All Continental European and Nordic TSOs' proposal for a Cost Benefit Analysis methodology in accordance with Article 156(11) of the Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation

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Contents

All Continental European and Nordic TSOs, taking into account the following,

Whereas

(1) This document is a common proposal jointly developed by all Transmission System Operators of the Continental European and the Nordic synchronous areas (hereafter referred to as the "TSOs") regarding the determination of assumptions and a methodology for a Cost Benefit Analysis (hereafter referred to as "CBA") to be conducted , in order to assess the time period required for frequency containment reserves (hereafter referred to as "FCR") providing units or groups (hereafter referred to as "FCR providers") with limited energy reservoirs to remain available during alert state, in accordance with Article 156(11) of Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation (hereafter referred to as "System Operation Guideline Regulation"). This proposal is hereafter referred to as "CBA methodology for FCR Proposal".

(2) The CBA methodology for FCR Proposal takes into account the general principles and goals set in the System Operation Guideline Regulation 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 the System Operation Guideline Regulation is safeguarding operational security, frequency quality and the efficient use of the interconnected system and resources. It sets for this purpose requirements to FCR providers ensuring that their FCR providing units or groups with limited energy reservoirs are able to fully activate FCR continuously in alert state for a minimum time period to be defined pursuant to Article 156 (10) and (11) of the System Operation Guideline Regulation.

(3) Article 156(9) of the System Operation Guideline Regulation provides that, in case no time period has been determined pursuant to Article 156 (10) and (11) of the System Operation Guideline Regulation, each FCR provider shall ensure that its FCR providing units or groups with limited energy reservoirs are able to fully activate FCR continuously for at least 15 minutes or, in case of frequency deviations that are smaller than a frequency deviation requiring full FCR activation, for an equivalent length of time, or for a period defined by each TSO, which shall not be greater than 30 or smaller than 15 minutes.
Furthermore, it provides that, if a time period has been determined pursuant to Article 156(10) and (11) of the System Operation Guideline Regulation, each FCR provider shall ensure that its FCR providing units or groups with limited energy reservoirs shall be able to fully activate FCR continuously in alert state for that time period assessed.

(4) Article 156(10) of the System Operation Guideline Regulation requires all Continental European and Nordic TSOs to develop a proposal concerning the minimum activation period to be ensured by FCR providers, and specifies that the period determined shall not be greater than 30 or smaller than 15 minutes. Such proposal shall take full account of the results of the CBA conducted pursuant to Article 156(11) of the System Operation Guideline Regulation.

(5) Article 156(11) of the System Operation Guideline Regulation requires the TSOs of the Continental European and Nordic synchronous areas to propose assumptions and methodology for a CBA to be conducted, in order to assess the time period required for FCR providing units or groups with limited energy reservoirs to remain available during alert state.

The CBA shall take into account at least:

(a) experiences gathered with different timeframes and shares of emerging technologies in different LFC blocks;

(b) the impact of a defined time period on the total cost of FCR reserves in the synchronous area;

(c) the impact of a defined time period on system stability risks, in particular through prolonged or repeated frequency events;

(d) the impact on system stability risks and total cost of FCR in case of increasing total volume of FCR;

(e) the impact of technological developments on costs of availability periods for FCR from its FCR providing units or groups with limited energy reservoirs.

(6) This CBA methodology for FCR Proposal is exclusively related to FCR providing units or group with energy limited reservoirs.

(7) According to Article 6(6) of the System Operation Guideline Regulation, the expected impact of the CBA methodology for FCR Proposal on the objectives of the System Operation Guideline Regulation has to be described.
The proposed CBA methodology for FCR Proposal generally contributes to the achievement of the objectives of Article 4 of the System Operation Guideline Regulation.
The CBA methodology for FCR Proposal shall form the basis on which the TSOs of the CE and Nordic synchronous areas shall assess the time period required for FCR providing units or groups with limited energy reservoirs to remain available during alert state in accordance with Article 156(11) of the System Operation Guideline Regulation, and it shall be taken into account by all TSOs of the CE and Nordic synchronous areas to develop a proposal concerning the minimum activation period to be ensured by FCR providers in accordance with Article 156(10) of the System Operation Guideline Regulation. The CBA methodology for FCR Proposal therefore provides the TSOs of the CE and Nordic synchronous areas with an underlying methodology to assess and develop a proposal concerning the minimum activation period to be ensured by FCR providers. The determination of a minimum activation period to be ensured by FCR providers during alert state contributes to the operation security of the interconnected system and ressources.

(8) In conclusion, the CBA methodology for FCR Proposal contributes to pursue the general objectives of the System Operation Guideline Regulation of safeguarding operational security by defining the proper time period for the full FCR activation in the alert state taking into account costs and benefits of the defined time period, to the benefit of all market participants and electricity end consumers.

SUBMIT THE FOLLOWING CBA METHODOLOGY FOR FCR PROPOSAL TO ALL REGULATORY AUTHORITIES OF THE CE AND NORDIC SYNCHRONOUS AREA:

Article 1
Subject matter and scope

The CBA assumptions and methodology as determined in this CBA methodology for FCR Proposal shall be considered as the common proposal of all Continental European and Nordic TSOs in accordance with Article 156(11) of the System Operation Guideline Regulation and shall form the basis on whichethe TSOs of the CE and Nordic synchronous areas shall assess the time period required for FCR providing units or groups with limited energy reservoirs to remain available during alert state.

Article 2
Definitions and interpretation

1. For the purposes of the CBA methodology for FCR Proposal, terms used in this document shall have the meaning of the definitions included in Article 3 of the System Operation Guideline Regulation, of Regulation (EC) 714/2009, Directive 2009/72/EC and Commission Regulation (EU) 543/2013.

2. In addition, in this CBA methodology for FCR Proposal, unless the context requires otherwise, the following terms shall have the meaning below:
   a) 'LER' means 'FCR production units or groups with limited energy reservoirs';
   b) 'LER Share' means the 'share of LER on the total FCR providers ';
   c) 'NPV' means the 'Net Present Value';
   d) 'Market induced imbalances' means the 'generation-load imbalance caused by the change in generation set points according to the results of the market scheduling'.
   e) 'System droop' means 'the ratio between frequency deviation and steady state power response provided by FCP';
   f) 'FCR cost curve' means 'the set of all the offered quantity of FCR with their correspondant cost';
   g) 'Time Period' means 'the time for which each FCR provider shall ensure that its FCR providing units with limited energy reservoirs are able to fully activate FCR continuously, as of triggering the alert state and during the alert state';
   h) 'Starting Year' means 'the year in which Time Period requirement is expected to entry into force'
   i) 'Long lasting frequency deviation' means an event with an average steady state frequency deviation larger than the standard frequency deviation over a period longer than the time to restore frequency.

3. In this CBA methodology for FCR Proposal, unless the context requires otherwise:
   a) the singular indicates the plural and vice versa;
   b) unless otherwise provided, any reference to an Article means an article of this CBA methodology for FCR Proposal;
   c) the table of contents and headings are inserted for convenience only and do not affect the interpretation of this CBA methodology for FCR Proposal; and
   d) any reference to legislation, regulations, directive, order, instrument, code or any other enactment shall include any modification, extension or re-enactment of it then in force.

Article 3
CBA methodology

The CBA methodology consistes of the identification of the combination of time period and LER share which entails the lowest total cost of FCR as resulting from Articles 4 and 5, over the time horizon described in Article 6, without jeopardising the system stability during the most relevant real frequency events according to Article 7. The time period resulting from the aforementioned criteria for selection is directly associated to a specific LER Share and a specific FCR dimensioning.

Article 4
Simulation of FCP in presence of LER

1. All TSOs of a shynchronous area shall develop a simulation model of FCP and FRR in time domain for each synchronous area.The simulation model shall simulate at least the FRP deployment dynamic, the system droop and the load droop.
   The simulation model shall be able to simulate the behaviour of LER corresponding to a defined Time Period and LER reservoir depletion phenomenon.

2. The simulation model of each synchronous area shall be used in a a workflow that allows to assess the costs and the benefits of a defined Time Period.
   The workflow shall test a wide combination of possible operation condition of the each synchronous area. This is possible by simulating several years of operation conditions of each synchronous area with a Monte Carlo probabilistic approach. The Monte Carlo probabilistic approach has the aim to generate a large number of random combinations of all the possible sources of frequency disturbance. Since the simulation model works on the time domain, this approach requires to simulate a long system operation period. The operation period to be simulated shall be long enough to generate statistically significant results.

3. The source of frequency disturbance that shall be taken into account when implementing the CBA methodology for FCR Proposal are:
   a. Deterministic frequency deviation. When implementing the CBA methology for FCR Proposal, the TSOs shall consider the market induced imbalances, analyse frequency historical trend of each synchronous area over a several years, and then statistically determine the typical trends and amplitudes of these frequency deviations in order to use them in the simulations.
   b. Long lasting frequency deviation. When implementing the CBA methology for FCR Proposal, the TSOs shall take into account events in which the frequency deviation cannot be restored to 50 Hz by FRP. During these events the frequency remains around the standard frequency range over a prolonged period.
      They shall analyse frequency historical trends in order to characterize the phenomena from a statistical point of view. The analysis shall determine:
      • the number of occurrences of these events;
      • the typical duration;
      • a representative frequency deviation trend;
      • typical time of occurrence, if highlighted by statistical analysis.
   c. Outages of relevant grid elements. When implementing the CBA methology for FCR Proposal, the TSOs shall define a list of all the grid elements whose outages lead to relevant load or generation loss and indeed to relevant FCR activation.
      The grid elements outages to be investigated are at least: generation plants failure, critical busbar fault and critical substation blackout. For each outage a probability of failure shall be defined.

4. All TSOs of a shynchronous area shall evaluate the impact of LER on the system stability using the probabilistic approach. The workflow shall use an iterative method aimed to increase the FCR if the presence of LER jeopardises the system stability.
   The workflow calculates firstly the effects of the presence of LER on the system stability, taking into account all the sources of frequency disturbance set in Article 4 (3), using the FCR dimensioning rule adopted by the synchronous area. If in the probabilistic calculation the system stability risk requirement defined in Article 4 (5) is not fulfilled, the probabilistic calculation is repeated with an increase in the FCR dimensioning.
   The iterations are repeated until the system stability risk requirement defined in Article 4 (5) is fulfilled.

5. The following system stability requirement is considered: LER depletion shall never lead the steady state frequency deviation to overcome the maximum steady state frequency deviation. If a LER depletion occurs, the activated FCR provided by LER is no more available. This activated FCR must

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be replaced by residual non-LER providers. The residual non-LER providers must have a sufficient not yet activated FCR to replace the depleted LER activated FCR.

Article 5
Assessment of total cost of FCR

1. All TSOs of a shynchronous area shall define a FCR cost curve which includes both LER and non LER FCR providers.

   The FCR cost for non-LER FCR providers shall be calculated by comparing the marginal cost of the FCR provider with the energy marginal price of the bidding zone. The comparison allows to estimate the cost of reserving capacity for FCR provision.

   The FCR cost for LER shall be calculated taking into account the investment to be sustained by new or existing LER providers in order to be qualified for FCR provision and considering a defined time period requirement.

   The following aspects shall be considered:
   a) the potential FCR cost variation of LER associated to a defined time period.
   b) The volumes of FCR to be provided, which shall be determined by means of the simulations defined in Article 4 (4).

Article 6
Simulation scenarios

1. The analyses described in Articles 4 and 5 shall be performed considering different scenarios and allow to calculate both FCR dimensioning and total costs of FCR taking into account different assumptions. The set of scenarios shall be defined to represent potential future developments of the energy system and regulations. Scenarios shall also be aimed to address uncertainties and assess the impact of different hypotheses which can affect the results of the cost-benefits analysis.

2. The set of scenarios shall include all the combinations of the following assumptions:
   a) Time Period. In order to evaluate the best solution in terms of minimum activation period which is not greater than 30 or smaller than 15 minutes, the interval of possible solutions have to be explored adopting an opportune discretization. When implementing the CBA methodology for FCR Proposal, the TSOs shall consider a discretization of 5 minutes, thus the results considering 15, 20, 25 and 30 minutes as minimum activation period shall be assessed.
   b) LER Share. The share of the LER can be affected by the cost effectiveness of LER but also by other factors, such as the presence of a market based procurement of FCR, or other technical and regulatory impacts on LER deployment. For this reason, different LER Shares shall be analysed in the 10-100% range with 10% discretization.
   c) Time horizon. All the analyses shall be performed considering the evolution in the mid-long term of the generation portfolio, demand forecast, transmission system development, fuel costs and LER investment costs. When implementing the CBA methodology for FCR Proposal, the TSOs shall define periodical snapshot years considering at least two time horizons among the short term (1-5 years range), medium term (5-10 years range), and long term (10-15 years range).

3. One single pan-European societal discount rate shall be used to calculate the NPV of total costs of FCR related to different years for each combination of LER Share and Time Period. This shall be a real

discount rate of 4% applied from the Starting Year to the last simulated snapshot year. The last simulated snapshot year is considered as the ending year of the assessment. The results for each year within the ending year of the assessment are derived from the results of the snapshot years aggregating across years as follows:

a) For years from the starting year to the first snapshot year the results of the first snapshot year will be extended backwards.
b) For years between snapshot years (two or three depending on the number of simulated time horizons) the results will be linearly interpolated between the snapshot years.

The elaboration of the results obtained performing the analyses described in Articles 4 and 5 to the whole set of scenarios shall allow to obtain FCR dimensioning and total costs of FCR for each combination of Time Period and LER Share.

Article 7
Simulation of the most relevant real frequency events in presence of LER

1. The simulations described in Article 4 cannot model all the possible combinations of each real grid element and its behaviour.
   Indeed there are complex sequences of events which can lead to significant power imbalances that cannot be investigated by means of probabilistic simulations.
   Since during this kind of events the FCP has a crucial role in avoiding a further deterioration of the system conditions and in helping to restore the stability, it is fundamental to assess how the presence of LER could affect the system.
   The only way to address this modelling complexity is to simulate actually occurred events, starting from recorded frequency data.
   The most relevant frequency disturbances occurred in the past shall be simulated modelling the presence of LER and assessing how the potential energy depletion would have affected the system stability.

2. Simulation of the most relevant real frequency events shall be performed for each combination of Time Period and LER Share defined in Article 6 (2a) and (2b). If a combination of Time Period and LER Share worsens operational security potentially leading to a blackout state the combination shall not be considered for the definition of the Time Period.

Article 8
Annex

The annexed document aims to provide interested parties with the background information, explanation and further details about the requirements specified in the CBA methodology for FCR Proposal and should be read in conjunction with CBA methodology for FCR Proposal.

Article 9
Publication and implementation of the CBA methodology for FCR Proposal

1. Each Continental European and Nordic TSO shall publish the CBA methodology for FCR Proposal without undue delay after all NRAs have approved the proposed CBA methodology for FCR Proposal, in accordance with Article 8 of the System Operation Guideline Regulation .

2. The Continental European and Nordic TSOs shall have implemented the adopted CBA methodology for FCR Proposal by 12 months after its approval by all regulatory authorities of the CE and Nordic synchronous areas. The implementation shall take place by submitting the results of the CBA conducted by the TSOs of the CE and Nordic synchronous areasaccording to the adopted CBA methodology for FCR Proposal to the concerned regulatory authorities suggesting a Time Period for FCR providers with limited energy reservoirs during which they shall be able to fully activate FCR

continuously in alert state, whereas this Time Period shall not be greater than 30 or smaller than 15 minutes .

Article 10
Language

The reference language for this CBA methodology for FCR Proposal shall be English. For the avoidance of doubt, where TSOs need to translate this CBA methodology for FCR 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 the System Operation Guideline Regulation 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 CBA methodology for FCR Proposal.

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