Network Code
on Operational Security

27 February 2013

Notice
This Network Code represents ENTSO-E's final proposals in line with the ACER Framework Guidelines on Electricity System Operation published on 02 December 2011 after the EC mandate letter was received by ENTSO-E on 24 February 2012. It reflects the comments received by ENTSO-E during the public consultation held between 03 September 2012 and 03 November 2012. Furthermore, it is based on the input received through extensive discussions and meetings with stakeholders, ACER and the European Commission. **This document is now called "Network Code on Operational Security" and is submitted to the Agency for the Cooperation of Energy Regulators for its reasoned opinion to be provided pursuant to Article 6 of Regulation (EC) No 714/2009.**

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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) 714/2009 of the European parliament and of the Council of 13 July 2009 and in particular Article 6,

Having regard to the priority list issued by the European Commission on 19 July 2012,

Having regard to the Framework Guidelines on Electricity System Operation issued by ACER on 2 December 2011,

Having regard to the letter from European Commission of 24 February 2012 by which the ENTSO-E was mandated to develop this Network Code,

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) 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 Interconnector 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 2 and Article 12 of Directive 2009/72/EC responsible for operating, ensuring the maintenance and development of the extra-high and high voltage interconnected Transmission System in a given area and, where applicable, its Interconnectors with other Transmission Systems, and for ensuring the long-term ability of the Transmission System to meet reasonable demands for the transmission of electricity. TSOs are responsible for the Operational Security in their Responsibility Areas and together in the Synchronous Areas and in the whole European Union, with a high level of reliability and quality.

(4) Secure Transmission System operation can be made possible only if there is an obligation for the TSOs, Distribution System Operators (DSOs) and Significant Grid Users 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 Operational Security aiming at setting out clear and objective requirements for TSOs, DSOs and Significant Grid Users in order to contribute to non-discrimination, effective competition and the efficient functioning of the Internal Electricity Market and to ensure system security.

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(6) This Network Code is the first one in the field of system operation, and serves as the 'umbrella' code for all the system operation network codes. It sets the overall principles for system operation, reflects on the common issues in the Network Codes for Load-Frequency Control and Reserves [NC LFCR], for Operational Planning and Scheduling [NC OPS] and identifies the key issues to be dealt with in detail in the Network Code for Emergency and Restoration which will be developed at a later stage, according to the requirements in the ACER Framework Guidelines on Electricity System Operation. This Network Code sets the provisions for the operational training and certification of System Operator Employees in Article 30.

(7) This Network Code has been drafted in accordance with the Article 8(7) of Regulation (EC) 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. For Transmission System Operators of small Responsibility Areas like Åland Islands, or stand-alone Transmission Systems like Canary Islands or Malta, it is not feasible to meet obligations of this Network Code.

(8) 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.

(9) 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.

(10) This Network Code should not be detrimental to the right of any party having a complaint against a Transmission System Operator or Distribution System Operator in relation to that operator's obligations under this Network Code to direct its complaint to the regulatory authority.

(11) To ensure the Operational Security of the interconnected Transmission Systems it is essential that a common set of minimum requirements for European Union–wide Operational Security principles is defined for the cross-border cooperation between the TSOs and for utilising relevant characteristics of the connected DSOs and Significant Grid Users.

(12) The distinction between the different types of Power Generating Facilities as defined in the Article 3 of the Network Code on Requirements for Grid Connection Applicable to All Generators [NC RfG] should be used in this Network Code to address Power Generating Facilities, respectively Power Generating Facility Owners, in a systematic and consistent manner.

(13) Transmission System Operators should respect the common principles in order to maintain the Operational Security, quality and stability of the interconnected Transmission Systems and to support the efficient functioning of the European Internal Electricity Market. These principles are the basis for the key elements, structure and provisions of this Network Code.

(14) Measuring and monitoring operational parameters in order to estimate the System State is the first step required for activities and applications to maintain Operational Security. State Estimation throughout the EU in a common and coherent way supports communication between Transmission System Operators and where necessary with Distribution System Operators and Significant Grid Users.

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(15) Each Transmission System Operator should operate the load frequency control in its Transmission System, in order to actively contribute to maintaining the global balance between generation and demand of all Transmission Systems interconnected within a Synchronous Area.

(16) Transmission System Operators should apply voltage control and Reactive Power management in order to keep voltages within the Operational Security Limits and maintain Reactive Power reserves.

(17) Transmission System Operators should deploy short-circuit management in order to calculate the short-circuit currents within their Responsibility Areas and thus to ensure prevention of or relief from a short-circuit limits deviation in the Transmission System.

(18) The goal of the power flows management is twofold: the effective and efficient functioning of the Internal Electricity Market and the maintaining of the Operational Security. These objectives should be attained by an adequate coordination between TSOs in order to get an overview of the power flows all over the Transmission System, to detect the potential constraints, and to set up the Remedial Actions when necessary.

(19) To identify contingencies which would endanger the Operational Security and lead to unplanned outages, the Transmission System Operators should rely on Contingency Analysis. The Contingency Analysis should be performed during the operational planning and in real-time operation. The results of the Contingency Analysis will allow identifying and deploying necessary pre-fault or post-fault Remedial Actions.

(20) Transmission system protection, coordinated with Dynamic Stability Management and short-circuit management, should establish the protection concepts and devices required to manage Faults and disturbances in the operation of the Transmission System.

(21) The correct functioning of the Transmission System elements, processes and facilities of the Significant Grid Users and DSOs which are directly connected to the Transmission System should be continuously monitored, tested if required and investigated following disturbances in a coordinated and coherent way throughout Europe. These monitoring, investigating and testing activities should take place before, during and after any changes affecting the Operational Security of the Transmission System.

(22) The Operational Security of the Transmission System and all the activities which contribute to it require an accurate, timely and adequate exchange of relevant data and information. Exchange of relevant data and information should not encounter any barrier between the different actors involved in ensuring the Operational Security.

(23) The education, on-the-job training and certification should be obligatory for the System Operator Employees who are in charge of the operation of the Transmission System and of its Operational Security. All European Transmission System Operators should adopt a coordinated and coherent approach towards training and certification.

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 Operational Security requirements and principles for Transmission Systems applicable to all TSOs, DSOs and Significant Grid Users of the Synchronous Areas in Normal and Alert System State. Furthermore, this Network Code identifies the general provisions in relation to the Emergency State, Blackout State and Restoration. Finally, this Network Code contains provisions for training and certification of System Operator Employees.

2. This Network Code aims at:
   a) determining common Operational Security requirements and principles;
   b) ensuring conditions for maintaining Operational Security throughout the EU; and
   c) coordinating system operation in a common and coherent way throughout the EU.

3. For the purpose of this Network Code, Existing Power Generating Modules shall be classified as type A, B, C and D according to the criteria defined in Article 3(6) of [NC RfG] for New Power Generating Modules. For the purpose of this Network Code, Existing Demand Facilities shall be classified according to the criteria defined in Article 5 and Article 8 of [NC DCC]. The Significant Grid Users within the scope of this Network Code are:
   a) Existing and New Power Generating Modules of type B, C and D according to the criteria defined in Article 3(6) of [NC RfG];
   b) Existing and New Demand Facilities with the Connection Point directly to the Transmission System according to the criteria defined in Article 5 and Article 8 of [NC DCC] and all Existing and New Closed Distribution Networks with the Connection Point directly to the Transmission System;
   c) Significant Demand Facilities and Closed Distribution Networks, or their Aggregators according to the [NC DCC], providing Demand Side Response directly to the TSO;
   d) Redispatching Aggregators and Providers of Active Power Reserve according to the [NC LFCR].

4. The TSOs of Lithuania, Latvia and Estonia operating under synchronous mode in the area in which not all the systems are bound by the EU legislation, apply the provisions of Article 9 only to the extent they could be duly applied and implemented within the entire Synchronous Area as long as these power systems are operating therein, taking into account the physical and technical nature of frequency regulation implemented in the whole Synchronous Area. Article 15(2) and Article 15(8) shall not apply to those systems.

5. Each TSO and DSO shall always respect relevant provisions for human safety 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.

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Article 2

Definitions

1. For the purpose of this Network Code, the definitions in Article 2 of Directive 2009/72/EC and in Article 2 of Regulation (EC) 714/2009 apply. The definitions in Article 2 of the [NC RfG], [NC CACM] and [NC DCC] also apply, except for the definition of ''Connection Point'', "Operational Security" and "Remedial Action" which are replaced by the following in this Network Code:
Connection Point is 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 characterized by thermal limits, voltage constraints, short-circuit current, frequency limits and stability limits;

   Remedial Action means any measure applied by a TSO in order to maintain Operational Security. In particular, Remedial Actions serve to fulfil the (N-1)-Criterion and to maintain Operational Security Limits.

2. The following definitions shall apply:

   (N-1)-Criterion means the rule according to which elements remaining in operation within TSO's Responsibility Area after a Contingency from the Contingency List must be capable of accommodating the new operational situation without violating Operational Security Limits;

   (N-1)-Situation means the situation in the Transmission System in which a Contingency from the Contingency List has happened;

   Active Power Reserve means the Active Power which is available for maintaining the frequency;

   Alert State means the System State where the system is within Operational Security Limits, but a Contingency from the Contingency List has been detected, for which in case of occurrence, the available Remedial Actions are not sufficient to keep the Normal State;

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

   Automatic Voltage Control means the automatic control actions at the generation node, at the end nodes of the AC lines or High-Voltage DC lines, on transformers, or other means, designed to maintain the set voltage level or the set value of Reactive Power;

   Blackout State means the System State where the operation of part or all of the Transmission System is terminated;

   Business Continuity Plan means the plan detailing TSO's responses to a loss of critical tools and facilities;

   Contingency Analysis means computer based simulation of Contingencies from the Contingency List;

   Contingency Influence Threshold means a numerical limit value against which the Influence Factors must be checked. The outage of an external Transmission System element with an Influence Factor higher than the Contingency Influence Threshold is considered having a

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significant impact on the TSO's Responsibility Area. The value of the Contingency Influence Threshold is based on the risk assessment of each TSO;

Contingency List means the list of Contingencies to be simulated in the Contingency Analysis in order to test the compliance with the Operational Security Limits before or after a Contingency took place;

Contingency means the identified and possible or already occurred Fault of an element within or outside a TSO's Responsibility Area, including not only the Transmission System elements, but also Significant Grid Users and Distribution Network elements if relevant for the Transmission System Operational Security. Internal Contingency is a Contingency within the TSO's Responsibility Area. External Contingency is a Contingency outside the TSO's Responsibility Area, with an Influence Factor higher than the Contingency Influence Threshold;

Control Program means the set-point value, also called schedule, for the netted power interchange of a LFC Area over Interconnectors;

Critical Fault Clearing Time means the maximum Fault duration for which the Transmission System remains stable;

Declared Availability means declaration and notice prepared in respect of a Significant Grid User, submitted to the TSO setting out the values and times applicable to those values of availability and Ancillary Services capability;

Disturbance means an unplanned event that may cause the Transmission System to divert from Normal State;

Dynamic Stability Assessment (DSA) means the Operational Security Assessment in terms of Dynamic Stability;

Dynamic Stability is a common term including the Rotor Angle Stability, Frequency Stability and Voltage Stability;

Emergency State means the System State where Operational Security Limits are violated and at least one of the operational parameters is outside of the respective limits;

Exceptional Contingency means the loss of a busbar or more than one element such as, but not limited to: a common mode Fault with the loss of more than one Power Generating Module, a common mode Fault with the loss of more than one AC or DC line, a common mode Fault with the loss of more than one transformer;

Fault means all types of short-circuits: single-, double- and triple-phase, with and without earth contact. It means further a broken conductor, interrupted circuit, or an intermittent connection, resulting in a permanent non-availability of the affected Transmission System element;

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

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

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

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

Frequency Stability means the ability of the Transmission System to maintain stable frequency in N-Situation and after being subjected to a disturbance;

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Influence Factor means a numerical value used to quantify the highest effect of the outage of an external Transmission System element on any Transmission System branch. The worse the effect, the higher the influence factor value is;

K-Factor means a factor used to calculate the frequency bias component of the ACE of a LFC Area or a LFC Block;

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

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

Local means the qualification of an Alert, Emergency or Blackout State when there is no risk of extension of the consequences outside of the Responsibility Area of a single TSO;

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

Nominal Frequency means the rated value of the System Frequency;

Normal State means the System State where the system is within Operational Security limits in the N-Situation and after the occurrence of any Contingency from the Contingency List, taking into account the effect of the available Remedial Actions;

N-Situation means the situation where no element of the Transmission System is unavailable due to a Fault;

Observability Area means the own Transmission System and the relevant parts Distribution Networks and neighbouring TSOs' Transmission Systems, on which TSO implements real-time monitoring and modelling to ensure Operational Security in its Responsibility Area;

Operational Reserves means the spinning and non-spinning reserves that are accessible to at least one TSO;

Operational Security Analysis means the entire scope of the computer based, manual and combined activities performed in order to assess Operational Security of the Transmission System, including but not limited to: processing of telemetered real-time data through State Estimation, real-time load flows calculation, load flows calculation during operational planning, Contingency Analysis in real-time and during operational planning, Dynamic Stability Assessment, real-time and offline short circuit calculations, System Frequency monitoring, Reactive Power and voltage assessment.

Operational Security Limits means the acceptable operating boundaries: thermal limits, voltage limits, short-circuit current limits, frequency and Dynamic Stability limits;

Operational Security Performance Indicators are used for monitoring of the Operational Security in terms of Faults, incidents, disturbances and other events which influence Operational Security, as specified in the ENTSO-E incidents classification scale developed pursuant to the Article 8(3)(a) of the Regulation (EC) 714/2009;

Operational Security Ranking is used for monitoring of the Operational Security on the basis of the Operational Security Performance Indicators, according to the ENTSO-E incidents classification scale developed pursuant to the Article 8(3)(a) of the Regulation (EC) 714/2009;

Ordinary Contingency means the loss of a Transmission System element such as, but not limited to: a single line, a single transformer, a single phase-shifting transformer, a voltage

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compensation installation connected directly to the Transmission System; it means further also the loss of a single Power Generating Module connected directly to the Transmission System, the loss of a single Demand Facility connected directly to the Transmission System, or the loss of a single DC line;

Out-of-Range Contingency means the simultaneous loss, without a common mode Fault, of several Transmission System elements such as, but not limited to: two independent lines, a substation with more than one busbar, a tower with more than two circuits, one or more Power Generating Facilities with a total lost capacity exceeding the Reference Incident;

Ramping Rate means the rate of change of Active Power by a Power Generating Module, Demand Facility or DC Interconnector;

Reactive Power Reserve means the Reactive Power which is available for maintaining voltage;

Redispatching Aggregator means a legal entity which is responsible for the operation of a number of Power Generating Modules by means of generation aggregation for the purpose of offering Redispatching;

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

Regional Security Coordination Initiative (RSCI) means regional unified scheme set up by TSOs in order to coordinate Operational Security Analysis in a determined geographic area;

Responsibility Area means a coherent part of the interconnected Transmission System including Interconnectors, operated by a single TSO with connected Demand Facilities, or Power Generating Modules , if any;

Restoration means the System State in which the objective of all activities in Transmission System is to re-establish the system operation and maintain Operational Security after a Blackout;

Rotor Angle Stability means the ability of synchronous machines to remain in synchronism under N-Situation and after being subjected to a disturbance;

Security Plan means the plan containing a risk assessment of critical TSO's assets to major physical- and cyber-threat scenarios with an assessment of the potential impacts;

Significant Grid User means the existing and new Power Generating Facility and Demand Facility deemed by the TSO as significant because of their impact on the Transmission System in terms of the security of supply including provision of Ancillary Services;

Stability Limits means the permitted operating boundaries of the Transmission System in terms of respecting the constraints of Voltage Stability, Rotor Angle Stability and Frequency Stability;

State Estimation means the methodology and algorithms used to calculate a reliable set of measurements defining the state of the Transmission System out of the redundant set of measurements;

Synchronous Area means an area covered by interconnected TSOs with a common System Frequency in a steady state such as the Synchronous Areas Continental Europe (CE), Cyprus (CY), Great Britain (GB), Ireland (IRE), Northern Europe (NE) and the power systems of Lithuania, Latvia and Estonia (Baltic) as a part of a Synchronous Area;

Synchronous Area Agreement means a multi-party agreement between all TSOs of a Synchronous Area if the Synchronous Area consists of more than one TSO. If a Synchronous Area consists of only one TSO, the Synchronous Area Agreement means a formal declaration of the obligations defined in this Network Code;

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System Defence Plan means the summary of all technical and organisational measures to be undertaken to prevent the propagation or deterioration of an incident in the Transmission System, in order to avoid a widespread disturbance and Blackout State;

System Frequency means the electric frequency of the system that can be measured in all parts of the Synchronous Area under the assumption of a coherent value for the system in the time frame of seconds, with only minor differences between different measurement locations;

System Operator Employee means the person who is a TSO employee in charge of system operation and control of the Transmission System in real-time, or the person who is a TSO employee in charge of operational planning;

System Protection Scheme (SyPS) means the set of coordinated and automatic measures designed to ensure fast reaction to Disturbances and to avoid the propagation of Disturbances in the Transmission System;

System State means the operational state of the Transmission System in relation to the Operational Security Limits: Normal, Alert, Emergency, Blackout and Restoration System States are defined;

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

Topology means necessary data about the connectivity of the different Transmission System or Distribution Network elements in a substation. It includes the electrical configuration and the position of circuit breakers and isolators;

Transitory Admissible Overloads means the temporary overloads of Transmission System elements which are allowed for a limited period and which do not cause physical damage to the Transmission System elements and equipment as long as the defined duration and thresholds are respected;

Virtual Tie-Line means a telemetered reading or value that is updated in real-time and represented as a “virtual” tie-line flow, but for which no physical Interconnector or energy metering actually exists. The integrated value is used as a metered energy value for accounting purposes;

Voltage Stability means the ability of a Transmission System to maintain acceptable voltages at all buses in the Transmission System under N-Situation and after being subjected to a Disturbance;

Wide Area means the qualification of an Alert, Emergency or Blackout State when there is a risk of propagation to the interconnected Transmission Systems.

Article 3
Regulatory aspects

1. The requirements established in this Network Code and their applications are based on the principle of proportionality, non-discrimination and transparency as well as the principle of optimization between the highest overall efficiency and lowest total cost for all involved parties.

2. Notwithstanding the above, the application of non-discrimination principle and the principle of optimization 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

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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 their methodologies 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 and respecting the TSO´s responsibility to ensure system security according to national legislation.

4. This Network Code relies on the capabilities required in the [NC RfG] and [NC DCC]. The Power Generating Facilities, Demand Facilities and HVDC links that are not a subject of the provisions in [NC RfG] and [NC DCC] shall continue to be bound by those technical requirements that apply to them pursuant to legislation in force in the respective Member States or contractual arrangements in force.

5. For nuclear power plants, nuclear safety has priority in the case of the conflict between applicable nuclear safety regulations and this Network Code.

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 for Operational Security as referred to in the Article 4(2) and Article 4(3).

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) Modifications of the Power Generating Module Capabilities required by the TSO pursuant to Article 9(4) and Article 10(3);

   b) Methodology for the definition of the Low Frequency Demand Disconnection Scheme pursuant to Article 14(7) and methodology for the definition of actions for over-frequency pursuant to Article 14(8);

   c) Enhancements of the means from Article 32(1)(a)-(e) pursuant to Article 32(1);

3. Each TSO of a Synchronous Area shall submit the following methodologies and conditions established by the TSOs of the Synchronous Area to National Regulatory Authorities or, when explicitly foreseen in national law, other relevant national authority for approval:

   a) Methodology developed by the TSO for the definition of minimum inertia required to maintain Operational Security and to prevent violation of Stability Limits identified pursuant to Article 15(3) and Article 15(8);

   b) Methodology for recovering the costs of tests of compliance with this Network Code pursuant to Article 5(4).

4. 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 request to amend the proposed methodology or condition.

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5. 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) No 713/2009.

Article 5
Recovery of costs

1. The costs related to the obligations referred to in this Network Code which have to be borne by regulated Network Operators shall be assessed by National Regulatory Authorities.

2. Costs assessed as efficient, reasonable and proportionate shall be recovered as determined by National Regulatory Authorities.

3. If requested 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.

4. TSOs or DSOs shall develop the methodology for recovering the costs of test of compliance foreseen by this Network Code.

Article 6
Confidentiality obligations

1. Each TSO, DSO and Significant Grid User shall preserve the confidentiality of the information and data submitted to them in connection with this Network Code and shall use them exclusively for the purpose they have been submitted in compliance with this Network Code.

2. Without prejudice to the obligation to preserve the confidentiality of commercially sensitive information obtained in the course of carrying out its activities, each TSO shall in compliance with the provisions of this Network Code, provide to the other TSOs, or where required DSOs, sufficient information to ensure the secure and efficient operation, coordinated development and interoperability of the interconnected system.

3. In accordance with Article 16(8), each TSO may have to provide confidential information to Regional Security Coordination Initiatives. The RCSIs 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.

Article 7
Agreement with TSOs not bound by this Network Code

1. No later than 12 months after entering into force of this Network Code, all TSOs except the TSOs of Lithuania, Latvia and Estonia shall implement a Synchronous Area Agreement within a

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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. No later than 12 months after entering into force of this Network Code, the TSOs of Lithuania, Latvia and Estonia shall endeavour to implement a Synchronous Area Agreement including the requirements of this Network Code.

CHAPTER 2
OPERATIONAL SECURITY REQUIREMENTS

Article 8
System states

1. Each TSO shall in real-time operation differentiate five System States, based on the Operational Security Limits according to Article 10 and Article 12, while respecting the Contingency Analysis provisions according to Article 13 and the frequency control management provisions according to Article 9. On this basis, each TSO shall classify the System State of its Transmission System applying the following criteria:

   a) Normal State:
      i. voltage and power flows are within the Operational Security Limits defined according to Articles 10 and Article 12 in accordance with Article 8(5) and frequency is within the frequency limits for the Normal State as defined in [NC LFCR];
      ii. Active and Reactive Power reserves are sufficient to withstand Contingencies from the Contingency List defined according to Article 13; and
      iii. operation of its Responsibility Area is and will remain within Operational Security Limits even after a Contingency from the Contingency List defined according to Article 13 and after effects of Remedial Actions;

   b) Alert State:
      i. voltage and power flows are within their Operational Security Limits defined according to Articles 10 and 12 in accordance with Article 8(5); and
      ii. at least one of the following conditions is fulfilled:
         a. Active Power Reserve requirements are not fulfilled with lack of more than 20% of the required amount of any of the following: FCR, FRR and RR according to the dimensioning in the [NC LFCR], for more than 30 minutes and with no means to replace them;
         b. frequency is within the frequency limits for the Alert State as defined in [NC LFCR];
         c. at least one Contingency from the Contingency List defined according to Article 13 can lead to deviations from Operational Security Limits, even after effects of Remedial Actions;

   c) Emergency State:
      i. there is at least one deviation from Operational Security Limits and times defined according to Articles 10 and 12 in accordance with Article 8(5); or
      ii. frequency is outside the frequency limits for the Normal State and outside the frequency limits for the Alert State as defined in [NC LFCR]; or
      iii. at least one measure of the System Defence Plan is activated; or
      iv. there is a complete loss of all tools and facilities defined according to Article 8(15) for more than 30 minutes.

   d) Blackout State:
      i. loss of more than 50% of load in the TSO Responsibility Area; or

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ii. total absence of voltage for at least 3 minutes in the TSO Responsibility Area and triggering Restoration plans.

e) Restoration:
   i. Procedures are implemented to bring frequency, voltage and other operational parameters within the Operational Security Limits defined according to Articles 9, 10 and 12 in accordance with Article 8(5); and
   ii. Demand Facilities are connected at a pace decided by the TSOs in charge of Restoration, depending on the technical capability and feasibility of the Transmission System resources and Significant Grid Users which are Power Generating Facilities.

2. In order to determine the System State, each TSO shall at least every 15 minutes perform Contingency Analysis in real-time, monitoring the parameters against a common set of criteria defined according to Article 8(1), while taking into account the effect of potential Remedial Actions and measures of the System Defence Plan.

3. Each TSO shall monitor in real-time the following parameters within its Responsibility Area based on real-time telemetry and measurements from its Observability Area, taking into account the structural and real-time data defined in Chapter 3:

   a) active and Reactive Power flows;
   b) busbar voltages;
   c) frequency and Frequency Restoration Control Error of its LFC Area;
   d) active and Reactive Power reserves; and
   e) generation and consumption.

4. Each TSO shall use its best endeavour to maintain in real time its Transmission System in a Normal State. For this purpose, each TSO shall plan Remedial Actions according to the requirements defined in the [NC OPS] and implement them when necessary.

5. For each element of its Transmission System, each TSO shall define before its use in operation the Operational Security Limits for:

   a) voltage ranges according to Article 10;
   b) short-circuit current ranges according to Article 11; and
   c) current limits in terms of thermal rating including the Transitory Admissible Overloads.

6. When defining the Operational Security Limits, each TSO shall take into account the capabilities required for Significant Grid Users which are Power Generating Modules in [NC RfG], for Significant Grid Users which are Demand Facilities and Closed Distribution Networks in [NC DCC] and the capabilities required in the national grid codes for those Significant grid Users who are not subject or are derogated from [NC RfG] and [NC DCC], in order to ensure that voltage and frequency ranges in Normal and Alert States do not lead to their disconnection.

7. In case of change in any equipment or device of an element of its Transmission System, each TSO shall validate and when necessary update the Operational Security Limits.

8. For each Interconnector, each TSO shall coordinate with the interconnected TSO, the common definition of Operational Security Limits including: current limits in terms of thermal rating and Transitory Admissible Overload_and voltage ranges defined according to Article 10(11).

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9. In real-time, if its Transmission System is in the Alert State, each TSO shall in coordination with the TSOs with which it has an agreement for Operational Security Analysis according to the provisions in the [NC OPS], and with DSOs and Significant Grid Users directly connected to its Transmission System:

   a) implement the pre-fault Remedial Actions which are rendered necessary to restore the Normal State and to prevent the propagation of the Alert State outside of its Responsibility Area; and
   b) identify the post-fault Remedial Actions which shall be implemented in case of occurrence of a Contingency.

10. In real-time, if its Transmission System is in Emergency State, each TSO shall, in coordination with the TSOs with which it has an agreement for Operational Security Analysis according to [NC OPS], and with DSOs and Significant Grid Users who are involved in system defence and Restoration, implement the measures of the System Defence Plan which are rendered necessary to restore the Alert or Normal State, and to prevent the propagation of Emergency State outside of its Responsibility Area.

11. In real-time, if its Transmission System is not in a Normal State and if that System State is qualified as Wide Area the TSO shall:

   a) inform all TSOs about the System State of its Transmission System via the European Awareness System;
   b) provide additional information on the elements of its Transmission System which are part of the Observability Area of the other TSOs, to those TSOs; and
   c) coordinate the joint Remedial Actions with the TSOs with which it has an agreement for Operational Security Analysis according to [NC OPS].

12. In real-time or during operational planning, when preparing and implementing a Remedial Action including Redispatching or Countertrading pursuant to [NC CACM] or a measure of the System Defence Plan which has an effect on other TSOs, a TSO shall cooperate with those TSOs in order to assess the impact of such Remedial Action or a measure of the System Defence Plan within and outside of its Responsibility Area and to coordinate with those TSOs with which it has an agreement for Operational Security Analysis according to [NC OPS]. Each TSO involved in the coordination shall provide to other involved TSOs all the information necessary for this cooperation.

13. When preparing a Remedial Action, including Redispatching or Countertrading pursuant to [NC CACM], or a measure of the System Defence Plan a TSO shall, in case of mutual implications, cooperate with the Significant Grid Users and DSOs with Connection Point directly to the Transmission System. Each TSO shall ex-ante cooperate with the DSOs involved with the Remedial Action or the measure of the System Defence Plan, to assess the impact of the Remedial Action on the Distribution Network, and coordinate with those DSOs to select the Remedial Action or the measure of the System Defence Plan which enhances Operational Security for all involved parties. Each affected DSO shall ex-ante provide all the information necessary for this cooperation.

14. When implementing a Remedial Action or a measure of the System Defence Plan, each Significant Grid User or DSO with Connection Point directly to the Transmission System shall execute the instructions given by the TSO to maintain Operational Security of the Transmission System, without undue delay. Unless decided otherwise by the TSO, DSOs shall communicate the instructions of the TSO to the Significant Grid Users if they are connected to the Distribution Network.

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15. Each TSO shall design its systems in order to ensure the availability, reliability and redundancy of the following critical tools and facilities, which are required for system operation:

    a) facilities for monitoring the System State of the Transmission System, including State Estimation applications;

    b) means for controlling switching;

    c) means of communication with control centres of other TSOs;

    d) tools for Operational Security Analysis.

    Where the above tools and facilities involve the DSOs with Connection Point directly to the Transmission System or Significant Grid Users which are involved in balancing, Ancillary Services, system defence, Restoration or delivery of real-time operational data according to Articles 20, 23, 26, 27, 28 and 29, the TSO, the DSOs with Connection Point directly to the Transmission System and those Significant Grid Users shall, cooperate and coordinate in ensuring the availability, reliability and redundancy of these tools and facilities.

16. Each TSO shall adopt a Business Continuity Plan, containing provisions for maintenance, replacement and development of critical tools and facilities. Business Continuity Plan shall be reviewed at least annually and updated as necessary or following any significant change of critical tools and facilities or relevant system operation conditions. Business Continuity Plan contents shall be shared with DSOs and Significant Grid Users to the extent to which they are affected.

17. Each TSO shall establish a confidential Security Plan containing a risk assessment of critical assets owned or operated by the TSO, to major physical or cyber threat scenarios to be conducted by the Member State with an assessment of the potential impacts. Each TSO shall have in place organizational, logistical and other physical measures which shall cover the major findings from the risk assessment. The plan shall be kept under regular review to limit the impact of threats and maintain the secure operation of the TSO's network and IT systems and the European interconnected Transmission Systems. These reviews can lead to set up intruder detection, access control, procedures, training, alert processes, preventive procedures, restoration plans and other counter-measures.

Article 9

Frequency control management

1. Each TSO shall contribute to the Load-Frequency Control Structure according to the requirements for frequency quality defining parameters and provisions for Active Power Reserves as defined in [NC LFCR].

2. In case the frequency is beyond the Maximum Steady-state Frequency Deviation, but within the range 49 – 51 Hz, all TSOs of the Synchronous Area shall apply commonly agreed Remedial Actions following coordinated procedures agreed among all TSOs of that Synchronous Area in order to recover frequency back within the range of Maximum Steady-state Frequency Deviation. The description of such coordinated procedures shall be published at the ENTSO-E website 12 months after entry into force of this Network Code.

3. In case the frequency is outside of the range 49 – 51 Hz, all TSOs of the Synchronous Area shall apply commonly agreed measures of the System Defence Plan following coordinated procedures agreed among all TSOs of that Synchronous Area in order to recover and restore

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frequency within the time ranges specified in [NC RfG] and Article 13 of [NC DCC]. These coordinated procedures shall be published on the ENTSO-E website 12 months after entry into force of this Network Code.

4. Significant Grid Users which are Power Generating Modules subject to the requirements of the [NC RfG] shall remain connected at least within the frequency and time ranges defined in the Article 8 of [NC RfG] when generating electrical power. All Significant Grid Users which are Power Generating Modules which are not subject to or derogated from the requirements of the [NC RfG] shall inform their TSOs and DSOs if connected to the Distribution Network, about their performance in comparison with the frequency requirements in [NC RfG] and in so doing they shall within 12 months after the entry into force of this Network Code declare the frequencies and time ranges they can withstand without disconnection. Where the TSO requires modifications by a Power Generating Module not subject to or derogated from the requirements of [NC RfG] to improve its performance then this requirement shall be approved by NRA.

5. While being in Emergency State, the system frequency can exceed the range of 49 – 51 Hz. TSOs shall take into account that Significant Grid Users which are Power Generating Modules and Demand Facilities subject to [NC RfG] and [NC DCC] can disconnect after the time periods required in [NC RfG] and [NC DCC] and take this into account in planning of Remedial Actions and measures of the System Defence Plan. For Significant Grid Users which are Power Generating Modules not subject to or derogated from the requirements of the [NC RfG], the TSOs shall take into account the frequency values at which each of these system users will disconnect.

6. Each Significant Grid User directly with Connection Point directly to the Transmission System shall adopt the criteria and conditions, defined by the TSO for manual or automatic re-synchronization. In case of manual re-synchronization, each Significant Grid User with Connection Point directly to the Transmission System shall obtain the permission from its TSO before re-synchronization.

7. Each DSO with Connection Point directly to the Transmission System shall adopt the criteria and conditions, defined by the TSO for manual or automatic re-synchronization of the Significant Grid Users with Connection Point to its Distribution Network. Each DSO with Connection Point directly to the Transmission System shall in turn ensure that those criteria and conditions are agreed upon with the Significant Grid Users with Connection Point directly to the Distribution Network. In case of manual re-synchronization, each such Significant Grid User shall obtain the permission from its DSO and from its TSO via its DSO before re-synchronization.

8. Notwithstanding the provisions of Article 10(6) and 10(7), each DSO with Connection Point directly to the Transmission System shall automatically disconnect at specified frequencies and in predefined Active Power steps, defined by the TSO. Notwithstanding the provisions of Article 9(6) and 9(7), each Significant Grid User which is a Power Generating Module shall automatically disconnect at specified frequencies, defined by the TSO.

9. Each TSO making use of the provisions from Article 9(6), 9(7) and 9(8) shall coordinate the frequency related Remedial Actions with all other TSOs of its Synchronous Area and shall ensure the necessary coordination with involved DSOs.

10. Each TSO shall operate its LFC Area with sufficient upward and downward Active Power Reserve, which may include shared or exchanged reserves, to face imbalances of demand

and supply within its LFC Area. Each TSO shall control the Frequency Restoration Control Error as defined in the [NC LFCR] in order to reach the required frequency quality within the Synchronous Area in cooperation with the TSOs in the same Synchronous Area. All TSOs within a Synchronous Area shall establish the methodology used within this Synchronous Area to determine the required upward and downward Active Power reserve in accordance with the provisions of the [NC LFCR].

11. Each TSO shall monitor close to real-time generation and exchange schedules, power flows, node injections and withdrawals and other parameters within its LFC Area relevant for anticipating a risk of a frequency deviation and when needed take joint measures to limit their negative effects on the balance between generation and demand in coordination with other TSOs of its Synchronous Area.

12. Each TSO shall activate, or set up conditions necessary to ensure the activation of Active Power Reserves at different time-frames according to the provisions of the [NC LFCR] in order to maintain:

    a) the scheduled Active Power exchange of its LFC Area;

    b) System Frequency and Frequency Restoration Control Error.

13. In case of a scheduled exchange or sharing of reserves, the TSO within whose Responsibility Area the reserves are connected and the TSO receiving the reserves, together with TSOs which connect the aforementioned TSOs in case they are not directly connected, shall carry out a common Operational Security Analysis and adopt the necessary measures to ensure that the resulting power flows do not endanger the Operational Security Limits during the exchange of reserves or activation of reserve according to the provisions of the [NC LFCR].

14. Each TSO shall be entitled to establish actions to improve System Frequency quality or establish actions where there is a justified expected risk to System Frequency quality. These actions can include restrictions on the Ramping Rates of Significant Grid Users and HVDC interconnectors.

Article 10

Voltage control and Reactive Power management

1. In accordance with Article 8(4), each TSO shall use its best endeavour to maintain the Transmission System steady-state voltage at the Connection Points within the ranges of Operational Security Limits as specified in the Tables 8.1 and 8.2, in Normal State and after the occurrence of a Contingency from the Contingency List defined according to Article 13(1).

Synchronous Area	Voltage range	Time duration
Continental Europe	0.90 pu – 1.118 pu	unlimited
Nordic	0.90 pu – 1.05 pu	unlimited
Great Britain	0.90 pu – 1.10 pu	unlimited
Ireland Ireland offshore	0.90 pu – 1.118 pu 0.90 pu – 1.10 pu	unlimited
Baltic	0.90 pu – 1.12 pu	unlimited

Table 8.1: Voltages ranges for reference voltages defined by TSOs between 110 kV to 300 kV (excluding)

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Synchronous Area	Voltage range	Time duration
Continental Europe	0.90 pu – 1.05 pu	unlimited
Nordic	0.90 pu – 1.05 pu	unlimited
Great Britain	0.90 pu – 1.05 pu	unlimited
Ireland Ireland offshore	0.90 pu – 1.05 pu 0.90 pu – 1.10 pu	unlimited
Baltic	0.90 pu – 1.10 pu	unlimited

Table 8.2: Voltages ranges for reference voltages defined by TSOs between 300 kV and 400 kV

The Voltage base for pu values shall be defined by each TSO and in accordance with provisions for Interconnectors in Article 8(8).

In the Responsibility Area of those TSO that decide in accordance with Table 6.2 of [NC RfG] that Power Generating Modules connected to nominal voltages between 300 kV and 400 kV shall stay connected for an unlimited time in the voltage range from 1,05 to 1,0875 pu, this voltage range shall be considered as amended to the table 8.2.

For voltage ranges below 110 kV, the responsible TSO shall agree the applicable voltage ranges with DSOs and Significant Grid Users with Connection Point directly to the Transmission System.

2. Each TSO can agree wider voltage ranges or limited times for operation with connected DSOs and Significant Grid Users with Connection Point directly to the Transmission System, while respecting the provisions of Article 8(8).

3. Significant Grid Users which are Power Generating Modules subject to the requirements of the [NC RfG] shall remain connected at least within the voltage and time ranges defined according to Article 11 of [NC RfG]. All Significant Grid Users which are Power Generating Modules with Connection Point directly to the Transmission System who are not subjected to or derogated from the [NC RfG] shall inform their TSO about their capabilities compared to the voltage requirements in [NC RfG] and in so doing they shall declare the voltages and time they can withstand without disconnection. Each TSO can require modifications of the capability of such Significant Grid User which is a Power Generating Module if this is necessary for maintaining Operational Security.

4. If voltages at Connection Point to the Transmission System are outside the ranges from Tables 8.1 and 8.2, each TSO shall apply voltage control and Reactive Power management measures in order to restore voltages within the ranges from Tables 8.1 and 8.2 and within the time ranges specified according to Article 11 of [NC RfG] and Article 14 of [NC DCC].

5. In Emergency State, if voltages at Connection Points to the Transmission System exceed the ranges from Tables 8.1 and 8.2, TSOs shall take into account that Significant Grid Users connected to the Transmission System and who are affected by [NC RfG] and [NC DCC] might disconnect after the time periods required in Article 11 of [NC RfG] or Article 14 of [NC DCC] and take this into account in defining Remedial Actions and measures of the System Defence Plan.

6. For Significant Grid Users with Connection Point to the Transmission System and who are not subject to or who are derogated from the [NC RfG] or [NC DCC], the TSOs shall take into account in their Operational Security Analysis the voltage values at which each of these Significant Grid Users may disconnect.

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7. Each TSO shall use its best endeavour to implement the provisions from the Article 10(1) to Article 10(6) in a coordinated way at the level of Synchronous Area.

8. Each TSO shall ensure Reactive Power reserve, with adequate volume and time response, in order to keep the voltages within its Responsibility Area within the Operational Security Limits ranges defined in Tables 8.1 and 8.2.

9. A Significant Grid User which is a Demand Facility shall automatically or manually, disconnect at specified voltages in the specified timeframe, defined by the TSO or by the DSO if this Demand Facility has Connection Point to the Distribution Network. Each TSO making use of the provision in Article 10(9) shall respect agreements with other TSOs pursuant to [NC OPS] and shall ensure the coordination with involved DSOs.

10. In accordance with Article 8(8), TSOs interconnected with AC Interconnectors shall define the voltage and/or Reactive Power flow limits on these Interconnectors commonly, in order to use the Reactive Power resources in the most effective way and ensure adequate voltage control.

11. Each TSO shall coordinate Operational Security Analysis with other TSOs in accordance with the agreements defined in the [NC OPS] in order to ensure respecting the Operational Security Limits of voltage ranges in its Responsibility Area and within the Responsibility Areas of these TSOs.

12. Each TSO shall define the Reactive Power set-points, power factor ranges and voltage set-points for voltage control in accordance with [NC DCC], which shall be maintained by the Significant Grid Users or DSOs with Connection Point directly to the Transmission System.

13. Each TSO shall be entitled to use all available Reactive Power resources with Connection Point to the Transmission System within its Responsibility Area to ensure effective Reactive Power management and maintaining the ranges of voltage Operational Security Limits defined in this Network Code.

14. Each TSO shall operate or direct the operation of Reactive Power resources within its Responsibility Area including blocking of automatic voltage/Reactive Power control of transformers, voltage reduction and Low Voltage Demand Disconnection, in order to maintain Operational Security Limits and to prevent voltage collapse of the Transmission System.

15. Each TSO shall coordinate and define the voltage control actions with the Significant Grid Users with Connection Point directly to the Transmission System, the DSOs with Connection Point directly to the Transmission System, and with neighbouring TSOs. TSOs in coordination with DSOs shall be entitled to direct Significant Grid Users with Connection Point to Distribution Network to follow voltage control instructions if this is relevant for the voltage and Reactive Power management of the Transmission System.

16. Each TSO shall maintain voltage ranges and each DSO and Significant Grid User which is a Demand Facility with Connection Point directly to the Transmission System shall maintain the power factor or Reactive Power flows at Connection Points within the ranges specified in Article 10(12) and in Article 16 of [NC DCC], unless an agreement is defined between the TSO and the DSO foreseeing the active voltage control by the DSO in accordance with Article 16(1)(c) of [NC DCC], or unless another value is defined in accordance with national legislation for Significant Grid Users with Connection Point directly to the Transmission System who are not subject to or are derogated from [NC RfG].

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17. If voltage deterioration jeopardizes Operational Security or threatens to develop into a voltage collapse in either N or (N-1)-Situation the TSO shall be entitled to instruct the DSOs, Closed Distribution Networks and Significant Grid Users with Connection Point directly to the Transmission System, to block automatic voltage and Reactive Power control of transformers or to follow other voltage control instructions. As a consequence of these measures directed by the TSO, the DSO may have to disconnect Significant Grid Users which are Demand Facilities in order to avoid jeopardising the Transmission System. This is part of the Defence Plan.

Article 11
Short-circuit current management

1. In accordance with Article 8(5), each TSO shall define the maximum short-circuit current at which the rated capability of circuit breakers and other equipment is exceeded and the minimum short circuit current for correct operation of protection equipment. Each TSO shall apply operational measures to prevent or relieve a deviation from these short-circuit current limits.

2. In accordance with Article 8(4) and while respecting provisions of Article 1(5), each TSO shall use its best endeavour to maintain the short-circuit current within the limits defined in Article 11(1) for the Contingencies of the Contingency List at all times and for all protection equipment. A deviation from these conditions is allowed only during switching sequences.

3. Each TSO shall perform short-circuit current and power calculation according to the best available data and its own practice approaches or according to agreed international standards.

4. When assessing the compliance with the limits defined according to Article 11(1), each TSO shall consider operational conditions that provide the highest conceivable level of short-circuit current, considering also the short-circuit contribution from other Transmission Systems, Distribution Networks and Closed Distribution Networks.

5. Each TSO shall perform short-circuit calculations in order to evaluate the impact of directly interconnected TSOs, Distribution Networks and Closed Distribution Networks with Connection Point directly to the Transmission System, on the short-circuit current level. In case of impact of a Distribution Network or Closed Distribution Network with Connection Point directly to the Transmission System, this has to be modelled in the Transmission System short-circuit calculations.

Article 12
Power flow management

1. Each TSO shall define Operational Security Limits for power flows on each Transmission System element within its own Responsibility Area in accordance with Article 8(5) and Article 8(8).

2. Each TSO shall maintain Active Power flows within the Operational Security Limits defined in accordance with Article 8(5) when the system is in Normal State and after the occurrence of a Contingency from the Contingency List defined according to Article 13(1).

3. Each TSO shall perform Operational Security analysis based on the forecast and real-time operational parameters from its Responsibility Area. Each TSO shall coordinate Operational Security analysis with the other TSOs in accordance with the agreements as defined in [NC

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OPS], in order to ensure the respecting of the Operational Security Limits of power flows in its Responsibility Area.

4. Each TSO shall be entitled to use Redispatching of available Significant Grid users with Connection Point directly to the Transmission System or to the Distribution Network.

5. In the (N-1)-Situation in Normal State each TSO shall keep power flows within the Transitory Admissible Overloads, preparing and executing Remedial Actions to be applied within the time allowed for Transitory Admissible Overloads.

Article 13
Contingency analysis and handling

1. Each TSO shall define the Contingency List including Internal and External Contingencies within its Observability Area, for which it shall be checked whether any of these Contingencies endangers the Operational Security in the TSO's Responsibility Area. The Contingency List shall at least include Ordinary Contingencies and may include Exceptional Contingencies defined according to Article 13(5).

2. In order to identify the Contingencies which endanger the Operational Security in its Responsibility Area and to identify the necessary Remedial Actions, each TSO shall perform Contingency Analysis in its Observability Area in real-time and in operational planning.

3. Each TSO shall perform Contingency Analysis on the basis of the real-time system operation parameters periodically, according to Article 8(2) and in operational planning according to the provisions defined in the [NC OPS]. Each TSO shall ensure that potential deviations from the Operational Security Limits in its Responsibility Area which are identified by the Contingency Analysis do not endanger the Operational Security of its Transmission System or of the interconnected Transmission Systems. In accordance with its own rules and procedures, a TSO can decide not to apply costly Remedial Actions if the effects of the Contingencies are Local and they do not impact Operational Security of the interconnected Transmission Systems.

4. Each TSO shall assess the risks associated with potential effects of Contingencies and prepare Remedial Actions after testing each Contingency from its Contingency Lists and after assessing whether it can maintain its Transmission System within the Operational Security limits in the (N-1)-Situation. The starting point for the Contingency Analysis in the N-Situation shall at any time be the up-to-date Topology of the Transmission System including planned outages. In case of an (N-1)-Situation caused by an unplanned outage, each TSO shall apply Remedial Actions in order to ensure that the Transmission System is restored within Operational Security Limits as soon as reasonably practicable and that this (N-1)-Situation becomes the new N-Situation.

5. Each TSO shall include Internal and External Contingencies in the Contingency List. External Contingencies shall be defined in line with the methodology developed according to the provisions in the [NC OPS]. Each TSO shall differentiate between Ordinary, Exceptional and Out-of-Range Contingencies, taking into account their probability of occurrence. In treatment of so classified Contingencies, each TSO shall apply the following principles:
   a) each TSO shall classify Contingencies for its own Responsibility Area;
   b) when and as long as conditions significantly increase the probability of an Exceptional Contingency, the TSO shall include this Exceptional Contingency in its Contingency List. The TSO shall determine the Remedial Actions necessary to maintain its Transmission

System within Operational Security Limits or to mitigate the impact of Exceptional Contingencies as far as reasonably practical;

c) when and as long as out of the ordinary conditions increase the probability of an Out-of-Range Contingency, the TSO shall use its best endeavour to prepare Remedial Actions to mitigate the impact of these very exceptional conditions;

d) each TSO shall determine the Ordinary and Exceptional Contingencies based on the up-to-date topology;

e) in order to account for Exceptional Contingencies with high impact on its own or neighbouring Transmission Systems, or with a high probability of occurrence, each TSO shall include such Exceptional Contingencies in its Contingency List. The included Exceptional Contingencies shall be reassessed and if necessary the Contingency List readjusted in case of significantly changed operational conditions; and

f) each TSO shall contribute to the development of common methodology and criteria for coordination and, as far as reasonably and practically possible economically efficient, harmonization of the key principles for establishment of Contingency Lists across the Synchronous Areas.

6. Each TSO shall prepare Remedial Actions including Redispatching pursuant to Article 8(12) and Article 8(13), or Countertrading to cope with any Contingency from its Contingency List for which potential deviation from Operational Security Limits is identified in accordance with Article 8(5).

7. Each TSO shall, upon any relevant change in real-time operation or in Transmission System topology, reassess the Contingencies from its Contingency List to be taken into account according to Article 13(5) in Normal State and adjust the prepared Remedial Actions.

8. Each TSO shall apply Remedial Actions upon identification of a Contingency during Contingency Analysis, for which there is a danger of not being able to cope efficiently and in a timely manner with the conditions occurring after that Contingency.

9. If after a Contingency the Transmission System is not compliant with the (N-1)-Criterion, the TSO shall initiate Remedial Actions to recover compliance with the (N-1)-Criterion as soon as reasonably practicable. If there is a risk of a post-Contingency Disturbance propagation involving interconnected TSOs, the TSO shall initiate Remedial Actions as soon as possible. Non-compliance with the (N-1)-Criterion is acceptable:

a) during switching sequences;

b) as long as there are only Local consequences within the TSO Responsibility Area; or

c) during the time period required to activate the Remedial Actions.

10. Each TSO shall ensure that its Observability Area used for Contingency Analysis is based upon a sufficient amount of accurate real-time data.

11. Each DSO with Connection Point directly to the Transmission System and Significant Grid User which is a Power Generating Facility of type B, C or D according to Article 3 of the [NC RfG] shall deliver all information for Contingency Analysis as requested by the TSO, including forecast and real-time data, with possible data aggregation according to Article 27(2).

12. Each TSO shall coordinate its Contingency Analysis in terms of coherent Contingency Lists at least with the TSOs from its Observability Area and in accordance to the agreements as defined in [NC OPS]. Each TSO shall cooperate at least with other TSOs from its Observability Area and

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deliver all information for Contingency Analysis including forecast and real-time data according to the provisions in Chapter 3.

13. Each TSO shall contribute to establishing the Common Grid Model. This contribution shall include the data for the Common Grid Model according to the defined contents and timeframes according to the provisions in Chapter 3 consistent with the [NC OPS] and [NC CACM].

14. Each TSO shall inform the TSOs from its Observability Area, about their External Contingencies taken into account in its Contingency list.

15. Each TSO shall inform and coordinate prior to implementation, any significant topological changes in parts of its Responsibility Area involving Transmission System elements which are included as External Contingencies of Contingency Lists of other TSOs.

Article 14
Protection

1. Each TSO shall install the necessary protection and backup protection equipment within its Transmission System in order to efficiently and effectively protect Transmission System elements and to coordinate with the protection of the equipment Significant Grid Users, from effects of Faults in Transmission System.

2. Each TSO shall at least every five years review and analyse the protection strategy and concepts and when necessary adapt the protection functions to ensure the correct functioning of the protection and maintain Operational Security. After every protection operation having impact outside of its own Responsibility Area, each TSO shall assess whether the protection system in its Responsibility Area worked as planned and shall undertake corrective actions if necessary.

3. Each TSO shall operate the protection of its Transmission System with Set-Points that ensure reliable, fast and selective fault clearing, including backup protection for Fault clearing in case of malfunction of the main protection system.

4. Each TSO shall install the necessary protection and backup protection equipment within its Transmission System in order to automatically prevent Disturbance propagation which can endanger the Operational Security of the interconnected Transmission System.

5. Each TSO shall coordinate with interconnected TSOs the protection Set-Points for the Interconnectors and inform and coordinate with those TSOs before changing the settings.

6. If a TSO is using a System Protection Scheme(SyPS), the TSO shall:
   a) perform analysis in order to ensure that each SyPS acts selectively, reliably and effectively. In the analysis of SyPS, the TSO shall evaluate the consequences for the Transmission System in the event of an incorrect SyPS function, taking into account the interaction with affected TSOs;
   b) verify that the SyPS has a comparable reliability to the protection systems used for the primary protection of Transmission System elements;
   c) operate the Transmission System with the SyPS within the Operational Security Limits determined according to Article 8(5) and Article 8(6); and

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d) coordinate SyPS functions, activation principles and Set-Points with interconnected TSOs and affected DSOs, Closed Distribution Network and Significant Grid Users with Connection Point directly to the Transmission System.

7. While respecting the provisions of the [NC DCC], each TSO shall define a Low Frequency Demand Disconnection Scheme with common principles and in coordination with the respective DSOs and the TSOs of its Synchronous Area. Each DSO or where relevant TSO shall implement the Low Frequency Demand Disconnection scheme in its area of responsibility and shall inform the TSOs of a Synchronous Area in case of change of the conditions and settings.

8. While respecting the provisions of the [NC RfG], each TSO shall define and implement actions for over-frequency in cooperation with Significant Grid Users which are Power Generating Facility Owners and in coordination with the TSOs of its Synchronous Area.

Article 15
Dynamic stability management

1. Each TSO shall monitor the dynamic state of the Transmission System in terms of Voltage, Frequency and Rotor Angle Stability by off-line studies, wide area measurements, or other approaches according to Article 15(5) including the exchange of relevant data with other TSOs if necessary, in order to be able to take the necessary Remedial Actions when Transmission System Operational Security is at a risk.

2. Each TSO shall ensure, in case of stability problems due to poorly damped inter-area oscillations affecting several TSOs, that coordinated Dynamic Stability Analysis shall be made on the Synchronous Area level as soon as reasonably practical. Each TSO is obliged to provide data as requested for this analysis.

3. Each TSO shall perform Dynamic Stability Assessment (DSA) studies in order to identify the Stability Limits and potential stability problems in its Transmission System. DSA studies shall be coordinated between the TSOs within each Synchronous Area and shall be done for the whole or relevant parts of the Synchronous Area. These studies can be offline.

4. Where a TSO identifies a potential mutual influence of Voltage, Rotor Angle or Frequency Stability with other interconnected Transmission Systems, the affected TSOs shall contribute to coordination of approaches to the DSA, including provision of data needed for DSA, preparation of joint Remedial Actions including the cooperation procedures between the TSOs required to relieve wide area oscillations.

5. In deciding the approach for DSA, each TSO shall apply the following rules:
   a) if with respect to the Contingency List, steady-state limits are reached before Stability Limits, the TSO shall base its DSA only on the offline stability studies carried out in the longer term operational planning phase;
   b) if under planned outage conditions, with respect to the Contingency List, steady-state limits and Stability Limits are close to each other or Stability Limits are reached before steady-state limits, the TSO shall perform a DSA in the day ahead operational planning phase whilst these outage conditions remain. The TSO shall prepare Remedial Actions to be used in real-time operation if necessary; and
   c) if network is under N-Situation with respect to the Contingency List, Stability Limits are reached before steady-state limits, the TSO shall perform a DSA in all phases of

operational planning and have a capability to re-assess the Stability Limits as soon as reasonably practical after a significant change in conditions is detected.

6. If the DSA indicates a violation of Stability Limits, the TSOs having the violation shall implement measures to keep the Transmission System stable. These measures may involve Significant Grid Users which are Power Generating Modules.

7. Each TSO shall ensure that the Fault clearing times for Faults that may lead to Wide Area system instability are less than the Critical Fault Clearing Time calculated by the TSO in its Dynamic Stability Assessment studies carried out according to Article 15.

8. In relation to the minimum inertia required for the Synchronous Area:
   a) all TSOs of that Synchronous Area shall conduct the studies to identify if a need exists for the definition of the minimum required inertia, not later than two years after entering into force of this Network Code and shall conduct a periodic review and update of these studies every two years;
   b) based on the results of the studies from Article 15(8)(a) all TSO from a Synchronous Area shall develop and implement the methodology for the definition of minimum inertia required to maintain Operational Security and to prevent violation of Stability Limits identified pursuant to Article 15(3); this methodology shall be developed not later than six months after first completion of the studies from Article 15(8)(a) which showed the need for the definition of a required minimum inertia and shall be regularly updated not later than six months after each new update of the studies from Article 15(8)(a) is available; and
   c) Each TSO shall be entitled to define and deploy in operation the minimum inertia in its own Responsibility Area, according to the defined methodology and obtained results in Article 15(8)(b).

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CHAPTER 3
DATA EXCHANGE

Article 16
General requirements

1. Each TSO shall use its best endeavor to use accurate data and information which reflect as closely as possible the real and forecasted situation in the Transmission System.

2. Each TSO shall use its best endeavor to resolve inaccuracies and uncertainties and continuously ensure high quality of the data and information used.

3. Each TSO shall be entitled to gather the information which is required for the Operational Security Analysis and related to the following items, as further detailed in Article 17 to Article 29:
   a) generation;
   b) consumption;
   c) schedules;
   d) balance positions;
   e) planned outages and substation topologies; and
   f) own forecasts.

   This information shall be transformable into the nodal injections and withdrawals of the TSO's own Transmission System model and shall respect requirements described in [NC OPS] to be gathered in a Common Grid Model.

4. Each TSO shall adjust the scope of the data exchange with the Significant Grids Users defined in this Chapter 3, according to the following categories:
   a) structural data;
   b) scheduling and forecast data;
   c) real-time data;
   d) individual instructions by TSOs or DSOs.

5. All TSOs shall make a common proposal regarding key organisational requirements, roles and responsibilities in relation to the data exchange, within 6 months after entry into force of this Network Code. The agreed proposal shall be published in the ENTSO-E website and shall encompass the following issues:
   a) obligations among the TSOs to communicate without undue delay to all neighbouring TSOs any changes in the protection settings, thermal limits and technical capacities at the Interconnectors between their Responsibility Areas;
   b) obligations of the DSOs directly connected to the Transmission System to inform within the agreed timescales their TSOs of any changes in the data and information scope and contents from Chapter 3 of this Network Code;
   c) obligations for the adjacent DSOs to inform each other within agreed timescales of any change in the data and information scope which are defined in Chapter 3 of this Network Code;
   d) obligations of the Significant Grid Users to inform their TSO within the timescales, about any relevant change in the scope and contents of the relevant data from Chapter 3 of this Network Code;

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e) detailed contents of the data and information referred to in this Chapter and in a coherent way with the data exchange provisions in other Network Codes and the EU legislation. These detailed definitions shall include but not be limited to: main principles, type of data, communication means, format and standards to be applied, timing and responsibilities;

f) the time stamping and periodicity for the data and information to be provided by Significant Grid Users, to be used by the TSO's systems at the different timescales. At least the frequency of information exchange for real-time data, scheduled data and update of structural data shall be defined; and

g) reporting formats of the data and information referred to in this Chapter and in a coherent way with the data exchange provisions in other Network Codes.

6. Data related to in-service installations at the Connection Point of the Transmission System shall be available to Significant Grid Users and DSOs which are connected at that Connection Point.

7. A TSO can entrust a Regional Security Coordination Initiative with some of the tasks that it shall perform in accordance with this Network Code, while retaining the sole responsibility and liability as a TSO. In such a case, the TSO shall inform other TSOs, about this delegation, so that these Regional Security Coordination Initiatives can get all the data and information needed to perform the tasks entrusted to them.

Article 17

Structural and forecast data exchange between TSOs

1. Neighbouring TSOs shall exchange the structural information related to the Observability Area including at least:

a) substations' regular Topology and other relevant data by voltage level;

b) transmission lines;

c) transformers connecting the DSOs, Significant Grid Users which are Demand Facilities and generators' block-transformers of Significant Grid Users which are Power Generating Facilities;

d) Maximum and minimum active and Reactive Power of Significant Grid Users which are Power Generating Modules;

e) phase-shifting transformers;

f) high voltage DC lines;

g) reactors, capacitors and Static VAR Compensators; and

h) Operational Security Limits defined by each TSO according to Article 8(5).

2. Neighbouring TSOs shall exchange the protection Set-Points of the lines included as external Contingencies in neighbouring TSOs Contingency Lists to allow protection coordination between the different Transmission Systems.

3. In order to support coordinated Operational Security Analysis and the establishment of the Common Grid Model, each TSO shall exchange with other TSOs according to the provisions in [NC OPS] at least the following data:

a) Topology of the 220 kV and higher voltage Transmission System within its Responsibility Area;

b) a model or an equivalent of the Transmission System with voltage below 220 kV with significant impact to its own Transmission System; and

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c) the forecast injection and the forecast withdrawal in every substation of the Transmission System for the different timeframes. This data shall correspond to the best forecast available at the TSO level. The resulting forecast situation in the Transmission System shall be as realistic and accurate as possible.

4. In order to support coordinated Dynamic Stability Assessment, each TSO shall, when required in according to Article 15(2), exchange with other TSOs within the relevant part of the Synchronous Area the necessary data for DSA, informing the affected Power Generating Facility Owner. Concerning Significant Grid Users which are Power Generating Modules, the TSO shall provide the necessary data at least on:

a) electrical parameters of the alternator suitable for DSA, including total inertia;

b) protection models;

c) alternator and prime mover;

d) step up transformer description;

e) minimum and maximum Reactive Power;

f) voltage and speed controller models; and

g) prime movers and excitation system models suitable for large disturbances.

Concerning tap changers, description of existing on load tap changers, step up and network transformers, the TSO shall provide the necessary data on:

a) type of regulation; and

b) voltage regulation range.

Concerning HVDC lines and FACTS devices, the TSO shall provide the necessary data on:

a) Dynamic models of the device and its associated regulation suitable for large disturbances.

Article 18

Real-time data exchange between TSOs

1. In accordance with Article 8(11)(a), each TSO shall exchange with all other TSOs in its Synchronous Area the necessary data on the System State of its Transmission System using the European Awareness System, including:

a) frequency;

b) Frequency Restoration Control Error or an equivalent parameter;

c) measured Active Power exchanges between LFC Areas;

d) aggregated generation infeed;

e) System State in accordance with Article 8(1);

f) set-value of the FR controller; and

g) power exchange via the Virtual Tie-Lines.

2. Each TSOs shall exchange with the TSOs from its Observability Area the following data from its own Transmission System:

a) actual substation Topology;

b) Active and Reactive Power in line bay, including transmission, distribution and lines connecting Significant Grid User;

c) Active and Reactive Power in transformer bay, including transmission, distribution and Significant Grid User connecting transformers;

d) Active and Reactive Power in Power Generating Facility bay;

e) regulating positions of transformers, including phase-shifting transformers;

f) measured or estimated busbar voltage;

g) Reactive Power in reactor and capacitor bay or from a Static VAR Compensator; and

h) restrictions on Active and Reactive Power supply capabilities with respect to the Observability Area.

Article 19

Structural data exchange between TSOs and DSOs within the TSO's Responsibility Area

1. Each TSO shall define the Observability Area of the Distribution Networks with Connection Point directly its Transmission System, which is relevant to accurately and efficiently determine the System State, based on the methodology developed according to the provisions of [NC OPS].

2. In those cases where a Distribution Network is not with the Connection Point directly to the Transmission System but whose electrical influence is deemed as significant for the proper representation of the system behaviour, such Distribution Networks may be defined by the TSO as being part of the Observability Area defined according to Article 19(1).

3. Each DSO shall provide to its TSO the structural information related to the Observability Area referred to in Article 19(1) and Article 19(2) including, but not limited to:

   a) substations by voltage;

   b) lines that connect the substations from a) above;

   c) transformers from the substations from a) above;

   d) Significant Grid Users; and

   e) reactors and capacitors connected to the substations from a) above.

4. Each DSO with the Connection Point to the Transmission System shall provide the TSO with updated structural information about the elements of the Observability Area referred to in Article 19(1) and Article 19(2), periodically, at least every six months.

5. Each DSO shall provide to its TSO the total aggregated generating capacity of all new type A Power Generating Modules and best possible estimate of type A Power Generating Modules, by primary energy source, which are not subject to or are derogated from [NC RfG], connected to its Distribution Network and the related information concerning their frequency behaviour.

Article 20

Real-Time data exchange between TSOs and DSOs within the TSO's Responsibility Area

1. Each DSO shall provide in real-time to its TSO the information related to the Observability Area referred to in Article 19(1) and Article 19(2), comprising:

   a) actual substation Topology;

b) Active and Reactive Power in line bay;

c) Active and Reactive Power in transformer bay;

d) Active and Reactive Power injection in Power Generating Facility bay;

e) tap positions of transformers connecting to the Transmission System;

f) busbar voltages;

g) Reactive Power in reactor and capacitor bay;

h) aggregated generation in the DSO area; and

i) aggregated consumption in the DSO area.

Article 21

Structural data exchange between TSOs, owners of Interconnectors or other lines and Power Generating Modules directly connected to the Transmission System

1. Each Significant Grid User which is a Power Generating Facility Owner operating a type D Power Generating Modules, shall provide at least the following data to the TSO:

   a) general data of the Power Generating Module, including installed capacity and primary energy source;

   b) turbine and Power Generating Facility data including time for cold and warm start;

   c) data for short-circuit calculation;

   d) Power Generating Facility transformer data;

   e) Frequency Containment Reserve data according to the definition and requirements of the [NC LFCR] for Power Generating Facilities offering or providing this service;

   f) Frequency Restoration Reserve data, according to the definition and requirements of the [NC LFCR]for Power Generating Modules that participate in this service;

   g) Replacement Reserve data for Power Generating Modules that participate in this service;

   h) data necessary for Restoration;

   i) data and models necessary for performing dynamic simulation;

   j) protection data; and

   k) voltage and Reactive Power control capability.

2. Each Significant Grid User which is a Power Generating Facility Owner operating a type B and C Power Generating Modules which is directly connected to the Transmission System shall provide at least the following data to the TSO:

   a) general data of the Power Generating Module, including installed capacity and primary energy source;

   b) data for short circuit calculation;

   c) Frequency Containment Reserve data according to the definition and requirements of the [NC LFCR] for Power Generating Modules offering or providing this service;

   d) Frequency Restoration Reserve data for Power Generating Modules that participate in this service;

   e) Replacement Reserve data for Power Generating Modules that participate in this service;

   f) protection data;

   g) Reactive Power control capability; and

   h) data necessary for performing DSA according to the provisions in [NC RfG].

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3. A TSO may request any Power Generating Facility Owner operating a Power Generating Module with Connection Point directly to the Transmission System, to provide further data needed for Operational Security Analysis.

4. Each HVDC Interconnector or Line owner shall provide at least the following data to the TSO:
   a) name plate data of the installation;
   b) transformers data;
   c) data on filters and filter banks;
   d) reactive compensation data;
   e) Active Power control capability;
   f) Reactive Power and voltage control capability;
   g) active or reactive operational mode prioritization if exists;
   h) frequency response capability;
   i) dynamic models for dynamic simulation;
   j) protection data; and
   k) Fault Ride Through capability.

5. Each AC Interconnector or Line owner shall provide at least the following data to the TSO:
   a) name plate data of the installation;
   b) electrical parameters; and
   c) associated protections.

Article 22

Scheduled data exchange between TSOs, owners of Interconnector or other lines and Power Generating Modules directly connected to the Transmission System

1. Each Significant Grid User which is a Power Generating Facility Owner operating a type B, C and D Power Generating Module with Connection Point directly to the Transmission System shall inform the TSO on a Day-Ahead and Intra-Day basis of its Active Power output and Active Power reserves amount and availability and, without delay, about its scheduled unavailability or Active Power capability restriction.

2. Each Significant Grid User which is a Power Generating Facility Owner operating a type B, C and D Power Generating Module with Connection Point directly to the Transmission System shall provide to the TSO any forecast restriction in the Reactive Power control capability.

3. In regions with central dispatching of generation, the Significant Grid User which is a Power Generating Facility Owner directly connected to the Transmission System shall submit the data required by the TSO to allow the TSO to construct an Active Power output schedule. This data shall be provided instead of that required in Article 22(1).

4. Each HVDC Interconnector owner or owner other than the TSO, of an internal HVDC line within a single TSO Responsibility Area shall provide the following data to the TSOs:
   a) on a Day-Ahead and Intra-Day basis its Active Power schedule and Active Power reserves and availability;
   b) without delay its scheduled unavailability or Active Power restriction; and

c) any forecast restriction in the Reactive Power or voltage control capability.

5. Each AC Interconnector or Line owner shall provide its scheduled unavailability or Active Power restriction data to the TSOs.

Article 23

Real-Time data exchange between TSOs, owners of Interconnector or other lines and Power Generating Modules directly connected to the Transmission System

1. Each Significant Grid User which is a Power Generating Facility Owner operating a type B, C and D Power Generating Module including its own house load, shall provide to the TSO in real-time the following information:
   a) position of the circuit breakers at the Connection Point or another point of interaction agreed with the TSO;
   b) active and Reactive Power at the Connection Point or another point of interaction agreed with the TSO; and
   c) in the case of Power Generating Facility with consumption other than auxiliary consumption, net active and Reactive Power.

2. Each HVDC or AC Interconnector owner or an owner of the HVDC or AC line other than the TSO within the TSO Responsibility Area, shall provide the following data referred to the Connection Point to the TSOs in real-time:
   a) position of the circuit breakers;
   b) operational status; and
   c) Active and Reactive Power.

Article 24

Structural data exchange between DSOs and Significant Grid Users according to Article 1(3)(a) and Article 1(3)(d) connected to the Distribution Network

1. Each Significant Grid User according to Article 1(3)(a) and Article 1(3)(d) Power Generating Facility Owner connected to the Distribution Network shall at least provide the following data to its DSO:
   a) general data of the Power Generating Module, including installed capacity and primary energy source or fuel type;
   b) Frequency Containment Reserve data according to the definition and needs of the [NC LFCR]for Power Generating Facilities offering or providing this service;
   c) Frequency Restoration Reserve data for plants that participate in this service;
   d) Replacement Reserve data for Power Generating Modules that participate in this service;
   e) protection data;
   f) Reactive Power control capability;
   g) capability of remote access to the circuit breaker;
   h) data necessary for performing dynamic simulation according to the provisions in [NC RfG]; and
   i) voltage level and location of each Power Generating Module.

2. Each DSO shall define and implement in a common and coherent way, the detailed contents of the data and information referred to in the Article 24(1). Each DSO shall consult its NRA, its TSO and the Significant Grid Users with Connection Point to the Distribution Network about the detailed content.

3. Each Significant Grid User affected by the Article 24(1), shall inform the DSO to which it has Connection Point, within the agreed time but before first commissioning or before any changes of the existing installation, about any change in the scope and the contents of the data according to Article 24(1).

Article 25

Scheduled data exchange between DSOs and Significant Grid Users according to Article 1(3)(a) and Article 1(3)(d)connected to the Distribution Network

1. Each Significant Grid User which is a Power Generating Facility Owner according to the Article 1(3)(a) and Article 1(3)(d) and with Connection Point to the Distribution Network, shall provide the DSO with its scheduled unavailability, Active Power restriction and its forecast scheduled Active Power output at the Connection Point.

2. Each Significant Grid User which is a Power Generating Facility Owner according to Article 1(3)(a) and Article 1(3)(d) shall provide to the DSO any forecasted restriction in the Reactive Power control capability.

3. In regions with central dispatching of generation, the Significant Grid User which is according to Article 1(3)(a) and Article 1(3)(d) Power Generating Facility Owner, shall submit the data required by the TSO to allow the TSO to construct an Active Power output schedule. This data shall be provided instead of that required in Article 25(1).

Article 26

Real-Time Data exchange between DSOs and Significant Grid Users according to Article 1(3)(a) and Article 1(3)(d) connected to the Distribution Network

1. The following requirements shall be defined by the TSO in coordination with DSO. Each Significant Grid User which is Power Generating Facility Owner according to Article 1(3)(a) and Article 1(3)(d) connected to the Distribution Network, shall provide to its DSO in real-time the following information:
   a) status of the switching devices and circuit breakers at the Connection Point; and
   b) Active and Reactive Power flows, current, and voltage at the Connection Point.

2. Each TSO shall define together with the responsible DSOs, whether and which Significant Grid Users might be exempted from providing the real-time data directly to the TSO whereas the real-time data of such Significant Grid Users need to be delivered by responsible DSOs to the TSO in an aggregated form.

Article 27

Data exchange between TSOs and Significant Grid User according to Article 1(3)(a) and Article 1(3)(d) connected to the Distribution Network

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1. Significant Grid Users which are Power Generating Facility Owners according to Article 1(3)(a) and Article 1(3)(d) with Connection Point to the Distribution Network or their DSOs, shall, if requested by the TSO, provide to the TSO all the information specified in Article 24, Article 25 and Article 26.

2. A TSO may request further data from any Significant Grid User according to the Article 1(3)(a) and Article 1(3)(d) which is a Power Generating Facility Owner with Connection point to the Distribution Network, if this is necessary for Operational Security Analysis and validation of models.

Article 28

Data exchange between TSOs and Demand Facilities directly connected to the Transmission System

1. Demand Facilities with Connection Point directly to the Transmission System shall provide the following structural data to the TSO:
   a) electrical data of the transformers connected to the Transmission System;
   b) characteristics of the load of the Demand Facility; and
   c) characteristics of the Reactive Power control.

2. Each Demand Facility with Connection Point directly to the Transmission System shall communicate to the TSO, as a minimum, its scheduled active and forecast reactive consumption on a day-ahead and intraday basis, including any changes of these schedules or forecast.

3. Each Demand Facility with Connection Point directly to the Transmission System shall communicate to the TSO any forecast restriction in the Reactive Power control capability.

4. Each Demand Facility directly connected to the Transmission System which participates in Demand Side Response shall inform the TSO about the structural minimum and maximum power to be curtailed.

5. Each Demand Facility directly connected to the Transmission System shall communicate to the TSO in real-time the following information:
   a) active and Reactive Power at the Connection Point; and
   b) minimum and maximum power to be curtailed.

6. In regions, with central dispatching of generation the Demand Facility with Connection Point directly to the Transmission System is not required to provide the data required by Article 28(2).

7. Each Demand Facility directly connected to the Transmission System shall describe to its TSO its behaviour at the voltage ranges according to the provisions in Article 10.

Article 29

Data exchange between TSOs and Demand Facilities connected to the Distribution Network or Aggregators

1. The following requirements shall be defined by the TSO in coordination with DSO. Each Significant Grid User which is a Demand Facility connected to the Distribution Network and

which participates in Demand Side Response, other than through an Aggregator, shall communicate to its TSO or via its DSO to the TSO the following scheduled and real-time data:

a) structural minimum and maximum Active Power available for Demand Side Response; and the maximum and minimum duration of any potential usage of this power for Demand Side Response;

b) forecast of unrestricted Active Power available for and any planned Demand Side Response;

c) real-time Active and Reactive Power at the Connection Point; and

d) confirmation that the estimated actual values of demand response are applied.

2. The following requirements shall be defined by the TSO in coordination with DSO. Each Significant Grid User which is an Aggregator which participates in Demand Side Response as defined in the [NC DCC], shall communicate to its TSO or via its DSO to the TSO at the day ahead and within a day at near real- time on behalf of all of its distribution connected demand sites:

a) Structural minimum and maximum Active Power available for Demand Side Response and the maximum and minimum duration of any potential activation of Demand Side Response in a specific geographical area defined by the TSO and DSO;

b) forecast of unrestricted Active Power available for and any planned level of Demand Side Response in a specific geographical area defined by the TSO and DSO;

c) real-time Active and Reactive Power; and

d) confirmation of the estimated actual values of Demand Side Response applied.

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CHAPTER 4
TRAINING

Article 30

Operational training and certification

1. Each TSO shall adopt and develop a training program for its System Operator Employees in charge of real-time operation of the Transmission System. Each TSO shall provide upon request to its relevant national authority the scope and details of its training and certification processes as established according to Article 30(6). In addition each TSO shall adopt and develop training programs for the System Operator Employees who are outside of the control rooms, who are carrying out operational planning and market balancing roles.

2. Each TSO shall include in its training programs the knowledge of the Transmission System elements, the operation of the Transmission System, use of the on-the-job systems and processes, inter-TSO operations and market arrangements. Each TSO shall also include in its training programs training on recognizing of and responding to exceptional situations as defined by the TSO.

3. To maintain and extend the System Operator Employees' skills, each TSO shall carry out training. The detailed contents and frequency of the training for all relevant roles shall be defined in the training programme of each TSO. The training shall include but not be limited to:
   a) relevant areas of electrical power engineering;
   b) relevant aspects of the European Internal Electricity Market;
   c) safety and security for persons, nuclear and other equipment in Transmission System operation;
   d) Transmission System operation in a Normal and all other System States;
   e) inter-TSO cooperation and coordination in real-time and in operational planning at the level of main control centres; this part of the training shall, if not otherwise specified and agreed, be in English; and
   f) exchange and training in conjunction with DSOs and Significant Grid Users with Connection Point directly to the Transmission System where deemed appropriate.

4. Each TSO shall prepare and carry out training plans, in accordance with Article 30(1), for all new System Operator Employees in training - trainees. The training plans shall be structured and detailed and take account of the trainees background and experience relative to the position they are being trained for. Adequate records of System Operators Employees' training plans shall be retained by the TSO for the period of employment as a System Operator Employee.

5. The training plans shall comprise:
   a) an initial program, to be followed by a trainee training for the role of System Operator Employee in real-time operation, before certification; and
   b) a program for the continuous development and extension of validity of the certification of a System Operators Employee in real-time operation, at least every five years;
   c) an program, to be followed by a trainee training for the operational planning.

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6. Each TSO shall appoint an experienced training coordinator, who is responsible for designing, monitoring and updating the complete training process in accordance with Article 30(1). The training coordinator shall be responsible for defining:
   a) qualifications for System Operator Employees;
   b) training required for certification of the System Operator Employees in real-time operation;
   c) processes with documentation for initial and continuous training;
   d) process for certification of System Operator Employees in real-time operation;
   e) process for extension of a training and certification period for the System Operator Employees in real-time operation; and
   f) competences for on-the-job trainers and training of trainers in teaching and mentoring skills.

7. Each TSO shall define the skills and the level of competence of the on-the-job trainers. This shall include the necessary practical experience. System Operator Employees acting as trainers shall be registered by each TSO and their on-the-job trainer status reviewed at the same time as their certification extension of valid until date is assessed.

8. Each TSO shall review training programmes at least annually or following any significant system changes and update them to reflect changing operational circumstances, market rules, network configuration and system characteristics, with particular focus on new transmission and generation technologies, changing generation patterns and market evolution.

9. Each TSO shall ensure the training includes on-the-job training and training offline. On-the-job training shall be carried out under the supervision of an experienced System Operator Employee. Offline training shall, as far as practicable, resemble the actual control room equipment with network modelling details appropriate to the role being trained for.

10. Each TSO shall ensure that training is based on a comprehensive database model with respective data also from neighbouring networks at a sufficient level to replicate inter-TSO operational issues. Where relevant, the role of neighbouring TSOs, DSOs and Significant Grid Users with Connection Point directly to the Transmission System shall also be simulated or directly involved in the offline training.

11. TSO shall co-ordinate regularly with DSOs and Significant Grid Users with Connection Point directly to the Transmission System to ensure TSO offline training regarding the impact of users' systems is as comprehensive as reasonably practical and reflects the latest developments in systems and equipment. TSOs, DSOs and Significant Grid Users with Connection Point directly to the Transmission System may run joint offline training simulations or training workshops for their System Operator Employees to enhance co-operation and understanding.

12. Each TSO shall ensure that System Operator Employees in real-time operation have a certification, issued by a nominated representative from their TSO, for the role they are to perform before they can work unsupervised in the control room.

13. Each TSO shall participate in the inter-TSO training at a defined frequency, taking into account the level of mutual influence of Transmission Systems and the type of interconnection - DC/AC links - with neighbouring systems. TSOs shall agree the frequency of this training.

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14. Each TSO shall define the level of competence and process to gain a certification for each relevant role for System Operator Employee in real-time operation within the control room. The certification shall only be awarded to the System Operator Employees in real-time operation following the passing of a formal assessment. A copy of the issued certificate shall also be retained by the TSO. The formal assessment shall comprise an oral exam and/or a written exam, and/or a practical assessment with pre-defined success criteria. The records of the formal assessment shall be retained by the TSO. NRAs shall, upon request, be provided with the TSOs certification examination records.

15. Each TSO shall record the period of validity of the certification issued to any System Operator Employee in real-time operation. The maximum period of any certification shall be defined by each TSO and shall not exceed five years. The extension of the valid until date of the certification before expiry shall be based on criteria defined by each TSO, including the System Operator Employees' participation in a continuous training programme with sufficient practical experience.

16. Each TSO shall collaborate with each neighbouring TSO to determine a common language for contacts between their System Operator Employees. If not otherwise agreed, the language shall be English. Each TSO shall train the relevant System Operator Employees to achieve a sufficient skill in this language to carry out their tasks.

17. Each TSO shall exchange operational experiences with their neighbouring TSOs and delegated entities defined in respective TSOs' agreements on RCSIs' in the region where they have a role in operational planning coordination between TSOs, including facilitating visits and exchange of experiences between System Operator Employees. There shall be regular training between neighbouring TSOs to improve the knowledge of the characteristics of neighbouring Transmission Systems and communication and coordination between System Operator Employees of neighbouring TSOs. The inter-TSO training shall include awareness of co-ordinated actions required under Normal and all other System States.

18. Each TSO shall collaborate with each neighbouring TSO to determine the need and frequency for holding joint training sessions and the minimum content and scope of those sessions, taking into account the level of mutual influence and operational cooperation needed. This inter-TSO training may include, but should not be limited to, joint training workshops and joint training simulator sessions.

19. Each TSO shall ensure that each System Operator Employee as a part of their initial training undergoes training in interoperability issues between neighbouring systems based upon operational experiences and feedback from the joint training carried out with their neighbouring TSOs. This part of the initial training regarding interoperability issues shall include awareness of co-ordinated actions required under Normal and all other System States.

20. In regions where RSCIs have a role in coordination of operational planning between the TSOs, the operators of the RCSIs' delegated entities defined in respective TSOs' agreements shall be trained as well in common training with the System Operator Employees.

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CHAPTER 5
COMPLIANCE

Article 31
Responsibility of the Significant Grid Users

1. Each Significant Grid User, DSO or Closed Distribution Network with Connection Point directly to the Transmission System shall ensure that its facilities are compliant with the requirements of this Network Code, which are relevant for their connection and interaction with the Transmission System. This compliance shall be maintained throughout the lifetime of the facility.

2. Before initiating any modification, each Significant Grid User shall notify the TSO or DSO to which it has Connection Point, about any planned modification of its technical capabilities which could have an impact on its compliance with the requirements of this Network Code.

3. Each Significant Grid User shall notify the TSO or DSO to which it has Connection Point, about any operational disturbance on its facility which could have an impact on its compliance with the requirements of this Network Code as soon as possible and without any delay after its occurrence.

4. In order to allow the TSO or DSO to evaluate and mitigate where necessary the risks to the Transmission System or Distribution Network, each Significant Grid User shall inform the TSO or DSO to which it has Connection Point of any foreseen tests or test schedules and procedures to verify compliance of a Significant Grid User's facility with the requirements of this Network Code.

5. The TSO or DSO to which the Significant Grid User has Connection Point, shall approve the foreseen tests, or test schedules and procedures, prior to their launch.

6. The Significant Grid Users shall enable the participation of the TSO or DSO to which it has Connection Point in such tests. The TSO or DSO to which the Significant Grid User has Connection Point, shall have the right to record the performance of these facilities of the Significant Grid Users.

7. When the Significant Grid User has Connection Point to the DSO and interacts, in line with Article 31(1) to Article 31(6) only with the DSO, the TSO shall be entitled to request any compliance testing results, if this is relevant for Operational Security of the Transmission System.

8. Upon request from the TSO or DSO, the Significant Grid User shall carry out compliance tests and simulations at any time throughout the lifetime of the Significant Grid User's facility and in particular after any Fault, modification or replacement of any equipment which could have an impact on the Significant Grid User's facility compliance with the requirements of this Network Code, capability to achieve its Declared Availability or physically contracted provision of Ancillary Services.

Article 32
Responsibilities of the TSOs and DSOs

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1. Each TSO has the sole responsibility for the Operational Security in its Responsibility Area in terms of:
   a. utilizing the means within the own Responsibility Area including real-time operation, operational planning, development and deployment of tools and solutions for prevention and remedy of Disturbances;
   b. utilizing the means provided through cooperation with other stakeholders including Redispatching or Countertrading and congestion management, operating reserves and other Ancillary Services;
   c. observing the rules of the ENTSO-E incidents classification scale in accordance with Article 8(3)(a) of Regulation (EC) 714/2009, in its current version;
   d. identifying, evaluating and implementing necessary enhancements of the means from Article 32(1)(a) and Article 33(1)(b), or initiating amendments of this or other Network Codes pursuant to Article 7 of the Regulation (EC) 714/2009, which are required in order to maintain Operational Security; for identification of those enhancements, each TSO shall rely on the results of the yearly report based on the ENTSO-E incidents classification scale developed pursuant to the Article 8(3)(a) of the Regulation (EC) 714/2009; and
   e. identifying, evaluating and implementing of necessary additional means to those from Article 32(1)(b), including development and implementation of new Ancillary Services and definition and implementation of new frameworks for data and information exchange, where cooperation with other stakeholders is needed and which are required in order to maintain Operational Security; for identification of those additional means each TSO shall rely on the results of the yearly report based on the ENTSO-E incidents classification scale developed pursuant to the Article 8(3)(a) of the Regulation (EC) 714/2009.

2. All TSOs shall contribute to the annual reporting developed pursuant to the Article 8(3)(a) of the Regulation (EC) 714/2009. The format and contents of this annual report shall be approved by ACER. The annual report shall contain the Operational Security Performance Indicators on scale 1-3:
   a. number of tripped Transmission System elements per year;
   b. number of tripped Power Generation Facilities per year;
   c. energy of disconnected Demand Facilities per year;
   d. time duration of being in Operational States other than Normal State;
   e. time duration within which there was a lack of reserves identified;
   f. voltage deviation exceeding the voltage thresholds for Emergency State;
   g. frequency deviation per Synchronous Area;
   h. number of system-split separations or local blackouts; and
   i. number of blackouts involving two or more TSOs.

   The yearly report developed pursuant to the Article 8(3)(a) of the Regulation (EC) 714/2009 shall contain explanation of reasons of incidents at the Operational Security Ranking Scales 2 and 3 according to Article 32(3).

3. The Operational Security Ranking in the yearly report according to Article 32(1)(d) and Article 32(1)(e) shall be based on the following scales:

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a) Scale 1 where any primary failure may have high security influence and/or high market influence consequences or cause noticeable violation of standards for at least two Transmission System Operators;

b) Scale 2 where any primary failure may lead to degradation of system adequacy with the necessity to activate at least one measure of the System Defence Plan;

c) Scale 3 where there is Blackout in the Responsibility Area of more than one TSO;

4. The TSO or DSO with Connection Point directly to the Transmission System shall assess and where necessary request to witness the testing of the compliance of a Significant Grid User's facility with the requirements of this Network Code at any time throughout the lifetime of the Significant Grid Users' facility.

5. Each TSO or DSO to which the Significant Grid User has Connection Point retains the right to evaluate a Significant Grid User's compliance with the requirements from this Network Code, expected input or output, and contracted provision of Ancillary Services.

6. The TSO or DSO to which the Significant Grid User has Connection Point, shall make publicly available the list of information and documents to be provided as well as the requirements to be fulfilled by the Significant Grid User in the framework of the compliance testing. Such list shall at least cover the following information, documents and requirements:

a) all documentation and Equipment Certificates to be provided by the Significant Grid User;

b) details of the technical data of the Significant Grid User facility with relevance for the system operation;

c) requirements for models for Dynamic Stability Assessment; and

d) studies by the Significant Grid Users demonstrating expected outcome of the Dynamic Stability Assessment, where applicable.

7. Each TSO or DSO where applicable, shall make publicly available the allocation of responsibilities of the Significant Grid Users and of the TSO or DSO for compliance testing and monitoring.

8. Each TSO shall carry out the necessary analysis and planning using the Common Grid Model or a part of it to ensure that tests in its Responsibility Area are carried out in a manner that minimizes the impact on Operational Security and economic operation of the interconnected Transmission Systems and Significant Grid Users.

9. Each TSO shall provide to the other TSOs at least that information on the test according to the agreements pursuant to provisions in [NC OPS]. Each TSO shall provide the same information to the directly connected DSOs in its own Responsibility Area.

10. Each TSO shall elaborate a list of high priority Significant Grid Users which are Power Generating Facilities or Demand Facilities, in terms of the conditions for their disconnection and re-energizing.

11. Each DSO is responsible for quality, reliability and security in its Distribution Network.

Article 33

Common testing and incident analysis responsibilities

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1. Each TSO, DSO and Significant Grid User with Connection Point directly to the Transmission System shall monitor their areas of responsibility, may perform operational testing when required and shall participate in the analysis of events in order to:
   a) ensure correct functioning of elements of Transmission System, Distribution Network and the Significant Grid Users facilities;
   b) maintain and develop operational procedures;
   c) ensure the fulfilment of Ancillary Services;
   d) train staff;
   e) acquire information about system and equipment performance under any conditions, including:
      i. tests involving the controlled application of frequency or voltage variations aimed at gathering information on Transmission System behaviour; and
      ii. tests of standard procedures in Emergency State and Restoration;

2. Each TSO shall have Operational Security of its own Transmission System and Responsibility Area as its main concern during testing. Any test may be postponed or interrupted due to unplanned system conditions as assessed by the TSO or due to safety of its personnel and equipment as assessed by the DSO or Significant Grid User.

3. In the event of System State degradation in the Transmission System in which the testing is being performed, the TSO shall be entitled to interrupt the testing. If a TSO or a Significant Grid User is conducting a test influencing another TSO and the System State of the affected Transmission System changes to Alert State or Emergency State, if required the TSO or Significant Grid User conducting the test shall, having been informed by its TSO, immediately cease the test.

4. TSOs, DSOs and Significant Grid Users shall exchange any relevant data, necessary to fully analyse both Local and Wide Area system incidents and facilitate system analysis.

5. Each TSO shall ensure that the relevant results of tests carried out and the analysis of system incidents are:
   a) incorporated into the training and certification process;
   b) used as inputs to the ENTSO-E research and development process; and
   c) used to improve operational procedures including also procedures in Emergency State and Restoration.

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CHAPTER 6
FINAL PROVISIONS

Article 34
Amendments of contracts and general terms and conditions

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

Article 35
Entry into force

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

It shall apply as from [*date*].

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

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