European Association for Storage of Energy

Specifications for the elaboration of a Cost-Benefit Analysis method to evaluate the impact of 15 vs 30 min activation period for energy storage providing FCR

Context

The System Operation (SO) Guideline, or network code, was approved in comitology in May 2016 and is expected to enter into force in early 2017. [The SO Guideline encompasses the Load Frequency Control and Reserve (LFCR) network code and two others which were being drafted separately through 2015.]

For frequency containment reserves (FCR), Article 156(9) of the SO Guideline establishes a cap and floor for national minimum activation periods, i.e., "the period determined shall not be greater than 30 or smaller than 15 minutes." These nationally-set periods will prevail only for a transitional period until a harmonised minimum activation period can be set.

Article 156(11) of the SO Guideline calls for a cost-benefit analysis (CBA) to be conducted within 24 months (6 months to propose a method, 6 months to approve the method, 12 months to realise the CBA) of its entry into force to inform the setting of a harmonised minimum activation period.

To our knowledge, such a CBA has never been realised before. EASE therefore wants to contribute to the policy making leading to the formulation of this CBA and to highlight the key points to be addressed in such a methodology.

To this extent and to formalise a contribution, EASE members are willing to finance an external study proposing a first version of such a CBA. The present document gives the specifications for such a study.

EASE - European Association for Storage of Energy
Avenue Adolphe Lacomblé 59/8 - B-1030 Brussels - tel: 02.743.29.82 - fax: 02.743.29.90 - info@ease-storage.eu - www.ease-storage.eu

Original question:

Article 156(11) gives only very broad guidelines with regards to the CBA [see Annex]. When considering the question from a system perspective:

- The **potential cost** for the system of choosing 15 minutes instead of 30 minutes (min) would be an increased probability of not having enough FCR after a series of exceptional events (e.g. 2 or 3 successive (within 15-30 min) losses of 3 GW of generation). Should such an FCR shortage occur, the solution to prevent black out would be to load shed part of the continental European consumption over a certain time (probably a few minutes), i.e. the time to reach a full frequency restoration reserves (FRR) deployment. The system cost would then be the cost of the unserved MWh[1]. It would be a very improbable but potentially significant cost.
- The **potential benefits** for the system of choosing 15 min vs 30 min would be to lower the cost of FCR provision in Europe as more technology solutions would be able to provide reserve in open market competition (e.g. : some run of river power plants are currently allowed to provide (inexpensive) reserve but would not be able to if the criteria were to be set to 30 min, some storage technologies could be sized with less storage capacity, thus a lower cost).

Most of these benefits would be reflected by a direct diminution (or an avoided increase) of the FCR cost.

The estimation of the benefits would be kept outside of the scope of the current study.

Therefore, **the scope of the current study would mainly be on the further characterisation of the potential system cost linked to a 15 min vs 30 min choice.**

[1] A first simplified calculation indicates that the cost could be over €100m: load shedding 10 % of a European consumption of 500 GW for 30 min, with a cost of the energy not served of €5k/MWh would translate into a cost of €125m.

EASE – European Association for Storage of Energy
Avenue Adolphe Lacomblé 59/8 – B-1030 Brussels – tel: 02.743.29.82 – fax: 02.743.29.90 – info@ease-storage.eu – www.ease-storage.eu

Outline of the tasks to be carried out:

As discussed previously, the goal is to better characterise the potential system cost of the 15 vs 30 min choice, by **quantifying** the following two assumptions:

- Assumption A: The risk of running out of reserve with 15 min and 30 min is extremely low (but how low?), and there is no significant difference between 15 and 30 min.
- Assumption B: In case the system would indeed run out of reserve, it could imply a significant cost (but how much?)

To this end, EASE envisages several tasks as described below – however, the potential contractors are highly welcome to propose other alternatives they think can better answer the question.

Task 1: historical analysis of the continental European frequency deviations

1. Grid Events Evaluation, with for the most relevant grid event (the list should be proposed by the contractor and discussed with EASE): a) Causes and location, b) maximum frequency deviation, c) duration of frequency deviation outside the dead-band. Ideally, proposition of a focus on grid events involving several consecutive losses (did such events happen? How many times?)
2. Choice of the top worst case historical situations for Task 2 (one to be chosen as the main reference, plus several others).

The contractor will have the task of gathering (and potentially buying) the needed data.

Task 2: Simulation of the behaviour of storage (use of the energy) providing FCR through the historical worst case, with a 15 and 30-minute sizing (and ideally other points, e.g. 5, 10, 20, 40 min) of storage (the approach being technologically neutral, such storage could be any technologies such as batteries, LAES, CAES, PHS, high temperature heat storage integrated in power plants).

⇨ This task would involve modelling the provision of FCR by storage, including the recharging strategy. The contractor will propose a modelling, and EASE members will discuss the assumptions chosen.

From this, analysis of whether there could have been a risk of FCR shortage because of the limits of the energy reservoirs of the different technologies, including aggregation, considering historic events.

EASE – European Association for Storage of Energy
Avenue Adolphe Lacomblé 59/8 – B-1030 Brussels – tel: 02.743.29.82 – fax: 02.743.29.90 – info@ease-storage.eu – www.ease-storage.eu

Task 3: Elaboration of "synthetic" worst case events and simulation

1. Pursuing Task 1.2, a synthetic worst case for frequency deviation should be designed (for example, by imagining that the historical worst cases would all happen within a limited time, e.g. less than 15-30 min – or by a succession of 3 GW losses – the contractor would be free to suggest any other method). The probability of occurrence of such a synthetic case should ideally be assessed by the contractor (for example, by comparing it to real cases)
2. Simulation of the behaviour of storage devices (use of the energy and follow up of the state of charge) through this "synthetic" worst case (i.e. replication of Task 2 with the synthetic data)

Task 4 (optional): perform Task 1-3 on non-synchronously interconnected areas (e.g. UK, Ireland, Sardinia, etc.)

Task 5 (optional): propose through a literature review an estimation of the societal cost of load shedding 5, 10 or 20% of the load for some minutes

1. Estimation of the load shedding episode duration
2. Estimation of its cost

Task 6: Re-run tasks 2 and 3 with the CBA Methodology defined by ENTSO-E once this methodology will have been defined.

Note on some assumptions:
The study will assume that the FCR sizing will remain unchanged in continental Europe (i.e. the dimensioning incident (loss of 3 GW) will not increase)

Timing & interactions with EASE members:
The study should be carried out over 2-3 months, starting in H1 2017.

Two workshops between the contractor and a steering committee of involved EASE members should be planned during the course of the study:

- A first workshop shortly after the beginning of the analyses, to discuss of the main hypotheses and assumptions.
- A second workshop close to finalisation of the work, to discuss the results (sufficient time should be allocated to taking into account the remarks of EASE members following this meeting).

These meetings will be organised at the EASE premises in Brussels by the EASE Secretariat in liaison with the contractor. Regular teleconferences should be planned with the EASE members involved and the EASE Secretariat (e.g. one per week or every two weeks).

ANNEX

SO Guideline, Article 156, as in the final (provisional) version, 4 May 2016 (available: https://ec.europa.eu/energy/sites/ener/files/documents/SystemOperationGuideline%20final%28provisional%2904052016.pdf)

1. Each TSO shall ensure the availability of at least its FCR obligations agreed between all TSOs of the same synchronous area in accordance with Articles 153, 163, 173 and 174.

2. All TSOs of a synchronous area shall determine, at least on an annual basis, the size of the K-factor of the synchronous area, taking into account at least the following factors:

   (a) the reserve capacity on FCR divided by the maximum steady-state frequency deviation;

   (b) the auto-control of generation;

   (c) the self-regulation of load, taking into account the contribution in accordance with Articles 27 and 28 of *Commission Regulation No [000/2015 DCC]*;

   (d) the frequency response of HVDC interconnectors referred to in Article 172; and,

   (e) the LFSM and FSM activation in accordance with Articles 13 and 15 of *Commission Regulation No* [*RfG*].

3. All TSOs of a synchronous area consisting of more than one LFC area shall, in the synchronous area agreement, determine the shares of the K-factor for each LFC area, which shall be based on at least:

   (a) the initial FCR obligations;

   (b) auto-control of generation;

   (c) the self-regulation of load;

   (d) frequency coupling via HVDC between synchronous area;

   (e) exchange of FCR.

4. An FCR provider shall guarantee the continuous availability of FCR, with the exception of a forced outage of a FCR providing unit during the period of time in which it is obliged to provide FCR.

EASE – European Association for Storage of Energy
Avenue Adolphe Lacomblé 59/8 – B-1030 Brussels – tel: 02.743.29.82 – fax: 02.743.29.90 – info@ease-storage.eu – www.ease-storage.eu

5. Each FCR provider shall inform its reserve connecting TSO, as soon as possible, about any changes in the actual availability of its FCR providing unit and/or its FCR providing group, in whole or in part, relevant for the results of prequalification.

6. Each TSO shall ensure, or shall require its FCR providers to ensure that the loss of a FCR providing unit does not endanger the operational security by:

(a) limiting the share of the FCR provided per FCR providing unit to 5 % of the reserve capacity of FCR required for each the whole CE and Nordic synchronous areas;

(b) excluding the FCR provided by the unit defining the reference incident of the synchronous area from the dimensioning process for GB, IE/NI and Nordic synchronous areas; and

(c) replacing the FCR which is made unavailable due to a forced outage or the unavailability of an FCR providing unit or FCR providing group as soon as technically possible and in accordance with the conditions that shall be defined by the reserve connecting TSO.

7. An FCR providing unit or FCR providing group with an energy reservoir that does not limit its capability to provide FCR shall activate its FCR for as long as the frequency deviation persists. For the GB and IE/NI synchronous areas, a FCR providing unit or FCR providing group with an energy reservoir that does not limit its capability to provide FCR shall activate its FCR until it activates its FRR or for the period specified in the synchronous area operational agreement.

8. A FCR providing unit or FCR providing group with an energy reservoir that limits its capability to provide FCR shall activate its FCR for as long as the frequency deviation persists, unless its energy reservoir is exhausted in either the positive or negative direction. For the GB and IE/NI synchronous areas, a FCR providing unit or FCR providing group with an energy reservoir that limits its capability to provide FCR shall activate its FCR until it activates its FRR or for the period specified in the synchronous area operational agreement.

9. For the CE and Nordic synchronous areas, each FCR provider shall ensure that the FCR from its FCR providing units or groups with limited energy reservoirs are continuously available during normal state. For the CE and Nordic synchronous areas, as of triggering the alert state and during the alert state, each FCR provider shall ensure that the FCR from its FCR providing units or groups with limited energy reservoirs are able to fully activate FCR continuously for a time period to be defined pursuant to paragraphs 10 and 11. Where no period has been determined pursuant to paragraphs 10 and 11, 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.

10. For the CE and Nordic synchronous areas, all TSOs shall develop a proposal concerning the minimum activation period to be ensured by FCR providers. The period determined shall not be greater than 30 or smaller than 15 minutes. The proposal shall take full account of the results of the cost–benefit analysis conducted pursuant to paragraph 11.

EASE – European Association for Storage of Energy
Avenue Adolphe Lacomblé 59/8 – B-1030 Brussels – tel: 02.743.29.82 – fax: 02.743.29.90 – info@ease-storage.eu – www.ease-storage.eu

11. By 6 months after entry into force of this regulation, all TSOs of the CE and Nordic synchronous areas shall propose assumptions and methodology for a cost-benefit analysis 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. By 12 months after approval of the assumptions and methodology by all regulatory authorities of the concerned region, the TSOs of the CE and Nordic synchronous areas shall submit the results of their cost-benefit analysis to the competent regulatory authority, suggesting a time period which shall not be greater than 30 or smaller than 15 minutes. The cost-benefit analysis shall take into account at least:

(a) experiences gathered with different time frames 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 reserves in case of increasing total volume of FCR reserves;

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

12. The FCR provider shall specify the limitations of the energy reservoir of its FCR providing units or FCR providing groups in the prequalification process in accordance with Article 155.

13. A FCR provider using FCR providing units or FCR providing group with an energy reservoir that limits their capability to provide FCR shall ensure the recovery of the energy reservoirs in the positive or negative directions in accordance with the following criteria:

(a) for the GB and IE/NI synchronous areas, the FCR provider shall use the methods specified in the synchronous area operational agreement;

(b) for the CE and Nordic synchronous areas, the FCR provider shall ensure the recovery of the energy reservoirs as soon as possible, within 2 hours after the end of the alert state.

EASE – European Association for Storage of Energy
Avenue Adolphe Lacomblé 59/8 – B-1030 Brussels – tel: 02.743.29.82 – fax: 02.743.29.90 – info@ease-storage.eu – www.ease-storage.eu