

Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation (Text with EEA relevance)

PART II

OPERATIONAL SECURITY

TITLE 1

OPERATIONAL SECURITY REQUIREMENTS

CHAPTER 1

System states, remedial actions and operational security limits

Article 18

Classification of system states

- 1 A transmission system shall be in the normal state when all of the following conditions are fulfilled:
- a voltage and power flows are within the operational security limits defined in accordance with Article 25;
 - b frequency meets the following criteria:
 - (i) the steady state system frequency deviation is within the standard frequency range; or
 - (ii) the absolute value of the steady state system frequency deviation is not larger than the maximum steady state frequency deviation and the system frequency limits established for the alert state are not fulfilled;
 - c active and reactive power reserves are sufficient to withstand contingencies from the contingency list defined in accordance with Article 33 without violating operational security limits;
 - d operation of the concerned TSO's control area is and will remain within operational security limits after the activation of remedial actions following the occurrence of a contingency from the contingency list defined in accordance with Article 33.
- 2 A transmission system shall be in the alert state when:
- a voltage and power flows are within the operational security limits defined in accordance with Article 25; and
 - b the TSO's reserve capacity is reduced by more than 20 % for longer than 30 minutes and there are no means to compensate for that reduction in real-time system operation; or
 - c frequency meets the following criteria:
 - (i) the absolute value of the steady state system frequency deviation is not larger than the maximum steady state frequency deviation; and

- (ii) the absolute value of the steady state system frequency deviation has continuously exceeded 50 % of the maximum steady state frequency deviation for a time period longer than the alert state trigger time or the standard frequency range for a time period longer than time to restore frequency; or
 - d at least one contingency from the contingency list defined in accordance with Article 33 leads to a violation of the TSO's operational security limits, even after the activation of remedial actions.
- 3 A transmission system shall be in the emergency state when at least one of the following conditions is fulfilled:
- a there is at least one a violation of a TSO's operational security limits defined in accordance with Article 25;
 - b frequency does not meet the criteria for the normal state and for the alert state defined in accordance with paragraphs 1 and 2;
 - c at least one measure of the TSO's system defence plan is activated;
 - d there is a failure in the functioning of tools, means and facilities defined in accordance with Article 24(1), resulting in the unavailability of those tools, means and facilities for longer than 30 minutes.
- 4 A transmission system shall be in the blackout state when at least one of the following conditions is fulfilled:
- a loss of more than 50 % of demand in the concerned TSO's control area;
 - b total absence of voltage for at least three minutes in the concerned TSO's control area, leading to the triggering of restoration plans.

A TSO of GB and IE/NI synchronous areas may develop a proposal specifying the level of demand loss at which the transmission system shall be in the blackout state. The TSOs of GB and IE/NI synchronous areas shall notify this instance to ENTSO for Electricity.

- 5 A transmission system shall be in the restoration state when a TSO, being in the emergency or blackout state, has started to activate measures of its restoration plan.

Article 19

Monitoring and determination of system states by TSOs

- 1 Each TSO shall, in real-time operation, determine the system state of its transmission system.
- 2 Each TSO shall monitor the following transmission system parameters in real-time in its control area, based on real-time telemetry measurements or on calculated values from its observability area, taking into account the structural and real-time data in accordance with Article 42:
- 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 load.
- 3 In order to specify the system state, each TSO shall perform contingency analysis at least once every 15 minutes, monitoring the transmission system's parameters defined in accordance with paragraph 2, against the operational security limits defined in accordance with

Article 25 and the criteria for system states defined in accordance with Article 18. Each TSO shall also monitor the level of available reserves against the reserve capacity. When carrying out the contingency analysis, each TSO shall take into account the effect of remedial actions and the measures of the system defence plan.

- 4 If its transmission system is not in normal state and if that system state is qualified as a wide area state the TSO shall:
- a inform all TSOs about the system state of its transmission system via an IT tool for the exchange of real-time data at pan-European level; and
 - b provide with additional information on its transmission system elements which are part of the observability area of other TSOs, to those TSOs.

Article 20

Remedial actions in system operation

1 Each TSO shall endeavour to ensure that its transmission system remains in the normal state and shall be responsible for managing operational security violations. To achieve that objective, each TSO shall design, prepare and activate remedial actions taking into account their availability, the time and resources needed for their activation and any conditions external to the transmission system which are relevant for each remedial action.

2 The remedial actions used by TSOs in system operation in accordance with paragraph 1 and with Articles 21 to 23 of this Regulation shall be consistent with the remedial actions taken into account in capacity calculation in accordance with Article 25 of Regulation (EU) 2015/1222.

Article 21

Principles and criteria applicable to remedial actions

1 Each TSO shall apply the following principles when activating and coordinating remedial actions in accordance with Article 23:

- a for operational security violations which do not need to be managed in a coordinated way, a TSO shall design, prepare and activate remedial actions to restore the system to the normal state and to prevent the propagation of the alert or emergency state outside of the TSO's control area from the categories defined in Article 22;
- b for operational security violations which need to be managed in a coordinated way, a TSO shall design, prepare and activate remedial actions in coordination with other concerned TSOs, following the methodology for the preparation of remedial actions in a coordinated way under Article 76(1)(b) and taking into account the recommendation of a regional security coordinator in accordance with Article 78(4).

2 When selecting the appropriate remedial actions, each TSO shall apply the following criteria:

- a activate the most effective and economically efficient remedial actions;
- b activate remedial actions as close as possible to real-time taking into account the expected time of activation and the urgency of the system operation situation they intend to resolve;
- c consider the risks of failures in applying the available remedial actions and their impact on operational security such as:

- (i) the risks of failure or short-circuit caused by topology changes;
- (ii) the risks of outages caused by active or reactive power changes on power generating modules or demand facilities; and
- (iii) the risks of malfunction caused by equipment behaviour;
- d give preference to remedial actions which make available the largest cross-zonal capacity for capacity allocation, while satisfying all operational security limits.

Article 22

Categories of remedial actions

- 1 Each TSO shall use the following categories of remedial actions:
 - a modify the duration of a planned outage or return to service transmission system elements to achieve the operational availability of those transmission system elements;
 - b actively impact power flows by means of:
 - (i) tap changes of the power transformers;
 - (ii) tap changes of the phase-shifting transformers;
 - (iii) modifying topologies;
 - c control voltage and manage reactive power by means of:
 - (i) tap changes of the power transformers;
 - (ii) switching of the capacitors and reactors;
 - (iii) switching of the power-electronics-based devices used for voltage and reactive power management;
 - (iv) instructing transmission-connected DSOs and significant grid users to block automatic voltage and reactive power control of transformers or to activate on their facilities the remedial actions set out in points (i) to (iii) if voltage deterioration jeopardises operational security or threatens to lead to a voltage collapse in a transmission system;
 - (v) requesting the change of reactive power output or voltage setpoint of the transmission-connected synchronous power generating modules;
 - (vi) requesting the change of reactive power output of the converters of transmission-connected non-synchronous power generating modules;
 - d re-calculate day-ahead and intraday cross-zonal capacities in accordance with Regulation (EU) 2015/1222;
 - e redispatch transmission or distribution-connected system users within the TSO's control area, between two or more TSOs;
 - f countertrade between two or more bidding zones;
 - g adjust active power flows through HVDC systems;
 - h activate frequency deviation management procedures;
 - i curtail, pursuant to Article 16(2) of Regulation (EC) No 714/2009, the already allocated cross-zonal capacity in an emergency situation where using that capacity endangers operational security, all TSOs at a given interconnector agree to such adjustment, and re-dispatching or countertrading is not possible; and

j where applicable, include the normal or alert state, manually controlled load-shedding.

2 Where necessary and justified in order to maintain operational security, each TSO may prepare and activate additional remedial actions. The TSO shall report and justify those instances to the relevant regulatory authority and, where applicable, the Member State, at least once every year, after the activation of the additional remedial actions. The relevant reports and justifications shall also be published. The European Commission or the Agency may request the relevant regulatory authority to provide additional information concerning the activation of additional remedial actions in those instances where they affect a neighbouring transmission system.

Article 23

Preparation, activation and coordination of remedial actions

1 Each TSO shall prepare and activate remedial actions in accordance with the criteria set out in Article 21(2) to prevent the system state from deteriorating on the basis of the following elements:

- a the monitoring and determination of system states in accordance with Article 19;
- b the contingency analysis in real-time operation in accordance with Article 34; and
- c the contingency analysis in operational planning in accordance with Article 72.

2 When preparing and activating a remedial action, including redispatching or countertrading pursuant to Articles 25 and 35 of Regulation (EU) 2015/1222, or a procedure of a TSO's system defence plan which affects other TSOs, the relevant TSO shall assess, in coordination with the TSOs concerned, the impact of such remedial action or measure within and outside of its control area, in accordance with Article 75(1), Article 76(1)(b) and Article 78(1), (2) and (4) and shall provide the TSOs concerned with the information about this impact.

3 When preparing and activating remedial actions which have an impact on the transmission-connected SGUs and DSOs, each TSO shall, if its transmission system is in normal or alert state, assess the impact of such remedial actions in coordination with the affected SGUs and DSOs and select remedial actions that contribute to maintaining normal state and secure operation of all involved parties. Each affected SGU and DSO shall provide to the TSO all necessary information for this coordination.

4 When preparing and activating remedial actions each TSO shall, if its transmission system is not in normal or alert state, coordinate to the extent possible such remedial actions with the affected transmission-connected SGUs and DSOs to maintain the operational security and the integrity of the transmission system.

When a TSO activates a remedial action each impacted transmission-connected significant grid user and DSO shall execute the instructions given by the TSO

5 Where constraints have only consequences on the local state within the TSO's control area and the operational security violation does not need to be managed in a coordinated way, the TSO responsible for its management may decide not to activate remedial actions with costs to relieve them.

Article 24

Availability of TSO's means, tools and facilities

1 Each TSO shall ensure the availability, reliability and redundancy of the following items:

- a facilities for monitoring the system state of the transmission system, including state estimation applications and facilities for load-frequency control;
- b means to control the switching of circuit breakers, coupler circuit breakers, transformer tap changers and other equipment which serve to control transmission system elements;
- c means to communicate with the control rooms of other TSOs and RSCs;
- d tools for operational security analysis; and
- e tools and communication means necessary for TSOs to facilitate cross-border market operations.

2 Where the TSO's tools, means and facilities referred to in paragraph 1 affect the transmission-connected DSOs or SGUs involved in supplying balancing services, ancillary services or in system defence or restoration or in delivery of real-time operational data according to Articles 44, 47, 50, 51 and 52, the relevant TSO and those DSOs and SGUs shall cooperate and coordinate to specify and ensure the availability, reliability and redundancy of these tools, means and facilities.

3 Within 18 months from the entry into force of this Regulation each TSO shall adopt a business continuity plan detailing its responses to a loss of critical tools, means and facilities, containing provisions for their maintenance, replacement and development. Each TSO shall review at least annually its business continuity plan and update it as necessary and in any case following any significant change of the critical tools, means and facilities or of the relevant system operation conditions. The TSO shall share parts of the business continuity plan which affect DSOs and SGUs with the DSOs and SGUs concerned.

Article 25

Operational security limits

1 Each TSO shall specify the operational security limits for each element of its transmission system, taking into account at least the following physical characteristics:

- a voltage limits in accordance with Article 27;
- b short-circuit current limits according to Article 30; and
- c current limits in terms of thermal rating including the transitory admissible overloads.

2 When defining the operational security limits, each TSO shall take into account the capabilities of SGUs to prevent that voltage ranges and frequency limits in normal and alert states lead to their disconnection.

3 In case of changes of one of its transmission system elements, each TSO shall validate and where necessary update the operational security limits.

4 For each interconnector each TSO shall agree with the neighbouring TSO on common operational security limits in accordance with paragraph 1.

Article 26

Security plan for critical infrastructure protection

1 Each TSO shall specify, taking into account Article 5 of Council Directive 2008/114/EC⁽¹⁾, a confidential security plan containing a risk assessment of assets owned or operated by the TSO, covering major physical or cyber threat scenarios determined by the Member State.

2 The security plan shall consider potential impacts to the European interconnected transmission systems, and include organizational and physical measures aiming at mitigating the identified risks.

3 Each TSO shall regularly review the security plan to address changes of threat scenarios and reflect the evolution of the transmission system.

CHAPTER 2

Voltage control and reactive power management

Article 27

Obligations of all TSOs regarding voltage limits

1 In accordance with Article 18, each TSO shall endeavour to ensure that during the normal state the voltage remains in steady-state at the connection points of the transmission system within the ranges specified in the Tables 1 and 2 of Annex II.

2 If the relevant TSO in Spain requires in accordance with Article 16(2) of Regulation (EU) 2016/631 that power generating modules connected to nominal voltages between 300 and 400 kV stay connected in the voltage range from 1,05 to 1,0875 per unit for an unlimited time, that additional voltage range shall be considered by the relevant TSO in Spain when complying with paragraph 1.

3 Each TSO shall define the voltage base for the per unit values' notation.

4 Each TSO shall endeavour to ensure that, during the normal state and after the occurrence of a contingency, the voltage remains, within wider voltage ranges for limited times of operation if there is agreement about those wider voltage ranges with transmission-connected DSOs, power generating facility owners in accordance with Article 16(2) of Regulation (EU) 2016/631 or HVDC system owners in accordance with Article 18 of Regulation (EU) 2016/1447.

5 Each TSO shall agree, with the transmission-connected DSOs and the transmission-connected significant grid users, about voltage ranges at the connection points below 110 kV if those voltage ranges are relevant for maintaining operational security limits. Each TSO shall endeavour to ensure that the voltage remains within the agreed range during the normal state and after the occurrence of a contingency.

Article 28

Obligations of SGUs concerning voltage control and reactive power management in system operation

1 By 3 months after entry into force of this Regulation, all SGUs which are transmission-connected power generating modules not subject to Article 16 of Regulation (EU) 2016/631, or which are HVDC systems not subject to Article 18 of Regulation (EU) 2016/1447, shall inform their TSO about their capabilities compared to the voltage requirements in Article 16 of Regulation (EU) 2016/631 or in Article 18 of Regulation (EU) 2016/1447, declaring their voltage capabilities and the time they can withstand without disconnection.

2 SGUs which are demand facilities subject to the requirements of Article 3 of Regulation (EU) 2016/1388 shall not disconnect due to a disturbance within the voltage ranges referred to in Article 27. By 3 months after entry into force of this Regulation, SGUs which are transmission-connected demand facilities and which are not subject to Article 3 of Regulation (EU) 2016/1388 shall inform their TSO about their capabilities in relation to the voltage requirements defined in Annex II of Regulation (EU) 2016/1388 declaring their voltage capabilities and the time they can withstand without disconnection.

3 Each SGU which is a transmission-connected demand facility shall maintain the reactive power setpoints, power factor ranges and voltage setpoints for voltage control in the range agreed with its TSO in accordance with Article 27.

Article 29

Obligations of all TSOs concerning voltage control and reactive power management in system operation

1 If voltage at a connection point to the transmission system is outside the ranges defined in Tables 1 and 2 of Annex II to this Regulation, each TSO shall apply voltage control and reactive power management remedial actions in accordance with Article 22(1)(c) of this Regulation in order to restore voltage at the connection point within the range specified in Annex II and within time range specified in Article 16 of Regulation (EU) 2016/631 and Article 13 of Regulation (EU) 2016/1388.

2 Each TSO shall take into account in its operational security analysis the voltage values at which transmission-connected SGUs not subject to the requirements of Regulation (EU) 2016/631 or Regulation (EU) 2016/1388 may disconnect.

3 Each TSO shall ensure reactive power reserve, with adequate volume and time response, in order to keep the voltages within its control area and on interconnectors within the ranges set out in Annex II.

4 TSOs interconnected by AC interconnectors shall jointly specify the adequate voltage control regime in order to ensure that the common operational security limits established in accordance with Article 25(4) are respected.

5 Each TSO shall agree with each transmission-connected DSO on the reactive power setpoints, power factor ranges and voltage setpoints for voltage control at the connection point between the TSO and the DSO in accordance with Article 15 of Regulation (EU) 2016/1388. To ensure that those parameters are maintained, each transmission-connected DSO shall use its

reactive power resources and have the right to give voltage control instructions to distribution-connected SGUs.

6 Each TSO shall be entitled to use all available transmission-connected reactive power capabilities within its control area for effective reactive power management and maintaining the voltage ranges set out in Tables 1 and 2 of Annex II of this Regulation.

7 Each TSO shall, directly or indirectly in coordination with the transmission-connected DSO where applicable, operate reactive power resources within its control area, including the 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 a voltage collapse of the transmission system.

8 Each TSO shall determine the voltage control actions in coordination with the transmission-connected SGUs and DSOs and with neighbouring TSOs.

9 When relevant for the voltage control and reactive power management of the transmission system, a TSO may require, in coordination with a DSO, a distribution-connected SGU to follow voltage control instructions.

CHAPTER 3

Short-circuit current management

Article 30

Short-circuit current

Each TSO shall determine:

- (a) the maximum short-circuit current at which the rated capability of circuit breakers and other equipment is exceeded; and
- (b) the minimum short-circuit current for the correct operation of protection equipment.

Article 31

Short-circuit current calculation and related measures

1 Each TSO shall perform short-circuit current calculations in order to evaluate the impact of neighbouring TSOs and transmission-connected SGUs and transmission-connected distribution systems including closed distribution systems on the short-circuit current levels in transmission system. Where a transmission-connected distribution system including closed distribution system has an impact on short-circuit current levels, it shall be included in the transmission system short-circuit current calculations.

- 2 While performing short-circuit current calculations, each TSO shall:
- a use the most accurate and high quality available data;
 - b take into account international standards; and
 - c consider as the basis of the maximum short-circuit current calculation such operational conditions, which provide the highest possible level of short-circuit current, including the short-circuit current from other transmission systems and distribution systems including closed distribution systems.

3 Each TSO shall apply operational or other measures to prevent deviation from the maximum and minimum short-circuit current limits referred to in Article 30, at all time-frames and for all protection equipment. If such a deviation occurs, each TSO shall activate remedial actions or apply other measures to ensure that the limits referred to in Article 30 are re-established. A deviation from those limits is allowed only during switching sequences.

CHAPTER 4

Power flow management

Article 32

Power flow limits

1 Each TSO shall maintain power flows within the operational security limits defined when the system is in normal state and after the occurrence of a contingency from the contingency list referred to in Article 33(1).

2 In the (N-1)-situation, in the normal state each TSO shall maintain power flows within the transitory admissible overloads referred to in Article 25(1)(c), having prepared remedial actions to be applied and executed within the time-frame allowed for transitory admissible overloads.

CHAPTER 5

Contingency analysis and handling

Article 33

Contingency lists

1 Each TSO shall establish a contingency list, including the internal and external contingencies of its observability area, by assessing whether any of those contingencies endangers the operational security of the TSO's control area. The contingency list shall include both ordinary contingencies and exceptional contingencies identified by application of the methodology developed pursuant to Article 75.

2 To establish a contingency list, each TSO shall classify each contingency on the basis of whether it is ordinary, exceptional or out-of-range, taking into account the probability of occurrence and the following principles:

- a each TSO shall classify contingencies for its own control area;
- b when operational or weather conditions significantly increase the probability of an exceptional contingency, each TSO shall include that exceptional contingency in its contingency list; and
- c in order to account for exceptional contingencies with high impact on its own or neighbouring transmission systems, each TSO shall include such exceptional contingencies in its contingency list.

3 Each transmission-connected DSO and SGU which is a power generating facility shall deliver all information relevant for contingency analysis as requested by the TSO, including forecast and real-time data, with possible data aggregation in accordance with Article 50(2).

4 Each TSO shall coordinate its contingency analysis in terms of coherent contingency lists at least with the TSOs from its observability area, in accordance with the Article 75.

5 Each TSO shall inform the TSOs in its observability area about the external contingencies included in its contingency list.

6 Each TSO shall inform, sufficiently in advance, the TSOs concerned in its observability area of any intended topological changes on its transmission system elements which are included as external contingencies in the contingency lists of the TSOs concerned.

7 Each TSO shall ensure that the real-time data is sufficiently accurate to allow the convergence of load-flow calculations which are performed in the contingency analysis.

Article 34

Contingency analysis

1 Each TSO shall perform contingency analysis in its observability area in order to identify the contingencies which endanger or may endanger the operational security of its control area and to identify the remedial actions that may be necessary to address the contingencies, including mitigation of the impact of exceptional contingencies.

2 Each TSO shall ensure that potential violations of the operational security limits in its control area which are identified by the contingency analysis do not endanger the operational security of its transmission system or of interconnected transmission systems.

3 Each TSO shall perform contingency analysis based on the forecast of operational data and on real-time operational data from its observability area. The starting point for the contingency analysis in the N-Situation shall be the relevant topology of the transmission system which shall include planned outages in the operational planning phases.

Article 35

Contingency handling

1 Each TSO shall assess the risks associated with the contingencies after simulating each contingency from its contingency list and after assessing whether it can maintain its transmission system within the operational security limits in the (N-1) situation.

2 When a TSO assesses that the risks associated with a contingency are so significant that it might not be able to prepare and activate remedial actions in a timely manner to prevent non-compliance with the (N-1) criterion or that there is a risk of propagation of a disturbance to the interconnected transmission system, the TSO shall prepare and activate remedial actions to achieve compliance with the (N-1) criterion as soon as possible.

3 In case of an (N-1) situation caused by a disturbance, each TSO shall activate a remedial action in order to ensure that the transmission system is restored to a normal state as soon as possible and that this (N-1) situation becomes the new N-Situation.

4 A TSO shall not be required to comply with the (N-1) criterion in the following situations:

- a during switching sequences;
- b during the time period required to prepare and activate remedial actions.

5 Unless a Member State determines otherwise, a TSO shall not be required to comply with the (N-1) criterion as long as there are only local consequences within the TSO's control area.

CHAPTER 6

Protection

Article 36

General requirements on protection

1 Each TSO shall operate its transmission system with the protection and backup protection equipment in order to automatically prevent the propagation of disturbances that could endanger the operational security of its own transmission system and of the interconnected system.

2 At least once every 5 years, each TSO shall review its protection strategy and concepts and update them where necessary to ensure the correct functioning of the protection equipment and the maintenance of operational security.

3 After a protection operation which had an impact outside a TSO's control area including interconnectors, that TSO shall assess whether the protection equipment in its control area worked as planned and shall undertake corrective actions if necessary.

4 Each TSO shall specify setpoints for the protection equipment of its transmission system that ensure reliable, fast and selective fault clearing, including backup protection for fault clearing in case of malfunction of the primary protection system.

5 Before protection and backup protection equipment entry into service or following any modifications, each TSO shall agree with the neighbouring TSOs on the definition of protection setpoints for the interconnectors and shall coordinate with those TSOs before changing the settings.

Article 37

Special protection schemes

Where a TSO uses a special protection scheme, it shall:

- (a) ensure that each special protection scheme acts selectively, reliably and effectively;
- (b) evaluate, when designing a special protection scheme, the consequences for the transmission system in the event of its incorrect functioning, taking into account the impact on TSOs concerned;
- (c) verify that the special protection scheme has a comparable reliability to the protection systems used for the primary protection of transmission system elements;
- (d) operate the transmission system with the special protection scheme within the operational security limits determined in accordance with Article 25; and

- (e) coordinate special protection scheme functions, activation principles and setpoints with neighbouring TSOs and affected transmission-connected DSOs, including closed distribution systems and affected transmission-connected SGUs.

Article 38

Dynamic stability monitoring and assessment

1 Each TSO shall monitor the dynamic stability of the transmission system by studies conducted offline in accordance with paragraph 6. Each TSO shall exchange the relevant data for monitoring the dynamic stability of the transmission system with the other TSOs of its synchronous area.

2 Each TSO shall perform a dynamic stability assessment at least once a year to identify the stability limits and possible stability problems in its transmission system. All TSOs of each synchronous area shall coordinate the dynamic stability assessments, which shall cover all or parts of the synchronous area.

3 When performing coordinated dynamic stability assessments, concerned TSOs shall determine:

- a the scope of the coordinated dynamic stability assessment, at least in terms of a common grid model;
- b the set of data to be exchanged between concerned TSOs in order to perform the coordinated dynamic stability assessment;
- c a list of commonly agreed scenarios concerning the coordinated dynamic stability assessment; and
- d a list of commonly agreed contingencies or disturbances whose impact shall be assessed through the coordinated dynamic stability assessment.

4 In case of stability problems due to poorly damped inter-area oscillations affecting several TSOs within a synchronous area, each TSO shall participate in a coordinated dynamic stability assessment at the synchronous area level as soon as practicable and provide the data necessary for that assessment. Such assessment shall be initiated and conducted by the concerned TSOs or by ENTSO for Electricity.

5 When a TSO identifies a potential influence on voltage, rotor angle or frequency stability in relation with other interconnected transmission systems, the TSOs concerned shall coordinate the methods used in the dynamic stability assessment, providing the necessary data, planning of joint remedial actions aiming at improving the stability, including the cooperation procedures between the TSOs.

6 In deciding the methods used in the dynamic stability assessment, 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 the dynamic stability assessment 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 dynamic stability assessment in the day-ahead operational planning phase while those conditions remain. The TSO shall plan remedial actions to be used in real-time operation if necessary; and
- c if the transmission system is in the N-situation with respect to the contingency list and stability limits are reached before steady-state limits, the TSO shall perform a dynamic

stability assessment in all phases of operational planning and re-assess the stability limits as soon as possible after a significant change in the N-situation is detected.

Article 39

Dynamic stability management

1 Where the dynamic stability assessment indicates that there is a violation of stability limits, the TSOs in whose control area the violation has appeared shall design, prepare and activate remedial actions to keep the transmission system stable. Those remedial actions may involve SGUs.

2 Each TSO shall ensure that the fault clearing times for faults that may lead to wide area state transmission system instability are shorter than the critical fault clearing time calculated by the TSO in its dynamic stability assessment carried out in accordance with Article 38.

3 In relation to the requirements on minimum inertia which are relevant for frequency stability at the synchronous area level:

- a all TSOs of that synchronous area shall conduct, not later than 2 years after entry into force of this Regulation, a common study per synchronous area to identify whether the minimum required inertia needs to be established, taking into account the costs and benefits as well as potential alternatives. All TSOs shall notify their studies to their regulatory authorities. All TSOs shall conduct a periodic review and shall update those studies every 2 years;
- b where the studies referred to in point (a) demonstrate the need to define minimum required inertia, all TSOs from the concerned synchronous area shall jointly develop a methodology for the definition of minimum inertia required to maintain operational security and to prevent violation of stability limits. That methodology shall respect the principles of efficiency and proportionality, be developed within 6 months after the completion of the studies referred to in point (a) and shall be updated within 6 months after the studies are updated and become available; and
- c each TSO shall deploy in real-time operation the minimum inertia in its own control area, according to the methodology defined and the results obtained in accordance with paragraph (b).

TITLE 2

DATA EXCHANGE

CHAPTER 1

General requirements on data exchange

Article 40

Organisation, roles, responsibilities and quality of data exchange

1 The exchange and provision of data and information pursuant to this Title shall reflect, to the extent possible, the real and forecasted situation of the transmission system.

2 Each TSO shall be responsible for providing and using high quality data and information.

3 Each TSO shall gather the following information about its observability area and shall exchange this data with all other TSOs to the extent that it is necessary for carrying out the operational security analysis in accordance with Article 72:

- a generation;
- b consumption;
- c schedules;
- d balance positions;
- e planned outages and substation topologies; and
- f forecasts.

4 Each TSO shall represent the information in paragraph (3) as injections and withdrawals at each node of the TSO's individual grid model referred to in Article 64.

5 In coordination with the DSOs and SGUs, each TSO shall determine the applicability and scope of the data exchange based on the following categories:

- a structural data in accordance with Article 48;
- b scheduling and forecast data in accordance with Article 49;
- c real-time data in accordance with Articles 44, 47 and 50; and
- d provisions in accordance with Articles 51, 52 and 53.

6 By 6 months after entry into force of this Regulation, all TSOs shall jointly agree on key organisational requirements, roles and responsibilities in relation to data exchange. Those organisational requirements, roles and responsibilities shall take into account and complement where necessary the operational conditions of the generation and load data methodology developed in accordance with Article 16 of Regulation (EU) 2015/1222. They shall apply to all data exchange provisions in this Title and shall include organisational requirements, roles and responsibilities for the following elements:

- a obligations for TSOs to communicate without delay to all neighbouring TSOs any changes in the protection settings, thermal limits and technical capacities at the interconnectors between their control areas;
- b obligations for DSOs directly connected to the transmission system to inform the TSOs they are connected to, within the agreed timescales, of any changes in the data and information pursuant to this Title;
- c obligations for the adjacent DSOs and/or between the downstream DSO and upstream DSO to inform each other within agreed timescales of any changes in the data and information pursuant to this Title;
- d obligations for SGUs to inform their TSO or DSO, within agreed timescales, about any relevant changes in the data and information established pursuant to this Title;
- e detailed contents of the data and information established pursuant to this Title, including main principles, type of data, communication means, format and standards to be applied, timing and responsibilities;
- f the time stamping and frequency of delivery of the data and information to be provided by DSOs and SGUs, to be used by TSOs in the different timescales. The frequency of information exchanges for real-time data, scheduled data and update of structural data shall be defined; and
- g the format for the reporting of the data and information established pursuant to this Title.

The organisational requirements, roles and responsibilities shall be published by ENTSO for Electricity.

7 By 18 months after entry into force of this Regulation, each TSO shall agree with the relevant DSOs on effective, efficient and proportional processes for providing and managing data exchanges between them, including, where required for efficient network operation, the provision of data related to distribution systems and SGUs. Without prejudice to the provisions of paragraph 6(g), each TSO shall agree with the relevant DSOs on the format for the data exchange.

8 Transmission-connected SGUs shall have access to the data related to their commissioned network installations at the connection point.

9 Each TSO shall agree with the transmission-connected DSOs on the scope of additional information to be exchanged between them concerning commissioned network installations.

10 DSOs with a connection point to a transmission system shall be entitled to receive the relevant structural, scheduled and real-time information from the relevant TSOs and to gather the relevant structural, scheduled and real-time information from the neighbouring DSOs. Neighbouring DSOs shall determine, in a coordinated manner, the scope of information that may be exchanged.

CHAPTER 2

Data exchange between TSOs

Article 41

Structural and forecast data exchange

1 Neighbouring TSOs shall exchange at least the following structural information related to the observability area:

- a the regular topology of substations and other relevant data, by voltage level;
- b technical data on transmission lines;
- c technical data on transformers connecting the DSOs, SGUs which are demand facilities and generators' block-transformers of SGUs which are power generating facilities;
- d the maximum and minimum active and reactive power of SGUs which are power generating modules;
- e technical data on phase-shifting transformers;
- f technical data on HVDC systems;
- g technical data on reactors, capacitors and static volt-ampere reactive (VAR) compensators; and
- h operational security limits defined by each TSO according to Article 25.

2 To coordinate the protection of their transmission systems, neighbouring TSOs shall exchange the protection setpoints of the lines for which the contingencies are included as external contingencies in their contingency lists.

3 To coordinate their operational security analysis and to establish the common grid model in accordance with Articles 67, 68, 69 and 70, each TSO shall exchange, with at least all other TSOs from the same synchronous area, at least the following data:

- a the topology of the 220 kV and higher voltage transmission systems within its control area;

Status: This is the original version (as it was originally adopted).

- b a model or an equivalent of the transmission system with voltage below 220 kV with significant impact on its own transmission system;
 - c the thermal limits of the transmission system elements; and
 - d a realistic and accurate forecasted aggregate amount of injection and withdrawal, per primary energy source, at each node of the transmission system, for different time-frames.
- 4 To coordinate the dynamic stability assessments pursuant to Article 38(2) and (4), and to carry them out, each TSO shall exchange with the other TSOs of the same synchronous area or of its relevant part the following data:
- a data concerning SGUs which are power generating modules relating to, but not limited to:
 - (i) electrical parameters of the alternator suitable for the dynamic stability assessment, including total inertia;
 - (ii) protection models;
 - (iii) alternator and prime mover;
 - (iv) step-up transformer description;
 - (v) minimum and maximum reactive power;
 - (vi) voltage models and speed controller models; and
 - (vii) prime movers models and excitation system models suitable for large disturbances;
 - b the data on type of regulation and voltage regulation range concerning tap changers, including the description of existing on-load tap changers, and the data on type of regulation and voltage regulation range concerning step-up and network transformers; and
 - c the data concerning HVDC systems and FACTS devices on the dynamic models of the system or the device and its associated regulation suitable for large disturbances.

Article 42

Real-time data exchange

- 1 In accordance with Articles 18 and 19, each TSO shall exchange with the other TSOs of the same synchronous area the following data on the system state of its transmission system using the IT tool for real-time data exchange at pan-European level as provided by ENTSO for Electricity:
- a frequency;
 - b frequency restoration control error;
 - c measured active power interchanges between LFC areas;
 - d aggregated generation infeed;
 - e system state in accordance with Article 18;
 - f setpoint of the load-frequency controller; and
 - g power interexchange via virtual tie-lines.

2 Each TSO shall exchange with the other TSOs in its observability area the following data about its transmission system using real-time data exchanges between the TSOs' supervisory control and data acquisition (SCADA) systems and energy management systems:

- a actual substation topology;
- b active and reactive power in line bay, including transmission, distribution and lines connecting SGUs;
- c active and reactive power in transformer bay, including transmission, distribution and SGUs 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.

3 Each TSO shall have the right to request all TSOs from its observability area to provide real-time snapshots of state estimated data from that TSO's control area if that is relevant for the operational security of the transmission system of the requesting TSO.

CHAPTER 3

Data exchange between TSOs and DSOs within the TSO's control area

Article 43

Structural data exchange

1 Each TSO shall determine the observability area of the transmission-connected distribution systems which is needed for the TSO to determine the system state accurately and efficiently, based on the methodology developed in accordance with Article 75.

2 If a TSO considers that a non-transmission-connected distribution system has a significant influence in terms of voltage, power flows or other electrical parameters for the representation of the transmission system's behaviour, such distribution system shall be defined by the TSO as being part of the observability area in accordance with Article 75.

3 The structural information related to the observability area referred to in paragraphs 1 and 2 provided by each DSO to the TSO shall include at least:

- a substations by voltage;
- b lines that connect the substations referred to in point (a);
- c transformers from the substations referred to in point (a);
- d SGUs; and
- e reactors and capacitors connected to the substations referred to in point (a).

4 Each transmission-connected DSO shall provide the TSO with an update of the structural information in accordance with paragraph 3 at least every 6 months.

5 At least once a year, each transmission-connected DSO shall provide the TSO, per primary energy sources, the total aggregated generating capacity of the type A power generating modules subject to requirements of Regulation (EU) 2016/631 and the best possible estimates of generating capacity of type A power generating modules not subject to or derogated from

Regulation (EU) 2016/631, connected to its distribution system, and the related information concerning their frequency behaviour.

Article 44

Real-time data exchange

Unless otherwise provided by the TSO, each DSO shall provide its TSO, in real-time, the information related to the observability area of the TSO as referred to in Article 43(1) and (2), including:

- (a) the actual substation topology;
- (b) the active and reactive power in line bay;
- (c) the active and reactive power in transformer bay;
- (d) the active and reactive power injection in power generating facility bay;
- (e) the tap positions of transformers connected to the transmission system;
- (f) the busbar voltages;
- (g) the reactive power in reactor and capacitor bay;
- (h) the best available data for aggregated generation per primary energy source in the DSO area; and
- (i) the best available data for aggregated demand in the DSO area.

CHAPTER 4

Data exchange between TSOs, owners of interconnectors or other lines and power generating modules connected to the transmission system

Article 45

Structural data exchange

1 Each SGU which is a power generating facility owner of a type D power generating module connected to the transmission system shall provide the TSO with at least the following data:

- 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 current calculation;
- d power generating facility transformer data;
- e FCR data of power generating modules offering or providing that service, in accordance with Article 154;
- f FRR data of power generating modules offering or providing that service, in accordance with Article 158;
- g RR data of power generating modules that offer or provide that service in accordance with Article 161;

- h data necessary for restoration of the transmission system;
 - i data and models necessary for performing dynamic simulation;
 - j protection data;
 - k data necessary for determining the costs of remedial actions in accordance with Article 78(1)(b); where a TSO makes use of market based mechanisms in line with Article 4(2) (d), the provision of prices to be paid by the TSO shall be considered sufficient;
 - l voltage and reactive power control capability.
- 2 Each SGU which is a power generating facility owner of a type B or a type C power generating module connected to the transmission system shall provide the TSO with at least the following data:
- a general data of the power generating module, including installed capacity and primary energy source;
 - b data for short-circuit current calculation;
 - c FCR data according to the definition and requirements of the Article 173 for power generating modules offering or providing that service;
 - d FRR data for power generating modules that offer or provide that service;
 - e RR data for power generating modules that offer or provide that service;
 - f protection data;
 - g reactive power control capability;
 - h data necessary for determining the costs of remedial actions in accordance with Article 78(1)(b); where a TSO makes use of market based mechanisms in line with Article 4(2) (d), the provision of prices to be paid by the TSO shall be considered sufficient;
 - i data necessary for performing dynamic stability assessment according to Article 38.
- 3 A TSO may request the power generating facility owner of a power generating module connected to the transmission system to provide further data where appropriate for operational security analysis in accordance with Title 2 of Part III.
- 4 Each HVDC system owner or interconnector owner shall provide the TSO with the following data regarding the HVDC system or interconnector:
- a nameplate data of the installation;
 - b transformers data;
 - c data on filters and filter banks;
 - d reactive power compensation data;
 - e active power control capability;
 - f reactive power and voltage control capability;
 - g active or reactive operational mode prioritization, if existing;
 - h frequency response capability;
 - i dynamic models for dynamic simulation;
 - j protection data; and
 - k fault-ride-through capability.
- 5 Each AC interconnector owner shall provide the TSO with at least the following data:
- a nameplate data of the installation;
 - b electrical parameters;
 - c associated protections.

Article 46

Scheduled data exchange

1 Each SGU which is a power generating facility owner of a type B, C or D power generating module connected to the transmission system shall provide the TSO with at least the following data:

- a active power output and active power reserves amount and availability, on a day-ahead and intra-day basis;
- b without any delay, any scheduled unavailability or active power restriction;
- c any forecasted restriction in the reactive power control capability; and
- d as an exception to points (a) and (b), in regions with a central dispatch system, data requested by the TSO for the preparation of its active power output schedule.

2 Each HVDC system operator shall provide the TSOs with at least the following data:

- a active power schedule and availability on a day-ahead and intra-day basis;
- b without delay its scheduled unavailability or active power restriction; and
- c any forecast restriction in the reactive power or voltage control capability.

3 Each AC interconnector or line operator shall provide its scheduled unavailability or active power restriction data to the TSOs.

Article 47

Real-time data exchange

1 Unless otherwise provided by the TSO, each significant grid user which is a power generating facility owner of type B, C or D power generating module shall provide the TSO, in real-time, at least the following data:

- 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 Unless otherwise provided by the TSO, each HVDC system or AC interconnector owner shall provide, in real-time, at least the following data regarding the connection point of the HVDC system or AC interconnector to the TSOs:

- a position of the circuit breakers;
- b operational status; and
- c active and reactive power.

CHAPTER 5

Data exchange between TSOs, DSOs and distribution-connected power generating modules

Article 48

Structural data exchange

1 Unless otherwise provided by the TSO, each power generating facility owner of a power generating module which is a SGU pursuant to Article 2(1)(a) and by aggregation of the SGUs pursuant to Article 2(1)(e) connected to the distribution system shall provide at least the following data to the TSO and to the DSO to which it has a connection point:

- a general data of the power generating module, including installed capacity and primary energy source or fuel type;
- b FCR data according to the definition and requirements of Article 173 for power generating facilities offering or providing the FCR service;
- c FRR data for power generating facilities offering or providing the FRR service;
- d RR data for power generating modules offering or providing the RR 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 Regulation (EU) 2016/631; and
- i voltage level and location of each power generating module.

2 Each power generating facility owner of a power generating module which is a SGU in accordance with Article 2(1)(a) and (e) shall inform the TSO and the DSO to which it has a connection point, within the agreed time and not later than the first commissioning or any changes to the existing installation, about any change in the scope and the contents of the data listed in paragraph 1.

Article 49

Scheduled data exchange

Unless otherwise provided by the TSO, each power generating facility owner of a power generating module which is a SGU in accordance with Article 2(1)(a) and 2(1)(e) connected to the distribution system shall provide the TSO and the DSO to which it has the connection point, with at least the following data:

- (a) its scheduled unavailability, scheduled active power restriction and its forecasted scheduled active power output at the connection point;
- (b) any forecasted restriction in the reactive power control capability; and
- (c) as an exception to paragraphs (a) and (b), in regions with a central dispatch system, data requested by the TSO for the preparation of its active power output schedule.

Article 50

Real-time data exchange

1 Unless otherwise provided by the TSO, each power generating facility owner of a power generating module which is a SGU in accordance with Article 2(1)(a) and (e) connected to the distribution system shall provide the TSO and the DSO to which it has the connection point, in real-time, at least the following data:

- 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 in coordination with the responsible DSOs which SGUs may be exempted from providing the real-time data listed in paragraph 1 directly to the TSO. In such cases, the responsible TSOs and DSOs shall agree on the aggregated real-time data of the SGUs concerned to be delivered to the TSO.

Article 51

Data exchange between TSOs and DSOs concerning significant power generating modules

1 Unless otherwise provided by the TSO, each DSO shall provide to its TSO the information specified in Articles 48, 49 and 50 with the frequency and level of detail requested by the TSO.

2 Each TSO shall make available to the DSO, to whose distribution system SGUs are connected, the information specified in Articles 48, 49 and 50 as requested by the DSO.

3 A TSO may request further data from a power generating facility owner of a power generating module which is a SGU in accordance with Article 2(1)(a) and (e) connected to the distribution system, if it is necessary for the operational security analysis and for the validation of models.

CHAPTER 6

Data exchange between TSOs and demand facilities

Article 52

Data exchange between TSOs and transmission-connected demand facilities

1 Unless otherwise provided by the TSO, each transmission-connected demand facility owner 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 Unless otherwise provided by the TSO, each transmission-connected demand facility owner shall provide the following data to the TSO:

- a scheduled active and forecasted reactive power consumption on a day-ahead and intraday basis, including any changes of those schedules or forecast;
 - b any forecasted restriction in the reactive power control capability;
 - c in case of participation in demand response, a schedule of its structural minimum and maximum power range to be curtailed; and
 - d by exception to point (a), in regions with a central dispatch system, the data requested by the TSO for the preparation of its active power output schedule.
- 3 Unless otherwise provided by the TSO, each transmission-connected demand facility owner shall provide the following data to the TSO in real-time:
- a active and reactive power at the connection point; and
 - b the minimum and maximum power range to be curtailed.
- 4 Each transmission-connected demand facility owner shall describe to its TSO its behaviour at the voltage ranges referred to in Article 27.

Article 53

Data exchange between TSOs and distribution-connected demand facilities or third parties participating in demand response

- 1 Unless otherwise provided by the TSO, each SGU which is a distribution-connected demand facility and which participates in demand response other than through a third party shall provide the following scheduled and real-time data to the TSO and to the DSO:
- a structural minimum and maximum active power available for demand response and the maximum and minimum duration of any potential usage of this power for demand response;
 - b a forecast of unrestricted active power available for demand response and any planned demand response;
 - c real-time active and reactive power at the connection point; and
 - d a confirmation that the estimations of the actual values of demand response are applied.
- 2 Unless otherwise provided by the TSO, each SGU which is a third party participating in demand response as defined in Article 27 of Regulation (EU) 2016/1388, shall provide the TSO and the DSO at the day-ahead and close to real-time and on behalf of all of its distribution-connected demand facilities, with the following data:
- a structural minimum and maximum active power available for demand response and the maximum and minimum duration of any potential activation of demand response in a specific geographical area defined by the TSO and DSO;
 - b a forecast of unrestricted active power available for the demand response and any planned level of demand response in a specific geographical area defined by the TSO and DSO;
 - c real-time active and reactive power; and
 - d a confirmation that the estimations of the actual values of demand response are applied.

TITLE 3

COMPLIANCE

CHAPTER 1

Roles and responsibilities

Article 54

Responsibility of the SGUs

1 Each SGU shall notify the TSO or DSO to which it has a connection point about any planned modification of its technical capabilities which could have an impact on its compliance with the requirements of this Regulation, prior to its execution.

2 Each SGU shall notify the TSO or DSO to which it has a connection point about any operational disturbance in its facility which could have an impact on its compliance with the requirements of this Regulation as soon as possible after its occurrence.

3 Each SGU shall notify the TSO or DSO to which it has a connection point of the planned test schedules and procedures to be followed for verifying the compliance of its facility with the requirements of this Regulation, in due time and prior to their launch. The TSO or DSO shall approve in advance and in a timely manner the planned test schedules and procedures and the approval shall not be unreasonably withheld. Where the SGU has a connection point to the DSO and interacts, pursuant to paragraph 2, only with the DSO, the TSO shall be entitled to request from the concerned DSO any compliance testing results, which are relevant for the operational security of its transmission system.

4 Upon request from the TSO or DSO, pursuant to Article 41(2) of Regulation (EU) 2016/631 and Article 35(2) of Regulation (EU) 2016/1388, the SGU shall carry out compliance tests and simulations in accordance with those Regulations at any time throughout the lifetime of its facility and in particular after any fault, modification or replacement of any equipment, which could have an impact on the facility's compliance with the requirements of this Regulation regarding the capability of the facility to achieve the values declared, the time requirements applicable to those values and the availability or contracted provision of ancillary services. Third parties providing demand response directly to the TSO, providers of redispatching of power generating modules or demand facilities by means of aggregation, and other providers of active power reserves shall ensure that the facilities in their portfolio comply with the requirements of this Regulation.

Article 55

Tasks of TSOs regarding system operation

Each TSO shall be responsible for the operational security of its control area and, in particular, it shall:

- (a) develop and implement network operation tools that are relevant for its control area and related to real-time operation and operational planning;
- (b) develop and deploy tools and solutions for the prevention and remedy of disturbances;

- (c) use services provided by third parties, through procurement when applicable, such as redispatching or countertrading, congestion management services, generation reserves and other ancillary services;
- (d) comply with the incidents classification scale adopted by ENTSO for Electricity in accordance with Article 8(3)(a) of Regulation (EC) No 714/2009 and submit to ENTSO for Electricity the information required to perform the tasks for producing the incidents classification scale; and
- (e) monitor on an annual basis the appropriateness of the network operation tools established pursuant to points (a) and (b) required to maintain operational security. Each TSO shall identify any appropriate improvements to those network operation tools, taking into account the annual reports prepared by ENTSO for Electricity based on the incidents classification scale in accordance with Article 15. Any identified enhancement shall be implemented subsequently by the TSO.

CHAPTER 2

Operational testing

Article 56

Purpose and responsibilities

1 Each TSO and each transmission-connected DSO or SGU may perform operational testing respectively of its transmission system elements and of their facilities under simulated operational conditions and for a limited period of time. When doing so, they shall provide notification in due time and prior to the test launch and shall minimise the effect on real-time system operation. The operational testing shall aim at providing:

- a proof of compliance with all relevant technical and organisational operational provisions of this Regulation for a new transmission system element at its first entry into operation;
- b proof of compliance with all relevant technical and organisational operational provisions of this Regulation for a new facility of the SGU or of DSO at its first entry into operation;
- c proof of compliance with all relevant technical and organisational operational provisions of this Regulation upon any change of a transmission system element or a facility of the SGU or of the DSO, which is relevant for system operation;
- d assessment of possible negative effects of a failure, short-circuit or other unplanned and unexpected incident in system operation, on the transmission system element, or on the facility of the SGU or of the DSO.

2 The results of the operational testing referred to in paragraph 1 shall be used by a TSO, DSO or a SGU, in order for:

- a the TSO to ensure correct functioning of transmission system elements;
- b the DSO and SGUs to ensure correct functioning of distribution systems and of the SGUs' facilities;
- c the TSO, DSO or SGU to maintain existing and develop new operational practices;
- d the TSO to ensure fulfilment of ancillary services;

- e the TSO, DSO or SGU to acquire information about performance of transmission system elements and facilities of the SGUs and DSOs under any conditions and in compliance with all relevant operational provisions of this Regulation, in terms of:
 - (i) controlled application of frequency or voltage variations aimed at gathering information on transmission system and elements' behaviour; and
 - (ii) tests of operational practices in emergency state and restoration state.

3 Each TSO shall ensure that operational testing does not endanger the operational security of its transmission system. Any operational testing may be postponed or interrupted due to unplanned system conditions, or due to safety of personnel, of the general public, of the plant or apparatus being tested, or of transmission system elements or of the facilities of the DSO or SGU.

4 In the event of degradation of the state of the transmission system in which the operational testing is performed, the TSO of that transmission system shall be entitled to interrupt the operational testing. If conducting a test affects another TSO and its system state is also degraded, the TSO or SGU or DSO conducting the test shall, upon being informed by the TSO concerned, immediately cease the operational test.

5 Each TSO shall ensure that the results of relevant operational tests carried out together with all related analyses are:

- a incorporated into the training and certification process of the employees in charge of real-time operation;
- b used as inputs to the research and development process of ENTSO for Electricity; and
- c used to improve operational practices including also those in emergency and restoration state.

Article 57

Performing operational tests and analysis

1 Each TSO or DSO to which the SGU has a connection point retains the right to test a SGU's compliance with the requirements of this Regulation, the SGU's expected input or output and the SGU's contracted provision of ancillary services at any time throughout the lifetime of the facility. The procedure for those operational tests shall be notified to the SGU by the TSO or DSO in due time prior to the launch of the operational test.

2 The TSO or DSO to which the SGU has a connection point shall publish the list of information and documents to be provided as well as the requirements to be fulfilled by the SGU for operational testing of compliance. Such list shall cover at least the following information:

- a all documentation and equipment certificates to be provided by the SGU;
- b details of the technical data of the SGU facility with relevance for the system operation;
- c requirements for models for dynamic stability assessment; and
- d studies by the SGU demonstrating expected outcome of the dynamic stability assessment, where applicable.

3 Where applicable, each TSO or DSO shall publish the allocation of responsibilities of the SGU and of the TSO or DSO for operational testing of compliance.

TITLE 4

TRAINING

*Article 58***Training program**

- 1 By 18 months after entry into force of this Regulation each TSO shall develop and adopt:
- a an initial training program for the certification and a rolling program for the continuous training of its employees in charge of real-time operation of the transmission system;
 - b a training program for its employees in charge of operational planning. Each TSO shall contribute to developing and adopting training programs for employees of the relevant regional security coordinators;
 - c a training program for its employees in charge of balancing.
- 2 The TSO's training programs shall include 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, market arrangements, recognising of and responding to exceptional situations in system operation, operational planning activities and tools.
- 3 TSO employees in charge of real-time operation of transmission system shall, as a part of its initial training, undergo training on interoperability issues between transmission systems based upon operational experiences and feedback from the joint training carried out with neighbouring TSOs in accordance with Article 63. That training on interoperability issues shall include preparation and activation of coordinated remedial actions required in all system states.
- 4 Each TSO shall include in its training program for the employees in charge of real-time operation of the transmission system the frequency of the trainings and the following components:
- a a description of the transmission system elements;
 - b operation of the transmission system in all system states including restoration;
 - c use of the on-the-job systems and processes;
 - d coordination of inter-TSO operations and market arrangements;
 - e recognition of and response to exceptional operational situations;
 - f relevant areas of electrical power engineering;
 - g relevant aspects of the Union internal electricity market;
 - h relevant aspects of the network codes or guidelines adopted according to Articles 6 and 18 of Regulation (EC) No 714/2009;
 - i safety and security of persons, nuclear and other equipment in transmission system operation;
 - j inter-TSO cooperation and coordination in real-time operation and in operational planning at the level of main control rooms which shall be given in English unless otherwise specified;
 - k joint training with transmission-connected DSOs and SGUs, where appropriate;
 - l behavioural skills with particular focus on stress management, human acting in critical situation, responsibility and motivation skills; and
 - m operational planning practices and tools, including those used with the relevant regional security coordinators in the operational planning.

5 The training program for employees in charge of operational planning shall include at least the aspects in points (c), (f), (g), (h), (j) and (m) of paragraph 4.

6 The training program for employees in charge of balancing shall include at least the aspects in points (c), (g) and (h) of paragraph 4.

7 Each TSO shall maintain records of employees' training programs for their period of employment. Upon request of the relevant regulatory authority, each TSO shall provide the scope and details of its training programs.

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

Article 59

Training conditions

1 Each TSO's training programs for employees in charge of real-time operation shall include on-the-job and offline training. On-the-job training shall be carried out under the supervision of an experienced employee in charge of real-time operation. Offline training shall be carried out in an environment which simulates the control room and with network modelling details at a level appropriate to the tasks being trained for.

2 Each TSO shall implement training for employees in charge of real-time operation based on a comprehensive database model of their network with respective data from other networks of, at least, the observability area, at a level of detail which is sufficient to replicate inter-TSO operational issues. Training scenarios shall be based on real and simulated system conditions. Where relevant, the role of other TSOs, transmission-connected DSOs and significant grid users shall also be simulated unless they can be directly represented in joint trainings.

3 Each TSO shall coordinate the offline training of the employees in charge of real-time operation with the transmission-connected DSOs and SGUs regarding the impact of their facilities on real-time operation of the transmission system, in a comprehensive and proportionate manner, reflecting the up-to-date network topology and characteristics of secondary equipment. When relevant, TSOs, transmission-connected DSOs and SGUs shall run joint offline training simulations or training workshops.

Article 60

Training coordinators and trainers

1 The training coordinator's responsibilities shall include the designing, monitoring and updating of the training programs, as well as the determination of:

- a the qualifications and selection process for TSO employees to be trained;
- b the training required for certification of the system operator employees in charge of real-time operation;
- c the processes, including relevant documentation, for the initial and the rolling training programs;
- d the process for certification of system operator employees in charge of real-time operation; and

- e the process for extension of a training period and certification period for the system operator employees in charge of real-time operation.
- 2 Each TSO shall determine the skills and the level of competence of on-the-job trainers. On-the-job trainers shall have an appropriate level of operational experience following their certification.
- 3 Each TSO shall have a register of the system operator employees in charge of real-time operation who carry out the functions of on-the-job trainers and review their capability to provide practical training when deciding upon the extension of their certification.

Article 61

Certification of system operator employees in charge of real-time operation

- 1 An individual may become a system operator employee in charge of real-time operation provided he or she is trained and subsequently certified by a nominated representative from his or her TSO for the concerned tasks within the timescale defined in the training programme. A system operator employee in charge of real-time operation shall not work unsupervised in the control room unless he or she is certified.
- 2 By 18 months after entry into force of this Regulation, each TSO shall define and implement a process, including the level of competence, for the certification of the system operator employees in charge of real-time operation.
- 3 TSO employees in charge of real-time operation shall be certified following a successful formal assessment which shall comprise an oral and/or a written exam, and/or a practical assessment with pre-defined success criteria.
- 4 The TSO shall keep a copy of the issued certificate and of the formal assessment results. Upon request by the regulatory authority, the TSO shall provide a copy of the certification examination records.
- 5 Each TSO shall record the period of validity of the certification issued to any employee in charge of real-time operation.
- 6 Each TSO shall determine the maximum period of the certification, which shall not exceed 5 years but which may be extended on the basis of criteria determined by each TSO, and may take into account the participation of employees in charge of real-time operation in a continuous training programme with sufficient practical experience.

Article 62

Common language for communication between the system operator employees in charge of real time operation

- 1 Unless otherwise agreed, the common contact language between the employees of a TSO and those of the neighbouring TSO shall be English.
- 2 Each TSO shall train its relevant system operator employees to achieve sufficient skills in the common contact languages agreed with the neighbouring TSOs.

Article 63

Cooperation between TSOs on training

1 Each TSO shall organise regular training sessions with its neighbouring TSOs to improve the knowledge of the characteristics of neighbouring transmission systems as well as the communication and coordination between employees of neighbouring TSOs in charge of real-time operation. The inter-TSO training shall include detailed knowledge of coordinated actions required under each system state.

2 Each TSO shall determine, in cooperation with at least the neighbouring TSO, the need and frequency for joint training sessions, including 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.

3 Each TSO shall participate with other TSOs, at least once a year, in training sessions on the management of inter-TSO issues in real-time operation. The frequency shall be defined taking into account the level of mutual influence of transmission systems and the type of interconnection — DC/AC links.

4 Each TSO shall exchange experiences from real-time operation, including visits and the exchange of experiences between system operator employees in charge of real-time operation, with their neighbouring TSOs, with any TSO with which there is or has been inter-TSO operational interaction and with the relevant regional security coordinators.

- (1) Council Directive 2008/114/EC of 8 December 2008 on the identification and designation of European critical infrastructures and the assessment of the need to improve their protection (OJ L 345, 23.12.2008, p. 75).