROCESS FOR FRR/RR**

- 1. The cross-border activation of FRR and RR Capacity between TSOs of the same or different Synchronous Areas is allowed in accordance with the provisions of Article 29 and Article 30.

## **CHAPTER 10 TIME CONTROL PROCESS**

### **Article 59 TIME CONTROL PROCESS**

- 1. The Electrical Time Control Process is used in a Synchronous Area to ensure that the average value of the System Frequency is equal to the Nominal Frequency.
- 2. Where applicable, all TSOs of a Synchronous Area shall define in a Synchronous Area agreement the methodology to correct the Electrical Time Deviation shall include:
  - a. time ranges within which the Electrical Time Deviation shall be maintained by the reasonable endeavours of TSOs.
  - b. Set Point Frequency adjustments to return Electrical Time Deviation to zero;
  - c. commonly agreed actions to increase or decrease the average System Frequency by means of Active Power Reserves.
- 3. Where applicable, all TSOs of a Synchronous Area shall appoint one TSO which shall:
  - a. monitor the Electrical Time Deviations;
  - b. calculate the Set Point Frequency adjustments;
  - c. coordinate the actions of the Time Control Process.

## **CHAPTER 11**

### **CO-OPERATION WITH DNOS**

#### **Article 60**

##### **RESERVE PROVIDING UNITS CONNECTED TO THE DNO GRID**

1. TSOs and DNOs shall collaborate and use reasonable endeavours to facilitate and enable the delivery of reserves located in Distribution Networks.
2. Within an agreed time period not exceeding two months before the Prequalification of a Reserve Providing Unit or Reserve Providing Group connected to a Distribution Network, the responsible Provider shall notify its respective Reserve Connecting DNO and the intermediate DNOs. Upon request by the Reserve Connecting DNO or an intermediate DNO this notification shall be supplemented as soon as reasonably practicable with:
  - a) voltage levels and Connection Points of the Reserve Providing Units or Groups;
  - b) the type of Active Power Reserves;
  - c) the maximum Reserve Capacity provided by the Reserve Providing Units or Groups at each Connection Point; and
  - d) the maximum rate of change of Active Power for the Reserve Providing Units or Groups.
3. During the Prequalification of a Reserve Providing Unit or Reserve Providing Group connected to its Distribution Network and in accordance with applicable legislation each Reserve Connecting DNO and each intermediate DNO may set limits in a non-discriminatory and transparent way to the delivery of reserves located in its Distribution Network.
4. In accordance with national legislation each Reserve Connecting DNO and each intermediate DNO may set temporary limits in a non-discriminatory and transparent way to the delivery of reserves located in its Distribution Network.
5. In accordance with national legislation, the respective TSOs shall agree with its Reserve Connecting DNOs and intermediate DNOs on procedures and methodologies for the information exchange required in relation to the provision of reserves.

## **CHAPTER 12**

### **TRANSPARENCY OF INFORMATION**

#### **Article 61**

##### **GENERAL REQUIREMENTS**

1. All TSOs shall ensure that information is published at a time and in a format which does not create an actual or potential competitive advantage or disadvantage to any individual party or category of party.
2. All TSOs shall have the right to define parameters and implement processes and methodologies without complying with publication timeframes defined in Article 66(3), Article 67(1), Article 67(2) or Article 68(1) if required for the maintenance of Operational Security.
3. Whenever in accordance with (2) one or more TSOs do not comply with publication timeframes, they shall ensure publication of the required data as soon as reasonably practicable.
4. All TSOs shall use reasonable endeavours to overcome technical constraints and ensure the availability and the correctness of the information published in accordance with Article 65(2).
5. All TSOs shall ensure the availability and the correctness of the information published in accordance with Article 63(1), Article 65, Article 66, Article 67 , Article 68 and Article 69.
6. All material for publication mentioned in *Article* 63, Article 65, Article 66, Article 67 , Article 68 and Article 69 shall be made available to ENTSO-E at least in English. ENTSO-E shall publish this material on the central information transparency platform established in accordance with [Transparency regulation].

#### **Article 62**

##### **INFORMATION ON OPERATIONAL AGREEMENTS**

1. Each TSO of each Synchronous Area shall share the contents of its Synchronous Area Operational Agreement with its NRA or, where applicable, with another relevant national authority.
2. Each TSO of each LFC Block shall share the contents of its LFC Block Operational Agreement with its NRA or, where applicable, with another relevant national authority.

#### **Article 63**

##### **INFORMATION ON FREQUENCY QUALITY**

1. All TSOs of each Synchronous Area shall publish the values of the following parameters for their Synchronous Area no later than one month before their applicability:
  - a. the Frequency Quality Defining Parameters;
  - b. the Frequency Quality Target Parameter;
  - c. the Frequency Restoration Control Error Defining Parameters; and
  - d. the Frequency Restoration Control Error Target Parameters.

2. All TSOs of each Synchronous Area shall publish the results of the Criteria Application Process for their Synchronous Area no later than six months after the last time stamp of the measurement period and at least four times a year. These results shall comprise at least:
  - a. the values of the Frequency Quality Evaluation Criteria;
  - b. the measurement resolution;
  - c. the precision of the recorded measurements; andthe calculation method.

#### **Article 64**

##### **ANNUAL REPORT ON LOAD-FREQUENCY CONTROL**

1. Starting at most two years after the applicability of this Network Code, all TSOs of each country shall ensure the following information is available to ENTSO-E within 3 months after the end of each calendar year:
  - d. the identification of the LFC Blocks, LFC Areas and Monitoring Areas contained within the country;
  - e. the identification of those LFC Blocks that are not contained within the country that contain LFC Areas and Monitoring Areas that are contained within the country;
  - f. the identification of the Synchronous Areas within which the country is contained;
  - g. the time evolution of the Frequency Quality Evaluation Criteria for each Synchronous Area and each LFC Block identified in points a), b), or c) of this paragraph over at least the last two calendar years;
  - h. the time evolution of the FCR Obligation and the Initial FCR Obligation of each TSO operating within the country over at least the last two calendar years;
  - i. a description and date of implementation of any mitigation measures taken in the last calendar year in accordance with Article 21 in which TSOs of the country were involved.
2. Where appropriate, TSOs of a Synchronous Area or LFC Block shall cooperate in collecting the data listed in paragraph 1.
3. For each country, ENTSO-E shall include the information listed in paragraph 1 within the annual report developed in accordance with Article 8(3)(e) of Regulation (EC) 714/2009.

#### **Article 65**

##### **INFORMATION ON LOAD-FREQUENCY-CONTROL STRUCTURE**

1. All TSOs of each Synchronous Area shall publish the following no later than 3 months before the entry into force of the Synchronous Area Operational Agreement in which it is contained:
  - a. information on their Process Activation Structure; and
  - b. information on their Process Responsibility Structure.

2. The publication according to Article 65(1) shall at least include the information on:
  - a. the defined Monitoring Areas, LFC Areas and LFC Blocks and their TSOs; and
  - b. the defined processes listed in Article 23(1) and Article 23(2).
3. All TSOs implementing an Imbalance Netting Process shall announce the starting date on their public websites no later than 1 month before the beginning of the operation.

#### **Article 66** **INFORMATION ON FCR**

1. Where applicable, all TSOs of each Synchronous Area shall publish the dimensioning approach for FCR for their Synchronous Area in accordance with Article 35(5) no later than 1 month before its applicability.
2. Where applicable, all TSOs of each Synchronous Area shall publish the total amount of FCR Capacity for their Synchronous Area and the shares of FCR required for each TSO defined in accordance with Article 35(1), Article 35(3) or Article 35(4) as the Initial FCR Obligation no later than 1 month before their applicability.
3. All TSOs of each Synchronous Area shall publish the FCR properties defined for their Synchronous Area in accordance with Article 36(2) and additional requirements for FCR Providing Groups in accordance with Article 36 (3) no later than 3 months before the applicability of their definition.

#### **Article 67** **INFORMATION ON FRR**

1. All TSOs of each Synchronous Area shall publish the FRR Technical Minimum Requirements defined for their Synchronous Area in accordance with Article 39(1) no later than 3 months before their applicability.
2. All TSOs of each LFC Block shall publish the FRR Availability Requirements in accordance Article 39(2) and the requirements for the connection accordance Article 39(3) for their LFC Block no later than 3 months before their applicability.
3. All TSOs of each LFC Block shall publish the FRR Dimensioning Rules defined for their LFC Block no later than 3 months before the entry into force of the TSO multi-party agreement referred to in Article 38(1).
4. All TSOs of each Synchronous Area shall ensure the publication of an outlook of the FRR Capacities of each LFC Block for the next year not later than 30 November of the current year. All TSOs of each Synchronous Area shall ensure the publication of the actual FRR capacities of each LFC Block of the past quarter not later than the 30 days after the end of the quarter on a common public website.

**Article 68**  
**INFORMATION ON RR**

1. All TSOs of each LFC Block which operates a Reserve Replacement Process shall publish the RR Technical Minimum Requirements defined for their Synchronous Area in accordance with Article 41(1) no later than 3 months before their applicability.
2. All TSOs of each LFC Block which operates a Reserve Replacement Process shall publish the RR Availability Requirements in accordance Article 41 (2) and the requirements for the connection accordance Article 41(3) for their LFC Block no later than 3 months before their applicability.
3. All TSOs of each Synchronous Area shall ensure the publication of an outlook of the RR Capacities of each LFC Block for the next year not later than the 30th of November of the current year. All TSOs of each Synchronous Area shall ensure the publication of the actual RR Capacities of each LFC Block of the past quarter not later than the 30 days after the end of the quarter.

**Article 69**  
**INFORMATION ON SHARING AND EXCHANGE**

1. All TSOs of each Synchronous Area shall publish on a common public website the annual compilation of the sharing agreements for each LFC Block as part of the publications required by Article 67(4) and Article 68(3). The publication shall include the information about:
  - a. the identity of the LFC Blocks between which a sharing agreement exists; and
  - b. the realized reduction of FRR and RR due to the sharing agreement.
2. All TSOs of each Synchronous Area shall publish the amount of FCR shared between Synchronous Areas as part of the publication required by Article 66(1). The publication shall include the information about:
  - a. the amount of shared/exchanged FCR Capacity between TSOs which entered sharing agreements; and
  - b. the effects of the sharing of FCR on the FCR Capacity of the involved TSOs.
3. All TSOs of each Member State shall publish the information on FCR, FRR and RR exchange in accordance with national legislation.

**CHAPTER 13**  
**FINAL PROVISIONS**

**Article 70**  
**AMENDMENT OF CONTRACTS AND GENERAL TERMS AND CONDITIONS**

By [date – the same as the date in Article 35], each relevant TSO, DSO and each relevant Significant Grid User shall amend all relevant clauses in contracts and relevant clauses in general terms and conditions, regardless of whether the relevant contracts or general terms and conditions contain an amendment process, in order to achieve compliance with the requirements of this Network Code.

**Article 71**  
**ENTRY INTO FORCE**

This Network Code shall enter into force on the twentieth day following the latest day of publication in the *Official Journal of the European Union* of the Operational Security, Operational Planning and Scheduling and Load Frequency and Reserves Network Codes.

It shall apply as from [date].

This Network Code shall be binding in its entirety and directly applicable in all Member States.

The implementation of the requirements defined in this NC and the agreement of the necessary Synchronous Area agreements and TSO multi-party agreements shall be finalised 12 months after the NC enters into force.

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