nationalgridESO

EBGL Article 26: Proposal for Defining and Using Specific Products for balancing energy and balancing capacity

Executive summary

This proposal sets out our requirement to create a new GB specific Frequency Containment Reserve (FCR) product, along with supporting justification. The product that we propose to create is:

- Dynamic Containment

The response needs of NGESO in our role of operating the system are increasing, and they will continue to do so due to the larger system loss and lower inertia in the near future. With lower inertia on the system, the frequency changes more quickly. These characteristics require a new faster response service to contain frequency within security standards. In the foreseeable future the existing products might not be sufficient and fast enough to secure frequency in certain situations. This means we need faster-acting response.

Dynamic containment is a fast-acting response service, and can reduce the overall volume of response needed, while also enabling the system to be secure for a range of loss sizes & types.

The Electricity Balancing Guideline (EBGL) requires this proposal to be re-visited at least every two years. Through the Future of Balancing Services work, NGESO are conducting a review of all products and services to ensure that they are fit for purpose for the future. This includes a reform of response services. For Frequency Containment Reserve products (FCR), there is no European Standard Product, and as such there is no requirement for us to use a Standard Product predominantly over any other GB specific products.

Purpose of this Proposal

Article 26.1 of the Electricity Balancing Guideline (EBGL) states:
"Following the approval of the implementation frameworks for the European platforms pursuant to Articles 19, 20 and 21, each TSO may develop a proposal for defining and using specific products for balancing energy and balancing capacity."

It is important to note that there is no implementation framework of a standard European FCR product, and therefore there no approval of an implementation framework for an equivalent European Standard product.

This proposal covers GB Balancing services and products equivalent to Frequency Containment Reserves, which NGESO requires to maintain system security. The product included within this document is:

- Dynamic Containment

Article 26.1 of the EBGL requires that the following information is included as part of this proposal:

a) a definition of specific products and of the time period in which they will be used;

b) a demonstration that standard products are not sufficient to ensure operational security and to maintain the system balance efficiently or a demonstration that some balancing resources cannot participate in the balancing market through standard products;

c) a description of measures proposed to minimise the use of specific products subject to economic efficiency;

d) where applicable, the rules for converting the balancing energy bids from specific products into balancing energy bids from standard products;

e) where applicable, the information on the process for the conversion of balancing energy bids from specific products into balancing energy bids from standard products and the information on which common merit order list the conversion will take place;

f) a demonstration that the specific products do not create significant inefficiencies and distortions in the balancing market within and outside the scheduling area.

NGESO do not intend to convert specific products into standard products, and as a result points d) and e) are not applicable and not included in this proposal. There is not a standard product to convert dynamic containment into; therefore, it is not possible to convert it into a standard product.

26.1.a) a definition of specific products and of the time period in which they will be used

Response Services definition

Frequency response is an automatic change in generation or demand to counteract changes in system frequency. Under normal circumstances, frequency in GB remains within the *operational range* of 50Hz +/- 0.2Hz. The Security and Quality of Supply Standard (SQSS) defines unacceptable frequency conditions as either:

- steady state frequency deviations outside the *statutory range, i.e.* of more than +/- 0.5Hz ; or
- transient frequency deviations outside the statutory range, lasting for longer than 60 seconds

Transient deviations, lasting no longer than 60 seconds, outside of the +/- 0.5Hz are permitted, but must occur only “reasonably… infrequently”.

Frequency Containment Reserve – definition

Dynamic containment is a product that is defined as a Frequency Containment Reserve (FCR) product.

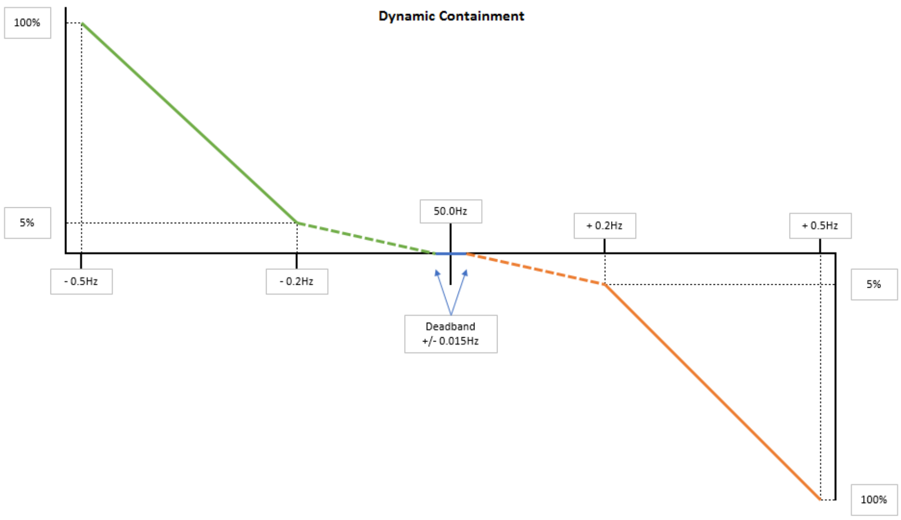
The legal definition of FCR products can be found in Article 3(2)(6) of the EU Network Code on System Operation:

"the active power reserves available to contain system frequency after the occurrence of an imbalance"

Further to this definition, these products " typically includes operating reserves with the activation time up to 30 seconds, they are usually activated automatically and locally.” (Emissions EUETS, 2020).

Dynamic Containment

Dynamic containment has been developed to meet the need to contain frequency within statutory limits (+/- 0.5Hz) for a range of loss sizes. Its activation starts at the edge of “operational limits” (+/- 0.2 Hz) and full delivery is achieved at statutory limits (+/- 0.5 Hz) within 1s. It is categorised as a post-fault service.



Characteristics	Dynamic Containment
Mode of activation	Automatic (activated by deviation from target frequency)
Preparation Period	Zero
Full Activation Time	1 second
Deactivation period	n/a (continuous service)
Minimum Quantity	1 MW
Maximum Quantity	None
Minimum duration of delivery period	15 minutes*
Maximum duration of delivery period	None*
***Delivery period**	There is no minimum or maximum duration of delivery period as delivery is an automatic response to system frequency. In theory if frequency was stable at 50Hz for the entire contract period (24hrs) then there would be zero required delivery; if frequency was stable at 49.5Hz then required delivery would be continuous. In practice, certain limits have been created to facilitate energy limited providers. For these technologies the requirement to deliver DC ceases once the Energy Requirement is exhausted (equivalent to 15 minutes at full output).
Location	Aggregation limited to within GSP group. Service is national.

Validity Period	24 hours
Minimum duration between the end of deactivation period and the following activation	n/a
Divisibility	Bids are not divisible
Price of bid	Defined by BSP via competitive tender
Availability price	Defined by BSP via competitive tender
Timeframe resolution	Contract duration is 24 hours
Gate Closure time	10:00am GMT each day

26.1.b) a demonstration that standard products are not sufficient to ensure operational security and to maintain the system balance efficiently or a demonstration that some balancing resources cannot participate in the balancing market through standard products

There is no standard product for FCR; thus products that are not standard are required in order to balance the system. In particular, dynamic containment is one such product that is designed to manage frequency post-fault.

As a standard product does not exist to rectify these issues, dynamic containment has been developed and will be used to address the issues stated below.

A demonstration that Dynamic Containment is necessary to ensure operational security

The energy industry is changing; we are seeing more and more renewable generation on the system, which is creating issues with low-inertia. Existing products (such as Primary, Secondary and High, PSH, Frequency Response) are not fast enough to secure our low-inertia system because the rate at which they deliver is not sufficient when frequency is changing quickly. Frequency hits statutory limits and below before it can be arrested by Primary response.

A new service is needed to arrest frequency in low-inertia, large loss scenarios. In these scenarios the Rate of Change of Frequency (RoCoF) is faster thus a faster response product is required. Dynamic containment delivers in 1 second.

A 'faster' version of PSH may help but ignores the distinction between pre-fault and post-fault management and the interaction of all frequency services in the control cycle. Our proposed new product suite is a faster version of PSH, but the issues we are managing have been split (pre/post-fault) and the products designed around the system need.

Static services are fast, but include compromises that will make them infeasible in the near future, such as managing their deactivation, and their unsuitability to manage a range of loss sizes.

The challenges of using static response arise precisely because they are not dynamic. The full contracted quantity is delivered onto the system in response to frequency reaching a pre-defined set-point regardless of the sequence of events that led to the change (e.g gradual or instantaneous). In some situations, this is desirable, but in others it can be an inflexibly disproportionate tool in meeting the system need. This approach is not viable on a system which experiences very large ranges of inertia (and hence RoCoF) and large ranges of loss sizes, both demand and generation.

Often the suggested approach is to change the quantity of static response as inertia and loss size change, and to use a range of frequency set-points to stagger the delivery of response. This approach in itself highlights why dynamic services are preferred to static services.

The ESO has previously outlined its thinking around static and dynamic services in the 2019 Operability Strategy Report.

Enhanced Frequency Response (EFR) is fast. Necessary tweaks to its design, e.g. to avoid harming pre-fault frequency, have resulted in Dynamic Containment.

The service design of EFR allows for energy limited providers to manage their state of energy when frequency is near to the deadband. The un-intended effect of this was to allow charging to occur when frequency is low and discharging to occur when frequency is high. Even with relatively small quantities of EFR (~200MW) this consequence has had a noticeable effect on the quality of pre-fault frequency. We solved this issue in the design of dynamic containment by implementing very specific rules on how and when energy limited providers could manage their state of energy.

There is a need for fast acting frequency response services now and in the future:

Now:

Large loss (nuclear power stations, large wind farms and interconnectors) and Loss of Mains (LoM) volume means we are at risk of being insecure in some periods because our response services are not fast enough to arrest the change before limits are reached/triggered.

Future:

LoM volume will be much diminished but large losses will still be present (new interconnection, large offshore wind and new nuclear). We will still need faster acting response products due to consistently lower inertia.

26.1.c) a description of measures proposed to minimise the use of specific products subject to economic efficiency

This section is not applicable to FCR products as there is not a standard FCR product that we can use in preference to any specific products. As there is no standard FCR product we may only use specific FCR products in an economically efficient manner in line with our license obligations to manage the system safely and effectively.

Dynamic containment, like other frequency containment reserve services, is always required to be available. An unexpected demand or generation loss can happen at any time. NGESO, in line with our ‘efficient and economic’ license condition will only procure the minimum required quantity of DC to mitigate the risks which it aims to secure.

Although dynamic containment will be available at all times its utilisation is expected to be very low. Delivered energy volumes will be up to 90% lower than the existing firm frequency response service. Frequency should only be in the delivery range (> 0.2Hz variance from 50Hz) less than 0.1% of the time.

26.1.f) a demonstration that the specific products do not create significant inefficiencies and distortions in the balancing market within and outside the scheduling area.

Impacts inside the scheduling area

Dynamic containment is technically different (see details below) from the currently available alternatives because it provides dynamic frequency response while restricting access to reserve at a ratio very close to 1:1 i.e. for every 1MW of DC, there is 1MW less power that could be used for reserve. The alternative (PSH) provides (slower) dynamic response but restricts access to reserve at a ratio of approx 1:1.55 i.e. or every 1MW of PSH we lose access to 1.55MW of power that could be used for reserve.

Within the scheduling area, other frequency response products are unlikely to be significantly affected as the technical parameters are so different. Dynamic containment is aiming to build volume through new assets and technology. There may be some existing assets that will move from the FFR tender (PSH) to the dynamic containment product; it is forecasted that these volumes will be fairly small[1]. Note that there has not been an impact on the volumes in the October round for FFR.

Impact on areas outside the scheduling area

Dynamic containment will not create inefficiencies or distortions outside the scheduling areas because there is no standard FCR product that is traded across scheduling areas for it to distort.

Key features of dynamic containment

The below analysis shows the key features of dynamic containment and outlines the differences to existing frequency response products. These details therefore show that the technical parameters are different enough to not cause significant inefficiencies or distortions within the scheduling area.

Pre-fault: available energy is not eroded and frequency is not skewed

There is a very small delivery when frequency is within the operational range (less than 5%). This means that when a loss occurs the full volume of DC can respond regardless of the starting frequency.

Primary, Secondary, High is continually delivering. If the starting frequency is 49.8Hz then some proportion of PSH will have already been eroded. This highlights the distinction between pre and post-fault frequency management.

EFR may be eroded and can skew frequency pre-fault. Rules of the 'envelope' mean that providers can be charging when frequency is below 50Hz (and can be discharging when frequency is >50Hz). This is partly why EFR can be bad for pre-fault frequency and also means that the volume delivered can be less (or more) than expected.

Dynamic and proportional

Delivery is proportional to frequency excursion. Dynamic containment delivers a small quantity in the operational range (up to 5% by 0.2Hz deviation) and the entire quantity (100%) when the deviation reaches 0.5Hz.

Static services are not proportional and can only offer one solution to a range of potential loss sizes. The delivery of a large volume of static in response to a small loss can destabilise frequency (e.g. cause a HF event by responding to a LF event).

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[1] Note we are forecasting this volume to initially be around 100MW. Over time, we expect this volume to increase up to 500MW. The long-term intention is that dynamic containment will replace FFR volumes as new response products are launched.

EFR is proportional, but it is damaging to pre-fault frequency. Dynamic containment is an improvement of EFR because it incorporates what we have learned and experienced from EFR.

Can secure both large and small losses

DC can secure large and small losses with equal certainty and predictability. Response is proportional, so delivery is relevant to the loss that occurs.

PSH is proportional but cannot deliver its response quickly enough in a low inertia system. Thus lots of PSH needs to be found to secure a large loss because the rate of frequency change cannot be matched by delivery of PSH.

A volume of static that has been contracted to secure a large loss is likely to be overkill for a small loss. There is a risk that in attempting to secure a large loss with static we create a high frequency excursion when the LF static is triggered by a smaller loss. We already face periods where this risk limits the volume of static that we can safely arm.

EFR can respond proportionally. But we know it is damaging to pre-fault frequency, especially if increased volumes were held to cater for the largest losses. Improvements to the design of EFR have resulted in dynamic containment.

Existing and new providers can do it

Many typical 'static' providers could also provide dynamic containment, this keeps them in the market but without the drawbacks of static.

Static services require management when the delivery period ends after activation (e.g. when the service stops delivery 30 mins after the event). Dynamic containment is only active outside of operational limits and therefore places no additional planning burden on operators.

Many providers that can deliver static services will also be able to deliver dynamic containment. We can also give a strong signal to the market which will encourage new-build. It is important to encourage build that can deliver the best service for our needs.

Dynamic containment will have a lower throughput than EFR (because DC is only active outside operational range). Whilst the service is technology agnostic we must acknowledge some (cost) benefits to a key sector: battery storage. Service providers utilising battery technologies will be able to offer better prices as throughput (which causes degradation) is a major cost consideration.

No headroom/footroom issues

Dynamic containment can be delivered as a 0MW energy service. A provider can be at 0MW and still fulfil the service obligations.

The majority of our PSH providers must be generating to offer response volume. Footroom and headroom often needs to be created on the system to allow sufficient PSH to be armed.

It is already a costly challenge over low demand periods to adequately re-position the market solution in order to access response, reserve, voltage and inertia.

Impact on other GB markets

Dynamic containment has been developed to reduce inefficiencies and distortions created by existing products and therefore is better than the current frequency response products. Dynamic containment is a response product; reserve products are very different, and the markets use different providers and assets. It is therefore foreseen that that will be no impact on reserve markets.

In respect of capacity markets, if providers are required to provide services to capacity markets, then they will prioritise this service over dynamic containment should a stress event occur. There is a very small chance that should stress event occur, that dynamic containment will not be delivered due to this prioritisation. Note that a stress event has never occurred and has been forecasted to be unlikely to occur. As a mitigating action, NGESO are exploring the option of registering dynamic containment as a Relevant Balancing Service which will remove the risk entirely. This activity is happening in parallel to go live.

Conclusion

The analysis shows that Dynamic Containment is a product that is required to ensure system security now and in the future. As there is no standard FCR product, there are no resulting limitations on its use, significant inefficiencies or distortions that it creates. The energy landscape is changing, and as such the way in which NGESO needs to manage the system, and the products it uses need to change. Dynamic Containment is part of this change. Without this fast acting product, there is a very real risk to system security.