

Network Code on Load-Frequency Control and Reserves

28 June 2013

Notice

This document reflects the status of the work of Transmission System Operator experts as of 28 June 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.

Such version of the Network Code is released for submission to the Agency for the Cooperation of Energy Regulators for its reasoned opinion in accordance with the provisions of the Article 6(7) 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 System Operators (DSOs), Providers' Power Generating Modules 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 DSOs, Providers' Power Generating Modules 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 System 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 System Frequency deviation after an incident within a pre-defined range. FRR shall aim at restoring the System 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 System Frequency quality target is defined at the level of the Synchronous Area, as the System 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 System 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 System 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 Area level. The amount of FRR and RR needed per LFC Block shall be established on LFC Block Level. The quality target values per TSO for the System Frequency restoration shall be defined per LFC Block and derived from the common System 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 before mentioned cross-border processes 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 DSOs and Reserve Providers.
2. This Network Code aims at:
 - a) achieving and maintaining a satisfactory level of System 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; and
 - c) determining common requirements and principles for FCR, FRR and RR; determining common requirements for cross-border exchange, sharing, activation and sizing of reserves.
3. For the 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, provisions of this Network Code shall apply only to the extent that they could be duly, physically and technically applied and implemented by the respective TSO.
4. The provisions of this Network Code shall not apply to the Transmission System or parts of the Transmission System of a member State which is not operating synchronously with or which is temporarily disconnected from the rest of the Synchronous Area.

In addition, the provisions of this Network Code shall not apply to the Aland islands.
5. The provisions of the NC are without prejudice to the relevant provisions for human and nuclear safety.
6. No action in fulfilment of this Network Code shall hinder the implementation of new applications.
7. 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 except for the definition of "Connection Point" and "Operational Security", which are replaced by the following in this Network Code:

Connection Point means the interface at which the Power Generating Module, Demand Facility, Distribution Network or Closed Distribution Network is connected to a Transmission System, Distribution Network or Closed Distribution Network;

Operational Security means the Transmission System capability to retain a Normal State or to return to a Normal State as soon and as close as possible, and is characterised by thermal limits, voltage constraints, short-circuit current, frequency limits and stability limits;

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);

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 Restoration Range for Synchronous Areas with only one LFC Area; for Synchronous Areas with more than one LFC Area the Time to Restore Frequency is the maximum expected time after the occurrence of an imbalance of an LFC Area within which the imbalance is compensated; and

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.

2. The following definitions shall apply in addition:

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 information on the Exchange of Reserves and/or Sharing of Reserves and/or Imbalance Netting Process and/or Cross-Border Activation Process is needed for the analysis and maintenance of Operational Security;

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

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

Automatic FRR Activation Delay means the period of time between the setting of a new Setpoint value by the frequency restoration controller and the start of physical Automatic FRR delivery;

Automatic FRR Full Activation Time means the time period between the setting of a new Setpoint value by the frequency restoration controller and the corresponding activation or deactivation of Automatic FRR;

Average FRCE Data means the Set of data consisting of the average value of the recorded instantaneous FRCE 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 its Reserve Capacity for a Control Capability Receiving TSO under conditions of an agreement for the Sharing of Reserves.

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 an agreement for the Sharing of Reserves.

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 Active Power 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 have the possibility to access 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 exclusively for 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 System Frequency by compensating imbalances by means of appropriate reserves;

Frequency Quality Defining Parameters means the main System Frequency variables that define the principles of Frequency Quality.;

Frequency Quality Evaluation Criteria means a set of calculations using System Frequency measurements that allow the evaluation of the quality of the System Frequency against the Frequency Quality Target Parameters;

Frequency Quality Evaluation Data means the set of data that allows the calculation of the Frequency Quality Evaluation Criteria;

Frequency Quality Target Parameter means the main System Frequency target variables on which the behaviour of FCR, FRR and RR activation processes are evaluated in Normal State;

Frequency Recovery Range means the System Frequency range to which the System Frequency is expected to return in the Synchronous Areas GB and IRE after the occurrence of an imbalance equal to or less than the Reference Incident within the Time to Recover Frequency

Frequency Restoration Range means the System Frequency range to which the System Frequency is expected in the Synchronous Areas GB, IRE and NE to return after the occurrence of an imbalance equal to or less than the Reference Incident within the Time to Restore Frequency;

FRCE Target Parameters means the target main LFC Block variables on basis of which the 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 LFC Areas within the Cross-Border FRR Activation Process;

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 Setpoint means the Frequency target value used in the FRP defined as 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 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 FRCEs 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 measurement period equal to or shorter than 1 second used for System Frequency quality evaluation purposes;

Instantaneous Frequency Deviation means a set of data measurements of the Frequency Deviation with a measurement period equal to or shorter than 1 second;

Instantaneous FRCE Data means a set of data of the FRCE for a LFC Block with a measurement period equal to or shorter than 10 seconds used for System Frequency quality evaluation purposes;

Level 1 FRCE Range means the first range used for System Frequency quality evaluation purposes on LFC Block level within which the FRCE should be kept for a specified percentage of the time;

Level 2 FRCE Range means the second range used for System Frequency quality evaluation purposes on LFC Block level within which the FRCE should be kept for a specified percentage of the time;

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 FRCE, FRR Activation and RR Activation within the LFC Block and the Imbalance Netting Power Exchange, the Frequency Restoration Power Interchange and the Replacement Power Interchange of this LFC Block with other LFC Blocks;

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);

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 value of an Instantaneous Frequency Deviation after the occurrence of an imbalance equal or less than the Reference Incident, beyond which emergency measures are activated.

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 Monitoring Areas, operated by one or more TSOs fulfilling the obligations of a Monitoring Area;

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 the control structure of the Synchronous Area;

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;

Ramping Period means a period of time defined by a fixed starting point and a length of time during which the input and/or output of Active Power will be increased or decreased.

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 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 additional 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 DSO means the DSO 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 Power Generating Modules, Demand Unit and/or Reserve Providing Units connected to more than one Connection Point fulfilling the requirements for FCR, FRR or RR;

Reserve Providing Unit means a single or an aggregation of Power Generating Modules and/or Demand Units connected to a common Connection Point fulfilling the 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 by the TSOs of a LFC Block regarding the availability of RR;

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

Sharing of Reserves means a 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;

Steady State Frequency Deviation means the absolute value of Frequency Deviation after occurrence an imbalance, once the System Frequency has been stabilized;

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;

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 Recover Frequency means, for the Synchronous Areas GB and IRE, 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.

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 44(3);
 - b) The exclusion of FCR Providing Groups from the provision of FCR pursuant to Article 44(3);
 - c) FRR technical requirements defined by the TSO pursuant to Article 47(3);
 - d) the exclusion of FRR Providing Groups from the provision of FRR pursuant to Article 47(4);
 - e) RR technical requirements defined by the TSO pursuant to Article 49(3); and
 - f) The exclusion of RR Providing Groups from the provision of RR pursuant to Article 49(4).
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) Definition of mitigation measures pursuant to Article 29;

- b) Definition of the Process Responsibility Structure pursuant to Article 32;
 - c) The definition of the methodology to limit the amount of FRR Capacity that can be made available for the Cross-Border FRR Activation Process pursuant to Article 37(7);
 - d) 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 38(7);
 - e) The measures to reduce the FRCE by requiring changes in the Active Power production or consumption of Power Generating Modules and Demand Units pursuant to Article 42(17);
 - f) Definition of FRR dimensioning rules pursuant to Article 46(1);
 - g) Escalation procedure pursuant to Article 46(4);
 - h) Definition of FRR Availability Requirements and control quality pursuant to Article 47(2);
 - i) Requirements of RR dimensioning rules pursuant to Article 48(3);
 - j) Escalation procedure pursuant to Article 48(7);
 - k) Definition of RR Availability Requirements pursuant to Article 49(2);
 - l) Limits for the Exchange of FCR within a LFC Block for Synchronous Area CE pursuant to Article 50(2);
 - m) Limits for the Exchange of FRR within a LFC Block Article 54; and
 - n) Limits for the Exchange of RR within a LFC Block Article 56(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 19(6);
 - b) Common methodology to assess the risk of FCR Exhaustion pursuant to Article 21(3);
 - c) Definition of mitigation measures pursuant to Article 29;
 - d) The dimensioning approach for FCR pursuant to Article 43(2);
 - e) Determination of additional properties of the FCR pursuant to Article 44(2);
 - f) methods to ensure recovery of energy reservoirs for FCR in GB and IRE pursuant to Article 45(6)b);
 - g) Limits for the Exchange of FCR within the Synchronous Areas IRE, GB and NE pursuant to Article 50(2);
 - h) Limits for the cross Synchronous Area Exchange of FCR pursuant to Article 59(1);
 - i) Limits for the cross Synchronous Area Sharing of FCR for GB and IRE pursuant to Article 60(2);
 - j) Limits for the cross Synchronous Area Exchange of FRR pursuant to Article 62(1);

- k) Limits for the cross Synchronous Area Sharing of FRR pursuant to Article 63(1);
 - l) Limits for the cross Synchronous Area Exchange of RR pursuant to Article 64(1); and
 - m) Limits for the cross Synchronous Area Sharing of RR pursuant to Article 65(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 REGULATORY NOTIFICATION

1. Each TSO shall submit the following methodologies and conditions to its National Regulatory Authority or, when explicitly foreseen in national law, other relevant national authorities, for notification:
 - a) The FRCE Target Parameters pursuant Article 20(1);
 - b) The ramping restrictions on Synchronous Area level pursuant Article 27;
 - c) The ramping restrictions on LFC Block level pursuant Article 28;
 - d) The TSO Notification pursuant Article 40(1);
 - e) The measure taken in the Alert State due to there being insufficient Active Power Reserves pursuant Article 42(12);
 - f) The request of the Reserve Connecting TSO to an FCR Provider to make the information available in real time pursuant Article 44(8); and
 - g) At the request of the Reserve Connecting TSO, a FCR Provider has to make available data for technical installations which are part of the same FCR Providing Unit in case it is necessary for pursuant Article 44(8).

Article 6 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 7

CONFIDENTIALITY OBLIGATIONS

1. Each TSO, DSO, CDSO, Reserve Provider, Power Generating Facility Operator, Demand Facility Operator and Owners of these Facilities shall preserve the confidentiality of the information and data submitted to them pursuant to this Network Code and shall use them exclusively for the purpose they have been submitted in compliance with the 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 provide to the operator of any other Transmission System with which its system is interconnected, sufficient information to ensure the secure and efficient operation, coordinated development and interoperability of the interconnected system.
3. The Regional Security Coordination Initiatives which are taking the form of a legal entity 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.

Article 8

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 8(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.
3. If an agreement according to Article 8(1) cannot be implemented within 12 months after entering into force of this Network Code, the TSO's operating in a Synchronous Area whose frequency is influenced in a predominant way by Power systems that are not bound by the EU legislation shall nevertheless endeavour to implement a Synchronous Area agreement within their 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.

Article 9

TSO COOPERATION

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.

CHAPTER 2

OPERATIONAL AGREEMENTS

Article 10

SYNCHRONOUS AREA OPERATIONAL AGREEMENT

By [date – 12 months after entry into force], all TSOs of each Synchronous Area shall establish a Synchronous Area Operational Agreement that shall at least include:

- a) The dimensioning approach and dimensioning rules for FCR in accordance with Article 43(2) and (4);
- b) additional properties of the FCR in accordance with Article 44(2);
- c) the Frequency Quality Defining Parameters and the Frequency Quality Target Parameter in accordance with Article 19(6);
- d) for Synchronous Areas CE and NE: the Frequency Control Error Target Parameters for each LFC Block in accordance with Article 20(1);
- e) the methodology to assess the risk and the evolution of the risk of FCR Exhaustion of the Synchronous Area in accordance with Article 21(3);
- f) the Synchronous Area Monitor in accordance with Article 23(1);
- g) the calculation of the Control Program from the Netted Area AC Position with a common Ramping Period for ACE calculation for a Synchronous Area with more than one LFC Area in accordance with Article 26;
- h) if applicable, restrictions for the Active Power output of HVDC Interconnectors between Synchronous Areas in accordance with Article 27.
- i) the Load-Frequency Control Structure in accordance with Article 30;
- j) if applicable, the methodology to reduce the Electrical Time Deviation in accordance with Article 67(2);
- k) whenever the Synchronous Area is operated by more than one TSO, the specific allocation of responsibilities between TSOs in accordance with Article 32(10);
- l) operational procedures for the case of exhausted FCR in accordance with Article 42(8);
- m) for GB and IRE: measures to ensure recovery of energy reservoirs according to Article 45(6) b).
- n) operational procedures to reduce the System Frequency Deviation to restore the System State to Normal State and to limit the risk to enter into Emergency State in accordance with Article 42(11).
- o) the roles and responsibilities of the TSOs implementing an Imbalance Netting Process, a Cross-Border FRR Activation Process or a Cross-Border RR Activation Process in accordance with Article 39(2);

- p) requirements for availability, reliability and redundancy of the technical infrastructure in accordance with Article 41(2);
- q) the common rules for the operation in Normal State and Alert State in accordance with Article 42(6) and the actions defined in accordance with Article 42(16);
- r) if applicable for a Synchronous Area except CE, limits for the Exchange of FCR between the TSOs in accordance with Article 50(2);
- s) the roles and responsibilities of the Reserve Connecting TSO, the Reserve Receiving TSO and the Affected TSO for the Exchange of FRR and RR defined in accordance with Article 52(1);
- t) the roles and responsibilities of the Control Capability Providing TSO, the Control Capability Receiving TSO and the Affected TSO for the Sharing of FRR and RR defined in accordance with Article 53(1);
- u) the roles and responsibilities of the Reserve Connecting TSO, the Reserve Receiving TSO and the Affected TSO for the Exchange of Reserves between Synchronous Areas, and of the Control Capability Providing TSO, the Control Capability Receiving TSO and the Affected TSO for the Sharing of Reserves between Synchronous Areas defined in accordance with Article 58(2);
- v) the methodology to determine limits on the amount of Exchange of FCR between Synchronous Areas defined in accordance with Article 59(1);
- w) for the Synchronous Areas GB and IRE: the methodology to determine limits on the amount of Sharing of FCR between Synchronous Areas defined in accordance with Article 60(2);
- x) the methodology to determine limits on the amount of Exchange of FRR between Synchronous Areas defined in accordance with Article 62(1) and the methodology to determine limits on the amount of Sharing of FRR between Synchronous Areas defined in accordance with Article 63(1); and
- y) the methodology to determine limits on the amount of Exchange of RR between Synchronous Areas defined in accordance with Article 64(1) and the methodology to determine limits on the amount of Sharing of RR between Synchronous Areas defined in accordance with Article 65(1).

Article 11

LFC BLOCK OPERATIONAL AGREEMENT

By [date – 12 months after entry into force], all TSOs of each LFC Block shall establish an LFC Block Operational Agreement that shall at least include:

- a) whenever the LFC Block consists of more than one LFC Area, FRCE Target Parameters for each LFC Area within the LFC Block defined in accordance with Article 20(3);
- b) the appointment of an LFC Block Monitor in accordance with Article 24(1);
- c) ramping restrictions for Active Power Output in accordance with Article 28;
- d) whenever the LFC Block is operated by more than one TSO, the specific allocation of responsibilities between TSOs within the LFC Block in accordance with Article 32(9);

- e) if applicable, the appointment of the TSO responsible for the tasks in Article 34(6);
- f) the definition of the methodology to limit the amount of FRR or RR Capacity that can be made available for the Cross-Border FRR or RR Activation Process in accordance with Article 37(7) and Article 38(7);
- g) additional requirements for the availability, reliability and redundancy of the technical infrastructure defined in accordance with Article 41(3);
- h) operational procedures for the case of exhausted FRR and RR in accordance with Article 42(9);
- i) the FRR Dimensioning Rules defined in accordance with Article 46(1);
- j) the RR Dimensioning Rules defined in accordance with Article 48(2);
- k) whenever the LFC Block is operated by more than one TSO, the specific allocation of responsibilities defined in accordance with Article 46(3), and if applicable, the specific allocation of responsibilities defined in accordance with Article 48(6);
- l) the escalation procedures defined in accordance with Article 46(4) and if applicable the escalation procedures defined in accordance with Article 48(7);
- m) the FRR Availability Requirements and the requirements on the control quality defined in accordance with Article 47(2), and if applicable, the RR Availability Requirements and the requirements on the control quality defined in accordance with Article 49(2);
- n) if applicable, any limits on the Exchange of FCR between the LFC Areas of LFC Blocks within Synchronous Area CE and the Exchange of FRR or RR between the LFC Areas of an LFC Block of a Synchronous Area consisting of more than one LFC Block defined in accordance with Article 50(2), Article 54 and Article 56(2);
- o) the 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 defined in accordance with Article 52(6);
- p) the 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/or RR defined in accordance with Article 53(7);
- q) 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 between Synchronous Areas in accordance with Article 61(2) ;
- r) coordination actions aiming to reduce the FRCE as defined in Article 42(15); and
- s) measures to reduce the FRCE by requiring changes in the Active Power production or consumption of Power Generating Modules and Demand Units in accordance with Article 42(17).

Article 12
LFC AREA OPERATIONAL AGREEMENT

By [date – 12 months after entry into force], all TSOs of each LFC Area shall establish a LFC Area Operational Agreement that shall at least include:

- a) the specific allocation of responsibilities between TSOs within the LFC Area according to Article 32(8).
- b) The TSO responsible for the implementation and operation of the Frequency Restoration Process according to Article 34(7).

Article 13
MONITORING AREA OPERATIONAL AGREEMENT

By [date – 12 months after entry into force], all TSOs of each Monitoring Area shall establish a Monitoring Area Operational Agreement that shall at least include:

- a) the specific allocation of responsibilities between TSOs within the Monitoring Area according to Article 32(7).

Article 14
IMBALANCE NETTING AGREEMENT

All TSOs participating in the same Imbalance Netting Process shall establish an Imbalance Netting Agreement that shall at least include:

- a) the roles and responsibilities of the TSOs according to Article 39(3)

Article 15
CROSS-BORDER FRR ACTIVATION AGREEMENT

All TSOs participating in the same Cross-Border FRR Activation Process shall establish a Cross-Border FRR Activation Agreement that shall at least include:

- a) the roles and responsibilities of the TSOs according to Article 39(3)

Article 16
CROSS-BORDER RR ACTIVATION AGREEMENT

All TSOs participating in the same Cross-Border RR Activation Process shall establish a Cross-Border RR Activation Agreement that shall at least include:

- a) the roles and responsibilities of the TSOs according to Article 39(3)

Article 17
SHARING AGREEMENT

All TSOs participating in the same Sharing of FCR, FRR or RR shall establish a Sharing Agreement that shall at least include:

- a) in case of the Sharing of FRR or RR within the Synchronous Area the roles and responsibilities of the Control Capability Receiving TSO and the Control Capability Providing TSO and the Affected TSOs according Article 53(3); or
- b) in case of the Sharing of Reserves between Synchronous Areas the roles and responsibilities of the Control Capability Receiving TSO and the Control Capability Providing TSO according to Article 58(4) and the procedures in case the Sharing of Reserves between Synchronous Areas fails in real-time according to Article 58(9).

Article 18
EXCHANGE AGREEMENT

All TSOs participating in the same Exchange of FCR, FRR or RR shall establish an Exchange Agreement that shall at least include:

- a) in case of the Exchange of FRR or RR within the Synchronous Area the roles and responsibilities of the Reserve Connecting and Reserve Receiving TSOs according to Article 52(3); or
- b) in case of the Exchange of Reserves between Synchronous Areas the roles and responsibilities of the Reserve Connecting and Reserve Receiving TSOs according to Article 58(4) and the procedures in case the Exchange of Reserves between Synchronous Areas fails in real-time according to Article 58(9).

CHAPTER 3

FREQUENCY QUALITY

Article 19

FREQUENCY QUALITY 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 Restoration Range for the Synchronous Areas GB, IRE and NE;
 - h) the Frequency Recovery Range for the Synchronous Areas GB and IRE; and
 - i) the Alert State Trigger Time for all Synchronous Areas.
2. The Nominal Frequency shall be 50Hz for all Synchronous Areas.
3. The default values of the Frequency Quality Defining Parameters listed in Article 19(1) shall be the values given in Table 1.

	CE	GB	IRE	NE
Standard Frequency Range	±50 mHz	±200 mHz	±200 mHz	±100 mHz
Maximum Instantaneous Frequency Deviation	800 mHz	800 mHz	1000 mHz	1000 mHz
Maximum Steady-state Frequency Deviation	200 mHz	500 mHz	500 mHz	500 mHz
Time to Recover Frequency	not used	1 minute	1 minute	not used
Frequency Recovery Range	not used	±500 mHz	±500 mHz	not used
Time to Restore Frequency	15 minutes	10 minutes	20 minutes	15 minutes
Frequency Restoration Range	not used	±200 mHz	±200 mHz	±100 mHz
Alert State Trigger Time	5 minutes	10 minutes	10 minutes	5 minutes

Table 1 : Frequency Quality Defining Parameters of the Synchronous Areas

- 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
Maximum number of minutes outside the Standard Frequency Range	15000	15000	10500	15000

Table 2 : Frequency Quality Target Parameters of the Synchronous Area

- 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 modified values in accordance with (6).
- All TSOs of a Synchronous Area shall have the right to define in the Synchronous Area Operational Agreement modified values of the Frequency Quality Defining Parameters (3) or the

Frequency Quality Target Parameter (4) based on an assessment of the historical values of the System Frequency and the Synchronous Area development 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 – Over frequency and Limited Frequency Sensitive Mode – Under frequency as defined in [NC RfG Article 8 (1) (c) and NC RfG Article 10 (2) (b)] and of Demand Units 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 of Power Generating Modules and Demand Facilities; and
- b) the impact on stakeholders is investigated through consultation.

Article 20

FRCE TARGET PARAMETERS

1. All TSOs of the Synchronous Areas CE and NE shall define in the Synchronous Area Operational Agreement the values of the Level 1 FRCE Range and the Level 2 FRCE Range for each LFC Block of the Synchronous Area at least every year, with the goal of respecting the provisions of Article 19.

The TSOs of the Synchronous Areas CE and NE, if consisting of more than one LFC Block, shall ensure that the Level 1 FRCE Ranges and the Level 2 FRCE 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 43 of the TSOs constituting the LFC Blocks.

2. The TSOs of the Synchronous Areas CE and NE shall use the following FRCE Target Parameters for each LFC Block of the Synchronous Area:
 - a) the number of time intervals per year outside the Level 1 FRCE Range within a time interval equal to the Time to Restore Frequency shall be less than 30 % of the time intervals of the year; and
 - b) the number of time intervals per year outside the Level 2 FRCE Range within a time interval equal to resolution the Time to Restore Frequency shall be less than 5 % of the time intervals of the year.

3. Where an LFC Block consists of more than one LFC Area, all TSOs of the LFC Block shall define in the LFC Block Operational Agreement the values of the Level 1 and Level 2 FRCE Ranges and of the FRCE Target Parameters for each LFC Area complying with Article 20(1)) shall apply mutatis mutandis.
4. For the Synchronous Areas GB and IRE the Level 1 FRCE Range shall be ± 200 mHz and the Level 2 FRCE Range shall be ± 500 mHz.
5. The TSOs of Synchronous Areas GB and IRE shall use the following FRCE Target Parameters of a Synchronous Area:
 - a) maximum number of time intervals outside the Level 1 FRCE Range as defined in Table 3, per year which shall be less than or equal to the value below as a % of the time intervals per year; and
 - b) maximum number of time intervals outside the Level 2 FRCE Range as defined in Table 3, per year which shall be less than or equal to the value below as a % of the time intervals per year.

All TSOs of the Synchronous Areas GB and IRE shall check the fulfilment of the FRCE Target Parameters at least an annual basis.

	GB	IRE
Level 1	3 %	2 %
Level 2	1 %	1 %

Table 3 : FRCE Target Parameters for GB and IRE

Article 21

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 1-month period for the Instantaneous Frequency Data:
 - i. the mean value;
 - ii. the standard deviation;
 - iii. the 1-, 5-, 10-, 90-, 95- and 99-percentile;
 - iv. the total time in which the absolute value of the Instantaneous Frequency Deviation was larger than the Standard Frequency Deviation, separate for negative and positive Instantaneous Frequency Deviations;

- v. the total time in which the absolute value of the Instantaneous Frequency Deviation was larger than the Maximum Instantaneous Frequency Deviation, separate for negative and positive Instantaneous Frequency Deviations;
- vi. the number of events for which the absolute value of 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 the Synchronous Area CE: to 50 % of the Standard Frequency Deviation; and
 2. for the Synchronous Areas GB, IRE and NE: to the Frequency Restoration Range;

within the Time to Restore Frequency (separate for negative and positive Frequency Deviations); and

- vii. for the Synchronous Areas GB and IRE, the number of events for which the absolute value of the Instantaneous Frequency Deviation was outside of the Frequency Recovery Range Frequency and was not returned to the Frequency Recovery Range within the Time to Recover Frequency, separate for negative and positive Frequency Deviations;

- b) for the LFC Blocks of the Synchronous Areas CE or NE for operation in Normal State or Alert State as defined by [NC OS Article 8]) for a 1-month period:

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

- i. the mean value;
- ii. the standard deviation;
- iii. the 1-,5-,10-, 90-,95- and 99-percentile;
- iv. the number of time intervals for which the average value of the FRCE was outside the Level 1 FRCE Range, separate for negative and positive FRCE;
- v. the number of time intervals for which the average value of the FRCE was outside the Level 2 FRCE Range, separate for negative and positive FRCE.

For a data-set containing the average values of the FRCE of the LFC Block over time intervals with a length of one minute:

The number of events within a 1-month period for which FRCE exceeded 60 % of the FRR Capacity and was not returned to 15 % of the 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 1-month period for a data-set containing the average values of the FRCE of the LFC Block over time intervals with a length of one minute:

the number of events for which the absolute value of the FRCE exceeded the Maximum Steady-State Frequency Deviation and the FRCE was not returned to

10 % of the Maximum Steady-State Frequency Deviation within the Time to Restore Frequency, separate for negative and positive FRCE;

3. The TSOs of each Synchronous Area shall define in the Synchronous Area Operational 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 each Synchronous Area shall provide the required input data for this analysis.

Article 22

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. The Frequency Quality Evaluation Data shall be:
 - a) for the Synchronous Area:
 - i. the Instantaneous Frequency Data; and
 - ii. the Instantaneous Frequency Deviation Data; and
 - b) for each LFC Block of the Synchronous Area the Instantaneous FRCE Data.
3. The measurement accuracy of the Instantaneous Frequency Data and of the Instantaneous FRCE (if measured in Hz) shall be 1 mHz or better.

Article 23

SYNCHRONOUS AREA MONITOR

1. All TSOs of a Synchronous Area shall appoint one TSO of the Synchronous Area in the Synchronous Area Operational Agreement 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 22.
3. The Synchronous Area Monitor shall implement the Criteria Application Process as defined in accordance with Article 21.

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 24
LFC BLOCK MONITOR

1. All TSOs of a LFC Block shall appoint a TSO of this LFC Block in the LFC Block Operational Agreement 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 in accordance with Article 21.
3. Each TSO of a LFC Area shall provide its LFC Block Monitor with the necessary 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 2 months from the time stamp of the last value of the Frequency Quality Evaluation Data.

Article 25
INFORMATION ON LOAD AND GENERATION BEHAVIOUR

In accordance with Article 16(3) and Article 16(4) of [NC OS], each Connecting TSO shall have the right to request the information necessary from 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 Setpoint for real-time and future operation; and
- b) the time-stamped total Active Power output.

Article 26
RAMPING PERIOD FOR THE SYNCHRONOUS AREA

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

Article 27
RAMPING RESTRICTIONS FOR ACTIVE POWER OUTPUT ON SYNCHRONOUS AREA LEVEL

In accordance with Article 9(14) of NC OS, all TSOs of each Synchronous Area shall have the right to define in the Synchronous Area Operational Agreement restrictions for the Active Power output of HVDC Interconnectors between Synchronous Areas to limit their influence on the fulfilment of the Frequency Quality Target of the Synchronous Area by defining:

- a) a unique maximum Ramping Rate and/or a unique Ramping Period applicable to all individual HVDC Interconnectors; and/or
- b) a combined maximum Ramping Rate for all HVDC Interconnectors of the Synchronous Area.

The restrictions shall not apply for Active Power Reserves or Imbalance Netting Power Interchange.

Article 28

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 in the LFC Block Operational Agreement common restrictions for the Active Power output of this HVDC Interconnector to limit their influence on the fulfilment of the FRCE Target Parameter of the connected LFC Blocks by agreeing on Ramping Periods and/or maximum Ramping Rates for this HVDC Interconnector while respecting the provisions of Article 27. The restrictions shall not apply for Active Power Reserves or Imbalance Netting Power Interchange.
2. In accordance with Article 9(14) of NC OS, all TSOs of an LFC Block shall have the right to define in the LFC Block Operational Agreement and apply the following measures to support the fulfilment of the FRCE Target Parameter of the LFC Block:
 - a) definition of Ramping Periods and/or maximum Ramping 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 Generating Modules, Demand Units and Active Power consumption within the LFC Block.
3. The TSOs of a Synchronous Area shall co-ordinate the measures defined in Article 28(2) within the Synchronous Area.

Article 29

MITIGATION

1. If the values calculated for the measurement period of one calendar year the Frequency Quality Target Parameters or the FRCE Target Parameters are outside the set targets for the Synchronous Area or for the LFC Block, all TSOs of the relevant Synchronous Area or of the relevant LFC Block shall
 - a) perform a frequency investigation analysing if the Frequency Quality Target Parameters or the FRCE Target Parameters will remain outside the set targets for the Synchronous Area or for the LFC Block or if there is a justified expected risk for it, analyse the root causes and develop recommendations; and
 - b) 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 30

BASIC STRUCTURE

1. All TSOs of a Synchronous Area shall define in the Synchronous Area Operational Agreement the Load-Frequency-Control Structure for the Synchronous Area. Each TSO is 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 31; and
 - b) a Process Responsibility Structure according to Article 32.

Article 31

PROCESS ACTIVATION STRUCTURE

1. The Process Activation Structure shall include:
 - a) a FCP according to Article 33; and
 - b) a FRP according to Article 34.
2. The Process Activation Structure may include:
 - a) a RRP according to Article 35;
 - b) an Imbalance Netting Process according to Article 36;
 - c) a Cross-Border FRR Activation Process according to Article 37;
 - d) a Cross-Border RR Activation Process according to Article 38; and
 - e) a Time Control Process according to Article 67.
3. The Process Activation Structure of CE shall include a Time Control Process according to Article 67.

Article 32

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. All TSOs of a Synchronous Area shall ensure that:
 - a) a Monitoring Area corresponds to or is part of only one LFC Area;
 - b) a LFC Area corresponds to or is part of only one LFC Block;
 - c) a LFC Block corresponds to or is part of only one Synchronous Area; and
 - d) each network element is part of only one Monitoring Area, only one LFC Area and only one LFC Block.
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 FRCE of the LFC Area;
 - b) implement and operate a FRP for the LFC Area;
 - c) make best endeavours to fulfil the FRCE Target Parameters of the LFC Area as defined in Article 20; and
 - d) have the right to implement one or several of the processes referred to in Article 31(2).
5. All TSOs of a LFC Block shall:
 - a) make best endeavours to fulfil the FRCE Target Parameters of the LFC Block as defined in Article 20; and
 - b) comply with the FRR Dimensioning Rules established in Article 46 and the RR Dimensioning Rules established in Article 48.
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 43; and
 - c) make best endeavours to fulfil the Frequency Quality Target Parameters as established in Article 19.
7. All TSOs of a Monitoring Area shall agree in a Monitoring Area Operational Agreement on the specific allocation of responsibilities between TSOs within the Monitoring Area for the implementation of the obligations established in Article 32(3).
8. All TSOs of a LFC Area shall agree in a LFC Area Operational Agreement on the specific allocation of responsibilities between TSOs within the LFC Area for the implementation of the obligations established in Article 32(4)
9. All TSOs of a LFC Block shall define in the LFC Block Operational Agreement on the specific allocation of responsibilities between TSOs within the LFC Block for the implementation of the obligations established in Article 32(5)

10. All TSOs of a Synchronous Area shall define in the Synchronous Area Operational Agreement the specific allocation of responsibilities between TSOs within the Synchronous Area for the implementation of the obligations established in Article 32(6)
11. All TSOs of two or more adjacent LFC Areas shall have the right to form a LFC Block if the requirements for the LFC Block set forth in this Network Code are fulfilled.

Article 33
FREQUENCY CONTAINMENT PROCESS (FCP)

1. The control target of FCP is 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 34
FREQUENCY RESTORATION PROCESS (FRP)

1. The control target of the FRP is to
 - a) regulate the FRCE towards zero within the Time to Restore Frequency; and
 - b) for the Synchronous Areas CE and NE to progressively replace the activated FCR by activation of FRR;
2. The FRCE is
 - 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 26
4. The Setpoint 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 FRCE to zero;
 - b) be operated in a closed-loop manner with FRCE as input and Setpoint 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 Setpoint value for manual FRR activation shall be left to the discretion of the TSO for its LFC Area.
6. Without prejudice to Article 32(4) and Article 34, when a LFC Block consists of more than one LFC Area all TSOs of the LFC Block shall have the right to appoint one TSO of the LFC Block in the LFC Block Operational Agreement to:
 - a) calculate and monitor the FRCE of the whole LFC Block; and
 - b) take the FRCE of the whole LFC Block into account for the calculation of the Setpoint value for FRR activation according to Article 34(4) and Article 34(5) in addition to the FRCE of the LFC Area.
7. Where a LFC Area consists of more than one Monitoring Area, all TSOs of the LFC Area shall appoint one TSO in a LFC Area Operational Agreement who shall be responsible for the implementation and operation of the Frequency Restoration Process.
8. Without prejudice to Article 32(4), where a LFC Area consists of more than one Monitoring Area, 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 35
RESERVE REPLACEMENT PROCESS (RRP)

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

Article 36
IMBALANCE NETTING PROCESS

1. The control target of the Imbalance Netting Process is to reduce the amount of simultaneous counteracting FRR activation of different participating 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 by concluding an Imbalance Netting Agreement.
2. The Imbalance Netting Process shall be implemented in such a way that it does 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 FRCE 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 be implemented in such a way that it does not exceed the actual amount of FRR activation which is necessary to regulate the FRCE of this LFC Area to zero without Imbalance Netting Power Interchange.
6. The Imbalance Netting Power Interchange between LFC Areas shall be implemented in such a way that it does not result in power flows which exceed Operational Security Limits.
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 can be guaranteed; and
 - b) comply with the requirements established in Article 36(2).
9. Where a LFC Block consists of more than one LFC Area and the FRR Capacity as well as the 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 36(3) with other LFC Areas of the same LFC Block while complying with Article 36(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 36(5) with other TSOs of the same Synchronous Area participating in this Imbalance Netting Process while complying with Article 36(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 involved shall be able fulfil the obligations established in Article 32(5) regardless of Imbalance Netting Power Interchange.

Article 37

CROSS-BORDER FRR ACTIVATION PROCESS

1. The control target of the Cross-Border FRR Activation Process is 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 by concluding a Cross-Border FRR Activation Agreement.

2. The Cross-Border FRR Activation Process shall be implemented in such a way that it does 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 FRCE 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 be implemented in such a way that it does not result in power flows which exceed Operational Security Limits].
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 in the LFC Block Operational Agreement 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 FRCE Quality Target in accordance with Article 19 and Article 20;
 - 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 46; 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 can be guaranteed; and
 - b) comply with the requirements established in Article 37(2).

Article 38

CROSS-BORDER RR ACTIVATION PROCESS

1. The control target of the Cross-Border RR Activation Process is 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 by concluding a Cross-Border RR Activation Agreement.
2. The Cross-Border RR Activation Process shall be implemented in such a way that it does 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 FRCE 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 be implemented in such a way that it does not result in power flows which exceed Operational Security Limits.
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 in the LFC Block Operational Agreement 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 FRCE Quality Target in accordance with Article 19 and Article 20;
 - 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 48; 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 can be guaranteed;

- b) comply with the requirements established in Article 38(2).

Article 39

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 define in the Synchronous Area Operational 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 shall define in an Imbalance Netting Agreement, all TSOs participating in the same Cross-Border FRR Activation Process shall define in a Cross-Border FRR Activation Agreement and all TSOs participating in the same Cross-Border RR Activation Process shall define in a Cross-Border RR Activation Agreement the 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; and
 - c) the implementation of operational procedures to ensure Operational Security.
4. Without prejudice to Article 36(9), Article 36(10) and Article 36(11) and as part of the multi-party agreements referred to in Article 39(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 in the technical implementation agreed between the parties for each process;
 - b) the amounts for potential Imbalance Netting Power Interchange, Frequency Restoration Power Interchange and Reserve Replacement Power Interchange are clearly divided between the single processes; and
 - c) the overall Imbalance Netting Power Interchange, Frequency Restoration Power Interchange and Reserve Replacement Power Interchange of this TSO do not result in power flows violating Operational Security Limits.

Article 40
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 the involved Synchronous Areas shall have the right to declare itself to all TSOs of the Synchronous Area 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 the 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 in real-time.

Article 41
INFRASTRUCTURE

1. All TSOs shall consider the technical infrastructure necessary to implement and operate one or more processes listed in Article 31 as critical according to [NC OS].
2. All TSOs of a Synchronous Area shall define in the Synchronous Area Operational Agreement minimum requirements for availability, reliability and redundancy of the technical infrastructure referred to in Article 41(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 additional requirements for availability, reliability and redundancy of the technical infrastructure in the LFC Block Operational Agreement while complying with Article 41(2).
4. Each TSO of a LFC Area shall:
 - a) ensure a sufficient quality and availability of the FRCE calculation;
 - b) perform real-time quality monitoring of the FRCE calculation;
 - c) take action in case of FRCE miscalculation; and,
 - d) where the FRCE is defined by the ACE, perform an ex-post quality monitoring of the FRCE calculation by comparing FRCE to reference values at least on an annual basis.

CHAPTER 5

OPERATION OF LOAD-FREQUENCY CONTROL

Article 42

SYSTEM STATES RELATED TO THE SYSTEM FREQUENCY

1. All TSOs of a Synchronous Area shall establish a real-time data exchange in accordance with [NC OS Article 18] of
 - a) the System State of the Transmission System as defined in [NC OS Article 8]; and
 - b) the real-time measurement data of the FRCE 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 [NC OS Article 8] according to the System Frequency limits defined in (3) and (4).
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 larger 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 ensure that all TSOs of all Synchronous Areas are informed in case the System Frequency Deviation fulfils one of the criteria for the Alert State.

6. The TSOs of a Synchronous Area shall define in the Synchronous Area Operational Agreement common rules for the operation of Load-Frequency Control in Normal State and Alert State.
7. The TSOs of a LFC Block shall reduce the FRCE of the LFC Block by activation of Active Power Reserves and if necessary by application of the actions as defined in (16).
8. The TSOs of a Synchronous Areas GB and IRE shall define in the Synchronous Area Operational Agreement operational procedures for the case of exhausted FCR. For these procedures the TSOs of a Synchronous Area shall have the right to require changes in the Active Power production or consumption of Power Generating Modules and Demand Units.
9. The TSOs of a LFC Block shall define operational procedures for the case of exhausted FRR or RR in the LFC Block Operational Agreement. For these procedures the TSOs of a LFC Block shall have the right to require changes in the Active Power production or consumption of Power Generating Modules and Demand Units.
10. The TSOs of a LFC Block shall make reasonable endeavours to avoid FRCEs persisting for more than the Time to Restore Frequency.
11. For the case of an Alert State due to a violation of System Frequency limits the TSOs of a Synchronous Area shall define in the Synchronous Area Operational Agreement operational procedures 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 define procedures in the Synchronous Area Operational Agreement for which the TSOs shall have the right to deviate from the obligation set in Article 34(1).
12. In case of an Alert State due to there being insufficient Active Power Reserves according to [NC OS Article 8] 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 Power Generating Modules or Demand Units within its area with the aim to reduce or to eliminate the violation of Active Power Reserve requirements.
13. For the case the 1-minute average of the FRCE of a LFC Block is above the Level 2 FRCE Range for at least the Time to Restore Frequency and in case the FRCE is not expected to be reduced sufficiently by the actions defined in (16) the TSOs of a LFC Block shall have the right to require changes in the Active Power production or consumption of Power Generating Modules and Demand Units within its area with the aim to reduce the FRCE as defined in (17).
14. For the Synchronous Areas CE and NE, for the case the FRCE of a LFC Block exceeds 25 % of the Reference Incident of the Synchronous Area for more than 30 consecutive minutes and in case the FRCE is not expected to be reduced sufficiently by the actions defined in (16) the TSOs of a LFC Block shall require changes in the Active Power production or consumption of Power Generating Modules and Demand Units within its area with the aim to reduce the FRCE as defined in (17).
15. The LFC Block Monitor shall determine any violation of the limits referred to in (13) and (14) in the case that these referenced clauses apply in the LFC Block. In these cases:
 - a) the LFC Block Monitor shall inform the other TSOs of the LFC Block; and

- b) the TSOs of the LFC Block shall take coordinated actions aiming to reduce the FRCE. The TSOs of the LFC Block shall define these coordinated actions in the LFC Block Operational Agreement.
16. For the cases as specified in (11) to (14) the TSOs of a Synchronous Area shall define in the Synchronous Area Operational Agreement 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 the Synchronous Area shall make reasonable endeavours to enable the TSOs of the concerned LFC Block to reduce its FRCE.
17. The TSOs of a LFC Block shall define in the LFC Block Operational Agreement measures to reduce the FRCE by requiring changes in the Active Power production or consumption of Power Generating Modules and Demand Units within its area.

CHAPTER 6

FREQUENCY CONTAINMENT RESERVES (FCR)

Article 43

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 43(4), Article 43(5) and Article 43(6).
2. All TSOs of the Synchronous Areas CE and NE shall define in the Synchronous Area Operational Agreement and shall apply a dimensioning approach in accordance with Article 43(5) for FCR based on a risk assessment criterion taking into account the pattern of load, generation and Inertia and Synthetic 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 43(4), Article 43(5) and Article 43(6).
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 in the Synchronous Area Operational Agreement 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 the Synchronous Areas 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:
 - a) For the Synchronous Area CE: the Reference Incident shall be the absolute value of the largest imbalance that may result from an instantaneous change of Active Power of one or

two Power Generating Modules or one or two HVDC Interconnectors connected to the same electrical node or the maximum instantaneous loss of Active Power consumption due to the tripping of one or two Connections Points;

b) For the Synchronous Areas 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 Power Generating Module, single Demand Facility, single HVDC Interconnector or from a tripping of an AC-Line or the maximum instantaneous loss of Active Power consumption due to the tripping of one or two Connections Points, separate for positive and negative direction.

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 44

FCR TECHNICAL MINIMUM REQUIREMENTS

1. Each Reserve Connecting TSO shall ensure that the FCR corresponds to the following properties listed for its Synchronous Area applying to all FCR Providing Units and FCR Providing Groups consistent with the values in [NC RfG Article 10 (2) (c)] in Table 4:

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

Table 4 : FCR Properties in the different Synchronous Area

2. All TSOs of a Synchronous Area shall have the right to define in the Synchronous Area Operational Agreement 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 ranges described in [NC RfG Article 10 (2) (c)] and [NC DCC Article 21 and 22]. These properties of FCR shall take into account 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 ranges described in [NC RfG Article 10 (2) (c)] and [NC DCC Article 21 and 22] based on technical arguments such as the geographical distribution of the Power Generating Modules or Demand Units establishing an FCR Providing Group 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.

The Reserve Connecting TSO shall have the right to exclude FCR Providing Groups from the provision of FCR based on technical arguments such as the geographical distribution of the Power Generating Modules or Demand Units establishing an FCR Providing Group to ensure Operational Security.

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 to assess the fulfilment of the technical and Availability Requirements by potential FCR Providing Units or FCR 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 FCR 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 44(1) and Article 44(2) and shall activate the agreed FCR in accordance to Article 44(1) and Article 44(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 FCR Providing Groups is in line with the requirements of the Synchronous Area according to Article 44(1), Article 44(2) and Article 44(3).

8. Each Reserve Connecting TSO shall monitor its contribution to the FCP and its FCR activation with respect to its FCR Obligation including FCR Providing Units and FCR Providing Groups. Each FCR Provider shall make available to the Reserve Connecting TSO for each of its FCR Providing Units and FCR Providing Groups at least the following information:
 - 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 Active 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 Unit with Demand Side Response Active Power Control as defined in [NC DCC Article 22];

Each FCR Provider shall have 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 1.5 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.

At the request of the Reserve Connecting TSO, a FCR Provider has to make available data for technical installations which are part of the same FCR Providing Unit in case it is necessary for clear verification of activation of FCR.

Article 45 FCR PROVISION

1. Each TSO shall ensure the availability of at least its FCR Obligation agreed upon in accordance with Article 43(6), Article 50, Article 59 and Article 60.
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 [NC DCC Article 21 and 22].
3. The shares of the K-Factor for each TSO shall be based on
 - a) its Initial FCR Obligation according to (1) of its area divided by the FCR Capacity; and
 - b) the amount of FCR Capacity from FCR Providing Units and FCR Providing Groups with a Connection Point inside the LFC Area
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 FCR Providing Unit to 5 % of the FCR Capacity required for the Synchronous Area 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. replacing the FCR which is made unavailable due to an Forced Outage or an unavailability of a FCR Providing Unit or FCR Providing Group 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 or, for the Synchronous Areas GB and IRE, until it activates its FRR.
 - 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 or, for the Synchronous Areas GB and IRE, until it activates its FRR.

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.

An FCR Provider using FCR Providing Units or FCR Providing Group with an energy reservoir that limits the FCR providing capability shall 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 in the Synchronous Area Operational Agreement by the TSOs of the Synchronous Area
- ii. for all other Synchronous Areas: as soon as possible but at the latest within 2 hours,

CHAPTER 7

FREQUENCY RESTORATION RESERVES (FRR)

Article 46

FRR DIMENSIONING

1. All TSOs of a LFC Block shall define in the LFC Block Operational Agreement FRR Dimensioning Rules.
2. The FRR Dimensioning Rules shall comprise at least the following requirements:
 - a) All TSOs of a LFC Block in the Synchronous Areas CE and NE 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 and NE shall determine the FRR Capacity of the LFC Block such that it is sufficient to respect the current FRCE Target Parameters in accordance with Article 20 for the considered historical period of time based at least on a probabilistic methodology. In this methodology restrictions due to 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, manual FRR Capacity, 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 Power Generating Module, single Demand Facility, and 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;
- h) All TSOs of a LFC Block shall ensure that the positive FRR Capacity or a combination of FRR and RR Capacity 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 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 a FRR Sharing Agreement 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 the Synchronous Areas CE and NE: 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 the Synchronous Areas CE and NE: shall never exceed 30 % of the size of the positive Dimensioning Incident.

- iii. For the Synchronous Areas GB and IRE 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 a FRR Sharing Agreement 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 the Synchronous Areas CE and NE: 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 the Synchronous Areas CE and NE: shall never exceed 30 % of the size of the Negative Dimensioning Incident.
 - iii. For the Synchronous Areas GB and IRE the negative 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 define in the LFC Block Operational Agreement the specific allocation of responsibilities between TSOs of the LFC Areas for the implementation of the obligations established in Article 46(2).
- 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 defined in the LFC Block Operational Agreement by all TSOs of a LFC Block.

Article 47
FRR TECHNICAL MINIMUM REQUIREMENTS

1. The FRR Technical Minimum Requirements shall be:
 - a) each FRR Providing Unit and each 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 Setpoint received from the Reserve Instructing TSO;
 - c) the Reserve Instructing TSO shall be the Reserve Connecting TSO or a TSO that shall be defined by the Reserve Connecting TSO in an FRR Exchange Agreement according to the provisions of Article 52(3) or Article 58(4);
 - 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 to the Reserve Connecting TSO and the Reserve Instructing TSO real-time measurements of the Connection Point or another point of interaction agreed with the Reserve Connecting TSO of:
 - i. time-stamped scheduled Active Power output;
 - ii. time-stamped instantaneous Active Power
 for
 - a) each FRR Providing Unit;
 - b) each FRR Providing Group; and

- c) each Power Generating Module or Demand Unit of a FRR Providing Group with a maximum Active Power output larger than or equal to 1.5 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 in the LFC Block Operational Agreement FRR Availability Requirements and requirements on the control quality of FRR Providing Units and FRR Providing Groups for their LFC Block while respecting the provisions of Article 46.
 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 such as the geographical distribution of the Power Generating Modules or Demand Units establishing an FRR Providing Group to ensure Operational Security.
 5. Each TSO shall implement a FRR Prequalification 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 that shall be defined by the Reserve Connecting TSO in a FRR Exchange Agreement according to the provisions of Article 52e(3) or Article 58(4).

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 48 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 31(2) and Article 48(1), performing a combined Dimensioning Process of FRR and RR to fulfil the requirements of Article 46 (2), shall define in the LFC Block Operational Agreement the RR Dimensioning Rules in order to respect the FRCE Target Parameters in accordance with Article 20.
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 FRCE Quality Target for the considered period of time, based on theoretical considerations; and
 - d) respect the Operational Security 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 a RR Sharing Agreement 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 20;
 - b) in order to ensure that Operational Security 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 a RR Sharing Agreement for this negative 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 negative RR Capacity:
 - a) in order to guarantee that it can still meet its FRCE Quality Targets as set forth in Article 20;

- b) in order to ensure that Operational Security 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 define in the LFC Block Operational Agreement 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 defined in the LFC Block Operational Agreement by all TSOs of a LFC Block.

Article 49

RR TECHNICAL MINIMUM REQUIREMENTS

1. The RR Technical Minimum Requirements for RR Providing Units and RR Providing Groups shall be:
 - a) each RR Providing Unit and each 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 the Reserve Instructing TSO;
 - c) the Reserve Instructing TSO shall be the Reserve Connecting TSO or a TSO that shall be defined by the Reserve Connecting TSO RR Exchange Agreement according to the provisions of Article 52 (3) or Article 58(4);
 - d) a RR Providing Unit or RR Providing Group shall activate its complete RR Capacity within the activation time defined by the Instructing TSO;
 - e) a RR Providing Unit or RR Providing Group shall de-activate RR according to the Set Point received from the Reserve Instructing TSO;
 - f) 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 to the Reserve Connecting TSO and the Reserve Instructing TSO real-time measurements of the Connection Point or another point of interaction agreed with the Reserve Connecting TSO of:
 - i. time-stamped scheduled Active Power output; and
 - ii. time-stamped instantaneous Active Power
 for
 - a) each RR Providing Unit;
 - b) each RR Providing Group; and
 - c) each Power Generating Module or Demand Unit of a RR Providing Group with a maximum Active Power output larger than or equal to 1.5 MW; and
 - g) a RR Providing Unit or RR Providing Group shall fulfil the RR Availability Requirements.
2. All TSOs of a LFC Block shall define in the LFC Block Operational Agreement RR Availability Requirements and requirements on the control quality of RR Providing Units and RR Providing Groups for their LFC Block while respecting the provisions of Article 46.

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 such as the geographical distribution of the Power Generating Modules or Demand Units establishing an RR Providing Group to ensure Operational Security.
5. Each TSO shall implement a RR Prequalification 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 that shall be defined by the Reserve Connecting TSO in a RR Exchange Agreement according to the provisions of Article 52 (3) or Article 58(4).

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); and
 - b) inform its Reserve Instructing TSO about a reduction of the actual availability or a Forced Outage of its RR Providing Unit or its RR 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) and the connection requirements according to (3) are monitored.

CHAPTER 9

EXCHANGE AND SHARING OF RESERVES

Section 1

EXCHANGE AND SHARING OF RESERVES WITHIN A SYNCHRONOUS AREA

Article 50

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 5:

Synchronous Area	Exchange of FCR allowed between:	Limits for the Exchange of FCR
Synchronous Area CE	TSOs of Adjacent LFC Blocks	<ul style="list-style-type: none"> - the TSOs of a LFC Block shall ensure that at least 30 % of their total combined Initial FCR Obligations, according to Article 43(1), is physically provided inside their LFC Block; and - 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"> o 30 % of the total combined Initial FCR Obligations, according to Article 43(1), of the TSOs of the LFC Block to which the FCR Capacity is physically connected; and o 100 MW of FCR Capacity.
	TSOs of the LFC Areas of the same LFC Block	<ul style="list-style-type: none"> - the TSOs of the LFC Areas constituting a LFC Block shall have the right to define in the LFC Block Operational Agreement internal limits for the Exchange of FCR between the LFC Areas of the same LFC Block in order to: <ul style="list-style-type: none"> o avoid internal congestions in case of the activation of FCR; o ensure an even distribution of FCR Capacity for the case of network splitting; and o avoid that the stability of the FCP or the Operational Security is affected.
Other Synchronous Areas	TSOs of the Synchronous Area	<ul style="list-style-type: none"> - The TSOs of the Synchronous Area shall have the right to define in the Synchronous Area Operational Agreement limits for the Exchange of FCR in order to: <ul style="list-style-type: none"> o avoid internal congestions in case of the activation of FCR; o ensure an even distribution of FCR for the case of network splitting; and o avoid that the stability of the FCP or the Operational Security is affected.

Table 5 : Limits and requirements for the Exchange of FCR

3. In case of the Exchange of FCR, the Reserve Connecting TSO and Reserve Receiving TSO shall perform a notification process according to Article 40.
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 result in 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 FRCE calculation to account for the Exchange of FCR.
7. The Reserve Connecting TSO shall be responsible for the requirements according to Article 44 and Article 45 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.
9. The involved TSOs shall ensure that Exchange of FCR does not hinder any TSO to fulfil the reserve requirements according to the provisions of Article 45.

Article 51

SHARING OF FCR WITHIN A SYNCHRONOUS AREA

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 43(1).

Article 52

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

1. All TSOs of a Synchronous Area shall define in the Synchronous Area Operational 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.
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 40.
3. The Reserve Connecting and Reserve Receiving TSOs involved in the Exchange of FRR/RR shall define in a FRR or RR Exchange 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 37 and Article 38;

- 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 for the FRR/RR Capacity subject to the Exchange of FRR/RR according to Article 47(5) and Article 49(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 47(8) and Article 49(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.
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 prevent any TSO from fulfilling the reserve requirements according to the FRR or RR Dimensioning Rules.
 6. All TSOs of a LFC Block shall define in the LFC Block Operational 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 53

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

1. All TSOs of a Synchronous Area shall define in the Synchronous Area Operational 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.
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 40.
3. The Control Capability Receiving TSO and the Control Capability Providing TSO participating in the Sharing of FRR/RR shall define in a FRR or RR Sharing 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 according to Article 37 and Article 38; 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.
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 Rules of Article 46 and Article 48 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 FRR/RR Exchange Agreement.
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 Operational Security;
 - 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 the LFC Block Operational 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 WITHIN A SYNCHRONOUS AREA

The Exchange of FRR within a Synchronous Area is allowed in accordance with the provisions of this article and Article 52. 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 6:

Synchronous Area	Exchange of FRR allowed between	Limits for the Exchange of FRR
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 Rules according to Article 46(1) and before any reduction due to the Sharing of FRR according to Article 46(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 define internal limits, for the Exchange of FRR between the LFC Areas of the LFC Block in the LFC Block Operational Agreement as to: <ul style="list-style-type: none"> o avoid internal congestions due to the activation of the FRR Capacity subject to the Exchange of FRR; o ensure an even distribution of FRR throughout the Synchronous Areas and LFC Blocks in case of network splitting; and o avoid that the stability of the FRP or the Operational Security is affected.

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

Article 55
SHARING OF FRR WITHIN A SYNCHRONOUS AREA

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 Rules in Article 46(1) while respecting the general provisions of Article 53.

Article 56
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 52.
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 7:

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 Rules according to Article 48 and before any reduction of RR Capacity as a result of the Sharing of RR according to Article 48(4) and Article 48(5) 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 define internal limits for the Exchange of RR between LFC Areas of the LFC Block in the LFC Block Operational Agreement as to: <ul style="list-style-type: none"> ○ avoid internal congestions due to the activation of RR Capacity subject to the Exchange of RR; ○ ensure an even distribution of RR throughout the Synchronous Area in case of network splitting; and ○ avoid that the stability of the RRP or the Operational Security is affected.

Table 7 : Requirements and limits for the Exchange of RR within the Synchronous Area

Article 57
SHARING OF RR WITHIN A SYNCHRONOUS AREA

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 Rules in accordance with Article 48(4) and Article 48 (5) while respecting the provisions of Article 53.

Section 2
EXCHANGE AND SHARING OF RESERVES BETWEEN SYNCHRONOUS AREAS

Article 58
GENERAL REQUIREMENTS

1. Each operator and/or owner of an HVDC Interconnector interconnecting Synchronous Areas shall provide the capability where the technology is installed 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 shall define in the Synchronous Area Operational 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 Active Power Reserves between Synchronous Areas.
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 40.
4. The Reserve Connecting and Reserve Receiving TSOs involved in the Exchange of Reserves shall define, in an Exchange 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 Reserves;
 - b) the amount of the Reserve Capacity subject to the Exchange of Reserves;
 - c) the implementation of the Cross-Border FRR/RR Activation Process according to Article 37 and Article 38;
 - d) the implementation of the Prequalification for the Reserve Capacity subject to the Exchange of Reserves according Article 47(5) and Article 49(5);
 - e) the responsibility to monitor the fulfilment of the Technical Requirements and Availability Requirements for the Reserve Capacity subject to the Exchange of Reserves according to Article 47(8) and Article 49(8); and
 - f) procedures to ensure that the Exchange of Reserves does not lead to power flows in violation with the Operational Security Limits.
5. The Control Capability Providing and Control Capability Receiving TSO involved in the Sharing of Reserves shall define in a Sharing Agreement their roles and responsibilities including but not limited to:
 - a) the amount of the Reserve Capacity subject to the Sharing of Reserves;
 - b) the implementation of the Cross-Border FRR/RR Activation Process according to Article 37 and Article 38; and
 - c) the procedures to ensure that the Sharing of Reserves does not lead to power flows in violation with the Operational Security Limits.

6. The Reserve Connecting and Reserve Receiving TSOs involved in the Exchange of Reserves or the Control Capability Providing and Control Capability Receiving TSO involved in the Sharing of Reserves shall agree with the HVDC Interconnector owners and/or HVDC 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.
7. Any Reserve Connecting TSO, Reserve Receiving TSO, Control Capability Providing TSO, Control Capability Receiving TSO or Affected TSO involved in the Exchange or Sharing of Reserves 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.
8. The involved TSOs shall ensure that Exchange of Reserves between Synchronous Areas does not prevent any TSO from fulfilling the reserve requirements according to Article 43, Article 46 and Article 48.
9. The Reserve Connecting and Reserve Receiving TSOs respectively the Control Capability Providing and Control Capability Receiving TSO shall define procedures in an Exchange Agreement or Sharing Agreement in case the Exchange respectively Sharing of Reserves between Synchronous Areas fails in real-time.

Article 59

EXCHANGE OF FCR BETWEEN SYNCHRONOUS AREAS

1. All TSOs of the Synchronous Area shall define in the Synchronous Area Operational Agreement a methodology to determine limits for the Exchange of FCR with their Synchronous Area. 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 TSOs of the Synchronous Area to reach the Frequency Quality Target Parameters in accordance with Article 19; and
 - d) the Operational Security.
2. Each 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 Reserve Receiving TSO in accordance with the FCR requirements established in Article 44.
3. All TSOs involved in the Exchange of FCR between Synchronous Areas shall organise the Exchange of FCR 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 43(1) within a second Synchronous Area.

The part of the total FCR Capacity required for the first Synchronous Area subject to the Exchange of FCR 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 43(1).

4. All TSOs of the involved Synchronous Areas shall agree in a FCR Exchange Agreement upon the Exchange of FCR.
5. The Reserve Receiving TSO shall respect the provisions of Article 45(5) in case of the Exchange of FCR between Synchronous Areas.

Article 60

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 the Synchronous Area Operational Agreement a methodology to determine limits for the Sharing of FCR with their Synchronous Area. 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 TSOs of the Synchronous Area to reach the Frequency Quality Target Parameters according to Article 19; and
 - d) the Operational Security.
3. Each operator of a HVDC Interconnector shall control the Active Power Flow over the HVDC Interconnector in accordance with instructions defined by the Control Capability Receiving TSO in accordance with the FCR requirements established in Article 44.
4. All TSOs involved in the Sharing of FCR between Synchronous Areas shall organise the Sharing of FCR 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 43(1) within a second Synchronous Area.
5. The Control Capability Receiving TSO shall respect the provisions of Article 45(5) in case of the Sharing of FCR between Synchronous Areas.

Article 61

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 Rules of Article 46 and Article 48 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 a FRR/RR Exchange Agreement.
2. All TSOs of a LFC Block shall define in the LFC Block Operational 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 in other Synchronous Areas.

Article 62

EXCHANGE OF FRR BETWEEN SYNCHRONOUS AREAS

1. All TSOs of the Synchronous Areas shall define in the Synchronous Area Operational Agreement a methodology to determine limits for the Exchange of FRR with their Synchronous Area. 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 TSOs of the Synchronous Area to reach the Frequency Quality Target Parameters in accordance with Article 19 and the FRCE Target Parameters in accordance with Article 20; and
 - d) the Operational Security.
2. All TSOs of LFC Blocks involved 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 46(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 Article 46(1).

3. Each operator of a HVDC Interconnector shall control the Active Power Flow over the HVDC Interconnector in accordance with instructions defined by either the Reserve Connecting TSO or Reserve Receiving TSO in accordance with the FRR Technical Minimum Requirements established in Article 47.
4. All TSOs of the LFC Blocks of the Reserve Connecting TSO and the Reserve Receiving TSO shall agree in a FRR Exchange Agreement upon the Exchange of FRR.

Article 63

SHARING OF FRR BETWEEN SYNCHRONOUS AREAS

1. All TSOs of the Synchronous Area shall define in the Synchronous Area Operational Agreement a methodology to determine limits for the Sharing of FRR with their Synchronous Area. 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 46 as a result from the FRR Sharing;
 - d) the ability of the Synchronous Area to reach the Frequency Quality Target Parameters in accordance with Article 19 and the FRCE Target Parameters in accordance with Article 20; and
 - e) the Operational Security.
2. All TSOs of LFC Blocks involved 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 46(1) from a LFC Block in the second Synchronous Area.
 3. Each operator of a HVDC Interconnector shall control the Active Power Flow over the HVDC Interconnector in accordance with instructions defined by either the Control Capability Providing TSO or Control Capability Receiving TSO in accordance with the FRR Technical Minimum Requirements established in Article 46(1).
 4. All TSOs of the LFC Blocks of the Control Capability Providing and Control Capability Receiving TSOs and the Reserve Receiving LFC Block shall agree in a FRR Sharing Agreement upon the Sharing of FRR.

Article 64

EXCHANGE OF RR BETWEEN SYNCHRONOUS AREAS.

1. All TSOs of the Synchronous Area shall define in the Synchronous Area Operational Agreement a methodology to determine limits for the Exchange of RR with their Synchronous Area. The methodology shall take into account:
 - a) the operational impact between the Synchronous Areas;
 - b) the stability of the RRP of the Synchronous Area;
 - c) the ability of the TSOs of the Synchronous Area to reach the Frequency Quality Target Parameters in accordance with Article 19 and the FRCE Target Parameters in accordance with Article 20; and
 - d) the Operational Security.
2. All TSOs of LFC Blocks involved 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 48(2) 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 48(2).
3. Each operator of a HVDC Interconnector shall control the Active Power Flow over the HVDC Interconnector in accordance with instructions defined by either the Reserve Connecting TSO or

the Reserve Receiving TSO in accordance with the RR Technical Minimum Requirements established in Article 49.

4. All TSOs of the LFC Blocks of the Reserve Connecting TSO and the Reserve Receiving TSO shall agree in a RR Exchange Agreement upon the Exchange of RR.

Article 65

SHARING OF RR BETWEEN SYNCHRONOUS AREAS

1. All TSOs of the Synchronous Area shall define in the Synchronous Area Operational Agreement a methodology to determine limits for the Sharing of RR with their Synchronous Area. The methodology shall take into account:
 - a) the operational impact between the Synchronous Areas;
 - b) the stability of the RRP of the Synchronous Area;
 - c) the maximum reduction of RR that can be taken into account in the RR Dimensioning Rules according to Article 48 as a result of the RR Sharing;
 - d) the ability of the TSOs of the Synchronous Area to reach the Frequency Quality Target Parameters in accordance with Article 19 and the ability of the LFC Blocks to reach the FRCE Error Target Parameters in accordance with Article 20; and
 - e) the Operational Security.
2. All TSOs of LFC Blocks involved 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 48(2) from a LFC Block in the second Synchronous Area.
3. Each operator of a HVDC Interconnector shall control the Active Power Flow over the HVDC Interconnector in accordance with instructions defined by either the Control Capability Providing TSO or the Control Capability Receiving TSO in accordance with the RR Technical Minimum Requirements established in Article 49.
4. All TSOs of the LFC Blocks of the Reserve Capability Providing and Reserve Capability Receiving TSO shall agree in a RR Sharing Agreement upon the Sharing of RR.

Section 3

CROSS-BORDER ACTIVATION PROCESS FOR FRR / RR

Article 66

CROSS-BORDER ACTIVATION PROCESS FOR FRR / RR

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 37 and Article 38.

CHAPTER 10

TIME CONTROL PROCESS

Article 67

TIME CONTROL PROCESS

1. The Electrical Time Control Process of a Synchronous Area shall be used 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 the Synchronous Area Operational Agreement the methodology to correct the Electrical Time Deviation which 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 DSOS

Article 68

RESERVE PROVIDING UNITS CONNECTED TO THE DSO GRID

1. TSOs and DSOs shall collaborate and use reasonable endeavours to facilitate and enable the delivery of Active Power Reserves by Reserve Providing Groups or Reserve Providing Units located in Distribution Networks.
2. The Reserve Connecting DSO and each intermediate DSO shall process the application of a Reserve Providing Unit or Reserve Providing Group connected to its Distribution Network within 2 months after provision of the notification and all the required information including:
 - 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 DSO and each intermediate DSO shall have the right to set limits to or exclude the delivery of Active Power Reserves located in its Distribution Network in cooperation with the TSO and in a non-discriminatory and transparent way based on technical arguments such as the geographical distribution of the Reserve Providing Units and Reserve Providing Groups.
4. In accordance with applicable legislation each Reserve Connecting DSO and each intermediate DSO shall have the right to set temporary limits at any point in time before reserve activation in cooperation with the TSO and in a non-discriminatory and transparent way to the delivery of Active Power Reserves located in its Distribution Network. The respective TSOs shall agree with its Reserve Connecting DSOs and intermediate DSOs on the applicable procedures.
5. In accordance with applicable legislation, the respective TSOs shall agree with its Reserve Connecting DSOs and intermediate DSOs on procedures and methodologies for the information exchange required in relation to Prequalification and the delivery of Active Power Reserves, including the notification of the Reserve Connecting DSO and intermediate DSOs.

CHAPTER 12

TRANSPARENCY OF INFORMATION

Article 69

GENERAL TRANSPARENCY REQUIREMENTS

1. All TSOs shall ensure that information mentioned in this Chapter is published at a time and in a format that does not create an actual or potential competitive advantage or disadvantage to any individual party or category of party.
2. Each TSO shall use the knowledge and tools available to this TSO to overcome technical constraints and to ensure the availability and the accuracy of the information made available to ENTSO-E in accordance with Article 71(3) and Article 72.
3. All TSOs shall ensure the availability and the accuracy of the information made available to ENTSO-E in accordance with Article 71(1), Article 71(2), Article 71 (3), Article 73, Article 74, Article 75, Article 76 and Article 77.
4. All material for publication mentioned in Article 71, Article 73, Article 74, Article 75 and Article 76 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 70

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 no later than one month before its entry into force
2. All TSOs of each Synchronous Area shall make the contents of its Synchronous Area Operational Agreement available to ENTSO-E for publication no later than one week after its entry into force.

3. 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 71

INFORMATION ON FREQUENCY QUALITY

1. Whenever modified values are defined in accordance with Article 19(6), all TSOs of each Synchronous Area shall make the adopted values of the following parameters for their Synchronous Area available to ENTSO-E for publication no later than one month before the entry into force of the Synchronous Area Operational Agreement in which they are contained:
 - a) the Frequency Quality Defining Parameters; and
 - b) the Frequency Quality Target Parameter.
2. Where applicable, all TSOs of each Synchronous Area shall make the values of the FRCE Target Parameters for each LFC Block and each LFC Area within their Synchronous Area available to ENTSO-E for publication no later than one month before their applicability.
3. All TSOs of each Synchronous Area shall make the methodology used to determine the risk of FCR Exhaustion available to ENTSO-E for publication no later than three months before the entry into force of the Synchronous Area Operational Agreement in which it is contained.
4. The Synchronous Area Monitor of each Synchronous Area shall make the results of the Criteria Application Process for their Synchronous Area available to ENTSO-E for publication no later than three 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 as calculated for the Synchronous Area and for each LFC Block within the Synchronous Area in accordance with Article 23(3);
 - b) the measurement resolution, measurement accuracy and calculation method defined in accordance with Article 22; and
 - c) all TSOs of each Synchronous Area shall make the Ramping Period defined in accordance with Article 18 available to ENTSO-E for publication no later than three months before their applicability.

Article 72

ANNUAL REPORT ON LOAD-FREQUENCY CONTROL

1. Starting at most two years after the entry into force of this Network Code, all TSOs of each country shall ensure the following information is available to ENTSO-E within three months after the end of each calendar year:
 - a) the identification of the LFC Blocks, LFC Areas and Monitoring Areas contained within the country;
 - b) 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;
 - c) the identification of the Synchronous Areas within which the country is contained;

- d) 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;
 - e) 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; and
 - f) a description and date of implementation of any mitigation measures taken in the last calendar year in accordance with Article 29 in which TSOs of the country were involved.
2. Where appropriate, TSOs of a Synchronous Area or LFC Block shall collaborate in collecting the data listed in (1).
 3. For each country, ENTSO-E shall include the information listed in (1) within the annual report developed in accordance with Article 8(3) (e) of Regulation (EC) N° 714/2009.

Article 73

INFORMATION ON THE LOAD-FREQUENCY CONTROL STRUCTURE

1. All TSOs of each Synchronous Area shall make the following information available to ENTSO-E no later than three months before the entry into force of the Synchronous Area Operational Agreement in which it is contained:
 - a) information on the Process Activation Structure of the Synchronous Area, including at least information on the defined Monitoring Areas, LFC Areas and LFC Blocks and their TSOs; and
 - b) information on the Process Responsibility Structure of the Synchronous Area, including at least information on the defined processes listed in Article 31(1) and Article 31(2).
2. All TSOs implementing an Imbalance Netting Process shall publish information regarding this Imbalance Netting Process in accordance with national legislation. This information shall include at least the list of participating TSOs and the starting date of the Imbalance Netting Process.

Article 74

INFORMATION ON FCR

1. All TSOs of each Synchronous Area shall make the dimensioning approach for FCR for their Synchronous Area in accordance with Article 43(4) available to ENTSO-E for publication no later than one month before its applicability.
2. Where applicable, all TSOs of each Synchronous Area shall make the total amount of FCR Capacity for their Synchronous Area and the shares of FCR Capacity required for each TSO defined in accordance with Article 43(1), Article 43(3) or Article 43(4) as the Initial FCR Obligation available to ENTSO-E for publication no later than one month before their applicability.
3. All TSOs of each Synchronous Area shall make the FCR properties defined for their Synchronous Area in accordance with Article 44(2) and additional requirements for FCR Providing Groups in accordance with Article 44(3) available to ENTSO-E for publication no later than three months before their applicability.

Article 75
INFORMATION ON FRR

1. All TSOs of each LFC Block shall make the FRR Availability Requirements and requirements for the control quality defined in accordance with Article 47(2) and the technical requirements for the connection defined in accordance with Article 47(3) for their LFC Block available to ENTSO-E for publication no later than three months before their applicability.
2. All TSOs of each LFC Block shall make the FRR Dimensioning Rules defined for their LFC Block in accordance with Article 46(1) available to ENTSO-E for publication no later than three months before the entry into force of the LFC Block Operational Agreement in which they are contained.
3. All TSOs of each Synchronous Area shall make an outlook of the FRR Capacities of each LFC Block for the next year available to ENTSO-E for publication no later than 30 November of each year.
4. All TSOs of each Synchronous Area shall make the actual FRR capacities of each LFC Block of the past quarter available to ENTSO-E for publication no later than 30 days after the end of the quarter.

Article 76
INFORMATION ON RR

1. All TSOs of each LFC Block that operates a Reserve Replacement Process shall make the RR Availability Requirements defined in accordance with Article 49(2) and the technical requirements for the connection defined in accordance with Article 49(3) for their LFC Block available to ENTSO-E for publication no later than three months before their applicability.
2. All TSOs of each Synchronous Area shall make an outlook of the RR Capacities of each LFC Block for the next year available to ENTSO-E for publication no later than 30 November of the current year.
3. All TSOs of each Synchronous Area shall make the actual RR Capacities of each LFC Block of the past quarter available to ENTSO-E for publication no later than 30 days after the end of the quarter.

Article 77
INFORMATION ON SHARING AND EXCHANGE

1. All TSOs of each Synchronous Area shall make the annual compilations of the agreements for Sharing of FRR and for Sharing of RR for each LFC Block within the Synchronous Area available to ENTSO-E as part of the material for publication required by respectively Article 75(3) and Article 76(2). These compilations shall include the following information:
 - a) the identity of the LFC Blocks between which an agreement for Sharing of FRR or RR exists; and
 - b) the realized reduction of FRR and RR due to each agreement for the Sharing of respectively FRR or RR.
2. All TSOs of the Synchronous Areas GB and IRE shall make information on the amount of Sharing of FCR between Synchronous Areas available to ENTSO-E as part of the material for publication required by Article 74(1). This information shall include the following:

- a) the amount of shared FCR Capacity between TSOs that entered agreements for the Sharing of FCR; and
 - b) the effect of the Sharing of FCR on the FCR Capacity of the involved TSOs.
3. All TSOs of each country shall publish information on the Exchange of FCR, FRR and RR in accordance with national legislation.

CHAPTER 13 FINAL PROVISIONS

Article 78

AMENDMENT OF CONTRACTS AND GENERAL TERMS AND CONDITIONS

By [date – the same as the date in Article 79], 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 79

ENTRY INTO FORCE

This Network Code shall enter into force on the twentieth day following that of the publication in the *Official Journal of the European Union* of [the Network Code on Operational Security, Operational Planning and Scheduling, or Load Frequency Control and Reserves, whichever is the latest].

With the exception of the Article 8 and Articles 10 to 13 which shall apply as from the entry into force, this Network Code shall apply as from [date –at minimum 18 months after entry into force].

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