European Network of
Transmission System Operators
for Electricity

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All TSOs' proposal for a common grid model methodology in accordance with Articles 67(1) and 70(1) of Commission Regulation (EU) 2017/1485 of 02 August 2017 establishing a guideline on electricity transmission system operation

12 February 2018

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TSOs, taking into account the following:

Whereas

(1) This document is a common proposal developed by all Transmission System Operators (hereafter referred to as "TSOs") regarding the development of a proposal for a common grid model methodology (hereafter referred to as "CGMM").

(2) This proposal (hereafter referred to as the "CGMM Proposal") takes into account the general principles and goals set in Commission Regulation (EU) 2017/1485 of 02 August 2017 establishing a guideline on electricity transmission system operation (hereafter referred to as "Regulation 2017/1485") as well as Regulation (EC) No 714/2009 of the European Parliament and of the Council of 13 July 2009 on conditions for access to the network for cross-border exchanges in electricity (hereafter referred to as "Regulation (EC) No 714/2009"). The goal of Regulation 2017/1485 is to lay down detailed guidelines on requirements and principles concerning system operation with the aim of ensuring the safe operation of the interconnected system. To facilitate this aim, it is necessary for all TSOs to use a common grid model. A common grid model can only be created on the basis of a common methodology for building such a model.

(3) Article 17 of Commission Regulation (EU) 2015/1222 of 24 July 2015 establishing a guideline on capacity allocation and congestion management (hereafter referred to as "Regulation 2015/1222") is referred to in Article 67(1) and Article 70(1) of Regulation 2017/1485 and defines several specific requirements that the CGMM Proposal should take into account:

"1. By 10 months after the entering into force of this Regulation all TSOs shall jointly develop a proposal for a common grid model methodology. The proposal shall be subject to consultation in accordance with Article 12.

2. The common grid model methodology shall enable a common grid model to be established. It shall contain at least the following items:

(a) a definition of scenarios in accordance with Article 18;

(b) a definition of individual grid models in accordance with Article 19;

(c) a description of the process for merging individual grid models to form the common grid model."

(4) Article 67(1) of Regulation 2017/1485 constitutes the legal basis for the proposal for a common grid model methodology as far as year-ahead common grid models are concerned and sets out several additional requirements:

"By 6 months after entry into force of this Regulation, all TSOs shall jointly develop a proposal for the methodology for building the year-ahead common grid models from the individual grid models established in accordance with Article 66(1) and for saving them. The methodology shall take into account, and complement where necessary, the operational conditions of the common grid model methodology developed in accordance with Article 17 of Regulation (EU) 2015/1222 and Article 18 of Regulation (EU) 2016/1719, as regards the following elements:

(a) deadlines for gathering the year-ahead individual grid models, for merging them into a common grid model and for saving the individual and common grid models;

(b) quality control of the individual and common grid models to be implemented in order to ensure their completeness and consistency; and

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(c) correction and improvement of individual and common grid models, implementing at least the quality controls referred to in point (b)."

(5) Article 70(1) of Regulation 2017/1485 constitutes the legal basis for the proposal for a common grid model methodology as far as day-ahead and intraday common grid models are concerned and contains the following additional requirements:

"By 6 months after entry into force of this Regulation, all TSOs shall jointly develop a proposal for the methodology for building the day-ahead and intraday common grid models from the individual grid models and for saving them. That methodology shall take into account, and complement where necessary, the operational conditions of the common grid model methodology developed in accordance with Article 17 of Regulation (EU) 2015/1222, as regards the following elements:

(a) definition of timestamps;

(b) deadlines for gathering the individual grid models, for merging them into a common grid model and for saving individual and common grid models. The deadlines shall be compatible with the regional processes established for preparing and activating remedial actions;

(c) quality control of individual grid models and the common grid model to be implemented to ensure their completeness and consistency;

(d) correction and improvement of individual and common grid models, implementing at least the quality controls referred to in point (c); and

(e) handling additional information related to operational arrangements, such as protection setpoints or system protection schemes, single line diagrams and configuration of substations in order to manage operational security."

(6) Whereas the CGMM pursuant to Regulation 2015/1222 aims at establishing a CGM for the purpose of calculating capacity for the day-ahead and intraday capacity calculation time frames and the CGMM pursuant to Commission Regulation (EU) 2016/1719 of 26 September 2016 establishing a guideline on forward capacity allocation aims at establishing a CGM for the purpose of calculating long-term capacity, the present CGMM Proposal addresses the building of CGMs for various system operation processes. Since the methodologies required by Article 67(1) and Article 70(1), respectively, referred to above are inherently linked, for the sake of efficiency this CGMM Proposal is a joint proposal for both methodologies.

(7) Article 2(2) of Regulation 2015/1222 defines the common grid model as:

"a Union-wide data set agreed between various TSOs describing the main characteristic (sic) of the power system (generation, loads and grid topology) and rules for changing these characteristics during the capacity calculation process"

(8) Article 2(4) of Regulation 2015/1222 defines a scenario as:

"the forecasted status of the power system for a given time-frame"

(9) Article 2(1) of Regulation 2015/1222 defines an individual grid model as:

"a data set describing power system characteristics (generation, load and grid topology) and related rules to change these characteristics during capacity calculation, prepared by the responsible TSOs, to be merged with other individual grid model components in order to create the common grid model"

(10) The requirements set out in Article 17 are spelt out in more detail in Articles 18 and 19 of Regulation 2015/1222. Article 18 on scenarios outlines the following:

"1.All TSOs shall jointly develop common scenarios for each capacity calculation time-frame referred to in Article 14(1)(a) and (b). The common scenarios shall be used to describe a

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specific forecast situation for generation, load and grid topology for the transmission system in the common grid model.

2.One scenario per market time unit shall be developed both for the day-ahead and the intraday capacity calculation time-frames.

3.For each scenario, all TSOs shall jointly draw up common rules for determining the net position in each bidding zone and the flow for each direct current line. These common rules shall be based on the best forecast of the net position for each bidding zone and on the best forecast of the flows on each direct current line for each scenario and shall include the overall balance between load and generation for the transmission system in the Union. There shall be no undue discrimination between internal and cross-zonal exchanges when defining scenarios, in line with point 1.7 of Annex I to Regulation (EC) No 714/2009."

1.7 of Annex I to Regulation (EC) No 714/2009 outlines the following:

"When defining appropriate network areas in and between which congestion management is to apply, TSOs shall be guided by the principles of cost-effectiveness and minimisation of negative impacts on the internal market in electricity. Specifically, TSOs shall not limit interconnection capacity in order to solve congestion inside their own control area, save for the abovementioned reasons and reasons of operational security. If such a situation occurs, this shall be described and transparently presented by the TSOs to all the system users. Such a situation shall be tolerated only until a long-term solution is found. The methodology and projects for achieving the long-term solution shall be described and transparently presented by the TSOs to all the system users."

(11) Article 19 of Regulation 2015/1222 sets out more specific requirements with respect to individual grid models, the basic building blocks of the common grid model:

"1.For each bidding zone and for each scenario:

(a) all TSOs in the bidding zone shall jointly provide a single individual grid model which complies with Article 18(3); or

(b) each TSO in the bidding zone shall provide an individual grid model for its control area, including interconnections, provided that the sum of net positions in the control areas, including interconnections, covering the bidding zone complies with Article 18(3).

2.Each individual grid model shall represent the best possible forecast of transmission system conditions for each scenario specified by the TSO(s) at the time when the individual grid model is created.

3.Individual grid models shall cover all network elements of the transmission system that are used in regional operational security analysis for the concerned time-frame.

4.All TSOs shall harmonise to the maximum possible extent the way in which individual grid models are built.

5.Each TSO shall provide all necessary data in the individual grid model to allow active and reactive power flow and voltage analyses in steady state.

6.Where appropriate, and upon agreement between all TSOs within a capacity calculation region, each TSO in that capacity calculation region shall exchange data between each other to enable voltage and dynamic stability analyses."

(12) Article 79(5) of Regulation 2017/1485 sets out the following requirement with respect to regional security coordinators:

" In accordance with the methodologies referred to in Articles 67(1) and 70(1), and in accordance with Article 28 of Regulation (EU) 2015/1222, a regional security coordinator shall

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be appointed by all TSOs to build the common grid model for each time-frame and store it on the ENTSO for Electricity operational planning data environment."

(13) Article 6(6) of Regulation 2017/1485 sets out two further obligations: *"The proposal for terms and conditions or methodologies shall include a proposed timescale for their implementation and a description of their expected impact on the objectives of this Regulation."* The expected impact on the objectives is presented below (points (13) to (18) of this Whereas Section).

(14) The CGMM Proposal contributes to and does not in any way hamper the achievement of the objectives of Article 4(1) of Regulation 2017/1485. In particular, the CGMM Proposal serves the objective of determining common operational security requirements and principles by prescribing a common methodology for the preparation of individual grid models to be merged into the common pan-European grid model.

(15) In accordance with Article 4(b) of Regulation 2017/1485, and taking into account the additional methodologies to be developed under Regulation 2017/1485, the creation of the common grid model and use thereof in operational planning will contribute to determining common interconnected system operational planning principles by ensuring a common methodology for the preparation of individual grid models to be merged into the common pan-European grid model.

(16) By having a common grid model prepared on the basis of a common, binding methodology, the CGMM Proposal will ensure that the objective of contributing to the efficient operation and development of the electricity transmission system and electriciy sector in the Union is met insofar as the creation of a common grid model is based on a binding methodology that has been subject to stakeholder consultation in accordance with Regulation 2017/1485 and that will be approved by regulatory authorities prior to application in the Union.

(17) The CGM Methodology ensures and enhances the transparency and reliability of information on transmission system operation by providing for monitoring of quality indicators and publishing the indicators and the results of the monitoring.

(18) The CGMM Proposal also contributes to the objective of ensuring the conditions for maintaining operational security throughout the Union (Article 4(1)(d) of Regulation 2017/1485) through the provision of a common grid model on the basis of a common methodology specifying inputs for the preparation of individual grid models to be merged into the common pan-European grid model.

(19) Finally, the CGMM Proposal will promote the coordination of system operation and operational planning by virtue of providing for the establishment of a common model of the pan-European grid that will be used in a coordinated manner throughout the Union (Article 4(1)(f) of Regulation 2017/1485).

(20) In conclusion, the CGMM Proposal contributes to the general objectives of Regulation 2017/1485 to the benefit of all TSOs, NEMOs, the Agency, regulatory authorities and market participants.

SUBMIT THE FOLLOWING CGMM PROPOSAL TO ALL REGULATORY AUTHORITIES:

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Article 1
Subject matter and scope

1. The common grid model methodology described in this proposal is the common proposal of all TSOs in accordance with Article 67(1) and Article 70(1) of Regulation 2017/1485.
2. This methodology shall apply to all TSOs in the area referred to in Article 2(2) of Regulation 2017/1485.
3. TSOs from jurisdictions outside the area referred to in Article 2(2) of Regulation 2017/1485 may provide their IGM, allow it to be merged into the CGM, and join the CGM process on a voluntary basis, provided that
    a. for them to do so is technically feasible and compatible with the requirements of Regulation 2017/1485;
    b. they agree that they shall have the same rights and responsibilities with respect to the CGM process as the TSOs referred to in paragraph 1; in particular, they shall accept that this methodology applies to the relevant parties in their control area as well;
    c. they accept any other conditions related to the voluntary nature of their participation in the CGM process that the TSOs referred to in paragraph 1 may set;
    d. the TSOs referred to in paragraph 1 have concluded an agreement governing the terms of the voluntary participation with the TSOs referred to in this paragraph;
    e. once TSOs participating in the CGM process on a voluntary basis have demonstrated objective compliance with the requirements set out in (a), (b), (c), and (d), the TSOs referred to in paragraph 1, after checking that the criteria in (a), (b), (c), and (d) are met, have approved an application from the TSO wishing to join the CGM process in accordance with the procedure set out in Article 5(3) of Regulation 2017/1485.
4. The TSOs referred to in paragraph 1 shall monitor that TSOs participating in the CGM process on a voluntary basis pursuant to paragraph 3 respect their obligations. If a TSO participating in the CGM process pursuant to paragraph 3 does not respect its essential obligations in a way that significantly endangers the implementation and operation of Regulation 2017/1485, the TSOs referred to in paragraph 1 shall terminate that TSO's voluntary participation in the CGM process in accordance with the procedure set out in Article 5(3) of Regulation 2017/1485.

Article 2
Definitions and interpretation

For the purposes of this proposal, the terms used shall have the meaning of the definitions included in Article 3 of Regulation 2017/1485 and the other items of legislation referenced therein as well as Article 2 of the Common Grid Model Methodology pursuant to Article 17 of Regulation 2015/1222.

Article 3
Scenarios

1. When building year-ahead IGMs pursuant to Article 66 of Regulation 2017/1485, each TSO shall build a year-ahead IGM for each of the scenarios developed pursuant to Article 65 of Regulation 2017/1485 as well as any additional scenarios defined pursuant to the common grid model methodology developed in accordance with Article 18 of Regulation (EU) 2016/1719.

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2. When building day-ahead IGMs for each market time unit on the day before the day of delivery and when building intraday IGMs for each future market time unit of the day of delivery, each TSO shall apply the principles set out in paragraph 3.
3. The following principles are applicable to all day-ahead and intraday scenarios:
    a. forecast situation for grid topology
        i. outages, irrespective of the reason for the outage, shall be modelled regardless of whether the network element is expected to be unavailable for the entire duration of the scenario or only part thereof;
        ii. network elements that support voltage control shall be included although they may be switched off for operational reasons;
        iii. the topology shall reflect the operational situation.
    b. where structural data change during the time period that the scenario relates to
        i. network elements being added or removed shall be included for the entire duration of the scenario and shall be removed from the IGM topology in all scenarios where they are not available for at least part of the duration of the scenario;
        ii. changes in the characteristics of network elements shall be handled by including those characteristics the use of which is most conservative from the point of view of operational security;
    c. operational limits
        i. each TSO shall apply the appropriate limits corresponding to Article 14(3) to each network element;
        ii. for thermal limits, each TSO shall use both PATLs and TATLs.
    d. with respect to the forecast situation for generation
        i. for intermittent generation each TSO shall use the latest forecast of intermittent generation;
        ii. for dispatchable generation: each TSO shall base its forecast on schedules;
    e. with respect to the forecast situation for load
        i. each TSO shall base its forecast on the best forecast of load;
    f. with respect to the net position in each bidding zone and the flow for each direct current line
        i. each TSO shall use the latest available results pursuant to Article 13 and Article 18.

Article 4
Individual Grid Models

1. Pursuant to Article 66(1) of Regulation 2017/1485, each TSO shall build a year-ahead IGM for each of the scenarios developed pursuant to Article 65 of Regulation 2017/1485.
2. Pursuant to Article 70(2) of Regulation 2017/1485, each TSO shall build a day-ahead IGM for each market time unit of the day of delivery. The mid-point of each market time unit shall be used as the reference timestamp.
3. Pursuant to Article 70(2) of Regulation 2017/1485, prior to each reference time each TSO shall build an intraday IGM for each market time unit of the day of delivery between the reference time and the time eight hours later than the reference time. The reference times shall be 00:00h,

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08:00h, and 16:00h. The mid-point of each market time unit shall be used as the reference timestamp.

4. Pursuant to Articles 70(2) and 76(1)(a) of Regulation 2017/1485, each TSO of each capacity calculation region shall build an intraday IGM for each market time unit of the day of delivery between the additional reference times defined pursuant to Article 76(1)(a) (if any) and the time T hours later than the reference time. All TSOs of each capacity calculation region shall jointly define the parameter T as well as the additional reference times pursuant to Article 76(1)(a) of Regulation 2017/1485 and publish this information (if any) on the internet. The mid-point of each market time unit shall be used as the reference timestamp.
5. When building IGMs, in order to ensure their quality, completeness and consistency each TSO shall complete the following steps:
    a. create an up-to-date equipment model comprising the structural data described in Articles 5 to 11;
    b. identify and incorporate structural changes pursuant to the principles set out in Article 3;
    c. incorporate up-to-date operating assumptions by including the variable data described in Articles 12 to 16 in the model;
    d. exchange with all other TSOs the data described in Article 17 via the ENTSO for Electricity operational planning data environment referred to in Article 21;
    e. apply the common rules for determining the net position in each bidding zone and the flow for each direct current line set out in Articles 18 and 19;
    f. ensure that the model is consistent with the net positions and flows on direct current lines established in accordance with Articles 18 and 19;
    g. ensure that remedial actions already decided (if any) are included in the model, can be clearly identified as required by Article 70(4) of Regulation 2017/1485 and are consistent with, inter alia, the methodology for the preparation of remedial actions managed in a coordinated way pursuant to Article 76(1)(b) of Regulation 2017/1485 and the general objective of non-discriminatory treatment pursuant to Article 4(2)(a) of Regulation 2017/1485;
    h. perform a load flow solution in order to verify
        i. solution convergence;
        ii. plausibility of nodal voltages and active and reactive power flows on grid elements;
        iii. plausibility of the active and reactive power outputs of each generator;
        iv. plausibility of the reactive power output / consumption of shunt-connected reactive devices; and
        v. compliance with applicable operational security standards;
    i. if required, modify the equipment model and / or operating assumptions and repeat step (h);
    j. if applicable, carry out network reduction pursuant to Article 11;
    k. as required by Article 79(2) of Regulation 2017/1485 export the IGM and make it available for merging into a common grid model via the ENTSO for Electricity operational planning data environment referred to in Article 21;
    l. ensure that the IGM meets the quality criteria pursuant to Article 23;
    m. repeat relevant steps as required and in accordance with the other obligations specified in this methodology.
6. Each TSO shall respect the process for merging IGMs into a CGM described in Article 20.

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7. Each TSO shall respect the requirements set out in Article 22. All times stated in this CGMM Proposal refer to market time as defined in Article 2(15) of Regulation 2015/1222.

Article 5
Data to be included in IGMs

1. IGMs shall contain the elements of the 220 kV and higher voltage transmission systems, including HVDC systems. Elements of the transmission system with voltage below 220kV shall be included if these have significant impact on the TSO's transmission system. At a minimum, this requires including the elements of the high-voltage network insofar as these are used in regional operational security analysis for the concerned time-frame as well as all additional grid elements which it is necessary to include for an appropriate representation of the corresponding parts of the grid including the grid elements connected to these.
2. A unique identifier shall be provided for each network element included.
3. Where this methodology refers to a breakdown by primary energy sources, a breakdown into primary energy sources consistent with those used by the central information transparency platform pursuant to Regulation 543/2013 is required.
4. If any of the data required are not available to the TSO, the TSO shall use its best estimate instead.

Article 6
Grid elements

1. The grid elements described in paragraph 2 of this Article shall be included in each IGM regardless of whether these are operated by the TSO or a DSO (including CDSO) if these grid elements are of a voltage level
    a. of 220 kV or above;
    b. of less than 220 kV and the grid elements of which are used in regional operational security analysis.
2. The relevant grid elements and the data to be provided for these are
    a. sub-stations: voltage levels, busbar sections and if applicable to the modelling approach used by the TSO switching devices, to include switching device identifier and switching device type, comprising either breaker, isolator or load break switch;
    b. lines or cables: electrical characteristics, the sub-stations to which these are connected;
    c. power transformers including phase-shifting power transformers: electrical characteristics, the sub-stations to which these are connected, the type of tap changer, and type of regulation, where applicable;
    d. power compensation devices and flexible AC transmission systems (FACTS): type, electrical characteristics, and type of regulation where applicable.
3. A model or an equivalent model of those parts of the grid operated at a voltage of less than 220 kV shall be included in the IGM regardless of whether these parts of the grid are operated by the TSO or a DSO (including CDSO) if
    a. these parts of the grid have elements which are used in regional operational security analysis, or
    b. the relevant grid elements in those parts of the grid are connecting

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i. a generation unit or load modelled in detail in accordance with Article 8 or 9 to the 220 kV or higher voltage level;
ii. two nodes at the 220 kV or higher voltage level.

4. Models or equivalent models of those parts of the grid operated at a voltage of less than 100 kV shall only be included in IGMs insofar as this is necessary for an appropriate representation of the corresponding parts of the grid including the grid elements connected to these.
5. Regardless of voltage level, models and equivalent models pursuant to paragraph 3 or 4 shall contain at least aggregates of load separated from generation and generation capacity separated by primary energy sources and separated from load in the corresponding parts of the grid broken down by sub-stations of the equivalent model or the sub-stations to which the corresponding parts of the grid are connected.

Article 7
Boundary points

1. For each relevant border the TSOs concerned shall demarcate their respective responsibilities as far as the modelling of the network is concerned by agreeing on the corresponding boundary points.
2. Each TSO shall include all relevant network elements on its side of each boundary point in its IGM.
3. Each TSO shall include each boundary point in its IGM with a fictitious injection.

Article 8
Generation

1. Generation units including synchronous condensers and pumps shall be modelled in detail if they are connected at a voltage level
   a. of 220 kV or above;
   b. of less than 220 kV and they are used in regional operational security analysis.
2. Several identical or similar generation units may be modelled in detail on a composite basis if this modelling approach is sufficient with respect to regional operational security analysis. For generation units modelled in detail on a composite basis an equivalent model shall be included in the IGM.
3. Generation capacity not modelled in detail shall be included in the IGM modelled as aggregates.
4. For both generation units modelled in detail and for aggregates of generation capacity, separated by primary energy sources and separated from load, the following data shall be included in the IGM:
   a. connection point;
   b. primary energy source.
5. For generation units modelled in detail the following data shall be included in the IGM:
   a. maximum active power and minimum active power; defined as those values which the generation unit can regulate to. In the case of hydroelectric pumped storage generation units, two cycles shall be modelled and two records have to be provided (i.e., one each for the generating and the pumping mode);
   b. the type of control mode, being one of the following: "disabled", "voltage control", "power factor control", "reactive power control" and, for voltage-controlled generation units, the regulated buses where the scheduled voltage is set up;

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c. maximum and minimum values of reactive power when the minimum and maximum active power is delivered as well as, if this is required for regional operational security analysis, the associated capability curve;
d. the auxiliary load of the generation unit representing the internal demand of the generation unit shall be modelled as a non-conforming load at the connection point of the generation unit if this is required for regional operational security analysis.

6. For generation units modelled as aggregates the following data shall be included in the IGM:
   a. aggregates of generation capacity separated by primary energy sources and separated from load in the corresponding parts of the grid broken down by sub-stations of the equivalent model or the sub-stations to which the corresponding parts of the grid are connected.

Article 9
Load

1. Loads shall be modelled in detail if they are connected at a voltage level
   a. of 220 kV or above;
   b. of less than 220 kV and they are used in regional operational security analysis.
2. Several identical or similar loads may be modelled in detail on a composite basis if this modelling approach is sufficient with respect to regional operational security analysis. For loads modelled in detail on a composite basis an equivalent model shall be included in the IGM.
3. Loads not modelled in detail shall be included in the IGM modelled as aggregates.
4. For both loads modelled in detail and for aggregates of loads separated from generation the following data shall be included in the IGM:
   a. connection point;
   b. power factor or reactive power;
   c. conforming flag (where the value "true" means that the active and reactive power consumption of the load shall be scaled when scaling the overall load).
5. For loads modelled as aggregates the following data shall be included in the IGM:
   a. aggregates of loads (separated from generation) in the corresponding parts of the grid broken down by sub-stations of the equivalent model or the sub-stations to which the corresponding parts of the grid are connected.

Article 10
HVDC links

1. HVDC links shall be modelled regardless of whether these are located entirely within a single bidding zone or they connect two bidding zones.
2. The TSO within whose bidding zone(s) the HVDC link is located or the TSOs whose bidding zones are connected by the HVDC link shall decide on the degree of detail with which the HVDC link is to be modelled. They shall base their decision on the functions for which the HVDC link is to be used. By default an HVDC link shall be modelled in detail and the AC/DC part of the HVDC link shall be exchanged by the TSOs concerned unless the functions that it is used for do not require this.
3. For both HVDC links modelled in detail and for those modelled in a simplified manner, the following data shall be included:

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a. connection points.

4. For cross-zonal HVDC links modelled in detail, the TSOs concerned shall agree on which of them is to provide the detailed model by either including it in its IGM or by making it available separately. In the case of HVDC links that connect the CGM area with a bidding zone that is not part of the CGM area, the TSO that is within the CGM area shall include the detailed model in its IGM. Detailed models of HVDC links shall include
    a. electrical characteristics;
    b. type and characteristics of supported control modes.
5. HVDC links modelled in a simplified manner shall be represented by equivalent injections at the connection points.
6. In the case of HVDC links that connect the CGM area with a bidding zone that is not part of the CGM area, the TSO that is within the CGM area shall endeavour to conclude an agreement with the owners of HVDC links not bound by this methodology with the aim of ensuring their cooperation in meeting the requirements set out in this Article.

Article 11
Modelling of adjacent grids

1. Each TSO shall model HVDC links with adjacent grids pursuant to Article 10.
2. Each TSO shall model AC links with adjacent grids as described in this Article.
3. At the start of the process described in Article 4, each TSO shall make use of an equivalent model of the adjacent grids in its IGM.

Article 12
Topology

1. When building its IGM, each TSO shall ensure that
    a. the IGM indicates the switched state, either open or closed, of all modelled switching devices;
    b. the IGM indicates the tap position of all modelled power transformers with tap changers including phase-shifting transformers;
    c. the topology of the IGM reflects the planned or forced unavailability of modelled items of equipment that are known to be unavailable in line with the scenarios described in Article 3;
    d. the topology of the IGM is updated to reflect remedial actions decided on the basis of the methodologies pursuant to Article 76(1)(b) of Regulation 2017/1485 as well as other topological remedial actions if applicable;
    e. taking into account c) and d), the topology of the IGM reflects the best forecast operational situation;
    f. the details of modelling and the connectivity status of interconnectors and tie-lines to other TSOs are consistent with the IGMs of the relevant neighbouring TSOs;
    g. the topology of all IGMs created for intraday purposes shall reflect the forced unavailability of modelled equipment.

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Article 13
Energy injections and loads

1. When building its IGM, each TSO shall respect the following general principles with respect to energy injections and loads:
    a. For the energy injections pattern
        i. the IGM specifies an active and reactive power injection for each modelled in-service generation unit including synchronous condensers and pumps and this is applicable for each generation unit whether modelled in detail on an individual or composite basis or modelled as an aggregate;
        ii. the specified active and reactive power injection for each modelled generation unit is consistent with the specified maximum and minimum active and reactive power limits and/or applicable reactive capability curve;
        iii. active power injections associated with generation within the IGM shall be consistent with relevant remedial actions in accordance with Article 76(1)(b) of Regulation 2017/1485 and other measures required to maintain the system within applicable operational security limits including but not limited to provision of sufficient upward and downward active power reserves as required for the purposes of frequency management;
    b. For the load pattern
        i. the IGM specifies an active and reactive power withdrawal for each modelled in-service load and pump;
        ii. the sum of the active modelled load power withdrawals of modelled in-service loads and pumps shall match the total load of the considered scenario.
2. When building its IGM, each TSO shall respect the following principles with respect to energy injections:
    a. in order to establish the injection pattern for the relevant scenario, the TSO shall scale or otherwise individually modify the active power injections associated with the modelled generation units;
    b. for generation units modelled in detail, the availability status shall take into account the following in line with the scenarios described in Article 3:
        i. outage plans;
        ii. testing profiles;
        iii. scheduled unavailability;
        iv. any active power capacity restrictions;
    c. for dispatchable generation units modelled in detail, the modelled dispatch pattern shall take into account the following in line with the scenarios described in Article 3:
        i. for all scenarios
            1. the availability status;
            2. the applicable priority dispatch policies and agreements;
        ii. for year-ahead models, the best forecast dispatch based upon a selection of the following:
            1. the relevant current, historical or forecast commercial/market data;
            2. a distinction between base load generation and marginal generation;
            3. established generation shift keys, merit orders or participation factors;
            4. any other relevant information;

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iii. for day-ahead and intraday models
1. the latest available market schedules;

d. for dispatchable generation units modelled as aggregates, the modelled dispatch pattern shall take into account
i. for all scenarios the best forecast dispatch pattern based on a selection of the following:
1. relevant current, historical or forecast commercial/market data;
2. distinction between base load generation and marginal generation;
3. established generation shift keys, merit orders or participation factors;
4. data on generation capacity of generation units modelled as aggregates, separated by primary energy sources and separated from load, and managed by an aggregator whose data are used in regional operational security analysis broken down by sub-stations of the equivalent model or the sub-stations to which the corresponding parts of the grid are connected;
5. any other relevant information;

e. for all scenarios, for intermittent generation units modelled in detail, the modelled dispatch pattern shall take into account the availability status in line with the scenarios described in Article 3;

f. for all intermittent generation units whether modelled in detail or modelled as aggregates, the modelled dispatch pattern shall take into account in line with the scenarios described in Article 3
i. for year-ahead models the most appropriate forecast in line with the scenarios developed pursuant to Article 65(1) of Regulation 2017/1485;
ii. for day-ahead and intraday models the latest forecast of intermittent generation derived from meteorological forecasts;

3. When building its IGM, each TSO shall respect the following principles with respect to loads:
a. in order to establish the load pattern, the TSO shall scale or otherwise individually modify the nodal active and reactive power withdrawals associated with modelled loads and pumps;
b. for all scenarios this shall be based upon a selection of the following:
i. representative historical reference data for the relevant season, day, time, and other relevant data;
ii. SCADA and/or metered data;
iii. state estimated data;
iv. statistical analysis or forecast data;
v. distinction between conforming and non-conforming load;
vi. planned outages at least for loads modelled in detail;
vii. for loads modelled in detail maximum active power consumption and characteristics of reactive power control, where installed as well as maximum and minimum active power available for demand response and the maximum and minimum duration of any potential usage of this power for demand response;
viii. for loads modelled as aggregates and managed by an aggregator whose data are used in regional operational security analysis, aggregates of maximum and minimum active power available for demand response, separated from generation,

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and the maximum and minimum duration of any potential usage of this power for demand response managed by the aggregator in the corresponding parts of the grid broken down by sub-stations of the equivalent model or the sub-stations to which the corresponding parts of the grid are connected;

ix. for loads modelled as aggregates and managed by an aggregator whose data are used in regional operational security analysis, a forecast of unrestricted active power available for demand response and any planned demand response;

x. for day-ahead and intraday models, for loads modelled in detail the IGM shall reflect the scheduled active and forecast reactive consumption;

xi. any other relevant information.

Article 14
Monitoring

1. When building each IGM, each TSO shall respect the rules set out in this Article with respect to operational security limits for all modelled grid elements.
2. For each scenario all operational limits shall be consistent with operational conditions including but not limited to the season and other relevant environmental and meteorological factors.
3. For each scenario, each TSO shall ensure that
   a. the IGM specifies, for each explicitly modelled transmission line, cable, transformer and relevant item of DC equipment, either
      i. a PATL if the rating does not depend upon meteorological conditions or the pre-fault loading; or
      ii. the best forecast rating if the rating is dependent upon meteorological conditions or the pre-fault loading;
   b. the IGM specifies, for the relevant assets, one or more TATLs, reflective of the corresponding season and based on the applicable PATL, for each explicitly modelled transmission line, cable, transformer and relevant item of DC equipment;
   c. the IGM specifies a TATL duration for all items of transmission equipment for which a TATL is specified, for each TATL specified;
   d. the IGM specifies a tripping current for each relevant item of explicitly modelled transmission equipment, if applicable;
   e. the IGM appropriately reflects the maximum and minimum acceptable voltages at each nominal voltage level, as per relevant locally applicable codes, standards, licences, policies and agreements;
   f. operational security limits that apply to interconnectors and tie-lines to other TSOs are consistent with those specified in the IGMs of the relevant neighbouring TSOs;
   g. operational security limits specified in the IGM are mutually consistent;
   h. the IGM specifies artificial PATL and TATL limits on relevant individual items or groups of items of modelled transmission equipment in order to incorporate local transmission constraints that are not associated with steady state thermal or voltage security including constraints associated with transient or voltage stability;
   i. for all equivalent models of transmission equipment and for modelled items of equipment not operated by the TSO, including distribution networks, that are relevant with respect to

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operational security analysis and cross-zonal capacity calculation, the IGM specifies appropriate equivalent operating limits.

Article 15

Control settings

1. When building each IGM, each TSO shall specify appropriate control settings for at least the following items of regulating equipment, where modelled and relevant:
    a. power transformers and associated tap changers;
    b. phase-shifting transformers and associated tap changers;
    c. reactive compensation devices, including but not limited to
        i. shunt compensators including shunt capacitors or reactors or discretely switchable banks of shunt capacitors or reactors;
        ii. static VAR compensators;
        iii. synchronous condensers;
        iv. static synchronous compensators (STATCOMs) and other flexible AC transmission system (FACTS) devices;
    d. generators assisting with voltage regulation;
    e. DC equipment.
2. In the case of the items of equipment referred to in points (a), (b), (c), and (d) of paragraph 1, each IGM shall include the following information, where relevant:
    a. regulation status -enabled/disabled;
    b. regulation mode -voltage, active power, reactive power, power factor, current, or other applicable mode;
    c. regulation target or target range in kV, MW, Mvar, p.u., or other appropriate units;
    d. regulation target deadband;
    e. regulation participation factor;
    f. regulated node.
3. In the case of the items of equipment referred to in point (e) of paragraph 1, each IGM shall include all relevant information regarding the following, where relevant:
    a. operating mode -inverter/rectifier;
    b. control mode -voltage, active power, reactive power, power factor, current, or other applicable mode;
    c. active power targets;
    d. voltage targets;
    e. regulated nodes.
4. Where a modelled item of DC equipment forms part of an interconnector each TSO shall ensure that the resultant flows on the interconnector are consistent with the agreed flows on direct current lines for the relevant scenario in accordance with Article 18.
5. Each TSO shall ensure that target voltages and target voltage ranges are reflective of the relevant scenario and are reflective of applicable voltage control policies and operational security limits.
6. Each TSO shall specify at least one slack node in each IGM for the purposes of managing mismatches between total generation and demand when performing a load flow solution.

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Article 16

Assumptions on adjacent grids

1. When building each IGM each TSO shall update the operational assumptions with respect to adjacent grids with the most reliable set of estimations practicable. Following the successful completion of the checks described in Article 4(5)(h), the equivalent models of the adjacent grids shall be removed and replaced with equivalent injections at the relevant boundary points.
2. For each IGM the sum of injections at boundary points shall be equal to the corresponding net position.

Article 17

Associated information

1. In order to make it possible to apply rules to change the characteristics of IGMs during relevant business processes, each TSO shall make the following information available to all TSOs via the ENTSO for Electricity operational planning data environment referred to in Article 21:
    a. generation shift keys.

Article 18

Net positions and flows on direct current lines

1. For all scenarios for the year-ahead IGMs pursuant to Article 3, each TSO shall follow the CGM alignment procedure described in Article 19.
2. For all scenarios for the day-ahead and intraday IGMs pursuant to Article 3,
    a. the best forecast of the net position for each bidding zone and of the flow on each direct current line shall be based on verified matched scheduled exchanges;
    b. each TSO shall share with all other TSOs the net position for its bidding zone(s) and the values for the flow on each direct current line used in its IGM via the ENTSO for Electricity operational planning data environment described in Article 21 in accordance with the CGM process described in Article 22.
3. For all scenarios pursuant to Article 3 in case of bidding zones connected by more than one direct current line, the TSOs concerned shall agree on consistent values for the flows on direct current lines to be used in each TSO's IGM. These shall also be the values that the TSOs make available to all other TSOs.

Article 19

CGM alignment

1. For each scenario for the year-ahead models pursuant to Article 3, each TSO shall prepare and share with all other TSOs via the ENTSO for Electricity operational planning data environment referred to in Article 21 in accordance with the CGM process description set out in Article 22 its best forecast of
    a. the net position for its bidding zone, being its preliminary net position;
    b. the flow on each direct current line connected to its bidding zone being the preliminary flows on each direct current line;
    c. any other input data required by the algorithm pursuant to paragraph 2.

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2. All TSOs shall jointly define an algorithm which for each scenario and for all bidding zones aligns the preliminary net positions and preliminary flows on each direct current line in such a way that following the adjustment by the algorithm
    a. the sum of adjusted net positions for all bidding zones in the CGM area balances the targeted net position for the CGM area;
    b. for all bidding zones connected by at least one direct current line the sum of flows on all direct current lines is mutually consistent for both bidding zones concerned.
3. The algorithm shall have the following properties or features in order to ensure that there is no undue discrimination between internal and cross-zonal exchanges:
    a. the alignments of preliminary net positions and preliminary flows on each direct current line shall be spread across all bidding zones and no bidding zone shall benefit from any preferential treatment or privileged status with respect to the operation of the algorithm;
    b. in its objective function the algorithm shall give appropriate weight to the following when determining the adjustments required:
        i. the size of the adjustments required to each preliminary net position and the preliminary flows on each direct current line, which shall be minimised;
        ii. the ability of a bidding zone to adjust its preliminary net position and the preliminary flows on each direct current line, based on objective and transparent criteria;
    c. the algorithm shall specify objective and transparent consistency and quality criteria which the input data required from each TSO shall meet;
    d. the algorithm shall be robust enough to provide the results pursuant to paragraph 2 in all circumstances given the input data provided to it.
4. TSOs shall agree on procedures
    a. to reduce the absolute value of the sum of preliminary net positions for all bidding zones in the CGM area; and
    b. to provide updated input data if necessary; and
    c. to take into account reserve capacity and stability limits if it becomes necessary to update input data.
5. TSOs shall regularly review and, if appropriate, improve the algorithm.
6. TSOs shall publish the algorithm as part of the data to be provided pursuant to Article 31(3) of Regulation 2015/1222 and Article 26(3) of Regulation 2016/1719. If the algorithm was modified during the reporting period, TSOs shall clearly state which algorithm was in use during which period and they shall explain the reasons for modifying the algorithm.
7. All TSOs shall jointly ensure that the algorithm is accessible to the relevant parties via the ENTSO for Electricity operational planning data environment referred to in Article 21.
8. Each TSO shall designate a regional security coordinator who shall perform, on behalf of the TSO, the following tasks in accordance with the process described in Article 22:
    a. check the completeness and quality of the input data provided pursuant to paragraph 1 and, if necessary, replace missing data or data of insufficient quality with substitute data;
    b. apply the algorithm in order to compute for each scenario and each bidding zone aligned net positions and aligned flows on all direct current lines that meet the requirements set out in paragraph 2 and make these available to all TSOs via the ENTSO for Electricity operational planning data environment referred to in Article 21;

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c. ensure that the results obtained are consistent with those obtained by all other regional security coordinators (if any).

9. Pursuant to Article 4(5)(f), each TSO shall ensure that its IGM is consistent with the aligned net position and aligned flows on direct current lines provided by the regional security coordinator.

Article 20

Common Grid Model

1. In accordance with Article 77(1)(a) of Regulation 2017/1485 each TSO shall designate a regional security coordinator who shall perform, on behalf of the TSO, the following tasks according to the process described in Article 22:
   a. check the consistency of the IGMs provided by the TSO against the quality criteria defined pursuant to Article 23;
   b. if an IGM fails the quality check referred to in (a), either obtain a new IGM of sufficient quality from the TSO responsible or substitute an alternative IGM in accordance with the substitution rules referred to in paragraph 4 and make this validated IGM available via the ENTSO for Electricity operational planning data environment referred to in Article 21;
   c. apply the requirements pursuant to paragraph 2 in order to merge all IGMs into a CGM pursuant to Article 79 of Regulation 2017/1485 and make the resulting CGMs available to all TSOs via the ENTSO for Electricity operational planning data environment referred to in Article 21;
   d. ensure that each CGM created is consistent with those obtained by all other regional security coordinators (if any);
   e. identify violations of operational security limits in the CGM;
   f. obtain from the TSOs concerned IGMs updated in the light of the remedial actions agreed if applicable and repeat steps (a) to (e) as required;
   g. validate the resulting CGM by checking that it is consistent with those obtained by all other regional security coordinators (if any) and make it available via the ENTSO for Electricity operational planning data environment referred to in Article 21.
2. All TSOs shall jointly define the requirements applicable to the regional security coordinators and the merging process in accordance with Article 23.
3. Each regional security coordinator shall meet the requirements referred to in paragraph 2 and shall implement the requirements applicable to the merging process referred to in paragraph 2.
4. All TSOs shall jointly define substitution rules applicable to IGMs that do not meet the quality criteria set out in Article 23.
5. Each TSO shall provide the data required by the substitution rules referred to in paragraph 4 via the ENTSO for Electricity operational planning data environment referred to in Article 21.

Article 21

ENTSO for Electricity operational planning data environment

1. All TSOs shall delegate the task of implementing and administering a joint ENTSO for Electricity operational planning data environment that provides at least the services described in paragraph 2 in accordance with Article 114 of Regulation 2017/1485.

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2. The ENTSO for Electricity operational planning data environment shall at a minimum support the CGM process in the following ways and it shall have all the features required to this end:
    a. year-ahead models - each TSO shall be able to use the ENTSO for Electricity operational planning data environment in order to share with all other TSOs pursuant to the CGM process described in Article 22 its best forecast of
        i. the net position for its bidding zone, comprising its preliminary net position;
        ii. the flow on each direct current line connected to its bidding zone comprising the preliminary flows on each direct current line;
        iii. any other input data required by the algorithm further to Article 19(2);
    b. the algorithm pursuant to Article 19(2) shall be accessible via the ENTSO for Electricity operational planning data environment;
    c. the regional security coordinator(s) shall be able to make the aligned net positions and aligned flows on direct current lines that meet the requirements set out in Article 19(2) available to all TSOs via the ENTSO for Electricity operational planning data environment;
    d. day-ahead and intraday models - each TSO shall be able to use the ENTSO for Electricity operational planning data environment in order to share with all other TSOs the net position for its bidding zone(s) and the values for the flow on each direct current line used in its IGM pursuant to the CGM process described in Article 22;
    e. the ENTSO for Electricity operational planning data environment shall allow all relevant information on scheduled exchanges to be available from the ENTSO for Electricity operational planning data environment;
    f. each TSO shall be able to make associated information specified in Article 17 available to all TSOs via the ENTSO for Electricity operational planning data environment;
    g. each TSO shall be able to make all its IGMs available to all TSOs via the ENTSO for Electricity operational planning data environment;
    h. for each TSO and each scenario, all data required by the substitution rules referred to in Article 20(5) shall be available via the ENTSO for Electricity operational planning data environment;
    i. the ENTSO for Electricity operational planning data environment shall be able to provide information on the quality status of submitted IGMs including substitutions that were necessary;
    j. all regional security coordinators shall be able to make the CGM available to all TSOs via the ENTSO for Electricity operational planning data environment;
    k. all information required with respect to boundary points pursuant to Article 7 shall be available via the ENTSO for Electricity operational planning data environment;
    l. the following items of information and/or data shall be available to all TSOs via the ENTSO for Electricity operational planning data environment:
        i. generation shift keys.

Article 22
CGM process

1. When preparing year-ahead CGMs, all TSOs and regional security coordinators shall complete the following steps:

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a. by 15 July plus three business days of the year preceding the year of delivery, each TSO shall make preliminary net positions, preliminary flows on direct current lines as well as any other input data required for the CGM alignment process available to all TSOs via the ENTSO for Electricity operational planning data environment referred to in Article 21;
b. by 15 July plus five business days of the year preceding the year of delivery, the regional security coordinator(s) shall check the completeness and quality of the input data provided pursuant to Article 19(1) and, if necessary, replace missing data or data of insufficient quality with substitute data;
c. by 15 July plus six business days of the year preceding the year of delivery, the regional security coordinator(s) shall apply the algorithm in order to compute for each scenario and each bidding zone aligned net positions and aligned flows on direct current lines that meet the requirements set out in Article 19(2);
d. by 15 July plus nine business days of the year preceding the year of delivery, the regional security coordinator(s) shall make these aligned net positions and aligned flows on direct current lines available to all TSOs via the ENTSO for Electricity operational planning data environment referred to in Article 21;
e. by 01 September each TSO shall make its IGM available via the ENTSO for Electricity operational planning data environment pursuant to Article 21; pursuant to Article 4(5)(f) the TSO shall ensure that its IGM is consistent with the aligned net position and aligned flows on direct current lines provided by the regional security coordinator(s);
f. by 01 September plus five business days the TSO's regional security coordinator shall
    i. check the consistency of the IGM provided by the TSO against the quality criteria defined pursuant to Article 23;
    ii. if an IGM fails the quality check referred to in (i), either obtain a new IGM of sufficient quality from the TSO responsible or substitute an alternative IGM in accordance with the substitution rules referred to in Article 20(4) and make this validated IGM available via the ENTSO for Electricity operational planning data environment referred to in Article 21;
g. by 01 September plus ten business days the TSO's regional security coordinator shall
    i. apply the requirements pursuant to Article 20(3) in order to merge all IGMs into a CGM pursuant to Article 79(5) of Regulation 2017/1485 and make the resulting CGMs available to all relevant parties via the ENTSO for Electricity operational planning data environment referred to in Article 21;
    ii. validate each CGM obtained and ensure it is consistent with those obtained by all other regional security coordinators (if any).

2. Pursuant to Article 68(1) of Regulation 2017/1485, where applicable TSOs shall send updated models up until the cut-off date of 01 September of each year and pursuant to Article 68(2) of Regulation 2017/1485 regional security coordinators shall prepare updated CGMs until the cut-off date of 01 September plus ten business days of each year.
3. The deadlines set out in paragraph 1 apply to the preparation of a year-ahead CGM covering a full calendar year beginning on 01 January and ending on 31 December. Where the target time horizon for the year-ahead CGM differs from this, the deadlines shall shift accordingly. All TSOs may jointly agree to shorten the deadlines in such a way that less time is allowed for the completion of one or more of the tasks listed in paragraph 1.

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4. T0 is defined as that point in the day-ahead CGM process at which each TSO needs to have submitted its IGMs for the following day in order for the CGM process to advance in a timely manner given all the subsequent steps in the process. T3 is defined as that point in the day-ahead CGM process at which a CGM based on at least one full iteration; i.e., based upon a set of IGMs updated in the light of a preceding version of the CGM; has to be available in order to allow for the completion of all subsequent steps in the process in a timely manner. T5 is defined as that point in the day-ahead CGM process at which all findings and decisions based on the coordinated security analysis building on the CGM have been consolidated and communicated and the process ends. When preparing day-ahead CGMs, all TSOs and regional security coordinators shall complete the following steps:
    a. by time T0 minus 95 minutes on the day before the day of delivery each TSO shall make its net position and flows on direct current lines for each day-ahead scenario available via the ENTSO for Electricity operational planning data environment referred to in Article 21. These net positions and flows on direct current lines shall reflect cross-zonal exchanges as of time T0 minus 120 minutes. TSOs in bidding zones where the cross-zonal intraday market for the following day opens before time T0 minus 90 minutes shall use the data as of time T0 minus 120 minutes;
    b. by time T0 minus 90 minutes on the day before the day of delivery aligned net positions and flows on direct current lines for each day-ahead scenario shall be available to all TSOs via the ENTSO for Electricity operational planning data environment referred to in Article 21.
    c. immediately after time T0 minus 15 minutes on the day before the day of delivery updated net positions and flows on direct current lines for each day-ahead scenario shall be made available to all TSOs via the ENTSO for Electricity operational planning data environment referred to in Article 21 by those TSOs whose net positions and flows on direct current lines change relative to the values established at T0 minus 120 minutes due to preventive remedial actions activated by these TSOs. The updated net positions and flows on direct current lines shall reflect cross-zonal exchanges as of T0 minus 120 minutes as well as TSO-TSO transactions entered into between that time and T0 minus 20 minutes for the purpose of activating preventive remedial actions.
    d. by time T0 minus 10 minutes on the day before the day of delivery updated aligned net positions and flows on direct current lines for each day-ahead scenario shall be available to all TSOs via the ENTSO for Electricity operational planning data environment referred to in Article 21.
    e. by time T0 on the day before the day of delivery each TSO shall make its IGM available via the ENTSO for Electricity operational planning data environment in accordance with Article 21; pursuant to Article 4(5)(f) the TSO shall ensure that its IGM is consistent with the scheduled exchanges referred to in Article 22(4)(d) as well as agreed remedial actions determined in the previous time frame;
    f. by time T0 plus 50 minutes on the day before the day of delivery the TSO's regional security coordinator shall
        i. check the consistency of the IGM provided by the TSO against the quality criteria defined pursuant to Article 23;
        ii. if an IGM fails the quality check referred to in (i), either obtain a new IGM of sufficient quality from the TSO responsible or substitute an alternative IGM in

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accordance with the substitution rules referred to in Article 20(4) and make this validated IGM available via the ENTSO for Electricity operational planning data environment referred to in Article 21;

g. by time T0 plus 60 minutes on the day before the day of delivery the TSO's regional security coordinator shall
    i. apply the requirements specified in Article 20(2) in order to merge all IGMs into a CGM pursuant to Article 79(5) of Regulation 2017/1485 and make the resulting CGMs available to all relevant parties via the ENTSO for Electricity operational planning data environment referred to in Article 21;
    ii. validate each CGM obtained to ensure that it is consistent with those obtained by all other regional security coordinators (if any);
h. following the validation of the CGM at time T0 plus 60 minutes on the day before the day of delivery
    i. TSOs and regional security coordinators shall carry out coordinated operational security analyses as required by the methodology for coordinating operational security analysis pursuant to Article 75(1) of Regulation 2017/1485, the common provisions for regional operational security coordination pursuant to Article 76(1) and other relevant procedures and agreements;
    ii. the regional security coordinator shall, where applicable, make available an updated CGM including any remedial actions agreed by time T3;
i. the process shall be repeated between time T0 and time T5 as required by the methodology for coordinating operational security analysis pursuant to Article 75(1) of Regulation 2017/1485.

5. All TSOs shall jointly define times T0 and T3 and T5 in accordance with the methodology for coordinating operational security analysis pursuant to Article 75(1) of Regulation 2017/1485 and publish these times on the ENTSO-E website. All TSOs may jointly agree to shorten the deadlines in such a way that less time is allowed for the completion of one or more of the tasks listed in paragraph 4.
6. When preparing intraday CGMs, all TSOs and regional security coordinators shall complete the following steps:
    a. by 1 hour 35 minutes before the reference time each TSO shall make its net position and flows on direct current lines for each intraday scenario available to all TSOs via the ENTSO for Electricity operational planning data environment referred to in Article 21. These net positions and flows on direct current lines shall reflect cross-zonal exchanges as of the reference time minus 2 hours;
    b. by 1 hour 30 minutes before the reference time aligned net positions and flows on direct current lines for each TSO and for each intraday scenario shall be available to all TSOs via the ENTSO for Electricity operational planning data environment referred to in Article 21;
    c. by 1 hour before the reference time each TSO shall make its IGM for each market time unit between the reference time and the time eight hours later than the reference time available via the ENTSO for Electricity operational planning data environment in accordance with Article 21; pursuant to Article 4(5)(f) the TSO shall ensure that its IGM is consistent with the scheduled exchanges referred to in Article 22(6)(b) as well as agreed remedial actions determined in the previous time-frame;
    d. by 55 minutes before the reference time the TSO's regional security coordinator shall

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i. check the consistency of the IGM provided by the TSO against the quality criteria defined pursuant to Article 23;
ii. if an IGM fails the quality check referred to in (i), either obtain a new IGM of sufficient quality from the TSO responsible or substitute an alternative IGM in accordance with the substitution rules referred to in Article 20(4) and make this validated IGM available via the ENTSO for Electricity operational planning data environment referred to in Article 21;

e. by 45 minutes before the reference time the TSO's regional security coordinator shall
i. apply the requirements specified in Article 20(2) in order to merge all IGMs into a CGM pursuant to Article 79(5) of Regulation 2017/1485 and make the resulting CGMs available to all relevant parties via the ENTSO for Electricity operational planning data environment referred to in Article 21;
ii. validate each CGM obtained to ensure that it is consistent with those obtained by all other regional security coordinators (if any);

f. without undue delay, following the validation of the CGM 45 minutes before the reference time
i. the regional security coordinator shall, where applicable, make available an updated CGM based on updated IGMs to be provided by each TSO including any remedial actions agreed in accordance with the methodology for coordinating operational security analysis pursuant to Article 75(1) of Regulation 2017/1485, the common provisions for regional operational security coordination pursuant to Article 76(1) and other relevant procedures and agreements.

7. The reference times referred to in paragraph 6 shall initially be 00:00h, 08:00h, 16:00h. All TSOs may jointly agree to define additional reference times and / or to shorten the deadlines in such a way that less time is allowed for the completion of one or more of the tasks listed in paragraph 6. Pursuant to Article 76(1)(a) of Regulation 2017/1485 as well as Article 4(4), all TSOs of a capacity calculation region may jointly agree to define additional reference times applicable to the TSOs of that capacity calculation region only as well as the associated substitution rules.
8. All TSOs shall ensure that the merging process and the CGM are completed in time for the relevant operational deadlines set out in the applicable legislation and associated methodologies to be met and such that the most accurate and up to date model possible can be delivered for each timeframe.

Article 23
Quality monitoring

1. All TSOs shall jointly define quality criteria that IGMs have to meet in order to be merged into a common grid model. An IGM that does not meet these quality criteria shall be replaced by a substitute IGM.
2. All TSOs shall jointly define quality criteria that CGMs have to meet before they can be made available via the ENTSO for Electricity operational planning data environment.
3. All TSOs shall jointly define criteria that the preliminary net positions and preliminary flows on direct current lines as well as the other input data required for the CGM alignment process pursuant to Article 19 have to meet. Data sets that do not meet these criteria shall be replaced by substitute data.

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4. All TSOs shall jointly define quality indicators that make it possible to assess all stages of the CGM process including, in particular, the CGM alignment process described in Article 19. They shall monitor these quality indicators and publish the indicators and the results of the monitoring as part of the data to be provided pursuant to Article 31(3) of Regulation 2015/1222 as well as Article 26(3) of Regulation 2016/1719.

Article 24
Timescale for implementation

1. Upon approval of the present methodology each TSO shall publish it on the internet in accordance with Article 8(1) of Regulation 2017/1485.
2. All TSOs shall jointly develop a governance framework for the ENTSO for Electricity operational planning data environment referred to in Article 21 which shall at a minimum address the topics of ownership, hosting, cost allocation, licensing requirements, and operational responsibility. This governance framework shall be prepared in a manner timely enough to allow all TSOs to meet the deadline set out in paragraph 3.
3. By three months after the approval of the common grid model methodology submitted pursuant to Articles 67(1) and 70(1) of Regulation 2017/1485 all TSOs shall organise the process of merging the individual grid models by completing the following tasks:
    a. all TSOs shall jointly develop the governance framework referred to in paragraph 2;
    b. each TSO shall formalise the delegation agreement with the regional security coordinator referred to in Article 19;
    c. all TSOs shall jointly specify and develop the algorithm referenced in Article 19 and shall also specify the rules and process associated with the said algorithm. All TSOs will publish on the internet the specifications, rules and process associated with the algorithm referenced in Article 19;
    d. all TSOs shall jointly define the quality criteria and quality indicators referred to in Article 23;
    e. all TSOs shall jointly formulate the requirements with respect to regional security coordinators and the merging process referred to in Article 20(2) as well as the substitution rules referred to in Article 20(4);
    f. each TSO shall formalise the delegation agreement with the regional security coordinator referred to in Article 20.
4. By six months after the approval of the common grid model methodology submitted pursuant to Articles 67(1) and 70(1) of Regulation 2017/1485, the ENTSO for Electricity operational planning data environment referred to in Article 21 shall be operational. All TSOs and all regional security coordinators shall be connected to the ENTSO for Electricity operational planning data environment and shall be able to make use of all of its features as described in the present methodology. All TSOs shall jointly ensure that the CGM process is operational and available for use by all relevant parties.
5. All TSOs shall jointly publish the available data related to quality monitoring on a yearly basis following the implementation of the OPDE.

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Article 25

Language

The reference language for this CGMM Proposal shall be English. For the avoidance of doubt, where TSOs need to translate this proposal into their national language(s), in the event of inconsistencies between the English version published by TSOs in accordance with Article 8(1) of Regulation 2017/1485 and any version in another language the relevant TSOs shall, in accordance with national legislation, provide the relevant national regulatory authorities with an updated translation of the proposal.

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