Load-Frequency-Control & Reserves Network Code
First Preliminary Draft - 04.07.12

1. Frequency Quality

#	Article
1	Each TSO shall collaborate with the other TSOs of its Synchronous Area to jointly define common System Frequency quality criteria for normal operation, consisting of • System Frequency Targets and • System Frequency Evaluation Criteria and to jointly review and publish the criteria on an at least annual basis.
2	The System Frequency Targets shall comprise: • Maximum Dynamic System Frequency Deviation Target; • Maximum Steady-State System Frequency Deviation Target; • Standard System Frequency Target ; • Time to restore System Frequency Target Maximum electrical time deviation Target • FURTHER TARGETS TO BE DEFINED The System Frequency Target Values for the Targets within this Article shall take into account the Synchronous Area characteristics.
3	For each Synchronous Area each TSO of this Synchronous shall collaborate with the other TSOs of this Synchronous Area in order to define the System Frequency Evaluation Criteria which shall comprise at least: • Time Outside Standard Frequency Range Criterion • FURTHER CRITERIA TO BE DEFINED
4	In order to ensure the frequency quality criteria, at the level of a Synchronous Area, each TSO collaborates with other TSOs to agree the power-frequency control structure, type and structure of reserves, the capabilities for providing and technical requirements for reserve activation. Dimensioning of reserves at a level of Synchronous Area and individual TSO shall respect a minimum of frequency quality criteria as: • Reference Incident; • Maximum System Frequency deviation; • Standard Frequency range; • Standard System Frequency criterion ; • Time to restore System Frequency ; • Maximum electrical time deviation;
5	Each TSO is responsible to monitor and shall use best endeavors to conform to the agreed System Frequency Quality Targets of the Synchronous Area which the Control Areas belongs to. Each TSO will implement the appropriate power-frequency control structure by providing and activating reserves according to the control structure of the Synchronous Area.
6	Each TSO shall collaborate with other TSOs of its Synchronous Area to jointly agree and publish on website: values of frequency criteria, current frequency evaluations criteria and the accuracy and sample rate of measurement, place of records and calculation formula.
7	Each TSO shall provide basic data necessary for frequency control analysis at its Synchronous Area level (e.g. annual consumption, internal reference incident, historical ACE values).

2. Load-Frequency Control Structure

#	Article
1	Each TSO of each Synchronous Area shall cooperate to define, to implement and to operate a Load-Frequency-Control structure for the Synchronous Area.
2	The Load-Frequency-Control structure of each Synchronous Area shall include: (a) a Process Activation Structure; and (b) a Process Responsibility Structure.
3	The Process Activation Structure shall at least include: (a) a Frequency Containment Process; and (b) a Frequency Restoration Process.
4	The Process Activation Structure may include: (a) a Reserve Replacement Process; (b) an Imbalance Netting Process; (c) a Cross-Border FRR Activation Process; (d) a Cross-Border RR Activation Process; and (e) a Time Control Process (to be further elaborated).
5	The Process Responsibility Structure for each process in each Synchronous Area shall be (a) centralised; or (b) decentralised. The Process Responsibility Structure shall be defined taking into account factors including but not limited to (a) size of the Synchronous Area; (b) network topology; (c) load and generation behaviour.
6	Where a Process Responsibility Structure is centralised, each TSO of the Synchronous Area shall cooperate to appoint one or more TSOs who shall be responsible for the fulfilment of Process Obligations.
7	Where a Process Responsibility Structure is decentralised, each TSO of the Synchronous Area shall be responsible for the fulfilment of its own Process Obligations.
8	Where Process Responsibility Structure is decentralised, Neighbouring TSOs may share the responsibility for the fulfilment of Process Obligations as a Control Block.
9	A Control Area shall not be part of more than one Control Block.
10	Each TSO of a Control Block cooperation shall notify all TSOs of the Synchronous Area about (a) its participation in a Control Block; and (b) its shared Process Obligations. Each TSO of the Synchronous Area has the right to object.
	Frequency Containment Process
12	The Frequency Containment Process shall stabilize the System Frequency only by activation of the FCR.
13	The Frequency Containment Control Error shall be the System Frequency Deviation.
14	The set-point value for total FCR activation in a Synchronous Area shall be defined by a piecewise-linear power-frequency characteristic.
	Frequency Restoration Process
15	The Frequency Restoration Process shall (a) regulate the Frequency Restoration Control Error to zero within the Time To Restore Frequency; and thereby (b) progressively replace the activated FCR by automated and/or manual activation of the FRR.
16	Where Process Responsibility Structure is centralised the Frequency Restoration Control Error shall be based on System Frequency Deviation. Where the Process Responsibility Structure is decentralised the Frequency Restoration Control Error shall be the ACE of a Control Area.
17	The ACE of a Control Area shall be calculated as the sum of (a) the difference between i. the total Tie-Line and Virtual Tie-Line active power flow; and ii. the Control Program; and

	(b) the product of the K-Factor of the Control Area and the System Frequency Deviation. Each TSO of each Synchronous Area shall collaborate to define K-Factors for each Control Area based on (a) FCR activation; and (b) Self-Regulation Effect of each Control Area.
18	The set-point value for automated FRR activation shall be defined by (a) a single Frequency Restoration Controller operated by one TSO where the Process Responsibility Structure is Central; or (b) a single Frequency Restoration Controller operated by each TSO of each Control Area where the Process Responsibility Structure is decentralised.
19	Where Control Areas are part of a Control Block the set-point value for FRR activation may take into account the ACE of the Control Block in addition to #18.
20	The Frequency Restoration Controller shall have the following properties: (a) The Frequency Restoration Controller shall be operated in a closed-loop manner with Frequency Restoration Control Error as input and set-point value for FRR activation as output. (b) The Frequency Restoration Controller shall have proportional-integral behaviour. (c) The Frequency Restoration Controller shall have an Anti-Windup Logic. (d) The Frequency Restoration Controller shall be operated with a Cycle Time no longer than 10 seconds.
21	The set-point value for manual FRR activation shall be defined by (a) one TSO where the Process Responsibility Structure is centralised; or (b) each TSO of each Control Area for its Control Area where the Process Responsibility Structure is decentralised taking into account factors including but not limited to (a) Frequency Restoration Control Error; (b) activated FRR; (c) load and generation behaviour; (d) Market Induced Imbalances.
	Reserve Replacement Process
22	The Reserve Replacement Process shall (a) progressively restore the activated FRR and/or; (b) support FRR activation by activation of RR.
23	The set-point value for manual RR activation shall be defined by (a) one TSO where the Process Responsibility Structure is Central; or (b) each TSO of each Control Area for its Control Area where the Process Responsibility Structure is decentralised taking into account factors including but not limited to (a) Frequency Restoration Control Error; (b) activated FRR and RR; (c) load and generation behaviour; (d) Market Induced Imbalances.
	Imbalance Netting Process
24	Where Process Responsibility Structure for the Frequency Restoration Process of a Synchronous Area is decentralised, the Imbalance Netting Process shall reduce the amount of simultaneous counteracting FRR activation of each participating Control Area by Imbalance Netting Power exchange.
25	The Imbalance Netting Process shall not affect (a) the stability of the Frequency Containment Process, the Frequency Restoration Process and the Replacement Process; and (b) the Operational Security.
26	The Imbalance Netting Power exchange between Control Areas of one Synchronous Area shall be implemented by (a) defining an active power flow over a Virtual Tie-Line which shall be part of ACE calculation; and/or (b) adjustment of active power flows over HVDC interconnectors.
27	The Imbalance Netting Power import respectively export of a Control Area shall not exceed the amount of positive FRR activation respectively negative FRR activation which is necessary to regulate the Frequency Restoration Control Error of that Control Area to zero without Imbalance Netting Power

	exchange.
29	The Imbalance Netting Power exchange shall not exceed the Available Transmission Capacity.
30	The Imbalance Netting Process shall include a fall-back mechanism that shall have the following properties: (a) The Imbalance Netting Power exchange of each Control Area shall be zero. (b) The requirements according to #25 shall be met without any exceptions.
	Cross-Border FRR Activation Process
32	The Cross-Border FRR Activation Process shall enable a TSO to perform the Frequency Restoration Process by Frequency Restoration Power exchange between Control Areas of a Synchronous Area.
33	The Cross-Border FRR Activation Process shall not affect (a) the stability of the Frequency Containment Process, the Frequency Restoration Process and the Replacement Process; and (b) Operational Security.
34	The Frequency Restoration Power exchange between Control Areas of one Synchronous Area shall be implemented by (a) defining an active power flow over a Virtual Tie-Line which shall be part of ACE calculation where FRR activation is automated; (b) adjustment of a Control Program and/or defining an active power flow over a Virtual Tie-Line between Control Areas where FRR activation is manual; and/or (c) adjustment of active power flows over HVDC interconnectors.
35	The Frequency Restoration Power exchange shall not exceed the Available Transmission Capacity.
37	The Cross-Border FRR Activation Process shall include a fall-back mechanism that shall have the following properties: (a) The Frequency Restoration Power exchange of each Control Area shall be zero. (b) The requirements according to #33 shall be met without any exceptions.
	Cross-Border RR Activation Process
38	The Cross-Border RR Activation Process shall enable a TSO to perform the Reserve Replacement Process through Replacement Power exchange between Control Areas of a Synchronous Area.
39	The Cross-Border RR Activation Process shall not affect (a) the stability of the Frequency Containment Process, the Frequency Restoration Process and the Replacement Process; and (b) Operational Security.
40	The Replacement Power exchange between Control Areas of one Synchronous Area shall be implemented by (a) adjustment of Control Programs between Control Areas where RR activation is manual; and/or (b) adjustment of active power flows over HVDC interconnectors.
41	The Replacement Power exchange shall not exceed the Available Transmission Capacity.
43	The Cross-Border RR Activation Process shall include a fall-back mechanism that shall have the following properties: (a) The Replacement Power exchange of each Control Area shall be zero. (b) The requirements according to #39 shall be met without any exceptions.
44	To be further elaborated: Each TSO of the Synchronous Area shall collaborate with other TSOs of the Synchronous Area to determine the roles and the responsibilities of TSOs involved and not involved in an Imbalance Netting Process, in a Cross-Border FRR Activation Process or in a Cross-Border RR Activation Process including but not limited to: (a) notification of implemented processes; (b) objection procedure; (c) scheduling and accounting of power exchange; (d) data delivery and transparency.
	Measurements and Infrastructure
45	To be further elaborated: Each TSO shall collaborate with other TSOs to define parameters for measurement and information exchange including but not limited to (a) accuracy of active power flow measurements; (b) communication protocols; (c) measurement cycle.

46	To be further elaborated: Each TSO shall collaborate with other TSOs to define requirements for the infrastructure necessary to perform Load-Frequency-Control including but not limited to (a) redundancy of measurements and (b) redundancy of control systems.

3. Frequency Containment Reserve

#	Article
1	Each TSO shall collaborate with the other TSOs of the same Synchronous Area in order to jointly determine the total FCR required for the Synchronous Area and the individually required shares of FCR for each TSO (Initial FCR Distribution). The key value for the calculation of the respective share of FCR for each TSO has to be the sum of its net generation and consumption divided by the sum of net generation and consumption of the Synchronous Area over a period of one year. Each TSO shall collaborate with the other TSOs of the same Synchronous Area in order to jointly recalculate the total FCR and the individual shares on an annual basis. The total FCR and the individual shares may be recalculated in case all TSOs of the Synchronous Area agree.
2	Each TSO shall collaborate with the other TSOs of the same Synchronous Area in order to jointly determine the properties, of the FCR required in the synchronous area by means of a set of technical parameters including at least but not limited to: • Minimum accuracy of frequency measurement • Maximum insensitivity of the controllers of the FCR Providing Units • FCR Full Activation Time • FCR Full Activation Deviation. The properties of FCR have to be in line with the Network Code Requirements for Generators and have to reflect the individual parameters of the Synchronous Area, particularly its size as well as its structure and behavior of consumption and generation. Each TSO shall collaborate with the other TSOs of the same Synchronous Area in order to jointly review the required properties of FCR on an at least annual basis.
4	Each TSO as well as each FCR Providing Unit shall comply with the required properties for FCR according to #2.
5	Each TSO shall collaborate with the other TSOs of the same Synchronous Area to apply a dimensioning approach for FCR based on risk assessment criteria that consider the behaviour of load and generation and Market Induced Imbalances. Correspondingly the dimensioning approach for FCR shall be based on the principle of covering imbalances that happen with a determined probability. The FCR has to cover the Reference Incident.
7	Each TSO shall organise the provision of at least the mandatory FCR that has been assigned to it according to #1
8	Each TSO shall require from its FCR Providing Units the continuous availability of FCR with the exception of an unplanned outage of a Reserve Providing Unit. Each TSO shall ensure and/or reflect in requirements to FCR Providers that • the outage of the biggest Reserve Providing Unit in its control area does not reduce the defined total FCR of the synchronous area by more than a defined percentage (max 3% of FCR for RG CE and Nordic) as agreed by the TSOs in the SA the total FCR • not more than a defined percentage (max 6% for RG CE) of the total FCR is provided per electrical node as agreed by the TSOs in the SA
9	Each FCR Provider has to comply with the availability requirements as defined in #8 of the control area its FCR Providing Units are connected to. Each FCR Provider shall inform its Reserve Connecting TSO immediately about an unavailability of a FCR Providing Unit.
10	Each FCR Providing Unit shall activate the agreed FCR power by means of a proportional controller reacting to frequency deviations or alternatively based on a piecewise linear power-frequency-characteristic corresponding to #2
11	Each FCR Providing Unit shall activate FCR as long as the Frequency Deviation persists and it is technically possible.

	• Each FCR Provider shall be able to activate its FCR at least as long as … (TO BE DEFINED) • To be prepared for persisting Frequency Deviations each TSO shall collaborate with the other TSOs of the same Synchronous Area in order to jointly determine appropriate remedial actions in advance.
12	Each TSO shall monitor all FCR Providing Units in its control area. Each FCR Provider shall make available for each of its FCR Providing Units at least the real time measuring values of • Instantaneous power • Instantaneous operating point without FCR activation • OTHERS TO BE DEFINED with a time resolution of at least 10 seconds
16	Each FCR Providing Unit can only have one Reserve Connecting TSO.

4. Frequency Restoration Reserve

#	Article
1	Each TSO shall operate its Frequency Restoration Process according to the rules set down in this Chapter.
2	Each TSO may cooperate with other Neighboring TSOs to fulfill the obligation set down in #1, within the limits defined in Chapter 6 (Sharing/Exchange Rules …)
3	Each TSO shall make best efforts to operate its Frequency Restoration Process to fulfill its ACE Quality Target.
5	FRR Providing Units shall fulfill the FRR Technical Requirements of its Control Area. Each TSO shall collaborate with the other TSOs of the same Synchronous Area in order to define the FRR Technical Minimum Requirements for the Synchronous Area. The FRR Technical Minimum Requirements shall comprise at least the following general regulations unique for all Synchronous Areas: • the automatic FRR Delay Time shall be smaller than 30 seconds • the FRR Providing Units shall be able to deliver its full amount of FRR within the Full Activation Time • The Full Activation Time shall be less or equal to the Time Restore Frequency • The FRR Provider shall supply online measurements of the momentary and reference power production or consumption for each FRR Providing Unit to the TSO that provides the set point for FRR activation. • The FRR Providing Unit shall respect the FRR Parameters of the Synchronous Area. • FRR Providing Units can only have one Reserve Connecting TSO. Each TSO shall define FRR Technical Requirements for its Control Area at least comprising the FRR Technical Requirements of its Synchronous Area. Each TSO shall make best efforts to ensure that each FRR Providing Unit for which he is Connecting TSO fulfills the FRR Technical Requirements of its Control Area. Each TSO shall monitor the fulfillment of the FRR Technical Requirements by each FRR Providing Unit for which he is Connecting TSO.
6	Each TSO shall dimension its FRR Capacity according to the FRR Dimensioning Rules. Each TSO shall collaborate with the other TSOs of the same Synchronous Area in order to define the FRR Dimensioning Rules for the Synchronous Area. The FRR Dimensioning Rules shall comprise and shall not neutralize the following regulations: • The FRR Capacity shall not be smaller than its Dimensioning Incident. • The FRR Capacity shall be dimensioned with respect to the ACE Quality Target • …
7	Each TSO shall fulfill the FRR distribution rules. Each TSO shall collaborate with the other TSOs of the same Synchronous Area in order to define FRR Distribution Rules for the Synchronous Area. The FRR Distribution Rules shall comprise and shall not neutralize the following regulations:

	• To be further elaborated …
8	Each TSO shall monitor the performance of its FRR

5. Replacement Reserve

#	Article
1	Each TSO shall individually determine the amount and characteristics of Replacement Reserves required restoring the level of FRR to respect the quality criteria.
2	Each TSO, which has contracted RR, shall ensure that the amount of RR is sufficient and effective.
3	Each Replacement Reserve provider shall respect the requirements defined by the corresponding TSO.
4	Each TSO may contract with other TSO reserves to be included in RR.

6. Exchange and Sharing of Reserves

#	Article
	Frequency Containment Reserves (FCR)
1	Each TSO of the Synchronous Area shall collaborate with other TSO's of the same Synchronous Area to share the Frequency Containment Reserves of the Synchronous Area, according to article 3.1 (FCR sharing article).
2	A TSO is allowed to transfer part of its FCR obligation to other TSOs within the Synchronous Area. All TSOs within the Synchronous Area shall collaborate to define common rules for the maximum exchange of FCR within a Control Area due to transfers of FCR obligations. (TO BE FURTHER ELABORATED)
3	The Reserve Connecting and Reserve Receiving TSO shall notify the planned transfer of FCR obligation to all TSOs of the Synchronous Area. The notification shall include (but is not restricted to): • the volume of FCR for which the obligation is transferred; • the period of time for which the obligation is transferred; • a simulation of the impact of the planned transfer of FCR obligation on the cross-border flows within the Synchronous Area in case of FCR activation.
4	Each TSO of the Synchronous Area shall collaborate to define a common threshold for the impact of the transfer of FCR obligation on the cross-border flows. A TSO is affected by the transfer of FCR obligation if the impact of this transfer on its cross-border flows exceeds this threshold.
5	Each affected TSO of the Synchronous Area has the right to object against the planned transfer of Frequency Containment Reserves obligation on the basis of technical arguments.
6	Each affected TSO of the Synchronous Area shall ensure that its Real-Time Reliability Margin is sufficient to enable the planned exchange of FCR according to stipulations in the Operational Planning and Scheduling Network Code.
7	If a de-central Process Responsibility Structure is implemented in the Synchronous Area, the Reserve Connecting and Reserve Receiving TSO shall adjust the parameters of their ACE calculation to take the transfer of FCR obligation into account.
8	FCR providers shall only have obligations towards the TSO who is responsible for the Control Area where the FCR providing unit to which is connected. The Reserve Connecting TSO is responsible for the provision and the monitoring of the FCR Providing Units within its Control Area.
	Frequency Restoration Reserves (FRR)
9	A TSO is allowed to foresee in its FRR provision by exchanging FRR with other TSOs of the Synchronous Area. Each TSO of the Synchronous Area shall guarantee that at least the Basic Volume of FRR, according to art. 4, remains available within its own Control Area.

10	A TSO is allowed to foresee in its FRR provision by sharing FRR with other TSOs of the Synchronous Area. Each TSO of the Synchronous Area shall guarantee that at least the Basic Volume of FRR, according to 4, is exclusively available for his control purposes and therefore not shared with other TSOs.
11	Each TSO of the Synchronous Area shall collaborate with other TSO's of the Synchronous Area to determine the Basic Volume of FRR that must remain located within its Control Area and cannot be shared with other TSOs of the Synchronous Area.
12	The exchange of FRR shall be organized in one of the following ways: • A/ the Reserve Receiving TSO contracts FRR from the Reserve Connecting TSO of the Synchronous Area. • B/ the Reserve Receiving TSO contracts FRR directly from a FRR providing unit outside its Control Area having the prior consent of the Reserve Connecting TSO. The sharing of FRR shall be organized in the following way: • The Reserve Connecting and Receiving TSO agree that the Reserve Receiving TSO can access part of the FRR of the Reserve Connecting TSO.
13	In case of the exchange of FRR the Reserve Receiving TSO is responsible to send the FRR activation setpoint to the Reserve Connecting TSO and if applicable to the FRR Providing Unit. In case the exchange of FRR is organized according to Option A of art. 2.4, the Reserve Connecting TSO is responsible for: • Activation of FRR; • Actual provision of FRR to the Reserve Receiving TSO; • Monitoring the performance of the exchanged FRR. In case the exchange of FRR is organized according to Option B of art 4, the Reserve Connecting and Reserve Receiving TSO shall agree on who is responsible for those processes.
14	In case of sharing of FRR the Reserve Receiving TSO is responsible to send the FRR activation setpoint to the Reserve Connecting TSO. The Reserve Connecting TSO is responsible for: • Activation of shared FRR; • Actual provision of shared FRR; • Monitoring the performance of the shared FRR.
15	Each TSO of the Synchronous Area shall collaborate with other TSOs of the Synchronous Area to determine the roles and responsibilities of the Reserve Connecting, Reserve Receiving and Reserve Transiting TSOs for both the exchange and the sharing of FRR in terms of (but not restricted to): (a) Notification of the XB exchange and sharing of FRR; (b) Scheduling / accounting of the activated exchanged and shared FRR; (c) Data delivery and transparency.
16	The Reserve Receiving and Reserve Connecting TSO shall consult any Reserve Transiting TSOs prior to the exchange and sharing of Frequency Restoration Reserves. The Reserve Receiving TSO shall declare any Reserve Transiting TSO involved: • the total amount of the planned exchange and sharing of FRR; • the period of time of the exchange and sharing; • expected power flow of the exchange and sharing of FRR.
17	An FRR Providing Unit may only have obligations to a single TSO at a time. • In case of the exchange of FRR this can either be the Reserve Connecting TSO or the Reserve Receiving TSO • In case of sharing of FRR the FRR providing unit can only have obligations to the Reserve Connecting TSO.
18	For exchange of FRR it has to be secured and ensured before real-time that the needed transmission capacity is available.
19	The Reserve Receiving TSO shall take transmission capacity congestions into account when sharing FRR with other TSOs of the Synchronous Area. The Reserve Receiving TSO is allowed to:

	• (TO BE FURTHER ELABORATED) apply a probabilistic approach to take transmission capacity congestions into account; in this case activation of the shared FRR is only allowed in case transmission capacity is actually available. • secure transmission capacity before real-time.
20	The Reserve Receiving TSO remains responsible to cope with imbalances/incidents within its Control Area in case the shared FRR are unavailable due to either: • transmission capacity congestion; • shared reserves are already activated by another TSO.
21	In case of a de-central Process Responsibility Structure for FRR, both Reserve Connecting and Reserve Receiving TSO shall take the activation of • Shared FRR • Exchanged FRR into account in their ACE calculation.
	Replacement Reserves (RR)
22	A TSO shall determine its Basic Volume of Replacement Reserves that must be kept within its Control Area at all times and that cannot be shared with other TSOs of the Synchronous Area.
23	A TSO is allowed to foresee in its RR provision by exchanging RR with other TSOs of the Synchronous Area. Each TSO of the Synchronous Area shall guarantee that at least the Basic Volume of RR, according to art. 22, remains available within its own Control Area.
24	A TSO is allowed to foresee in its RR provision by sharing RR with other TSOs of the Synchronous Area. Each TSO of the Synchronous Area shall guarantee that at least the Basic Volume of RR, according to 22, is exclusively available for his control purposes and therefore not shared with other TSOs.
25	The exchange of RR shall be organized in one of the following ways: • A/ the Reserve Receiving TSO contracts RR from the Reserve Connecting TSO of the Synchronous Area. • B/ the Reserve Receiving TSO contracts RR directly from a RR providing unit outside its Control Area having the prior consent of the Reserve Connecting TSO. The sharing of RR shall be organized in the following way: • The Reserve Connecting and Receiving TSO agree that the Reserve Receiving TSO can access part of the RR of the Reserve Connecting TSO.
26	In case of the exchange of RR the Reserve Receiving TSO is responsible to send the RR activation setpoint to the Reserve Connecting TSO and if applicable to the RR Providing Unit. In case the exchange of RR is organized according to Option A of art. 4, the Reserve Connecting TSO is responsible for: • Activation of RR • Actual provision of RR to the Reserve Receiving TSO • Monitoring the performance of the exchanged RR In case the exchange of RR is organized according to Option B of art 4, the Reserve Connecting and Reserve Receiving TSO shall agree on who is responsible for those processes.
27	In case of sharing of RR the Reserve Receiving TSO is responsible to send the RR activation setpoint to the Reserve Connecting TSO. The Reserve Connecting TSO is responsible for: • Activation of shared RR; • Actual provision of shared RR; • Monitoring the performance of the shared FRR.
28	Each TSO of the Synchronous Area shall collaborate with other TSOs of the Synchronous Area to determine the roles and responsibilities of the Reserve Connecting, Reserve Receiving and Reserve Transiting TSOs for both the exchange and the sharing of RR in terms of (but not restricted to): (a) Notification of the XB exchange and sharing of RR; (b) Scheduling / accounting of the activated exchanged and shared RR; (c) Data delivery and transparency.

29	An RR Providing Unit may only have obligations to a single TSO at a time: • In case of the exchange of RR this can either be the Reserve Connecting TSO or the Reserve Receiving TSO • In case of sharing of FRR the FRR providing unit can only have obligations to the Reserve Connecting TSO.
30	The Reserve Receiving TSO shall only activate exchanged or shared RR in case transmission capacity is available.
31	In case of a de-central Process Responsibility Structure for RR, both Reserve Connecting and Reserve Receiving TSO shall take the activation of • Shared RR • Exchanged RR into account in their ACE calculation.

7. Time Control

#	Article
1	As support of frequency control, at a Synchronous Area each TSO shall collaborate in order to define and implement the common rules concerning Electrical Time Control, inside the maximum electrical time deviation. TSOs jointly define thresholds for synchronous time compensation and appoint a TSO responsible for measurement and control.

8. Definitions

#	Article
1	Frequency quality criteria
	Synchronous Area: Geographical territory covering a collection of interconnected electrical lines, generators and loads operated at the same *System Frequency*. A particular case of a *Synchronous Area* is an isolated system that is not or only weakly interconnected to other synchronous areas. *System Frequency:* Number of instantaneous oscillations of alternating current in a power system per time interval. The System Frequency is given in the SI* unit Hz. In general the same per *Synchronous Area*. *Nominal System Frequency*: The rated value of the *System Frequency* in a power system. *System Frequency Deviation*: Difference between System Frequency and Nominal System Frequency. It can be negative or positive. *Standard Frequency Range:* A defined interval within which the System Frequency of a *Synchronous Area* is supposed to be operated (i.e. normal operation). 1. *Standard Frequency Criterion*: Maximum number of time intervals in which the *System Frequency* of a *Synchronous Area* is allowed to be outside the *Standard Frequency Range*. *Maximum Frequency Deviation*: Maximum instantaneous *System Frequency Deviation*, beyond which emergency measures are activated. *Maximum Steady-State Frequency Deviation*: Maximum expected *System Frequency Deviation* after the occurrence of the *Reference Incident*. *Reference Incident*: The maximum expected instantaneous power deviation between generation and demand in a *Synchronous Area*.

	Time To Restore System Frequency: Maximum expected time after the occurrence of the *Reference Incident* in which the *System Frequency* is restored to be inside the *Standard Frequency Range.* **SI = Système international d'unités / International System of Units*
2	Frequency containment reserves
	Frequency Containment Reserves (FCR): Operating reserves activated for stabilizing *System Frequency* after an imbalance. *Activation deviation for FCR*: Rated value of *System Frequency Deviation* at which the FCR activation is triggered. *Reference Activation Deviation for FCR*: Rated value of *System Frequency Deviation* at which the determined minimum FCR in a *Synchronous Area* is fully activated. *Activation Delay of FCR*: Time delay between the occurrence of a *System Frequency* Deviation larger than the A*ctivation Deviation for FCR* and the start of activation of *FCR*. *Full Activation time of FCR*: Time period between the occurrence of the *Reference Incident* (idealized step-shaped) and the corresponding full activation of the FCR. *Self-Regulation of Load*: Relation between frequency variation and respective load variation.
3	Frequency restoration reserves
	Frequency Restoration Reserves (FRR): Reserves activated to restore *System Frequency* to the *Nominal Frequency* and, where applicable, power balance to the scheduled value. *Set Point Frequency*: Frequency target value for FRR. In general the sum of the Nominal System Frequency and an offset value needed to reduce an Electrical Time Deviation. *Activation Delay of FRR*: Time delay between receives of a set point from the TSO and the start of activation of FRR. *Full Activation Time of FRR*: Time period between receives of a set point from the TSO (idealized step-shaped) and the adequate full activation of FRR. *Mode of Activation of FRR*: Implementation of activation of FRR ("manual" or "automatic") depending on whether FRR are triggered manually by an operator or automatically by means of a closed-loop regulator.
4	Replacement reserves
	Replacement Reserves (RR): Reserves used to restore the required level of FRR to be prepared for a further system imbalance. This category includes operating reserves with activation time from Time to Restore Frequency up to hours. *Relieve Time for FRR:* Time period after which FRR, that have already been exhausted have to be relieved by RR. *Period linked RR: RR* that is exclusively activated for complete settlement/accounting periods. *Flexible RR: RR* that can be activated/deactivated at flexible time without restrictions connected to accounting periods *Full Activation Time of RR*: Time period to fully activate already ordered RR
6	Exchange and sharing of reserves
	Shared Reserves: Reserves that can be accessed by two or more TSOs (i.e. by definition FCR is a shared reserve in a *Synchronous Area*). *Exchange of Reserves*: A concept for reserves located in one control area but exclusively accessed by a

	TSO in another area. *Even Distribution of Reserves*: *A distribution of Operational Reserves* without an undue concentration that could lead to a reduction of system security.
7	Time control
	Electrical Time Deviation: Time discrepancy between synchronous time and UTC. *Maximum Electrical Time Deviation:* Maximum deviation of the system time (the time integral of the *System Frequency*) from the astronomical time (UCT), agreed by TSOs of the *Synchronous Area*.

Additional definitions Chapter Control Structure (to be further elaborated)	
Term	**Definition**
ACE	Instantaneous difference between the actual and the set-point value (measured total power value and scheduled Control Program) for the power interchange of a Control Area, taking into account the effect of the Frequency Bias for that Control Area according to the Network Power Frequency Characteristic of that Control Area and the overall System Frequency Deviation.
Anti-Windup Logic	A control logic which is part of the Frequency Restoration Controller and limits the output of its integral part to the available FRR.
Available Transmission Capacity	Transmission capacity that can be used for Imbalance Netting Power, Frequency Restoration Power or Replacement Power exchange without a negative impact on power system security.
Control Area	A coherent part of a Synchronous Area (usually coincident with the territory of a company, a country or a geographical area, physically demarcated by the position of points for measurement of the interchanged power and energy to the remaining interconnected network), operated by a single TSO, with physical loads and controllable generation units connected within the Control Area. A Control Area may be a coherent part of a Control Block.
Control Block	Comprises one or more Control Areas which share for the fulfilment of the obligations related to the load-frequency-control processes.
Control Error	Difference between the set-point value and the actual value of a controlled variable.
Control Program	Constitutes the schedule of the total programmed exchange of a Control Area.
Frequency Containment Control Error	The Control Error which is controlled by the Frequency Containment Process.
Frequency Containment Process	A load-frequency-control process which stabilizes the Frequency Containment Control Error by activation of FCR.
Frequency Restoration Control Error	The Control Error which is controlled by the Frequency Restoration Process.
Frequency Restoration Power	Power which is exchanged via Virtual Tie-Lines, Control Program adjustment and/or HVDC interconnectors between Control Areas in order to perform the Cross-Border FRR Activation Process.
Frequency Restoration Process	A load-frequency-control process which regulates the Frequency Restoration Control Error by activation of FRR.
Imbalance Netting Power	Power which is exchanged via Virtual Tie-Lines and/or HVDC interconnectors between Control Areas in order to perform the Imbalance Netting Process.
Imbalance Netting Process	A load-frequency-control process which coordinates FRR activation in different Control Areas through Imbalance Netting Power exchange.
Load-Frequency-Control	A set of coordinated automated and manual load-frequency-control processes which regulate the power balance of a Synchronous Area.
Market Induced Imbalances	Power imbalances which are caused by market design.
Process Activation Structure	A structure which defines the load-frequency-control processes in a Synchronous Area.
Process Obligations	Obligations with respect to implementation of a load-frequency-control process including but not limited to operation of the infrastructure, reserve dimensioning, organisation of reserve activation and monitoring.

Process Responsibility Structure	A structure which defines the responsibilities of TSOs with respect to the implementation of a load-frequency-control process in a Synchronous Area.
Replacement Power	Power which is exchanged via Control Program adjustment and/or HVDC interconnectors between Control Areas in order to perform the Cross-Border FRR Activation Process.
Replacement Process	A load-frequency-control process which restores activated FRR, reduces FRR activation or supports FRR activation.
Tie-Line	A Tie-Line is a circuit (e.g. a transmission line) connecting two or more Control Areas or systems of an electric system.
Virtual Tie-Line	A Virtual Tie-Line represents a telemetered reading or value that is updated in real-time and used as a Tie-Line flow in the ACE equation but for which no physical tie or energy metering actually exists.

Remark: The numbering of the articles is not always consecutive, some numbers are intentionally skipped to enable an easy cross-reference to the work in progress.